

A new *Baltoeurypter* (Eurypterida: Chelicerata) from the Wenlock of Norway

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The genus *Baltoeurypter* previously had two described species, of which *B. tetragonophthalmus*, (Fisher, 1839), is the best known. A third species, *B. henningsmoeni* n. sp. is described here, based on two almost complete specimens and several fragments. This species is separated from *B. tetragonophthalmus* by a broader paddle (L/W-ratio 1.8), a rounder metastoma (L/W-ratio 1.36) and by the presence of small lateral epimerae on the postabdomen. The distal part of a swimming leg of a pterygotid eurypterid is also described. These fossils constitute the oldest eurypterid remains known from Norway.

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Introduction

Eurypterids are extinct aquatic arthropods belonging to the Chelicerata, and are thus related to the living marine xiphosurans (horseshoe crabs) and the terrestrial arachnids (e.g., scorpions and spiders). Their habitats are controversial; they were clearly primarily aquatic, but equipped with additional respiratory organs that were probably used to breathe air during short amphibious excursions on land (Selden 1985). They are rare as fossils because of their thin nonmineralized cuticle and their preference for restricted marine and freshwater environments.

The eurypterid specimens described here were first discovered and collected at Gjetum in Bærum, west of Oslo (topographical map 1:50000, M711-series, Asker sheet 1814 I [1976], map reference: NM851422), by Professor G. Henningsmoen in 1953. He also made additional collections in the summer of 1959. The amazing coincidence that prompted their discovery is worthy of mention. Henningsmoen was planning to visit a new Silurian eurypterid locality at Ringerike (Hanken & Størmer 1975; loc. 2 in Fig. 1), discovered in 1953 by Dr. R. Denison, Chicago (Størmer, 1954). This new locality was about 1.5 km north-east of the well-known locality at Rudstangen, where Professor J. Kiær (Kiær 1911) discovered a fauna of Silurian agnathans and eurypterids in 1909. However, Henningsmoen missed the bus to Ringerike, and decided instead to visit the somewhat older beds exposed at Gjetum where he found a freshly excavated building site containing 'beds with a scent of eurypterids'. Here he found many fragmentary and two

fairly complete eurypterids. In an oral statement, presented at Nordisk Geologisk Vintermøte, Göteborg in January 1954, he reported the presence of *Eurypterus fisheri* [= *Baltoeurypterus tetragonophthalmus* (Fischer 1839)] and fragments of *Pterygotus* sp. However, notes left by both Henningsmoen and Professor L. Størmer indicate that they both later believed these eurypterids represented a new species. Størmer obviously intended to study the specimens, but he did not complete this work before his death in 1979.

The beds yielding the eurypterids represent a transition between the old Stages 9b and 9c (Henningsmoen, unpublished data) as defined by Kiær (1908), now assigned to the Wenlock Sjørvoll Member of the Steinsfjorden Formation (Worsley *et al.* 1983). The beds consist of grey slaty limestones interbedded with layers of dolomitic limestone. Mudflake conglomerates, desiccation cracks and algal laminations are common in the beds. The cephalopod *Armenoceras* sp. and abundant ostracodes (*Leperditia* sp. as identified by Henningsmoen, unpublished data) occur together with the *Baltoeurypter* and pterygotid remains described herein. A fragment of a monograptid graptolite and small inarticulate brachiopods were also found, not in direct association with the eurypterid slabs, but presumably in the same level as the eurypterids.

Additional eurypterid occurrences in the Oslo area are known from the Upper Sjørvoll Member (Stage 9d; Størmer, 1933, 1938), and the Ranberget Member (Stage 9g; Størmer, 1934), both within the Steinsfjorden Formation at Ringerike. This indicates that the present material from Gjetum represents the oldest known eurypterids from Norway to date.

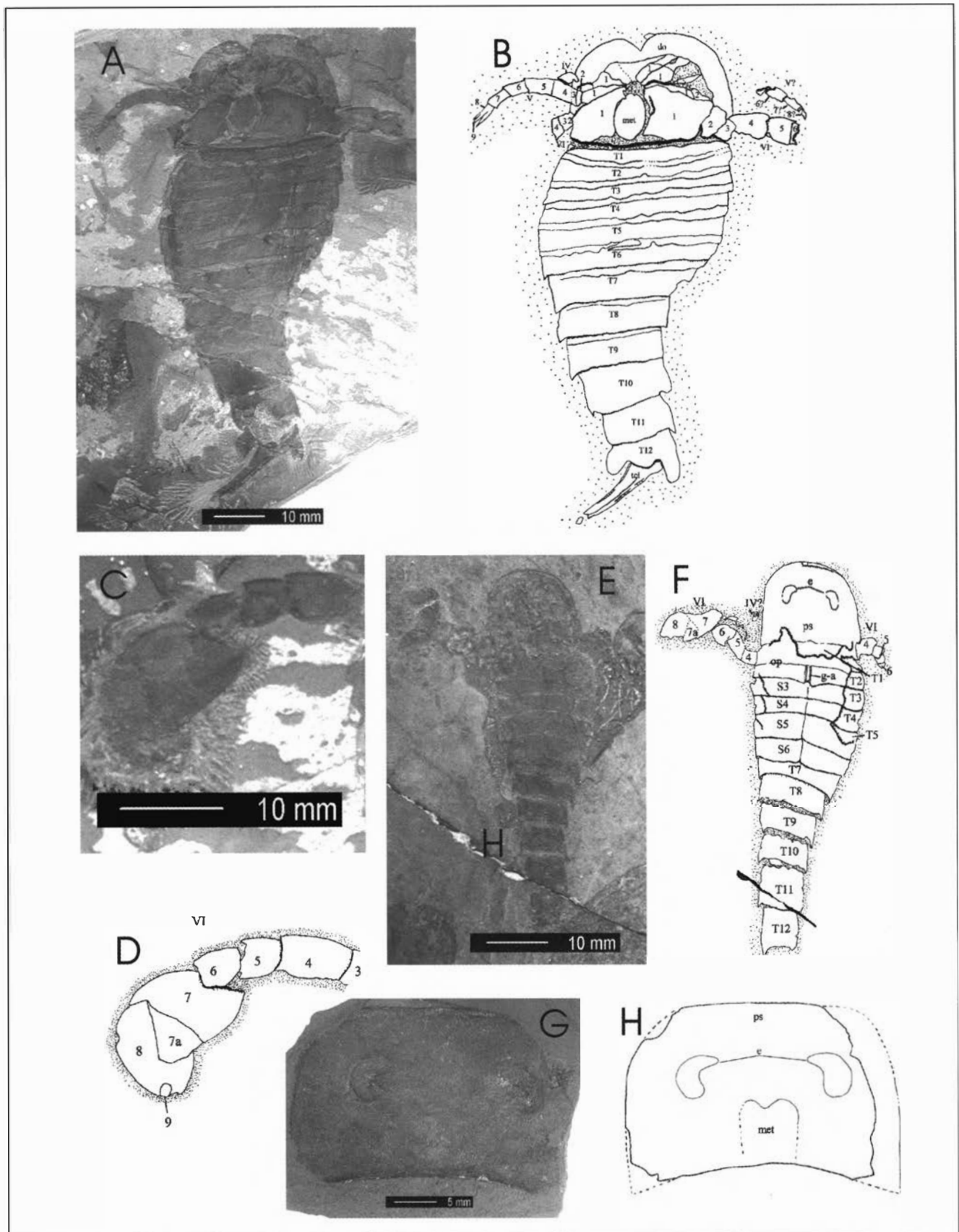


Figure 1: *Baltoeurypterus henningsmoeni* n. sp. A) PMO 70561, ventral view, photographed under alcohol; B) camera lucida drawing of the same specimen; C) PMO 70688, dorsal view of swimming leg, photographed under water; D) camera lucida drawing of the same specimen; E) PMO 70696, ventral view, photographed under water; F) camera lucida drawing of the same specimen; G) PMO 70665, dorsal view, photographed under alcohol; H) Composite camera lucida drawing of the same specimen and the counterpart PMO 70662. The outline of the right hand side can be interpreted from PMO 70662.

Material and terminology

The material described is housed in the Paleontologisk Museum, Oslo (hereafter abbreviated PMO), and includes the holotype material (part and counterpart of a nearly complete specimen) and 4 paratypes (listed below). The holotype material was partly prepared by Henningsmoen to reveal most of the telson, pretelson, one paddle and one of the walking legs. Further preparation has revealed the rest of the pretelson, paddle and most of the telson. A thin layer of calcite partly covering the fossil was removed using a 5% solution of hydrochloric acid. No further preparation was done on the paratypes. The terminology used follows that proposed by Tollerton (1989) and Selden (1981). The prosomal appendages are denoted by Roman numerals with the individual podomeres numbered from proximal to distal with Arabic numerals.

SYSTEMATIC PALAEOLOGY

Order EURYPTERIDA Burmeister, 1843

Suborder EURYPTERINA Burmeister, 1843

Superfamily EURYPTEROIDEA Burmeister, 1843

Family EURYPTERIDAE Burmeister, 1843

Genus BALTOEURYPTERUS Størmer, 1973

Revised diagnosis: Medium-sized Eurypteridae. Prosoma trapezoid to subquadrate; eyes arcuate and relatively large; oval metastoma with deep anterior notch; walking legs differentiated with legs II-IV spiniferous of *Hughmilleria* type and leg V non-spiniferous of *Eurypterus* type; swimming leg of *Eurypterus* type with podomere 8 larger than podomere 7; genital appendage type A 3-segmented of *Baltoeurypterus* type; opisthosoma not constricted; ornamentation of scales partly in longitudinal rows; pretelson with large rounded epimerae; telson long and lanceolate with a median carina, bifurcating proximally.

***Baltoeurypterus henningsmoeni* n. sp.**

Figures: 1A-H, 2A-F

Synonymy: 1954 *Eurypterus fisheri* (Eichwald, 1860); Størmer, p. 22.

Holotype: PMO 70561 and PMO 70688 (part and counterpart)

Type horizon and locality: Sjørvoll Member, Steinsfjorden Formation, Gjetum, Bærum, Norway. For stratigraphy see Worsley *et al.* (1983, pp. 38-42.).

Other material: Paratypes: PMO 70696 (slab with several specimens), PMO 70662, PMO 70665 (part and counterpart) and PMO 70705.

Diagnosis: *Baltoeurypterus* with a relatively broad and short prosoma, a broad paddle (L/W ratio of 1.8), a very broad metastoma (L/W ratio of 1.36), opisthosomal segments 6-11 with small postero-lateral epimerae, an upwardly curving telson.

Etymology: Named in honour of Professor Gunnar Henningsmoen, who discovered and collected the material.

Description

The prosoma of the holotype is trapezoid (PMO 70561; Figs. 1A and 1B). The juvenile specimen (PMO 70696; Figs. 1E and 1F) has a longer, narrower and anteriorly more rounded prosoma (parabolic shape), and the eyes are reniform and very large, and thus comparable to ontogenetic stages seen in *Eurypterus* (e.g. Andrews *et al.* 1974). The width of the doublure averages 3.5 mm on the holotype and can be followed around most of the prosoma, except where the coxae of appendage VI cover it. A median suture of *Eurypterus* type is apparent on the doublure of PMO 70696. An additional prosoma referred to this species is seen in PMO 70662 (part) and PMO 70665 (counterpart); this prosoma is shorter and broader than the prosoma of the holotype, as would be expected from a larger specimen. The eyes are reniform (Figs. 1G and 1H).

The chelicerae (I) and the 3 pairs of spinous walking legs (II - IV) are not preserved on the holotype, with the exception of one podomere of appendage IV on the left side and the coxae of II-IV. In front of the left swimming leg of PMO 70561, 3 distal podomeres (6, 7 and 8) of appendage V are preserved, but the distal spines of podomere 8 are lacking. The right appendage V is completely preserved and shows a triangular coxa, projecting slightly posteriorly and much smaller than the coxa of appendage VI. Podomeres 2 and 3 are thin ring-like structures, while 4 - 7 are rectangular in outline, each longer than wide, and decreasing in length distally. Podomere 8 is long and terminates in two distal spines and the spine-shaped podomere 9. The coxae of the walking legs are best seen on the right side, and are imbricated posteriorly. Spines are exposed on the inside of the coxae IV, V and VI, against the mouth. Lateral to the metastoma of the holotype, the coxae of appendage VI are large and trapezoidal in outline. The left swimming leg is completely preserved in PMO 70688 (Figs. 1C and 1D), and the proximal 6 podomeres are preserved on the right swimming leg in PMO 70561. A partial swimming leg is present on the left side of the juvenile on PMO 70696 (Figs. 1E and 1F). On the same slab, a single swimming leg from a large individual is preserved (Figs. 2A and 2B); the paddle on this swimming leg is even more rounded than on the holotype, but more poorly preserved. The metastoma (PMO 70561) is oval (Figs. 1A and 1B), with an extremely low L/W-ratio of 1.36.

The opisthosomal segments (measurements in Table 1) increase in width anteriorly towards the 4th segment, which is the widest. The genital appendage is not preserved on the holotype, but indications of a small genital appendage are preserved on the juvenile on PMO 70696. However, on the same slab, a nearly complete type A genital appendage is preserved (Figs. 2C and 2D), and is very similar to the same structure in *B. tetragonophthalmus* (see Braddy & Dunlop 1997, Fig. 2 A). On the holotype, the posterior half of segment 10, and segments 11 and 12 are seen in dorsal view and bear scales. Segment

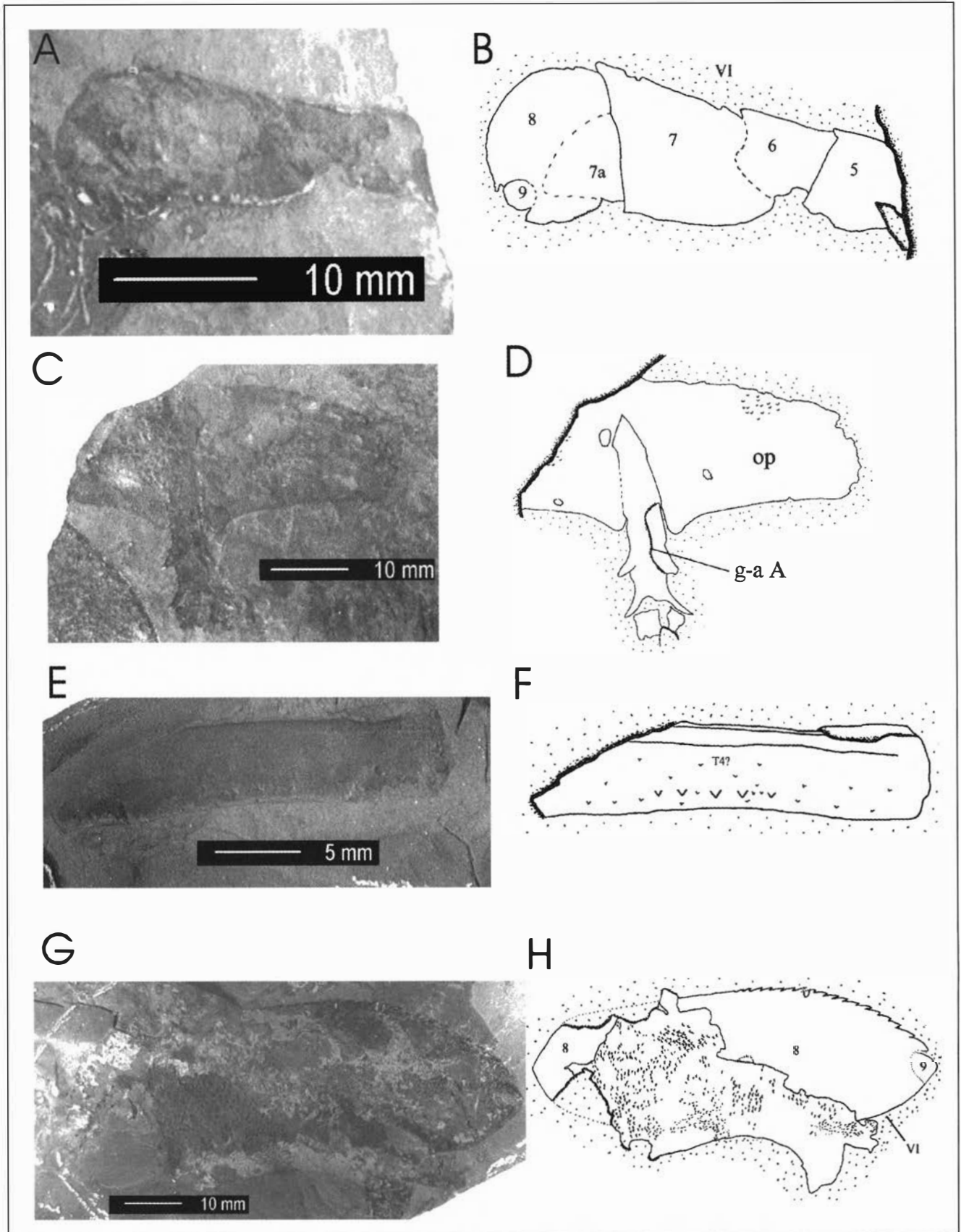


Figure 2: *Baltoeurypterus henningsmoeni* n. sp. (A to F) and pterygotid (G and H). A) PMO 70696, dorsal (?) view of swimming leg, photographed under water; B) camera lucida drawing of the same specimen; C) PMO 70696, dorsal view of genital appendage type A, photographed under water; D) camera lucida drawing of the same specimen; E) PMO 70705, dorsal view, photographed under alcohol; F) camera lucida drawing of the same specimen; G) PMO 70692, dorsal view of pterygotid paddle, photographed under water; H) camera lucida drawing of the same specimen.

12 has rounded postero-lateral prolonged epimerae, one on each side of the telson, and imbricated scales rim the margin of these epimerae. The juvenile specimen on PMO 70696 shows a different development of the pretelson, with small pointed epimerae, resembling those found on adults of the genus *Eurypterus*. The ornamentation can be seen on PMO 70705 (Figs. 2E and 2F) and is similar to the ornamentation of *B. tetragonophthalmus* (see Holm 1898, Table 1, Fig. 1), consisting of five longitudinal rows of large scales, with smaller scales between the rows of principal scales.

The telson, seen in ventral view on the holotype, is bulbous anteriorly, lanceolate and tapers posteriorly. A ventral median keel, bifurcation anteriorly is present. The telson is rimmed with imbricated scales similar to those on the pretelson. A carina is visible along the left, ventral side. The telson is broken but clearly curves upwards, contrary to Kjellesvig-Waering's statement (1979, p. 131) that the telsons of all *Baltoeurypterus* species curve downwards, and is considered a feature of this new species.

Discussion

Størmer (1973) distinguished *Baltoeurypterus* from *Eurypterus* mainly based on the development of the distal podomeres of the swimming leg. Kjellesvig-Waering (pers. comm. in Andrews *et al.* 1974) agreed with this distinction, but Andrews *et al.* (1974) assigned all species of both genera to *Eurypterus*. Later, these two genera have been retained (e.g. Selden, 1981).

B. henningsmoeni n. sp., shows morphological features shared by both genera, but diagnostic features like the shape of the metastoma, the shape of the paddle, the type A genital appendage and the rounded postero-lateral epimerae on the pretelson are reasons to assign this material to *Baltoeurypterus* rather than *Eurypterus*.

The prosoma is comparatively shorter and broader than in *B. tetragonophthalmus* (Figs. 1G and 1H), but this only occurs in the later ontogenetic stages (Figs. 1E and 1F). The metastoma is more rounded in *B. henningsmoeni* n. sp. with a L/W-ratio of 1.36, compared to 1.75 for *B. tetragonophthalmus* (measured from Schmidt 1883).

On the pretelson, *B. henningsmoeni* n. sp. has large and rounded epimerae similar to those in *B. tetragonophthalmus* (Fischer, 1839), while in *E. remipes* DeKay, 1825 these are acute and much smaller. No detailed work on the ontogeny of *Baltoeurypterus* is known, but Holm (1898; pl. 2, Fig. 21) figured juveniles of *B. tetragonophthalmus* with the '*Eurypterus*' type of epimerae, so it is probable that the two genera resembled each other closely in early ontogenetic stages. However, *B. henningsmoeni* n. sp. and *E. remipes* share the posteriorly pointed epimerae on segments 6-11, not shared by *B. tetragonophthalmus*.

As pointed out by Størmer (1973), the four distal podomeres, forming the paddle of the swimming leg, are the most important features separating *Eurypterus* from *Baltoeurypterus*. The paddle of *E. remipes* is the longest and most slender in the family Eurypteridae, while *B. henningsmoeni* n. sp. has the shortest and widest paddle. The L/W-ratio of the paddle would be about 1.8 in an extended position and this is well below the values of both *B. tetragonophthalmus* (2.2) and *E. remipes* (2.3-2.5) as measured by Størmer (1973). As seen in Fig. 1D, the paddle of *B. henningsmoeni* most closely resembles the paddle of *E. remipes* in podomeres 7 and 7a - and the paddle of *B. tetragonophthalmus* on the two distal podomeres (8 and 9). In *B. henningsmoeni* n. sp., the podomeres 7 and 8 of appendage VI are broader and shorter than in *B. tetragonophthalmus*, giving the paddle a more circular outline (Figs. 1C, D and 2A, B).

Kjellesvig-Waering (1979, p. 130) found the ornamentation of the telson to be an important distinguishing feature between the genera and species of *Eurypterus* and *Baltoeurypterus*, and stated this to be a stable character. The telson of *B. tetragonophthalmus* is longer and more slender distally than the telson of *E. remipes*, and while the ornamentation on the edge is composed of scales in *Baltoeurypterus*, *Eurypterus* has commonly a serrated edge on the posterior part of the telson.

In *B. henningsmoeni* n. sp., the lateral epimerae on the postabdominal segments are much larger and directed more posteriorly than those noted on *B. tetragonophthalmus* by Schmidt (1883), Holm (1898), Størmer (1955) and Wills (1965). The postero-lateral epimerae on the pretelson of *B. henningsmoeni* n. sp. are rounded and similar to those in *B. tetragonophthalmus*. In *B. henningsmoeni* n. sp. the 5 postabdominal segments have a generally smaller L/W-ratio than the corresponding segments on *B. tetragonophthalmus* and the overall shape of the animal thus appears shorter and more compact. However, since the gender of the holotype is unknown, these properties may relate to sexual dimorphism of the abdomen, as reported by Wills (1965) in *B. tetragonophthalmus*, or by telescoping of the holotype. Norwegian material of *B. tetragonophthalmus* (Fischer 1839) has previously been described from the Upper Silurian beds of Ringerike (Størmer 1938), and examination of this material and material from Ösel, Estonia, leaves little doubt that the present specimens belong to another species.

The material of *B. serratus* (Jones & Woodward, 1888) was originally described as belonging to the phyllocarid *Phasganocaris pugio* (Barrande) var. *serratus*, but was correctly assigned to *Baltoeurypterus* by Kjellesvig-Waering (1979). In *B. serratus* only the telson, metastoma, 10th and 11th tergites and the basitarsal (6th) podomere of a walking leg are known, and only the telson and metastoma were figured by Kjellesvig-Waering (1979, Fig. 35, p. 130). The metastomas in both *B. serratus* and *B. henningsmoeni* n. sp. are oval, but in the latter, it is more rounded with a L/W-ratio of 1.36 as opposed to 1.68 in *B. serratus*. The telson of *B. henningsmoeni* n.

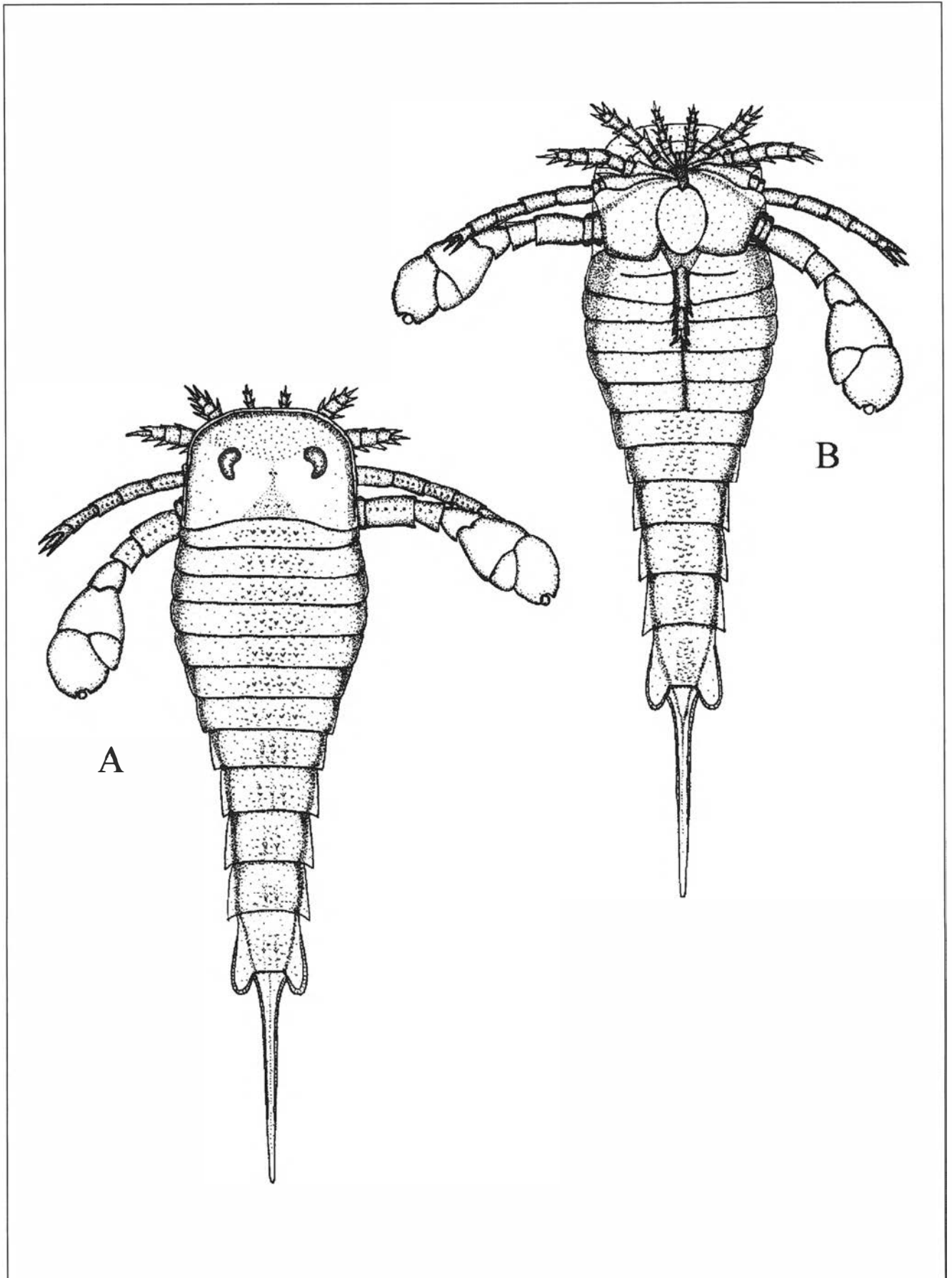


Figure 3: *Baltoerypterus henningsmoeni* n. sp. Idealized reconstruction of *B. henningsmoeni* n. sp. based on all available information. A is a dorsal view while B is a ventral view of a specimen with genital appendage type A.

Table 1.				
Segment number	Width mm	Length mm	Width mm	Length mm
	PMO 70561	PMO 70561	PMO 70696	PMO 70696
Prosoma	29.5	20.8	14.7	12.0
1	29.6	3.5 (est)	15.2 (est)	3.6
2	31.0	4.0	15.5 (est)	2.4
3	33.0	4.6	17.8 (est)	2.7
4	33.5	4.8	17.3 (est)	2.8
5	32.8	5.7	16.3	4.0
6	29.6	6.0	14.1	3.8
7	24.1	5.6	12.0	3.2
8	19.1	5.6	9.8	3.8
9	16.9	5.9	9.3	4.0
10	15.1	7.7	8.1	4.5
11	12.0	6.0	7.0	5.6
12	12.6	5.7	5.5	5.9
Telson	7 (est)	24 (est)	NA	NA
Metastoma	6.6	9.0	NA	NA
Total	NA	85.3	NA	NA

Table 1: Measurements of the holotype (PMO 70561) and paratype (PMO 70696). Measurements have been recorded medially on each opisthosomal segment, posterior on the prosoma and anterior on the telson; (est) = estimated.

sp. also differs from that of *B. serratus* in having a distinct median ventral keel, which bifurcates proximally. At the lateral margins there are raised areas with an ornamentation of narrow lunule-scales, totally unlike the raised serrated lateral margins of *B. serratus*. There seems to be no difference between the tergites of *B. henningsmoeni* n. sp. and *B. serratus* as both possess posteriorly pointed lateral epimerae.

Material described as *Baltoerypter* n. sp. A figured by Jones & Kjellesvig-Waering (1985, Figs. 3-5, pp. 414-416) from the north-eastern part of Somerset Island, Arctic Canada, is represented by only a few prosomas, telsons, two metastomas, abdominal segments and podomeres of a paddle. *B. henningsmoeni* n. sp. differs in having a more rounded metastoma with a L/W-ratio of 1.36, that of *Baltoerypter* n. sp. A being 1.69. Podomere 8 of appendage VI in *Baltoerypter* n. sp. A is more elongated and closely resembles that of *B. tetragonophthalmus*.

SYSTEMATIC PALAEOLOGY

Suborder PTERYGOTINA Caster and Kjellesvig-Waering, 1964

Superfamily PTERYGOTOIDEA Clarke and Ruedemann, 1912

Pterygotid indet.

Figure: 2G & 2H

Horizon and locality: As above.

Material: Three specimens PMO 70692, PMO 70727 and a small fragment on PMO 70696.

Description

PMO 70727 is a cuticular fragment showing the typical ornamentation of narrow chevron scales. The size of the fragment (length 39.5 mm) suggests a relationship to the pterygotids. PMO 70692 (Figs. 2G and 2H) is clearly the distal two podomeres (8 and 9) of a pterygotid swimming leg (appendage VI). The posterior (?) edge of podomere 8 is serrated, showing 19 serrations. The joint between the two podomeres is not visible. Based on reconstructions of pterygotids (e.g. Størmer 1955, Fig. 22), the length of the two podomeres (length = 76.2 mm) can be used to calculate the approximate length of the living pterygotid to have been about 115 cm (without chelicerae extended). Overlying the podomeres is a fragment of cuticle with the same ornamentation as PMO 70727 and PMO 70696 although it is not clear whether this represents a fragment from the same animal.

Discussion

The preserved parts are insufficient to relate them to a species or even a genus, but it seems clear based on their size and ornament that they represent pterygotids. The only other pterygotid known from the sequence is *Eretopterus* (?) *holmi* (Størmer, 1934) from the Rudstangen Fauna. The swimming legs of this species are poorly known, so no further comparisons can be made.

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