

metallic salts which can be readily precipitated. The organic impurities are usually small in amount, and can be mixed with ordinary domestic sewage and treated along with the latter.

The remaining polluting substances are of an inorganic type, such as finely suspended matter from ore-washing or coal-washing plants, coke-oven effluents, pickle-liquors from metal works, etc. Most of these effluents are amenable to simple treatment, with the exception of the tar-products from gas-works and coke-ovens.

The most interesting part of the paper is that which deals with the work done, all over the world, upon the effects of many substances on stream-life, particularly dissolved gases, tar-products and sewage. A notable series of experiments are those of STEINMANN and SURBECK, who proved that many compounds are toxic even in very dilute solutions. A curious and somewhat unexpected result is that young fish are more resistant to tar poisons than adults. Small quantities of sewage have no adverse effects, but large amounts reduce the dissolved oxygen necessary for respiration to dangerously low levels. The experiments of SHELFORD are of particular interest as it appears that fish cannot detect most poisons and, therefore, make no attempt to avoid polluted areas.

A number of substances have an indirect adverse effect upon aquatic animals and plants. For example, most forms of stream-life are best suited by a slightly alkaline water, so that an acid effluent may soon reduce the population of a stream. Again, suspensions of coal-dust inhibit the growth of water-plants, and silt may spoil the spawning grounds of such fish as trout and salmon.

Stress is laid throughout the paper upon the utilisation of the self-purifying properties of a stream and upon the necessity for the adequate dilution of all effluents.

Dr. REDEKE also summarises the anti-pollution laws of many countries and supplies a useful bibliography; his paper may be recommended as an able account of a very intricate subject. C. H. R.

T. G. THOMPSON, J. W. LANG and L. ANDERSON. The Sulphate-Chloride Ratio of the Waters of the North Pacific. Publications of Puget Sound Biological Station, Vol. V, pp. 277 et seq., 1927.

In the past very variable values have been found by various observers for the ratio of the sulphate ion to chlorine in seawater. The variation has been certainly due in part to the difficulty of making an accurate determination of the sulphates. The very consistent results obtained by the writers of the paper here reviewed are ascribed by them to the fact that the precipitate of barium sulphate was thrown down in dilute solution.

(1) The first series of samples, 41 in all, was taken at various positions and depths down to 1097 metres on a line running 64 miles seaward from Yakutat Bay on the southern coast of Alaska. The average value of the ratio  $\text{SO}_4/\text{Cl}$  was 0.1396 with a maximum deviation from this of 0.0002; the salinities lay between 31.04 and 34.33.

(2) The average value of the ratio determined on 21 samples collected in the nearly land-locked San Juan Archipelago, north of the entrance

to Puget Sound, in salinities of 28.13 to 31.18, was 0.1397 with a maximum deviation from the mean of 0.0005.

(3) Sixteen samples collected in Puget Sound, near Seattle, gave a ratio of 0.1396 with a maximum deviation of 0.0003 in water of salinity 27.68 to 30.35.

(4) Samples collected near Shelton in Puget Sound in shallow water of salinity 25.08 to 27.83 containing large numbers of minute organisms gave a mean value of the ratio of 0.1395 with a mean deviation of 0.0010 and a difference between extremes of 0.0019.

(5) The greatest variation of the ratio was found in water collected near the mouths of rivers in Grays Harbour on the Washington coast with salinities of 1 to 23.22, the difference between extremes being 0.0046.

The agreement between the results obtained in the open sea is very good when allowance is made for the difficulty of the analytical process, and goes to show that the ratio is constant away from the coasts in the north-eastern Pacific Ocean. There is equally good proof that the ratio is variable in the waters of land-locked bays and harbours containing many marine organisms. A striking fact is that the ratio decreases as the salinity falls, although the reverse might be expected owing to the high ratio of sulphates to chlorine in river water. A possible explanation is the adsorption of the  $\text{SO}_4$  ion by colloidal matter.

The authors quote an interesting series of determinations of the ratio made by other observers, varying between 0.1363 found by ALLEMANDET and 0.1449 found by GIRAL, both in the waters of the North Atlantic Ocean and the Mediterranean.

The investigation is a valuable contribution to the work done on the vexed question of the constancy of the composition of the mixture of salts found in the sea, and it is to be hoped that it will be extended to other oceans by the same observers using the same methods. They must be the same since there is no method known which is to be relied upon to give the absolute value of the ratio. For oceanographical purposes, however, relative values are nearly as useful.

DONALD J. MATTHEWS.

