

Applying the method, the author finds, in the Clyde Sea Area, during the summer months, a surface-content of 0.001—0.003 mg. nitrite-nitrogen per litre; the amount becomes greater with increasing depth, and reaches 0.009 mg. per litre at one station in 5 fathoms. There are irregularities in the depth-distribution curve which call for further investigation.

A brief, but useful, résumé of the causes, physical and biological, leading to the variation of the nitrite-content of the sea, is appended.
J. R. B.

H. W. HARVEY. Nitrate in the Sea. *Journal of the Marine Biological Association of the U. K., N. S., XIV*, pp. 71—88, (1926).

The author finds that the Denigés test for nitrite and nitrate — the production of a red compound with an acid solution of "reduced strychnine" — is available as a quantitative method when suitably modified, and applied under standard conditions. While ferric salts have been shown by KOLTHOFF to interfere with the delicacy of the test, the iron present in sea-water is without effect upon the reaction. It is apparently held in some organic combination, which only responds to the tests for the ferric (or ferrous) ion when broken down by vigorous oxidation. Nitrites could only be detected in polluted waters, and it is assumed that the reaction, in the case of open sea and deep water samples, is wholly attributable to nitrate. Directions are given for making up the special reagent, and the technique, involving only the usual laboratory apparatus, is described. Unfortunately for the simplicity of the method, differences in salinity, and certain undefined factors, give rise to variation in the depth of colour produced when samples from different stations or depths, but of equal nitrate-content, are examined. It is not permissible, therefore, to assume that the absolute relation of the nitrate-contents of a number of samples is proportional to their relative depths of colour, and it becomes necessary to determine, for each sample, the colour-increment, measured in arbitrary units, resulting from known additions of nitrate-N₂; the original nitrate-content is then readily determined by extrapolation. The method is not applicable to waters containing any considerable quantity of organic matter, whether in the form of sewage or plankton.

An investigation of the distribution of nitrate-N₂ in the sea, during 1925, reveals several important facts. Definite evidence is adduced to show that deficiency of nitrate is a limiting factor for plant growth in the sea — a view to which the earlier results of BRANDT did not lend support. The annual fluctuation of nitrate-N₂ in the surface water of the English Channel, at a point 22 miles S.W. of Plymouth, stands in evident relation to the seasonal phytoplankton curve; from April to September the nitrate-content is practically nil, and at the onset of winter it rises to 70 mg. per cubic metre. The metabolic demands of the spring and early summer diatom-outburst correspond to a depletion of the surface layers, while the autumn is marked by a rapid rise in the nitrate-content at 50 metres, resulting from the breakdown of the dead and sinking organisms. Finally the approach of winter, with a shallowing thermal gradient and more

efficient vertical mixing, results in the return of the nitrate-stores to the sunlit surface waters.

The author was enabled to examine samples of sea-water from the open Atlantic, the Bay of Biscay and the North Sea, and the general conclusion was reached that the nitrate-concentration of the surface-layer is low (0—10 mg. per cubic metre) where there is no upwelling from the deeper waters. The high nitrogen content of the ocean-depths, however, is well illustrated by a series of samples collected by the R. R. S. *Discovery*, (in Lat. 37°44' N., Long. 13°21' W.) at depths down to 3000 metres. From these it would appear that the waters below 500 metres may contain 200—270 mg. per cubic metre, and an interesting, though purely speculative, calculation places the potential nitrate reserves of the great oceans at somewhere about 25×10^{10} metric tons.

In a very useful discussion of the Nitrogen Cycle, the author expresses the belief that, in the open sea, the cycle is a closed one, the proteins of the plant-body passing by various channels, direct and indirect, through ammonium salts and nitrates, back to the living plant, with bacteria as the active agents at every stage of the transformation. While this may be true in general of the open sea, there are unquestionably complicating factors at work in the coastal waters. Here, the cycle can no longer be regarded as a closed one; there are accessions and removals of nitrogenous material of great magnitude — thousands of tons of sewage are poured daily into our seas, a million tons of fish are landed annually at our ports, and 400,000 tons of seaweed are gathered annually from the coasts of western Europe. These figures, perhaps, are trivial in comparison with the waters of the globe, and the results may be purely local in their incidence, but it must not be forgotten that the coastal region is of far greater importance, from the point of view of organic production, than the open ocean.

With these inshore problems in view, and with the rôle and distribution of nitrifying bacteria as yet obscure, the nitrate in the sea still calls for intensive study. We trust that Mr. HARVEY will continue his investigation, and furnish us with further data from the region we have indicated.

J. R. B.

W. R. G. ATKINS. Seasonal Changes in the Silica Content of Natural Waters in Relation to the Phytoplankton. *Journal of the Marine Biological Association of the U. K., N. S., XIV*, pp. 89—99, (1926).

Dr. ATKINS has now applied to sea-water the method of DIÉNERT and WANDENBULCKE (1923) for the estimation of silica, which gave such interesting results, in his hands, in connection with the diatom periodicity in fresh water ponds.

The method consists in the addition of 2 cc. of a 10 per cent. soln. of ammonium molybdate to 100 cc. of the water to be tested, followed by 4 drops of 50 per cent. (vol.) sulphuric acid. This results in the production of a yellow colour, which is conveniently matched against a very dilute solution of picric acid — 0.369 mg. per litre of picric acid giving a depth of tint equal to that given by 0.50 mg. per litre of SiO_2 present