

SVERIGES GEOLOGISKA UNDERSÖKNING

SER. C.

Avhandlingar och uppsatser.

N:o 477.

ÅRSBOK 40 (1946) N:o 1.

AGNOSTIDEA
OF THE MIDDLE CAMBRIAN
OF SWEDEN

BY

A. H. WESTERGÅRD

WITH 16 PLATES.

Pris 5 kronor

STOCKHOLM 1946

KUNGL. BOKTRYCKERIET. P. A. NORSTEDT & SÖNER

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Preface.

The bulk of the material on which this memoir is based belongs to the Geological Survey of Sweden, and the greater part of it has been collected by the writer from all areas of Sweden, except Lapland, in which Middle Cambrian deposits are accessible. Numerous borings carried out by the Geological Survey in later years in order to gain closer information about the alum shales from an economic point of view have added materially to our knowledge also of the Middle Cambrian fauna and stratigraphy, particularly of those areas in which this series does not crop out or where exposures do not exist. Further, the writer has had the advantage of using the collections of the Paleozoological Department of the State Museum of Natural History and the Geological-Mineralogical Institution of the University of Lund. The writer tenders his sincere thanks to the Directors of these museums for their courtesy in placing the collections at his disposal.

The illustrations of the Agnostidea published by Angelin, Linnarsson, Tullberg, and other earlier authors, were reproduced from drawings which were not always as good as might be desired, and an endeavour was therefore made to obtain photographic pictures. The writer tried to identify, as far as possible, the originals used by the authors for re-illustration of lectotypes, and if the syntypes could not be found and appeared to be lost, topotypes were figured. Quite a number of specimens are illustrated of most of the species, this because of the individual variability being fairly great in practically all agnostids that occur in any abundance.

Very little of the foreign scientific literature published during the recent war is as yet available in the Swedish libraries, which may serve as an excuse if some recent works on the Agnostidea are not commented upon in the present memoir.

Geological Survey of Sweden, April 1946.

Stratigraphy of the Middle Cambrian.

The lower boundary of the Middle Cambrian is as a rule strongly pronounced in Scandinavia, faunistically and lithologically, and in the southern and south-western areas the lowest part of the series is lacking. But in the Mjösen district of Central Norway there are found transition beds in which Lower and Middle Cambrian forms are mingled (Kiaer, 1916), and in a boring profile at File Haidar, Northern Gothland, the boundary is lithologically obscure (Thorslund & Westergård, 1938). The upper boundary is not very well defined, the zone of *Lejopyge laevigata* merging into that of *Agnostus pisiformis*. As regards the lithology the two lower stages display a varying development in different areas, whereas the uppermost stage is in all areas made up of black or dark-brown alum shale with lenses and thin layers of stinkstone,¹ sometimes partly or in its entirety replaced by a thin phosphoritic calcareous conglomerate, the Exporrecta conglomerate.

The Middle Cambrian is divided into the following stages and zones.²

¹ Stinkstone is used for the Swedish term "orsten", a fine- or coarse-crystalline, often columnar, rarely dense, dark limestone which, when pulverized, gives off an odour resembling that of petroleum.

² In a recent paper by Kaj Hansen (1945, p. 51) the complete development of the Middle Cambrian of Scandinavia is stated to comprise the following zones:

Zone with <i>Lejopyge laevigata</i>	
» » <i>Paradoxides forchhammeri</i>	} Tessini Zone
» » <i>Paradoxides davidis</i>	
» » <i>Liostracus linnarssoni</i>	
» » <i>Ctenocephalus exsulans</i>	
» » <i>Paradoxides oelandicus</i> .	

As regards the range and geographic distribution of the index fossils used by Hansen the following comments may be made.

The zone of *C. exsulans* forms part of our zone of *Ptychagnostus (Triplagn.) gibbus*. According to the present writer's experience the former species is confined to a thin layer in which it is common in Scania, on Bornholm, and on Öland, but from other Scandinavian areas with the *gibbus* zone accessible only a few fragments are known from one locality in Norrland (Hillsand, Northern Jämtland) and from the Mjösen district in Norway (Strand, 1929). It is not recorded by Brögger (1878) from the Olso district, nor has it been met with in Västergötland, Östergötland, and Närke. Thus *C. exsulans* seems to be absent or rare in most Scandinavian areas and is thus no very expedient index fossil in a stratigraphic scheme applicable to the whole of Scandinavia.

The zone of »*Liostracus*» *linnarssoni* approximately corresponds to the upper part of Zone Br and Zones B 2 and 3. Distinct forms seem to have been identified as »*L.*» *linnarssoni*, however, hence the range of the true *linnarssoni* is so far not ascertained. This and allied forms except »*L.*» *aculeatus* are as a rule infrequent in Sweden.

In parts of the Middle Cambrian of Sweden specimens of *Paradoxides* are rare and the fragments found are usually not identifiable with full certainty as to the species. Accordingly, the present writer has founded the division of the Middle Cambrian chiefly on the agnostids, which are beyond

- C. *Paradoxides forchhammeri* stage
3. Zone of *Lejopyge laevigata*
 2. Zone of *Solenopleura brachymetopa* (Andrarum limestone and, in the quarries at Andrarum, the immediately underlying layers, i. e. a 0.3 m thick shale bed and a discontinuous thin bed of stinkstone, the so-called *Hyalithes* limestone).
 1. Zone of *Ptychagnostus* (*Triplagn.*) *lundgreni* and *Goniagnostus nathorsti*.
- B. *Paradoxides paradoxissimus* stage
4. Zone of *Ptychagnostus* (*Ptychagn.*) *punctuosus*
 3. » » *Hypagnostus parvifrons*
 2. » » *Tomagnostus fissus* and *Ptychagnostus* (*Ptychagn.*) *atavus*
 1. » » *Ptychagnostus* (*Triplagn.*) *gibbus* (inclusive of the limestone layer with *Ctenocephalus exsulans*).
- A. *Paradoxides oelandicus* stage
2. Zone of *Paradoxides pinus*
 1. » » *Paradoxides insularis*.

It may be observed that the zones are less sharply delimited in the Middle than in the Upper Cambrian, the leading fossils having a less restricted range in the former than in the latter series.

The above classification is the same as suggested by the present writer in 1936 for Stage A and in 1942 and 1944 a for Stages B and C. The only amendment made is that two index fossils are given for Zone C 1 — as is the case also in Zone B 2 — the reason being that in some areas or localities one of the species predominates and the other is rare or even absent, and in other areas conditions are reversed. As regards the frequency of the index fossils of Zone C 1, the following facts may be adduced.

At Andrarum, where this zone was made accessible by excavations and proved to be thicker than at other localities in South-Eastern Scania, *Ptychagnostus* (*Triplagn.*) *lundgreni* and *Goniagnostus nathorsti* occur associated, the former being somewhat more common than the latter, and have, broadly speaking, the same range. The former appears sparsely already in the uppermost part of Zone B 4 and ranges into the lower part of Zone C 2, but has not been found in the Andrarum limestone proper. The latter has not been observed below the base of Zone C 1 and ranges into the Andrarum limestone, where it is very

comparison much more common than other trilobites and as a rule occur in a state of preservation that allows of a safe identification.

According to Hansen (p. 53) the zone of *Par. davidis* is faintly developed on Öland. »Only very few of its fossils are known, some from the upper part of the Tessini sandstone and others from the Exporrecta Conglomerate.« As far as the present writer is aware no species confined to that zone is so far known from Öland (Westergård, 1944 b).

The Middle Cambrian under Gothland, which is known from two borings, is stated by Hansen to belong to the Oelandicus and parts of the Paradoxissimus beds. However, the cores have not yielded a single species distinctive of either the upper part of the former or any part of the latter beds, and in the Visby core, but 21 mm in diameter, *Ellipsocephalus polytomus*, one of the leading fossils of the Oelandicus beds, occurs 0.3 m below the Cambrian-Ordovician boundary. Thus it seems to the present writer more reasonable to presume that not only the Paradoxissimus beds but also the upper zone of the Oelandicus beds are missing in the cores.

rare, however. In the strata at other localities in South-Eastern Scania (see below), which because of their fossils and stratigraphic position should be considered contemporaneous with at least part of Zone C 1 at Andrarum, *G. nathorsti* is often common and *Pt. (T.) lundgreni* sometimes absent. Conditions are the same in Northern Sweden. The last-mentioned species has so far been found at but one locality, viz. Vedjeön in Northern Jämtland, and is there not associated with *G. nathorsti*, which, on the other hand, is fairly common at several localities in Northern Jämtland, Ångermanland, and Västerbotten.¹

Below is given a brief review of the stratigraphy and lithology of the Middle Cambrian in the different areas of Sweden.

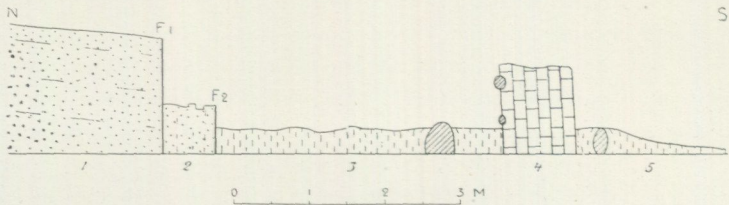
Scania. — In this province the *Par. oelandicus* stage is in all probability absent. The two upper stages are developed as alum shale with scattered stinkstone lenses and two interstratified thin layers of gray (or black) limestone, viz. the Andrarum limestone and the Exsulans limestone, the former 0.6—1.2 and the latter usually less than 0.5 m thick. The total thickness is in South-Eastern Scania about 20 m and at Södra Sandby, 10 km E of Lund, it is estimated at about 30 m. This figure is approximately the same as that recorded by Brögger (1878) from the Oslo district, about 26 m. It is higher than in any other area in Sweden in which the thickness is known for certain, and much higher than on Bornholm where it is about 4 m. Owing to tectonic disturbances no safe figures for the thickness can be obtained in Northern Sweden and in the Mjösen district in Norway.

In the sections at Andrarum and in a boring profile at Gislövshammar, 8 km SSE of Simrishamn (Westergård, 1944 a), the sequence in the two upper stages seems to be complete, though at a few localities mentioned below there is a very small break immediately below the Andrarum limestone.

At Kiviks-Esperöd, 15 km NNW of Simrishamn, only minor parts of the Middle Cambrian are accessible. The Andrarum limestone, which lithologically and faunistically agrees with the layer at the type locality, is immediately underlain, and grown together with, a thin stratum of stink-

¹ Grönwall recorded *Goniagn. nathorsti* from the upper part of the *Par. davidis* zone on Bornholm, i. e. from a stratum which because of its strongly reduced thickness was included in that zone but should probably be correlated with our zone C 1. On the other hand, the species seems to have a somewhat greater range in Norway and Northern Sweden. Thus it appears already in the oldest strata of the *Par. rugulosus* zone in the Oslo district (Brögger, 1878), and it has been found associated with *Par. paradoxissimus* or a closely related form at one locality in Ångermanland. Whether the species occurs in Great Britain has not been ascertained as yet, and in such a case it should appear at the top of the Upper *Par. davidis* zone, where it must be very rare (Illing, 1916). At all events, according to the present writer's experience, the species is common in Sweden only in the strata between zones B₄ and C₂.

In New Brunswick, Canada, *G. nathorsti* is stated to occur in a formation »probably equivalent in age to the younger beds of the *Paradoxides hicksi* zone, and possibly to the oldest beds of the *Paradoxides davidis* zone» (Howell, 1937 b, p. 87). Accordingly the species seems to appear earlier in the western than in the eastern part of the North Atlantic Basin and to be one of the leading fossils in older beds in America than in Europe. Also in Australia forms closely allied to — one of them possibly identical with — the Scandinavian species are recorded from beds correlated with the *davidis* zone (Whitehouse, 1939).



Text-fig. 1. Section through the Middle Cambrian at Baskemölla, 5 km NNW of Simrishamn, Scania.
 1. Gray, slightly quartzitic Lower Cambrian sandstone. — 2. Greenish gray, glauconitic Lower Cambrian sandstone. — 3. Alum shale with stinkstone lenses; zone of *Ptychagnostus* (*Pt.*) *punctuosus*. — 4. Gray Andrarum limestone. — 5. Alum shale with stinkstone lenses; zone of *Lejopyge laevigata*. — F1, F2. Fault lines.

stone rich in fossils. *Goniagnostus nathorsti*, *Diplagnostus planicauda bilobatus*, and *Peronopsis fallax ferox* predominate; *Ciceragnostus cicer* is fairly infrequent, and *Phalacroma marginatum*, *Ph. glandiforme*, and *Peronopsis pusilla* are rare. This faunule thus contains members of Zones B 4 and C 1, which are not separated at this locality.

At Baskemölla, 5 km NNW of Simrishamn, the upper part of the Middle Cambrian, Zones B 4—C 3, has been sunk by faults into the Lower Cambrian sandstone and is accessible on the very shore. The complex, whose dip is about 90° and strike E—W, is made up of a lower 4 m thick shale bed,

Fossils in some stinkstone lenses at Baskemölla, Scania.

p = predominant r = rare (maximum two specimens)

	Lower shale bed Zone B 4					Partly grown into the Andrarum Limestone Zone C 1				
	1	2	3	4	5	6	7	8	9	10
<i>Peronopsis fallax ferox</i>	r	r	+				+		+	+
» <i>cylindrica</i>	r									
» <i>pusilla</i>			r							
<i>Hypagnostus nepos</i>							+	+	+	+
<i>Diplagnostus planicauda bilobatus</i>							+		+	+
<i>Ptychagnostus</i> (<i>Triplagn.</i>) <i>elegans</i>	+	r	p		+					
» (<i>Ptychagn.</i>) <i>punctuosus</i>	+	p	r	p	+					
<i>Goniagnostus nathorsti</i>						+	p	r	+	+
<i>Doryagnostus incertus</i>	+	r	+	r	+					
<i>Ciceragnostus cicer</i>	+	r	r				+	r	+	+
<i>Phalacroma</i> (<i>resectum</i> ?)			r							
<i>Paradoxides davidis</i>			r	?						
<i>Schmalenseia acutangula</i> sp. n.	r				r		r			
<i>Polyphyma angelini armata</i>							r			
<i>Hyalithes socialis</i>		r								
» cf. <i>tenuistriatus</i>									r	?
<i>Acrothele</i> sp.				r						
<i>Acrotreta schmalenseei</i>							+		+	+

the Andrarum limestone, and an upper shale bed not reaching above sea level. In the lower shale bed a single limestone lens in situ (No. 5 in the table, p. 10) was found 0.7 m below the Andrarum limestone, and the loose lenses represented only Zones B 4 (No. 1—4) and C 3, those from the latter zone rich in *Lejopyge laevigata* and *Aluta primordialis*.¹ Thus we may conclude that the lower shale bed in its entirety belongs to the former zone.

At the lower surface of the Andrarum limestone were observed five small lenses of stinkstone partly grown into the limestone, all belonging to Zone C 1. Their bedding planes were either angulate or perpendicular to that of the Andrarum limestone, thus indicating a gap between Zones C 1 and 2, which obviously is unimportant, however.

Along the shore between Brantevik and Gislövshammars, SSW of Simrishamn, the Middle Cambrian crops out, though only Zone B 1 reaches above sea level. Pebbles and boulders of the series occur abundantly on the beach, however, and those of stinkstone are common particularly 1—1.3 km S of Brantevik and 0.6—1.0 km N of Gislövshammars. More than 1000 stinkstone boulders representing the whole of the Middle Cambrian at this locality have been thoroughly examined by the writer. Except those of Zone B 1 they were as a rule poor in fossils. The fauna of some of them is listed in the following table.

In a boring at Gislövshammars (Westergård, 1944 a) no break was observed (except that the *Oelandicus* beds are absent). Zone C 1 was about 0.5 m thick and yielded but few specimens of *Ptychagnostus* (*Triplagn.*) *lundgreni*. However, 1 km N of the boring place two boulders were found made up of Andrarum limestone grown together with stinkstone rich in *Ptychagnostus* (*Pt.*) *punctuosus* and other species distinctive of Zone B 4 (see G 106 in the table). Thus Zone C 1 must be absent at some place in the neighbourhood of Gislövshammars, and the gap immediately below the Andrarum limestone indicated in the sequences at Baskemölla and Kiviks-Esperöd is there more strongly pronounced.

Öland. — The *Par. oelandicus* stage has a greater thickness and is more fully developed on Öland than in other areas of Sweden. In ascending order it is built up of dark-gray or black arenaceous shale, greenish gray more or less arenaceous shale, and greenish gray usually soft shale, all of the beds with scattered lenses or discontinuous thin layers of impure limestone. The total thickness has been stated to be 57 m (?) in a boring section 2.5 km S of Borgholm,² decreases from there to the south, and probably also to the

¹ In the explanation of the map-sheet Simrishamn *Agnostus* [*Glyptagnostus*] *reticulatus* ANG. is the only species recorded from the upper shale bed. However, the specimen on which this statement was founded is a poorly preserved cephalon of *Ptychagnostus* (*Pt.*) *punctuosus* and may originate from the lower shale bed.

² In the boring, which was made by percussion drill, the Paradoxissimus beds were stated to be 12 m and the *Oelandicus* beds 57 m. However, the former figure is but the half of the one recorded by Tullberg from the cliff at Borgholm Castle and the latter figure is higher than might be expected from known conditions at Borgholm (Westergård, 1929, 1936). Probably it was not possible to fix the boundary between the units with certainty. If we presume that the Paradoxissimus beds have about the same thickness at the boring and at Borgholm Castle — which is made probable by a recent core boring on the eastern coast at Skärlov revealing the thickness of the unit to be 20 + x m at that locality — the *Oelandicus* beds would be about 43 m, which may be more reasonable.

Fossils in stinkstone boulders on the beach S of

p = predominant r = rare

	Zone B 1		Zone B 2				
	G 12 ¹	B 1	B 11	B 47	G 6	G 16	B 22
<i>Eodiscus punctatus scanicus</i>							
<i>Condylopyge spinigera</i>							
<i>Peronopsis fallax</i>	r	+	+		+		
» <i>fallax depressa</i>							
» <i>fallax ferox</i>							
» <i>cylindrica</i>							
» <i>scutalis</i>	+	r	p	r	+		
» <i>pusilla</i>							
<i>Hypagn. parvifrons</i>						r	
» <i>parvifrons mammillatus</i>							
» <i>truncatus</i> f. 1							
» <i>nepos</i>							
<i>Cotalagn. lens</i>							
» <i>lens claudicans</i>		+	+	+	+		
<i>Tomagn. fissus</i>	+	+	+	r	+	r	r
» <i>perrugatus</i>	+		+		r		r
» cf. <i>corrugatus</i>	+						
<i>Diplagn. planicauda bilobatus</i>							
<i>Ptychagn. (Triplagn.) praecurrens</i>	+						
» » <i>gibbus</i>	p						
» » <i>hybridus</i>							
» » <i>convexus</i>			+	r	r	r	
» » <i>elegans</i>							
» » <i>elegans laevissimus</i>							
» » <i>lundgreni</i>							
» (Ptychagn.) <i>atavus</i>			r			+	+
» » <i>punctuosus</i>							
» » <i>punctuosus affinis</i>							
<i>Goniagn. nathorsti</i>							
» <i>scanensis</i>							
<i>Doryagn. incertus</i>							
<i>Ciceragn. cicer</i>							
<i>Phalacroma scanicum</i>							
» <i>resectum</i>							
» <i>Agnostus</i> sp. 2							
» sp. 3							r
<i>Schmalensecia acutangula</i> sp. n.		+	r	r	+		
<i>Paradoxides paradoxissimus</i>		r					
» cf. <i>hicksii</i>			r				
<i>Ctenocephalus exsulans</i>	r						
<i>Bailella impressa</i>	r						
<i>Solenopleura parva</i>	r						
» <i>Liostracus</i> <i>aculeatus</i>	+	+					
» <i>linnarssoni</i>	+						
» cf. <i>linnarssoni</i>							
<i>Hyolithes socialis</i>			r				
» cf. <i>socialis</i>		r			r		
<i>Acrotreta</i> cf. <i>schmalenseei</i>		r			r		

¹ Black calcareous shale grown together with gray Exsulans limestone; the fauna of the

Brantevik (B) and N of Gislövshammar (G), Scania.

(maximum two specimens)

				Zone B 3				Zone B 4									Zone C r	
B 24	B 18	G 13	B 80	G 104	G 99	G 116	G 9	G 96	G 7	G 18	G 25	B 56	B 67	G 106	G 95	B 3	B 45	
r			P +			+	+											
			+					+	r	+	+	+	r	+	r	+	r	
+	r		+	+	P	P	+	+	r	+		r	r	r	r	+		
			+					+										
r		r	+															
+	r	r	+	r		r											+	
			+			+												
									+	P	+				r	P		
+	P	P	+				+		+	+	r	+	P	P	r	P	+	
												+						
								r	+	+	+	+	r	r	+	+	+	
			r									+						
	r		r		r	r				r	r							
			r															
			+					?										
r			r									r						
r	r		r															

latter is omitted.

north. Both zones are developed on the middle and southern parts of the island, but at the Northern Point the upper seems to be absent. A detailed account of the stratigraphy and fauna of the stage was published by the present writer in 1936.

The *Par. paradoxissimus* stage is initiated by a thin calcareous conglomerate rich in *Acrothele granulata*, which is covered by a 0.1—0.2 m thick stratum of dark- or light-gray arenaceous limestone or calcareous sandstone with *Ctenocephalus exsulans* and *Ptychagnostus (Triplagn.) gibbus*, thus belonging to Zone B 1.¹ The bulk of the stage immediately overlying the latter layer varies somewhat lithologically; it is built up of gray more or less calcareous thin-bedded sandstone with interstratified laminae and thin strata of shale. Parts of it are accessible at some localities and have yielded a poor and monotonous fauna. Although none of the index fossils characteristic of Zone B 2 have been found, it should probably be parallelized with that zone.

At Degerhamn and a locality 4 km farther to the south the sandstone terminates in a thin sandstone conglomerate in whose matrix *Hypagnostus parvifrons* and the subspecies *mammillata* are the predominant forms. The conglomerate is accordingly referable to Zone B 3, in which there is tentatively included also the overlying barren layer of black or dark-gray shale and stinkstone. Thus this zone is poorly developed on Southern Öland; in the neighbourhood of Borgholm and farther to the north it is absent.

No evidence so far known indicated Zone B 4 to be present on Öland (Westergård, 1944 b).

As mentioned above the total thickness of the Paradoxissimus stage is about 26 m in the cliff at the ruined Borgholm Castle (Tullberg, 1882), and in a recent core boring on the eastern coast at Skärlov, 52 km S of Borgholm, it is 20 + x m. The thickness decreases from the neighbourhood of Borgholm northwards. At the Northern Point the Middle Cambrian crops out in a submarine cliff, and by the aid of the boulders on the shore J. G. Andersson (1896, pp. 37—41) reconstructed the sequence. As he found boulders of a brecciated rock with pieces of limestone of the *Ælandicus* beds cemented by stinkstone yielding *Agnostus pisiformis*, but no boulders of sandstone from the Paradoxissimus beds, he concluded that the latter are absent in this section. However, according to the present writer's researches at this locality boulders of Paradoxissimus sandstone are not lacking, though they are rare, and thus it seems more likely that the total thinning out of Stage B takes place only at some distance N of Öland.

The *Par. forchhammeri* stage has a maximum thickness of 0.5 m (in a boring on the Southern Point). On Southern Öland it is usually represented by the *Exporrecta* conglomerate, a thin discontinuous layer with nodules of phosphorite and pebbles of stinkstone, usually barren but sometimes yielding *Agnostus pisiformis*, in a calcareous matrix crowded with fossils. The fauna

¹ A sample of this rock from the shore 4 km S of Mörbylänga proved to contain 61.1 % of CaCO₃ and 36.5 % of quartz grains and silt; another sample from the shore 2 km E of Borgholm yielded 61.6 and 34.0 % of the respective components. Cf. Wiman, 1906, p. 287.

proves that the conglomerate replaces Zones C 2 and 3 (no form confined to C 1 has been observed), and, as *A. pisiformis* appears in the pebbles and is often common in the matrix too, the sedimentation of the conglomerate obviously continued into the early *pisiformis* phase. Between Äleklinta and Djupvik, 12 and 18 km NNE of Borgholm, there occurs a thin discontinuous conglomerate at the boundary between the Paradoxissimus sandstone and a stinkstone layer with *A. pisiformis*. The matrix, a calcareous sandstone, is crowded with pebbles of sandstone and shale like the rocks in the underlying layers and of stinkstone. Fossils are very rare; *A. pisiformis* and fragments of brachiopods (*Acrothele* and ? *Oligomys exporrecta*) in the matrix indicate that this conglomerate should be correlated with that on Southern Öland. — A conglomerate covering the Paradoxissimus sandstone at Horn Point farther to the north has yielded *Lejopyge laevigata* (rare) in addition to species from the Olenidian and the *Dictyonema* zone, and it thus replaces a much larger series of deposits than the one just mentioned.

Gothland. — The Cambrian sequence under Gothland is known from two deep borings, at Visby (Hedström, 1923) and File Haidar, 8 km W of Slite, (Thorslund & Westergård, 1938). Of the Middle Cambrian but Zone A 1 is developed. It is built up of alternating layers of gray more or less arenaceous shale and white fine-grained sandstone, shale being predominant in the Visby profile and sandstone in that of File Haidar. The thickness is in the former 35.1 and in the latter 31.4 m. The fauna is poor and monotonous. — This zone is directly overlain by the *Asaphus* limestone.

Östergötland. — The uppermost stage is, or has been, accessible in a few alum shale quarries; the two lower stages are known almost exclusively from boulders and some recent borings, of which two in the eastern part of the area pierce the whole of the Middle Cambrian (Westergård, 1940, 1944 b).

The *Par. oelandicus* stage is made up of a very thin basal conglomerate covered by a greenish gray glauconitic and slightly phosphoric and fairly coarse sandstone, dark-green glauconitic shale, and greenish, gray, and black, rather soft shales. The total thickness is 6 m. At least the upper half belongs to the upper zone, and no evidence so far known disproves that also the lower part should be included in this zone.

Of the *Par. paradoxissimus* stage but the lowest zone is developed in the eastern part of the area; in the central part the second, and farther to the west also the third, zone are added. The fourth zone is absent. The rocks are made up of shales with sparse thin layers of sandstone and scattered lenses of impure limestone; in the eastern part light-coloured and in the central and western parts darker gray shales and black alum shale poor in organic matter prevail. The thickness of the lowest zone is 8—9 m; the total thickness of the stage is unknown.

The *Par. forchhammeri* stage is built of a meagre and in its lower portion arenaceous alum shale with scattered lenses of stinkstone. A thin basal conglom-

merate appears at some localities. The fauna is poor and indicates that the third and probably also the second zone are represented. No species distinctive of the first zone has been observed. The total thickness varies from 4.3 to 6.4 m.

Västergötland. — Cambro-Silurian deposits occupy four separate areas: Halle- and Hunneberg, Kinnekulle, Lugnås, and Billingen-Falbygden, the latter including Mount Billingen and a wide area around the town of Falköping.

The *Par. oelandicus* stage is absent.

The *Par. paradoxissimus* stage. — The Lower Cambrian sandstone is overlain by a bed which has a varying lithologic character at the various localities: it is made up of a dark-green conglomerate or light-green sandstone rich in glauconite and phosphorite, green glauconitic shale, and (at Hunneberg) black arenaceous and pyritic shale. This bed, which is 0.2—1 m thick, has yielded no fossils of stratigraphic value. It is covered by a meager black alum shale with stinkstone and sporadic very thin strata of greenish gray shale. Upwards the stage terminates in a practically continuous 0.4—0.8 m thick band of greenish, dark-gray or black stinkstone. The total thickness of the stage varies between 3.5 m (Kinnekulle) and 9 m (Eastern Falbygden). The three lower zones are always present and the fourth zone is practically absent; at two localities, Hunneberg and Djupadalen, a few specimens of the index fossil of the latter zone have been found associated with forms distinctive of Stage C, and possibly occur secondarily.

The *Par. forchhammeri* Stage. — In the areas of Kinnekulle and Billingen-Falbygden the stinkstone band forming the top of Zone B 3 is covered by the *Exporrecta* conglomerate, a thin discontinuous stratum with pebbles of stinkstone and nodules of phosphorite in a dark calcareous matrix crowded with fossils, particularly brachiopoda. The pebbles have only yielded fossils from Zone B 3; in the matrix forms characteristic of the *Andrarum* limestone, but none of the index fossils of the underlying zone, have been found. At a few localities the conglomerate merges into a light-gray slightly glauconitic limestone the fauna of which agrees with that of the former. The conglomerate is overlain by a bed of alum shale, more bituminous than the rock in Stage B, with scattered lenses of stinkstone. This bed belongs to Zone C 3, which in Falbygden has a fauna richer in species than in any other Scandinavian area. The total thickness of Stage C in the areas now discussed is 2.5—4 m.

At Hunneberg Stage C occupies the upper part (maximum 0.4 m) of a stinkstone layer whose lower part belongs to Zone B 3. Fossils distinctive of Zones C 1—3 and a few specimens of forms from B 4 occur mixed. The rock is not distinctly conglomeratic; the fauna indicates, however, that the layer may have been formed during alternating phases of sedimentation and erosion.

Närke. — The Middle Cambrian is rarely accessible; nevertheless it is fairly well known due to numerous core borings made in recent years, some

of which have been described by the present writer (Westergård, 1940; 1941).

The *Par. oelandicus* stage is made up of a 1—3 m thick bed of a greenish, glauconitic and phosphoritic, coarse sandstone overlain by greenish gray glauconitic shale and greenish or light-gray soft shale or mudstone with lenses and thin layers of impure limestone. The total thickness varies between 7 and 15 m and is greater in the eastern than in the western part of the area. More than the upper half of the stage belongs to the upper zone, and no evidence so far known indicates that also the lower zone may be represented. Lithologically as well as faunistically the stage agrees with that in Östergötland except that interstratified dark-gray and black shales are absent in Närke.

The *Par. paradoxissimus* stage — gray or greenish gray, usually soft shale with thin lenses and layers of impure limestone — is poorly represented. The thickness is in Eastern Närke 0.3—5 m and increases in the western part of the area to maximum 12 m, a figure which is uncertain, however, owing to numerous gliding planes angulate to the bedding plane. The fauna is poor and monotonous. In the eastern part of the area only the lowest zone is developed, and no reliable facts so far known prove that also younger strata may be found in the western part (cf. Westergård, 1940, p. 47, foot-note 1).

Also the *Par. forchhammeri* stage is poorly developed. It has not been found to exceed 1 m, and is usually thinner. Sometimes the alum shale is replaced by a discontinuous and very thin conglomerate rich in *Oligomys exorrecta*, and at a few localities the stage is found to be absent. The relatively poor fauna seems to indicate that the bed represents parts of the two upper zones, which in this area are not separated. No representative of the lowest zone has been observed.

The Northern Baltic area. — The Cambro-Silurian in the Southern part of the Gulf of Bothnia inclusive of the Bay of Gävle is almost exclusively known from pebbles and boulders. No definite proof of the presence of the Middle Cambrian has as yet been produced. Some boulders lithologically resembling the *Par. paradoxissimus* sandstone of Öland have yielded fossils which may be of Middle Cambrian age, but even if this is correct the Middle Cambrian series is of a certainty poorly represented in this area (cf. Westergård, 1939, pp. 49—52).

Norrland inclusive of Dalecarlia. — In Central Dalecarlia, i. e. the area around Lake Siljan, the whole of the Cambrian is absent, the basal bed of the Ordovician — a phosphoritic conglomerate with *Obolus apollinis* EICHWALD — being directly underlain by the Archaean.

Along the eastern border of the Scandinavian Mountain Range Cambro-Silurian deposits crop out in a strip which is narrow in the south (Dalecarlia and Härjedalen) and the north (Lapland), long stretches being in the former area concealed by thrust masses of older deposits; in Jämtland it attains a maximum breadth of about 100 km. The rocks are strongly pressed and folded, thrusts on a large scale have taken place, and masses of older strata are found

to cover younger deposits. Thus autochthonous and allochthonous series occur, and in many cases it cannot be decided for certain which series is present.

Fossiliferous Middle Cambrian is accessible at many localities, the southernmost in Dalecarlia and the northernmost in Southern Lapland (Västerbotten), but nowhere is there a complete section through the whole of the Middle Cambrian. The series is in its entirety made up of alum shales with stinkstone poor in organic matter, and thus the lowest stage in Norrland differs to some extent lithologically from the stage in Southern Sweden.

In Southern Jämtland the *Par. oelandicus* stage has a thickness of at least 20 m. The bulk belongs to the upper zone, and a few boulders which have yielded *Condylopyge regia* indicate the presence of the lower zone too. At Brunflo, 15 km SE of Östersund, the stage mentioned is immediately overlain by a 1 to 2 m thick layer with *Par. jemtlandicus* and very rare fragments of a form of the *Par. oelandicus* group, which is regarded as the basal stratum of the lowest zone of the *Par. paradoxissimus* stage. W of Brunflo younger layers of the same zone occur. Of the overlying zones of the stage only the third has so far been observed in Southern Jämtland (Thorslund, 1940, p. 102). The *Par. forchhammeri* stage is represented by the *Exporrecta* conglomerate to the east and by alum shale to the west. The fossils indicate the second zone.

In Northern Jämtland and Ångermanland the *Par. oelandicus* stage is absent in the autochthonous and present in the allochthonous series, this according to Thorslund (1935). The poor fauna found indicates the upper zone. Of the *Par. paradoxissimus* stage, which increases in thickness from SE to NW, the four zones are met with though not all of them at one and the same locality. As always seems to be the case in Norrland the *Par. forchhammeri* stage is represented by the *Exporrecta* conglomerate farthest to the east and by alum shale with stinkstone to the west. At Aborrället, 2 km NW of the northern end of Lake Tåsjön, Ångermanland, the thickness is estimated at more than 10 m. The first and second zones are met with at several localities but it seems doubtful whether also the third zone is distinguishable in this area; at all events it is sometimes lacking.

Recent researches on the eastern part of the Mountain Range in Southern Lapland (Västerbotten) were published by Kulling in 1942. The Middle Cambrian is rarely accessible as solid rock but boulders of disintegration in the place have been found at a great many localities. Of the *Par. oelandicus* stage the upper zone is present, the four zones of the *Par. paradoxissimus* stage have been met with at different localities, and of the *Par. forchhammeri* stage, which is sometimes developed as a phosphoritic conglomerate (with *Oligomys exporrecta?*), at least the second and possibly also the first and third zones have been identified.

From Northern Lapland (Norrbotten) fossiliferous Middle Cambrian is so far unknown. However, also in this area fossiliferous late Lower Cambrian strata are overlain by black alum shales, the lower part of which are presumed to be of Middle Cambrian age. Nor have fossiliferous Middle Cambrian deposits been found in the western facies of the Cambro-Silurian, the so-called Köli Group, of the Mountain Range.

The Middle Cambrian sequence in different areas of Sweden.

Breaks are marked with vertical lines.

Stages	Zones	Scania	Väster- götland	Öster- götland	Öland	Gotland	Närke	Southern Jämtland	Northern Jämtland Ångermanl.	Southern Lapland
<i>Paradoxides</i>	<i>Lejopyge laevigata</i>		/		2			?	?	?
	<i>Solenopleura brachymetapa</i> (Andrarum Limestone)		1		3		4	5	5	5
<i>Forchhammeri</i>	<i>Ptychagnostus</i> (<i>Triplagn</i>) <i>lundgreni</i> and <i>Öniagnostus nathersti</i>	/	/					?		
<i>Paradoxides</i>	<i>Ptychagnostus</i> (<i>Ptychagn</i>) <i>punctuosus</i>		/					?		
	<i>Hypagnostus parvifrons</i>				/					
<i>paradoxissimus</i>	<i>Tomagn. fissus</i> and <i>Ptychagn.</i> (<i>Ptychagn</i>) <i>atavus</i>			/			?	?		
	<i>Ptychagnostus</i> (<i>Triplagn</i>) <i>gibbus</i>				/					
<i>Paradoxides</i>	<i>Paradoxides pinus</i>	/				/				
<i>oelandicus</i>	<i>Paradoxides insularis</i>	/		2			2	2	/	?

1. Exporrecta conglomerate; at Hunneberg a thin limestone layer.
2. A thin layer of alum shale with stinkstone lenses on the Southern Point, otherwise replaced by the Exporrecta conglomerate.
3. Exporrecta conglomerate.
4. Exporrecta conglomerate and/or alum shale with stinkstone lenses.
5. Exporrecta conglomerate to the east and alum shale with stinkstone to the west.

Trilobitae.

Superfamily **Agnostidea** (SALTER, 1862) R. & E. RICHTER, 1941.

Beecher (1897) included *Agnostus* and »*Microdiscus*» (*Eodiscus*) in the family Agnostidae, thereby recognizing the affinity between the agnostids and eodiscids. Even though intermediate forms linking the groups together are unknown, the morphological similarities between them are strongly pronounced, however, and make it highly probable that they arose from common ancestors, an opinion accepted by many but in later years opposed by others, in particular by American students of trilobites. Of the latter Resser (1938 b, p. 47) goes farthest, regarding the agnostids as an independent »subclass parallel to Trilobita», and, as the eodiscids are left in the trilobites, the agnostids have according to him nothing in common with the eodiscids.

Jaekel (1909) divided the trilobites into two suborders, Polymera with six or more than six segments and Miomera with two or three segments in the thorax, the latter comprising the agnostids and the eodiscids. Of the latter group only the genus *Eodiscus* was as yet known at that time — as a well-known fact blind and having three thoracic segments. Later also eodiscids with eyes and facial suture were described: *Pagetia* WALCOTT (1916) and *Hebediscus* WHITEHOUSE (1936), the former with two and the latter with three thoracic segments. *Hebediscus*, whose genotype is *Ptychoparia attleborensis* SHALER & FOERSTE (1888) from the Lower Cambrian of Massachusetts, is »more like a polymerid trilobite than any other member of the Miomera» (Whitehouse, 1936, p. 81). As far as the present writer can see, it differs from the Polymera but in the smaller number of thoracic segments, a criterion which varies within many genera of this group and whose taxonomic value obviously was overestimated by Jaekel.

Recently R. & E. Richter (1941) subjected the Miomera to a close study as regards their relations to one another and to the Polymera. The separation of the agnostids from the trilobites is stated to be contradicted by the facts that »die Agnostidae einerseits keine wesentlichen positiven Merkmale besitzen, die nicht auch bei anderen Trilobiten auftreten können, und dass ihnen andererseits auch nichts fehlt, was nicht auch bei anderen Trilobiten verloren gehen kann» (p. 19). The authors emphasize that, in recent Arthropoda as well in the trilobites, there are examples incontestably proving that blind forms arose from eye-bearing ones whereas no evidence indicating an evolution in the reverse direction is known. Accordingly, *Hebediscus* must be considered the most primitive form of the eodiscids from which the blind *Eodiscus* arose, not vice versa as claimed by Whitehouse. Also the agnostids are supposed to be derived from eodiscids like *Hebediscus*. Further the authors state that there is no gap between the Miomera and Polymera as regards the number of segments in the thorax. Forms with four and five thoracic segments in the adult are known and, thus, »ein ununterbrochener Zusammenhang auch in der Zahl der Rumpfglieder zwischen allen Trilobiten besteht» (p. 20). The

distance between the agnostidean and non-agnostidean trilobites is consequently smaller than claimed by Jaekel, Kobayashi, Whitehouse, and others, and does not justify the former group being awarded rank of order or suborder. The homogeneity of the agnostids as well as of the eodiscids makes it natural to give the groups the rank of family and because of their morphological similarities they have been brought together in a superfamily, as suggested by Richter in 1932. The name of the unit has been amended from Eodiscidea to Agnostidea, however, since Salter in 1862 placed Agnostidae in the higher unit Agnostini and named it ascendant.

As the present writer considers the taxonomy advanced by R. & E. Richter to be in better accordance with our present knowledge of the trilobites than those giving the Agnostidae and Eodiscidae rank above that of family, it is followed in this paper.

Eodiscidae (COQUIN, 1896) RAYMOND, 1913.

In this family Raymond included the following genera:

Eodiscus MATTHEW, 1896. Genotype: *Microdiscus schucherti* MATTHEW, 1896.

Goniodiscus RAYMOND, 1913. Genotype: *Agnostus lobatus* HALL, 1847.

Weymouthia RAYMOND, 1913. Genotype: *Agnostus? nobilis* FORD, 1872.

Goniodiscus differs from *Eodiscus* only in having ribbed lateral lobes in the pygidium, and it was suggested by Cobbold (1931) to be synonymous with *Eodiscus*, an opinion accepted by some later authors, but opposed by others. As the name *Goniodiscus* was occupied, Howell (1935 b) replaced it by *Calodiscus*, which Resser later (1937) replaced by *Dawsonia* HARTT, 1868. The latter name has been used by subsequent American authors; according to R. & E. Richter it is an invalid »Papierkorb-Name», however, as it was never published by Hartt and was rejected by himself.

Pagetia WALCOTT (1916) was erected to receive forms of Eodiscidae characterized by eyes and facial suture. This genus and *Dipharus* T. H. CLARK (1923) were by Kobayashi (1935) placed in the family Pageti[i]dae, and in 1939 he included Eodiscidae and Pagetiidae in the section Eodiscidi of the order Agnostida. *Dipharus* is no valid genus, however, since it is a larva, possibly of *Hebediscus*, as made probable by Cobbold's researches in Shropshire.

Hebediscus WHITEHOUSE (1936), based on *Ptychoparia attleborensis* SHALER & FOERSTE (1888) which Cobbold tentatively included in *Pagetia*, was by the author excluded from Pagetiidae, though he admitted »that possibly *Pagetia* and *Hebediscus* are not far removed genetically» (p. 81), and in 1939 he placed the blind and eye-bearing eodiscids in the suborder Eodiscida.

As mentioned above, R. & E. Richter (1941) included all eodiscids in the family Eodiscidae. The authors recognized but three genera, viz. *Eodiscus*, *Pagetia*, and *Hebediscus*. *Weymouthia*, with which *Delgadoia* VOGDES, 1917 (= *Delgadodiscus* KOBAYASHI, 1935) was proved to be synonymous, was considered a subgenus of *Eodiscus*. Another subgenus, *Serrodiscus*, was erected for forms distinct from the subgenus *Eodiscus* in the tail: pygidium long; axis long, multisegmentate (at least 8 + x rings), broader than the lateral lobe; margin tending to develop weak spines, usually directed downwards.

Recently Rasetti (1945) erected the genus *Pagetides* for a group of Lower Cambrian forms which differ from *Pagetia* in the longer and more distinct palpebral lobes, cephalic rim of less uniform width and with less distinct radial impressions, and in the lack of an axial spine on the pygidium» (p. 312). Rasetti also called attention to the fact that the imperfectly known *Ptychoparia attleborensis* from Massachusetts, has so far not been ascertained to be congeneric with the better known Shropshire eodiscid identified as *attleborensis* by Cobbold (and Whitehouse) but later proved by Resser (1937) to be specifically distinct and called *Hebediscus cobboldi*. Thus Rasetti concluded that it is not certain that *Hebediscus*, which is based on *Pt. attleborensis*, is a genus of eodiscids.

The Eodiscidae in the sense used in this paper may obviously be divided into two subfamilies, Pagetiinae and Eodiscinae, comprising sutured and non-sutured forms respectively; it is not necessary, however, and a new form described below links the groups together.

Only the genus *Eodiscus* (inclusive of *Calodiscus* and *Weymouthia*, the latter of which was recorded from the Mjösen district of Norway by Kiaer, 1916) has hitherto been known from Scandinavia. A late Middle Cambrian eodiscid to be described does not seem to be referable to any of the genera mentioned and is thus placed in the new genus *Aulacodiscus*. It is characterized by bilobate glabella and a pair of tubercles which may be homologous with the eyes of the sutured eodiscids, but it lacks facial suture. If the tubercles are reduced eyes like those in e. g. *Harpes*, the facial suture in *Aulacodiscus* is in a state of symphysis and the genus is intermediate between the sutured and blind eodiscids. And, since the blind and non-sutured forms were derived from eye-bearing and sutured ones, *Aulacodiscus* arose from *Pagetia* and is more primitive than *Eodiscus* though it appears later than the latter.

Eodiscidae is a small and short-lived group which appears in the Lower Cambrian and ranges through the whole of the Middle Cambrian. The family is cosmopolitan, members being known from Europe, eastern and western North America (Howell & Mason, 1938), Australia, Himalaya, and Eastern Asia.

Eodiscus MATTHEW, 1896.

Genotype: *Microdiscus schucherti* MATTHEW, 1896.

Eodiscus oelandicus (WESTERGÅRD, 1936). — Pl. I, figs. 1, 2.

1936. *Calodiscus oelandicus* WESTERGÅRD, S. G. U., Ser. C, No. 394, p. 30, pl. 1, figs. 24—26. (Description and figs. of cephalon and pygidium from the zone of *Par. pinus* at Mossberga and Mörbylånga, Öland.)

Remarks. — *E. oelandicus* seems to display close resemblance to the imperfectly known *E. sculptus* (HICKS) from the *Par. harknessi* zone of South Wales (cf. Lake, 1907). As regards the cephalon no safe differences can so far be pointed out; in the pygidium the Swedish form is distinguished by narrower axis and smooth instead of tuberculate axial rings. The Swedish form is readily

distinguished from *E. dawsoni* (HARTT) of the *Par. lamellatus* shale of New Brunswick by the shorter and subcylindrical, not conical glabella.

Horizon and Localities. — Zone of *Par. pinus*. — Öland: Mossberga and Mörbylånga. — Närke: Vinala. — Rare.

Eodiscus borealis sp. n. — Pl. I, figs. 3—5.

Diagnosis. — Distinct from the genotype by strongly convex cheeks, coarse and fairly long occipital spine, distinctly crenulated cephalic rim, long pygidial axis, and strongly pronounced ribs on the lateral lobes.

Description. — Cephalon forming rather more than a semi-circle, length about three-fourths of the breadth; posterior corners angulate. Glabella and cheeks strongly convex, the former on a side-view anteriorly slightly lower and posteriorly higher than the latter, separated by deep and broad axial furrows increasing in width backwards. Glabella occupying about two-thirds of the cephalic length, subcylindrical, with two pairs of faint lateral furrows (the anterior pair sometimes indiscernible). Occipital furrow faintly marked laterally and effaced at the middle line; occipital spine coarse at the base, rapidly tapering, subequal in length to the glabella in full-grown specimens, rising upwards-backwards at an angle of about 45° , hooking downwards at the tip. Cheeks moderately tapering forwards, separated by a broad preglabellar groove; surface minutely and thinly granulate. A pair of knobs in the axial furrows in front of the occipital segment. Rim fairly broad in front, narrowing backwards, faintly convex, with a row of closely-set transverse furrows; marginal furrow faint.

Thorax unknown.

Pygidium like cephalon in outline, of higher convexity than the latter. Axis prominent, narrower than the lateral lobe (the rim not counted), bounded by well-defined straight axial furrows, not extending quite to the rim, with seven rings and a very small end-lobe, each of the two or three anterior rings with a median tubercle. Lateral lobes with four pairs of arched ribs separated by deep furrows; surface of the ribs faintly granulate as the cheeks. Rim narrower than the cephalic rim, standing out horizontally from the lateral lobes and then bent downwards more decidedly than in the cephalon; marginal furrow weak.

Size. — The holotype (fig. 4), the largest cephalon present, is 3.1 mm long (exclusive of the spine) and 3.5 mm broad; the largest pygidium (fig. 5) 2.9 mm long and 3.7 mm broad.

Remarks. — Six cephalons and five pygidia exist, all collected from one slab and some of them in a good state of preservation.

Affinities. — *E. borealis* cannot be confounded with any of the Scandinavian species so far known. It approaches *E. punctatus* in the cephalon; in the pygidium the differences are conspicuous, however. It compares very well with the Canadian *E. dawsoni* (HARTT) as regards the pygidium but is distinct by shorter and less conical glabella. It seems to be most closely allied to *Calodiscus foveolatus* HOWELL (1935 b) from the early Middle Cambrian of Southern France.

Horizon and Locality. — Zone of *Ptychagn.* (*Triplagn.*) *gibbus*. Vedjeön (boulder 1), Jämtland.

Eodiscus punctatus (SALTER, 1864). — Pl. I, figs. 12—15.

1864. *Microdiscus punctatus* SALTER, Q. J. G. S., vol. 20, p. 237, pl. 13, figs. 11 a—c. (Briefly characterized, figs. of a complete dorsal shield and detached cephalo and pygidia. Associated with *Par. davidis*. St. David's, Wales.)
1883. *Microdiscus eucentrus* LINNARSSON, S. G. U., Ser. C, No. 54 (1882), p. 30, pl. 4, figs. 19, 20. (Characterized and compared with *M. scanicus* and *M. punctatus*. Associated with *Ptychagn. (Pt.) punctuosus*. Andrarum, Tullberg's loc. 10, Scania.)
1896. *Microdiscus punctatus* SALTER, Matthew, Trans. N. Y. Acad. Sci., vol. 15, p. 244 (Comments on species. Zone of *Par. davidis*, Newfoundland.)
1902. *Microdiscus scanicus* f. *eucentra* LINNARSSON, Grönwall, D. G. U., II. Række, No. 13, p. 79, pl. 1, fig. 20. (Considered *M. eucentrus* a time mutation of *scanicus*, both distinct from *punctatus* by having granulate instead of punctate test. Fig. of a well preserved cephalon from the zone of *Par. davidis* (?) on Bornholm.)
1907. *Microdiscus punctatus* SALTER [partim], Lake, Pal. Soc., Brit. Cambr. Trilob., pt. II, p. 36, pl. 3, figs. 11, 12 (13—17?). (Exhaustive description of *punctatus* in a wide sense including forms with short and more erect occipital spine referable to the subspecies *scanicus*. New figure of Salter's specimen fig. 11 c. Menevian. Wales.)
1916. *Microdiscus punctatus* SALTER, Illing, Q. J. G. S., vol. 71, p. 423, pl. 33, figs. 9, 10. (The specific name was confined to forms characterized *inter alia* by a very long occipital spine; figs. of two cephalo. Zones of *Hartshillia* and *Par. davidis*. Nuneaton, England.)
1916. *Microdiscus punctatus* SALTER [partim], Nicholas, *idem*, p. 460. (Only the form described from the upper horizon at St. Tudwal's Peninsula, Wales; no fig.)

Remarks. — Linnarsson's descriptions of *Microdiscus eucentrus* and *scanicus* were founded on poorly preserved specimens in shale. The former was stated to differ from the latter mainly in higher convexity of the shields and longer occipital spine, and as these differences, to some extent at least, were believed to be due to differences in the mode of preservation he recorded the forms with hesitation as independent species. He compared the Swedish forms with some specimens of *punctatus* from Wales which he had the opportunity to examine and found among these a cephalo which was identical with *eucentrus* but in some features distinct from Salter's figures of *punctatus*, and, as more than one species of the genus appeared to be represented in the Welsh material, he did not identify *eucentrus* with *punctatus*.

Grönwall included the Scanian forms in one species and regarded *eucentrus* as a time mutation of *scanicus*. As the test was interpreted as granulate instead of punctate, the species was considered specifically distinct from *punctatus*.

After a close examination of an abundant material of *E. punctatus* from Wales Lake stated that »on account of the differences between the exterior and interior of the test, and between the young and the adult, there is considerable variety in the appearance of different specimens, and but for the large series obtained from South Wales, some of the variations due to age or to the mode of preservation might be supposed to constitute distinct species». As regards Linnarsson's *eucentrus* and *scanicus* Lake concluded that they »appear to be the same form under different conditions of preservation, and seem to be indistinguishable from the British species» (Lake, 1907, p. 38). However, by his studies of the Middle Cambrian eodiscids at Nuneaton Illing (1916) established that in addition to the typical *punctatus* there occurs a closely related form distinguished *inter alia* by a shorter and more erect occipital spine, which is generally broken off short. The former was found in

the zones of *Par. davidis* and *Hartshillia* and the latter in the zones of *Hartshillia* and *Par. hicksii*, i. e. at horizons approximately corresponding with those from which Linnarsson recorded *eucentrus* and *scanicus* respectively. Thus Illing identified *eucentrus* as synonymous with *punctatus* and *scanicus* as a subspecies of the latter. Contemporaneously Nicholas (1916) recorded these forms from the same horizons at St. Tudwal's Peninsula.

The present material of the forms under consideration from Scania and Bornholm corroborates Illing's opinion: *eucentrus* is identical with Salter's *punctatus*, and *scanicus*, which is connected with *punctatus* by intermediate links, should be awarded but subspecific rank. In *punctatus* the occipital spine is much longer than the cephalon proper and rises at an angle of about 20° from the plane of the cephalon, in *punctatus scanicus* the spine is shorter than the cephalon — in topotypes even shorter than the glabella — and the angle mentioned is at any rate not less than 45°. The crenulation of the cephalic rim is rarely discernible on the exterior surface of the test but is well defined on internal casts preserved in limestone. In well preserved specimens of both forms the exterior surface of the test on the cheeks and the lateral lobes of the pygidium is distinctly punctate and usually also more or less distinctly granulate, the granulation being more pronounced in the pygidium than in the cephalon. Thus the character of the test is in this case of little value and cannot be used as a specific criterion as claimed by Matthew and Grönwall.

The form from the *Par. davidis* zone of Newfoundland identified as *punctatus* by Matthew (1896) may be identical with Salter's species. On the other hand the form from New Brunswick described and illustrated as *punctatus* by Walcott (1884) is probably referable to the subspecies *scanicus*.

Horizon and Localities. — Zones of *Hypagn. parvifrons* and *Ptychagn. (Pt.) punctuosus*. — Scania: Andrarum. — Jämtland: Siljeåsen. — Infrequent at the former and very rare at the latter locality.

Bornholm. — Great Britain. — Newfoundland.

Eodiscus punctatus scanicus (LINNARSSON, 1883). — Pl. I, figs. 6—II.

1883. *Microdiscus scanicus* LINNARSSON, S. G. U., Ser. C, No. 54 (1882), p. 29, pl. 4, figs. 17, 18. (Description and figs. of cephalon and pygidium. Associated with *Tomagn. fissus*. Andrarum, Scania.)
1884. *Microdiscus punctatus* SALTER, Walcott, Bull. U. S. Geol. Surv., No. 10, p. 24, pl. 2, figs., 1, 1 a—c. (Description and figs. of cephalon and pygidium. St. John, New Brunswick, Canada.)
1886. *Microdiscus punctatus* var. *pulchellus* HARTT, Matthew, Proc. Trans. Roy Soc. Canada, Vol. 3, Sect. 4, p. 74, pl. 7, figs. 12 a—c. (Walcott's description supplemented; figs. of cephalon and pygidium. Zone of *Par. abenacus*. St. John Basin, New Brunswick, Canada.)
1896. *Microdiscus pulchellus* HARTT, Matthew, Trans. N. Y. Acad. Sci., vol. 15, p. 242, pl. 17, figs. 8 a—f. (Walcott's description cited and supplemented, figs. of cephalon and pygidium of immature and adult specimens. Zone of *Par. abenacus*. New Brunswick, Canada.)
1902. *Microdiscus scanicus* LINNARSSON, Grönwall, D. G. U., II. Række, No. 13, p. 79. (Subspecies recorded from Bornholm and considered an independent species distinct from *punctatus* by granulate instead of punctate test.)
1907. *Microdiscus punctatus* SALTER [partim], Lake, Pal. Soc., Brit. Cambr. Trilob., pt. II, p. 36. (Considers *scanicus* synonymous with *punctatus*.)
1916. *Microdiscus punctatus* var. *scanicus* LINNARSSON, Illing, Q. J. G. S., vol. 71, p. 423, pl. 33, figs. 11 a—c, 12. (Records *scanicus* from the zones of *Par. hicksii* and *Hartshillia* at Nuneaton, England, and proves it to be a subspecies of *punctatus*; figs. of two complete dorsal shields.)

1916. *Microdiscus punctatus* SALTER [partim], Nicholas, idem., p. 460. (Only the form from the lower horizon at St. Tudwal's Peninsula, Wales; no fig.)
 ? 1929. *Microdiscus* cf. *punctatus* SALTER, Strand, N. G. T., vol. 10, p. 348. (A small pygidium, not illustrated, found associated with »*Liostracus*» *linnarssoni* BRÖGGER. Mjösen district, Norway.)

Remarks. — Linnarsson's originals of *E. scanicus* in the collections of the Geological Survey are poorly preserved internal casts in shale. The cephalon is selected lectotype. Better preserved topotypes are illustrated on pl. 1 of this memoir.

As stated above the subspecies is distinct from the species mainly by shorter and more erect occipital spine, which, accordingly, in most specimens of the subspecies is broken off at its base, and lower convexity of both shields. Moreover, the lateral furrows on the glabella are as a rule somewhat more distinct and the transverse furrows on the cephalic rim slightly more close-set in the former than in the latter. The subspecies seems to merge into the species by intermediate forms. A great many well-preserved specimens of such a form (pl. 1, figs. 10 and 11) were collected from boulder 80 at Brantevik, which, as proved by its fauna (p. 13), originates from a somewhat higher level than that yielding the originals of *scanicus*. In this form the occipital spine is almost as long as the cephalon and rises at an angle of about 45°. Although the spine is proportionally about twice as long as that of the topotype in fig. 8, it is much shorter and more slender than the spine of the typical species, and also in other features the form is more closely allied to the subspecies.

The present writer agrees with Lake in considering the form described and figured by Matthew in 1886 as *Microdiscus punctatus pulchellus* HARTT and in 1896 as *M. pulchellus* HARTT to be referable to *E. punctatus* in a wide sense; probably it should be included in the subspecies *scanicus*. The fact that the pygidium of *pulchellus* is stated to be tuberculate instead of punctate does not imply specific distinction for reasons quoted above.

Horizon and Localities. — Zone of *Tomagn. fissus* and *Ptychagn. (Pt.) atavus*. — Scania: Andrarum; Brantevik (boulder 80); Gislövshammar (boring). — Not infrequent.

Bornholm (?). — Mjösen district of Norway (?). — Great Britain. — New Brunswick, Canada. — The form from the *Par. hicksii* zone of Newfoundland identified by Howell (1925) as *punctatus* is supposed to belong to the subspecies *scanicus*.

Aulacodiscus gen. n.

Genotype: *Aulacodiscus bilobatus* sp. n.

Diagnosis. — Eodiscidae with a pair of tubercles on the cheeks (homologous with the eyes of *Pagetia*), traces of "ocular ridges", and bilobate glabella. Facial suture absent.

The genotype is the only species known.

Aulacodiscus bilobatus sp. n. — Pl. I, figs. 16—22.

Diagnosis. — See the generic diagnosis.

Description. — Cephalon forming somewhat more than a semi-circle in outline, broader than long, gently constricted at the posterior margin; posterior corners angulate. Glabella and cheeks strongly convex, the former higher than the latter, separated by deep and fairly broad axial furrows. Glabella slightly conical, not extending quite to the marginal furrow, obtusely pointed in front, distinctly bilobate; posterior lobe about one and a half the length of anterior lobe, with a pair of very faint lateral furrows. Occipital furrow marked but on the sides of the axial lobe; occipital spine strong, directed upwards-backwards. Cheeks narrowing forwards, separated by a broad depression in front of the glabella, with a pair of elongate tubercles on the summit and a pair of very weak »ocular ridges» (in most specimens indiscernible), sloping steeply from the tubercle to the rim; surface minutely and thinly granulate or smooth. Rim subequal in width throughout, flat or gently concave, somewhat depressed in front of the glabella, with about twenty faint transverse furrows; marginal furrow indistinct.

Thorax unknown.

Pygidium semi-circular, slightly broader than long, strongly convex. Axis prominent, subequal in breadth to the lateral lobe (the rim not counted), slightly conical, extending almost to the rim, with two well-defined rings, each with a faint median tubercle, and a relatively long indistinctly segmented end-lobe. Axial furrows narrow and shallow. Lateral lobes horizontal interiorly, strongly sloping exteriorly, with a pair of very weak pleural furrows, confluent behind the axis; surface lacking granulation. Rim proportionally equal in width to the cephalic rim, flat, sharply set off from the lateral lobes; marginal furrow indistinct.

Size. — A very small form. The holotype (fig. 21), one of the largest cephalata found, is 1.3 mm long (exclusive of the spine) and 1.75 mm broad; a pygidium (fig. 20) measures 1.0 mm in length and 1.35 mm in breadth.

Remarks. — In addition to a few specimens from Östergötland and Västergötland, three of which are illustrated in figs. 20—22, twenty cephalata and four pygidia have been found at Andrarum, Scania, those from the latter locality poorly preserved internal casts and external moulds (impressions) in shale. The Scanian specimens agree with the holotype in all essential features except that the tubercles on the cheeks are more or less obscured, which may be due to imperfect preservation, and as all of the specimens from the areas mentioned were collected from one and the same zone, they may be considered conspecific.

In fig. 22 the exterior portions of the cheeks are broken away in the position of the facial suture in *Pagetia*, and before the holotype was found the former was believed to have such a suture. However, in the holotype, which is excellently preserved except that the spine is broken, there is no trace of the facial suture, nor is it discernible in any other specimen. Even though the facial suture in some forms of *Pagetia* is sometimes apparently lacking (cf. Walcott,

1916, and Whitehouse, 1936), the material of *A. bilobatus* available does not allow us to presume that the suture is developed also in this form.

In Eodiscidae the glabella is usually smooth or has one or more pairs of faint lateral furrows; in e. g. *E. lobatus* it is more or less distinctly divided by transverse furrows into three lobes subequal in length, and if the furrows tend to become obsolete, they first disappear in the anterior part of the glabella. Thus the bilobate glabella seems to be a unique feature in this family, a criterion which *Aulacodiscus* has in common with the majority of the Agnostidae. Unfortunately a comparison as regards the thorax is so far excluded, and in the pygidium no criterion of particular value is to be found.

In spite of the differences mentioned *Aulacodiscus* displays closer resemblance to *Pagetia* than to any other eodiscid known to the present writer, and it is believed to descend from that genus.

A. bilobatus is probably the youngest member of this family so far known.

Horizon and Localities. — Zone of *Lejopyge laevigata*. — Scania: Andrarum; (S. Sandby?). — Östergötland: Berg (boulder 11); Knivinge. — Västergötland: Gudhem; Torbjörntorp; Djupadalen. — Rare.

Agnostidae McCoy, 1849.

The classifications of the agnostids advanced in the years 1935—1939 by Howell, Whitehouse, Harrington, and Kobayashi (the present writer does not know whether still more recent studies on this group have been published) differ greatly owing to the respective authors' divergent opinions as to which characters should be awarded generic value, and due to the difficulties of tracing separate lineages, all of which indirectly demonstrates the homogeneity of the group in spite of its abundance of forms. Below are some comments on the classifications mentioned based on the present writer's studies of the Middle Cambrian agnostids of Sweden.

In splitting the genus *Agnostus* — in the old and wide sense used even in later years — into genera and families Howell has gone farther than other authors. A great many new genera and families were erected, the latter numbering nine besides three older ones which were strongly restricted, and yet several genera were left without family reference. Whitehouse divided the agnostids into seven families, three of which were new. Four are common in names with those of Howell, but differ greatly as to the content, since they were more narrowly delimited by Howell than by Whitehouse. The classifications advanced by Harrington (1938) and Kobayashi (1939), the latter of which was published before the author had had access to the former, comprise the whole group of agnostids. In Kobayashi's memoir the earlier classifications of the group are reviewed in detail, and all forms described up to that time are discussed. Harrington and Kobayashi agree in distinguishing three families, viz. Condylopygidae, Peronopsidae, and Agnostidae, to which Kobayashi added a fourth family, Sphaeragnostidae, with the single genus *Sphaeragnostus* HOWELL & RESSER based on *Agnostus similis* BARRANDE.

Condylopygidae corresponds to Tullberg's group Limbati-Regii. It is distinct from other agnostids by the expansion of the frontal lobe of the glabella and the terminations of the thoracic pleura being directed backwards. Harrington's statement that this group furthermore differs in having four segments in glabella and pygidial axis, the number being three or less than three in all other agnostids, is disproved by clear facts, however. Thus, four segments in the glabella are traceable not only in *Goniagnostus* HOWELL — on account of this feature placed by Harrington in Condylopygidae, though it is distinct in other and more important criteria — but also in many species of Peronopsidae and Agnostidae, and four or more than four segments in the pygidial axis are sometimes indicated in *Tomagnostus*, *Diplagnostus*, *Aagnostus*, and other genera, as seen from specimens illustrated in this paper.

Condylopygidae is a small and short-lived group confined to (the late Lower Cambrian? and) the early and medial Middle Cambrian. It comprises the genera *Condylopyge* CORDA and *Pleuroctenium* CORDA. Whether the late Lower Cambrian *Mallagnostus* HOWELL, the type of his family Mallagnostidae in which *Condylopyge* was included, also belongs here must be left undecided until *M. desideratus* (WALCOTT), genotype and only known species, is more fully known. On the other hand there is no doubt that *Goniagnostus* HOWELL, which was placed in Condylopygidae by Harrington and in Agnostidae by Kobayashi, is referable to the latter family.

Peronopsidae and Agnostidae include a great many genera arranged by Harrington and Kobayashi in a number of subfamilies. These groups are clearly distinct from Condylopygidae, as stated above, but display fairly close resemblance to one another, and in some cases it is questionable whether a genus belongs to the one group or the other, as mirrored by the disagreements in the taxonomic schemes of the authors. Broadly speaking Peronopsidae corresponds to Tullberg's groups Limbati-Fallaces + Parvifrontes and Agnostidae to Longifrontes.

Kobayashi (1939, pp. 110 and 144) drew up the diagnoses of the families thus:

Peronopsidae: »Agnostids with subquadrate, or less commonly subovate shields; glabella not expanded forward; preglabellar median furrow generally absent; surface mostly smooth.»

Agnostidae: »Agnostids with rounded, or less commonly subquadrate, shields; glabella not expanded forward; preglabellar median furrow generally present in Middle and early Upper Cambrian forms, but absent in later ones; surface smooth, corrugate, or granulate.»

Harrington (1938, p. 150) defined the families thus (in translation):

Peronopsidae: »Agnostids with three or less than three segments in glabella and pygidial axis. Cheeks always confluent even in the most primitive genera. Pleural lobes of pygidium separated in primitive and confluent in progressive genera. Pygidial axis lanceolate or pointed behind. Only in one subfamily is it rounded, but the pleural lobes are separated at the middle line.»

Agnostidae: »Agnostids with three or less than three segments in glabella and pygidial axis. Cheeks separated in primitive genera. Pleural lobes of pygidium separated in more primitive genera, in which also the cheeks are separated. Separated pleural lobes and confluent cheeks are never met with. In progressive genera first pleural lobes and then cheeks become confluent. Axis of pygidium lanceolate in primitive and rounded in progressive genera. In all genera with pygidial axis rounded at the rear pleural lobes are confluent at the middle.»

Of the characters distinguishing Peronopsidae from Agnostidae the preglabellar median furrow is one of the most conspicuous. In Agnostidae it is present in earlier and usually absent in later forms. Thus, in all Scandinavian Middle Cambrian species of *Ptychagnostus* (inclusive of *Triplagnostus*), *Doryagnostus*, and *Goniagnostus* the furrow is well defined. *Agnostus pisiformis sub-sulcatus* subsp. n., occurring associated with the typical *pisiformis* at the top of the Middle Cambrian, is the earliest form of this family in which the furrow is almost or wholly effaced, and in the Upper Cambrian *Agnostus* (*Homagnostus*) *obesus* it is usually present but sometimes absent, the extremes being connected by intermediate links. In Peronopsidae the preglabellar furrow is stated by Kobayashi to be generally absent and according to Harrington it is always lacking. The latter opinion is exaggerated, however, as proved by some examples.

In »*Agnostus*» *quadratus* TULLBERG, included by both authors in Peronopsidae, to which the present writer agrees, the preglabellar furrow is usually absent but sometimes present (cf. pl. 3, figs. 22—29; pl. 4, figs. 1—2). *Tomagnostus* HOWELL and *Diplagnostus* JAEKEL, in which this criterion also varies, may be referable to an independent lineage and will be discussed below; it may be remarked, however, that but for the reason that the preglabellar furrow is absent in the specimen on which *Diplagnostus* was based and present in *Enetagnostus* WHITEHOUSE, Harrington concluded that these genera belong to separate lineages. In reality *Enetagnostus* is a synonym of *Diplagnostus*, however, as proved by the topotypes of *D. planicauda bilobatus* illustrated in this paper (pl. 8, figs. 14—16). *Euagnostus* WHITEHOUSE from layers corresponding to the Scandinavian Forchhammeri beds is another genus, according to the original diagnosis with or without a preglabellar furrow, whose taxonomic position seems to be somewhat questionable. It was by Whitehouse and Harrington included in Agnostidae and by Kobayashi considered a synonym of *Triplagnostus*. As *E. opimus* WHITEHOUSE, genotype and only known species, in general features resembles *Peronopsis* it might as well be included in the latter genus. Also *Clavagnostus* HOWELL which was placed in Clavagnostidae by Howell and in Peronopsidae by Harrington and Kobayashi, may be mentioned in this connection. Two species referable to this genus, viz. *repandus* (genotype) and *sulcatus* (pl. 4, figs. 19—22 and 23—26), are known from the late Middle Cambrian of Sweden. The former has confluent cheeks and the glabella rounded in front, whereas in the latter the cheeks are separated by a well-defined preglabellar furrow and the glabella is pointed. Considering their close agreement in all other characters, it would be unnatural to refer them to different genera and lineages.

No single criterion distinguishing Peronopsidae from Agnostidae is to be found, nor do the combinations of characters adduced by Harrington and Kobayashi always give a reliable answer to the question whether an individual form is referable to the former or to the latter group. However, the present writer agrees with the authors that two parallel lineages are traceable with tolerable probability. In Scandinavia these lineages are initiated by *Peronopsis*

jallax and *Ptychagnostus* (*Triplagn.*) *praecurrens* respectively, both appearing in the late *Ælandicus* beds. The lineage of the latter species, which constitutes the main line of the agnostids, seems to be traceable into the Ordovician, that of the former to the top of the Middle Cambrian.

Opinions diverge greatly as regards the taxonomic position of *Tomagnostus* HOWELL (type *Agn. fissus*). Tullberg included the genotype in *Longifrontes*, and Jaekel placed it in *Agnostidae*. Howell did not assign any family reference to this genus; Whitehouse included it, together with *Diplagnostus* JAEKEL (type *planicauda bilobatus*) and *Enetagnostus* WHITEHOUSE (as stated above a synonym of the former), in an independent family, *Diplagnostidae*; Harrington placed it together with *Diplagnostus* in *Peronopsidae*, and Kobayashi referred *Tomagnostus* to *Agnostidae* but *Diplagnostus* and *Linguagnostus* KOBAYASHI (type *kjerulfi*) to *Peronopsidae*. In cephalon as well as pygidium *Tomagnostus* bears a close resemblance to *Diplagnostus*, which makes it highly probable that the latter arose from the former, and apparently also *Linguagnostus* and *Oidalagnostus* nov. belong to this group. Thus, these genera may be members of an independent lineage as suggested by Whitehouse;¹ whether it branched off from an early form either of *Peronopsidae* or *Agnostidae* is so far left undecided. — *Diplagnostidae* ranges through the whole of the *Paradoxissimus* beds.

Peronopsidae as well as *Agnostidae* developed smooth forms with the axial furrows in cephalon and pygidium partly or wholly effaced. Tullberg placed these in the group *Laevigati*. Among the earliest of the «smooth» genera are *Cotalagnostus* WHITEHOUSE and *Lejopyge* CORDA, which were brought together by Harrington and Kobayashi in the subfamily *Lejopyginae*, of *Peronopsidae*. The genotype of *Cotalagnostus*, *Agn. lens* GRÖNWALL, arose from a form of *Hypagnostus truncatus*, and the latter genus was in all probability derived from some form of *Peronopsis* by effacement of the frontal lobe of the glabella. Thus *Cotalagnostus* is a member of *Peronopsidae*. On the other hand, *Lejopyge laevigata*, the type of the genus, is a descendant of *Ptychagnostus* (*Triplagn.*) *elegans* (cf. p. 75) and belongs to *Agnostidae*. Another form, «*Agnostus*» *altus* GRÖNWALL, which has the axial furrows in the cephalon effaced and the pygidial axis outlined as in *Cotalagnostus* and which on account of that was placed in this genus by Whitehouse, Harrington, and Kobayashi, no doubt arose from *Ptychagnostus* (*Triplagn.*) *convexus* sp. n. (cf. p. 73) and thus also belongs

¹ The present writer does not agree with Whitehouse in his presumption that the Upper Cambrian family *Glyptagnostidae* WHITEHOUSE, including *inter alia*, *Glyptagnostus reticulatus* (ANGELIN), possibly derived from the Middle Cambrian *Diplagnostidae*, a suggestion which was endorsed and sharpened by Troedsson (1937, p. 28). The supposed affinity was based on the statements that the median furrow or depression in the frontal glabellar lobe is common to *Glyptagnostus* and the members of *Diplagnostidae* and that some forms of *Tomagnostus* foreshadow the typical ornament of *Glyptagnostidae*. However, both criteria apply also to *Ptychagnostus* JAEKEL (type *punctuosus*) — beyond doubt a member of the *Agnostidae* — and, as *Glyptagnostus* in general features displays closer resemblance to the latter genus than to *Tomagnostus* and *Diplagnostus*, it seems more likely that *Glyptagnostus* is a member of *Agnostidae*, as suggested by Kobayashi.

to Agnostidae. *Cotalagnostus* as well as Lejopyginae in the sense of the authors mentioned are consequently polyphyletic.

Further effacement of the axial furrows gives rise to such Middle Cambrian forms as *Ciceragnostus* KOBAYASHI, *Phoidagnostus* WHITEHOUSE, and *Phalacroma* CORDA (the Upper Cambrian and Ordovician smooth agnostids omitted). These genera, in addition to *Lejopyge* and *Cotalagnostus*, were by Whitehouse included in Phalacromidae, which in this sense approximately corresponds to Tullberg's Laevigati and, as stated above, is polyphyletic. Harrington and Kobayashi placed the three former genera in Phalacrominae, of Peronopsidae; in Howell's classification Phalacromidae was used in a strongly restricted sense, comprising but *Phalacroma nudum*, *Ph. [Grandagnostus] glandiforme*, and closely resembling forms. It does not seem to be established, however, that the genera under consideration belong in the Peronopsidae; it is not out of question that one or more of them might be derived from members of the Agnostidae. Kobayashi's statement (1939 a, p. 134): »Judging from the change in axial breadth through growth in *latirhachis* [Holm & Westergård, 1930] it is certain that the Phalacrominae was derived from the Peronopsidae stock» may be right as regards that species but is not very convincing since the breadth of the axial lobe varies within wide limits in the adult of some species (or at least congeneric forms), e. g. *Phalacroma glandiforme* and *Ciceragnostus cicer*.

The above discussion may be summed up thus:

The agnostids constitute a pronouncedly homogeneous group and are awarded rank of family.¹

The Middle Cambrian genera of Scandinavia are included in the following subfamilies:

Condylopyginae RAYMOND, 1913 (partim).

Genera: *Condylopyge*, *Pleuroctenium*.

Peronopsinae (WESTERGÅRD, 1936).

Genera: *Peronopsis*, *Hypagnostus*, *Cotalagnostus*, *Clavagnostus*.

Diplagnostinae (WHITEHOUSE, 1936).

Genera: *Tomagnostus*, *Diplagnostus*, *Linguagnostus*, *Oidalagnostus*.

Agnostinae (JAEKEL, 1909).

Genera: *Ptychagnostus* (inclusive of *Triplagnostus*), *Goniagnostus*, *Doryagnostus*, *Aagnostus*, *Lejopyge*.

Phalacrominae (CORDA, 1847). Provisional; possibly polyphyletic.

Genera: *Ciceragnostus*, *Phoidagnostus*, *Phalacroma*.

The taxonomy of the agnostids must for the time being be founded to a great extent on morphological features, and much work remains to be done before it is possible to establish a safe phyletic foundation.

Observations on the ontogeny of the agnostids are still poor, but little having been added to that made known by Barrande as early as 1852.

¹ See also Troedsson, 1937, p. 19.

Condylopyginae RAYMOND, 1913.**Condylopyge** CORDA, 1847.Genotype: *Battus rex* BARRANDE, 1846.

In this genus there is here included a new species, *spinigera*, which is distinct from the genotype and other species belonging in it by a pair of marginal spines in the pygidium.

Representatives of the genus are known from the early and medial Middle Cambrian of Europe (Sweden, Great Britain, Bohemia, Southern France) and the Atlantic province of North America.

Condylopyge regia (SJÖGREN, 1872). — Pl. 2, figs. 1 a—b.

1936. *Condylopyge regia* (SJÖGREN), Westergård, S. G. U., Ser. C. No. 394, p. 27, pl. 1, figs. 1—3. (List of synonymy. Figs. of the complete dorsal shield. Öland.)

Remarks. — Sjögren illustrated this species by a very rough sketch of the dorsal shield and recorded it from Stora Frö and Borgholm. His specimens are possibly kept in the Paleozool. Dept. of the State Museum where, however, no complete specimen is to be found, and, as the type locality is not stated, no lectotype can be selected. Thus the specimen from Stora Frö figured in this paper may be considered neotype.

Agn. regius globosus ILLING, known only from the pygidium and found in the zone of *Par. hicksii* at Nuneaton, is sharply distinct from Sjögren's species as it lacks the oblique grooves on the lateral lobes and has a strongly elongate instead of circular tubercle on the axis.

Horizon and Localities. — *Par. oelandicus* stage (in Öland confined to the zone of *Par. insularis*). — Öland: Borgholm; Mossberga (boring); Stora Frö; Torp, parish of Böda (boulder). — Jämtland: Brunflo (boulder). — Fairly infrequent in Öland, rare in Jämtland.

Condylopyge carinata WESTERGÅRD, 1936. — Pl. 2, fig. 2.

1936. *Condylopyge carinata* WESTERGÅRD, S. G. U., Ser. C, No. 394, p. 27, pl. 1, figs. 4—8. (Described and discussed; figs. of the complete dorsal shield. Öland.)

Horizon and Localities. — Zone of *Par. pinus*. — Öland: Borgholm; Mossberga (boring). — Fairly infrequent.

Condylopyge spinigera WESTERGÅRD, 1944. — Pl. 2, figs. 3—8.

1944. *Condylopyge spinigera* WESTERGÅRD, S. G. U., Ser. C, No. 459, p. 23. (Imperfect cephalon and pygidium, in shale, briefly characterized and compared with *C. rex* and *Pleuroctenium*; no figure. Basal layer of the zone of *Ptychagn. (Pt.) punctuosus*. Andrarum, Scania.)

Description. — After the above paper was published some better preserved specimens (detached cephalata, pygidia, and one thoracic segment) of this form were collected from a stinkstone boulder at Brantevik.

3—462426. S. G. U. Ser. C, No 477. Westergård.

Cephalon subquadrangular, slightly constricted at the rear, moderately convex, rim of moderate breadth, marginal furrow well defined. Anterior glabellar lobe obtusely pointed in front, posterior lobe with a pair of faint lateral furrows at the anterior third and a feeble median keel in the posterior half. Cheeks swollen along the axial furrows, the swellings being divided by a pair of depressions opposite the transverse glabellar furrow. Occipital segment well-defined, off the axial furrows swollen and projecting into a pair of blunt points; basal lobes indistinctly separated from the narrow band behind the glabella.

A detached thoracic segment resembles that of the genotype.

Pygidium subquadrangular, slightly constricted anteriorly, of low convexity; rim fairly broad, with a pair of short marginal spines; marginal furrow well defined (in young specimens curving slightly forwards at the median line). Axis almost parallel-sided, widened anteriorly, convex, with a prominent median keel extending from the anterior margin into the third ring; three rings in addition to the end-lobe indicated by lateral furrows, the anterior pair distinct, the two posterior pairs faint. Lateral lobes with a pair of furrows starting from the anterior ring furrow and curving backwards; display a pair of oblique depressions (recalling the oblique grooves in *C. regia*) and, behind these, a pair of bosses which in young specimens are more strongly pronounced than in full-grown and in the former separated by a median furrow that is effaced in the latter.

Size. — The largest cephalon retaining the original convexity (fig. 4) 5.6 mm long and 5.5 mm broad; a pygidium (holotype, fig. 8) 3.8 mm long, the spines not considered.

Affinities. — In the cephalon there do not exist any very important differences between *spinigera* and *rex*: the subquadrangular outline is more pronounced and the marginal furrow better defined in the former than in the latter, and the depression across the swellings of the cheeks in the former are absent in the latter. The marginal spines of the pygidium are absent in other known species referable to *Condylopyge* and are a characteristic which *spinigera* has in common with the otherwise remote *Pleuroctenium*.

The nature of the furrows in the lateral lobes is doubtful. The present writer has never observed this character in the adult of any other agnostid, and even in immature forms it is extremely rare (cf., e. g., *Agn. acadicus declivis* MATTHEW, 1896, pl. 15, fig. 11 c). As the furrows in *spinigera* start directly from the ring furrow, they do not seem to be homologous with those sometimes occurring in the Eodiscidae, which correspond to the pleural furrows in the thoracic segments. They might be compared with the diagonal accessory furrows of *Pseudagnostus* and *Oidalagnostus*, which, however, start from the second instead of the first ring furrow.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) atavus* at Brantevik (boulder 80); basal layer of the zone of *Pt. (Pt.) punctuosus* and probably also the former zone at Andrarum (boring), Scania. — Rare.

Condylopyge rex (BARRANDE, 1846). — Pl. 2, figs. 9—13.

1846. *Battus rex* BARRANDE, Notice prélim. sur le syst. Silurien et les Trilob. de Bohême, p. 17.
 1847. *Condylopyge rex* (BARRANDE), Hawle & Corda, Prodröm. Monogr. böhm. Trilob., p. 50, pl. 3, fig. 24 (Description and fig. of the dorsal shield. Skrey, Bohemia.)
 1852. *Agnostus rex* (BARRANDE), Barrande, Syst. Silur., vol. 1, p. 908, pl. 49. (Exhaustive description and figs. of the dorsal shield at different stages of growth. Skrey, Bohemia.)
 1880. *Agnostus rex* (BARRANDE), Tullberg, S. G. U., Ser. C, No. 42, p. 30, pl. 2, figs. 21 a, b. (Description and figs. of cephalon and pygidium. Andrarum, loc. 7, Scania.)
 1895. *Agnostus rex* (BARRANDE), Pompeckj, Jahrb. k. k. Reichsanst., vol. 45, p. 523. (Remarks on species. Tejrovic and Skrey, Bohemia.)
 1916. *Agnostus rex* (BARRANDE), Illing, Q. J. G. S., vol. 71, p. 420, pl. 32, figs. 15, 16, (17?); pl. 33, fig. 1. (Description and figs. of cephalon and pygidium. Zones of *Par. aurora* and *Par. hicksii*. Nuneaton, England.)

Remarks and Affinities. — A great number of specimens from Andrarum are present, all poorly preserved in shale, however. In the Scanian form the frontal glabellar lobe is usually rounded anteriorly, rarely tending to become subtriangular (fig. 10) as in Barrande's figures, and the anterior tubercle of the posterior glabellar lobe is circular instead of elongate. Otherwise it seems to agree with the Bohemian form.

C. rex is closely related to *C. carinata*. It differs in having the cheeks slightly narrower in their anterior portion, a faint tubercle just in front of the centre of the posterior glabellar lobe, the keel-shaped tubercle on the axis of the pygidium extending into the first ring, and the axial end-lobe slightly more widened.

Horizon and Localities. — Not infrequent in a thin layer in the zone of *Hypagn. parvifrons* at Andrarum, Scania. An imperfect cephalon occurring immediately above the Exsulans limestone in a boring core from this locality, which was tentatively identified as *rex* by the present writer in 1944, may belong to *spinigera*, since the latter species was recently found at about the same horizon at Brantevik.

Bohemia; zone of *Par. rugulosus*. — Great Britain; zones of *P. aurora* (rare) and *P. hicksii*. — Newfoundland; zones of *P. hicksii* and *P. davidis*.

Pleuroctenium CORDA, 1847.

Genotype: *Battus granulatus* BARRANDE, 1846.

The genus has the same range and geographic distribution as *Condylopyge*.

Pleuroctenium scanense sp. n. — Pl. 2, figs. 14—17.

Remarks and Affinities. — Two cephalons and four pygidia of a *Pleuroctenium* are present, which, however, are too poorly preserved to allow of a close description. Broadly speaking, the species agrees fairly well with the genotype recorded from Bohemia, Great Britain, and Newfoundland. It differs in the following characteristics: the median indentation at the anterior outline of the glabella is more pronounced, median and radiating furrows on the frontal glabellar lobe are not discernible (which might be due to imperfect preservation), the axial end-lobe is less expanded, and the marginal spines

of the pygidium are shorter. It cannot be ascertained whether the test is finely granulate or smooth. The species is more remote from other Middle Cambrian species referable to this genus, i. e. *Agnostus bifurcatus* ILLING and *A. tuberculatus* ILLING at Nuneaton, England, and *Pl. magnificum* HOWELL from Hérault, France.

Size. — Largest cephalon, the holotype, 4.0 mm long and 3.4 mm broad; largest pygidium 4.0 mm long and 3.7 mm broad.

Horizon and Locality. — Zone of *Hypagn. parvifrons*. Associated with *Condylopyge rex*. Andrarum, Scania. — Very rare.

Peronopsinae (WESTERGÅRD, 1936).

Peronopsis CORDA, 1847.

Genotype: *Battus integer* BEYRICH, 1845.

Quadragnostus HOWELL (1935 a), whose type, *Q. solus* HOWELL, displays a close resemblance to *Agn. quadratus* TULLBERG, includes a group of forms which, as compared with *Peronopsis*, has the transverse glabellar furrow curving backwards, the pygidium somewhat expanded posteriorly, and the axial end-lobe depressed. In these features the pygidium of *P. fallax depressa* described below approaches *quadratus* and its allies, and the course of the glabellar furrow is variable and no reliable criterion, in *fallax* sometimes curving backwards and in *quadratus* sometimes being straight. Thus the present writer agrees with Kobayashi in considering *Quadragnostus* a synonym of *Peronopsis*; at the utmost the former should be awarded subgeneric rank.

As a new genus of Peronopsidae Kobayashi (1939 a) erected *Acadagnostus* with *Agn. acadicus* HARTT as the type, which was characterized thus: »Archaeagnostinae with conical axis and post-axial furrow on rounded pygidium without spines. Cephalic outline tends to be subquadrate.» These criteria seem to be of little value, however. In the genus were included *inter alia*, *scutalis* SALTER (pars) and *pusillus* TULLBERG, i. e. species which in cephalon and pygidium, too, except in the length of the axis, agree fairly well with *integer*, and thus they are here referred to *Peronopsis*.

In Scandinavia *Peronopsis* appears in the zone of *Par. pinus* and ranges to the top of the Middle Cambrian. It has a world-wide distribution.

Peronopsis integra (BEYRICH, 1845).

1936. *Peronopsis integra* (BEYRICH), Westergård, S. G. U., Ser. C, No. 394, p. 28, pl. 1, figs. 16—18. (Figs. of a complete specimen and two pygidia, possibly collected from the lowest portion of the *Par. oelandicus* beds at Vickleby, Öland.)

Remarks. — As emphasized in the paper cited it is very doubtful whether this species was really found in Öland. If it was, it is the oldest agnostid so far known from Sweden. It should be noted that *integra* is recorded from much younger strata in England, viz. the zone of *Par. hicksii* (Illing, 1916).

Peronopsis fallax (LINNARSSON, 1869). — Pl. 2, figs. 18—24.

1936. *Peronopsis fallax* (LINNARSSON), Westergård, S. G. U., Ser. C, No. 394, p. 28, pl. 1, figs. 9—15. (List of synonymy; remarks on species; figs of specimens at different stages of growth from the zone of *Par. pinus*, Öland.)

R e m a r k s. — Some specimens of *P. fallax* in a slab of stinkstone collected by Linnarsson from the *gibbus* zone at Djupadalen, Västergötland, probably belong to the syntypes of the species. Two of them are illustrated in this paper (figs. 18 and 19). These as well as specimens from the same zone at other localities indicate that Linnarsson's figures may be inadequate in some details. Thus the frontal glabellar lobe is in reality slightly shorter, the posterior glabellar lobe has a pair of faint lateral impressions at the anterior third and a faint tubercle at the centre, the basal lobes are slightly larger, and the axis of the pygidium usually shorter than in Linnarsson's figures. — The outline of the cephalon is sometimes subquadrangular and sometimes evenly rounded in front. As a rule the pygidial axis does not extend quite to the marginal furrow except in the form predominant in the zone of *Par. pinus*. The lateral lobes are separated by a shallow and fairly broad post-axial furrow or confluent. The present writer has never found a specimen with the pygidial axis so distinctly trilobed and the end-lobe so strongly widened as seen in Tullberg's fig. 22 of pl. 2. The various forms are sometimes found associated on one bedding plane.

A form from Wales was identified as *fallax* by Lake (1906); as only the cephalon is known the identification is uncertain, however. Illing's *fallax* from the Upper *Par. hicksii* zone and the Lower *Par. davidis* zone at Nuneaton has a somewhat narrower, and in his fig. 14 more tapering, axis than Linnarsson's species with which it otherwise seems to agree.¹ The fragments from the *Par. davidis* fauna of Comley illustrated by Cobbold (1911) as *fallax* possibly belong to this species. The Canadian forms resembling *fallax* and described by Matthew (1896) want a re-examination. It should also be remarked that certain other American forms display more or less close resemblance to *fallax*, e. g. *Agn. bonnerensis* RESSER (1938a, 1939a), «a typical form of the Cordilleran Middle Cambrian».

H o r i z o n a n d L o c a l i t i e s. — Ranges from the base of the zone of *Par. pinus* to the top of the zone of *Hypagn. parvifrons*. Fairly sparse in the *pinus* zone, very rare in the Exsulans limestone, as a rule not infrequent — sometimes even common — in the overlying zones. Found in all Scandinavian areas where the beds mentioned are accessible.

Peronopsis fallax depressa subsp. n. — Pl. 2, figs. 25, 26.

D i a g n o s i s. — Pygidium of low convexity, slightly widened posteriorly; axial end-lobe gently depressed.

R e m a r k s. — A complete young specimen proves that the illustrated shields belong to one and the same form. The transverse glabellar furrow is

¹ Of the specimens illustrated by Illing, Kobayashi (1939, p. 117) distinguished figs. 13 and 15 as *P. fallax* forma *hartshillensis* and fig. 14 as *P. fallax* forma *conica*.

straight or bent slightly backwards. The cheeks are as a rule smooth but in a few specimens slightly grooved. In the pygidium *depressa* is distinct from other forms of *fallax* and approaches *cylindrica* described below. — The holotype fig. 26, of middle size, is 4.0 mm long and 4.3 mm broad.

Horizon and Locality. — Zone of *Hypagn. parvifrons*. Gislövshammar (boulders 99 and 116), Scania. — Infrequent.

Peronopsis fallax ferox (TULLBERG, 1880). — Pl. 2, figs. 27 a, b; pl. 3, figs. 1, 2.

1878. *Agnostus fallax* LINNARSSON [partim], Brögger, N. M. N., vol. 24, p. 65 (49). (The form No. 4 from the zone of *Par. rugulosus*, whose pygidium is described but not depicted, may belong here. Krekling, Norway.)

1880. *Agnostus fallax* LINNARSSON, forma *ferox* TULLBERG, S. G. U., Ser. C, No. 42, p. 32, pl. 2, figs. 23 a—c. (Description and figs. of cephalon and pygidium. Zones of *Ptychagn. (Pt.) punctuosus* and *Pt. (Triplagn.) lundgreni*. Andrarum, Scania; Bornholm.)

1902. *Agnostus fallax* LINNARSSON, forma *ferox* TULLBERG, Grönwall, D. G. U., II. Række, No. 13, p. 69. (Remarks on this form from Bornholm.)

Remarks. — One of Tullberg's specimens from Borregaard, Bornholm, is illustrated in fig. 27 and is selected lectotype. This form is distinct from *fallax* by the shorter pygidial axis and the lateral lobes being subequal in breadth throughout and confluent. Forms intermediate between the species and subspecies occur mainly in the layers between those in which the species and subspecies predominate.

Horizon and Localities. — Not infrequent in the zones of *Ptychagn. (Pt.) punctuosus* and *Pt. (Triplagn.) lundgreni*, rare in the lowest portion of the zone of *Solenopleura brachymetopa*.¹ — Known from the Scandinavian areas in which these zones are well developed and accessible.

Peronopsis fallax minor (BRÖGGER, 1878). — Pl. 3, figs. 3—7.

1878. *Agnostus fallax* LINNARSSON, var. 3 BRÖGGER, N. M. N., vol. 24, p. 65 (49). (Briefly characterized; no fig. The subspecific name is found on the table facing p. 34 (18). *Par. forchhammeri* beds. Krekling, Norway.)

Remarks. — Brögger characterized this form thus: distinct from *fallax* by the lateral lobes being confluent behind the axis and by the smaller size of the shields (length 2.5 mm). Consequently the form might be expected to agree with *fallax ferox* except in the size. The Swedish specimens from the zone in question are variable, however, especially as regards breadth and length of the pygidial axis, which sometimes is short and in such a case the lateral lobes are confluent, and sometimes extends to the rim. The rim of cephalon as well as pygidium is flat and the marginal furrow almost effaced whereas in *ferox* and other forms of *fallax* the very border is relatively narrow and convex and the marginal furrow pronounced and fairly broad. The size is small, no shield present exceeding 3 mm in length. This variable form may be referable to Brögger's var. 3.

¹ Tullberg's statement that *P. fallax ferox* ascends into the zone of *Lejopyge laevigata* in Västergötland (Gudhem) has not been corroborated by later researches and is probably incorrect. A cephalon from this zone at Djupadalen, Västergötland, identified as *fallax ferox* by Wallerius (1895, p. 43) is described below under the name of *Oidalagnostus trispiniifer*.

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum. — Jämtland: Vedjeön. — Ångermanland: Aborrället. — Very rare in Scania, infrequent in Northern Sweden. — Norway: Oslo district.

Peronopsis brunfloensis sp. n. — Pl. 3, figs. 8, 9.

Diagnosis. — Distinct from *P. fallax* and its subspecies by proportionally longer anterior glabellar lobe, semi-elliptical outline of pygidium, and rudimentary marginal spines.

Description. — Both shields with evenly rounded distal outline, slightly convex rim of moderate breadth, not very pronounced marginal furrow, and rather high convexity. Glabella occupying about two-thirds the cephalic length, subcylindrical or gently conical; anterior lobe slightly more than one-third the glabellar length; posterior lobe with a pair of faint lateral impressions at the anterior third and a small tubercle at, or in front of, the centre. Basal lobes moderate, triangular. Cheeks subequal in breadth throughout.

Thorax like that of *fallax*.

Pygidium varying as regards breadth, length, and convexity of the axis, and, accordingly, the lateral lobes are almost as broad as the latter or much narrower and subequal in breadth throughout or narrowing posteriorly. Annulation of the axis quite or almost imperceptible; median tubercle prominent. Post-axial median furrow absent or, in young specimens, faintly indicated. — Test of cephalon and pygidium smooth.

Size. — The holotype, a large specimen, is about 8 mm in total length (cephalon 3.4, pygidium 3.1) and 3.6 mm broad across the cephalon.

Horizon and Locality. — Common in a layer with *Par. jemtlandicus* forming the basal layer of the *Par. paradoxissimus* beds at Brunflo, Jämtland.

Peronopsis cylindrica sp. n. — Pl. 3, figs. 17—21.

Diagnosis. — A form closely related to *P. quadrata* from which it differs in having subcylindrical instead of conical glabella (in full-grown specimens) and the pygidial axis being parallel-sided instead of tapering in the anterior two-thirds. Both shields more strongly constricted at the proximal margin in the former than in the latter.

Description. — Cephalon and pygidium subquadrangular, widened distally; rim rather flat and broad, narrowing to the proximal margin; marginal furrow especially in the pygidium indistinct and very shallow. Cephalon convex posteriorly, with the cheeks steeping vertically at the posterior corners. Glabella subcylindrical, transverse furrow curving strongly backwards; anterior lobe small, much broader than long; posterior lobe with a pair of well-defined lateral impressions at about the anterior third and a small central tubercle. Basal lobes of varying size, sometimes almost meeting at the middle line. Cheeks slightly narrower than the glabella, subequal in breadth throughout, smooth (faintly scrobiculate in one specimen).

Thorax unknown.

Pygidium less convex than the cephalon; axis subequal in breadth in the anterior two-thirds, rapidly tapering and depressed in the posterior third, not extending to the rim, with a prominent median tubercle; annulation obsolete. Lateral lobes narrower than the axis, confluent.

Size. — The holotype, fig. 18, one of the largest pygidia present, is 5.4 mm in length and breadth.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) punctuosus*. Gislövshammar and Brantevik (boulders), Scania. — Infrequent.

Peronopsis quadrata (TULLBERG, 1880). — Pl. 3, figs. 22—29.

1880. *Agnostus quadratus* TULLBERG, S. G. U., Ser. C., No. 42, p. 34, pl. 2, figs. 25 a, b. (Description and figs. of cephalon and pygidium from the Andrarum limestone. Andrarum, Scania.)

Remarks and Affinities. — Two of Tullberg's syntypes are seen in fig. 22, the pygidium is selected lectotype. In young specimens the glabella is subcylindrical, in full-grown conical. The transverse glabellar furrow is as a rule bent backwards, rarely straight. The pygidium is slightly widened backwards and the lateral outline is gently curved (not straight as in Tullberg's figure). Ratio of length and breadth varies in both shields. At Aborrhallet, Ångermanland, the typical form is associated with a form differing in having a faint and short median furrow in the posterior portion of the preglabellar area, as in the subspecies *sulcata* to be described.

P. quadrata should be compared with *Quadragnostus solus* HOWELL (1935 a, 1937 a) from the *Centropleura vermontensis* zone of Vermont. As regards the pygidium the resemblance seems to be complete, save that the axis in the latter touches the rim and the tubercle is more elongate. Also in the cephalon the species agree in essential features at least; a close comparison cannot be carried out, however, due to the imperfect preservation of the American specimen.

P. fallax, *fallax depressa*, *cylindrica*, and *quadrata* form a rather continuous evolutionary series.

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum; Kiviks-Esperöd; Gislövshammar (boring). — Västergötland: Torbjörntorp. — Jämtland: Vedjeön; Hillsand; Siljeåsen. — Ångermanland: Brattbäcken; Kvarnån; Aborrhallet. — Rare in Scania and Västergötland, fairly infrequent in Jämtland and Ångermanland.

Bornholm.

Peronopsis quadrata sulcata subsp. n. — Pl. 4, figs. 1, 2.

Diagnosis. — Distinct from *quadrata* by having faint radiating grooves and rounded pits in the checks and a short and weak median furrow in the posterior portion of the preglabellar area. The holotype, fig. 1, is 4.5 mm long.

But a few specimens have been found; they are associated with *quadrata*. — Andrarum, Scania. Aborrhallet, Ångermanland.

Peronopsis sp. — Pl. 4, figs. 3 a, b.

A single cephalon of this form is present. It does not seem to be referable to any hitherto known form and may be more closely related to *quadrata* than to any form of *fallax*. It was collected from the upper part of the zone of *Lejopyge laevigata* at Gudhem, Västergötland.

Peronopsis scutalis (SALTER in HICKS, 1872). — Pl. 4, figs. 4—11.

1872. *Agnostus scutalis* SALTER [partim], HICKS, Q. J. G. S., vol. 28, p. 175, pl. 5, figs. 12 and 13, probably figs. 11 and 14, not figs. 9 and 10. (Description based on different species; figs. of complete specimens from the Menevian of Wales.)
1880. *Agnostus parvifrons* LINNARSSON, forma 1 TULLBERG, S. G. U., Ser. C., No. 42, p. 35, pl. 2, fig. 26. (Pygidium described and depicted. Andrarum, loc. 6, Scania.)
1902. *Agnostus exaratus* GRÖNWALL, D. G. U., II. Række, No. 13, p. 77, pl. 1, fig. 17. (Description and fig. of pygidium. Zones of *Hypagn. parvifrons* and *Par. davidis*. Bornholm.)
1906. *Agnostus exaratus* GRÖNWALL, Lake, Pal. Soc., Brit. Cambr. Trilob., p. 6, pl. 1, figs. 8—10. (Revised description and new fig. of one of Hicks's specimens and figs. of other specimens from the Menevian of Wales.)
1916. *Agnostus exaratus* GRÖNWALL, var. *tenuis* ILLING, Q. J. G. S., vol. 71, p. 406, pl. 28, figs. 2—5. (Description and figs. of complete specimens. Zones of *Par. aurora* — *Par. davidis*. Nuneaton, England.)

Remarks. — After examination of the syntypes known Lake established that Hicks included in *scutalis* specimens of at least two distinct species, viz. *exaratus* GRÖNWALL and *punctuosus* ANGELIN. Illing distinguished two closely related forms, one identical with *exaratus* and occurring at the same level in Great Britain as on Bornholm, and the variety *tenuis* with greater range than *exaratus* from which it was stated to differ in the subquadrate shape of the anterior glabellar lobe, the narrower and more tapering pygidial axis, and larger size. This form agrees with Hicks's and Lake's figures quoted above.

Since different species were originally included in *scutalis*, Salter's specific name was discarded by Lake and replaced by Grönwall's *exaratus*, a suggestion accepted by Illing and Kobayashi. According to the International Rules the former name, used in a restricted sense, is valid, however.

As seen from the figures the Scanian species identified as *scutalis* varies in the breadth of the glabella and the length and breadth of the pygidial axis. The latter is, as a rule at least, narrower than in the holotype of *exaratus*, which, if distinguished, should be called *P. scutalis exaratus* (GRÖNWALL). Well-preserved specimens display a very faint tubercle at the centre of the posterior glabellar lobe. The deep and broad axial and post-axial furrows, conspicuous especially on internal casts, seem to constitute a good characteristic. — In most of the specimens present cephalon and pygidium are 2—3 mm long; 5—6 mm long shields are rare.

In the cephalon *P. scutalis* resembles the associated *fallax* from which it differs in markedly longer frontal glabellar lobe and on a side-view (see the figs.). The pygidium might be confounded with that of the associated *Cotalagnostus lens claudicans*; compared with the latter it has deeper and broader furrows, narrower, more pointed, and generally shorter axis which is more or less depressed posteriorly. — Tullberg's *Agn. parvifrons* forma 1, a poorly preserved specimen in shale of which a new figure is given in this paper, probably belongs to *scutalis*.

Kobayashi (1939 a) included this species in his new genus *Acadagnostus*.

Horizon and Localities. — Appears immediately above the Exsulans limestone and ranges to the top of the *Ptychagn. (Pt.) atavus* zone. Andrarum; Brantevik and Gislövshammar, Scania. Not infrequent in some boulders from the latter localities.

Great Britain. — Newfoundland(?).

Peronopsis pusilla (TULLBERG, 1880). — Pl. 4, figs. 12—18.

1880. *Aagnostus pusillus* TULLBERG, S. G. U., Ser. C., No. 42, p. 36, pl. 2, fig. 30. (Description and fig. of pygidium. Zone of *Ptychagn. (Pt.) punctuosus*. Andrarum, Scania.)

1902. *Aagnostus pusillus* TULLBERG, Grönwall, D. G. U., II. Række, No. 13, p. 77, pl. 1, fig. 18. (Description and fig. of pygidium. Zones of *Hypagn. parvifrons* and *Par. davidis*. Bornholm.)

?1902. *Aagnostus lingula* GRÖNWALL [partim], idem, p. 73, pl. 1, fig. 14, not fig. 15. (The described and illustrated cephalon agrees with *pusilla*. Zone of *Par. davidis*, Bornholm.)

Description. — Both shields fairly convex, slightly broader than long, rarely equal in length and breadth. Cephalon with a narrow rim followed by a shallow furrow. Glabella occupies about two-thirds the length and about one-third the breadth of the cephalon, almost parallel-sided; anterior lobe rounded or gently angulate in front; posterior lobe with a pair of faint lateral impressions at the anterior third and, between them, a small median tubercle. Axial furrows deep along the posterior and shallow along the anterior glabellar lobe. Basal lobes small, connected by a thread-like band behind the glabella. Cheeks narrowing forwards, confluent, with scattered short and faint furrows and pits.

Thorax unknown.

Pygidium with rather evenly rounded posterior outline or tending to become subquadrangular; rim a little broader than in the cephalon, slightly widened at the rear; marginal furrow shallow, widened posteriorly. Axis occupying about one-third the total breadth, short but varying in length, inconsiderably contracted at the second ring which bears an elongate tubercle; ring furrows very faint in young and almost or quite obliterated in full-grown specimens. Lateral lobes equal in breadth throughout or narrowing backwards, separated by a narrow and shallow post-axial furrow; test smooth or very faintly shagreened.

Size. — The largest cephalon found (fig. 14) is 3.3 mm long and 3.7 mm broad; the largest pygidium (fig. 15) 3.4 and 3.8 mm in length and breadth.

Remarks. — Tullberg knew this species but from the pygidium — a new figure of the holotype is seen in fig. 12. Since then a great many specimens have been collected, and even though no complete dorsal shield has been found, there may be no doubt that the cephalon here in question is conspecific with the pygidium.

The cephalon of *Agn. lingula* GRÖNWALL which was based on two cephalons and one pygidium from the *Par. davidis* zone of Bornholm has the furrows on the cheeks more strongly pronounced than might be concluded from Grönwall's figure and is not distinguishable from that of *pusilla*. The pygidium differs from the latter in having confluent and faintly granular lateral lobes. Thus it

seems probable that the cephalon should be identified as *pusilla* and that the cephalon of *lingula* is unknown. If, on the other hand, cephalon and pygidium are conspecific, as advocated by Grönwall, *lingula* may be a subspecies of *pusilla*. No pygidium like that of *lingula* has so far been found in Scania.

Kobayashi (1939 a) included *pusilla* in his new genus *Acadagnostus*.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) punctuosus*. — Scania: S. Sandby (boring); Andrarum; Kiviks-Esperöd; Baskemölla; Brantevik and Gislövshammar. — Västergötland: Byklev (teste Grönwall). — Everywhere infrequent.

Bornholm. — Öksna in Norway (teste Grönwall). — On Bornholm and in Norway the species appears already in the zone of *Hypagn. parvifrons*. — *Agn. cf. pusillus* was recorded from Newfoundland by Howell (1925).

Peronopsis insignis (WALLERIUS, 1895). — Pl. 3, figs. 10—15.

1895. *Aagnostus fallax* LINNARSSON var. *insignis* WALLERIUS, Zonen med *Aagnostus laevigatus*, p. 44 pl. 1, figs. 3 a, b. (Description and figs. of cephalon and pygidium. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland.)
1930. *Aagnostus insignis* WALLERIUS, G. F. F., vol. 52, p. 58, fig. 7. (The form awarded rank of independent species; the figs. of the preceding paper reproduced.)

Remarks and Affinities. — *P. insignis* is distinct from *fallax* and its subspecies by semi-elliptical outline of cephalon and pygidium, somewhat shorter and more conical glabella, more tapering pygidial axis, axial furrows almost or quite effaced at the termination of the axis, and rudimentary marginal spines. The rim is rather flat and the marginal furrow shallow in both shields. Test smooth; one cephalon has faintly scrobiculate cheeks.

A small pygidium (pl. 3, fig. 16), associated with *insignis*, is distinct from this species by proportionally greater length, broader axis, and lacking any traces of marginal spines. The axis displays four pairs of muscle scars. It may belong to a form closely related to *insignis*.

Horizon and Localities. — Zone of *Lejopyge laevigata*, upper part. — Västergötland: Gudhem; Torbjörntorp; Djupadalen; Ödegården; Oltorp. — Not infrequent.

Hypagnostus JAEKEL, 1909.

Genotype: *Aagnostus parvifrons* LINNARSSON, 1869.

The most conspicuous characteristic of this group is the short and non-lobate glabella whose frontal lobe is effaced. This induced Tullberg to place it in an independent section, Parvifrontes. In some forms, e. g. *truncatus*, the glabella is strictly truncate and has the anterior corners sharply angulate, as is the case in agnostids with the anterior lobe developed. Specimens of the genotype and other congeneric forms sometimes display an indistinctly delimited elevation immediately in front of the glabella, and, exceptionally, the anterior lobe seems to be very faintly outlined (cf. *truncatus* BRÖGGER, 1875, and *parvifrons tessella* MATTHEW, 1896). These are transitional forms between Limbati-Fallaces and Parvifrontes, as pointed out by Matthew, and indicate that *Hypagnostus* arose from *Peronopsis*.

As regards the taxonomic position of *Agn. exsculptus* ANGELIN divergent opinions have been advanced. The cheeks of the species have radiating grooves, two of which simulate prolonged axial furrows. Tullberg interpreted these grooves as true axial furrows and the space between them as the anterior glabellar lobe, which in such a case extends to the marginal furrow. Accordingly he included the species in Longifrontes, an opinion with which Jaekel agreed as he placed *exsculptus* in Agnostidae. On the other hand Wallerius (1895) emphasized that the grooves in question are homologous with the other grooves of the cheeks, that no anterior glabellar lobe is traceable, and that the species belongs to Parvifrontes. Wallerius's interpretation of the grooves is beyond doubt correct and Whitehouse (1936) evidently arrived at the same result and included *exsculptus* in *Hypagnostus*. Kobayashi (1939) is of a different opinion, however, stating: »I agree with Tullberg in combining *exsculpta* with [*Tomagnostus*] *fissus* in Longifrontes rather than placing it in Parvifrontes, because the cephalon of *exsculptus* agrees with that of Matthew's *trifissus* in most respects» (p. 151) and regards *exsculptus* as the type of an independent genus denominated *Tomagnostella*. In some respects *exsculptus* resembles full-grown specimens of *Ptychagn. (Triplagn.) convexus* sp. n. and on account of that (not for the reasons adduced by Kobayashi) the present writer at first believed that *Tomagnostella* might be a valid genus and a member of the Agnostinae but soon had to give up this idea. In young specimens of *convexus* the anterior glabellar lobe and the preglabellar median furrow are well-defined; no very young specimens of *exsculptus* are present but of the closely allied *sulcifer* one mm long cephalons do not display any vestiges of either the anterior glabellar lobe or the preglabellar furrow (but sometimes a depression rather than a furrow in the anterior portion of the preglabellar area). On the other hand there is a striking resemblance in the cephalon between *exsculptus* and certain species of *Hypagnostus*, e. g. *truncatus* forma 1 (pl. 5, fig. 10). The pygidium of *exsculptus* is not yet definitely known; that of *sulcifer* is very like that of *H. nepos*, however. Thus, as far as can be concluded from our present knowledge of *exsculptus* and akin forms, they should be included in *Hypagnostus*.

Spinagnostus HOWELL (1935 a), with *franklinensis* from the *Centropleura vermontensis* fauna of Vermont as the type and only known species, is distinct from *Hypagnostus* by a pair of short spines at the rear corners of the cephalon and a pair of stout marginal spines on the pygidium. As no other differences of any importance are to be found and the spinosity itself does not imply generic distinction (cf. *Lejopyge laevigata armata*, *Goniagnostus spiniger*, and *Aagnostus pisiformis spiniger*) the present writer considers *Spinagnostus* a synonym of *Hypagnostus*. — *Cyclopagnostus* HOWELL (1937 a) may be another synonym (cf. *H. brevifrons*).

In Scandinavia *Hypagnostus* appears in the zone of *Ptychagnostus (Pt.) atavus* and ranges to the top of the zone of *Lejopyge laevigata*. Outside Scandinavia representatives of the genus are known from the Middle Cambrian of Great Britain, the Atlantic province of North America, Eastern Asia, and Australia.

Hypagnostus parvifrons (LINNARSSON, 1869). — Pl. 4, figs. 27—31.

1869. *Agnostus parvifrons* LINNARSSON, Vet.-Ak. Handl., vol. 8, No. 2, p. 82, pl. 2, figs. 56, 57. (Description and figs. of cephalon and pygidium. Zone of *H. parvifrons*. Hällekis, Västergötland.)
1880. *Agnostus parvifrons* LINNARSSON [partim], Tullberg, S. G. U., Ser. C., No. 42, p. 34, pl. 2, figs. 27 a, b. (Only forma 2; described and depicted. Andrarum, loc. 8, Scania.)
1902. *Agnostus parvifrons* LINNARSSON [partim], Grönwall, D. G. U., II. Række, No. 13, p. 74. (Remarks on species from Bornholm.)
1916. *Agnostus parvifrons* LINNARSSON, Illing, Q. J. G. S., vol. 71, p. 422, pl. 32, fig. 10. (Cephalon, probably belonging to this species, described and figured. Zones of *Par. hicksii* and *P. davidis*. Nuneaton, England.)
1929. *Agnostus parvifrons* LINNARSSON, Strand, N. G. T., vol. 10, p. 347, pl. 1, fig. 14. (Pygidium figured. Mjösen district, Norway.)

Remarks. — The cephalon depicted by Linnarsson and an associated pygidium, are re-illustrated in figs. 27 and 28 on pl. 4. The following characteristics should be noticed: the glabella is not quite half as long as the cephalon and rounded in front; the pygidial axis is shorter than the lateral lobes but nevertheless meets the rim, which projects forwards at the axial line.

The species varies in the glabella, which is sometimes somewhat larger than in the holotype but does not exceed half of the cephalic length; sometimes it is fairly truncate in front. The cheeks are as a rule smooth, very rarely faintly scrobiculate and, in such a case, approaching *cicatricosus* subsp. n. The pygidium varies in convexity and length of the axis but is otherwise fairly constant, and the rim projecting forwards at the axial line seems to be a reliable characteristic.

In addition to the typical form Brögger distinguished two varieties, viz. *mammillata* and *nepos*, the latter of which is here awarded specific rank. Tullberg included in *parvifrons* three distinct forms of which but No. 2 is identical with Linnarsson's species; No. 3 is referable to *H. nepos* and No. 1 may belong to *Peronopsis scutalis*.

Of the extra-Scandinavian forms identified as *parvifrons* the one described by Illing probably belongs to this species, whereas the varying forms from the *Par. forchhammeri* grits of the Rushton area made known by Cobbold (1934) seem to be remote. Forms similar to *parvifrons* occur in the Atlantic province of North America, and the true *parvifrons* was recorded by Howell (1937 b) from New Brunswick. *H. vortex* WHITEHOUSE (1936) and *clipeus* WH. (1939) from Australia differ from *parvifrons* mainly in the pygidium whose rim is not expanded at the rear. *H. latelimbatus* (LORENZ) from Schantung in China, re-examined by Kobayashi (1938), seems to display closer resemblance to the Swedish species than claimed by Kobayashi.

Horizon and Localities. — Appears in the lower portion of the *Ptychagn. (Pt.) atavus* zone and is common in the *H. parvifrons* zone at many localities. Widely distributed in Scandinavia.

Great Britain. — Eastern North America.

Hypagnostus parvifrons mammillatus (BRÖGGER, 1878). — Pl. 5, figs. 2—4.

1878. *Agnostus parvifrons* LINNARSSON var. *mammillata* BRÖGGER, N. M. N., vol. 24, p. 72 (56), pl. 5, figs. 3 a—d. (Description and figs. of a complete, enrolled specimen. Krekling, Norway.)

1929. *Agnostus parvifrons mammillatus* BRÖGGER, Strand, N. G. T., vol. 10, p. 347, pl. 1, figs. 15, 19. (Description and figs. of cephalon and pygidium. Zones of *Par. paradoxissimus* and *P. rugulosus*. Mjösen district, Norway.)

Remarks. — Compared with *parvifrons* the subspecies has more convex pygidium with greatly raised axis, the tubercle more nearly to the centre, and the rim still more widened behind the axis. The subspecies occurs associated with the species and is connected to it by intermediate stages.

Horizon and Localities. — Appears in the zone of *Ptychagn. (Pt.) atavus*, is usually common in the upper part of the *H. parvifrons* zone, and continues into the zone of *Ptychagn. (Pt.) punctuosus* where it is rare. — Scania: Andrarum; Brantevik and Gislövshammar. — Öland: on the shore WSW of Mörbylilla; Degerhamn. — Västergötland: Falbygden, Billingen, Kinnekulle, and Hunneberg. — Jämtland: Hillsand. — Ångermanland; Brooklet 2 km E of Tåsjö church; Tjärnmyrberget.

Bornholm. — Norway: Oslo and Mjösen districts. — *H. cf. parvifrons mammillatus* was recorded by Howell (1925) from Newfoundland.

Hypagnostus parvifrons cicatricosus subsp. n. — Pl. 5, fig. 1.

Diagnosis. — Differs from *parvifrons* in the cheeks, which are ornamented with well defined though narrow and shallow irregular radiating furrows. Intermediate stages have been observed.

The holotype, a cephalon retaining the original convexity, 4.2 mm long and 4.1 mm broad, was collected from a stinkstone boulder at Trolmen, Västergötland, crowded with specimens of *parvifrons* and *parvifrons mammillatus*. — Very rare.

Hypagnostus truncatus (BRÖGGER, 1878).

1875. *Agnostus* sp. BRÖGGER, G. F. F., vol. 2, p. 579, pl. 25, fig. 1. (A cephalon with the anterior glabellar lobe very faintly outlined briefly characterized and depicted. Öksna, Norway.)
 1878. *Agnostus truncatus* BRÖGGER, N. M. N., vol. 24, p. 72 (56), pl. 6, fig. 8. (Cephalon characterized and illustrated. Öksna, Norway.)
 1929. *Agnostus truncatus* BRÖGGER, Strand, N. G. T., vol. 10, p. 348, pl. 1, figs. 9—11. (New fig. of the holotype and figs. of cephalon and pygidium from the zone of *Par. rugulosus* of the Mjösen district, Norway.)

Remarks. — The holotype of *truncatus* is a cephalon from the Paradoxissimus beds at Öksna, a new figure of which was published by Strand (1929). The pygidium was unknown to Brögger. With this species Strand identified a form from the zone of *Par. rugulosus* in the Mjösen district whose pygidium is characterized by short axis and confluent lateral lobes. It seems questionable, however, whether these forms from different zones and localities are identical since they do not perfectly agree in the cephalon, as admitted by Strand, and the pygidium of Brögger's form is still unknown. Thus further researches are necessary before *truncatus* can be considered fully characterized and distinguished from allied forms.

In the Swedish material present there are three different forms which agree with *truncatus* in having truncate glabella about half as long as the cephalon; the anterior glabellar corners are sharply angulate as in the holotype or faintly

rounded due to individual variability. In the pygidium they differ from each other as stated below. They are distinct from the closely related *parvifrons* by truncate and slightly longer glabella and by lacking the rear forward projection of the pygidial rim. Probably one of these forms should be identified as Brögger's *truncatus*, at present none can be pointed out, however. Thus, pending the results of future researches of additional material of Brögger's species from the type locality, the Swedish forms are here provisionally recorded as unnamed forms of *truncatus*.

Forma 1. — Pl. 5, figs. 9—12.

The cephalon is in all probability identical with *Agn. lens* var. *frontosa* GRÖNWALL from the *parvifrons* zone on Bornholm, which was stated to have rectangular glabella slightly more than half as long as the cephalon and usually somewhat grooved cheeks. The specimens illustrated in this paper were collected from boulder 80 at Brantevik, Scania, originating from the upper part of the zone of *Ptychagn. (Pt.) atavus*. Of the associated pygidia but the form seen in fig. 12 can be combined with the cephalon.

Forma 2. — Pl. 5, figs. 13—19.

The axis of the pygidium does not extend to the rim and a post-axial median furrow is usually absent, sometimes faintly indicated. The figured specimens were collected from a stinkstone lens at Aborrället, Ångermanland, which was fairly rich in this species but did not yield any other form; probably it belongs to the *parvifrons* zone. This form from the locality mentioned was described and illustrated by Thorslund (1935) as *Agn. parvifrons* var. It is abundant in a layer immediately below the one yielding *parvifrons* in a boring at Motala, Östergötland (Westergård, 1944 b, level 171.5 m).

Forma 3. — Pl. 5, figs. 20—23.

The glabella is slightly larger and the rim broader than in the preceding forms, and in the pygidium the lateral lobes are separated by a well defined post-axial furrow even in the largest specimens. The specimens illustrated originate from a stinkstone lens at Tjärnmyrberget, Ångermanland, in which this form was abundant and which otherwise yielded but one pygidium of *H. parvifrons mammillatus* and a few poor fragments of *Ptychagn. (Pt.) punctuosus affinis*(?). It occurs also at Siljeåsen, Northern Jämtland. Of the forms under consideration this one seems to display the closest resemblance to the holotype.

Hypagnostus nepos (BRÖGGER, 1878). — Pl. 5, figs. 5—8.

1878. *Agnostus parvifrons* LINNARSSON var. *nepos* BRÖGGER, N. M. N., vol. 24, p. 72 (56), pl. 6, fig. 2. (Description and fig. of a complete specimen. Zone of *Par. rugulosus*. Krekling, Norway.)
1880. *Agnostus parvifrons* LINNARSSON [partim], Tullberg, S. G. U., Ser. C., No. 42, p. 35, pl. 2, figs. 28 a, b. (Only forma 3; cephalon and pygidium described and depicted. *Hyalolithes* limestone [0.3 m below the Andrarum limestone]. Andrarum, Scania.)
1929. *Agnostus parvifrons nepos* BRÖGGER, Strand, N. G. T., vol. 10, p. 348, pl. 1, fig. 16 (Pygidium described and figured. Zone of *Par. rugulosus*. Mjösen district, Norway.)

Remarks. — The glabella occupies one-half, or a little more than one-half, of the length of the cephalon and is thus slightly longer than in *parvifrons*. The cheeks are as a rule smooth, very rarely faintly grooved. In the pygidium the form differs from the latter in the rim being subequal in breadth throughout and, more particularly, in having annulated axis — the second ring furrow is less strongly defined than the first, however. The axis extends to the rim or nearly so, and in the latter case the lateral lobes are confluent or separated by a shallow and not very well defined post-axial furrow. As this form is sharply distinct from *parvifrons* in the pygidium and no intermediate links have been observed, it is raised to the rank of an independent species.

Horizon and Localities. — Appears probably in the *Ptychagn. (Pt.) punctuosus* zone and ascends into the lower portion of the *Solenopleura brachymetopa* zone. — Scania: Andrarum; Baskemölla; S. Sandby (boring). — Västergötland: Byklev. — Jämtland: Kopparrökhällarna. — Ångermanland: Aborrfallet; (Kvarnån?). — Not infrequent.

Norway: Oslo and Mjösen districts. — (Bornholm?).

Hypagnostus tjernviki sp. n. — Text-fig. 2.

Diagnosis. — Distinct from the genotype and other congeneric forms by having the rim greatly expanded posteriorly.

Remarks. — Only the small specimens figured are present, the cephalon measuring 0.9 and the pygidium, holotype, 1.4 mm in length.

The glabella is longer and the weak median tubercle situated more backwards than in the genotype (characteristics which possibly do not distinguish the full-



Text-fig. 2. *Hypagnostus tjernviki* sp. n. Cephalon and pygidium, the latter in different aspects. *Par. forchhammeri* beds. Gymninge, Närke. — $\times 8$.

grown form from the latter species, however). The pygidial axis occupies about two-thirds of the total length and half of the total breadth, extends to the rim, displays no traces of segmentation, and has a very weak median tubercle well forward. The rim is rather flat, occupies almost one-third of the total length, tapers rapidly forward, and is very narrow at the anterior corners. The furrow bounding the rim is almost effaced at the axial furrows.

The species is named in honour of Mr. Torsten Tjernvik who by indefatigable and intelligent collecting has added materially to our knowledge of the Cambrian fauna of Närke.

Horizon and Locality. — *Par. forchhammeri* beds. Gymninge, Närke. — Very rare.

Hypagnostus brevifrons (ANGELIN) 1851, — Pl. 5, figs. 24—29.

1851. *Aagnostus brevifrons* ANGELIN, Pal. Suec., fasc. I, p. 6, pl. 6, fig. 4. (Brief diagnosis, fig. of complete specimen from the Andrarum limestone. Andrarum, Scania.)

1878. *Agnostus brevifrons* ANGELIN, Brögger, N. M. N., vol. 24, p. 73 (57), pl. 6, fig. 10. (Fig. of a nearly complete specimen from the *Par. forchhammeri* beds at Krekling, Norway.)
1880. *Agnostus brevifrons* ANGELIN [partim] Tullberg, S. G. U., Ser. C., No. 42, p. 35, pl. 2, figs. 29 a, b. (Description and figs. of cephalon and pygidium from the type locality. The form from the shale above the Andrarum limestone identified as *brevifrons* is an independent species; cf. *H. denticulatus*.)

Remarks and Affinities. — Four of Angelin's syntypes are illustrated in figs. 24—27, the first of which is the lectotype. The glabella is more or less tapering, in no specimen present subrectangular as in Brögger's figure. In specimens with the test preserved the axial furrows are shallow, more particularly in the cephalon, and the furrows on the axis of the pygidium are as a rule wholly effaced, sometimes faintly indicated at the sides. It is a large form, the cephalon attaining 7 mm in length.

Howell (1937 a) included *H. brevifrons* in his new genus *Cyclopagnostus* (type *C. hesperius* from the *Centropleura vermontensis* fauna of Vermont), which was placed in an independent family, Cyclopagnostidae, distinct from other forms with short and non-lobate glabella mainly by shorter and posteriorly ovally rounded pygidial axis. The generic diagnosis contains but one characteristic: the furrows on the pygidial axis are obsolete, a criterion which applies just as well to *parvifrons*, the type of *Hypagnostus*, however. The dissimilarities do not appear to be very important and, thus, the present writer agrees with Kobayashi in considering *Cyclopagnostus* a synonym of *Hypagnostus*.

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum; Gislövshammar (boring); S. Sandby (boring). — Västergötland: Byklev; Hällekis; Djupadalen. — Jämtland: Brunflo; Vedjeön; Hill-sand; Siljeåsen. — Ångermanland: Aborrället. — Västerbotten: Marbäcken. — More infrequent in Southern than in Northern Sweden.

Bornholm. — Oslo district, Norway.

Hypagnostus denticulatus sp. n. — Pl. 5, figs. 30—33.

Diagnosis. — This form is distinct from *H. brevifrons* by narrower rim in the cephalon, annulated and more tapering axis of the pygidium, and having marginal spines.

Description. — Only flattened specimens in shale are present.

Glabella about half as long as the cephalon or a little shorter, tapering, truncate or slightly rounded in front, with a very weak tubercle (usually indiscernible) behind the centre. Axial furrows well defined. Basal lobes moderate, triangular. Rim very narrow, thread-like.

Thorax unknown.

Axis of pygidium trilobed, slightly constricted at the second ring which bears a faint tubercle, somewhat varying in length, bluntly pointed or rather acuminate. Axial furrows distinct, ring furrows faint, the second sometimes almost obsolete. Lateral lobes subequal in breadth or slightly narrowing backwards, confluent (young specimens seem to have a weak post-axial furrow, however). Rim of moderate breadth, much broader than in the cephalon; marginal spines short.

4—465226. S. G. U. Ser. C, No 477. Westergård.

Size. — The holotype, a middle-sized cephalon (fig. 30), is 4.2 mm in length and breadth; largest shield found, a pygidium, is 4.7 mm long and broad.

Remarks. — Because of its resemblance to *brevifrons*, with which it was identified by Tullberg, this form is included in *Hypagnostus*. It should be noted, however, that in some features it recalls certain forms of the greatly varying *Lejopyge laevigata*.

Horizon and Localities. — Zone of *Lejopyge laevigata*. Not infrequent in a thin layer about 0.3 m above the Andrarum limestone at Andrarum, Scania. — (?Byklev, Västergötland).

Hypagnostus scrobiculatus sp. n. — Pl. 5, figs. 34 a, b.

Diagnosis. — Cephalon slightly broader than long, of high convexity, with rounded frontal outline. Glabella subrectangular, inconsiderably widened at the middle, with a faint elongate tubercle anteriorly; axial and transverse furrows well defined. Basal lobes moderate, triangular, connected by a fairly narrow band. Cheeks sub-equal in breadth to the glabella, slightly widened anteriorly, confluent, with irregular short grooves. Rim narrow, convex; marginal furrow well defined, relatively broad.

Remarks and Affinities. — Only the illustrated specimen is present. It compares fairly well with *H. truncatus* and *exsculptus* but is readily distinguished from both by the irregularly grooved cheeks, convex rim, and well defined marginal furrow.

Size. — Cephalon 4.9 mm long and 5.3 mm broad.

Horizon and Locality. — Zone of *Hypagn. parvifrons*(?). Scania: Brantevik (boulder B. Associated specimens: *Ptychagn. (Pt.) punctuosus affinis* and an imperfect pygidium of *Pt. (Triplagn.) hybridus*?).

Hypagnostus exsculptus (ANGELIN, 1851). — Pl. 5, figs. 35 a, b;
pl. 6, figs. 1, 2 (3—5)?.

1851. *Agnostus exsculptus* ANGELIN [partim], Pal. Suec., Fasc. I, p. 7, pl. 6, fig. 8. (Brief diagnosis and fig. of a restored complete specimen. Only the cephalon; see below. Andrarum limestone. Andrarum, Scania.)
1880. *Agnostus exsculptus* ANGELIN [partim], Tullberg, S. G. U., Ser. C, No. 42, p. 22, pl. 1, fig. 10. (Description and fig. of a cephalon of Angelin's syntypes. The «pygidium» of Angelin's fig. is identified as the cephalon of *Goniagn. nathorsti*.)
1902. *Agnostus exsculptus* ANGELIN [partim], Grönwall, D. G. U., II. Række, No. 13, p. 53. (Notes on the form from the Andrarum limestone of Bornholm.)
1939. *Tomagnostella exsculpta* (ANGELIN), Kobayashi, Journ. Fac. Sci. Tokyo, sect. II, vol. 5, p. 150. (Species discussed and designated as the type of *Tomagnostella* gen. n.)

Remarks. — After examination of the material labelled *Agnostus exsculptus*, Andrarum, kept in the Paleozool. Dept. of the State Museum, in all six specimens and Angelin's syntypes, Tullberg found that especially two (Ar. 2007 a, b), in Andrarum limestone, agree fairly well with the cephalon as figured by Angelin. One was depicted by Tullberg and is here refigured (figs. 35 a, b); it is selected lectotype. Two other cephala (Ar. 2006 a, b) were according to Tullberg preserved in stinkstone and supposed to originate from a lower level and to belong to an ancestral form. In the present writer's opinion one of them,

illustrated in fig. 1 on pl. 6, is preserved in Andrarum limestone,¹ however, and may be conspecific with the lectotype, whereas the other, imperfectly preserved in stinkstone, is distinct by almost obsolete circumglabellar furrows. The remaining two of the six specimens in question, also preserved in Andrarum limestone and resembling the pygidium in Angelin's figure, Tullberg correctly identified as the cephalon of *Goniagn. nathorsti*.

In addition to the above three, there have been found five more cephalons from the Andrarum limestone at Andrarum and two from the equivalent layer at Kiviks-Esperöd and S. Sandby, which are referable to *exsculptus*. In the smaller specimens the transverse glabellar furrow is angular or straight and well impressed, in the larger straight, shallower, and almost effaced at the middle line. The glabella is anteriorly slightly keel-shaped due to an elongate tubercle, and an imperfect specimen from Siljeåsen, Jämtland, probably belonging to this species, has a second elongate median tubercle in the posterior portion of the glabella. The cheeks bear coarse radiating grooves and rounded pits, the former pronounced particularly in the anterior portion of the shield.

The pygidium is not known for certain; probably we have to choose only between two forms, however. One, fig. 5, resembles the pygidium of *sulcifer* except that the axis is slightly narrower, the first ring furrow fainter and the second effaced. The other form, of which two imperfect specimens, figs. 3 and 4, were found (the former associated with the cephalon fig. 2), differs in that the end-lobe extends to the marginal furrow and is depressed at the rear. At present it cannot be established which of these forms should be combined with the cephalon.

Size. — The lectotype, fig. 35, is 3.0 mm and the largest cephalon 6.5 mm long.

Affinities. — In 1895 Wallerius described two closely allied forms from the zone of *Lejopyge laevigata* in Västergötland, viz. *Agn. exsculptus* forma *sulcifera* and *A. exsculptus* forma *integra*, and in 1930 he identified the former with *exsculptus*. Even though the dissimilarities between *exsculptus* and *sulcifer* are not very important and opinions may differ as to their value, the forms are at all events not identical; in the material present intermediate links are absent, and confusion seems to be excluded. Thus they may be considered specifically distinct, and forma *integra* a subspecies of *sulcifer*.

There is also a close resemblance between *exsculptus* and *scrobiculatus*, the dissimilarities being mainly confined to the cephalic rim: in the former the rim is flat, relatively broad, and expanded backwards at the middle line, and the marginal furrow is very faint, whereas in the latter the rim is convex, narrow, and of uniform breadth, and the furrow is pronounced.

Horizon and Localities. — Zone of *Solenopleura brachymetopa* (Andrarum limestone). — Scania: Andrarum; Kiviks-Esperöd; S. Sandby (boring). — Jämtland: Siljeåsen. — Very rare.

Bornholm (teste Grönwall).

¹ The very small slab is more like Andrarum limestone than stinkstone, and, moreover, it yielded also a cephalon of *Agnostus neglectus* sp. n., which is not known from older strata than the Andrarum limestone.

Hypagnostus exsculptus geminus subsp. n. — Pl. 6, figs. 6 a, b.

Diagnosis. — Distinct from *H. exsculptus* by having smooth cheeks.

Remarks. — Two cephalae are present, one certainly and the other probably collected from the Andrarum limestone at Andrarum. In the illustrated specimen the axial furrows are straight, in the other they curve slightly outwards at the middle of the glabella, as in *exsculptus*. Forms intermediate between the species and subspecies have not been observed. Cf. *H. sulcifer integer*.

The holotype is 3.7 mm long.

Hypagnostus sulcifer (WALLERIUS, 1895). — Pl. 6, figs. 7—17.

1895. *Agnostus exsculptus* ANGELIN forma *sulcifera* WALLERIUS, Zonen med *Agn. laevigatus*, p. 38, pl. 1, figs. 1 a, b. (Description and rough figs. of cephalon and pygidium. Upper portion of the zone of *Lejopyge laevigata*. Gudhem, Västergötland.)
1930. *Agnostus exsculptus* ANGELIN, Wallerius, G. F. F., vol. 52, p. 58, figs. 5 a, c. (New figs. of cephalon and pygidium. Gudhem, Västergötland.)

Remarks and Affinities. — This species is fairly variable, as seen from the figured specimens, all collected from a thin layer at the type locality. The predominant form is illustrated in figs. 7 and 13. Many a specimen displays a more or less pronounced elevation immediately in front of the glabella as is also the case in other species of this genus.

Compared with *exsculptus*, *sulcifer* has slightly broader and more tapering glabella, fainter glabellar tubercle, narrower band connecting the basal lobes, fainter and narrower grooves in the cheeks, and subtrapezoidal instead of subquadrangular outline of the cephalon.

Horizon and Localities. — Zone of *Lejopyge laevigata*, upper part. — Västergötland: Gudhem; Torbjörntorp; Djupadalen; Ödegården; Oltorp; Stenstorp (boulders). — Östergötland: Berg; Tomta. — Common in Västergötland, very rare in Östergötland.

Hypagnostus sulcifer integer (WALLERIUS, 1895). — Pl. 6, figs. 18, 19.

1895. *Agnostus exsculptus* ANGELIN forma *integra* WALLERIUS, Zonen med *Agnostus laevigatus*, p. 38. (Description of the cephalon; no fig. Gudhem, Västergötland.)
1930. *Agnostus exsculptus didymus* WALLERIUS, G. F. F., vol. 52, p. 58, fig. 5 b. (Cephalon illustrated. Gudhem, Västergötland.)

Remarks. — Distinct from *sulcifer* by smooth cheeks; a short and fairly broad depression rather than a groove in the anterior portion of the preglabellar area is more persistent than other grooves of the cheeks and is usually present, however. The subspecies is connected to the species by intermediate forms. Although a very large material is present no complete specimen either of *sulcifer* or *integer* has been found.

In 1930 Wallerius changed the name *integer* to *didymus* as the former name was occupied for *Agnostus* [*Peronopsis*] *integer* (BEYRICH). According to the International Rules the older name is valid, however.

The dissimilarities between *exsculptus geminus* and *sulcifer integer* are the same as between *exsculptus* and *sulcifer*, q. v.

Horizon and Localities. — Associated with *H. sulcifer* and common in the localities of Västergötland, from which the latter is recorded.

Cotalagnostus WHITEHOUSE, 1936.Genotype: *Agnostus lens* GRÖNWALL, 1902.

According to Grönwall *lens* is connected with *lens frontosus* (= *Hypagn. truncatus* forma 1) by intermediate links, a statement corroborated by the Scanian material present. Thus *lens* arose from *truncatus*. *C. lens* is distinct from allied forms by having the glabella (i.e. the posterior lobe) outlined at the sides and in front merging imperceptibly into the cheeks, and the axis of the pygidium outlined throughout.

Because of the close resemblance between *Cotalagnostus* and *Lejopyge*, Harrington and Kobayashi included them in an independent subfamily, Lejopyginae, of Peronopsidae. The genera are phylogenetically distinct, however, since *Cotalagnostus* arose from *Hypagnostus* and *Lejopyge* from *Ptychagnostus* (*Triplagnostus*) (see p. 75). The resemblance is nevertheless so close that, in fact, it seems difficult to point out any safely distinguishing criteria. Thus it is sometimes difficult to decide whether a form of which specimens in young stages of growth are not available should be referred to the one or the other of these genera. The following examples may be adduced: Whitehouse and Kobayashi included Grönwall's *altus* in *Cotalagnostus*, whereas the present material proves that it is a descendant of *Ptychagnostus* (*Triplagn.*) *convexus* sp. n.; *confusus* was referred to *Lejopyge* but more likely belongs to *Cotalagnostus*, even though the axial furrows in full-grown specimens are obscure at the rear.

Cotalagnostus ranges from the *Tomagn. fissus* zone into the *Solenopleura brachymetopa* zone. Outside Scandinavia representatives are known from Great Britain and, probably, from the Atlantic province of North America, Eastern Asia, and ?Australia.

Cotalagnostus lens (GRÖNWALL, 1902). — Pl. 7, figs. 1—5.

1902. *Agnostus lens* GRÖNWALL, D. G. U., II Række, No. 13, p. 65, pl. 1, figs. 8, 9. (Description and figs. of cephalon and pygidium. Zone of *Hypagn. parvifrons*. Bornholm.)
1916. *Agnostus lens* GRÖNWALL, Illing, Q. J. G. S., vol. 71, p. 414, pl. 31, figs. 3—7. (Description and figs. of complete specimens. Zones of *Hartshillia* and *Par. davidis*. Nuneaton, England.)
1929. *Agnostus truncatus lens* GRÖNWALL, Strand, N. G. T., vol. 10, p. 348, pl. 1, figs. 12, 13. (Description and figs. of cephalon. Zones of *Par. paradoxissimus* and *P. rugulosus*. Mjösen district, Norway.)
- ?1934. *Agnostus lens* GRÖNWALL, Cobbold & Pocock, Phil. Trans. Roy. Soc., Ser. B., vol. 223, p. 342, pl. 44, figs. 5—8 (Notes on species; figs. of cephalon and pygidium. *Par. forchhammeri* grit. Rushton, England.)

Remarks. — The Scanian form, represented by some isolated cranidia and pygidia most of which are preserved in shale, agrees with the original description and figures. The cheeks are smooth or faintly grooved. The lateral lobes are confluent behind the axis; a well preserved small pygidium from the *Ptychagn. (Pt.) punctuosus* zone displays, however, a weak post-axial furrow more shallow than the axial furrows.

The British form identified as *lens* by Cobbold has markedly broader cephalon than the typical form and seems to resemble *C. confusus*. The pygidium combined with the cephalon agrees with *lens*, however.

Horizon and Localities. — Upper part of the *Hypagn. parvifrons* zone and lower part of the *Ptychagn. (Pt.) punctuosus* zone. Borings at Andrarum (Westergård, 1944 a; level 51.4—51.8 m) and Gislövshammar (level 83.6—86.2); boulder 96 from the latter locality, Scania. — Infrequent.

Bornholm. — Mjösen district of Norway. — Great Britain.

Cotalagnostus lens claudicans subsp. n. — Pl. 6, figs. 20—27.

Diagnosis. — Distinct from *lens* by the glabella being very faintly bounded in front and the lateral lobes of the pygidium being separated by a post-axial furrow.

Remarks. — A great many well preserved isolated shields are present; no complete specimen has been found. The anterior boundary of the glabella is usually marked out by a very feeble depression rather than a furrow discernible on a side view of specimens retaining their original convexity. In a few specimens an actual short furrow is seen at the corners of the glabella and fades out to the middle line. The cheeks are smooth or faintly grooved in the anterior portion of the shield. The post-axial furrow is well-defined even in the largest specimens.

The subspecies occurs associated with *Hypagn. truncatus* forma 1 in older strata than those yielding *C. lens*, of which it is obviously a forerunner. It bridges the gap between *truncatus* and *lens*.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) atavus*. Boulders at Brantevik and Gislövshammar and in a boring at the latter locality (Westergård, 1944 a; level 89.9—90.6 m), Scania. — Fairly infrequent.

Bornholm.

Cotalagnostus confusus (WESTERGÅRD, 1930). — Pl. 7, figs. 6—13, 15—20, (14?).

1878. *Agnostus bituberculatus* ANGELIN, Brögger, N. M. N., vol. 24, p. 75 (59), pl. 6, figs. 9 a, b. (Figs. of cephalon and pygidium. *Par. forchhammeri* beds. Krekling, Norway.)
1930. *Agnostus confusus* WESTERGÅRD, Holm & Westergård, Mém. Acad. Sci. URSS, vol. 21, No. 8, p. 12; pl. 4, figs. 7, 8. (The above Norwegian species is proved to be an independent species. Fig. of cephalon and pygidium from the Andrarum limestone at Andrarum, Scania.)

Description. — Cephalon broader than long, well convex, sloping more or less abruptly in its axial portion at the posterior margin. Axial furrows faint, fading out at about one-fourth to one-third of the cephalic length. Glabella anteriorly merging imperceptibly into the cheeks or outlined by an almost indiscernible, curved furrow, with a very faint tubercle well forward. Basal lobes moderate, faintly outlined, connected by a fairly broad band behind the glabella. Cheeks smooth, rarely faintly grooved in the anterior portion of the shield. Rim of moderate breadth, fairly flat.

Thorax unknown.

Pygidium broader than long, well convex. Axial furrows shallow, in young specimens continuing throughout and meeting a short distance in front of the rim, in full-grown specimens usually fading out at about the anterior third and

rarely traceable throughout. Axis lacking traces of annulation, with a well-defined median tubercle. Rim broader than in the cephalon, widening posteriorly, gently arched; marginal furrow broad and shallow.

The largest cephalon (fig. 10) 4.7 mm long and 5.6 mm broad.

R e m a r k s. — The above description applies to well preserved specimens retaining the test. Exfoliated specimens display slightly deeper axial furrows. The basal lobes appear distinctly on a view from behind but in shields dipping abruptly at the posterior margin they are invisible on a dorsal view (figs. 6 and 9). This may explain the fact that the basal lobes are absent in Brögger's figure. In specimens with the pygidial axis outlined throughout the furrows are so feeble at the rear that they cannot be expected to be discernible on specimens in shale. The convexity of both shields and the breadth of the rim in the pygidium are fairly varying. Thus, the differences between the illustrated specimens from Kinnekulle (figs. 17—20) and those from Scania are proved by the material present to have no specific value.

It is easily to be understood that Whitehouse and Kobayashi included *confusus* in *Lejopyge* in view of the illustrations and very cursory characterization of it hitherto published. However, if we imagine that in a form resembling *lens claudicans* the effacement of the axial furrows be extended to the posterior part of the pygidium, we get a form like *confusus*. In addition to the above description this indicates that the species may have developed from the same branch as *lens*.

H o r i z o n a n d L o c a l i t i e s. — Zone of *Solenopleura brachymetopa* (Andrarum limestone and Exporrecta conglomerate). — Scania: Andrarum; Kiviks-Esperöd; Gislövshammar (boring and boulder 107); S. Sandby (boring). — Västergötland: Råbäck; Hällekis; Byklev; Munkesten. — Närke; Gymninge. — Infrequent.

In the *Par. forchhammeri* beds of the Oslo district, Norway.

Clavagnostus HOWELL, 1937.

Genotype: *Aagnostus repandus* WESTERGÅRD, 1930.

D i a g n o s i s (supplemented). — Glabella long, consisting of a single lobe; rounded or pointed in front; preglabellar median furrow absent or present. Axis of pygidium long, lanceolate, not segmented, depressed posteriorly; lateral lobes separated at the rear. Spines in cephalon and pygidium in hitherto known species.

By the presence of a preglabellar furrow, *C. sulcatus* sp. n. is sharply distinct from the genotype. As the species in other essential and partly aberrant characteristics agrees with the latter, it is included in *Clavagnostus*, and possibly *sulcatus* is a direct descendant of *repandus*.

Tomorhachis RESSER (1938 b), known only from the pygidium and occurring in the early Upper Cambrian of Alabama, is believed to be synonymous with *Clavagnostus*. Kobayashi (1939 a) tentatively included in this genus also *Agn.*

czekanowskii F. SCHMIDT (1886) and *A. varius* BUTTS (1926). It is true that the former in the cephalon recalls *Clavagnostus* but the pygidium combined with the cephalon is of quite a different type and excludes the species from this genus, nor does the latter, judging from the figure published by Butts, seem to be congeneric with *repandus*. Whitehouse (1936) referred *repandus* to *Hypagnostus*, which it recalls as regards the unlobed glabella. The length of the glabella indicates, however, that the effacement has not struck the anterior glabellar lobe but the furrow separating the lobes, as pointed out by Kobayashi, and in the pygidium the differences are conspicuous. Harrington (1938) considered *Clavagnostus* closely allied to, or possibly synonymous with, *Spinagnostus* HOWELL, which in the present writer's opinion is a synonym of *Hypagnostus* (cf. p. 44).

The taxonomic position of *Clavagnostus* is uncertain, which is mirrored by the classification advanced by different authors.

Howell regarded *Clavagnostus* as the type of an independent family; even though the genus in cephalon as well as pygidium displays criteria unusual in the agnostids, Howell's discrimination may go farther than necessary, however. Whitehouse tentatively placed *Hypagnostus* (with *repandus*) in Trinodidae HOWELL, and Harrington and Kobayashi included *Clavagnostus* in Peronopsidae, an opinion which seems to be plausible.

In the sense given the genus in this paper it is known from the late Middle Cambrian of Sweden, Bennett Island (north of Siberia), and north-western Vermont, and from the early Upper Cambrian in Alabama.

Clavagnostus repandus (WESTERGÅRD, 1930). — Pl. 4, figs. 19—22.

1930. *Aagnostus repandus* WESTERGÅRD, Holm & Westergård, Mém. Acad. Sci. l'URSS, 8. Sér., Cl. phys.-math., vol. 21, No. 8, p. 13, pl. 1, figs. 35—39 (40—43?); pl. 4, figs. 11, 12. (Description and figs. of cephalon and pygidium from Andrarum, Scania, and Bennett Island, north of Siberia.)

Description. — A dozen cephala and the same number of pygidia are present.¹

Both shields subequal in length and breadth, convexity somewhat higher in cephalon than in pygidium; rim of moderate breadth, expanded behind the axis; spines in both shields short; test smooth. — Glabella occupying about two-thirds the cephalic length, somewhat shorter in young than in full-grown specimens, tapering in the anterior one-third, rounded or bluntly pointed in front, with a faint elongate tubercle, lacking traces of segmentation. Basal lobes moderate, triangular. Cheeks confluent.

Thorax unknown.

Axis of pygidium lanceolate, lacking annulation, anteriorly convex and raised into a keel-shaped tubercle, posteriorly deeply depressed and bearing a pair of elongate pits, at the rear truncated by the rim.

¹ Whitehouse (1936, p. 104) stated that the pygidium of this species is unknown. Even though no complete dorsal shield has been found there is no doubt, however, but that the cephalon and pygidium under consideration are conspecific, as pointed out in the original description, p. 14, footnote 1.

Size. — A small form; the largest cephalon present, holotype, 2.5 mm in length and breadth, the largest pygidium 2.7 mm long and 2.5 mm broad.

Horizon and Localities. — Andrarum limestone at Andrarum and S. Sandby (boring), Scania. — *Par. forchhammeri* beds at Ullavi, Ösby, Vrana (boring), and Gymninge, Närke. — Rare.

Bennett Island, N. of Siberia.

Clavagnostus sulcatus sp. n. — Pl. 4, figs. 23—26.

Diagnosis. — Distinct from the genotype by having the glabella pointed in front, the cheeks separated by a preglabellar median furrow, and shorter and pointed pygidial axis.

Description. — Four cephalons and three pygidia are present.

Cephalon subpentagonal in outline; convexity moderate. Glabella occupying two-thirds of the cephalic length or shorter and somewhat less than one-third the breadth, anteriorly tapering and sharply pointed, very weakly keeled at the middle, lacking traces of segmentation. Basal lobes small, not very well defined. Cheeks subequal in breadth throughout, separated by a narrow and deep preglabellar furrow. Rim fairly narrow, somewhat expanded and slightly angulate at the axial line, the latter characteristic unique in the agnostids. Cephalic spines slender, attaining at least one-third the cephalic length.

Thorax unknown.

Pygidium subquadrangular; convexity lower than in the cephalon. Axis slightly narrower than the lateral lobes, not extending to the rim, acute, anteriorly convex and faintly keeled, posteriorly depressed and with a pair of elongate pits, lacking annulation, in one specimen slightly constricted at the anterior third. Lateral lobes separated by a broad and deep post-axial furrow. Rim narrow at the sides, expanded posteriorly; marginal spines long and slender. — Axial furrows in both shields narrow and deep. Test smooth.

Size. — The largest cephalon, holotype, 3.0 mm long (the spines not considered) and 2.8 mm broad; the largest pygidium 3.9 and 3.6 mm in length and breadth.

Affinities. — In the pygidium *C. sulcatus* displays closer resemblance to *C. aequalis* HOWELL (1937 a) from the *Centropleura* fauna of north-western Vermont and *Tomorhachis spinosa* RESSER (1938 b) from the early Upper Cambrian of Alabama than to the genotype. Unfortunately the cephalon of the two American species is unknown. — It should be remarked that two very small fragmentary shields from Bennett Island illustrated by Holm & Westergård (1930, pl. I, figs. 46 and 47) and tentatively interpreted as the pygidium of an undescribed agnostid may be the cephalon of a form resembling *sulcatus*.

Horizon and Localities. — Zone of *Lejopyge laevigata*, upper part. Gudhem and Torbjörntorp, Västergötland. Very rare.

Diplagnostinae (WHITEHOUSE, 1936).**Tomagnostus** HOWELL, 1935.

Genotype: *Agnostus fissus* (LUNDGREN MS) LINNARSSON, 1879.

The taxonomic position of *Tomagnostus* is discussed on p. 31.

The genus ranges from the Exsulans limestone to the *Hypagn. parvifrons* zone both inclusive. Representatives of it are known from Scandinavia, Great Britain, and the Atlantic province of North America.

Tomagnostus fissus (LUNDGREN MS; LINNARSSON, 1879). — Pl. 7, figs. 21—29; (pl. 16, fig. 8?).

1879. *Agnostus fissus* (LUNDGREN MS.) LINNARSSON, S. G. U., Ser. C., No. 35, p. 23, pl. 2, fig. 34. (Cephalon briefly characterized and illustrated. Exsulans limestone; Gislöv, Scania.)
1880. *Agnostus fissus* LUNDGREN MS., Tullberg, S. G. U., Ser. C, No. 42, p. 16, pl. 1, figs. 3 a—d. (Description and figs. of cephalon, thorax, and pygidium. Exsulans limestone and overlying shale. Andrarum and Fågelsång, Scania.)
1896. *Agnostus fissus* LUNDGREN and var. *trifissus* MATTHEW, Trans. N.Y. Acad. Sci., vol. 15, p. 230, pl. 16, fig. 10. (Cites Tullberg's diagnosis translated into English and records species from the *Par. abenacus* zone. Description of the variety at different stages of growth and fig. of a complete dorsal shield of the adult. New Brunswick, Canada.)
1906. *Agnostus fissus* LUNDGREN MS., Lake, Pal. Soc., Brit. Cambr. Trilob., p. 3, pl. 1, figs. 1—3. (Description and figs. of the dorsal shield. Menevian. Wales.)
1916. *Agnostus fissus* LUNDGREN MS., Illing, Q. J. G. S., vol. 71, p. 406, pl. 28, figs. 6—8. (Remarks on species, figs. of complete specimens. *Par. hicksii* zone. Nuneaton, England.)
1916. *Agnostus fissus* LUNDGREN MS., Nicholas, idem., p. 452. (Remarks on species; no fig. St. Tudwal's Peninsula, Wales.)
- 1935 c. *Tomagnostus fissus* LUNDGREN MS., Howell, Bull. Wagner Free Inst. Sci., vol. 10, p. 15. (Assigns species as the genotype of *Tomagnostus*. Figs. of cephalon and pygidium from Andrarum, Scania.)

Remarks. — The holotype which was collected from the Exsulans limestone at Gislöv, i. e. on the shore about 1 km south of Brantevik, is lost, and the figure was reproduced from an obviously not very good drawing. In the description Linnarsson stated *inter alia* that »the cheeks have radiating furrows which usually are fairly indistinct, however, and thus do not appear in the figure» (translated). The specimens figs. 21—23 on pl. 7 are topotypes and fig. 22, which is equal in size to the holotype, should be considered neotype.

This species is liable to a considerable variation and a number of fairly different forms occur which merge into each other. Cephalon and pygidium are subelliptical or subquadrangular in outline, and moderately to strongly convex. The anterior glabellar lobe is almost as long as broad or much broader than long and is cleft in front by a furrow usually short and rarely extending to the transverse glabellar furrow; it is more deeply impressed in specimens of high than in those of low convexity. As a rule the furrow continues into the preglabellar area and sometimes extends to the marginal furrow but usually it fades out at some distance from the glabella; in a great many perfectly preserved specimens, varying from 1 to 4.5 mm in length, there is no trace of a preglabellar furrow, however. The transverse glabellar furrow is straight or angulate and projects forward at the middle line. The basal lobes are small and connected by a very narrow thread-like band. The cheeks usually display

faint or fairly broad and deep radiating grooves but are sometimes smooth. In some specimens the axial furrows are continued by grooves in the cheeks (fig. 27) as in *fissus trifissus* MATTHEW. In the pygidium the axial end-lobe always has a transverse depression, sometimes with a pair of lateral faint pits like those in *perrugatus* but less pronounced than in the latter; immediately in front of this depression a weak median tubercle is usually discernible. In a few specimens (fig. 29) there are two minute tubercles at the axial line of the first axial lobe like those observed by Matthew in *fissus trifissus*. The axial furrows are usually well defined throughout and are rarely almost effaced at the rear. The lateral lobes are confluent behind the axis and as a rule smooth, in a few specimens faintly granulate, however.

Forms in which the shields have subelliptical outline and long anterior glabellar lobe predominate in older and occur rarely in younger strata, those with subquadrangular outline and short anterior glabellar lobe seem to be confined to the latter, as is the case also in the sequence at Nuneaton according to Illing. As regards other dissimilarities the forms seem to merge more irregularly into each other. A single pygidium (pl. 16, fig. 8) from the *Hypagn. parvifrons* zone at Gislövshammar has longer and more conical axis than the genotype and possibly belongs to an independent species.

Agn. fissus perrugatus GRÖNWALL is specifically distinct from *fissus* and synonymous with *sulcatus* ILLING.

Agn. fissus mancus COBBOLD (Cobbold & Pocock, 1934) from the *Par. bohemicus salopiensis* fauna at Rushton, England, is remote from *fissus* and its reference to *Tomagnostus* is questionable.

Horizon and Localities. — Appears in the Exsulans limestone and ranges to the top of the zone named from the species. In Scandinavia found only in Scania: Brantevik and Gislövshammar; Andrarum; Tosterup; Fågelsång; S. Sandby (boring). Rare in the Exsulans limestone proper, fairly common in the highest stratum of the *gibbus* zone and at different levels in the overlying zone.

Great Britain. — The Atlantic province of North America.

Tomagnostus perrugatus (GRÖNWALL, 1902). — Pl. 8, figs. 1—10.

1902. *Aagnostus fissus* LUNDGREN MS., var. *perrugata* GRÖNWALL, D. G. U., II. Række, No. 13, p. 50, pl. 1, fig. 1. (Description and figure of cephalon. Zone of *Hypagn. parvifrons*. Bornholm.)
 1916. *Aagnostus sulcatus* ILLING, Q. J. G. S., vol. 71, p. 411 pl. 30, figs. 3—6. (Description and figs. of complete specimens from the zone of *Par. hicksii* at Nuneaton, England.)

Remarks. — Of this form Grönwall knew but a single cephalon, 2.5 mm in length, which was stated to resemble *fissus* except in the sculpture of the test: »Its cheeks are highly furrowed by irregular, radiating furrows; besides there are two pairs of longitudinal, curved furrows, one pair for each of the lobes of the glabella» (p. 209). The present writer has had an opportunity of examining the holotype for comparisons with a number of specimens collected at Brantevik and Gislövshammar and arrived at the result that *perrugatus* is sharply distinct from *fissus* and agrees with *sulcatus* as described and illustrated by Illing; at

any rate no dissimilarities of specific value seem to exist. In the Swedish form the short longitudinal furrow in the frontal glabellar lobe usually continues into the posterior portion of the preglabellar area and, in young specimens, extends to the marginal furrow. The anterior pair of the longitudinal furrows on the cheeks mentioned by Grönwall is constantly developed but the posterior pair is rarely so pronounced as in the holotype and in our fig. 6 and, sometimes, it is absent. In a few well-preserved specimens of the pygidium the anterior axial ring is tripartite by a pair of shallow grooves as described by Illing; usually it seems to be smooth, however. The axial end-lobe has a deep transverse depression with a pair of well-marked pits (rarely confluent to a narrow furrow). The rim is posteriorly either flat and smooth or divided into two ridges separated by a shallow groove (rarely so distinctly marked as in fig. 2), a feature not mentioned by Illing but indicated in his figs. 4 and 6. The lateral lobes are confluent in adult but separated by a faint post-axial furrow in young specimens; surface shagreened rather than granular. — The largest cephalon and pygidia present are about 6 mm long.

When the specimens found at different horizons are compared, there appear to be two slightly different forms of the species corresponding to different positions in the sequence. Thus in the specimens from the *gibbus* zone the posterior rim displays two faint ridges separated by a shallow groove and its outline is evenly curved, whereas specimens with smooth rim and the outline tending to become angular occur at higher horizons; moreover the glabella seems to be somewhat more strictly parallel-sided in the former than in the latter specimens. Additional material is necessary before a more definite statement can be made, however.

Horizon and Localities. — Appears in the zone of *Ptychagn.* (*Triplagn.*) *gibbus* and ranges into the zone of *Hypagn. parvifrons*. — Scania: Andrarrum; Brantevik and Gislövshammar (boulders and a boring at the latter locality). — Närke: Tomta (boulder). — Infrequent; very rare in the uppermost zone.

Bornholm. — Nuneaton, England. — Newfoundland (Howell, 1925).

Tomagnostus cf. *corrugatus* (ILLING, 1916). — Pl. 8, figs. 11, 12.

1916. *Aagnostus corrugatus* ILLING, Q. J. G. S., vol. 71, p. 409, pl. 29, figs. 4—9. (Description and figs. of complete specimens. Zone of *Par. hicksii*. Nuneaton, England.)

Remarks. — Associated with *T. perrugatus* there occurs an allied species which differs from it in having conical instead of sub-cylindrical glabella and lacking marginal spines in the pygidium. It agrees with *corrugatus* except in some details in the pygidium: the axis is slightly longer in the Swedish than in the English form and terminates in a blunt point in the former but is acutely pointed in the latter. Otherwise no safe dissimilarities can be established by the aid of Illing's description and somewhat poor illustrations.

The largest cephalon present is 6.0 mm long.

Horizon and Localities. — Zones of *Ptychagn.* (*Triplagn.*) *gibbus* and *Pt.* (*Pt.*) *atavus*. Gislövshammar (boulder 12) and Brantevik (boulder 80), Scania. — Rare.

Nuneaton, England.

Diplagnostus JAEKEL, 1909.

Genotype: *Agnostus planicauda* TULLBERG, 1880 (non ANGELIN, 1851).

Tullberg's as well as Angelin's type specimens seem to be lost. The former originated from a thin bed of stinkstone immediately below the Andrarum limestone at Kiviks-Esperöd, which belongs to the zone of *Goniagn. nathorsti*, the latter from the Andrarum limestone proper at Andrarum. From both these layers a great many specimens are present showing that the species varies more than stated by Tullberg, especially as regards the median sulcus in the cephalon and the sculpture of the test, and that the form depicted by Tullberg is not quite identical with the one illustrated by Angelin. This was observed by Kobayashi (1939 a, p. 141), who distinguished the former as *D. planicauda* forma *bilobata*. In 1895 Wallerius described forma *vestgothica* from the zone of *Lejopyge laevigata* in Västergötland. All these forms, which mainly differ in the sculpture of the test, are connected by intermediate links and constitute a continuous evolutionary series.

In 1936 Whitehouse erected *Enetagnostus*, with *E. humilis* WHITEHOUSE as the genotype, which was stated to be distinct from *Diplagnostus* by the median sulcus of the anterior glabellar lobe, which »in *Diplagnostus* is in the form of a furrow bisecting the anterior lobe», whereas »in *Enetagnostus* it is a depression rather than a furrow» (p. 90). Furthermore the latter has a faint median furrow in the preglabellar area, which is absent in Tullberg's figure of the former. As mentioned above the median furrow is a variable criterion, however, and topotypes of forma *bilobata* are present which agree with *Enetagnostus humilis* except that the shields of the latter are markedly broader. Thus *Enetagnostus* is a synonym of *Diplagnostus* as suggested by Kobayashi and cannot even be awarded subgeneric rank.

Representatives of the genus occur in the late Middle Cambrian and are so far known but from Scandinavia and Australia.

Diplagnostus planicauda (ANGELIN, 1851). — Pl. 8, figs. 22—24.

1851. *Agnostus planicauda* ANGELIN, Pal. Suec., Fasc. I, p. 7, pl. 6, fig. 9. (Inexpressive diagnosis and fairly rough figure of the dorsal shield. Andrarum limestone. Andrarum, Scania.)

Remarks. — The form predominant in the Andrarum limestone agrees with Angelin's figure better than claimed by Tullberg. Cheeks faintly scrobiculate — the sculpture being caused by small rounded pits rather than radiating furrows — and separated by a narrow but distinct median furrow extending to the marginal furrow. Anterior glabellar lobe always cleft in front, rarely throughout, in the latter case the furrow is very weak posteriorly. Axial end-

lobe evenly convex (very rarely gently depressed in its posterior portion), does not touch the rim. Lateral lobes confluent.

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum; S. Sandby (boring). — Ångermanland: Aborrället. — *Par. forchhammeri* beds in Närke: Ullavi; Ösby (boulder). — Infrequent.

Diplagnostus planicauda bilobatus KOBAYASHI, 1939. — Pl. 8, figs. 13—21.

1880. *Agnostus planicauda* ANGELIN [partim], Tullberg, S. G. U., Ser. C., No. 42, p. 33, pl. 2, figs. 24 a, b. (Only the form described and illustrated from Kiviks-Esperöd and from the *Hyolithes* limestone 0.3 m below the Andrarum limestone at Andrarum, Scania. Not the form from Västergötland described on p. 37.)
1902. *Agnostus planicauda* ANGELIN [partim], Grönwall, D. G. U., II. Række, No. 13, p. 71, pl. 1, fig. 12. (Remarks on species; fig. of cephalon. Bornholm.)

Remarks. — The topotypes present display a greater variability than admitted by Tullberg. Cheeks smooth, rarely with very weak pits. Median furrow in the preglabellar area as a rule faintly developed posteriorly and obsolete anteriorly, sometimes wholly absent as in Tullberg's figure, in the anterior glabellar lobe usually distinct anteriorly and obsolete posteriorly; in one specimen (fig. 15) the furrow extends to the marginal furrow but does not continue backwards into the glabella. Axial end-lobe sometimes slopes evenly to the terminal point, sometimes depressed in its middle portion and with a pair of faint elongate lateral pits indicating a third ring furrow, does not touch the rim. Lateral lobes separated by a faint furrow or confluent.

Horizon and Localities. — Zones of *Ptychagn. (Pt.) punctuosus* and *Pt. (Triplagn.) lundgreni* and lower part of the zone of *Solenopleura brachymetopa*. — Scania: Andrarum; Kiviks-Esperöd; Baskemölla; Brantevik and Gislövshammar; S. Sandby (boring). — Västergötland: Byklev; Munkesten. — Jämtland: Vedjeön; Hillsand; Siljeåsen. — Ångermanland: Sågbäcken; Karbäcken; Tjärnmyrberget; Aborrället. — Västerbotten: Bredsele; Skansholm. — At some localities fairly common, in others infrequent.

Bornholm. — Norway: Mjösen district.

Diplagnostus planicauda vestgothicus (WALLERIUS, 1895). — Pl. 8, figs. 25—29.

1880. *Agnostus planicauda* ANGELIN [partim], Tullberg, S. G. U., Ser. C., No. 42, p. 37. (Only the form from the *Lej. laevigata* zone in Västergötland.)
1895. *Agnostus planicauda* ANGELIN forma *vestgothica* WALLERIUS, Zonen med *Agnostus laevigatus*, p. 41, pl. 1, fig. 2 a, b. (Description and rough figs. of cephalon and pygidium. Zone of *Lej. laevigata*, upper part. Gudhem and Djupadalen, Västergötland.)
1930. *Agnostus planicauda vestgothicus* WALLERIUS, G. F. F., vol. 52, p. 58, fig. 6. (Figs. of cephalon and pygidium.)

Remarks. — Cheeks sculptured by strongly marked, radiating, more or less closely set fine furrows, and separated by a pronounced preglabellar median furrow extending to the marginal furrow and continuing backwards into the anterior portion of the anterior glabellar lobe but fading out in the posterior portion of the lobe. Axis of the pygidium comparatively short, with the end-lobe evenly sloping to the point. Lateral lobes smooth or finely granulate, confluent.

Horizon and Localities. — Very rare in the Andrarum limestone at Andrarum, Scania. Not infrequent in the upper part of the *Lejopyge laevigata* zone in Falbygden of Västergötland: Gudhem; Torbjörntorp; Djupadalen; Ödegården; Oltorp; Stenstorp (boulders). A pygidium from the latter zone at Berg, Östergötland, may belong to this form.

Linguagnostus KOBAYASHI, 1939.

Genotype: *Agnostus kjerulfi* BRÖGGER, 1878.

Original diagnosis. — »Diplagnostinae with wide, relatively short pygidial axis, divided into anterior segments and a subtriangular tongue-shaped terminal lobe; prominent median ridge crossing anterior segments; surface smooth» (p. 142).

In his new genus *Enetagnostus* Whitehouse included in addition to *humilis* (genotype) the following species: *kjerulfi* BRÖGGER, *arcticus* WESTERGÅRD, and with hesitation *vestgothicus* WALLERIUS. The genotype and the last-named form are not generically distinct from *Diplagnostus*, however; on the other hand, *kjerulfi* and *arcticus* differ from the latter genus in the pygidium, which induced Kobayashi to remove them into the new genus *Linguagnostus*. Of the criteria adduced in the diagnosis but the one of the axial end-lobe makes a clear distinction between this group and *Diplagnostus*, and as it may be of generic value the present writer accepts *Linguagnostus* as an independent genus though with some hesitation. Besides the two species just mentioned Kobayashi included in the genus two more forms, viz. *grönwalli* KOBAYASHI (= *kjerulfi* GRÖNWALL) and *insularis* GRÖNWALL. The generic reference of the latter, which is known but from the pygidium, may be uncertain, however.

Linguagnostus ranges from the *Ptychagn. (Pt.) punctuosus* zone to the *Solenopleura brachymetopa* zone, both inclusive. Forms referable to it are known from Scandinavia, Great Britain, Newfoundland (Howell, 1925), and Bennett Island, north of Siberia.

Linguagnostus grönwalli KOBAYASHI, 1939. — Pl. 8, figs. 30 a, b.

1902. *Agnostus kjerulfi* BRÖGGER, Grönwall, D. G. U., II. Række, No. 13, p. 69, pl. 1, fig. 11. (Pygidium described and illustrated. Upper part of the *Par. davidis* zone. Bornholm.)

1939. *Linguagnostus kjerulfi* forma *grönwalli* KOBAYASHI, Journ. Fac. Sci. Tokyo, sect. II, vol. V, pt. 5, p. 142. (Species discussed.)

Remarks. — A single pygidium is present. It agrees with the holotype save that the ring-furrows are slightly fainter; like the holotype it differs from *kjerulfi* in the keel of the axis being effaced in the first ring and traversed by the second ring furrow, the presence of a well defined post-axial furrow, and the absence of an undulating ridge between the marginal spines. The ratio of length and breadth is about the same in both species. The cephalon is unknown but even though it might be identically like that of *kjerulfi*, the differences in the pygidium, as earlier pointed out by the present writer (Holm & Westergård, 1930, p. 13, foot-note 1), award this form rank of an independent species, probably a forerunner of *kjerulfi*.

A form from the Upper *Par. davidis* zone at Nuneaton, England, identified as *kjerulfi* by Illing (1916), displays closer resemblance to *grönwalli* than to *kjerulfi*. It does not seem to be identical with the former, however, since the post-axial furrow is absent.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) punctuosus*. Boring core from S. Sandby, Scania. — Very rare.

Bornholm.

Linguagnostus kjerulfi (BRÖGGER, 1878). — Pl. 8, figs. 31, 32; pl. 9, figs. 1—3.

1878. *Aagnostus kjerulfi* BRÖGGER, N. M. N., vol. 24, p. 65 (49), pl. 5, figs. 7 a, b. (Description and figs. of cephalon and pygidium. *Par. forchhammeri* beds. Krekling, Norway.)
 1880. *Aagnostus kjerulfi* BRÖGGER, Tullberg, S. G. U., Ser. C., No. 42, p. 32. (Records species from the Andrarum limestone at Andrarum, Scania.)
 1930. *Aagnostus kjerulfi* BRÖGGER, Holm & Westergård, Mém. Acad. Sci. L'URSS, 8. Sér., Cl. Phys.-Math., vol. 21, No. 8, pl. 4, figs. 13, 14. (New figs. of Brögger's type specimens.)

Remarks. — Of the cephalon a single specimen referable to this species is present. It differs from Brögger's specimen in having slightly scrobiculate cheeks, an unimportant dissimilarity, however, and possibly but apparent due to the former being preserved in limestone and the latter in shale. Otherwise the agreement seems to be complete. Thus, the rim is followed by a very broad and shallow marginal furrow narrowing towards the postero-lateral corners, in the anterior glabellar lobe there is indicated a faint short median furrow or depression, the posterior lobe has slightly impressed sides and a faint elongate median tubercle, and the large sub-equilateral basal lobes nearly meet at the middle line. The pygidium agrees completely with Brögger's type specimen (a slight difference in the proportions of length and breadth is due to different modes of preservation, the Swedish specimens being in full relief and the Norwegian strongly flattened).

In the cephalon there is a close resemblance between *L. kjerulfi* and the associated *Diplagnostus planicauda*, which might cause confusion. The former is distinct from the latter by broader and shallower marginal furrow, the absence of a preglabellar median furrow, and larger size.

Affinities. — A form from the *Par. davidis* zone of Bornholm identified as *kjerulfi* by Grönwall (1902) is described above as *L. grönwalli*. Illing (1916) and Nicholas (1916) identified and figured two imperfectly known British forms as *kjerulfi*. The former is more closely allied to *grönwalli* and the figure of the latter does not allow of a safe specific identification. Another closely related form, *L. arcticus* (WESTERGÅRD), is known from Bennett Island, north of Siberia (Holm & Westergård, 1930).

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. Scania: Andrarum; Kiviks-Esperöd. — Ångermanland: Aborrället. — Very rare.

Oslo district of Norway.

Oidalagnostus gen. n.¹Genotype: *Oidalagnostus trispiniifer* sp. n.

D i a g n o s i s. — Cephalon agrees broadly speaking with that of *Diplagnostus* and *Linguagnostus*; pygidium distinguished by a large swollen posterior pseudo-lobe and tricuspidate margin.

This peculiar form does not seem to be referable to any hitherto known genus. It is allied to *Linguagnostus* though the differences are conspicuous and are believed to have generic value. At all events the differences between *Oidalagnostus* and *Linguagnostus* are more important than those between the latter and *Diplagnostus*. In the expanded pseudo-lobe *Oidalagnostus* recalls *Pseudagnostus* to some extent. The median marginal spine is a unique characteristic of adult agnostids and is rarely observed in immature forms.²

An imperfectly known species, *dubius* to be described, is tentatively included in this genus. No other form known to the writer is referable to it.

Oidalagnostus occurs in the late Middle Cambrian and is so far known but from Sweden.

Oidalagnostus trispiniifer sp. n. — Pl. 9, figs. 4—7.

1895. *Agnostus fallax* LINNARSSON forma *ferox* TULLBERG, Wallerius, Zonen med *Agn. laevigatus*, p. 43. (The cephalon recorded from Djupadalen, Västergötland, belongs to *trispiniifer* and is illustrated in fig. 4 on pl. 9 of this memoir.)

D i a g n o s i s of the species is that of the genus.

D e s c r i p t i o n. — Cephalon of low convexity, subquadrangular, slightly constricted posteriorly. Glabella subrectangular, occupying about three-fourths of the cephalic length; anterior glabellar lobe much broader than long, bounded posteriorly by a furrow fainter than the circum-glabellar furrow; posterior lobe with two pairs of very weak lateral impressions at the anterior and posterior thirds respectively and a faint elongate median tubercle in front of the centre. Basal lobes large, sub-equilateral, nearly meeting at the middle line. Cheeks scrobiculate, with faint rounded pits and short furrows, separated by a weak preglabellar furrow. Rim broad, narrowing backwards, with a narrow convex border and a broad and shallow furrow.

Thorax unknown.

Pygidium of about the same convexity as the cephalon, subquadrangular. Axial furrows well defined anteriorly, behind the second axial ring shallow and running backwards-inwards, traceable across the large pseudo-lobe to the marginal furrow (discernible on the pseudo-lobe of the exfoliated holotype, fig. 6, but invisible on fig. 7 retaining the test). Axis broad and well defined anteriorly, apparently short, in reality extending to, and truncated by, the marginal furrow; the two anterior rings — the first much shorter than the second — marked off by faint lateral furrows, with a prominent median keel slightly

¹ οἰδᾶλέος = swollen.

² Cf. *Agn. fallax* var. *tricuspis* BRÖGGER, 1878, *Agn. pisiformis* mut. β (*rugulosus*) and mut. λ (*affinis*) MATTHEW, 1898.

projecting into the third ring, the latter separated by a deep groove from the large pseudo-lobe; annulation indicated on the pseudo-lobe by two pairs of very weak knobs (discernible only in fig. 6). Two pairs of grooves starting from the posterior corners of the second and third axial rings and running outwards-backwards mark off an elevation divided by an oblique groove into two bosses. Lateral lobes, including in addition to these bosses the exterior portions of the pseudo-lobe, faintly scrobiculate anteriorly. Rim narrow, convex, expanded at the rear and tending to become divided by a transverse depression in front of which it is raised into a sharp ridge higher at the sides than at the axial line, with a faint median pit in the depression, tricuspidate; marginal furrow narrow.

Size. — Largest cephalon 5.3 mm long and 6.1 mm broad; largest pygidium, holotype, about 6.2 mm long (exclusive of the median spine) and 6.7 mm broad.

Remarks and Affinities. — Four cephalons and three pygidia are present; although no complete dorsal shield has been found there is no doubt but that the isolated shields are conspecific.

As pointed out above, *trispinifer* displays close resemblance to *Linguagn. kjerulfi* as to the cephalon. There is a slight difference in the median furrow, which in the former is present in the preglabellar area and absent in the front of the anterior glabellar lobe, whereas it is quite the contrary in the latter, an unimportant dissimilarity, however, as seen from the allied *Diplagnostus* (cf. pl. 8, figs. 14—16). Furthermore, *trispinifer* has two pairs of very faint lateral impressions on the posterior glabellar lobe while there seems to be but one pair in *kjerulfi*. In the pygidium the differences are particularly the different length of the axis and the large pseudo-lobe in addition to the median marginal spine in *trispinifer*, characteristics lacking any analogies in *kjerulfi*. The following similarities should be noted: the transverse groove behind the median keel, which may coincide with the third ring furrow, is to be found in both, the ridge on the posterior rim of *trispinifer* may be homologous with the undulating ridge between the marginal spines in *kjerulfi*, and both have a small median pit on the posterior rim.

In the expanded pseudo-lobe *trispinifer* recalls *Pseudagnostus* and *Sulcatagnostus* KOBAYASHI (1937), the latter of which was founded on (the Middle Cambrian?) *Agn. securiger* LAKE (1906) and distinguished from the former only by having grooved side lobes in both shields, a poor generic criterion according to the present writer's experience. Divergent interpretations of the pseudo-lobe in the case of *Pseudagnostus* have been advanced. Thus Kobayashi (1935, p. 108) pointed out that it is not homologous with the axial end-lobe, which usually is obsolete but in some species very faintly outlined or indicated by two rows of weak pits or knobs (muscular attachments). For the furrows bounding the pseudo-lobe at the sides he proposed the term »diagonal accessory furrows» and interpreted them »as having arisen from some other adaptation». This interpretation was opposed by Troedsson (1937, p. 24), who considered the furrows bounding the end-lobe of *Pseudagnostus* and *Rhaptagnostus* (the latter probably a synonym of the former) as true axial furrows. As regards *O. trispinifer* it cannot be doubted that the faint furrows on the pseudo-lobe represent

the axial furrows. This species is distinct from *Pseudagnostus*, however, by having two pairs of diagonal accessory furrows the anterior pair of which is homologous to that of *Pseudagnostus* and the posterior pair wants any analogy in the latter. Thus the pseudo-lobe in *Pseudagnostus* is homologous to the pseudo-lobe inclusive of the bosses at its anterior corners and the third axial ring in *Oidalagnostus*. In this connection also *Condylopyge spinigera* (p. 34) should be mentioned, whose furrows are more suggestive of segmentation, however.

Horizon and Localities. — Zone of *Lejopyge laevigata*, upper part. — Västergötland: Gudhem; Torbjörntorp; Djupadalen; Ödegården. — Very rare.

Oidalagnostus? dubius sp. n. — Pl. 9, figs. 8 a, b.

Diagnosis. — Pygidium subquadrangular, moderately convex. Axial furrows well defined; axis broad, slightly widening posteriorly, extending to the marginal furrow, three-lobed, the first ring furrow faint, the second almost obsolete; a prominent elongate median tubercle on the second lobe; the end-lobe with a transverse depression anteriorly. Lateral lobes narrowing backwards, smooth. Marginal furrow fairly broad; rim moderate, convex, with three coarse and short cusps. Length of the holotype 3.8 mm (exclusive of the median cusp), breadth 4.0 mm.

Remarks and Affinities. — Only the illustrated specimen is present.

There is a considerable difference between this species and *trispinifer* as to the end-lobe (pseudo-lobe), and no evidence proves that the axial end-lobe of the former should occupy but the interior part of the outlined lobe. It should be noted, however, that only due to the find of a specimen in a favourable mode of preservation was the axial end-lobe revealed in *trispinifer*. Moreover, in the case of *Pseudagnostus* the pseudo-lobe is in some species greatly expanded and in others relatively narrow, and in but a few species has the axial end-lobe been found to be traceable. Thus, *dubius* is tentatively included in *Oidalagnostus*.

Horizon and Locality. — ? Andrarum limestone at Andrarum, Scania.

Agnostinae (JAEKEL, 1909).

Ptychagnostus JAEKEL, 1909.

Genotype: *Agnostus punctuosus* ANGELIN, 1851.

Original diagnosis: — »Mit doppelten Nebenloben [basal lobes] des Kopfschildes und radialen Falten oder unregelmässigen Höckern auf den Genae und meist nach den Pleuren des Schwanzschildes» (p. 401).

In addition to the genotype, Jaekel included in the genus: *atavus* TULLB., *intermedius* TULLB., *exsculptus* ANG., *aculeatus* ANG., *reticulatus* ANG., and *trisectus* SALT., the four latter, however, being removed into new genera by subsequent authors. As all the forms recorded by Jaekel have furrowed or scrobiculate cheeks and *exsculptus* and *trisectus* always have entire basal lobes, he

obviously considered the latter criterion particularly distinctive of this genus, which may also be concluded from its name. But even in the restricted sense given *Ptychagnostus* by recent authors the characteristics adduced by Jaekel are not reliable. Even though the cheeks are constantly grooved in the genotype though the furrows sometimes are very faint, young as well as full-grown perfectly preserved specimens of *atavus* (and *intermedius* which is a synonym of *atavus*) with smooth cheeks are present, and the basal lobes are sometimes distinctly or faintly divided and sometimes entire in both species. Thus, Kobayashi's statement that the most significant characteristic of *Ptychagnostus* »is the bilobed basal side-lobe that cannot be seen in any other agnostid» (1939 a, p. 152) has not validity even for the genotype, and distinctly divided basal lobes are found also in e. g. *aculeatus*, which Kobayashi included in *Goniagnostus*.

In 1935 Howell erected the genus *Triplagnostus* based on *Agnostus gibbus* LINNARSSON, 1869, which was defined thus:

»Agnostians with well developed dorsal furrows, glabellas, and pygidial axes, with the anterior lobe of the glabella pointed in front and the cheeks divided by a medial furrow, with the pygidial axes long and bluntly pointed at the rear, and with distinct transverse furrows on the glabella and the axis. In the known species the test is smooth and the flange of the pygidium does not bear spines, and these features are probably characteristic of the genus» (Howell, 1935 c, p. 14).

This diagnosis applies to *Ptychagnostus* as well, except in the ornamentation of the test, which in itself is no generic criterion. And the shape of the basal lobes — entire in *Triplagnostus* and divided or entire in *Ptychagnostus* — is not even a reliable specific character, as stated above.

No criterion safely distinguishing *Triplagnostus* from *Ptychagnostus* seems to exist even though the genotypes at first sight appear to be sharply distinct. In Scandinavia the earliest species of *Triplagnostus*, i. e. *praecurrens* and *gibbus*, occur in the late Celandicus and early Paradoxissimus beds, and species referable to the genus are met with also at higher levels, into the Forchhammeri beds. The earliest form referable to *Ptychagnostus* is *atavus*, which appears after the extinction of *praecurrens* and *gibbus*. *Pt. atavus*, *punctuosus affinis*, and *punctuosus* constitute a fairly continuous evolutionary series, which may have branched off from some early form of *Triplagnostus*. It seems convenient to keep apart these groups, typified by *Pt. punctuosus* and *Tr. gibbus*, as subgenera, and, in such a case, the older name *Ptychagnostus* is the valid generic name (Article 28 of IRZN) even though *Ptychagnostus* probably arose from *Triplagnostus* and not *vice versa*.

Triplagnostus displays close resemblance also to *Agnostus* s. str. (type *pisi-formis*), in which Jaekel included *gibbus*. As regards the Scandinavian species that in the present writer's opinion are referable to these genera the following differences should be noticed: in *Triplagnostus* the anterior glabellar lobe is relatively long and pointed in front and the axis of the pygidium pointed at the rear, whereas in *Agnostus* the anterior glabellar lobe is short and fairly blunt and the termination of the pygidial axis rounded. The preglabellar median furrow seems constantly to be developed in the former but is sometimes effaced in the latter genus. The absence of marginal spines in the pygidium of the former

and their presence in the latter is of minor value. The distinguishing characteristics are not very important but may have generic value.

Two species which may be referable to *Triplagnostus*, viz. *convexus* nov. and *elegans* TULLBERG, are distinguished by very weak axial and transverse furrows in both shields, by which they differ from the remainder of the subgenus.

Solenagnostus WHITEHOUSE, 1936, (genotype *Agn. longifrons* NICHOLAS, 1916), in which *lundgreni* TULLBERG was included, may be synonymous with *Triplagnostus*, as suggested by Harrington and Kobayashi. The taxonomic position of *Euagnostus* WHITEHOUSE, 1936, (*E. opimus* WHITEHOUSE), which Kobayashi considered a synonym of *Triplagnostus*, is uncertain (cf. p. 30). *Hastagnostus* HOWELL, 1937, (*H. angustus* HOWELL), which Kobayashi also regarded as synonymous with *Triplagnostus*, is distinguished by a short and bluntly pointed anterior glabellar lobe and bluntly pointed pygidial axis, by which it approaches *Aagnostus*.

In Scandinavia *Ptychagnostus* (inclusive of *Triplagnostus*) ranges through the Middle Cambrian, exclusive of the *Par. insularis* and the *Lej. laevigata* zones. Forms referable to the genus are known from Scandinavia, Great Britain, eastern and western North America (Howell & Mason, 1938), and Australia.

Subgenus *Triplagnostus* (HOWELL, 1935).

Subgenotype: *Aagnostus gibbus* LINNARSSON, 1869.

Ptychagnostus (*Triplagnostus*) *praecurrens* (WESTERGÅRD, 1936).

Pl. 9, figs. 9—12, (13, 14?).

1936. *Aagnostus gibbus praecurrens* WESTERGÅRD, S. G. U., Ser. C, No. 394, pl. 1, figs. 19—23. (Described and compared with *gibbus* and *gibbus hybridus*; figs. of cephalon and pygidium. Zone of *Par. pinus*. Mossberga and Borgholm, Öland.)

Remarks and Affinities. — This form has no cephalic spines, the glabella is moderately convex at the rear, the axis of the posterior thoracic segment has no spine, the axial tubercle of the pygidium is blunt and does not extend beyond the second ring furrow, the lateral lobes are confluent behind the axis in full-grown specimens (but separated by a furrow in young holaspid specimens). By these characteristics the form is distinct from *gibbus*, and is here raised to specific rank. Ratio of length and breadth is a less reliable characteristic. As a rule cephalon and pygidium are slightly broader than long in *praecurrens* and equal in length and breadth in *gibbus*, but specimens of the former are present in which the length even slightly exceeds the breadth. Compare also *Pt. (Tr.) hybridus* (p. 71).

The specimen in fig. 9 is somewhat aberrant, the axis of the pygidium being acutely pointed; in associated specimens the axis is less pointed or blunt as in the typical form, however.

Horizon and Localities. — *Par. oelandicus* stage (in Öland confined to the zone of *Par. pinus*). — Öland: Borgholm; Mossberga (boring); Mörbylånga. — Östergötland: Tornby (boring). — Närke: Bredsätter and Övre Åkerby

(borings); Vinala (boulder). — Jämtland: Bingsta; Västerskucku; Funäs; Önsvede.

Zone of *Ptychagn.* (*Triplagn.*) *gibbus* (Exsulans limestone). — Scania: Gislövs-hammar. — Östergötland: Tornby (boring); Grankulla (boring).

As a rule fairly infrequent in the lower zone, rare in the upper zone.

? Norway: Mjösen district.

Ptychagnostus (*Triplagnostus*) *angermanensis* sp.n. — Pl. 9, figs. 15, 16.

D i a g n o s i s. — Glabella subcylindrical, posteriorly prominent and with a small well defined tubercle; a pair of deep impressions at the antero-interior corners of the undivided basal lobes. Cheeks smooth, in some specimens very faintly scrobiculate; cephalic spines absent. Pygidium like that of *Pt.* (*Tr.*) *praecurrens*.

S i z e. — A middle-sized cephalon, holotype, 3.7 mm long and 3.9 mm broad.

R e m a r k s. — A great many specimens were collected from a boulder of calcareous shale at Brattbäcken, Ångermanland, yielding no other species. Broadly speaking the form resembles *praecurrens* but in certain features of the cephalon it agrees with *gibbus* and is tentatively counted as an independent species. Probably it belongs either to the *gibbus* or to the *atavus* zone.

Ptychagnostus (*Triplagnostus*) *gibbus* (LINNARSSON, 1869).

Pl. 9, figs. 17—24.

1869. *Agnostus gibbus* LINNARSSON, Vet.-Ak. Handl., vol. 8, No. 2, p. 81, pl. 2, figs. 52, 53. (Description and figs. of cephalon and pygidium. Lowest portion of the *Par. paradoxissimus* beds. Djupadalen; Hvittened, at Hunneberg, Västergötland.)
1878. *Agnostus gibbus* LINNARSSON, Brögger, N. M. N., vol. 24, p. 62 (46), pl. 6, figs. 11 a, b. (Figs. of cephalon and pygidium. Hestkin and Krekling, Norway.)
1879. *Agnostus gibbus* LINNARSSON, Linnarsson, S. G. U., Ser. C., No. 35, p. 22, pl. 2, figs. 31, 32. (Figs. of cephalon and pygidium. Exsulans limestone of Scania.)
1880. *Agnostus gibbus* LINNARSSON, Tullberg, S. G. U., Ser. C., No. 42, p. 15, pl. 1, figs. 2 a—c. (Description and figs. of cephalon and pygidium. Exsulans limestone. Andrarum and Gislöv, Scania.)
1934. *Agnostus gibbus* LINNARSSON, Cobbold & Pocock, Phil. Trans. Roy. Soc. London, Ser. B., vol. 223, p. 341, pl. 44, figs. 3, 4. (Description and figs. of cephalon and pygidium. *Par. bohemicus salopiensis* fauna. Rushton, England.)
- 1935 c. *Triplagnostus gibbus* (LINNARSSON), Howell, Bull. Wagner Free Instit. Sci., vol. 10, No. 2, p. 14, pl. figs. 5, 6. (Assigns species as the genotype of *Triplagnostus*. Figs. of cephalon and pygidium from Andrarum, Scania.)
- ?1936. *Triplagnostus gibbus* (LINNARSSON), Whitehouse, Mem. Queensland Mus., vol. 11, pt. 1, p. 84, pl. 8, figs. 6, 7; pl. 10; figs. 1, 2. (Records species from Queensland, Australia; figs. of cephalon and pygidium.)
1936. *Agnostus gibbus* LINNARSSON, Westergård, S. G. U., Ser. C, No. 394, p. 29. (Description supplemented.)
1943. *Triplagnostus gibbus* (LINNARSSON), Westergård, S. G. U., Ser. Aa, No. 182, p. 44, fig. 15. (Cephalon and pygidium illustrated. Oil-works at Kinnekulle, Västergötland.)

R e m a r k s. — The cephalic spines seem to form a constant characteristic, are slender or coarse and of varying length. In specimens in limestone they are usually broken off, and only the scars are to be seen. The posterior thoracic segment bears a small axial spine, and also the second axial ring of the pygidium has a coarse short spine. By the spinosity the species is distinct from

other Scandinavian forms referable to *Triplagnostus*. The cheeks are smooth; in a few specimens they were found to be faintly scrobiculate, which at least in fig. 21 is a primary characteristic.

The form illustrated in figs. 22—24 differs from the type by slightly longer basal lobes and somewhat broader rim in cephalon and pygidium. Several associated specimens display complete identity with the genotype, however.

The Australian form identified by Whitehouse as *gibbus* is at any rate closely akin to Linnarsson's species, though, possibly, not identical with it. It is not clearly seen from the figures whether it has cephalic spines or not, and whether the pygidial axis bears a coarse spine or a blunt tubercle.

Horizon and Localities. — *Pt. (Tr.) gibbus* is the index fossil of the lowest zone of the *Par. paradoxissimus* stage and occurs constantly wherever this zone is developed and accessible in Scandinavia. — Usually common, at many localities abundant.

Bornholm. — Norway. — England. — Australia(?). — Howell (1925) recorded *Agn. cf. gibbus* from Newfoundland.

Ptychagnostus (Triplagnostus) hybridus (BRÖGGER, 1878). — Pl. 9, figs. 25, 26; pl. 10, figs. 1, 2.

1878. *Agnostus gibbus* var. *hybrida* BRÖGGER, N. M. N., vol. 24, p. 62 (46), pl. 5, figs. 4 a, b. (Description and figs. of cephalon and pygidium. Associated with *Hypagn. parvifrons* and *Ptychagn. (Pt.) punctuosus*. Krekling, Norway.)
1902. *Agnostus gibbus* var. *hybrida* BRÖGGER, Grönwall, D. G. U., II. Række, No. 13, pp. 49, 197. (Remarks on the form found on Bornholm.)
- ?1916. *Agnostus pulchellus* ILLING, Q. J. G. S., vol. 71, p. 410, pl. 30, figs. 1, 2. (Description and figs. of cephalon and pygidium. Basal layer of the zone of *Par. davidis*. Nuneaton, England.)
1929. *Agnostus gibbus hybridus* BRÖGGER [partim], Strand, N. G. T., vol. 10, p. 343. (Recorded from the zone of *Par. paradoxissimus* in the Mjösen district, Norway. The form from the *Par. oelandicus* beds may belong to *Pt. (Tr.) praecurrens*.)
1935. *Agnostus cf. gibbus hybridus* BRÖGGER, Thorslund, S. G. U., Ser. C, No. 382, p. 106, fig. 1 (Description and sketch of cephalon. Zone of *Hypagn. parvifrons*. Högnäsån, Ångermanland.)
1935. *Agnostus* sp., Thorslund, idem., p. 108, pl. 1, fig. 8. (Fig. of a pygidium, somewhat disfigured by pressure. Zone of »*Agn. intermedius*». Högnäsån, Ångermanland.)

Remarks and Affinities. — The Scanian form agrees with the Norwegian but the one from Hunneberg is distinct by slightly shorter anterior glabellar lobe. The post-axial median furrow is always lacking in the material from Hunneberg, according to Thorslund it is sometimes indicated in specimens from Ångermanland, as is the case in the forms from Scania and the Mjösen area, too.

In the absence of spines *hybridus* is distinct from *gibbus* and displays closer resemblance to *praecurrens*. Compared with the latter, *hybridus* has cephalon and pygidium more strongly arched, the axial tubercle of the pygidium extending beyond the second ring furrow, and the axial end-lobe more swollen. In the broader pygidial axis, the undivided first axial ring, and the smooth cheeks *hybridus* differs from *stenorrhachis*.

Illing compared *pulchellus* with *stenorrhachis*, but judging from his description and figures the former is more closely allied to, and possibly a synonym of, *hybridus*.

Horizon and Localities. — Zones of *Hypagn. parvifrons* (and *Ptychagn. (Pt.) punctuosus?*) — Scania: Gislövshammar (boulders). — Västergötland: Munkesten and Byklev, Hunneberg. — Jämtland: Kopparrökhällarna(?). — Ångermanland: Högnäsån; Karbäcken. — Not infrequent at Hunneberg, rare in Scania.

Bornholm. — Norway: Oslo and Mjösen districts. — England(?). — Howell (1937 b) recorded *T. cf. gibbus hybridus* from New Brunswick, Canada.

Ptychagnostus (Triplagnostus) stenorrhachis (GRÖNWALL, 1902).

Pl. 10, figs. 3, 4.

1902. *Agnostus stenorrhachis* GRÖNWALL, D. G. U., II. Række, No. 13, p. 76, pl. 1, fig. 16. (Description and fig. of pygidium; cephalon unknown. Associated with *Goniagn. nathorsti* and *Diplagn. planicauda bilobatus*. Bornholm.)
- ?1934. *Agnostus stenorrhachis* GRÖNWALL, Cobbold & Pocock, Phil. Trans. Roy. Soc. London, Ser. B., vol. 223, p. 342, pl. 44, fig. 22. (Pygidium illustrated; cephalon unknown. *Par. bohemicus salopiensis* fauna. Rushton, England.)
1939. *Triplagnostus stenorrhachis* (GRÖNWALL), Kobayashi, Journ. Fac. Sci. Tokyo, Sect. II, vol. V, pt. 5, p. 146. (Species included in *Triplagnostus*.)

Remarks and Affinities. — A few cephalae and pygidia are present. As stated above, the species is closely allied to *hybridus*, which may be a fore-runner of *stenorrhachis*. In the cephalon, which has hitherto been unknown, the difference is confined to the cheeks being faintly scrobiculate with pits and short irregular grooves in *stenorrhachis* whereas *hybridus* has smooth cheeks. The pygidium, fig. 4, collected from the *punctuosus* zone in a boring at Gislövshammar, has slightly broader axis than the holotype; another pygidium from the top of the same zone in a boring at S. Sandby agrees exactly with the holotype, however. Two complete specimens collected by Mr. Seth Nilsson from the *lundgreni* zone at S. Sandby, which, thanks to the courtesy of Mr. Nilsson, the present writer had the opportunity of examining, agree in the cephalon with our fig. 3 and in the pygidium with the holotype. A pygidium from the *parvifrons* zone at Kopparrökhällarna, Jämtland, is in the breadth of the axis and the character of the first axial ring intermediate between *hybridus* and *stenorrhachis* and, thus, additional material will possibly prove that the latter should be considered a subspecies of the former.

The cephalon of *stenorrhachis* resembles that of *Ptychagn. (Pt.) atavus*; it is distinct from the latter mainly by shorter and broader basal lobes.

It is questionable whether the imperfectly known English form whose pygidium Cobbold identified as *stenorrhachis* is referable to this species; the backward extension of the medial portion of the second axial segment is broader and shorter in the English than in the Scandinavian form, which, moreover, occurs in much younger strata.

Size. — The largest pygidium present (fig. 4) is 5.0 mm long and 4.7 mm broad.

Horizon and Localities. — Zones of *Ptychagn. (Pt.) punctuosus* and *Pt. (Triplagn.) lundgreni*. — Scania: Gislövshammar; S. Sandby. — Rare. Bornholm.

Ptychagnostus (*Triplagnostus*) *convexus* sp. n. — Pl. 10, figs. 5—10.

Diagnosis. — Distinct from »*Agn.*» *altus* GRÖNWALL by having faintly outlined glabella, a weak preglabellar median furrow, and more deeply impressed axial and transverse furrows in the pygidium.

Description. — Cephalon and pygidium of high convexity, considerably broader than long, ovate in outline. Axial furrows of cephalon in young specimens well defined throughout, in full-grown specimens posteriorly faint, anteriorly very weak and usually discernible only on exfoliated specimens. Glabella occupying about four-fifths of the cephalic length and one-third of the breadth, inconsiderably elevated above the cheeks, slightly tapering, bluntly pointed in front; anterior glabellar lobe sub-equal in length and breadth; transverse glabellar furrow curving slightly backwards or straight; posterior glabellar lobe with a very weak (sometimes indiscernible) tubercle anteriorly. Basal lobes moderate, sub-equilateral, connected by a very narrow band. Cheeks tapering forwards, separated by a weak preglabellar furrow, smooth or faintly scrobiculate. Rim narrow, sub-equal in breadth, convex; marginal furrow distinct, very narrow.

Thorax unknown.

Axial furrows of pygidium narrow and well-defined, more distinct than those of the cephalon. Axis occupying about four-fifths of the total length, trilobed, slightly constricted at the second ring, terminating in a blunt point; transverse furrows fairly distinct, the second fainter than the first; second ring subhexagonal, with a small elongate tubercle posteriorly. Lateral lobes sub-equal in breadth throughout, confluent (in young specimens separated by a faint post-axial furrow?). Rim somewhat broader than in the cephalon, rather flat; marginal furrow well-defined, shallow. — Test of cephalon and pygidium smooth, under a strong lense thinly punctate or compact; surface of exfoliated specimens as a rule very faintly shagreened.

Size. — One of the largest cephalata found, the holotype fig. 8, 7.0 mm long and 7.3 mm broad; largest pygidium, fig. 10, 8.6 mm long.

Remarks and Affinities. — 18 cephalata and 10 pygidia, most of them perfectly preserved, are present, displaying some variability as to the convexity and distinctness of the furrows in both shields. Cephalata up to 4 to 5 mm in length have the anterior glabellar lobe distinctly outlined in exfoliated specimens and traceable on the surface of the test. In the largest cephalata and pygidia all furrows are weaker and the anterior glabellar lobe indiscernible on the surface of the test.

This form is closely allied to »*Agn.*» *altus* GRÖNWALL, from which it differs in having the glabella faintly outlined throughout, whereas in large specimens of the latter the glabella is separated from the cheeks only at, and immediately in front of, the basal lobes, the axial furrows otherwise being effaced. Also in the pygidium the axial and transverse furrows are more pronounced in the former than in the latter. No specimen so far found in Scania can be identified as *altus*. The latter was recorded from the zones of *Hypagn. parvifrons* and *Par.*

dauidis on Bornholm, and as *convexus* appears in older strata, it may be a fore-runner of *altus*. Whitehouse and Kobayashi included *altus* in *Cotalagnostus*, from which it evidently is phylogenetically distinct, however.

Pt. (Tr.) elegans is another species to which *convexus* displays close resemblance, the axial and transverse furrows being faint or sometimes almost indiscernible in both. The differences are not very important: the glabella and pygidial axis are less tapering, the cephalic rim is slightly broader, the small tubercle on the posterior glabellar lobe is situated markedly more forwards, the convexity — particularly of the pygidium — is higher, and the size is larger in *convexus* than in *elegans*. Both were the ancestors of smooth forms.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) atavus*. Brantevik and Gislövshammar (boulders), Scania. — Infrequent.

Ptychagnostus (Triplagnostus) elegans (TULLBERG, 1880).

Pl. 10, figs. 11—20.

1880. *Aagnostus elegans* TULLBERG, S. G. U., Ser. C., No. 42, p. 19, pl. 1, figs. 7 a—d. (Described and discussed; figs. of cephalon and pygidium. Zone of *Ptychagn. (Pt.) punctuosus*. Andrarum, Scania, and Bornholm.)

1902. *Aagnostus elegans* TULLBERG, Grönwall, D. G. U., II. Række, No. 13, p. 57. (Notes on the occurrence of the species on Bornholm.)

Remarks. — Two of Tullberg's type specimens are illustrated in figs. 11 (lectotype) and 12. A great many specimens have been collected at Baskemölla, Brantevik, and Gislövshammar, showing some variability as to the axial and transverse furrows, which are fairly distinct to almost imperceptible, the breadth of the rim, and the convexity of cephalon and pygidium; the cheeks are quite smooth or very faintly grooved irrespective of the axial furrows being distinct or not, the axial end-lobe is sometimes somewhat depressed posteriorly, and in a few specimens the end-lobe displays two to four pairs of lateral impressions (fig. 12). The species compares fairly well with *convexus*, q. v.

Pt. (Tr.) elegans merges in a smooth form, *elegans laevissimus*, described below.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) punctuosus*. — Scania: S. Sandby (boring); Andrarum; Baskemölla; Brantevik and Gislövshammar (boulders). — Fairly infrequent.

Bornholm.

Ptychagnostus (Triplagnostus) elegans laevissimus subsp. n.

Pl. 10, figs. 21, 22.

Diagnosis. — Distinct from *elegans* by having the axial furrows developed in the proximal part and wholly effaced in the distal part of both shields.

Remarks. — By intermediate links the subspecies grades into the species. It displays very close resemblance to *Lejopyge laevigata*, the dissimilarities being confined to slightly broader glabella and pygidial axis and the small glabellar tubercle being situated a little more forwards in the former than in the

latter. Thus *Ptychagnostus* (*Tr.*) *elegans*, *elegans laevis*, and *Lejopyge laevigata* constitute an evolutionary series with very small intervals.

Horizon and Localities. — Associated with *elegans* at Brantevik and Gislövshammar, Scania. — Infrequent.

As *Lejopyge laevigata* has not been found with full certainty in older strata than in the lower part of the zone of *Solenopleura brachymetopa* in Sweden, and as, on the other hand, Brögger (1878) stated this species to be even abundant in the uppermost part of the *Par. paradoxissimus* beds at Krekling, Norway, the latter form is supposed to be identical with *elegans laevis*.

Ptychagnostus (*Triplagnostus*) *lundgreni* (TULLBERG, 1880). — Pl. 10, figs. 23—25; pl. 11, figs. 1, 2.

1880. *Agnostus lundgreni* TULLBERG, S. G. U., Ser. C., No. 42, p. 20, pl. 1, figs. 8 a, b. (Description and figs. of cephalon and pygidium. Zones of *Ptychagn.* (*Pt.*) *punctuosus* and *Pt.* (*Tr.*) *lundgreni*. Andrarum, Scania; Bornholm.)
1902. *Agnostus lundgreni* TULLBERG, Grönwall, D. G. U., II. Række, No. 13, pp. 51 and 197. (Notes on the occurrence of the species on Bornholm.)
1929. *Agnostus lundgreni* TULLBERG, Strand, N. G. T., vol. 10, p. 345. (Records species from the *Par. rugulosus* zone of the Mjösen district, Norway.)
1929. *Agnostus atavus* TULLBERG, Strand, idem, p. 344, pl. 1, fig. 20. (The illustrated specimens belong either to *lundgreni* or *lundgreni nanus*. Zone of *Par. rugulosus*. Mjösen district, Norway.)
1934. *Agnostus lundgreni* TULLBERG, Cobbold & Pocock, Phil. Trans. Roy. Soc. London, Ser. B., vol. 223, p. 342, pl. 44, fig. 20. (Fig. of cephalon. *Par. forchhammeri* grit. Rushton, England. The pygidium, fig. 21, tentatively included in the species, seems to be distinct.)

Remarks. — Two of Tullberg's type specimens from Bornholm are illustrated on pl. 10, figs. 23 (lectotype) and 24. According to Tullberg the cheeks are smooth and glossy (glaber); specimens with grooved cheeks are by no means rare, however, and the forms with quite smooth and distinctly grooved cheeks are connected by intermediate links. The grooved form recalls *atavus*, with which it was in fact identified by Strand, but is distinguished by shorter and constantly undivided basal lobes.

Horizon and Localities. — Appears in the uppermost part of the *Ptychagn.* (*Pt.*) *punctuosus* zone, where it is rare, and continues into the lower part of the *Solenopleura brachymetopa* zone. — Scania: Andrarum; Brantevik and Gislövshammar; S. Sandby (boring); Åkarpsmölla (boring). — Västergötland: Byklev. — Jämtland: Vedjeön. — At some localities common.

Bornholm. — Mjösen district of Norway. — England.

Ptychagnostus (*Triplagnostus*) *lundgreni nanus* (GRÖNWALL, 1902).
Pl. 11, figs. 3—7.

1902. *Agnostus lundgreni* TULLBERG, var. *nana* GRÖNWALL, D. G. U., II. Række, No. 13, p. 51, pl. 1, fig. 2. (Description and fig. of pygidium. Associated with *lundgreni*. Bornholm.)
1929. *Agnostus lundgreni nanus* GRÖNWALL, Strand, N. G. T., vol. 10, p. 345, pl. 1, figs. 5, 6. (Description and figs. of cephalon and pygidium. Zone of *Par. rugulosus*. Mjösen district, Norway.)

Remarks. — This form is distinct from the typical *lundgreni* by somewhat shallower axial and transverse furrows, slightly lower convexity of glabella and pygidial axis, and narrower axial end-lobe, the latter being the most

conspicuous difference. The specimens, figs. 3—5, from a bedding plane crowded with the subspecies and yielding but few specimens of the species, are variable as to the shape of the anterior glabellar lobe.

The subspecies resembles *elegans* but is distinguished by more pronounced axial and transverse furrows in both shields.

Horizon and Localities. — Associated with *lundgreni*.

Subgenus **Ptychagnostus** JAEKEL, 1909.

Subgenotype: *Agnostus punctuosus* ANGELIN, 1851.

Ptychagnostus (*Ptychagnostus*) *atavus* (TULLBERG, 1880).

Pl. II, figs. 8—23, (24, 25?).

1880. *Agnostus atavus* TULLBERG, S. G. U., Ser. C., No. 42, pp. 14, 37, pl. 1, figs. 1 a—d. (Description and figs. of cephalon and pygidium from a loose stinkstone lens at Andrarum, Scania.)
 1880. *Agnostus intermedius* TULLBERG, idem, p. 17, pl. 1, figs. 4 a, b. (Description and figs. of cephalon and pygidium. Andrarum, loc. 9, Scania.)
 1936. *Triplagnostus atavus* (TULLBERG), Whitehouse, Mem. Queensland Mus., vol. 11, pt. 1, p. 85, pl. 8, figs. 8, 9; pl. 10, fig. 1 (pars). (Records species from Australia; figs. of complete specimens of different sizes.)

Remarks. — Tullberg's type specimens of *atavus* are perfectly preserved in limestone, those of *intermedius* poorly preserved in shale, flattened, and with a thin coating of calcite. According to Tullberg's descriptions and figures the following differences exist. In *atavus* the glabella is cleft in front by a weak longitudinal furrow and the small tubercle of the posterior glabellar lobe is situated behind the centre; in *intermedius* the anterior glabellar lobe is not cleft and the tubercle is situated at the centre of the lobe. The pygidium of the former has a post-axial median furrow; in the figure of the latter the lateral lobes are confluent, and the pygidium was stated to resemble that of *Tomagn. fissus* although no transverse depression of the axial end-lobe is discernible; this was supposed possibly to be due to imperfect preservation. The test of cephalon and pygidium of *intermedius* are »opaque due to a fine granulation» which, as far as the present writer can see, is an adventitious feature and due to the coating of calcite.

After a careful examination of the syntypes and a large material of topotypes as well as specimens from other localities — some of which were labelled *Agnostus atavus* and *A. intermedius* resp. by the hand of Tullberg — the present writer has arrived at the result that the above-mentioned differences are not of specific value and may be due to the different modes of preservation and the individual variability.

In most of the specimens of *atavus* (syntypes and specimens from Västergötland identified as *atavus* by Tullberg) the glabella is not cleft in front; on the other hand a furrow is indicated in a few topotypes of *intermedius*.¹ In *atavus* the tubercle of the glabella is situated somewhat behind the centre of the posterior lobe, in *intermedius* (syn- and topotypes) about in the centre or a little

¹ This furrow is probably a primary characteristic and not an adventitious feature.

farther back. The basal lobes are of variable size in both forms, and the furrow traversing the lobes is usually distinct in *atavus* but as a rule less conspicuous and often absent in *intermedius*. This distinction may be of little value, however, owing to the imperfect preservation of the latter form; at any rate there are topotypes of *intermedius* in which the furrow is distinct, and specimens have been observed with one of the basal lobes divided and the other entire. It should also be noted that, in boring cores from Andrarum and Gislövshammar (Westergård, 1944 a), specimens with divided and entire lobes are mixed in the oldest as well as youngest strata yielding this species. In both forms the grooves of the cheeks are, broadly speaking, more strongly marked in full-grown than in young specimens, but there are also large specimens with smooth cheeks. — In the pygidium the two forms seem to agree. In young holaspid specimens of both, the post-axial longitudinal furrow is distinct, in full-grown specimens usually weak or absent (more often discernible on internal casts than on the outer surface of the test). Thus, as the present writer is not able to point out any characteristic by which *atavus* and *intermedius* can be definitely distinguished, the latter is considered a synonym of the former.

In addition to the radiating grooves of the cheeks there sometimes occurs a pair of curved grooves subparallel to the outlines of the anterior glabellar lobe. This form is common in some localities and rare in others. Specimens with smooth cheeks, those with strongly scrobiculate cheeks, and intermediate links have been observed associated on one bedding plane. The former display very close resemblance to *praecurrens*, possibly a forerunner of *atavus*.

The type specimens of *atavus* were collected from a loose stinkstone lens at Forsemölla, Andrarum, which was supposed to originate from a layer above the »fragment limestone» and below the Exsulans limestone. Tullberg therefore believed this species to be the oldest agnostid in the sequence at Andrarum and considered it a forerunner of *Ptychagn. (Tr.) gibbus* and *Tomagn. fissus*. This opinion is incorrect, however, as *atavus*, when found in solid rock, occurs constantly at a higher level than does *gibbus*.

The Australian form identified as *atavus* by Whitehouse agrees very well with Tullberg's species.

A form from Högnäsån, Ångermanland, identified as *intermedius* by Thorslund (1935) is here referred to *Ptychagn. (Pt.) punctuosus affinis*.

The Norwegian form illustrated by Strand (1929, p. 344, pl. 1, fig. 20) and identified as *atavus* belongs to the group of *Pt. (Tr.) lundgreni*.

A closely allied form, *Agn. cf. intermedius*, was described by Illing (1916, p. 408) from the zones of *Par. aurora* and *P. hicksii* at Nuneaton, England.

Horizon and Localities. — *Pt. (Pt.) atavus* is the index fossil of a zone above that of *Pt. (Tr.) gibbus* and is as a rule common, often abundant, in all Swedish areas with this zone developed and accessible. It has not been found at Hunneberg, possibly owing to no limestone being met with at the level in question, nor on Öland where the beds above the *gibbus* zone are rarely exposed and poor in fossils.

Bornholm. — Mjösen district of Norway (teste Strand). — Australia.

Ptychagnostus (Ptychagnostus) punctuosus (ANGELIN, 1851).

Pl. 11, figs. 34, 35; pl. 12; figs. 1—7.

1851. *Agnostus punctuosus* ANGELIN, Pal. Suec., fasc. 1, p. 8, pl. 6, fig. 11. (Brief diagnosis and rough figure of the dorsal shield. Stinkstone boulder. Andrarum, Scania.)
1872. *Agnostus scutalis* SALTER [partim], Hicks, Q. J. G. S., vol. 28, p. 175, pl. 5, only figs. 9 (and 10?). (Figs. of the pygidium of two young specimens, re-illustrated by Lake, 1906. Menevian, Wales.)
1872. *Agnostus scarabaeoidis* SALTER, Hicks, idem, p. 175, pl. 5, fig. 8. (Description and figure of a flattened and somewhat imperfect dorsal shield, re-illustrated by Lake, 1906. Menevian, Wales.)
1875. *Agnostus punctuosus* ANGELIN [partim], Brögger, G. F. F., vol. 2, p. 576, pl. 25, figs. 2. (Notes on species, figs. of cephalon and pygidium. Öksna, Norway.)
1878. *Agnostus punctuosus* ANGELIN, Brögger, N. M. N., vol. 24, p. 67 (51), pl. 6, figs. 12 a, b. (Emphasizes the variability of the species occurring at Norwegian localities; figs. of cephalon with attached thorax and isolated pygidium from Andrarum, Scania.)
1880. *Agnostus punctuosus* ANGELIN, Tullberg, S. G. U., Ser. C., No. 42, p. 17, pl. 1, figs. 5 a—d. (Description and figs. of complete specimen and two pygidia of different sizes. Andrarum, loc. 10 and 11, Scania.)
1896. *Agnostus punctuosus* ANGELIN, Matthew, Trans. N.Y. Acad. Sci., vol. 15, p. 232, pl. 16, figs. 11 a, b. (Cites Tullberg's diagnosis translated into English. Figs. of cephalon and pygidium. Zone of *Par. davidis*. Newfoundland.)
1902. *Agnostus punctuosus* ANGELIN, Grönwall, D. G. U., II. Række, No. 13, p. 55. (Comments on species; no figure. Zone of *Par. davidis*, Bornholm.)
1906. *Agnostus punctuosus* ANGELIN, Lake, Pal. Soc., Brit. Cambr. Trilob., p. 4, pl. 1, figs. 4, 5, (6?). (Description and new figs. of the specimens illustrated by Hicks as *Agn. scutalis* and *scarabaeoides* mentioned above.)
1916. *Agnostus punctuosus*, ANGELIN, Illing, Q. J. G. S., vol. 71, p. 409, pl. 29, figs. 2, 3. (Notes on species; figs. of a large dorsal shield and a detached small pygidium. Zone of *Par. davidis*. Nuneaton, England.)

Remarks. — The specimens illustrated in figs. 3 and 4 on pl. 12 are believed to belong to Angelin's syntypes; the cephalon is selected lectotype.

As pointed out by Brögger and subsequent authors this species is variable in many respects. In specimens of middle or larger size the anterior glabellar lobe is usually entire but sometimes cleft by a longitudinal furrow that is fainter than the preglabellar furrow, the basal lobes are broad and triangular or narrow and elongate and entire or divided by a transverse furrow, the radiating grooves on the cheeks are very faint or fairly well impressed and numerous or scattered, the granulation is pronounced or rather weak and is confined to the cheeks or extends also to the anterior glabellar lobe. The pygidium is of varying convexity, the axis is subequal in breadth to the lateral lobes or markedly broader, the axial end-lobe has usually a broad transverse depression across the middle and is rarely evenly convex, its termination is blunt or fairly pointed, a small median tubercle is often discernible at about the centre, and sometimes the end-lobe displays a faint median ridge; rarely a pair of tubercles are to be found on the first and second axial rings, as illustrated by Tullberg; the lateral lobes are always and the axis is sometimes distinctly granulated. Young specimens differ from the adult mainly in having almost smooth cheeks and lateral lobes, shorter and acutely pointed pygidial axis, and a well-defined post-axial furrow, which becomes fainter in proportion as the animal grows and finally becomes effaced (in pygidia more than 4 mm long).

Of the many different forms of *punctuosus* but the one described by Brögger as var. *affinis* — a forerunner of the typical species — is here maintained as a distinct subspecies.

Horizon and Localities. — Zone of *Pt. (Pt.) punctuosus*. — Scania: Andrarum; Baskemölla; Brantevik and Gislövshammar; Tosterup; S. Sandby (boring); Traneröd, parish of Konga (boulders). — Västergötland: Djupadalen; Byklev (teste Grönwall). — Jämtland: Hillsand. — Ångermanland: Tjärnmyrberget. — In Scania usually common or even abundant, in Northern Sweden less common than in Scania.

Bornholm. — Oslo and Mjösen districts in Norway. — Great Britain. — Newfoundland. — *Pt. punctuosus* var. was recorded by Howell (1937 b) from New Brunswick, Canada.

Ptychagnostus (Ptychagnostus) punctuosus affinis (BRÖGGER, 1878).

Pl. II, figs. 26—33.

1878. *Agnostus punctuosus* ANGELIN var. *affinis* BRÖGGER, N. M. N., vol. 24, p. 68 (52), pl. 5, figs. 2 a, b. (Description and figs. of cephalon and pygidium. Middle portion of the *Par. paradoxissimus* beds. Krekling, Norway.)
- ?1878. *Agnostus punctuosus* ANGELIN v.l. *bipunctata* BRÖGGER, idem., pl. 5, fig. 2 c. (Diagnosis and fig. of pygidium. Associated with the preceding form.)
1935. *Agnostus intermedius* TULLBERG, Thorslund, S. G. U., Ser. C., No. 382, p. 106, pl. 1, figs. 5—7. (Description of pygidium; figs. of cephalon and pygidium. Högnäsån, Ångermanland.)

Remarks. — This form differs from the typical *punctuosus* mainly in that the cheeks want granulation and the lateral lobes of the pygidium are more faintly granulated, the tubercle on the posterior glabellar lobe is very faint and less elongate and situated slightly less forwards than in the species. The axial end-lobe usually displays one to five pairs of faint lateral impressions and the post-axial furrow is sometimes present so in full-grown specimens. The basal lobes are divided by a transverse furrow or entire. Intermediate links exist, and young specimens of the subspecies are not distinguishable from the young of the species.

Pt. punctuosus affinis is also closely allied to *atavus*; in the former the tubercle on the posterior glabellar lobe is located slightly more forwards than in the latter, the lateral lobes of the pygidium are faintly granulated instead of smooth, and the axial end-lobe is as a rule depressed posteriorly instead of evenly convex. But there are intermediate stages also between these forms (cf. pl. II, figs. 24 and 25). Thus, *atavus*, *punctuosus affinis*, and *punctuosus* form a practically continuous evolutionary series.

Horizon and Localities. — Infrequent in the zone of *Hypagn. parvifrons*, sometimes fairly common in the zone of *Ptychagn. punctuosus*; not observed in the uppermost portion of the latter zone. — Scania: Andrarum; Brantevik and Gislövshammar. — Öland: on the shore SW of Mörbylilla. — Jämtland: Hillsand; Siljeåsen. — Ångermanland: Aborrället; Högnäsån; Tjärnmyrberget(?).

Bornholm. — Oslo district of Norway.

Ptychagnostus (Ptychagnostus) aculeatus (ANGELIN, 1851). — Pl. 12, figs. 8—11.

1851. *Agnostus aculeatus* ANGELIN, Pal. Suec., fasc. 1, p. 8, pl. 6, fig. 12. (Brief diagnosis and rough figure. Andrarum limestone. Andrarum, Scania.)

1878. *Agnostus aculeatus* ANGELIN, Brögger, N. M. N., vol. 24, p. 71 (55), pl. 5, figs. 5 a, b. (Description and figs. of cephalon and pygidium. *Par. forchhammeri* beds. Krekling, Norway.)
1880. *Agnostus aculeatus* ANGELIN, Tullberg, S. G. U., Ser. C., No. 42, p. 23, pl. 1, figs. 11 a, b. (Description and figs. of cephalon and pygidium. Andrarum limestone. Andrarum, Scania.)
1902. *Agnostus aculeatus* ANGELIN, Grönwall, D. G. U., II. Række, No. 13, p. 197. (Records species from Bornholm.)
1929. *Agnostus aculeatus* ANGELIN, Strand, N. G. T., vol. 10, p. 345, pl. 1, fig. 7. (Compares species with *Pt. punctuosus*; fig. of cephalon. Zone of *Par. forchhammeri*. Mjösen district, Norway.)

Remarks. — Three specimens, in all probability belonging to Angelin's syntypes, are illustrated on pl. 12, figs. 8—10, of which fig. 8 is the lectotype.

The basal lobes are usually divided by a transverse or oblique furrow, but sometimes they are entire and not always marked off from the glabella anteriorly; if divided, the anterior portion is sometimes shorter and sometimes longer than the posterior. Cephalons with the posterior margin undamaged display a pair of short spines. The post-axial furrow is well defined in young and, as a rule, also in middle-sized but effaced in large specimens. The posterior portion of the axial end-lobe is usually slightly depressed.

Kobayashi included this species in *Goniagnostus*, but the present writer considers it to be more closely allied to *Ptychagnostus*. It differs from *Pt. punctuosus* in several features, particularly in the position of the median glabellar tubercle at the rear instead of the centre of the glabella, much longer and more prominent keel on the pygidial axis, and more strongly pronounced granulation of the test of both shields. The basal lobes of the two forms are alike. *Pt. aculeatus* possibly is the latest member of the *atavus-punctuosus* branch.

Horizon and Localities. — Zone of *Solenopleura brachymetopa* and *Exporrecta conglomerata*. — Scania: Andrarum; Baskemölla; S. Sandby (boring). — Västergötland: Råbäck. — Jämtland: Brunflo; Kläppe; Vedjeön; Siljeåsen; Fånån. — Ångermanland: Kvarnån; Aborrfallet. — Everywhere infrequent.

Bornholm. — Oslo and Mjösen districts of Norway.

Goniagnostus HOWELL, 1935.

Genotype: *Agnostus nathorsti* BRÖGGER, 1878.

Original diagnosis. — «Agnostians with well developed dorsal furrows, glabellas, and pygidial axes, with the anterior lobe of the glabella pointed in front and the cheeks divided by a medial furrow, with the pygidial axis long and pointed at the rear, and with distinct transverse furrows on the glabella and the axis. In the known species of the genus the cheeks are crossed by furrows, the surface of the lateral lobes is granulated, the main lobe of the glabella has two indentations on each side behind the transverse furrow, and the flange of the pygidium has a spine at each rear corner; and these features are probably characteristic of the genus» (Howell, 1935 c, p. 13).

The genus has most of the characteristics mentioned in common with *Ptychagnostus*. It differs from the latter mainly in having subquadrangular instead of triangular basal lobes and marginal spines in the pygidium. The differences are not very important and it seems questionable whether *Goniagnostus* should be awarded rank of an independent genus (cf. Whitehouse, 1939, p. 257).

In *Goniagnostus* Howell included *Agn. sulcatus* ILLING (= *perrugatus* GRÖN- WALL) and *confluens* MATTHEW. The latter doubtlessly belongs here but it

would seem more reasonable to refer the former to *Tomagnostus* as suggested by Kobayashi. On the other hand, Kobayashi included *aculeatus* ANGELIN in *Goniagnostus*, whereas in the present writer's opinion this form displays closer resemblance to *Ptychagnostus*. As regards Harrington's suggestion that *Goniagnostus* belongs in Condylropyginae see p. 29.

In the sense given *Goniagnostus* above the genus is confined to the medial and late Middle Cambrian of the North Atlantic Basin and Australia.

Goniagnostus nathorsti (BRÖGGER, 1878). — Pl. 12, figs. 12—16.

1851. *Agnostus exsculptus* ANGELIN [partim], Pal. Suec., fasc. I, p. 7, pl. 6, fig. 8; pygidium only. (Andrarum limestone. Andrarum, Scania.)
1878. *Agnostus nathorsti* BRÖGGER, N. M. N., vol. 24, p. 68 (52), pl. 5, fig. 1. (Description and fig. of a complete specimen. Zones of *Par. rugulosus* and *Par. forchhammeri*. Styggeadal, Hedemarken; Krekling; Norway.)
1880. *Agnostus nathorsti* BRÖGGER, Tullberg, S. G. U., Ser. C., No. 42, p. 21, pl. 1, fig. 9. (Description and fig. of complete specimen. Zones of *Ptychagn. (Tr.) lundgreni* and *Solenopleura brachymetopa*. Andrarum and Kiviks-Esperöd, Scania.)
1896. *Agnostus nathorsti* BRÖGGER, Matthew, Trans. N.Y. Acad. Sci., vol. 15, fig. 12, p. 229. (Cites Tullberg's diagnosis translated into English. Records species from the zone of *Par. abenacus*. New Brunswick, Canada.)
- ?1916. *Agnostus* cf. *nathorsti* BRÖGGER, Illing, Q. J. G. S., vol. 71, p. 408, pl. 29, fig. 1. (Description and figure of the pygidium. Upper *Par. davidis* zone. Nuneaton, England.)
1929. *Agnostus nathorsti* BRÖGGER, Strand, N. G. T., vol. 10, p. 345. (Compares species with *Ptychagn. punctuosus* and *Doryagn. incertus*. Zone of *Par. rugulosus*. Mjösen district, Norway.)
- 1935 c. *Goniagnostus nathorsti* (BRÖGGER), Howell, Bull. Wagner Free Inst. Sci., vol. 10, No. 2, p. 13, pl., figs. 1—2. (Assigns species as the genotype of *Goniagnostus*; figs. of cephalon and pygidium from Krekling, Norway.)

R e m a r k s. — This characteristic species is remarkably constant from its appearance to its extinction.

Judging from Illing's description and figure of the English form, known from but two pygidia, it seems to be referable to Brögger's species. The surface of the lateral lobes are stated to be smooth, whereas it is faintly shagreened in the Scandinavian form, a difference of little value, however, as the ornamentation is rarely perceivable on specimens preserved in shale.

H o r i z o n a n d L o c a l i t i e s. — Zones of *Ptychagn. (Tr.) lundgreni* (common at many localities) and *Solenopleura brachymetopa* (rare). — Scania: Andrarum; Kiviks-Esperöd; Baskemölla; Brantevik (boulder 45); S. Sandby (boring); Åkarpsmölla (boring). — (Västergötland: Byklev?). — Jämtland: Vedjeön; Kopparrökhällarna; Havsnäset; Siljeåsen. — Ångermanland: Tjocknäsbacken; brooklet 2 km E of Tåsjö church; Tåsjö church; Brattbacken; Kvarnån; Aborrfallet. — Västerbotten: Skansholm; Skikkisjöberget.

Bornholm. — Oslo and Mjösen districts, Norway. — (Nuneaton, England?). — New Brunswick, Canada. — A very closely related (possibly identical) form was described by Whitehouse (1939) from Australia. (As regards the range of the species in North America and Australia see p. 9, foot-note 1.)

Goniagnostus scanensis sp. n. — Pl. 12, figs. 17 a, b.

D i a g n o s i s. — In the pygidium this form differs from the genotype in the following features: the axis is markedly broader, the first axial ring is not

(distinctly) trilobed, the second ring bears a low and blunt tubercle instead of a prominent posteriorly pointed keel, the transverse depression across the end-lobe is very weak, and the marginal spines are more rudimentary. To the naked eye the test is smooth, under a strong lens very faintly shagreened.

Two pygidia are present. In spite of the cephalon being unknown the generic reference seems to be safe.

Size. — Holotype 4.0 mm long and 3.5 mm broad.

Horizon and Locality. — Associated with *Goniagn. nathorsti*. Brantevik (boulder 45), Scania. Very rare.

Goniagnostus spiniger (WESTERGÅRD, 1931). — Pl. 12, figs. 18, 19.

1931. *Agnostus nathorsti spiniger* WESTERGÅRD, S. G. U., Ser. Aa, No. 172, p. 46. (Briefly characterized. Karlsfors, Västergötland.)

Description. — Cephalon bearing a pair of a very strong spines, otherwise like the genotype. In the pygidium the marginal spines are strong, the axis is narrower than the lateral lobes, the second axial ring as wide as the end-lobe, and, accordingly, the axial furrows straight. In these characteristics the form differs from *nathorsti*. The spinosity itself may not be of specific value, and mainly on account of the additional differences mentioned the form is here raised to specific rank.¹

Size. — A large cephalon, the holotype, is 4.7 and 5.0 mm, a large pygidium 5.5 and 4.7 mm in length and breadth resp. (flattened specimens in shale).

Horizon and Localities. — Zone of *Lejopyge laevigata*, basal layer. — Scania: Andrarum (rare). — Västergötland: Karlsfors (not infrequent); Djupadalen. — Närke: Ullavi.

Doryagnostus KOBAYASHI, 1939.

Genotype: *Agnostus incertus* BRÖGGER, 1878.

Original diagnosis. — »Agnostinae² with bilobed glabella, pygidial spine, and faintly segmented pygidial axis which is depressed at pointed hind and continues to post-axial furrow» (Kobayashi, 1939 a, p. 148).

Whitehouse (1939) erected the genus *Ceratagnostus*, based on *C. magister* WHITEHOUSE, from a horizon of the Australian sequence approximately corresponding to the European *Par. davidis* zone. According to Whitehouse, »*C. magister* is very similar to *C. incertus* BRÖGGER sp. (as figured by Tullberg, 1880, pl. 1, figs. 6 a, b), differing in the larger sizes (it is about 50 % larger in linear dimensions) and by the slightly more obtuse termination to the axis of the pygidium» (p. 256). Obviously *Doryagnostus* and *Ceratagnostus* are synonymous and, as the former name was published ten days earlier than the latter, the former is valid. Moreover, *magister* does not seem to be specifically distinct

¹ It may be noted that *G. spiniger* is associated with another spinous agnostid, *Lejopyge laevigata armata*, both being very closely related to preceding forms, with no or very weak spines. The spinous forms are in Västergötland confined to a thin layer immediately above the Exporrecta conglomerate deposited during a beginning transgression. The coincidence of spinosity in these cases can hardly be fortuitous but must be caused by the changed milieu.

² Evidently a misprint. Kobayashi included *Doryagnostus* in Triplagnostinae.

from *incertus*. In the original diagnosis of *incertus* the pygidium is stated to attain a maximum length of 7 mm (in the Swedish material cephalon and pygidia 5 to 6 mm long are by no means rare) and according to the diagnosis of *magister* «the average length of specimen» is 13 mm. If specimen in this case means complete specimen, which seems reasonable as the complete specimen figured has exactly the length mentioned, *incertus* and *magister* are equal in size. The termination of the pygidial axis of *incertus* varies, and specimens are present in which it is even slightly blunter than in the illustrated specimen of *magister*. The only difference possibly existing seems to be in the anterior glabella lobe, which in the latter specimen is inconsiderably shorter than in *incertus*.

Doryagnostus agrees with *Ptychagnostus* (*Triplagn.*) in the cephalon, and in the pygidium it recalls *Goniagnostus*. It differs from *Triplagnostus* in having the termination of the axial end-lobe constricted and depressed, almost or quite obsolete transverse furrows on the axis, and a pair of marginal spines. It is sharply distinct from *Goniagnostus* in the cephalon, and in the pygidium the dissimilarities are mainly confined to differences in the segmentation of the axis and the ornamentation of the lateral lobes. The transverse depression on the axial end-lobe is also found in other genera, e. g. *Tomagnostus*, *Clavagnostus*, and *Linguagnostus*, and sometimes in *Ptychagnostus*, too.

Whitehouse suggests that the group of *Agn. exaratus* GRÖNWALL (in the present paper called *Peronopsis scutalis*) is the ancestor of «*Ceratagnostus*» (*Doryagnostus*). In the present writer's opinion these forms are remote, whereas *Doryagnostus* may be closely allied to *Triplagnostus* and should possibly be regarded as another subgenus of *Ptychagnostus* (cf. Whitehouse, 1939, p. 255).

Doryagnostus is known from the uppermost portion of the medial Middle Cambrian of Scandinavia, England, Newfoundland (Howell, 1925), and Australia.

Doryagnostus incertus (BRÖGGER, 1878). — Pl. 12, figs. 20—23;
pl. 13, figs. 1—3.

1878. *Aagnostus incertus* BRÖGGER, N. M. N., vol. 24, p. 70 (54), pl. 6, figs. 4 a, b. (Description and figs. of cephalon and pygidium. Zone of *Par. rugulosus*. Krekling, Norway.)
1880. *Aagnostus incertus* BRÖGGER, Tullberg, S. G. U., Ser. C., No. 42, p. 19, pl. 1, figs. 6 a, b. (Description and figs. of cephalon and pygidium. Zone of *Ptychagn. punctuosus*. Andrarum, loc. 11, Scania.)
1902. *Aagnostus incertus* BRÖGGER, Grönwall, D. G. U., II. Række, No. 13, p. 52. (Remarks on the variability of the species from Bornholm; no fig.)
?1907. *Aagnostus incertus* BRÖGGER, Lake, Pal. Soc., Brit. Camb. Trilob., p. 29, pl. 3 figs. 1—3. (Description and figs. of cephalon and pygidium. Shropshire, England.)
?1916. *Aagnostus* cf. *incertus* BRÖGGER, Illing, Q. J. G. S., vol. 71, p. 407, pl. 28, fig. 10. (Fig. of an imperfect pygidium. Lower *Par. davidis* zone. Nuneaton, England.)
1929. *Aagnostus incertus* BRÖGGER, Stränd, N. G. T., vol. 10, p. 344. (Remarks on species from the *Par. rugulosus* zone of the Mjösen district, Norway; no figure.)
1939. *Ceratagnostus magister* WHITEHOUSE, Mem. Queensland Mus., vol. 40, pt. 3, p. 256, pl. 25, fig. 27. (Description and fig. of complete specimen from beds correlated with the zone of *Par. davidis*. North-eastern Australia.)

Remarks. — Cephalon as well as pygidium usually equal in breadth and length or slightly longer than broad; in some shields retaining the original convexity the breadth is somewhat broader than the length. Cheeks usually smooth, rarely faintly scrobiculate. The axis of the pygidium varies in breadth

but in no specimen present is it as broad as in Brögger's figure. In young individuals one or two ring furrows are faintly marked across the pygidial axis, in full-grown specimens indicated on the sides or quite obliterated. The termination of the axial end-lobe is usually acutely pointed, sometimes fairly blunt.

The form illustrated by Lake has broader pygidial axis (in which it agrees with Brögger's figure) and the marginal spines situated farther back than in any specimen present. The pygidium figured by Illing is too poorly preserved to allow of a safe specific determination. As stated above, *Ceratagnostus magister* WHITEHOUSE is in all probability synonymous with *D. incertus*.

Horizon and Localities. — Zone of *Ptychagn. (Pt.) punctuosus*. — Scania: Andrarum; Baskemölla; Brantevik and Gislövshammar; S. Sandby (boring). — Västergötland: Munkesten. — Ångermanland: Karbäcken. — Västerbotten: Skikkisjöberget. — Not infrequent in Scania.

Bornholm. — Oslo and Mjösen districts of Norway. — England(?). — Australia. — *Agn. cf. incertus* was recorded by Howell (1925) from Newfoundland.

Agnostus BRONGNIART, 1822.

Genotype: *Entomolithus paradoxus* γ *pisiformis* LINNÆUS, 1757.

Agnostus may have arisen from *Triplagnostus*; the differences are discussed on p. 68. It appears in the late Middle Cambrian and ranges into the Upper Cambrian. The genus is known from the N. Atlantic province, Novaya Zemlya, Bennett Island (N of Siberia), and western North America (Evans, 1933). A recently described Australian form, *Agnostus seminula* WHITEHOUSE (1939), from layers approximately corresponding to the zone of *Par. hicksii* seems to be more closely allied to *Triplagnostus* and in general features it compares with e. g. *lundgreni* and *stenorrhachis*.

Agnostus pater WESTERGÅRD, 1930. — Pl. 13, figs. 4—6.

1930. *Agnostus pisiformis pater* WESTERGÅRD, Holm & Westergård, Mém. Acad. Sci. URSS., Sér. VIII, Cl. phys.-math., vol. 21, No. 8, p. 9, pl. 4, figs. 9, 10; (pl. 1, fig. 1?). (Compared with *A. pisiformis*; figs. of cephalon and pygidium from the Andrarum limestone at Kiviks-Esperöd, Scania. An illustrated somewhat imperfect pygidium from the *Centropleura* zone, Bennett Island, N. of Siberia, is identified with this form.)

Remarks and Affinities. — *Agn. pater* differs from the genotype in that the lateral outline of both shields is almost straight at the articulating margin and parallel to the axial line, whereas it is curved inwards in full-grown specimens of the latter. Otherwise the forms agree as to the cephalon. In the pygidium the segmentation of the axis is more strongly pronounced in *pater* than in *pisiformis*. See also *Agn. neglectus*.

The above-mentioned pygidium from Bennett Island agrees with the Swedish form as far as it is preserved except that the second axial ring is slightly shorter.

Size. — *A. pater* is a small form; a cephalon of average size, fig. 4, measures 2.4 mm in length and 2.6 mm in breadth; an associated pygidium, the holotype, fig. 5, is 2.3 mm long and 2.7 mm broad.

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum; Kiviks-Esperöd. — Västergötland: Byklev; Munkesten. — Närke: Gymninge; Ullavi; Ösby (boulder). — Also in the *Exporrecta* conglomerate at Degerhamn and on the shore NW of Ventlinge, Öland, and at Ödegården, Västergötland. — Rare.

? Bennett Island, N. of Siberia.

Agnostus neglectus sp. n. — Pl. 13, figs. 7—9.

Diagnosis. — This form differs from the genotype in the following characteristics: the lateral furrows on the anterior third of the posterior glabellar lobe are more strongly defined and almost continuous across the glabella, the glabella is posteriorly gently keeled and attains its highest convexity at the rear, the weak median tubercle is situated behind instead of in front of the centre of the posterior glabellar lobe; in the pygidium the transverse furrows on the axis are more strongly pronounced, the second axial lobe is slightly constricted, and the end-lobe is slightly expanded. Cheeks usually smooth, rarely faintly scrobiculate.

Size. — The holotype, a middle-sized cephalon, is 2.3 mm long and 2.4 mm broad; one of the largest pygidia present (fig. 9) is 2.8 and 3.0 mm in length and breadth.

Affinities. — *A. neglectus* seems hitherto to have been identified as *pisiformis* although the differences are conspicuous and, as regards the cephalon, clearly visible on a side view. The dissimilarities in the cephalon distinguish *neglectus* also from *pater*, and in the pygidium it differs from the latter in the slightly widened axial end-lobe. No intermediate links connecting these forms have been observed. In the widened axial end-lobe *neglectus* recalls *Agn.* (*Homagn.*) *obesus* (BELT).

Horizon and Localities. — Zone of *Solenopleura brachymetopa* (very rare). — Scania: Andrarum; Kiviks-Esperöd. — Västergötland: Byklev.

Zone of *Lejopyge laevigata*, upper part. — Västergötland: Gudhem; Torbjörntorp; Djupadalen; Ödegården. — Närke: Ösby (boulders). — Not infrequent in Västergötland.

Agnostus pisiformis (LINNÆUS, 1757). — Pl. 13, figs. 10—14.

For list of synonymy see Westergård, 1922, p. 115.

Remarks. — A form referable to *A. pisiformis* appears even in the upper part of the zone of *Lejopyge laevigata*. Specimens from the *pisiformis* zone vary as regards breadth and length of the pygidial axis and the ring furrows, which sometimes are distinct though very shallow and narrow and sometimes almost or quite obliterated. The same variability is also found in specimens from the lower zone, in which a form with relatively broad and smooth axis seems to be predominant. The constriction of the shields at the articulating margin is somewhat more pronounced in specimens from the upper than in those from the lower zone.

The form in the *laevigata* zone is fairly small, the average length of the cephalon being 2.5—3.0 mm.

Horizon and Localities. — Zone of *Lejopyge laevigata*, upper part. — Scania: Andrarum. — Östergötland: Berg. — Västergötland: Kinnekulle; Håkansgården; Gudhem; Torbjörntorp; Djupadalen; Ödegården. — Närke: Vrana; Sättran; Gymninge. — Not infrequent at the localities in Falbygden, Västergötland; otherwise rare.

A. pisiiformis is common in the Exporrecta conglomerate at many localities but only in areas in which the *laevigata* zone is absent, and the sedimentation of the conglomerate has continued into the *pisiiformis* phase, i. e. on Öland, in parts of Närke, and in the eastern part of the Cambro-Silurian area of Northern Sweden. — The species is as a rule abundant in the *pisiiformis* zone, wherever this zone is developed. It is beyond comparison the most common agnostid in Sweden.

North Atlantic Basin. — Novaya Zemlya. — Western North America.

Agnostus pisiiformis spiniger (DALMAN, 1828). — Pl. 13, figs. 15, 16.

1828. *Battus pisiiformis* β *spiniger* DALMAN, Vet.-Acad. Årsber., 1828, p. 137. (Description; no fig. Kinnekulle, Västergötland.)

1837. *Battus pisiiformis* β *spiniger* DALMAN, Hisinger, Lethaea Suecica, p. 20, pl. 4, fig. 6. (Fig. of cephalon from Hönsäter, Västergötland.)

Remarks. — This form is distinct from *pisiiformis* by having a pair of small cephalic spines. Specimens with shorter spines than those of fig. 15 exist, and a fairly continuous series of stages between the latter and the non-spinous form is present. As the slender spines are often broken and with difficulty made visible by preparing they are easily overlooked. On slabs rich in specimens from the *pisiiformis* zone the spinous and non-spinous forms sometimes occur associated, e. g. at Karlevi, Öland; on a slab from Råbäck, Västergötland, the spinous form is predominant and possibly the only one existing, and on slabs from many other localities it is sought in vain. This might indicate that the spinous form is confined to a fixed level of the *pisiiformis* zone. It has not been observed in the *laevigata* zone.

Agnostus pisiiformis subsulcatus subsp. n. — Pl. 16, figs. 4, 5.

Diagnosis. — Distinct from *pisiiformis* by the preglabellar median furrow being practically absent or very faintly indicated posteriorly and effaced anteriorly. Marginal spines of pygidium rudimentary; transverse furrows on the axis faint or obsolete.

Size. — The holotype, a cephalon of medium size, is 4.0 mm long and 4.4 mm broad.

Remarks. — *A. pisiiformis subsulcatus* is the earliest Swedish form of the Agnostinae in which the preglabellar furrow is obsolete, a feature more strongly pronounced in later genera of this branch.

Horizon and Localities. — *Par. forchhammeri* beds. Ullavi, Sättran, and Ö. Rynninge, in Närke. — Fairly infrequent.

Agnostus? sp. — Pl. 13, fig. 17.

A single pygidium with well-defined, long, and very faintly segmented axis and lacking actual marginal spines from the Andrarum limestone at Andrarum, Scania, possibly belongs to an unknown species of *Agnostus*. Length 2.1 mm.

Lejopyge CORDA, 1847.

Genotype: *Battus laevigatus* DALMAN, 1828.

Tullberg emphasized the close affinity between *Lejopyge laevigata* and *Ptychagnostus* (*Triplagn.*) *elegans*. On the other hand, Kobayashi (1937, 1939 a) and Harrington (1938) suggested that *Lejopyge* arose from *Cotalagnostus*, which in its turn derived from *Hypagnostus* (according to Harrington from *Quadragnostus*), and, accordingly, the authors co-ordinated *Cotalagnostus* and *Lejopyge* in an independent subfamily, Lejopyginae, of Peronopsidae. As stated below the material present establishes, however, that the genotype of *Lejopyge* derived from *Ptychagn.* (*Tr.*) *elegans laevissimus* subsp. n. Consequently, Lejopyginae in the sense used by Kobayashi and Harrington is polyphyletic.

In addition to the greatly variable genotype several forms have been referred to this genus. Thus Whitehouse and Kobayashi included *Agn. confusus* in *Lejopyge*; in the present writer's opinion it would seem more likely to belong to *Cotalagnostus*, however (see p. 55). Three forms from the *Par. davidis* zone of Newfoundland described by Matthew (1896) as varieties of *laevigata* — *terranoivicus*, *ciceroides*, and *mammilla* — require a re-examination before their generic reference can be ascertained; Whitehouse and Kobayashi included them in *Cotalagnostus*. The imperfectly known *Lejopyge exilis* WHITEHOUSE from the *Phoidagnostus* stage of Australia seems to differ from *laevigata* in lacking the basal lobes (on a dorsal view), and according to Whitehouse it is perhaps most closely allied to *confusus*.

In Sweden (and Scandinavia in its entirety?) *Lejopyge* is confined to the *Par. forchhammeri* stage.

Lejopyge laevigata (DALMAN, 1828). — Pl. 13, figs. 18—26 (27?); pl. 16, fig. 9.

1828. *Battus laevigatus* DALMAN, Vet.-Acad. Årsber. 1828, p. 136. (Brief description, no figure. Zone of *L. laevigata*. Hönsäter, Västergötland.)
1837. *Battus laevigatus* DALMAN, Hisinger, Leth. Suec., p. 20, pl. 4, fig. 7. (Brief diagnosis, rough fig. of cephalon, Hönsäter, Västergötland.)
1847. *Lejopyge laevigata* (DALMAN), Hawle & Corda, Prodrum Mon. böhm. Trilob., p. 51, pl. 3, fig. 25. (Description and a fairly good sketch of the dorsal shield drawn from syntypes.)
1851. *Agnostus laevigatus* (DALMAN), Angelin, Pal. Suec., fasc. I, p. 6, pl. 6, fig. 3. (Brief diagnosis and rough fig. of the dorsal shield. Zone of *L. laevigata*. Hönsäter, Västergötland.)
1878. *Agnostus laevigatus* (DALMAN) [partim], Brögger, N. M. N., vol. 24, p. 74 (58), pl. 5, fig. 6. (Records the range of the species in Norway. Fig. of complete specimen, which, however, differs from the type in having the rim of the cephalon as broad as that of the pygidium. Fig. 5 on pl. 6, a cephalon from the upper part of the *Par. paradoxissimus* beds, has relatively broad glabella and is possibly referable to *Ptychagnostus* (*Triplagn.*) *elegans laevissimus*.)
1880. *Agnostus laevigatus* (DALMAN), Tullberg, S. G. U., Ser. C., No. 42, p. 27, pl. 2, figs. 17 a, b. (Description and figs. of cephalon and pygidium. Andrarum limestone, Andrarum, Scania.)
1895. *Agnostus laevigatus* (DALMAN), Wallerius, Zonen med *Agn. laevigatus*, p. 35. (Records the variability and range of the species in Västergötland.)

1902. *Agnostus laevigatus* (DALMAN), Grönwall, D. G. U., II. Række, No. 13, p. 60. (Review of the forms from Scandinavia and Newfoundland referred to this species.)
1929. *Agnostus laevigatus* (DALMAN) [partim], Strand, N. G. T., vol. 10, p. 346. (Description of species recorded from the zones of *Par. rugulosus* — *L. laevigata*. Mjösen district, Norway.)

Remarks. — Dalman's type specimens are kept in the Paleozool. Dept. of the State Museum. Seven small slabs of stinkstone, each with an attached label marked »Kinnekulle, Hönsäter, Dalman 1827» contain two different forms, one without spines, the other with well-developed spines in cephalon and pygidium and referable to Linnarsson's var. *armata*. The forms occur in different slabs and both are associated with *Andrarina* [»Liostracus»] *costata* (ANGELIN). Consequently both originate from the *laevigata* zone, the non-spinous form probably from a somewhat higher level than the spinous. The specimens of the former are the syntypes of *laevigata*.

This species is liable to a considerable variability, especially in the absence or presence of spines in cephalon and pygidium, which induced Linnarsson to distinguish the var. *armata*, and in the sculpture of the test of the cephalon, whose cheeks are usually quite smooth but in many specimens more or less distinctly scrobiculate. Specimens with the spinosity or rugosity strongly pronounced differ greatly in general aspect from the type and might at first sight be considered independent species. However, non-spinous and spinous as well as smooth and wrinkled forms occur associated and irrespective of the level in the *laevigata* zone, and as the extreme forms are connected by intermediate links they are awarded subspecific rank only. A slight variability is to be found also in other characteristics: in the breadth of the rim in cephalon and pygidium, the breadth of the axial lobe and the convexity of the basal portion of the glabella. Cephalons from the Andrarum limestone have sometimes slightly broader rim than specimens from older and younger strata; the present writer has, however, never found a cephalon with the rim as broad as in Brögger's fig. 6 on pl. 5.

In adult specimens the axial furrows are fairly distinct in the proximal part of both shields, otherwise as a rule entirely obliterated. In immature specimens, however, the furrows are fully developed though shallow, and also in full-grown individuals the furrows can sometimes be traced throughout, mainly as shades in the test. In this case a form arises which approaches *Ptychagnostus* (*Triplagn.*) *elegans*.

A pygidium, fig. 27, displaying four pairs of small pits and an unpaired pit in the axial end-lobe indicating segmentation, is tentatively included in this species. It may be noted that several pygidia in the present material undoubtedly belonging to *laevigata* show two or more pairs of similar though much weaker impressions.

Brögger (1878) described two varieties, *similis* and *forfex*, from the *Par. forchhammeri* beds of Norway, whose generic reference seems to be questionable. The former, known but from the cephalon, has a short unlobed distinctly outlined glabella and recalls a Swedish form (pl. 7, fig. 17), which is tentatively included in *Cotalagn. confusus* in spite of the glabellar lobe being faintly outlined also in front. The latter, a pygidium, resembles our fig. 31 on pl. 13 except that

the axial furrows, judging from Brögger's fig. and description, are much deeper, particularly in the posterior portion of the shield.

Brögger recorded *laevigata* as early as from the uppermost strata with *Par. paradoxissimus* and *Hypagn. parvifrons* and illustrated a cephalon (pl. 6, fig. 5) from this zone. In the breadth of the glabella it agrees better with *Ptychagn. (Tr.) elegans laevissimus*, however.

Horizon and Localities. — In Sweden *L. laevigata* has not been found with full certainty in older strata than immediately below the Andrarum limestone, possibly already in the subjacent zone, and ranges to the top of the *laevigata* zone. It is common, sometimes even abundant, in the zone to which it has given its name but generally occurs more sparsely in the older zone. It has a wide regional distribution and is found in all districts of Scandinavia, in which any one of the above-mentioned zones are developed.

Lejopyge laevigata armata (LINNARSSON), 1869. — Pl. 13, figs. 28—36.

1869. *Agnostus laevigatus* var. *armata* LINNARSSON, Vet.-Ak. Handl., vol. 8, No. 2, p. 82, pl. 2, figs. 58, 59. (Description and figs. of cephalon and pygidium. Zone of *L. laevigata*. Karlsfors and Gudhem, Västergötland.)

1895. *Agnostus laevigatus* var. *armata* LINNARSSON, Wallerius. Zonen med *Agn. laevigatus*, p. 37. (Records the stratigraphical range of the variety in Västergötland. Cf. foot-note 1.)

Remarks. — Linnarsson's type specimens are probably lost; the cephalon is selected lectotype. His figures show a form with long and slender spines in cephalon and pygidium, resembling the form from Gudhem illustrated in our figs. 32 and 34. Detached thoracic segments associated with these specimens have the pleura produced into long spines directed backwards. Forms with shorter spines and more or less distinctly furrowed cheeks connect this long-spined and smooth form on the one hand with the typical *laevigata* and on the other hand with the subspecies *perrugata*.

Horizon and Localities. — The long-spined form occurs abundantly and is beyond comparison predominant in the basal part of the *laevigata* zone at some localities in Västergötland and has been found in the upper part of the zone at Knivinge and Skåningstorp (boring) in Östergötland. Forms with shorter spines have been observed at different levels and in almost all localities from which *laevigata* is known; they are very rare in the zone of *Solenopleura brachymetopa*, however.¹

Lejopyge laevigata perrugata subsp. n. — Pl. 14, figs. 1, 2.

Diagnosis. — This form is distinguished by strongly furrowed cheeks and short cephalic spines.

¹ Wallerius states that he has never found the subspecies *armata* in the lower part of the *laevigata* zone in Västergötland and is thus inclined to consider it confined to the upper part of the zone, which at any rate is said to be the case in the road section at Gudhem. This supposition is incorrect, however. Figs. 32—34 on pl. 13 originate just from the basal strata of the section mentioned, and on some surfaces at this level at Gudhem as well as at other localities in Falbygden the long-spined form is abundant and seems to be the only one existing. It is true that also spinous forms are by no means rare in the upper part of the zone in Falbygden, but the spines, especially in the pygidium, are as a rule much shorter and most of these forms resemble more closely the associated non-spinous type than Linnarsson's subspecies.

The form in which the rugosity is most strongly pronounced is very rare. The holotype, fig. 2, was collected from the lower part of the *laevigata* zone at Karlsfors, Västergötland. Associated pygidia do not differ from that of *laevigata*, except that most of them have marginal spines of varying length. Intermediate forms connecting *perrugata* on the one hand with the non-spinous type and, on the other hand, with the subspecies *armata* have been found at several localities.

Lejopyge laevigata rugifera subsp. n. — Pl. 14, fig. 3.

D i a g n o s i s. — Distinct from *laevigata* by having strongly furrowed cheeks.

The holotype, which is associated with one cephalon whose cheeks are but faintly furrowed and six pygidia quite like the type of the species, originates from the *laevigata* zone at Sjögestad, Östergötland. Forms intermediate between this subspecies and *laevigata* have been found associated with the latter at many localities (cf. fig. 22, pl. 13).

Phalacrominae (CORDA, 1847).

Ciceragnostus KOBAYASHI, 1937.

Genotype: *Aagnostus barlowii* BELT, 1868.

Kobayashi established this genus for forms which closely resemble *Phoidagnostus* WHITEHOUSE but are distinguished by having »the axial lobe marked by furrows at a distance from the articulating margin» (p. 442). In addition to the genotype and *cicer* TULLBERG, which was considered synonymous with the former, Kobayashi included in the genus also *Agn. barlowii spinatus* ILLING from the Lower *Par. hicksii* zone at Nuneaton, England.

Ciceragnostus cicer (TULLBERG, 1880). — Pl. 14, figs. 4—9.

1880. *Aagnostus cicer* TULLBERG, S. G. U., Ser. C, No. 42, p. 26, pl. 2, figs. 16 a, b. (Description and figs. of cephalon and pygidium, both turned upside down on the plate. Zone of *Ptychagn. punctuosus*, Andrarum, Scania.)
1902. *Aagnostus cicer* TULLBERG, Grönwall, D. G. U., II Række, No. 13, p. 59. (Records the range of the species on Bornholm.)
1902. *Aagnostus cicer* TULLBERG var. *forfex* GRÖNWALL, idem, p. 59, pl. 1, fig. 5. (Description and fig. of pygidium. Zone of *Par. davidis*. Bornholm.)

R e m a r k s. — Only a pygidium of Tullberg's syntypes has been found; it is illustrated in fig. 4 and is selected lectotype.

The cephalon is usually somewhat broader than long, sometimes equal in length and breadth as is the case in the pygidium. In the typical form the pygidial axis occupies more than half the total breadth; specimens with narrower axis are present, however. In small pygidia, less than 1.5 mm in length, the axis is usually outlined throughout, an immature feature which sometimes persists in full-grown specimens; this form Grönwall distinguished as var. *forfex*.

A pygidium, fig. 6 on pl. 16, distinct from the typical form of *cicer* by somewhat deeper axial furrows and higher convexity of its posterior portion is possibly referable to this species.

Lake (1906) considered *cicer* synonymous with *barlowii* BELT, the age of which

does not seem to be known for certain. It is somewhat questionable, however, whether these forms in reality are identical. According to Belt and Lake the British form has a very narrow rim in the cephalon and the minute median tubercle is situated about one-third of the length of the cephalon from the posterior margin, whereas in the Swedish form there is no trace of a rim (except at the posterior margin), even in the most perfectly preserved specimens, and the tubercle is located more closely to the centre.

C. barlowii spinatus (ILLING, 1916), known but from the pygidium and occurring in the Lower *Par. hicksii* zone, differs mainly in having a pair of short marginal spines and in its greater size.

Horizon and Localities. — Appears in the zone of *Ptychagn. (Pt.) punctuosus* (according to Tullberg a single specimen has been found in the zone of *Pt. »intermedius» = atavus*) and ranges into the zone of *Solenopleura brachymetopa*. As a rule fairly infrequent in the *punctuosus* zone and very rare in the overlying zones. — Scania: Andrarum; Kiviks-Esperöd; Baskemölla; Brantevik and Gislövshammar; S. Sandby (boring). — Jämtland: Siljeåsen. — Ängermanland: Aborrället; (Karbäcken?).

Bornholm.

Ciceragnostus(?) sp. — Pl. 16, figs. 7 a, b.

The illustrated pygidium has faint and short axial furrows bounding a broad axis with a long and weak median keel divided by a transverse depression.

Andrarum limestone. Andrarum, Scania.

Phoidagnostus WHITEHOUSE, 1936.

Genotype: *Phoidagnostus limbatus* WHITEHOUSE, 1936.

Original diagnosis. — «Smooth agnostids that differ from *Phalacroma* in retaining the accessory lobes of the glabella» (p. 93).

The genotype — occurring in the Australian *Phoidagnostus* Stage, which is approximately equal in age to the zone of *Par. davidis* in the North Atlantic Basin — has a narrow rim in the cephalon but seems otherwise to agree with *Agn. bituberculatus* ANGELIN. Its pygidium is not known with certainty. No other species so far described seems to be referable to this genus.

Phoidagnostus bituberculatus (ANGELIN, 1851). — Pl. 14, figs. 10—14.

1851. *Agnostus bituberculatus* ANGELIN, Pal. Suec., fasc. I, p. 6, pl. 6, fig. 2. (Brief diagnosis and a rough figure of the dorsal shield. A statement in the text that the cephalon is marginate, is incompatible with the figure and may be due to an error in writing or a misprint. Andrarum limestone. Andrarum, Scania.)
1902. *Agnostus glandiformis* ANGELIN [partim], Grönwall, D. G. U., II. Række, No. 13, p. 63, pl. 1, fig. 6. (The form interpreted by Grönwall as the young of *Phalacroma glandiforme* in reality belongs to *Phoidagn. bituberculatus*. Fig. of pygidium. Andrarum limestone. Bornholm.)
1930. *Agnostus bituberculatus* ANGELIN, Holm & Westergård, Mém. Acad. Sci. URSS., Sér. 8, Cl. phys.-math., vol. 21, No. 8, p. 11, pl. 1, figs. 10—12; pl. 4, figs. 4—6. (Angelin's species was duly fixed. Figs. of cephalon and pygidia from the Andrarum limestone at Andrarum, Scania, and the *Centropleura* zone of Bennett Island, N. of Siberia.)
- Non:
1878. *Agnostus bituberculatus* ANGELIN, Brögger, N. M. N., vol. 24, p. 75 (59), pl. 6, figs. 9 a, b (Cf. *Cotalagnostus confusus*.)

R e m a r k s. — Angelin's type specimens cannot be identified with certainty. The specimens from the Andrarum limestone illustrated on pl. 14, figs. 10—12, agree with Angelin's figure, at any rate better than any other form from the type locality. No complete specimen has been found but there is little doubt that the cephalon and pygidium under consideration are conspecific in view of the manner in which they occur associated.

The cephalon, which is more strongly convex than the pygidium, has a pair of well defined transverse basal lobes and a very faint median ridge immediately before the centre; it does not display any trace of a rim. In the pygidium the median elongate tubercle is fairly well-defined; the rim is uniform in breadth in young and slightly widened at the sides in full-grown specimens.

Ratio of length and breadth is variable, the cephalon being longer than broad or equal in length and breadth. — The largest cephalon and pygidia do not exceed 5.5 mm in length.

Whitehouse suggested that the form from Bennett Island is possibly specifically distinct from Angelin's species since the cephalon from Andrarum illustrated by Holm & Westergård (pl. 4, fig. 4) is longer in proportion than the one from Bennett Island (pl. 1, fig. 10). However, also in this feature the latter agrees exactly with the broad form from Andrarum (pl. 14, fig. 12).

P. bituberculatus is clearly distinct from young specimens of the associated *Phalacroma glandiforme*, with which it was earlier confounded by having well defined basal lobes and a faint elongate median ridge in front of the centre of the cephalon, more ovate and more strongly convex pygidium with an elongate instead of circular median tubercle, the rim slightly widened at the sides in the adult, and the differently shaped doublure.

H o r i z o n a n d L o c a l i t i e s. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum; Kiviks-Esperöd; Baskemölla; Gislövshammar (boring); S. Sandby (boring). — Ångermanland: Aborrället. — Not infrequent in Scania, rare in Ångermanland.

Bornholm. — Bennett Island, N of Siberia.

Phalacroma CORDA, 1847.

Genotype: *Battus bibullatus* BARRANDE, 1846 (lecto-genotype by Raymond, 1913 a).

Raymond's selection of genotype of *Phalacroma* was overlooked by subsequent authors (cf. Richter, 1941), which has caused some confusion as to the nomenclature of the smooth agnostids. Thus, as the type of this genus Howell (1935 b) assigned *Battus nudus* BEYRICH, 1845, Kobayashi (1935) selected *Ph. scutiforme* CORDA, which he in 1937 amended to *Battus nudus*, and Whitehouse (1936) followed Kobayashi's earlier proposal.¹

¹ After re-examination of Corda's material Barrande (1852) stated that *Phalacroma scutiforme* CORDA, 1847, is synonymous with *Battus nudus* BEYRICH, 1845, and that cephalon and pygidium were confused in Corda's restored illustration of *scutiforme*, the cephalon of the figure being in reality the pygidium and *vice versa*.

On the other hand, Howell (1935 b) selected *Battus bibullatus* BARRANDE, the same species as the lecto-genotype of *Phalacroma* by Raymond, 1913, as the type of *Platagnostus* HOWELL, which name is thus invalid. *Bibullatus* differs from *nudum* (Howell's type of *Phalacroma*) in having the pygidial axis outlined throughout and expanded posteriorly, whereas the axial furrows are effaced in both shields of *nudum*. If this distinction be of generic or subgeneric value, which may be true and was agreed to by Harrington and Kobayashi but opposed by Whitehouse, *nudum* and its allies must be removed from *Phalacroma*.

Howell (1935 a, b) erected two more new genera of smooth agnostids, *Grandagnostus* (type: *G. vermontensis* HOWELL from the *Centropleura* fauna of Vermont, U. S. A.) and *Gallagnostus* (type: *G. geminus* HOWELL from the late Middle Cambrian of Hérault, France). *Grandagnostus*, in which Howell included also *Agn. glandiformis* ANGELIN, was stated to be distinguished mainly by its large size. »S o l a n g e die Wissenschaft diesem einzigen Unterschied keinen generischen Wert beimessen kann, ist *Grandagnostus* HOWELL 1935 hinfällig durch I s o t y p i e» (Rud. Richter, 1941, p. 187). *Gallagnostus* is distinguished by a well-defined rim on the cephalon subequal in breadth to that of the pygidium, a criterion which according to the present writer's experience is of no generic value, however, as it is found to vary quite considerably in other species. Thus, *geminus* and *nudum* may be congeneric.

The classifications of the smooth agnostids advanced by recent authors diverge greatly and obviously further investigations of the group are required. Pending the results of these the writer for the present desists from suggesting any change in the generic reference of the Scandinavian forms hitherto included in *Phalacroma*.

Phalacroma scanicum (TULLBERG, 1880). — Pl. 14, figs. 15—18.

1880. *Aagnostus nudus* BEYRICH var. *scanicus* TULLBERG, S. G. U., Ser. C., No. 42, p. 29, pl. 2, figs. 18 a, b. (Description and figs. of cephalon and pygidium. Zones of *Hypagn. parvifrons* and *Ptychagn. (Pt.) punctuosus*. Andrarum, Scania.)

R e m a r k s. — Of Tullberg's specimens only the cephalon illustrated in fig. 15, has been found; it is selected lectotype. But a few more specimens, all poorly preserved, are present.

This form is distinct from *Ph. nudum* by a faintly marked fairly narrow rim in the cephalon (discernible in internal casts as well as specimens retaining the test). In the pygidium, with a broad rim subequal in breadth or slightly expanded at the rear and a faint elongate median tubercle, *scanicum* agrees with the Bohemian form.

H o r i z o n a n d L o c a l i t i e s. — Zones of *Ptychagn. (Pt.) atavus* (upper part), *Hypagn. parvifrons*, and *Ptychagn. (Pt.) punctuosus*. Andrarum, Brantevik (boulder 80), and Gislövshammar (boring), Scania. — Rare.

Bornholm.

Phalacroma resectum (GRÖNWALL, 1902). — Pl. 14, figs. 19 a, b.

1902. *Aagnostus glandiformis* ANGELIN, var. *resecta* GRÖNWALL, D. G. U., II. Række, No. 13, p. 64, pl. 1, fig. 7. (Description and fig. of pygidium. Zone of *Par. davidis*. Bornholm.)

R e m a r k s. — The original description was founded on a single pygidium, 8 mm long. The form is characterized by a narrow rim, which, according to Grönwall, is developed only at the sides, tapers backwards, and is effaced at the rear (in reality traceable also at the rear).

Three pygidia and an imperfect internal cast of the cephalon, all on one bedding plane, may belong to this form. In the largest pygidium (fig. 19) the rim is indicated throughout though the marginal furrow is very faint at the rear, and in another specimen the furrow is wholly effaced posteriorly. In the holotype the outline is subcircular, whereas the Scanian form is slightly elongate. Considering the greatly varying ratio of length and breadth in the species of *Phalacroma* this criterion is of little value, however. The associated cephalon agrees with that of *glandiforme* so far as comparisons are possible. Thus it is of higher convexity than the pygidium, immarginate, has a very small circular median tubercle, and lacks any trace of basal lobes. As the pygidium is sharply distinct from that of *glandiforme* the form is awarded rank of an independent species.

H o r i z o n a n d L o c a l i t i e s. — Zone of *Ptychagn. (Pt.) punctuosus*. Brantevik (boulder 56) and ?Baskemölla, Scania.

Bornholm.

Phalacroma marginatum (BRÖGGER, 1878). — Pl. 14, figs. 20—29;
pl. 15, figs. 1, 2.

1878. *Agnostus nudus* BEYRICH var. *marginata* BRÖGGER, N. M. N. vol. 24, p. 73 (57), pl. 6, fig. 3. (Description and fig. of complete specimen. Zone of *Par. rugulosus*. Krekling, Norway.)
1880. *Agnostus nudus* BEYRICH var. *marginatus* BRÖGGER, Tullberg, S. G. U., Ser. C., No. 42, p. 29, pl. 2, figs. 19 a, b. (Description and figs. of cephalon and pygidium. *Hyolithes* limestone and overlying shale bed. Andrarum, Scania.)
1902. *Agnostus nudus* BEYRICH, var. *marginata* BRÖGGER, Grönwall, D. G. U., II. Række, No. 13, pp. 62, 198. (Records species from the upper part of the *Par. davidis* zone and the lower part of the Andrarum limestone on Bornholm; no fig.)
1929. *Agnostus nudus marginatus* BRÖGGER, Strand, N. G. T., vol. 10, p. 346, pl. 1, fig. 8. (Description and fig. of pygidium. Zone of *Par. rugulosus*. Mjösen district, Norway.)

R e m a r k s. — Cephalon and pygidium moderately convex, the former slightly higher than the latter. Cephalon has a narrow rim, which is faintly marked on the outer surface of the test but more strongly pronounced on internal casts, and a very weak circular median tubercle (often indiscernible) about one-third of the length of the cephalon from the posterior margin. In the pygidium the rim is narrow at the anterior corners, widens backwards, and is greatly expanded at the rear. The median tubercle, when discernible, is very small and circular. A small cephalon, 2.2 mm long (fig. 24) probably referable to this species, has the axial furrow faintly marked out at the rear on the left side where the test is absent, and an exfoliated pygidium, 1.3 mm long (fig. 22), has the axis faintly outlined throughout to the marginal furrow.

The specimens included in this species vary in the ratio of length and breadth of both shields and, more particularly, in the breadth of the rim or the pygidium, which might imply specific distinction. Judging from the material present it seems more likely, however, that the differences are due to the individual

variability. Thus the form in fig. 26 on p. 14 and fig. 2 on pl. 15, which display closer resemblance to *nudum ovale* (ILLING, 1916, pl. 31, fig. 10) from the Lower *Par. davidis* zone at Nuneaton than to Brögger's fig. of *marginatum*, are tentatively included in the latter.

Ph. marginatum agrees with *scanicum* as regards the cephalon; in the pygidium the differences are conspicuous: the rim is narrow anteriorly and greatly expanded posteriorly in the former but subequal in breadth or slightly widened at the rear in the latter, the oblique furrow crossing the rim at the anterior corners in the latter is absent in the former, and the median tubercle is minute and circular in the former but elongate in the latter.

Horizon and Localities. — Zones of *Ptychagn.* (*Triplagn.*) *lundgreni* and *Solenopleura brachymetopa* (recorded from the zone of *Par. rugulosus* in Norway). — Scania: Andrarum (not infrequent in the so-called *Hyolithes* limestone, 0.3 m below the Andrarum limestone, but very rare in the latter); Baskemölla; S. Sandby (boring). — Jämtland: Vedjeön; Hillsand; Siljeåsen. — Ångermanland: Aborrfallet; Brattbäcken. — Västerbotten: Skansholm; Gole- sen; Lubbräsk. — Less common in Scania than in Northern Sweden.

Bornholm. — Oslo and Mjösen districts of Norway.

Phalacroma glandiforme (ANGELIN, 1851). — Pl. 15, figs. 3—17,
pl. 16, figs. 1, 2.

1851. *Agnostus glandiformis* ANGELIN, Pal. Suec., fasc. I, p. 5, pl. 6, fig. 1. (Brief diagnosis and rough fig. of the dorsal shield exhibiting a narrow rim in the cephalon incompatible with the diagnosis — «capite immarginato». Andrarum limestone. Andrarum, Scania.)
1878. *Agnostus glandiformis* ANGELIN, Brögger, N. M. N., vol. 24, p. 74 (58), pl. 6, fig. 7. (Records species from the *Par. forchhammeri* beds at Krekling, Norway; fig. of pygidium.)
1880. *Agnostus glandiformis* ANGELIN, Tullberg, S. G. U., Ser. C., No. 42, p. 29, pl. 2, figs. 20 a, b. (Description and figs. of cephalon and pygidium. Andrarum limestone and immediately underlying strata at Andrarum, Scania.)
1901. *Agnostus glandiformis* ANGELIN, Lindström, Sv. Vet.-Akad. Handl., vol. 34, No. 8, p. 37, pl. 1, fig. 7. (Fig. of a vertical section of a part of a rolled up specimen displaying the doublures (and remnants of the intestine?). Andrarum, Scania.)
1902. *Agnostus glandiformis* ANGELIN [partim], Grönwall, D. G. U., II. Række, No. 13, p. 63. (Remarks on species from Bornholm. The cephalon and pygidium, pl. 1, fig. 6, interpreted as young individuals of *glandiforme* belong to *Phoidagn. bituberculatus*.)
- ?1916. *Agnostus glandiformis* ANGELIN, Illing, Q. J. G. S., vol. 71, p. 414, pl. 31, fig. 2. (Description and fig. of a complete dorsal shield differing from Angelin's species in having subcircular cephalon and pygidium. Uppermost portion of the Upper *Par. davidis* zone. Nuneaton England.)
1930. *Agnostus glandiformis* ANGELIN, Holm & Westergård, Mém. Acad. Sci. URSS, Sér. 8, Cl. Phys.-Math., vol. 21, No. 8, p. 10, pl. 1, figs. 2—5; pl. 4, figs. 1—3. (The species is definitely distinguished from *Phoidagn. bituberculatus* with which it was confounded by Grönwall (and Tullberg?). Figs. of cephalon and pygidium from Bennett Island, N of Siberia, and of pygidium showing the doublure from Andrarum.)

Remarks. — The exfoliated cephalon in fig. 6 is in all probability one of Angelin's syntypes and as it has exactly the dimensions of Angelin's figure of *glandiforme* (length 15 and breadth 14 mm) it is selected lectotype. In this, as in some other exfoliated cephalons (topotypes), a narrow rim is discernible in certain light, which may have induced the drawer to mark out a distinct rim. According to the original diagnosis the cephalon is immarginate, however, which is true as none of the many examined cephalons retaining the test, young or full-grown, display any trace of a marginal rim.

The youngest cephala present referable to this species, about 2 mm in length, exhibit neither basal lobes nor axial furrows. The pleural part of the occipital segment is traceable on young as well as full-grown specimens as a very narrow upturned rim fading outwards.

Ratio of length and breadth is in both shields greatly variable. 30 cephalo and 33 pygidia from the Andrarum limestone between 6 and 16 mm in length, perfectly preserved and retaining their original convexity, have been measured. In the cephalo (exclusive of fig. 13) the breadth was found to occupy from 0.91 to 0.99 of the length and in the bulk (19 specimens) it fell within 0.93 and 0.96. In the pygidia (fig. 12 excluded) the breadth was fairly evenly distributed between 0.93 and 1.00 of the length. Thus a long and a broad form do not seem to be sharply distinct but merge into each other. Two of the specimens measured deviate from the remainder. In the rolled up specimen fig. 13 the ratio of length and breadth in the cephalon is 1 : 0.89 (in the pygidium 1 : 0.93), the anterior outline tends to become angulate, and the axial lobe, as concluded from the shape of the articulating margin, is narrower than in the predominant form. As regards the outline intermediate links connect this form with the type, and the narrower axis does not seem to indicate specific distinction (cf. e. g., *Ciceragn. cicer* and *Agn. pisiformis*). The specimen fig. 12 is the proportionally longest pygidium observed, the breadth being but 0.89 of the length. Both these specimens are tentatively included in the form series of *glandiforme*.

The remarkable doublure of cephalon and pygidium was investigated by Lindström (1901) and Holm & Westergård (1930) by the aid of vertical sections; it is exhibited in figs. 5, 10, and 11 on pl. 15 of this memoir.

The test is sometimes finely and closely punctate (porous) and sometimes smooth (compact). In some specimens the punctate structure is visible to the naked eye or under a low-power lens, in others it is discernible only at stronger magnification, and in others again the test proves compact even at a very strong magnification. As otherwise the specimens agree, the different structure of the test does not seem to imply specific distinction.

A couple of internal casts display rough markings arranged by pairs; in the pygidium three pairs are visible, in the cephalon one pair and posteriorly one large odd marking across the middle line (pl. 16, figs. 1 and 2). The writer does not dare to express any definite opinion about the import of these markings. Their arrangement in the pygidium indicates that they may be homologous with the small pair-set pits or knobs sometimes seen on many other agnostids and interpreted as muscle attachments. In well preserved internal casts of the cephalon a very faint median tubercle is visible; it has not been observed on specimens retaining the test.

The largest cephalon present is 16.0 mm long and 15.0 mm broad. The species is the largest agnostid found in Scandinavia.

For reasons quoted above it is questionable whether the British form identified as *glandiforme* by Illing is referable to this species.

Howell (1935 a) placed *glandiforme* in an independent genus, *Grandagnostus* (see p. 93).

Horizon and Localities. — Zone of *Solenopleura brachymetopa*. — Scania: Andrarum; Kiviks-Esperöd; Baskemölla; Gislövshammar; S. Sandby (boring). — Jämtland: Vedjeön; Siljeåsen(?). — Ångermanland; Aborrfallet. — As a rule fairly common in Scania, rare in Northern Sweden. Bornholm. — Oslo district in Norway. — Bennett Island, N. of Siberia.

Phalacroma sp. — Pl. 16, fig. 3.

A small, 1.2 mm long pygidium at an early holaspid stage from the Andrarum limestone at Andrarum is characterized by a greatly convex axis with an elongate tubercle at the centre and a gently arched broad limb subequal in width throughout. The specimen does not seem to be referable to any one of the associated species of *Phalacroma* and may belong to a form the adult of which is so far unknown.

Undetermined Agnostidae.

»*Agnostus*» sp. No. 1. — Pl. 16, fig. 10.

A single pygidium is present from the zone of *Ptychagn. (Pt.) atavus* at Djupadalen, Västergötland; cephalon unknown. It is distinct from *Pt. (Triplagnostus)* by its short axis, in which it recalls some Lower Ordovician forms referable to *Geragnostus* HOWELL, 1935.

»*Agnostus*» sp. No. 2. — Pl. 16, fig. 11.

Two pygidia were collected from boulder 80 at Brantevik (p. 13), Scania, zone of *Ptychagn. (Pt.) atavus*. None of the associated cephalons seem to be referable to this form. Broadly speaking it resembles *Peronopsis fallax* but differs in its distinctly three-lobed axis.

»*Agnostus*» sp. No. 3. — Pl. 16, figs. 12 a, b.

A single pygidium is present. Axis not extending to the marginal furrow; axial furrows almost effaced at the rear. The form resembles *Ciceragn. cf. cicer* (fig. 6), but, as it occurs at a much lower horizon, it is not suggested to be conspecific with that form. Of the species occurring at the same horizon it compares only with *Ptychagn. (Triplagn.) convexus*, from which it is distinct by broader axis lacking transverse furrows.

Associated with *Ptychagn. (Pt.) atavus* and *Tomagn. fissus*. Brantevik (boulder 22), Scania.

»*Agnostus*» sp. No. 4. — Pl. 16, figs. 13—16 (17?).

Axial furrows in the pygidium posteriorly effaced or, in fig. 13, faintly discernible in certain light. Axis extending almost to the marginal furrow. Cephalon unknown.

The form is distinct from *Ciceragn. cicer* by deeper axial furrows and narrower and longer axis. From *Hypagn. brevifrons*, with which it seems to have been confounded, it differs in its longer axis not outlined at the rear.

Andrarum limestone. Andrarum and Kiviks-Esperöd, Scania.

»*Agnostus*» sp. No. 5. — Pl. 16, figs. 18 a, b.

Resembles but does not seem to be identical with the pygidium which is illustrated in fig. 5 on pl. 6, possibly referable to *Hypagn. exsculptus*.
Andrarum limestone. Andrarum, Scania.

»*Agnostus*» sp. No. 6. — Pl. 16, figs. 19 a, b.

Pygidium with short pointed non-segmented axis and a very faint post-axial median furrow fading away backwards.
Andrarum limestone. Andrarum, Scania.

Tabular summary of the range and geographical distribution

* = a closely allied

	Z o n e s								
	A 1	A 2	B 1	B 2	B 3	B 4	C 1	C 2	C 3
<i>Eodiscus oelandicus</i> (WESTERGÅRD)		+							
» <i>borealis</i> sp. n.			+						
» <i>punctatus</i> (SALTER)					+	+			
» <i>punctatus scanicus</i> (LINNARSSON) ..				+					
<i>Aulacodiscus bilobatus</i> gen. n. et sp. n.									+
<i>Condylopyge regia</i> (SJÖGREN)	+								
» <i>carinata</i> WESTERGÅRD		+							
» <i>spinigera</i> WESTERGÅRD				+		+			
» <i>rex</i> (BARRANDE)						+			
<i>Pleuroctenium scanense</i> sp. n.						+			
<i>Peronopsis fallax</i> (LINNARSSON)		+	+	+	+				
» <i>fallax depressa</i> subsp. n.					+				
» <i>fallax ferox</i> (TULLBERG)						+	+	+	
» <i>fallax minor</i> (BRÖGGER)								+	
» <i>brunfloensis</i> sp. n.			+						
» <i>cylindrica</i> sp. n.						+			
» <i>quadrata</i> (TULLBERG)								+	
» <i>quadrata sulcata</i> subsp. n.								+	
» sp.									+
» <i>scutalis</i> (SALTER, in HICKS).....			+	+					
» <i>pusilla</i> (TULLBERG)						+			
» <i>insignis</i> (WALLERIUS)									+
<i>Hypagnostus parvifrons</i> (LINNARSSON)				+	+				
» <i>parvifrons mammillatus</i> (BRÖGGER)				+	+	+			
» <i>parvifrons cicatricosus</i> subsp. n.					+	+			
» <i>truncatus</i> (BRÖGGER) f. 1				+	?				
» <i>truncatus</i> (BRÖGGER) f. 2					+				
» <i>truncatus</i> (BRÖGGER) f. 3					+				
» <i>nepos</i> (BRÖGGER)						?	+	+	

	Z o n e s								
	A 1	A 2	B 1	B 2	B 3	B 4	C 1	C 2	C 3
<i>Hypagnostus tjernviki</i> sp. n.								?	?
» <i>brevifrons</i> (ANGELIN)								+	
» <i>denticulatus</i> sp. n.									+
» <i>scrobiculatus</i> sp. n.					?				
» <i>exsculptus</i> (ANGELIN)								+	
» <i>exsculptus geminus</i> subsp. n. . .								+	
» <i>sulcifer</i> (WALLERIUS)									+
» <i>sulcifer integer</i> (WALLERIUS) ..									+
<i>Cotalagnostus lens</i> (GRÖNWALL)					+	+			
» <i>lens claudicans</i> subsp. n.				+					
» <i>confusus</i> (WESTERGÅRD)								+	
<i>Clavagnostus repandus</i> (WESTERGÅRD)								+	?
» <i>sulcatus</i> sp. n.									+
<i>Tomagnostus fissus</i> (LUNDGREN MS.; LINNARSSON)			+	+	?				
» <i>perrugatus</i> (GRÖNWALL)			+	+	+				
» cf. <i>corrugatus</i> (ILLING)			+	+					
<i>Diplagnostus planicauda</i> (ANGELIN)								+	
» <i>planicauda bilobatus</i> KOBAYASHI						+	+	+	
» <i>planicauda vestgothicus</i> (WALLERIUS)								+	+
<i>Linguagnostus grönwalli</i> KOBAYASHI						+			
» <i>kjerulfi</i> (BRÖGGER)								+	
<i>Oidalagnostus trispinifer</i> gen. n. et sp. n. . . .									+
» (?) <i>dubius</i>								?	
<i>Ptychagn. (Triplagn.) praecurrens</i> (WESTERGÅRD)		+	+						
» » <i>angermanensis</i> sp. n.				?					
» » <i>gibbus</i> (LINNARSSON) ..			+						
» » <i>hybridus</i> (BRÖGGER) ..					+	?			
» » <i>stenorrhachis</i> (GRÖNWALL)						+	+		
» » <i>convexus</i> sp. n.				+					
» » <i>elegans</i> (TULLBERG) ..						+			
» » <i>elegans laevissimus</i> subsp. n.						+			
» » <i>lundgreni</i> (TULLBERG) ..						+	+	+	
» » <i>lundgreni nanus</i> (GRÖNWALL)							+	+	
<i>Ptychagn. (Ptychagn.) atavus</i> (TULLBERG) ..				+					
» » <i>punctuosus</i> (ANGELIN)						+			
» » <i>punctuosus affinis</i> (BRÖGGER)					+	+			
» » <i>aculeatus</i> (ANGELIN) ..								+	
<i>Goniagnostus nathorsti</i> (BRÖGGER)						?	+	+	
» <i>scanensis</i> sp. n.							+		
» <i>spiniger</i> (WESTERGÅRD)									+
<i>Doryagnostus incertus</i> (BRÖGGER)						+			

	Z o n e s								
	A 1	A 2	B 1	B 2	B 3	B 4	C 1	C 2	C 3
<i>Agnostus pater</i> WESTERGÅRD								+	
» <i>neglectus</i> sp. n.								+	+
» <i>pisiformis</i> (LINNÆUS)									+
» <i>pisiformis subsulcatus</i> subsp. n.									+
» <i>pisiformis spiniger</i> (DALMAN) ¹									+
» (?) sp.								+	
<i>Lejopyge laevigata</i> (DALMAN)							?	+	+
» <i>laevigata armata</i> (LINNARSSON)									+
» <i>laevigata ferrugata</i> subsp. n.									+
» <i>laevigata rugifera</i> subsp. n.									+
<i>Ciceragnostus cicer</i> (TULLBERG)						+	+	+	
» (?) sp.								+	
<i>Phoidagnostus bituberculatus</i> (ANGELIN)								+	
<i>Phalacroma scanicum</i> (TULLBERG)				+	+	+			
» <i>resectum</i> (GRÖNWALL)						+			
» <i>marginatum</i> (BRÖGGER)							+	+	
» <i>glandiforme</i> (ANGELIN)								+	
» sp.								+	
» <i>Agnostus</i> sp. 1				+					
» sp. 2				+					
» sp. 3				+					
» sp. 4									
» sp. 5								+	
» sp. 6								+	
» sp. 7								+	
» sp. 8									+

¹ So far observed but in the zone of *Agnostus pisiformis*.

Localities.

Scania.

Åkarpsmölla, 2 km NW of Konga church, 18 km NNW of Eslöv.
 Andrarum, 30 km NW of Simrishamn.
 Baskemölla, 5 km NNW of Simrishamn.
 Brantevik, 5 km S of Simrishamn.
 Gislövshammar, 8 km SSW of Simrishamn.
 Kiviks-Esperöd, 15 km NNW of Simrishamn.
 Södra Sandby, 10 km E of Lund.
 Tosterup, 12 km ENE of Ystad.
 Traneröd, 3 km NW of Konga church, 18 km NNW of Eslöv.

Öland.

Degerhamn, 18 km N of the Southern Point.
 Karlevi, 2.5 km N of Vickleby church, 42 km N of the Southern Point.
 Mörbylånga, 37 km N of the Southern Point.
 Mörbylilla, 12 km N of the Southern Point.
 Mossberga, 2 km N of Högstrum church, 13 km S of Borgholm.
 Stora Frö, 2.5 km SW of Vickleby church, 42 km N of the Southern Point.
 Torp, 9 km NW of Böda church and 7 km SW of the Northern Point.
 Ventlinge, 10 km N of the Southern Point.

Råbäck, on the north-western slope of Mount Kinnekulle.
 Stenstorp, 15 km NE of Falköping.
 Stora Stolan, at the northern end of Mount Billingen.
 Törnsäter, on the eastern slope of Mount Kinnekulle.
 Torbjörntorp, 7 km NE of Falköping.
 Trolmen, on the western slope of Mount Kinnekulle.

Närke.

Bredsätter, 7 km E of Hallsberg junction, 24 km S of Örebro.
 Edsbergs Sanna, 2.7 km WSW of Knista church, 20 km SW of Örebro.
 Gymninge, 2 km NNW of Tysslinge church, 11 km W of Örebro.
 Ösby, 2.5 km S of Sköllersta church, 16 km SSE of Örebro.
 Ö. Rynninge, 17 km ESE of Örebro.
 Övre Åkerby, 3.5 km SSW of Sköllersta church, 16 km SSE of Örebro.
 Sättran, 1.5 km SW of Lännäs church, 25 km SE of Örebro.
 Sköllersta, 16 km SSE of Örebro.
 Tomta, 3 km SE of Hallsberg junction, 24 km S of Örebro.
 Ullavi, 1.5 km SSE of Sköllersta church, 16 km SSE of Örebro.
 Vinala, 2 km SE of Sköllersta church, 16 km SSE of Örebro.
 Vrana, 1.2 km NNW of Sköllersta church, 16 km SSE of Örebro.

Jämtland.

Bingsta, 7 km SE of Berg church, at the southern end of Lake Storsjön.
 Brunflo, 15 km SE of Östersund.
 Fånån, on the brook Fånån, 15 km NNW of its mouth at the north-western end of Lake Flåsjön.
 Funäs, 3 km ENE of Myssjö church, 32 km SSW of Östersund.
 Havsnäset, on the western shore of Lake Flåsjön and 12 km N of the southern end of the lake.
 Hillsand, on the western shore of Lake Dragan (Ströms Vattudal) and 30 km NNW of Strömsund.
 Kläppe, 3 km NW of Marby church, on the western shore of Lake Storsjön and 19 km WSW of Östersund.
 Kopparrökhällarna, on the rivulet Jerilån and 9 km NW of the southern end of Lake Flåsjön.
 Önsvede, on the eastern shore of Lake Storsjön, 4 km S of Sunne church, 12 km SW of Östersund.
 Siljeåsen, on the northern shore of Lake Flåsjön and 10 km NW of Alanäs church.
 Västerskucku, 4 km SE of Berg church, at the southern end of Lake Storsjön.
 Vedjeön, on the western shore of Lake Dragan (Ströms Vattudal) and 24 km NNW of Strömsund.

Ångermanland.

Aborrfallet, on the river Sjougdälven, 1 km from its mouth at the northern end of Lake Täsjön.
 Brattbäcken, brook 8 km NNW of Täsjö church.
 Högnäsån, brook 22 km NNW of Täsjö church.
 Karbäcken, brook 13 km NNW of Täsjö church.
 Kvarnbäcken, brook 3 km NW of Täsjö church.
 Sägbäcken, brook 6 km SW of Täsjö church.
 Tjärnmyrberget, 3 km NW of the northern end of Lake Täsjön.

Southern Lapland (Västerbotten).

Bredsele, on the river Långselån and 40 km NW of Dorotea church.
 Goleen, 7 km NW of Nästansjö and 25 km NNW of Vilhelmina church.
 Lubbräsk, 22 km W of Stensele church.
 Marbäcken, tributary to the rivulet Djupån, 13 km NNE of Täsjö church.
 Skansholm, on the western shore of Lake Malgomaj and 18 km WNW of Vilhelmina church.
 Skikkisjöberget, 28 km WSW of Stensele church.

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Abbreviations:

- S. G. U. = Sveriges Geologiska Undersökning, Stockholm.
G. F. F. = Geologiska Föreningens i Stockholm Förhandlingar, Stockholm.
D. G. U. = Danmarks Geologiske Undersøgelse, København.
N. G. T. = Norsk Geologisk Tidsskrift, Oslo.
N. M. N. = Nyt Magazin for Naturvidenskaberne, Christiania (Oslo).
Q. J. G. S. = Quarterly Journal of the Geological Society, London.

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Explanation of Plates.

If nothing is mentioned as regards the rock, the specimen is preserved in limestone and retains its original convexity (exclusive of a few specimens from Northern Sweden disfigured due to pressure).

If no other statement is made, the specimen belongs to the Geological Survey of Sweden.

Abbreviations:

RM. = Paleozoological Department of the State Museum of Natural History, Stockholm.

G.-M. I. Lund = Geological-Mineralogical Institution of the University of Lund.

Plate 1.

Eodiscus oelandicus (WESTERGÅRD). — Page 22.

- Fig. 1. Cephalon, partly retaining the test. Mossberga (boring), Öland.
 Figs. 2 a, b. Pygidium, cast of an external mould; holotype. 1 km SSW of Mörby-långa church, Öland.
 Figs. 1 and 2 preserved in shale. Zone of *Paradoxides pinus*. Copies from Westergård, 1936, pl. 1, figs. 25 and 26.

Eodiscus borealis sp. n. — Page 23.

- Figs. 3—5. Two cephalons and associated pygidium; fig. 4 holotype. Zone of *Ptychagnostus* (*Triplagnostus*) *gibbus*. Vedjeön (boulder 1), Jämtland.

Eodiscus punctatus scanicus (LINNARSSON). — Page 25.

- Figs. 6, 7. Entire dorsal shield and detached cephalon, both lacking the test.
 Figs. 8, 9. Cephalon and pygidium, both retaining the test.
 Figs. 6—9 topotypes, in shale. Andrarum (Tullberg's loc. 6), Scania. — RM.
 Figs. 10, 11. Cephalon and pygidium retaining the test. Brantevik (boulder 80), Scania.
 Figs. 6—11 zone of *Ptychagnostus* (*Pt.*) *atavus*.

Eodiscus punctatus (SALTER). — Page 24.

- Fig. 12. Cephalon, impression (external mould) in shale photographed in reversed light.
 Fig. 13. Pygidium lacking the test, in shale.
 Figs. 12 and 13 two of Linnarsson's syntypes of *Microdiscus eucentrus*. Zone of *Ptychagnostus* (*Pt.*) *punctuosus*. Andrarum (Tullberg's loc. 10). Scania.
 Figs. 14 a, b. Cephalon partly retaining the test. New figure of the specimen illustrated by Grönwall, 1902, pl. 1, fig. 20.
 Figs. 15 a, b. Pygidium lacking the test.
 Figs. 14 and 15 from the zone of *Paradoxides davidis*(?). Bornholm. — RM.

Aulacodiscus bilobatus gen. n. et sp. n. — Page 27.

- Figs. 16—19. Three cephalons and associated pygidium, poorly preserved internal casts in shale. Zone of *Lejopyge laevigata* (stratum 0.3 m above the Andrarum limestone). Andrarum, Scania.
 Fig. 20. Pygidium. Zone of *L. laevigata*, upper part. Gudhem, Västergötland.
 Fig. 21. Cephalon with the occipital spine broken away but retaining the test; holotype. Zone of *L. laevigata*. Berg (boulder 11), Östergötland.
 Fig. 22. Imperfect cephalon. Associated with *L. laevigata armata* (Pl. 13, figs. 35, 36). Knivinge, Östergötland.

Figs. 1—9, 14—22 photographed and retouched by J. W. Englund.
 Figs. 10—13 photographed by C. Larsson.

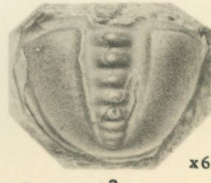
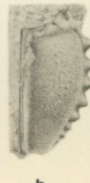
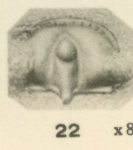
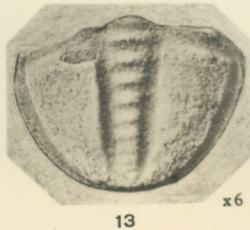
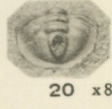
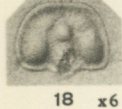
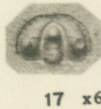
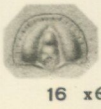
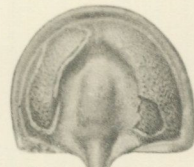
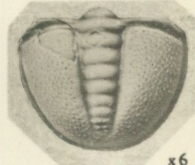
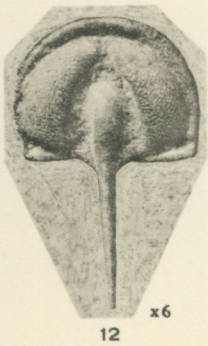
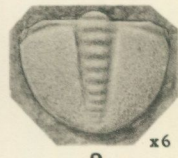
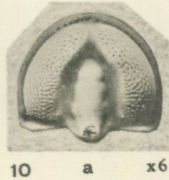
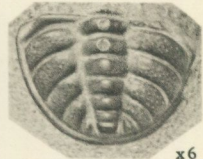
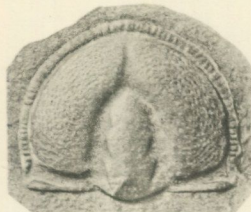
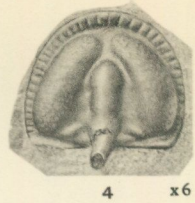
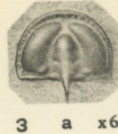
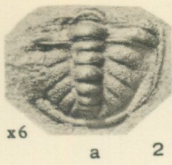


Plate 2.

Condylopyge regia (SJÖGREN). — Page 33.

Figs. 1 a, b. Complete dorsal shield in different aspects; neotype. Copies of figs. 1 a, b, pl. 1, in Westergård, 1936. Zone of *Paradoxides insularis*. Stora Frö, Öland.

Condylopyge carinata WESTERGÅRD. — Page 33.

Fig. 2. Complete dorsal shield, in shale; holotype. Copy of fig. 5, pl. 1, in Westergård, 1936. Zone of *Paradoxides pinus*. Borgholm, Öland.

Condylopyge spinigera WESTERGÅRD. — Page 33.

Figs. 3—6. Two cephalae and two pygidia of different sizes. Zone of *Ptychagnostus (Pt.) atavus*. Brantevik (boulder 80), Scania.

Figs. 7—8. Cephalon (internal cast) and pygidium (test preserved), in shale; fig. 8 is the holotype. Basal stratum of the zone of *Ptychagnostus (Pt.) punctuosus*. Boring at Andrarum, Scania (Westergård, 1944 a; level 51.1 m).

Condylopyge rex (BARRANDE). — Page 35.

Figs. 9—12. Two cephalae and two pygidia of Tullberg's specimens, in shale. Zone of *Hypagnostus parvifrons*. Andrarum (Tullberg's loc. 7), Scania. — G.-M. I. Lund.

Fig. 13. Imperfect dorsal shield, impression in shale photographed in reversed light. The same horizon and locality as the preceding specimens.

Pleuroctenium scanense sp. n. — Page 35.

Figs. 14—17. Two cephalae and two pygidia, in shale; fig. 14 is the holotype. Associated with the preceding specimens. Collected by G. v. Schmalensee in 1877.

Peronopsis fallax (LINNARSSON). — Page 37.

Figs. 18—19. Cephalon and pygidium. Probably two of Linnarsson's syntypes. In the pygidium the post-axial furrow is faintly indicated. Zone of *Ptychagnostus (Triplagnostus) gibbus*. Djupadalen, Västergötland.

Figs. 20—21. Cephalon and pygidium. Zone of *Ptychagnostus (Pt.) atavus*. Oltorp, Västergötland.

Fig. 22. Complete dorsal shield, internal cast in shale. Zone of *Ptychagnostus (Pt.) atavus*. Andrarum (Tullberg's loc. 9), Scania. — RM.

Fig. 23. Pygidium, internal cast in shale. Similar to the form predominant in the zone of *Paradoxides pinus*. The same horizon and locality as fig. 22.

Fig. 24. Pygidium with three pairs of scars (muscle attachments) on the axis; internal cast in limestone. Brunflo (boulder), Jämtland.

Peronopsis fallax depressa subsp. n. — Page 37.

Figs. 25, 26. Cephalon and pygidium; fig. 26 is the holotype. Zone of *Hypagnostus parvifrons*. Gislövshammar (boulder 99), Scania.

Peronopsis fallax ferox (Tullberg). — Page 38.

Figs. 27 a, b. Pygidium; one of Tullberg's syntypes; lectotype. Borregaard, B o r n h o l m. — G.-M. I. Lund.

Figs. 1, 2, 9, 11, 12, 20, 21, 24 photographed and retouched by J. W. Englund.

Figs. 3—8, 10, 13—19, 22, 23, 25—27 photographed by Carl Larsson and very slightly retouched by A. H. Westergård.

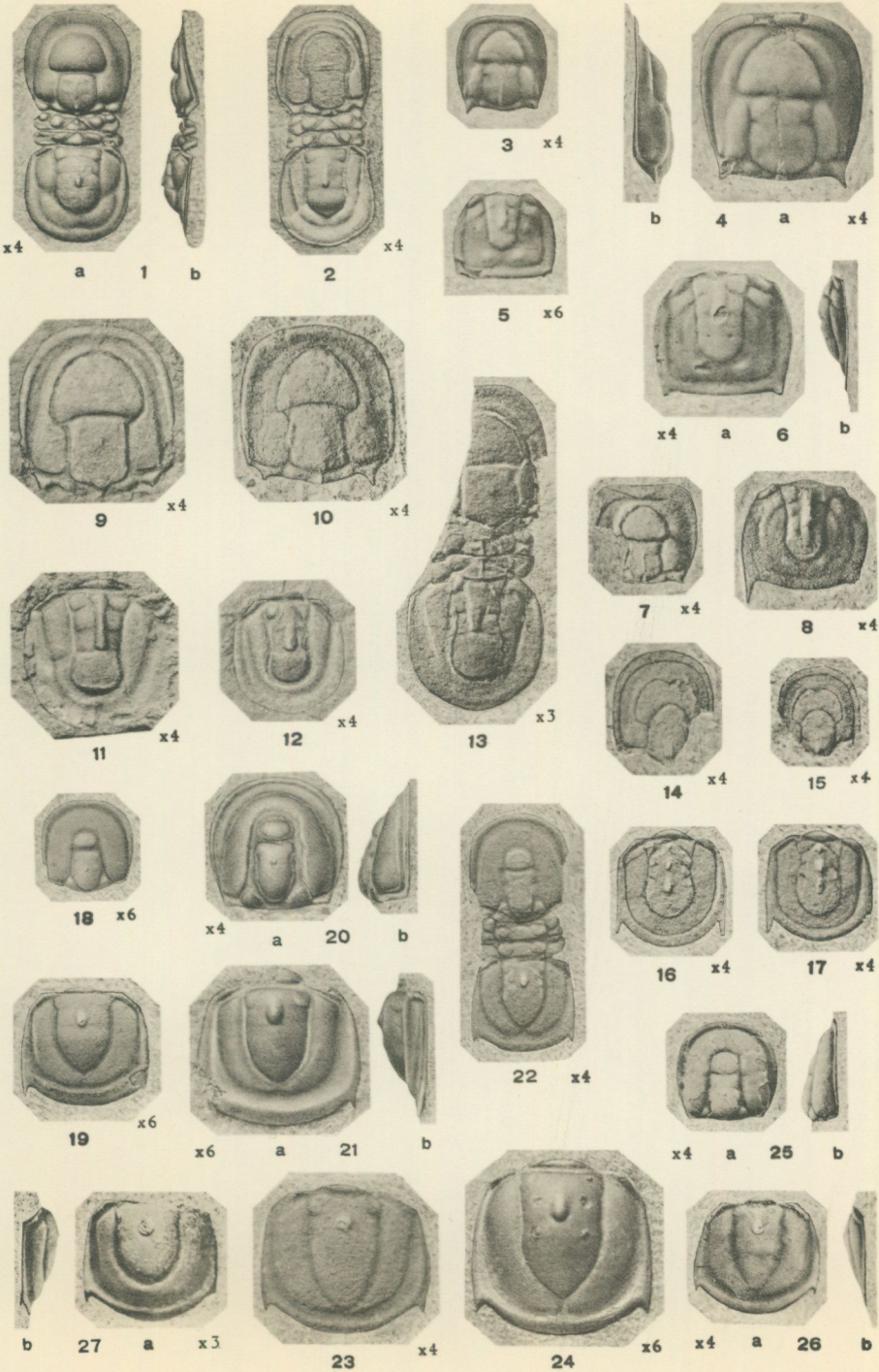


Plate 3.

Peronopsis fallax ferox (TULLBERG). — Page 38.

Figs. 1, 2. Cephalon and pygidium. Zone of *Ptychagnostus* (*Pt.*) *punctuosus*. Baske-
mölla, Scania.

Peronopsis fallax minor (BRÖGGER). — Page 38.

Figs. 3—7. Two cephalon and three pygidia displaying a considerable variability
in cephalon and pygidial axis. *Paradoxides forchhammeri* beds. Aborr-
fallet, Ångermanland.

Peronopsis brunfloensis sp. n. — Page 39.

Figs. 8, 9. Complete specimen, holotype, and detached pygidium with exceptionally
broad and swollen axis. Associated with *Paradoxides jemtlandicus*. Brunflo
railway station, Jämtland.

Peronopsis insignis (WALLERIUS). — Page 43.

Figs. 10, 11. Cephalon and pygidium. Wallerius's type specimens; fig. 10 is the
lectotype. Gudhem, Västergötland. — G.-M. I. Lund.

Figs. 12, 13. Cephalon and pygidium. Gudhem, Västergötland.

Figs. 14, 15. Cephalon and pygidium. Djupadalen. Västergötland.

Figs. 10—15 zone of *Lejopyge laevigata*, upper part.

Peronopsis cf. *insignis* (WALLERIUS). — Page 43.

Figs. 16 a, b. Pygidium wanting marginal spines and with four pairs of scars on
the axis. Zone of *Lejopyge laevigata*, upper part. Djupadalen, Västergöt-
land.

Peronopsis cylindrica sp. n. — Page 39.

Figs. 17, 18. Cephalon and pygidium of unusually large specimens; fig. 18 is the
holotype. Gislövshammar (boulder 96), Scania.

Figs. 19 a, b. Cephalon. Gislövshammar (boulder 7), Scania.

Figs. 20 a, b. Cephalon. Gislövshammar (boulder 25), Scania.

Figs. 21 a, b. Pygidium. Gislövshammar (boulder 18). Scania.

Figs. 17—21 zone of *Ptychagnostus* (*Pt.*) *punctuosus*.

Peronopsis quadrata (TULLBERG). — Page 40.

Fig. 22. Cephalon and pygidium. Two of Tullberg's syntypes; the pygidium is
selected lectotype. Andrarum limestone. Andrarum, Scania. — G.-M. I.
Lund.

Figs. 23, 24. Cephalon and pygidium. Horizon and locality as in fig. 22. — The
former belongs to the State Museum.

Figs. 25—27. Two cephalon and a pygidium. *Paradoxides forchhammeri* beds. Aborr-
fallet, Ångermanland.

Figs. 28, 29. Cephalon with a faint median furrow in the posterior portion of the
preglabellar area, and associated pygidium. The same beds and locality
as figs. 25—27.

Figs. 1—3, 5, 8 a, 12—16 a, 23 a, 25, 27 photographed and retouched by J. W. Englund.

Figs. 4, 6, 7, 8 b—11, 16 b—22, 23 b, 24, 26, 28, 29 photographed by C. Larsson and very slightly
retouched by A. H. Westergård.

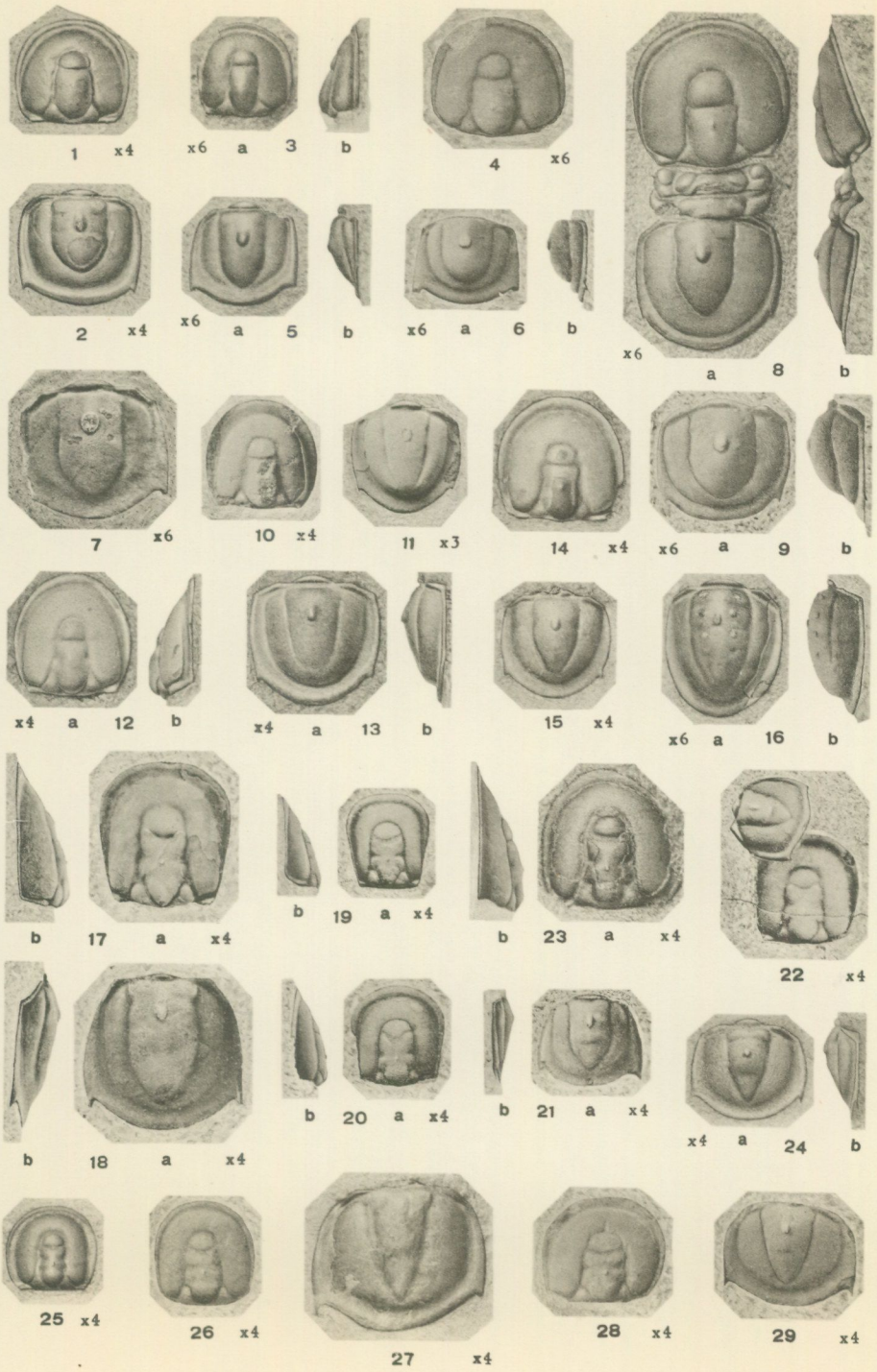


Plate 4.

Peronopsis quadrata sulcata subsp. n. — Page 40.

- Fig. 1. Defective cephalon, holotype. Andrarum limestone. Andrarum, Scania.
— RM.
- Fig. 2. Cephalon. Associated with figs. 25—27 on pl. 3. *Paradoxides forchham-
meri* beds. Aborrfallet, Ångermanland.

Peronopsis sp. — Page 41.

Figs. 3 a, b. Cephalon. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland.

Peronopsis scutalis (SALTER MS, HICKS). — Page 41.

Fig. 4. Pygidium, in shale. New figure of Tullberg's »*Agnostus parvifrons* forma 1» (Tullberg, 1880, pl. 2, fig. 26). Zone of *Ptychagnostus* (*Pt.*) *atavus*. Andrarum (Tullberg's loc. 6), Scania. — G.-M. I. Lund.

Figs. 5—7. Three complete dorsal shields and a detached pygidium, in calcareous shale. Zone of *Ptychagnostus* (*Triplagnostus*) *gibbus*. Gislövshammar (boulder 12), Scania.

Figs. 8—10. Cephalon and two pygidia. Brantevik (boulder 11), Scania.

Figs. 11 a, b. Pygidium. Gislövshammar (boulder 6), Scania.

Figs. 8—11 zone of *Ptychagnostus* (*Pt.*) *atavus*.

Peronopsis pusilla (TULLBERG). — Page 42.

Fig. 12. Pygidium. New figure of the holotype (Tullberg, 1880, pl. 2, fig. 30). Andrarum (Tullberg's loc. 11), Scania. — G.-M. I. Lund.

Fig. 13. Cephalon and pygidium, Andrarum, Scania. — RM.

Figs. 14 a, b. Cephalon. Gislövshammar (boulder 20), Scania.

Figs. 15 a, b. Pygidium. Brantevik (boulder 30), Scania.

Fig. 16. Pygidium. Gislövshammar (boulder 18), Scania.

Fig. 17. Pygidium. Brantevik (boulder 3), Scania.

Fig. 18. Pygidium with exceptionally long axis, probably this species. Gislövshammar (boulder 8), Scania.

Figs. 12—18 zone of *Ptychagnostus* (*Pt.*) *punctuosus*.

Clavagnostus repandus (WESTERGÅRD). — Page 56.

Figs. 19, 20. Cephalon (G.-M. I. Lund) and pygidium; the former is the holotype. Andrarum limestone. Andrarum, Scania. Figs. 19 a and 20 a copies from Holm & Westergård, 1930, pl. 4, figs. 11 and 12.

Figs. 21, 22. Cephalon and pygidium. *Paradoxides forchhammeri* beds. Stinkstone boulder at Sköllersta, Närke.

Clavagnostus sulcatus sp. n. — Page 57.

Figs. 23—26. Three cephalons, the smallest with the spines broken, and a pygidium; fig. 25 is the holotype. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland.

Hypagnostus parvifrons (LINNARSSON). — Page 45.

Figs. 27, 28. Cephalon and pygidium, two of Linnarsson's syntypes. The former, which is the specimen illustrated by Linnarsson in his fig. 56, is the lectotype. Zone of *H. parvifrons*. Stinkstone boulder at Hälleklis, Kinnekulle, Västergötland.

Figs. 29, 30. Cephalon and pygidium. Zone of *Ptychagnostus* (*Pt.*) *atavus*. Brantevik (boulder 24), Scania.

Fig. 31. Cephalon with attached thorax, in shale. Zone of *H. parvifrons*. Boring at Motala, Östergötland (Westergård 1944 b; level 170.9 m).

Figs. 1, 2, 11, 13, 17—23, 26 photographed and retouched by J. W. Englund.

Figs. 3—10, 12, 14—16, 24, 25, 27—31 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

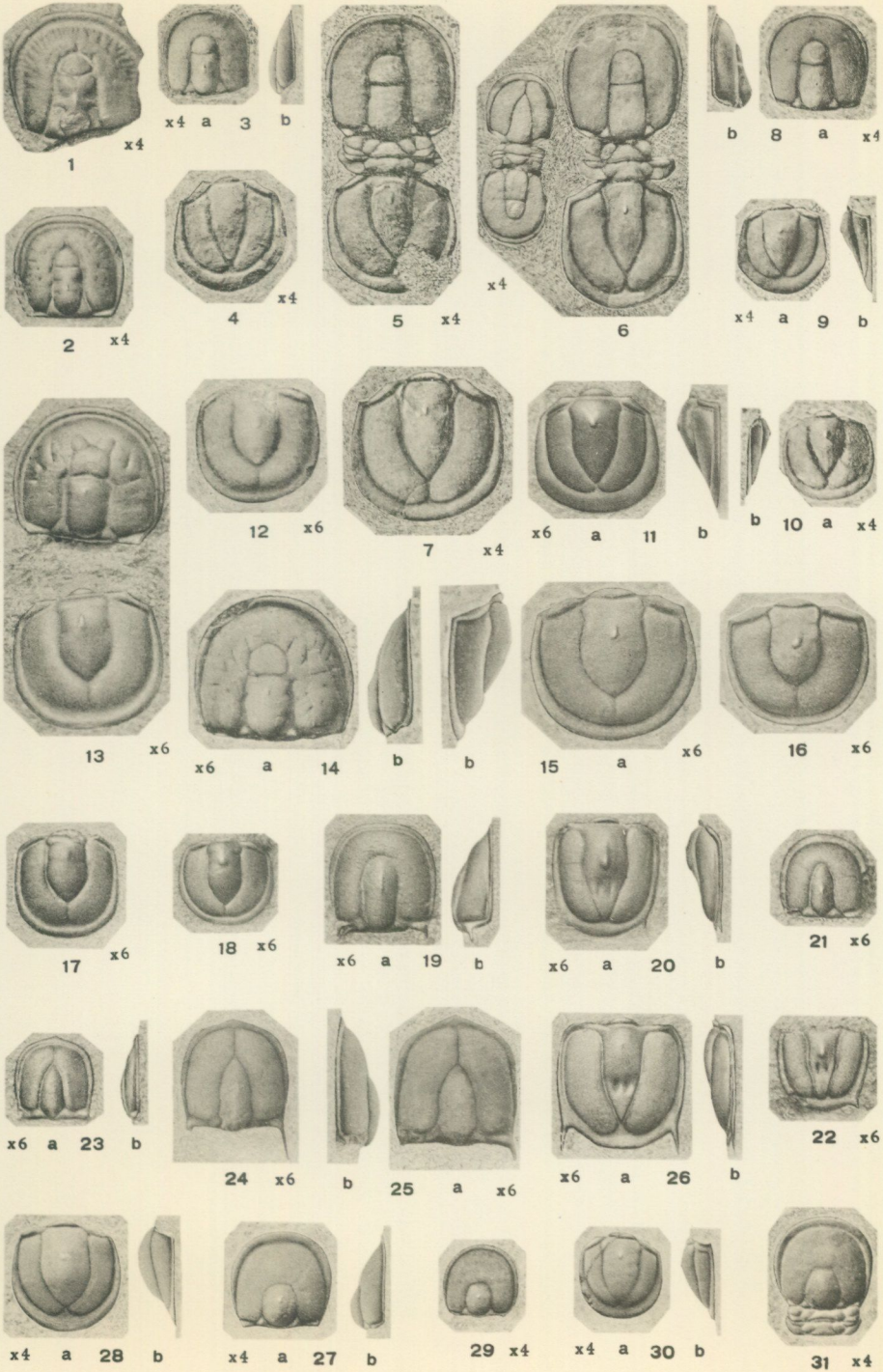


Plate 5.

Hypagnostus parvifrons cicatricosus subsp. n. — Page 46.

Fig. 1. Cephalon. Associated with *H. parvifrons* and *parvifrons mammillatus* (the latter abundant). Trolmen (boulder), Kinnekulle, Västergötland.

Hypagnostus parvifrons mammillatus (BRÖGGER). — Page 45.

Figs. 2, 3. Cephalon and pygidium. Zone of *H. parvifrons*, upper part. Törnsäter, Kinnekulle, Västergötland.

Figs. 4 a, b. Pygidium with exceptionally high axis. Zone of *H. parvifrons*, upper part. Stora Stolan, Billingen, Västergötland.

Hypagnostus nepos (BRÖGGER). — Page 47.

Figs. 5, 6. Cephalon and pygidium. Zone of *Goniagnostus nathorsti*. Baskemölla, Scania.

Figs. 7, 8. Cephalon and pygidium. *Paradoxides forchhammeri* beds. Aborrfallet, Ångermanland.

Hypagnostus truncatus (BRÖGGER), forma 1. — Page 47.

Figs. 9—12. Three cephalata and associated pygidium. Zone of *Ptychagnostus (Pt.) atavus*. Brantevik (boulder 80), Scania.

Hypagnostus truncatus (BRÖGGER), forma 2. — Page 47.

Figs. 13—19. Three cephalata and four pygidia from a limestone lens yielding no other species. Zone of *H. parvifrons*(?). Aborrfallet, Ångermanland.

Hypagnostus truncatus (BRÖGGER), forma 3. — Page 47.

Figs. 20—23. Two cephalata and two pygidia. Zone of *H. parvifrons*, upper part. Tjärnmyrberget, Ångermanland.

Hypagnostus brevifrons (ANGELIN). — Page 48.

Figs. 24—27. Two cephalata and two pygidia of Angelin's syntypes; fig. 24 is selected lectotype. Andrarum limestone. Andrarum, Scania. — RM.

Figs. 28—29. Cephalon and pygidium from the same bed as the preceding specimens. — RM. No. Ar. 2003 a.

Hypagnostus denticulatus sp. n. — Page 49.

Figs. 30—33. Two cephalata and two pygidia, in shale. Fig. 30 is the holotype. Zone of *Lejopyge laevigata* (0.3 m above the Andrarum limestone). Andrarum, Scania.

Hypagnostus scrobiculatus sp. n. — Page 50.

Figs. 34 a, b. Cephalon. Zone of *Hypagnostus parvifrons*(?). Brantevik (boulder B), Scania.

Hypagnostus exsculptus (ANGELIN). — Page 50.

Figs. 35 a, b. Cephalon, new figure of the specimen illustrated by Tullberg (1880, pl. 1, fig. 10), lectotype. Andrarum limestone. Andrarum, Scania. — RM.

Figs. 1, 9—12, 14—16, 18—20, 24—26, 31, 34 b, 35 b photographed by C. Larsson and very slightly retouched by A. H. Westergård.

Figs. 2—8, 13, 17, 21—23, 27—30, 32, 33, 34 a, 35 a photographed and retouched by J. W. Englund.

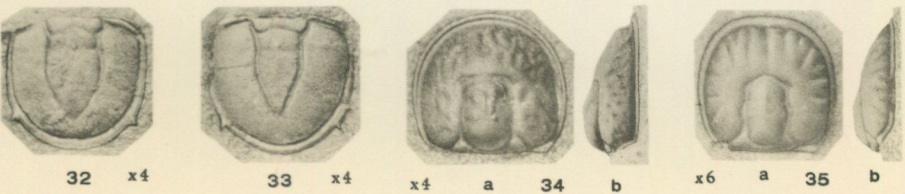
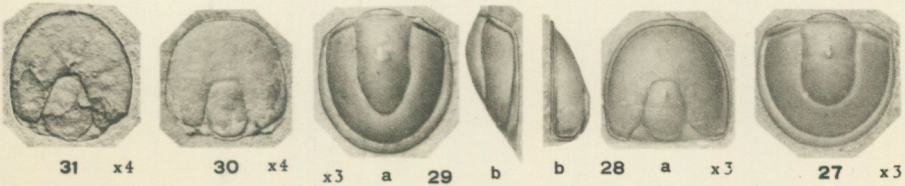
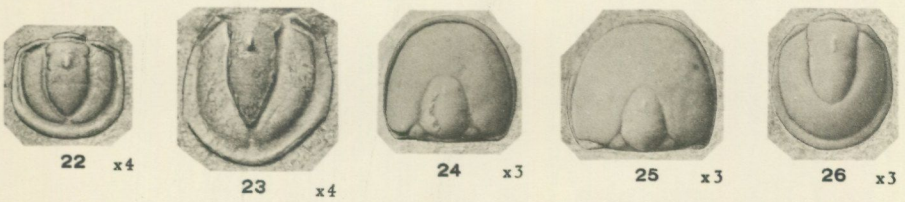
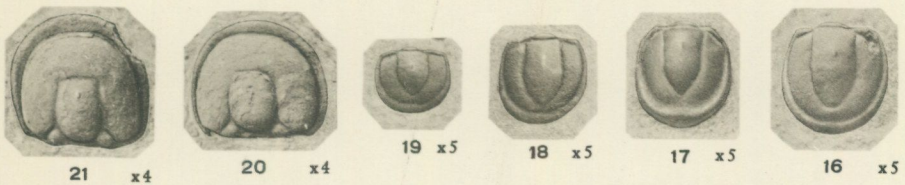
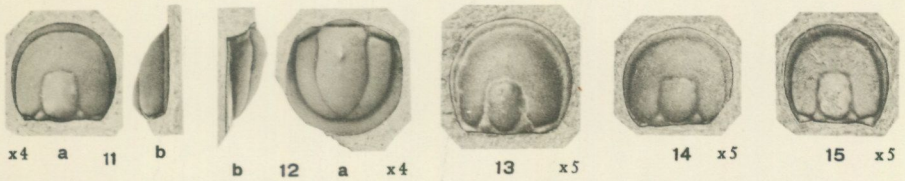
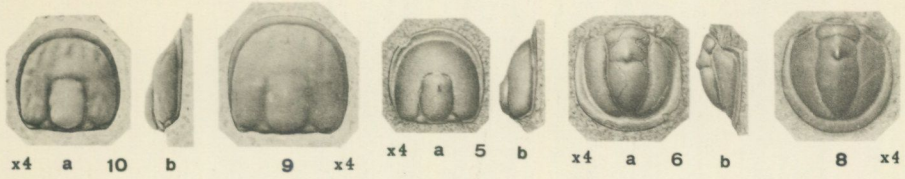
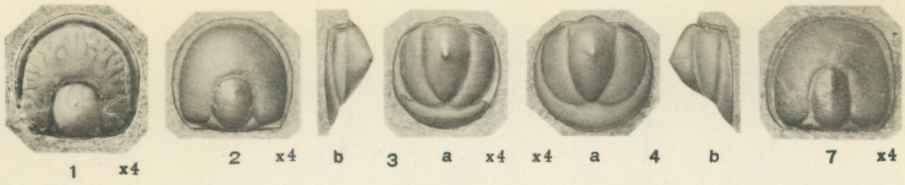


Plate 6.

Hypagnostus exsculptus (ANGELIN). — Page 50.

- Figs. 1 a, b. Cephalon, one of Angelin's syntypes. Andrarum limestone. Andrarum, Scania. — RM. No. Ar. 2006.
- Figs. 2, 3. Cephalon and associated pygidium (of this species?). Thin shale stratum in the uppermost part of the Andrarum limestone. Boring at S. Sandby, Scania (Westergård, 1944 a; level 77.4 m).
- Fig. 4. Pygidium, of this species? Andrarum limestone. Andrarum, Scania. — RM.
- Figs. 5 a, b. Pygidium of this species? Andrarum limestone, Kiviks-Esperöd, Scania. — RM.

Hypagnostus exsculptus geminus subsp. n. — Page 52.

- Figs. 6 a, b. Cephalon. Andrarum limestone. Andrarum, Scania. — RM.

Hypagnostus sulcifera (WALLERIUS). — Page 52.

- Fig. 7. Cephalon, one of Wallerius's syntypes; lectotype. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland. — G.-M. I. Lund.
- Figs. 8—15. Three cephalata and five pygidia displaying the variability of the species; the predominant form is illustrated in figs. 7 and 13. Same locality and layer as in fig. 7.
- Figs. 16, 17. Transverse sections (slides) of cephalon and pygidium showing the doublure. Zone of *Lejopyge laevigata* (stinkstone lens 2.4 m above the Exporrecta conglomerate). Djupadalen, Västergötland.

Hypagnostus sulcifera integer (WALLERIUS). Page 52.

- Figs. 18, 19. Two cephalata, the former with all grooves on the cheeks effaced, the latter with a short and faint median groove. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland.

Cotalagnostus lens claudicans subsp. n. — Page 54.

- Figs. 20—22. Two cephalata, the smaller with faintly grooved cheeks, and associated pygidium; fig. 20 is the holotype. Gislövshammar (boulder 6), Scania.
- Figs. 23, 24. Cephalon and associated pygidium. Brantevik (boulder 11), Scania.
- Figs. 25 a, b. Cephalon with the transverse furrow well defined at the corners of the glabella but wholly effaced at the middle line. Brantevik (boulder 47), Scania.
- Figs. 26, 27. Cephalon and associated pygidium. Brantevik (boulder 80), Scania.
- Figs. 20—27 zone of *Ptychagnostus* (*Pt.*) *atavus*.

Figs. 1 a, 5 a, 6 a, 9, 12, 13, 15 a, 18—20 photographed and retouched by J. W. Englund.

Figs. 1 b—4, 5 b, 6 b—8, 10, 11, 14, 15 b—17, 21—27 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

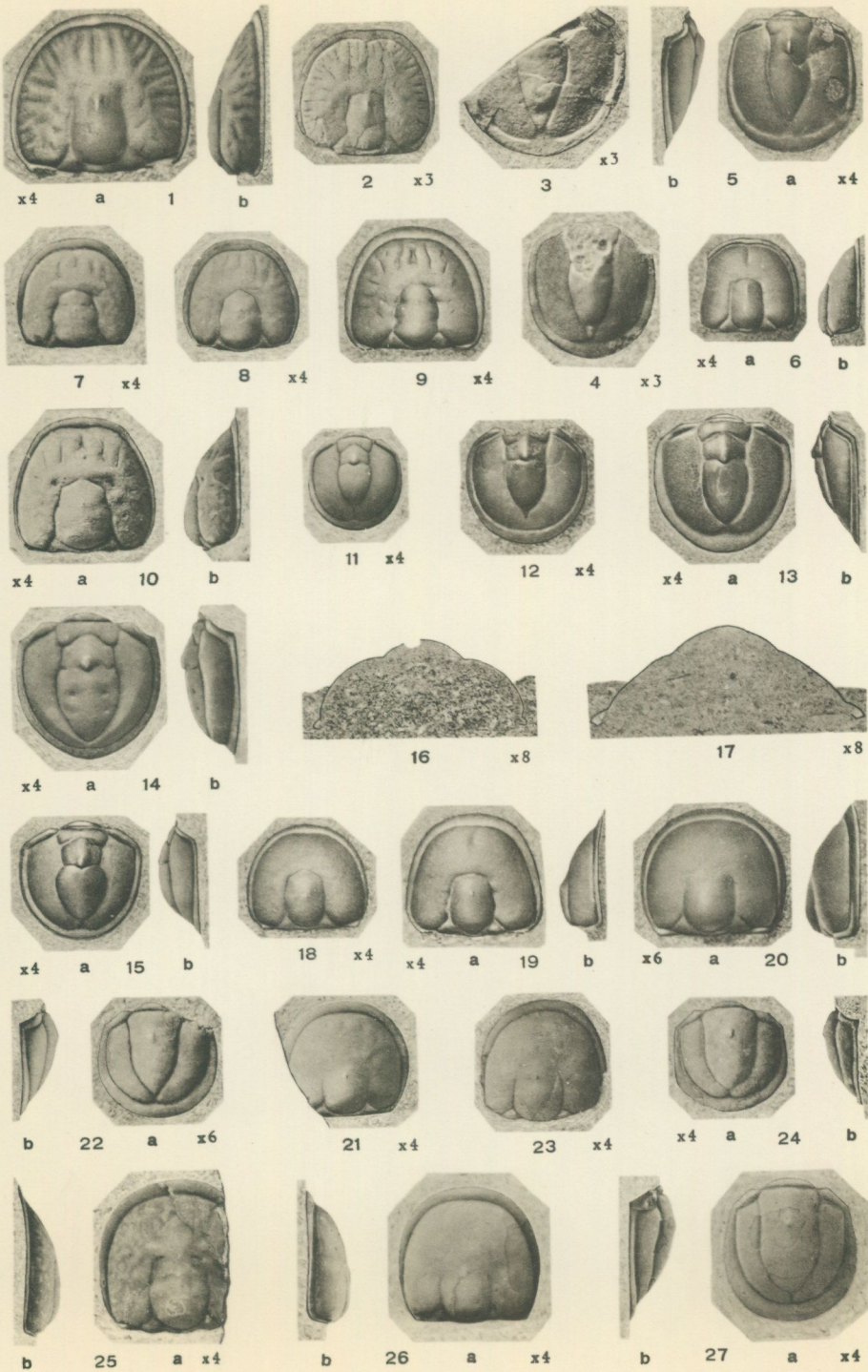


Plate 7.

Cotalagnostus lens (GRÖNWALL). — Page 53.

- Figs. 1—3. Two cephala, the smaller with faintly grooved cheeks, and associated pygidium. Gislövshammar (boulder 96), Scania.
 Figs. 4—5. Cephalon and pygidium. in shale. Boring at Gislövshammar, Scania (Westergård, 1944 a, level 84.6 m).
 Figs. 1—5 zone of *Ptychagnostus* (*Pt.*) *punctuosus*, lower part.

Cotalagnostus confusus (WESTERGÅRD). — Page 54.

- Figs. 6—11. Six cephala, 7 and 8 with the glabella very feebly outlined in front, in 9 the basal lobes are visible but on a view from behind, 11 has faintly furrowed cheeks.
 Figs. 12, 13. Two pygidia, the smaller with the axial furrows traceable throughout.
 Fig. 14. Pygidium with the axis traceable throughout and comparatively narrow rim. Probably this species.
 Figs. 6—14 from the Andrarum limestone, Andrarum, Scania. Figs. 6 and 13 a copies from Holm & Westergård, 1930, pl. 4, figs. 7 and 8. — Figs. 8 and 10 belong to RM, fig. 11 to G.-M. I. Lund.
 Fig. 15. Pygidium. Andrarum limestone. Kiviks-Esperöd, Scania.
 Fig. 16. Pygidium. Andrarum limestone. Gislövshammar (boulder 107), Scania.
 Figs. 17—19. Cephalon with the glabella faintly outlined in front and two exfoliated pygidia, the latter with the axis traceable throughout. Exporrecta conglomerate. Råbäck, Kinnekulle, Västergötland.
 Figs. 20 a, b. Cephalon. Exporrecta conglomerate. Hällekis, Kinnekulle, Västergötland.

Tomagnostus fissus (LUNDGREN MS., LINNARSSON). — Page 58.

- Figs. 21—23. Two cephala and associated pygidium. Fig. 22, which is of the same size as the lost holotype and displays the predominant form of the layer, is selected neotype. Exsulans limestone. On the shore 1 km S of Brantevik (Linnarsson's loc. Gislöv), Scania.
 Fig. 24. Cephalon with smooth and confluent cheeks. Brantevik (boulder 11), Scania.
 Fig. 25. Two cephala, the smaller with almost imperceptible preglabellar furrow. Associated with the preceding specimen.
 Fig. 26. Cephalon lacking the preglabellar median furrow, in shale. Andrarum (Tullberg's loc. 6), Scania.
 Figs. 27, 28. Cephalon, exceptionally convex, and pygidium. Gislövshammar (boulder 13), Scania.
 Figs. 29 a, b. Complete specimen. Brantevik (boulder 1), Scania.
 Figs. 24—29 zone *Ptychagnostus* (*Pt.*) *atavus*.

Figs. 1—5, 9, 10 b, 12, 14, 16, 20—25, 27, 28 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

Figs. 6—8, 10 a, 11, 13, 15, 17—19, 26, 29 photographed and retouched by J. W. England.

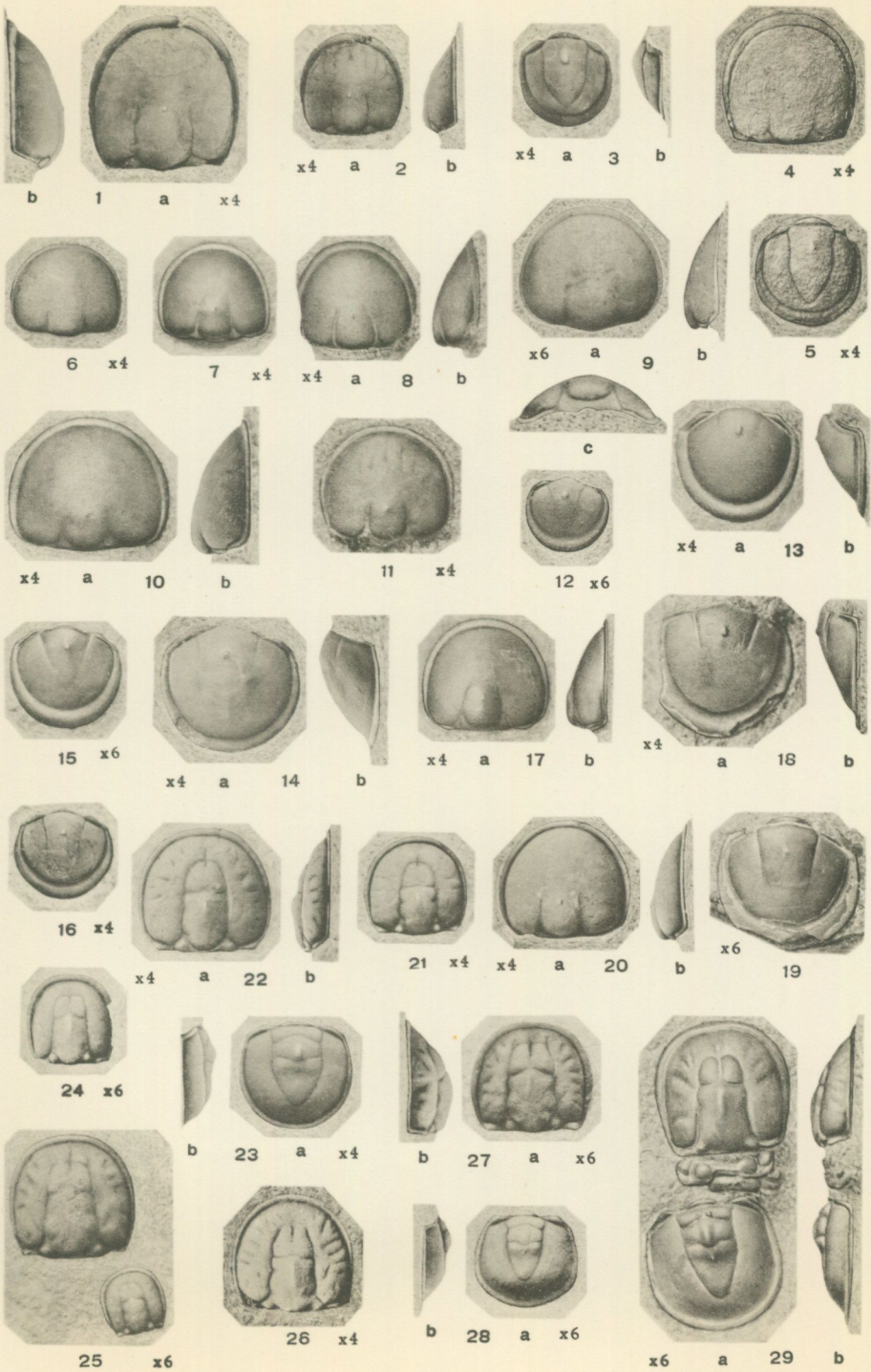


Plate 8.

Tomagnostus ferrugatus (GRÖNWALL). — Page 59.

- Figs. 1, 2. Cephalon and pygidium, in calcareous shale. Zone of *Ptychagnostus* (*Triplagnostus*) *gibbus*. Gislövshammar (boulder 12), Scania.
 Fig. 3. Cephalon with attached thorax. Andrarum (Tullberg's loc. 6), Scania.
 Figs. 4, 5. Cephalon and pygidium. Locality as in fig. 3.
 Figs. 6—8. Two cephalons and associated pygidium. Brantevik (boulder 80), Scania.
 Figs. 3—8 zone of *Ptychagnostus* (*Pt.*) *atavus*.
 Figs. 9—10. Cephalon of young specimen and pygidium. Zone of *Hypagnostus parvifrons*. Gislövshammar (boulder 104), Scania.

Tomagnostus cf. *corrugatus* (ILLING). — Page 60.

- Figs. 11, 12. Two fairly complete dorsal shields, in calcareous shale. Zone of *Ptychagnostus* (*Triplagnostus*) *gibbus*. Gislövshammar (boulder 12), Scania.

Diplagnostus planicauda bilobatus KOBAYASHI. — Page 62.

- Fig. 13. Pygidium with well developed post-axial median furrow. Zone of *Ptychagnostus* (*Pt.*) *punctuosus*. Brantevik (boulder 34), Scania.
 Figs. 14—17. Three cephalons varying as regards the median furrow, and associated pygidium; fig. 16 neotype. Zone of *Goniagnostus nathorsti* (stinkstone immediately below the Andrarum limestone). Kiviks-Esperöd, Scania.
 Figs. 18, 19. Cephalon and pygidium. Zone of *Goniagnostus nathorsti*. Baskemölla, Scania.
 Figs. 20, 21. Cephalon and pygidium. *Paradoxides forchhammeri* beds. Aborrället, Ångermanland.

Diplagnostus planicauda (ANGELIN). — Page 61.

- Figs. 22, 23. Cephalon and pygidium displaying the predominant form in the Andrarum limestone. Andrarum, Scania.
 Fig. 24. Cephalon with very faintly furrowed cheeks, approaching *bilobatus*. Layer and locality as in the preceding specimens.

Diplagnostus planicauda vestgothicus (WALLERIUS). — Page 62.

- Fig. 25. Cephalon. Andrarum limestone. Andrarum, Scania.
 Figs. 26, 27. Cephalon and pygidium. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland.
 Figs. 28, 29. Cephalon and pygidium, Wallerius's type specimens; fig. 28 selected lectotype. Zone and locality as in figs. 26 and 27. — G.-M. I. Lund.

Linguagnostus grönwalli KOBAYASHI. — Page 63.

- Figs. 30 a, b. Pygidium. Zone of *Ptychagnostus* (*Pt.*) *punctuosus*. Boring at S. Sandby, Scania (Westergård, 1944 a; level 84.3 m).

Linguagnostus kjerulfi (BRÖGGER). — Page 64.

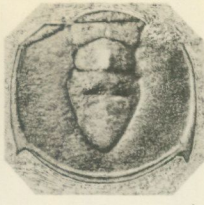
- Figs. 31, 32. Cephalon and pygidium, in shale. Two of Brögger's syntypes; the pygidium is the lectotype. Copies from Holm & Westergård, 1930, pl. 4, figs. 13, 14. *Paradoxides forchhammeri* beds. Krekling, Norway. — Paleozool. Mus. Oslo.

Figs. 1, 2, 6—17, 20, 21, 24, 25, 28—30 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

Figs. 3—5, 18, 19, 22, 23, 26, 27, 31, 32 photographed and retouched by J. W. Englund.



1 x4



2 x4



3 x4



4 x6



6 x6



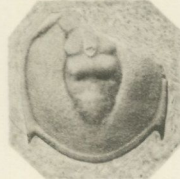
x6



b



a



b



x6



11 x4



13 x6



b



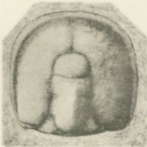
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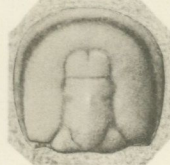
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14 x6



15 x6



16 x6



12 x4



17 x6



x6

a



b



x6

a



b



x6



21 x6



22 x6



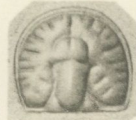
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24 x6



25 x8



26 x6



27 x6



31 x4



28 x6

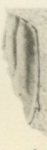


29 x8



x4

a



b



32 x4

Plate 9.

Linguagnostus kjerulfi (BRÖGGER). — Page 64.

Figs. 1—3. Cephalon and two pygidia. Andrarum limestone. Andrarum. Scania.
Figs. 1 and 3 belong to RM.

Oidalagnostus trispiniifer sp. n. — Page 65.

Figs. 4 a, b. Cephalon. Djupadalen, Västergötland. Collected by I. D. Wallerius in 1894. — G.-M. I. Lund.

Figs. 5—6. Cephalon and pygidium, the latter exfoliated and displaying traces of the axial furrows and two pairs of very faint knobs on the pseudo-lobe; fig. 6 is the holotype. Gudhem. Västergötland.

Fig. 7. Pygidium. Torbjörntorp, Västergötland.

Figs. 4—7, zone of *Lejopyge laevigata*, upper part.

Oidalagnostus? dubius sp. n. — Page 67.

Figs. 8 a, b. Pygidium. (Andrarum limestone. Andrarum. Scania?) — RM.

Ptychagnostus (Triplagnostus) praecurrens (WESTERGÅRD). — Page 69.

Figs. 9 a, b. Complete dorsal shield with aberrant pygidial axis. *Paradoxides oelandicus* beds. Västerskucku, Jämtland.

Fig. 10. Incomplete dorsal shield and detached cephalon, in calcareous shale. Zone of *Ptychagnostus (Triplagnostus) gibbus*. Gislövshammar (boulder 12), Scania.

Fig. 11. Pygidium with exceptionally broad axis, probably this species. Associated with the preceding specimens.

Fig. 12. Pygidium of very large specimen, probably this species. Exsulans limestone. Gislövshammar, Scania.

Figs. 13, 14. Cephalon with attached thorax and associated pygidium. From the boulder yielding figs. 10 and 11.

Ptychagnostus (Triplagnostus) angermanensis sp. n. — Page 70.

Figs. 15, 16. Cephalon, holotype, and pygidium, in calcareous shale. (Zone of *Ptychagnostus (Pt.) atavus?*). Brattbäcken (boulder), Ångermanland.

Ptychagnostus (Triplagnostus) gibbus (LINNARSSON). — Page 70.

Figs. 17, 18. Cephalon, with both spines broken, and pygidium. Exsulans limestone. Andrarum, Scania.

Fig. 19. Cephalon. Exsulans limestone. Brantevik. Scania.

Figs. 20, 21. Complete dorsal shield and detached cephalon, the latter with slightly grooved cheeks. Zone of *Ptychagnostus (Triplagnostus) gibbus*. Boring at Grankulla, Östergötland (Westergård, 1944 b; level 44.5 and 46.8 m resp.).

Figs. 22—24. Cephalon, thorax, and pygidium. Zone as in figs. 20, 21. Edsbergs Sanna, Närke.

Ptychagnostus (Triplagnostus) hybridus (BRÖGGER). — Page 71.

Figs. 25—26. Cephalon and pygidium. Zone of *Hypagnostus parvifrons*. Gislövshammar (boulder 116), Scania.

Figs. 1, 2 b, 4, 5, 6 b, 9 b—14, 19—21, 25, 26 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

Figs. 2 a, 3, 6 a, 7—9 a, 15—18, 22—24 photographed and retouched by J. W. England.

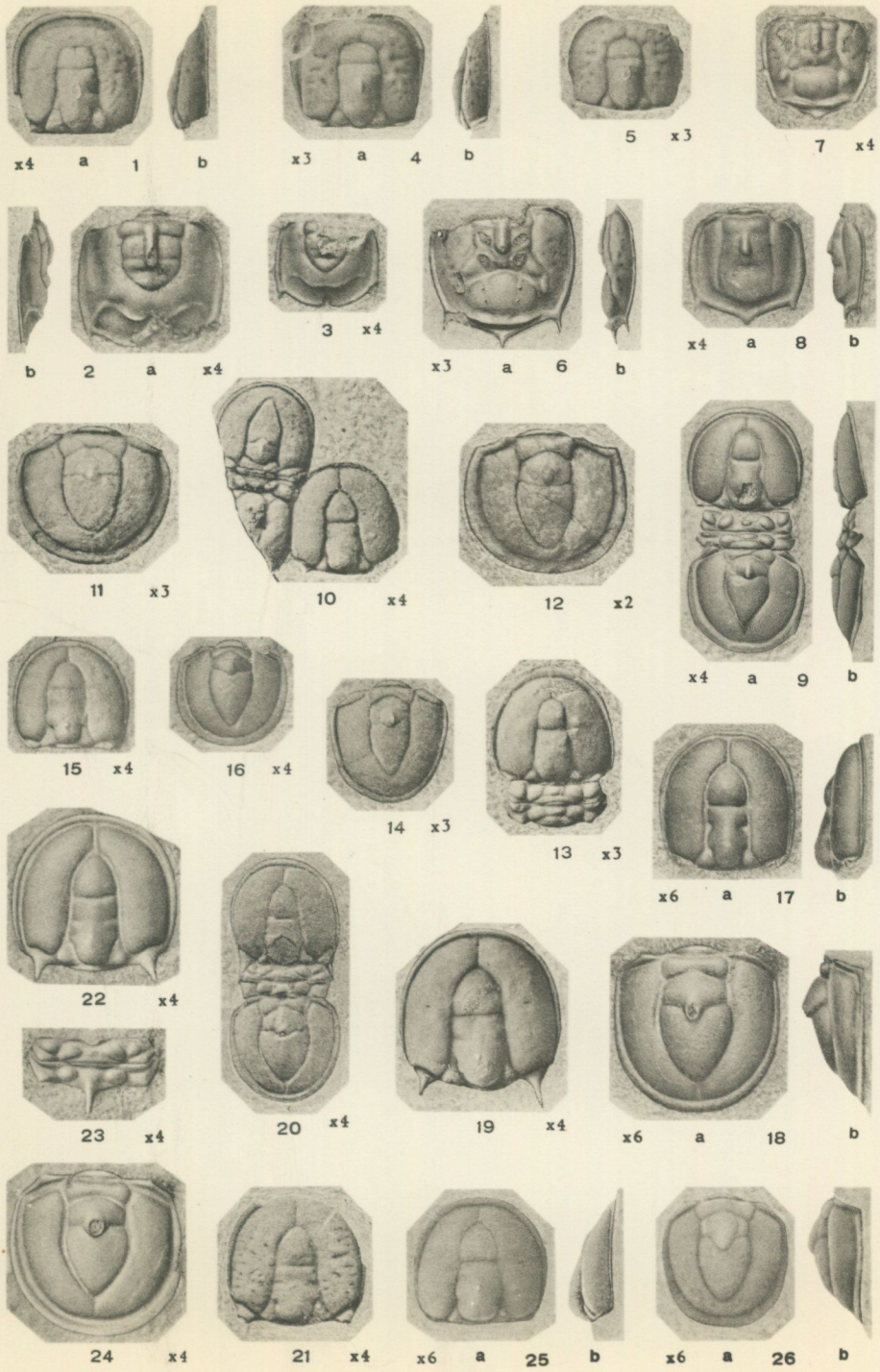


Plate 10.

Ptychagnostus (Triplagnostus) hybridus (BRÖGGER). — Page 71.

Figs. 1, 2. Cephalon and pygidium. Zone of *Ptychagnostus (Pt.) punctuosus*(?). Munkesten, Hunneberg, Västergötland.

Ptychagnostus (Triplagnostus) stenorrhachis (GRÖNWALL). — Page 72.

Figs. 3, 4. Cephalon and pygidium. Zone of *Ptychagnostus (Pt.) punctuosus*. Boring at Gislövshammar, Scania (Westergård, 1944 a; level 82.8 m).

Ptychagnostus (Triplagnostus) convexus sp. n. — Page 73.

Figs. 5—7. Two cephalata, the smaller with smooth and the larger with faintly scrobiculate cheeks, and associated pygidium. Brantevik (boulder 11), Scania.

Figs. 8 a, b. Cephalon of full-grown individual, holotype. Under a lens the anterior glabellar lobe, the preglabellar median furrow, and very faint pits on the cheeks are discernible. Brantevik (boulder 14), Scania.

Figs. 9 a, b. Cephalon, with the anterior glabellar lobe and the preglabellar median furrow effaced, features by which it approaches »*Aagnostus*» *altus* GRÖNWALL. Brantevik (boulder 61), Scania.

Fig. 10. Pygidium, largest specimen found. Gislövshammar (boulder 16), Scania. Figs. 5—10 zone of *Ptychagnostus (Pt.) atavus*.

Ptychagnostus (Triplagnostus) elegans (TULLBERG). — Page 74.

Figs. 11, 12. Cephalon and pygidium, two of Tullberg's syntypes; fig. 11 lectotype. Andrarum (Tullberg's loc. 11), Scania. — G.-M. I. Lund.

Figs. 13, 14. Cephalon with gently grooved cheeks and associated pygidium. Stinkstone lens 0.7 m below the Andrarum limestone. Baskemölla, Scania.

Figs. 15, 16. Cephalon and pygidium. Baskemölla (lens 2), Scania.

Figs. 17—19. Two cephalata, the smaller with the glabella distinctly outlined throughout and the larger with the anterior glabellar lobe effaced, and pygidium. Gislövshammar (boulder 7), Scania.

Fig. 20. Pygidium of very young specimen. Gislövshammar (boulder 25), Scania. Figs. 11—20 zone of *Ptychagnostus (Pt.) punctuosus*.

Ptychagnostus (Triplagnostus) elegans laevissimus subsp.n. — Page 74.

Figs. 21, 22. Cephalon and pygidium, the former holotype. Associated with specimens of the typical *elegans*. Zone of *Ptychagnostus (Pt.) punctuosus*. Gislövshammar (boulder 18), Scania.

Ptychagnostus (Triplagnostus) lundgreni (TULLBERG). — Page 75.

Figs. 23, 24. Cephalon and pygidium, Tullberg's syntypes, the former lectotype. Borregaard, Bornholm. — G.-M. I. Lund.

Figs. 25 a, b. Pygidium. Vedjeön (boulder 6), Jämtland.

Figs. 1, 2, 13—16, 25 photographed and retouched by J. W. Englund.

Figs. 3—12, 17—24 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

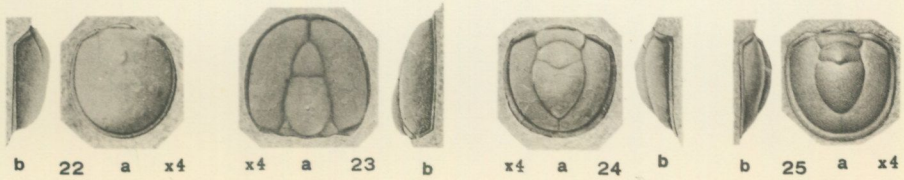
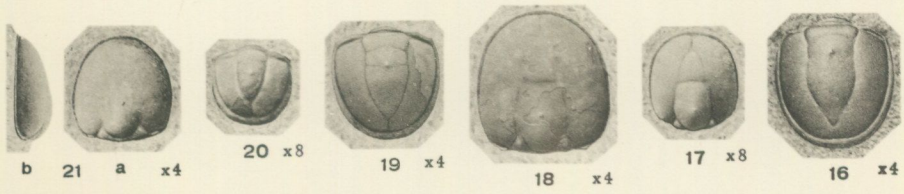
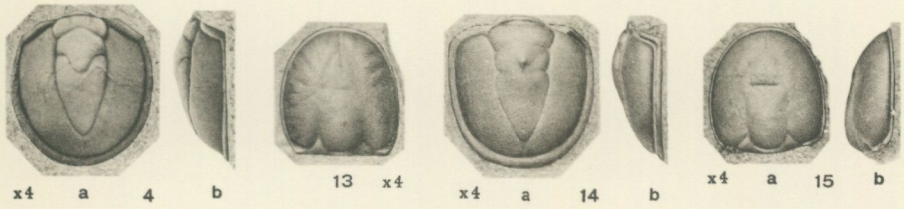
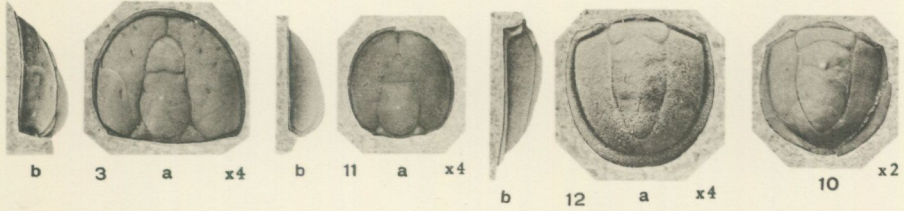
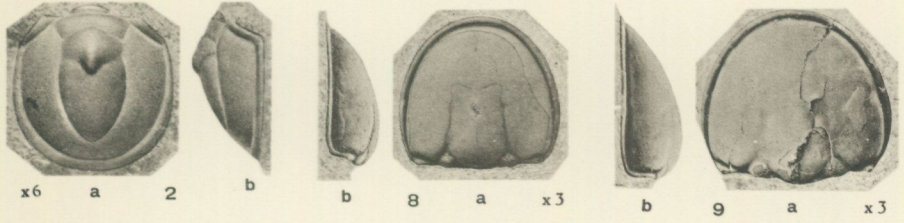
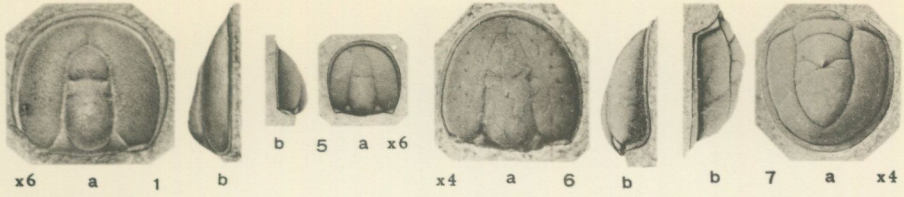


Plate 11.

Ptychagnostus (Triplagnostus) lundgreni (TULLBERG). — Page 75.

Figs. 1, 2. Two cephala, the former with smooth and the latter with grooved cheeks, probably belonging to this species (possibly to the subspecies *nanus*). Basal layer of the zone of *Solenopleura brachymetopa* (stinkstone lens 0.3 m below the Andrarum limestone). Andrarum, Scania.

Ptychagnostus (Triplagnostus) lundgreni nanus (GRÖNWALL). — Page 75.

- Figs. 3—6. Three cephala, displaying the variability of the glabella, and associated pygidium. Limestone lens abundant in this form and otherwise yielding but *Pt. (Tr.) lundgreni* (infrequent) and *Peronopsis fallax ferox* (rare). Vedjeön (boulder 6), Jämtland.
- Figs. 7 a, b. Pygidium, associated with figs. 1 and 2.

Ptychagnostus (Ptychagnostus) atavus (TULLBERG). — Page 76.

- Fig. 8. Cephalon. New figure of Tullberg's specimen fig. 1 a; lectotype. Loose stinkstone lens at Forsemölla, Andrarum, Scania. — G.-M. I. Lund.
- Figs. 9, 10. Cephalon and pygidium, associated with fig. 8.
- Figs. 11 a, b. Cephalon (identified as *atavus* by Tullberg, 1880, p. 37). Oltorp, Västergötland.
- Figs. 12, 13. Two cephala, the smaller with almost smooth cheeks and the larger with deeply impressed grooves and pits. Brantevik (boulder 18), Scania.
- Figs. 14—17. Three middle-sized cephala displaying the variability of the glabella, basal lobes, and sculpture of the cheeks, and an associated pygidium. Stinkstone lens (B) rich in this species and otherwise yielding but a specimen (pygidium) of *Hypagnostus parvifrons*. Kopparrökhällarna, Jämtland.
- Fig. 18. Cephalon with a pair of curved furrows off the anterior glabellar lobe; in shale. Boring at Andrarum, Scania (Westergård, 1944 a; level 57 m).
- Figs. 19—21. Two cephala and a pygidium, in shale. Tullberg's syntypes of *Agn. intermedius*. Andrarum (Tullberg's loc. 9), Scania. — G.-M. I. Lund.
- Figs. 22, 23. Detached cephalon and complete dorsal shield, in shale. Locality as in figs. 19—21.
- Figs. 24—25. Cephalon and pygidium of a form approaching *punctuosus affinis*. Associated with *Hypagnostus parvifrons* (fairly common) and *Ptychagnostus (Triplagnostus) hybridus* (rare). Kopparrökhällarna, Jämtland.

Ptychagnostus (Ptychagnostus) punctuosus affinis (BRÖGGER). — Page 79.

- Figs. 26—27. Cephalon and pygidium. *Hypagnostus parvifrons* only associated species. Gislövshammar (boulder 3), Scania.
- Figs. 28, 29. Cephalon and pygidium. *Hypagnostus parvifrons mammillatus* only associated form. Brantevik (boulder 76), Scania.
- Fig. 30. Cephalon with two small median tubercles on the posterior glabellar lobe. *Hypagnostus parvifrons mammillatus* only associated form. Gislövshammar (boulder 9), Scania.
- Figs. 31—33. Two cephala and a pygidium. Associated with *Hypagnostus parvifrons mammillatus* and *Schmalenseeia acutangula* sp. n. Hillsand, Jämtland.

Ptychagnostus (Ptychagnostus) punctuosus (ANGELIN). — Page 78.

- Figs. 34, 35. Cephalon and pygidium, approaching the subspecies *affinis*. Baske-mölla (stinkstone lens 3), Scania.

Figs. 1 a, 2—6 a, 7 a, 8—11, 14, 17, 19—25 photographed and retouched by J. W. Englund.
Figs. 1 b, 6 b, 7 b, 12, 13, 15, 16, 18, 26—35 photographed by C. Larsson and very slightly retouched by A. H. Westergård.



Plate 12.

Ptychagnostus (Ptychagnostus) punctuosus (ANGELIN). — Page 78.

Figs. 1, 2. Cephalon and pygidium. Boring at Gislövshammar, Scania (Westergård, 1944 a, level 82.8 m).

Figs. 3, 4. Cephalon and pygidium, the latter with a faint post-axial furrow. Probably belonging to Angelin's syntypes; fig. 3 is the lectotype. Scania. — RM.

Figs. 5—7. Cephalon and two pygidia, the smaller with well-defined post-axial furrow, the larger with confluent lateral lobes. Andrarum (Tullberg's loc. 10), Scania.

Figs. 1—7 zone of *P. punctuosus*.

Ptychagnostus (Ptychagnostus) aculeatus (ANGELIN). — Page 79.

Figs. 8—10. Cephalon and two pygidia, in all probability Angelin's syntypes; fig. 8 lectotype. Andrarum limestone. Andrarum, Scania. — RM. No. Ar 1997 a, b.

Figs. 11 a, b. Cephalon, displaying a short spine on the posterior margin. From the same layer and locality as the preceding specimens.

Goniagnostus nathorsti (BRÖGGER). — Page 81.

Figs. 12, 13. Cephalon and pygidium. Baskemölla (stinkstone lens 10), Scania. Zone of *G. nathorsti*.

Figs. 14—16. Cephalon and two pygidia. Stinkstone lens a little below the Exporta conglomerate at Sägbacken, Ångermanland.

Goniagnostus scanensis sp. n. — Page 81.

Figs. 17 a, b. Pygidium. Associated with *G. nathorsti*. Brantevik (boulder 45), Scania.

Goniagnostus spiniger (WESTERGÅRD). — Page 82.

Figs. 18, 19. Cephalon and pygidium, in shale; the former is the holotype. Basal layer of the zone of *Lejopyge laevigata*. Karlsfors, Västergötland.

Doryagnostus incertus (BRÖGGER). — Page 83.

Figs. 20—22. Two cephalata, the larger with slightly scrobiculate cheeks, and associated pygidium. Baskemölla, Scania.

Fig. 23. Cephalon. Gislövshammar (boulder 18), Scania.

Figs. 20—23 zone of *Ptychagnostus (Pt.) punctuosus*.

Figs. 1—4, 7, 8, 10, 14—17, 23 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

Figs. 5, 6, 9, 11—13, 18—22 photographed and retouched by J. W. Englund.

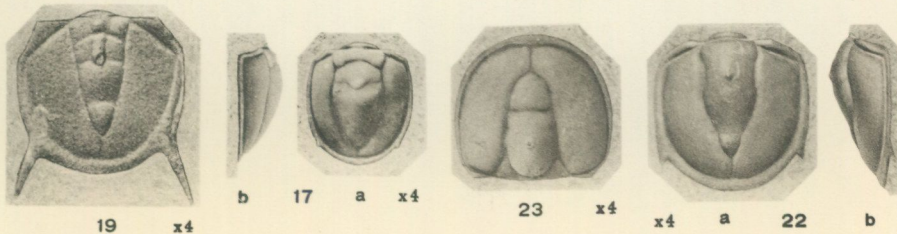
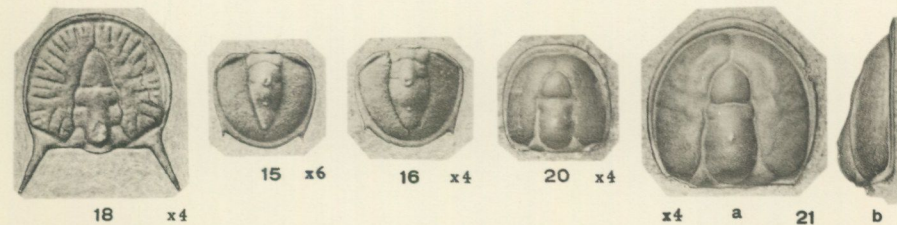
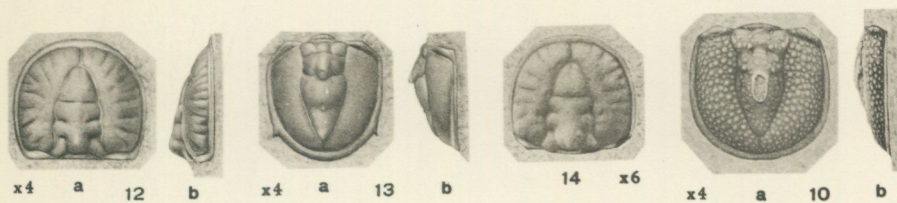
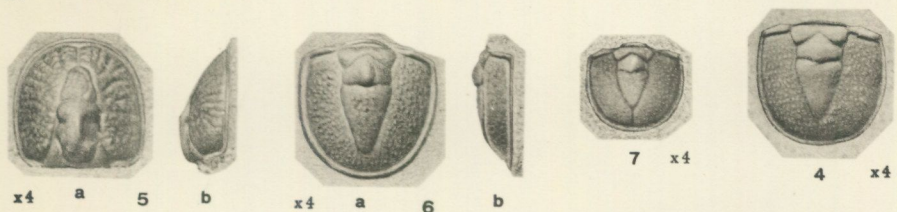
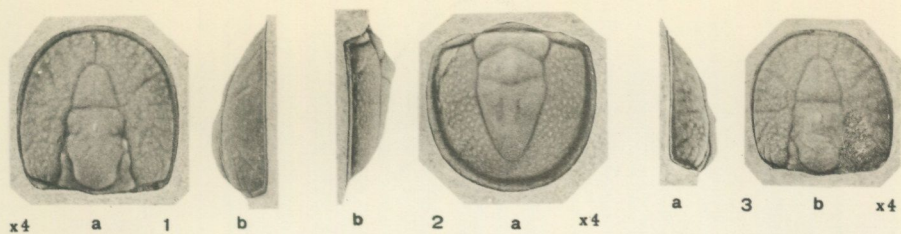


Plate 13.

Doryagnostus incertus (BRÖGGER). — Page 83.

- Fig. 1. Cephalon of young individual, truncate in front. Gislövshammar (boulder 8), Scania.
Fig. 2. Pygidium of young individual. Gislövshammar (boulder 7), Scania.
Fig. 3. Pygidium of a form with unusually broad axis. Gislövshammar (boulder 21), Scania.

Figs. 1—3 zone of *Ptychagnostus* (*Pt.*) *punctuosus*.

9†—462426. S. G. U. Ser. C, N:o 477. Westergård.

Agnostus pater WESTERGÅRD. — Page 84.

Figs. 4, 5. Cephalon and pygidium; the latter is the holotype. Copies from Holm & Westergård, 1930, pl. 4, figs. 9 and 10. Andrarum limestone. Kiviks-Esperöd, Scania. — RM.

Figs. 6 a, b. Pygidium. Andrarum limestone. Andrarum, Scania.

Agnostus neglectus sp. n. — Page 85.

Figs. 7, 8. Cephalon and pygidium, the former holotype. Gudhem, Västergötland.

Fig. 9. Pygidium with three pairs of impressions on the axial end-lobe. Torbjörntorp, Västergötland.

Figs. 7—9 zone of *Lejopyge laevigata*, upper part.

Agnostus pisiformis (LINNÆUS). — Page 85.

Figs. 10—12. Cephalon and two pygidia, the former with smooth and the latter with faintly segmented axis. Zone of *Lejopyge laevigata*, upper part. Gudhem, Västergötland.

Fig. 13. Pygidium. Zone of *L. laevigata*, upper part (stinkstone lens 2.4 m above the Exporrecta conglomerate). Djupadalen, Västergötland.

Fig. 14. Pygidium with exceptionally broad axis, probably this species. Zone of *A. pisiformis*. Andrarum, Scania (Westergård, 1922, p. 18, fig. 4, level 6.1 m).

Agnostus pisiformis spiniger (DALMAN). — Page 86.

Figs. 15, 16. Cephalon and associated pygidium. Zone of *A. pisiformis*. Karlevi, Öland.

Agnostus? sp. — Page 87.

Fig. 17. Pygidium. Andrarum limestone. Andrarum, Scania.

Lejopyge laevigata (DALMAN). — Page 87.

Figs. 18—20. Two cephalata, the larger with unusually broad rim, and pygidium. Andrarum limestone. Andrarum, Scania.

Figs. 21—23. Two cephalata and associated pygidium of Dalman's syntypes. Fig. 21 lectotype; fig. 22 has the glabella faintly outlined throughout and gently grooved cheeks. Zone of *L. laevigata*. Hönsäter, Kinnekulle, Västergötland. — RM, No. Ar. 287 b and f.

Figs. 24, 25. Cephalon and pygidium. Associated with fig. 13.

Figs. 26 a, b. Pygidium with three pairs of faint pits on the axial end-lobe. Zone of *L. laevigata*, upper part. Gudhem, Västergötland.

Fig. 27. Defective pygidium with four pairs and an unpaired pit on the axial end-lobe; tentatively included in this species. Zone of *L. laevigata* (stinkstone lens 0.4—0.6 m above the Exporrecta conglomerate). Ödegården, Västergötland.

Lejopyge laevigata armata (LINNARSSON). — Page 89.

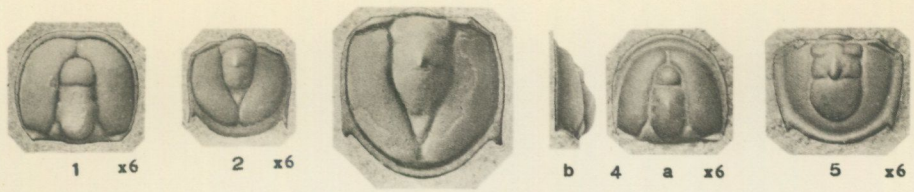
Figs. 28—31. Two cephalata and two associated pygidia. Fig. 31 has the axis outlined throughout and resembles to some extent var. *forfex* BRÖGGER (1878) but has far shallower axial furrows. Zone of *L. laevigata*, upper part. Gudhem, Västergötland.

Figs. 32—34. Cephalon, posterior thoracic segment, and pygidium; in shale. Basal layer of the zone of *L. laevigata*. Gudhem, Västergötland.

Figs. 35, 36. Cephalon and pygidium. The radiating dark lines in the cheeks are caused rather by shades in the test than by true furrows. Zone of *L. laevigata*, upper part. Knivinge, Östergötland.

Figs. 1—3, 4 b, 11 b, 12, 14, 16, 18, 21—23, 26, 30, 31 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

Figs. 4 a, 5—11 a, 13, 15, 17, 19, 20, 24, 25, 27—29, 32—36 photographed and retouched by J. W. Englund.



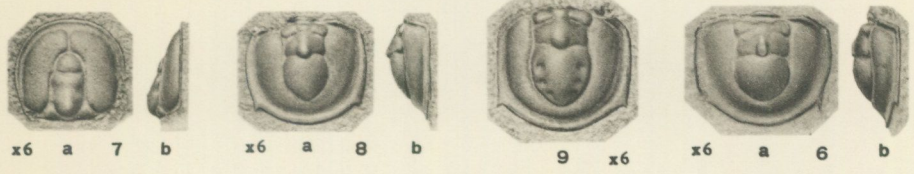
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2 x6

3 x4

b 4 a x6

5 x6

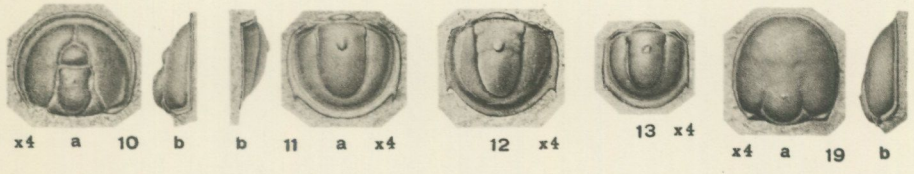


x6 a 7 b

x6 a 8 b

9 x6

x6 a 6 b



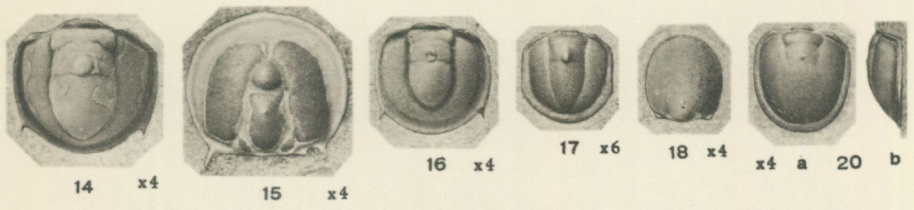
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b 11 a x4

12 x4

13 x4

x4 a 19 b



14 x4

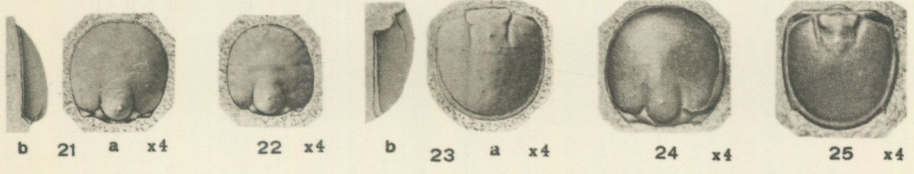
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17 x6

18 x4

x4 a 20 b



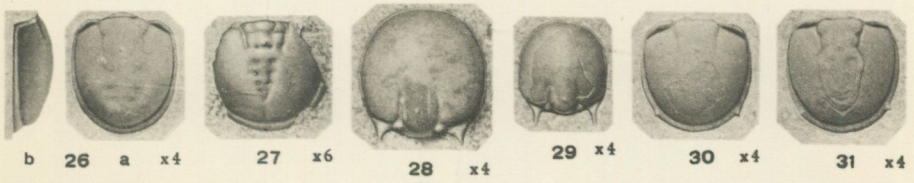
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b 23 a x4

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b 26 a x4

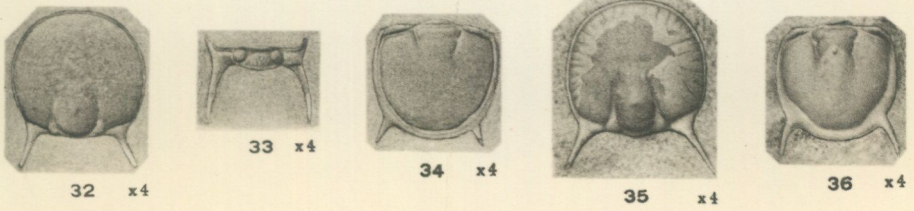
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28 x4

29 x4

30 x4

31 x4



32 x4

33 x4

34 x4

35 x4

36 x4

Plate 14.

Lejopyge laevigata perrugata subsp. n. — Page 89.

- Fig. 1. Cephalon. Zone of *L. laevigata*, lower part. Håkansgården, Billingen, Västergötland.
- Fig. 2. Cephalon, holotype. Zone of *L. laevigata*, lower part. Karlsfors, Billingen, Västergötland.

Lejopyge laevigata rugifera subsp. n. — Page 90.

Fig. 3. Cephalon. Zone of *L. laevigata*. Sjögestad, Östergötland.

Ciceragnostus cicer (TULLBERG). — Page 90.

Figs. 4 a, b. Pygidium, the only specimen found of Tullberg's syntypes; lectotype. Zone of *Ptychagnostus* (*Pt.*) *punctuosus*. Andrarum, Scania. — G.-M. I. Lund.

Figs. 5, 6. Cephalon and pygidium. Zone of *P. punctuosus*. Gislövshammar (boulder 7), Scania.

Figs. 7, 8. Cephalon and pygidium, the latter with narrow axis. Zone of *Goniagnostus nathorsti* (stinkstone underlying and grown together with Andrarum limestone). Kiviks-Esperöd, Scania.

Figs. 9 a, b. Pygidium. Andrarum limestone. Andrarum, Scania.

Phoidagnostus bituberculatus (ANGELIN). — Page 91.

Figs. 10, 11. Cephalon and associated pygidium. Andrarum, Scania. Copies from Holm & Westergård, 1930, pl. 4, figs. 4, 5. — RM.

Fig. 12. Cephalon, broad form. Andrarum, Scania.

Fig. 13. Pygidium. Kiviks-Esperöd, Scania.

Fig. 14. Pygidium of young individual. Baskemölla, Scania.

Figs. 10—14 from the Andrarum limestone.

Phalacroma scanicum (TULLBERG). — Page 93.

Fig. 15. Cephalon, in shale. Lectotype. Andrarum, Scania. — G.-M. I. Lund.

Fig. 16. Pygidium, in shale. Andrarum (Tullberg's loc. 10), Scania.

Fig. 17. Pygidium, in shale. Andrarum (boring 1; Westergård, 1944 a, level 51.9 m), Scania.

Figs. 18 a, b. Pygidium. Gislövshammar (boring; Westergård, 1944 a, level 82.85 m), Scania.

Figs. 15—18 zone of *Ptychagnostus* (*Pt.*) *punctuosus*.

Phalacroma resectum (GRÖNWALL). — Page 93.

Figs. 19 a, b. Pygidium. Zone of *Ptychagnostus* (*Pt.*) *punctuosus*. Brantevik (boulder 56), Scania.

Phalacroma marginatum (BRÖGGER). — Page 94.

Figs. 20—22. Cephalon and two pygidia, exfoliated; the younger pygidium with the axis outlined throughout. Zone of *Solenopleura brachymetopa* (*Hyo-lithes* limestone). Andrarum, Scania.

Figs. 23 a, b. Cephalon, retaining the test; probably this species. Andrarum limestone. Andrarum, Scania.

Fig. 24. Cephalon of young individual, exfoliated at the left postero-lateral corner and displaying there a faint and short axial furrow. *Paradoxides forchhammeri* beds. Aborrället, Ångermanland.

Fig. 25. Cephalon, internal cast. Associated with fig. 24.

Figs. 26—29. Four pygidia at different stages of growth. Associated with figs. 24 and 25.

Figs. 1—3, 5 a, 6 a, 7 a, 8, 10, 11, 13—16, 25, 28 photographed and retouched by J. W. Englund.
Figs. 4, 5 b, 6 b, 7 b, 9, 12, 17—24, 26, 27, 29 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

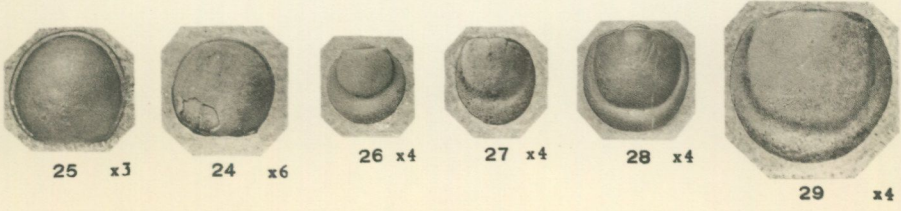
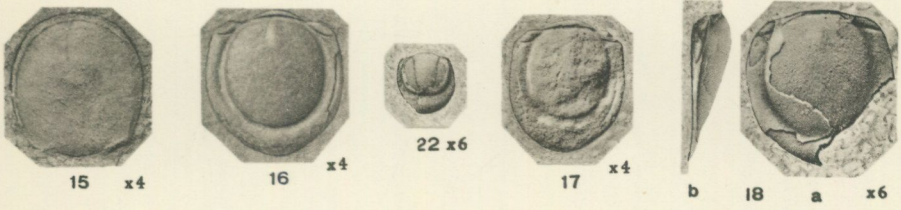
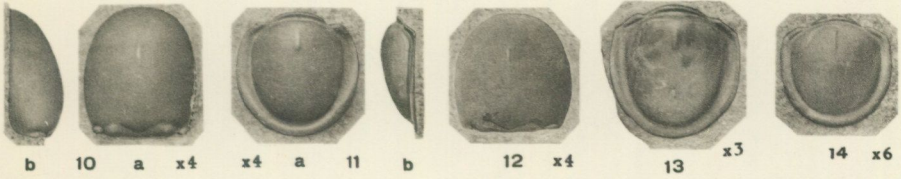
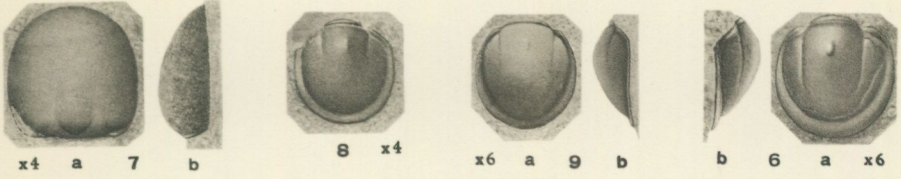
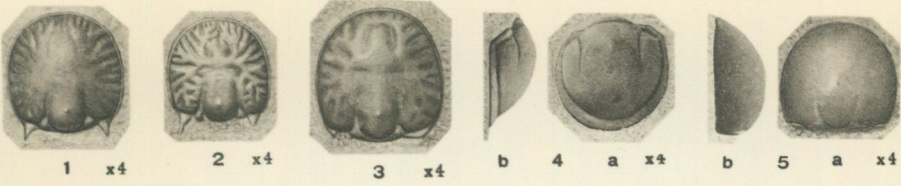


Plate 15.

Phalacroma marginatum (BRÖGGER). — Page 94.

Figs. 1, 2. Cephalon and pygidium, associated with figs. 24—29 on pl. 14. *Paradoxides forchhammeri* beds. Aborrället, Ångermanland.

Phalacroma glandiforme (ANGELIN). — Page 95.

Figs. 3, 4. Two cephalata, exfoliated; surface smooth. — Fig. 4 belongs to RM.

Figs. 5 a, b. Cephalon, b seen from the under-side and exhibiting the doublure — RM.

Figs. 6 a, b. Cephalon, lectotype. — RM.

Figs. 7—9. Three pygidia of different size.

Figs. 10 a, b. Pygidium, displaying the doublure. New figs. of the specimen illustrated by Holm & Westergård, 1930, pl. 4, figs. 1 a, b.

Fig. 11. Longitudinal vertical section (slide) of pygidium, displaying the doublure.

Fig. 12. Pygidium, exceptionally elongate; test compact. — RM.

Figs. 13 a—d. Enrolled specimen with the distal outline of both shields tending to become angulate, narrow axis, and punctate test; probably this species.

Figs. 3—13 from the Andrarum limestone. Andrarum, Scania.

Fig. 14. Pygidium. Andrarum limestone. Kiviks-Esperöd, Scania.

Figs. 15—17. Two cephalata and associated pygidium. *Paradoxides forchhammeri* beds. Aborrället, Ångermanland.

Figs. 1, 2, 5, 9, 12, 13, 16, 17 photographed and retouched by J. W. Englund.

Figs. 3, 4, 6—8, 10, 11, 14, 15 photographed by C. Larsson and very slightly retouched by A. H. Westergård.

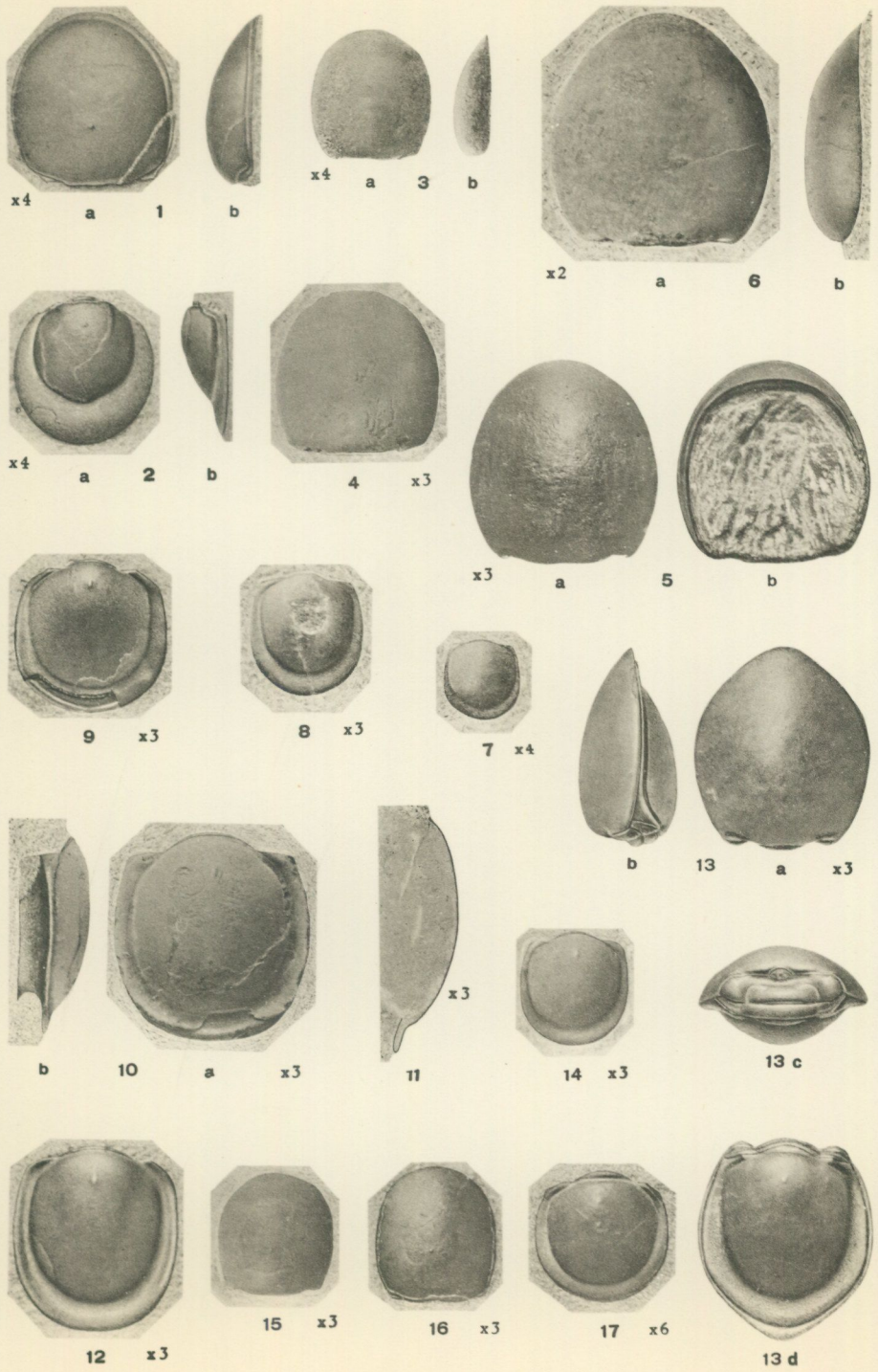


Plate 16.

Phalacroma glandiforme (ANGELIN). — Page 95.

Figs. 1, 2. Cephalon and pygidium, internal casts (retaining parts of the test) displaying faint markings (muscle attachments?). Andrarum limestone. Andrarum, Scania. — RM.

Phalacroma sp. — Page 97.

Fig. 3. Pygidium of young individual at an early holaspid stage. Andrarum limestone. Andrarum, Scania.

Agnostus pisiiformis subsulcatus subsp. n. — Page 86.

Figs. 4, 5. Cephalon and pygidium. Zone of *Lejopyge laevigata*. Ullavi (boulder), Närke. Collected and presented to the Geological Survey by Mr. T. Tjernvik, Örebro.

Ciceragnostus cf. cicer (TULLBERG). — Page 90.

Figs. 6 a, b. Pygidium. Andrarum limestone(?). Andrarum, Scania. — RM.

Ciceragnostus(?) sp. — Page 91.

Figs. 7 a, b. Pygidium. Andrarum limestone. Andrarum, Scania.

Tomagnostus cf. fissus (LUNDGREN MS., LINNARSSON). — Page 59.

Fig. 8. Pygidium, in shale. Zone of *Hypagnostus parvifrons*. Gislövshammar (boring; Westergård, 1944 a, level 87.6 m), Scania.

Lejopyge laevigata (DALMAN). — Page 87.

Fig. 9. Complete dorsal shield. *Paradoxides forchhammeri* beds. Ullavi (boulder), Närke. Collected and presented to the Geological Survey by Mr. T. Tjernvik, Örebro.

»*Aagnostus*» sp. No. 1. — Page 97.

Fig. 10. Pygidium. Zone of *Ptychagnostus (Pt.) atavus*. Djupadalen, Västergötland.

»*Aagnostus*» sp. No. 2. — Page 97.

Figs. 11 a, b. Pygidium. Zone of *Ptychagnostus (Pt.) atavus*. Brantevik (boulder 80), Scania.

»*Aagnostus*» sp. No. 3. — Page 97.

Figs. 12 a, b. Pygidium. Zone of *Ptychagnostus (Pt.) atavus*. Brantevik (boulder 22), Scania.

»*Aagnostus*» sp. No. 4. — Page 97.

Fig. 13. Pygidium. Kiviks-Esperöd, Scania.

Figs. 14, 15. Two pygidia. Andrarum, Scania. — RM.

Fig. 16. Pygidium. Andrarum, Scania. — G.-M. I. Lund.

Fig. 17. Pygidium, cast of impression; tentatively included in this species. Andrarum, Scania. — RM.

Figs. 13—17 from the Andrarum limestone.

»*Aagnostus*» sp. No. 5. — Page 98.

Figs. 18 a, b. Pygidium; recalling a form suggested to belong to *Hypagnostus exsculptus* (pl. 6, fig. 5). Andrarum limestone. Andrarum, Scania. — RM. No. 2012 a.

»*Aagnostus*» sp. No. 6. — Page 98.

Figs. 19 a, b. Pygidium. Andrarum limestone. Andrarum, Scania. — RM.

»*Aagnostus*» sp. No. 7. — Plate 99.

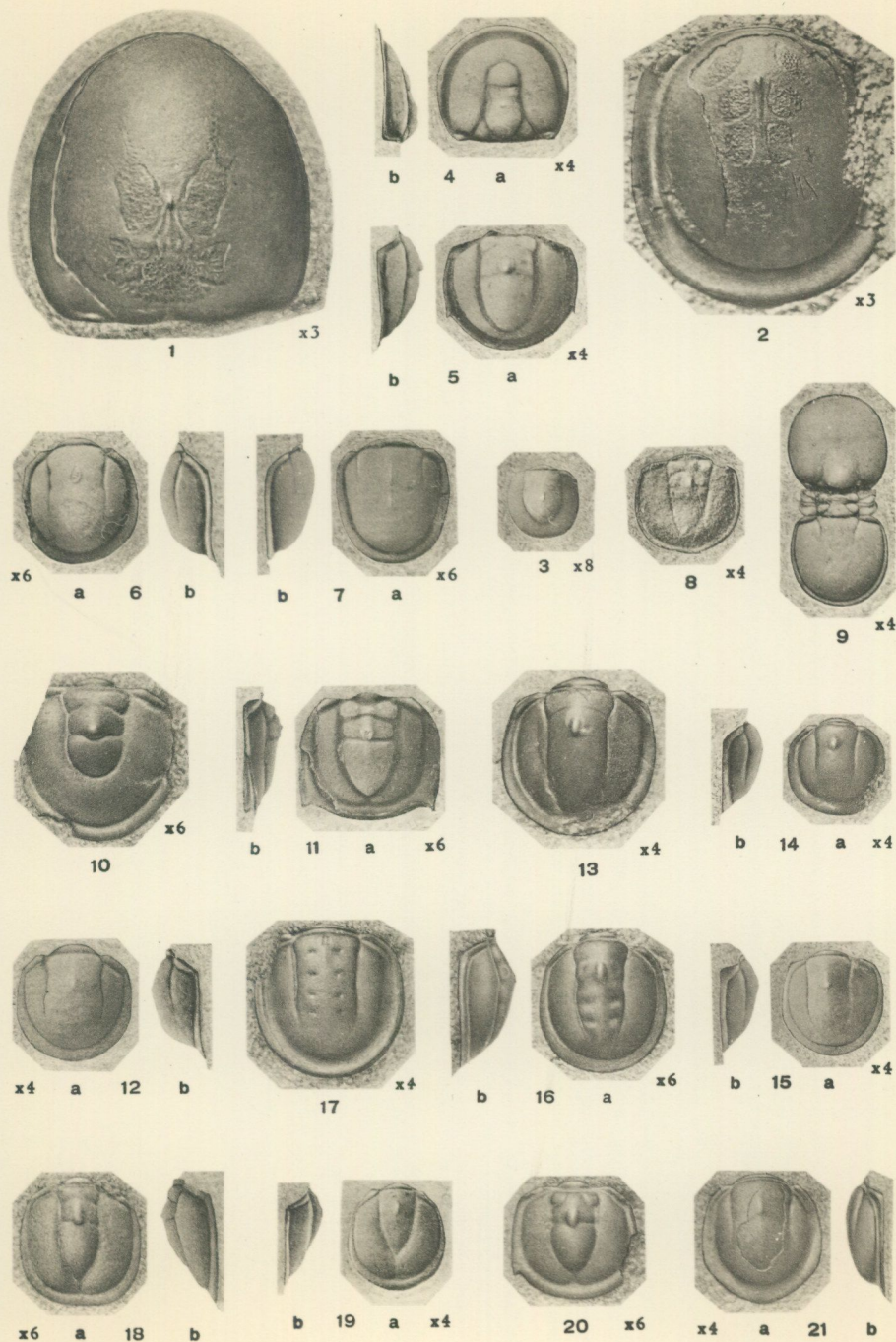
Fig. 20. Pygidium. Andrarum limestone. Andrarum, Scania. — RM.

»*Aagnostus*» sp. No. 8. — Page 99.

Figs. 21 a, b. Pygidium. Zone of *Lejopyge laevigata*, upper part. Torbjörntorp, Västergötland.

Figs. 1, 2, 10, 12, 13 a, 15, 16, 18 a, 20, 21 photographed and retouched by J. W. Englund.

Figs. 3—9, 11, 13 b, 14, 17, 18 b, 19 photographed by C. Larsson and very slightly retouched by A. H. Westergård.



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