Vitamin Content of Marine Plankton.

THE synthesis of vitamin A in *Nitzschia* and other organisms grown in cultures of artificial sea-water (Jameson, Drummond, and Coward, *Biochem. J.*, **16**; 1922, and subsequent workers) has constituted the main evidence for assuming that marine organisms rely upon phytoplankton for their supplies of vitamins. A search for vitamin D in the same diatom (Leigh-Clare, *Biochem. J.*, **21**; 1927) proved unsuccessful; and little further attention has been given either to the possible presence and rôle of vitamins A and D in planktonic organisms or to the origin of the exceptionally rich stores found in the cod's liver.

To determine what may be, in the natural habitat of the plankton, the possible source and supply of vitamins A and D, plankton was collected and extracted by one of us (E. R. G.). Collections of diatoms and of zooplankton were made from Port Erin in the spring and summer of 1928, and through the kindness of Sir F. G. Hopkins the work of extraction was carried out at the Biochemical Laboratory, Cambridge. The dried plankton was treated in soxhlets with light petroleum and precautions were taken to ensure against overheating and against oxidation through access of air.

Vitamin tests have been conducted both at the Department of Biochemistry, University College, London, and, through the courtesy of The British Drug Houses, Ltd., by Dr. S. W. F. Underhill in their Physiological Laboratory. The feeding tests for vitamin A were supplemented by observations upon the colour reaction with antimony trichloride and by spectroscopic examination. In testing for vitamin D the degree of healing was determined both by histological (line test) and by X-ray examinations.

The following is a summary of the results hitherto obtained:

Nature of Test.	Result from Phytoplankton.	Result from Zooplankton.
VITAMIN A.		
(1) Growth tests .	Positive (in 20 mgm. doses)	Negative
(2) Antimony trichloride	Strong blue colour obtained	Negative
(3) Absorption spectrum	..	No band at 310–330 $\mu\mu$
VITAMIN D.		
(1) Line test . .	Doubtfully positive (much less than 100 Coward antirachitic units per c.c. in 0·02 c.c. doses)	Positive (less than 100 Coward antirachitic units per c.c. in 0·02 c.c. doses)
(2) X-ray . . .	Negative (in 50 mgm. doses)	Negative (in 20 mgm. doses)

The extracts of both animal- and phyto-plankton were strongly pigmented and with antimony trichloride produced red and yellow colours which in some samples were so intense as to render the determination of the blue colour almost impossible. When the antimony trichloride reaction was applied to the unsaponifiable fractions prepared from some of the oils the response was much more definite. A clear blue colour was given by the material isolated from the phytoplankton oil. How far this was due to carotene was not determined by spectroscopic examination, as the quantity of material available was insufficient, but that pigment was undoubtedly present. The unsaponifiable fraction examined from two zooplankton oils did not give a blue coloration with the antimony trichloride.

The probable absence of vitamin D in the phytoplankton is in agreement with the result obtained by Leigh-Clare for *Nitzschia*, which showed no antirachitic activity. It has not been possible to test the amount that would be required to show an order of activity much lower than 100 units per c.c.; therefore the possibility of its having a strength comparable to that of butter (2 units per c.c.) remains an open question. Small doses of the animal plankton, on the other hand, seemed to show fairly definite signs of antirachitic activity, and the possible discrepancy arising in the X-ray examination may be due to the greater delicacy of the line test. The tests suggest that the small amount of vitamin D which appears to be present in these animals results from their irradiation while in surface waters, rather than from a prolonged diet of phytoplankton.

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Scattering of X-Rays by Bound Electrons.

IN two letters to NATURE (May 17 and June 7), Dr. B. B. Ray announces an interesting experimental observation on what he calls "Scattering of X-rays by Bound Electrons". He allowed $K\alpha$ radiation of copper to pass through soot and air, and found that the photograph of the transmitted beam showed, besides the primary $K\alpha$ beam, lines of lesser frequency, namely, $\nu - \nu'$, where ν is the characteristic K-frequency of carbon, oxygen, and nitrogen (matter traversed). The nickel $K\alpha$ radiation also shows a similar modification, the quantum being deprived of a part of its energy corresponding to the K-radiation of the substance traversed.

The object of the present note is to point out that the phenomenon observed has nothing to do with scattering as Dr. Ray seems to think, but is a case of photoelectric ionisation. When a beam of frequency ν traverses matter, it may hit an electron in the K-shell, and will thereby be deprived of a part of its energy equal to $h\nu_K$ where ν_K is frequency of the characteristic K-radiation of the substance traversed. The modified beam will have, according to energy principles, the energy $h(\nu - \nu_K)$, and this may pass on as such, or be absorbed by the electron, which will be ejected with an equivalent velocity. This method has been utilised by De Broglie and Robinson in determining the energy levels of different atoms (from an analysis of the photoelectrons emitted), and by Ellis, E. Meitner, and others in determining the wave-length of nuclear γ-rays. This last application is very interesting, because as the γ-rays from the nucleus of a radioactive substance, say radium-actinium, pass through the nucleus, they release β-rays having the energies $h(\nu - \nu_K)$, $h(\nu - \nu_L)$, etc., and when the β-ray spectrum is analysed, it reveals the characteristic difference $(\nu_{K_1} - \nu_{L_{II}})$, etc., of the atom traversed.

Dr. Ray has, however, gone a step further, and has been the first to analyse the modified (by absorption) beam of primary quanta by a spectroscopic method, and supplemented the work of De Broglie and Black. It is therefore a remarkable experimental verification of photo-ionisation, and hence it easily explains why no modified beam is observed in any other than the forward direction.

The diffuseness of the modified lines is due to the fact that the characteristic $K\alpha$ radiation of the light elements from neon downwards is very diffuse, as observed by Söderman (*Zeit. f. Physik*, 52), and the diffuseness increases the lighter the element. It appears to me that it affords probably a far more accurate and less troublesome method for determining wave-lengths of the softer radiation from light