

of pollution and of harm, actual or potential, to domestic or other uses, to public health or property; the results of the engineering studies of feasible remedies; and the economic facts relating to the conservation of stream resources. It would require the balancing of the value of remedial measures in the terms of public good against the cost of the requisite improvements.

On the one hand, it is evident that the paramount importance of public health and the binding obligations of the treaty must be borne in mind. These make impossible the recommendation of such lenient remedial measures as would work economic injustice or would endorse officially the continued spoilation of a natural resource to the injury of the citizens upon both sides of these waters.

Must Not Be Unreasonable

On the other hand, sewage treatment requirements must not be made so excessive and unreasonable as to involve the cities and towns along these waters in an expenditure entirely unjustifiable. They should be reasonable and feasible from the standpoint of engineering construction or adaptability to local conditions, of the availability of necessary lands, of out-falls and incident structures, and of costs.

In view of the fact that pollution in the Detroit and Niagara Rivers, and its transboundary effects therein, are much greater than in the other boundary waters, these two rivers will be treated in one class and the remaining boundary waters as another class.

The problem of necessary bacterial purification of the sewage discharged into the two former is one of extreme perplexity, owing to the difficulty or impossibility of obtaining definite and ample data and the relative importance to be attached to many of the factors which enter into it.

After a great deal of consideration, the Commission has, in view of all the circumstances of the case, come to the conclusion that for the present, and as an immediate step in the way of restoration of the purity of these streams, the communities responsible for the discharge of raw sewage into them should purify it to such an extent that the resulting average cross-sectional pollution in each river will not exceed the limit of safe loading for a water-purification plant.

In other words, the standard of purification required of these communities should be such that the streams, after receiving their treated sewage, would have a mean annual cross-sectional average of *B. coli* not exceeding 500 per 100 c.c.

Compliance with the requirements of this standard would not impose upon the riparian communities along these rivers discharging their sewage therein a burden which would be unreasonable or greater than that ordinarily imposed upon urban communities which purify their sewage.

Water and Sewage Standards Both Tentative

It necessarily follows that this standard of sewage purification, being based upon a tentative standard of safe loading of water-purification plants, must itself be tentative. The growing appreciation of sanitation, the consequent demand for a higher degree of purity in water supplies, and the constant improvement that is taking place in the processes of sewage treatment tend to make a proper standard of sewage purification one of ever-increasing stringency. The discovery of a new and much more economical, or possibly a profitable, method of dis-

posal of sewage, for example, would naturally lead to the adoption of a stricter standard of permissible pollution in heavily polluted streams. Furthermore, any limit of permissible impurity that might be established, even temporarily, for a given stream must be influenced largely by strictly local consideration.

The data necessary for the formulation of a fixed standard, either of sewage purification or of water purification, are not sufficiently well established at the present time. By more precise methods of experimental study there will doubtless be obtained in the future a more ample and accurate command of facts, which will admit of the determination of a more definite standard.

Bacterial Standard Not Sufficient

In view of the difficulties and uncertainties of bacteriological technique, it is distinctly advantageous to have, if possible, a working rule which is more accurate and readily determinable than the bacterial standard suggested. Professor Phelps, the consulting engineer, taking the results of the extensive investigations reported upon in the "Progress Report" as an index of the conditions actually existing, worked out, as will appear from his calculations on page 9 of his report to the Commission, such a rule or standard.

He found that if the sewage of the cities be diluted in a stream flow to four cubic feet per second per capita of the population, the resulting water will contain approximately 500 *B. coli* per 100 c.c. If the dilution is proportionately less than this, a corresponding degree of purification of the sewage will be necessary to maintain the final stream condition. Further investigations will no doubt make possible a more accurate statement of these relations, but, as the entire matter of standards is always subject to revision in the light of accumulated knowledge, it is considered that for all purposes of a present enquiry, the practical equivalence of the dilution and the bacteriological standards may be accepted.

Standards for Boundary Rivers

These standards are not applicable to rivers other than the Niagara and Detroit, but it is in no sense to be inferred, however, that remedial or protective measures are not required in their case, where the dilution, based upon the entire cross-section of the stream, exceeds in every instance four feet per second per capita of the population.

The view of the advisory engineers is adopted that no untreated sewage should be discharged into boundary waters, but the Commission considers it inadvisable at the present time to prescribe what the amount of treatment should be in the case of these remaining rivers. The sewage from each community along their banks must be considered by itself in respect of the degree of purification that is necessary, basing the standard on the reasonable use of the waters, the practical possibilities of remedial and protective measures, the economic value of stream purification, and also the economic value of stream pollution, proper regard being had to the public health.

After giving much attention to the question of standards of purification in these six boundary rivers, the Commission has come to the conclusion that the fixing of standards for them and the subsequent modifications of these standards, from time to time, should be left to some authority clothed with the necessary power to deal with the question. This authority should also have power to vary, from time to time as conditions demand, the standards of sewage purification in the Detroit and Niagara rivers.