

Dabei ist zu berücksichtigen, dass die Farbe, die Nitrit-Stickstoff ergibt, etwa 20—40 % schwächer ist, als die durch Nitrat-Stickstoff hervorgerufene. Als kolorimetrische Vergleichslösung empfiehlt der Verfasser eine 0.0008 %ige Lösung von Safranin, deren Intensität etwa der durch 90—130 mg. Stickstoff entwickelten Nitratfärbung entspricht.

H. W.

**Per Ottestad.** "On the Biology of some Southern Copepoda." Det norske Videnskabs-Akademi. Hvalrådets Skrifter, Nr. 5. Oslo, 1932.

This paper is an account of some of the Copepoda taken during the voyage of the "Vikingen" to the Weddel Sea in 1927—8. The species dealt with are *Calanus acutus*, *C. propinquus*, *Rhincalanus grandis*, *Metridia gerlachei*, and, very briefly, *M. curicauda*.

Hydrographic observations indicate the existence in this locality of a surface layer of negative temperature and low salinity, a warmer intermediate layer of higher salinity of Atlantic origin, and, close to the bottom, below 1500 m., Antarctic water with a negative temperature. Only the two upper layers were investigated, two vertical hauls, one in each layer, being made at various positions, fourteen in all, during the Antarctic summer between 27th October, 1927, and 12th February, 1928.

*Calanus acutus*, the most abundant Copepod in Antarctic regions, where it occupies a position corresponding to that of *Calanus finmarchicus* in northern waters, is discussed at greatest length. This species is mainly found in the Polar surface layer, where spawning begins at the end of November. Three groups, distinguished by their sizes and, in part, by their local distribution, are identified in the material examined, and the view is put forward that they have originated in waters of different temperatures and have been carried by currents to the locality in which they are now found. One of these groups, the smallest in size is, it is suggested, carried from warmer waters towards the south in the intermediate layer. The two groups of larger specimens are regarded as coming in independently from the south. The spawning of these three groups, it is maintained, provides the whole stock for the current year, the adults dying after spawning. The author rejects the possibility of a biennial development, on the one hand, and, on the other, considers that there is no evidence for thinking that the produce of one year will spawn before the following winter.

*Calanus propinquus*, another abundant copepod, exhibits a parallel course of development to *C. acutus*, and the material furnished three corresponding size groups.

*Rhincalanus grandis* is found principally in the intermediate layer and hence it is inferred, with some probability, that it is of Atlantic or sub-Antarctic origin (the latter surely is the more likely) and not, as has generally been assumed, a typically Antarctic species. The absence of nauplii and of the earlier copepodite stages seems to show that it does not spawn in the Weddel Sea.

*Metridia gerlachei* is probably, after *C. acutus* and *C. propinquus*, the most characteristic Antarctic copepod. The author admits its Antarctic character, though he remarks that it occurs principally in the intermediate layer. He does not put forward the obvious explanation of this, namely, that the genus *Metridia* is one which undertakes very extensive diurnal vertical migrations, an allied species *M. lucens* descending below 200 m. by day,

though he hints that this may be the cause of its not being found in the upper 50 m., "at all events not during the day-time".

If the author's conclusions lay themselves open to criticism it is mainly because they are based on the assumption that the copepod distribution is uniform, not patchy, and that a single haul may be taken as representative of a large area. Such an assumption may be true, but it would not hold good in some northern temperate waters, where adjacent hauls may give widely differing results as regards the proportions of the different stages of development present. Further no allowance is made for the fact that in catches with a net of composite mesh, the smaller stages, which would pass through the meshes of the coarser portion, are strained from a much smaller quantity of water than are the larger stages and consequently their numbers are not represented in their true proportions.

Papers such as this, on the biology of selected species, are a welcome addition to the lists of purely systematic treatises, necessary as the latter may be in the preliminary survey of an area.

G. P. F.

**A. C. Gardiner.** "Vertical distribution in *Calanus finmarchicus*." Journ. Mar. Biol. Assoc. N. S., Vol. XVIII, No. 2. Plymouth, 1933.

This important contribution to the study of *Calanus*, based on a technique which has not been used before, may be described as a modification of F. S. Russell's method of horizontally hauled tow-nets with the townets replaced by Hardy (non-recording) plankton indicators, which consist of metal cylinders with narrow mouths and detachable silk discs to filter the macroplankton. Three of these instruments were fixed to a single warp so as to be towed horizontally at approximate depths near the surface, in mid-water and near the bottom; each haul extended for 1 mile and took 20 minutes. This method has advantages over Russell's in that the error of bringing the open "net" to the surface at the end of each haul is diminished since each haul occupies a longer time, and that a number of instruments can be fished on the same warp more conveniently. It has the disadvantage compared to townets hauled either horizontally or vertically that the catches are much smaller and consequently may be less representative. This error might be reduced, however, as pointed out by the author, by using indicators with larger mouths.

The main series of observations was made during the hours of daylight in May, 1931, in the North Sea off Shields, where the spring herring fishery is centred. Since all the catches were counted in three categories — stage VI (adults), stage V and stages IV + III, the author has established that in the North Sea in spring young *Calanus* (IV + III) are concentrated by day near the surface at a little less than 10 fathoms, and that the distribution of older stages is erratic, but on the whole they are concentrated in rather deeper water, the adults a little below stage V. Furthermore the measurement of lengths shows that in stage V the larger individuals live a little below the smaller. The results, presented numerically and graphically, show clearly how the population varies from station to station. Thus there is further evidence of the "importance of the ontogenetical state of the individual in relation to its vertical distribution", but since the observations were made at various times from 6 a.m. to 6 p.m. (sunrise and set at 4 a.m. and 8 p.m.) it should be stressed that the position at which the majority of