

Notes on North Sea Basin Cainozoic echinoderms, Part 1. Miocene comasterid crinoids from central Limburg, the Netherlands

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From strata assigned to the Breda Formation (Early to ?late Middle Miocene) penetrated in borehole 60B-122 at Pey-Echt (province of Limburg, the Netherlands), a single radial and an axillary primibrach (IBr₂), both tentatively referred to comasterid crinoids, are recorded. In contrast to occurrences in central Europe (Paratethys and Mediterranean), crinoids appear to be extremely rare in the Miocene of the North Sea Basin. An overview of post-Paleocene comatulid crinoid records is added, with the emphasis on Europe.

KEY WORDS: Echinodermata, Crinoidea, Comasteridae, Miocene, the Netherlands.

Introduction

The present paper is the first in a series of brief notes on Cainozoic crinoids, asteroids, ophiuroids and echinoids from the North Sea Basin. The material considered originates from hand-picked sieve residues of sampled boreholes (*e.g.* IJsselmuiden-1 well; see Gaemers, 1986) and of (temporary) outcrops in the eastern and southern Netherlands, NW Belgium and NW Germany. For instance, collections recently made include astropectinid starfish from the Miocene of Liessel (Noord-Brabant, the Netherlands), bathyrcrinid crinoids and ophiolepidid ophiuroids from the Oligocene of Winterswijk-de Vlijt (Gelderland, the Netherlands), astropectinid, luidiid and goniasterid asteroids from the Miocene of Winterswijk-Miste (compare Jagt, 1991), and echinoid faunules from the Pliocene of Kallo (Antwerp area, Belgium).

In the present contribution two dissociated ossicles of comatulid crinoids from the Miocene of central Limburg (the Netherlands) are described and illustrated. These ossicles were recognised by one of us (JP) in samples taken from spoil heaps left at the site of borehole Pey-Echt (file no. 60B-122, 'reverse airlift' drilled 3 July-26 July 1991; co-ordinates x - 190.770, y - 344.750; see Figure 1). Having reached a depth of *c.* 230 m, only the lower 30-40 m in this well turned out to be assignable to the Breda Formation (Parren, 1993, 1994). Fossils, mainly molluscs, were found to be concentrated in one or two comparatively thin beds. Remarkably, astartid bivalves are very rare, while caecid gastropods are quite common in the sieve residues screened.

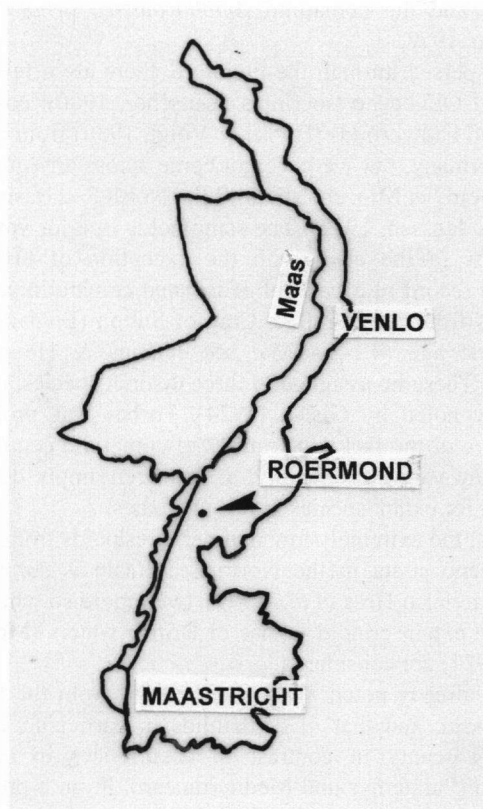


Figure 1. Map of the province of Limburg (the Netherlands), showing (arrowed) the location of borehole 60B-122 at Pey-Echt.

On the basis of teleost otoliths (P.A.M. Gaemers, pers. comm.), it is possible that part of the material collected from the spoil heaps is of late Middle Miocene ('Langenfeldian'; compare Gaemers, 1987) age.

With few exceptions, crinoids appear to be quite rare in the North Sea Basin Cainozoic, and most records generally are based either on single specimens (e.g., Anderson, 1967) or on dissociated ossicles that are non-diagnostic below the family level. Notable exceptions are the highly diverse faunas from the Lower Paleocene of Denmark. These comprise a considerable number of bourgueticrinid/bathycrinid, isocrinid, comatulid and holopodid taxa (Rasmussen, 1961; Kjaer, 1993; Kjaer & Thomsen, 1999). Comparable, albeit less diverse, faunas of similar age have recently been recorded from the Maastricht area. Jagt (1999) described the bourgueticrinids/bathycrinids *Bourgueticrinus danicus* (Brünnich Nielsen, 1913), *B. bruennichiense* Ødum, 1926 and *Democrinus? maximus* Brünnich Nielsen, 1915, the placometrinid *Atuatucametra annae* Jagt, 1999 and an antedonid, assigned with a query to *Hertha* gr. *mystica* (von Hagenow, 1840). In addition, well-preserved crinoid faunas have been recorded from the Lower Eocene of the London area (Rasmussen, 1972; Paul, 1992). Typical are the isocrinids *Isselicrinus subbasaltiformis* (Miller, 1821) and *Cainocrinus tintinnabulum* Forbes, 1852, the bathycrinid *Democrinus londinensis* (Forbes, 1852), and the comatulid *Amphorometra ornata* Rasmussen, 1972.

Dispersed through the literature, there are a few records of Oligocene isocrinids (Kutscher, 1980), comatulids and bathycrinids (Hucke & Voigt, 1930) from northern Germany, but we have not come across any mention of crinoids in Miocene strata of the North Sea Basin (see also R. Janssen, 1972). The same holds true for younger deposits in the area, with the exception of Forbes's (1852) record of a handful of isolated comatulid centro-dorsals from the Coralline Crag of Sutton (England), of Pliocene age (4.1-2.4 Ma; see Jenkins & Houghton, 1987). These he assigned to three distinct species, but as already noted by Gislén (1924), Forbes was probably unaware of the fact that features of comatulid centro-dorsals may vary considerably, as has been amply demonstrated for extant species in recent studies.

Yet, the extremely low number of crinoids from post-Oligocene strata in the North Sea Basin is surprising (compare also Hess *et al.*, 1999), even more so when the diverse extant crinoid faunas of British waters (Mortensen, 1927) are considered.

As already noted, the crinoid record from the North Sea Basin, and that of comatulids in particular, is extremely scanty in contrast to occurrences in central Europe (Paratethys and Mediterranean). From a preliminary survey of the more accessible literature sources, it appears that numerous comatulid taxa have been recorded from Cainozoic strata in southern France, north-

ern Italy and central Europe (Austria, Hungary, Poland). However, with a few exceptions, these records are in serious need of a modern revision. Taxa are often based on single specimens only, criteria on which to define species have varied considerably amongst the various authors, and individual variation has rarely been duly considered. It may well be that upon closer scrutiny quite a number of taxa turn out to be synonymous. In addition, in most cases generic attribution must ultimately rely on a detailed comparison with extant comatulids. This, of course, is a highly ambitious and time-consuming undertaking. As a starting point, all post-Paleocene comatulid taxa from Europe are listed below (Table 1), based mainly on Gislén (1924, 1934), Biese & Sieverts-Doreck (1939) and Rasmussen (1978). This list also includes a number of post-1978 records, as well as references to extra-European taxa, preferably where these have been formally named.

The material described here is housed in the collections of the Natuurhistorisch Museum Maastricht (NHMM).

Description and discussion

Superfamily Comasteracea A.H. Clark, 1908

Family Comasteridae A.H. Clark, 1908

Indeterminate comasterid

Material — A single radial (NHMM 1997 062), and an axillary primibrach (IBr₂) (NHMM 1997 061) are available; although this cannot be demonstrated beyond doubt, these ossicles are here considered to be conspecific.

Description — The radial (Figure 2b, c) is a relatively small (width 2.2 mm, height 1.8 mm), but stout plate, rounded trapezoidal in plan view and in elevation. The free lateral surface is smooth, narrow (0.4 mm high medially), being wider towards both interradial. The rim which separates the free lateral surface from the dorsal (= aboral) ligament pit is prominent, blunt. The dorsal ligament pit is wide, occupying about half the width of the plate, and deep centrally, below a relatively large (0.4 mm across), subcircular nerve (= axial) canal, with the adoral margin concave centrally (Figure 2b). The fulcral (= transverse) ridge is comparatively wide, but rather inconspicuous. The interarticular ligament pits are rounded, taller than wide, widest aborally, deep and bounded by a well-developed rim adorally. The ventral (= adoral) muscle pits are retracted, moderately deep, and rather narrow, with a deep midradial furrow separating them and the interarticular ligament pits. This furrow is widest and broadly rounded at its aboral end and

more constricted adorally. One of the ventral muscle pits (see Figure 2c) appears to have suffered damage during life, which has led to stereom irregularities. The adoral groove is shallow. In lateral view, the radial shows a sloping articular face. Unfortunately, the axillary primibrach (Figure 2a) is poorly preserved; it is a compara-

tively stout, c. 2.3 mm wide plate with a smooth outer surface, and oblique muscular articulations adorally. The aboral (= proximal) articular face shows a prominent synarthrial ridge, a comparatively large, semicircular nerve canal and small, concave ligament pits, bounded by a wide rim.

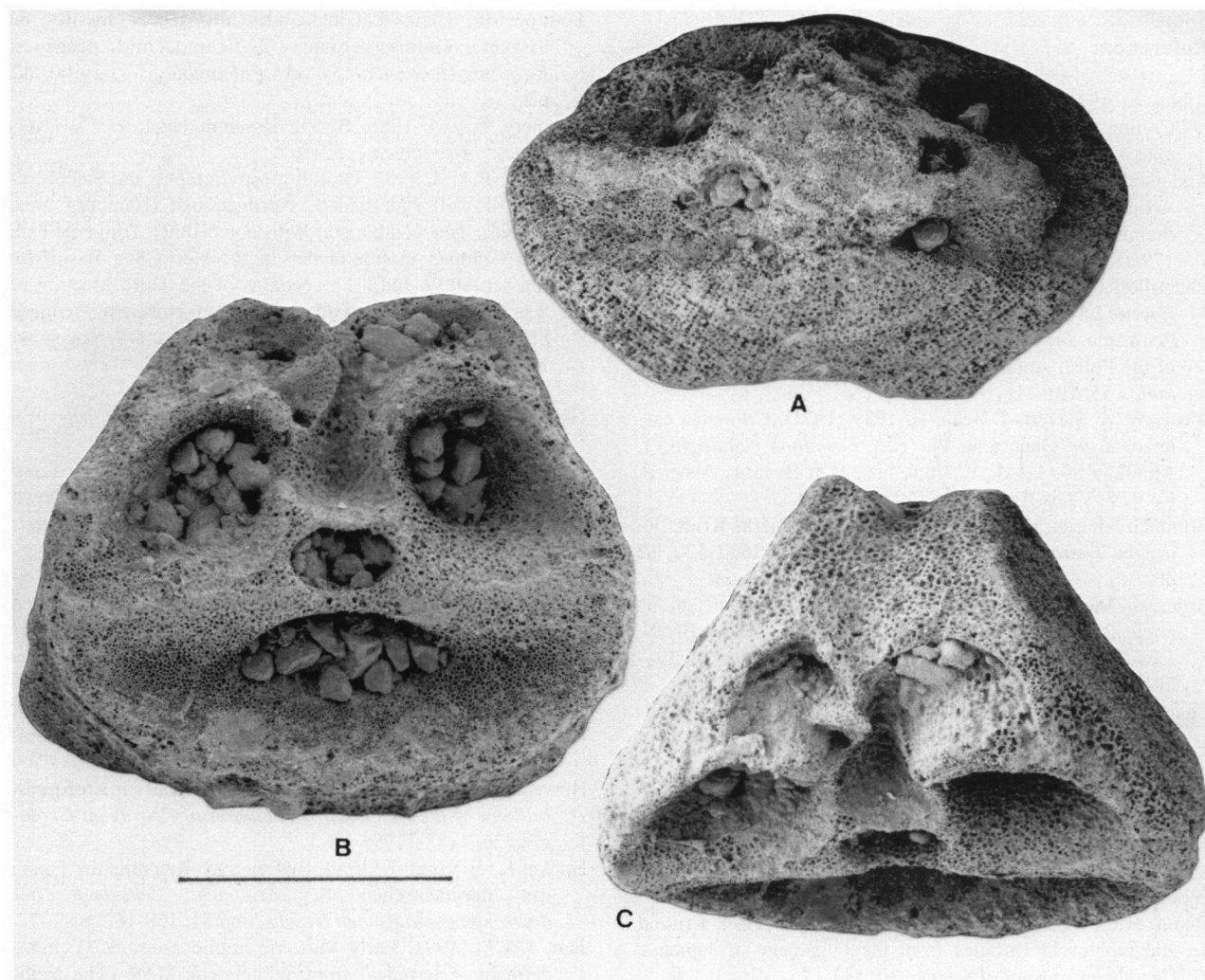


Figure 2. Indeterminate comasterid; borehole 60B-122, Pey-Echt (central Limburg, the Netherlands), c. 190-230 m depth, Breda Formation (Early to ?late Middle Miocene). Scale bars equal 1 mm:
 A axillary primibrach (IBr₂, NHMM 1997 061), distal face with oblique muscular articulation;
 B-C radial (NHMM 1997 062), both *ex* Parren Collection.

Discussion — In the absence of cups and/or centrodorsals, assignment of these dissociated ossicles cannot be but tentative. However, the combination of tall and wide interarticular ligament pits, low ventral muscular pits, not projecting at interrarial edges and forming narrow bands along a near-horizontal ventral edge and faintly curved downwards along a wide midradial furrow, is found in comasterid comatulids, and in some mariametraceans (see Rasmussen, 1978, pp. T885-893). However, in the

latter, interarticular ligament pits tend to be large, tall and wide. The present radial (NHMM 1997 062) is quite similar to the ones illustrated by Rasmussen (1978, fig. 589/2c, d), as well as to radials and axillary primibrachs of *Sievertsia polonica*, figured by Radwanska (1987, text-fig. 3, pls 1, 3). For the time being, NHMM 1997 061-062 are therefore considered to represent indeterminate comasterids.

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Table 1. Post-Paleocene comatulid taxa described in the literature, with the emphasis on Europe, but including records from elsewhere, in particular where crinoids have been formally named.

Note: Rasmussen (1978, p. T882) transferred Gislén's (1924, p. 142) new genus *Palaeocomaster*, to which he assigned a number of Cainozoic forms (see below), to the Solanocrinitacea. Unless species have subsequently been transferred, generic attribution below is that of the original publication. Taxa are arranged in alphabetical order. Where we have doubts as to generic placement of some species, inverted commas ('...') are used. For instance, following Rasmussen (1961), the genus *Glenotremites* is now restricted to comatulid species of early Late Cretaceous (Cenomanian-Coniacian/Santonian) age (see also Paul & Donovan, 1988).

Eocene

Amphorometra ornata Rasmussen, 1972

(p. 34, pl. 1, figs 10-15; see also Paul, 1992, p. 117, pl. 1, figs 1-12; pl. 2, figs 1-10; southeast England)

Antedon breviceps Tate & Dennant, 1893

(p. 226; *nomen nudum*, according to Gislén, 1924, p. 113; Australia)

Antedon pertusa E.V. Clark, 1900

(p. 5; *nomen nudum*, according to Gislén, 1924, p. 114; Australia)

Conometra alticeps (Philippi, 1844)

(p. 540, pl. 6b, figs a-d; see also Rasmussen, 1978, p. T896; southern Italy)

'*Glenotremites*' *atacticus* (Doncieux, 1911)

(p. 160, pl. 15, fig. 28; southern France)

Himerometra bassleri Gislén, 1934

(p. 49, figs 3-36; see also Oyen, 1995, pl. 1, fig. 1; South Carolina, Florida)

Himerometra caldwellensis Strimple & Mapes, 1984

(p. 790, fig. 1f-j; Louisiana)

Himerometra louisianensis Strimple & Mapes, 1984

(p. 790, fig. 1a-e; Louisiana)

Microcrinus conoideus Emmons, 1858

(p. 311, figs 246, 247; see also Gislén, 1934, p. 54, figs 37-47; North and South Carolina)

Nemaster sp.

(see Howe, 1942, p. 1192; Rasmussen, 1978, p. T883; South Carolina)

Notocrinus rasmusseni Meyer & Oji, 1993

(p. 254, figs 5, 6; Seymour Island, Antarctica)

Notocrinus seymourensis Baumiller & Gazdzicki, 1996

(p. 110, text-figs 7, 8; pl. 27, fig. 1; Seymour Island, Antarctica)

Palaeantedon caroliniana (Gislén, 1934)

(p. 57, figs 49-59, 61; see also Rasmussen, 1978, p. T909; South Carolina)

'*Semiometra*' *italica* (Schlüter, 1878)

(p. 48, pl. 3, figs 8-10; northern Italy)

Vicetiametra albertinii Malaroda, 1950

(p. 6, pl. 1; northern Italy)

unidentified comatulid crinoid

(see Oyen, 1995, pl. 1, fig. 2; Florida)

Oligocene

Himerometra grippae Anderson, 1967

(p. 179, figs 1-5; northwest Germany)

indeterminate comatulid (see Dixon *et al.*, 1994, p. 143, figs 1, 2; Jamaica)

Miocene

'*Actinometra*' *bruni* Valette, 1928

(p. 29, fig. 4; southern France)

'*Actinometra*' *matraverehelyensis* Szalai, 1926

(pp. 173, 174, 341; Hungary)

Allionia oblita Michelotti, 1861

(p. 353, pl. 10, fig. 1; see also Rasmussen, 1978, p. T915; northern Italy)

- '*Antedon*' *admirabilis* Nicolas, 1898
(p. 406 = *Antedon avenionensis* var. *minor* Nicolas, 1898, p. 406; southern France)
- '*Antedon*' *avenionensis* Nicolas, 1897
(p. 104, fig. 10; see also Nicolas, 1898, p. 405, fig. 5; southern France)
- '*Antedon*' *boelcskeyensis* Szalai, 1926
(pp. 171, 340; Hungary)
- '*Antedon*' *glandiferus* Nicolas, 1897
(p. 104, fig. 11; see also Nicolas, 1898, p. 406, fig. 6; ? = *A. anglesensis*, according to Gislén, 1924, p. 113; southern France)
- '*Antedon*' *hungarica* Vadász, 1915
(p. 87, pl. 7, figs 7-9; Hungary)
- '*Antedon*' *miocenicus* Nicolas, 1897
(p. 104, fig. 7; see also Nicolas, 1898, p. 404, fig. 2; ? = *Discometra rhodanica*; southern France)
- '*Antedon*' *pentagonalis* Albus, 1930
(p. 280, pl. 11, fig. 15; northern Italy)
- '*Antedon*' *pilularis* Nicolas, 1897
(p. 104, fig. 9; see also Nicolas, 1898, p. 405, fig. 4; southern France)
- '*Antedon*' *quinquepetalus* Szalai, 1926
(pp. 172, 340; Hungary)
- '*Antedon*' *rovasendai* Albus, 1930
(p. 280, pl. 11, figs 11, 13; northern Italy)
- '*Antedon*' *sphaeroidalis* Nicolas, 1897
(p. 104, fig. 8; see also Nicolas, 1898, p. 404, fig. 3; southern France)
- Comaster formae* (Noelli, 1900)
(pp. 20, 46, 47, pl. 1, figs 77-79; see Rasmussen, 1978, p. T883; northern Italy)
- Cypelometra iheringi* (de Loriol, 1902)
(p. 22, pl. 2, figs 3, 4; see also Rasmussen, 1978, p. T897; Argentina)
- Discometra eggenburgensis* (Schaffer, 1912)
(p. 186, pl. 58, figs 14-16 = *Antedon excavatus* Schaffer, 1912, p. 187, pl. 58, figs 9-13, 17-19; see also Sieverts-Doreck, 1961, p. 105, text-fig. 3, pl. 3; Austria)
- Discometra meneghiniana* (Fontannes, 1879a)
(p. 412, pl. 2, fig. 11; southern France)
- Discometra michelottii* (Noelli, 1900)
(p. 34, pl. 1, figs 47-49; northern Italy)
- Discometra rhodanica* (Fontannes, 1877)
(p. 669; see also Fontannes, 1879b, pl. 2, fig. 10; de Loriol, 1897, p. 121, pl. 4, figs 8-10; Schütze, 1904, p. 156, pl. 2, figs 4, 5); southern France, northern Italy, southern Germany, Hungary, central Poland)
- Discometra speciosa* (Pomel, 1887)
(p. 337, pl. D3, figs 1-4; = *D. rhodanica*, according to de Loriol, 1897, p. 122; Algeria, Egypt; see Fourtau, 1920, p. 94)
- '*Glenotremites*' *allardi* (de Loriol, 1897)
(p. 126, pl. 4, fig. 12; see also Vadász, 1915, p. 8, pl. 1, figs 14, 17; Valette, 1928, p. 26, fig. 2; southern France, northern Italy, Hungary)
- '*Glenotremites*' *anglesensis* (de Loriol, 1897)
(p. 121, pl. 4, fig. 7; see also Noelli, 1900, pp. 20, 41, 43, pl. 1, fig. 67; Valette, 1928, p. 24, fig. 1; southern France, northern Italy)
- '*Glenotremites*' *depereti* (de Loriol, 1897)
(p. 125, pl. 4, fig. 14; see also Noelli, 1900, pp. 20, 37, pl. 1, figs 53-57; southern France, northern Italy)
- '*Glenotremites*' *fontanesi* (de Loriol, 1897)
(p. 126, pl. 4, fig. 13; see also Vadász, 1915, pl. 1, figs 22, 23; Valette, 1928, p. 27, fig. 3; southern France, northern Italy, Hungary)
- '*Glenotremites*' *hungaricus* (Vadász, 1915)
(p. 91, pl. 7, figs 27-29; Hungary)
- '*Glenotremites*' *hungaricus* var. *rotundatus* (Vadász, 1915)
(p. 91, pl. 7, figs 30-32; Hungary)
- '*Glenotremites*' *miocaenicus* (Vadász, 1915)
(p. 92, pl. 8, figs 1-3; Hungary)
- '*Glenotremites*' *nicolasi* (Noelli, 1900)
(p. 20, pl. 1, figs 64-66; northern Italy)
- '*Glenotremites*' *paronai* (Noelli, 1900)
(p. 20, 42, pl. 1, fig. 68; northern Italy)
- '*Glenotremites*' *protomacronema* (Chapman, 1913)
(p. 179, pl. 17, fig. 18; Australia)
- Hertha taurinensis* (Noelli, 1900)
(p. 20, pl. 1, figs 58-60; northern Italy)

Horaeometra sp. (see Donovan & Veltkamp, 2001, p. 726, fig. 4/3, 4; Carriacou, Antilles)

Palaeantedon ambigua (Pomel, 1887)

(p. 334, pl. D2, fig. 15; Algeria)

Palaeantedon cartenniensis (Pomel, 1887)

(p. 333, pl. D2, figs 10-12; see also Albus, 1930, p. 279, pl. 11, fig. 10; Algeria, northern Italy)

Palaeantedon depressa Gislén, 1924

(p. 184 = *Antedon taurinensis* Vadász, 1915, *non* Noelli, 1900, pp. 11, 164, 171, pl. 1, figs 1-6; Hungary)

Palaeantedon globosa (Pomel, 1887)

(p. 334, pl. D2, figs 13, 14; Algeria)

Palaeantedon lineata (Pomel, 1887)

(p. 335, pl. D2, figs 16-18; Algeria)

Palaeantedon minima (Noelli, 1900)

(pp. 20, 39, pl. 1, figs 61-63; northern Italy)

Palaeantedon neogradiensis Szalai, 1926

(p. 172; Hungary)

Palaeantedon pannonica (Vadász, 1915)

(p. 88, pl. 7, figs 10-13; Hungary)

Palaeantedon soluta (Pomel, 1887)

(p. 336, pl. D2, figs 22-27; see also Rasmussen, 1978, p. T909; Algeria)

Sievertsia polonica Radwanska, 1987

(pp. 117, 118, text-figs 2-6; pls 1-4; central Poland)

Stenometra pellati (de Loriol, 1897)

(p. 124, pl. 4, fig. 11; see also Noelli, 1900, pp. 20, 44, 45, pl. 1, figs 72-76; Rasmussen, 1978, p. T900; southern France, northern Italy)

Stiremetra stellata (Noelli, 1900)

(p. 20, pl. 1, figs 69-71; see also Rasmussen, 1978, p. T901; northern Italy)

Himerometridae indet. (see Radwanska, 1987, p. 126, text-figs 7, 8, pl. 4, figs 13, 14; pl. 5, figs 1-6; pl. 6, figs 1-5; central Poland)

indeterminate comatulids (see Kroh & Harzhauser, 1999, p. 151, pl. 4, figs 1-4; northeast Austria)

?colobometrid (see Shibata & Oji, 2001, p. 65; possibly better referred to the Tropiometracea, representing either Calometridae or Chariometridae (T. Shibata, pers. comm. 15 October 2001, and in prep.; western Japan).

Pliocene-Pleistocene

'*Glenotremites*' *brownii* (Forbes, 1852)

(p. 19, pl. 1, fig. 19; southeast England)

'*Glenotremites*' *woodwardi* (Forbes, 1852)

(p. 19, pl. 1, fig. 20 = '*G.*' *brownii*; southeast England)

'*Glenotremites*' *ransomi* (Forbes, 1852)

(p. 20, unnumbered fig.; southeast England)

'*Glenotremites*' sp. (see Sieverts, 1933, pp. 148, 159-160; Indonesia)

Palaeantedon rosacea (Pomel, 1887)

(p. 336, pl. D2, figs 19-21; Algeria)

Palaeantedon weberi Sieverts, 1933

(pp. 148, 157-159, fig. 7a-c; Indonesia)

Sievertsia seranensis (Sieverts, 1933)

(see Sieverts, 1933, pp. 148-151, fig. 1a, b, as *Palaeocomaster seranensis*; Radwanska, 1987; Indonesia)

Asterometridae indet. (see Sieverts, 1933, pp. 148, 151-156, figs 2a, b, 3a, b, 4-6, as *Astrometridae* sp.; Indonesia)