stabilize some factors to give stable genotrophs, and break down others to give plastic genotrophs, the environment thereby directly altering the characteristics of a population, as distinct from its indirect action in natural selection. Although it is possible that heterozygous individuals in natural populations may be buffered to a greater extent against all three classes of heritable change, such changes may be widespread, and potent factors in biological evolution.

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BIOASSAY OF TRADE WASTES

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During recent years river boards, with the co-operation of local authorities and industry, have done much to improve the condition of many rivers which are heavily polluted by sewage and industrial wastes. Standard methods of analysis have been developed, but there is a lack of information concerning the toxic effects of discharges of complex wastes on the plants and animals in natural waters. In particular, there appears to be a need of a quantitative method for the assessment of the toxicity to fish of trade wastes. Much work has been done on the subject; but so far all the methods have been prolonged and the interpretation of results leaves much to be desired.

A relatively simple and rapid method applicable both to field and laboratory investigations has been developed in this laboratory. A series of dilutions of a representative sample of effluent is prepared with water of similar composition to the natural water receiving the discharge. A glass bottle with a capacity of 2 l. is filled with each test solution, two fingerling brown trout are introduced and the containers are stoppered, avoiding air bubbles. The dissolved oxygen concentration in each solution is measured at the beginning of the experiment and on the death of the fish, using a portable dissolved oxygen meter which incorporates a dropping mercury electrode. It has been found that the residual oxygen concentration is moderately constant for a given batch of fish in clean water, but when harmful substances are present the residual oxygen concentrations are higher. Since the toxicity to fish of many compounds increases as the dissolved oxygen of the water falls toxicity is enhanced as the fish respires and consequently the survival period of the fish decreases.

Experimental results are presented in Fig. 1 which show that concentrations of cyanide down to 0·025 p.p.m. and copper down to 0·1 p.p.m. inhibit the uptake of oxygen by trout in the sealed containers during experiments of 300 min duration. Thus, compared with conventional bioassay, this method constitutes a more rapid and sensitive means of detecting these substances in low concentrations. For example, Herbert and Merken[1] found that the median survival period of rainbow trout was at least 10,000 min in water saturated with oxygen containing 0·05 p.p.m. of cyanide, and it is recorded in the annual report of the Water Pollution Laboratory for 1959[2] that the median survival period of rainbow trout is of the order of 1,000 min in aerated water containing 0·1 p.p.m. of copper.

The new technique has also been used for the bioassay of complex chemical wastes, and the results compare favourably with those obtained from a more conventional method of bioassay where fish were immersed in aerated solutions of effluent and their survival time noted. Concentrations of effluent which killed fish within 96 h in aerated waters also impaired the reduction of the oxygen concentration by trout in sealed containers within 300 minutes.

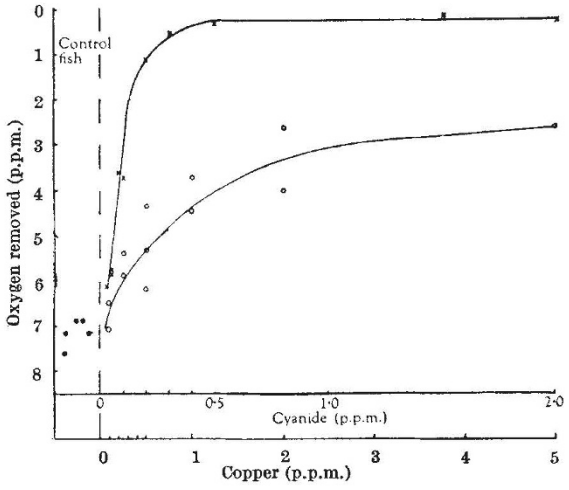

Fig. 1. Effect of cyanide (×) and copper (○) on the uptake of oxygen by brown trout

It is concluded that the technique permits the rapid detection of solutions containing low concentrations of copper and cyanide which are toxic to fish. It seems likely that the method might also be used to make rapid assessments of the toxicity to fish of complex trade wastes.

Where many effluents are discharged to a watercourse it would be advantageous to pinpoint the more toxic discharges at the site of their discharge. The new technique is particularly suitable for this type of investigation, as it is a rapid method and the apparatus is simple and portable. Investigations at the site of discharge would also avoid transporting samples to a central laboratory during which time the quality of the effluent might be altered by chemical reactions or biological activity.

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