

LEIF STÖRMER. Copepods from the "Michael Sars" Expedition, 1924.
 Cons. Perm. Intern. pour l'Exploration de la mer. Extrait from
 Rapp. et Proc. Verb. Vol. LVI, Copenhagen 1929.

The most important part of Mr. STÖRMER'S interesting paper is that dealing with the development and migrations of *Calanus finmarchicus* off the west coast of Greenland. He seeks to explain the occurrence of two size-groups, and comes to the conclusion that the larger individuals which are found at the northern stations, were spawned in Greenland waters during the previous summer, and were therefore over a year old; while the smaller specimens, which are characteristic of the southern stations, were spawned farther south in the spring of the same year, and had been carried north by currents. As adult stages were comparatively scarce, his observations are based on individuals of the fifth copepodite stage. He found the vertical distribution to be as follows:—

Nauplii and First Copepodites: 50—0 m. exclusively.

Second Copepodites: 100—0 m. exclusively.

Third Copepodites: mainly in upper 100 m. but may be deeper down.

Fourth and Fifth Copepodites: at all depths.

Adult ♀ mainly 100—50 m., or scattered throughout all depths.

Adult ♂ between 300—50 m.

There is a northerly current along the west coast of Greenland, the surface waters of which have a somewhat greater velocity than the underlying ones; further, there is a wedge of cold water extending southwards over the banks. These two conditions are important factors in the distribution and development of the young stages of *Calanus* which are derived from spawning on the banks. The youngest stages are in the warmer and swifter moving surface waters, while the older stages have migrated downwards into the colder and more sluggish water. This power to migrate seems to be acquired by *Calanus* at about the third copepodite stage. The cold water retards development—even during August—and as the copepods move north and west they get into still colder water. The individuals tend to remain at stages III and IV for a considerable time, and assuming a steady spawning throughout a lengthy period, there would be a great preponderance of these stages, which Mr. STÖRMER finds to be the case. Autumn and winter follow, and development continues to be slow, and leads to the production of larger individuals than usual. We are left in some doubt as to the fate of the younger stages that are carried north in the surface waters.

Calanus appears to remain in the fifth copepodite stage until conditions are favourable for spawning, when it passes through the relatively short period of maturity.

Similar observations were made on the principal copepod species collected during the expedition, but it was not always possible to separate the early copepodite stages so readily as in the case of *Calanus finmarchicus*. Evidence was found of a more or less definite spawning of *Calanus hyperboreus* in the Norwegian Sea; the vertical distribution of *Pseudocalanus minutus* (= *elongatus*) agreed fairly well with that of *Calanus finmarchicus*. An interesting feature of the vertical range of the stages of

Euchaeta norvegica was that the smallest copepodite stages were found at deeper levels than the larger ones; a result which he finds does not agree with previous investigations; it is not, however, inconsistent with BIGELOW's results in the Gulf of Maine; he found *Euchaeta* to be almost limited to the waters below 100 metres, and states that reproduction takes place entirely below that depth.

Oithona helgolandica was very common and composed 48.2 per cent. of all the copepods counted in surface samples (50—0 m.). *Oithona spinirostris* had a more restricted distribution and appeared to follow the warm Atlantic water which lay beneath the colder water from north and west.

R. E. S.

WINFRED EMORY ALLEN. Quantitative Studies on Inshore Marine Diatoms and Dinoflagellates, collected in Southern California in 1924." — Bulletin of the Scripps Institute of Oceanography, La Jolla, California. Technical Series, Vol. I. No. 15. 1928.

— "Review of Five Years of Studies on Phytoplankton at Southern California Piers, 1920—1924 inclusive. — Ibid. No. 16. 1928.

In the first of these papers Mr. W. E. ALLEN continues the description of his plankton researches in Southern California, the sixth of the series; in the second he brings the results of five years work together in review.

As in preceding years daily collections were taken throughout the year at three piers, Scripps Institute of Oceanography, at La Jolla, Oceanside and Pt. Hueneme. The great excess in numbers of diatoms at Pt. Hueneme and the exceptional maximum at La Jolla in 1924 is noteworthy, and dinoflagellates were so numerous at La Jolla in June that there was a distinct discoloration of the water, the most prominent case of "red water" for years. The chief species causing discoloration was *Prorocentrum micans*. After the disappearance of the red water came "stinking water" which is usually supposed to be the direct consequence of the former. In this the most important organism was a tintinnid although numbers of peridinians and a few diatoms were present. Earlier cases of red water were chiefly due to *Gonyaulax polyedra* and it is interesting to find that from time to time especially in latter years the cause was *Prorocentrum micans*.

The methods used successfully by Mr. ALLEN for the five years described (1919—1924) include dipping, measuring and filtering through No. 25 Dufour bolting silk (average diameter of mesh about 0.05 mm.) of the samples to be studied. All enumerations were made by use of the Sedgwick-Rafter counting cell and the Whipple ocular disc micrometer.

There is considerable variability in annual production of diatoms and dinoflagellates in the Southern Californian region in general and in some localities in particular, the total number of diatom cells at Pt. Hueneme for the five years being more than one-fourth greater than the total at La Jolla, those at Oceanside being less than either, but there has been a steady decline in numbers after 1921 at La Jolla and a steady increase at Pt. Hueneme, the reason being obscure and apparently in no way due to temperature and salinity. The seasonal distribution, however, agrees