

boiling off the ammonia from a sample of water, this was digested with aluminium amalgam whereby the nitrates present were reduced to ammonia. This was distilled off and estimated colorimetrically by means of NESSLER solution. Blank determinations with distilled water allowed a correction to be made for any ammonia produced from nitrogen occluded in the amalgam. However, in this digestion with amalgam, ammonia is produced not only from nitrates and from nitrogen occluded in the amalgam (which is allowed for as stated) but also from certain organic compounds such as yield "albumenoid ammonia" and which are present in sea water. Hence there is every reason to suppose that this treatment with amalgam splits off ammonia from organic matter in solution, as it is known to do with natural waters (THRESH and BEALE. The Examination of waters and water supplies. London. 1925).

The values obtained for the nitrate-nitrogen in North Sea waters by this method reached a minimum of 60 to 70 mg. per cubic meter during the summer months, whereas SCHREIBER'S method depending upon the growth of *Carteria* in water after filtration indicated that practically no nitrate was present during June in water collected off Heligoland, and the method of estimation by means of reduced strychnine has given values of under 10 mg. per cubic meter for nitrate-nitrogen in the surface water at several positions in the North Sea during the summer.

The distribution of nitrates in the sea and its utilisation by phytoplankton is receiving considerable attention. The work of WATTENBERG in the South Atlantic, of SUND in North Norwegian waters and of the "Dana" now cruising round the world are already yielding results, and additional information may be expected from the "Carnegie" at present on an extended cruise.

The other nitrogen compounds, ammonia and nitrogenous organic matter, appear on the other hand to have an irregular distribution in the sea, with no obvious correlation except that they tend to be maximal close inshore.

H. W. H.

F. S. RUSSELL. The Vertical Distribution of Marine Macroplankton. VII. Observations on the Behaviour of *Calanus finmarchicus*. Journal Mar. Biol. Assoc. (N. S.) Vol. XV, Nr. 2. 1928.

Mr. RUSSELL, in this the seventh instalment of the account of his investigations, based on horizontal hauls of a stramin net at serial depths checked by a depth recorder, concentrates his attention on a single species. In previous papers he has put forward evidence to show that in general the depth of the main body of *Calanus finmarchicus*, adult and penultimate stages, is regulated both for its diurnal and annual cycle by the intensity of the light, the optimum depth being less in spring and autumn than in the summer and at dusk than at midday. More detailed observations have shown that this generalization does not hold good in every case and a noticeable exception is the occurrence of adults during July, August and September in the Plymouth samples much nearer the surface than in the preceding three months. Records of the light intensity and of the ultra violet radiation on the dates on which the samples were taken show

that neither the weather conditions nor the actinic quality of the light sufficed to account for the decrease in depth of the *Calanus* maximum. Mr. RUSSELL in this paper seeks for some other explanation. He finds a tentative explanation in the fact that the sizes of both males and females show a progressive increase from their first appearance in April to a maximum towards the end of May, a steady decrease to the end of July, and a maintenance of this small size till the end of September. This seasonal variation in size is a well attested fact in several species of Copepods and is reasonably assigned to the effect of the temperature at which they were hatched or developed. Mr. RUSSELL suggests that there may be a physiological difference between the large spring brood and the smaller summer brood, the latter preferring a higher intensity of light and consequently living at a higher level in the water.

This suggestion, for it is nothing more, is an interesting one but it is perhaps premature, for the connection between the large and the small broods is by no means clear and there are other possibilities which might be considered. The real value of the paper, however, lies in the detailed information it gives as to the actual vertical distribution under accurately recorded conditions.

The author is also inclined to see in the existence of two broods an explanation for the sporadic appearance of swarms of *Calanus* at the surface in bright sunlight, but this seems hardly sufficient to account for what at first sight seems to be a reversal of the normal reaction.

G. P. F.

HELEN S. OGILVIE. Observations on the Food of Post-Larval Herring from the Scottish Coast. Fishery Board for Scotland, Scientific Investigations, 1927, No. 1.

Very little has up to the present time been published on the feeding of the post-larval herring measuring from about 30 to 45 mm. in length. Mrs. OGILVIE has therefore published the results of investigations on the food of these particular stages of the herring from Scottish waters. The fish which form the subject of the investigations consisted of three samples caught on the 17th June 1926 outside Aberdeen Breakwater, the 21st June 1926 off North Pier, Aberdeen and on the 30th April 1925 off Kincardine-on-Forth. The sizes in question varied from 27.5 to 47.5 mm., and the paper is illustrated by photographs of three different specimens, showing the general appearance of the fish.

The food of the herring at this stage consisted almost entirely of copepods, and the main feature of the results was the predominance in each of the three lots of fish examined of one particular copepod, viz. *Pseudocalanus* in the first, *Oithona* in the second, and *Eurytemora* in the third. The predominance of *Eurytemora* in the sample from the Firth of Forth depends, no doubt, on the special locality, as no other of the usual open-sea copepods would generally be found so far up the Firth. The two samples of herring caught off Aberdeen showed rather different results, the copepods *Pseudocalanus* and *Oithona* dominating in each of the samples. The relative numbers of these two copepods taken by the fish were respectively