THE MIDDLE ORDOVICIAN OF THE OSLO REGION, NORWAY

22. Preliminary report on conodonts from the Oslo-Asker and Ringerike districts

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With 7 Plates and 6 Figures in the text

CONTENTS

Abstract. About 3,000 specimens have been studied from the Chasmops Series in the Central Oslo Region (Oslo–Asker, Ringerike districts). The presence of conodonts in the Ogygiocaris Shale ($4a\alpha_3$) is reported. A new genus, *Eoplacognathus*, and 13 new species are described. Similarities between the European (Scotland, Sweden, Central Oslo Region) Caradoc and the North American midcontinent Upper Ordovician conodont facies are discussed. A preliminary account of the stratigraphical succession of conodonts from the Central Oslo Region is given.

Acknowledgements

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Introduction

The present paper appears as No. 22 in a series dealing with the Middle Ordovician stratigraphy and palaeontology of the Oslo Region. 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 the Humanities.

In 1964, I published the first paper on Norwegian conodonts. These were from the Ringerike district, where conodont faunas from the lowermost Ampyx Limestone were described. New studies have been made on conodonts with special reference to the faunas of the Ampyx Limestone and the Upper Chasmops Limestone. Also included are conodont faunas from the closely associated horizons of the Lower Chasmops Shale and Limestone (4bα, 4bβ) and the Upper Chasmops

Shale (4bγ), and a few badly preserved specimens are reported from the Ogygiocaris Shale (4aα_3). Altogether, 3,000 specimens have been identified.

Three conodont zones are proposed within the Chasmops Series and three subzones in the Ampyx Limestone.

Swedish conodont faunas from Scania (HADDING 1913, LINDSTRÖM 1955, NILSSON 1960) belonging to the subzone of *Climatograptus haddingi* have been shown earlier (HAMAR 1964) to be older than the Norwegian Ampyx Limestone fauna. The same has been suggested (HAMAR 1964) for faunas from the southern uplands of Scotland (LAMONT and LINDSTRÖM 1957) and the fauna of the Pratt Ferry Formation of Alabama in North America (SWEET and BERGSTRÖM 1962).

The present paper discusses the similarities and differences between the fauna of the Norwegian Chasmops Series and that of the Swedish Dalby (Ludibundus) Limestone (BERGSTRÖM 1961), that of the Llandeilo and Caradoc conodont faunas from Wales (RHODES 1953, BERGSTRÖM 1964) and that of the Upper Ordovician of the North American midcontinent conodont provinces or facies. The fauna of the Swedish Dalby Limestone can be compared in some ways with the insufficiently known fauna of the Lower Chasmops Shale and Limestone (4bα, 4bβ) of the Central Oslo Region. The conodont fauna of Wales differs strikingly from that of the Central Oslo Region, which itself is similar to that of the North American midcontinent province; but the long-ranging elements are, in fact, present in all geographic regions.

In Europe, two main conodont provinces can be recognized, one of which has been found in Russia, Estonia, Sweden, Scotland, and the Central Oslo Region, whereas the other is restricted to the Welsh region and possibly to the hitherto undescribed fauna of the Northern Oslo Region.

Faunas similar to the first-mentioned conodont fauna have been found in the South German Bavarian Region (SANNEMANN 1955) and, outside Europe, in the eastern part of North America, Maine, (SWEET and BERGSTRÖM 1962 p. 1217), New Jersey (ETHINGTON *et al.* 1958), Alabama (SWEET and BERGSTRÖM 1962).

The designation PMO indicates that the specimen referred to is in the Palaeontological Museum of the University of Oslo; and the catalogue number of the specimen is given.

Technique used for pyrite-rich samples

A new technique has been used with samples rich in pyrite. After the heavy liquid separation with bromoform (S.G. 2,87), the heavy fraction is placed in methyleneiodide (S.G. 3,2). The light fraction of this secondary separation contains the conodonts and these can be readily handpicked, thereby reducing to a considerable degree the time needed to prepare material.

On the composition of the Norwegian conodonts, a correction

In an earlier paper (HAMAR 1964), I reported spectrographic analyses of Swedish and Norwegian conodonts. Further spectrographic and X-ray analyses have been carried out on Norwegian Lower Ordovician conodonts. The spectrographic analyses have been made especially to establish the presence of fluorine. The X-ray analyses confirmed that conodonts are composed of apatite. The present conclusion on the composition of the Norwegian conodonts indicates that their mineralogical composition is as described previously by R. Phillips (in RHODES 1954).

Description of localities

The fossils occur in the central part of the Oslo Region, which includes the Oslo–Asker and Ringerike districts as outlined by Störmer (1953). (Map references: BRÖGGER 1887, Geologisk kart over öerne ved Kristiania; HOLTEDAHL and DONS 1962, Geologisk kart over Oslo og omegn.)

Sample No.

OGYGIOCARIS SHALE ($4a\alpha_3$)

165 Blindern, Oslo, Institute of Geology. On the west side of the Institute building, the Ogygiocaris Shale is found with some carbonaceous shale lenses. The rock contains badly preserved macrofossils which have been identified, though with some degree of uncertainty, and referred to: *Pseudomegalaspis patagiata, Ogygiocaris sarsi, Trinucleus foveolatus, ?Trilacinoceras discors, Dicranograptus* sp., *Obulus* sp. Fragmentary conodonts were easily obtained from a very small carbonaceous lens. The sample of rock treated weighed 0.2 kg.

Ampyx Limestone (4aβ)

95 Ildjernet is a small island about 10 km SSW of Oslo centre. The nodular Ampyx Limestone is exposed in the NE part of the island. One limestone lens in the middle of the Ampyx Limestone unit, which was very rich in trilobite fragments, has been dissolved; about 2.0 kg.

187 Rodelökken, Bygdöy, Oslo. From the NE side of the Bygdöy peninsula north of Rodelökken café, a series of collections has been made. From the uppermost 10 m of the Ampyx Limestone, three samples were collected. Sample 187 is from the lower part of a 20-cm-thick limestone bed. The dissolved fossiliferous material weighed 0.6 kg.

188 Rodelökken, Bygdöy, Oslo. 8 m below the grey Lower Chasmops Shale, about 2.0 kg of an approximately 25-cm-thick fossiliferous Limestone bed with *Reedolithus carinatus* was collected and dissolved.

189 Rodelökken, Bygdöy, Oslo. 60 m N of the Rodelökken café, the top boundary of the Ampyx Limestone with the overlying 4bα is exposed. The uppermost nodular limestone bed, which is rich in fossils, has been sampled and about 2.3 kg of rock dissolved.

111 Tandberg, Ringerike. About 3 km SE of Hönefoss at Tandberg farm in road cut just W of the farm, the Ogygiocaris Shale (the uppermost 3 m) and nearly the whole Ampyx Limestone are exposed. The shale (S in the road cut), with rare limestone lenses and without fossils, is succeeded by about 30 m of nodular limestone, with minor faults and overthrusts. This tectonized nodular limestone is poor in fossils except at about 21 m from the base, where an approximately 5-cm-thick fossil-rich layer is observed. *Reedolithus carinatus*, *Asaphus ludibundus*, *Remopleurides* sp., and *Ampyx* sp. are found there. The dissolved sample weighed 2.0 kg.

181 South of the Kullerud farm, Ringerike (50 m S of the locality mentioned in my previous paper, 1964), a sample was collected from a small field exposure, belonging to the uppermost part of the Ampyx Limestone. One fossiliferous lens from the nodular limestone weighing about 0.4 kg has been dissolved.

Lower Chasmops Shale (4bα)

160 Rodelökken, Bygdöy, Oslo. 150 m SE of Rodelökken café the upper part of the Chasmops shale and L. Chasmops Limestone are exposed. Samples from the third limestone bed (from the boundary 4bα–4bβ) of the 4bα have been collected by Dr. T. Örvig. 2.0 kg of the rock have been dissolved.

Lower Chasmops Limestone (4bβ)

159 Hovedöya, Oslo (map: Brögger 1887). Along the northwestern shore of the island occurs the L. Chasmops Limestone. The dissolved sample was 2.6 kg.

158 Nakholmen, Oslo (map: BRÖGGER 1887). In the southwestern part of the island, the L. Chasmops Shale is exposed and succeeded by the nodular limestone 4bβ. 2 m above the shale-limestone border, *Chasmops* sp., *Asaphus* sp., and other trilobite fragments were collected. The dissolved sample was 4.2 kg.

UPPER CHASMOPS SHALE (4bγ)

190 60 m NE of Rodelökken café (Bygdöy, Oslo), the nodular limestone 4bβ is exposed and succeeded by the shale 4bγ. 1 m above the border 4bβ–4bγ, a sample was collected from a fossiliferous layer in a limestone bed about 10 cm thick and dissolved. The sample weighed 1.5 kg.

UPPER CHASMOPS LIMESTONE (4bδ_1–4bδ_2)

161 Bjerköy (map: HOLTEDAHL and DONS 1962), an island situated about 15 km SW of Oslo centre. The sample was collected by Störmer about 7–8 m below the black Tretaspis Shale on the eastern side of the island. The typical development of the 4bδ_1 in the Asker district has been described by STÖRMER (1953 p. 68) from Boröya. The sample was rich in fossil fragments, especially trilobites and brachiopods. The dissolved weight was 2.4 kg.

138 Bjerköy (map: HOLTEDAHL and DONS 1962). The sample is from the same locality as 161 but from only 1–2 m below the black Tretaspis Shale. It was collected by Störmer. The dissolved sample was 0.5 kg.

139 Terneholmen, a small island 13 km SW of Oslo centre. The sample was collected by J. Kiær from a limestone layer about 0.1–0.3 m thick with a rough lower surface. The bed lies about 2 m below the base of the black Tretaspis Shale. The dissolved weight was 0.5 kg.

163 Steilene (map: HOLTEDAHL and DONS 1962). About 12 km S of Oslo centre is a group of small islands, and the southernmost island (Landsteilene) yielded this sample collected by Prof. N. Spjeldnæs. 6 m below the black Tretaspis Shale is a structureless limestone bed (see STÖRMER 1953 p. 66, — 6 m —) which yielded a relatively rich conodont fauna. Macrofossils such as *Diacalymene* sp., graptolites, and brachiopod fragments have also been collected. The dissolved sample was 1.0 kg.

162 Rödskjær. The island is situated about 1 km south of Terneholmen. Two
164 samples from the southern part of Northern Rödskjær, Asker, have been dissolved. The samples were collected by Prof. N. Spjeldnæs. Sample No. 162 is from a limestone bed about 4 m below the base of the black Tretaspis shale and sample No. 164 is from a short distance beneath this. The dissolved weight of both samples was 0.8 kg.

157 Nakholmen (map: BRÖGGER 1887) has been described as the type section for the Oslo district (STÖRMER 1953 pp. 65, 68). The exact position of the locality sampled is the western part of the southern bay. The sample was

collected from the top boundary which is rich in macrofossils. *Diacalymene* sp. and *Lonchodomas* sp. occur here. The dissolved sample was 4.0 kg.

93 Frognöy, Ringerike. The locality ($4b\delta_2$) was described by STØRMER (1953 pp. 86–87). The sample was collected by Prof. N. Spjeldnæs from the richly fossiliferous layer with *Tretaspis kiaeri*. Dissolved sample was about 2.5 kg.

The conodont fauna and its stratigraphical distribution in the Central Oslo Region

The degree to which conodonts can be used as stratigraphical indicators depends on the stratigraphical value of the samples, on the number of samples, and finally on the restriction of conodonts to particular layers. This work aims at giving a more complete faunal list than has been available before from the Ampyx Limestone ($4a\beta$) and a new, fairly complete, fauna list of the Upper Chasmops Limestone ($4b\delta_{1-2}$). Of the fauna between these deposits ($4a\beta$–$4b\delta_1$), it is possible to give only a brief account, but it is apparent that the fauna is not stratigraphically distinct.

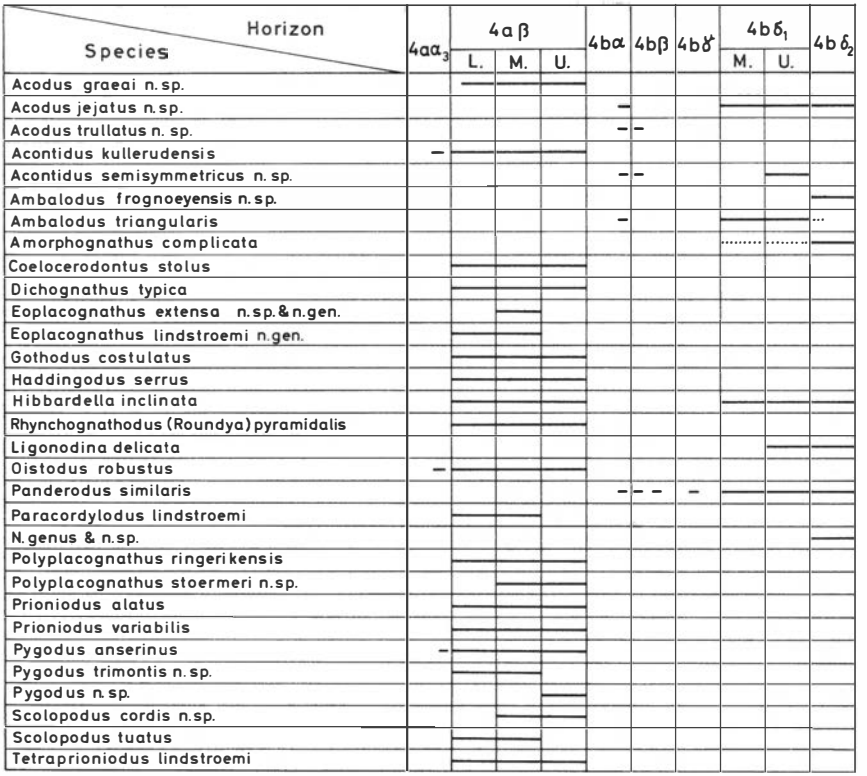
There are 79 species listed (Table 1), two of which, *Polyplacognathus* sp. and *Prioniodus* sp., are for the first time recorded from the Ogygiocaris Shale ($4a\alpha_3$). *Distacodus? cambricus* Müller, *Furnishina* n. sp., *Hertzina? americana* Müller, *Oneotodus* aff. *gallatini* Müller, *Proacodus* n. sp. 1, *Proacodus* n. sp. 2, and *Westergaardodina bicuspidata* Müller are still only questionably referred to conodonts. When one excludes these species from the list of conodonts, the list contains only 70 accepted conodont species. Twenty-six of these 70 species occur throughout the Caradoc—from the lowermost $4a\beta$ to uppermost $4b\delta_2$—and 31 show limited occurrence within the Caradoc (Text-fig. 1). The remaining 13 species seem to have little stratigraphical value in Norway.

The Norwegian Caradoc may be divided into three main stratigraphical zones in the region under study. *The lowest zone* coincides with the Ampyx Limestone unit ($4a\beta$). The characteristic elements in this zone are: *Acodus graeai* n. sp., *Acontiodus kullerudensis*, *Coeloce-rodontus stolus*, *Dichognathus typica*, *Eoplacognathus extensa* n. gen. and sp. *E.* (*Ambalodus*) *lindstroemi*, *Gothodus costulatus*, *Haddingodus serrus*, *Rhynchognathodus* (*Roundya*) *pyramidalis*, *Oistodus robustus*, *Paracordylodus lindstroemi*, *Prioniodus alatus*, *P. variabilis*, *Pygodus*

Species \ Horizon / sample numbers	4aα₂	4aβ						4bα	4bβ		4bγ	4bδ₁						4bδ₂		Total
	Ogygocaris Shale	Ampyx Limestone						L. Chasmops Shale	L. Chasmops Limestone		U. Chasmops Shale	Upper Chasmops Limestone								
		middle					upper					middle						upper		
	165	95	187	188	111	189	181	160	158	159	190	161	138	139	163	162	164	157	93	
Acodus graeai n. sp.	—	8	3	—	—	3	2	—	—	—	—	—	—	—	—	—	—	—	—	16
Acodus inornatus	—	5	6	—	1	—	—	9	9	4	—	—	—	—	—	—	—	15	7	56
Acodus jejatus n. sp.	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	6	1	9
Acodus similaris	—	17	—	—	38	2	1	68	48	17	24	—	3	6	8	2	—	242	107	583
Acodus trullatus n. sp.	—	—	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	—	—	6
Acontiodus kullerudensis	2	5	3	—	10	2	2	—	—	—	—	—	—	—	—	—	—	—	—	24
Acontiodus rectus	1	40	6	—	24	8	7	—	—	—	—	—	—	1	—	—	—	—	—	87
Acontiodus semisymmetricus n. sp.	—	—	—	—	—	—	—	3	5	—	—	—	—	—	—	—	—	21	—	29
Ambalodus frognoeyensis n. sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	41	41
Ambalodus triangularis	—	—	—	—	—	—	—	1	—	—	—	11	3	5	4	2	—	16	1?	43
Amorphognathus complicata	—	—	—	—	—	—	—	—	—	—	—	22?	7?	13?	—	5?	1?	28?	38	114
Belodina cf. dispansa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Belodina n. sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Centrognathodus n. sp.	—	6	—	—	—	—	?	—	—	—	—	—	—	—	—	—	—	—	—	6
Coelocerodontus digonius	—	2	—	—	7	2	—	—	—	—	—	—	—	1	—	—	—	1	—	13
Coelocerodontus stolus	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Coelocerodontus trigonius	—	1	1	—	6	1	1	—	—	—	—	—	—	—	1	—	—	3	2	16
Cordylodus elongatus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	4
Dichognathus typica	—	—	—	—	4	—	1	—	—	—	—	—	—	—	—	—	—	—	—	5
Distacodus bygdoeyensis n. sp.	—	2	—	—	—	1	5	—	1	—	1	—	—	—	1	—	—	—	—	11
Distacodus? cambricus	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Drepanodus cf. arcuatus	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	4	6
Drepanodus homocurvatus	—	6	4	—	—	—	4	—	2	—	2	—	—	3	—	1	—	—	7	29
Drepanodus suberectus	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Eoplacognathus extensa n. sp.	—	16	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17
Eoplacognathus lindstroemi	—	—	3	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Falodus prodentatus	—	10	4	—	—	—	37	2	6	2	—	1	—	—	1	—	—	11	3	77
Furnishina n. sp.	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Gothodus costulatus	—	—	2	—	14	10	—	—	—	—	—	—	—	—	—	—	—	—	—	26
Haddingodus serrus	—	28	9	1	97	8	14	—	—	—	—	—	—	—	—	—	—	—	—	157
Hertzina? americana	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Hibbardella (Roundya) inclinata	—	2	—	—	8	3	1	—	—	—	—	1	—	—	—	—	—	3	14	32
Keislognathus gracilis	—	—	—	—	—	—	1	—	—	—	—	—	1	—	1	—	—	3	10	16
Ligonodina delicata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	7	12
Oistodus breviconus	—	4	—	—	—	—	—	—	1	1	—	2	—	—	—	—	—	8	5	21
Oistodus excelsus	—	7	—	—	—	—	—	—	—	3	—	—	—	3	1	1	—	3	3	21
Oistodus longiramis	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Oistodus robustus	1	9	1	—	16	2	1	—	—	—	—	—	—	—	—	—	—	—	—	30
Oistodus venustus	—	22	3	—	6	8	2	12	13	4	6	—	1	8	1	—	—	24	3	113
Oneotodus aff. gallatini	—	—	—	—	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Oneotodus simplex	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
Oulodus tortilis	—	—	—	—	—	—	7	—	—	—	—	—	—	—	—	—	—	—	—	7
Panderodus compressus	—	19	3	3	16	4	—	17	20	3	1	10	—	2	2	2	1	22	12	137
Panderodus gracilis	1	—	—	—	6	—	—	6	3	2	—	3	—	—	—	1	—	16	27	65
Panderodus nakholmensis n. sp.	—	—	—	—	—	—	—	6	—	1	—	1	—	—	—	—	—	5	1	14
Panderodus similaris	—	—	—	—	—	—	—	5	10	1	1	5	—	—	—	—	—	—	11	33
Panderodus unicostatus	1	27	4	—	13	7	2	21	6	3	1	8	—	6	2	—	—	45	35	181

Species \ Horizon / sample numbers	4aα₃	4aβ						4bα	4bβ	4bγ	4bδ₁							4bδ₂		Total
	Ogygocaris Shale	Ampyx Limestone						L. Chasmops Shale	L. Chasmops Limestone	U. Chasmops Shale	Upper Chasmops Limestone									
		middle				upper					middle							upper		
	165	95	187	188	111	189	181	160	158	159	190	161	138	139	163	162	164	157	93	
Paracordylodus bergstroemi	—	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	1	—	4
Paracordylodus lindstroemi	—	14	1	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21
Periodon aculeatus	—	14	2	2	—	1	27	1	1	—	—	—	—	—	—	—	—	1	6	55
Periodon grandis	—	2	—	—	—	—	15	—	—	—	—	—	—	—	—	—	—	6	1	24
Phragmodus undatus	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Polyplacognathus elongata	—	39	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	42
Polyplacognathus ringerikensis .	—	13	4	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	21
Polyplacognathus stoermeri n. sp.	—	8	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	10
Polyplacognathus sp.	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Prioniodina macrodentata	—	2	2	—	—	6	21	1	1	1	—	—	—	—	—	—	—	10	1	45
Prioniodus alatus.....	—	13	2	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	18
Prioniodus variabilis	—	12	—	—	24	8	—	—	—	—	—	—	—	—	—	—	—	—	—	44
Prioniodus sp.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Proacodus n. sp. 1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Proacodus n. sp. 2	—	1	—	—	4	1	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Pygodus anserinus.....	2?	35	12	2	103	7	8	—	—	—	—	—	—	—	—	—	—	—	—	169
Pygodus trimontis n. sp.	—	—	—	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
Pygodus n. sp.	—	—	—	—	—	—	1(3?)	—	—	—	—	—	—	—	—	—	—	—	—	4
Rhynchognathodus (Roundya) pyramidalis.....	—	3	—	—	9	3	1	—	—	—	—	—	—	—	—	—	—	—	—	16
Sagittodontus robustus.....	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Scandodus inflexus n. sp.	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	2
Scandodus osloensis n. sp.	—	6	—	2	—	1	—	—	1	—	—	—	—	—	—	—	—	—	19	29
Scandodus unistriatus	—	—	—	—	5	—	1	—	—	—	—	—	—	—	3	—	—	24	—	33
Scolopodus cordis n. sp.	—	4	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	6
Scolopodus peselephantis	1	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	2	—	6
Scolopodus tuatus	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Scolopodus insculptus	—	3	1	—	30	—	11	—	1	—	16	—	8	37	33	8	5	208	2	363
Tetraprioniodus asymmetricus ..	—	14	1	—	20	2	—	—	—	—	—	—	—	—	—	—	—	—	4	41
Tetraprioniodus lindstroemi	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	3
Trichonodella cf. erecta	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Westergaardodina bicuspidata ..	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
N. genus & n. sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	14
Total/sample	15	430	84	10	496	104	180	156	131	44	53	64	23	86	59	22	7	733	389	3086

TABLE 1



Text-fig. 1. Diagram showing the stratigraphical occurrence of 31 species of conodonts from the Central Oslo Region. They are from Caradoc beds, except for one sample from the Middle Llandeilo (Ogygiocaris Shale).

→

Text-figs. 2–6. Fifty of the Chasmops Series specimens drawn by use of Abbe's apparatus. Text-fig. 2, no. 3, about × 45; Text-fig. 4, nos. 13–16, about × 22.5; all the other figures, × 70. Explanations of sample numbers are given on pp. 30–33.

Abbreviations: a. & ant. = anterior; c. = costa; l. & lat. = lateral; out. = outer; p. & post. = posterior; proc. = process.

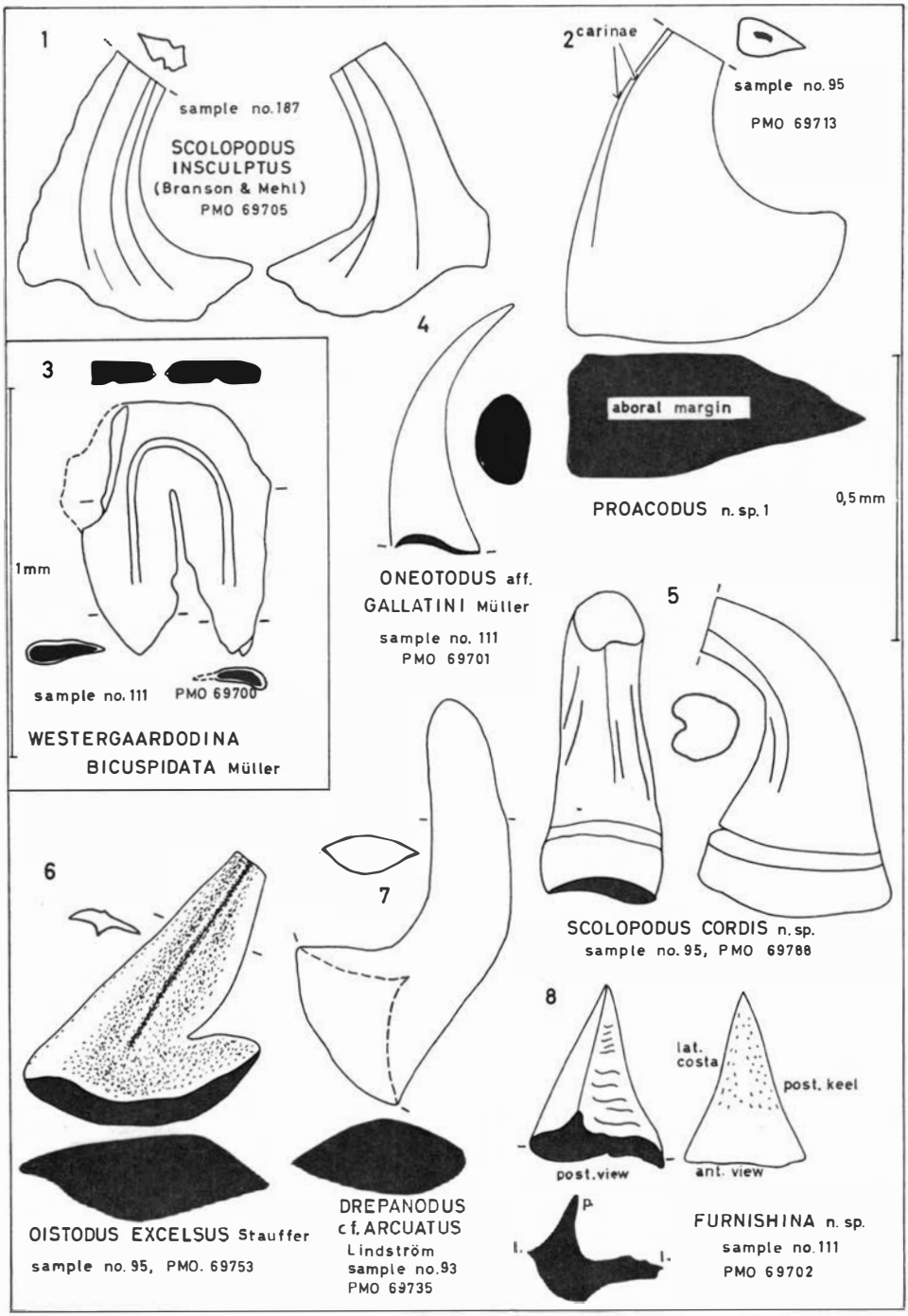

1
sample no. 187
SCOLOPODUS
INSCULPTUS
(Branson & Mehl)
PMO 69705
2 carinae
sample no. 95
PMO 69713
3
1mm
sample no. 111
PMO 69700
WESTERGAARDODINA
BICUSPIDATA Müller
4
ONEOTODUS aff.
GALLATINI Müller
sample no. 111
PMO 69701
aboral margin
PROACODUS n. sp. 1
0,5 mm
5
SCOLOPODUS CORDIS n. sp.
sample no. 95, PMO 69788
6
OISTODUS EXCELSUS Stauffer
sample no. 95, PMO. 69753
7
DREPANODUS
cf. ARCUATUS
Lindström
sample no. 93
PMO 69735
8
lat.
costa
post. keel
post. view
ant. view
p
l.
l.
FURNISHINA n. sp.
sample no. 111
PMO 69702

Fig. 2.

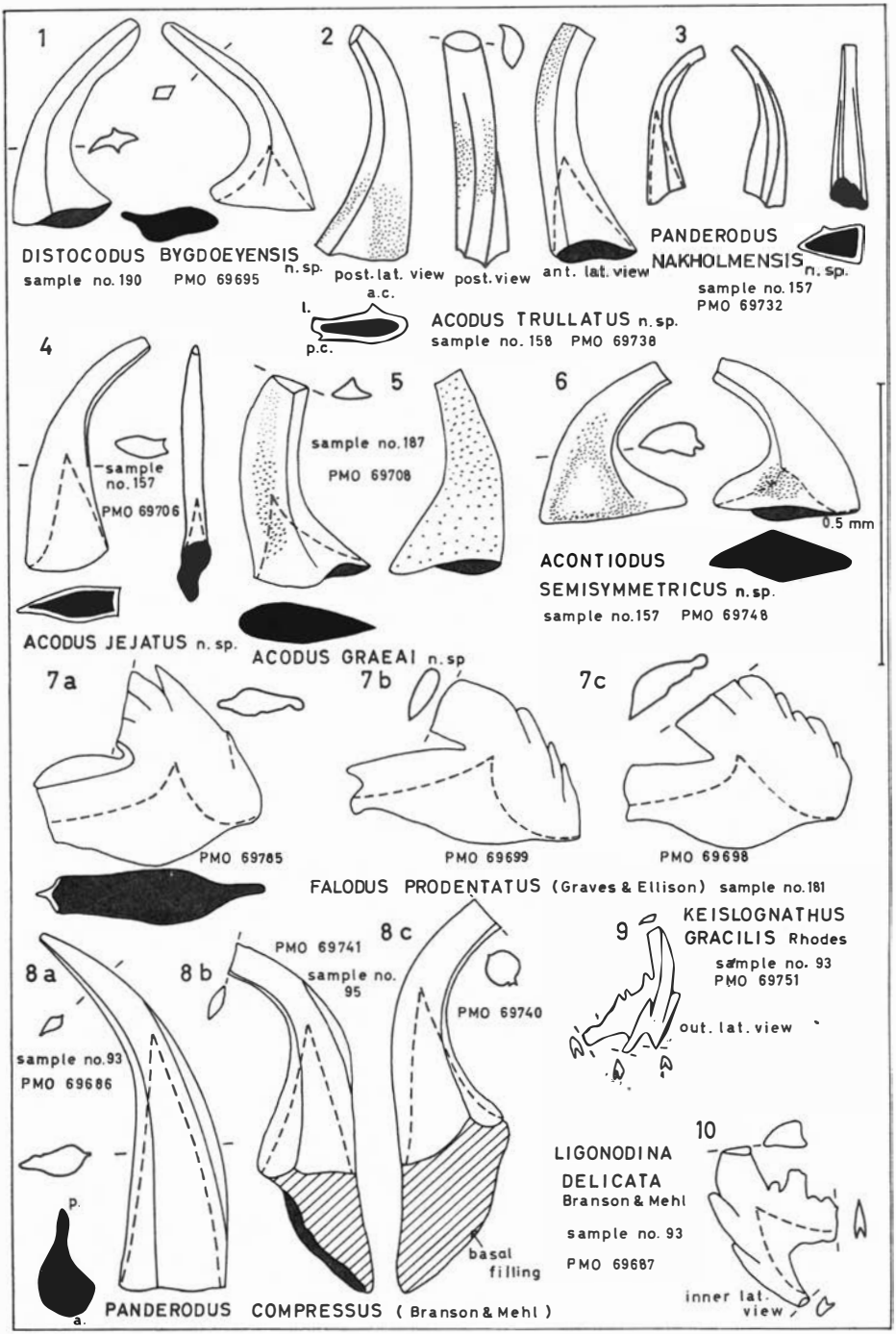

1
DISTOCODUS BYGDOEYENSIS n. sp.
sample no. 190 PMO 69695
2
post. lat. view
post. view
ant. lat. view
3
PANDERODUS NAKHOLMENSIS n. sp.
sample no. 157
PMO 69732
a.c.
l.
p.c.
ACODUS TRULLATUS n. sp.
sample no. 158 PMO 69738
4
sample no. 157
PMO 69706
5
sample no. 187
PMO 69708
6
0.5 mm
ACONTIODUS SEMISYMMETRICUS n. sp.
sample no. 157 PMO 69748
ACODUS JEJATUS n. sp.
ACODUS GRAEAI n. sp
7a
7b
7c
PMO 69785
PMO 69699
PMO 69698
FALODUS PRODENTATUS (Graves & Ellison) sample no. 181
8a
8b
8c
PMO 69741
sample no. 95
PMO 69740
sample no. 93
PMO 69686
p.
a.
basal filling
PANDERODUS COMPRESSUS (Branson & Mehl)
9
KEISLOGNATHUS GRACILIS Rhodes
sample no. 93
PMO 69751
out. lat. view
10
LIGONODINA DELICATA
Branson & Mehl
sample no. 93
PMO 69687
inner lat. view

Fig. 3.

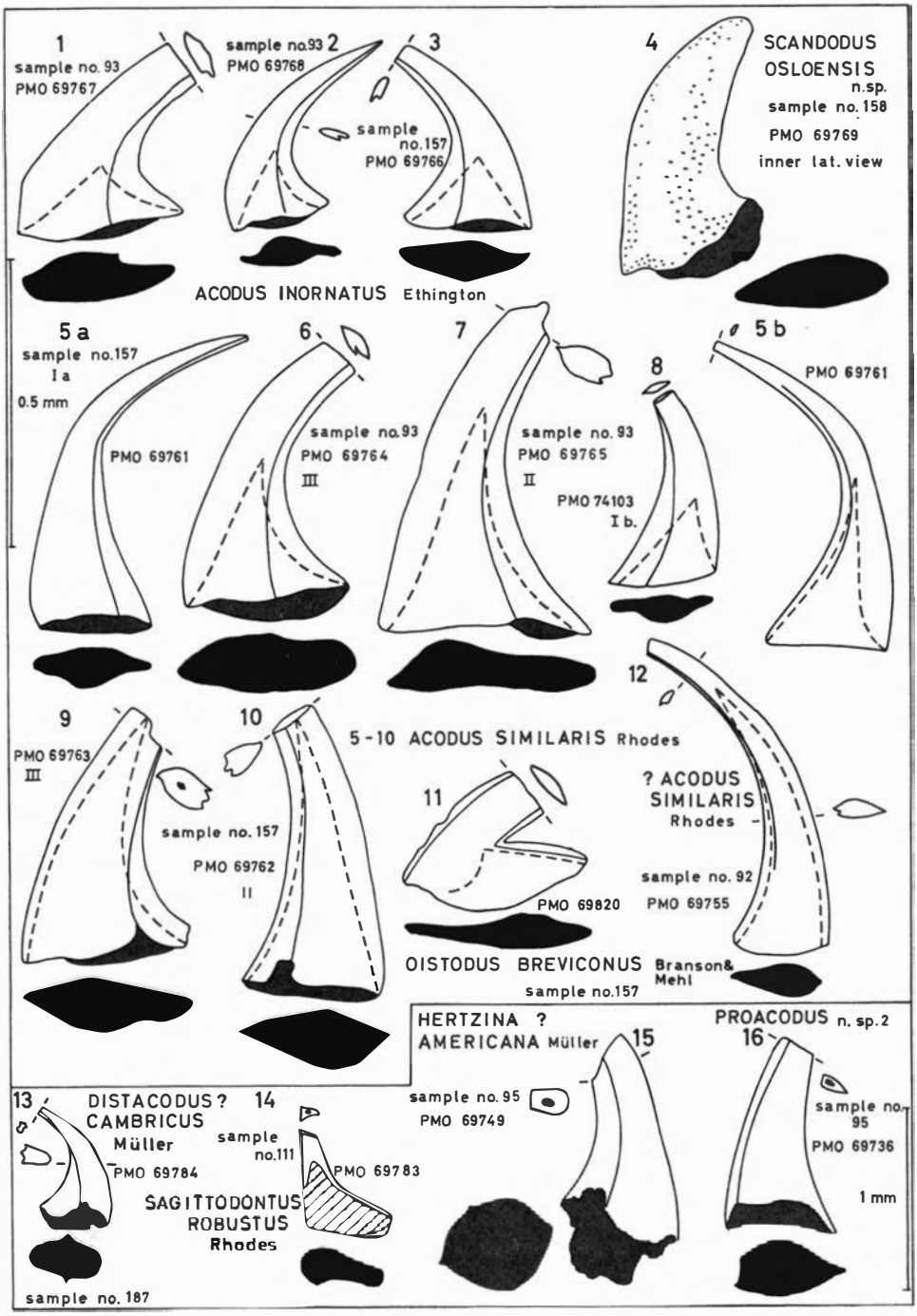

1
sample no. 93
PMO 69767
sample no.93 2
PMO 69768
3
sample
no.157
PMO 69766
4
SCANDODUS
OSLOENSIS
n.sp.
sample no. 158
PMO 69769
inner lat. view
ACODUS INORNATUS Ethington
5 a
sample no.157
I a
0.5 mm
PMO 69761
6
sample no.93
PMO 69764
III
7
sample no. 93
PMO 69765
II
8
PMO 74103
I b.
5 b
PMO 69761
9
PMO 69763
III
10
sample no. 157
PMO 69762
II
5-10 ACODUS SIMILARIS Rhodes
11
PMO 69820
12
? ACODUS
SIMILARIS
Rhodes
sample no. 92
PMO 69755
OISTODUS BREVICONUS Branson&
Mehl
sample no.157
HERTZINA ?
AMERICANA Müller
15
sample no. 95
PMO 69749
PROACODUS n. sp. 2
16
sample no.
95
PMO 69736
1 mm
13
DISTACODUS ?
CAMBRICUS
Müller
PMO 69784
14
sample
no.111
PMO 69783
SAGITTODONTUS
ROBUSTUS
Rhodes
sample no. 187

Fig. 4.

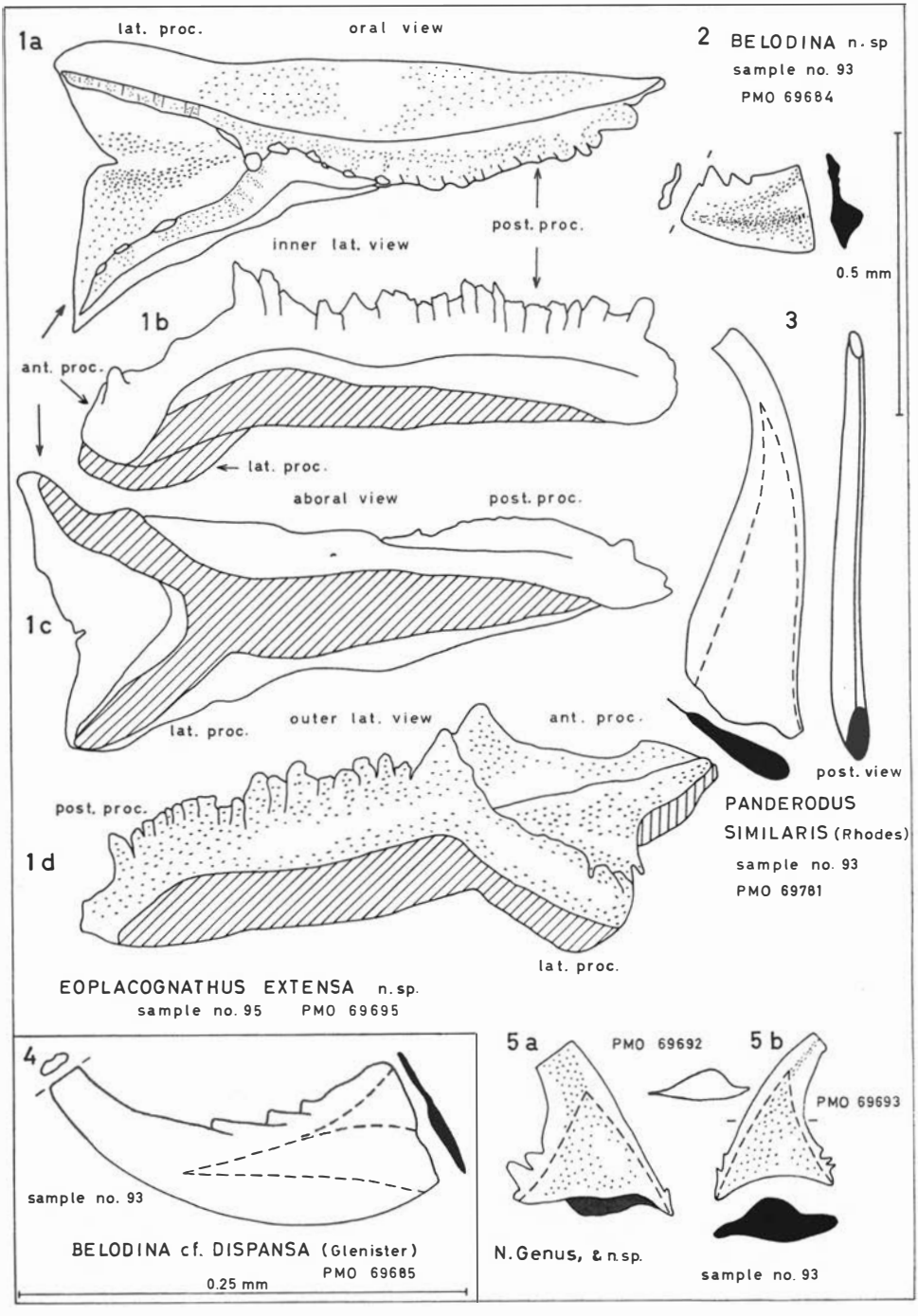

1a
lat. proc.
oral view
post. proc.
inner lat. view
1b
ant. proc.
lat. proc.
aboral view
post. proc.
1c
lat. proc.
outer lat. view
ant. proc.
post. proc.
1d
lat. proc.
EOPLACOGNATHUS EXTENSA n. sp.
sample no. 95 PMO 69695
2 BELODINA n. sp
sample no. 93
PMO 69684
0.5 mm
3
post. view
PANDERODUS SIMILARIS (Rhodes)
sample no. 93
PMO 69781
4
sample no. 93
BELODINA cf. DISPANSA (Glenister)
PMO 69685
0.25 mm
5a
PMO 69692
5b
PMO 69693
N. Genus, & n. sp.
sample no. 93

Fig. 5.

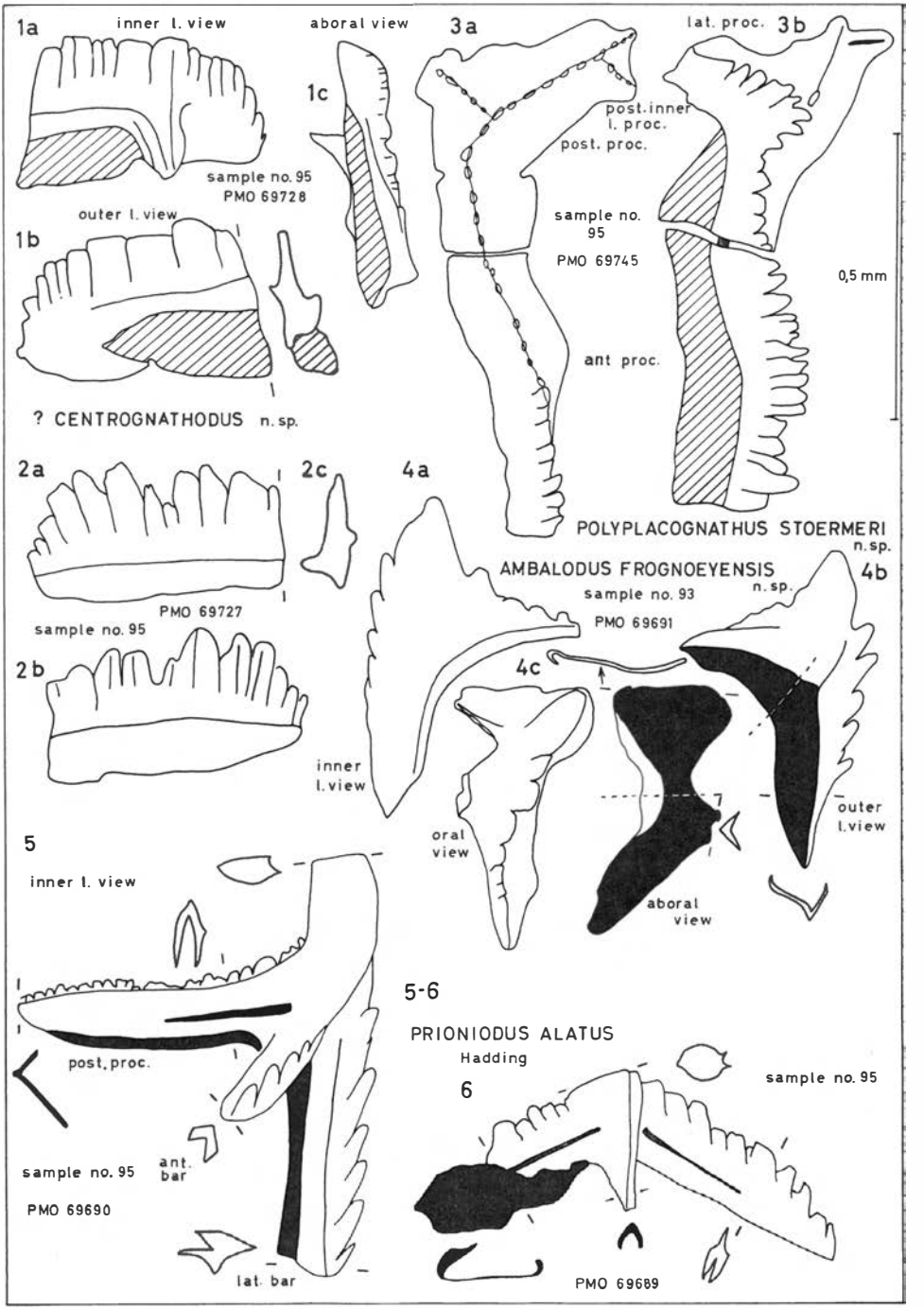

1a
inner l. view
aboral view
1c
sample no. 95
PMO 69728
outer l. view
1b
? CENTROGNATHODUS n. sp.
3a
lat. proc.
3b
post. inner l. proc.
post. proc.
sample no. 95
PMO 69745
ant proc.
0,5 mm
2a
2c
PMO 69727
sample no. 95
2b
4a
POLYPLACOGNATHUS STOERMERI n. sp.
AMBALODUS FROGNOEYENSIS n. sp.
sample no. 93
PMO 69691
4b
4c
inner l. view
oral view
aboral view
outer l. view
5
inner l. view
post. proc.
sample no. 95
PMO 69690
ant. bar
lat. bar
5-6
PRIONIODUS ALATUS
Hadding
6
sample no. 95
PMO 69689

Fig. 6.

anserinus, *P. trimontis* n. sp., *P.* n.sp., *Polyplacognathus ringerikensis*, *P. elongata*, *P. stoermeri* n. sp., *Scolopodus cordis* n. sp., *S. tuatus*, and *Tetraprioniodus lindstroemi*. None of these species have been found in strata younger than the Ampyx Limestone.

Stratigraphically somewhat uncertain subzones within the Ampyx Limestone can be established for the following species. In the lowest subzone, *Eoplacognathus lindstroemi* n. gen., *Paracordylodus lindstroemi*, *Pygodus trimontis* n. sp., and *Scolopodus tuatus* have been found. In addition to these species, *Eoplacognathus extensa* n. gen. and sp. *Polyplacognathus stoermeri* n. sp., and *Scolopodus cordis* n. sp. characterize the middle subzone. The upper part of the Ampyx Limestone lacks the conodont elements of the Lower subzone and *Eoplacognathus extensa* n. sp. of the middle subzone, but contains the remaining species of the middle subzone together with *Pygodus* n. sp. which is otherwise very rare in the samples.

The middle zone includes the lithostratigraphical units Lower Chasmops Shale (4bα), Lower Chasmops Limestone (4bβ), Upper Chasmops Shale (4bγ), and Upper Chasmops Limestone (4bδ_1). The most striking contrasts between the lower and middle zones are the appearance of *Ambalodus* and *Amorphognathus* and the disappearance of *Eoplacognathus* n. gen. and *Polyplacognathus* species in the younger strata. In addition to the species mentioned above, the following, which do not occur in strata older than the Lower Chasmops Shale, have been recorded from the middle zone: *Acodus jejatus* n. sp., *Acodus trullatus* n. sp., *?Amorphognathus complicata*, *Ligonodina delicata*, and *Panderodus similaris*. In the middle zone, it is remarkable that the new species *Acodus trullatus* has been found only in the lower two units (4bα, 4bβ), while *Ligonodina delicata* occurs only in the sample from the top boundary of 4bδ_1.

The upper zone is characterized by new elements in the fauna such as *Ambalodus frognoeyensis* n. sp., *Belodina* species, and N. genus and n. sp. The specimens of *Belodina* are very rare but the occurrence of these is remarkable because they are the first specimens of this genus to be reported from Europe. The fauna from the upper zone is quite characteristic and only found in the Ringerike district. In the Oslo–Asker district, the zone with *Tretaspis kiaeri* (4bδ_2) is missing (STÖRMER 1953 p. 128), and this zone is identical with the upper conodont zone. Fragments of *Amorphognathus* have been found in large numbers

in the Upper Chasmops Limestone and in the zone of *Tretaspis kiaeri* ($4b\delta_2$), but only from the latter zone (i.e. the upper zone) came the material identifiable as *A. complicata*.

Remarks on stratigraphy

In an earlier paper (1964), I discussed the stratigraphical position and the correlation of the Ampyx Limestone fauna ($4a\beta$) with Swedish, British, and North American conodont faunas. It was concluded that the Ampyx Limestone fauna is uppermost Llandeilian or most probably lowermost Caradocian in age. All of the new occurrences of conodonts which are described in this paper—except sample No. 165 (Oggiocaris Shale, $4a\alpha_3$)—are younger than those described in the previous paper. In the light of this fact, the following remarks may be made.

SWEDEN

BERGSTRÖM (1961) reported conodonts in limestone boulders from the Tvären area. Bergström's paper has small importance stratigraphically because the material described was not *in situ*. Nevertheless, interesting problems were discussed concerning the relationship between the Tvären Dalby (Ludibundus) Limestone and certain Norwegian faunas. Samples 7–12 in Bergström's paper show some resemblance to the Norwegian Ampyx Limestone fauna. The species *Oistodus robustus*, *Paracordylodus lindstroemi*, *Prioniodus variabilis*, and *Dichognathus typica* occur both in samples 7–12 from the Tvären area and in the Ampyx Limestone in Norway. Other species such as *Ambalodus triangularis*, *Amorphognathus ordovicica*, and *Strachanognathus parva* are entirely wanting in the Ampyx Limestone but occur in large numbers in the above mentioned Swedish samples. *Ambalodus* and *Amorphognathus* species have been found only in rocks younger than the Ampyx Limestone, while *Strachanognathus parva* has not been found in Norway. *Pygodus* species and *Haddingodus serrus*, which are very characteristic elements in the Ampyx Limestone in Norway, do not occur in the Swedish samples from the Tvären area. These facts suggest that samples 7–12 from the Tvären area belong to younger deposits than the Ampyx Limestone; it is possible that their age corresponds to that of the Lower Chasmops Shale or a little younger.

GREAT BRITAIN

Of the species identified from Wales by RHODES (1953) and BERGSTRÖM (1964), 14 are identical with species in the Ampyx Limestone fauna and 15 are identical with species in the Upper Chasmops Limestone of Norway. But most of the species common to Wales and the Central part of the Oslo Region range throughout the Caradoc. Species such as *Acodus similaris, Drepanodus homocurvatus, Hibbardella* (*Roundya*) *inclinata, Oistodus excelsus, O. venustus, Panderodus compressus, P. gracilis, P. unicostatus, Tetraprioniodus asymmetricus* (including *Tetraprioniodus* sp. Bergström 1964) appear to be long-ranging forms in Norway. *Ambalodus* and *Amorphognathus* are similarly long-ranging forms in Wales, but in the central part of the Oslo Region these genera have significant stratigraphical value. *Ambalodus triangularis* is reported from the Llandeilo Limestone and occurs throughout the Caradoc in Wales. In the central part of the Oslo Region, the earliest known specimens of this species have been found in 4bα. *Amorphognathus* has in Wales as great a stratigraphical range as *Ambalodus*, while in Norway this genus can only be reported from the uppermost Caradoc (4bδ), but as specifically indeterminable fragments. One of the several species of *Panderodus* has a limited vertical distribution in both regions. This is *P. similaris* which is common from 4bα to the youngest Caradoc. *Sagittodontus robustus* reported from the Middle Caradoc of Wales appears only in restricted numbers from the Central Oslo Region, from the Ampyx Limestone. *Cordylodus elongatus* and *Drepanodus suberectus* range through the Llandeilo and Caradoc in Wales, while in Norway both species are very rare. *Ligonodina delicata* from the Middle and ?Upper Caradoc from Wales is restricted to the Upper Chasmops Limestone (4bδ) in Norway.

There are two main differences between the Welsh and Norwegian conodont faunas. The Welsh fauna contains *Holodontus, Icriodella, Ozarkodina, Spathognathodus*, and *Zygognathus* which are completely absent from the Central Oslo Region. The other significant difference is that whereas *Pygodus* and *Haddingodus* are very important in the Llandeilo of the European provinces mentioned, these forms have not been found in the Llandeilo of Wales.

NORTH AMERICA

In the Central Oslo Region, the conodont fauna is composed of elements which are characteristic of the European provinces (not Welsh), but also includes a number of species found in the Ordovician of North America, both from the Appalachian and the midcontinent faunal provinces. It is an established fact (HAMAR 1964) that the greatest similarities are found between the faunas of the Central Oslo Region and the faunas of the Appalachian province. Two earlier papers are concerned with the latter, the Pratt Ferry fauna (SWEET and BERGSTRÖM 1962) is somewhat older than the Norwegian faunas at present under discussion (HAMAR 1964), while the Martinsburg Shale fauna from New Jersey is still imperfectly known for correlation purposes.

Nine species are abundant in the Chasmops Series in the Central Oslo Region (*Dichognathus typica*, *Drepanodus homocurvatus*, *D. suberectus*, *Oistodus excelsus*, *O. venustus*, *Panderodus compressus*, *P. gracilis*, *P. unicostatus*, and *Phragmodus undatus*), and these are also well known long-ranging forms from the North American midcontinent province. One of these species, *Dichognathus typica* is so far as is known at present restricted to the Ampyx Limestone (4aβ) in the Central Oslo Region, while the other species occur throughout the Norwegian Caradoc.

Another group of conodonts including *Ambalodus triangularis*, *Amorphognathus complicata*, *Belodina dispansa*, *Keislognathus gracilis*, and *Ligonodina delicata* includes well-known Upper Ordovician forms from the North American midcontinent province. These are now reported from the Middle Ordovician of the Central Oslo Region.

It appears that the species of *Ambalodus*, *Amorphognathus*, *Keislognathus*, and *Ligonodina* mentioned above originated from the Appalachian–European province in the Middle Ordovician, and at the end of this time migrated into the midcontinent province of North America. This possibility has already been mentioned by PULSE and SWEET (1960), and they suggest that migration occurred during Edenian or early Maysvillian times in North America.

In addition to the species mentioned above, some other species could be discussed here which are known from the early Upper Ordovician Dubaque from North America (Galena Formation, ETHINGTON 1959) and from the Middle Ordovician fauna of the Central Oslo

Region. These are *Acodus inornatus*, *Coelocerodontus trigonius*, *C. stolus*, and *Sagittodontus robustus* which, so far as is known at present, might well belong to the fauna which 'migrated' from the 'European' province to the North American midcontinent province.

Species of *Polyplacognathus* are known sporadically from the North American continent. Of the four species described, *P. ramosa* (the type species, from the Decorah Shale, STAUFFER 1953; and also from the Harding Formation, SWEET 1955), *P. lingualis* (Harding Formation, SWEET 1955), *P. rutriformis*, and *P. stelliformis* (Pratt Ferry Formation, SWEET and BERGSTRÖM 1962) are all from Middle Ordovician strata, but none of them is identical with the known Norwegian species. The occurrence of *Polyplacognathus* in the midcontinent province indicates an earlier date for the beginning of the 'migration' from the European–Appalachian provinces to the midcontinent region. The 'migration' of species typical of the European–Appalachian provinces to the midcontinent province of North America can be recognized in present faunal studies and fixes the approximate age of the Wilderness strata in North America at about that of the Middle part of the Caradoc in Europe.

List of the species not included in the systematic descriptions

The stratigraphical range and the number of specimens are given in Table 1. Where figured in this paper, plate references are added.

Acontiodus kullerudensis Hamar, 1964
Acontiodus rectus Lindström, 1954 . . . . . Pl. 1, Fig. 5
Coelocerodontus digonius Sweet & Bergström, 1962
Coelocerodontus stolus (Lindström, 1954)
Coelocerodontus trigonius Ethington, 1959
Drepanodus homocurvatus Lindström, 1954 . . . . . Pl. 2, Fig. 15
Haddingodus serrus (Hadding, 1913)
Oistodus longiramis Lindström, 1954 . . . . . Pl. 7, Fig. 19
Oistodus robustus Bergström, 1961 . . . . . Pl. 1, Fig. 21
Oistodus venustus Stauffer, 1935/a. . . . . Pl. 1, Fig. 20
Oneotodus simplex (Furnish, 1938)
Panderodus gracilis (Branson & Mehl, 1933) . . . . . Pl. 1, Fig. 7
Paracordylodus bergstroemi Hamar, 1964
Paracordylodus lindstroemi Bergström, 1961 . . . . . Pl. 7, Fig. 25
Periodon aculeatus Hadding, 1913
Periodon grandis (Ethington, 1959) . . . . . Pl. 5, Fig. 14

Polyplacognathus elongata (Bergström, 1961) . . . . . Pl. 4, Fig. 2
Polyplacognathus ringerikensis Hamar, 1964 . . . . . Pl. 4, Fig. 1
Polyplacognathus sp. . . . . Pl. 5, figs. 10–11
Prioniodina marcodentata (Graves & Ellison 1941)
Prioniodus variabilis Bergström, 1961
Pygodus anserinus Lamont & Lindström, 1957 . . . . . Pl. 7, Fig. 1
Scolopodus peselephantis, Lindström, 1954
Scolopodus tuatus Hamar, 1964 . . . . . Pl. 3, Fig. 3
Tetraprioniodus lindstroemi Sweet & Bergström, 1962
Indeterminate fragment . . . . . Pl. 5, Fig. 16

Systematic descriptions

CONODONTS

Genus ACODUS Pander, 1856

TYPE SPECIES: *Acodus erectus* Pander, 1856

Acodus graeai n. sp.

Pl. 3, figs. 11–14; Text-fig. 3, no. 5

HOLOTYPE: PMO 69708; *paratype:* PMO 69709.

DIAGNOSIS: An *Acodus* with proclined cusp and a posterior lateral costa. The cross section is triangular.

DESCRIPTION: The cone is proclined, with a lateral costa which is situated posteriorly. Between this costa and the posterior keel, the platform is concave. Anterior of this costa, the lateral face is slightly convex or planar. The other (outer) face is convex. The cone is weakly twisted. Aboral margin is narrowly obovate (SADT, 46), and the cross section is triangular. Basal cavity is as deep as wide.

REMARKS: *A. graeai* n. sp. differs from *A. bicostatus* Branson & Mehl, in the single lateral costa, and the cone is not recurved. *A. graeai* n. sp. is similar to *'Acontiodus' triangularis* Pander, but differs in the development of the aboral margin. *A. tetrahedron* Lindström has a lateral costa placed well towards the front, and a tetrahedral aboral margin unlike that of *A. graeai* n. sp. *Acodus unicostatus* Branson & Mehl (1947) is more robust at its basal part and tapers more rapidly than *A. graeai* n. sp.

OCCURRENCE: 4aβ, Oslo–Asker, Ringerike districts.

MATERIAL: 16 specimens.

Acodus inornatus Ethington, 1959

Pl. 2, figs. 1–2, 10; Text-fig. 4, nos. 1–3

A. inornatus Ethington, 1959, p. 268, Pl. 39, fig. 11; Hamar 1964, pp. 256–257, Pl. 1, figs. 4–5, Text-fig. 4, no. 1.

Remarks: Only a little can be added to the excellent description by Ethington. The edge of the lateral costa may be rounded or blunt, especially in the basal region. The costa always reaches the aboral margin. This species can be separated easily from *A. similaris* Rhodes because of the more extended basal part, in the blunter but stronger developed lateral costa, and because the costa always appears as a flexure in the outline of the aboral margin.

Occurrence: 4aβ, 4bα, 4bβ, 4bδ_1, 4bδ_2; Oslo–Asker, Ringerike districts.

Material: 56 specimens.

Acodus jejatus n. sp.

Pl. 1, figs. 10–11; Text-fig. 3, no. 4

Holotype: PMO 69706.

Diagnosis: An *Acodus* with a sharp anterior keel, with two symmetrically or nearly-symmetrically posteriorly-situated costae, and with a long oral margin and a deep basal cavity.

Description: Symmetrical or nearly-symmetrical simple cone with a sharp anterior keel which is flexed a little laterally. The lateral faces in the region of the basal cavity are convex, later becoming planar. The cone is proclined, continuously curved along the anterior keel. Posteriorly there are two symmetrically or nearly-symmetrically situated costae. They form a posterior platform of which only the basal part is convex; higher up it becomes concave. The basal cavity is generally deep, the depth corresponding to about half the length of the cone. The aboral margin is triangular.

Occurrence: 4bδ_1, 4bδ_2, Oslo–Asker, Ringerike districts.

Material: 9 specimens.

Acodus similaris Rhodes, 1955

Pl. 2, figs. 3–9, 13; Text-fig. 4, nos. 5–10, 12.

A. similaris Rhodes, 1955, pp. 124, 125, Pl. 10, figs. 7, 10, 14, 16, 18, 23, 26, 27, 28, 30; Hamar 1964, p. 256, Pl. 1, fig. 4; Bergström 1964, pp. 8–9, 52, 56, 59, 62 (not Text-fig. 2 = ? *Acodus inornatus*); Flajs 1964, p. 371.

Drepanodus arcuatus Pander – RHODES 1955, p. 126, Pl. 10, figs. 24, 21; RHODES 1953, p. 292, Pl. 21, fig. 110.
Drepanodus altipes Henningsmoen – RHODES 1953, Pl. 21, fig. 105.
Distacodus proceurus Ethington, 1959, p. 275, Pl. 39, fig. 8 (not *D. proceurus* Ethington – ETHINGTON and FURNISH 1962, pp. 1265–1266).

REMARKS: About 500 specimens have been examined from Norway. The variation of *A. similaris* in this material is illustrated in the Text-figures and Plates. *A. inornatus* is very similar to *A. similaris* and the distinctions are described above. *Panderodus similaris* Rhodes, can be distinguished from *A. similaris* because of the very deeply developed (panderoid) basal cavity. The specimens in the Norwegian material can be classified on the basis of the development of the costae (unicostate or biocostate), the curvature (continuously curved or sharply curved about the middle of the cones), and, finally, the development of the lateral faces (flat, slightly convex, or strongly convex).

In sample No. 157 (Upper Chasmops Limestone 4bδ), there are 242 specimens of *A. similaris* Rhodes. These units are classified thus:

I. The anterior edge is sharp and the basal part of the cone is well extended anterio-posteriorly and forms an equilateral triangle up to the point of strongest curvature; one lateral face is flat, the other is slightly convex.

a. one lateral costa which does not reach the aboral margin (sinistral–42; dextral–65).
b. two lateral costae, neither of which reaches the aboral margin; the costa on the flat lateral face is much shorter than the other (sinistral–10; dextral–9).

II. Rounded lateral faces with one or two lateral costae, which are weakly developed and run close to the posterior edge. Anterior and posterior edges are sharp. The cones are continuously curved. Basal cavity varies from shallow to deep (extending up to about half the height of the cone) (sinistral–37; dextral–51).

III. This group differs from group II in that its curvature is characterized by a *relatively* short posterior margin which makes an angle of about 45° with the posterior edge and by a continuously curved anterior edge. The posterior lateral costa is much more strongly developed and sometimes commences from a triangular incision basally.

There are also unicostate and bicostate forms in this group (sinistral –20; dextral–10).

A few specimens of doubtful systematic position have been included here. The lateral face carries a costa which is developed only on the upper half of the cone. The structure is intermediate between that of *A. similaris* and that of *Panderodus similaris*, differing from the former in the very deep basal cavity, and from the latter in the posterior lateral not very conspicuous costa. At present, it is difficult to refer this material to any other species than *A. similaris* (sensu lato).

OCCURRENCE: 4aβ, 4bα, 4bβ, 4bγ, 4bδ_1, 4bδ_2; Oslo–Asker, Ringerike districts.

MATERIAL: 583 specimens.

Acodus trullatus n. sp.

Pl. 1, fig. 15; Text-fig. 3, no. 2

HOLOTYPE: PMO 69738.

DIAGNOSIS: An *Acodus* which has a strongly twisted cone, so that the posterior keel is flexed to the outer lateral side, the anterior keel to the inner lateral side. The lateral costa is situated posteriorly and runs upwards on the inner lateral face to about two-thirds of the length of the cone.

DESCRIPTION: The cone is strongly twisted. The posterior and anterior keels are sharp. The lateral costa is basally situated posteriorly and is blunter than the keels. The inner lateral face is divided by the lateral costa into two unequal areas, the posterior one being narrower and concave in the basal region up to half of the length of the cone, but convex above. The anterior inner lateral face is much wider and basally concave and the upper half of the cone only slightly convex. The outer lateral face merges basally with the anterior face and it is strongly convex; more posteriorly it is only slightly convex. The aboral margin ovate (SADT 38). Basal cavity triangular and deep.

REMARKS: The species resembles *Coelocerodontus trigonius* Ethington but is distinguished by the depth of the basal cavity.

OCCURRENCE: 4bα, 4bβ; Oslo–Asker district.

MATERIAL: 6 specimens.

Genus ACONTIODUS Pander, 1856

TYPE SPECIES: *A. latus* Pander, 1856

Acontiodus semisymmetricus n. sp.

Pl. 7, figs. 5–6; Text-fig. 3, no. 6

?*Acontiodus* n. sp. – Lindström, 1960, p. 95, Fig. 7, no. 10; fig. 6, no. 11.

HOLOTYPE: PMO 69748; *paratype* PMO 74090.

DIAGNOSIS: An *Acontiodus* with well-extended base anterio-posteriorly, which flares out laterally in the middle. There are sharp anterior and posterior keels, of which the anterior is flexed laterally, and posteriorly there are two lateral costae.

DESCRIPTION: Recurved erect or slightly proclined cones, with sharp anterior and posterior keels. The oral margin is relatively long. The posterior lateral costae are symmetrically developed on the cone, but one costa, sited basally on the more convex lateral face, is shorter and becomes indistinct at a level corresponding to the apex of the basal cavity. The other costa can be followed nearly to the aboral margin. The anterior edge, which is flexed laterally, makes the cone asymmetrical so that an inner and an outer lateral face can be distinguished. The inner lateral face has basally a triangular depression between the anterior keel and posterior lateral costa; the depression is separated from the aboral margin, and runs on the lateral face parallel with the anterior keel as a narrow canal. Posterior to this groove the face is slightly convex, anterior it is planar. The other lateral face is convex. The aboral margin is pointed anteriorly, rounded posteriorly, and in the middle flares out markedly. The basal cavity is not very deep and its lateral outline is that of an equilateral triangle. The apex of the cavity occurs about half way up the cone.

REMARKS: The species resembles *A. rectus* Lindström, but differs in the laterally flexed anterior keel, in the deeper and more centrally projected basal cavity, and in the narrower aboral margin posteriorly.

OCCURRENCE: 4bα, 4bβ, 4bδ_1; Oslo–Asker district.

MATERIAL: 29 specimens.

Genus AMBALODUS Branson & Mehl, 1933

TYPE SPECIES: *A. triangularis* Branson & Mehl, 1933

Ambalodus frognoeyensis n. sp.

Pl. 4, figs. 5,8; Pl. 7, figs. 7–8; Text-fig. 6, no. 4a–c

HOLOTYPE: PMO 69791; *paratypes:* PMO 69797, 69696.

DIAGNOSIS: An *Ambalodus* with three processes, one platform type and clearly asymmetrical anteriorly, one broadly expanded process posteriorly, and a short bar-like process on the outer lateral side of the species. The cusp is well developed.

DESCRIPTION: The anterior process is the longest. The oral platform is wide and smooth, while near to the outer lateral margin there is a ridge with well developed denticles which are basally fused, orally pointed, and increase in size towards the cusp. The inner side of the anterior process slopes aborally and is wide. Distally this process decreases in width about two-thirds of the way along the cusp, leaving the distal part as a bar. This type of development of the anterior process is not always found, generally specimens show a wide, platform-like development, and the distal end of the process is always pointed.

The posterior process is shorter than the anterior. Orally it bears a few weakly developed denticles on the oral ridge which runs parallel and near to the inner lateral margin. On the outer lateral side of the ridge, the process is strongly expanded (similar to *A. elegans* Rhodes) and slopes slightly in the aboral direction.

The lateral process is short and carries a few weakly developed denticles. The process is bar-like, triangular in cross section, and this section is thick orally but gradually thins aborally. The cusp is erect (where the posterior process is oriented horizontally), and large, lateral faces are convex. Anterior and posterior keels are sharp. The lateral aboral ledges are weakly developed. On the inner lateral side, the ledge is continuous from the distal end of the posterior process to two-thirds the length of the anterior process where the ledge disappears. On the outer lateral side, the ledge is only developed on the posterior process where it starts within a short distance of the basal part of the cusp and makes an angle with the inner lateral border of the posterior process of about 60°–90°. Aborally the unit is deeply excavated.

REMARKS: *A. frognoeyensis* n. sp. systematically lies between *A.*

triangularis Branson & Mehl and *A. elegans* Rhodes. Differs from *A. triangularis* in the broadly expanded posterior process and from *A. elegans* in the wide platform-type anterior process.

OCCURRENCE: 4bδ_2, Ringerike district.

MATERIAL: 41 specimens.

Ambalodus triangularis Branson & Mehl, 1933

Pl. 7, fig. 10

REMARKS: One specimen in sample 93 perhaps belongs to *A. triangularis* but it is so rare that exact determination is impossible.

OCCURRENCE: 4bα, 4bδ_1, 4bδ_2?; Oslo–Asker, Ringerike districts.

MATERIAL: 43 specimens.

Genus *Amorphognathus* Branson & Mehl, 1933

TYPE SPECIES: *A. ordovicica* Branson & Mehl, 1933

Amorphognathus complicata Rhodes, 1953

Pl. 7, figs. 2–4

A. complicata Rhodes, 1953, p. 282, Pl. 20, figs. 42, 45, 46; BERGSTRÖM 1964, pp. 15, 56, 58, 62.

REMARKS: Few specimens can be identified with certainty as *A. complicata* Rhodes (sensu stricto). Most of the specimens are broken. The specimen figured in Pl. 7, figs. 3–4 has only the posterior and the unilobate lateral process preserved. The angles and the development of the processes are similar to those described by Rhodes for this species. One complete specimen (Pl. 7, fig. 2) has been extracted from the same sample as that containing the mentioned fragmentary specimens, and therefore it is most probable that all the fragments also belong to this species. Before new material becomes available, no other species of *Amorphognathus* can be reported from Norway.

OCCURRENCE: ? 4bδ_1; 4bδ_2, Oslo–Asker, Ringerike districts.

MATERIAL: 1 complete specimen, 113 fragments.

Genus BELODINA Ethington, 1959

TYPE SPECIES: *Belodus grandis* Stauffer, 1935

Belodina cf. *dispansa* (Glenister, 1957)

Pl. 7, fig. 18; Text-fig. 5, no. 4

DESCRIPTION: The aboral margin is similar to that in *B. dispansa* (Glenister), in which the oral part is narrow, the middle part is expanded laterally, and the anterior part is narrow again. The anterior margin is continuously curved and the basal two-thirds first sharp and later rounded. Lateral ridge is observed, but only on the middle region—located below the oral denticles. The oral edge is short. Three apically directed, fused denticles are situated on the posterior margin. Lateral faces of the apical part of the cone are slightly convex.

REMARKS: There are striking similarities between this specimen and *B. dispansa* (Glenister) in the apically inclined denticles on the posterior edge, and in the development of the aboral margin, but differs from it in the number of the denticles and in the cross section of the cusp.

OCCURRENCE: 4bδ_2, Ringerike district.

MATERIAL: 1 specimen.

Belodina n. sp.

Pl. 7, fig. 13; Text-fig. 5, no. 2

DESCRIPTION: There are typical double basal cavities. Both lateral faces are slightly convex except for the anterior basal portion (to one-third of the height), where the lateral face is not symmetrically strongly carinate. Oral edge is short and sharp edged. There are about three small, laterally compressed, apically pointed denticles on the posterior edge. Anterior edge is first basally sharp, later rounded. Anterior and posterior of the lateral carina are small, narrow 'grooves'.

REMARKS: The specimen resembles in general features *B. ornata* (Branson & Mehl) but differs in the well developed carinae.

OCCURRENCE: 4bδ_2, Ringerike district.

MATERIAL: 1 specimen.

Genus CENTROGNATHODUS (Branson & Mehl, 1933)

TYPE SPECIES: *Centrognathus sinuosa* Branson & Mehl 1933

GENERIC DESCRIPTION (Branson & Mehl): 'Denticulate bar- or somewhat blade-like mandibular pieces; straight or arched in the vertical plane; laterally straight, curved, or sinuous; with anterior end bent inward and a denticulate spur directed outward or out and forward at or near the point of the flexure of the anterior end. Denticles subcircular, subequal, and more or less separated above a shallow basal sheathing. Suppressed germ denticles not common. Aboral edges sharp.'

Centrognathodus? n. sp.

Pl. 5, figs. 12–13; Text-fig. 6, nos. 1a–c, 2a–c

DESCRIPTION: A straight unit, denticulated orally, aborally sharp-edged. The cusp is situated near to the posterior distal end. BRANSON and MEHL (1933) pointed out that the side with a lateral process is the inner lateral side. The lateral process also enables the position of the cusp to be determined. Posterior to the cusp, there are about seven denticles which are narrow but high (in lateral view) and fused. Anterior to the cusp there are 3–4 denticles, but beyond this the specimen is broken off. The lateral process is broad (in oral view) and the middle of the process carries a sharp costa running from the lateral side of the cusp to the distal end of the lateral process. Aborally, a short distance from the base of the denticles, a conspicuous ledge runs on each side of the anterior blade. On the inner lateral side, the ledge is continuous near to the distal end of the lateral process, but it is poorly developed on the posterior blade and the posterior face of the lateral process. On the outer lateral side of the unit the ledge is well developed, and a short distance from the cusp on the posterior blade it disappears. The posterior blade is keeled aborally. The basal cavity is small and filled with a basal funnel. The basal funnel is developed from just below the cusp and along all of the preserved anterior blade. The denticles on the lateral side are mostly costate and the cross section of the blades is asymmetrical.

Another specimen has been found which appears to be the anterior part of the same species (see Text-fig. 2a–c). There are several denticles

on the blade (about 10 denticles) in a row, which are irregular and fused. The blade is aborally sharp-edged (without basal cavity or basal funnel), and a ledge runs asymmetrically on both lateral faces between the base of the denticles and the aboral edge. The distal end of the blade decreases slightly in size.

REMARKS: Only a few of these forms have been found, and none of them is complete. The oldest known representative of this genus is reported from the Upper Devonian, and therefore it may be questionable that these conodont fragments really belong here, but these fragments are not sufficiently complete to permit a complete description, either generic or specific.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 6 specimens.

Genus CORDYLODUS Pander, 1856

TYPE SPECIES: *C. angulatus* Pander, 1856

Cordylodus elongatus Rhodes

Pl. 7, fig. 15

C. elongatus Rhodes – HAMAR, 1964, p. 262, Pl. 4, fig. 20

REMARKS: The few specimens which have been extracted from the new samples are badly preserved.

OCCURRENCE: 4bδ_1, Oslo–Asker district.

MATERIAL: 4 specimens.

Genus DICHOGNATHUS Branson & Mehl, 1933

TYPE SPECIES: *D. prima* Branson & Mehl, 1933

Dichognathus typica Branson & Mehl, 1933

D. typica Branson & Mehl, 1933, p. 113, Pl. 9, figs. 27–29; HAMAR 1964, pp. 262–263, Pl. 3, fig. 10. As to further synonyms, see HAMAR 1964.

REMARKS: This species seems to occur only locally in the Ringerike district of Norway, in restricted numbers.

OCCURRENCE: 4aβ, Ringerike district.

MATERIAL: 5 specimens.

Genus DISTACODUS Hinde, 1879

TYPE SPECIES: *Machairodus incurvus* Pander, 1856

Distacodus bygdoeyensis n. sp.

Pl. 1, figs. 12–14: Text-fig. 3, no. 1

HOLOTYPE: PMO 69695; *paratypes:* PMO 69805, 69806.

DIAGNOSIS: A *Distacodus* with sharp anterior and posterior keels, and two lateral costae. One lateral face is concave, the other convex.

DESCRIPTION: An erect or proclined cone with short oral margin and sharp posterior keel. The anterior keel, which is also sharp, is smoothly curved from the base up to two-thirds of its length and later is straight. The lateral costae start just above the aboral margin and run along the middle of the cone to the apex. On some specimens, the costae are situated on the upper half of the cone posterior to the mid-line of the cone. The cross section of the upper half of the cone is rhombic (SADT 28). Aboral margin narrowly elliptic (SADT 2) with the anterior part narrower and flexed laterally. The basal cavity has a cross section approximating an equilateral triangle, and its apex points along the cone axis.

On the basal half of the cone, one lateral face is concave and carries a strong costa on the mid-line. The opposite face is convex with a somewhat weaker-developed costa on the middle of it.

OCCURRENCE: 4aβ, 4bβ, 4bγ, 4bδ_1; Oslo–Asker and Ringerike districts.

MATERIAL: 11 specimens.

Genus DREPANODUS Pander, 1856

TYPE SPECIES: *D. arcuatus* Pander, 1856

Drepanodus cf. *arcuatus* Pander, 1856

Pl. 1, figs. 16–17; Text-fig. 2, no. 7

D. cf. *arcuatus* Pander – LINDSTRÖM, 1954, pp. 560–561, Pl. 2, figs. 45–46, Text-fig. 4c.

REMARKS: As pointed out by Lindström, this species is systematically a very difficult group of conodonts. In the Norwegian material, the forms included here show a transition into the new species *Scan-*

dodus osloensis; the similarities and differences are discussed later in the description of the new species.

OCCURRENCE: 4aβ, 4bδ_2, Oslo–Asker and Ringerike districts.

MATERIAL: 6 specimens.

Drepanodus suberectus (Branson & Mehl, 1933)

Pl. 1, figs. 8–9

Oistodus suberectus Branson & Mehl, 1933, p. 111, Pl. 9, fig. 7; *Drepanodus* (possibly *Oistodus*) *incurvus* (Hinde) – BRANSON and MEHL 1933, p. 154, Pl. 12, fig. 11.

Drepanodus suberectus (Branson & Mehl) – BERGSTRÖM 1964, pp. 22, 24, 49, 50, 52, 56, 59, 62.

As further synonyms, see BERGSTRÖM 1964.

REMARKS: The Norwegian specimens have narrower carinae on the lateral faces than the specimens described by Branson and Mehl, but otherwise the material agrees in all respects with the type specimen.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 3 specimens.

Genus EOPLACOGNATHUS n. gen.

TYPE SPECIES: *Ambalodus lindstroemi* Hamar, 1964

DIAGNOSIS: There are three processes, one anterior, one posterior, and one lateral. The anterior-posterior axis is either straight or undulating. In the middle of the processes, there are numerous nodes or denticles, and one of these (the cusp) is generally developed much more strongly than the others. On either side of the cusp, there are usually smaller denticles developed. The costa, which continues with the ridge on the lateral process, starts either on the outer lateral side of the first anterior denticle from the cusp or the outer lateral side of the cusp itself. In cross section the processes are 'polyplacognathoid'.

REMARKS: The new genus *Eoplacognathus* with the genus *Polyplacognathus* form a closely united group of conodonts with the typical cross section which distinguishes them from the very similar group of species including the genera *Ambalodus* and *Amorphognathus*.

Eoplacognathus extensa n. sp.

Pl. 4, figs. 3–4; Text-fig. 5, no. 1a–d*

HOLOTYPE: PMO 69695.

DIAGNOSIS: An *Eoplacognathus* with a short posterior process and an anterior process twice as long. The lateral process diverges at a small angle from the anterior process. All processes are pointed at their distal ends.

DESCRIPTION: The posterior process is short and asymmetrical, carrying a ridge orally. On the ridge, carrying narrowly elliptic (SADT 1) denticles which are weakly developed. The ridge is slightly arched over to the inner lateral side, and its central part (at the cusp position) to the outer lateral side. The same undulation is followed by the border of the posterior process on the inner lateral side. The outer lateral border of this process is convex and only separated from the lateral process by a depression (canal). The depression starts a short way from the junction of the posterior and lateral ridges and deeper distally (in oral view). The anterior process is about twice as long as the posterior. The median ridge of the posterior process is connected to the undulating ridge of the anterior process, where the denticlse are low and fused basally but much more clearly developed than on the anterior process. The denticles on the anterior process increase in height towards the middle of the platform and later decrease distally. They are irregular in height and wide and unfused only at their apices, and bent continuously to the inner lateral side from the central part of the platform all along to the distal end. The outline of the platform is narrowly triangular (SADT 74). The ridge of the lateral process starts from the anterior part of the outer lateral side of the cusp. On the ridge the denticles are weakly developed so it is difficult to separate one from the other. Generally they are irregular—similar to those on the posterior process. The lateral and posterior processes are equally long. The cross section of all the processes is 'polyplacognathoid'. Basal funnel is well developed. All three processes are pointed at their distal end.

REMARKS: The species differs from *E. lindstroemi* (Hamar) in the

* In Text-fig. 5, 1a-d, the anterior and posterior determinations are the opposite of those used in the text here.

pointed distal ends of the platforms and in the coalesced border regions of the posterior and lateral processes.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 17 specimens.

Eoplacognathus lindstroemi (Hamar, 1964)

Pl. 4, fig 9

Ambalodus lindstroemi Hamar, 1964, p. 258, Pl. 5, figs. 1, 4, 7, 8, 11, Text-fig. 5, nos. 1a–b, 3a–b, 4a–b.

REMARKS: Few specimens, all badly preserved, have been collected of this species, so it is impossible to add anything further to the previous description.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 6 specimens.

Genus FALODUS Lindström, 1954

TYPE SPECIES: *Oistodus prodentatus* Graves & Ellison, 1941

Falodus prodentatus (Graves & Ellison, 1941)

Pl. 5, fig. 15; Text-fig. 3, no. 7a–c

F. prodentatus (Graves & Ellison) – HAMAR 1964, p. 265, Pl. 4, figs. 9–10, Text-fig. 4, no. 8.

Further synonyms, see HAMAR (op. cit.).

REMARKS: The species seems to be highly variable, especially in the number of denticles anteriorly. The figured specimen (Text-fig. 2, no. 7c) shows clearly separable denticles and a sixth fused with the cusp although the precise nature of this sixth denticle is not clear. All transitions can be observed between this type and forms with only two denticles on the anterior edge. In transmitted light, these latter specimens reveal evidence of a third denticle basally. The other characters of the specimens are identical. The large number of specimens from the Norwegian Middle Ordovician clearly resemble the specimens described by Sweet and Bergström from the Pratt Ferry Formation and reported by Graves and Ellison from the Fort Peña Formation.

OCCURRENCE: 4aβ, 4bα, 4bβ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 77 specimens.

Genus GOTHODUS Lindström, 1954

TYPE SPECIES: *G. costulatus* Lindström, 1954

Gothodus costulatus Lindström, 1954

Pl. 5, figs. 5–6

G. costulatus Lindström, 1954, Pl. 5, figs. 23, 25; HAMAR 1964, pp. 265, 266, Pl. 1, figs. 15–16.

REMARKS: The Norwegian specimens seem to be better preserved than the type specimens of Lindström. These new specimens differ from Lindström's description in the longer posterior bar which shows 'hindeodellid' denticulation, and the more proclined cusp which makes an angle of about 130°–140° with the posterior bar. These differences are not sufficient to warrant a new species and therefore these units are here included with this species.

OCCURRENCE: 4aβ, Oslo–Asker and Ringerike districts.

MATERIAL: 26 specimens.

Genus HIBBARDELLA Bassler, 1925

TYPE SPECIES: *Prioniodus angulatus* Hinde, 1879

Hibbardella (*Roundya*) *inclinata* (Rhodes, 1953)

Pl. 7, fig. 21

Trichonodella inclinata Rhodes, 1953, p. 315, Pl. 22, figs. 176, 177, 186.
Roundya sp. Hamar, 1954, p. 281, Pl. 3, fig. 16, Text-fig. 4, no. 11.
Hibbardella? inclinata (Rhodes) – BERGSTRÖM 1964, pp. 24, 25, 48, 49, 62, Text-fig. 10.
For further synonyms see BERGSTRÖM 1964.

REMARKS: The specimens which were referred to this species are symmetrical, with 'hindeodellid' denticulation on the posterior bar. The lateral bars make small angles with the posterior bar.

OCCURRENCE: 4aβ, 4bδ_1, 4bδ_2, Oslo–Asker and Ringerike districts.

MATERIAL: 22 specimens.

Genus KEISLOGNATHUS Rhodes, 1955

TYPE SPECIES: *Keislognathus gracilis* Rhodes, 1955

Keislognathus gracilis Rhodes, 1955

Pl. 5, fig. 7; Text-fig. 3, no. 9

K. gracilis Rhodes, 1955, pp. 119, 131, Pl. 7, figs. 7–8; PULSE and SWEET 1960, p. 254, Pl. 36, fig. 3; WOLSKA 1961, p. 350, Pl. 2, figs. 2–3; BERGSTRÖM 1964, pp. 25–26.

REMARKS: There are many difficulties to be encountered in the identification of material belonging to *Keislognathus gracilis*, *'Roundya' diminuta*, or *Hibbardella* (*Roundya*) *gracilis* (Rhodes), especially when preservation is poor. Such badly preserved material has been reported and figured by PULSE and SWEET (1960) and WOLSKA (1961, Pl. 2, fig. 2) and referred to *Keislognathus gracilis* Rhodes. These specimens are very similar to previously described *'Roundya' diminuta* Rhodes because the posterior bar is partly broken off; the denticulation is supposed to be 'hindeodellid', and the cusp is erect (typical of *R. diminuta*). But denticulation is clear on the lateral bars and it is asymmetrical. However, the precise shape of the cusp and the exact mathematical symmetry are difficult characters to use in systematics or accounts of natural variations.

The Norwegian specimens—which are generally poorly preserved —could be separated into two different groups. One of these is clearly identical with *K. gracilis*, with asymmetrical lateral bar arrangement, 'hindeodellid' posterior bar denticulation, and proclined cusp. The other group of specimens has an erect cusp and slightly asymmetrical lateral bar arrangement. The detailed symmetry of the denticulation has not been investigated on the lateral bars, because many specimens have previously been included with the bilaterally symmetrical forms even though they are asymmetrically denticulated (cf. HAMAR 1964, *Rhynchognathodus* (*Roundya*) *pyramidalis*, Text-fig. 4, no. 12). The author does not consider that these three species are synonymous. The Norwegian material which is 'perfectly' bilaterally symmetrical referred to *Hibbardella inclinata* (Rhodes) and the asymmetrical material to *Keislognathus gracilis* Rhodes.

OCCURRENCE: 4aβ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 16 specimens.

Genus LIGONODINA Bassler, 1925

TYPE SPECIES: *L. pectinata* Ulrich & Bassler, 1926

Ligonodina delicata (Branson & Mehl), 1933

Pl. 7, figs. 11, 20; Text-fig. 3, no. 10

Phragmodus delicatus Branson & Mehl, 1933, p. 123, Pl. 10, fig. 22; BERGSTRÖM 1964, pp. 27–29.

REMARKS: A few specimens from the Upper Chasmops Limestone can be referred to this species. They are clearly identical with the type specimen.

OCCURRENCE: 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 12 specimens.

Genus OISTODUS Pander, 1856

TYPE SPECIES: *O. lanceolatus* Pander, 1856

Oistodus breviconus Branson & Mehl, 1933

Pl. 1, fig. 19; Text-fig. 4, no. 11

O. breviconus Branson & Mehl, 1933, pp. 109–110, Pl. 9, figs. 13, 14. BERGSTRÖM 1964, pp. 29–30.

REMARKS: The Norwegian specimens differ from *O. venustus* in a higher base and in the acarinate lateral faces of the cusp, and differ from *O. abundans* in the more inclined cusp. The figured specimen has slightly convex lateral faces basally and a narrow basal cavity.

OCCURRENCE: 4aβ, 4bβ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 21 specimens.

Oistodus excelsus Stauffer, 1935

Pl. 2, fig. 14; Text-fig 2, no. 6

O. excelsus Stauffer, 1935/b, p. 610, Pl. 74, fig. 43; FAY 1952, p. 135; BERGSTRÖM 1961, p. 44, Pl. 2, figs. 18–19; WOLSKA 1961, p. 351, Pl. 3, figs. 1a–b.

? *O. basiovalis* Sergeeva, 1963, pp. 96–97, Pl. 7, figs. 6–7, Text-fig. 3.

REMARKS: *O. basiovalis* Sergeeva seems to be identical with *O. excelsus* Stauffer.

OCCURRENCE: 4aβ, 4bβ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 21 specimens.

Genus Oulodus Branson & Mehl, 1933

Type species: *O. mediocris* Branson & Mehl, 1933

Generic description of Branson & Mehl: 'Complex dental pieces consisting of a bent and twisted denticulate bar. The longer limb of the bar is straight or slightly curved and aborally grooved to clasp the oral edge of the mandible. At the apex of the bend is a large denticle directed appreciably forward, and beyond this is the short limb, which is bent aborally and more or less posteriorly, and is deeply grooved on the aboral side.'

Oulodus tortilis (Sweet & Bergström, 1962

Pl. 5, fig. 17

Ligonodina tortilis Sweet & Bergström, 1962, pp. 1230–1231, Pl. 170, figs. 13, 14.
Oulodus tortilis (Sweet & Bergström) – Lindström 1964, p. 85, Fig. 30c.

Remarks: This form of *Oulodus* is atypical for this genus, with its shallow basal cavity of 'inverted' type on the posterior bar. These few specimens belong undoubtedly to *O.* (*Ligonodina*) *tortilis* (Sweet & Bergström). The transitional forms between this species, on the one hand, and *Prioniodina macrodentata*, on the other, have been observed and included in the later species in the present Norwegian material.

Occurrence: 4aβ, Ringerike district.

Material: 7 specimens.

Genus Panderodus Ethington, 1959

Type species: *Paltodus unicostatus* Branson & Mehl, 1933

Panderodus compressus (Branson & Mehl, 1933)

Pl. 1, figs. 1–4; Text-fig. 3, no. 8a–c.

Paltodus compressus Branson & Mehl, 1933, p. 109, Pl. 8, fig. 19; Fay 1952, p. 143. For literature before 1952, see Fay.
Panderodus compressus Ethington, 1959, p. 284, Pl. 39, fig. 4.
Paltodus acostatus Branson & Branson, 1947, p. 554, Pl. 82, figs. 1–5, 23–24; Fay 1952, p. 143; Rhodes 1953, p. 296, Pl. 21, figs. 111–112, Pl. 22, figs. 163–164, Pl. 23, figs. 212–213; Glenister 1957, p. 727, Pl. 85, fig. 7; Walliser 1960, p. 31, Pl. 7, no. 10; Walliser 1957, p. 42, Pl. 2, figs. 6 (?5).
Panderodus acostatus Bergström, 1961, p. 48, Pl. 1, figs. 13–14; Bergström 1964, pp. 31, 49, 56, 63.

? Paltodus cornutus Stauffer, 1935/b, p. 612, Pl. 7, figs. 11–15, 19; FAY 1952, p. 143; WOLSKA 1961, p. 353, Pl. 4, figs. 1a–b.

REMARKS: *P. compressus* (Branson & Mehl) has been described from the Plattin collection. The type specimen has a short oral margin and is proclined. One (the inner lateral) face has a narrow groove between the lateral mid-line of the cone and the posterior margin. The anterior keel is sharp and the basal cavity is as deep as half the length of the cone. *P. acostatus* (Branson & Branson) has been described from the Lower Silurian Brassfield Formation and later reported by several authors from the Middle Ordovician (RHODES 1953, BERGSTRÖM 1961, 1964) and Upper Ordovician (GLENISTER 1957).

The Norwegian specimens show a very broad variation in the development of the lateral faces. The outline of the anterior keel is the most typical feature of the species. The keel, starting a short distance from the base, continues for two-thirds of the length of the cone and then disappears. On the middle of the cone the keel is most prominent, viz. broadest. Its edge is narrowly rounded or blunt. The anterior keel can be much shorter and less prominent than described above.

There are specimens with slightly convex lateral faces—with a cross section narrowly elliptic (SADT 2)—and with sharp anterior and posterior keels. Material with elliptic (SADT 4) cross section or in extreme cases circular (SADT 6) cross section develops a very short anterior keel or only a weak indication that a keel is present. Text-fig. 3, no. 8 shows these different types of specimens. Study of the relatively large numbers of these specimens gives the impression that characters such as convexity of the lateral faces and the longer and sharper, or shorter and blunter, anterior keel are continuously variable and suggest the presence of only one species, i.e. *P. compressus*. The list of synonyms (see above) is based on these observations which indicate that the Norwegian material appears to include all these species.

There is no definite costa on the lateral faces, and the posterior lateral faces are slightly depressed; one of these faces has a narrow groove running from the base to the apex of the cone.

GLENISTER (op. cit.) recorded doubtful *P.? acostatus*. The figured specimen seems to be identical with *P. compressus* (Branson & Mehl) (= *P. acostatus*). GLENISTER remarks (1957, pp. 727–728) that in the Maquoketa collection there occurs material with the same characters

as *P. compressus* but 'some specimens develop faint costae on the lateral faces'. Such material should perhaps be excluded from the very variable *P. compressus*.

OCCURRENCE: 4aβ, 4bα, 4bβ, 4bγ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 137 specimens.

Panderodus nakholmensis n. sp.

Pl. 7, figs. 22–24; Text-fig. 3, no. 3

Paltodus n. sp. Hamar, 1964, p. 271, Pl. 1, figs. 21–22, Text-fig. 4, no. 6.

HOLOTYPE: PMO 69732; *paratype:* PMO 69655.

DIAGNOSIS: A *Panderodus* with one posterior, two anterior lateral, and one or two lateral costae. The two lateral costae are more weakly developed. The aboral margin is triangulate. The basal cavity is as deep as half the length of the cone.

DESCRIPTION: The cone is erect and continuously curved. The posterior keel is basally situated laterally but at about half the length of the cone it assumes a posterior position. Basally there is a posteriorly situated lateral costa which is sharper than the posterior keel, but towards the apex the costa runs to its normal lateral position, and at about half the length of the cone it disappears. The two anterior lateral costae are somewhat asymmetrically developed but continue up to the apex of the cone. The anterior face is strongly convex. The lateral faces are planar or slightly concave. On the lateral face, which carries the posteriorly-situated lateral costa, another short weak costa can be developed. The other lateral face is planar or slightly concave, without a costa. The aboral margin is triangular, and the posterior keel appears as a lateral costa (Text-fig. 3, no. 3). The basal cavity is as deep as half the length of the whole cone.

REMARKS: *Paltodus comptus* Branson & Mehl (1933) and perhaps *Paltodus variabilis* Sergeeva (1963) differ from the new species in that *Panderodus nakholmensis* n. sp. has a typical triangular aboral margin, and deep basal cavity while the other two species have a rectangular aboral margin and small basal cavity.

OCCURRENCE: 4bα, 4bβ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 14 specimens.

Panderodus similaris (Rhodes, 1953)

Pl. 2, figs. 11–12; Text-fig. 5, no. 3

Drepanodus similaris Rhodes, 1953, pp. 292–293, Pl. 21, figs. 97–99; Rhodes 1955, p. 126, Pl. 10, figs. 4, 5.

Drepanodus altipes Henningsmoen – Rhodes 1953, p. 192, Pl. 21, figs. 102, 103, 104 (not fig. 105 = *Acodus similaris*); Rhodes 1955, pp. 125–126, Pl. 10, figs. 6, 8, 29.

Oistodus sp. Rhodes, 1955, p. 126, Pl. 10, figs. 13, 20 (?9).

Panderodus similaris (Rhodes) – Bergström 1964, pp. 31, 56, 63, Text-fig. 15.

Remarks: The differences between *P. compressus* (Branson & Mehl) and the present species lie in the development of the aboral margin and the posterior lateral groove. *P. compressus* has a typical rounded anterior aboral margin, and *P. similaris* (Rhodes) has a sharp anterior edge basally and lacks the posterior lateral groove.

Occurrence: 4bα, 4bβ, 4bγ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

Material: 33 specimens.

Panderodus unicostatus (Branson & Mehl, 1933)

Pl. 1, fig. 6

Panderodus cf. *unicostatus* Hamar, 1964, p. 272, Pl. 1, figs. 28–29, Text-fig. 6, no. 1a–b.

Occurrence: 4aα_3, 4aβ, 4bα, 4bβ, 4bγ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

Material: 181 specimens.

Genus Phragmodus Branson & Mehl, 1933

Type species: *P. primus* Branson & Mehl, 1933

Phragmodus undatus Branson & Mehl, 1933

Pl. 5, fig. 9

Remarks: One well-preserved species has been found.

Occurrence: 4bδ_1, Oslo–Asker district.

Genus POLYPLACOGNATHUS Stauffer, 1935

TYPE SPECIES: *P. ramosa* Stauffer, 1935/b

Polyplacognathus stoermeri n. sp.

Pl. 4, fig. 7, Pl. 5, figs. 1–2; Text-fig. 6, no. 3a–b

HOLOTYPE: PMO 69745, *paratype:* PMO 69746.

DIAGNOSIS: There is a short posterior process and an anterior process three times as long and a lateral process which is a little shorter than the posterior. The posterior process near its distal end is bilobate.

DESCRIPTION: The posterior process is short, straight, carries on its platform a row (about 7–8 in number) of irregular denticles on a median ridge. At the position of the fifth denticle from the cusp, the median ridge divides to produce a short inner lateral process (with 2–3 definite denticles on it) and the distal end of the posterior process. These two processes are equal in length from their point of divergence. The median ridge of the lateral process with denticles on it starts from the anterior lateral side of the cusp. This process is shorter than the posterior one. Accepting the definition that the cusp stays in the position of the outer lateral process, the cusp is not always the largest denticle. The position of the largest denticle varies and either stays posterior to or at a point 2–3 denticles anterior to the cusp. These denticles in cross section are either broadly elliptic (SADT 5) or circular (SADT 6). The anterior process is about three times longer than the posterior. The posterior third of the process carries denticles on the median ridge which is low and laterally compressed but not keeled anterior-posteriorly. The distal two-thirds of the process carry high, laterally flattened, apically pointed, but fused denticles. These denticles of the distal one-third of the process are flexed to the inner lateral side of the unit. The platforms do not lie in the same horizontal plane. The outer lateral process is strongly deflexed aborally, the posterior process is only slightly inclined, compared with the anterior process, and the anterior process is markedly undulating compared with a horizontal plane on its oral face as well as on its lateral border. Cross sections of the processes are 'polyplacognathoid'. Basal funnel generally present.

REMARKS: The species in general view is three-pointed, but the bifid posterior process (or the short posterior inner lateral process) re-

sembles the genus *Polyplacognathus* more than the new genus *Eoplacognathus* which includes species with three processes. The species is otherwise most related to *Eoplacognathus lindstroemi* (Hamar).

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 10 specimens.

Genus PRIONIODUS Pander, 1856

TYPE SPECIES: *P. elegans* Pander, 1856

Prioniodus alatus Hadding

Pl. 4, fig. 6; Pl. 5, fig. 3; Text-fig. 6, nos. 5–6

P. alatus Hadding, 1913, pp. 32, 87, Pl. 1, figs. 9–10; SERGEEVA 1963, p. 93; HAMAR 1964, p. 287, Pl. 4, fig. 15, Pl. 5, figs. 17, 22, Text-fig. 6, no. 7; BERGSTRÖM 1964, pp. 11, 35.

P.? n. sp. 2 Lindström, 1960, p. 96, Fig. 8, no. 1.

REMARKS: Two closely-related groups of specimens have been included here from the Norwegian Middle Ordovician. These two groups occur in the same samples, so they are regarded as infraspecific variations of the species. Both these groups of specimens differ from the type specimens in that they carry basally more prominent ledges but these are never continuously developed. These specimens are excluded from *Ambalodus elegans* Rhodes for two reasons. Firstly, both anteriorly situated bars have a continuous costa on the cusp; the weaker developed bar is the anterior one. The other difference between *P. alatus* and the Norwegian specimens is that the posterior platform expands laterally (outer lateral side) conspicuously, not locally as in the type specimens of *P. alatus*, and none of the specimens show decreasing width of the posterior bar distally. The specimens which have a posterior bar with a small angle of divergence carry numerous (about 20) small, slightly irregular denticles (Pl. 4, fig. 6). The other forms with an angle of divergence of about 30° carry well-developed, irregular, and relatively few denticles (Pl. 5, fig. 3). These are clearly *Prioniodus* and form part of a transition between it and *Ambalodus*. At the moment, all of these Norwegian specimens are referred to *P. alatus* with reservation.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 18 specimens.

Genus PYGODUS Lamont & Lindström, 1957

TYPE SPECIES: *Pygodus anserinus* Lamont & Lindström, 1957

Pygodus trimontis n. sp.

Pl. 7, figs. 12, 16, 17

P. sp. Hamar, 1964, p. 280, Pl. 4, figs. 5–8, Text-fig. 6, no. 8.

For further synonyms, see HAMAR 1964.

HOLOTYPE: PMO 74094; *paratype:* PMO 74095.

DIAGNOSIS: A *Pygodus* with a small cusp from which radiate three ridges which run on a triangular shaped platform.

DESCRIPTION: A *Pygodus* with three ridges which diverge at small angles from the cusp. The cusp is small, rounded at its apex and its axis lies in the oral plane. It is situated at the anterior end of the posterior ridge. The posterior ridge runs in the middle of the triangular platform. The outer margin of the platform is slightly convex; the inner margin is slightly concave. Aborally nearly the whole platform is open, and its margin is V-shaped. The ridges—inner marginal ridge, outer marginal ridge, and posterior ridge—are rough or smooth or carry small nodes on their oral face. The platform between the ridges is concave, in oral view, and either carries small irregular nodes or is smooth.

REMARKS: The three different forms (right, slightly curved, and curved), as described by HAMAR (1964) in connection with *P. anserinus*, have been recognized in this new species also.

OCCURRENCE: 4aβ, Ringerike district.

MATERIAL: 12 specimens.

Pygodus n. sp.

Pl. 5, fig. 8

DESCRIPTION: The new species has 5 ridges on the oral platform.

REMARKS: Only one fragmentary specimen has been found where the posterior part could be studied. There are five clearly separated ridges carrying small rounded denticles. It is different from a *Pygodus anserinus* in that there is one more ridge on the platform. The range of the genus *Pygodus* is now extended in that the earliest species has only three ridges (*Pygodus trimontis* n. sp.) and the latest (this new species) five. A detailed study of '*Pygodus anserinus*' in Norway makes

reference to this new species' being regarded as questionable. Possibly some of this material is transitional between *P. anserinus* and *P.* n. sp., when these specimens have on the inner lateral margin more expanded denticles (or nodes) extending laterally. From the fifth or sixth denticle starts a new (the fifth) ridge, but it is weakly developed. One of these specimens is figured on Pl. 7, fig. 1. The systematic position of this specimen is doubtful but it is included by the author with *Pygodus anserinus*.

OCCURRENCE: 4aβ, Ringerike district.

Genus RHYNCHOGNATHODUS Ethington, 1959

TYPE SPECIES: *R. typica* Ethington, 1959

REMARKS: ETHINGTON (1959, p. 286) stated this genus only for asymmetrical forms. The present author believes that this generic character is of secondary importance and wishes to refer several previously described species to this genus, based on the main character, 'the basal sheated development between the bars'. Of the asymmetrical forms, *'Prioniodus' triangularis* Lindström, 1954 undoubtedly belongs to this genus. Of the symmetrical forms could be included here *'Trichonodella' longa* Lindström, 1954 from the Swedish Lower Ordovician and *'Roundya' pyramidalis* Sweet & Bergström, 1962 from the Middle Ordovician. *'Trichonodella' longa minor* Lindström, 1954, represented a group of transition forms between the genus *Rhynchognathodus* on the one hand and *Sagittodontus* on the other.

Rhynchognathodus pyramidalis (Sweet & Bergström, 1962)

Roundya pyramidalis Sweet & Bergström, 1962, p. 1243, Pl. 170, figs. 7–9; HAMAR 1964, p. 280, Pl. 5, figs. 15–16, 20–21, Text-fig. 4, no. 12.

REMARKS: Previously, the present author included slightly asymmetrical forms in this species, these being typically transitional forms. *Rhynchognathodus* (*Prioniodus*) *triangularis*, including asymmetrical conodont elements from the early Lower Ordovician, probably developed into *R. pyramidalis* in the early Middle Ordovician, when changing its asymmetry to symmetry.

OCCURRENCE: 4aβ, Oslo–Asker and Ringerike districts.

MATERIAL: 16 specimens.

Genus SAGITTODONTUS Rhodes, 1953

TYPE SPECIES: *S. robustus* Rhodes 1953

Sagittodontus robustus Rhodes, 1953

Pl. 6, fig. 7; Text-fig. 4, no. 14

S. robustus Rhodes, 1953, p. 311, Pl. 21, figs. 141–142; ETHINGTON 1959, p. 287, Pl. 39, fig. 12; BERGSTRÖM 1964, pp. 51, 53, 57–59, 62.

Acodus robustus (Rhodes) — LINDSTRÖM 1959, p. 433, Pl. 4, figs. 22–27; (not HAMAR 1964, p. 255, Pl. 1, figs. 23, 24, Text-fig. 4, no. 2 = *Coelocerodontus trigonius*).

REMARKS: In HAMAR (1964), *S. robustus* was referred to *Acodus robustus* (Rhodes) but there was only one questionable specimen from Norway, and this must now be excluded from this species. It is regarded as an uncertain *Acodus* species, or perhaps a *Coelocerodontus*.

New Norwegian material is now available which without doubt belongs to *S. robustus*.

OCCURRENCE: 4aβ, Ringerike district.

MATERIAL: 2 specimens.

Genus SCANDODUS Lindström, 1954

TYPE SPECIES: *S. furnishi* Lindström, 1954

Scandodus inflexus n. sp.

Pl. 3, figs. 15–17

? Drepanodus inflexus Pander, 1856, p. 20, Pl. 1, fig. 15, (not Pl. 1, fig. 3, and Pl. 2, fig. 16).

HOLOTYPE: PMO 69818.

DIAGNOSIS: Strongly twisted *Scandodus*, with sharp anterior and posterior keels and a very deep basal cavity.

DESCRIPTION: The cone is twisted so that the anterior and posterior costae on the upper one-third of the cone are directed laterally. The costae are very sharp. The anterior costa disappears basally. The aboral margin is narrowly ovate (SADT 37). On the middle of the inner lateral side, basally there is an equilateral triangular shaped depression. Otherwise both lateral faces are convex. The basal cavity is very deep (*Panderodus*-like).

REMARKS: The species differs from *Acontiodus falcatus* Ethington in the lack of the posterior costa (in the present orientation: on the

inner lateral side) and the development of the aboral margin. *S. inflexus* n. sp. differs from Pander's specimen (Pl. 1, fig. 15) in the very deep basal cavity and in that the anterior keel does not reach the aboral margin.

OCCURRENCE: 4bβ, 4bδ_2, Oslo–Asker and Ringerike districts.

MATERIAL: 3 specimens.

Scandodus osloensis n. sp.

Pl. 2, figs. 16–17; Text-fig. 4, no. 4

HOLOTYPE: PMO 69770, *paratype:* PMO 69769.

DIAGNOSIS: A *Scandodus* which has a strongly twisted cusp relative to the base. Anterior keel is sharp and flexed to the inner lateral side along the whole cone except basally where it is flexed outwards. Aboral margin is obovate.

DESCRIPTION: Strongly twisted cones with sharp anterior keel and blunted posterior keel and oral edge. The oral edge is short and rounded with a weak costa on it. The anterior keel is flexed to the inner lateral side and becomes overturned basally. The lateral faces are convex but not equally so. The outer face is more convex and the inner lateral face anterior to the carina develops a broad groove which anteriorly is bordered by the laterally flexed anterior keel. The groove expands basally, both posteriorly and anteriorly. The aboral margin is obovate (SADT 48) but anteriorly it is more compressed. The basal cavity is deep and its apex directed along the axis of the cone.

REMARKS: This is, systematically, a very difficult group of conodonts. Their similarity to *Drepanodus* cf. *arcuatus* Lindström is undoubted in at least some of the Norwegian material. Some untwisted, slightly twisted, and strongly twisted units have been found. The last two types are included in *S. osloensis* n. sp. The characteristic lateral carinae of the *Drepanodus* cf. *arcuatus* are unknown in the present new species.

OCCURRENCE: 4aβ, 4bβ, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 29 specimens.

Scandodus unistriatus Sweet & Bergström, 1962

Pl. 3, figs. 1, 7

S. unistriatus Sweet & Bergström, 1962, p. 1245, Pl. 168, fig. 12, Text-fig. 1E.
S. lunatus Hamar, 1964, pp. 281–282, Pl. 2, figs. 16–17.

REMARKS: The previously described species (*S. lunatus*) of the author may be identical with *S. unistriatus*. The differences between them are so small that they are hardly of specific significance. The newly available material confirms this view. A little can be added to the description. The carinae on both sides of the groove are differently developed in some specimens. The posterior carina basally can become sharpened like a costa, while the anterior one can become obsolete. The posterior edge meets the aboral margin along a sharp edge. An inverted basal cavity is observed.

OCCURRENCE: 4aβ, 4bδ_1; Oslo–Asker and Ringerike districts.

MATERIAL: 33 specimens.

Genus SCOLOPODUS Pander, 1856

TYPE SPECIES: *S. sublaevis* Pander, 1856

Scolopodus cordis n. sp.

Pl. 3, figs. 4–6; Text-fig. 2, no. 5

HOLOTYPE: PMO 69788, *paratype:* PMO 69789.

DIAGNOSIS: A *Scolopodus* with relatively few, irregularly arranged short costae on the posterior lateral and posterior faces. The cross section is typically heart-shaped.

DESCRIPTION: There is a proclined to erect cusp with two posterior lateral carinae. The carinae can also develop partly as costae. The posterior face is concave, and generally in the middle of it one or two short costae are developed basally. The lateral faces carry a few costae which can be parallel or subparallel with the posterior carinae, but all costae are short and never developed as continuous costae from the base to the apex. The cone is bilaterally symmetrical but this is not a constant character. Well-twisted units are also observed. The basal cavity is small. A well-developed basal funnel is observed. The cross section is heart-shaped.

REMARKS: The species resembles *Scolopodus tuatus* Hamar but always has weaker-developed costae and the cross section is typically heart-shaped.

OCCURRENCE: 4aβ, Oslo–Asker and Ringerike districts.

MATERIAL: 6 specimens.

Scolopodus insculptus (Branson & Mehl, 1933)

Pl. 1, fig. 18; Text-fig. 2, no. 1

Phragmodus insculptus Branson & Mehl, 1933, p. 124, Pl. 10, figs. 32–34; GRAVES and ELLISON 1941, p. 6, Pl. 3, fig. 1.

S. varicostatus Sweet & Bergström, 1962, p. 1247, Pl. 168, figs. 4–9, Text-fig. 1A, C, K; HAMAR 1964, p. 284, Pl. 1, figs. 1–2, Text-fig. 4, no. 7a–b.

S. insculptus (Branson & Mehl) – SWEET, WARNER, TURCO and WILKIE 1959, p. 1063, Pl. 130, fig. 6.

Distacodus insculptus Ethington, 1959, pp. 275–276, Pl. 39, fig. 10.

REMARKS: Specimens previously referred to *S.* (*Phragmodus*) *insculptus* (Branson & Mehl) seem to be identical in part with *S. varicostatus*. The type specimen of *Scolopodus insculptus* is fragmentary; the apical half and a part of the base are broken off. GRAVES and ELLISON (1941) have listed and figured this species from the Maravillas Formation, but the material is poorly preserved. ETHINGTON (1959) referred this species to *Distacodus* and figured a complete specimen. This appears to be identical with *Scolopodus varicostatus*, the bilaterally symmetrical form of Sweet & Bergström. I have had to opportunity to examine Professor Rhodes' collection from the Galena Formation near Decorah (probably locality no. 3 or 4 of Ethington) which contains specimens of symmetrical and slightly asymmetrical forms of *S. insculptus*. The Fulton-Economy member specimen (SWEET *et al.* 1959) is identical with Ethington's Galena specimen and also with the bilaterally symmetrical Pratt Ferry specimen. The similarity has already been mentioned by SWEET *et al.* (1959) in the Pratt Ferry specimens. A complete description of *Scolopodus varicostatus* has been given by SWEET and BERGSTRÖM (1962), who include three different types of *Scolopodus*. This description mentioned neither similarities nor differences between *S. varicostatus* and *S. insculptus*. My Pratt Ferry collection (provided by Prof. N. Spjeldnæs) contains specimens of the bilaterally symmetrical type, which are clearly identical with

the Fulton-Economy member specimen. A new variant of *S. insculptus* can be reported here. It is an asymmetrical form, developed from the bilaterally symmetrical group of Sweet & Bergström. The structures are arranged in the following order: There are posterior and anterior keels, two posterior-lateral and two lateral costae. On the side of the specimens between the posterior lateral and the lateral costae is a weak short costa which starts from near the base and continues to about two-thirds of the length of the cusp. Otherwise the specimens are similar to *S. insculptus*.

OCCURRENCE: 4aβ, 4bβ, 4bγ, 4bδ_1, 4bδ_2; Oslo–Asker and Ringerike districts.

MATERIAL: 363 specimens.

Genus TETRAPRIONIODUS Lindström, 1954

TYPE SPECIES: *T. robustus* Lindström, 1954

Tetraprioniodus asymmetricus Bergström, 1961

Pl. 5, fig. 4

T. asymmetricus Bergström, 1961, p. 55, Pl. 2, figs. 15–17; HAMAR 1964, p. 284, Pl. 5, fig. 19; BERGSTRÖM 1964, pp. 48–49, 55, 63, Text-fig. 21B.

T. superbus Rhodes – WOLSKA, 1961, Pl. 6, fig. 3 (not figs. 1–2).

? Trapezognathus quadrangulum Lindström – HAMAR, 1964, pp. 285, 286, Pl. 4, figs. 12, 17–19, Text-fig. 4, no. 17.

REMARKS: HAMAR (1964) referred a few specimens with quadrangular cusp cross section to *Trapezognathus quadrangulum* Lindström. These specimens are either identical with *T. asymmetricus* or represent a new *Tetraprioniodus* species, but the present material is insufficient to decide the exact systematic position of these specimens. They are always associated with *T. asymmetricus* throughout the whole Norwegian Caradoc and this possibly indicates that this Middle Ordovician *Trapezognathus* cf. *quadrangulum* is a junior synonym of *T. asymmetricus* Bergström.

OCCURRENCE: 4aβ, 4bδ_2, Oslo–Asker and Ringerike districts.

MATERIAL: 41 specimens.

Genus TRICHONODELLA (Branson & Mehl, 1933)

TYPE SPECIES: *Trichognathus prima* Branson & Mehl, 1933

Trichonodella cf. *erecta* Branson & Mehl, 1933

Pl. 7, fig. 9

T. erecta Branson & Mehl, 1933, p. 118, Pl. 10, fig. 5.

REMARKS: A single specimen has been found which resembles this species. It has a short (incomplete) undenticulated posterior bar, the lateral bars are denticulated by regular, small, apically directed denticles. The cusp is small and short. Basally deeply excavated.

OCCURRENCE: 4aβ, Ringerike district.

N. genus and n. sp.

Pl. 3, figs. 8–10; Text-fig. 5, no. 5a–b

Microcoelodus? sp. Rhodes, 1955, p. 133, Pl. 10, figs. 2, 15, 19, 22, 25.

DIAGNOSIS: A simple cone unit with large proclined cusp, small pointed denticles basally on the anterior and posterior edges. Lateral faces are smooth and convex. The basal cavity is very deep.

DESCRIPTION: Symmetrical or slightly asymmetrical units with a large proclined cusp. The cross section of the cusp is narrowly ovate (SADT 36) with sharp anterior and posterior edges. Basally the anterior edge carries a few, small, flat denticles. The oral edge is similar, the denticles being somewhat larger than the anterior ones. The lateral faces are convex, one of these is more flared outward basally than the other. The basal cavity is very deep, and equilateral-triangular shaped in lateral view.

REMARKS: The specimens are fragmentary and none of the known genus could be referred.

OCCURRENCE: 4bδ_2, Ringerike district.

MATERIAL: 14 specimens.

Microfossils of uncertain (conodont?, scolecodont?) affinities
Generic names presented by Müller, 1959

Distacodus? cambricus Müller, 1959

Pl. 6, figs. 9–10; Text-fig. 4, no. 13

D.? cambricus Müller, 1959, p. 450, Pl. 14, figs. 1–2.

Remarks: The Ordovician specimen resembles Upper Cambrian species in the rounded anterior and posterior margins and in the laterally symmetrically developed costae, but differs in that the cone is not shaped in lateral view. The costae run basally along the mid-line of the lateral faces and, in the direction of the apex, continuously shift towards the posterior. However, near to the apex itself, the costae are replaced by grooves on the mid-line of the lateral face (see Text-fig. 3, no. 13). Aborally the cone expands strongly. The basal cavity is deep. The composition must be the same as that in conodonts because the material sinks in bromoform.

Occurrence: 4aβ, Oslo–Asker district.

Material: 1 specimen.

Furnishina n. sp.

Pl. 6, figs. 4–5; Text-fig. 2, no. 8

Description: A *Furnishina* with a posterior keel and two lateral costae. The anterior face is rounded, convex, and there is a marked carina along the midline, and, on both sides of this carina, there are two smaller carinae. One of the posterior lateral faces is flat, the other is somewhat more expanded laterally at its base and is strongly undulated. Posteriorly the face is concave, laterally half is convex. The two costae and the posterior keel are sharp and are continuously curved from the base to the apex.

Remarks: The same orientation as used by Müller is used here. The specimen is very similar to *F. asymmetrica* but the latter is more ornamented and the aboral margin is more asymmetrical.

Occurrence: 4aβ, Ringerike district.

Material: 1 specimen.

Hertzina? americana Müller, 1959

Pl. 6, fig. 6; Text-fig. 4, no. 15

H. americana Müller, 1959, p. 455, Figs. 25–26.

DESCRIPTION: Slightly asymmetrical proclined cone with two posterior lateral costae. Anterior and posterior margins are rounded. Lateral faces are convex. The whole cone is irregularly perforated by small holes which are broader on the side of the basal cavity. These holes do not always penetrate the relatively thick cone wall. The cone is very deeply excavated.

REMARKS: The material differs from *H. americana* Müller in its very deep basal cavity and its thick wall. Similarities have been found in the form of the cross section and in the shape of the cone.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 1 specimen.

Oneotodus aff. *gallatini* Müller, 1959

Pl. 3, fig. 2; Pl. 7, fig. 14; Text-fig. 2, no. 4

O. n. sp. ? aff. *gallatini* Müller, 1959, p. 457, Pl. 13, figs. 16, 19, 21.

REMARKS: The Ordovician material is basally more closed (not so expanded) than the Cambrian. The systematic position of these specimens is between *O. gallatini* and *O. tenuis* Müller.

OCCURRENCE: 4aβ, Oslo–Asker and Ringerike districts.

MATERIAL: 6 specimens.

Proacodus n. sp. 1

Pl. 6, figs. 2–3; Text-fig. 2, no. 2

DESCRIPTION: A *Proacodus* with sharp, curved posterior keel and short oral margin. Anteriorly there are two nearly symmetrical lateral carinae which are slightly keeled basally. The aboral margin (in lateral view) is curved, in aboral view triangular. The anterior and lateral faces are smooth. The cone is deeply excavated, nearly to the apex of the cone.

OCCURRENCE: 4aβ, Oslo–Asker district.

MATERIAL: 1 specimen.

Proacodus n. sp. 2

Pl. 6, fig. 8; Text-fig. 4, no. 16

DESCRIPTION: A *Proacodus* without any definite oral margin, which means that the sharp posterior keel is continuously, slightly, curved from the base to the apex. Of the two anterior lateral carinae, one is slightly costate. The carinae are rough (sinuid) from the base to the top of the cone. Otherwise the faces are smooth. The aboral regions are fragmentary in all of the specimens but in outline are triangular. The whole cone is excavated, but thick-walled.

REMARKS: The specimens differ from the *Proacodus* specimens of Müller in the unexpanded base.

OCCURRENCE: 4aβ, Oslo–Asker and Ringerike districts.

MATERIAL: 6 specimens.

Westergaardodina bicuspidata Müller, 1959

Pl. 6, fig. 1; Text-fig. 2, no. 3

Problematicum I Westergård, 1953, p. 466, Pl. 5, figs. 1–5, 13.
W. bicuspidata Müller, 1959, p. 468, Pl. 15, figs. 1, 4, 7, 9, 10, 14.

REMARKS: The U-shaped conodonts as described by Müller have 'side holes' (seitenhöle) on both sides of the lateral teeth. These 'side holes' are not seen on the available specimen. On the 'teeth' laterally are small excrescences which show some similarity to Westergård's *Problematicum I*. The whole specimen is excavated on the inner side (see Text-fig.). One of the lateral faces is more planar than the other and a canal runs along the length of the two prongs and is continuous in the basal region. The other lateral face is rounded and depressed on the inner lateral side of the teeth.

OCCURRENCE: 4aβ, Ringerike district.

MATERIAL: 1 specimen.

REFERENCES

ASH, S. R. 1961. Bibliography and index of conodonts, 1949–1958. Micropal. 7, no. 2: 213–44.

BERGSTRÖM, S. M. 1961. Conodonts from the Ludibundus Limestone (Middle Ordovician of the Tvären area (S. E. Sweden). Ark. för Min och Geol. Bd. 3, no. 1:1–64, Pls. 1–5.

— 1964. Remarks on some Ordovician conodont faunas from Wales. Acta Univ. Lundensis. Sect. II, no. 3:1–66, 22 Text-figs.

BRANSON, E. B. and BRANSON, C. C. 1947. Lower Silurian conodonts from Kentucky. Jour. Paleont. 21:549–56, Pls. 81–82.

— and MEHL, M. G., 1933–1934. Conodont Studies. Missouri Univ. Studies, v. 8, 349 pp. 28 Pls.

— — 1943. Ordovician conodont faunas from Oklahoma. Jour. Paleont. 17:374–87, Pls. 63–64.

— , MEHL, M. G. and BRANSON, C. C. 1951. Richmond conodonts of Kentucky and Indiana. Jour. Paleont. 25:1–7, Pls. 1–4.

CARLSON, C. C. 1960. Stratigraphy of the Winnipeg and Deadwood Formation in North Dakota. North Dakota Geol. Surv. Bull. 35: 1–149, 2 Pls.

ELLISON, S. 1962–1963–1964. Annotated Bibliography and Index of Conodonts; supplement; second supplement Univ. of Texas, Austin.

ETHINGTON, R. L. 1959. Conodonts of the Galena Formation. Jour. Paleont. 33:257–92, Pls. 39–41.

— and FURNISH, W. M. 1962. Silurian and Devonian conodonts from Spanish Sahara. Jour. Paleont. 36:1253–90, Pls. 172–73, 1 Text-fig.

— — and MARKEWICZ, F. J. 1958. Ordovician conodonts in New Jersey. Jour. Paleont. 32:763–65.

FAY, R. O. 1952. Catalogue of conodonts. Univ. Kansas Paleont. Contr. Vert. Art. 3, 206 pp.

FURNISH, W. M. 1938. Conodonts from the Prairie du Chien (Lower Ordovician) beds of the Upper Mississippi Valley. Jour. Paleont. 12:318–40, Pls. 41–42.

GLENISTER, A. T. 1957. The conodonts of the Ordovician Maquoketa Formation in Iowa. Jour. Paleont. 31:715–36, Pls. 85–88.

GRAVES, R. W. and ELLISON, S. 1941. Ordovician conodonts of the Marathon Basin, Texas. Univ. Missouri School Mines & Met. Bull. Tech. ser. 14:1–26, Pls. 1–3.

HADDING, A. 1913. Undre Dicellograptusskiffern i Skåne jämte några därmed ekvivalenta bildningar. Lunds Univ. Årsskr., N.F., Avd. 2, Bd. 9, no. 15:1–90, Pls. 1–8.

HAMAR, G. 1964. The Middle Ordovician of the Oslo Region, Norway, 17. Conodonts from the lower Middle Ordovician of Ringerike. Norsk geol. tidsskr. 44:243–92, Pls. 1–6, Text-figs. 1–6.

LAMONT, A. and LINDSTRÖM, M. 1957. Arenigian and Llandeilian cherts identified in the southern uplands of Scotland by means of conodonts, etc. Edinburgh Geol. Soc. Trans. 17, pt. 1:60–70, Pl. 5.

LINDSTRÖM, M. 1954. Conodonts from the lowermost Ordovician strata of south-central Sweden. Geol. Fören. Förh. 76 (4):517–604, Pls. 1–10.

— 1955. The conodonts described by A. R. Hadding, 1913. Jour. Paleont. 29:105–11, Pl. 22.

— 1959. Conodonts from the Crûg Limestone (Ordovician, Wales). Micropal. 5 (4):427–52, Pls. 1–4.

— 1960. A Lower-Middle-Ordovician succession of conodont faunas. Int. Geol. Congress XXI. Part VII:88–96.

— 1964. Conodonts. Elsevier Publishing Co. Amsterdam, 196 pp., 64 Pls.

MÜLLER, K. J. 1959. Kambrische Conodonten. Deutsche geol. Gesell. Zeitschr. 111:434–85, Pls. 11–15.

PANDER, C. H. 1856. Monographie der Fossilen Fische des Silurischen Systems der Russisch-Baltischen Gouvernements. K. Akad. Wiss. St. Petersburg, pp. 1–91, 7 Pls.

PULSE, R. R. and SWEET, W. C. 1960. The American Upper Ordovician Standard, III, Conodonts from the Fairview and McMillan Formation of Ohio, Kentucky and Indiana. Jour. Paleont. 34:237–64, Pls. 35–37.

RHODES, F. H. T. 1953. Some British Lower Paleozoic conodont faunas. Roy. Soc. [London] Philos. Trans. ser. B, no. 647, 237:261–334, Pls. 20–23.

— 1954. The zoological affinities of the conodonts. Cambridge Philos. Soc., Biol. Reviews, 29 : 419-52.

— 1955. The conodont fauna of the Keisley Limestone. Geol. Soc. London, Quart. Jour. 111:117–42, Pls. 7–10.

SADT, (Systematic Association Committee for Descriptive Biological Terminology) 1962. Taxon. 11 (5): 145–56.

SANNEMANN, D. 1955. Ordovicium und Oberdevon der bayerischen Fazies des Frankenwaldes nach Conodontenfunden. Neues Jahrb. Geologie u. Paläontologie Abh. 102:1–36, Pls. 1–3.

SERGEEVA, S. P. 1963. Conodonts from the Lower Ordovician of Leningrad Region. Akad. Nauk. SSSR, Paleont. Jour. no. 2:93–108, Pls. 7–8 (in Russian).

STAUFFER, C. R. 1935a. Conodonts of the Glenwood beds. Geol. Soc. America Bull. 46:125–68, Pls. 9–12.

— 1935b. The conodont fauna of Decorah Shale (Ordovician). Jour. Paleont. 9:596–620, Pls. 71–75.

STÖRMER, L. 1953. The Middle Ordovician of the Oslo Region, Norway; 1. Introduction to Stratigraphy. Norsk geol. tidsskr. 31:37–141.

SWEET, W. C. 1955. Conodonts from the Harding Formation (Middle Ordovician) of Colorado, Jour. Paleont. 29:226–62, Pls. 27–29, Text-figs. 1–16.

— and BERGSTRÖM, S. M. 1962. Conodonts from the Pratt Ferry Formation (Middle Ordovician) of Alabama, Jour. Paleont. 36:1214–52, Pls. 168–71, Text-figs. 1–5.

— TURCO, C. A., WARNER, E. and WILKIE, L. C. 1959. The American Upper Ordovician Standard, I: Eden conodonts from the Cincinnati region of Ohio and Kentucky. Jour. Paleont. 33:1029–68, Pls. 130–33.

ULRICH, E. O. and BASSLER, R. S. 1926. A classification of the toothlike fossils, conodonts with descriptions of American Devonian and Mississippian species. [U.S.] Nat. Mus. Proc. 68, art. 12, no. 2613:1–63, Pls. 1–11.

WALLISER, O. H. 1957. Conodonten aus dem oberen Gotlandium Deutschlands und der Karnischen Alpen. Notizbl. hess. L.-Amt. Bodenforsch. 85:28–52, 3 Pls.

— 1960. Scolecodonts, Conodonts, and Vertebrates. *In* Boucut, A. J. *et al.*, A late Silurian fauna from the Sutherland River Formation, Devon Island, Canadian Arctic Archipelago. Canada Geol. Survey Bull. 65: 21–39, Pls. 5–8.

WESTERGÅRD, A. H. 1953. Two Problematic Fossils from the Cambrian in Sweden. Geol. Fören. Förh. 75 (4):465–67, Pl. 5.

WOLSKA, Z. 1961. Konodonty z ordowickich głazów Narzutowych Polski. Acta Paleont. Polonica 6 (4):339–65, Pls. 1–6.

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PLATES 1—7

The photographs, which were taken by the author, are not retouched. They were taken with a Leica camera, bellow 50 cm and lens Summar 42 mm.

All magnifications: × 70.

For each figured specimen, the catalogue number of the Palaeontological Museum, Oslo (PMO), is given, followed by the horizon symbol and the sample (locality) number. Explanations of sample numbers are given on pp. 30–33.

PLATE 1

* denotes species not described in this paper. All × 70

Figs. 1–4. *Panderodus compressus* (Branson & Mehl), *1–2*: PMO 69686, 4bδ_2, 93, *3*: PMO 69740, 4aβ, 95, *4*: PMO 69741, 4aβ, 95, lateral views.

*Fig. 5. *Acontiodus rectus* Lindström, PMO 69811, lateral view, 4aβ, 95.

Fig. 6. *Panderodus unicostatus* (Branson & Mehl), PMO 69802, lateral view, 4bδ_2, 93.

*Fig. 7. *Panderodus gracilis* (Branson & Mehl), PMO 69801, lateral view, 4bδ_2, 93.

Figs. 8–9. *Drepanodus suberectus* (Branson & Mehl), PMO 69804, *8*: lat. view, *9:* post. view, 4aβ, 95.

Figs. 10–11. *Acodus jejatus* n. sp., PMO 69706, *10:* post. view, *11:* lat. view, 4bδ_1, 157.

Figs. 12–14. *Distacodus bygdoeyensis* n. sp., *12:* PMO 69695, 4bγ, 190, *13:* PMO 69805, 4aβ, 95, *14:* PMO 69806, 4aβ, 95, all in lat. views.

Fig. 15. *Acodus trullatus* n. sp., PMO 69738, inner lat. view, 4bβ, 158.

Figs. 16–17. *Drepanodus* cf. *arcuatus* Pander, *16:* PMO 69734, *17:* PMO 69735, both in lat. views, 4bδ_2, 93.

Fig. 18. *Scolopodus insculptus* (Branson & Mehl), PMO 69705, lat. view, 4aβ, 187.

Fig. 19. *Oistodus breviconus* Branson & Mehl, PMO 69820, lat. view, 4bδ_1, 157.

*Fig. 20. *Oistodus venustus* Stauffer, PMO 69681, lat. view, 4bδ_2, 93.

*Fig. 21. *Oistodus robustus* Bergström, PMO 69807, lat. view, 4aβ, 95.

PLATE 1

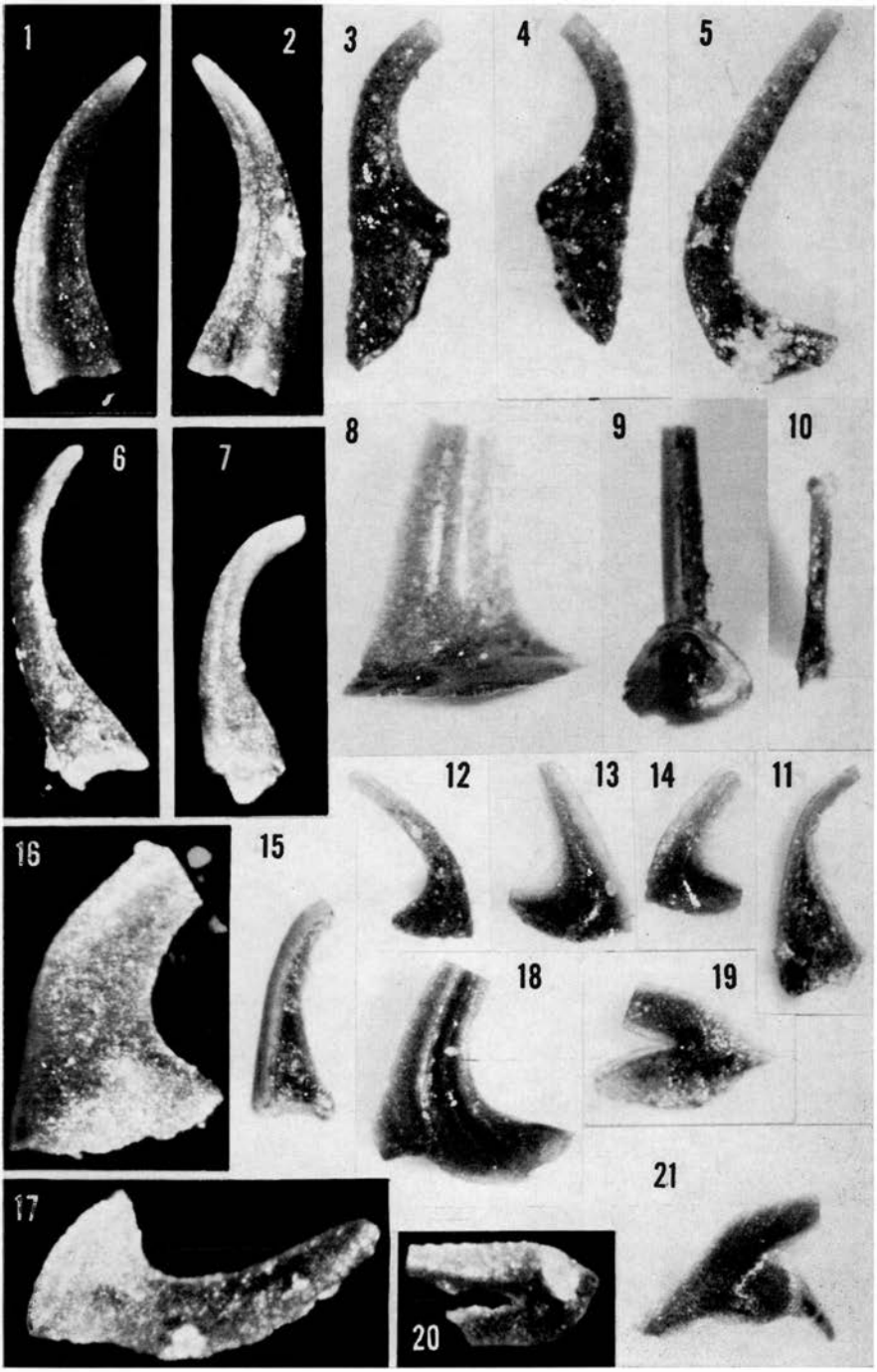

PLATE 2

* denotes species not described in this paper. All × 70

Figs. 1–2, 10. *Acodus inornatus* Ethington, *1:* PMO 69767, 4bδ_2, 93, *2:* PMO 69768, 4bδ_2, 93, *10:* PMO 69808, 4aβ, 95, all in lat. views.

Figs. 3–9, 13. *Acodus similaris* Rhodes, *3:* PMO 69763, *4:* PMO 69762, *5:* PMO 69764, *6:* PMO 69755, *7–8*: PMO 69761, *9*: PMO 69765, *13:* PMO 74102, lat. views. *3–4*, *7–8*, *13:* 4bδ_1, 157; *5–6*, *9:* 4bδ_2, 93.

Figs. 11–12. *Panderodus similaris* (Rhodes), *11:* PMO 69782, *12:* PMO 69781; both in lat. views, 4bδ_2, 93.

Fig. 14. *Oistodus excelsus* Stauffer, PMO 69810, lat. view, 4aβ, 95.

*Fig. 15. *Drepanodus homocurvatus* Lindström, PMO 69809, lat. view, 4bδ_2, 93.

Figs. 16–17. *Scandodus osloensis* n. sp., PMO 69770, *16:* outer lat. view, *17:* apical view, 4aβ, 95.

PLATE 2

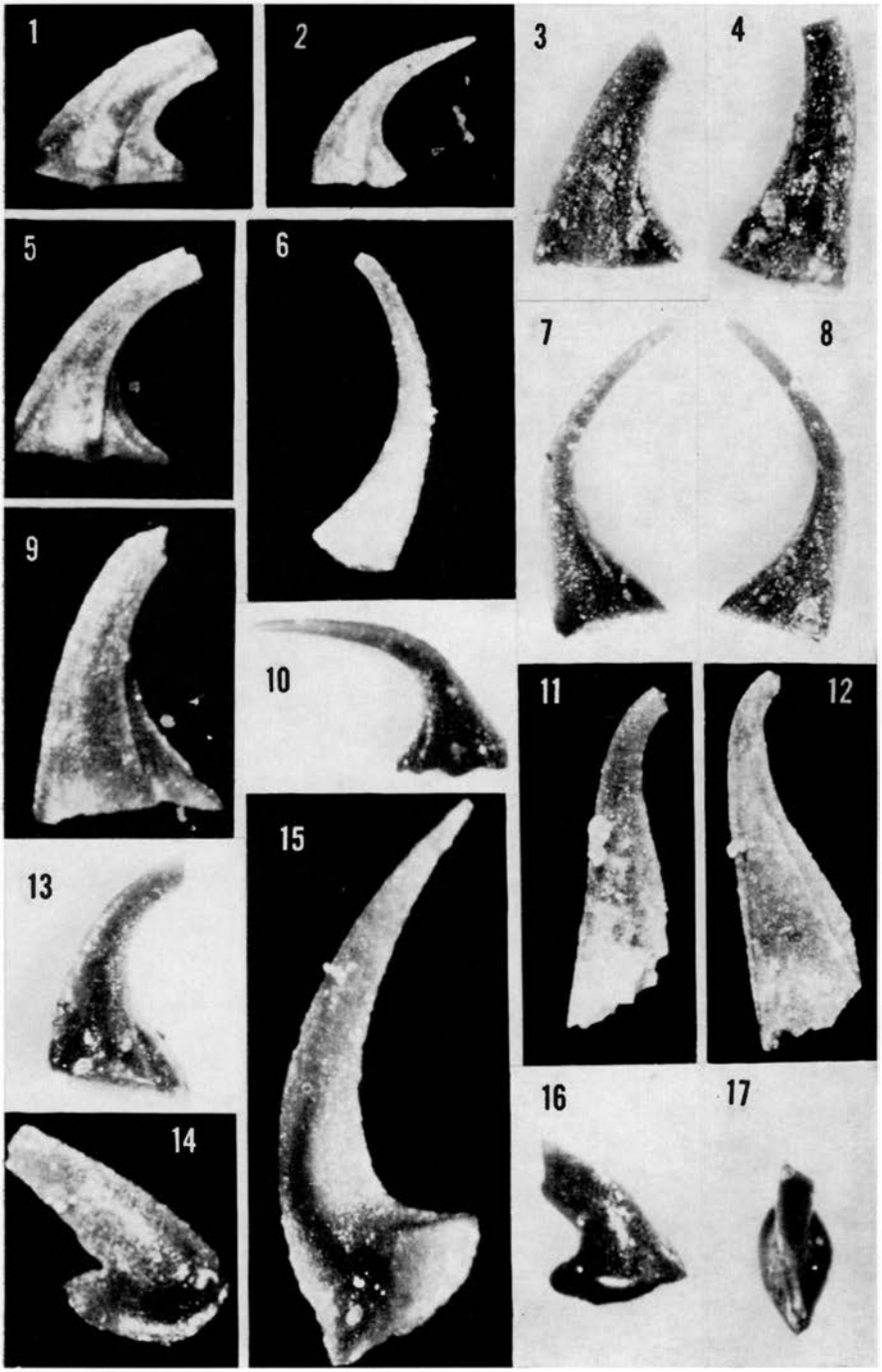

PLATE 3

* denotes species not described in this paper. All × 70

Figs. 1, 7. *Scandodus unistriatus* Sweet & Bergström, *1:* PMO 69816, inner lat. view, *7:* PMO 69817, outer lat. view; both 4bδ_1, 157.

Fig. 2. *Oneotodus* aff. *gallatini* Müller, PMO 69701, lat. view, 4aβ, 111.

*Fig. 3. *Scolopodus tuatus* Hamar, PMO 69812, lat. view, 4aβ, 95.

Figs. 4–6. *Scolopodus cordis* n. sp., *4:* PMO 69789, *5–6:* PMO 69788; *4, 6:* post. views, *5:* lateral view; both 4aβ, 95.

Figs. 8–10. *N.* genus & n. sp., *8:* PMO 69693, *9:* PMO 69692, *10:* PMO 69694; all in lat. views, 4bδ_2, 93.

Figs. 11–14. *Acodus graeai* n. sp., *11, 13:* PMO 69708, *12, 14:* PMO 69709, *11:* outer lat. view, *12, 13:* inner lat. views, *14:* apical view; both 4aβ, 187.

Figs. 15–17. *Scandodus inflexus* n. sp., PMO 69818, *15:* inner lat. view, *16:* outer lat. view, *17:* aboral view, 4bδ_2, 93.

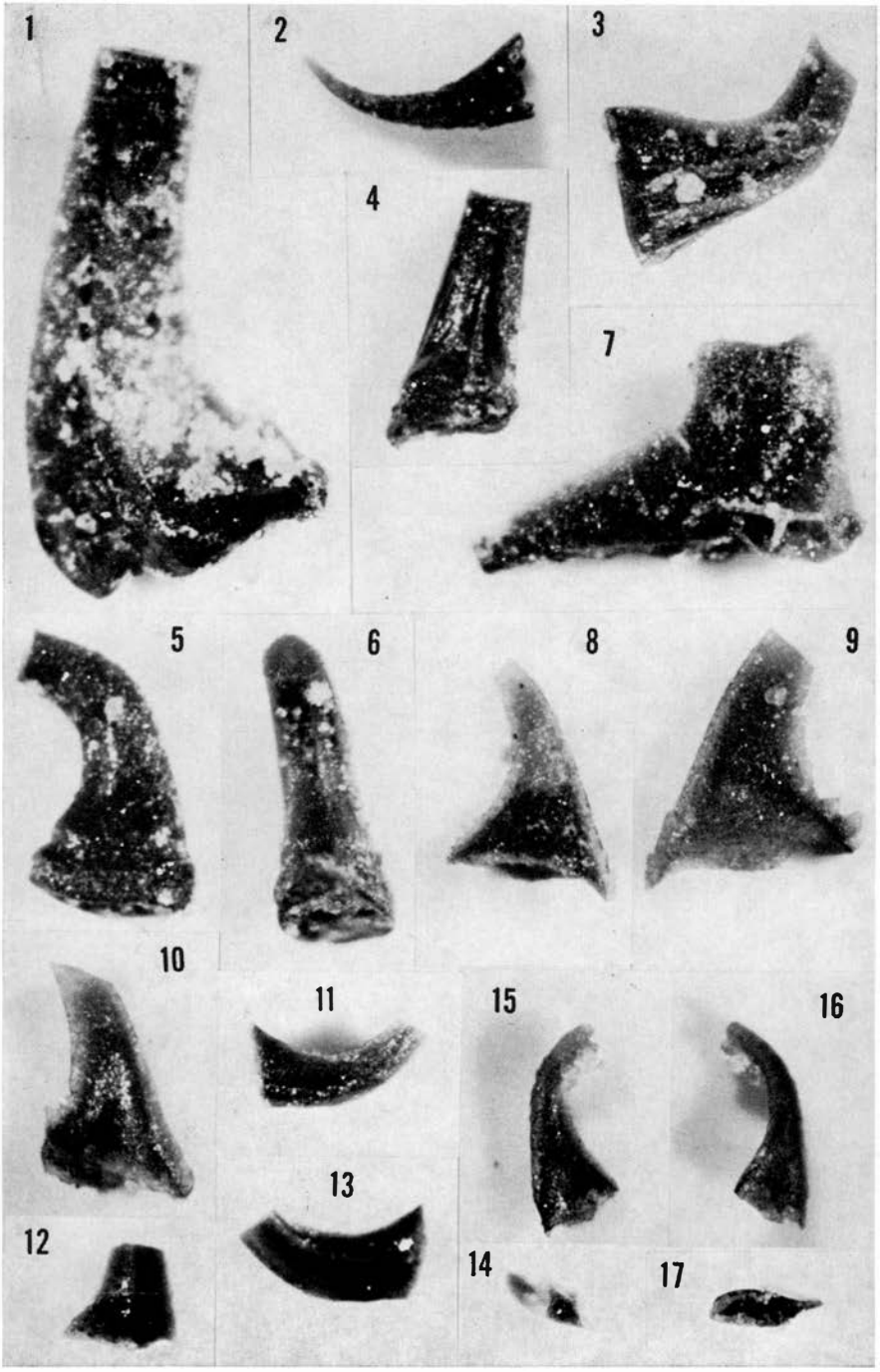
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PLATE 4

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*Fig. 1. *Polyplacognathus ringerikensis* Hamar, PMO 69710, oral view, 4aβ, 95.

*Fig. 2. *Polyplacognathus elongata* (Bergström), PMO 69660, oral view, 4aβ, 95.

Figs. 3–4. *Eoplacognathus extensa* n. sp., PMO 69695; *3:* aboral view, *4:* oral view; 4aβ, 95.

Figs. 5, 8. *Ambalodus frognoeyensis* n. sp., PMO 69796; *5:* inner lat. view, *8:* outer lat. view; 4bδ_2, 93.

Fig. 6. *Prioniodus alatus* Hadding, PMO 69690, inner lat. view, 4aβ, 95.

Fig. 7. *Polyplacognathus stoermeri* n. sp., PMO 69746, oral view, 4aβ, 95.

Fig. 9. *Eoplacognathus lindstroemi* (Hamar), PMO 69696, oral view, 4aβ, 95.

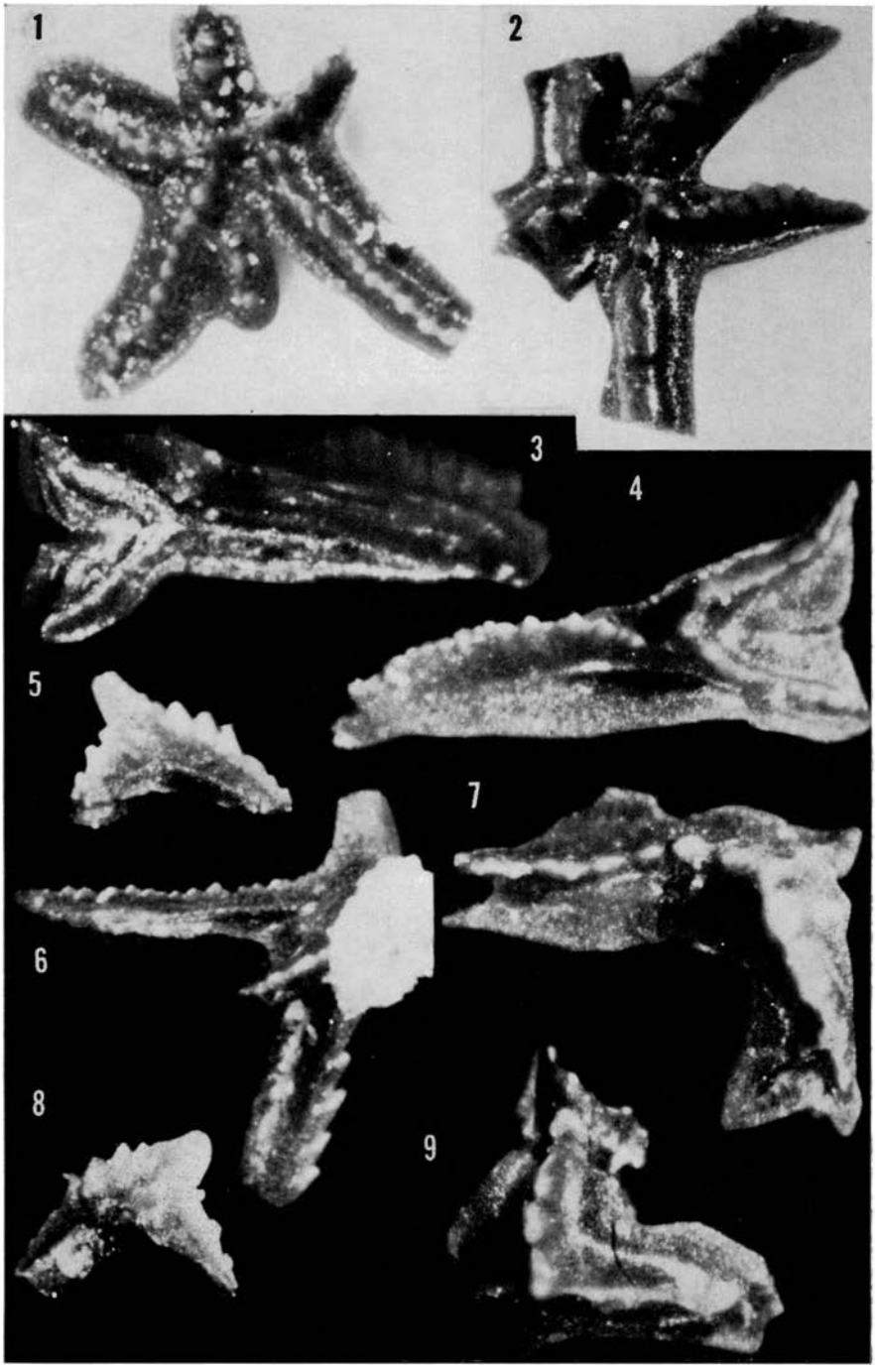
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PLATE 5

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Figs. 1–2. *Polyplacognathus stoermeri* n. sp., PMO 69745, *1:* oral view, *2:* aboral view, 4aβ, 95.

Fig. 3. *Prioniodus alatus* Hadding, PMO 69689, oral view, 4aβ, 95.

Fig. 4. *Tetraprioniodus asymmetricus* Bergström, PMO 69652, inner lat. view, 4aβ, 95.

Figs. 5–6. *Gothodus costulatus* Lindström, *5:* PMO 69664, inner lat. view, *6:* PMO 69665, outer lat. view; both from 4aβ, 111.

Fig. 7. *Keislognathus gracilis* Rhodes, PMO 69751, lat. view, 4bδ_2, 93.

Fig. 8. *Pygodus* n. sp., PMO 69631, oral view, 4aβ, 181.

Fig. 9. *Phragmodus undatus* Branson & Mehl, PMO 69632, outer lat. view, 4bδ_1, 139.

Figs. 10–11. *Polyplacognathus* sp., *10:* PMO 69671, *11:* PMO 69712, both oral view, 4aβ, 111.

Figs. 12–13. *Centrognathodus?* n. sp., *12:* PMO 69728, *13:* PMO 69727; lat. views, 4aβ, 95.

*Fig. 14. *Periodon grandis* (Ethington), PMO 74100, outer lat. view, 4aβ, 181.

Fig. 15. *Falodus prodentatus* (Graves & Ellison), PMO 69699, inner lat. view, 4aβ, 181.

Fig. 16. Indeterminate fragment, PMO 69732, 4aβ, 95.

Fig. 17. *Oulodus tortilis* (Sweet & Bergström), PMO 74101, inner lat. view, 4aβ, 181.

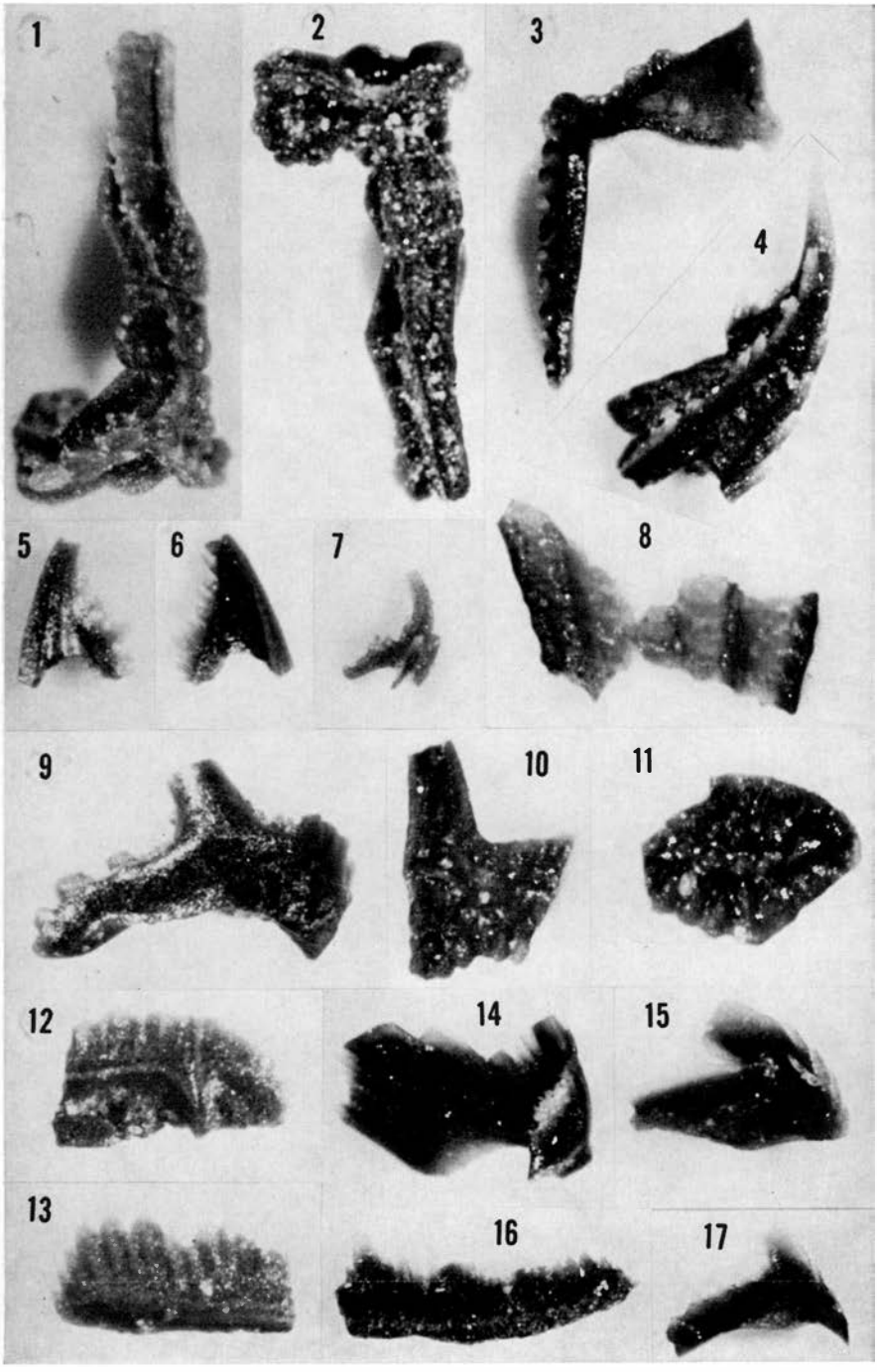
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PLATE 6

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Fig. 1. *Westergaardodina bicuspidata* Müller, PMO 69700, outer lat. view, 4aβ, 111.

Figs. 2–3. *Proacodus* n. sp. 1; PMO 69713, lateral views, 4aβ, 95.

Figs. 4–5. *Furnishina* n. sp., PMO 69702, *4:* post. view, *5:* ant. view; both 4aβ, 111.

Fig. 6. *Hertzina? americana* Müller, PMO 69749, post. view, 4aβ, 95.

Fig. 7. *Sagittodontus robustus* Rhodes, PMO 69783, lat. view, 4aβ, 111.

Fig. 8. *Proacodus* n. sp. 2; PMO 69736, inner lat. view, 4aβ, 95.

Figs. 9–10. *Distacodus? cambricus* Müller, PMO 69784, *9:* post. view, *10:* lat. view, 4aβ, 187.

PLATE 6

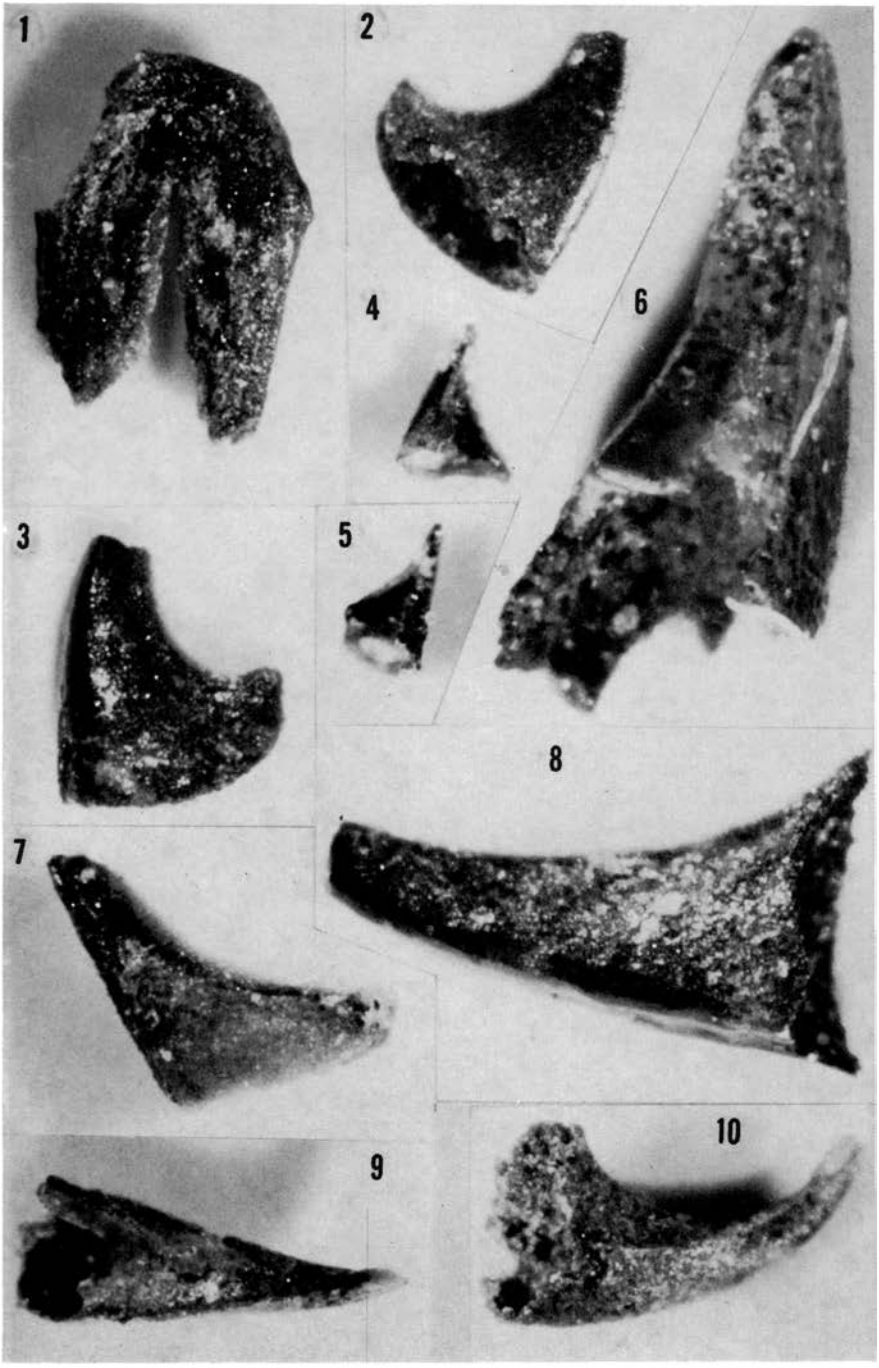

PLATE 7

* denotes species not described in this paper. All × 70

*Fig. 1. *Pygodus anserinus* Lamont & Lindström, PMO 69630, oral view, 4aβ, 181.

Fig. 2. *Amorphognathus complicata* Rhodes, PMO 74091, oral view, 4bδ_2, 93.

Figs. 3–4. *Amorphognathus? complicata* Rhodes, PMO 74092, *3:* oral view, *4:* aboral view, 4bδ_2, 93.

Figs. 5–6. *Acontiodus semisymmetricus* n. sp., *5:* PMO 69748, *6:* PMO 74090; both in lat. views, 4bδ_1, 157.

Figs. 7–8. *Ambalodus frognoeyensis* n. sp., *7:* PMO 69797, *8:* PMO 69691, both in outer lat. views, 4bδ_2, 93.

Fig. 9. *Trichonodella* cf. *erecta* (Branson & Mehl), PMO 74093, post. view, 4aβ, 111.

Fig. 10. *Ambalodus triangularis* Branson & Mehl, PMO 69653, oral view, 4bδ_1, 157.

Figs. 11, 20. *Ligonodina delicata* Branson & Mehl, *11:* PMO 69688, outer lat. view; *20:* PMO 69687, inner lat. view; both from 4bδ_2, 93.

Figs. 12, 16–17. *Pygodus trimontis* n. sp., *12:* PMO 74094, oral view; *16–17:* PMO 74095; *16:* aboral view, *17:* oral view; both from 4aβ, 111.

Fig. 13. *Belodina* n. sp., PMO 69684, lateral view, 4bδ_2, 93.

Fig. 14. *Oneotodus* aff. *gallatini* Müller, PMO 69786, post. view, 4aβ, 189.

Fig. 15. *Cordylodus elongatus* Rhodes, PMO 74096, outer lat. view, 4bδ_1, 157.

Fig. 18. *Belodina* cf. *dispansa* Glenister, PMO 69685, lat. view, 4bδ_2, 93.

*Fig. 19. *Oistodus longiramis* Lindström, PMO 74097, lat. view, 4aβ, 95.

Fig. 21. *Hibbardella* (*Roundya*) *inclinata* (Rhodes), PMO 74098, post. view, 4aβ, 111.

Figs. 22–24. *Panderodus nakholmensis* n. sp., *22, 24:* PMO 69655, 4bβ, 159, *22:* post. view, *24:* lat. view; *23:* PMO 69732, lat. view. 4bδ_1, 157.

*Fig. 25. *Paracordylodus lindstroemi* Bergström, PMO 74099, inner lat. view, 4aβ, 95.

PLATE 7