

The middle Cambrian Andrarum Limestone and Exporrecta Conglomerate of Västergötland, Sweden: supplementary data on the fossil fauna

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New material of trilobites and agnostoids has been collected from *in situ* occurrences of the Miaolingian Exporrecta Conglomerate in Västergötland, Sweden, and from Pleistocene ice-rafted boulders of the Andrarum Limestone and Exporrecta Conglomerate in Denmark, which are assumed to derive from that region. Both units represent the lower part of the *Lejopyge laevigata* Zone. The erratic boulders of Andrarum Limestone consist of compact, light- to dark-grey, highly fossiliferous limestone, essentially identical to the Andrarum Limestone in southernmost Scandinavia (Skåne–Bornholm). To date, no *in situ* occurrences of this lithology have been documented from anywhere in Scandinavia north of Skåne. The new fossil material includes well-preserved specimens of *Acontheus acutangulus*, *Corynexochus spinulosus* and *Dolichometopus svecicus*. Notably, the new pygidia of these taxa show features not recorded in the respective type specimens, which are refigured here for comparison.

Keywords. Miaolingian, Sweden, Västergötland, Andrarum Limestone, Exporrecta Conglomerate, trilobites, agnostoids

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‘Middle’ Cambrian strata, now assigned to the Miaolingian, are well known from the province of Västergötland, Sweden (Fig. 1). In this region, the succession rests unconformably on the ‘lower’ Cambrian File Haidar Formation and is overlain conformably by Furongian Alum Shale. The lower part of the Miaolingian, consisting of strongly glauconitic sand/siltstone c. 1 m thick, represents the Kvarntorp Member of the Borgholm Formation (Nielsen & Schovsbo 2015 and references therein). This interval is overlain by the Alum Shale Formation, which contains frequent limestone concretions and beds (referred to as stinkstone, orsten or anthraconite), making up the remainder of the Miaolingian succession (Nielsen & Schovsbo 2007, 2015). This part is 9–13.5 m thick in the area (cf. Westergård 1943; Andersson *et al.* 1985; Ahlberg *et al.* 2016). Note that the Miaolingian encompasses the *Agnostus pisiformis* Zone, formerly assigned to the ‘upper’ Cambrian. The strata

are accessible for study in several abandoned shale quarries and a few streams in the area. The Miaolingian trilobite–agnostoid fauna of Västergötland has been treated by Linnarsson (1869, 1873), Wallerius (1894, 1895, 1896, 1930), Holm (1901), Munthe (1905), Westergård (1922, 1931, 1943, 1946, 1948, 1950, 1953), Weidner *et al.* (2004), Axheimer *et al.* (2006) and Ahlberg *et al.* (2016).

The sea level fluctuated repeatedly during the Miaolingian, so periods of deposition were interrupted by phases of non-deposition and erosion, including recurrent episodes of reworking. As a result, the Miaolingian succession in Västergötland is strongly condensed (Fig. 2). The *Ptychagnostus punctuosus* and *Goniagnostus nathorsti* zones, as well as the lower part of the *Lejopyge laevigata* Zone (corresponding to the *Erratojincella brachymetopa* trilobite Zone), are particularly incomplete and the present paper focuses on that stratigraphic interval (Fig. 3).

Investigated succession

The uppermost part of the *Acidusus atavus* Zone (the *Hypagnostus parvifrons* Zone *sensu* Westergård 1946) is developed at most localities as a bituminous limestone bed, up to 60 cm thick (e.g. at St. Stolan, see Westergård 1922, fig. 28), informally referred to as the ‘*Hypagnostus* limestone bank’ (Weidner *et al.* 2004). It is overlain by various thin conglomerates, detailed below, which are locally replaced by a thin limestone. This condensed succession is, in turn, overlain by the upper part of the *Lejopyge laevigata* Zone, marking renewed deposition of Alum Shale in the area (Figs 2, 3).

Three lithological units can be distinguished in the interval between the *A. atavus* Zone and the upper part of the *L. laevigata* Zone (all localities mentioned are shown in Fig. 1):

1) The ‘*Hypagnostus conglomerate*’: At some localities, the ‘*Hypagnostus* limestone bank’ is overlain by a few cm thick, conglomeratic, bituminous limestone layer in which only fragments of *Paradoxides paradoxissimus* have been found. The clasts are angular, giving the rock a breccia-like appearance. This layer has been recorded at three localities (Fig. 3). The age of the conglomerate is uncertain, but it probably represents the *A. atavus* Zone.

2) The ‘*Punctuosus-nathorsti conglomerate*’: At other localities, the ‘*Hypagnostus* limestone bank’ is overlain by a quite fossiliferous, up to 15 cm thick, bituminous limestone conglomerate, also predominantly with angular clasts. It contains reworked fossils from the *Ptychagnostus punctuosus* and *Goniagnostus nathorsti* zones. Deposition presumably took place during or immediately after the latter zone, but it cannot be ruled out that additional rework-

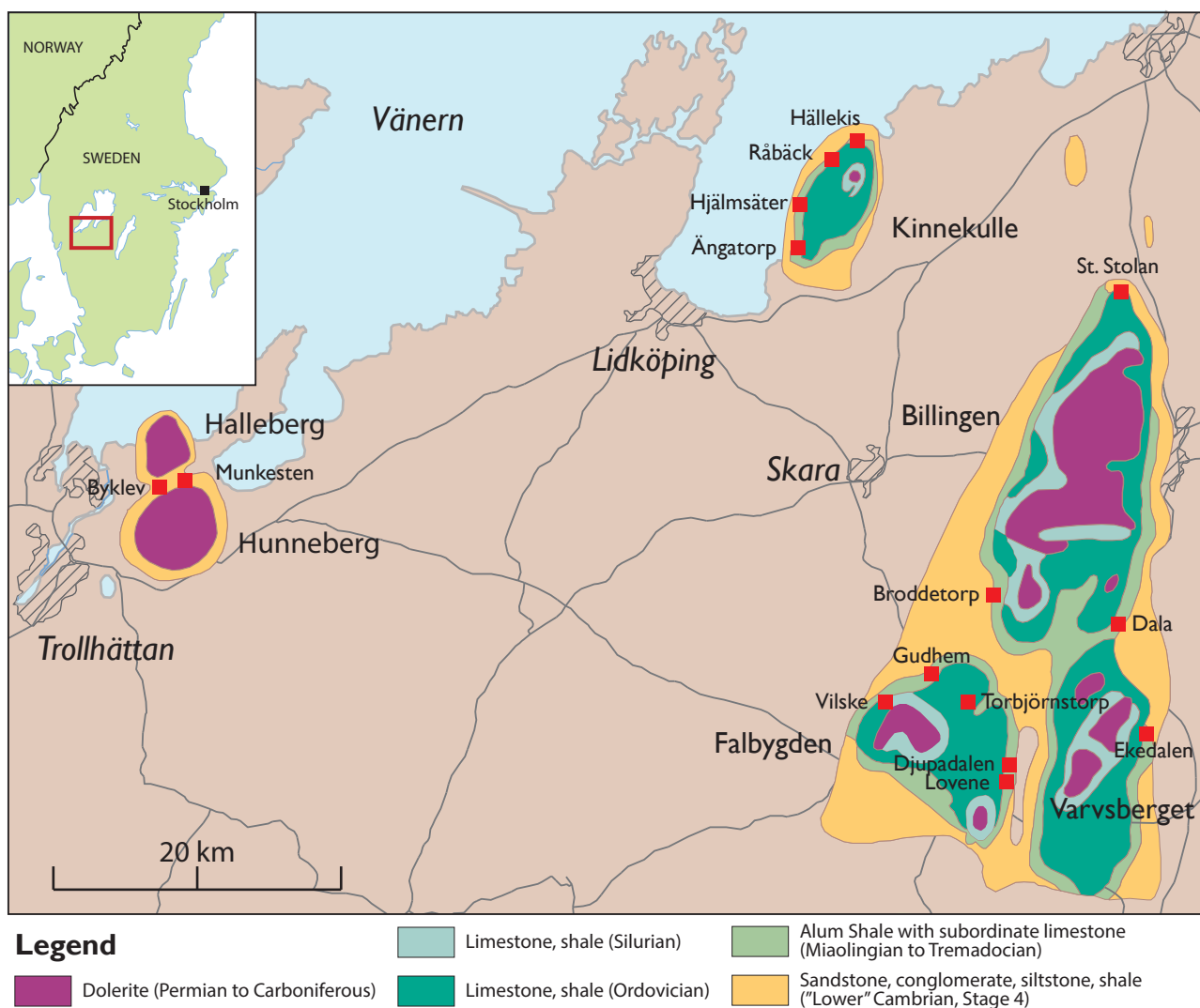


Fig. 1. Map of Västergötland, Sweden, showing the present-day distribution of ‘lower’ Palaeozoic strata and localities referred to in the text.

ing events took place in this stratigraphic interval. This conglomerate has been observed at seven localities (Fig. 3); its lithology and fossil content were described by Weidner *et al.* (2004). At Ängartorp, orsten concretions representing the *P. punctuosus* Zone were found (however, collected *ex situ*), indicating that a pocket of Alum Shale representing this zone may have escaped reworking at this site.

3) **The Exporrecta Conglomerate:** This is the youngest layer investigated in the present study (for formal lithostratigraphy, see Nielsen & Schovsbo 2007). The name refers to the brachiopod *Oligomys exporrecta*, which is typically abundant in the conglomerate and commonly associated with other brachiopods,

trilobites, agnostoids, and hyoliths (Rudolph 1994; Buchholz 2010, 2013; this study). This distinctive bed varies considerably across Sweden in terms of composition, thickness, biostratigraphic range and faunal content (Buchholz 2010, 2013; Fig. 4). It is widespread in Västergötland (Fig. 3), where it is usually developed as a conglomerate with pebbles of orsten and phosphorite (Fig. 5). However, locally, the conglomerate is replaced by – or passes into – a coarse-grained, grey, occasionally glauconitic limestone (Westergård 1946, 1948). At Råbäck and Hälleklis, this limestone is 6–7 cm thick. The faunal content of both the conglomerate and the limestone shows that these lithologies represent the lower part of the *L. laevigata*

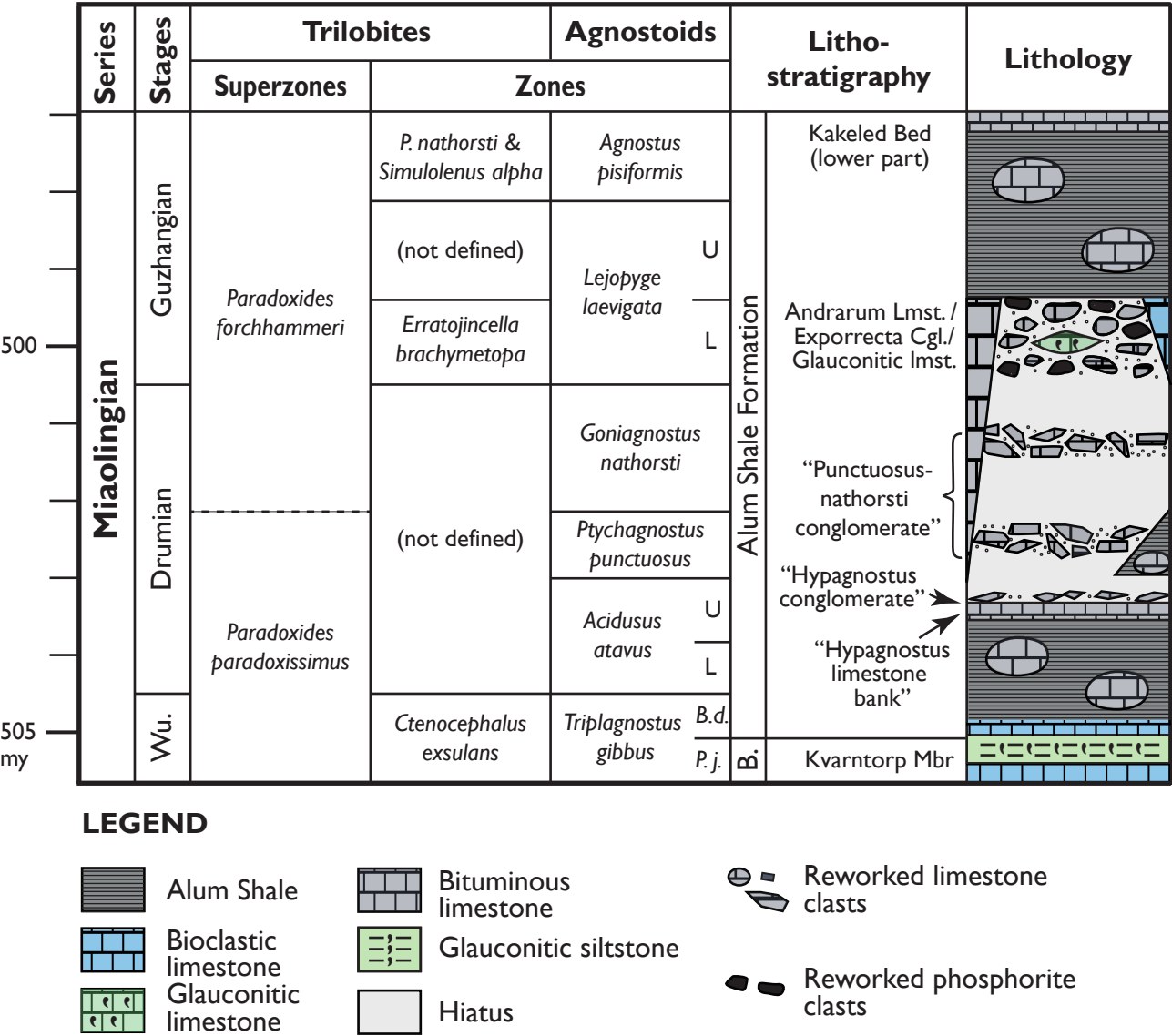


Fig. 2. Zonation of the Miaolingian in Västergötland, Sweden, showing the stratigraphic distribution of the various lithologies. The present paper focuses on the strongly condensed interval from the *Acidusus atavus* Zone to the *Lejopyge laevigata* Zone. Lithostratigraphy follows Nielsen & Schovsbo (2007). The time scale is based on Peng *et al.* (2020). Abbreviations: Wu. = Wuliuan; *P. nathorsti* = *Proceratopyge nathorsti*; B. = Borgholm Formation; B.d. = *Bailiaspis dalmani*; P.j. = *Paradoxides jemtlandicus*; U = Upper; L = Lower.

Zone. The conglomerate is locally very fossiliferous and has yielded 21 taxa, whereas no more than three taxa have been recorded from the limestone. *Baltico-glaucus* [formerly *Parasolenopleura*] *spinigerus*, found at Råbäck, and *Lejopyge elegans*, found at Hälleklis, originate from the *A. atavus* and *P. punctuosus* zones, respectively, and demonstrate reworking of older strata during deposition of the Exporrecta Conglomerate. However, the bed contains surprisingly few reworked fossils (see also Westergård 1946, p. 16), although it should be noted that no systematic search for reworked fossils in the clasts was undertaken as part of the present study.

The Exporrecta Conglomerate was reported as ‘Andrarum Limestone’ from several localities at Kinnekulle and Falbygden by Linnarsson (1873), although it differs markedly from the compact, light-to dark-grey, highly fossiliferous Andrarum Limestone Bed known from Skåne–Bornholm. Although Linnarsson was undoubtedly familiar with the Andrarum Limestone of Skåne, he nevertheless referred to the conglomerate in Västergötland as ‘Andrarum Limestone’, probably due to the shared faunal elements. Linnarsson (1877) later reported Andrarum Limestone on Hunneberg in western Västergötland, and Westergård (1946) likewise referred to this slightly metamorphic (baked), bituminous limestone as Andrarum Limestone, despite its deviating lithology and mixed faunal content compared with the coeval limestone in Skåne. Andrarum Limestone of the same type as occurring in Skåne and Bornholm has not been observed in any other Swedish province north of Skåne. However, finds of Pleistocene ice-rafted boulders of this limestone at As Hoved (see below) suggests that it is most likely developed somewhere in central Västergötland, but despite more than twenty years of searching in the province,

no *in situ* occurrences have yet been found (TW unpublished).

Ice-rafted boulders at As Hoved, Denmark

A large number of ice-rafted boulders of Andrarum Limestone and Exporrecta Conglomerate have been collected at As Hoved, Jylland, Denmark, during more than 30 years of sampling effort by TW (Weidner *et al.* 2004; Figs 4, 6). At this locality, four different moraines of Elsterian, Saalian and Weichselian age have been identified, all originating from the north (Norway) and north-east (south-central Sweden; Houmark-Nielsen 1987; Houmark-Nielsen in Larsen & Kronborg 1994). The 6 km-long shoreline of the As Hoved peninsula is crowded with ice-rafted boulders of ‘lower’, ‘middle’ (Miaolingian) and ‘upper’ (Furongian) Cambrian sedimentary rocks, and the so-called Kinnediabase is also common. These erratics have repeatedly contributed with fossils that have enhanced the understanding of the Cambrian succession in Västergötland. For example, fossiliferous, metamorphosed ‘lower’ Cambrian Lingulid Sandstone, previously unknown in Västergötland, was later discovered *in situ* on Halleberg following the recognition of this lithology among the erratics at As Hoved (see Weidner *et al.* 2015 for details). Similarly, the discovery of the ‘*Punctuosus-nathorsti* conglomerate’ at As Hoved prompted a years-long search that ultimately led to its identification as a thin layer in Falbygden, Billingen and Kinnekulle (Weidner *et al.* 2004). It is emphasised that the assemblage of Miaolingian ice-rafted boulders at As Hoved corresponds closely, with respect to both lithology and faunal content, to the stratigraphic succession

Legend												
x <i>In situ</i>			Lin. Linnarsson (1873)									
● Observed ex situ			We. Westergård (1948)									
			Joh. Johansson (unpubl.)									
Superzones	Zones	Lithology	Vilse	Djupadalen	Torbjörntorp	Broddetorp	Ekdalen	St. Stolan	Hjälmsäter	Råbäck	Hälleklis	
<i>Paradoxides forchhammeri</i>	U <i>Lejopyge laevigata</i>	Alum Shale	x	x				●		x	x	
		Glaucinitic limestone		x	We.						x	x
	L <i>G. nathorsti</i>	Exporrecta Cgl.	x	x	We.	Lin.	We.	●	●	x	x	
		“Punctuosus – nathorsti conglomerate”	x	x	We.			x		●	x	x
<i>Paradoxides paradoxissimus</i>	<i>P. punctuosus</i>											
	<i>Acidus atavus</i>	“Hypagnostus conglomerate”						x	Joh.		x	
		“Hypagnostus limestone bank”	x	x				●	●	x	x	●

Fig. 3. Chart showing the localities and occurrences of the treated conglomerates in central Västergötland. Observations made by other authors are specified.

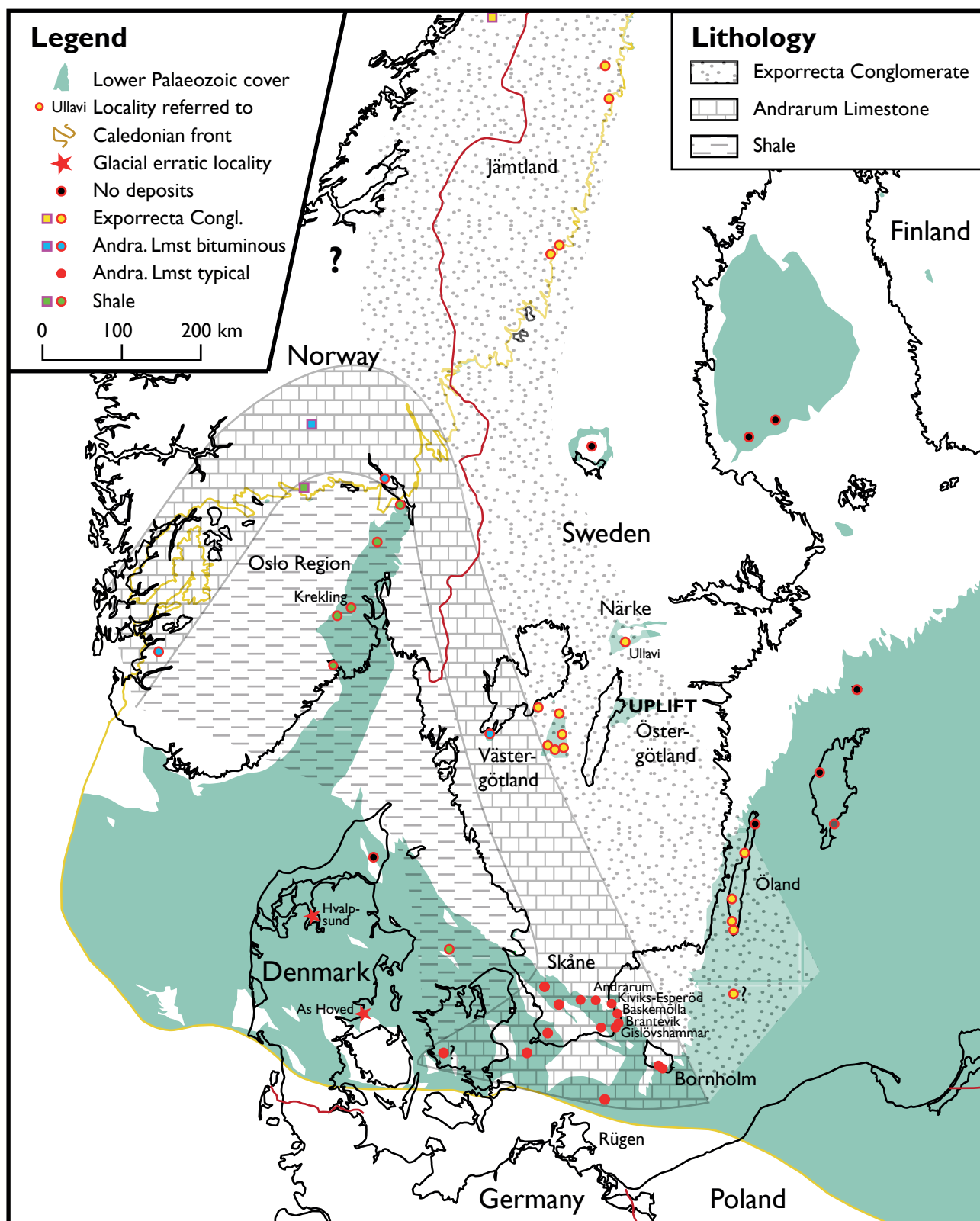


Fig. 4. Map of southern Scandinavia showing facies belts during the early *Lejopyge laevigata* Chron and localities referred to in the text. Square symbols represent allochthonous sections in their inferred approximate original positions (see Nielsen & Schovsbo 2011 for details). The map is based on data from various sources, both published and unpublished (for a list of most of the localities and drill-holes, see Nielsen & Schovsbo 2015 and Weidner *et al.* 2023). The present-day distribution of preserved Lower Palaeozoic cover is also indicated.

known from Västergötland. Representative samples are preserved in the Weidner collection at the Museum of Evolution, Uppsala. Not a single block of the 'Ölandicus' Mudstone (known from Öland, Östergötland, Närke), Exsulans Limestone (Skåne, Bornholm), 'Paradoxissimus Sandstone' (Öland) or 'Punctuosus Limestone' (Skåne, Bornholm) has been recorded, although these lithologies occur abundantly as ice-rafted boulders in southern Denmark and northern Germany (Rudolph 1994; Buchholz 1997, 2004, 2012; Mischuk 2006, 2012). For this reason, the Andrarum Limestone and Exporrecta Conglomerate collected at As Hoved are confidently interpreted as originating from Västergötland, where the Exporrecta Conglomerate is common both *in situ* or as local loose boulders. In contrast, *in situ* occurrences of the Andrarum Limestone *s.str.* are still lacking, as remarked above.

The Andrarum Limestone erratics found at As Hoved consist of light- to dark-grey, dense limestone, essentially identical to the lithology known from Skåne–Bornholm. These boulders have yielded nine trilobite taxa (compared with 26 in Skåne) and seven agnostoid taxa (versus 19 in Skåne), but they lack brachiopods and hyoliths. The largest block found weighed 1.5 kg. The coeval Exporrecta Conglomerate found at As Hoved contains common *Oligomys exporrecta* together with various other brachiopods, hyoliths, trilobite fragments and agnostoids, including six trilobite taxa and eight agnostoid taxa,



Fig. 5. Block of 'Hypagnostus conglomerate' found at As Hoved.

compared with nine, respectively six, collected in Västergötland. Trilobites and agnostoids from the Andrarum Limestone and the Exporrecta Conglomerate are listed in Appendix 1 and illustrated in Figs 7–14.

At As Hoved, two head-sized blocks of the 'Hypagnostus conglomerate' were also found. In Västergötland, this layer is exposed in streams or beneath small waterfalls and is therefore difficult to observe and sample. The blocks from As Hoved consist of large, rounded pebbles of bituminous limestone in a calcareous matrix (Fig. 5). Only a single cephalon, representing *Hypagnostus parvifrons* or *H. mammillatus*, has been recovered. At Ekedalen and Råbäck, this conglomerate consists predominantly of angular clasts.

Systematic palaeontology

Several agnostoid and trilobite species known from the Andrarum limestone and the Exporrecta Conglomerate have recently been treated by Weidner *et al.* (2023); see also Rudolph (1994). However, most of the species occurring in these units have not been illustrated or redescribed since Westergård (1946, 1948, 1950, 1953; see list in Appendix 1). In the present study, we address only four trilobite species for which the new material contributes to improved taxonomic understanding: *Acontheus acutangulus* Angelin, 1851; *Corynexochus spinulosus* Angelin, 1854; *Dolichometopus suecicus* Angelin, 1854; and *Dorypyge aenigma* (Linnarsson, 1869). All other material is illustrated in Figs 13 (trilobites) and 14 (agnostoids). In the classification of the Solenopleuridae we follow Geyer (2024).



Fig. 6. The shore line at As Hoved.

Repositories. NRM (Naturhistoriska Riksmuseet, Swedish Museum of Natural History, Stockholm); PMU (Palaeontological collections, Uppsala University, Sweden); SGU (Geological Survey of Sweden, Uppsala); SMF (Senckenberg-Institut, Frankfurt/Main, Germany).

Family Corynexochidae Angelin, 1854

Genus *Acontheus* Angelin, 1851

Type species. By monotypy, *Acontheus acutangulus* Angelin, 1851, from the Andrarum Limestone Bed, Andrarum, Skåne. The type material is reillustrated here in Fig. 7A₁–A₄, B₁–B₄, C.

Diagnosis. See Westergård (1950), Poulsen (1959) and Jago *et al.* (2011).

Remarks. Only the type species, occurring in the lower part of the *L. laevigata* Zone, is reported from the Miaolingian of Scandinavia (see references below). Jago *et al.* (2011) commented on species of *Acontheus* from other regions.

Acontheus acutangulus Angelin, 1851

Fig. 7

1851 *Acontheus acutangulus* n. sp. – Angelin, p. 5, pl. 5, figs 4–5.

1854 *Aneucanthus acutangulus* [sic] – Angelin, pp. 63–64, pl. 33, fig. 19.

1950 *Acontheus acutangulus* Angelin – Westergård, pp. 9–10, pl. 8, figs 4–6.

1959 *Acontheus acutangulus* Angelin – Poulsen, p. 0227, fig. 165: 3a–b.

1994 *Acontheus acutangulus* Angelin – Rudolph, pp. 161–162, pl. 13, fig. 4.

2022 *Acontheus acutangulus* Angelin – Schöning, pl. 6, fig. 96.

Lectotype (designated by Westergård 1950). Cranidium, NRM Ar1930c, from the Andrarum Limestone Bed, Andrarum, Skåne, originally figured by Angelin (1851, pl. 5, figs 4–5). It was refigured by Westergård (1950, pl. 8, figs 4a–b) and is illustrated here in Fig. 7A₁–A₄.

Occurrence & new material. *Acontheus acutangulus* is a comparatively rare species and only 8 cranidia and 8 pygidia were reported from the Andrarum Limestone at Andrarum by Westergård (1950). Two pygidia have subsequently been described from ice-rafted boulders of Andrarum Limestone found on the island of Rügen (Rudolph 1994) and near Osnabrück in northern Germany (Schöning 2022). The

latter specimen has been available for study (Fig. 7D₁–D₂; described below). Two additional, more poorly preserved pygidia have been collected from ice-rafted boulders of Andrarum Limestone at As Hoved, Denmark. A fifth pygidium, collected from the Andrarum Limestone at Brantevik, has been donated to PMU by H.-J. Schmütz (Fig. 7E). Jago *et al.* (2011, fig. 7N–S) figured three pygidia from the Guizhangian (probably the lower part of the *L. laevigata* Zone), Northern Victoria Land, Antarctica, as *Acontheus* cf. *acutangulus*. These specimens, 2.5 to 3 mm long, compare well with the Swedish material found to date, but in the absence of associated cranidia, the authors refrained from a definitive species assignment.

Description. The two pygidia collected at As Hoved are fragmentary; one is illustrated in Fig. 7F. In contrast, the pristine specimen, 1.9 mm long, found by Schöning (2022) and shown here in Fig. 7D₁–D₂, allows a reappraisal of several characters noted by Westergård (1950). In this specimen, the area behind the terminal piece reveals more detail than in any previously illustrated pygidium of the species.

Westergård (1950, pl. 8, figs 4–6) figured two pygidia, including a comparatively large specimen, c. 3.9 mm long (Appendix 2). He described the pygidium as having three pairs of pleural ribs and an axis extending to the border, composed of two well-defined rings and a long blunt end-lobe that rarely is divided by a shallow transverse furrow, followed by a narrow, inconspicuous postaxial ridge. This ridge is relatively well-defined in one of our new specimens (Fig. 7F). In the excellently preserved smaller pygidia at hand (Fig. 7D₁–D₂, E), as well as in the three pygidia illustrated by Jago *et al.* (2011, fig. 7N, R–S), the axis does not reach the border furrow. Here we observe three axial rings in addition to the articulating half ring and a terminal piece that is narrower than the third ring. In the small specimen (Fig. 7D₁–D₂), the postaxial ridge is divided, with an anterior part interrupted by the border furrow, separating it from a posterior part extending to the pygidial margin. We also observe a subtle fourth pair of short pleural ribs, not previously described, though they are faintly visible in Westergård's illustrated specimens (here reillustrated in Figs 7B₄ and 7C). It appears that, with increasing size, the axis extends to the border furrow and the third ring furrow fades, creating the impression of a single long end-lobe, as described by Westergård (1950).

A new image of the lectotype cephalon (Fig. 7A₁–A₄) reveals a set of paradoublural furrows on the anterior part of the genae.

Genus *Corynexochus* Angelin, 1854

Type species. By monotypy, *Corynexochus spinulosus* Angelin 1854, from the Andrarum Limestone, Andrarum, Skåne, Sweden.

Diagnosis. See Poulsen (1959).

Remarks. Two species are recorded from the Miaolinian of Scandinavia, *C. bornholmiensis* Grönwall,

1902, from the upper part of the *A. atavus* Zone and the *P. punctuosus* Zone, and *C. spinulosus* Angelin, 1854 from the lower and, less commonly, the upper part of the *L. laevigata* Zone (Grönwall 1902; Weidner & Nielsen 2014).

Corynexochus spinulosus Angelin, 1854

Figs 8, 9

1854 *Corynexochus spinulosus* n. sp. [*partim*] – Angelin, p. 59,

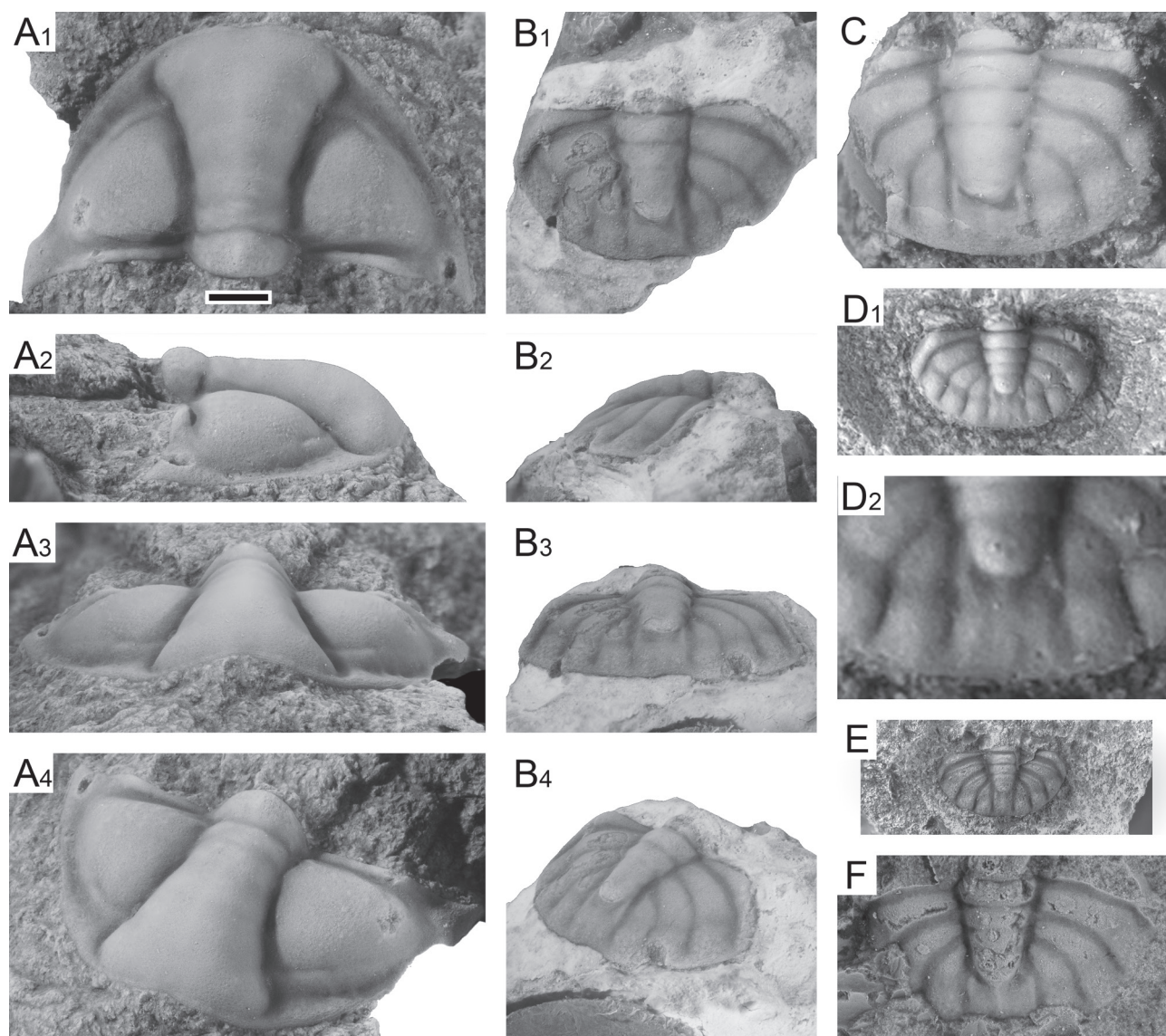


Fig. 7. *Acontheus acutangulus* Angelin, 1851. All from the Andrarum Limestone Bed, lower part of the *Lejopyge laevigata* Zone. **A1–A4:** lectotype cranidium, NRM Ar1930c, in dorsal, lateral, anterior and oblique views. From Andrarum. It was originally figured by Angelin (1851, pl. 5, figs 4–5) and refigured by Westergård (1950, pl. 8, figs 4a–b). **B1–B4:** pygidium, NRM Ar1930d, in dorsal, lateral, posterior and oblique views. From Andrarum. It was originally figured by Angelin (1854, pl. 33, fig.19) and refigured by Westergård (1950, pl. 8, figs 6a–b). **C:** pygidium, NRM Ar1930c. From Andrarum. It was previously figured by Westergård (1950, pl. 8, fig. 5). **D1–D2:** pygidium, SMF 107667, with close-up view of the posterior area. From an ice-rafted boulder at Laerheide, Germany. It was previously illustrated by Schöning (2022, pl. 6, fig. 96). **E:** pygidium, PMU 35689/2, from Brantevik. **F:** pygidium, PMU 39707c, from an ice-rafted boulder at As Hoved. Scale bar in A is 1 mm (for all).

pl. 33, figs 9–9a (not fig. 11 = indet.).

1902 *Corynexochus spinulosus* Angelin – Grönwall, pp. 139–140, 216, pl. 4, figs 3–4.

1916 *Corynexochus spinulosus* Angelin – Walcott, pp. 323–324, pl. 55, figs 1, 1a, 1b.

1939 *Corynexochus spinulosus* Angelin – Whitehouse, p. 235.

1948 *Corynexochus spinulosus* Angelin – Westergård, pp. 9–11, pl. 3, figs 7–9.

1948 *Corynexochus* sp. – Westergård, p. 11, pl. 3, fig. 10, text-fig. 1.

1959 *Corynexochus spinulosus* Angelin – Poulsen, p. O227, fig. 165: 1a–c.

non 1994 *Corynexochus spinulosus* Angelin – Rudolph, pp. 159–160, pl. 13, figs 1–2. [Assigned to *Erratobalticus pomeranus* by Buchholz (1997)].

1997 *Corynexochus spinulosus* Angelin – Buchholz, pp. 220–

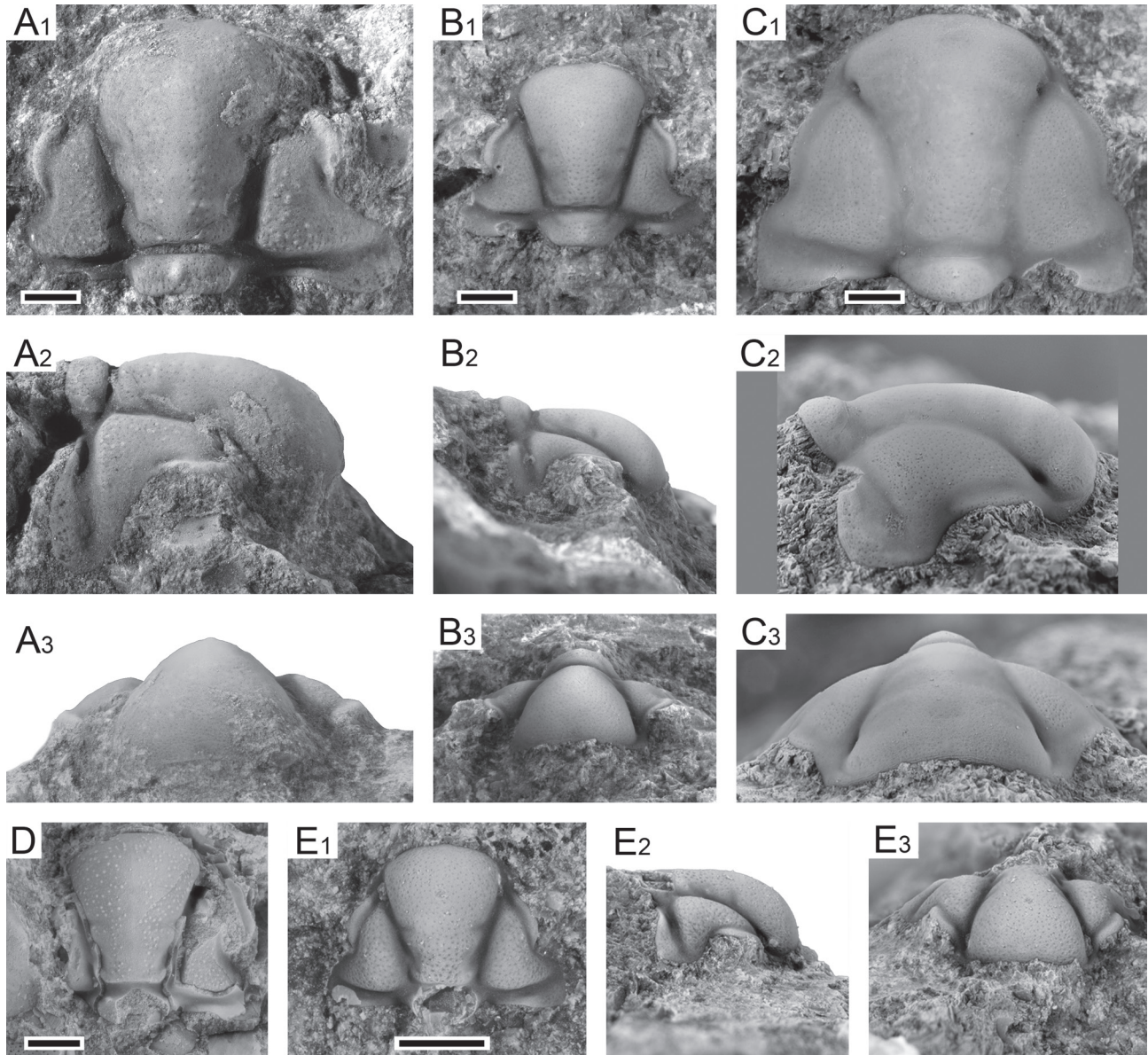


Fig. 8. Cranidia of *Corynexochus spinulosus* Angelin, 1854. All from the lower part of the *Lejopyge laevigata* Zone. **A1–A3:** lectotype, NRM Ar1951a, in dorsal, lateral and anterior views. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Angelin (1854, pl. 33, figs 9–9a), and later refigured by Grönwall (1902, pl. 4, fig. 3a, b) and Whittington (2009, pl. 1, fig. 1:1–3). **B1–B3:** SGU 6383, in same views. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Westergård (1948, pl. 3, fig. 8). **D:** PMU 39718b. From the Exporrecta Conglomerate Bed at As Hoved. Note the coarse granulation. **E1–E3:** PMU 39726 in dorsal, lateral and anterior views. From the Exporrecta Conglomerate Bed at As Hoved. **C1–C3:** cranidium of *Corynexochus bornholmiensis* Grönwall, 1902, from Øleå, Bornholm, Denmark. Upper part of the *Acidusus atavus* Zone. For comparison. MGUH 30169 in dorsal, lateral and anterior views. It was originally figured by Weidner & Nielsen (2014, fig. 45 I, H, G). Scale bars for A–E are 1 mm.

221, pl. 18, figs 7, 8?; pl. 20, fig. 6.

2003 *Corynexochus spinulosus* Angelin – Jell & Adrain, p. 361.

2009 *Corynexochus spinulosus* Angelin – Whittington, pp. 1–3, fig. 1:1–6.

2009 Pygidium indet. – Whittington, pp. 1–2, fig. 1:7–8.

Lectotype (designated by Westergård 1948). Cranidium, NRM Ar1951a, from the Andrarum Limestone, Andrarum, Skåne. Originally figured by Angelin (1854, pl. 33, figs 9–9a), and later refigured by Grönwall (1902, pl. 4, fig. 3a–b) and Whittington (2009, pl. 1, fig. 1:1–3). It is reillustrated here in Fig. 8A1–A3.

Occurrence. *Corynexochus spinulosus* is recorded from the Andrarum Limestone of Skåne (localities include Andrarum, Baskemölla, Brantevik, Gislövshammar, Kiviks-Esperöd), the bituminous ‘Andrarum Limestone’ at Munkesten (on Hunneberg), and the Exporrecta Conglomerate of Västergötland (at Ödegården [=Ekedalen], Djupadalen, Hällekis), and Närke (Ullavi; Grönwall 1902; Westergård 1948). Rudolph (1994) and Buchholz (1997) reported a few specimens from ice-rafted boulders of Andrarum Limestone found in northern Germany. Both Westergård (1948) and Rudolph (1997) also mentioned very rare occurrences in limestone concretions from the upper part of the *L. laevigata* Zone. Our new material derives from ice-rafted boulders of the Andrarum Limestone and Exporrecta Conglomerate collected at As Hoved.

Material. Two new cranidia and five new pygidia are available. In addition, we have re-investigated

the three cranidia and three pygidia previously illustrated by Angelin (1854), Grönwall (1902) and Westergård (1948, Appendix 2).

Description. Westergård (1948) supplemented Grönwall’s (1902) description of *C. spinulosus* and illustrated two cranidia, both better preserved than the lectotype. Whittington (2009) discussed additional features observed in the lectotype cranidium. Our new cranidia are consistent with the limited material from Sweden published to date. The well-preserved smaller specimen shown in Fig. 8B1–B3 retains the test and displays a punctate surface on the glabella, fixigenae and occipital ring, as previously described by Grönwall (1902) and Westergård (1948). The larger new specimen, an internal mould, shows a surface covered with irregular, coarse granules (Fig. 8D).

Four of the five new pygidia assigned here to *C. spinulosus* were found in a block of Exporrecta Conglomerate, associated with a cranidium of the same species. As the pygidia cannot belong to any of the other trilobites species recorded from the Exporrecta Conglomerate, we confidently assign them to *C. spinulosus*. They are subtriangular in shape, with a prominent, elevated, tapering axis ending in a blunt terminal piece. The axis consists of three rings (only two in one specimen) and a terminal piece, in addition to the articulating half-ring. The axial rings narrow medially (Fig. 9E, G, H). Two pleural ribs (only one in one specimen) are developed as short ‘humps’ on the rather flat pleural field between the wide axial furrow and the border furrow. Only in one of the two larger specimens (Fig. 9H) do the axial rings extend

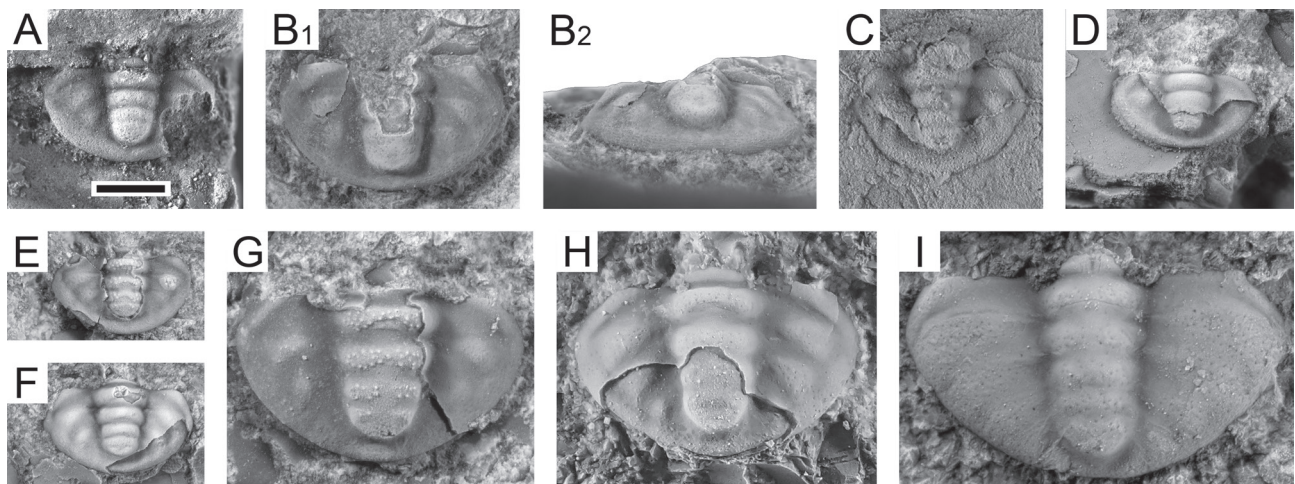


Fig. 9. Pygidia of *Corynexochus spinulosus* Angelin, 1854. All from the lower part of the *Lejopyge laevigata* Zone. **A:** NRM Ar1949. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Grönwall (1902, pl. 4, fig. 4). **B1–B2:** SGU 6384, in dorsal and posterior views. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Westergård (1948, pl. 3, fig. 9). **C,** SGU 6384. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Westergård (1948, pl. 3, fig. 10). **D–H:** all from the Exporrecta Conglomerate Bed at As Hoved. PMU 39718a/2, PMU 39718b/3, PMU 39720a/2, PMU 39718a/1, PMU 39718a/1. **I** paralectotype pygidium of *Corynexochus bornholmiensis* Grönwall, 1902, from Øleå, Bornholm, Denmark. *P. punctuosus* Zone? For comparison. NRM Ar33738. It was previously figured by Grönwall (1902, pl. 4, fig. 2) and by Weidner & Nielsen (2014, fig. 45O). Scale bar in A is 1 mm (for all).

into clearly defined pleural ribs, and here the border and bounding furrow are well developed. The test is punctate, whereas exfoliated parts show a coarse granulation (Fig. 9E, G, H), as in the cranidia.

Remarks. The identification of the pygidium of *C. spinulosus* has long been uncertain. The pygidium originally attributed to this species by Angelin (1854) has marginal spines, hence the name '*spinulosus*', but it does not belong to this species (Grönwall 1902; Westergård 1948). According to Westergård (1948), the assignment of the 1.5 mm long pygidium figured by Grönwall (1902) is probably correct (Fig. 9A; Ap-

pendix 2). He thus accepted ontogenetic variability in the development of the border and border furrow, whereas Whittington (2009, fig. 1:7–8) regarded Grönwall's small specimen as unassignable even to genus. Westergård further noted that adult pygidia of *C. spinulosus* are characterized by "having the marginal [i.e. border] furrows almost or quite effaced" (Westergård 1948, pl. 3, fig. 9; see also Poulsen 1959, fig. 165:1c), and in this respect were thought to resemble the pygidium of *C. bornholmensis* (Fig. 9B1–B2, G, H versus I). An additional poorly preserved pygidium was figured by Buchholz (1997, pl. 20, fig. 6) without measurement or comments.

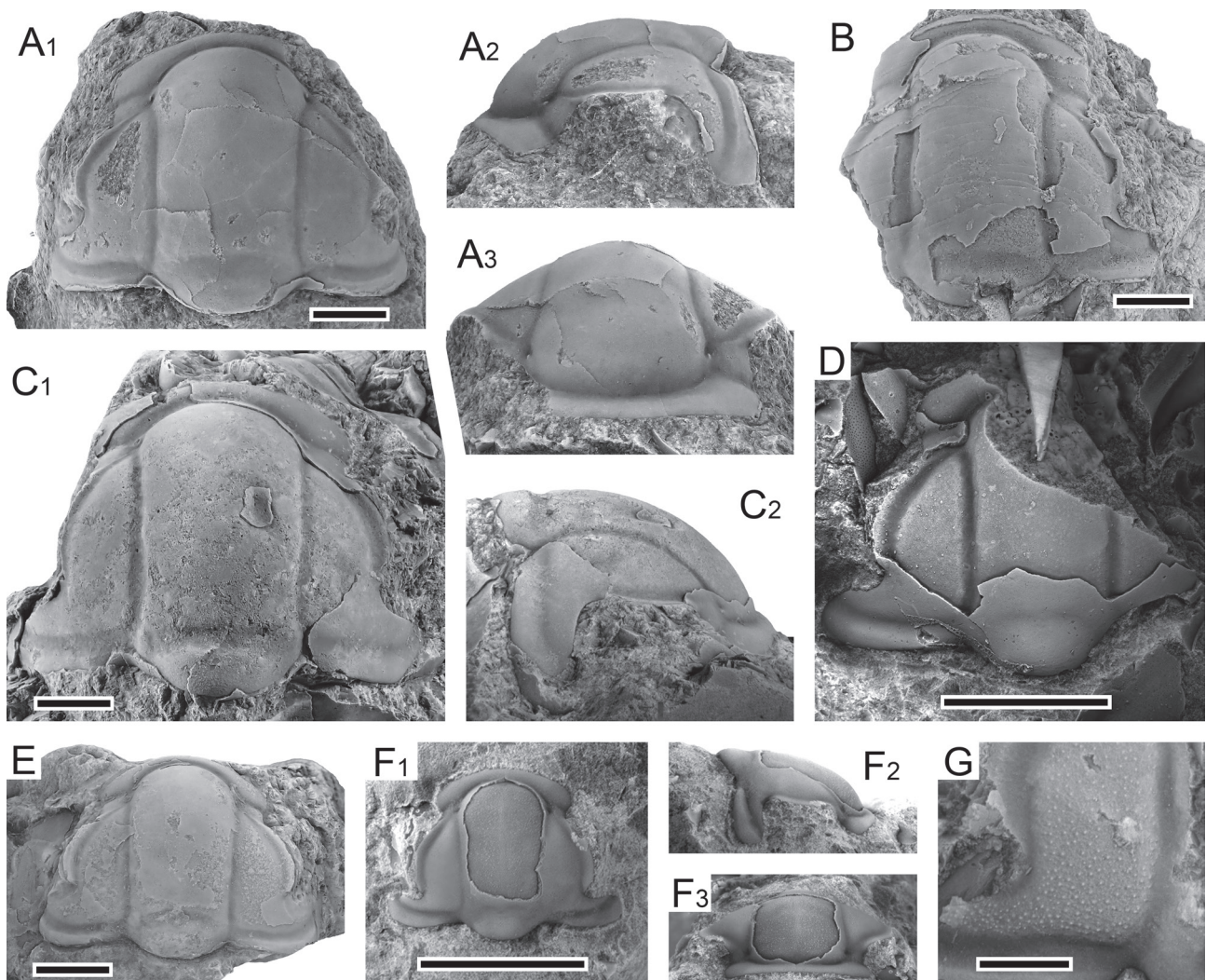


Fig. 10. Cranidia of *Dolichometopus svecicus* Angelin, 1854. All from the lower part of the *Lejopyge laevigata* Zone. **A1–A3:** lectotype, NRM Ar1958b, in dorsal, lateral and anterior views. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Angelin (1854, pl. 37, figs 9, 9b–c) and refigured by Westergård (1948, pl. 3, fig. 14). **B:** PMU 39729. From the Exporrecta Conglomerate Bed at Hjälmåsäter, Kinnekulle. **C1–C2:** PMU 39727, in dorsal and lateral views. From the Exporrecta Conglomerate Bed at Råbäck, Kinnekulle. **D:** PMU 39711c. From the Andrarum Limestone Bed at As Hoved. **E:** NRM Ar1958c. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Westergård (1948, pl. 3, fig. 13). **F1–F3:** PMU 39711b, in dorsal, lateral and anterior views. From the Andrarum Limestone Bed at As Hoved. **G:** PMU 39714, close up view of the left cheek to show granulation on surface. From the Exporrecta Conglomerate Bed at As Hoved. Scale bars in A–F are 5 mm; in G it is 1 mm.

Grönwall's small pygidium, reillustrated in Fig. 9A, and the slightly larger pygidium from the upper part of the *L. laevigata* Zone figured by Westergård (1948, pl. 3, fig. 10) as *Corynexochus* sp. (here shown in Fig. 9C), correspond closely to the three smaller new specimens examined in this study (Fig. 9D–F); sizes are provided in Appendix 2. The original illustration of Westergård's larger pygidium (1948, pl. 3, fig. 9) indeed resembles the pygidia of *C. bornholmiensis* (cf. Weidner & Nielsen 2014, fig. 45O–R) in showing poorly defined pleural ribs and furrows, and lacking a border and border furrow. However, the depiction is misleading. The new images of the specimen reveal that the pleural ribs are, in fact, developed as humps between a wide axial furrow and a broad, indistinct border, separated by a shallow

border furrow (Fig. 9B₁–B₂) — a morphology matching that of the two larger new pygidia (Fig. 9G–H). Thus, there is no close resemblance between the pygidia of *C. spinulosus* and *C. bornholmiensis*, as stated by Westergård (1948).

Family Dolichometopidae Walcott, 1916

Genus *Dolichometopus* Angelin, 1854

Type species. By monotypy, *Dolichometopus svecicus* Angelin, 1854, from the Andrarum Limestone, Andrarum, Skåne, Sweden.

Diagnosis. See Poulsen (1959).

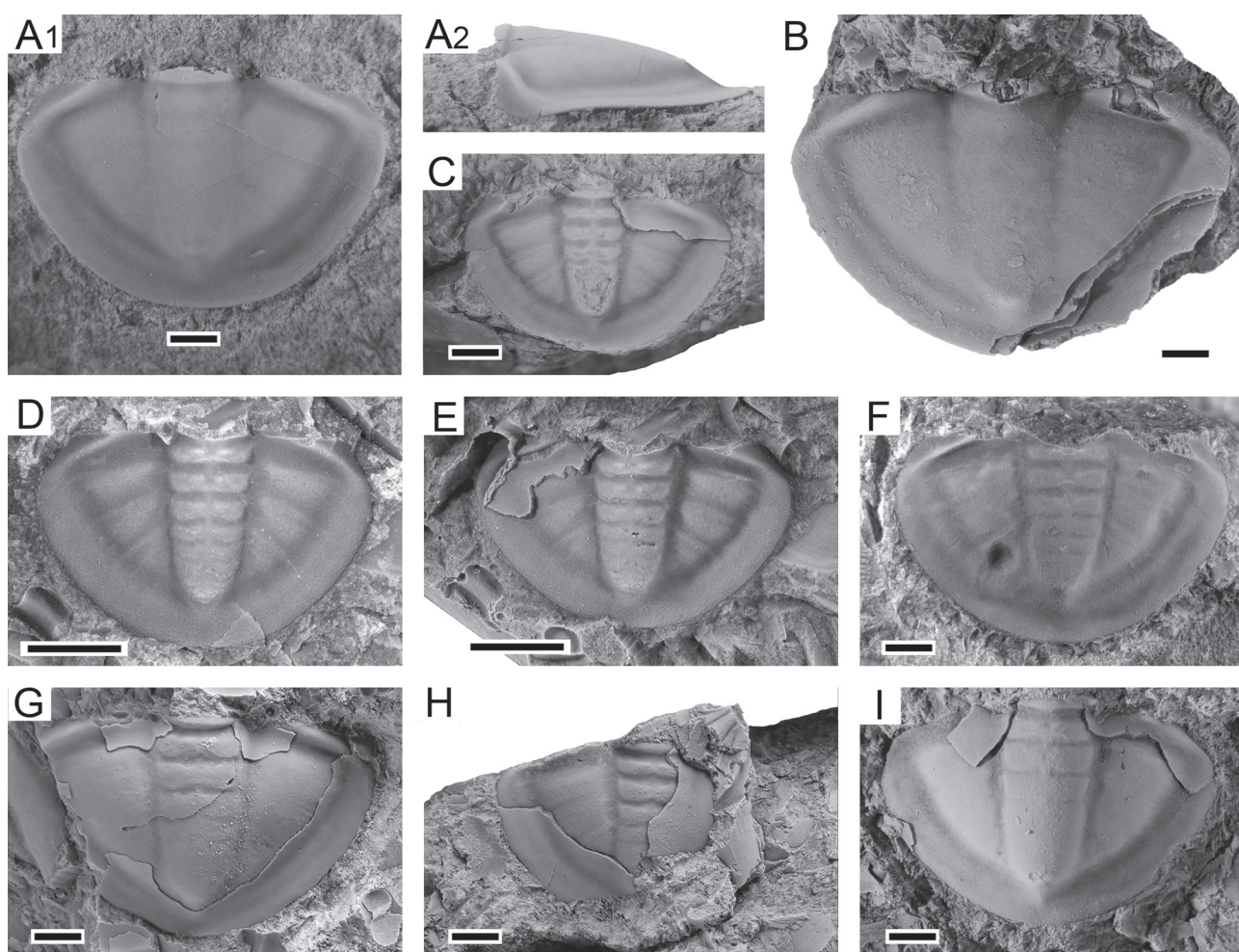


Fig. 11. Pygidia of *Dolichometopus svecicus* Angelin, 1854. All from the lower part of the *Lejopyge laevigata* Zone. **A1–A2:** NRM Ar11455b, in dorsal and lateral views. From the Andrarum Limestone Bed at Andrarum. It was originally figured by Westergård (1948, pl. 3, fig. 16). **B:** PMU 39720b, from the Exporrecta Conglomerate Bed at As Hoved. **C:** NRM Ar11455a, from the Andrarum Limestone Bed at Andrarum. It was originally figured by Westergård (1948, pl. 3, fig. 15). **D:** PMU 39716, from the Andrarum Limestone Bed at As Hoved. **E:** PMU 39718b, from the Exporrecta Conglomerate Bed at As Hoved. **F:** PMU 39710, from the Andrarum Limestone Bed at As Hoved. **G:** PMU 39711a, from the Andrarum Limestone Bed at As Hoved. **H:** PMU 39711a, from the Andrarum Limestone Bed at As Hoved. **I:** PMU 39720a, from the Exporrecta Conglomerate Bed at As Hoved. Scale bars are 2 mm.

Remarks. Only the type species is known from the Miaolingian of Scandinavia. Most records are from the lower part of the *L. laevigata* Zone, but it also occurs, albeit less commonly, in the upper part of the zone (see references below). Note the correct original spelling of the species name.

***Dolichometopus svecicus* Angelin, 1854**

Figs 10, 11

1854 *Dolichometopus svecicus* n. sp. – Angelin, p. 73, pl. 37, figs 9, 9b–c.

1878 *Dolichometopus suecicus* Angelin [sic] – Brøgger, p. 46, pl. 3, figs 12, 12a.

1897 *Dolichometopus suecicus* Angelin [sic] – Matthew, pp. 184–185, pl. 3, fig. 7a–b.

1916 *Dolichometopus suecicus* Angelin [sic] – Walcott, pp. 372–373, pl. 50, figs 3–4.

1948 *Dolichometopus suecicus* Angelin [sic] – Westergård, pp. 11–12, pl. 3, figs 12–16.

1959 *Dolichometopus svecicus* Angelin – Poulsen, pp. O221–O222, fig. 163: 1a–b.

1994 *Dolichometopus suecicus* Angelin [sic] – Rudolph, pp. 162–163, pl. 13, figs 7–10.

2002 *Dolichometopus svecicus* Angelin – Rushton & Weidner, pp. 103–106, fig. 1A–J.

2010 *Dolichometopus suecicus* Angelin [sic] – Buchholz, pl. 4, fig. 2.

Lectotype (designated by Westergård 1948). Cranidium, NRM Ar1958b, from the Andrarum Limestone, Andrarum, Skåne. Originally figured by Angelin (1854, pl. 37, figs 9, 9b–c) and refigured by Westergård (1948, pl. 3, fig. 14). It is reillustrated here in Fig. 10A1–A3.

Occurrence. *Dolichometopus svecicus* is reported from the Andrarum Limestone of Skåne (localities include Andrarum, Gislövshammar, and Kiviks-Esperöd), the bituminous ‘Andrarum Limestone’ at Byklev and Munkesten on Hunneberg, Västergötland, and the Exporrecta Conglomerate at various localities on Öland, in Västergötland and Jämtland (Westergård 1948). It is also described from the *P. forchhammeri* Superzone at Krekling in Norway (Brøgger 1878). Rudolph (1994) and Buchholz (2010) reported the species from ice-rafted boulders of the Exporrecta Conglomerate found in northern Germany, and Rudolph (1994) also described it from limestone nodules deriving from the upper part of the *L. laevigata* Zone. Rushton & Weidner (2002) described a compacted cranidium from an ice-rafted block of Exporrecta Conglomerate found at Hvalpsund, Denmark. Our new material derives from erratics of the Andrarum Limestone and Exporrecta Conglomerate collected at As Hoved, and from the Exporrecta Conglomerate at several localities in Västergötland (Fig. 3).

Material. Nine cranidia, measuring 11.8–21.9 mm in length, and nine pygidia, 4.2–12.0 mm long, are at hand (Appendix 2). The largest cranidium recorded in the literature measures 31 mm, and the largest pygidium 20 mm (Westergård 1948).

Description. Compared with the relatively large lectotype cranidium (19.2 mm long; Fig. 10A1–A3), our smallest well-preserved cranidium (11.8 mm long; Fig. 10F1–F3) has proportionally longer palpebral lobes (see also Rushton & Weidner 2002). It is the first illustrated cranidium of this species to show a well-developed pair of fossulae. In testaceous specimens

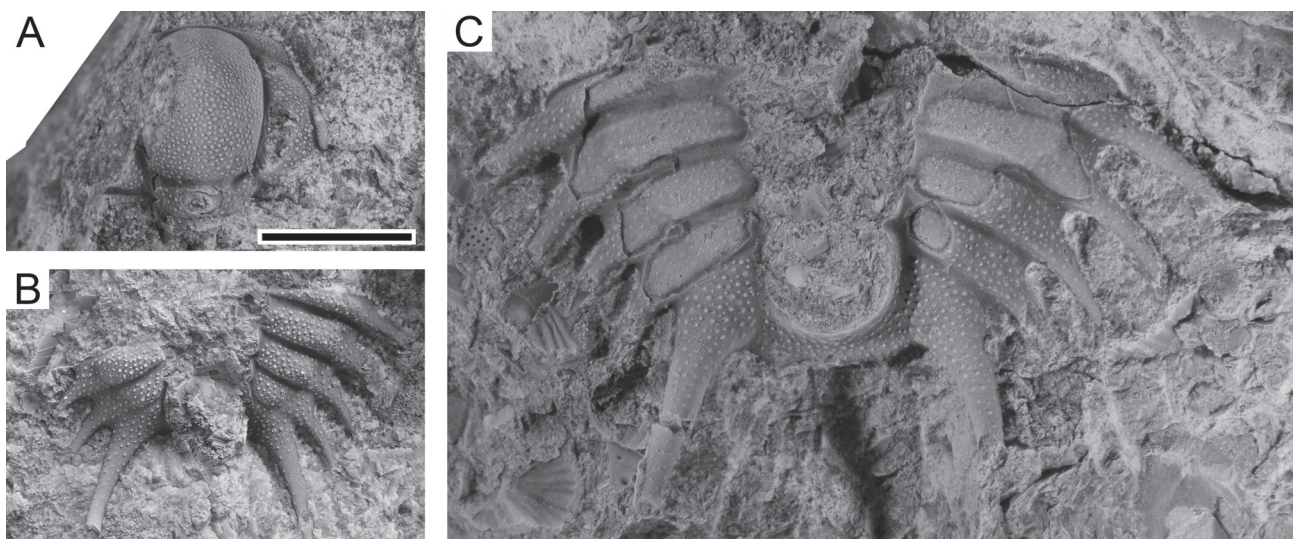


Fig. 12. *Dorypyge aenigma* (Linnarsson, 1869), from the lower part of the *Lejopyge laevigata* Zone. **A:** cranidium, PMU 39721a/8, from glauconitic limestone at Hällekis. **B:** pygidium, PMU 39703/1, from glauconitic limestone at Hällekis. **C:** pygidium, PMU 39725a/1, from the Exporrecta Conglomerate Bed at Råbäck. Scale bar in A is 5 mm (for all).

the surface is smooth, whereas exfoliated specimens are covered by fine granules (Fig. 10D, F1–F3, G).

Seven of our nine pygidia are exfoliated or nearly so, revealing details of the axis. It consists of six rings – not five, as stated by Westergård (1948) – and a terminal piece in addition to the articulating half-ring. The ring furrows become progressively shallower rearwards, and the furrow separating the sixth ring from the terminal piece is almost indiscernible (Fig. 11D–F). In some specimens (Fig. 11C–F, I), an indistinct axial keel is visible, and the terminal piece is extended into a broad postaxial ridge that crosses the border furrow (Fig. 10B–E, G–I). Each axial ring carries a pair of knobs adjacent to the axial keel, which become less distinct rearwards (see enlarged images in Fig. 11C–F); these swellings likely represent muscle insertion sites. The test is smooth. Exfoliated parts show, under strong magnification, punctae, granules, or both (see captions). These subtle features are difficult to capture in published photographs, but see Fig. 11D–F, H.

Remarks. The species name has been subject to inconsistent spelling in the literature; the original spelling of Angelin (1854) is followed here.

Family Dorypygidae Kobayashi, 1935

Genus *Dorypyge* Dames, 1883

Type species. By original designation, *Dorypyge richthofeni* Dames, 1883, from the middle Cambrian Zhangxia Fm, Liaoning, China.

Diagnosis. See Grönwall (1902) and Poulsen (1959).

Remarks. Three species of *Dorypyge* are reported from the Miaolingian of Scandinavia, viz. *D. oriens* (Grönwall, 1902) from the *T. gibbus* Zone, *D. danica* (Grönwall, 1902) from the *P. punctuosus* Zone, and *D. aenigma* (Linnarsson, 1869) from the lower part of the *L. laevigata* Zone.

Dorypyge aenigma (Linnarsson, 1869)

Fig. 12

1869 *Trilobites aenigma* n. sp. – Linnarsson, pp. 83–84, pl. 2, figs 63–64.

1931 *Dorypyge aenigma* (Linnarsson) – Westergård, p. 44.

1948 *Dorypyge aenigma* (Linnarsson) – Westergård, pp. 7–9, pl. 2, figs 1–8.

1959 *Dorypyge aenigma* (Linnarsson) – Poulsen, p. O217, fig. 159: 1a–1e, 2.

1994 *Dorypyge aenigma* (Linnarsson) – Rudolph, pp. 163–164, pl. 13, figs 5–6.

Lectotype (designated by Westergård 1948). A fragmentary pygidium, SGU 5320a–b, from the Exporrecta Conglomerate at Hällekis, Kinnekulle, Västergötland, illustrated by Linnarsson (1869, pl. 2, fig. 63).

Occurrence & material. *Dorypyge aenigma* occurs in the lower part of the *L. laevigata* Zone and has been reported from the Andrarum Limestone at Andrarum and Kiviks-Esperöd in Skåne, as well as from the Exporrecta Conglomerate and the coeval glauconitic limestone at several localities in Västergötland (Westergård 1948). However, judging from the illustrated specimens, Westergård (1948, pl. 2, figs 1–8) apparently had only rather fragmentary material at his disposal. Rudolph (1994) illustrated two pygidia from ice-rafted boulders of Andrarum Limestone and the Exporrecta Conglomerate found in northern Germany, one of which is almost complete. Our new material, collected from the Exporrecta Conglomerate at Råbäck and the glauconitic limestone at Hällekis, comprises one cranidium and two pygidia, all fragmentary. No new morphological features have been recognised, apart from the preservation of coarse granules on the pygidial surface, similar to those seen on the cranidium (Fig. 12C).

Conclusions

Newly collected erratic boulders from As Hoved, Denmark, with provenance from Västergötland, Sweden, represent true Andrarum Limestone that is lithologically indistinguishable from the equivalent bed in Skåne–Bornholm. This suggests that the same facies also occurs in Västergötland, although it has never been found *in situ*. These boulders have yielded 16 trilobite and agnostoid taxa, known also from the Andrarum Limestone in Skåne. Other material from both Danish erratics and localities in Västergötland clarifies the identity of the pygidium of *Corynexochus spinulosus*, and provides new information on previously poorly known pygidial characters in *Acontheus acutangulus* and *Dolichometopus sveccicus*.

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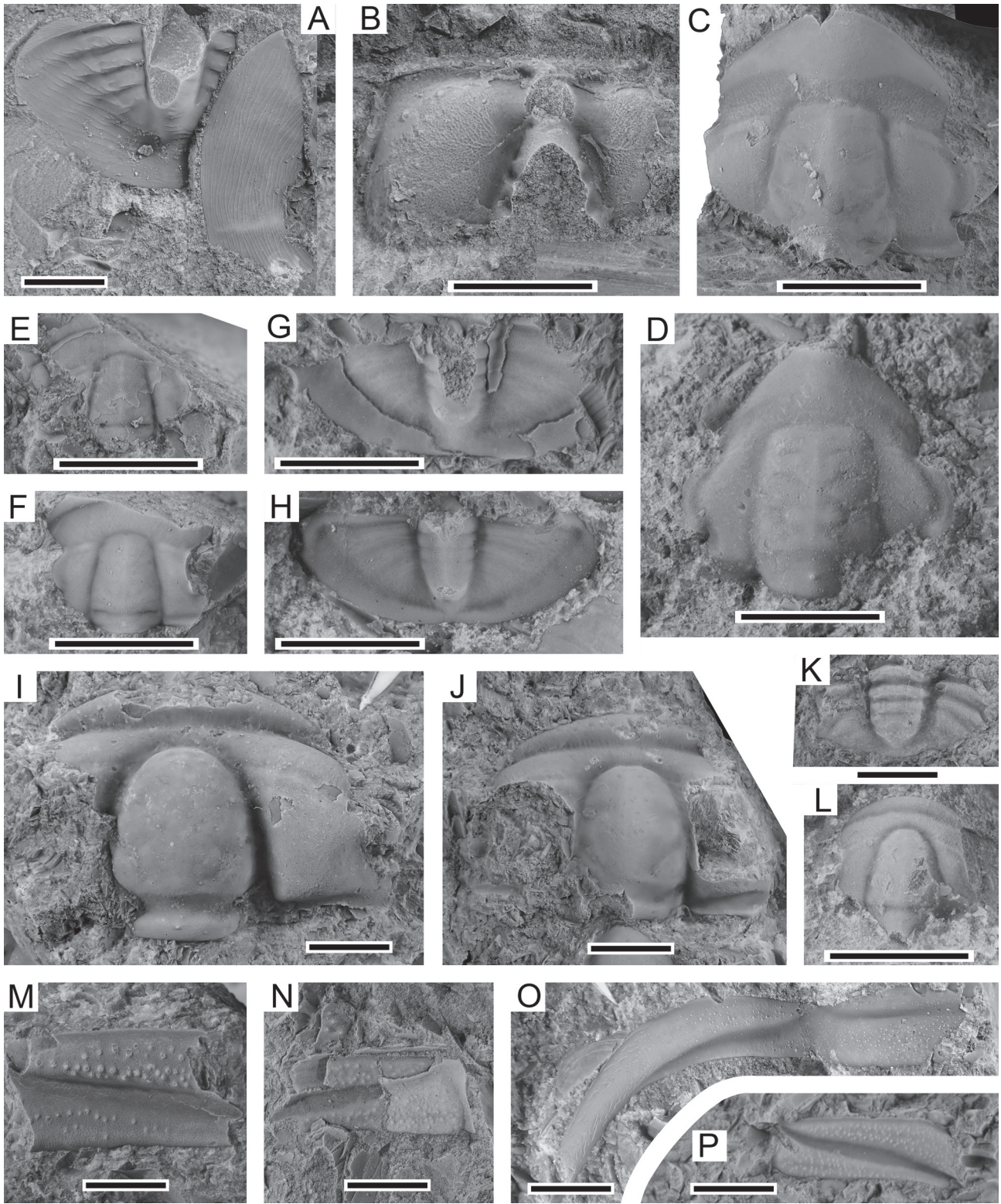


Fig. 13. Additional trilobites from the Andrarum Limestone (A.L.) and Exporrecta Conglomerate (E.C.), collected from ice-rafted boulders at As Hoved, unless otherwise stated. **A:** *Anomocarina excavata* (Angelin, 1851), pygidium, PMU 39706/1 (from the A.L.). **B:** *Elyx laticeps* (Angelin, 1851), cranidium, PMU 39706/2 (from the A.L.). **C, D:** *Proampyx difformis* (Angelin, 1851), cranidia, PMU 39707a/2 (from the A.L.) and PMU 39721b (from the E.C.). **E–H:** *Groenwallia microphthalma* (Angelin, 1851), **E, F**, cranidia, PMU 39723/2, PMU 39730; **G, H**, pygidia, PMU 39714/1, PMU 39723/1 (all from the E.C.). **I–K:** *Erratojincella brachymetopa* (Angelin, 1851), **I, J**, cranidia, PMU 39713b/1, PMU 39713b/2; **K**, pygidium, PMU 39713a (all from the A.L.). **L:** *Balticoglaucus spinigerus* Westergård, 1953), cranidium, PMU 39724b (from the E.C. at Råbäck). **M–P:** *Paradoxides forchhammeri* Angelin, 1851, **M**, fragment of pleura, PMU 39739 (from the E.C. at Vilske); **N**, fragment of thoracic pleura, PMU 39733 (from the E.C. at Gudhem); **O**, partial thoracic segment, PMU 39712/1 (from the A.L.); fragment of thoracic pleura, PMU 39718a/4 (from the E.C.). Scale bars are 5 mm.

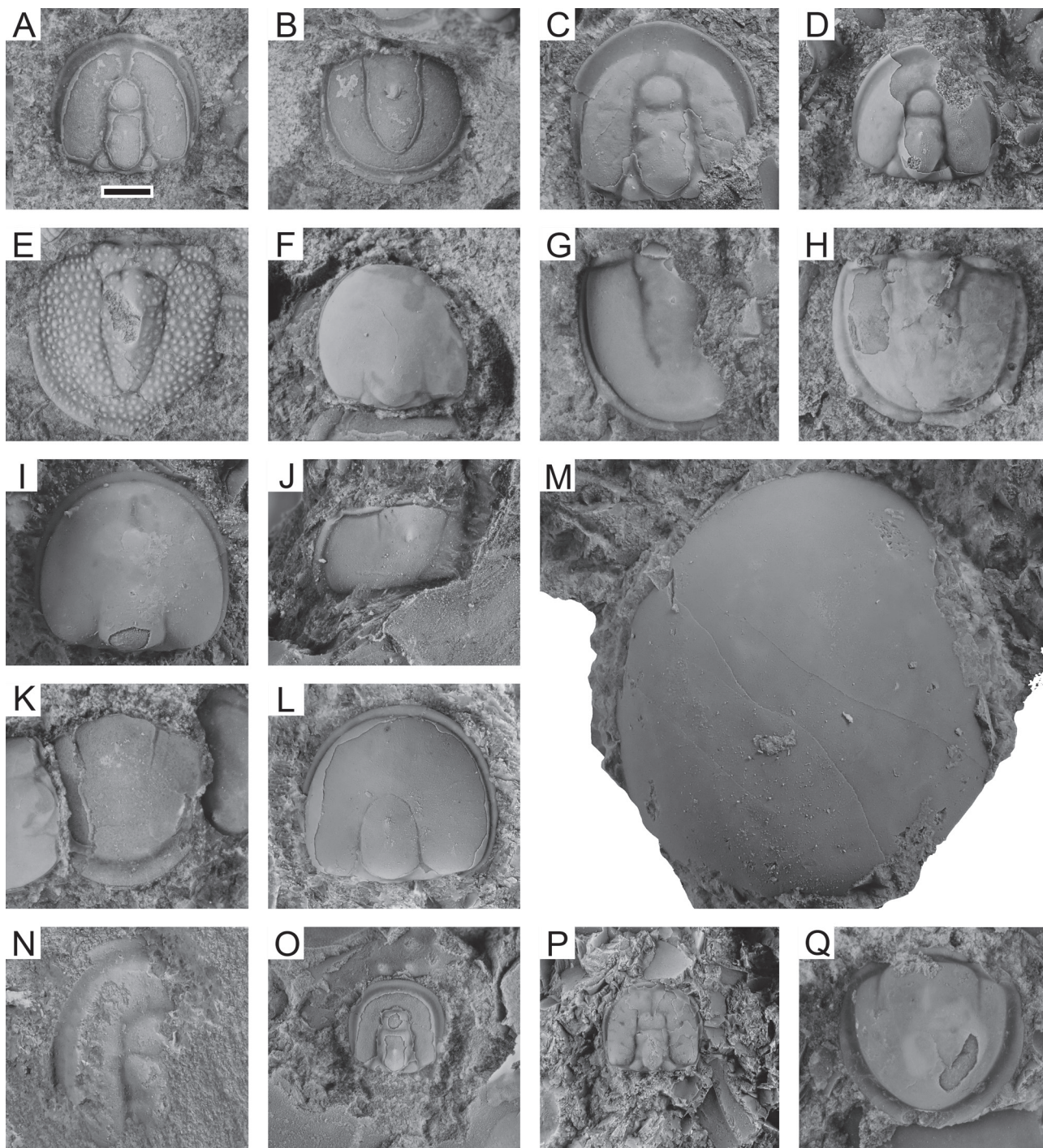


Fig. 14. Additional agnostoids collected from ice-rafted boulders of the Andrarum Limestone (A.L.) and Exporrecta Conglomerate (E.C.) at As Hoved. **A–B:** cephalon, PMU 39742/1, and pygidium, PMU 39742/2, of *Agnostus pisiformis* (Wahlenberg, 1818) (from the E.C.). **C–D:** cephalon, PMU 39711b/3 and PMU 39711e, of *Homagnostus pater* (Westergård, 1930) (from the A.L.). **E,** pygidium, PMU 39719/1, of *Ptychagnostus aculeatus* (Angelin, 1851) (from the E.C.). **F–H:** cephalon (PMU 39721a/5) and two pygidia (PMU 39731/1, PMU 39731/2) of *Lejopyge armata* (Linnarsson, 1869) (from the E.C.). **I–K:** *Cotalagnostus confusus* (Westergård, 1930). Cephalon (PMU 39711c/2) (from the A.L.), and two pygidia, PMU 39705/1 (from glauconitic limestone, Hälleklis) and PMU 39721a/6 (from the E.C.). **L:** cephalon, PMU 39711d, of *Hypagnostus brevifrons* (Angelin, 1851) (from the A.L.). **M:** cephalon, PMU 39707b/2, of *Megagnostus glandiformis* (Angelin, 1851) (from the A.L.). **N:** cephalon, PMU 39707a/1, of *Diplorrhina quadrata* (Tullberg, 1880) (from the A.L.). **O:** cephalon, PMU 39718b/4, of *Acadagnostus ferox* (Tullberg, 1880) (from the E.C.). **P:** cephalon, PMU 39708c, *Diplagnostus planicauda vestgothicus* (Wallerius, 1895) (from the E.C.). **Q:** pygidium, PMU 39715/1, of *Glaberagnostus? cicer* (Tullberg, 1880) (from the A.L.). Scale bar in A is 1 mm (for all).

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Appendix 1. List of trilobites and agnostoids described from the Andrarum Limestone Bed of Skåne (Westergård 1948, 1950, 1953, 1946) and ice rafted boulders at As Hoved (collected by Weidner), and from the Exporrecta Conglomerate Bed of central Västergötland (Linnarsson 1873; Westergård 1948, 1950, 1953, 1946) and As Hoved (collected by Weidner). Trilobites marked by an * are only known from Skåne

Trilobites and agnostoids	Skåne	As Hoved	central Västergötland	As Hoved
Trilobites	Andrarum Lst.	Andrarum Lst.	Expo . Congl.	Expo . Congl.
<i>Acontheus acutangulus</i> Angelin, 1851*	x	x	-	-
<i>Anomocare laeve</i> (Angelin, 1851)	x	-	-	-
<i>Anomocare longifrons</i> Westergård, 1950	x	-	-	-
<i>Anomocarina excavata</i> (Angelin, 1851)*	x	x	-	-
<i>Anomocarina extornata</i> (Westergård, 1930)	x	-	-	-
<i>Anomocarioides limbatus</i> (Angelin, 1851)	x	-	-	-
<i>Bailliaspis glabrata</i> (Angelin, 1854)	x	-	-	-
<i>Centropleura angelini</i> Westergård, 1950	x	-	-	-
<i>Centropleura lovéni</i> (Angelin, 1851)	x	-	-	-
<i>Corynexochus spinulosus</i> Angelin, 1854	x	x	x	x
<i>Dasometopus breviceps</i> (Angelin, 1854)	x	-	-	-
<i>Dolichometopus svecicus</i> Angelin, 1854	x	x	x	x
<i>Dorypyge aenigma</i> (Linnarsson, 1869)	x	-	x	-
<i>Elyx laticeps</i> (Angelin, 1851)*	x	x	-	-
<i>Erratojincella brachymetopa</i> (Angelin, 1851)	x	x	x	x
<i>Foveatella bucculenta</i> (Grönwall, 1902)	x	-	-	-
<i>Gonzaloia canaliculata</i> (Angelin, 1851)	x	-	-	-
<i>Groenwallia platyrrhina</i> (Grönwall, 1902)	x	-	-	-
<i>Groenwallia microphthalma</i> (Angelin, 1851)	x	x	x	x
<i>Paradoxides forchhammeri</i> Angelin	x	x	x	x
<i>Proampyx difformis</i> (Angelin, 1851)	x	x	x	x
<i>Proampyx aculeatus</i> (Angelin, 1851)	x	-	x	-
<i>Proampyx acuminatus</i> (Angelin, 1851)	x	-	x	-
<i>Proampyx anceps</i> Westergård, 1953	x	-	-	-
<i>Solenopleura holometopa</i> (Angelin, 1851)	x	-	-	-
<i>Solenopleura conifrons</i> Westergård, 1953	x	-	-	-
No. of trilobite taxa found	26	9	9	6
Agnostoids	Andrarum Lst.	Andrarum Lst.	Expo . Congl.	Expo . Congl.
<i>Acadagnostus ferox</i> (Tullberg, 1880)	-	-	-	x
<i>Agnostus pisiformis</i> (Wahlenberg, 1818)	-	-	-	x
<i>Clavagnostus repandus</i> (Westergård, 1930)	x	-	-	-
<i>Cotalagnostus confusus</i> (Westergård, 1930)	x	x	x	x
<i>Diplagnostus planicauda</i> (Angelin, 1851)	x	-	-	-
<i>Diplagnostus planicauda bilobatus</i> Kobayashi, 1939	x	-	-	-
<i>Diplagnostus planicauda vestgothicus</i> (Wallerius, 1895)	x	x	-	-
<i>Diplorrhina quadrata</i> (Tullberg, 1880)	x	x	x	-
<i>Glaberagnostus bituberculatus</i> (Angelin, 1851)	x	-	-	-
? <i>Glaberagnostus? cicer</i> (Tullbeg, 1880)	x	x	-	-
<i>Goniagnostus nathorsti</i> (Brøgger, 1878)	x	-	-	x
<i>Homagnostus pater</i> (Westergård, 1930)	x	x	x	x
<i>Hypagnostus brevifrons</i> (Angelin, 1851)	x	x	x	-
<i>Innitagnostus neglectus</i> (Westergård, 1946)	x	-	-	x
<i>Lejopyge armata</i> (Linnarsson, 1869)	-	-	-	x
<i>Lejopyge laevigata</i> (Dalman, 1828)	x	-	x	-
<i>Linguagnostus kjerulfi</i> (Brøgger, 1878)	x	-	-	-
<i>Lisogoragnostus confluentus</i> (Rudolph, 1994)	x	-	-	-
<i>Megagnostus glandiformis</i> (Angelin, 1851)	x	x	-	-
<i>Ptychagnostus aculeatus</i> (Angelin, 1851)	x	-	x	x
<i>Tomagnostella exsculpta</i> (Angelin, 1851)	x	-	-	-
<i>Valenagnostus marginatus</i> (Brøgger, 1878)	x	-	-	-
No. of agnostoid taxa found	19	7	6	8

Appendix 2. Measurements of specimens studied herein

Acontheus acutangulus Angelin, 1851. An asterisk marks the holotype.

Catalogue no.	Fig. this paper	Part	Length mm	1st illustration	Original assignment
NRM Ar1930c*	7A ₁ –A ₄	Cranidium	4.3	Angelin (1851), pl. 5 fig. 4, 5	<i>Acontheus acutangulus</i>
NRM Ar1930d	7B ₁ –B ₄	Pygidium	2.8	Angelin (1854), pl. 33, fig. 19	<i>Aneucanthus acutangulus</i>
NRM Ar1930c	7C	Pygidium	3.9	Westergård (1950), pl. 8, fig. 5	<i>Acontheus acutangulus</i>
SMF 107667	7D ₁ , D ₂	Pygidium	1.9	Schöning (2022), pl. 6, fig 96	<i>Acontheus acutangulus</i>
PMU 35689/2	7E	Pygidium	1.2	This paper	<i>Acontheus acutangulus</i>
PMU 39707c	7F	Pygidium	2.5	This paper	<i>Acontheus acutangulus</i>

Corynexochus spinulosus Angelin, 1854. An asterisk marks the holotype.

Catalogue no.	Fig. this paper	Part	Length mm	1st illustration	Original assignment
NRM Ar1951a*	8A ₁ –A ₃	Cranidium	5.4	Angelin (1854), pl. 33, figs 9–9a)	<i>Corynexochus spinulosus</i>
SGU 6383	8B ₁ –B ₃	Cranidium	3.6	Westergård (1946), pl. 3, fig. 8	<i>Corynexochus spinulosus</i>
PMU 39718b/1	8D	Cranidium	3.7	This paper	<i>Corynexochus spinulosus</i>
PMU 39726	8E ₁ –E ₃	Cranidium	2.2	This paper	<i>Corynexochus spinulosus</i>
NRM Ar1949	9A	Pygidium	1.5	Grönwall (1902), pl. 4, fig. 4	<i>Corynexochus spinulosus</i>
SGU 6384	9B ₁ , B ₂	Pygidium	2.1	Westergård (1948), pl. 3, fig. 9	<i>Corynexochus spinulosus</i>
SGU 6385	9C	Pygidium	1.6	Westergård (1948), pl. 3, fig. 10	<i>Corynexochus</i> sp.
PMU 39718a/2	9D	Pygidium	1.2	This paper	<i>Corynexochus spinulosus</i>
PMU 39718b/3	9E	Pygidium	1.3	This paper	<i>Corynexochus spinulosus</i>
PMU 39720a/2	9F	Pygidium	1.4	This paper	<i>Corynexochus spinulosus</i>
PMU 39720a/2	9G	Pygidium	2.6	This paper	<i>Corynexochus spinulosus</i>
PMU 39708a	9H	Pygidium	2.8	This paper	<i>Corynexochus spinulosus</i>

Dolichometopus svecicus Angelin, 1854. An asterisk marks the holotype.

Catalogue no.	Fig. this paper	Part	Length mm	1st illustration	Original assignment
NRM Ar1958b*	10A ₁ –A ₃	Cranidium	19.2	Angelin (1854), pl. 37, figs 9, 9b–c	<i>Dolichometopus svecicus</i>
PMU 39729	10B	Cranidium	20.0	This paper	<i>Dolichometopus svecicus</i>
PMU 39727	10C ₁ –C ₂	Cranidium	21.9	This paper	<i>Dolichometopus svecicus</i>
PMU 39711c/1	10D	Cranidium	–	This paper	<i>Dolichometopus svecicus</i>
NRM Ar1958c	10E	Cranidium	13.9	Westergård (1948), pl. 3, fig. 13	<i>Dolichometopus svecicus</i>
PMU 39711b/1	10F ₁ –F ₃	Cranidium	5.6	This paper	<i>Dolichometopus svecicus</i>
PMU 39714/4	10G	Cranidium	–	This paper	<i>Dolichometopus svecicus</i>
NRM Ar11455b	11A ₁ , A ₂	Pygidium	10.4	Westergård (1948), pl. 3, fig. 16	<i>Dolichometopus svecicus</i>
PMU 39720b	11B	Pygidium	12.0	This paper	<i>Dolichometopus svecicus</i>
NRM Ar11455a	11C	Pygidium	7.1	Westergård (1948), pl. 3, fig. 15	<i>Dolichometopus svecicus</i>
PMU 39716	11D	Pygidium	4.7	This paper	<i>Dolichometopus svecicus</i>
PMU 39718b/2	11E	Pygidium	4.2	This paper	<i>Dolichometopus svecicus</i>
PMU 39710	11F	Pygidium	9.2	This paper	<i>Dolichometopus svecicus</i>
PMU 39711b/2	11G	Pygidium	9.6	This paper	<i>Dolichometopus svecicus</i>
PMU 39711a/1	11H	Pygidium	–	This paper	<i>Dolichometopus svecicus</i>
PMU 39720a/1	11I	Pygidium	9.8	This paper	<i>Dolichometopus svecicus</i>

Dorypyge aenigma (Linnarsson, 1869).

Catalogue no.	Fig. this paper	Part	Length mm	1st illustration	Original assignment
PMU 39721a/8	12A	Cranidium	6.7	This paper	<i>Dorypyge aenigma</i>
PMU 39703/1	12B	Pygidium	~5.7	This paper	<i>Dorypyge aenigma</i>
PMU 39725a/1	12C	Pygidium	~10.7	This paper	<i>Dorypyge aenigma</i>