

Water Pollution Research.

MAINTENANCE of the purity of our rivers and streams becomes of increasing social importance with the growth of industry, of population, and the consequent use of water to carry away waste products.

On one hand is the desire to preserve the amenities of the country; to preserve fisheries providing open-air recreation to many and a valuable yearly yield of salmon from several of our rivers; to meet the increasing demand for water of good quality for domestic and industrial use requiring neither expensive treatment to free it from the effects of pollution nor long and expensive pipelines to bring it from distant unpolluted sources.

On the other hand lies the necessity of disposing of sewage and trade effluents in the most economical manner, without overburdening the rivers with putrefiable or poisonous discharges. Rivers can deal with relatively large quantities of such discharges, since they are soon oxidised after sufficient dilution in a stream of well oxygenated water; but when this is overstepped, death of fish, noxious-smelling by-products, and the growth of fungus on the river bed result.

Publicity has done much to allay the natural increase of harmful pollution during recent years. Many problems have arisen: When does pollution become so harmful that it is to the interest of the community to purify particular effluents, and what are the most economical means of doing so? Is it possible to do so in sufficient degree to restore or maintain the amenities of a river without putting an undue burden upon an industry or upon the local rates? In order to decide such questions, exact and accurate information, often of a very varied nature, is frequently required.

In the "Report of the Water Pollution Research Board, 1929-1930",¹ an account is given of several investigations now in progress. In order to obtain information of general application, especially concerning the effects on a river of sewage and trade effluents of various kinds and the quantity which can be allowed to enter without unduly retarding the process of self-purification, it was decided several years ago to make a thorough survey of the flora, fauna, and water of a typical river, and their variation throughout the seasons. For this purpose the River Tees and its estuary were chosen. The present Report gives a short account of the first year's work.

The head waters pass within half a mile of the river's source on to a limestone bed, where in the course of only a few yards the pH value rose from 4 to 7. The water remains at about this value until it mixes with the more alkaline sea-water in the estuary, throughout which the mixed waters oscillate backwards and forwards with the tides. In addition, a circulatory system is set up, the ebb tidal stream being strongest at the surface and the flood tidal stream strongest at depths below one fathom. This is very marked when much fresh water enters the estuary. Matter suspended in the water of the upper layer has a residual movement seaward,

while matter suspended in the lower layers has a residual movement towards the head of the estuary.

Above the estuary the river suffers little pollution except from one tributary. Series of observations throughout periods of twenty-four hours have been made to determine the changes in the river water and in the quantities of dissolved gases during the day and night. Diurnal variations were found in the number of bacteria and dissolved nitrogenous compounds in the water; further investigations are being made with the aim of finding an explanation of this phenomenon.

The central portion of the estuary between Stockton and Cargofleet receives the discharge of many industrial effluents and the untreated sewage from 275,000 inhabitants, which gives rise to a heavily polluted zone oscillating up and down the estuary with the tides. The effluents undergo oxidation at the expense of the dissolved oxygen in the water, which may fall to below 20 per cent of saturation value during the summer, the minimum found during 1929 being 5 per cent in the central part of the polluted zone. Life is almost absent in this portion of the river, where the bottom-living animals and plants are also exposed to the greatest changes in salinity, while numerous species occur above it and below. Various marine fishes have been found dead and dying at the lower end of this polluted belt, and great numbers of salmon smolt at the upper end as they enter it during their migration to the sea. From the results obtained during the first year of the survey, the general changes in the composition of the river water at different times of year, and under different conditions of rainfall and states of the tide, have been ascertained. The nature of many effluents has been examined. Their poisonous constituents and influence on the water and fauna of the estuary continue to be the subject of investigation, which has proved increasingly fruitful during the second year's work.

The Report deals next with the purification of effluent from beet sugar factories. By using over again the wash water and by biological filtration of the effluent, this can now be rendered relatively harmless. The experiments have demonstrated the conditions under which percolating filters can be operated satisfactorily throughout a beet sugar campaign for the requisite purification of pulp press liquor, suitably diluted with river water or with effluent from the filters.

The parts played by various organisms present in the filters continue to be investigated, with the object of isolating pure strains specially active in decomposing and oxidising the substances present in the effluents. It is noteworthy that the work has led to the discovery of new strains of nitrifying bacteria which belong to neither *Nitrosomonas* nor *Nitrococcus*.

The changes taking place in the zeolite process of water softening and the treatment of corrosive and plumbo-solvent waters are also the subject of

research. Water mains sometimes become so corroded that they burst when under pressure, or deposition of organic and inorganic substances may take place to such an extent as to diminish seriously their water-carrying capacity. There is a lack of exact information, not only as regards the best treatment of the plumbo-solvent waters, but also on the variation of this plumbo-solvent character with the composition of the water.

For the most economical working of the activated sludge process of sewage disposal, more precise knowledge of the various factors involved is required. As the relative importance of the parts played by the bacterial and the physico-chemical changes is unknown, experiments are being made with sewage effluent freed from bacteria. An investigation is also being carried out on the dissolved colloids and the conditions which affect their quantity and nature.

Although much of this varied research is still in the initial stage, it is abundantly clear that it cannot fail to yield many facts of scientific interest as well as of practical importance. The work of the Board on the treatment of effluents from beet sugar factories has already provided a solution to an urgent social problem.

The Committee appointed in May 1919 by the Ministry of Transport and the Ministry of Agriculture and Fisheries to investigate the question whether tarred roads are harmful to fisheries, has also published a report² containing a wealth of experimental results. The toxicity towards fish of aqueous extracts from various tars has been investigated, and also the toxicity of their various poisonous constituents, phenol and higher phenols, bases such as ammonia and quinoline, and hydrocarbons such as naphthalene. Similar experiments

have been made with the drainage from tarred surfaces, which lose much of this toxic property after the first heavy rains have washed out the more soluble substances.

The major experiment consisted in passing the rain washings from an area of tarred road into small ponds stocked with trout, through which there was a flow of fresh water. These trials proved that undiluted washings from the freshly tarred roads were deadly to fish—unless diluted, for safety, with about ten times their volume of unpolluted water. The subsequent drainage from the road was less toxic, but rose again where the surface began to disintegrate. Parallel trials were made with rain washings which were stored or allowed to pass through a filter of cut turf, it being known that the phenols constituting tar acids and naphthalene are broken down by the action of bacteria which occur in soil. In both cases the treatment was found to reduce the injurious character of the rain washings.

As a result of these investigations, mostly carried out between 1920 and 1922, and the experience gained by this Committee, the Ministry of Transport warned all road authorities against the use of unsuitable tars on roads draining directly into streams. It cannot be doubted that there has been a diminution in destruction of fish during the last six years. The investigations are still proceeding, and include the examination of samples of home-produced coal-tar preparations which aim at being non-toxic, and so able to replace bitumen without danger to fisheries.

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¹ "Report of the Water Pollution Research Board for the year ended June 30, 1930." Department of Scientific and Industrial Research. H.M. Stationery Office, 1930. 9d.

² "Detailed Biological and Chemical Reports on Tars used for Road-Surfacing." Ministry of Transport and Ministry of Agriculture and Fisheries. H.M. Stationery Office, 1930. 2s. 6d.

Obituary.

LT.-COL. SIR RICHARD TEMPLE, BART., C.B., C.I.E.

WE regret to record the death of Lieutenant-Colonel Sir Richard Temple, the distinguished Oriental scholar, which took place on Mar. 3, at Territet, Switzerland. Sir Richard Temple was born at Allahabad on Oct. 15, 1850, and was educated at Harrow and Trinity College, Cambridge. He joined the Royal Scots Fusiliers in 1871, and after six years' service in India was transferred to the Indian Army, serving in the 38th Dogras and 1st Gurkhas. After a distinguished military and administrative career, in which he served in Afghanistan and Burma, in 1895 he was appointed High Commissioner of the Adamans and Nicobars and superintendent of the Penal Settlement of Port Blair, a post which he held until his retirement in 1904. On his return to England, Temple settled on his family estate in Worcestershire. During the War, as chairman of the Worcestershire Territorial Association, he took an active part in the recruiting, organisation, and training of reinforcements, and he also worked hard in connexion with the St. John's Ambulance Association, of which he was assistant director, his war services being recognised in 1916 by the award of the C.B.

Sir Richard Temple was a quick and indefatigable

worker. A busy official career which would have left most men little leisure only served to afford him opportunities for increasing the range of his knowledge. There were few matters connected, however slightly, with Indian culture on which he was not qualified to speak as an expert—history, religion, ethnology, linguistics, numismatics, archaeology, or folk-lore. His census reports for Burma in 1891 and the Andamans and Nicobars for 1901 contain many noteworthy contributions to the folk-lore and ethnology of these districts. He had, however, long before, taken a recognised place as an authority on folk-lore by his "Legends of the Punjab" (1883-1890) and his notes to Mrs. Flora Annie Steel's "Wideawake Stories" (1884). He had also founded and edited *Punjab Notes and Queries*. In Burma he made a special study of the Burmese belief in spirits, revising Burnell's "Devil-Worship of the Tuluvas", and publishing his own study of "The Thirty-Nine Nats". He also collaborated with the late E. H. Man in a work on the languages of the Andamanese, and he elaborated a "Theory of Universal Grammar applied to Savage Languages", a scheme of which the merits have not been fully recognised. An equal originality was shown in his studies of the currency systems of