

MAASTRICHTIAN ADHERENT FORAMINIFERA ENCIRCLING CLIONID PORES

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A further example is described of attached arenaceous foraminifera coiled round surface pores of a clionid sponge boring. The substrate is an oyster, *Pycnodonte vesicularis* (Lamarck), the boring *Entobia cretacea* Portlock, the foraminifera *Placopsilina cenomana* d'Orbigny and *Bdelloidina vincentownensis* Hofker, and the age lowermost Upper Maastrichtian.

Unusual adherent arenaceous foraminifera were recently described by Bromley (1970). The tests were closely coiled round the surface pores of sponge borings in the substrate shell. The foraminifera were identified as *Arenonina cretacea* Barnard on Campanian oysters and *Placopsilina* sp. on Coniacian *Inoceramus*. However, examination of further Campanian material from the same locality indicates that the species in the former case is *Bdelloidina vincentownensis* Hofker rather than *A. cretacea*.

Almost simultaneously, Voigt (1970) described *Bdelloidina vincentownensis* and *Placopsilina cenomana* d'Orbigny showing a similar relationship to boring openings. In this case, most of the borings concerned were ascribed to phoronids and were located in the hardened walls of burrows in Upper Maastrichtian hardgrounds.

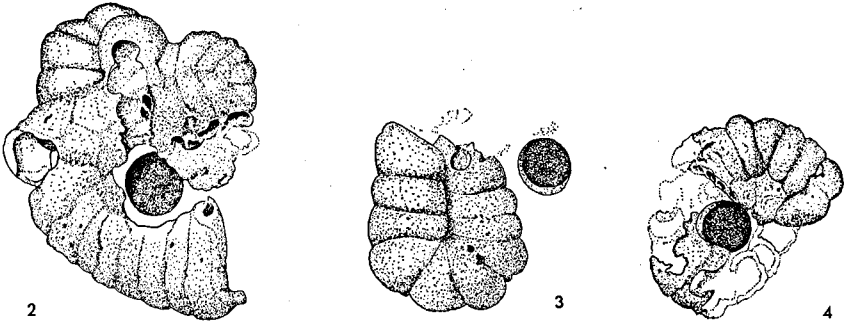
The relationship between hole and foraminiferan is so remarkable that it is considered worthwhile to report another example of the phenomenon, which involves the same two species of foraminifera.

The left valve of an oyster, *Pycnodonte vesicularis* (Lamarck), from the lowermost Upper Maastrichtian white chalk, zone 8 (Surlyk, 1970), of Lindholm Pit near Aalborg, Denmark, shows a number of unusual features which are to be described elsewhere by E. Håkansson. The specimen (pl. 1, fig. 1) is housed in the Mineralogical Museum, Copenhagen, as no. MMH 11031. The shell has been bored after the oyster's death by a sponge to produce a typical *Entobia cretacea* Portlock bore system in the dorsal region. Small pores of the entobian are distributed fairly equally on the two surfaces of the shell.

Adherent foraminifera are intimately associated with some of these holes, but only on the inner surface of the shell and mostly posterior to the umbo

Fig. 1. Part of the inner surface of an oyster, showing the distribution of entobian pores and foraminifera. The broadly striated area towards the right is the resifier, partly covered at its left end by the remains of an encrusting *Arretia nilssoni* (Hagenow).





Figs 2-4. 2: *Bdelloidina vincentownensis* encircling a pore. The aperture is unusual, consisting of a single large opening directed towards the sponge pore. 3: A fragment of *Bdelloidina vincentownensis* beside a pore. 4: A possible *Bdelloidina vincentownensis* encircling a pore. $\times 13$.

(fig. 1). Of the 110 entobian pores on this surface at least 27 have been encircled by foraminifera. In addition there are small fragments of three foraminifera which are possibly not associated with entobian pores. The mode of growth of the foraminifera is illustrated in figs 2-15.

Two species of foraminifera are involved. At least two examples of *Bdelloidina vincentownensis* can be identified (pl. 1, fig. 2; figs 2, 3 and perhaps 4), and several tests are clearly *Placopsilina cenomana* (figs 5 and 6). The other fragments possibly also belong to one or the other of these species but are too incomplete for certain determination.

A membraniform cheilostome bryozoan has encrusted part of the area in question (fig. 1). In one place (fig. 13) the zoarium has avoided growing over an entobian pore, having instead grown round it and met itself on the other side. The strong influence thus shown by this pore on the growth of

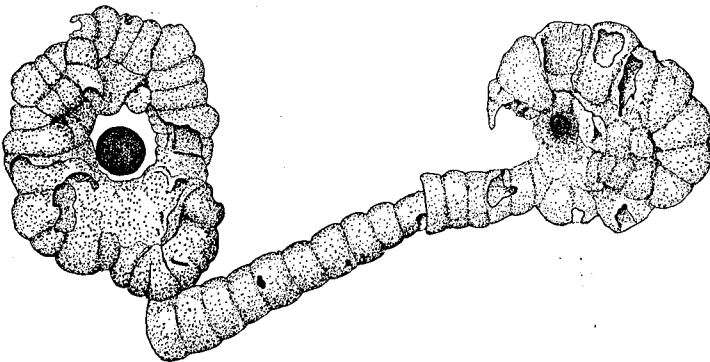


Fig. 5. Two *Placopsilina cenomana* tests, each encircling a pore. $\times 13$.

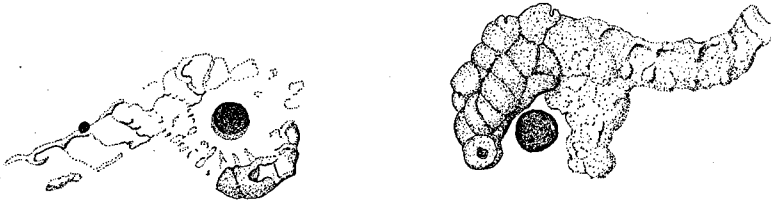
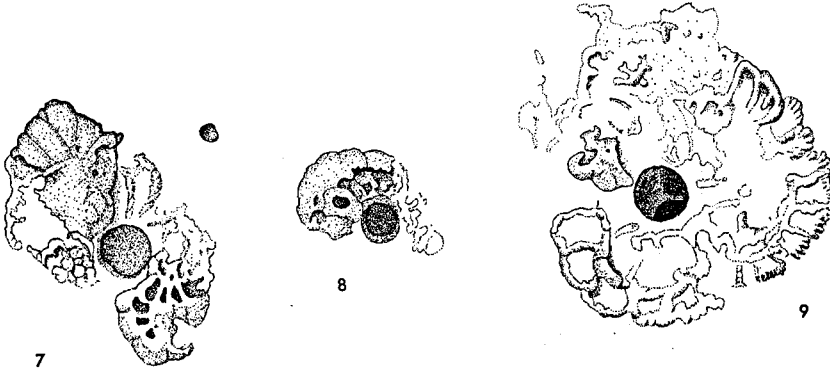
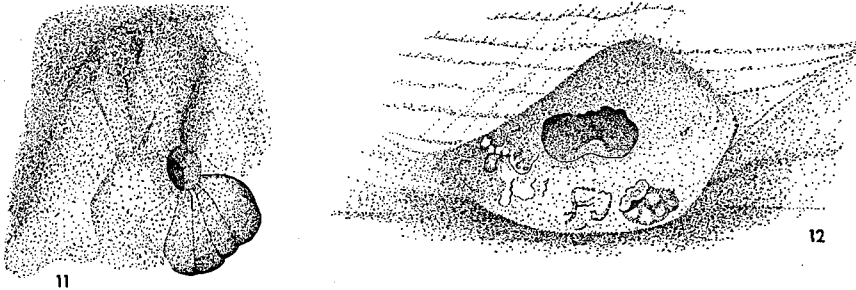


Fig. 6. Two *Placopsilina cenomana* tests, each encircling a pore. $\times 13$.



Figs 7-9. Remains of foraminifera encircling pores. $\times 13$.

Fig. 10. Remains of probable *Placopsilina* associated with entobian pores, and an isolated fragment some distance from a pore. $\times 13$.



Figs 11-12. 11: Fragment of a foraminiferan which encircled a pore. 12: Small depression in the oyster's resilifer containing an irregular entobian pore and fragments of foraminifera. $\times 13$.

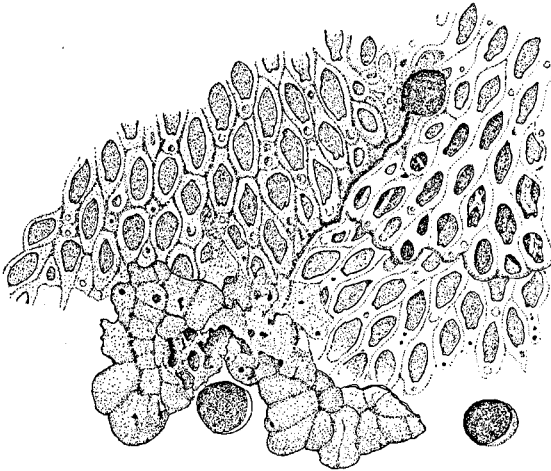


Fig. 13. Three entobian pores. A bryozoan has avoided crossing one of them, and a foraminiferan has partly encircled another. $\times 13$.

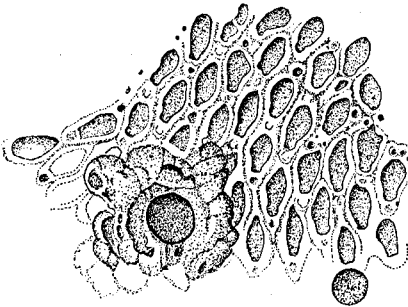


Fig. 14. A damaged foraminiferan test encrusting a bryozoan and encircling an entobian pore. $\times 13$.



Fig. 15. A bryozoan skeleton has been encrusted by *Atreta nilssoni* (lower right) and a foraminiferan which has encircled an entobian pore. $\times 13$.

the bryozoan may indicate that the sponge was in residence at the time. There is further evidence for this. At another point (pl. 1, fig. 3) the sponge bored two small pores through the bryozoan skeleton. Also the growth of the zoarium stopped at a line of entobian pores (fig. 1) which were thus probably occupied by sponge papillae at the time.

The bryozoan was presumably dead when the foraminifera settled since in every case where these are in contact with it they post-date the zoarium (figs 13–15). The bryozoan has produced a second layer of zoarium over the first in one place, again avoiding crossing the sponge papilla (fig. 13), but the new zoarium does not reach the foraminifera.

That the sponge was still living when the foraminifera settled is highly likely, and is the most reasonable explanation for the special distribution of their tests. In some cases (figs 5 and 6) *Placopsilina* has produced two whorls of chambers, one above the other, round the hole, rendering something resembling the chimney effect observed by Bromley (1970, fig. 3) and Voigt (1970). This probably resulted from an attempt by the foraminiferan to maintain the closest possible contact with water currents produced by the sponge. On the other hand, however, it is possible that the foraminiferan grew round the outside of the papilla itself which had extended beyond the boring pore in response to the presence of the encircling first whorl of the test. Were this the case the relationship between the two animals would represent an example of partial immuration (Voigt, 1970).

Acknowledgement. The authors are indebted to Prof. E. Voigt and Mr. E. Håkansson for the interpretation of the bryozoan.

Dansk sammendrag

Et nyt eksempel på fastsiddende foraminiferer omkring porer i clionide svampeboringer beskrives. Substratet er en østers, *Pycnodonte vesicularis* (Lamarck), boringen *Entobia cretacea* Portlock, foraminifererne *Placopsilina cenomana* d'Orbigny og *Bdelloidina vincentownensis* Hofker og alderen er nederste Øvre Maastrichtien.

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References

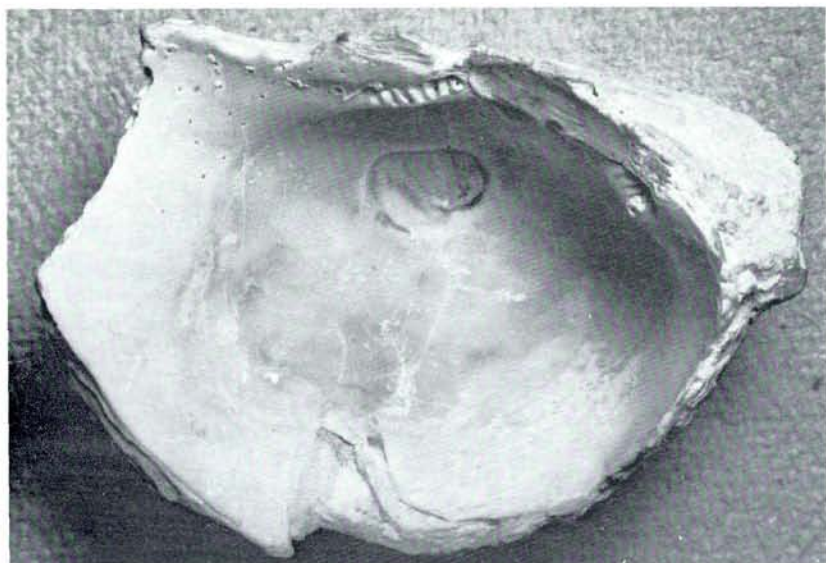
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Plate 1

Fig. 1. The inner surface of an oyster shell, slightly enlarged. The adherent foraminifera are mainly distributed along the upper margin of the shell, see text-fig. 1.

Fig. 2. *Bdelloidina vincentownensis* encircling an entobian pore. $\times 18$, see also text-fig. 2.

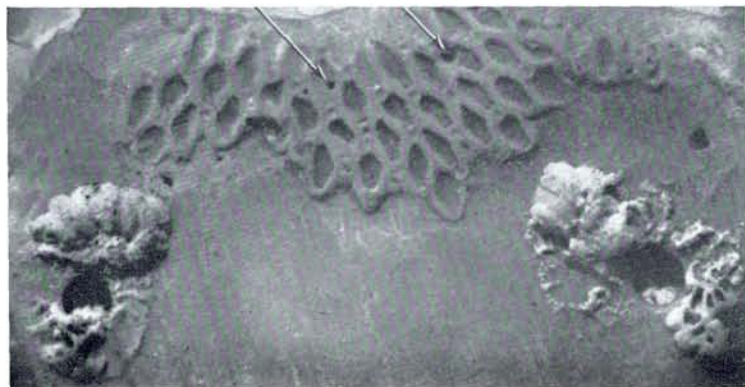
Fig. 3. Two foraminifera and a bryozoan encrusting the shell. The arrows indicate small entobian pores which have pierced the bryozoan skeleton. $\times 12$.



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