net methods in use. It does give the volume of the water wherein a catch of organisms has been living, though it still has the serious drawback of all net methods, viz., the loss of the nannoplankton. Variations in the composition of the phytoplankton, especially in the relative amounts of diatoms, dinoflagellates and other groups, which all have different pigmentation, may also in most places lead to unreliable results if one and the same colour solution is used throughout the year. For these reasons the method is not satisfactory as a *general* method for measuring the amount of vegetable matter in the waters, but it may be of great value for special investigations in certain waters (like the investigation of H a r v e y reviewed below). Also, it would seem to furnish interesting supplementary data when the phytoplankton production is studied by the centrifuge method and hydrographical and chemical methods now in use.

Trygve Braarud.

H. W. Harvey. "Annual Variation of Planktonic Vegetation, 1933." Journ. Mar. Biol. Assoc. N. S., Vol. XIX, No. 2. Plymouth, 1934.

The amount of plant pigment, estimated according to the method described in the paper reviewed above, was determined in the waters off Plymouth at frequent intervals throughout a year and used as a measure of the vegetable matter in the waters.

The spring diatom outburst in 1933 was described. As a whole the evidence indicated that with lengthening days and increasing sunshine the stock of diatoms increased from February to March 28th, producing daily more than was eaten by the herbivores. (The actual production was calculated from the decline in the phosphate content and from analyses of the phosphate content in diatoms, carried out by C o o p e r). The diatom maximum was recorded on March 28th, before all the dissolved phosphate was used up. A sudden outburst of larvæ at that time rapidly ate down the stock of diatoms to a low level, and kept it eaten down closely for the following five weeks, during which time the small stock was producing vegetable food for the herbivores. A rough calculation suggested that the stock was producing more than its own weight of vegetable food daily.

From May 11th to 22nd the diatom population increased and *Rhizosolenia alata* attained a density of over 30,000 cells per l. By June 12th this population had been grazed down or died down, much zooplankton and their fœcal pellets being present in the catch. On June 20th an outburst of *Rh. Stolterfothi* and *Guinardia flaccida* was found close inshore, the hauls containing very little zooplankton. It was noted that zooplankton was relatively sparse, both when *Rh. alata* was dense in May and when *Rh. Stolterfothi* was dense later, suggesting that the summer outbursts occur only when and where the demand of the herbivores slacken and, naturally, where there are enough nutrient salts.

During August lack of nutrient salts limited the production. A rough calculation suggested that, until the end of August and the dying down of the summer zooplankton, only a very small quantity of phosphate was regenerated and used again, and that the phosphorus abstracted from the water in the form of phosphate by the phytoplankton earlier in the year was kept almost entirely locked away as phosphoproteins in the animals until the end of August in this relatively shallow area. (Farther seaward it had been observed by A t k i n s that in several previous years, regeneration of phosphate took place in considerable quantity before the end of July).

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In the shallow waters, which had probably some nutrient salts available, diatoms were present during August, when the water offshore was barren. In September the copepods in the catches decreased and a mixed diatom plankton appeared, and the phosphate content reached 19 mg. P_2O_5 per m.^{3}. It was suggested that rather wholesale death of herbivorous organisms and some of the carnivores dependent upon them for food was brought about at the end of August through starvation. By the end of September the plankton was sparse. During October and November there was much sunshine and few herbivorous animals in the catches; diatoms increased, maximum catches being obtained on November 22nd, when the same diatom species were dominant as in September. During the winter months of December, January and February, 1934, considerable quantities of diatoms were present. This may be an abnormal condition.

The interpretation of the observations was in accordance with the following view: "An intimate relation or balance exists between the ever-varying populations of carnivores, herbivores, and vegetable food, which in its turn is sometimes controlled and always affected by the available nutrient salts and illumination. If the proportion of carnivorous to herbivorous animals is displaced for a period by an 'abnormally' large number of carnivores, then the diatoms are free to flourish and increase their population. If, on the other hand, the balance is displaced for a period by an 'abnormally' small proportion of carnivores, then the herbivores freed from their enemies can flourish, keep the breeding stock of vegetation closely grazed and by so doing limit their own increase. This would automatically delay the utilisation of nutrient salts."

The author mentions the grazing as possibly being of special importance for the production of phytoplankton in the southern seas, where the amount of nutrient salts does not seem to set any limit for the productivity of the waters.

This investigation represents a valuable contribution to the understanding of the seasonal variation in the phytoplankton of the waters off Plymouth. The interpretation of the spring, summer and autumn maxima as caused by variations in the grazing of zooplankton seems convincingly demonstrated. Some highly interesting quantitative data are obtained on a factor of productivity for which even the roughest idea of its quantitative importance has been lacking. It is to be hoped that the author will continue his work along these lines which have proved so successful. If one should express some wishes for further publications it might be for further information on the effect of sinking, which seems to some extent to have been underrated; also for a discusssion of the hydrographical data in connection with the phytoplankton problem, and some information on the relative amount of nannoplankton and net plankton throughout the year.

Trygve Braarud.

M. V. Lebour. "Rissoid Larvae as Food of the Young Herring. The Eggs and Larvae of the Plymouth Rissoidae." Journ. Mar. Biol. Assoc. N. S., Vol. XIX, No. 2. Plymouth, 1934.

Heringslarven nähren sich bei Plymouth zur Zeit wo der Dottersack verschwindet von den Larven von *Rissoa sarsii*. Diese sind im Winter reichlich vorhanden, doch ist das erwachsene Tier im Untersuchungsgebiet nicht gefunden, vielleicht wegen Vorkommens an unzugänglichen Stellen. Es wird eine Übersicht der Rissoen von Plymouth und die Beschreibung der Eier und Larven von 9 Arten mit Abbildungen gegeben.

E. H.

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