# Eurypterids

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At Vattenfallet Eurypterida are restricted almost entirely to Högklint *d*. Two other horizons (18.9–19.1 and 20.20–20.25 m) contain rare eurypterids, represented respectively by a single leg spine of *Holmipterus* and by small patches of skin also referable to that genus. For the distribution of eurypterid skin fragments in the insoluble residue of Laufeld's samples (not examined by me) see Fig. 66. In the past Högklint *d* has commonly been referred to as *Pterygotus* Marl, with reference to the abundant pterygotids in its well-preserved eurypterid assemblage; this assemblage was previously considered to be equivalent to the famous assemblage from the Lower Ludlovian Rootsiküla Stage ($K_1$) of Saaremaa, but the Vattenfallet eurypterids are now known to be of early Wenlock age and are thus much older. They comprise five genera, one of which is described here as new, and five species, four of which are new, as follows:

*Holmipterus suecicus* n.gen., n.sp. (common)
*Baltoeurypterus serratus* (Jones and Woodward) (rare)
*Dolichopterus gotlandicus* n.sp. (rare)
*Truncatiramus serricaudatus* n.sp. (common)
*Erettopterus carinatus* n. sp. (rare)

It seems probable that all these species were known to Gerhard Holm, as in his posthumous plates (Wills 1963) he figured nearly all specimens reported here. The famous scorpion *Palaeophonus nuncius* Thorell and Lindström also occurs in this bed and various fragments have been noted in addition to the original specimen. Clearly, this assemblage, consisting mainly of *Holmipterus* and Pterygotidae, belongs in the eurypterid assemblage No. 1 (Kjellesvig-Waering 1961:794), which comprises mainly pterygotids and carcinosomatids (or Mixopteridae and Megalograptidae) associated with a rich marine fauna.

The Vattenfallet eurypterids are all fragmentary. Nevertheless, the preservation is remarkable, much like that in the Rootsiküla eurypterid beds of Saaremaa, where the chitin is preserved without change and retains original colors. Many Vattenfallet specimens had been dissolved out of the limestone by Holm and mounted in Canada Balsam. This type of preservation necessitates that all specimens be covered with a thin coating of lacquer or some suitable fixing compound, otherwise flaking of the fragile skins will occur until practically nothing is left but the external imprint of the skin. The flaking begins immediately upon exposure at the collecting site. It is therefore highly important that the lacquer is administered as soon as exposure occurs.

The fragmentary state of the eurypterids indicates that currents or other agencies have disarticulated the various components of the exuviae. In this connection, Brower & Reyment (in Andrews et al. 1974:89) ascribed a catastrophic termination as the cause of the accumulation of nearly entire eurypterids, as in the Silurian Fiddlers Green eurypterid assemblage of Passage Gulf, New York. This was in contradiction to the general view that the great majority of all eurypterids, whole or fragmentary, represented moulted instars (Clarke & Ruedemann 1912:25; Størmer 1934:57). Although the purpose of this paper is not to refute Brower's & Reyment's supposition, it must be acknowledged that, of nearly all exoskeletons preserved in which the venter of the carapace is exposed to reveal whether or not the eurypterid had moulted, there is no doubt that the specimens are cast-off exuvia and in no way indicate either a catastrophic termination or accumulation. Indeed, in the few instances known where thanatosis is involved (as attested by preservation of the alimentary canal) each event has been so unusual as to merit a separate notice in the literature. The eurypterid exoskeletons in areas such as Saaremaa and Passage Gulf could only have accumulated by either being transported by currents – and the evidence is to the contrary – or by the animals themselves seeking a quiet, current-free area in which to moult. The process of moulting in arthropods involves a highly hazardous period, one requiring a quiet area free from disturbing influences, both mechanical and biological. Apparently, Passage Gulf, Saaremaa and the other areas where eurypterids occur concentrated, represented such areas.

The lack of scavenging activity is also cited by Brower & Reyment (1974:89) as one of the reasons for a catastrophic burial. I would suspect that the lack of scavenging activity is more properly due to the important fact that the exuviae did not contain any organic matter that could be scavenged such as would occur had catastrophic death been involved.

## Suborder Eurypterina Burmeister, 1843

Superfamily Mixopteroidea Caster and Kjellesvig-Waering, 1955; Family Megalograptidae Caster and Kjellesvig-Waering, 1955.

*Holmipterus* n. gen.

Megalograptidae of large size, male mesial organ consisting of three parts, a long tubular basal with an expanded, rounded end consisting of the terminal joints; walking legs carcinosomatoid; telson spike-like with expanded anterior and serrated dorsal platform, with articulating cercal blades on each side of the platform.

*Derivation of name.* – In honour of the great Swedish paleontologist Gerhard Holm, Head of the Department of Paleozoology at Riksmuseum 1901–1922, whose work remains as a model for all who study arthropods.

*Remarks.* – There is little doubt in my mind that *Holmipterus* is so different from *Megalograptus* that when more specimens of the former are known, it will be best to separate them into different families. The legs of *Megalograptus* are differentiated and not of the carcinosomatoid type as in *Holmipterus*. The serrated telsonic platform is a unique morphological feature of the latter, and certainly is sufficient to separate this genus from all other eurypterids. Again this surprising telson merely emphasizes the great diversity of the Eurypterida, and also how little we really know of this Order.

### *Holmipterus suecicus* n. sp.

Figs. 32–33

All specimens reported here were known to Holm, who figured them in plates that were printed but never released for publication, nor was a description ever made. The important cercal blades were not identified, nor figured by Holm, but this is not surprising as these structures were unknown in Eurypterida until much later (Caster & Kjellesvig-Waering 1964). The chelicera is known from a paratype (Ar. 31832) of which only the 3rd joint is preserved (assuming that Megalograptidae have four joints as in the Eurypteridae and Pterygotidae). Most of the hand is present showing that it is about as broad as long, with a socket for the articulation of the condyle of the 4th joint. The pincer is long, very narrow, falcate and colored very dark brown to black on the extremities. The hand is light brown on the outer parts, grading towards black on the inner edges. The hand is 11.5 mm long, 11.9 mm wide, and the falcate pincer is 12.4 mm long (see Fig. 32F).

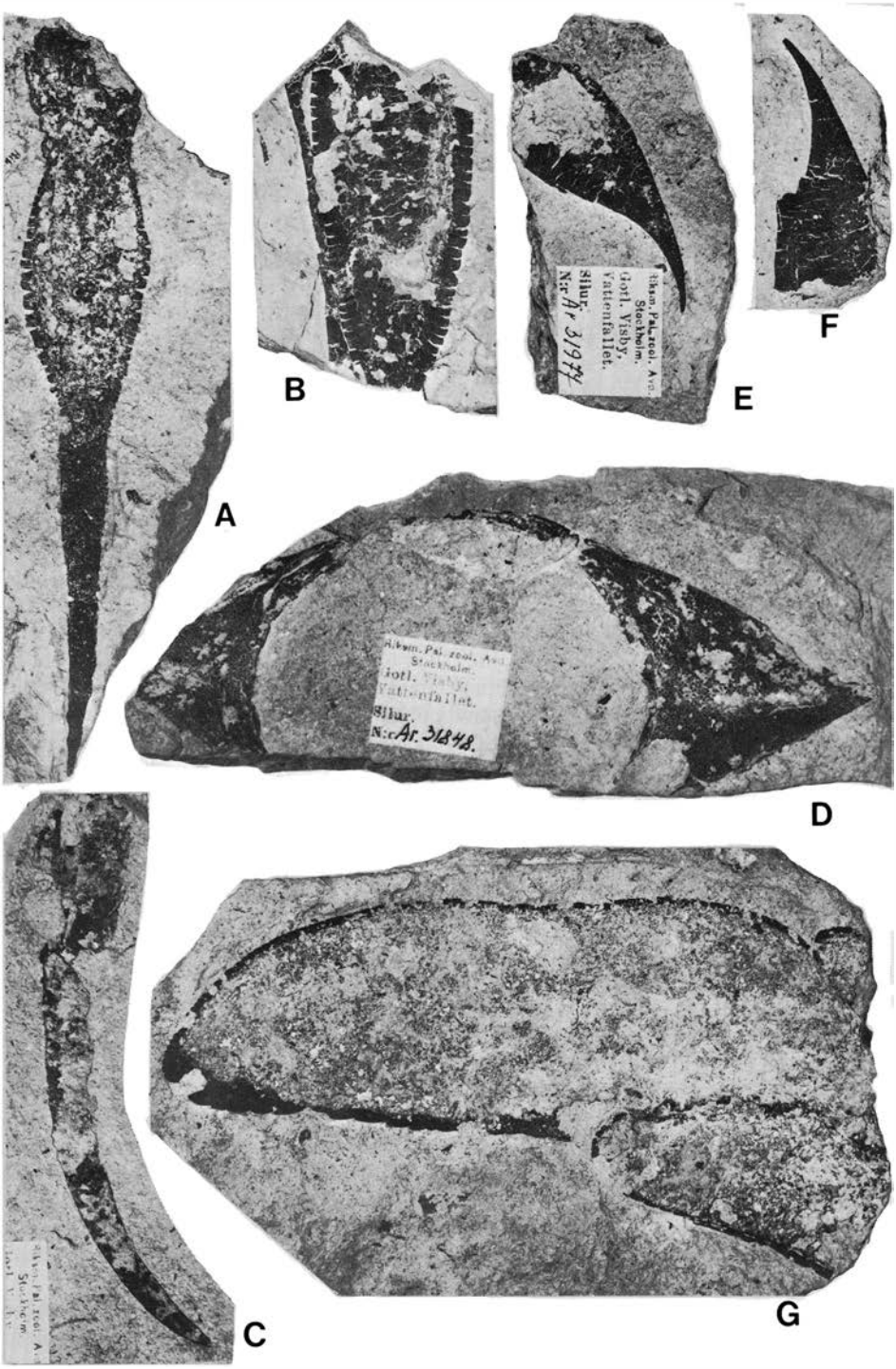
The walking legs are practically unknown except for two joints (Ar.31833 and Ar.32002). Both have large, curved spines, one on each side and characteristic of most of the Carcinosomatidae wherein the legs are flattened and with the venters turned anteriorly. These carcinosomatoid legs are very different from the highly differentiated legs of *Megalograptus*. The spines of the legs are striated with narrow, longitudinal ridges along the posterior of the curved part (Fig. 33F).

The swimming leg or sixth appendage is known from a nearly complete paddle retaining part of the sixth and all of the seventh segment which constitutes most of the paddle, and several pieces containing the distal end of the paddle which is important in identification of these mixopteroid eurypterids (Ar. 31828, Ar. 31836, Ar. 31857, Ar. 31859).

The triangular lobe of the sixth joint is very long and has linear scales along most of the posterior or outer edge which grade into serrated scales at the distal end. The seventh joint is also very long, finely serrated along the anterior edge and increasingly coarser along the distal end. The posterior edge is coarsely serrated (Fig. 33G). The eighth joint is a small triangular spine (Fig. 33G). The seventh joint (Ar. 31828) measures 78.8 mm in length and 25.8 mm in width at midsection. The other paratypes indicate individuals of considerably greater size, possibly reaching 1.5 m in total length.

The operculum and median organ is known only from two well preserved specimens, both of Type A, considered by Størmer & Kjellesvig-Waering (1969) to be male, but by Wills (1965) to be female. The male operculum is deeply cleft at the anterior median edge, separating the opercular lobes; thus there is no development of the usual anterior median suture. Deltoidal plates are well developed, triangular in shape and covered with small semilunar scales, black in color and contrasting with the light brown background.

Two distinct, curved slits occur on each side of the hastate section of the mesial appendage. These slits separate a lighter colored brown area which also has much finer semilunar scales than the adjacent part of the lobe, indicating that these areas, on each


A
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G

side of the mesial appendage, are the anchylosed lateral lobes. The entire opercular lobes are covered by even sized, small semilunar scales, black in color and evenly distributed on light brown integument.

The mesial appendage is composed of three distinct parts, a long, slightly tapering basal joint which comprises almost the entire organ, and which probably extended to the succeeding two abdominal plates. The haft part is, as in many eurypterids, triangular. The base is an inverted triangular area with a small, median, triangular protrusion. Attached to this area is a bulbous part which seems to have been rather inflated, because in the holotype the left side was noted to be larger, suggesting that in compaction this part was laterally dislocated. The terminal joints are unique, consisting of two nearly elliptical plates.

The mesial appendage is devoid of any ornamentation except at the hastate part and also on the anterior, median part of the shaft where small black semilunar scales are present.

The holotype (Ar.31827) is 102.5 mm wide across the middle of the opercular lobes. The mesial appendage is 57.4 mm long. A paratype (Ar.31845) measures 105 mm in reconstructed length indicating that *H. suecicus* reached an overall length of about one metre from the anterior of the carapace to the distal end of the telson.

Specimen Ar.31901 possibly represents the distal end of the Type B, or female, mesial appendage. It is round, apparently club shaped and is ornamented at the edge by a row of scales which appear to represent the distal part of radiating striations. The outside (ventral) part of this organ is black but the inside (covered dorsal in life) is light brown. I cannot at present conceive of this fragment belonging to anything but the female appendage of this eurypterid (see Fig. 33E). The colors indicate this interpretation, as well as the improbability, if not impossibility, of it belonging to the other known associated eurypterids. The distal end is 9 mm wide, indicating a specimen comparable in size with other adult *H. suecicus* found in this horizon.

The preabdomen is known from three large fragments.

An irregular piece (Ar.31850) 50 mm by 33 mm, reveals that the ornamentation consisted of black, rather small, semilunar to mucronate scales on a background of very dark brown. The underside is known by a large incomplete abdominal plate (Ar. 31879) which is possibly the first plate succeeding the operculum. The plate is bilobate, dark brown, lighter anteriorly than posteriorly, and rounded at the outer posterior angles. The central part is covered with very small semilunar scales, much smaller than those occurring on the dorsal plates. The semilunar scales decrease in size anteriorly and posteriorly; the entire posterior part of the abdominal plate is smooth. The plate is estimated at 150 mm in width of which 130 mm are preserved, and is 40 mm long. Another fragment (Ar. 31578 and counterpart Ar. 31579) is apparently part of the epimera of the first tergite. The edge slopes posteriorly, thus positive proof that the entire mesosoma was highly tumid, much as in the Carcinosomatidae.

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Fig. 32. *Holmipterus suecicus* n.sp. Magnification ×1.2. A. Telson from the dorsal side showing the enlarged, serrated, flattened platform against which the cercal blades operate as double forceps (for cercal blade see Fig. 32E). Ar. 31696. B. Anterior platform of telson revealing the serrated, but truncated, teeth. Ar. 31691. C. Telson from the side; the horizontal serrated platform is seen on the left side of the photograph which represents the dorsal side. Ar. 31804. D. Pretelson preserved from the anterior (vertical on the bedding plane) end, thus revealing the round cauda and the flaring epimera. Ar. 31848. E. A cercal blade. Ar. 31977. F. The hand and fixed ramus of the chelicera, showing the condyle for the articulation of the free ramus. Ar. 31832. G. The distal part of the sixth, and all of the seventh joints of the paddle; the notch at the end of the seventh joint represents the site of the small terminal or eighth joint. Ar. 31828. All specimens from Högklint *d* at Vattenfallet. Photograph U. Samuelson.

An abdominal plate of a young individual (about 36 mm wide) also verifies that these plates were bilobed and joined in the center line by a suture. Only half of the plate is preserved (Ar. 31679).

Small pieces of integument, possibly tergites of the dorsal side of the mesosoma (Ar. 31695 and Ar. 31834) were dissolved out of the rock by Holm and reveal that the ornamentation probably covering the main part of the eurypterid consisted of scales,

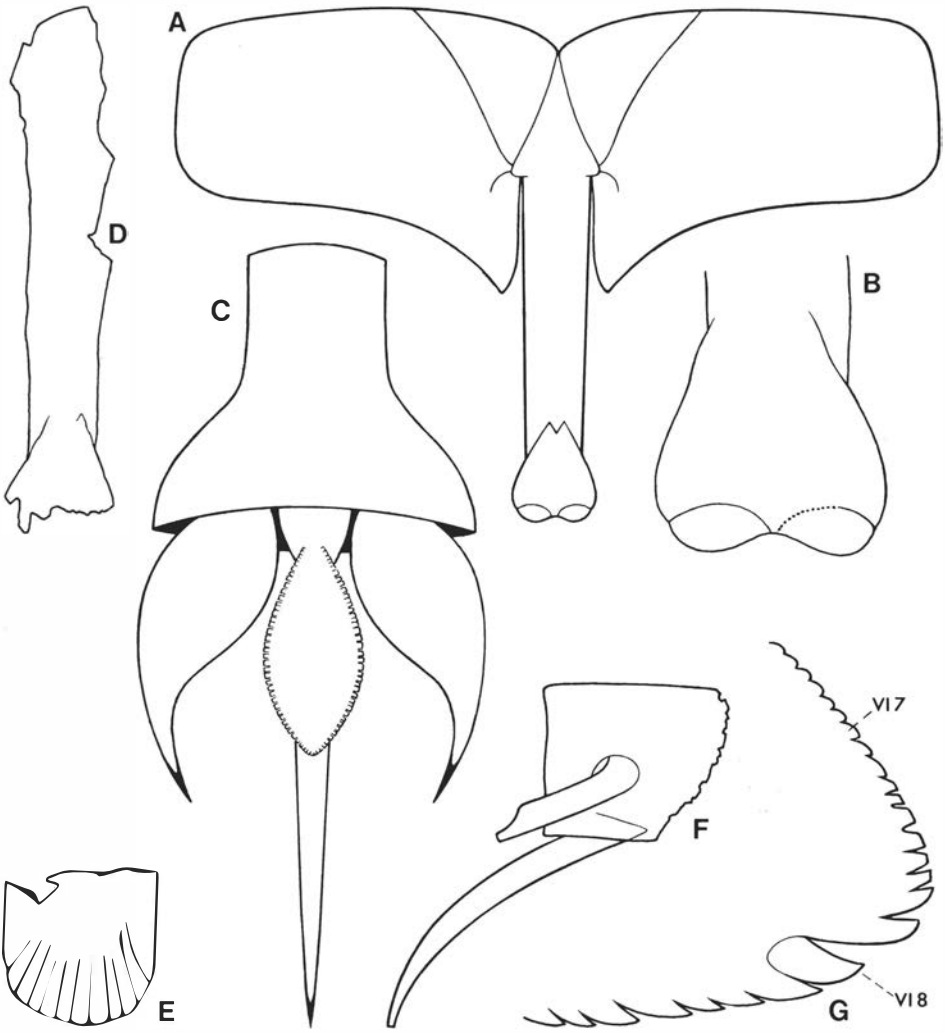



Fig. 33. *Holmipterus suecicus* n.sp. A. Restoration of operculum and Type A mesial appendage, based mainly on the holotype. Approxim. ×1. B. Distal end of the mesial appendage of the holotype. Ar. 31827, ×3. C. Restoration of pretelson, cercal blades and telson. D. Unattached male mesial appendage of considerably greater size than the holotype. Ar. 31845, ×0.8. E. Possible Type B median appendage. Ar. 31901, ×2. F. Joint and attached spines of a walking leg. Ar. 31833, ×1.5. G. Distal part of swimming leg. Ar. 31859, × 1. All specimens from Högklint *d* at Vattenfallet.

hemi-elliptical in shape, about as long as wide and all of a distinct, regular size interspersed by very small, semilunar scales. In areas such as edges the scales become mucronate. All these scales are very dark brown to black and contrast against the light brown of the rest of the integument.

The metasoma is known from three large fragments (Ar. 31849) which would include the last tergite (7th) of the preabdomen, and the first two tergites (8th and 9th) of the postabdomen or cauda. Although width measurements cannot be made as parts are missing, it is possible to measure the lengths, which are as follows: tergite 7–31.0 mm, tergite 8–41.3 mm, tergite 9–60.4 mm. The tergites are covered with small mucronated scales. The cauda seems to be black, at least dorsally, as the doublures are dark brown in color and therefore the black coloring is primary and has not been altered. There is an indication that strong constriction occurs between the seventh and eighth tergites as in other eurypterids, but preservation does not permit determination of the amount of constriction.

The most surprising morphological feature of this eurypterid, as in other megalograptids, is the pretelson-telson assemblage which includes the cercal blades. The pretelson is preserved in a flattened condition, but flattened from the anterior end; thus in burial it was covered upright and perpendicular to the bedding plane. Although only one specimen is preserved (Ar. 31847–Ar. 31848), it can be stated that the anterior, and therefore probably the entire cauda, was nearly round in cross-section. This would be in keeping with many genera of Carcinosomatidae, Mixopteridae and Megalograptidae which had rounded, or tubular cauda capable of being thrust "overhead" as in the scorpions. The basal part is widely flaring, very probably to accomodate the wide cercal blades (see Fig. 32D). The pretelson measures 45 mm "in the round" and each flaring end is 28.3 mm long; therefore, the basal end of the flaring pretelson measures 91.6 mm in width.

The cercal blades are known from two specimens (Ar. 31977, Ar. 32003) both of which are nearly complete except for the bases. The part preserved shows the specimen to be bulbous/flattened and produced into a long, falcate termination (Fig. 32E).

The remarkable telson is unique among eurypterids. Fortunately it is represented by four specimens (Ar. 31691, Ar. 31696, Ar. 31804, and Ar. 32083). The telson is robust in lateral view, curved downward in life (Fig. 32A), and has a flat, serrated platform on the anterior part near the bulbous articulation of the telson. The serrated edge of the telsonic platform is laterally rounded and overlaps the underlying shaft of the telson. The teeth along the serrated edge are truncated at the apical ends, so that each tooth appears to be squarish. These serrations are clearly visible in both Ar.31691 and Ar.31696 from the dorsal side, and laterally in Ar. 31804 and Ar. 32083 (see Fig. 32A–C).

By comparison with numerous specimens of the American Upper Ordovician *Megalograptus ohioensis* (Caster & Kjellesvig-Waering 1964) it is possible to assemble the various parts which compose the terminal part of the cauda with considerable confidence. The cercal blades fit on each side of the flaring pretelson and articulate against the raised, serrated, telsonic platform (see restoration Fig. 33A). The entire downwardly-bent telson acted as a third or middle pincer between the two falcate, forceps-like cercal blades, and because the cauda could be thrust over the carapace, as in scorpions, this combination formed a particularly formidable grasping weapon. The complete telson (Ar. 31696) is 86.5 mm long, 14.5 mm estimated at the base, 8 mm at the anterior of the platform, 14.6 mm in greatest width of the platform, and 10.8 mm at the posterior of the platform or anterior of the spike. The telsonic platform of Ar.31691 is much larger, measuring 18.2 mm in greatest width.

*Remarks.* – The scorpion-like cauda and telson was a formidable weapon although there is no evidence that a pair of poison glands occurred as in the scorpions. In fact, although it has been suggested in the past that some of the Mixopteridae and Carcinosomatidae may have possessed poison glands in the curved telson, this does not seem possible. The eurypterid telson is far too thick or blunt, and the double poison glands, if present at the base of the telson, would be located too far away from the terminal end to be effective. In contrast, the scorpion has a very sharp point, with openings on each side, and the paired poison glands are close to the openings for instantaneous injection of the poison.

The upward thrust-action of the downwardly-curved telson, and the rounded tubular cauda are features that are common in scorpions and some eurypterids such as *Holmipterus, Mixopterus* and *Paracarcinosoma*. This was apparently a development in the eurypterids for the use of the forcep-like cercal blades and not for a supposed poison-injecting telson. In genera such as *Mixopterus* and *Paracarcinosoma,* the cercal blades disappeared, and evidence for this conclusion will probably be forthcoming in older eurypterids such as those from the Lower Silurian and Ordovician. This also implies that early scorpions, older than Middle Silurian, might have developed the up-thrusting tail primarily for the accomodation of cercal blades and later developed the vesicle and aculeus with the paired poison glands.

## Superfamily Stylonuracea Diener, 1924; Family Dolichopteridae Kjellesvig-Waering and Størmer, 1952

### *Dolichopterus gotlandicus* n. sp.

Fig. 34

This large *Dolichopterus* is represented by a metastoma (Ar.31697) designated as the holotype and by three coxae of the swimming leg.

The metastoma, although not complete, is sufficiently preserved so that most of the important characters of the plate can be described and compared with other species. Anteriorly it is cordate, with an inverted, obtuse angular notch in the middle. Each side of the notch is superimposed with a single row of seven, evenly shaped, squarish, even-sized denticles. The lateral margins of the metastoma are nearly parallel, with a

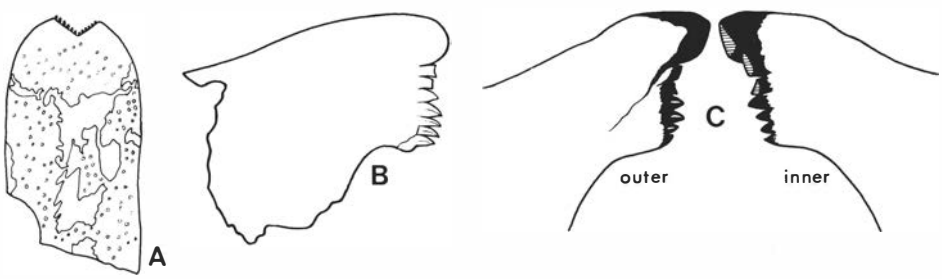



Fig. 34. *Dolichopterus gotlandicus* n.sp. A. Metastoma. Holotype, Ar. 31697, ×2. B. Part of coxae of swimming leg. Ar. 31840, ×2. C. Gnathobase of swimming leg; the principle or anterior tooth is on a lower level than the rest of the teeth. Ar. 37698, ×2 (see also Fig. 36F). All specimens from Högklint *d* at Vattenfallet.

slight constriction posteriorly; therefore, the sides are slightly convergent posteriorly. The ornamentation comprises evenly spaced and even sized, pilious pustules. Each pustule is surmounted with a round opening or setal site, and each is black in color and contrasts with the rich, shiny brown color of the integument (see Fig. 34A).

The three paratypes reveal the typical *Dolichopterus* type of coxae, being very wide with a long neck and the gnathobase at the inner end. The gnathobase of *Dolichopterus* is very similar to that of *Baltoeurypterus,* having a ventral anterior, or principle tooth, which is truncated and striated on the inside. On a higher plane is a row of smaller teeth. This row contains two much smaller truncated teeth, followed on the same row by four triangular teeth which decrease in size posteriorly. Specimen Ar. 37698 has been freed from the matrix by Holm, and all details are available (Fig. 34C). Another, about 50 per cent larger specimen reveals the same arrangement. The coxae are covered with hughmilleriid type of linear scales or ridges, and are dark brown in color, contrasting against the rich shiny dark brown color of the integument.

*Remarks.* – By comparison with other Dolichopteridae, the two species from Saaremaa, *Dolichopterus stoermeri* Caster and Kjellesvig-Waering and *Dolichopterus* sp. show considerable differences. The peculiar ornamentation of the metastoma in *D. stoermeri* is sufficient for differentiation. In *D. stoermeri,* the much deeper anterior notch and the smaller and lesser number of teeth also represent differences from the Vattenfallet species. From *Dolichopterus* sp. (Holm 1898, pl. 10:11) the differences are immediately apparent in the highly constricted metastoma in comparison with the nearly parallel sides of the Gotland form. It is very likely that *Dolichopterus* sp., although belonging within the Dolichopteridae, will not be retained within the limits of the genus *Dolichopterus* when more parts are known.

## Superfamily Eurypteracea Burmeister, 1845; Family Eurypteridae Burmeister, 1845.

### *Baltoeurypterus serratus* (Jones and Woodward)

Fig. 35B–C

1888 *Phasganocaris pugio* (Barrande) var. *serrata* Jones and Woodward, p. 149, pl. VI, figs. 3–6.

The various fragments of *Baltoeurypterus* reported below had been described and figured in manuscript form when Dr. W. D. Ian Rolfe forwarded to the writer the syntypes and other specimens of the supposed phyllocarid *Phasganocaris pugio* (Barrande) var. *serrata* Jones and Woodward, as he had properly recognized that all represent eurypterids rather than phyllocarids. Nearly all the specimens were determined as belonging to *Baltoeurypterus* including at least one syntype of the Jones & Woodward species (1888, Pl. VI:4, refigured here as Fig. 35D). This specimen (Ar.31589) is here designated as the lectotype. It is a Type A telson which is considered to represent the male. It is not as well preserved nor as complete as some of the telsons described below.

Besides the lectotype and three other syntypes the material comprises six male (Type A) telsons (Ar.31803, 31808, 31811, 31812, 31819, and 31845, the last being associated on the same bedding plane with a large paratype of *Holmipterus suecicus*), a large female metastoma (Ar.31716), a 10th tergite (Ar.31715), an 11th tergite (Ar.31716), and two basitarsal (6th) joints (Ar.31718 and 31717 which are on the same bedding plane as the metastoma).

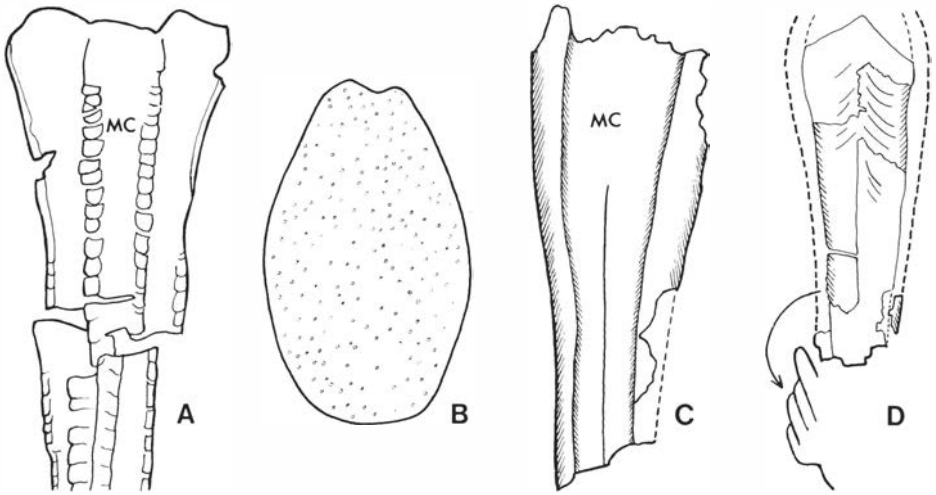



Fig. 35. *Baltoeurypterus tetragonophthalmus* (Fischer): A. Details of the anterior, ventral part of the male (Type A) telson. Ar. 48931, ×3. Saaremaa, Viita quarry; Rootsiküla ($K_1$) Stage.
*Baltoeurypterus serratus* (Jones and Woodward): B. The Type A metastoma. Ar 31717, ×3. C. Details of the anterior, ventral part of the male (Type A) telson. Ar. 31811, ×3. D. Telson, lectotype. Ar. 31589, ×3 (enlargement of "serrations" ×12). Högklint *d*, Vattenfallet.

The telson is of prime importance in the differentiation of eurypterids. In the Eurypteridae it is one of the most consistently preserved parts, and fortunately of more diagnostic importance for the separation of minor taxa than even the carapace. *Eurypterus remipes* DeKay and *Eurypterus lacustris* Harlan, can easily be distinguished by the ornamentation on the telson. The same is true of species of *Baltoeurypterus*. I have material of several further species of *Baltoeurypterus* from Gotland and Saaremaa which also reveal the importance of the telson for the separation of species. Comparison has been made directly with specimens from Holm's collection of preparations so that comparisons are possible with as much accuracy as if one were using tissues from living specimens. The great number of specimens studied show that the characteristics of the telson are constant.

Specimen Ar.31803, consisting of a nearly complete male telson, is bulbous anteriorly and tapers to a spike. The anterior bulbous area is 7.7 mm wide, and its overall length is estimated at 36.5 mm. The ventral side is bounded by a flat, wide carina which is bounded on the edges by an ornamentation of fine diagonal, plumose striations in single narrow rows (see Fig. 35C). The central part of the flat carina is smooth. A median groove separates the median carina. The lateral margins of the telson are also bounded by a margin of fine, diagonal, plumose striations, but these are slanting in the opposite direction to those on the median carina. No scales are present on the lateral margins which appear to be entirely smooth. In contrast, male telsons of the same size in *B. tetragonophthalmus* (Fischer) (Fig. 35A) have a much narrower, inferior carina which is bounded on each side by a row of large semilunar scales on the anterior, and which grade into a narrow ridge on each side of the carina and converge posteriorly. The lateral margins are bounded by a serrated edge of long, flat scales.

Incredible as it may seem in dealing with middle Silurian fossils, the coloration can be compared. In *B. serratus*, the rows of striations on the lateral margins of the carina and

telson are black; the lateral margins of the carina in *B. tetragonophthalmus* are black, but the scales on the lateral margins of the telson are dark brown. The central part of the carina in *B. serratus* is dark brown to black; the same area in *B. tetragonophthalmus* is light brown. The rest of the venter of the telson, that is the area between the carina and the margins of the telson in both species, is light brown. The dorsal part of the telson of *B. tetragonophthalmus* is flat and is bounded on each side of the telson by a single row of dark brown, elongated scales (about 2–3 times as long as wide). The rest of the telson is light brown and smooth. In *B. tetragonophthalmus* the median groove on the dorsal carina is not as prominent except distally.

The distal end of the telson is known from specimen Ar. 31845 which has the telson lying on its side. This reveals that the striated spines, particularly on the lateral margins of the telson, grade distally into coarse mucronated scales.

The female (Type B) telson is considerably narrower, and although the piece known (Ar. 31819) is only from the central dorsal part, it is probably safe to assume that it is long, and downwardly bent as in other species of *Baltoeurypterus*. The central carina and the edges of the telson are ornamented as in the male.

The two joints of the paddle (Ar. 31717 and Ar. 31718) comprise the basitarsus or 6th joint and are typical of the genus in being very short and wide. Ar. 31717 is 10.0 mm in greatest width and 5.2 mm long, measured through midsection to the suture of the triangular lobe, whereas Ar. 31718 is 10.2 mm wide and 7.2 mm long.

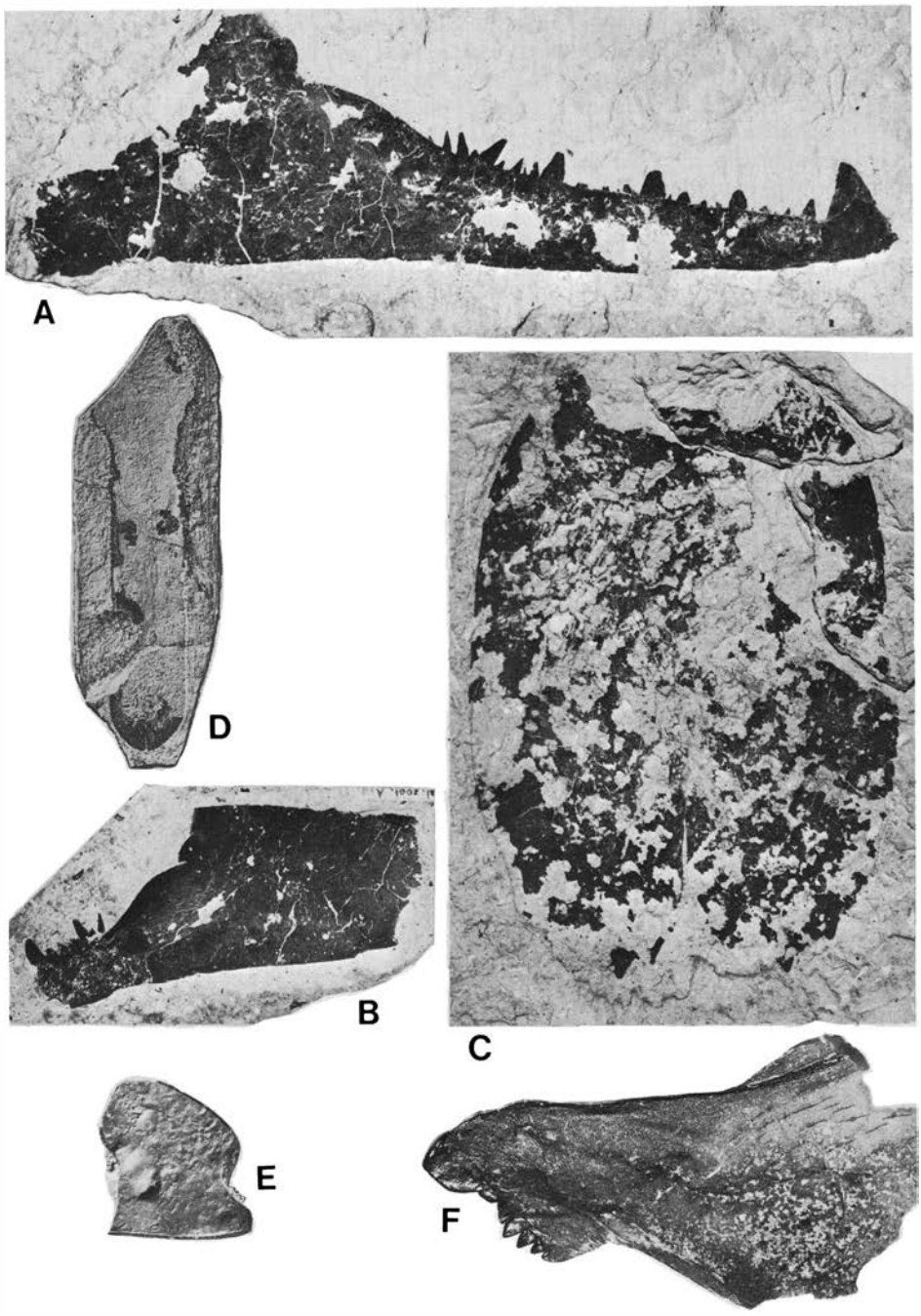
The metastoma (Ar. 31717) is ovoid as in *B. tetragonophthalmus* except that it is narrower at the anterior end, and the development of denticles on the indented anterior end is not as great. If this metastoma is typical of the species, it differs from *B. tetragonophthalmus* in being more pyriform. The surface of the metastoma is covered with small pustules, all of which are pileous as each has an opening at their apices. This type of ornamentation on the metastoma (see Remarks), as well as being the broad type, denotes a female (Type B). The metastoma has a maximum length of 13.7 mm and is 8.7 mm wide.

The tenth tergite of the metastoma is rather piceous at the centre, thus denoting a female. The basal border is bounded by a single row of evenly spaced scales, giving the tergite a serrated edge. The genal angles are produced into short horns, and the ventral side, which is the only side exposed, reveals that the lateral pleural areas are covered with mucronated scales, whereas the central part is thickened with imbricating scales, all of which are piceous. The pleural areas are light brown. A well developed anterior marginal rim is defined by a row of small scales, which continue anteriorly. The tergite is 22.5 mm wide and 10 mm long, both measurements through the center.

In the eleventh tergite the ventral side is not complete, but enough is preserved for a fair description and comparison with *B. tetragonophthalmus*. The central part is piceous, plumose and thickened. The pleural areas are devoid of scales. This contrasts with the imbricating, semilunar, large irregular scales of the central part of the corresponding segment in *B. tetragonophthalmus*. The 11th tergite is obviously from a female specimen.

## Suborder Pterygotina Caster and Kjellesvig-Waering, 1964

### Superfamily Pterygotoidea Clarke and Ruedemann, 1912; Family Pterygotidae Clarke and Ruedemann, 1912


A
D
B
C
E
F

## *Truncatiramus serricaudatus* n. sp.

Figs. 36, 37A–D

1964 *Erettopterus osiliensis* (Schmidt): Waterston, p. 18, Pl. 2, figs. 1–3.

By far the most common eurypterid at Vattenfallet is a large pterygotid represented by many disjointed pieces, of which the diagnostic telsons and cheliceras can be correlated as belonging to the same species. This is important as there is definitely another pterygotid present (*Erettopterus carinatus* n. sp.). A metastoma, also of diagnostic value, is referred to *T. serricaudatus*. Many other pieces, very likely belonging to *T. serricaudatus*, cannot safely be referred to either pterygotid as the parts represented – coxae, tergites – are not sufficiently diagnostic.

The holotype (Ar. 31886) is the fixed ramus with part of the hand of a large chelicera. Other specimens are Ar. 31888, 31890, 31891, 32013, 32026, 32071, 32073, and 32075; telsons Ar. 31894, 32084 and metastoma Ar. 31893. The holotype reveals a fixed ramus with acute termination and considerably smaller teeth of uneven size, placed at right angles to the ramus. There are two large central teeth and in the rear of the ramus is a cluster of diagonally opposed teeth which are characteristic. The condyle for the articulation of the free ramus is located within one third of the width of the hand. Paratype Ar. 31888, also a fixed ramus and an entire hand, reveals that the hand is long and without ornamentation, as are both of the rami. The color of the chelicera is dark reddish-brown, with the teeth and condyle, as well as the terminal tooth, being black. The holotype measures 56 mm from the terminal tooth along the ramus to a line drawn from the condyle to the base of the ramus. The width of the hand in the area of the condyle (greatest width) is 23.3 mm. The hand of paratype Ar. 31888 has a maximum width of 18.5 mm and is 25.7 mm long from the condyle to the base of the cheliceral hand.

The free ramus has a double acute termination that straddles the main tooth of the fixed ramus. This is notably present in all pterygotids but in preservation is nearly always covered. This double termination is well shown on the paratypes of this species. The ramus is also very straight on the outer edge and is surmounted by small teeth, all of which, except at the base, are bent evenly backward. Two central teeth are more prominent than others but details of the teeth are best revealed by comparison of the photographs.

The metastoma is represented by only one specimen (Ar. 31893) which reveals a form typical of the genus. It is highly cordated anteriorly, the major width of the structure lies in the anterior half and is tapering posteriorly into a rounded termination. It is covered with small, semilunar to mucronated scales, all of even size and densely distributed.

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Fig. 36. *Truncatiramus serricaudatus* n.sp.: A. Fixed ramus and part of the hand of the chelicera. Holotype, Ar. 31886, ×1.5. B. Hand and part of the fixed ramus of the chelicera. Ar. 31888, ×1.2. C. Telson. Ar. 32084, ×1.2. D. Type A mesial appendage. This photograph is from Holm's posthumous plate; the specimen has not been located and is assumed here that the original came from Vattenfallet. ×1.

*Baltoeurypterus serratus* (Jones and Woodward): E. The sixth joint of the paddle which has been freed from the matrix. Ar. 31718, ×1.6.

*Dolichopterus gotlandicus* n.sp.: F. Gnathobase and neck of the coxa which has been freed from the matrix. Ar. 37698, ×3 (see also Fig. 34C). All specimens from Högklint *d* at Vattenfallet. Photograph (except for Fig. D) U. Samuelson. Fig. D was photographed by G. Holm and retouched by G. Liljevall.

The telson is represented by four specimens (Ar. 31894, 31898, 32084, and 32085), all well preserved and retaining the original color which is dark reddish-brown, darkening to black at the edges, particularly on the coarse serration of triangular bordering spines. More important, two specimens are preserved so that it is possible to determine dorsal from ventral sides. In specimen Ar. 31894 the dorsal side is preserved, showing that it is devoid of any median or slight flat ridge as in *T. osiliensis* (Schmidt). The ventral side is indented in the central part, with both lobes gently sloping from the centre line. Both sides are covered with semilunar to sub-mucronated scales on the anterior, and bordered by a row of about two or more flat and rhombic scales, which increase in length to become large, triangular scales on the rounded cordated end of the telson. These large scales are separated by much smaller triangular scales, which together with the coarse scales account for the serrated termination. Ar. 31894 has an estimated length of 95 mm and is 57 mm wide; Ar. 32084 is 65.3 mm long and 44.3 mm wide; and Ar. 32085 is 43 mm in estimated length and 30.5 mm in width.

Many other specimens in the Riksmuseum collections could very likely be referred, with only slight doubt, to this species, but these parts are gnathobases and coxae which, with our present knowledge, are not diagnostic. Some of these could represent *Erettopterus carinatus*.

A Type A median appendage requires description as this organ is of considerable diagnostic value. Unfortunately, the specimen has been misplaced and my description is based only on the excellent photograph in Holm's posthumous plate (Fig. 11 of an unlabelled plate; Fig. 36D herein). Inasmuch as the specimen is surrounded by figures of Vattenfallet specimens, it is quite safe to assume it is from Vattenfallet. The mesial appendage (estimated length 60 mm) consists of an unjointed organ, triangular anteriorly, with parallel sides and rounded posteriorly where it appears to be divided by a narrow notch. It is unusual in not retaining an enlarged bulbous terminalia of the mesial appendage as in most pterygotids. It is rather safe to assume that the specimen is referable to *Truncatiramus serricaudatus* or *Erettopterus carinatus*, as these are the only pterygotids at Vattenfallet, and because nearly all of the recognizable specimens belong to the most common pterygotid, it seems reasonable to assign this specimen to *T. serricaudatus*.

*Remarks.* – In comparison with the outwardly bowed rami of the type species *T. osiliensis* (Schmidt) from the Rootsiküla Stage ($K_1$) of Saaremaa differs from the straight rami of *T. serricaudatus*. The details of the form and grouping of the teeth are also completely different in both. Apart from the chelicerae, the telson of both are easily separated on the basis of the serrations as well as the low median ridge on the anterior of the telson of *T. osiliensis* which is totally lacking in *T. serricaudatus*.

A specimen (Ar. 32089) of unusual interest is referred with hesitation to *T. serricaudatus*. This comprises parts of the first and second joints of the chelicerae in articulation. The joints in articulation between the two joints are rarely found, as they are nearly always broken and this has led to the erroneous assumption that the pterygotid chelicerae consisted of three, rather than four joints (see Kjellesvig-Waering 1964:334–339). At that time, I thought that the pterygotid chelicerae articulated with the base of the epistoma, but although it was very close to the epistoma in position it did not in fact articulate with it, but occupied a position as in *Eurypterus, Baltoeurypterus* and *Limulus*, adjacent to the doublure, and articulating against each side of the labrum. This condition has not been found in the pterygotids but is highly likely as it is present in *Eurypterus* and *Baltoeurypterus*. The chelicerae consist of part of the first joint, which is considerably narrower than the second, articulating inside the second joint, and

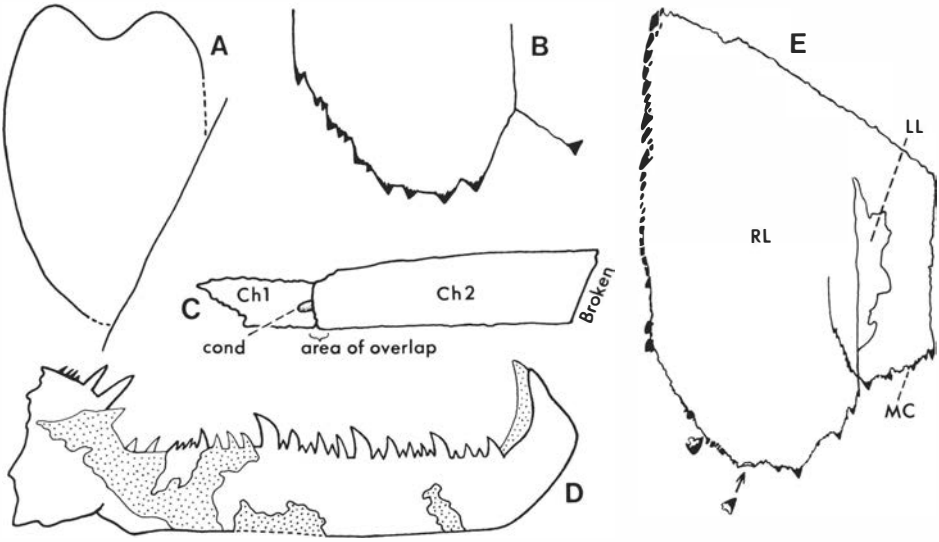


Fig. 37. *Truncatiramus serricaudatus* n.sp.: A. Metastoma. Ar. 31893, ×1. B. Details of well preserved, posterior part of the telson. Ar. 31898, ×2. C. First and second joints of the chelicera. Ar. 32089, ×0.6. D. Free ramus of chelicera; the stippled areas represent parts where the skin has been flaked off; however, the impression of the structures, such as the teeth, is present – the double termination of the terminal teeth is particularly well preserved. Ar. 31891, ×2.7.

*Erettopterus carinatus* n.sp.: E. Details of telson seen from the ventral side. RL, right lobe; LL, left lobe; MC, median carina. Holotype, Ar. 31896, ×3. All specimens from Högklint *d* at Vattenfallet.

attached by a condyle and socket of the second joint. The second joint is slightly bent against the first and is straight on the outer edge and bowed outward on the inner. This results in the second joint being thicker proximally. The color of the entire chelicerae is bright brown.

The Type B median appendage has been fully described by Waterston (1964:18, Pl. 2:1–3).

## *Erettopterus carinatus* n. sp.

Fig. 37E

This species is based on a fragment of the base of the telson (Ar.31896) which has been freed from the matrix by Holm. It is mounted in Canada Balsam and reveals that a true *Erettopterus* is present at Vattenfallet. The fragment measures 20.5 mm by 13 mm, and indicates a telson of 40 mm estimated length, 20 mm in maximum width (each horizontal lobe is 10 mm wide) with a carina or vertical lobe of at least 5 mm in height (3 mm preserved).

The right lobe is represented by a large fragment showing a highly serrated terminal part which is acutely cordated and is bordered by at least three large triangular spines. The border of spines continues on the lateral edges where they become more linear and with the points close to the edges of the telson but pointed posteriorly. The middle carina extends to the centre of the cordated notch, has considerably thinner or narrower

spines, and more mucronated, smaller spines than the lateral or horizontal lobes (see Fig. 37E).

*Remarks.* – The differences between *T. serricaudatus* and *E. carinatus* are apparent in the presence of the carinated telson of the latter. From the Scottish Upper Llandovery *Erettopterus bilobus* Salter, it differs in having each lateral lobe much narrower and in having coarse serrations on the cordated area.

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