The Dangers of Unfiltered Water.—II.

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(Continued from p. 491, Vol. XXXII.)

Many other instances could be quoted to prove the efficiency of sand filtration for the purification of water on a large scale. In Berlin, the mortality from typhoid has been reduced to 4 or 5 per 100,000 of the population per annum; and in Amsterdam the reduction has been from 19 per 100,000 in 1890 to 3 per 100,000 in 1896. American municipalities have not adopted sand filtration, and the death-rate from typhoid is very high.

According to Dr. Koch, the necessary requirements for effective working are:—(1) "That a proper thin layer of mud or slime should be formed on the top of the filter bed, that it should not be disturbed during the process of filtration, and that when the deposit becomes too thick and impermeable it should be removed; (2) that the thickness of sand should never be less than 11·8 in.; (3) that the downward movement of the water through the sand layer must not exceed 3·95 in. in the hour." It is necessary to have several filter beds at work, for the gelatinous mass does not form on the top until the filter has been at work for two days. The thickness then gradually increases, until, by the end of seventy days, the mass is so thick that the downward movement of the water is too slow to be of service, although the efficacy of the filter in keeping back organisms is unimpaired. The sand layer is then removed and washed by means of a hose, and when it is aërated by exposure to the air it is replaced in the filter bed.

Similar results are produced when water is acted upon by ozone. This method is adopted in the waterworks of Charlottenburg and of Lille, and, in both cases, favourable reports have been issued of the results. With the water thus treated with ozone equal to 6 milligrammes per litre of air, all pathogenic and saprophytic microbes are destroyed, organic matter is diminished, and the aëration of the water is increased. The apparatus required renders the ozone treatment less simple than sand filtration.

Thus water which has been purified on a large scale may be regarded as fairly wholesome, but not absolutely safe, for the collecting drains, culverts, and wells through which the water passes subsequent to filtration are not sterile, and, even when the water has been delivered to the houses, it still runs a risk of contamination. The risk is minimised since the more general adoption of the constant service of water supply, but, where this system does not prevail, the water which is stored in cisterns must always be regarded with suspicion. The fault of cistern contamination lies chiefly with the builders, who have a weakness for placing cisterns where they are inaccessible, or else too ready of access. After builders, householders are in fault, for where cisterns are in use they should be provided with well-fitting lids, and should be subject to periodic cleansings every three or four months.

The rural population of England depends almost exclusively upon shallow wells for its water supply, and in such districts there is always the risk of contamination by liquid filth and by minute organisms which give rise to parasitic diseases, besides, occasionally, the specific bacteria which give rise to "water-borne" diseases. Purification must then be carried out on a small scale in order to render such waters safe. Dr. Pehlumberg has suggested the addition of bromine to surface water. "Experiments have proved that 0·06 gramme of bromine per litre, after five minutes' exposure, will render most surface waters safe for drinking purposes. The colour and taste of the bromine are readily removed after the five minutes' treatment by adding 0·095 gramme of sodium hyposulphite and 0·04 gramme of anhydrous sodium carbonate to each litre of water."

In ordinary practice the most common method of purifying water on a small scale is by means of a domestic filter, and on this subject there is much misunderstanding. With some people the word "filter" means safety, yet it has been proved many times over that some filters do more harm than good.

The simplest form of filter is the sponge filter, in which the water, in passing from an upper reservoir into a lower one, passes through an aperture fitted with a sponge. Such a filter is useful in keeping back leaves, twigs, gravel, and sand, but in order to do this work the sponge should be soaked daily in Condy's Fluid. If this is not done, the organic impurities accumulate in the sponge and form a perfect breeding-place for pathogenic and saprophytic germs, which it passes through into the lower vessel in greater numbers than they exist in the unfiltered water.

Animal charcoal is also common in domestic filters. It has great powers of absorption, so that it absorbs oxygen from the air, by which means organic matter is oxidised and converted into harmless products. It likewise absorbs impurities from water and from the air, so that it becomes a source of danger instead of a safeguard. It adds nitrogen and phosphates to the water, both of which substances serve to foster the growth of organisms. The only point in favour of animal charcoal is that it removes metallic salts, and, in particular, salts of lead. The same objections are made to vegetable charcoal, and both substances require more attention than they are likely to receive in a domestic filter.

Block filters of silicated carbon and manganous carbon are open to less objection than the unmixed