THE CONTROL OF STREAM POLLUTION.*

By Paul Hansen,
Engineer, State Water Survey, Urbana, Ill.

IN uninhabited or even rural districts the evil results of stream pollution are practically negligible, but in urban districts streams are rendered exceedingly foul by the enormous quantities of sewage and industrial wastes poured into them from city sewers. These streams become totally unfit for pleasure purposes, the land along the banks is depreciated in value, and public water supplies drawn from the streams may be grossly contaminated and constitute an extreme danger to public health. An enormous toll in human lives is annually exacted as a result of polluted streams, not to mention the economic loss due to depreciation in property values.

To prevent the evils of stream pollution gaining too great headway, central governmental control backed by an intelligent public opinion is essential. The molding of an intelligent public opinion is, however, a rather difficult matter, for even among persons who have given considerable thought to sanitary subjects, there exist gross misconceptions as to the logical and practicable way to treat the problem of stream pollution. There has been a tendency to permit sentimentality to get the upper hand, and this has resulted in giving wide currency to some extravagant demands that are wholly impracticable. There is, however, a group of sanitary engineers who have come into intimate contact with actual problems relating to the prevention of stream pollution, and among these engineers there has gradually come about a unanimity of opinion regarding certain essential factors relating to the stream pollution problem. It will be the object of this paper to present these opinions, and the statements made will be largely based upon recent careful inquiries among sanitary engineers and others interested in sanitation.

The subject may best be treated by first considering in a broad way what the functions of a stream really are. Having reached a satisfactory conclusion upon this point, it will be possible to consider certain special uses of streams with respect to stream pollution.

General Functions of Streams.—The proper conception of a stream recognizes the dual function of watering and draining the country through which it passes. Some pollution of streams is inevitable; for with increased density of population, increased cultivation of the soil and increased numbers of urban communities, it is practically impossible to prevent the discharge of all deleterious matter into streams. It is only reasonable to require that the pollution of streams be maintained at less than a certain fixed maximum, and this permissible maximum pollution must vary according to the character of the stream, the population along the banks of the stream and the uses to which the waters of the stream are placed.

Streams Used as Sources of Public Water Supplies.—Since streams in the ordinary course of events must receive more or less contamination, it follows that public water supplies drawn from surface streams must of necessity be polluted, and should not be delivered to the consumers unless the water is first adequately purified. One exception may be made to this general rule, namely, in the case of water supplies derived from streams draining comparatively small watersheds. In such cases it is sometimes feasible for the water supply authorities to own the entire watershed and control it in such manner as to make contamination of the water courses impossible. But in general we have this question to contend with: How much pollution may be permitted to enter a stream before the water thereof is polluted to a point beyond redemption by water purification methods? This is a question that taxes the greatest ingenuity of sanitary experts, and it is always necessary for any specific problem to be considered on its particular merits in order to obtain what is the best and most economical solution.

Notwithstanding the great difficulty in defining that degree of pollution which is permissible in streams which are to be used as public water supplies after purification, there would seem to be an advantage in attempting to approximate a general rule for the control of such streams. A rule has been formulated in the light of the present available evidence, but it must be admitted that this rule is not based upon any very scientific data and it can, therefore, only be put forward tentatively, with the expectation that it will be modified from time to time as more and more experience is acquired. This rule may be stated as follows:

The time in hours required for the passage of a particle of water from a sewer outlet to the point of waterworks intake during high water multiplied by the dilution available during low water in cubic feet per second per 1,000 persons tributary to the sewers should equal a constant and this constant should not equal less than 40. This may be expressed mathematically as follows:—

$$T + D = C.$$

In which T = time in hours required for the passage of a particle of water from the sewer outlet to the waterworks intake at high water;

D = dilution available during low water in cubic feet per second per 1,000 persons tributary to the sewers; and

C = constant which it is recommended be not less than 40.

The above formula applies to streams in which there is no appreciable increase in volume of flow between the sewer outlet and the point of waterworks intake. In the case of streams which receive the discharge of large tributaries between the point of sewer outlet and the point of waterworks intake, the formula must, of course, be modified. Generally it will be merely necessary to assign a value of D, which represents the mean of the quantity of water flowing past the sewer outlet and that flowing past the waterworks intake. If the factor of safety proves to be more than 40, purification of the sewage will not be necessary for the protection of the water supply. If the factor of safety is less than 40, some form of purification will be necessary, and this may vary all the way from plain sedimentation to intermittent sand filtration followed by sterilization.

The formula, of course, is intended to be used merely as a rough guide, and it is conceivable that there are instances where it will not apply. Take, for example, the case of a very large stream, where a sufficiently large factor of safety may be obtained with the sewer outlet at a very short distance above the point of waterworks intake, and on the same side of the stream; here it is manifest, due to the impracticability of securing a mixture of the sewage with the entire volume of the stream, that the sewage must receive treatment or the waterworks intake must be extended to a point above or, at

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