

**NOTE ON THE OCCURRENCE OF ? *AMPHIURA SENONENSIS* VALETTE, 1915
(ECHINODERMATA, OPHIUROIDEA) IN EARLY PALAEOCENE (DANIAN)
DEPOSITS OF THE BELGIAN PROVINCE OF LIMBURG**

by

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Isolated lateral and ventral arm plates of ? *Amphiura senonensis* Valette, 1915, a species of brittle-star, are reported from the basal part of the Geulhem Member of the Houthem Formation (Early Palaeocene) from an exposure along the Albert Canal near Vroenhoven, municipality of Riemst, province of Limburg, Belgium. Some remarks on the biostratigraphy of the Geulhem Member are added.

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SAMENVATTING

Aantekening over het voorkomen van ? *Amphiura senonensis* Valette, 1915 (Echinodermata, Ophiuroidea) in vroeg-paleocene afzettingen (Danien) in de Belgische provincie Limburg.

Uit een vrij klein sedimentmonster, verzameld aan de basis van de Kalksteen van Geulhem (Formatie van Houthem) langs het Albertkanaal bij Vroenhoven-Riemst (Belgisch Limburg), worden geïsoleerde skeletelementen van de slangster ? *Amphiura senonensis* beschreven en afgebeeld.

Er wordt op gewezen dat een biostratigrafische indeling van de Kalksteen van Geulhem aan de hand van nannoplankton en het echinidengenus *Tylocidaris* het best in het stratotype van deze eenheid (groeve Curfs, Geulhem) opgesteld kan worden. De ontsluiting langs het Albertkanaal is, gezien de afgravingsmethoden, niet geschikt voor een dergelijke indeling. Zolang een gedetailleerde biozonering niet beschikbaar is, kan de Kalksteen van Geulhem niet gekorreleerd worden met Deense voorkomens van Danien-afzettingen.

INTRODUCTION

In the lowermost member of the Houthem Formation, the Geulhem Member, the mesofauna contains fairly large numbers of isolated echinoderm skeletal remains. No detailed investigation of this interesting material has been carried out yet. Moreover, the biostratigraphic subdivision of this member is still not very detailed. Consequently, a correlation with the Danish type area, where the Danian deposits are biostratigraphically subdivided by means of nannoplankton and dinocyst assemblages and the regular echinoid genus *Tylocidaris*, is as yet impossible.

The type section of the Geulhem Member in the Curfs quarry near Geulhem (Dutch province of Limburg) probably offers the most favourable conditions for a biostratigraphic subdivision based on nannoplankton and zonal populations of *Tylocidaris*. The unfavourable method of excavation hampers the construction of lithostratigraphic and biostratigraphic subdivisions of this member along the Albert Canal (Belgian province of Limburg).

The isolated ossicles of ? *Amphiura senonensis* are briefly described and illustrated. This species is of particular interest since it crosses the Cretaceous/Tertiary boundary morphologically unchanged.

SYSTEMATIC PALAEONTOLOGY

- Subclassis Ophiuroidea Gray, 1840
- Ordo Ophiurida Müller & Troschel, 1840
- Subordo Gnathophiurina Matsumoto, 1915
- Familia Amphiuridae Ljungman, 1867
- ? Genus *Amphiura* Forbes, 1843

? *Amphiura senonensis* Valette, 1915

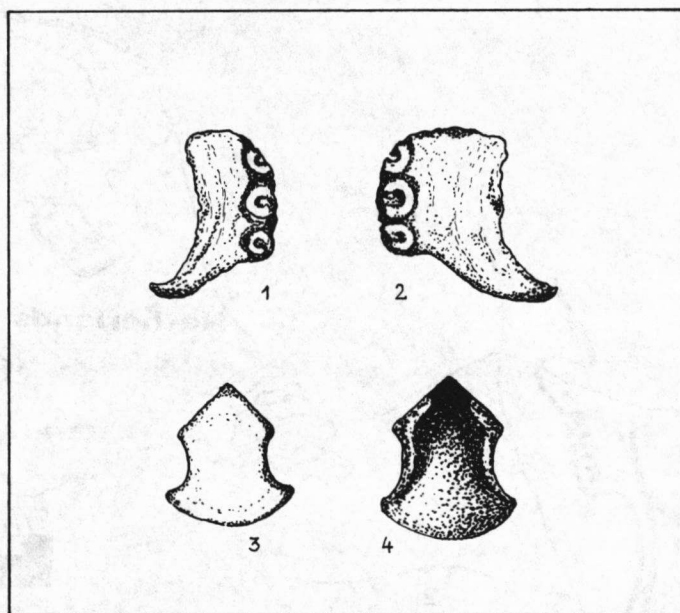
Figs 1-4

- 1915 *Amphiura senonensis* Valette, p. 140, fig. 6.
- 1950 *Amphiura* (?) *senonensis* — Rasmussen, p. 118, pl. 15, figs 6-10.
- 1952 *Amphiura* ? *senonensis* — Rasmussen, p. 50, figs 4-5.
- 1972 *Amphiura* ? *senonensis* — Rasmussen, p. 59, pl. 6, fig. 1.
- 1979 *Amphiura senonensis* — Rasmussen, p. 71, tab. 6.

Material — 23 lateral arm plates (lateralia) and 7 ventral arm plates (ventralia). Lowermost part of the Geulhem Member (Houthem Formation). Exposure 61F-15, c. 200 m North of Vroenhoven bridge, municipality of Riemst, province of Limburg, Belgium. Coll. Jagt, reg.-nr. 2481 a-b. (Dorsal arm plates and vertebrae of this species could not be recognized with certainty in the sample studied).

Description — This species is characterized especially by its lateralia and, according to Rasmussen (1952, p. 50), also by its ventralia. Plates of the disc have not yet been recognized. Rasmussen (1950, p. 119, pl. 15, figs 7-9) recorded remains of arms of this species, in which all elements are in connection. The reader is referred to this paper and to the original description of the species by Valette (1915) for the composition of the arm. Here only the isolated arm ossicles will be described.

The ventralia are slightly tumid and their distal margins are strongly curved and produced into lateral processes which vary in strength (Rasmussen, 1950, pl. 15, figs 7 and 9). The proximal end is



Figs 1-4. ? *Amphiura senonensis* Valette, 1915

1. Proximal lateral arm plate, $\times 24$.
2. Lateral arm plate, $\times 24$.
3. Ventral arm plate, outer surface, $\times 30$.
4. Ventral arm plate, inner surface, $\times 30$.

All specimens coll. Jagt, reg.-nr. 2481a-b. Section 61F-15 along Albert Canal, Vroenhoven-Riemst (province of Limburg, Belgium). Lowermost part of the Geulhem Member (Houthem Formation), Danian.

broadly v-shaped, while the sides are distinctly concave. The arching of these plates is along the axis of the arm. On the inner surface a v-shaped ridge is apparent on the proximal end.

The lateralia have a very characteristic appearance. The proximal part is less tumid than the distal part. Usually there is a slight but distinct constriction between the proximal and distal margins of a plate. The distal margin shows the horseshoe-shaped bosses of three strong armspines with small interspaces. Valette (1915) stated that the central one of these bosses is much larger than the other two, but Rasmussen (1950) did not observe any marked differences in the size of the bosses in his material. In my material I noticed that usually the middle boss is slightly larger than the other two. The bosses may be surrounded by a weak, blunt ridge. The proximal part touching the ventral arm plates is fairly low and shows a very characteristic proximal extension.

Geographical and stratigraphical distribution — ? *Amphiura senonensis* was first described by Valette (1915) from the Campanian (Late Cretaceous) of Sens and Michery (départ. Yonne, France). Subsequently Rasmussen (1950, 1952, 1972) recorded it from the Late Cretaceous (Campanian-Maastrichtian) of Denmark, the United Kingdom, the G.D.R. and Spain, from the Early Palaeocene (Danian) of Nyvang Gård (Jylland, Denmark) and Limhamn (Scania, Sweden) and from the Late Palaeocene (Landenian) of Kroisbach (Austria) and New Jersey (U.S.A.). Furthermore, the species was recently found by me in the Late Campanian of the Belgian province of Liège (Jagt, in prep.).

The occurrence in the basal part of the Geulhem Member, as described in this paper, is of Early Palaeocene (Danian, possibly Early to early Middle Danian) age. As yet nothing can be stated about

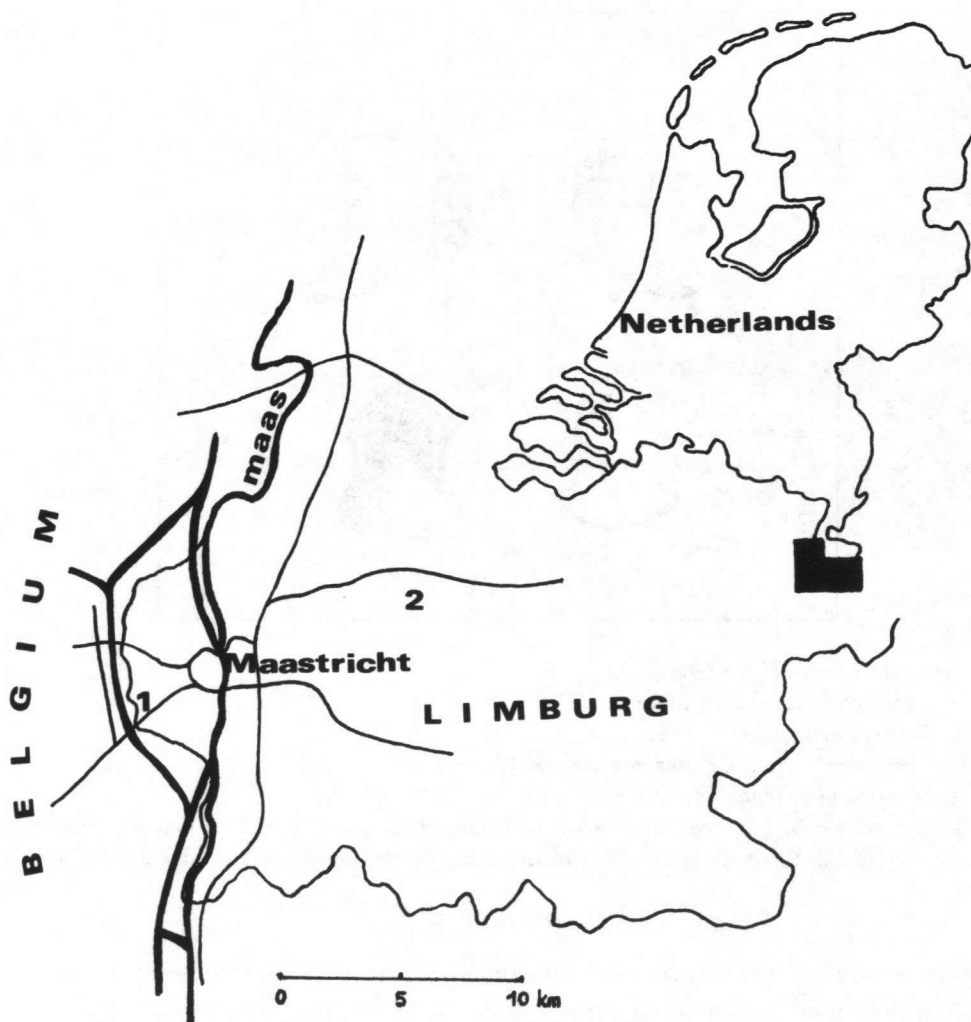


Fig. 5. Location map of the Maastricht area, The Netherlands, showing the outcrop along the Albert Canal near Vroenhoven-Riemst (1) and the stratotype of the Geulhem Member (Houthem Formation) near Geulhem (Curfs quarry) (2).

the vertical range of this species within the Geulhem Member. A future treatment of the ophiuroid fauna of this member will undoubtedly throw light on this matter.

In order to find out if ? *Amphiura senonensis* occurred in situ in the Geulhem Member extensive samples of the underlying Maastrichtian Meerssen Member (Maastricht Formation) were taken and analysed. No skeletal material of this species was found however, so it must be concluded that ? *A. senonensis* does belong to the indigenous fauna of the Geulhem Member.

Remarks — The study of isolated ophiuroid ossicles is seriously hampered by the fact that various (even unrelated) species may have identical plates and that within a single arm of one species the distal and proximal elements may vary considerably in morphology. Studying arm fragments in which all ossicles are found in connection prevents the obvious difficulties and errors resulting from combining ossicles of several species on a purely hypothetical basis (Rasmussen, 1950, 1952; Hess, 1962).

I agree with Hess (1962, p. 600-2) that among isolated ophiuroid skeletal remains the lateralia constitute taxonomically the most reliable basis for the description of (new) species, if no arm fragments are available.

Berry (1942, p. 395, pl. 60, figs 5 and 8) illustrated a ventral arm plate (sub nomen *Ophiomusium stephensoni* Berry) that might belong to ? *Amphiura senonensis*, since Rasmussen (1952, p. 56) mentioned this species from the Vincentown Sand (Late Palaeocene, Landenian). This ossicle certainly does not belong to *Ophiomusium* since ventralia are vestigial in this genus.

The present species is referred to the Recent genus *Amphiura* with considerable doubt. As a matter of fact, hardly any fossil ophiuroid fits into the taxonomy based on living forms (see Spencer & Wright, 1966; Rasmussen, 1950).

BIOSTRATIGRAPHY OF THE GEULHEM MEMBER

The glauconitic, rather coarse-grained calcarenitic limestones directly overlying the Meerssen Member of the Maastricht Formation (Maastrichtian, Late Cretaceous) and separated from the latter by a locally well-developed hardground was named 'Kalksteen van Geulhem' (= Geulhem Limestone) by Felder (1975). This unit constitutes the basal member of the Houthem Formation. Extensive lithostratigraphic information about the Geulhem Member in two outcrops in the Dutch and Belgian provinces of Limburg can be found in Meijer (1959).

El-Naggar (1967, p. 106) mentioned the occurrence of planktonic foraminifers of the *Globorotalia compressa*/*Globigerina daubjergensis* Zone in NE Belgium and Holland. Still, the biostratigraphy of the Geulhem Member is a rather rough one. Albers & Felder (1979, p. 74) and Doppert & Neele (1983, p. 9-12) assigned the Houthem Formation to the FK-foraminifer zone (= *Pararotalia globigeriniformis*-*Rotalia saxorum* Assemblage Zone), which is partially Montian, partially Danian in age. As yet a subdivision of this zone has not been introduced.

Letsch & Sissingh (1983) introduced a new zonation in which the FK-zone corresponds to the *Globoconusa daubjergensis* Subzone (the older subzone of the *Anomalinoides danica* Zone). Cepek & Moorkens (1979, p. 140-1) recognized several zonations in the outcrop at Geulhem (Curfs quarry): based on calcareous nannoplankton assemblages (*Biantholithus sparsus* Zone), planktonic (*Globoconusa daubjergensis* Zone) and benthic foraminifers (*Pararotalia globigeriniformis* Acme Zone).

The Danian deposits in their type area in Denmark (Fakse and Stevns Klint, Sjaelland) have traditionally been subdivided by means of *Tylocidaris* species. This zonation was applied and refined by Brotzen (1959) for a Swedish outcrop of Danian age (Limhamn). Up to now, this zonal scheme has not been questioned. Hansen (1977) however has shown that this zonation is slightly diachronous within the Danish Basin, being influenced by facies. It should be noted that as yet no biometric analyses of the Danish *Tylocidaris* populations have been carried out. The stratigraphic ranges of the various species were dealt with by Brotzen (1959) and Wind (1954). Kongiel (1958) introduced a variety, *Tylocidaris pomifer* (Boll) var. *masoviensis* Kongiel, based on specimens from Poland, using biometric characteristics. It is not clear how this taxon fits into the Danish *Tylocidaris* lineage. The same can be said about the Limburgian species *T. hardouini* (Desor, 1856) and *T. aff. bruennichi* Ravn, 1928, which are thought to be closely related to (or even conspecific with) the Danish forms *T. abildgaardi* Ravn, 1928 and *T. bruennichi* respectively (Brotzen, 1959; Wind, 1954).

In order to arrive at a biostratigraphic subdivision of the Geulhem Member by means of biometrically characterized populations of *Tylocidaris* a continuous section of this member will have to be sampled. Because of the excavation methods this will hardly be possible in the Albert Canal section near Vroenhoven-Riemst. Apart from the publications of Meijer (1959) and Albers *et al.* (1978) the exposures along this canal have not yet been studied in detail. The section exposed in the Curfs quarry (exposure 62A-13) at Geulhem (municipalities of Meerssen and Valkenburg aan de Geul), which is stratotype of the Geulhem Limestone (Felder, 1975, p. 64; Albers & Felder, 1979), would obviously constitute the best possibilities for such a biozonation. Up to now, only a restricted number of authors have studied material from this unit (usually in papers on Late Cretaceous faunas), e.g. articulate brachiopods (Backhaus, 1959), craniacean brachiopods (Krutzter & Meijer, 1958; Krutzter, 1969), echinoids (Meijer, 1965; Geys, 1982), crinoids (Rasmussen, 1965), asteroids (Rasmussen, 1965, 1972), octocorals (Voigt, 1958), ostracods (Deroo, 1966) and foraminifers (Hofker, 1966; also references in Felder, 1975).

The sample, from which the ophiuroid ossicles described here were isolated, was collected at the very base of the Geulhem Member. The terminating Maastrichtian hardground is absent here. The Vroenhoven Horizon, which separates the Meerssen Member from the Geulhem Member has a very wavy appearance and is directly overlain by pockets of fossil grit that contain reworked Cretaceous elements and redeposited Danian mesofossils. Typically Maastrichtian elements encountered in the sample are among others (see also Jagt, 1985) the octocoral *Graphularia meijeri* Voigt, 1958, the bivalve mollusc '*Pycnodonte vesiculare*' auct. (non Lamarck, 1816), the echinoderms *Nucleopygus scrobiculatus* (Goldfuss, 1829), *Hemiaster (Bolbaster) prunella* (Lamarck, 1816) and *Hemipneustes striatoradiatus* (Leske, 1778), isolated cirrals of an isocrinid or a comatulid crinoid, an unidentified terebratulid brachiopod and the following ostracod species (pers. comm. Dr M.J.M. Bless): *Bairdia biloculata* Van Veen, 1934, *Pterygocythere alata* (Bosquet, 1847), *Mauritsina hieroglyphica* (Bosquet, 1847), *Veenia foersteriana* (Bosquet, 1847), *Semicytheretta elegans* (Bosquet, 1847), *S. furcifera* (Bosquet, 1847), *Tumidoleberis bonnemai* Deroo, 1966, *Cythereis nodulosa* (Bosquet, 1854), *Spongicythere celleporacea* (Bosquet, 1854), *S. koninckiana* (Bosquet, 1847), *Mosaeleberis interrupta* (Bosquet, 1847), and *Limburgina ornata* (Bosquet, 1847).

The following ostracods present in the sample studied, are considered to indicate a Danian age of the grit in those pockets (pers. comm. Dr M.J.M. Bless): *Alatacythere heerlenensis* Deroo, 1966, *Ruggieria pustulosa* (Marlière, 1958), *Trachyleberis aculeata* (Bosquet, 1850), *Limburgina calciporacea* Deroo, 1966, *L. longiporacea* Deroo, 1966 and *L. cf. dorsocarinata* (Marlière, 1958). Of three species present in the sample (*Bairdia* sp., *Cytherella* ex gr. *contracta* Van Veen, 1932 and *Macrocypris* sp.) no definite statement as to their stratigraphic age is possible. The above mentioned ostracod material is now kept at the Natural History Museum at Maastricht.

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