

In *Actinosphaerium* the twelve radial lines of microtubules would presumably isolate the active sectors from one another.

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Swarming of Hyperiid Amphipods

FOLLOWING a period of moderately strong westerly wind, on June 26, 1966, the beaches of Robin Hood's Bay, Filey, and Sandsend, Yorkshire (extending for about 40 km of coastline), were turned white by a covering of vast numbers of hyperiid amphipods.

A sample of these was found to consist of fifty-six large specimens, all but two being sexually mature or nearly mature, and more than a hundred small juvenile specimens. The large specimens were identified as *Parathemisto* (*Euthemisto*) *gaudichaudii* (Guerin), both the *compressa* and *bispinosa* forms¹ being present in about equal proportions. The small specimens could be identified with certainty only as *Parathemisto* sp., but considering that all of them were curled, as within the maternal oostegites, it was obvious that they had just been released.

Specimens of *Parathemisto* had occurred previously in small numbers in April and May 1966. In early June, mature specimens (containing young) were common in the surface plankton off Sandsend. Following the invasion of the shore, large numbers of small specimens of *Parathemisto* were taken in July in plankton hauls off Sandsend and only rarely were specimens taken later in the year. Thus swarming appears to be associated with the reproductive phase.

On June 17, that is, before the invasion, the stomachs of cod (*Gadus morrhua*) of 33–60 cm length trawled in 14 m of water, 1.2 km off Sandsend, were all found to be distended with specimens of *Parathemisto gaudichaudii* (identified by J. E. Kane). The cod were in large numbers and it seems likely that the amphipods had been swarming.

Swarms of *Parathemisto gaudichaudii* have been reported on other occasions; for example, off the Gulf of Maine^{2,3}, off the French Atlantic coast⁴ and in the Antarctic Ocean^{5,6}. Where examined^{4,5}, as in the present case, the composition of the swarms showed them to have been in a reproductive phase.

The coastline discussed faces north-east and the residual tidal current is south-east. Westerly winds activated by the Coriolis force might have intensified the south-easterly current and brought the swarming amphipods closer to the beaches. A similar invasion occurred in May 1913, also following a period of westerly wind⁷. Other invasions in February 1892, April 1907 and April 1908 followed periods of more directly onshore winds, north or north-east. Thus it is quite possible that the prevailing wind in each case could have contributed to the invasion of the shore by the swarming amphipods.

A sample collected from the beach at Redcar, Yorkshire, in April 1907 by T. H. Nelson was referred to as *Euthemisto compressa* by Ritchie⁷, and noted as *Euthemisto compressa* (Goës) var. *gracilipes* Norman (Reg. No. 1907–79, Royal Scottish Museum). According to modern usage this species is *Parathemisto* (*Euthemisto*) *gracilipes*⁸. On re-examination, this sample was found to consist of

110 specimens, all but five being sexually mature or nearly mature, many of the females carrying eggs or young. As in the 1966 invasion, the composition therefore suggested a reproduction phase although the species in the two invasions were different.

It appears that the neritic species⁸, *Parathemisto gracilipes*, is generally the most usual one in the southern North Sea⁹, although difficulty in nomenclature tends to confuse this^{10,11}. Thus the presence of *P. gaudichaudii* might be considered unusual and, considering its normal oceanic existence^{1,8}, indicative of an influx of water from the Atlantic Ocean. Similarly, swarms of the pteropod, *Limnacia lesueurii*, and of the radiolarian, *Phyllostaurus quadifolius*, normally in the Atlantic, occurred off the north-east coast of England in the late summer and early autumn of 1921¹². These organisms were considered to have been carried around the north of Scotland. More frequently, successive swarms are brought only as far as the north of Scotland¹³. In 1965, for example, the euphausiid *Thysanoessa longicaudata*, which is normally oceanic, was found swarming in Lerwick Harbour in the Shetland Islands, where one would expect *T. inermis* or *T. rashi*¹³. Here, as with the amphipods, the swarm was in a reproductive state and is believed to have been influenced by local wind conditions.

The Sei whale in the Antarctic is reported to feed almost exclusively on *Parathemisto gaudichaudii*⁵, and the tunny (*Thunnus alalunga*) is known to feed on immense surface swarms of this species (as *Euthemisto compressa*) which occur beyond the continental shelf off the French Atlantic coast⁴. The cod off Langelens, Iceland¹⁴, and off Bear Island¹⁵, has been reported to take *Parathemisto obliqua* (prob. = *P. abyssorum*) on some occasions as its predominant food. The feeding to gorging, as shown for the cod off the Yorkshire coast, however, is here reported for the first time.

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Apparent Photosynthesis and Respiration in Populations of *Lolium perenne* from Contrasting Climatic Regions

MEASUREMENTS of net assimilation rate by growth analysis techniques have shown significant differences between North European and Mediterranean populations of *Dactylis glomerata* in controlled environments at low and high temperatures¹, and between a similar range of populations of *D. glomerata*, *Festuca arundinacea* and *Lolium perenne* in the winter, spring and autumn at Aberystwyth². Greater net assimilation rates were found