of household sewage or brewery waste produce an abundant growth. It also requires much oxygen, and grows, therefore, best in broken streams. Finally, it needs constant sustenance with small amounts of sugar, and, therefore, a continuous small stream of polluting liquid furthers the growth more than large quantities at infrequent intervals. It is better, therefore, that discharges of effluent should under these circumstances be held up, say, for twenty hours and discharged all together in a short time. . . .

The labors of the scientific biologist can be considerably assisted if those in charge of sewage works would keep systematic records of the more characteristic developments occurring under specific conditions—e.g., of composition of sewage, time of year, temperature, etc. . . .

Careful accumulation of facts is necessary before a conclusion can be reached as to the best means of dealing with these growths when they occur. They can be temporarily arrested, of course, as has been shown, by sterilization. Such a process, however, is costly and open to objection, on the ground of its possibly deleterious effect on the normal life of streams, especially if used at all carelessly. On the other hand, there can be no doubt that many fungoid growths form excellent habitats for larvæ, small worms, such as tubifex, and probably numerous forms of crustacea. The development of gnat larvæ, indeed, is a matter of rather serious moment. This has been carefully watched in connection with the effluent from the percolating filter at Davyhulme already mentioned, and at certain periods of the year gnats appeared in objectionable numbers at the manhole covers of the closed channel through which the effluent passed. The development from the larval to the insect stage has been followed in the laboratory. These forms of life, however, may constitute excellent food for fish, and at the Berlin sewage fields large ponds have been constructed, into which the final effluent flows, together with a stream of fresh water, and in which carp and other coarse fish attain large sizes.

It is now generally recognized that the provision of some kind of tank to arrest deposits from percolating filters is necessary, and the Royal Commission suggest a similar provision in the case of contact beds. It is worth consideration whether this idea might not be developed and such tanks extended to form aquaria. Careful management would be essential in order, by the growth of aquatic plants or otherwise, to maintain an adequate supply of dissolved oxygen.

When this suggestion was made in the paper read at Leeds, certain subsequent critics appeared to think that it could hardly be seriously intended. Apart, however, from its adoption on a very large scale in Berlin, other successful applications of the same methods are cited by Hofer, with actual figures as to the weight of fish produced. A careful study by Marsson of the flora and fauna of a sewage works also leads up to the suggestion that when an effluent is so far purified that small crustacea can live in it, it is then most suitable as a source of food for fish.

It is possible, as pointed out by Sir James Crichton Browne, in his address to the Hygienic Section at the International Congress of Applied Chemistry, that considerable diminution in the bacterial content of effluents would result from such storage, on the analogy of Dr. Houston's obse - vations in connection with the storage of drinking water. The cost of storage might be partly met by the value of the fish produced, and in any event the complete cycle from offensive organic matter through mineral matter and back again to organized life would be under control, instead of, as is at present the case, allowing the effluent to pass direct into the stream with all the possible contingencies which may arise. The suggestion of an aquatic sewage farm has already been made by Dr. Letts, in connection with the ulva nuisance in Belfast. There are probably many cases where analogous provisions might without great difficulty be made at inland sewage works. A typically suitable case would be where land of an impervious character could be excavated for a pond, and where a portion of a fresh-water stream could be diverted through the pond along with the effluent. Such a method might be considered the equivalent of final land treatment.

The general argument of this paper leads, therefore, to the following conclusions:—

1. That the standards suggested by the Royal Commission are, with possible slight modifications, the most practicable and adaptable of any yet suggested.

2. That where the self-purifying power of the body of water receiving the effluent is high, they may be too stringent.

3. That effluents may pass these standards and yet develop considerable growths at the outfall.

4. That the final treatment of effluents in large and well-aërated, scientifically managed ponds can in many cases be advantageously adopted.

5. That careful and continuous research is necessary in order more fully to determine the different links in the cycle of nature, upon conformity with which efficiency and economy in the disposal of the waste products of human life must ultimately depend.

FRAZIL.

The approach of winter recalls the fact that the frazil and anchor ice season is again at hand. It will be interesting to hear what has been accomplished at Hull, Quebec, and Ottawa, Ont., during the last few years in connection with the problem of preventing frazil from shutting down the hydro-electric plants at these places and demoralizing the electric light, industrial power and electric railway services which are supplied from them.

We are informed that some forty water wheels in the power district at and near Ottawa are now equipped with heating devices, which prevent frazil from stopping the wheels and clogging the gates and gate-operating mechanism. The Ottawa and Hull Power and Manufacturing Company, which supplies Ottawa's city distributing system, and also the International Cement Works with power, increased the capacity of its generating station this year, and while this work was in progress it also increased the capacity of its frazil-combatting plant, which has been in successful operation during the last three years. A 30 horse-power boiler was formerly employed, and the new equipment consists of a 100 horse-power boiler, which, it is anticipated, will supply an ample amount of steam to keep the plant in operation in the face of frazil attacks, while the output of the station is as high as 10,000 horse-power. An interesting feature of the latest 3,000 horse-power unit at this station is the arrangement of the water wheels and their controlling gates for heating purposes. The chutes and gate chambers have been cored out, and have pipe connections to the openings, so that steam or hot water may be kept circulating through them when frazil is anticipated.

The power houses of the Ottawa Electric Railway and of the Ottawa Electric Company are also equipped with water wheel heating systems, and these plants have had similar satisfactory experiences to those of the Hull company during the last two and four winters, respectively.

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