THE CONTROL OF STREAM POLLUTION

PAUL HANSEN

In uninhabited or even rural districts the evil results of stream pollution are practically negligible, but in localities where there are urban districts, streams are rendered exceedingly foul by the enormous quantities of sewage and industrial wastes that are 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. In the past and even at the present time 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. Notable examples in this country of streams which have been rendered foul and useless, other than as open sewers through excessive pollution are the Passaic River in New Yersey, the Naponset River in Massachusetts, and Mill Creek in Ohio near Cincinnati In our own state we have the Chicago River and the Chicago main drainage canal which are becoming so contaminated that it will be necessary to spend millions of dollars for sewage treatment unless the government permits the diversion of increased quantities of water from Lake Michigan.

To prevent the evils of stream pollution gaining too great headway, central governmental control backed by intelligent public opinion is essential. The moulding 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.

One extreme view of the functions of streams is that they are provided by nature for conveying water to the populations that live upon their banks to be used freely for all purposes for which water may be needed and that, therefore, no one has a right to defile streams by discharging into them impurities which may injure health, reduce the value of the water in the stream for any purpose or add to the discomfort of the water user at points lower down upon the stream. Further, it is argued that common decency damands that a community dispose of its excrementitious matter in some other way than by passing it on to neighbors.

The other extreme view is that streams are our natural drainage courses and that they were provided by nature for carrying off all the wastes of human activity and that to deprive persons of the right to so use streams is an injustice.

In point of fact both of these views contain elements of right, and yet both are wrong. 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. The extent of pollution that is reasonably permissible in streams will be discussed somewhat in detail under the headings, "Streams Used for Public Water Supplies," "Streams Used for Recreation Purposes," "Fish and Shell Fish," "Discharge of Manufacturing Wastes into Streams," and "Legal Control Over Stream Pollution."

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 water sheds. 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 cantamination 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.

Merely to indicate the wide range of conditions that are met in actual practice, we have on the one hand a water purification plant constructed for the purpose of purifying crude though rather weak sewage at the Chicago stock yards. It was claimed that the results obtained at this plant were satisfactory when judged by analytical standards and by the safety of the water for human consumption. Even though it is possible to transform such a filthy liquid into drinking water, the esthetic sense of the community rebels and it is not probable that water once so highly polluted, even with most thorough purification, will ever be considered as acceptable water for public water supplies. At the other extreme is the community which derives its supply from a clear mountain stream, possibly having its source in large springs yielding a water of unquestioned purity. In such a case there would seem to be but trifling danger, and authorities might be tempted to omit purification of such a water. The disastrous results that may come from this ommission is well illustrated by the experience in Plymouth, Pa., in 1885. In this case the source of water supply was a mountain stream such as above described, with but two houses upon the entire drainage basin. Nevertheless a single case of typhoid in one of these houses was responsible for 1104 cases and 114 deaths among the consumers of the water.

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 the sewer outlet to the point of water works intake during high water, multiplied by the dilution available during low water in cubic feet per second per 1000 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 x D equals C.

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

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

C equals 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 sewer outlet and the point of water works intake. In the case of streams which receive the discharge of large tributaries between the point of sewer outlet and the point of water works intake, the formula must, of course, be modified. Generally it will be merely necessary to assign a value D which represents the mean of the quantity of water flowing past the sewer outlet and that flowing past the water works 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 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 water works 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 treatement or the water works intake must be extended to a point above or at any rate beyond the influence of the sewer outlet. As a rough guide, however, such a formula may serve a useful purpose in narrowing down the widely divergent practice of the present time.

Streams for Recreation Purposes

Of recent years growing importance, is attached to the maintenance of our streams for pleasure purposes. Every summer there may be found scattered along the streams within a radius of 50 miles or more of our large cities numerous camps. This form of summer vacation is a comparatively cheap and normally a healthful means of recreation. It ought to be regarded as one of the means of improving the health tone of our urban communities inasmuch as it is within the means of so great a number of people.

Under this head may be asked how high a degree of purity should be demanded in a stream which is extensively used for recreation purposes, but not for public water supply? Within the last few years much emphasis has properly been placed upon the purification of sewage by dilution, which after all, is purification by oxygenation in which a natural resource is utilized instead of an artifically constructed purification works. It has generally been held and in most instances rightly held that the degree of dilution necessary is merely that which will prevent a nuisance, having reference primarily to unsightly floating matter and bad odors. For most rivers and many of the smaller streams of the country, this requirement as to the cleanness of the waters is all that is necessary.

There is, however, a certain class of streams which because of the beauty of the country through which they flow and their specially favorable location becomes highly prized for camping and recreation purposes. It is a striking circumstance, in fact, that recreation seekers nearly always look for the stream valleys which illustrates the craving of man for a combination of land and water, by means of which nature presents her most alluring and most picturesque aspects. These streams, as a rule, have no large cities upon their banks but merely here and there a small town or village. The sewage from such small towns and villages may not be sufficient to produce a visible coontamination except possibly throughout a very short distance below the sewer outfalls, but such contamination does offend the esthetic sense and undoubtedly does add some danger to public health for the reason that when a stream is used for recreation purposes, it will be used for boating and bathing and as a domestic supply to some extent among campers, though it may not and should not be used for drinking water. It seems to the writer that such streams as those deserve greater protection against contamination than merely to prevent nuisance.

No definite rules to apply to all cases can be laid down, but as a general principle, it may be said that if such a stream is not polluted to any material extent by storm water and street wash such as would obtain in the case of a city of considerable size located upon the banks, it would seen perfectly feasible to purify the sewage to a point where it will give no evidence of its existence even in the vicinity of the outlet and further the sewage effluent should be sterilized by the cheap and satisfactory means of using bleaching powder so as in large measure to guard against dangers to health among vacationists which may result from boating, bathing and domestic uses of the stream water, other than for drinking.

A very striking example of a stream serving the useful function of providing recreation for vacationists is the Little Miami River near Cincinnati. The lower reaches of this stream are lined with cottages and tents of campers during the summer months and it requires but a very little contamination of the stream to immediately give rise to a storm of complaint. There are few villages located on this stream and these contribute some minor manufacturing wastes and a negligible quantity of street wash. If the sewage from these towns were purified, and it is understood that purification works have been ordered by the Ohio State Board of Health, the stream could be preserved for what appears to the writer to be its highest and most valuable use, namely, recreation.

Fish and Shell Fish

Many streams are valuable to the community on account of their fish life. It may be said in general that there is rarely necessity for so polluting a stream as to endanger fish life, though there are some circumstances where the continuance of certain liquid waste producing industries injurious to fish is of so great importance to the general welfare that fish life in certain streams must be sacrificed.

The maintenance of fish life does not necessarily imply an unpolluted stream. It is merely necessary that the alkalinity of the water be maintained and that the pollution be not so great as to absorb the dissolved oxygen in the water to an extent that will suffocate the fish. The fact is: a moderate degree of pollution favors fish life in that it favors the growth of microscopic aquatic organisms which constitute valuable fish food. Certain difficulties have been encountered in the contamination of fish by polluted water which causes the fish to decay rapidly and become unfit for human consumption. The danger of infection of human beings with specific disease through eating fish taken from polluted streams is almost negligible, for the reason that in this part of the world at any rate fish are not eaten raw. With shell fish, however, the case is quite different, because they are very frequently eaten raw. It has been a common practice along the coast to float oysters in shallow polluted waters which causes them to become bloated and appear fat. Such an oyster perhaps makes a more delectable morsel of food, but in it may be lurking the germs of typhoid fever or some other water borne disease. The problem of protecting the shell fish industry is a very complicated one and all its intricacies have not been worked out. Here again is where the services of experts are needed to study each zone of shell fish pollution in the light of diverse local conditions. As a concrete example of the efforts that are made to protect shell fish may be mentioned the case of the city of Baltimore, which at the expense of millions of dollars is purifying its sewage so as to convert it into a liquid which is not only clear and inoffensive but also practically sterile.

Discharge of Manufacturing Wastes into Streams

Many of our important industries, such as paper mills, woolen mills, dye works, starch factories, and tanneries, require large volumes of water to carry on their industrial operations and they also produce large volumes of waste which are capable of undergoing offensive putrefaction. The discharge of these wastes into streams often causes unsightly, and malodorous conditions, yet, with the exception of tanneries, these waters do not menace the public health since they do not contain the specific infections of disease. (Tannery wastes may contain anthrax bacilli)· In fact some of the processes are such that the wastes are quite inimicable to the existence of disease germs. In some cases it is practicable to treat the wastes so that offensive conditions in a stream may be in part or wholly relieved, but for certain industries such treatment of the wastes is prohibitively expensive.

Enjoining industries against causing objectionable stream pollution may, and in some instances actually has, necessitated the shutting down of works. It is conceivable, in the case of large industires upon which are dependent a considerable population, that an order to cease stream pollution, which is virtually an order to shut down the works, might result in great hardship without adequate returns accruing from the cleaner conditions of the stream. There may be instances, therefore, where a limited few of the streams of the country may legitimately be turned over to the manufacturing interests. Now that the stream pollution problem has become more acutely an issue and the disadvantages of filthy streams is better understood it would not seem wise to permit waste producing industries to be located upon any but very large streams which have an ample volume to dilute the wastes to an inoffensive condition. That is to say, the streams which are now clean should be maintained clean for the reason that we have an ample number of large streams which can effectually take care of wastes from waste producing industrial plants for an indefinite period in the future.

Legal Control Over Stream Pollution

A discussion of stream pollution would not be complete unless some consideration is given to legal control. As already indicated the cleanness of streams cannot be conserved unless under a central governmental supervision. If left to individual communities, very little could be expected in the way of results. Communities are not likely to be altruistic enough to spend large sums of money for sewage purification works to protect neighbors on the stream below unless such altruism is induced by damage suits which render sewage purification the cheapest way out of the difficulty. But law suits are costly if long drawn out and the results are often unsatisfactory.

It is essential that specific problems relating to stream pollution must for successful solution be placed in the hands of experts and it is, therefore, necessary or at least strongly advisable that every state have an expert commission. Among many there is a strong prejudice against commissions inasmuch as the multiplication of commissions is looked upon as a delegation of legislative and executive powers to others than direct representatives of the people. This need not necessarily be so, however, for a law may be framed requiring in general terms that streams must be maintained in an inoffensive condition and that they shall not be detrimental to health. This leaves to the commission not arbitrary powers, but the simple function of determining points of fact within limits prescribed by prior legislative enactment. That is to say, the commission will determine when a stream is in danger of being made offensive and when it is in danger of being made detrimental to health, and thereupon decide what, if any, purification of sewage is necessary, what, if any, purification of industrial wastes is necessary, whether water supplies may or may not be taken from streams and to what extent they must be purified. Such a commission should be supplied with ample appropriations to enable it to obtain all necessary information for its guidance whether this consists in maintaining laboratories or carrying on experimental and research work. As even the best of commissions may at times grow arbitrary or become unduly baised in its views there should alawys be made provision for ready appeal from the decisions of a commission to an independent special arbitration board of experts, and, of course, there must exist the inalienable right of appeal to the courts.

Summary

Summarizing in the briefest possible terms, it may be said that all surface streams must of necessity be polluted to an extent that renders them unsafe as domestic water supplies without purification. On the other hand the public is entitled to clean streams and special protection should be afforded to those streams which because of their beauty and accessibility from the cities constitute valuable recreation grounds for urban populations. When not a menace to health, certain exceptions may be permitted with respect to the maintenance of clean streams. Such exceptions, however, must always be regarded as special cases, necessitated by unusual local conditions. A limitation of stream pollution is most effectively and most equitably carried out when under the general supervision of some central expert authority operating under somewhat elastic general laws which represent in broad terms the will of the people.