

The presence of a bothriocidarid (Echinoid) in the Ordovician of Norway

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Eight loose plates of a bothriocidarid sea urchin have been found in the Upper Ordovician, Kalvsjø Formation, Hadeland, Oslo Region. The characteristic type of plates indicate that they belong to *Neobothriocidarid*, and may be referred to *N. peculiaris* Paul from approximately equivalent beds in Scotland.

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Eight loose plates from two different localities in the Upper Ordovician Kalvsjø Formation, Hadeland, were collected by one of us (P.I.B.) during work on crinoid ossicles. The material occurring in a calcite-poor sediment has been decalcified in acid and studied using rubber casts. The specimens and associated fauna come from a flank or interbank facies off small carbonate mud mounds consisting of mudstones and siltstones interbedded with 5–10 cm thick calcitic limestone beds with calcarenites or occasionally calcic siltites. The fauna is rich in crinoid debris, brachiopods, and bryozoans, but poor in trilobites. The recognition of plates of bothriocidarids adds to the diversity of the fauna and extends the distribution of the bothriocidarids.

The bothriocidarids are a primitive family of a sea urchin known only from the upper part of the

Middle Ordovician and the Upper Ordovician of Europe and North America. At present two genera are assigned to the family Bothriocidaridae, *Bothriocidarid* Eichwald and *Neobothriocidarid* Paul. A third, hitherto undescribed genus is also known (P. M. Kier, pers. comm. 1977).

Description

The bothriocidarids are regular echinoids characterized by thick non-imbricating plates. They have single columns of imperforate plates and a single row of non-poriferous plates. The pores pairs open externally in distinct peripodia surrounded by a rim on which perforate spine mamele are developed. Perforate plates of *Bothriocidarid* and *Neobothriocidarid* are quite dif-

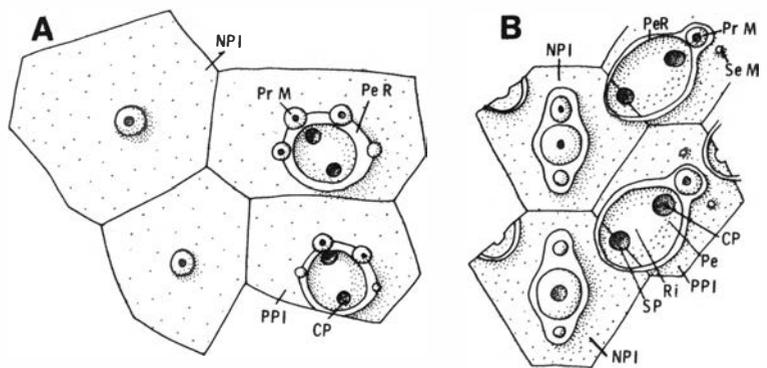


Fig. 1. Schematic diagrams of poriferous and non-poriferous plates of *Bothriocidarid* (A) and *Neobothriocidarid* (B), modified from Paul (1967). CP, central pore; NPI, non-poriferous plates; Pe, peripodium; PeR, peripodium rim; PPI, poriferous plates, PrM, primary spine mamele; Ri, ridge; SeM, secondary spine mamele; sp, sutural pore. Orientation of plates same as of Paul (1967).

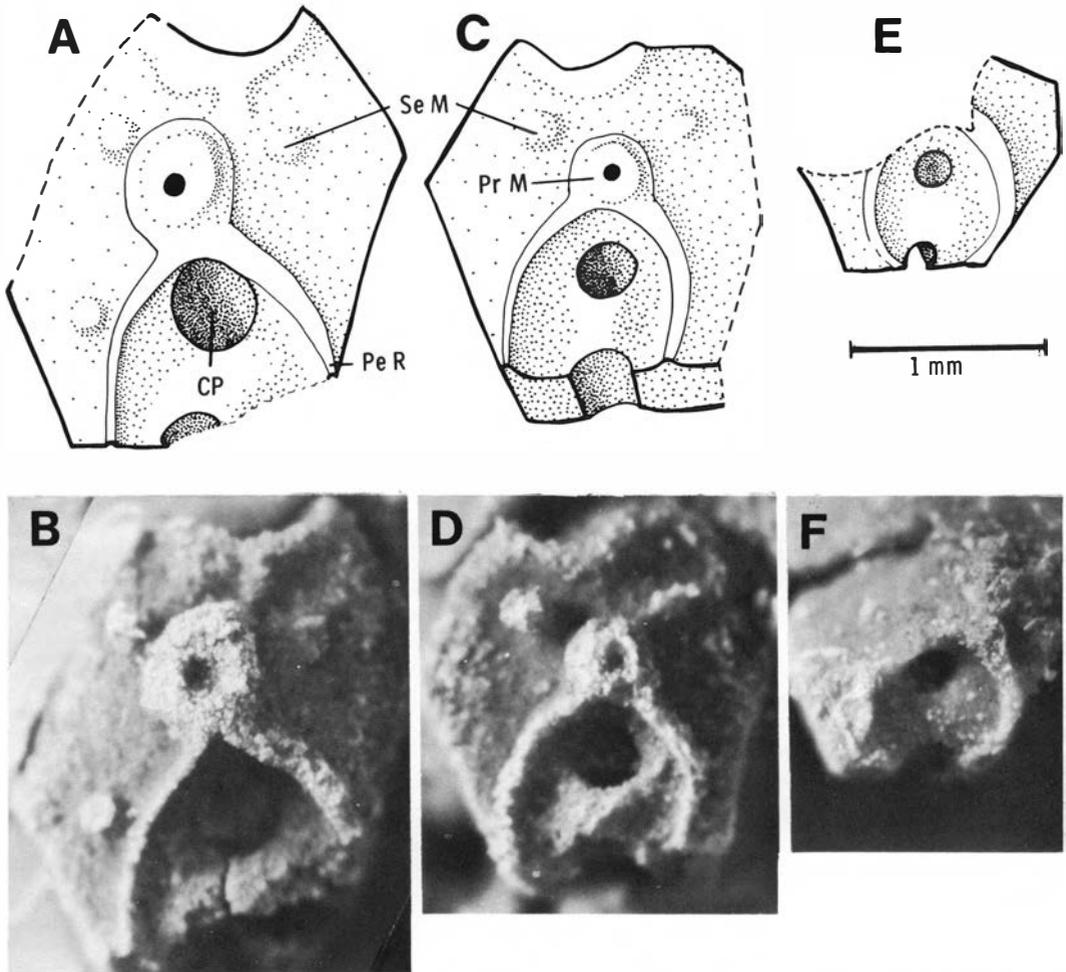


Fig. 2. Three plates of *Neobothriocidaris peculiaris* from Hadeland, Norway. Drawings correspond to photographs below. A, B: PMO 104920 from Bjertnes I; C, D: PMO 104915 from Bjertnes I; E, F: PMO 104625 from Korsrudbakken, Lunner. Terminology as in Fig. 1.

ferent. In *Bothriocidaris* one peripodium is present *within* the plate (Fig. 1 A) and the peripodium rim has two to four primary spine mamela. Species are defined according to the number of these mamela (Männil 1962). In *Neobothriocidaris*, one pore of each pore-pair is shared by two adjacent plates in the perforate plates (Fig. 1 B). The peripodium rim has one primary mamelon. The presence and positions of secondary mamela are also used as an aid to distinguish between species.

In the present material assigned to *Neobothriocidaris* all the eight plates are loose and perforate. One pore of each pore-pair is shared by two adjacent plates. The size of the plates

differs (Fig. 2) according to original position on the test, but the plates are generally small. The maximum width of the plates equals the height and varies from 1.1 by 1.3 mm to 2.2 by 2.2 mm. The plate thickness is 0.8 mm. All the plates have a primary mamelon on the peripodium rim, and two secondary mamela on the plate surface. The peripodium rim is well developed, elongate, and has a large central pore (0.20 mm in the smallest plate and 0.44 mm in the largest). The peripodium is ovate. The diameter of the primary spine attachment varies from 0.28 mm in the smallest to 0.40 mm in the largest plate. No imperforate plates or spines have yet been found.

Comparisons

Only two species of *Neobothriocidaris*, *N. peculiaris* and *N. minor*, are known, and both occur in the Girvan area of Scotland (Paul 1967:535) in beds of approximately the same age as that described here. The present material is most like *N. peculiaris* from the Ashgillian Starfish bed (Drummuck Group) and likewise has one primary mamelon on the peripodium rim, and two secondary mamela on the plate surface of the perforate plates.

Distribution of *Bothriocidaridae*

The presence of bothriocidarids in the Oslo Region can be expected since *Bothriocidaris* itself is known with four species from Estonia (Männil 1962) ranging from Upper Caradoc (D₁) to Lower Ashgill (F_{1c}). *Bothriocidaris* is also known from the Upper Ordovician (Cincinnatian) of Iowa (Kolata et al. 1977) while *Neoboth-*

riocidaris occurs in Ashgill rocks in Scotland and in Norway. The bothriocidarids seem to be confined to relatively coarse or least firm bottom conditions. In the Oslo Region it seems that *Neobothriocidaris* lived below the wave base.

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