

THE MIDDLE ORDOVICIAN OF THE OSLO REGION, NORWAY

13. Trilobites of the family Asaphidae

By

GUNNAR HENNINGSMOEN

(Paleontologisk Museum, Oslo)

With 14 plates and 5 figures in text.

Abstract. More than 20 asaphid trilobite forms are described from the Middle Ordovician of the Oslo region. New are: *Ogygiocaris striolata*, *O. striolata corrugata*, *O. sarsi regina*, *O. sarsi delicata*, *Asaphus* (*Neoasaphus*) *heintzi*, *Ogmiasaphus jaanussoni*, *O. kiaeri*, *O. stoermeri*, and *O. multistriatus*.

Ontogenetic stages of *Ogygiocaris sarsi* show that the pygidium becomes relatively narrower during growth, the pygidial axis becomes relatively wider and shorter, and the relative width of the doublure increases both in the pygidium and in the cephalon.

Certain glabellar features in *Ogygiocaris* suggest the presence of three pre-or al segments, A₁, pnt, and X, which all three seem to take part in the formation of the eye lobe.

The deformation of fossils is discussed and the term *L-form* suggested for elongated and/or narrowed forms, *W-form* for shortened and/or widened forms, and *O-form* for specimens preserving the original length/width proportion.

Two new descriptive terms are introduced, *paradoublural line* for a line on the dorsal test directly above and conformable with the inner margin of the doublure, and *band furrow* for the furrow separating the posterior band of the occipital and axial rings from their main part. The term "longitudinal" (long.) is preferred over "exsagittal" (exsag.) and/or "sagittal" (sag.) in relation to directions of measurements.

CONTENTS	page
Abstract	203
Acknowledgements	205
Introduction	205
Remarks on the deformation of fossils	207
Terminology	210
Family Asaphidae BURMEISTER, 1843	211

Notes on ontogenetic variation	211
Notes on some glabellar structures	212
Subfamily Ogygiocaridinae RAYMOND, 1937	213
Genus <i>Ogygiocaris</i> ANGELIN, 1854	213
<i>Ogygiocaris dilatata</i> (BRÜNNICH, 1781)	217
<i>O. striolata</i> n. sp.	221
<i>O. striolata striolata</i> n. sp. & subsp.	222
<i>O. striolata corrugata</i> n. sp. & subsp.	223
<i>O. sarsi</i> ANGELIN, 1878	223
<i>O. sarsi sarsi</i> ANGELIN, 1878	225
<i>O. sarsi regina</i> n. subsp.	227
<i>O. sarsi delicata</i> n. subsp.	228
<i>O. sarsi lata</i> HADDING, 1913	229
Subfamily Asaphinae BURMEISTER, 1843	231
Genus <i>Asaphus</i> BRONGNIART, 1822	231
Subgenus <i>Neoasaphus</i> JAANUSSON, 1953	231
<i>Asaphus</i> (<i>Neoasaphus</i>) <i>heintzi</i> n. sp.	231
<i>A. (N.) ludibundus</i> TÖRNQUIST, 1884	233
<i>A. (N.) cf. ludibundus</i> TÖRNQUIST, 1884	234
<i>A. (Neoasaphus?)</i> sp. A.	235
<i>A. (Neoasaphus?)</i> sp. B.	235
Genus <i>Ogmasaphus</i> JAANUSSON, 1953	235
<i>Ogmasaphus jaanussoni</i> n. sp.	237
<i>O. kiaeri</i> n. sp.	238
<i>O. multistriatus</i> n. sp.	241
<i>O. stoermeri</i> n. sp.	242
<i>Ogmasaphus</i> sp.	244
Genus <i>Pseudoasaphus</i> SCHMIDT, 1901	245
<i>Pseudoasaphus limatus</i> JAANUSSON, 1953	245
<i>Pseudoasaphus</i> sp.	247
Genus <i>Pseudobasilicus</i> REED, 1930	247
<i>Pseudobasilicus cf. kuckersianus</i> (SCHMIDT, 1898)	247
<i>P. cf. kegelensis</i> (SCHMIDT, 1898)	247
<i>Pseudobasilicus?</i> sp.	248
Genus <i>Pseudomegalaspis</i> JAANUSSON, 1953	248
<i>Pseudomegalaspis patagiata</i> (TÖRNQUIST, 1884)	248
<i>Pseudomegalaspis?</i> sp.	251
Subfamily Isotelinae ANGELIN, 1854	251
Genus <i>Isotelus</i> DEKAY, 1824	251
<i>Isotelus cf. platyrhachis</i> STEINHARDT, 1874	251
Present determination of Middle Ordovician asaphids previously recorded from the Oslo region	252
References	254
Known stratigraphical and geographical distribution of Middle Ordovician asaphids in the Oslo region (table)	258
Plates 1–14 and explanation of plates.	

Acknowledgements.

I wish to acknowledge my indebtedness to Professor A. Heinz (Palaeontological Museum of the University of Oslo) and Professor L. Størmer (Palaeontological Department of the Geological Institute of the University of Oslo) for facilitating my study of the Middle Ordovician asaphids of the Oslo region, and to the latter also for having proposed that I undertook this study.

I am also grateful to Dr. V. Jaanusson (Palaeontological Institute of the University of Uppsala) and Dr. N. Spjeldnæs (Palaeontological Museum of the University of Oslo) for the discussion of certain problems.

For the loan of material I am greatly indebted to Professor Chr. Poulsen (Mineralogical Museum of the University of Copenhagen), Professor G. Regnéll (Palaeontological Institute of the University of Lund), Professor E. Stensiö (Palaeozoological Department of the Swedish Museum of Natural History), and Professor P. Thorslund (Palaeontological Institute of the University of Uppsala).

I have great pleasure in thanking Miss B. Mauritz for taking the photographs and Miss I. Lowzow for help with the drawings. The manuscript has kindly been read by Dr. R. D. Morton.

Introduction.

The present paper appears as no. 13 in a series dealing with the Middle Ordovician stratigraphy and fossils of the Oslo region. A team work on this subject was initiated by Professor Leif Størmer in 1950, and is supported by grants from the Norwegian Research Council for Science and Humanities.

The term Middle Ordovician is taken in the sense defined by STØRMER (1953), *i.e.* from and including the Llanvirnian zone of *Didymograptus bifidus* to and including the Caradocian zone of *Dicranograptus clingani*.

As proposed by STØRMER (1953, p. 51; map p. 53), the Cambro-Silurian of the Oslo region is divided into several districts, namely the southern districts Skien—Langesund (previously referred to as Langesund—Gjerpen), Eiker—Sandsvær, and Holmestrand; the central districts Oslo—Asker, Modum, Ringerike, and Hadeland; and the northern (or Mjøsa) districts Toten, Feiring, Hamar—Nes, and Rings-

aker. Some of the districts are further divided into two or more areas, thus the Oslo—Asker district comprises from east to west the Oslo, Bærum, and Asker area.

The first description of a fossil species based on Norwegian material is that of a Middle Ordovician asaphid from the Oslo region, namely *Trilobus dilatatus* (now *Ogygiocaris dilatata*) described by BRÜNNICH in 1781.

Since then, only a few asaphids have been described from the Middle Ordovician of Norway. ANGELIN (1878) erected two subspecies of *Ogygiocaris dilatata*, which were named *sarsi* and *stroemi*. More recently, JAANUSSON (1953) has given descriptions or redescrptions, partly based on material from the Oslo region, of some Middle Ordovician Scandinavian asaphids, *i.e.* *Pseudoasaphus limatus* JAANUSSON, 1953, *Pseudomegalapsis patagiata* (TÖRNQUIST, 1884), and *P. formosa* (TÖRNQUIST, 1884).

Several species described in other countries have so far merely been recorded from the Middle Ordovician of the Oslo region, *e.g.* by BRØGGER from the Skien—Langesund district (1884) and the Oslo area (1887), by HOLTEDAHN (1909) from the Mjøsa district, and by STØRMER (1953) from the whole of the Oslo region.

In the present paper the Middle Ordovician asaphids of the Oslo region are treated monographically. Unfortunately most of the material consists of detached parts of the shield, whereas complete dorsal shields are rare and have not been found in several of the forms. For this reason, and because the preservation is not always too good, there are numerous specimens in the collections which I have not been able to determine, or at the best have only been able to determine with doubt. Some of these specimens suggest that there are more species present than described here. Most probably more species will be recognized when all the districts of the Oslo region have been more thoroughly investigated, and the geographical distribution of the known species may prove to be more extensive than recorded here. It is regrettable that stratigraphical data are inadequate or even missing for many specimens in the collections.

Asaphids from the "transition beds" between the Lower Ordovician Orthoceros limestone and the Middle Ordovician *Ogygiocaris* series have not been included here, since the detailed stratigraphy of these beds has not been fully worked out, and because they may be of

Lower rather than Middle Ordovician age. *Megistaspis* species are rather common in these transition beds. A dorsal shield (P.M.O. no. 72127) from Hornsodden (not Hovodden as previously stated) at Randsfjord, Hadeland, was assigned to *Asaphus* (*Neoasaphus*) *bottnicus* JAANUSSON, 1953 by JAANUSSON (1953a, p. 498) and was mentioned under this name by STØRMER (1953, p. 89). Dr. V. JAANUSSON has kindly informed me (1959) that it actually belongs to an undescribed species, which, however, resembles the somewhat later species *A. (N.) bottnicus*¹. The dorsal shield from Hornsodden was collected 10.6 m above the compact Endoceras limestone, in a sequence of shale and limestone lenses which also yield *Megistaspis* species and thus apparently belong to the transition beds.

The following abbreviations are used in connection with catalogue numbers:

P.M.O. = Paleontologisk Museum, University of Oslo, Norway.

P.I.L. = Paleontologiska Institutionen, University of Lund, Sweden.

P.I.U. = Paleontologiska Institutionen, University of Uppsala, Sweden.

RM. = Palaeozoologiska avdelningen, Naturhistoriska Riksmuseet (Palaeozoological Department, Swedish Museum of Natural History), Stockholm, Sweden.

S.G.U. = Sveriges geologiska undersökning (Geological Survey of Sweden), Stockholm, Sweden.

Remarks on the deformation of fossils.

Just as the enclosing rock, fossils can be deformed by tectonic action. This naturally impedes the interpretation of the original appearance of the fossil. When a fossil is obliquely (asymmetrically) distorted, the distortion is readily recognized as such. More dangerous are the symmetrical distortions, which may be hard to detect. In respect to the orientation of bilaterally symmetrical fossils (like trilobites), one may distinguish between three main types of symmetrical distortion. The one is dorso-ventral compression (flattening). A slight dorso-ventral compression can be difficult to ascertain. Stronger flattening is usually recognized as such, *e.g.* in fossils lying parallel to the bedding planes in shales. Another type of symmetrical distortion is present where length is enlarged in relation to width, either by a stretching along the longitudinal direction of the fossil or

¹ (Cf. also JAANUSSON, 1960, p. 278, footnote 1.)

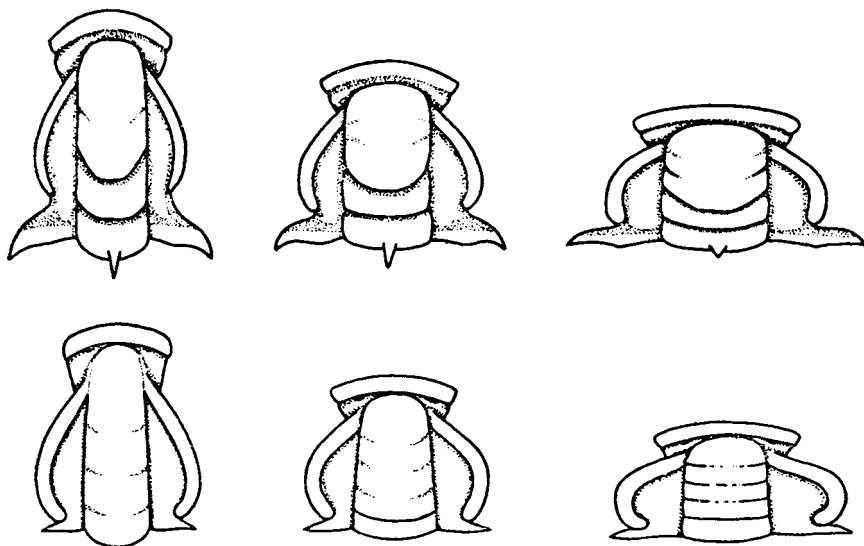


Fig. 1. L-, O-, and W-form of *Saukianda andalusiae* (above) and *Perrector perrectus* (below). The O-forms are restorations, the L- and W-forms are based on actual specimens. After HENNINGSMOEN (1957a).

by a compression normal to it, or both. The third type is present where the width is enlarged in relation to length, in a corresponding manner. The two latter types of symmetrically distorted fossils may be called *L-forms* ("long forms") and *W-forms* ("wide forms"), respectively, as suggested in an earlier paper (HENNINGSMOEN, 1957a, p. 253). Fossils with original length/width proportion may be called *O-forms*. L-, W-, and O-forms may of course be dorso-ventrally flattened.

Palaeontology is rich in examples where L-forms and W-forms of the same species have been taken as showing the original appearance of the fossil, and have been described under different names (cf. HENNINGSMOEN, 1957a). Apparently BARRANDE's "forme longue" and "forme large" of trilobite species merely represent forms differing in their type of deformation, namely L-forms and W-forms, respectively (cf. KIELAN, 1960, p. 41). In some cases O-forms and L-forms or O-forms and W-forms of the same species have been given different names. Dorso-ventrally flattened fossils have less commonly been believed to represent the original appearance.

When describing or comparing fossils it is important to find out whether they are symmetrically distorted, and especially be on guard

for the treacherous L-forms and W-forms. One should be specially cautious in establishing names for forms differing from each other only in length/width proportion. It should also be remembered that other characters than this proportion may differ in L-forms and W-forms of the same species (cf. text fig. 1). Thus ridges normal to the direction of stretching may become much less pronounced or even erased, whereas ridges and furrows normal to the direction of compression may become accentuated, and may even appear in places where they were not developed in O-forms. Furthermore, all angles will be changed in L-forms and W-forms, except right angles with one side parallel to the stretching or compression. Similarly, the convexity of curves and surface will change.

Symmetrical distortion in a fossil may be indicated by the deformation of the rock and also by the associated fossils. The presence of obliquely distorted fossils is important, since they betray the deformation, and what appear to be O-forms probably are L-forms or W-forms. Furthermore, there is good reason for suspecting symmetrical distortion when similar forms oriented normal to each other on a bedding plane have different length/width proportions. A good example of this is shown by the two pygidia of *Ogygiocaris sarsi sarsi* in pl. 4, fig. 5. It may be mentioned that collectors sometimes tend to collect L-forms and W-forms rather than obliquely distorted specimens, since they look undistorted.

When a single L-form or single W-form is present, it is difficult to establish the original length/width proportion of the fossil. When both L-forms and W-forms are present, the original proportion can be calculated in some cases.

When it can be assumed that an L-form and a W-form had the same length/width proportion (P) before the deformation, and that the degree of deformation is the same in both, we have:

$$P = \frac{L'}{W'} \frac{X}{Y} \text{ and } P = \frac{L''}{W''} \frac{Y}{X}$$

Where L' and W' are the length and width of the L-form, L'' and W'' the length and width of the W-form, and X and Y denote the lengthening (or shortening) factors.

From this we have that:

$$P = \sqrt{\frac{L' L''}{W' W''}}$$

To be able to assume that the degree of deformation is the same when only one L-form and one W-form are present, they should be in close proximity in the rock (as in the example mentioned above), since the deformation of the rock (and thus of the fossils) may vary over short distances. When a large number of L-forms and W-forms are present, the most extreme L-forms and the most extreme W-forms may be assumed to have the same degree of deformation. Since the length/width proportion may vary during ontogeny, the L-form and W-form used for calculating P should be chosen among specimens which may assumed to have had about the same original size.

Terminology.

On the whole I follow the terminology suggested in volume *O* of the Treatise on Invertebrate Paleontology, except that the term *glabella* is used in its original sense, *i.e.* including the occipital ring. Furthermore the symbols $S1$, $S2$, etc. and $L1$, $L2$, etc. are used for the glabeller furrows and lobes, respectively, counted from the rear (cf. JAANUSSON, 1956; HENNINGSMOEN, 1957). The terms *paradoublural line* and *band furrow* are new. The paradoublural line is a line on the dorsal test and lies directly above the inner margin of the doublure, with which it is conformable. It may be developed as a furrow, a more or less step-like flexure, or as a faint ridge. When present, it is usually better developed in the free cheeks (text fig. 5) and pygidium (pl. 2, fig. 6). The occipital ring is in some cases divided transversely by a forwards more or less convex furrow into the main part of the ring and a posterior band, widest in the median line. This band has been termed the «posterior band of the occipital ring» in the Treatise on Invertebrate Paleontology. Since the thoracic rings may show the same features, the term *posterior band* may be used for these rings, too. The furrow separating the posterior band from the main part of the ring, I propose to call the *band furrow*. Apparently it is located directly above the anterior margin of the articulating half ring of the succeeding axial ring. It was referred to as the transversal line by STØRMER (1942,

text fig. 14) and as the curving furrow by HENNINGSMOEN (1957, text fig. 1).

Where it is not obvious in which direction length and width are measured, (*tr.*) is added for transverse measurements, which are taken along lines transverse to the whole dorsal shield, and (*long.*) is added for longitudinal measurements, whether taken along the median line (sagittal line of some authors) or along a line parallel to it on either side (exsagittal line of some authors, sagittal line of others.) The same procedure has recently been suggested by KIELAN (1960, p. 6).

Longitudinal measurements of thorax and pygidium do not include the parts hidden in an outstretched dorsal shield (*i.e.* articulating half ring), even in a detached pygidium for example. This is done to facilitate comparison of lengths of *e.g.* a detached pygidium and a pygidium in a complete dorsal shield.

Family Asaphidae BURMEISTER, 1843.

NOTES ON ONTOGENETIC VARIATION

JAANUSSON (1953, p. 390) has shown that in *Asaphus* (*Neoasaphus*) *lepidus* TÖRNQUIST, 1884 the increase of height of the eyes in relation to the length of the cephalon is distinctly positively allometric ($k = 1.13$), whereas the length of the eyes shows a negative allometry ($k = 0.47$) and the height of the visual surface of the eye is isometric. Furthermore he shows that in *A.* (*Neoasaphus*) *ludibundus* TÖRNQUIST, 1884 there is a distinct negative allometry in all three cases. This shows that the size of the eye in relation to that of the cephalon cannot be used as a characteristic without taking into account the ontogenetic stage.

As pointed out to me by Dr. V. JAANUSSON, the relative widths of the pygidial and thoracic axes increase with growth in *A.* (*Neoasaphus*) *ludibundus*, as is also evident from his measurements (JAANUSSON, 1953, p. 405).

Due to the distortion, which may be greater or smaller but has affected most specimens, the present material does not lend itself readily to statistical investigations. However, ontogenetic stages of the pygidium of *Ogygiocaris sarsi* show that there is a very distinct increase in the length/width proportion of the pygidium, and a distinct increase of the relative width of the pygidial axis during growth (pl. 6, figs.

6–10, 12; pl. 5, figs. 1–2). Also the relative width of the doublure increases with size, both in the pygidium and in the cephalon (and apparently also in the thorax). Since the pygidial axis reaches as far back as the inner margin of the doublure, the relative length of the axis as a consequence decreases with growth.

NOTES ON SOME GLABELLAR STRUCTURES

The trilobite glabella (including the occipital ring) in many cases show traces of the segmentation. In several trilobites the occipital furrow (SO) and 4 glabellar furrows or pairs of furrows (S1–S4) are present, separating the occipital ring (LO), 4 glabellar lobes (L1–L4), and a frontal glabellar lobe (or anterior lobe). L0–L3 have been interpreted as representing the postoral segments; L4 and the frontal lobe the preoral segments (cf. *e.g.* STØRMER, 1942, p. 123). L4 is usually regarded as the axial portion of the antenullar segment (A_1). Following HUPÉ (1953), two other segments may be distinguished in front of A_1 in some trilobites, namely the preantennular segment (pnt) and the segment X.

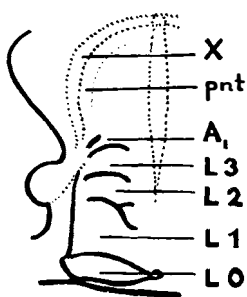


Fig. 2. Interpretation of segmentation of glabella of *Ogygiocaris*.

Better preserved specimens of *Ogygiocaris dilatata* and *O. sarsi* seem to show at least traces of all these segments. Thus the parafrontal band would correspond to the segment X, which is separated from the rest of the glabella by the shallow parafrontal furrow. In *O. sarsi* the parafrontal band (text fig. 5) is rather flat and confluent with the cheek areas, whereas the part of the glabella inside the parafrontal furrow is rather convex and might be taken as the whole of the glabella. In *O. dilatata*, however, the parafrontal band is more clearly a part of the glabella. The preantennular segment (pnt) is delimited by the parafrontal furrow in front and at the sides by the short S4. In some specimens

there is a very faint furrow inside and parallel to the parafrontal furrow, possibly representing the boundary between pnt and A_1 and apparently constituting a continuation of the short but more distinct S4 (text fig. 2).

It appears that segments A_1 , pnt, and possibly X take part in the formation of the eye lobe in *Ogygiocaris*, as is also suggested by HUPÉ (1953) for some Cambrian trilobites.

The parafrontal band is visible in some other asaphids as well, e.g. in *Pseudobasilicus? brachyrhachis* (cf. JAANUSSON, 1953, pl. IX, fig. 1).

A pair of longitudinal furrows, or rather rows of impressions, one on each side of the median line (cf. p. 219) may possibly represent the places of attachment of a ligamentary suspensory (of the heart?) and may be compared with an unpaired, median line of impressions in *Nileus armadillo* DALMAN, described by MOBERG in 1902 (cf. also HUPÉ, 1953, and HARRINGTON in Treatise on Invertebrate Paleontology, p. O101). The area between the two furrows in *Ogygiocaris* is almost ridge-like in some specimens (even in such retaining the original convexity). Similar structures occur in several other asaphids, e.g. *Pseudoasaphus aciculatus* (cf. JAANUSSON, 1953, pl. IV, fig. 3) and *Ogmasaphus praetextus* (l.c., pl. V, fig. 4). Some well preserved cranidia of *Ogygiocaris dilatata* and *O. sarsi* show patches with extremely fine furrows, probably representing areas of attachment.

SUBFAMILY OGYGIOCARIDINAE RAYMOND, 1937

Genus *Ogygiocaris* ANGELIN, 1854

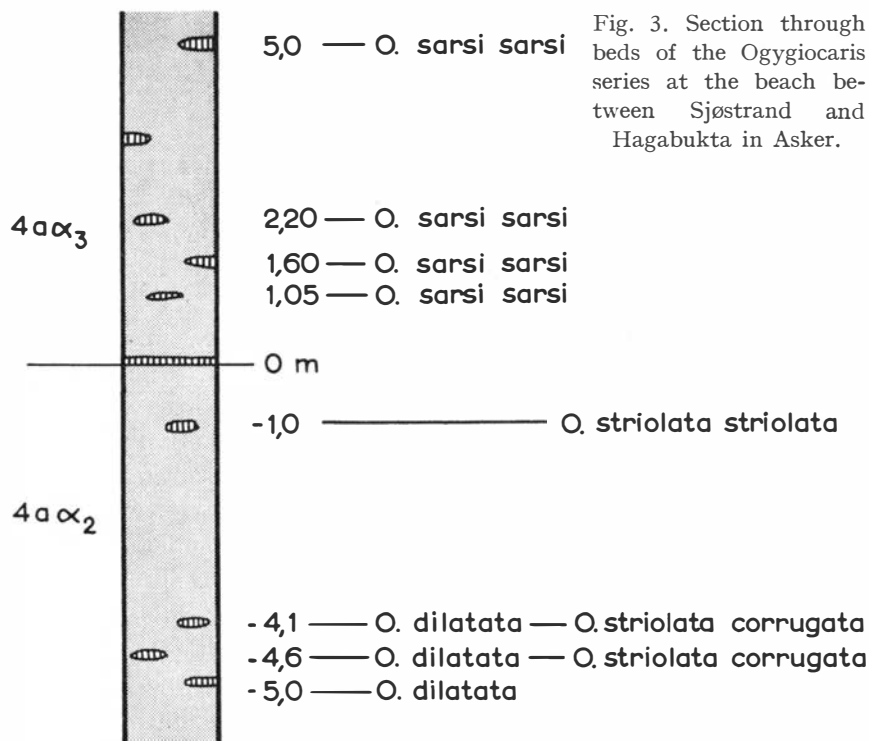
Type species: — *Trilobus dilatatus* BRÜNNICH, 1781 (pending ICZN, cf. below).

Remarks on name: — The generic name *Ogygiocaris* was published by ANGELIN (1854, p. 92). Although he listed *Ogygia* BRONGN. as a synonym, it is not quite clear whether he regarded *Ogygiocaris* as a substitute name for the supposedly preoccupied generic name *Ogygia* BRONGNIART in BRONGNIART & DESMAREST (1822), or as a new generic name for a group of species including *i.a.* *Trilobus dilatatus* BRÜNNICH, 1781. It has been proposed to the ICZN to use its Plenary Powers to give a ruling that the latter is the case, and that the type species of *Ogygiocaris* is *Trilobus dilatatus* BRÜNNICH, 1781.

Delimitation of genus: — The dainty pygidia of *Ogygiocaris* are often sent in to the Palaeontological Museum in Oslo as "fossil butterflies". Actually the pygidium seems to be the most characteristic part of *Ogygiocaris*, as restricted below. All the Scandinavian species

of *Ogygiocaris* have in common the unusual, distinctly wavy inner margin of the pygidial doublure and the similarly wavy paradoublural line on the dorsal test of the pygidium. I suggest to restrict the genus *Ogygiocaris* to those species which show these characteristics. This means that the genus *Ogygiocaris* apparently has not been recorded outside Scandinavia, except in drift boulders from Scandinavia in N. Germany. *Ogygiocaris araiorhachis*, described from the Arenigian of Argentina by HARRINGTON & LEANZA (1957, p. 157), does not seem to show these features and should consequently be excluded from the genus, with which, however, it probably is related. Much the same can be said about *Ogygiocaris*? *plana* and *O.*? *inflexicostata* described from the Arenigian of France by THORAL (1946). The specimen described by RICHTER & RICHTER (1937, p. 302) as *Ogygiocaris*? sp. and mentioned by them again in 1954 (p. 14) from the Caradocian in Germany is a 5 mm long larval form whose affinities are uncertain. *Ogygia dilatata plautini* and *O. dilatata panderi*, both erected by SCHMIDT (1904, pp. 59, 62), have previously been excluded from the Asaphidae. The former was assigned to *Stygina* by SKJESETH (1955, p. 14). The latter form was made the type of the genus *Homoglossa* by RAYMOND in 1912. This genus is now regarded as a synonym of the styginid genus *Bronteopsis*, to which also *Ogygia*? *concentrica* LINNARSSON, 1869 is now assigned (cf. THORSLUND, 1940, p. 139 and SKJESETH, 1955, p. 16). The form assigned to *Ogygiocaris concentrica* (LINNARSSON) by FUNKQUIST (1919, p. 10) has later been described by SKJESETH (1955, p. 17) as *Bronteopsis holtedahli*. The only undoubted members of *Ogygiocaris* appear to be those described below.

Stratigraphical range of species; — A single fragment of an *Ogygiocaris* pygidium has been reported from the transitional beds between the Endoceras limestone (3c γ) and the *Ogygiocaris* series (4aa) near Furnes Church in Nes, Hamar-Nes (cf. STØRMER, 1953, p. 102). In Eiker-Sandsvør *Ogygiocaris dilatata* appears in 4aa₁ and occurs also in 4aa₂ as well as in the upper part of the *Ogygiocaris* series and apparently in the basal beds of the overlying Ampyx limestone (4a β) (cf. STØRMER, 1953, pp. 72–73). In a section through the *Ogygiocaris* series along the beach between Sjøstrand and Hagabukta in Asker (text fig. 3), *O. dilatata* occurs in a horizon of limestone lenses in 4aa₂, 5 m below a continuous, thin limestone bed which may be regarded as being the basal bed of 4aa₃. However, graptolites are few in this



section, and the graptolite succession has not been worked out. Two other horizons of limestone lenses, 4.6 m and 4.1 m below this continuous limestone bed, contain *O. dilatata* associated with *O. striolata corrugata* n. subsp. and *Pseudomegalaspis patagiata*, whereas a limestone lens only 1 m below contained *O. striolata striolata* n. subsp. alone. The continuous limestone bed yielded no specimens of *Ogygiocaris*, but *O. sarsi sarsi* occurs in a horizon of limestone lenses 1.05 m above it and is very common up to about 5 m above the assumed base of 4aα₃ at this locality. Higher up the section is disturbed by faults. A section through the same beds is exposed slightly further north, at the southern shore of the peninsula of Elnestangen. Here, *O. striolata corrugata* and *O. dilatata* have been found in loose limestone lenses from 4aα₂, and *O. striolata striolata* in a lens 1 m below the thin, continuous limestone bed which is regarded as the base of 4aα₃. This bed

yielded *O. sarsi sarsi*, which is very common all through 4aa₃, here about 14 m thick. *O. dilatata* and *O. striolata corrugata* reoccured in a limestone lens, apparently in situ, 3.5 m above the base of 4aa₃. The section continues up through the beds with *Trinucleus bronni* (4aa₄) and the overlying Ampyx limestone (4aβ). A 9 cm thick cross-bedded arenaceous limestone is regarded as the basal bed of 4aa₄, which is about 12 m thick. *O. sarsi sarsi* was found 4 m above the base of 4aa₄ and fragments of *O. sarsi* occurred even higher up, but were not well enough preserved to allow a determination of the subspecies, except for a single cranidium of *O. sarsi delicata* n. subsp. Poorly preserved specimens of *O. sarsi* have been found in the lowermost beds of the Ampyx limestone at other localities. Whereas *O. dilatata* apparently ranges all through the Ogygiocaris series (4aa) in the Eiker-Sandsvær district, *O. sarsi* seems to be a vicarious form in the upper part of the series in the central and northern districts of the Oslo region (cf. STØRMER, 1953, p. 120), where the shale is darker. It has not been possible for me to determine the stratigraphical relationship between *O. sarsi sarsi*, *O. sarsi regina*, and *O. sarsi delicata*, but there are indications that the two latter appear later than *O. sarsi sarsi*. Besides the specimen of *sarsi delicata* mentioned above, this subspecies has been found in situ on Helgøya (Hamar-Nes) just below the horizon with small limestone nodules between the shale with *Ogygiocaris* and the overlying Cephalopod shale as well as in the Cephalopod shale itself, whereas *O. sarsi sarsi* occurs further down. If we arrange the forms of *Ogygiocaris* according to the width of the doublure, *O. dilatata* has the widest doublure, and it becomes progressively narrower in *O. striolata*, *O. sarsi sarsi*, *O. sarsi regina*, and *O. sarsi delicata*. It is tempting to assume that they appeared in this order, and that narrowing of the doublure was connected with the adaption to the rather poorly ventilated conditions under which the darkest Ogygiocaris shales were deposited. *O. sarsi* has been found as far down as in 4aa₁, 150 cm above its base, in black shales in Oslo—Asker. Unfortunately the specimens are not well enough preserved to allow a determination of the subspecies. *O. sarsi lata* has only been found in the dark Ogygiocaris shale of Andersön in Jämtland, Sweden. It is possible that this shale is somewhat younger than the Ogygiocaris shales in Norway and that *Ogygiocaris* survived longer there than in the Oslo region.

Ogygiocaris dilatata (BRÜNNICH, 1781)

Pl. 1, figs. 1–7; pl. 2, figs. 1–6; text. fig. 4.

- 1781 *Trilobus dilatatus* — BRÜNNICH, p. 393. (Descr.)
- 1817 *Asaphus debuchianus* n. sp. — BRONGNIART in DESMAREST.
(Descr. based on material from Eiker, Norway.)
- 1822 *Asaphus debuchii* (pars) — DESMAREST, p. 20. (Material from Eger = Eiker in Norway mentioned, not figured.)
- 1827 *Asaphus dilatatus* — DALMAN, p. 272 (reprint, p. 87), pl. III, fig. 1. (Remarks on and short descr. and fig. of BRÜNNICH's original.)
- 1835 *Asaphus dilatatus* DALM. (pars) — SARS, p. 336. (Not the figures, which are of *O. sarsi*.)
- 1838 *Trilob[ites] dilatatus* BRÜN. (pars) — BOECK in KEILHAU, p. 141. (Mentioned.)
- 1854 *Ogygiocaris dilatata*. BRÜNN. (pars) — ANGELIN, p. 92. (Descr. It has not been possible for me to find a copy of this paper with the original pl. XLII, only the revised pl. XLII of the 1878 Appendix. Consequently I cannot say whether figs. 2a–c in the original pl. XLII were of *O. dilatata* or *O. sarsi*.)
- 1878 *Ogygiocaris dilatata*. BRÜNNICH, genuina — ANGELIN, p. 96, pl. XLII, fig. 2. (Diagn. Fig. of dorsal shield, apparently the specimen described by BRÜNNICH.)
- 1878 *Ogygiocaris dilatata*. var. *Stromi*. ANG. — ANGELIN, p. 96 pl. XLII, fig. 2*. (Diagn. Fig. of dorsal shield without free cheeks.)
- 1886 *Ogygia dilatata*, BRÜNN., genuina — BRØGGER, p. 54, pl. III, fig. 39. (Remarks, fig. of hypostome.)
- 1887 *Ogygia dilatata* BRÜNN. (pars) — BRØGGER, pp. 16, 17. (Recorded. Most specimens belong to *O. sarsi*.)
- 1953 *Ogygiocaris dilatata* forma typica — STØRMER, p. 120 e.a., pl. 1. (Remarks on distribution in Norway. Fig. of slab surface with one almost entire dorsal shield and parts of others.)

Type data: — BRÜNNICH (1871) had several specimens at hand when he described this species, but based his description on a single dorsal shield. As lectotype I select an almost complete dorsal shield (pl. 1 fig. 1) preserved in the Mineralogical and Geological Museum of the University of Copenhagen, Denmark. The accompanying label does not state that it is the specimen on which BRÜNNICH based his description, but this can hardly be doubted. Its dimensions agree with those given by BRÜNNICH, and an old plaster cast of the specimen, preserved in the Department of Paleozoology of the Swedish Museum of Natural History, Stockholm, Sweden, bears an inscription on the reverse stating that the original is from Fossum Iron Works in Norway

and belongs to Mr. Spengler in Copenhagen, just as stated by BRÜNNICH. DALMAN's rough drawing (1872, pl. 3, fig. 1) of *Asaphus dilatatus* apparently is based on the same specimen. Thus his drawing shows only 7 thoracic segments, which can readily be explained since the 8th. thoracic segment of the lectotype is telescoped over the slightly displaced pygidium, and is partly broken away.

The lectotype occurs in a hard, slightly (contact) metamorphosed dark shale (no doubt from the *Ogygiocaris* series) in the vicinity of Fossum in the Skien area of the Skien—Langesund district. The lectotype appears to be somewhat flattened. It is 10.5 cm long at the axial line and has maximum width of 8.4 cm.

Diagnosis: — A species of *Ogygiocaris* with the following characteristics: Pygidial margin with distinct posterior incurvation. Dorsal surface of pygidium with relatively openly spaced terrace lines. Pygidial doublure with openly spaced terrace lines and about half as wide as pleural regions in front. Cephalic doublure more than 4/5 as wide as distance from eye to cephalic margin.

Description: — Exoskeleton moderately convex, isopyguous, and with subelliptical outline. About 1.3 times as long as wide.

Cephalon subsemicircular, with genal spines, with isoteliform type of facial sutures, and with median suture across the doublure.

Cranidium with dominating, moderately convex glabella and rather flat cheek areas. Glabella (including occipital ring) about 1.4 times as long as wide, with slightly key-hole-shaped outline, and well defined laterally by dorsal furrows, but not along anterior lobe, where only a more or less distinct bend delimits the glabella. Occipital ring with distinct posterior band furrow. Each half of the occipital furrow deepest in the middle and slightly convex forwards, outer ends not reaching dorsal furrow except as very faint impressions, inner ends of the two halves meeting the posterior band furrow medially, just behind small glabellar node, which has a rather posterior position. Glabellar furrows shallow and poorly defined. None of the furrows are connected across the glabella and they do not reach the dorsal furrow except as very faint depressions. S1 obliquely S-shaped. S2 slightly convex forwards, on the whole directed slightly backwards and inwards. S3 slightly convex forwards, on the whole transverse. S4 short, oblique forwards and inwards. There is a faint furrow slightly inside and parallel to the margin of the anterior lobe, separating a parafrontal band. Two

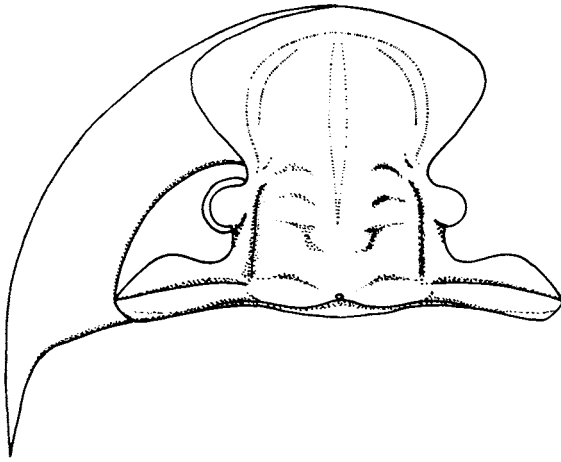


Fig. 4. Schematic reconstruction of cranidium and left free cheek of *Ogygiocaris dilatata*.

very faint furrows are situated close to each other on each side of the median line from the anterior end of the glabella to more than half-way on the glabella backwards. Especially in compressed specimens the area between these two longitudinal furrows may appear as a faint ridge. The furrows in question seem to be formed by a row of faint pits or rather short transverse depressions. Postocular cheek areas $3/4$ as wide (tr.) as occipital ring. Postocular incurvation opposite L1. Interocular cheek areas very narrow. Preocular incurvation opposite S4. Palpebral lobes relatively small, semicircular. Preocular cheek areas up to about $1/2$ as wide as postocular cheek areas. Frontal area relatively short. Anterior margin slightly pointed medially. Free cheeks wide, genal spines stout and confluent with margin. Distinct paradoublural line. Eyes holochroal. Cephalic doublure wide, more than $4/5$ as wide as distance from eye to cephalic margin. Dorsal surface of cephalon with distinct terrace lines parallel to margin, on the free cheeks as far in as the paradoublural line, on the cranidium only close to the margin. Doublure with distinct terrace lines subparallel to margin. No panderian openings.

Hypostome subrectangular, only slightly longer than wide, and with bluntly pointed posterior margin. Border relatively narrow. Maculae and terrace lines distinct.

Thorax with 8 segments. Axial rings with posterior band furrow and a pair of poorly defined knob-like elevations in front of it. Pleurae less than twice as wide (tr.) as axial rings. Dorsal furrow distinct. Fulcrum located at about $2/5$ the distance from dorsal furrow. Pleural furrows distinct, reaching $2/3$ across pleurae from dorsal furrow. Outer $1/3$ of pleurae with terrace lines subparallel to anterior and posterior margin of pleurae. Pleural tips falcate. Pleural doublures rather wide (tr.), with concave inner margin, but without any special panderian opening, and with terrace lines subparallel to outer margin of thorax.

Pygidium subsemielliptical in outline, with small but distinct incurvation posteriorly, and about 1.4 times as wide as long. Pleural regions about twice as wide as axis. Axis tapering backwards, not reaching posterior margin, and with slightly concave sides. Axis with 9 distinct axial rings and a posterior part with two indistinct axial rings and an endlobe. Pleural regions with 9 pleural furrows, the posterior one rather indistinct, all terminating well inside the margin. Pleural ribs faintly furrowed by the interpleural furrow in some specimens. The pleural ribs and furrows give the surface a corrugated appearance. Paradoublural line distinct and developed as a bend, along which the adaxial part of the surface is slightly depressed in relation to the abaxial part. Paradoublural line distinctly undulating, being closest to the axis on the ribs, and closest to the margin in the pleural furrows. Anteriorly the paradoublural line and the inner margin of the doublure are situated about halfway between axis and margin, and progressively nearer to axis rearwards, reaching axis slightly anterior to terminal lobe. Dorsal surface with relatively openly spaced and rather distinct and more or less transverse terrace lines on the border area outside the paradoublural line and in the pleural furrows inside this line as well as on the posterior half on the axial rings. Doublure wide, with undulating inner margin, and with relatively openly spaced terrace lines subparallel to outer margin, except near inner margin where they are progressively more undulating adaxially. Pygidium with somewhat flattened border.

Remarks: — Most of the material assigned to *Ogygiocaris dilatata* is from the Eiker—Sandsvær district. The lectotype is from the Skien area and its pygidium seems to differ from that of the common Eiker—Sandsvær form in being wider and shorter. However, the lectotype is

rather flattened and may also be somewhat foreshortened. The pygidia from Eiker—Sandsvær have their convexity better preserved in most cases, but some are similar to the pygidium of the lectotype. For this reason I believe that the material from the two districts belong to the same form. Since ANGELIN's *Ogygiocaris dilatata* var. *Strömi* is similar to the Eiker—Sandsvær material, it becomes a synonym of *Ogygiocaris dilatata* (*dilatata*).

Dimensions: — The present material apparently includes only holaspide specimens. The smallest entire dorsal shield is 9.6 cm long, the largest 13.2 cm long. Fragments of larger specimens indicate that the dorsal shield may have attained a length of about 18 cm.

Occurrence: — *Ogygiocaris dilatata* occurs in the *Ogygiocaris* series (4aa) and possibly also in the lowermost beds of the overlying Ampyx limestone (4aβ) (cf. also p. 216). It is extremely common in certain horizons in the Eiker-Sandsvær district and rather rare further north. OSLO—ASKER: Huk on Bygdøy, Hjortnestangen and Lille Frøen in Oslo; Engervik (4aa₂) and Elnestangen (4aa₂) in Asker; East of southern shore of Holsfjord, Lier. — SKIEN—LANGESUND: Fossum, Bø north of Skien; Brevik station; Skinnviktangangen near Langesund. — EIKER—SANDSVÆR: Muggerudkleiva in Sandsvær; Krekling; Vestfossen. — MODUM. — RINGERIKE: Gomnes; Trøgstad in Norderhov.

Ogygiocaris striolata n. sp.

Name: — From Latin *striola*, diminutive of *stria*, furrow, line, stripe, alluding to the extremely thin and densely spaced terrace lines on the outer surface.

Type data: — See under *O. striolata striolata* n. subsp.

Diagnosis: — An *Ogygiocaris* species with extremely fine and densely spaced terrace lines on the outer surface. Cephalon resembling that of *O. dilatata*. Posterior margin of pygidium without terminal incurvation, but may be terminally truncated. Paradoablural line in the anterior part of the pygidium closer to margin than to dorsal furrow.

Description, Dimensions, Occurrence: — See under the two sub-species.

Remarks: — Except for the characteristic ornamentation of fine terrace lines, *O. striolata* is morphologically intermediate between *O. dilatata* and *O. sarsi*. The cephalon of *O. striolata* is rather similar

to that of *O. dilatata*, whereas the pygidium resembles more that of *O. sarsi*, both in the position of the paradoublural line and in not having a terminal incurvation. The pygidium of *O. striolata corrugata* resembles, however, the pygidium of *O. dilatata* in the roundness of the ribs, and has a truncated posterior margin, which may be regarded as intermediate between the incurved condition in *O. dilatata* and the predominantly evenly convex posterior margin in *O. sarsi*. The pleural ribs of *O. striolata striolata* are flattened, resembling more those of *O. sarsi*. In agreement with this, *O. striolata striolata* appears to be slightly younger than *O. striolata corrugata*.

Ogygiocaris striolata striolata n. subsp.

Pl. 3, figs. 4—10.

Type data: — Holotype is a pygidium (P.M.O. no. 72108 with counterpiece P.M.O. no. 72116) from the top of 4aa₂ between Sjøstrand and Hagabukta in Asker. Collected by G. Henningsmoen 1958.

Diagnosis: — An *Ogygiocaris* form with densely spaced terrace lines, both on the outer surface and on the doublure. Cephalon resembling that of *O. dilatata*. Pygidium resembling that of *O. sarsi*, with flattened pleural ribs and without terminal indentation.

Description: — Cranidium imperfectly known, apparently rather similar to that of *O. striolata corrugata* n. subsp. An incomplete free cheek shows that the paradoublural furrow is located about midway between the eye and the lateral border. Genal spine probably present. The hypostome resembles that of *O. sarsi*, but has finer terrace lines. Thorax unknown. Pygidium rather similar to that of *O. sarsi sarsi*, with evenly convex posterior margin, flattened pleural ribs, and paradoublural line markedly closer to lateral margin than to dorsal furrow in the anterior half of the pygidium. Densely spaced terrace lines, in a holaspide pygidium 4.1 cm long about 50 terrace lines pr. cm on the outer surface, and about 20 pr. cm on the doublure. Fine terrace lines are developed also on parts of the surface of the cranidium and free cheeks.

Dimensions: — Only a few specimens have been collected of this subspecies. The largest pygidium is about 7 cm wide (restored) and 4.1 cm long, indicating an overall length of the dorsal shield of about 10.5 cm.

Occurrence: — OSLO—ASKER: Between Sjøstrand and Hagabukta in Asker; Fornebu in Bærum. — RINGERIKE: Beach at Gomnes.

Horizon: — Cf. p. 215.

Ogygiocaris striolata corrugata n. subsp.

Pl. 3, figs. 1—3, 11.

Name: — From Latin *corrugata*, corrugated, alluding to the corrugated appearance of the pygidium.

Type data: — Holotype is an incomplete pygidium (P.M.O. no. 72134) from the top of 4aa₂ between Sjøstrand and Hagabukta in Asker. Collected by G. Henningsmoen 1958.

Diagnosis: — An *Ogygiocaris* form with fine and densely spaced terrace lines on the outer surface and rather openly spaced terrace lines on the doublure. Cephalon resembling that of *O. dilatata*. Pygidium with truncated posterior margin and with rather convex cross section of pleural ribs.

Description: — Cranidium resembling that of *O. dilatata*, but with very short (long.) preglabellar field and with smaller and narrower (tr.) preocular cheek areas. Free cheeks, hypostome, and thorax unknown. Pygidium resembling that of *O. striolata striolata* n. subsp. but with a more convex cross section of the pleural ribs, which are slightly inflated outside the paradoublural line, and with a truncated posterior margin. In a holaspid pygidium 3.9 cm long there are about 30 terrace lines pr. cm on the outer surface and about 20 pr. cm on the doublure. Also the cranidium is ornamented with densely spaced terrace lines on the outer surface.

Dimensions: — Only a few specimens have been collected. The largest pygidium is about 4 cm long, indicating an overall length of the dorsal shield of about 10.5 cm.

Occurrence: — OSLO—ASKER: Between Sjøstrand and Hagabukta, and at Elnestangen in Asker.

Horizon: — Cf. pp. 215, 216.

Ogygiocaris sarsi ANGELIN, 1878.

Remarks: — This species has hitherto been regarded as a subspecies of *Ogygiocaris dilatata*. I have preferred to recognize *O. sarsi* as a

separate species, partly because I have seen no transitional forms between it and *O. dilatata*, and partly because 4 subspecies can be distinguished within *O. sarsi*, all of which having certain features in common, which differ from those in *O. dilatata*.

Synonyms: — See under the different subspecies.

Type data: — See under *Ogygiocaris sarsi sarsi*.

Diagnosis: — An *Ogygiocaris* species without or with very faint posterior incurvation of the pygidial margin, with the paradoublural line anteriorly closer to the axis than to the margin of the pygidium, with the cephalic paradoublural line located at less than 4/5 the distance from margin to eye, and with relatively densely spaced terrace lines.

Description: — *Ogygiocaris sarsi* resembles on the whole *O. dilatata*, but differs in the following features. The glabella is narrower (about 1.7 times as long as wide) and more pointed in front. The postocular cheek areas are as wide as or wider (tr.) than the occipital ring, and the preocular cheek areas are also wider than in *O. dilatata*. The doublures are narrower in *O. sarsi*. The cephalic paradoublural line is closer to the margin in *O. sarsi*, and so is the pygidial paradoublural line, which anteriorly is located closer to the margin than to the axis. The pygidium has no or only a faint posterior incurvation in the margin. The terrace lines are on the whole more densely spaced in *O. sarsi* and less disconnected on the dorsal surface of the pygidium. Furthermore they usually cover the pleural ribs but are absent or poorly developed in the pleural furrows. The location (or absence) of the paradoublural line in the cephalon provides the best means of distinguishing the different subspecies of *O. sarsi*, whereas the pygidia are rather similar.

Dimensions: — See under the different subspecies. On the whole, *O. sarsi* is noticeably smaller than *O. dilatata*, although certain individuals may have reached a comparable size, and the subspecies *regina* may have attained an even larger size.

Remarks on ontogeny: — Small pygidia (of all subspecies) are relatively wider and shorter and have a narrower doublure than large pygidia, and their axes are relatively narrower. The axis reaches further back in small pygidia. The smallest pygidia have a rather evenly curved outer margin, whereas large pygidia tend to have a faintly triangular outline. During growth, the pygidia thus become relatively narrower and longer, the pygidial axis and the doublure

become relatively wider, the axis becomes relatively shorter, and the outline of the pygidium becomes more triangular. In the cephalon, the glabellar furrows are better defined in small specimens.

Occurrence: — *Ogygiocaris sarsi* occurs in Norway in the Ogygiocaris series and in the lowermost beds of the overlying Ampyx limestone. NORWAY: Oslo region and adjacent districts to the northwest and northeast (for details, see under each subspecies.) — SWEDEN: Öland, Västergötland, Jämtland.

Ogygiocaris sarsi sarsi ANGELIN, 1878

Pl. 4, figs. 1–10; text fig. 5.

- 1835 *Asaphus dilatatus* DALM. (pars) — SARS, p. 336, pl. VIII, figs. 5a–b, pl. IX, fig. 11. (Descr., figs. of cephalon, pygidium, and hypostome.)
- 1838 *Trilob[ites] dilatatus* BRÜN. (pars) — BOECK in KEILHAU, p. 141. (Mentioned.)
- 1854 *Ogygiocaris dilatata*. BRÜNN. (pars) — ANGELIN, p. 92. (cf. synonymy list of *O. dilatata*.)
- 1878 *Ogygiocaris dilatata*. var. *Sarsi*. ANG. — ANGELIN, p. 96, pl. XLII, figs. 1, 1a–c. (Diagn. Figs. of dorsal shield, hypostome and side view of cephalon.)
- 1886 *Ogygia* (*Ogygiocaris*, ANG.) *dilatata*, BRÜNNICH, var. *Sarsi*. ANG. — BRØGGER, p. 53, pl. III, fig. 38. (Descr. and fig. of hypostome.)
- 1887 *Ogygia dilatata*, BRÜNN. (pars) — BRØGGER, p. 16, 17. (Recorded. Most specimens belong to *O. sarsi*.)
- 1898 *Ogygia dilatata*, var. *Sarsi* ANG. — BJØRLYKKE, p. 24, fig. on p. 25. (Mentioned. Reduced reproduction of ANGELIN's fig. of dorsal shield.)
- 1901 *Ogygia dilatata* var. *Sarsi* ANG. — LINDSTRÖM, p. 63, pl. V, figs. 27–28. (Descr. and figs. of hypostome.)
- 1940 *Ogygiocaris dilatata* (BRÜNNICH) — STØRMER, p. 125, text fig. 3; figs. 5a–b. (Mentioned. Reproduction of SARS' figs.)
- 1940 *Ogygiocaris dilatata* (BRÜNN.) — GRØRUD, pp. 158–160. (Recorded.)
- 1953 *Ogygiocaris dilatata sarsi* (pars) — STØRMER, p. 12. (Remarks on distribution in Norway of *O. sarsi*. The fig. on pl. 2 is of *O. sarsi regina* n. subsp.)

Type data: — The specimen figured by ANGELIN (1878) has not been located. As neotype I select a specimen collected by M. SARS and believed to be the original of his drawing (P.M.O. no. 20287 and counterpiece no. 20288). If ANGELIN's drawing is a reconstruction, it may in part be based on this specimen. The neotype occurs in dark limestone from the Ogygiocaris series, no doubt from the Ogygiocaris shale s.s. (4aa₃), from Hjortnestangen in Oslo.

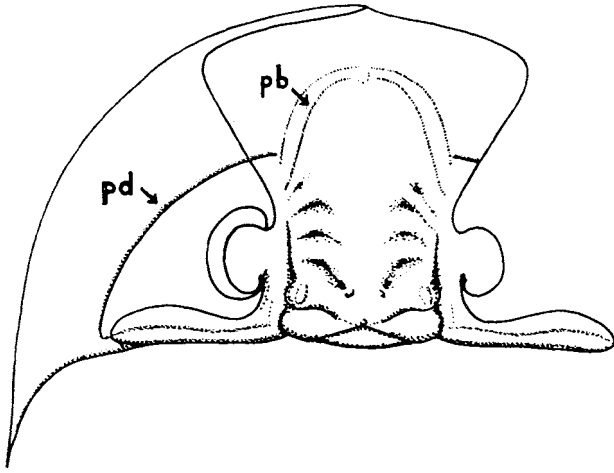


Fig. 5. Schematic reconstruction of cranidium and left free cheek of *Ogygiocaris sarsi sarsi*. pb = parafrontal band, pd = paradoublural line.

Diagnosis: — A subspecies of *Ogygiocaris sarsi* with the cephalic paradoublural line closer to eye than to margin and with frontal area longer (long.) than occipital ring.

Description: — The main differences from *Ogygiocaris dilatata* are pointed out under the description of *O. sarsi*. The paradoublural line on the cephalon is located at about 1/4 the distance from eye to margin, and is present also on the cranidium. The anterior margin is well pointed in front in most specimens. As in *O. dilatata*, a faint furrow is located parallel to and slightly inside the dorsal furrow in the anterior lobe, but the two furrows close to the median line of the glabella are not visible in *O. sarsi sarsi*. On the other hand, *O. sarsi sarsi* has in some specimens a small node-like elevation at the anterior median point of the glabella, and the hypostome has a small antero-median notch in the median body. The deeper parts of the glabellar furrows are pit-like, especially in smaller specimens. The pits delimit a stem-like area behind the anterior lobe, the latter having an almost circular outline and being markedly more convex than the rest of the glabella. A slightly elongated elevation is present on each of the basal lobes, rather close to the dorsal furrow. The postocular cheek areas are about as wide (tr.) as the occipital ring and the preocular cheek

areas about $2/3$ as wide as the postocular ones. A faint postaxial ridge is discernible in some pygidia.

Dimensions: — No complete dorsal shields have been found of this subspecies. The largest pygidium present is 6.2 cm wide and 3.5 cm long, indicating an overall length of the dorsal shield of about 9 cm. The largest cranidium present is 5.6 cm wide (restored) and 3.3 cm long, indicating an overall length of about 10.5 cm. The smallest pygidium present is 1.0 cm wide and 0.5 cm long.

Occurrence: — *Ogygiocaris sarsi sarsi* occurs with certainty in 4aa₃ and 4aa₄, and *O. sarsi* (probably subspecies *sarsi*) is infrequently met with in 4aa₁ and 4aa₂ in the Oslo—Asker district. It is very common in 4aa₃ in the Oslo—Asker district.

OSLO—ASKER: Hjortnestangen, Frogner Park, Maridalsveien 13, Dovregata, Lille Frøen, Huk on Bygdøy, Vekkopp on Bygdøy in Oslo; Stabekk and Fornebu in Bærum; Steilene; Djuptrekkodden, Eternittfabrikken, Elnestangen and between Sjøstrand and Haga-bukta in Asker, as well as in other places where the *Ogygiocaris* shale crops out. — SKIEN—LANGESUND: Skinnvikbukta. — EIKER—SANDSVÆR: Råenkollen. — HAMAR-NES: Flakstadelva.

Ogygiocaris sarsi regina n. subsp.

Pl. 5, figs. 1—8; pl. 6, fig. 5.

1913 *Ogygiocaris dilatata* BRÜNN. var *Sarsi* ANG. (pars) — HADDING, p. 72, text fig. 23. (Descr. and fig. of large pygidium.)

1935 *Ogygiocaris lata* (HADDING) n. sp. (pars) — THORSLUND in THORSLUND & ASKLUND, p. 18, pl. 1, fig. 1. (Descr. and fig. of cranidium.)

1953 *Ogygiocaris dilatata sarsi* (pars) — STØRMER, pl. 2. (Fig. of dorsal shield.)

Name: — The name *regina* (L., queen, princess) alludes to a nickname, "the Toten princess", which has been given to the holotype.

Type data: — The holotype is an entire dorsal shield (P.M.O. no. 72090) and its counterpiece (no. 72092), belonging to an old collection from the *Ogygiocaris* series in Toten.

Diagnosis: — A subspecies of *Ogygiocaris sarsi* with the paradoublure line located about midway between the eye and the margin of the cephalon, and with the frontal area about as long (long.) as the occipital ring.

Description: — Apart from the narrower cephalic doublure and

the location of the paradoublural line on the cephalon, the subspecies *regina* is apparently rather similar to the nominal subspecies. Pygidia of *O. sarsi regina* n. subsp. (and of *O. sarsi delicata* n. subsp.) tend to have a more triangular outline than those of *O. sarsi sarsi*, especially in larger specimens. The holotype pygidium and some other pygidia of *O. sarsi regina* n. subsp. have a faint posterior incurvation of the margin, not observed in *O. sarsi sarsi*. It is not as distinct as the posterior incurvation in *O. dilatata*.

Dimensions: — The holotype is 6.8 cm long and 5.15 cm wide. Separate pygidia and fragments of cephalia indicate that the species could become somewhat larger. Swedish material suggests a considerably larger size.

Notes on Swedish material: — Cranidia and other parts from different localities in Jämtland, Sweden, agree very well with the Norwegian form, except that some of the Swedish specimens represent considerably larger individuals. Of several large cranidia, the largest is 7.7 cm wide (restored) and 4.7 cm long, corresponding to an overall length of the dorsal shield of about 15 cm. Several large pygidia are also present, including the huge pygidium figured by HADDING (1913, text fig. 23) as *O. dilatata* var. *Sarsi*. It is 8.05 cm long, suggesting that the entire dorsal shield was more than 20 cm long. This is more than the greatest calculated length (18 cm) for *O. dilatata*, which generally is a larger form than the subspecies of *O. sarsi*.

Occurrence: — *Ogygiocaris sarsi regina* occurs in Norway in the *Ogygiocaris* series, exact horizon not known (uppermost part? Cf. p. 216).

OSLO—ASKER: Rådhuset in Oslo; Fornebu Air Field in Bærum; Slemmestad in Asker; Ildjernet. — MODUM: Melå. — HADELAND: Haugalandet; Hovstangen in Gran; North of Juv in Gran. — TOTEN: Dyste bridge. — HAMAR—NES: Hovindsholm on Helgøya. — SWEDEN: Andersön and Raftan in Jämtland.

Ogygiocaris sarsi delicata n. subsp.

Pl. 6, figs. 1—4, 6—12.

Name: — From Latin *delicata* (delicate, dainty), alluding to the narrow doublure which gives this subspecies a dainty appearance.

Type data: — Holotype (P.M.O. no. 36673) is a cranidium from

Helgøya (Hamar—Nes), preserved in dark limestone and collected by W. C. BRØGGER in 1881. Exact horizon not known.

Diagnosis: — A subspecies of *Ogygiocaris sarsi* with a rather narrow doublure and with the paradoublural line of the cephalon closer to the margin than to the eyes. Frontal area somewhat shorter (long.) than occipital ring.

Description: — Apart from the differences mentioned in the diagnosis, this subspecies is rather similar to *O. sarsi sarsi*. The rather anterior position of the paradoublural line on the cranidium places it near the widest (tr.) part of the preocular cheek areas, and the line is thus relatively longer (tr.) than in the other subspecies.

Dimensions: — The few specimens referable to this subspecies are all rather small. The largest pygidium indicates an overall length of the dorsal shield of about 2.6 cm.

Remarks: — One might suspect that this subspecies is only a larval form of e.g. *O. sarsi regina*, especially as the relative width of the doublure increases with growth in *Ogygiocaris*. However, cranidia of *O. sarsi regina* show the typical position of the paradoublural line (and thus of the inner margin of the doublure) even when they are as small as or even smaller than cranidia of *O. sarsi delicata*. Neither do these two subspecies seem to occur together.

Occurrence: — *Ogygiocaris sarsi delicata* n. subsp. occurs apparently only in the uppermost part of the *Ogygiocaris* series (cf. p. 000) and in the Cephalopod shale in the northern districts.

HADELAND: South of Skiaker in Gran; Hovstangen in Gran.
— TOTEN: Kolbo in N. Toten. — HAMAR—NES: Helskjær and Hovindsholm on Helgøya; Sterudstranda in Nes. — RINGSAKER: Furnes Church.

Ogygiocaris sarsi lata HADDING, 1913

Pl. 5, fig. 9.

- 1913 *Ogygiocaris dilatata* BRÜNN, var *lata* n. var. — HADDING, p. 72, pl. VII, figs. 8, 9a—c. (Descr. and figs. of pygidium and free cheeks.)
1913 *Ogygiocaris dilatata* BRÜNN, var. *Sarsi* ANG. — HADDING, p. 70, pl. VII, figs. 1—7. (Descr. Figs. of cranidium, free cheeks, hypostome, thoracic segment, and pygidia. Not text fig. 23 = *O. sarsi regina*.)
1913 *Ogygiocaris dilatata* BRÜNN, var. *Strömi* ANG. — HADDING, p. 72, pl. VII, fig. 10. (Remarks. Fig. of pygidium.)

1935 *Ogygiocaris lata* (HADDING) n. sp. (pars) — THORSLUND in THORSLUND & ASKLUND, p. 18. (Remarks. The descr. and fig. of cranium are of *O. sarsi regina* n. subsp.)

Type data: — As lectotype I select the free cheek (P.I.L. no. LO 2530), figured by HADDING (1913, pl. VII, fig. 8). It is from the Ogygiocaris shale of Andersön in Jämtland, Sweden.

Diagnosis: — A subspecies of *Ogygiocaris sarsi* with no traces of the paradoublural line on the cranium (only on the free cheeks) and with facial sutures more divergent in front of the eyes than in the other subspecies.

Descriptive remarks: — Besides the differences mentioned above, the glabella of this subspecies appears to be relatively wider than in the other subspecies. It might perhaps be regarded as a separate species, but its pygidium is very similar to that of the other subspecies of *O. sarsi*, except that the adult pygidia appear to have a slightly more semicircular outline.

Remarks: — In 1913 HADDING erected *Ogygiocaris dilatata* var. *lata* which was based on small free cheeks and pygidia from Andersön in Jämtland, Sweden. It was to differ from *O. dilatata* var. *Sarsi* (= *O. sarsi*) in being smaller, in having a relatively longer pygidial axis, and in having a relatively wider pygidium. However, this is just what is characteristic of small pygidia of *O. sarsi*. The free cheeks assigned to var. *lata* have very narrow doublure. This is true also of small free cheeks of *O. sarsi*. It therefore appears that var. *lata* was erected on larval forms of *O. sarsi*. The question is then of which subspecies. Besides var. *lata*, HADDING (1913) described *O. dilatata* var. *Sarsi* (= *O. sarsi*) and *O. dilatata* var. *Strömi* (= *O. dilatata*) from the Ogygiocaris shale of Andersön. The latter is determined on a couple of pygidia, which are of the *sarsi* type rather than the *dilatata* type, with relatively narrow doublure. They were assigned to var. *Strömi* (= *O. dilatata*) because of the posterior indentation. However, the indentation is more distinct in *O. dilatata*, whereas a faint indentation is known in some pygidia of *O. sarsi*. A huge pygidium, assigned by HADDING (1913) to var. *Sarsi*, seems to belong to *O. sarsi regina* n. subsp. which occurs on Andersön (cf. p. 228). The other specimens assigned by HADDING to var. *Sarsi* do not belong to any of the subspecies of *O. sarsi* described from Norway. Most probably the larval forms described as var. *lata* belong to this form rather than to *O. sarsi regina* n. subsp.

The originals of var. *lata* are unfortunately not associated with larger cranidia or free cheeks, but they seem to come from the same bed as this form, which is associated with larval parts of the shield similar to those described as var. *lata*. *O. sarsi regina* seems to occur in another, possibly lower level on Andersön. For the above reasons the material assigned to *O. dilatata* var. *Sarsi* by HADDING is believed to represent adult specimens of the subspecies *lata*.

In 1935 THORSLUND described a cranidium as in all probability belonging to HADDING's var. *lata* (which was given rank of species, *O. lata*). It came from the Ogygiocaris shale at Raftan in Jämtland and agreed with the pygidium of *lata* in having the same width/length proportion, i.e. 2 : 1. However, it came from a larger specimen than the parts assigned to *lata* by HADDING, and, as pointed out above (p. 211), the ratio changes with the size of the pygidium. The cranidium described by THORSLUND apparently belongs to the form described here as *O. sarsi regina*, but appears to be somewhat deformed (W-form), probably because it is embedded in its matrix at an angle to the bedding plane.

Material: — The largest cranidium examined is 2.6 cm long and 4.6 cm wide, indicating a total length of the dorsal shield of about 7.5 cm.

Occurrence: — Ogygiocaris shale, Andersön in Jämtland, Sweden.

SUBFAMILY ASAPHINAE BURMEISTER, 1843

Genus *Asaphus* BRONGNIART, 1822

Subgenus *Neoasaphus* JAANUSSON, 1953

Type species: — *Asaphus ludibundus* TÖRNQUIST, 1884.

Synonym: — *Trematophorus* BALAŠOVA, 1953.

Asaphus (*Neoasaphus*) *heintzi* n. sp.

Pl. 7, figs. 1–3.

Name: — The species is named in honour of Professor, Dr. Anatol Heintz, who collected most of the material of this species.

Type data: — The holotype is an almost complete, but somewhat distorted dorsal shield (P.M.O. no. 72073) from the Lower Chasmops shale (4ba) in a road cut in the road Oslo—Drammen (Drammensveien) near Gyssestad, Asker. Collected by A. Heintz, 1932.

Material: — Six more or less complete dorsal shields and several detached plates preserved in shale, all compressed and distorted.

Diagnosis: — A species of *Asaphus* (*Neoasaphus*) apparently without frontal area, genal corners apparently without spines, and preocular cheek areas moderately wide at anterolateral corners. Thorax with unusually wide axis as wide as or slightly wider than pleural regions; inner margin of pleural doublure oblique forward and inward, slightly sinuous. Pygidium twice as wide as long, axis in front about $4/3$ as wide as pleural region. Doublure somewhat less than half as wide as pleural regions along anterior pleural furrow and with inner margin subparallel to pygidial margin.

Description: — The general features are seen in the illustrations.

Cephalon apparently without frontal area, as far as can be judged from the present specimens. Genal corners angular, apparently without spines. Posterior border of free cheek moderately convex. Preocular cheek areas about $1/4$ as wide as glabella at rounded anterolateral corners. Eyes much closer to posterior than to anterior cephalic margin and longer (long.) than their distance from posterior cephalic margin. Postocular cheek areas about $2/3$ as wide (tr.) as occipital ring. Doublure about half as wide as distance from eye to cephalic margin and with terrace lines subparallel to margin. Slit-like panderian opening. Hypostome unknown.

Thorax with axis as wide as or wider than pleural region. Fulcrum at about $2/3$ of distance from dorsal furrow to lateral margin. Doublure with terrace lines and isolated panderian openings. Inner margin of pleural doublure oblique inwards and forwards, slightly sinuous (slightly concave).

Pygidium about twice as wide as long. Axis in front about $3/4$ as wide as pleural region. Terrace lines lacking on outer surface of test, but this may be due to the state of preservation. Doublure somewhat less than half as wide as pleural region at anterior pleural furrow and with terrace lines subparallel to margins. Inner margin of doublure subparallel to pygidial margin, except posteriorly where it curves around the posterior tip of axis.

Dimensions: — The specimens are all rather distorted. The least distorted dorsal shield (P.M.O. no. 55696) is about 10.8 cm long and about 8 cm wide. Other specimens show that the species attained a somewhat larger size.

Affinities: — *Asaphus* (*Neoasaphus*) *heintzi* n. sp. resembles *A.* (*N.*) *ludibundus* and probably belongs to the group of *A.* (*N.*) *ludibundus*. It differs from all the other known members of this group in its very wide thoracic axis.

Occurrence: — *Asaphus* (*Neoasaphus*) *heintzi* n. sp. is known with certainty only from the Lower Chasmops shale (4ba).

OSLO—ASKER: Near Slependen in Asker (4ba); Sportsplassen on Bygdøy in Oslo (4b); ?Bjerkholmen near Fornebu in Bærum (horizon?).

Asaphus (*Neoasaphus*) *ludibundus* TÖRNQUIST, 1884

Pl. 8, figs. 1–5.

1884 *Asaphus ludibundus* n. sp. — TÖRNQUIST, p. 71, pl. III, figs. 4–5. (Descr., figs. of dorsal shield and cephalon.)

1884 *Asaphus acuminatus* NIEZK. (nicht BOECK) — BRØGGER, p. 260. (Recorded.)

1884 *Asaphus acuminatus* NIEZK. var. — BRØGGER, p. 261. (Recorded.)

1886 *Asaphus ludibundus* TÖRNQUIST — BRØGGER, p. 30, pl. I, fig. 7. (Descr. and fig. of hypostome.)

1887 *Ptychopyge* conf. *glabrata*, ANG. — BRØGGER, p. 19. (Recorded.)

1887 *Asaphus* conf. *acuminatus* NIEZKOWSKI — BRØGGER, p. 19. (Recorded.)

1953 *Asaphus* (*Neoasaphus*) *ludibundus* TÖRNQUIST, 1884 — JAANUSSON, p. 399, pl. I, figs. 1–12; pl. II, figs. 1–2; text figs. 3(5), 5(2), 6. (Detailed descr. Figs. of all parts of dorsal shield. List of synonymies. Recorded for the first time from Norway.)

1953 *Asaphus ludibundus* — STØRMER, p. 65. (Recorded.)

Type data: — Lectotype (selected by JAANUSSON, 1953) is a dorsal shield (P.I.L. no. LO 618 T) from the Ludibundus limestone in Kårgårde, Siljan area, Sweden.

Norwegian material: — Four more or less complete dorsal shields, numerous detached parts of the shield. Most of the specimens are preserved in limestone.

Remarks: — *Asaphus* (*Neoasaphus*) *ludibundus* differs from the other Middle Ordovician asaphids occurring in Norway in the following combination of characters: Dorsal surface rather smooth; thus the dorsal furrow is not very distinct, the axial rings in the pygidium are poorly defined, and the pleural ribs are only faintly developed in the pygidium. Genal corners more or less rounded, without spines. No frontal area. Glabella rather steep in front. Anterolateral corners of glabella rather well rounded. Preocular cheek areas moderately to rather narrow. Cephalic doublure channelled (as seen from above)

and only slightly wider than distance from eye to outer margin. Pygidium tending towards a faintly triangular outline, rather evenly vaulted. Pygidial doublure somewhat less than half as wide as pleural region at anterior pleural furrow.

As observed by JAANUSSON (1953) several characters vary somewhat from specimen to specimen, *e.g.* the angle of the genal corners, the height of the glabella compared with that of the palpebral lobes, and the width of the preocular cheek areas. Furthermore the relative length and the height of the eyes decrease with growth, and the width of the thoracic axis increases. These variations are seen also in the Norwegian material, which on the whole agrees well with the Swedish specimens. However, on the whole the pleural regions of the pygidia are somewhat wider in relation to the axis in the Norwegian material (this may partly be due to flattening) and the fulcrum is placed slightly more distally in some specimens. Furthermore the palpebral lobes seem to be more tilted, at least in some of the Norwegian specimens.

Dimensions: — Some of the Norwegian specimens are larger than those described from Sweden. A dorsal shield has an overall length of about 10.9 cm and detached pygidia indicate a total length of the dorsal shield of at least 12 cm.

Occurrence: — *Asaphus* (*Neoasaphus*) *ludibundus* occurs in the Ampyx limestone (4a β), the Lower Chasmops shale (4b α), and the Lower Chasmops limestone (4b β). It is relatively common. A few specimens have been found in Coelosphaeridium beds (4ba?) at Toten.

OSLO—ASKER: Oslo (4b?); Huk on Bygdøy (4a?); Bygdøy (4ba); Rambergøya (4b β and top of 4ba); Nakkholmen (4b β); Western point of Ildjernet (top of 4a β); Southern point of Persteilene (4b); Ostøya (4ba- β); Gyssestad (4a β ?). — SKIEN—LANGESUND: Saltboden (4a β). — RINGERIKE: Bratterud (4ba- β); Section Gomnes—Rud (4ba?). TOTEN: Sund (4ba?) — SWEDEN.

Asaphus (*Neoasaphus*) cf. *ludibundus* TÖRNQUIST, 1884

Pl. 8, fig. 6.

1909 *Asaphus* n. sp. — HOLTEDAHL, pp. 9, 29, 40. (Recorded.)

Remarks: — A complete but somewhat worn dorsal shield in a round limestone lens from the Cephalopod shale of the Mjøsa districts

has the fulcrum placed much further out and has considerably wider (tr.) cheeks than *A. (N.) ludibundus*, with which it has many features in common. It is here referred to as *A. (N.) cf. ludibundus*. The specimen is 8.1 cm long.

Asaphus (Neoasaphus?) sp. A

Pl. 14, fig. 9.

Remarks: — Two pygidia, rather similar to each other, have been collected from the Encrinite limestone (4bδ) at Ås at Frierfjorden, Skien—Langesund. They have rather narrow pleural regions and a rather roundish outline.

Asaphus (Neoasaphus?) sp. B

Pl. 14, fig. 10.

Remarks: — A single asaphid pygidium has been collected from the Upper Chasmops limestone (4bδ) on Nakkholmen, Oslo—Asker. It has a characteristic subtriangular outline. The specimen is partly exfoliated, but preserved parts of the outer test show faint terrace lines near the margin.

Genus *Ogmasaphus* JAANUSSON, 1953

Type species: — *Asaphus praetextus* TÖRNQUIST, 1884, by original designation.

Remarks: — According to JAANUSSON (1953, p. 427) *Ogmasaphus* differs from *Asaphus* mainly in having as a rule more distinctly defined frontal area and a pygidium with as a rule more distinct pleural ribs, with a wider doublure, and with a distinct indication of a "Limbus" (a flattened border). As pointed out by JAANUSSON (1953, p. 427), species like *Asaphus (Neoasaphus) lepidus* and *A. (N.) glabratus* may also have a rather distinctly defined frontal area.

Although less pronounced than in the type species of *Ogmasaphus*, pleural ribs are likewise known in several species of *Asaphus*. As to the "Limbus", one may see very faint indications of it even in pygidia of *Asaphus (Neoasaphus) ludibundus*, type species of the subgenus

Neoasaphus. The two species originally assigned to *Ogmasaphus* differ from *Asaphus* in having better developed terrace lines on the outer surface of the pygidium. However, at least some such terrace lines occur even in several species of *Asaphus*. From the above it appears that several of the differences between *Asaphus* and *Ogmasaphus* only are differences in degree of relief, *Ogmasaphus* having a more strongly developed relief than *Asaphus*. Forms with high relief and forms with low relief (smooth forms) seem to occur in all kinds of shellbearing animals and need not necessarily indicate generic distinction; on the contrary, forms with high relief may often be very closely related to forms with low relief. JAANUSSON also mentioned the width of the pygidial doublure as a distinguishing character between *Ogmasaphus* and *Asaphus*. The difference is not great, and *Ogmasaphus stoermeri* n. sp. has a relatively narrow doublure, as compared with that of *Asaphus*. Thus not even the width of the pygidial doublure seems to be a reliable distinguishing character between the two genera. JAANUSSON (1953, p. 427) suggests that the genus *Ogmasaphus* may have developed from the group of *Ptychopyge cincta*. As pointed out by him, the pygidia of this group are very similar to those of *Ogmasaphus*. However, the cranidia of *Ogmasaphus* differ from those of *Ptychopyge* in having a much shorter frontal area. This may not be of great importance, but it is more suspicious that no cranidia of *Ogmasaphus* show even an indication of the little node behind the eyes so typical of *Ptychopyge*. On the whole I am inclined to believe that *Ogmasaphus* is closer related to *Asaphus* than to *Ptychopyge* and believe that the species assigned to *Ogmasaphus* may be regarded as, so to say, forms of *Asaphus* (*Neoasaphus*) with relatively strong relief. As a consequence, *Ogmasaphus* might perhaps rather be regarded as a subgenus of *Asaphus* (or of a genus *Neoasaphus*) than a distinct genus. However, since the relationship are not clear, I refrain here from any "Bessermachen" and retain *Ogmasaphus* as a separate genus. If the species described below are correctly assigned to *Ogmasaphus*, its species vary rather much in proportions, and it is possible that the genus *Ogmasaphus* contains several off-shoots from *Asaphus* (*Neoasaphus*). It is also possible that the genus *Ogmasaphus* should be distinguished from *Asaphus* (*Neoasaphus*) on other characters. Thus at least the group of *Asaphus* (*Neoasaphus*) *ludibundus* seems to differ from the species assigned to *Ogmasaphus* in having a steep front of the glabella.

Ogmasaphus jaanussoni n. sp.

Pl. 9, figs. 1–3.

1884 *Asaphus platyurus* (partim) — BRØGGER, p. 17 (Listed.)]

Name: — The species is named in honour of Phil. Dr. Valdar Jaanusson (Palaeontological Institution, University of Uppsala).

Type data: — The holotype is an almost complete dorsal shield (P.M.O. no. 61519) from Ruseløkkveien in Oslo. Horizon unknown, probably lower Middle Ordovician. Collector unknown.

Material: — The description is based on three almost complete dorsal shields. They are all more less distorted, but show all the small genal spines. Additional material seems strangely enough to be rare. A detached pygidium and a fragmentary free cheek are tentatively assigned to this species. The specimens are preserved in limestone or marly shale.

Diagnosis: — A species of *Ogmasaphus* with the following characteristics: Small genal spines present. Cephalic doublure relatively narrow, only slightly more than half as wide as distance from eye to lateral cephalic margin. Cranidium with rather wide preocular cheek areas (about $1/3$ as wide as glabella) and with bluntly rounded anterolateral corners. Outer part of pleurae about 1.5 times as wide (tr.) as inner part. Pygidium with relatively narrow doublure, reaching less than halfway from margin to dorsal furrow along 1st pleural furrow, and surrounding only about posterior sixth of axis. Dorsal surface of pygidium with numerous terrace lines, some of which crossing the axis.

Description: — The general features are seen in the illustrations. The following description is based on the holotype.

Cephalon with small genal spines. Outer margin evenly convex except for small pointed protrusion in front. Narrow depressed frontal area. Postocular cheeks about as wide (tr.) as occipital ring. Eyes about twice as long (long.) as distance from posterior margin. Preocular cheeks about $1/3$ as wide as glabella. Bluntly rounded anterolateral corners. Sutural margin slightly concave behind anterolateral corners. Doublure only slightly wider than distance from eye to outer margin, channelled along margin (as seen from above) and with terrace lines subparallel to margin. Slit-like panderian opening. Hypostome unknown.

Thorax with axis about $2/3$ as wide as pleural region (the holotype is somewhat compressed). Fulcrum at about $2/3$ of distance from dorsal furrow to lateral margin. Doublure with terrace lines and isolated Panderian openings. Inner margin of doublure poorly seen, apparently almost straight or slightly concave.

Pygidium about twice as wide as long (restored). Axis in front about half as wide as pleural region, and about $4/5$ as long as pygidium. Outer surface with more or less transverse terrace lines. Doublure less than half as wide as pleural region along 1st pleural furrow and with terrace lines subparallel to margins. Inner margin of doublure subparallel to outer margin, except where it curves around posterior sixth of axis.

A single detached pygidium (P.M.O. no. 56580) agrees with that of the holotype, also in having a relatively narrow doublure, and may be conspecific. It is somewhat better preserved than the pygidia of the dorsal shields, and shows some characters which are poorly or not seen in those. The pleural ribs are double, being divided by the interpleural furrow into a thin anterior ridge and a broader posterior ridge. The outer surface of the pygidium shows a bend which corresponds in location to the inner margin of the doublure. The area outside this bend is somewhat depressed and more densely covered with terrace lines. Some terrace lines cross the axis.

Dimensions (in cm): —

Specimen	Dorsal	shield	Ceph.	Thorax	Pygidium	
	L.	W.	L.	L.	L.	W.
61519 (holotype) .	11.7	c.7.5	3.7	3.8	4.2	c.6.9
20289 (dors. sh.) .	—	c.6	—	2.9	c.3.2	5
61143 (dors. sh.) .	7.7	5.9	2.3	2.5	2.9	5.5
56580 (pyg.)	—	—	—	—	2.6	c.5

The holotype, 11.7 cm long, represents the largest specimen present.

Occurrence: — *Ogmaphus jaanussoni* n. sp. occurs in the lower Middle Ordovician, exact horizon not known, probably Ampyx limestone (4a β) or slightly above or below.

OSLO—ASKER: Ruseløkkveien in Oslo (horizon?); Oslo (4a?); Oslo? (horizon?);? Huk on Bygdøy (4a?);? Building ground of Rådhuset (City Hall) in Oslo (4a?);? Bjerkås in Asker (4aa).

Ogmasaphus kiaeri n. sp.

Pl. 10, figs. 1–12.

1887 *Ptychopyge glabrata* ANG. — BRØGGER, p. 17. (Recorded.)1887 *Asaphus platyurus* (pars) — BRØGGER, p. 17. (Recorded.)1887 *Ptychopyge* cf. *glabrata* ANG. (pars) — BRØGGER, p. 19. (Recorded.)1940 *Asaphus platyurus* ANG. — GRØRUD, pp. 159–160. (Recorded.)1953 Einer *Ogmasaphus*-Art — JAANUSSON, p. 427. (Mentioned.)

Name: — The species is named in honour of the late Director of Paleontologisk Museum in Oslo, Professor, Dr. Johan Kiær, who collected the holotype as well as other specimens of it.

Type data: — The holotype is an almost complete, enrolled dorsal shield (P.M.O. no. 19112) from the Ampyx limestone (4a β) at S. Kojatangen, Asker. Collected by J. Kiær in 1898.

Material: — Numerous detached parts of the shield and a few more or less complete dorsal shields. Preserved in limestone.

Diagnosis: — A species of *Ogmasaphus* with the following characteristics: No genal spine. Cephalic doublure about twice as wide as distance from eye to outer cephalic margin. Cranidium with preocular cheek areas somewhat less than $1/3$ as wide as glabella and with well rounded anterolateral corners. Sutural margin practically straight behind anterolateral corners. Pygidium with doublure reaching about half way from margin to dorsal furrow along anterior pleural furrow, and surrounding about posterior fifth of axis. Dorsal surface of pygidium with numerous, chiefly short terrace lines.

Description: — The general features are seen in the illustrations. The description is based on the holotype. Additional information from other specimens is added in parenthesis.

Cephalon with narrow depressed frontal area. Genal corners broken (other specimens show angular corners without spine and a slightly convex, almost straight posterior border of the free cheek). Postocular cheek areas about as wide as occipital ring. Eyes about twice as long (long.) as distance from posterior margin. Preocular cheek areas less than $1/3$ as wide as glabella. Anterolateral corners well rounded. Sutural margin practically straight behind anterolateral corners. Cephalic doublure about twice as wide as distance from eye to outer margin, channelled along margin (as seen from above) and with terrace lines subparallel to margin. Slit-like panderian opening. Hypostome unknown.

Thorax with fulcrum closer to dorsal furrow than to lateral margin. Doublure with terrace lines. (Other specimens show the isolated panderian openings and the slightly convex, almost straight inner margin of the pleural doublure).

Pygidium of holotype exfoliated and somewhat distorted. It shows, however, that the doublure is about half as wide as pleural region along anterior pleural furrow, and the presence of faint terrace lines on the inner impression of the test, indicating well developed terrace lines on the outer surface. (Other, probably conspecific pygidia shows that the ribs are double as in *O. jaanussoni* n. sp., that the outer surface of the test has numerous mainly short terrace lines, and that the doublure is faintly concave.)

(A poorly preserved but possibly conspecific hypostome is of the *Ogmasaphus* type.)

Dimensions (in cm): —

Specimen	Dorsal shield		Cephal.	Thorax	Pygidium	
	L.	W.	L.	L.	L.	W.
19112 (holotype) .	—	c.5.5	3.0	—	3.6	—
3490 (dors. sh.) .	c.4.2	c.2.5	1.4	1.5	c.1.3	—
4098 (pyg.)	—	—	—	—	1.9	3.4

The largest parts of the shield in the present material suggests a total length of the dorsal shield of about 10 cm.

Remarks: — *Ogmasaphus kiaeri* n. sp. resembles *O. jaanussoni* n. sp. but differs in that it lacks genal spines and has a wider doublure, both in the cephalon and in the pygidium. Furthermore, the anterolateral corners of the cranidium are more pointed in *O. kiaeri* n. sp. and the suture is straighter between the eyes and the anterolateral corners. *O. kiaeri* n. sp. apparently resembles *O. glabratus* (ANGELIN, 1854), which, however, is not yet well enough known to allow a detailed comparison and which seems to be slightly younger.

Occurrence: — *Ogmasaphus kiaeri* n. sp. occurs rather frequently in the Ampyx limestone (4a β).

OSLO—AKER: Bygdøy in Oslo (4a β); Fornebu in Bærum (hor.?); Terneholmen in Asker (4a β); Gyssestad (4a β); Holmen at Vollen in Asker (4a β); Elnestangen in Asker (4a β); S. Kojatangen in Asker (4a β).

Ogmasaphus multistriatus n. sp.

Pl. 6, figs. 13–17.

1887 Ny *Asaphus*-art (new species of *Asaphus*) — BRØGGER, p. 17. (Mentioned.)?1909 *Pseudasaphus globifrons* var. — HOLTEDAHL, pp. 7, 28. (Mentioned.)1909 *Asaphus* n. sp. aff. *A. striatus* S. & B. — HOLTEDAHL, pp. 7, 28.

(Mentioned.)

Name: — The name *multistriatus* alludes to the large number of terrace lines on the pygidial doublure.

Type data: — The holotype is a pygidium (P.M.O. no. 36822a) from the Ogygiocaris shale (4aα) at Storhamar in Hamar—Nes.

Remarks: — *Ogmasaphus multistriatus* n. sp. is based on the pygidium. It is usually not recommendable to erect a species on the pygidium alone, but it has been done here because the pygidium is rather characteristic and frequently met with. No complete specimens have been found, but some cranidia and cephalae which are associated with the characteristic pygidia may belong to the same species. The holotype has been chosen partly because it occurs on the same small chip of rock as a small cranidium. The associated cephalae are rather similar to that of *O. kiaeri* n. sp. If they really belong to *O. multistriatus* n. sp., it is possible that *multistriatus* should rather be regarded as a subspecies of *O. kiaeri* n. sp. However, *O. multistriatus* apparently appears at a lower horizon than *O. kiaeri* n. sp.

Diagnosis: — A species of *Ogmasaphus* with very densely striated pygidial doublure. Pygidial doublure reaching more than halfway from margin to dorsal furrow at anterior pleural furrow.

Description: — Pygidium about twice as wide as long. In well-preserved specimens the pleural ribs are seen to be double as in *O. jaanussoni* n. sp. Outer surface of test with terrace lines. Doublure more than half as wide as pleural areas at anterior pleural furrow and surrounding posterior fifth of axis. Doublure markedly concave along outer margin, and with densely spaced terrace lines (5–6 in 1 mm in a pygidium about 2 cm long).

A single, poorly preserved specimen consists of the pygidium, thorax, and a free cheek. Only a tiny fragment is preserved of the thoracic doublure, but it shows that this, too, is ornamented with densely spaced terrace lines. Neither this nor other associated free cheeks show whether genal spines are present or not. A few associated

and probably conspecific cranidia are all rather small, but seem to resemble the cranidium of *O. kiaeri* n. sp.

Dimensions of pygidia (in cm): —

Specimen	L.	W.	Number of terrace lines in 1 mm on the doublure.
21921	3.4	c.6.2	c.2
21922	1.35	c.2.6	c.6
58928	1.9	c.3.6	c.6
6007	2.2	c.4.2	c.5

A single pygidium suggests a total length of the dorsal shield of almost 10 cm. The other pygidia present suggest a total length of about 6 cm or less.

Occurrence: — Pygidia of *O. multistriatus* occur in the Ogygiocaris shale (4aa₃₋₄) and the Ampyx limestone (4aβ).

OSLO—ASKER: Terneskjær in Asker (4aβ); Håkavik in Asker (4aa); Vollen in Asker (4aβ), Gyssestad (4aβ); Fornebu in Bærum (4a?); Steilene (4aβ). — HADELAND; Melbostad (4aa); Hovstangen, Gran (4aa). HAMAR—NES: Helgøya (4aa); Storhamar (4aa).

Ogmasaphus stoermeri n. sp.

Pl. 11, figs. 1—6.

1884 *Asaphus* confr. *platyurus* — BRØGGER, p. 259. (Recorded.)

Name: — The species is named in honour of Professor, Dr. Leif Størmer, who collected several of the specimens preserved in the Palaeontological Museum.

Type data: — Holotype is a small but fairly complete and well preserved dorsal shield (P.M.O. no. 4684) from the Ogygiocaris series (4aa) at Teigen slate pit, Eiker. Collected by M. Langeberg and presented to the Palaeontological Museum by S. Swensen in 1892.

Material: — A few more or less complete dorsal shields and numerous detached plates. The specimens occur in a slightly metamorphosed mudstone and are more or less compressed.

Diagnosis: — A species of *Ogmasaphus* with the following characteristics. Angular genal corners but no genal spines. Cephalic doublure almost $2/3$ as wide as distance from eye to outer margin. Cranidium with preocular cheek areas about $1/6$ as wide as glabella and with well rounded anterolateral corners. Thorax with pleural regions wider than axis and fulcrum closer to dorsal furrow than to lateral margin. Pygidium with narrow axis less than half as wide as pleural region in front. Pygidial doublure markedly less than half as wide as pleural region in front, with inner margin subparallel to outer margin of pygidium except where it curves around posterior tip of axis.

Description: — The general features are seen in the illustrations.

Cephalon evenly rounded in front and with only a narrow (long.) and poorly defined frontal area. Genal corners angular and without spines. Preocular cheek areas rather narrow, about $1/6$ as wide as glabella at the rounded anterolateral corners. Eyes nearer to posterior than to anterior cephalic margin and about twice as long (long.) as their distance from posterior margin. Postocular cheek areas slightly narrower (tr.) than occipital ring. Cephalic doublure almost $2/3$ as wide as distance from eye to outer margin and with relatively openly spaced terrace lines subparallel to margins of doublure. Nature of panderian opening unknown. Hypostome of *Asaphus* type.

Thorax with pleural regions wider (tr.) than axis. Fulcrum closer to dorsal furrow than to lateral margin. Doublure with terrace lines. Nature of panderian openings and inner margin of doublure unknown.

Pygidium about twice as wide as long. Axis narrow (in front less than half as wide as pleural region), short (reaching about $3/4$ of distance to posterior margin), and tapering relatively sharply rearwards with rather straight (not concave) dorsal furrows. Axis with about 11 rings and an endlobe; the posterior rings are poorly defined. Paradoublural line developed as a distinct bend or even as a thin ridge, but this character may have been exaggerated by the flattening of the specimens. Pleural ribs and furrows faintly developed inside the paradoublural line. Terrace lines well developed both outside and inside paradoublural line; one terrace line is connected across axis in each ring. Pygidial doublure markedly less than half as wide as pleural region in front, and with inner margin subparallel to outer margin except where it curves around posterior tip of axis. Doublure with rather openly spaced terrace lines.

Dimensions (in cm): —

	Dorsal L.	shield W.	Cephal. L.	Thorax L.	Pygidium	
					L.	W.
4684 (holotype) .	4.3	3.2	1.3	1.5	1.5	c.3.2
4682 (dor. sh.) ..	5.9	c.4.4	1.8	2.0	2.1	c.4.3
60509 (dor. sh.) ..	4.65	c.3.4	1.4	1.75	1.5	3.3
60365 (pygidium)	—	—	—	—	3.6	c.7.0
60379 (pygidium)	—	—	—	—	4.05	c.8.0
72069 (pygidium)	—	—	—	—	4.8	9.4

The largest pygidium present (P.M.O. no. 72069) indicates an overall length of the dorsal shield of about 14 cm.

Remarks: — The pygidium seems to be especially characteristic of this species and distinguishes it from all other species assigned to *Ogmasaphus*.

Occurrence: — *Ogmasaphus stoermeri* n. sp. occurs in 4aa₁, apparently also in 4aa₂, and possibly in 4aa₃.

EIKER—SANDSVÆR: Teigen shale quarry (4aa); Muggerud-kleiva (4aa₁); Vestfossen (4aa); Krekling (4aa). — SKIEN—LANGE-SUND: Rognstrand (4aa); Bø in Gjerpen (4aa).

Ogmasaphus sp.

Pl. 12, fig. 9.

1909 *Asaphus latus*, PAND. var. — HOLTEDAHL, pp. 9, 29, 40. (Recorded from the Cephalopod shale.)

Remarks: — A few pygidia (some with attached thoracic segments) from the Cephalopod shale in the Mjøsa districts do not seem to agree with any of the above described species. More material is needed to give a full description of the present form. The pygidium has a relatively narrow axis and the pygidial doublure is less than half as wide as the pleural regions in front. Terrace lines are developed in a marginal zone about as wide as the doublure.

Occurrence: — *Ogmasaphus* sp. occurs in nodules in the Cephalopod shale.

TOTÈN: Arnestad; Hammerstad. — HAMAR—NES: Hovindsholm on Helgøya.

Genus *Pseudoasaphus* SCHMIDT, 1901

Synonym: — *Pseudasaphus* SCHMIDT, 1904 (*nom. null.*).

Type species: — *Ptychopyge globifrons* EICHWALD, 1875, by subsequent designation by REED, 1930.

Pseudoasaphus limatus JAANUSSON, 1953

Pl. 9, fig. 4; pl. 13, figs. 1–5.

1884 *Asaphus* cfr. *undulatus* STEINH. — TÖRNQUIST, p. 69, pl. II, fig. 22.

(Descr. and fig. of pygidium.)

1884 *Asaphus nobilis* BARANDE aff. — BRÖGGER, pp. 261, 262. (Recorded.)

1953 *Pseudasaphus*? sp. — STØRMER, pp. 74, 75, 80. (Recorded.)

1953 *Pseudasaphus limatus* n. sp. — JAANUSSON, p. 421, pl. III, figs. 6–7.

(Descr. and figs. of pygidia.)

Type data: — Holotype (by original designation) is a pygidium (P.M.O. no. 58931, figured by JAANUSSON, 1953, pl. III, fig. 7) from 4a β or 4ba at Fornebu Air Field, Bærum in Oslo-Asker.

Description: — The pygidium is adequately described by JAANUSSON (1953, p. 421). It may added be that a large fragmentary pygidium (P.M.O. no. 72069) shows fine pits on the upper surface of the test. (Pl. 9, fig. 4). A few more or less fragmentary thoracic shields are known, some with pygidium attached. The axial rings are ornamented with curved terrace lines subparallel to the anterior margin of the articulating half ring. The pleural tips are not well preserved, but seem to be pointed at their posterolateral corners. The pleurae are ornamented with terrace lines directed outwards and forwards. The nature of the inner margin of the thoracic doublure is unknown. Fine pits may be seen on the outer surface of the thorax, especially on the axis.

Some fragments of cephalae are probably conspecific. An incomplete cephalon (P.M.O. no. 58911) is attached to a part of the thorax. Its cranidium resembles an isolated, but larger cranidium (P.M.O. no. 40355). The cranidia recall those of *P. tecticaudatus* (STEINHARDT, 1874), but their preocular cheek areas are wider, since the facial sutures diverge more strongly in *P. limatus*. In the one specimen where the anterior margin is fully preserved, this is less pointed than in *P. tecticaudatus*. The material of free cheeks is very fragmentary, but

includes part of a stout genal spine. The cephalic doublure is unknown. A couple of fragmentary and poorly preserved large hypostomes are of the *Pseudoasaphus* type.

Variations in the pygidium: — As discussed by JAANUSSON (1953, p. 422) the main differences between the pygidia of *P. limatus* and *P. tecticaudatus* are those between the terrace lines on the axis and on the pleural regions close to the axis. In *P. tecticaudatus* the posterolaterally oriented terrace lines are strongly developed on the pleural regions close to the axis and there is a strong transversal terrace line across the whole of each axial ring. In *P. limatus* the terrace lines on the axis are more numerous and only rarely traverse the whole of the axial ring, and in the pleural regions the anterolateral direction of the terrace lines predominate also in the area close to the axis. However, in some pygidia here included in *P. limatus* the terrace lines in the axis or in the pleural regions close to the axis agree better with those of *P. tecticaudatus*. In a single specimen, unfortunately not too well preserved, the terrace lines both on the axis and on the pleural regions seem to agree best with those of *P. tecticaudatus*, and it is possible that this specimen belongs to *P. tecticaudatus*. In any case the pattern and also the density of the terrace lines vary somewhat in *P. limatus*. Furthermore, small pygidia of *P. limatus* have a concave posterior margin, whereas large pygidia are almost straight (truncated) posteriorly.

Dimensions: — The smallest pygidium present (RM. no. Ar 37755) is 2.7 cm long and about 4.6 cm wide (restored). The holotype pygidium is 3.9 cm long and 5.2 cm wide (restored). A large pygidium (P.M.O. no. 58938) is 7.5 cm long and about 9.5 cm wide (restored). The largest pygidium present (P.M.O. no. 57447) is 8.9 cm long and about 13.6 cm wide (restored), suggesting a total length of the dorsal shield of about 25 cm.

Occurrence: — *Pseudoasaphus limatus* occurs in the Ampyx limestone (4a β) and possibly also in the Ogygiocaris series (4aa) and the Lower Chasmops shale (4ba). It also occurs in the Echinospaerites beds and apparently in the Bryozoan beds in Skien—Langesund.

OSLO—ASKER: Oslo centre (4), Bygdøy Allé near Frogner Church (4), Hjortnestangen (4a?), and on Bygdøy in Oslo; Fornebu Air Field (4a β or 4ba?) in Bærum; Gyssestad (4a β); Djuptrekkodden (4a β ?), Håkavik (4a β), and Vollen (4a β) in Asker. — EIKER—SANDSVÆR:

Recorded from 4aa. — RINGERIKE: Norderhov Church (4aβ). — HADELAND: Kløvstad in Gran (4aβ?), — SKIEN—LANGESUND: Gravestranda at Frierfjord. — SWEDEN.

Pseudoasaphus sp.

Pl. 13, fig. 6.

Remarks: — A single, 5.7 cm long pygidium from the Coelosphaeridium beds between Tørud and Brattberg (Ringsaker) apparently belongs to *Pseudoasaphus*. The surface ornamentation is not preserved, and it is hardly possible to determine the species until more material has been collected.

Genus *Pseudobasilicus* REED, 1930

Type species: — *Ptychopyge lawrowi* SCHMIDT, 1898.

Pseudobasilicus cf. *kuckersianus* (SCHMIDT, 1898)

Pl. 13, fig. 7.

Remarks: — A single pygidium, 1.9 cm long, from the Ampyx limestone (4aβ) near Gyssestad, Oslo-Asker, resembles the small pygidium of *Pseudobasilicus kuckersianus* figured by SCHMIDT (1904, pl. IV, fig. 14).

Pseudobasilicus cf. *kegelensis* (SCHMIDT, 1898)

Pl. 14, figs. 1, 4, 8.

1909 *Basilicus Kegelensis*, F. SCHM. — HOLTEDAHL, pp. 20, 27, 32. (Recorded.)

Material: — Two cranidia, a pygidium and a few fragments of dorsal shields.

Remarks: — The two cranidia agree fairly well with that of *Pseudobasilicus kegelensis* figured by SCHMIDT (1904, pl. V, fig. 1), as far as they can be compared. The associated pygidium is more triangular and with a narrower border than the pygidium figured by SCHMIDT (1904, pl. V, fig. 3), but this may possibly be due to its smaller size. However, for the time being it seems safest to refer to the Norwegian material as *P. cf. kegelensis*.

Dimensions: — The larger of the two cranidia suggests a total length of the dorsal shield of about 7 cm, but other fragments indicate that this form may have reached a greater size.

Occurrence: — *Pseudobasilicus* cf. *kegelensis* occurs in the Cyclocrinus beds.

HAMAR—NES: Furuberget.

Pseudobasilicus? sp.

Pl. 14. figs. 2–3.

Remarks: — Two incomplete cranidia from the Cyclocrinus beds of Furuberget (Hamar—Nes) are rather smooth and resemble somewhat *Isotelus*. However, they have a distinct glabellar node, faint indications of basal glabellar furrows, and the eyes are situated further forwards than in *Isotelus*. They probably belong to a smooth species of *Pseudobasilicus* or possibly of *Pseudoasaphus*.

Genus *Pseudomegalaspis* JAANUSSON, 1953

Type species: — *Megalaspis formosa* TÖRNQUIST, 1884, by original designation.

Remarks: — To the diagnosis of the genus given by JAANUSSON (1953, p. 451) may be added that genal spines are present.

Pseudomegalaspis patagiata (TÖRNQUIST, 1884)

Pl. 12, figs. 1–7.

1884 *Megalaspis patagiata* n. sp. — TÖRNQUIST, p. 82, pl. III, figs. 15–17.

(Descr. Figs. of incomplete cranidium and 2 pygidia.)

1887 *Megalaspis* n. sp. — BRØGGER, p. 16. (Recorded.)

1909 *Megalaspis patagiata* — HOLTEDAHL, pp. 7, 28. (Recorded.)

1953 *Pseudomegalaspis patagiata* — STØRMER, pp. 58, 83, 90, 97, 103, 109. (Recorded.)

1953 "*Megalaspis*" s.p — STØRMER, p. 109. (Recorded.)

1953 *Pseudomegalaspis patagiata* (TÖRNQUIST, 1884) — JAANUSSON, p. 456, pl. IX, figs. 4–7; pl. X, fig. 1; text fig. 5(9).

(Descr. Figs. of dorsal shield and parts of dorsal shields.)

1953 *Pseudomegalaspis formosa* (TÖRNQUIST, 1884) (partim) — JAANUSSON, p. 452. (Norwegian material only, pl. X, figs. 2 and 3.)

Type data: — The holotype (by monotypy) is an enrolled dorsal shield (S.G.U. no. c. 66) from the Schroeteri beds of Kårgårde, Siljan area, Dalarna, Sweden.

Norwegian material: — A few more or less complete dorsal shields and numerous detached parts of the shield. Preserved in limestone, more or less distorted.

Remarks: — An almost complete dorsal shield (P.M.O. no. 56556, pl. 12, figs. 1–2), which was assigned to *Pseudomegalaspis formosa* TÖRNQVIST, 1884)) by JAANUSSON (1953, p. 455, pl. X, figs. 2–3), is associated with a smaller pygidium with about the same proportions. Both specimens appear to be deformed by lateral compression and/or elongation. In the same rock sample there are two other pygidia which are relatively somewhat shorter and thus agree with *P. patagiata*. The two latter pygidia are oriented normal to the axis of elongation in the other specimens and it seems probable to me that all 4 specimens only represent two different types (L-forms and W-forms) of deformation of the same species.

According to JAANUSSON (1953, p. 459), the main differences between *P. formosa* and *P. patagiata* are that 1) the cephalic and pygidial margin are more or less semicircular in *P. patagiata* and subparabolic in *P. formosa*, 2) the anterior border of the glabella is rather weakly convex in *P. patagiata* and evenly rounded in *P. formosa*, 3) the pygidial facets are relatively somewhat shorter in *P. patagiata*, and 4) the anterolateral corners of the facets more rounded in *P. patagiata* than in *P. formosa*. As to points 1) and 2), these differences could be readily explained if *P. patagiata* represents the W-form and *P. formosa* the L- or O-form. This is probably not true of points 3) and 4), but these differences are very small and hardly of great importance.

The holotype pygidium of *P. formosa* is ornamented with terrace lines all over the area outside the paradoublural line as well as on the rib furrows, whereas the lectotype pygidium of *P. patagiata* chiefly has the terrace lines concentrated in a zone along the paradoublural line. However, as pointed out by JAANUSSON (1953, p. 458) some pygidia of *P. patagiata* are covered with terrace lines all over the outer surface. In Norwegian pygidia, which in any case would have been assigned to *P. patagiata*, the development of the terrace lines varies from forms with terrace lines only along the paradoublural line to

forms where they cover practically the whole of the test. The pattern of the terrace lines can thus hardly be used to distinguish between *P. formosa* and *P. patagiata*.

The holotype pygidium of *P. formosa* is relatively somewhat longer than the lectotype pygidium of *P. patagiata*. However, intermediate forms occur as well in the Norwegian material, and it is important that all the relatively shortest pygidia appear to be longitudinally compressed and/or transversely widened (W-forms). The dorsal shield (P.M.O. no. 3695) figured by JAANUSSON (1953, pl. X, fig. 1) is rather an extreme W-form. Actually the differences in proportions are greater between the pygidium of this specimen and of the lectotype of *P. patagiata* than between those of the latter and the holotype pygidium of *P. formosa*.

It seems rather probable to me that the Norwegian specimen previously referred to *P. formosa* is conspecific with those assigned to *P. patagiata*. This, of course, does not imply that the types of *P. formosa* and *P. patagiata* necessarily are conspecific. If they are, *P. formosa* would represent the L-form or O-form and *P. patagiata* the W-form of the same species. This could perhaps be proved or disproved by examining a great number of specimens from their common type locality in Sweden and especially search for their eventual type of deformation.

Description: — A few additions may be made to the description given by JAANUSSON (1953). Some specimens with the genal corners preserved show that well-developed genal spines are present. This is true also of the specimen (P.M.O. no. 56556) previously assigned to *P. formosa*. The cephalic doublure is slightly wider than half the distance from the eye to the cephalic margin. Some well-preserved free cheeks and pygidia show that the outer surface of the test is ornamented with very small pits. A few associated hypostomes which may be conspecific, are of the *Asaphus* type.

Dimensions: — See JAANUSSON (1953, p. 458). The largest part present (a pygidium) suggests a total length of the dorsal shield of about 10 cm.

Occurrence: — *Pseudomegalaspis patagiata* occurs in Norway in the upper part of the Ogygiocaris series, in at least the uppermost part of the Upper Didymograptus shale (4a₂), in the Ogygiocaris shale s.s. (4a₃), and probably also in the *Trinucleus bronni* beds (4a₄).

OSLO—ASKER: Huk on Bygdøy (4aa₃); Vekkopp on Bygdøy (4aa₃); Building site of the Vigeland Fountain in the Frogner Park in Oslo (4aa₃); Håkavik, Engervik, and Elnestangen in Asker (4aa₃), and several other localities. — EIKER—SANDSVÆR: Vestfossen (4aa); Muggerudkleiva (4aa). — RINGERIKE: (4aa). — HADELAND: Lunner in Gran (4aa₃). — TOTEN: (4aa₃). — HAMAR—NES: Helgøya (4aa); Nes (4aa); Flakstadelva (4aa). — RINGSAKER: Furnes Church (4aa). — SWEDEN.

Pseudomegalaspis? sp.

Pl. 12, fig. 8.

Remarks: — A single, somewhat worn dorsal shield resembles *Pseudomegalaspis patagiata*, but differs *i.a.* in having wider preocular cheek (about 1/3 as wide as glabella), in apparently lacking anterior pits, in having a relatively longer pygidial axis and in having a less concave border of the pygidial doublure (as seen from above). No genal spines are preserved, but the preservation of the genal corners is rather poor. It is hard to tell how wide the pygidial doublure is, but it appears to be rather narrow, and in this character the specimen resembles *Pseudomegalaspis*. The cephalon, however, also resembles that of *Ogmasaphus*. The outer surface of the test is too poorly preserved to show whether terrace lines were present or not.

Dimensions: — The specimen (P.M.O. no. 36832) is 7.3 cm long.

Occurrence: — In a loose limestone lens, probably from the Cephalopod shale, Hamar—Nes.

Subfamily Isotelinae ANGELIN, 1854

Genus *Isotelus* DEKAY, 1824

Type species: — *Isotelus gigas* DEKAY, 1824.

Isotelus cf. *platyrhachis* STEINHARDT, 1874

Pl. 14, figs. 5—7.

1897 *Asaphus* cf. *Powisii*, MURCH. — KLÆR, pp. 39, 73. (Recorded.)

1909 *Asaphus* aff. *Powisii*, MURCH. — HOLTEDAHL, pp. 20, 23, 32. (Recorded.)

Material: — Several more or less fragmentary detached parts of the dorsal shield, preserved in limestone.

Remarks: — The cranidia resemble that assigned to *Isotelus*

platyrhachis by SCHMIDT (1901, pl. X, fig. 14) but expands somewhat less in front of the eyes. As in other species of *Isotelus*, no glabellar node is developed. The free cheeks have a well developed genal spine and a flattened, slightly concave border, which widens posteriorly. The doublure is strongly concave, as seen from above. Two fragmentary hypostomes show that the hypostome is of the *Isotelus* type with short anteromedian body and with stout posterior projections with a subtriangular cross section (with ventral "keel"), as in the hypostome of *I. remigum* illustrated by SCHMIDT (1901, pl. X, figs. 17, 17a). Only fragments of pleurae are present of the thorax. Pygidium elongated subtriangular and agreeing rather well with the pygidium of *I. platyrhachis* figured by SCHMIDT (1901, pl. X, fig. 16). The border is depressed. Two rather small pygidia (6 and 9 mm long) differ in being relatively shorter and wider, but may belong to the same species since the length of the pygidium increases with growth in relation to width also in e.g. *I. gigas*. The fragmentary character of the material impedes a comparison with other forms, but the present form is probably rather close to the species assigned to *I. platyrhachis* by SCHMIDT (1901).

Dimensions: — The most complete detached parts of the shield all belong to rather small individuals. Fragments of larger individuals indicate that the form may have reached a total length of 15 cm or more.

Occurrence: — *Isotelus* cf. *platyrhachis* occurs in the Mjøsa limestone and in the underlying Cyclocrinus beds in Hamar—Nes. Most of the material comes from the uppermost part of the Mjøsa limestone, where some beds are rather rich in fragments of it. I have not been able to locate the specimens assigned to *Isotelus* cf. *gigas* by BRØGGER (1884, p. 265) from the Encrinite limestone in Skien—Langesund. It is possible that they belong to the same form as in the contemporaneous Mjøsa limestone.

HAMAR—NES: Bergvika on Helgøya; Furuberget. — ?SKIEN—LANGESUND.

Present determination of Middle Ordovician asaphids previously recorded from the Oslo region.

Some species which were recorded previously, have been redetermined, and the generic name has been changed in some species. The following list may be useful when consulting earlier papers.

Name used by

Name used in the present paper

BRØGGER, 1884

<i>Asaphus</i> cf. <i>platyrurus</i>	<i>Ogmasaphus stoermeri</i> n. sp.
<i>Asaphus acuminatus</i>	<i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
<i>Asaphus nobilis</i> aff.	<i>Pseudoasaphus limatus</i>
<i>Isotelus</i> cf. <i>gigas</i>	? <i>Isotelus</i> cf. <i>platyrhachis</i>

BRØGGER, 1887

<i>Asaphus acuminatus</i>	<i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
Ny <i>Asaphus</i> -art. (New sp. of <i>A.</i>) ...	<i>Ogmasaphus multistriatus</i> n. sp.
<i>Asaphus platyrurus</i>	<i>Ogmasaphus jaanussoni</i> n. sp. and <i>Ogmasaphus kiaeri</i> n. sp.
<i>Asaphus</i> cf. <i>acuminatus</i>	<i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
<i>Ptychopyge glabrata</i>	<i>Ogmasaphus kiaeri</i> n. sp.
<i>Ptychopyge</i> cf. <i>glabrata</i>	<i>Ogmasaphus kiaeri</i> n. sp. and <i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
<i>Ptychopyge</i> cf. <i>brachyrhachis</i>	? (specimens not located.)
<i>Megalaspis</i> n. sp.	<i>Pseudomegalaspis patagiata</i>

HOLTEDAHL, 1909

<i>Asaphus</i> n. sp. aff. <i>A. striatus</i> (pyg.)	<i>Ogmasaphus multistriatus</i> n. sp.
<i>Pseudasaphus globifrons</i> var. (ceph.)	<i>Ogmasaphus multistriatus</i> n. sp.
<i>Asaphus</i> n. sp.	<i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
<i>Asaphus latus</i> var.	<i>Ogmasaphus</i> sp.
<i>Asaphus lepidus</i> var.	? (specimens not located.)
<i>Asaphus laevigatus</i>	? (specimens not located.)
<i>Megalaspis patagiata</i>	<i>Pseudomegalaspis patagiata</i>
<i>Basilicus kegelensis</i>	<i>Pseudobasilicus</i> cf. <i>kegelensis</i>
<i>Basilicus</i> aff. <i>Powisii</i>	<i>Isotelus</i> cf. <i>platyrhachis</i>

STØRMER, 1953

<i>Ogygiocaris dilatata</i>	<i>Ogygiocaris dilatata</i>
<i>Ogygiocaris dilatata sarsi</i>	<i>Ogygiocaris sarsi</i> (3 subsp.)
<i>Pseudomegalaspis patagiata</i>	<i>Pseudomegalaspis patagiata</i>
<i>Pseudasaphus</i> sp.	<i>Pseudoasaphus limatus</i>
<i>Pseudasaphus</i> ? sp.	<i>Pseudoasaphus limatus</i>
<i>Asaphus ludibundus</i>	<i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
<i>Asaphus</i> sp.	<i>Ogmasaphus kiaeri</i> n. sp. and <i>Asaphus</i> (<i>Neoasaphus</i>) <i>ludibundus</i>
<i>Asaphus</i> (<i>Neoasaphus</i>) <i>bottnicus</i>	<i>Asaphus</i> n. sp. (transition beds.)

REFERENCES

- ANGELIN, N. P., 1854: *Palæontologia scandinavica. Pars I. Crustacea formationis transitionis. Fasc. II.* — Pp. I—IX, 21—92, pls. XXV—XLI. Holmiæ (Stockholm).
- 1878: *Idem. Appendix (Editor G. LINDSTRÖM)* — Pp. 93—96, pls. I—III, XLII, Holmiæ (Stockholm).
- BALAŠOVA, E. A., 1953: *K istorii razvitija roda Asaphus v ordovike pribaltiki.* — *Trudy VNIGRI, nov. ser.*, 78, pp. 385—437, pls. I—V. Leningrad — Moskva.
- BJØRLYKKE, K. O., 1898: *Geologisk kart med beskrivelse over Kristiania by.* — *Norges geol. unders.*, no. 25, pp. 1—86, 1 map. Kristiania (Oslo).
- BOECK, C., 1838: *Uebersicht der bisher in Norwegen gefundenen Formen der Trilobiten-Familie.* — In KEILHAU: *Gaea Norwegica*, I pp. 138—145. Christiania (Oslo).
- BROGGER, W. C., 1882: *Die Silurischen Etagen 2 und 3 im Kristianiagebiet und auf Eker.* — *Universitätsprogram für 2. Sem. 1882*, pp. I—VIII, 1—376, pls. I—XII. Kristiania (Oslo).
- 1884: *Spaltenverwerfungen in der Gegend Langesund—Skien.* — *Nyt Mag. Naturvid.*, 28, pp. 253—419. Christiania (Oslo).
- 1886: *Ueber die Ausbildung des Hypostomes bei einigen skandinavischen Asaphiden.* — *Bihand till Kongl. Svenska Vet.-Akad. Handl.*, 11, no. 3, also: *Sveriges geol. unders. Ser. C*, no. 82, pp. 1—78, pls. I—III. Stockholm.
- 1887: *Geologisk kart over øerne ved Kristiania.* — *Nyt Mag. Naturvid.*, 31, no. 2, pp. 162—192 (reprint, pp. 1—36), 1 map. Kristiania (Oslo).
- BRONGNIART, A., & DESMAREST, A.-G., 1822: *Histoire Naturelle des Crustacés Fossiles, sous les rapports zoologiques et géologiques.* — Paris.
- BRÜNNICH, M. T., 1781: *Beskrivelse over Trilobiten, en Dyreslægt og dens Arter, med en ny Arts aftegning.* — *Kongl. Danske Vid. Selsk. Skr., Nye Saml.*, Deel 1, pp. 384—395, 1 pl. Kiøbenhavn (Copenhagen).
- BURMEISTER, H., 1843: *Die Organisation der Trilobiten.* — Pp. I—XII, 1—148, pls. I—IV. Berlin.
- DALMAN, J. W., 1827: *Om Palæaderna eller de så kallade Trilobiterna.* — *Kongl. Vet. Acad. Handl. 1826*, pp. 113—162, 226—294, pls. I—VI. Stockholm.
- DEKAY, J. E., 1824: *Observations on the structure of trilobites and description of an apparently new genus; with notes on the geology of Trenton Falls, by James Renwick.* — *Ann. Lyceum Nat. Hist.*, 1, p. 174. 2 pls. New York.
- DESMAREST, A.-G., 1817: *Nouveau dictionnaire d'histoire naturelle*, vol. VIII. 2nd. edition. — Pp. 1—154, pls. I—XI. Paris.
- EICHWALD, E., 1857: *Beiträge zur geographischen Verbreitung der fossilen Thiere Russland's.* — *Bull. Soc. Nat.*, 30. Moscow.
- FUNKQUIST, H. P. A., 1919: *Asaphusregionens omfattning i sydöstre Skåne och på Bornholm.* — *Lunds Univ. Årsskr.*, N. F., Avd. 2, vol. 16, no. 1,

- also: Kungl. Fysiogr. Sällsk. Handl., N. F., vol. 31, no. 1, pp. 1—56, pls. I—II. Lund.
- GROKUD, H.-F., 1940: Et profil gjenem Ogygiaskifer og Ampyxkalk på Tørtbergf, Frogner ved Oslo. — Norsk geol. tidsskr., 20, pp. 157—160. Oslo.
- HADDING, A., 1913: Undre Dicellograptusskiffern i Skåne jämte några därmed ekvivalenta bildningar. — Lunds Univ. Årsskr., N. F., afd. 2, vol. 9, no. 15; also Kongl. Fysiogr. Sällsk. Handl., N. F., vol. 24, no. 15; also Meddel. Lunds geol. fältklubb, ser. B, no. 6, pp. 1—91, pls. I—VIII. Lund.
- HARRINGTON, H. J., & LEANZA, A. F., 1957: Ordovician trilobites of Argentina. — Dept. Geol., Univ. Kansas, Spec. Publ. no. 1, pp. 1—276, 139 text figs. Lawrence, Kansas.
- HENNINGSMOEN, G., 1957: The trilobite family Olenidae. With description of Norwegian material and remarks on the Olenid and Tremadocian series. — Skr. Norske Vidensk.-Akad., I kl., 1957, no. 1, pp. 1—303, pls. 1—31 Oslo.
- 1957a: Los trilobites de las capas de Saukianda, cambrico inferior, en Andalucia. — Estud. Geol., 14, nos. 35—36, pp. 251—270, pls. XXXVI—XXXIX. Madrid.
- HOLTEDAHL, O., 1909: Studien über die Etage 4 des norwegischen Silursystems beim Mjösen. — Vidensk.-Selsk. Skr., I kl., 1909, no. 7, pp. 1—76. Christiania (Oslo).
- HUPÉ, P., 1953: Contribution à l'étude du cambrien inférieur et du précambrien III de l'Anti-Atlas marocain. — Serv. géol. Maroc, Notes et mém., no. 103, 1952, pp. 1—402, pls. I—XXIV.
- JAANUSSON, V., 1953: Untersuchungen über baltoskandische Asaphiden I. Revision der mittelordovizischen Asaphiden des Siljan-Gebietes in Dalarna. — Arkiv Miner. Geol., 1, no. 14, pp. 377—464, pls. I—X. Stockholm.
- 1953a: Untersuchungen über baltoskandische Asaphiden II. Revision der Asaphus (Neoasaphus)-Arten aus dem Geschiebe des südbottnischen Gebietes. — Arkiv Miner. Geol., 1, no. 15, pp. 465—499, pls. I—V. Stockholm.
 - 1956: On the trilobite genus *Celmus* Angelin, 1854. — Bull. Geol. Inst. Uppsala, 36, pp. 35—49, pl. I. Uppsala.
 - 1956a: Proposed use of the Plenary Powers to suppress the generic name "*Asaphus*" as published by Brongniart in Desmarest, 1817, and to designate a type species in harmony with general usage for the genus "*Asaphus*" Brongniart, 1822 (Class Trilobita). — Bull. zool. Nomencl., 12, pt. 3, pp. 90—96, pl. I. London.
 - 1960: The Viruan (Middle Ordovician) of Öland. — Bull. Geol. Inst. Univ. Uppsala, 38 pp. 207—288, pls. 1—5. Uppsala.
- KIÆR, J., 1897: Faunistische Uebersicht der Etage 5 des norwegischen Silursystems. — Vidensk.-selsk. Skr., I kl., 1897, no. 3, pp. 1—76. Kristiania (Oslo).
- KIELAN, Z., 1960: Upper Ordovician trilobites from Poland and some related

- forms from Bohemia and Scandinavia. — *Palaeont. Polonica*, no. 11, 1959, pp. 1—198, pls. I—XXXVI. Warszawa.
- LINDSTRÖM, G., 1901: Researches on the visual organs of the trilobites. — *Kongl. Svenska Vetensk.-Akad. Handl.*, 34, no. 8, pp. 1—86, pls. I—VI. Stockholm.
- LINNARSSON, J. G. O., 1896: Om Vestergötlands Cambriska och Siluriska aflagringar. — *Kungl. Svenska Vetensk.-Akad. Handl.*, 8, no. 2, pp. 1—89, pls. I—II. Stockholm.
- MOBERG, J. G., 1902: Bidrag till kännedomen om trilobiternas byggnad. — *Geol. Fören. Förhandl.*, 24, 5, pp. 295—302, pl. 3. Stockholm.
- RAYMOND, P. E., 1912: Notes on parallelism among the Asaphidae. — *Trans. Roy. Soc. Canada*, 3rd. ser., vol. V, sect. IV, pp. 111—120, pls. I—III. Ottawa.
- 1937: Upper Cambrian and Lower Ordovician Trilobita and Ostracoda from Vermont. — *Bull. Geol. Soc. America*, 48, pp. 1079—1146, pls. 1—4. New York.
- REED, F. R. C., 1930: A review of the Asaphidae. — *Ann. & Mag. Nat. Hist.*, ser. 10, vol. V, pp. 288—320. London.
- RICHTER, R., & RICHTER, E., 1937: Die Herscheider Schiefer, ein zweites Vorkommen von Ordovizium im Rheinischen Schiefergebirge und ihre Beziehung zu den wiederergefundenen Dayia-Schichten. — *Senckenbergiana*, 19, nos. 3/4, pp. 289—313. Frankfurt a. M.
- & — 1954: Die Trilobiten des Ebbe-Sattels und zu vergleichende Arten. (Ordovizium, Gotlandium/Devon). — *Abhandl. Senckenberg. Naturforsch. Ges.*, 488, pp. 1—76, pls. 1—6. Frankfurt a. M.
- SARS, M., 1835: Ueber einige neue oder unvollständig bekannte Trilobiten. — *Okens Isis*, 1835, no. 4.
- SCHMIDT, F., 1898: Revision der ostbaltischen silurischen Trilobiten. Abteilung V. Asaphiden. Lieferung I. — *Mem. Acad. Impér. Sci. St.-Pétersbourg*, 8. ser., vol. 6, no. 11, pp. 1—46. St.-Pétersbourg (Leningrad).
- 1901: Idem. Lieferung II. — *Idem.*, vol. 12, no. 8, pp. 1—113, pls. I—XII.
- 1904: Idem. Lieferung III. — *Idem.*, vol. 14, no. 10, pp. 1—68, pls. I—VIII.
- SKJESETH, S., 1955: The Middle Ordovician of the Oslo region, Norway 5. The trilobite family Styginidae. — *Norsk geol. tidsskr.*, 35, pp. 9—28, pls. I—V. Oslo.
- STEINHARDT, E. T. G., 1874: Die bis jetzt in preuss. Geschieben gefundenen Trilobiten. Beiträge zur Naturkunde Preussens 3. — Pp. 1—64, pls. I—VI. Königsberg.
- STØRMER, L., 1940: Early descriptions of Norwegian trilobites. The type specimens of C. Boeck, M. Sars and M. Esmark. — *Norsk geol. tidsskr.*, 20, pp. 113—151, pls. 1—3. Oslo.
- 1942: Studies on trilobite morphology. Part II. The larval development, the segmentation and the sutures, and their bearing on trilobite classification. — *Norsk geol. tidsskr.*, 21, pp. 49—164, pls. 1—2. Oslo.

- STØRMER, 1953: The Middle Ordovician of the Oslo region, Norway 1. Introduction to stratigraphy. — Norsk geol. tidsskr., 31, pp. 37—141, pls. 1—6. Oslo.
- THORAL, M., 1946: Cycles géologiques et formations nodulifères de la Montagne Noire. — Nouv. Arch. Mus. Hist. Nat. Lyon, fasc. 1, pp. 1—103, pls. I—XVI. Lyon.
- THORSLUND, P., & ASKLUND, B., 1935: Stratigrafiske och tektoniska studier inom Föllingeområdet i Jämtland. — Sveriges geol. unders., Ser. C., no. 388, pp. 1—61, pls. 1—3. Stockholm.
- THORSLUND, P., 1940: On the Chasmops series of Jemtland and Södermanland (Tvären). — Sveriges geol. unders., Ser. C., no. 436, pp. 1—191, pls. 1—15. Stockholm.
- TÖRNQVIST, S. L., 1884: Undersökningar öfver Siljanområdets trilobitfauna. — Sveriges geol. unders., Ser. C., no. 66, pp. 1—101, pls. I—III. Stockholm.
- TREATISE ON INVERTEBRATE PALEONTOLOGY, Part O, Arthropoda 1. Pp. I—XIX, 01—0560. Lawrence, Kansas, 1959.
- WAHLENBERG, G., 1821: Petrificate telluris svecana. — Nova Acta Soc. Reg. Sci., 8, pp. 1—116, pls. 1—4. Upsaliae.

KNOWN STRATIGRAPHICAL AND
GEOGRAPHICAL DISTRIBUTION OF
MIDDLE ORDOVICIAN ASAPHIDS
IN THE OSLO REGION

[illegible]

PLATES 1—14

The photographs, which were taken by Miss B. Mauritz in co-operation with the author, are not retouched.

The specimens were given a light coating of ammonium chloride before photographing.

P.M.O. = Palaeontological Museum, Oslo.

P.I.L. = Palaeontological Institute, Lund.

P.I.U. = Palaeontological Institute, Uppsala.

RM. = Swedish Museum of Natural History, Palaeozoological department.

PLATE 1

All $\times 0.8$

Ogygiocaris dilatata (BRÜNNICH, 1871).

- Fig. 1. Dorsal shield, *lectotype*. Evidently 4aa. From near Fossum Iron works, north of Skien, Skien—Langesund. BRÜNNICH's specimen. Mineralogisk Museum, Copenhagen. $\times 0.8$.
- Fig. 2. Dorsal shield without free cheeks. 4aa. Eiker. Lectotype of *O. dilatata* var. *stroemi* ANGELIN, 1872. P.M.O. no. 67032. $\times 0.8$.
- Fig. 3. Cranidium retaining convexity. 4aa. Muggerudkleiva, Eiker—Sandsvør. Coll. L. Størmer, 1925—27. P.M.O. no. 60441. $\times 0.8$.
- Fig. 4. Cranidium and parts of free cheeks. The anterior lobe shows traces of the parafrontal band and a similar band inside it. 4aa. Muggerudkleiva, Eiker—Sandsvør. Coll. L. Størmer, 1925—27. P.M.O. no. 60451. $\times 0.8$.
- Fig. 5. Cranidium, strongly compressed, showing median ridge and traces of parafrontal band and a similar band inside it. 4aa. N. Fossum, Bø, Gjerpen, Skien—Langesund. Coll. G. Holm, 1879. RM. no. Ar 37050. $\times 0.8$.
- Fig. 6. Incomplete hypostome and part of cephalic doublure. 4aa. Muggerudkleiva, Eiker—Sandsvør. Coll. L. Størmer, 1925—27. P.M.O. no. 60541. $\times 0.8$.
- Fig. 7. Small pygidium. 4aa. Between Hagabukta and Sjøstrand, Asker. (Associated with *O. striolata corrugata* n. subsp.) Coll. G. Henningsmoen, 1958. P.M.O. no. 72138. $\times 0.8$.

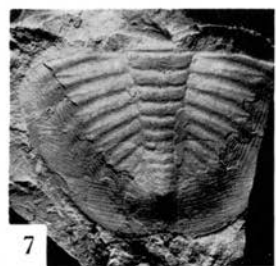
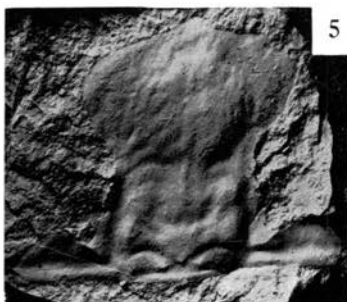
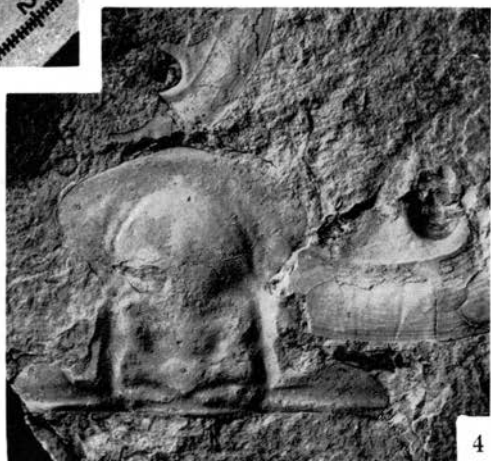
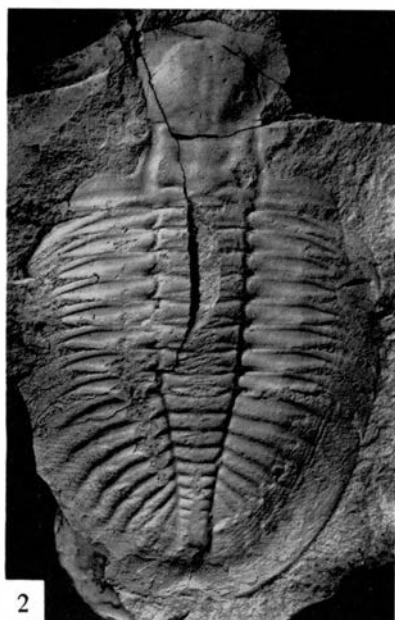
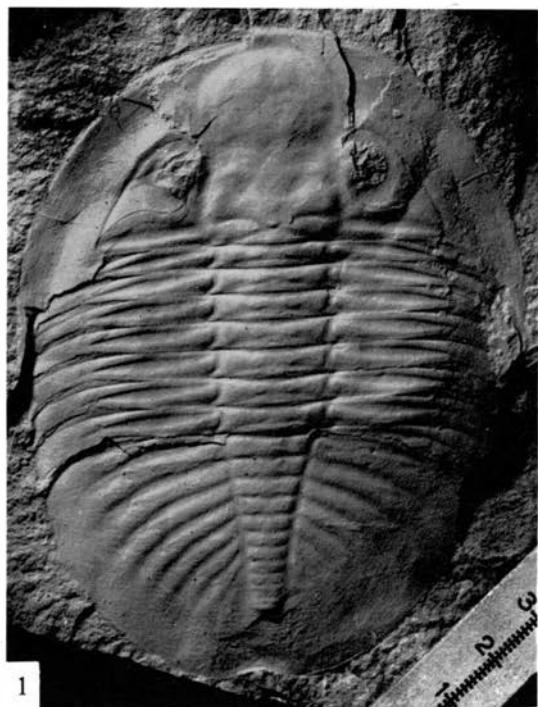


PLATE 2

All natural size.

Ogygiocaris dilatata (BRÜNNICH, 1871).

- Fig. 1. Latex cast of part of cephalon. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 60457. $\times 1$.
- Fig. 2. Free cheek showing doublure. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 60551. $\times 1$.
- Fig. 3. Latex cast of pygidium. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 72144. $\times 1$.
- Fig. 4. Pygidium. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 60471. $\times 1$.
- Fig. 5. Pygidium. Terrace lines on test less transverse than in most specimens. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 72143b. $\times 1$.
- Fig. 6. Pygidium. The right side shows well the undulating paradoublural line. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 72103. $\times 1$.

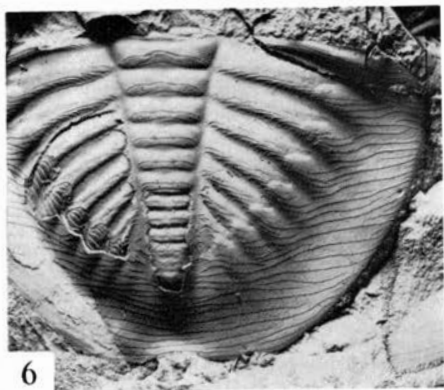
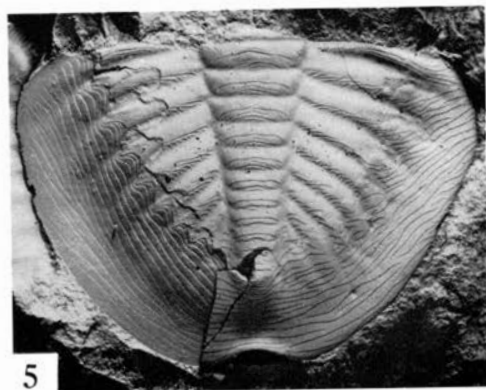
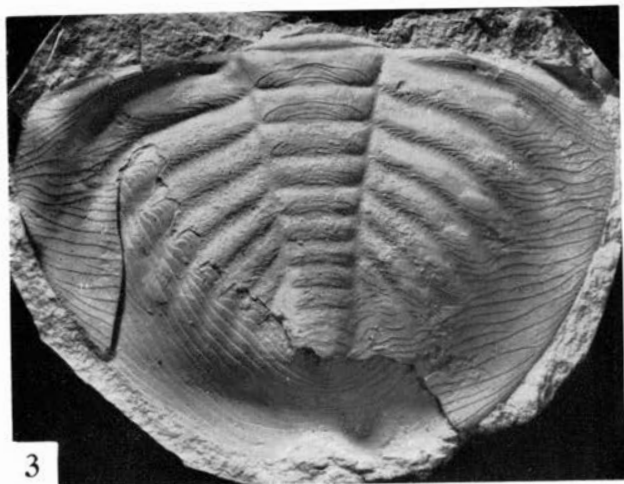


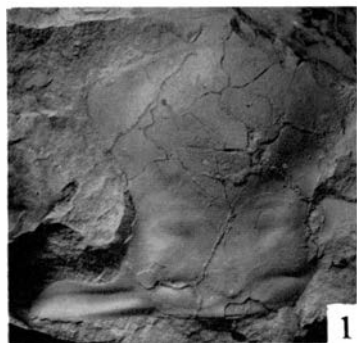
PLATE 3

Ogygiocaris striolata corrugata n. sp. & subsp.

- Fig. 1. Cranidium. Loose limestone lens with calcite fillings, 4aa. Elnestangen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72131. $\times 1$.
- Fig. 2. Fragmentary pygidium. Same lens as the specimen in fig. 1. P.M.O. no. 72120. $\times 1$.
- Fig. 3. Fragmentary pygidium, holotype. Limestone lens, 4aa, 4.60 m below continuous limestone bed in the section in text fig. 3. Between Hagabukta and Sjøstrand, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72134. $\times 1$.
- Fig. 11. Detail of pygidium in fig. 3. $\times 3$.

Ogygiocaris striolata striolata n. sp. & subsp.

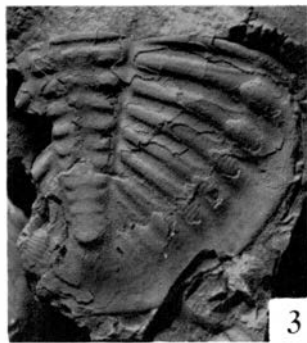
- Fig. 4. Fragmentary free cheek. 4aa. Limestone lens 1.0 m below continuous limestone bed in section in text fig. 3. Between Hagabukta and Sjøstrand, Asker. Coll. G. Henningsmoen, 1958. P.M.O. no. 72112. $\times 1$.
- Fig. 5. Fragmentary cranidium. From same lens as the specimen in fig. 4. P.M.O. no. 72115. $\times 1$.
- Fig. 6. Pygidium. Light from behind. From same lens as the specimen in fig. 4. P.M.O. no. 72114. $\times 1$.
- Fig. 7. Hypostome. 4aa. Limestone lens ca. 1 m below lowest continuous limestone bed. Elnestangen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72104. $\times 1$.
- Fig. 8. Pygidium (*holotype*) from same lens as the specimen in fig. 4. P.M.O. no. 72108. $\times 1$.
- Fig. 9. Pygidium. 4aa. Fornebu, Bærum, Oslo-Asker. Coll. W. Werenskiöld, 1910. P.M.O. no. 3750. $\times 1$.
- Fig. 10. Detail of pygidium in fig. 8. $\times 3$.



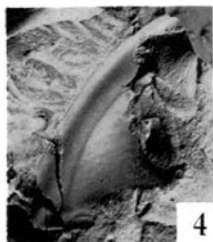
1



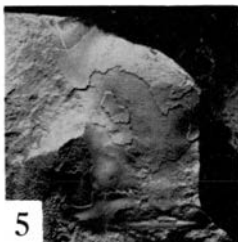
2



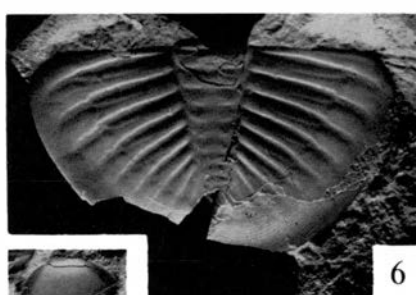
3



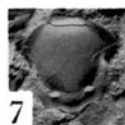
4



5



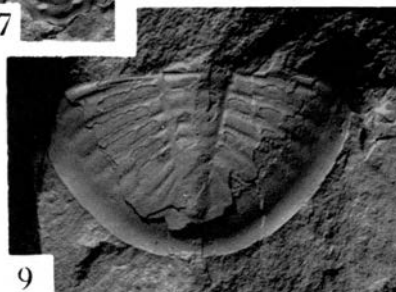
6



7



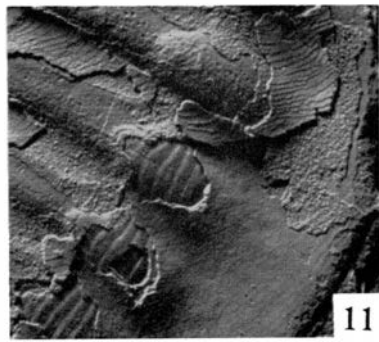
8



9



10



11

PLATE 4

Ogygiocaris sarsi sarsi ANGELIN, 1872.

- Fig. 1. Disconnected dorsal shield, *lectotype*. 4aa, evidently 4aa₃. Hjortnes-tangen, Oslo. Coll. M. Sars. P.M.O. no. 20287. × 1.
- Fig. 2. Latex cast of counterpiece of lectotype. The specimen appears to be somewhat forelengthened. P.M.O. no. 20288. × 1.
- Fig. 3. Pleuron, partly showing doublure. 4aa. Vekkopp, Bygdøy, Oslo. Coll. P. Størmer. P.M.O. no. 53298. × 1.8.
- Fig. 4. Hypostome, slightly forelengthened. 4aa. Håkavik, Asker. Coll. G. Holm, 1879. Figured by LINDSTRÖM, 1901, pl. 5, figs. 27–28. RM. no. Ar 37135. × 1.
- Fig. 5. Sample showing two deformed pygidia, oriented at right angles to each other. The left pygidium (P.M.O. no. 20286a) with exaggerated width (W-form), the right pygidium (no. 20286b) with exaggerated length (L-form). 4aa₃. Huk, Bygdøy, Oslo. × 1.
- Fig. 6. Side view of eye. 4aa. Hjortnestangen, Oslo. The old collection. P.M.O. no. 56320. × 4.5.
- Fig. 7. Small pygidium. 4aa. Huk, Bygdøy, Oslo. The old collection. P.M.O. no. 3647. × 1.
- Fig. 8. Cranidium. 4aa₃. Huk, Bygdøy, Oslo. Coll. Excursion, 1907. P.M.O. no. 3647. × 1.9.
- Fig. 9. Same cranidium as in fig. 8. × 1.
- Fig. 10. Pygidium. 4aa. Steilene, Oslo-Asker. Coll. J. Kiær, 1920. P.M.O. no. 3681. × 1.

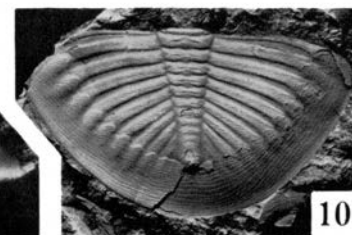
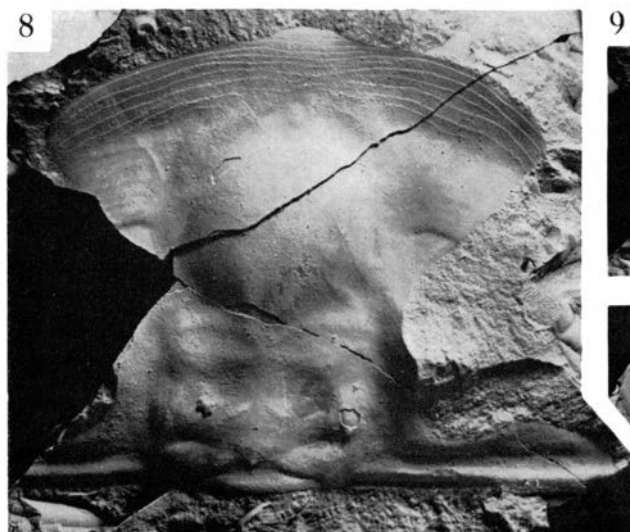
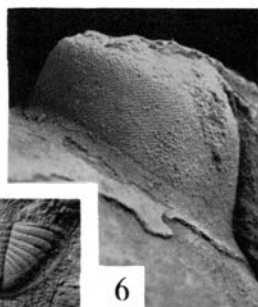
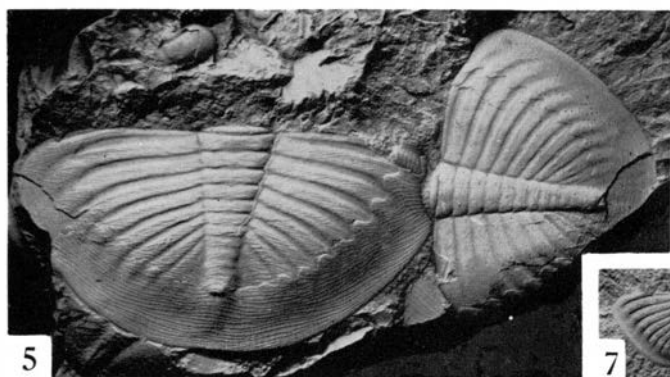
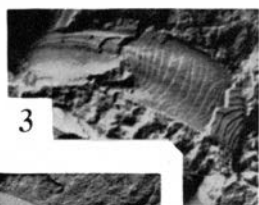
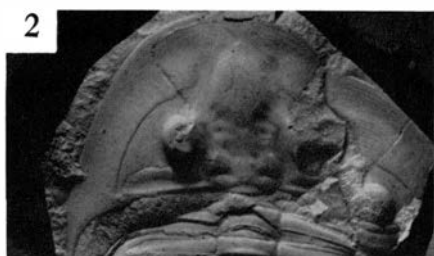


PLATE 5

Ogygiocaris sarsi regina n. subsp.

- Fig. 1. Large pygidium, probably of this subspecies. Probably from 4aa in Toten. P.M.O. no. 72117. $\times 1$.
- Fig. 2. Small pygidium. Ogygiocaris shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1906. P.M.O. no. 36730. $\times 2$.
- Fig. 3. Free cheek with spine brooken off. Ogygiocaris shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1906. P.M.O. no. 36786. $\times 1$.
- Fig. 4. Small cranidium. Ogygiocaris shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. G. Henningsmoen, 1957. P.M.O. no. 72099. $\times 1$.
- Fig. 5. Cranidium. Ogygiocaris shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1906. P.M.O. no. 36790. $\times 1$.
- Fig. 6. Cranidium. Ogygiocaris shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. G. Henningsmoen, 1959. P.M.● no. 72082. $\times 1$.
- Fig. 7. Dorsal shield, *holotype*. Ogygiocaris shale, Toten. Collector unknown. no. 72090. $\times 0.95$.
- Fig. 8. Cephalon. Ogygiocaris shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1906. P.M.O. no. 36722. $\times 1$.

Ogygiocaris sarsi lata HADDING, 1913.

- Fig. 9. Cephalon. Ogygiocaris shale. Andersön, Jämtland, Sweden. Coll. K. Fahlander & E. Julin, 1929. P.I.U. no. ar 1046.

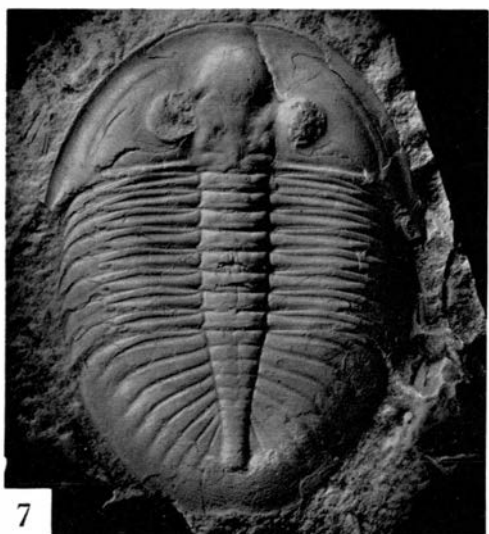
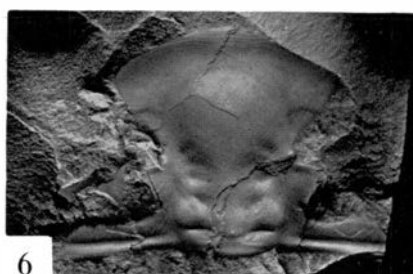
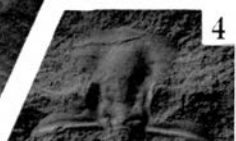
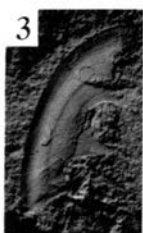


PLATE 6

Ogygiocaris sarsi delicata n. subsp.

- Fig. 1. Cranidium, *holotype*. Helgøya, Hamar—Nes. Coll. W. C. Brøgger, 1881. P.M.O. no. 36673. $\times 1$.
- Fig. 2. Free cheek. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1906. P.M.O. no. I 1418b.
- Fig. 3. Small cranidium. Kolbo, N. Toten. Coll. G. Holm, 1897. RM. no. Ar 37119. $\times 2$.
- Fig. 4. Tiny cranidium. Main road north of Hval, Ringerike. Coll. Th. Munster, 1892. P.M.O. no. 33067. $\times 2$.
- Fig. 6. Pygidium. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1906. P.M.O. no. I 1418a. $\times 1$.
- Fig. 7. Pygidium. Hovindsholm, Helgøya, Hamar—Nes. Coll. W. C. Brøgger, 1881. P.M.O. no. 36675. $\times 1$.
- Fig. 8. Two pygidia. Hovindsholm, Helgøya, Hamar—Nes. Coll. G. Henningsmoen, 1957. P.M.O. no. 72091. $\times 1$.
- Fig. 9. Pygidium. Sterudstranda, Hamar—Nes. Coll. S. Skjeseth, 1950. P.M.O. no. 72071. $\times 2$.
- Fig. 10. Tiny pygidium (counterpiece). Sterudstranda, Hamar—Nes. Coll. S. Skjeseth, 1950. P.M.O. no. 72072. $\times 2$.
- Fig. 11. Hypostome. Hovindsholm, Helgøya, Hamar—Nes. Coll. W. Dean, F. Hagemann, & G. Henningsmoen, 1954. P.M.O. no. 72094. $\times 2$.
- Fig. 12. Pygidium. Sterudstranda, Hamar—Nes. Coll. S. Skjeseth, 1954. P.M.O. no. 72071. $\times 2$.

Ogygiocaris sarsi regina n. subsp.

- Fig. 5. Thorax and pygidium. *Ogygiocaris* shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. G. Henningsmoen, 1957. P.M.O. no. 72098. $\times 1$.

Ogmasaphus multistriatus n. sp.

- Fig. 13. Pygidium, *holotype*. (Associated with the cranidium in fig. 16.) *Ogygiocaris* shale. Storhamar, Hamar—Nes. Coll. ?, 1883. P.M.O. no. 36822a. $\times 1$.
- Fig. 14. Pygidium. 4a? Kilen, Fornebu, Bærum, Oslo—Asker. Coll. W. Wereniskiold, 1907. P.M.O. no. 6007. $\times 1$.
- Fig. 15. Part of cephalon. *Ogygiocaris* shale. Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1907. P.M.O. no. 21931. $\times 2.5$.
- Fig. 16. Small cranidium. *Ogygiocaris* shale. Storhamar, Hamar—Nes. Coll. ?, 1883. P.M.O. no. 36822b. $\times 2.4$.
- Fig. 17. Pygidium, same species? Ampyx limestone (4a β). Road section at Gyssestad, Oslo—Asker. Coll. A. Heintz, 1933. P.M.O. no. 40345. $\times 1$.

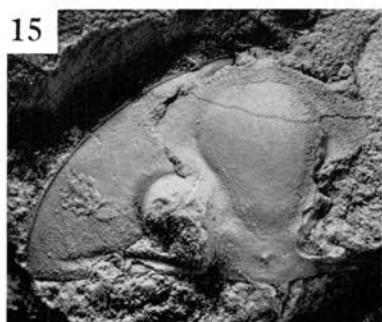
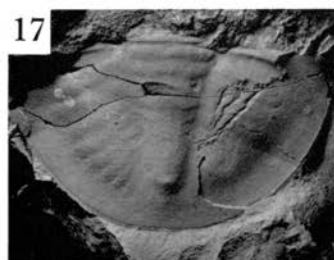
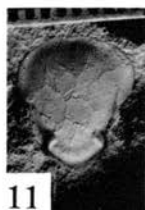
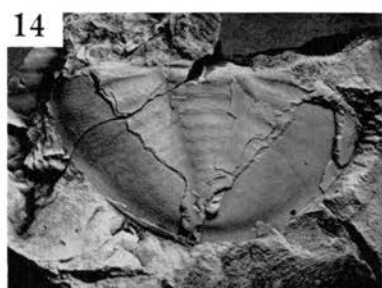
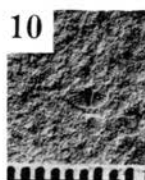
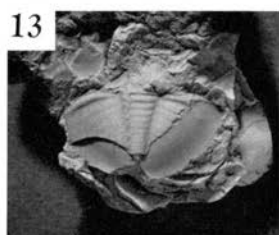
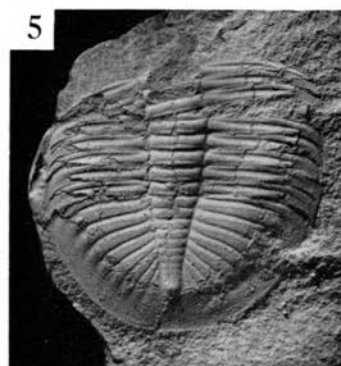
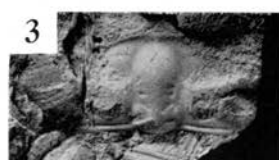


PLATE 7

Asaphus (*Neosaphus*) *heintzi* n. sp.

- Fig. 1. Dorsal shield, *holotype*. Lower Chasmops shale (4ba). Road section, State Road no. 40 at Gyssestad, Oslo—Askær. Coll. A. Heintz. 1932. P.M.O. no. 72073. $\times 1$.
- Fig. 2. Dorsal shield without free cheeks. Same horizon, locality, and collector. P.M.O. no. 55969. $\times 0.8$.
- Fig. 3. Free cheek. Same horizon, locality, and collector. P.M.O. no. 18899. $\times 1$.

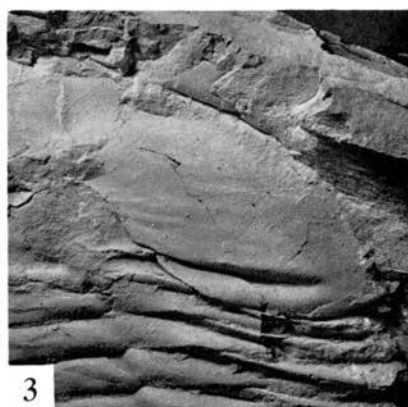
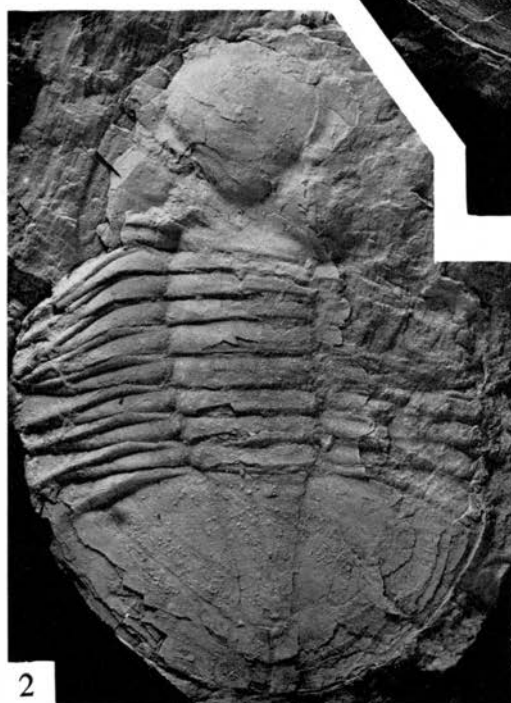
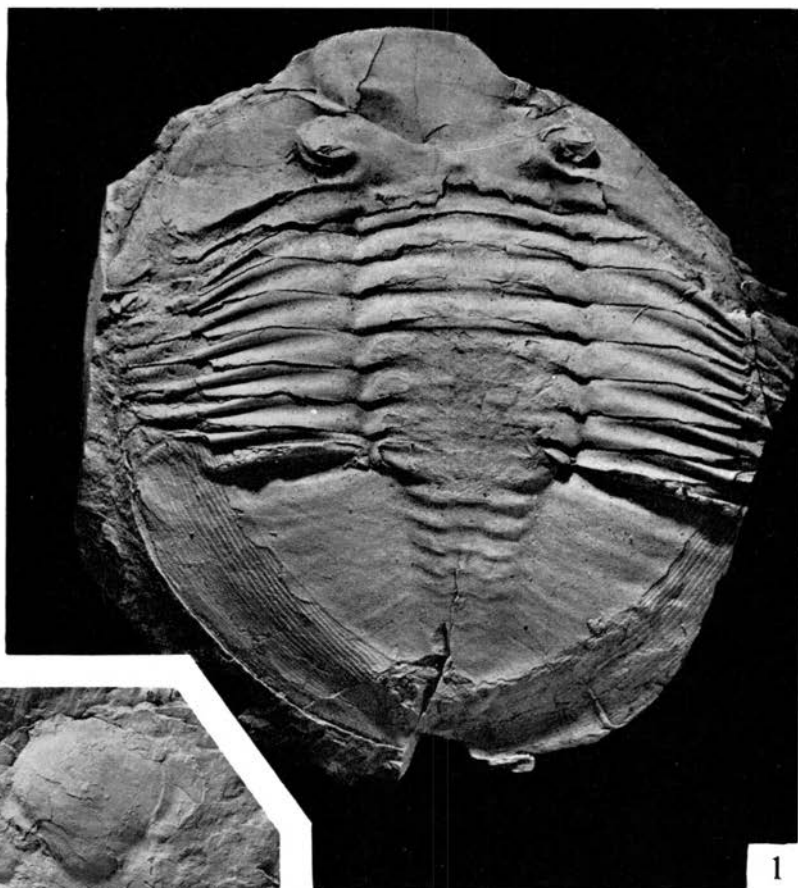


PLATE 8

All ca. natural size.

Asaphus (*Neoasaphus*) *ludibundus* TÖRNQUIST, 1884.

- Figs. 1—3. Dorsal shield. Dorsal views of cephalon, entire specimen (with somewhat drooping cephalon and pygidium), and pygidium. Probably Ampyx limestone (4a β). Fornebu, Bærum, Oslo—Asker. Coll. ?, 1935. P.M.O. no. 58932. \times 1.
- Fig. 4. Enrolled specimen showing concave (from above) cephalic doublure. Horizon unknown. South end of Persteilene, Oslo—Asker. Coll. ? P.M.O. no. 6165. \times 1.
- Fig. 5. Cranidium of form with narrow preocular fixigenal areas. 4a β or 4ba. West side of Røysetangen, Ringerike. Coll. J. Kiær, 1913. P.M.O. no. 7464. \times 1.
- Asaphus* (*Neoasaphus*) cf. *ludibundus* TÖRNQUIST, 1884.
- Fig. 6. Dorsal shield. Cephalopod shale. Mjøsa districts (locality unknown). Coll. ? P.M.O. no. 36941. \times 1.

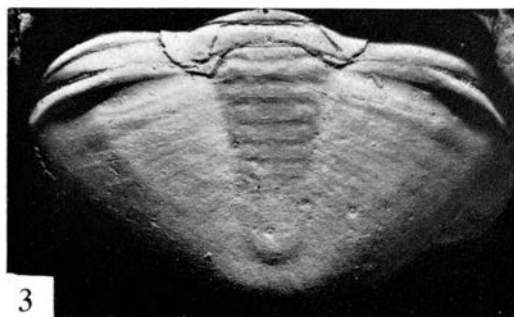
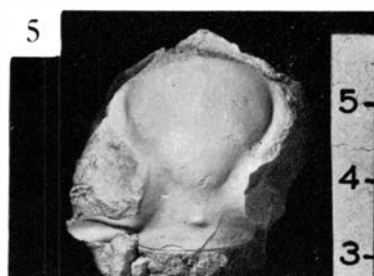
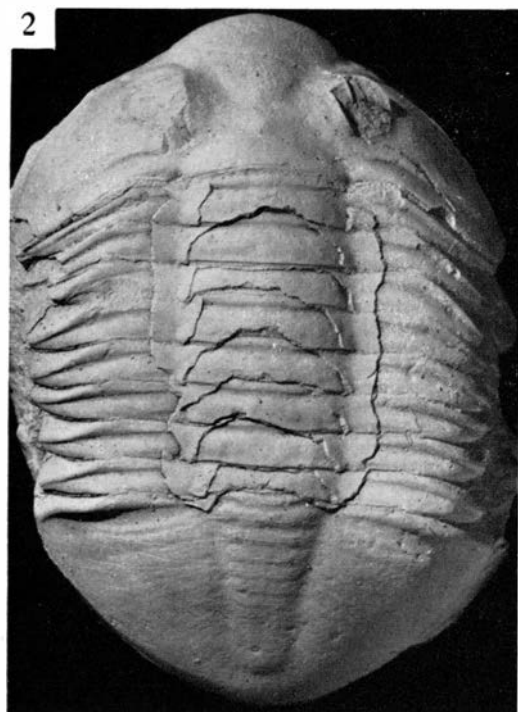
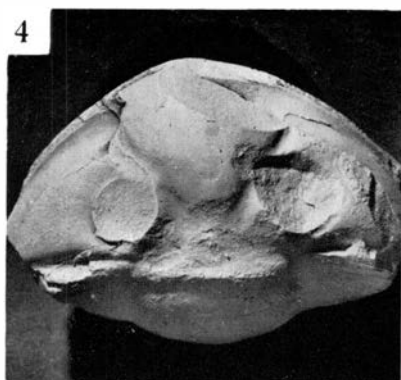
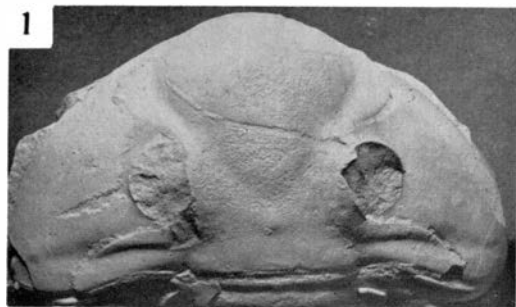


PLATE 9

Ogmasaphus jaanussoni n. sp.

- Fig. 1. Dorsal shield, *holotype*. Horizon unknown. Ruseløkkveien, Oslo. Coll.? P.M.O. no. 61519. $\times 1$.
- Fig. 2. Conspecific? pygidium. 4a? Building site of Rådhuset (City Hall) in Oslo. Coll. A. Heintz. 1933. P.M.O. no. 56580. $\times 1$.
- Fig. 3. Dorsal shield. Horizon? Oslo. A.G. Strøm dedit., 1891. P.M.O. no. 20289. $\times 1$.

Pseudoasaphus limatus JAANUSSEN, 1953.

- Fig. 4. Detail of pygidial axis, showing pits on the outer surface. Horizon? Fornebu Air Field, Bærum, Oslo—Asker. Coll. Kristiansen, 1935. P.M.O. no. 72067. $\times 2$.

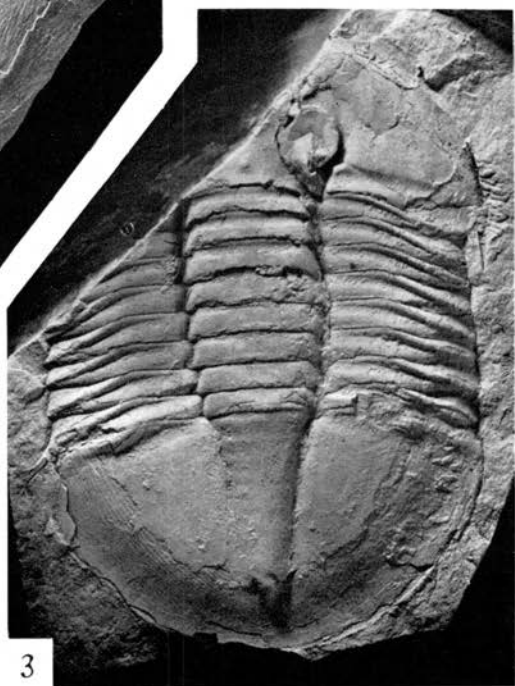
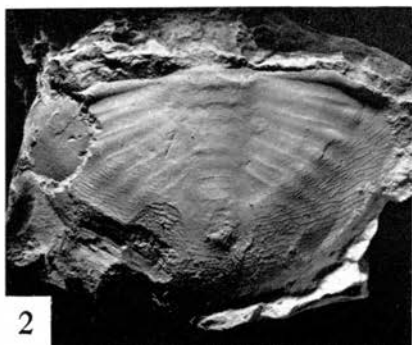
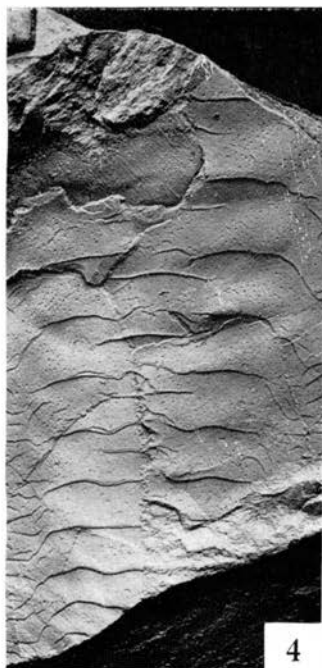
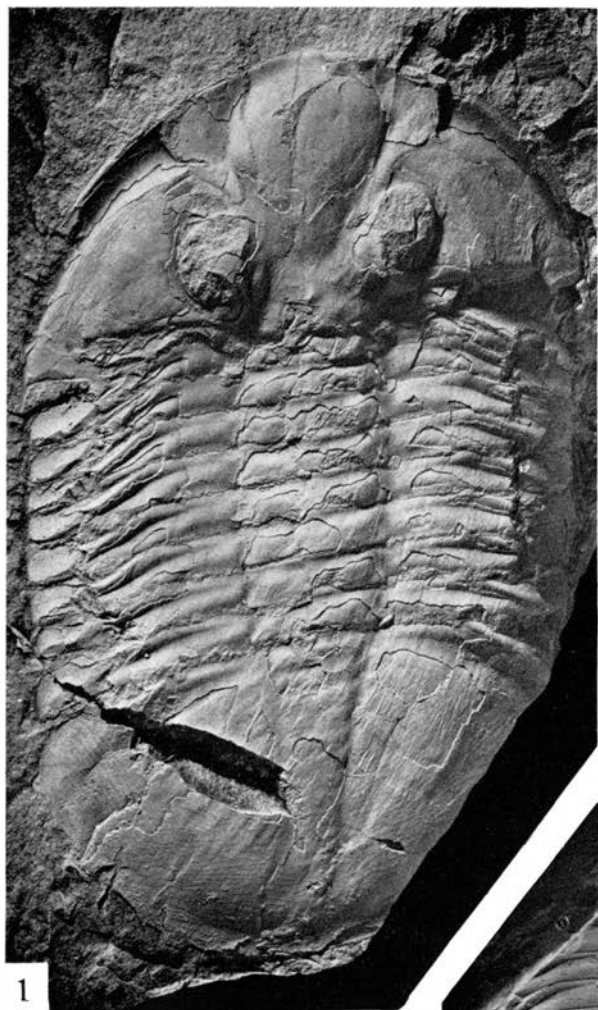


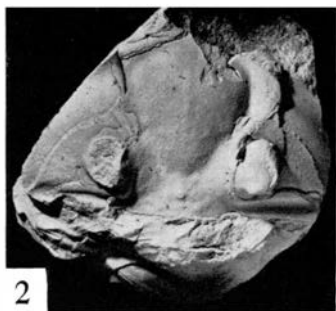
PLATE 10

Ogmasaphus kiaeri n. sp.

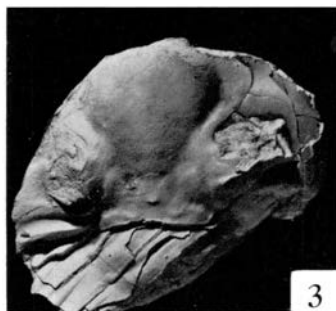
- Fig. 1. Detail of dorsal shield of this species (?), showing cephalic and thoracic doublure and genal angle. 4a—b? Sarpsborggata, Oslo. Coll. S. Rønning, 1932. P.M.O. no. 58932. $\times 1$.
- Fig. 2. Cephalon. 4a β . Holmen, Vollen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72057. $\times 1$.
- Figs. 3—4. Cephalon and pygidium of dismembered enrolled dorsal shield. 4a β . Holmen, Vollen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. nos. 72063—64. $\times 1$.
- Fig. 5. Cranidium. 4a β . Small peninsula on Bygdøy, opposite Skarpsno, Oslo. Coll. G. Henningsmoen, 1941. P.M.O. no. 63460. $\times 1$.
- Fig. 6. Pygidium with parts of outer test preserved. 4a β . Holmen, Vollen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72058. $\times 1$.
- Fig. 7. Exfoliated pygidium. 4a β ? Fornebu Air Field, Bærum, Oslo—Asker. Coll. ?, 1935. P.M.O. no. 58929. $\times 1$.
- Fig. 8. Exfoliated pygidium, also showing some of the doublure. 4a β . Road section, State Road no. 40 at Gyssestad, Oslo—Asker. Coll. A. Heintz, 1933. P.M.O. no. 40341. $\times 1$.
- Fig. 9. Hypostome. 4a β . Holmen, Vollen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72056. $\times 1$.
- Fig. 10. Pygidium showing most of the doublure. Outer test surface present only at anterior end of axis. 4a β . Terneskjær, Oslo—Asker. Coll. J. Kiær, 1898. P.M.O. no. 4110. $\times 2.8$.
- Figs. 11—12. Enrolled specimen, somewhat dismembered. *Holotype*. Outer test missing, except in small patches. 4a β . S. Kojatange, Asker. Coll. J. Kiær, 1898. P.M.O. no. 19112. $\times 1$.



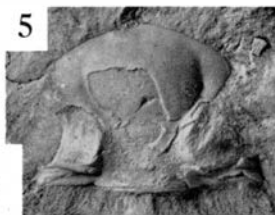
1



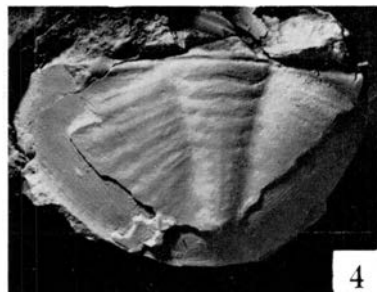
2



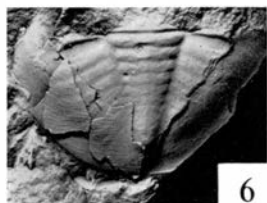
3



5



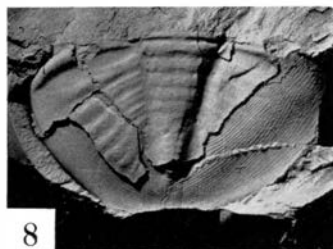
4



6



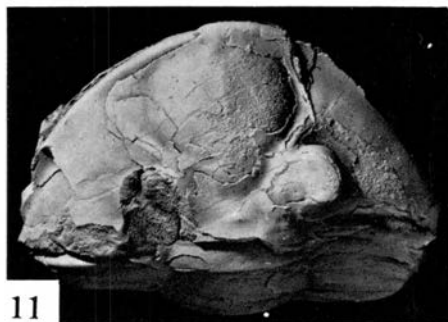
7



8



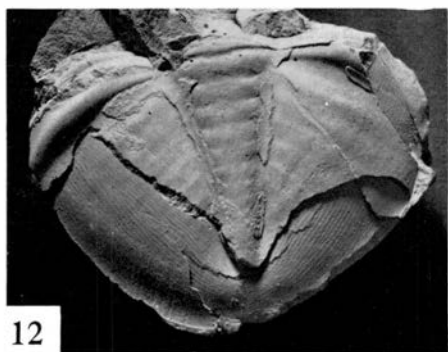
9



11



10



12

PLATE 11

All natural size.

Ogmasaphus stoermeri n. sp.

- Fig. 1. Dorsal shield, *holotype*. 4aa. Teigen slate pit, Eiker. Coll. M. Langberg; S. Swensen dedit., 1892. P.M.O. no. 5684. $\times 1$.
- Fig. 2. Dorsal shield. Part of glabella missing, showing incomplete hypostome in situ. 4aa. Teigen slate pit, Eiker. Coll. M. Langberg; S. Swensen dedit., 1892. P. M. O. no. 4682. $\times 1$.
- Fig. 3. Dismembered cephalon, showing genal angle of right free cheek. 4aa. Muggerudkleiva, Eiker—Sandsvær. Coll. L. Størmer, 1925—27. P.M.O. no. 60390. $\times 1$.
- Fig. 4. Hypostome. Same horizon, locality, and collector. P.M.O. no. 60390b $\times 1$.
- Fig. 5. Pygidium. Same horizon, locality, and collector. P.M.O. no. 60379. $\times 1$.
- Fig. 6. Unusually large pygidium. Most probably from 4aa in Eiker—Sandsvær. P.M.O. no. 72069. $\times 1$.

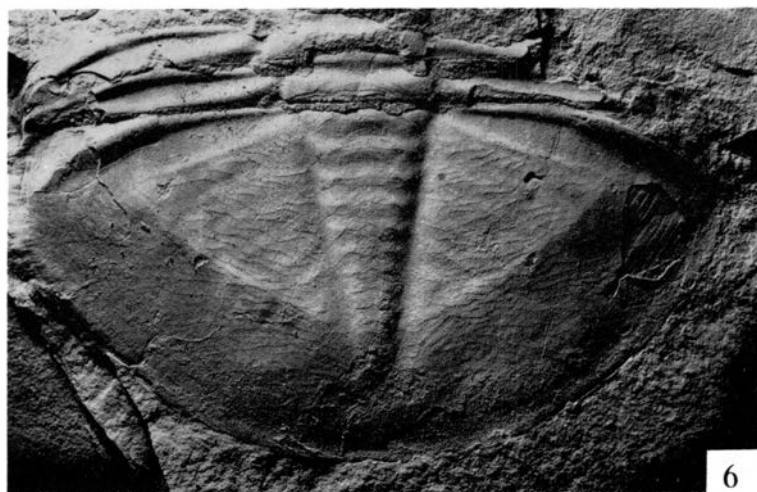
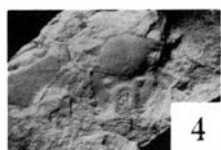
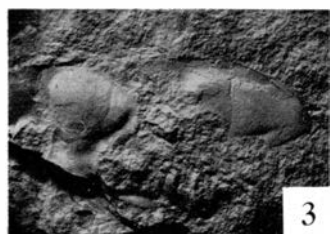
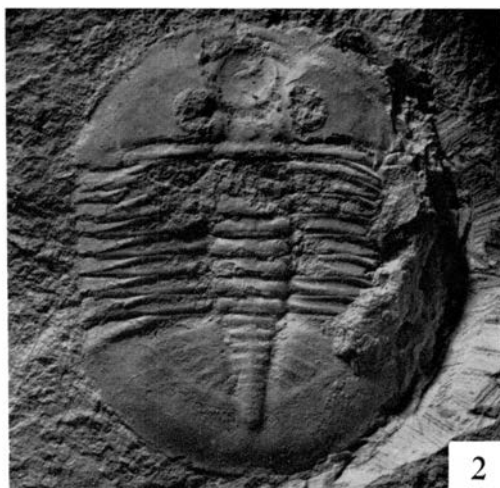
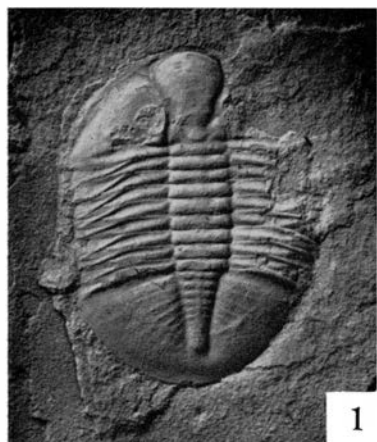


PLATE 12

All natural size.

Pseudomegalaspis patagiata (TÖRNQUIST, 1884).

- Figs. 1–2. Dorsal shield, showing left genal spine. The pygidium of this specimen was figured by JAANUSSON (1953, pl. X, fig. 2), as *P. formosa*. 4aa. Site of Vigeland fountain, Vigeland Park, Oslo. Coll. A. Heintz, 1934. P.M.O. no. 56556. $\times 1$.
- Fig. 3. Pygidium showing zone of terrace lines along paradoublural line. 4aa₃. Engerodden, Asker. Coll. N. Spjeldnæs, 1951. P.M.O. no. 72075. $\times 1$.
- Fig. 4. Free cheek (genal spine broken off). 4aa₃. Elnestangen, Asker. Coll. G. Henningsmoen, 1959. P.M.O. no. 72079. $\times 1$.
- Fig. 5. Pygidium showing terrace lines on various parts of the surface. 4aa₃. Huk, Bygdøy, Oslo. Coll. ?, 1915. P.M.O. no. 20193. $\times 1$.
- Fig. 6. Pygidium. Ogygiocaris shale. Ringerike. Coll. J. Kiær. P.M.O. no. 72089. $\times 1$.
- Fig. 7. Cranidium. Ogygiocaris shale. Ringerike. Coll. J. Kiær. P.M.O. no. 72083. $\times 1$.

Pseudomegalaspis? sp.

- Fig. 8. Dorsal shield. Most probably Cephalopod shale. Storhamar, Hamar—Nes. Coll. N. Johansen; J. Jørgensen dedit., 1898. P. M. O. no. 36832. $\times 1$.

Ogmasaphus sp.

- Fig. 9. Pygidium. Cephalopod shale. Hovindsholm, Helgøya, Hamar—Nes. Coll. O. Holtedahl, 1907. P.M.O. no. 72074. $\times 1$.

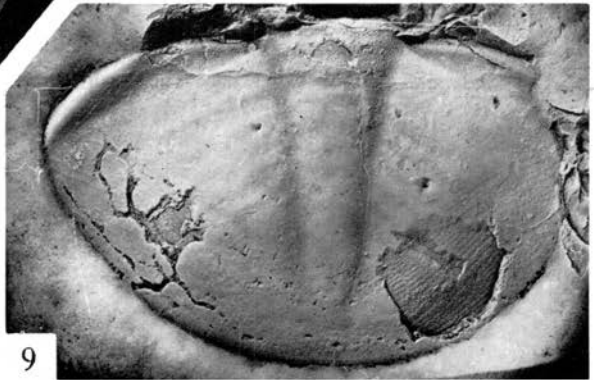
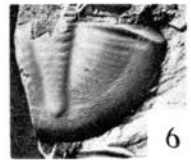
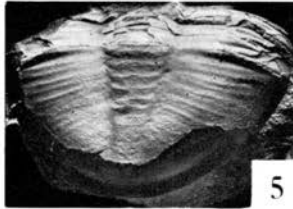
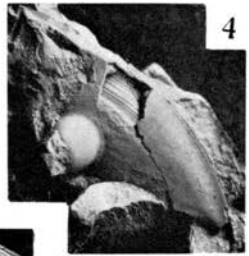
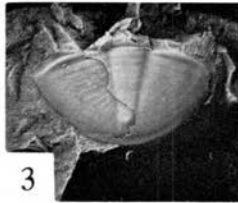
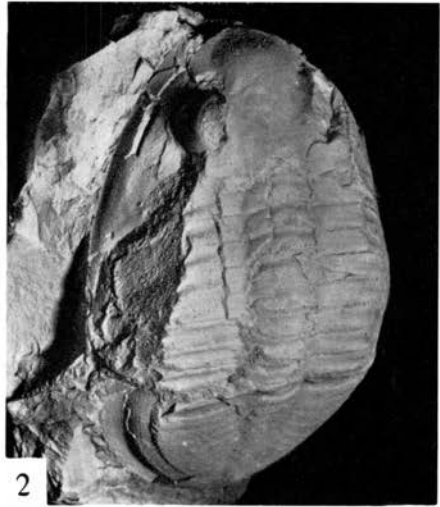
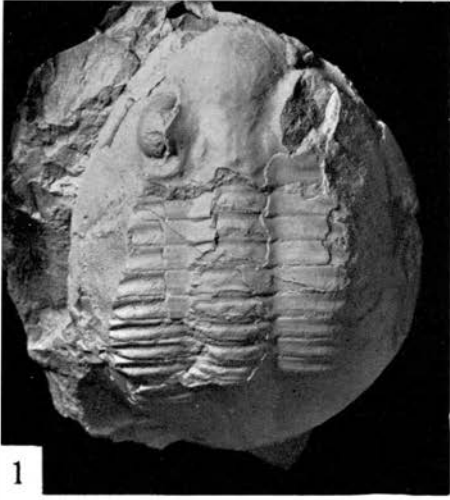


PLATE 13

All natural size.

Pseudoasaphus limatus JAANUSSON, 1953.

- Fig. 1. Pygidium. Oslo region (horizon and locality unknown). P.M.O. no. 20137. $\times 1$.
Fig. 2. Cranidium. 4a β . Road section, State Road no. 40 at Gyssestad, Oslo — Asker. Coll. A. Heintz, 1933. P.M.O. no. 40355. $\times 1$.
Fig. 3. Hypostome. Same horizon, locality, and collector. P.M.O. no. 40400. $\times 1$.
Fig. 4. Incomplete dorsal shield. 4a β ? Fornebu Air Field, Bærum, Oslo — Asker. Coll. ?, 1935. P.M.O. no. 58911. $\times 1$.
Fig. 5. Incomplete dorsal shield, counterpiece. 4a β ? Fornebu Air Field, Bærum, Oslo — Asker. Coll. 4, 1935. P.M.O. no. 58917. $\times 1$.

Pseudoasaphus sp.

- Fig. 6. Pygidium. Coelosphaeridium beds. Shale pit between Tørud and Brattberg, Ringsaker. Coll. W. Dean, F. Hagemann, & G. Henningsmoen, 1954. P.M.O. no. 67290. $\times 1$.

Pseudobasilicus cf. *kuckersianus* (SCHMIDT, 1898).

- Fig. 7. Pygidium. 4a β . Road section, State Road no. 40 at Gyssestad, Oslo — Asker. Coll. A. Heintz, 1933. P.M.O. no. 44246. $\times 1$.

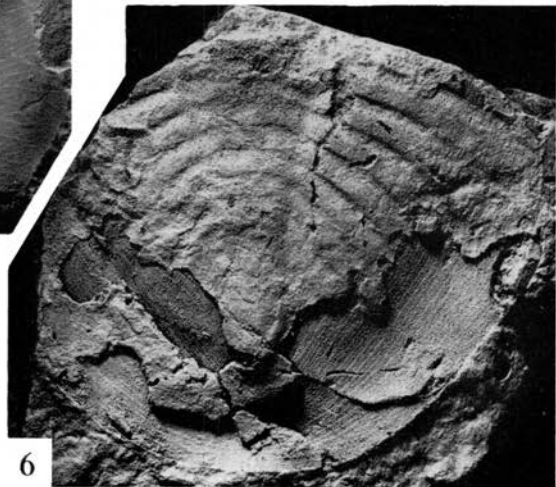
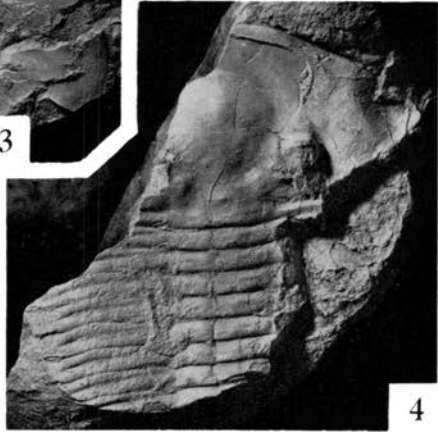
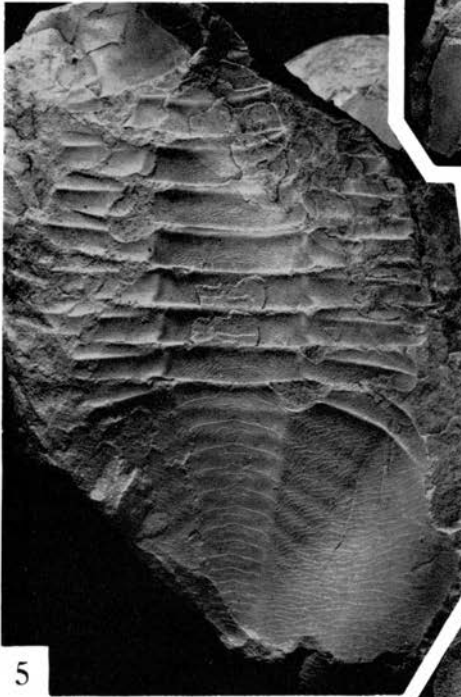
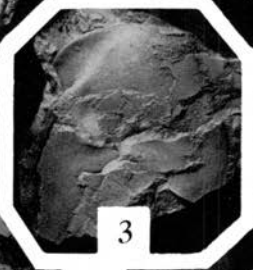
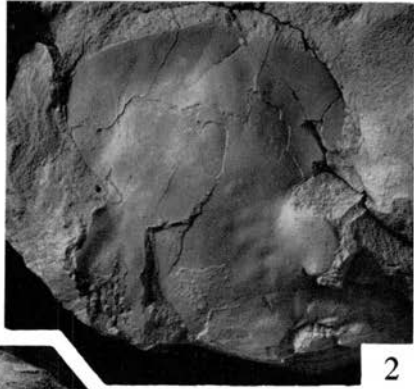
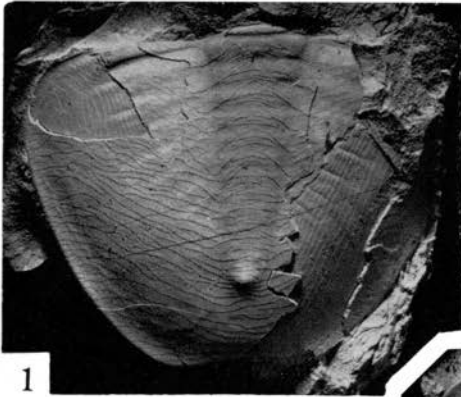


PLATE 14

Pseudobasilicus cf. *kegelensis* (SCHMIDT, 1898).

- Fig. 1. Cranidium. Cyclocrinus beds. Furuberget, Hamar—Nes. Coll. J. Kiær, 1896. P.M.O. no. 38029. $\times 2.7$.
 Fig. 4. Cranidium. Same horizon, locality, and collector. P.M.O. no. 38252 $\times 2.7$.
 Fig. 8. Conspecific? pygidium. Same horizon, locality, and collector. P.M.O. no. 38253. $\times 2.6$.

Pseudobasilicus? sp.

- Fig. 2. Cranidium. Cyclocrinus limestone, Furuberget. Coll. O. Holtedahl, 1907. P.M.O. no. 37918. $\times 1$.
 Fig. 3. Cranidium. Same horizon, locality, and collector. P.M.O. no. 37916. $\times 1$.

Isotelus cf. *platyrhachis* STEINHARDT, 1874.

- Fig. 5. Cranidium. Top of Mjøsa limestone, beds with *Rajnesquina mjoesensis*. North side of northern Bergvika peninsula, Helgøya, Hamar—Nes. Coll. S. Skjeseth and G. Henningsmoen, 1952. P.M.O. no. 67932. $\times 1$.
 Fig. 6. Pygidium. Mjøsa limestone. Furuberget, Hamar—Nes. Coll. J. Kiær, 1896. P.M.O. no. 22023. $\times 1$.
 Fig. 7. Pygidium. Mjøsa limestone. Furuberget, Hamar—Nes. Coll. J. Kiær, 1922. P.M.O. no. 22057. $\times 2.6$.

Asaphus (*Neasaphus?*) sp. A.

- Fig. 9. Pygidium. Encrinite limestone. Ås at Frierfjorden, Skien—Langesund. Coll. W. C. Brøgger, 1881. P. M. O. no. 8548. $\times 1$.

Asaphus (*Neasaphus?*) sp. B.

- Fig. 10. Pygidium. Upper Chasmops limestone (4bδ). Nakkholmen, Oslo—Asker. Coll. J. Kiær excursion, 1916. P.M.O. no. 5338. $\times 2.7$.

