# THE MIDDLE ORDOVICIAN OF THE OSLO REGION, NORWAY

## 17. Conodonts from the lower Middle Ordovician of Ringerike

By

György Hamar
(Institute of Geology, Blindern, Oslo)

With 6 plates and 6 figures in text.

Abstract. 55 species of conodonts are reported from two localities in the Ringerike district. The age of the fauna, determined by correlation with Swedish conodont faunas, is uppermost Llandeilian or basal Caradocian. Chemical composition of the conodonts has been investigated by use of spectrographic techniques. Problems concerning the genus *Loxognathus* are discussed. An attempt is made to relate groups of conodont "species" to original organisms using statistical methods and the results are compared with groupings of conodont "species" described from the Pratt Ferry Formation of Alabama (Sweet & Bergström, 1962).

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## Acknowledgements

I am greatly indebted to my teacher Professor Leif Størmer (Institute of Geology, University of Oslo) for his friendly advice, criticism and generous help, without which the work could never have been done. To Dr. N. Spjeldnæs (Institute of Geology, University of Oslo) I wish to express my sincere thanks for helpful discussions, encouragement, and his kindness in reading the manuscript.

I have great pleasure in thanking Dr. M. Lindström and Dr. S. Bergström (Institute of Palaeontology, University of Lund, Sweden) for their advice on conodont systematics, valuable discussions and for making Swedish conodont material from Lund University available for study. Thanks are also due to Professor I. Oftedal who carried out the spectrographic work.

I also wish to thank Mr. O. Brynildsrud and Miss S. Grotting for preparing the photographs and Mrs. Sommerfeldt—Colberg for assistance with the drawings.

Dr. F. M. Broadhurst has kindly revised the English of the text.

## Introduction

The present paper appears as No. 17 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 Council for Science and Humanities.

Conodonts have not previously been reported from Norway although Lower Ordovician conodonts were found in Norway some years ago by Dr. M. Lindström.

Dr. N. Spjeldnæs during a study of silicified fossils in the Middle Ordovician of Norway, examined his material for conodonts without success, but inspired me to search for conodonts in the Middle Ordovician rocks I had been mapping in the Ringerike district. As a result two localities, Kullerud and Gomnæs, have been found to yield an abundance of conodonts and this material forms the subject of the present paper. More than 2000 conodonts have been examined and over 1500 identified.

The Ampyx Limestone conodont fauna consists of species which clearly indicate its age. Among species present are *Haddingodus serra* and *Pygodus anserinus* which do not occur in rocks younger than Lower Caradocian (LINDSTRÖM, 1960; SWEET & BERGSTRÖM, 1962). On the other hand the absence of species such as *Cordylodus ramosus* and *C. spinatus*, which are characteristic of the Upper Llandeilo (see SWEET & BERGSTRÖM, loc. cit.), suggests a Lower Caradocian age for the Ampyx Limestone, a conclusion supported by the presence of other fossils such as *Reedolithus carinatus* (STØRMER, 1953).

The results show that conodonts are very useful stratigraphically to correlate between the Middle Ordovician of Norway and other parts of the world. It is hoped that future extensions of the work will help to solve many as-yet unsolved stratigraphical problems.

The species described are listed in alphabetical order.

The designation PMO indicates that the specimen in question is in the Paleontological Museum of the University in Oslo; and the number is the catalogue number of the specimen.

## Methods of study

Material from Kullerud and Gomnæs was dissolved in 20% formic acid (HCOOH). The limestone samples used weighed between 2.0 and 2.5 kg. That so much material had to be treated from these Norwegian localities to recover conodonts supports LINDSTRÖM's theory (1959, p. 429) that the population density of conodonts decreases from epicontinental to geosynclinal areas. After treatment with acid the residues were wet-seived and the grade 0.67—0.10 mm recovered. The heavy fraction of this grade was separated, using Bromoform (S.G. 2.87), and from the heavy fraction the conodonts were hand-picked. Other methods used on these and other Middle Ordovician shales and limestones were unsuccessful. They included attempts to disintegrate shales by sodium hydroxide and sodium sulphate, but the disintegration was incomplete and no conodonts were found. The CAMPBELL method (LINDSTRÖM, 1954) is unsuccessful in the presence of pyrite and this mineral occurs in most Middle Ordovician sediments of the Oslo region. Magnetic separation techniques for concentrating conodonts (ECKERT et al,, 1961) proved unsuccessful because the conodonts always had adherent material present.

## Properties of some Scandinavian Ordovician conodonts

Norwegian conodonts are mostly black or dark and only a few are light tan coloured. In liquid some are slightly translucent, some glass-clear at the basal part and slightly white-opal on the teeth.

Spectrographic analysis has been used to investigate the chemical composition of Scandinavian conodonts. The exact chemical composition of the conodonts is difficult to determine but Professor I. OFTEDAL (Institute of Geology, University of Oslo) lists the elements present with an indication of their relative abundance. In the results given below the number of asterisks is proportional to the relative abundance of the element.

Sample 1. Killeröd, Scania, Sweden, "Orthoceratite" Limestone, 1/2 m below the top of exposure. P**, Mg***, Mn, Si**, Ba*, Al**, Fe**, Ca***, Na*, Y, Ti, Cu.

Sample 2. Hukodden, Bygdøy, Oslo, Norway, from the uppermost part of Endoceras Limestone. P*, (relatively small), Mg**, Mn, Si**, Ba, Al**, Fe**, Ca***, Na, Y, Ti, (Zr), (Cu).

These result are consistent with the conclusion of R. Phillips (in Rhodes, 1954, p. 429) that conodonts are composed of "hydroxy-carbonate-fluor-apatite" minerals except that here there is an absence of fluorine. The Norwegian conodonts apparently contain less phosphorus than the Swedish.

## The conodont fauna

About 1500 specimens have been identified and they comprise 55 species representing 29 genera. Seven new species are described and named and eight new species are described but not named. The number of specimens of each species collected from the Ringerike localities (Kullerud and Gomnæs) is given in Table 1. About twice as many specimens were collected from Gomnæs as from Kullerud.

In some previous papers on conodonts, the grouping of conodont species into "natural assemblages" has been discussed. The taxonomic position of these "assemblages" has been discussed by several authors and the most recent papers on this subject were printed in the Treatise on Invertebrate Paleontology, Part W (HASS, RHODES, MOORE, MÜLLER, 1962). A "natural conodont species" consists of distinct

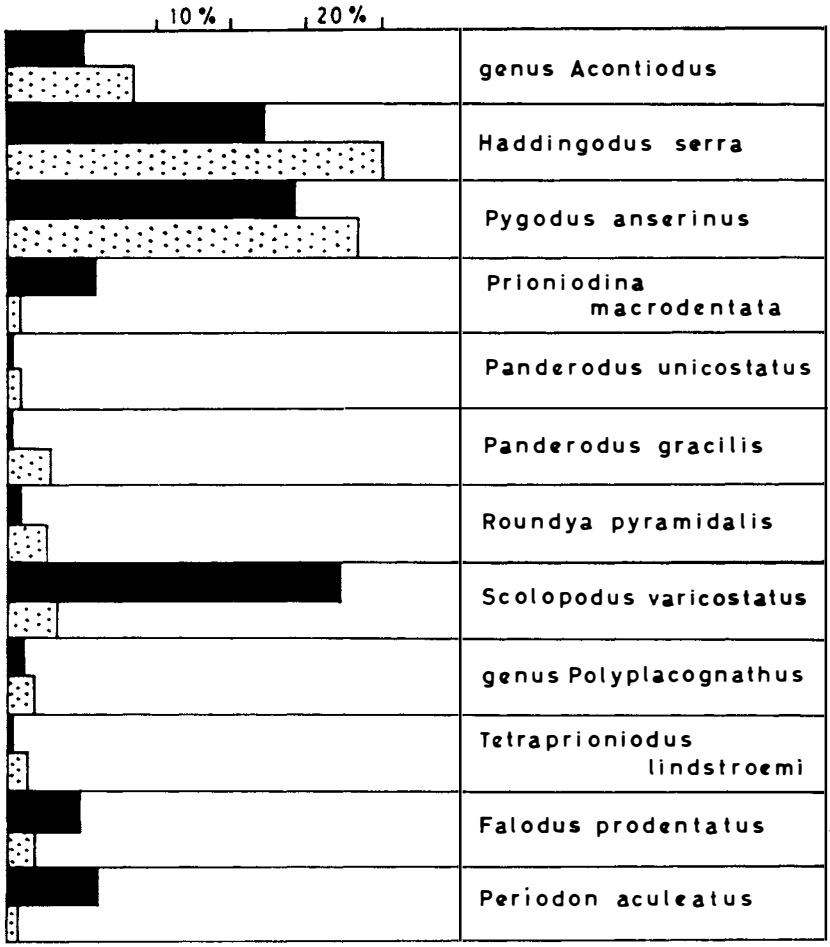
Table 1.

| | |
|---|---|
| *Acodus robustus* (RHODES) | 1 |
| *Acodus similaris* RHODES | 14 |
| *Acodus tetrahedron* LINDSTRÖM | 3 |
| *Acodus n.sp.* | 4 |
| *Acontiodus cooperi* SWEET & BERGSTÖM | 1 |
| *Acontiodus kullerudensis n.sp.* | 28 |
| *Acontiodus rectus* LINDSTRÖM | 92 |
| *Ambalodus lindstroemi* n.sp. | 28 |
| *Ambalodus aff. lindstroemi* n.sp. | 5 |
| *Chirognathus* sp. | 2 |
| *Coelocerodontus digonius* SWEET & BERGSTRÖM | 7 |
| *Coelocerodontus trigonius* ETHINGTON | 10 |
| *Coelocerodontus tetragonius* ETHINGTON | 3 |
| *Cordylodus elongatus* RHODES | 2 |
| *Dichognathus typica* BRANSON & MEHL | 5 |
| *Distacodus* n.sp. | 2 |
| *Drepanodus arcuatus* PANDER | 4 |
| *Drepanodus homocurvatus* LINDSTRÖM | 24 |
| *Falodus prodentatus* (GRAVES & ELLISON) | 29 |
| *Gothodus costulatus* LINDSTRÖM | 26 |
| *Haddingodus serra* (HADDING) | 419 |
| *Loxognathus grandis* ETHINGTON | 12 |
| *Oistodus aff. delta* LINDSTRÖM | 1 |
| *Oistodus robustus* BERGSTRÖM | 10 |
| *Oistodus venustus* STAUFFER | 18 |
| *Oistodus* sp. | 2 |
| *Oneotodus* n.sp. | 1 |
| *Oneotodus simplex* (FURNISH) | 9 |
| *Paltodus* n.sp. | 1 |
| *Panderodus gracilis* (BRANSON & MEHL) | 13 |
| *Panderodus cf. unicostatus* (BRANSON & MEHL) | 43 |
| *Paracordylodus bergstroemi* n.sp. | 4 |
| *Paracordylodus lindstroemi* BERGSTRÖM | 17 |
| *Periodon aculeatus* HADDING | 11 |
| *Phragmodus undatus* BRANSON & MEHL | 1 |
| *Polyplacognathus elongata* (BERGSTRÖM) | 25 |
| *Polyplacognathus ringerikensis* n.sp. | 13 |
| *Prioniodina macrodentata* (GRAVES & ELLISON) | 12 |
| *?Prioniodina aflexa* n.sp. | 17 |
| *Prioniodus alatus* HADDING | 8 |
| *Prioniodus variabilis* BERGSTRÖM | 33 |
| *Pygodus anserinus* LAMONT & LINDSTRÖM | 352 |
| *Pygodus sp.* LINDSTRÖM | 19 |
| *Roundya pyramidalis* SWEET & BERGSTRÖM | 35 |
| *Roundya* sp. | 8 |
| *Scandodus lunatus* n.sp. | 9 |
| *Scandodus rectus* LINDSTRÖM | 3 |
| *Scandodus* sp. | 3 |
| *Scolopodus ? peselephantis* LINDSTRÖM | 4 |
| *Scolopodus tuatus* n.sp. | 4 |
| *Scolopodus varicostatus* SWEET & BERGSTRÖM | 50 |
| *Tetraprioniodus asymmetricus* BERGSTRÖM | 25 |
| *Tetraprioniodus lindstroemi* SWEET & BERGSTRÖM | 22 |
| *Tetraprioniodus crassulus* (LINDSTRÖM) | 9 |
| *Trapezognathus quadrangulum* LINDSTRÖM | 8 |
| Total | 1511 |

conodont genera and species; thus distinct conodont elements are easily identified in a "natural species". It is much more difficult to recognize that certain distinct conodont genera and species belong to one "natural assemblage". Many suggestions as to the solution of this problem have been put forward e.g. SCOTT (1942), DUBOIS (1943), LINDSTRÖM (1960), BERGSTRÖM (1961), and SWEET & BERGSTRÖM (1962), but without any satisfactory result. SWEET & BERGSTRÖM (1962) have studied the relations between the conodont species and genera in an individual fauna and the results of this work have proved to be useful, even if the results are somewhat uncertain. The errors may be reduced, if the species are represented by a great number of individuals.

In the following section I will compare the faunas of the Pratt Ferry Formation with those of the Ampyx Limestone. These formations are probably not quite contemporary (see below p. 254), but they have many species in common, (see text-fig. 1). SWEET & BERGSTRÖM (1962) noted that in the Pratt Ferry fauna two pairs of species could be recognised, the number of individuals in the species of each pair being approximately equal, i.e. in the pair *Haddingodus serra* — *Pygodus anserinus* and in *Prioniodus macrodentata* — *Periodon aculeatus*. In the Ampyx Limestone precisely the same situation is found! However it must be stated that only a few specimens of *Prioniodina macrodentata* and *Periodon aculeatus* were found. The four species mentioned above probably belong to two rather than to one "natural species". *Haddingodus serra* and *Pygodus anserinus* have been reported together from several other localities (e.g. Sweden, Great Britain).

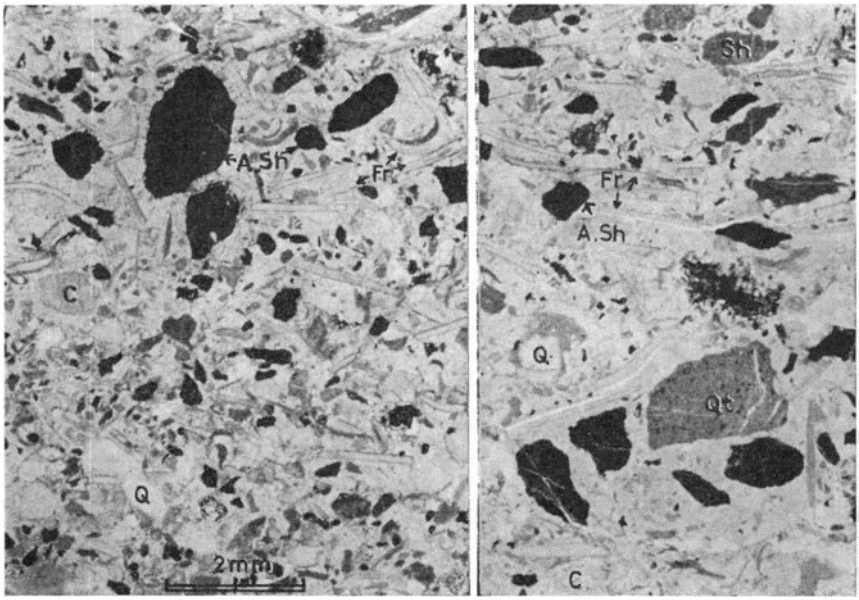
It is suggested here that the *Haddingodus* — *Pygodus* association can be extended to include the genus *Acontiodus*. There are sufficient specimens of the genus *Acontiodus* in the Pratt Ferry Formation on the one hand and the Ampyx Limestone on the other to permit an examination of this possibility. The genus *Acontiodus* consists of four species, *A. cooperi* and *A. robustus* from the Pratt Ferry Formation and *A. rectus* and *A. kullerudensis* n.sp. from the Ampyx Limestone. The three components of the suggested "assemblage" (*Acontiodus*, *Haddingodus*, *Pygodus*) are present in ratios of 1 : 3 : 3 respectively in the Pratt Ferry Formation and 1 : 3.5 : 3.5 respectively in the Ampyx Limestone. The ratios are very similar and do, in fact, suggest the presence of a "natural assemblage" but the evidence is not considered as conclusive.




Text-fig. 1. Conodont species common to the faunas from the Pratt Ferry Formation in Alabama (black) and from the Ampyx Limestone in Norway (dotted). These species comprise approximately 82% of the whole conodont fauna of the Pratt Ferry Formation and 75% of the conodont fauna in the Ampyx Limestone.

*Scolopodus varicostatus* is numerically as strong as *Haddingodus* or *Pygodus* in the Pratt Ferry Formation. In the fauna of the Ampyx Limestone this species is represented by only a few individuals, indicating that it is not part of the *Haddingodus–Pygodus* "natural species".

Comparisons of this kind, in the future, should be very useful for the recognition of "natural species" in separate faunas, when additional statistically comparable faunas are available.




Text-fig. 2. Micro-photograph of thin-section of the intraformational conglomerate bed from Gomnæs. (Q. — quartz, Qt. — quartzite, A.Sh. — alum shale, Sh. — shale, C. — calcite, Fr. — fossil fragments.) 9x.

## Description of localities

The conodonts described in the present paper were found in two samples from the lower part of the Ampyx Limestone of the Ringerike district. One locality, Kullerud, is situated 3 km ESE of Hønefoss, the other locality, Gomnæs on Tyrifjord 11 km SW of Kullerud. In addition to these localities another occurrence of conodonts from the Ampyx Limestone has recently been found at Ildjernet island 10 km SSW of Oslo center. Of the latter fauna only one species is described in the present paper.

Gomnæs. A detailed description of the section has been published by STØRMER (1953, p. 83) and is also available in KIÆR's notes of 1925. The dip varies between 0°—20° to the SE and much of the section is covered by loose material. The lower part of the section (in the North) consists of about 5 m of shale with relatively few limestone lenses. These lenses contain *Ogygiocaris dilata sarsi*, *Pseudomegalaspis patagiata*, *Telephus* sp., *Nileus armadillo*, *Alwynella* sp., and *Trinu-*

Text-fig. 3. Vertical section through the intraformational conglomerate bed from Kullerud. 1x.

*cleus bronni* which indicate the upper part of the Ogygiocaris Shale ($4a\alpha_{3-4}$) (STØRMER, 1953). The shale with few lenses is succeeded by about 20 m of shale with more frequent limestone lenses. This forms a lithological transition into the Ampyx Limestone ($4a\beta$). A distinct bed of a "minute conglomerate or sedimentary breccia with a thickness of 15 cm" (STØRMER, 1953) marks the beginning of the characteristic nodular Ampyx Limestone. New measurements of the bed indicate a thickness of 20 cm. The bed consists of two limestone layers separated by 1 cm of shale. Text-figure 2 shows a thin section of one of the limestones. The rock consists mainly of coarse-grained calcite, fossil fragments, and rock fragments. There are two types of rock fragments: one sometimes contains graphite, the other is rich in quartz and contains a yellow-brown mineral (biotite ?). Other minerals in the bed are: quartz, biotite, feldspar, chlorite, and ore (mainly pyrite). Both the minerals and the rock fragments occur as rounded and angular types. The fossil fragments are mainly of trilobites and brachiopods.

The conodonts occur throughout the bed. Separate samples at different levels show limited faunal zoning.

Kullerud. At this locality a similar intraformational conglomerate has been found. It has a thickness of about 10 cm and occurs in a sequence of strongly folded (isoclinal folds) shattered shale with limestone lenses. Beneath the bed there are 9 m of shales with limestone lenses and below these again are shales without limestone lenses. Above the bed with the intraformational conglomerate comes the typical nodular Ampyx Limestone (4a$\beta$).

The intraformational conglomerate has four lithological horizons, two of coarse breccia and two of finer arenaceous beds (Text-fig. 3). The arenaceous beds show cross-bedding. The lowermost layer rests on a limestone bed in which the following macrofossils were found: *Trinucleus hibernicus broeggeri, Trinucleus foveolatus, Reedolithus carinatus, Ampyx* sp., and *Asaphus* sp. The conodonts were obtained from samples of the whole intraformational conglomerate (10 cm thickness).

Ildjernet. In the Ampyx Limestone Dr. N. Spjeldnæs has collected a limestone lens which has yielded a relatively rich fauna of conodonts. The fauna is similar to that of Ringerike. *Pygodus anserinus, Haddingodus serra, Ambalodus lindstroemi* n.sp., and *Polyplacognathus ringerikensis* n.sp. occur as a chief constituents of the conodont fauna. *P. ringerikensis* n.sp. occurs more commonly, however, than at Ringerike. In the description of the species, specimens from Ildjernet are all considered.

## Stratigraphical correlation

Middle Ordovician conodont faunas are well known from Sweden, Great Britain, and North America.

Sweden. Similar conodont faunas have been described from the Crassicauda Limestone and equivalent deposits regarded to be of Llandeilian age.

At Öland abundant conodont faunas occur in the Crassicauda Limestone and have been listed and partly figured by LINDSTRÖM (1960) and mentioned by BERGSTRÖM (in SWEET & BERGSTRÖM, 1962, p. 1218). Of the conodonts listed the following species occur both at Öland and in the Oslo region: *Haddingodus serra, Pygodus anserinus, Polyplacognathus elongata, Periodon aculeatus, Prioniodus alatus,*

*Ambalodus* aff. *lindstroemi* n.sp., *Pygodus* sp., *Paltodus* sp., *Acontiodus rectus*, *Oistodus venustus*, *Drepanodus homocurvatus*. Among these species are three which are mentioned and figured by LINDSTRÖM (1960) as characteristic of the lower part of the Crassicauda Limestone. These three species are *Pygodus* sp., *Ambalodus* aff. *lindstroemi* n.sp., and *Amorphognathus* n. sp. 2., *Pygodus anserinus*, *Polyplacognathus elongata* (= *Amorphognathus* n. sp. 3), and *Ambalodus* n. sp. 7, are chosen by LINDSTRÖM (loc. cit.) to be guide fossils of the upper part of the Crassicauda Limestone.

In my samples *Pygodus* sp. occurs at Kullerud and Gomnæs only in the lower part of the bed but associated with species from the upper faunal zone of LINDSTRÖM.

The other localities at Öland mentioned by LINDSTRÖM (1955) as containing *Haddingodus serra*, *Periodon aculeatus*, and *Prioniodus alatus* belong to the Crassicauda Limestone (LINDSTRÖM, 1960) rather than to the Schröteri Limestone.

In Scania at Fågelsång, conodonts similar to the faunas mentioned above, have been found and described by HADDING (1913), LINDSTRÖM (1955), and listed by NILSSON (1960). All the species listed and partly figured from Öland occur in the Fågelsång district, with the exception of *Polyplacognathus elongata*, *Ambalodus* aff. *lindstroemi* n.sp. *Acontiodus rectus*, *Oistodus venustus*, and *Drepanodus homocurvatus*. On the other hand *Acontiodus falcatus*, *A. robustus*, *Cordylodus ramosus* and *C. spinatus* occur at Fågelsång and are not reported from Öland and are absent from the Ampyx Limestone in Norway. The phosphorite conglomerate bed in which the conodonts occur at Fågelsång belongs to the subzone of *Cimacograptus haddingi* (HADDING, 1913). According to NILSSON (1960) *Pygodus anserinus* is rather common in the upper part of the subzone of *Climacograptus haddingi* in Scania, but has hitherto not been found at higher horizons.

In the Killeröd district (Scania) only *Haddingodus serra*, *Drepanodus* cf. *robustus*, and *Drepanodus* sp. have been reported (NILSSON, 1951). The shale with conodonts is succeeded by a conglomerate, and a little higher up in the section occurs the guide fossil *Trinucleus bronni* characteristic of the zone 4a$\alpha_4$ in the Oslo region.

From what is said above the species common to Sweden and Norway occur in Sweden mostly in the subzone of *Climacograptus haddingi* and the upper part of the Crassicauda Limestone. However, it

seems that *Pygodus anserinus, Haddingodus serra,* and *Polyplacognathus elongata* may also occur in the Ludibundus Limestone. On the other hand the following species *Cordylodus ramosus, C. spinatus, Acontiodus robustus* are regarded by SWEET & BERGSTRÖM (1962) as being confined to the subzone of *Climacograptus haddingi.* These last species have not been found in the Norwegian material, a fact which suggests that the Norwegian beds are younger than the subzone of *Climacograptus haddingi.*

The conodonts thus indicate that the Ampyx Limestone of the Oslo region is younger than the subzone with *Climacograptus haddingi* and probably corresponds to the upper part of the Crassicauda Limestone and possibly the lowest part of the Ludibundus Limestone.

Great Britain. In South Wales the Llandeilo Limestone conodont fauna (RHODES, 1953) shows very little resemblance to the Ampyx Limestone fauna in Norway. Of the six described species from Wales only one, *Panderodus unicostatus,* also occurs in Norway.

Conodont faunas of Middle Ordovician age have been reported from the Southern Uplands of Scotland (LAMONT & LINDSTRÖM, 1957). Only the following species are known to occur in these strata: *Pygodus anserinus, Haddingodus serra, Periodon aculeatus, Cordylodus ramosus, C. spinatus, Falodus* sp. and simple conodonts. These conodonts, occurring in various localities, are regarded as belonging to the upper part of the Llandeilian. The fauna corresponds to that of the subzone of *Climacograptus haddingi* in Sweden. Since the Norwegian fauna apparently is younger the correlation may suggest that the Ampyx Limestone belongs to the lowest part of the Caradocian, as suggested by STØRMER (1953).

North America. The Pratt Ferry Formation of Alabama also has a conodont fauna similar to that of the Ampyx Limestone in Norway. The species common to both formations are: *Drepanodus homocurvatus, Falodus prodentatus, Haddingodus serra, Oistodus venustus, Panderodus gracilis, P. unicostatus, Periodon aculeatus, Prioniodina macrodentata, Pygodus anserinus, Scolopodus varicostatus, Tetraprioniodus lindstroemi.* All of these species are well represented in the Ampyx Limestone fauna in Norway and constitute about 65% of the whole conodont fauna. The Pratt Ferry fauna, however, includes *Cordylodus ramosus, C. spinatus,* and *Acontiodus robustus* which indicate the Pratt Ferry Formation to be somewhat older than the zone of *Nemagraptus*

*gracilis* in Scania (SWEET & BERGSTRÖM, 1962) and probably a little older than the Ampyx Limestone in Norway.

From the "Martinsburg Shale" of New Jersey a few badly preserved specimens of *Periodon aculeatus* and *Pygodus anserinus* have been described by ETHINGTON et al. (1958).

GRAVES & ELLISON (1941) described conodonts from the Fort Peña Formation of the Maraton basin in Texas, which probably are related to the Ampyx Limestone conodonts in Norway. The material, which is rather fragmentary, contains the following species *Falodus prodentatus, Loxognathus flabellata, Prioniodina macrodentata, Panderodus gracilis,* and *Phragmodus undatus, Periodon aculeatus* (SWEET & BERGSTRÖM, 1962) and this fauna is closely comparable (possibly with the exception of *Loxognathus flabellata*), with the fauna of the Ampyx Limestone in Norway.

Comparison with the foreign conodont faunas indicates that the Ampyx Limestone of the Oslo region belongs to the zone of *Nemagraptus gracilis* of the lower part of the Caradocian.

## Description of the conodonts

Genus *Acodus* PANDER.

*Type species: Acodus erectus* PANDER 1856.

PANDER's description (translated by LINDSTRÖM, 1954): "Teeth more or less curved, with front and hind keels as a rule unequally big. The lateral faces are unsymmetrical, one evenly convex, the other more strongly developed, standing out as a blunt or sharp carina. The different curvature of the teeth and the difference of size in the carinae of one of the lateral faces makes us separate the following single forms from one another".

*Remarks:* As LINDSTRÖM (1959) suggested *Sagittodontus* RHODES, 1953, might be included with *Acodus*.

*Acodus robustus* (RHODES).

Pl. 1, figs. 23—24; Text-fig. 4, no. 2.

*Sagittodontus robustus* RHODES, 1953, Roy. Soc. London, Philos. Trans. ser. B, v. 237, no. 647, p. 311, pl. 21, figs. 141—142; ETHINGTON, 1959, Journ. Paleont. v. 33, no. 2, p. 287, pl. 39, fig. 12.

*Acodus robustus* LINDSTRÖM, 1959, Micropal. v. 5, no. 4, p. 433, pl. 4, figs 22—27.

One specimen has been observed. The lateral edge forms an angle anteriorly of about 80° with the antero-postero plane. The sheaths between the edges are folded inwards. The aboral margin is different from that of the typical *A. robustus* in the absence of the "three undenticulated processes" (RHODES, 1953) at the aboral part of the edges. The whole unit is hollow with very thin sheath walls. The edges are sharp.

*Occurrence:* Gomnæs.

### *Acodus similaris* RHODES.

Pl. 1, fig. 3.

*A. similaris* RHODES, 1955, Geol. Soc. London, Quart. Journ. v. 111, p. 124, pl. 10, figs. 7, 10, 14, 16, 18, 23, 26—28, 30; LINDSTRÖM, 1959, Micropal. v. 5, no. 4, p. 435, pl. 3, figs. 6—9.

These are very variable specimens like those from the Keisley Limestone. No more can be added to the description.

*Material:* 14 specimens.

*Occurrence:* Kullerud, Gomnæs.

### *Acodus tetrahedron* LINDSTRÖM.

Text-fig. 4, no. 3.

*Acodus tetrahedron* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, H. 4, p. 546, Pl. 4, figs. 1—2.

Few specimens could be referred to *A. tetrahedron* LINDSTRÖM, but they were in all characters, identical with Lindström's description.

*Occurrence:* Kullerud.

*Material:* 2 specimens.

### *Acodus* n. sp.

Pl. 1, figs. 4—5, 9; Text-fig. 4, no. 1.

*Description:* The cusp is suberect or reclined. The basal cavity is small, conical and its apex is central. On one of the posterior lateral faces is a well developed costa and between that and the posterior keel is a deep canal which on the upper part of the cusp is as deep as the middle of the cross-section. The oral edge is short and the anterior and posterior keels are sharp. Lateral faces of the cone are smooth.

*Remarks:* The species resembles *A. similaris* RHODES, but differs in the curvature and in the aspect of the base.

*Occurrence:* Gomnæs.

*Material:* 4 specimens.

## Genus *Acontiodus* PANDER, 1856.

*Type species. Acontiodus latus* PANDER, 1856.

Redefined by LINDSTRÖM (1954), "To the genus *Acontiodus* belong simple, more or less symmetrical conodonts with smooth lateral faces and a posterior keel to each side of which is a lateral costa".

### *Acontiodus cooperi* SWEET & BERGSTRÖM.

Unfigured.

*Acontiodus cooperi* SWEET & BERGSTRÖM, 1962, Journ. Paleont. vol. 36, pp. 1221—22, pl. 168, figs. 2—3, text-fig. 1G.

One fragmentary specimen has been observed, which has the same cross section as *A. cooperi*.

*Occurrence:* Gomnæs.

### *Acontiodus kullerudensis* n.sp.

Pl. 1, figs. 6—7, 14, 18; Text-fig. 4, no. 5.

*Type specimen:* PMO 69771, paratypes: PMO 69772, PMO 69800.

*Diagnosis:* An *Acontiodus* with one strong posterior lateral costa, the other is weaker. The cross section is asymmetrical. Basal cavity is small.

*Description:* Simple erect or curved cones with anterior and posterior keels and two posterior lateral costae. In cross section one of the posterior lateral costae more strongly developed than the other. Between this costa and the posterior keel is a deep canal which is v-shaped or rounded and its trough directed to the centre of the cross-section.

The posterior lateral costae almost reach the aboral margin but do not flex it, (text-fig. 4, no. 5). Aboral margin is rounded and broad posteriorly, narrow anteriorly. Oral margin is short.

The basal cavity is small. The depth and width ratio is between 0.3 and 1.0.

*Remarks:* The species resembles *A. rectus* LINDSTRÖM, but differs from it in the cross-section.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 28 specimens.

*Acontiodus rectus* LINDSTRÖM, 1954.

Pl. 1, figs. 10, 12, 13, 17; Text-fig. 4, no. 4a—b.

*Acontiodus rectus* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 549, pl. 2, figs. 7—11, text-fig. 2 k—m, 3B.

*Remarks:* My specimens show much continuous variation in curvature and form of basal cavity. Aboral margin expanded posteriorly and narrow anteriorly. Basal cavity is deeper than it is wide. Depth/width ratio is from 1.0—1.8. The specimens have symmetrical or slightly asymmetrical cross-section. Posterior keel is flexed a little laterally. Some specimens have two lateral grooves on both sides at the anterior basal part. The grooves are as long as the basal cavity is deep.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 92 specimens.

Genus *Ambalodus* BRANSON & MEHL, 1933.

*Type species. Ambalodus triangularis* BRANSON & MEHL, 1933.

*Ambalodus lindstroemi*, n.sp.

Pl. 5, figs. 1, 4, 7—8, 10—11; Text-fig. 5, nos. 1a—b, 3a—b, 4a—b.

*Type specimen:* PMO 69791, *paratypes:* PMO 69792, PMO 69790, PMO 69793.

*Diagnosis:* An *Ambalodus* with a short posterior bar and with an anterior process 3 or 4 times longer than the posterior bar. The lateral platform makes an angle of about 60°—90° with the posterior bar.

*Description:* Posterior bar is short and has about 4—7 laterally compressed denticles on the median ridge. The bar is narrow and about as long as the lateral process. It makes an angle of about 120° with the anterior process and is usually perpendicular to the lateral process.

Anterior process is about 3—4 times longer than the posterior bar. This process is wide near the cusp but it gradually tapers in the distal half of the process. The anterior process is laterally curved and verti-

cally undulated in the proximal half of the process, distally it is straight. The distal part is occasionally twisted so the denticles point towards the inner side. The denticles vary on the anterior platform. They are generally pointed, small denticles but some of my specimens have large, high denticles. From the cusp towards the distal end of the anterior process there are small denticles which increase in size to approximately 2/3-rds of the length of the platform and then decrease in size again.

The cusp is small, laterally compressed, with sharp anterior and posterior edges and pointed at the apex. Basally the cusp is fused with one or more anterior and posterior denticles. In my material specimens have been observed with large cusps and oval- or rounded cross-sections.

The lateral process is platform-like and about twice as long as wide. The median ridge originates from the middle of the cusp. On the lateral side of the cusp is a lateral costa which is sometimes very weak or absent. The process is bent downwards about 20°—30°. There are 5 to 7 small, low denticles on the lateral process. The cross-section of the bars is "polyplacognathoid".

The basal cavity is deep and narrow. It is well developed along all three processes. A basal funnel is observed.

*Remarks:* As to the variation in form of the cusp and the denticles as well as to the origin of the lateral process it seems that this form may be divided into several species, but I have not sufficient material to do this at the moment.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 28 specimens.

### *Ambalodus* aff. *lindstroemi* n.sp.

Pl. 5, figs. 5, 12; Text-fig. 5, no. 2a—b.

*Ambalodus* n.sp. LINDSTRÖM 1960. Int. Geol. Congr. XXI s. Part VII, pp. 94—95, fig. 6, no. 1, 2, and fig. 7, no. 5, 7.

*Type specimen:* PMO 69784, pl. 5, fig. 12, text-fig. 5, no. 2a—b, *paratype:* PMO 69636.

*Diagnosis:* An *Ambalodus* with short platform-like posterior process and an anterior process about 3—4 times longer than the posterior process. Lateral process projects from the middle of the lateral side of a small cusp. Lateral process is longer than the posterior one.

*Description:* Posterior process is short and carries about 2—3 low and rounded denticles. The process is just about as long as broad.

The cusp is small, laterally compressed, basally fused together with the nearest anterior and posterior denticles.

Anterior process — from the cusp to the first free denticle the anterior process has the same axis as the posterior process. But at the first free denticle the anterior process bends abruptly towards the inner side and becomes curved, convex towards the inner side, only to become straight distally. The axis along the distal straight part of the anterior process makes an angle with the posterior process of 120°. The curved part of the process is also undulated vertically.

The lateral process is about twice as long as the posterior one, and on the median ridge it accommodates about 7 denticles which are similar to those on the anterior and posterior processes. The lateral process make an angle of about 130°—145° with the posterior process.

The aboral margin is narrow and runs along all three processes. The cross-section of the processes is typically "polyplacognathoid".

The posterior and lateral bars are flexed downwards about 5°.

*Remarks:* This form differs from *A. lindstroemi* n.sp. sensu stricto in that the posterior process is much wider.

*Occurrence:* Kullerud.

*Material:* 5 specimens.

Genus *Chirognathus* BRANSON & MEHL.

*Type species: Chirognathus duodactyla* BRANSON & MEHL, 1933.

*Chirognathus* sp.

Pl. 4, fig. 14.

*Description:* Fragmentary specimens have been found at Kullerud. A weakly curved base is very small. Aboral side is cigar-shaped in outline and flat. There are four laterally compressed denticles, with sharp edges, which sit on the base like the fingers of a flexed hand. The fragments do not include an escutcheon. It seems that one of the lateral ends of the base is complete, the other is broken. The two middle denticles are higher and broader than the other denticles. Translucent light shows fibrous structure of the specimens.

*Occurrence:* Kullerud.

*Material:* 2 specimens.

## Genus *Coelocerodontus* ETHINGTON

*Type species: C. trigonius* ETHINGTON, 1953.

### *Coelocerodontus digonius* SWEET & BERGSTRÖM

Pl. 2, fig. 13; Text-fig. 4, no. 8.

*C. digonius* SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1225, pl. 168, fig. 1, text-fig. 1F.

*Description:* Subsymmetrical or symmetrical horn-shaped conodont elements with anterior and posterior keels. The basal cavity extending to the apex. All of my specimens have fragmentary aboral margins. Lateral faces are smooth and convex. Some specimens show the posterior part of the lateral faces flexed inwards. The cross-section is pear-shaped.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 7 specimens.

### *Coelocerondontus trigonius* ETHINGTON

Pl. 2, fig. 15; Text-fig. 4, no. 10.

*C. trigonius* ETHINGTON, 1959, Journ. Paleont. v. 33, p. 273, pl. 9, fig. 14.

*Description:* Most of my specimens have slightly asymmetrical cross-section. The cone is continuously curved to two-thirds of the height, later it becomes straight. The costae are sharp. The two anterior costae directed laterally and the third one posteriorly. The anterior sheath flexed inwards basally, higher up becomes convex. The lateral sheath-faces flare slightly basally otherwise concave or planar. The whole cone is hollow.

*Occurrence:* Gomnæs.

*Material:* 10 specimens.

### *Coelocerodontus tetragonius* ETHINGTON.

Pl. 2, fig. 14; Text-fig. 4, no. 9.

*C. tetragonius* ETHINGTON, 1959, Journ. Paleont. v. 33, p. 273, pl. 39, fig. 15.

*Description:* Simple curved teeth with weakly-asymmetrical quadrate cross-section. The two anterior costae directed laterally and both posterior ones posteriorly. The costae are sharp. The anterior face is convex, the two lateral and the posterior sheath-faces basally

either flexed inwards or planar, higher up become planar or concave. The specimens are often twisted. Basal cavity is continuous to the apex.

*Occurrence:* Gomnæs.

*Material:* 3 specimens.

## Genus *Cordylodus* PANDER.

*Type species: C. angulatus* PANDER, 1856.

### *Cordylodus elongatus* RHODES.

Pl. 4, fig. 20.

*C. elongatus* RHODES, 1953, Phil. Trans. Roy. Soc. London, Ser. B. No. 647, v. 237, p. 299, pl. 22, figs. 114—118.

*Description:* A *Cordylodus* with proclined cusp and strongly elongated posterior bar. The cusp is rounded. Aboral extension of the cusp is well developed, its end is pointed and somewhat flexed laterally.

The posterior bar is higher than broad. The denticles are laterally compressed, and irregularly flexed laterally with pointed apices and with sharp anterior and posterior keels. The denticles increase in height posteriorly.

Aboral sides of processes deeply excavated to form a basal cavity. Part of the basal cavity extends into the basal part of the cusp.

*Occurrence:* Kullerud.

*Material:* 2 specimens.

## Genus *Dichognathus* BRANSON & MEHL.

*Type species: D. prima* BRANSON & MEHL, 1933.

### *Dichognathus typica* BRANSON & MEHL.

Pl. 3, fig. 10.

*Dichognathus typica* BRANSON & MEHL, 1933, Missouri Univ. Studies, v. 8, p. 113, pl. 9, figs. 27—29.

*D. typicus* STAUFFER, 1935a, Bull. Geol. Soc. Am. v. 46, no. 1, p. 141, pl. 11, figs. 2, 3, 5, 8, 10; STAUFFER, 1935b, Journ. Paleont. v. 9, p. 604, pl. 71, fig. 23.

*D.* cf. *typica* BRANSON & MEHL, 1943, Journ. Paleont. v. 17, p. 374, pls. 63—64. SANNEMANN, 1955, Neues Jahrb. Geol. Palëont. Abh. Bd. 102, p. 25, pl. 2, fig. 13.

*D. typica* BRANSON & MEHL, 1944, in Shimer & Shrock, Ind. Foss. of N. Am. pp. 89—90, pl. 13, figs. 39, 43, 44, 45; FAY, 1952, Univ. Kansas, Paleont. Contr. Vert. art. 3. p. 86; GLENISTER, 1957, Journ. Paleont. v. 31, p. 735, pl. 88, figs. 4, 6; ETHINGTON, 1959, Journ. Paleont. v. 33, p. 274, pl. 40, fig. 17; SWEET, TURCO, WARNER & WILKIE, 1959, Journ. Paleont. v. 33, p. 1048, pl. 132, fig. 6; BERGSTRÖM, 1961, Ark. Min. Geol. Bd. 3, no. 1, p. 37, pl. 5, fig. 6.

*Description:* Posterior and lateral bar make an angle of about 160°. The angle between the lateral and anterior bar — which is flexed laterally — is about 80°. The edge of the anterior bar is sharp, without denticles. Posterior bar has more than 7 denticles, which are fused basally, compressed laterally and apically are free. The lateral bar has orally two or three flat, large, and pointed denticles which decrease in dimensions distally. The cups is large and reclined. It has slightly convex lateral faces, and its edges are sharp. Aboral margin runs along all three processes. The lateral bar a little curved in oral view, Basal cavity is deep and extends into the basal part of the cusp.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 5 specimens (2 sin., 3 dextr.).

## Genus *Distacodus* HINDE, 1873.

*Type species: Machairodus incurvus* PANDER, 1856.

### *Distacodus* n.sp.

Pl. 1, figs. 19—20; Text-fig. 6, no. 3a.

*Description:* An asymmetrical or near-symmetrical cone with reclined, apically pointed, conspicuously tapered and twisted cusp.

The oral margin is short, which makes a sharp angle with the posterior keel. There is a costa on both lateral faces. The costa on the outer side is stronger developed and situated more on the middle of the face than is the costa on the inner side. The aboral margin is broad and its posterior part is flexed upwards so the basal cavity opens posteriorly and also towards the inner lateral side. The basal cavity is as deep as is the flexure of the posterior part of the aboral margin. The cone has sharp anterior and posterior keels.

*Occurrence:* Kullerud.

*Material:* 2 specimens.

## Genus *Drepanodus* PANDER.

*Type species: D. arcuatus* PANDER, 1856.

### *Drepanodus arcuatus* PANDER.

Pl. 2, figs. 1—2; Text-fig. 6, no. 4.

*D. arcuatus* PANDER, 1856, Russisch-Baltischen Gow. St. Petersburg, p. 20, pl. 1, figs. 4—5, (not. 2, 17, 30, 31); FAY, 1952, Kansas Univ. Paleont., Contr. Art. 3, p. 89. For literature before 1952, see FAY. LINDSTRÖM, 1954, Geol. För. Förh. Bd. 76, p. 558, pl. 2, figs. 30—33, text-fig. 3J; RHODES, 1955, Quart. Journ. Geol. Soc. London, v. 111, p. 126, pl. X, fig. 24; 1962, Tret. Invert. Paleont. Part. W, p. W43, fig. 22, no. 40.

*Remarks:* Fragmentary specimens which most resemble the figured specimen of PANDER (loc. cit. pl. 1, fig. 4) have been found in the Ampyx Limestone.

The oral margin is very long. The cup is reclined and has sharp anterior and posterior keels. Oral margin makes an angle of about 45° with the aboral margin. The cross-section is oval. The basal cavity is deep and its apex directed anteriorly. The lateral faces are smooth and convex, where the curvature is most marked the faces are finely striated.

*Occurrence:* Kullerud.

*Material:* 1 specimen.

### *Drepanodus homocurvatus* LINDSTRÖM 1954.

Pl. 2, figs. 3—4; Text-fig. 6, no. 3b.

1933, *Oistodus curvatus* BRANSON & MEHL, Missouri Univ. Studies, v. 8, p. 110, pl. 9, figs. 4, 10, 12; FAY, 1952, Univ. Kansas Paleont. Contr., Vertebrata, art. 3, p. 134.

1954, *Drepanodus homocurvatus* LINDSTRÖM, Geol. Fören. Förh. bd. 76, p. 563, pl. 2, figs. 23, 24, 39, text-fig. 4d; PULSE & SWEET, 1960, Journ. Paleont. v. 34, p. 252, pl. 35, figs. 4, 13; CARLSON, 1960, North Dakota Geol. Survey, Bull. 35, tab. II; BERGSTRÖM, 1961, Ark. f. Min. Geol. bd. 3, pp. 39—41, pl. 2, figs. 13, 14, pl. 5, figs. 19, text-figs. 3E, 4A; WOLSKA, 1961, Acta Geol. Polonica, v. 6, p. 348, pl. 2, figs. 7a—b, SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1226, pl. 169, fig. 9.

*Remarks:* My fragmentary *D. homocurvatus* specimens can be identified with certainty.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 24 specimens.

## Genus *Falodus* LINDSTRÖM, 1954.

*Type species: Oistodus prodentatus* GRAVES & ELLISON, 1941.

### *Falodus prodentatus* GRAVES & ELLISON

Pl. 4, figs. 9—10; Text-fig. 4, no. 18.

*Oistodus prodentatus* GRAVES & ELLISON, 1941, Missouri Univ. School of Mines & Metallurgy, Bull. Techn. ser. v. 14, p. 13, pl. 2, figs. 8, 22, 23, 28; FAY 1952, Univ. Kansas Paleont. Contr. Vert. Art. 3, p. 136.

*Falodus prodentatus* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 569, pl. 5, figs. 21?, 22?, 30; LINDSTRÖM, 1957, Geol. Fören. Förh. Bd. 79, p. 164; ETHINGTON, 1959, Journ. Paleont. v. 33, p. 277, pl. 39, fig. 18?; CARLSON, 1960, North. Dakota Geol. Surv. Bull. 35, p. 71, tab. II; Tret. Invert. Paleont. Part W, 1962, p. W54, (fig. 33, no. 4 = *F. extensus*); SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1227, pl. 170, figs. 2—3, text-fig. 2B;

*Falodus* n.sp. LINDSTRÖM, 1957, Geol. Fören. Förh. Bd. 79 p. 173, pl. 1 & text-fig. 2, nos. 25?, 26.

*Falodus* sp. LAMONT & LINDSTRÖM, 1957, Edinb. Geol. Soc. Trans. v. 17, pp. 63—65.

*Description: Falodus* with large flat cusp with convex lateral faces. The posterior process is markedly elongate. The anterior process has no more than four denticles. They are rounded. Aboral margin is sinuous. Basal cavity is narrow and small.

*Remarks:* My specimens are similar to those in the Pratt Ferry collection. Resemblance to the Swedish Lower Ordovician specimens is small. (cf. SWEET & BERGSTRÖM).

*Occurrence:* Kullerud, Gomnæs.

*Material:* 29 specimens.

## Genus *Gothodus* LINDSTRÖM.

*Type species: G. costulatus* LINDSTRÖM, 1954.

### *Gothodus costulatus* LINDSTRÖM.

Pl. 1, figs. 15—16

*G. costulatus* LINDSTRÖM, 1954. Geol. Fören. Förh. Bd. 76, p. 569, pl. 5, figs. 23, 25; ASH, 1961, Micropal. v. 7, p. 231; 1962, Tret. Invert. Paleont. Part W, p. W48, fig. 27, no. 2.

*Description:* The cusp is relatively large and proclined with three costae on its face. Anticusp or anterior process is smaller and a little

shorter, than the cusp. The anticusp and cusp lie on one axis which is evenly curved in lateral aspect. The anterior costa on the cusp is situated anteriorly, whereas on the anterior process it is situated laterally. The posterior process is short, and orally denticulated with few similar denticles. The process is always fragmentary in my collection. The lateral costa is usually weakly developed and is situated on the crest of a conspicuous fold of the sheath, this fold being projected downwards below the general level of the aboral margin. Basal cavity is conical.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 26 specimens.

## Genus *Haddingodus* SWEET & BERGSTRÖM, 1962.

*Type species: Arabellites serra* HADDING, 1913.

### *Haddingodus serra* (HADDING).

Pl. **4**, figs. 13, 16; Text-fig. 5, no. 6a—b.

*Arabellites serra* HADDING, 1913, Lunds. Univ. Årskr. N.F. Afd. 2, Bd. 9, no. 15, p. 13, pl. 1, figs. 12—13; NILSSON, 1951, Geol. Fören. Förh. Bd. 73, pp. 684, 687, 690;

*"Arabellites" serra* LINDSTRÖM, 1960, XXI Int. Geol. Congr. Rep. Part VII, p. 95, figs. 7, no. 6 & 8, no. 10.

*Periodon serra* LINDSTRÖM, 1955, Journ. Paleont. v. 29, p. 110, pl. 22, figs. 17, 20—25; LAMONT & LINDSTRÖM, 1957, Edinburg Geol. Soc. Trans. v. 17, Part 1, pp. 63—64, 67; SWEET, TURCO, WARNER & WILKIE, 1959, Journ. Paleont. v. 33, p. 1057; REGNELL, 1960, XXI. Int. Geol. Congr. Guide to Exc. A22 & C 17, p. 21.

*Haddingodus serra* SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1229, pl. 170, figs. 1, 4.

*Remarks:* Viewed from the aboral side the posterior bar makes an angle of about 90° with the lateral bar and 130°—140° with the anterior bar. The cusp is small and pointed and flexed a little to the inner side. On the outer lateral side of the cusp is a narrow groove on some of my specimens. The groove is short and disappears a short way posteriorly from the point of attachment of the lateral bar. The cusp is occasionally fused together basally with one or two of the anterior and posterior denticles. No more can be added to the description.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 419 specimens (193 dextral, 174 sinistral and 52 fragmentary specimens).

## Genus *Loxognathus* GRAVES & ELLISON.

*Type species: Loxognathus flabellata* GRAVES & ELLISON, 1941.

*L. flabellata*, GRAVES & ELLISON, 1941, Missouri Univ. School of Min. & Met. Bull. Techn. Ser. v. 14, no. 2, p. 12, figs. 29?, 31, 32?; FAY, 1952, Kansas Univ. Paleont. Contr. Vert. Art. 3, p. 127; LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 600; SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, pp. 1216, 1235.

*Dichognatus* = *Loxognathus*, ELLISON, 1946, Am. Ass. Petr. Geol. Bull. v. 30, no. 1, p. 109.

*Remarks:* The genus was proposed on fragmentary material. Recently SWEET & BERGSTRÖM (1962), suggested that two of the figured paratypes (GRAVES & ELLISON, 1941, figs. 29, 32) be removed from the genus. They resemble most closely *Periodon aculeatus* Hadding.

ETHINGTON (1959), described the species *Loxognathus grandis*.

There are two possibilities for a revision of the genus *Loxognathus* as defined by GRAVES & ELLISON (loc. cit.).

1) If the genoholotype possessed denticulated posterior and lateral bars, an undenticulated anterior bar, a strongly arched posterior bar carrying a denticle bigger than the cusp, and a posteriorly flexed lateral bar then it is quite distinct from *L. grandis*.

2) If the genoholotype possessed denticulated anterior, posterior, and lateral bars, a strongly arched posterior bar carrying a denticle bigger than the cusp, and a posteriorly flexed lateral bar then *L. grandis*, becomes identical with the genoholotype.

## *Loxognathus grandis* ETHINGTON.

Pl. 3, figs. 22, 24, 26—27; Text-fig. 4, no. 15a—b.

*L. grandis* ETHINGTON, 1959, Journ. Paleont. v. 33, p. 281, pl. 40, fig. 6.

*Description:* The cusp is reclined and on the rounded face run three costae, one for each process and on some of my specimens there is a fold or carina between the anterior and posterior costae. The carina begins about the middle of the lateral sheath and runs near the posterior costa.

The posterior process is arched downwards distally and is also twisted in the vertical plane. On the oral edge there are about 8—10 denticles, one of which (in the middle of the row) is always larger than the cusp, itself. The denticles on either side of the large denticle decrease in size away from it.

The anterior process or anticusp is directed downwards and bears about seven small, rounded, basally fused and pointed denticles.

The lateral process is bent a little downwards and flexed strongly posteriorly. It makes an angle of about 30° with the posterior process. The lateral bar has about five, small, posteriorly reclined and pointed denticles, about as small as on the anterior processs.

The basal cavity is deep under the cusp and continues as a narrow groove under the anterior and lateral processes. The basal cavity on the posterior process is tapered posteriorly and just under the biggest denticle takes on the form of an "inverted basal cavity".

*Remarks:* The differences between *L. grandis* and my specimens are in the carina on the cusp and in the smaller and more numerous denticles on the lateral process.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 12 specimens.

## Genus *Oistodus* PANDER.

*Type species: O. lanceolatus* PANDER, 1856.

### *Oistodus* aff. *delta* LINDSTRÖM.

Pl. 1, fig. 8.

*Oistodus delta* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 573, pl. 3, figs. 3—9.

*Description:* The cone is proclined and has a posterior keel and two lateral wings. Anteriorly the sheath between the wings is convex. The two lateral faces are concave. The basal cavity is about as deep as the oral margin is long, and the basal cavity extends into the wings and the posterior keel. The specimens are bilaterally-symmetrical.

*Remarks:* My specimens are different from the typical *O. delta* in that the posterior keel and the upper part of the cone are more elongated.

*Occurrence:* Gomnæs.

*Material:* 1 specimen.

*Oistodus robustus* BERGSTRÖM.

Pl. 3, figs. 1, 2, 7, 14.

*O. robustus* BERGSTRÖM, 1961, Ark. för Min. Geol. Bd. 3, no. 1, p. 45, pl. 3, figs. 7—10, text-fig. 3F.

? *Oistodus* sp. LINDSTRÖM, 1959, Micropal. v. 5, no. 4, p. 441, pl. 3, figs. 11—12.

*Remarks:* The fragmentary specimens have a reclined cusp which is compressed laterally, and a robust base. The basal cavity is narrow, frequently with basal filling. *O. robustus* BERGSTRÖM has an aboral margin which is triangular in form (the apex of the triangle on the inner side), the "base", or outer side of the triangle being slightly concave. But in my specimens the "base" or outer side of the triangle is planar or weakly convex. Denticles on the oral margin have not been observed in my specimens.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 10 specimens.

*Oistodus venustus* STAUFFER.

Pl. 3, figs. 3—6, 9, 11; Text-fig. 6, no. 10.

*O. venustus* STAUFFER, 1935a, Bull. Geol. Soc. Am. v. 46, no. 1, p. 147, pl. 12, fig. 12; FAY, 1952, Univ. Kansas Paleont. Contr. Vert. art. 3, p. 136; RHODES, 1953, Philos, Trans. Roy. Soc. London, Ser. b, v. 237, p. 295, pl. 22, figs. 168—170; ETHINGTON, 1959, Journ. Paleont. v. 33, p. 282, pl. 39, fig. 22; SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1232, pl. 168, figs. 10,11.

*O.* cf. *venustus* BERGSTRÖM, 1961, Ark. för Min. Geol. Bd. 3, p. 46, pl. 5, figs. 8—9, text-figs. 3B, 5.

*Oistodus* sp. LINDSTRÖM, 1957, Geol. Fören. Förh. Bd. 79, p. 174, pl. 1, fig. 8, text-fig. 2.

*Oistodus fornicalus* GRAVES & ELLISON, 1941, Missouri Univ. School of Mines & Met. Bull. Tech. ser. v. 14, p. 4, pl. 2, fig. 18.

*Description:* The much elongated base flares out laterally on the inner side beneath the cusp and it is straight on the outer side. The oral margin is sharp. Anterior edge make an angle of about 50° with the aboral margin. Basal cavity is deep. The postero-basal angle is sharp, and the antero-basal region is evenly curved. The carina is usually very weakly developed.

*Remarks:* My collection consists mainly of small specimens but they are in all characters identical with the described species.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 16 specimens.

*Oistodus* sp.

Pl. 3, figs. 8, 13.

Both specimens are lost. They are very similar to *O. excelsus* STAUFFER 1935. Juvenile specimens. The cusp is without lateral carinae.

*Occurrence:* Kullerud.

*Material:* 2 specimens (lost).

Genus *Oneotodus* LINDSTRÖM.

*Type species: Distacodus? simplex* FURNISH, 1938.

*Definition:* (LINDSTRÖM, 1959) "Simple teeth with a well-defined basal cavity and the cusp un-keeled and subcircular in cross-section".

*Oneotodus simplex* (FURNISH).

Pl. 1, fig. 27.

*Distacodus? simplex* FURNISH, 1938, Journ. Paleont. v. 12, p. 328, pl. 42, figs. 24—25.

*Description:* A horn-shaped cone is proclined and with a long oral margin. The cross-section is always circular. The aboral margin is either circular or slightly elliptical. Basal cavity is deep and conical. The face of the cone is slightly striated, which can be observed with high (200x) magnification. Basal funnel is frequently observed.

*Remarks:* The typical *O. simplex* has a more slender cone than have my specimens.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 9 specimens.

*Oneotodus* n.sp.

Pl. 2, figs. 8, 12; Text-fig. 4, no. 16.

*Diagnosis:* An *Oneotodus* which has a continuously curved cone, with rounded cross-section and with a short posterior costa.

*Description:* A continuously curved cone with pointed apex and rounded cross-section. The posterior costa is weak and can be observed on the basal two-thirds of the whole cone. The basal cavity extends into the cone as far as the limit of the posterior costa.

*Remarks:* The specimen resembles *O. tenuis* MÜLLER, 1959, but is more curved, shorter and the cross-section is more rounded than the Cambrian specimens.

*Occurrence:* Gomnæs.

*Material:* One specimen.

## Genus *Paltodus* PANDER.

*Type species: P. subaequalis* PANDER, 1856.

### *Paltodus* n.sp.

Pl. 1, figs. 21—22; Text-fig. 4, no. 6.

*Description:* A strongly curved cone with long oral margin. It has four costae, one posterior, one anterior and two on one lateral side. Three of the costae are continuous up to the apex. The anterior lateral costa disappears a little above the point of maximum curvature. On the basal part of the sheath between the costae are four triangular nodes. Two nodes are on the sheath between the anterior and posterior costae. One triangular node is between the anterior lateral and posterior lateral costae. The fourth node is between the postero-lateral and posterior costae. The sheath between the anterior and antero-lateral costae is concave without a node. The aboral margin is triangular.

*Remarks:* The specimen resembles *P. comptus* BRANSON & MEHL, 1933, but *P. comptus* has a four-angled aboral margin.

*Occurrence:* Kullerud.

*Material:* 1 specimen.

## Genus *Panderodus* ETHINGTON, 1959.

*Type species: Paltodus unicostatus* BRANSON & MEHL, 1933.

### *Panderodus gracilis* (BRANSON & MEHL).

Pl. 1, figs. 25, 26; Text-fig. 6, no. 2a—b.

*Paltodus gracilis*, BRANSON & MEHL, 1933, Missouri Univ. Studies, v. 8, p. 108, pl. 8, figs. 20—21; FAY, 1952, Univ. Kansas, Paleont. Contr. Vert. art. 3, p. 144; AMSDEN, 1957, Okl. Geol. Surv. Circ. 43, p. 35.

*Pandariodus gracilis*, ETHINGTON, 1959, Journ. Paleont. v. 33, p. 285, pl. 39, fig. 1; PULSE & SWEET, 1960. Journ. Paleont. v. 34, p. 256, pl. 35, figs. 3, 6; CARLSON, 1960, North Dakota Geol. Surv. Bull. 35, tab. II;

WOLSKA, 1961, Acta Paleont. Polonica, v. 6, p. 353, pl. 4, fig. 2a—b; SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1233, text-fig. 1H.

*Description:* Posterior keel is short and about as high as the basal cavity, and the upper part of the posterior side is rounded. The lateral anterior costae never reach the aboral margin. On the inner side of the aboral margin is a triangular incision, and from its top starts a small continuous furrow to the apex. One of the lateral costae is stronger developed but it is shorter than the other. The antero-basal angle is about 90° or a little more. The posterior aboral margin is elongated and makes a sharp angle with the oral margin. (The text-figure illustrates a specimen which is not complete).

*Occurrence:* Kullerud, Gomnæs.

*Material:* 13 specimens.

*Panderodus* cf. *unicostatus* (BRANSON & MEHL).

Pl. 1, figs. 28—29; Text-fig. 6, no. 1a—b.

*Description:* The cone is curved and slightly twisted. The postero-basal part is expanded a little. The sharp posterior keel begins near the aboral margin. The anterior margin is rounded in cross-section. Aborally there is a lateral sharp costa which runs parallel to the anterior margin up to the point of maximum curvature of the cone and then migrates into an anterior position to form an anterior edge. On the outer side of the sheath a short way from the posterior costa is a triangular incision in the aboral margin. From the apex of the triangular incision a small, narrow furrow runs at first posterior, later parallel with the posterior keel.

The antero-basal angle is more than 90°. The basal cavity extends to more than half the height of the cone. The aboral margin is pear-shaped.

*Remarks:* My specimens differ from *P. unicostatus* in their cross-section. *P. intermedius* has a more posteriorly-situated lateral costa than have my specimens.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 43 specimens.

*Paracordylodus* LINDSTRÖM, 1954.

*Type species: Paracordylodus gracilis* LINDSTRÖM, 1954.

*Paracordylodus bergstroemi* n.sp.

Pl. 3, figs. 20, 23, 25; Text-fig. 6, no. 12.

*Type specimen:* PMO 69657, paratypes: PMO 69659, and PMO 69742.

*Diagnosis:* A *Paracordylodus* which has a high sheath between the anterior and posterior processes, and a conical deep basal cavity. The cusp is reclined, the posterior bar is slightly arched with a minutidenticulated oral edge but a few of these denticles are as big as or bigger than the cusp.

*Description:* The cusp is reclined, rounded and has two costae on the face, one posterior, the other nearly anterior.

The anterior process is without denticles, longer than the cusp and connected to the posterior process with a sheath on each side. Its anterior edge is flexed inwards. The sheath on the outer side is slightly expanded outwards in the region of the aboral margin. The posterior process is arched and its distal end bent to the outer side. Adjacent to the cusp is a series of denticles; within the series there is a denticle which is as big as or bigger than the cusp itself — and at least more than five denticles away from the cusp. The denticles are basally fused, laterally depressed, and apically pointed.

The aboral margin is sinuous. Basal cavity is deep anteriorly, posteriorly it is like an "inverted basal cavity" beneath the largest denticle.

*Remarks:* It has some affinity with *P. gracilis* LINDSTRÖM, but my specimens have a deep basal cavity and the sheath is higher. The lack of denticulation on the anterior process and the absence of a lateral costa distinguish the specimens from *Periodon aculeatus*.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 4 specimens.

*Paracordylodus lindstroemi* BERGSTRÖM.

Pl. 5, fig. 9; Text-fig. 6, no. 13.

*P. lindstroemi* BERGSTRÖM, 1961, Arkiv. f. Min. Geol. Bd. 3, no. 1, p. 50, pl. 2, figs. 8—12, text-fig. 20.

*Remarks:* My specimens display the same variation as described from the Ludibundus Limestone, so I cannot add to the description.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 17 specimens.

## Genus *Periodon* HADDING.

*Type species: P. aculeatus* HADDING, 1913.

### *Periodon aculeatus* HADDING.

Pl. 3, figs. 17, 21.

*Periodon aculeatus* HADDING, 1913, Lunds Univ. Årsskr., N.F. Afd. 2, Bd. 9, no. 15, p. 33, pl. 1, fig. 14; LINDSTRÖM, 1955, Journ. Paleont. v. 29, p. 110, pl. 22, figs. 10, 11, 14—16, 35; LAMONT & LINDSTRÖM, 1957, Edinb. Geol. Soc. Trans. v. 17, part 1. pp. 61, 63—65, 67, pl. 5, fig. 15; SWEET, TURCO, WARNER & WILKIE, 1959, Journ. Paleont. v. 33, pp. 1057—1958, LINDSTRÖM, 1960, XXI Geol. Congr. Part VII, p. 89; Treatise on Invert. Paleont. Part W, p. W 49, pl. 27, figs. 7a—b; SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1235, pl. 171, figs. 3, 9.

*P.* n.sp. aff. *aculeatus* LINDSTRÖM, 1957, Geol. Fören. Förh. Bd. 79, p. 174, pl. 1, figs. 15—19.

*Phragmodus* spp. ETHINGTON, FURNISH & MARKEWICZ, 1958, Journ. Paleont. v. 32, p. 763, text-figs. A—D.

*Eoligonodina magma*, ETHINGTON, 1959, Journ. Paleont. v. 33, p. 277, pl. 40, figs. 3—4.

*Loxognathus flabellata* GRAVES & ELLISON, 1941, Missouri Univ. School of Mines & Metall. Bull. Techn. ser. v. 14, p. 12, pl. 2, figs. 29, 32 (not. fig. 31).

*Remarks:* Very limited variation in my specimens, undoubtedly identical with *P. aculeatus*. I cannot add to the description.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 11 specimens.

## Genus *Phragmodus* BRANSON & MEHL.

*Type species: P. primus* BRANSON & MEHL, 1933.

### *Phragmodus undatus* BRANSON & MEHL.

Pl. 3, fig. 12; Text-fig. 6, no. 5.

*Phr. undatus* BRANSON & MEHL, 1933, Missouri Univ. Stud. v. 8, p, 115, pl. 8, figs. 22—26; Literature before 1952 see FAY, and before 1959 see SWEET, TURCO, WARNER & WILKIE, 1959, Journ. Paleont. v. 33, p. 1058, pl. 133, figs. 7, 10, 13; PULSE & SWEET, 1960, Journ. Paleont. v. 34, p. 257, pl. 37, figs. 4, 16, 18—19, text-figs. 2 A—E; 1962, Tret. Inv. Paleont. Part W, p. W49, pl. 27, no. 10b.

*Remarks:* A single specimen has been observed and is identical in all respects to *P. undatus*.

*Occurrence:* Kullerud.

*Material:* 1 specimen.

## Genus *Polyplacognathus* STAUFFER.

*Type species: Polyplacognathus ramosa* STAUFFER, 1935b.

*Generic description:* "Asymmetrical dental plates of few or many lobes, the larger of which tend to be wing-like. Under surface of plates smooth except for furrows, ridges, and growth-like lines; upper surface of each lobe has, or tends to have, a median nodose ridge, on both sides of which are less definite nodose ridges or groups of nodes and denticles. Any of these ridges may become a series of short stubby denticles or may be formed by the lateral union of such a dental series. These ridges radiate irregularly from a central point which appears to be more or less the center of the development of plate"..

*Remarks:* As pointed out by SWEET et al., 1959; BERGSTRÖM, 1961, and later by SWEET & BERGSTRÖM, 1962, the genus is distinctly different from *Amorphognathus*.

### *Polyplacognathus elongata* (BERGSTRÖM).

Pl. 6, figs. 3, 6—10: Text-fig. 5, nos. 7a—b, 9a—b—c.

*Amorphognathus elongata* BERGSTRÖM, 1961, Ark. f. Min. Geol. Bd. 3, no. 1, p. 31, pl. 5, figs. 1—3.

*Amorphognathus* n.sp. 3, LINDSTRÖM, 1960. XXI Int. Geol. Congr. Part VII, p. 95, fig. nos. 13, 14.

*Remarks:* The differences between *P. elongata* and my specimens are striking but they are considered to be within the limits of specific variation.

The antero-postero axis never bends as does that in specimens from the Ludibundus Limestone, and so the angles between the anterior and lateral processes are as follows: with the unilobate lateral process about 75°; with the anterior lobe of the bilobate process 45°; and posterior lobe of the bilobate process 120°. Size and length of the lobes are the same as in *P. elongata*. Other differences are found on the bilobate process. It does not meet the antero-postero axis in a sharp angle. The median ridge (denticle row) and also the whole of the bilobate process are continuously arched except at their distal ends. The denticle belonging to the row of arched denticles and to the antero-postero axis has a weak ridge joining it to this axis. The ridge joining the denticles of the lateral process also continues to the antero-postero axis. The distal end of the unilobate process is mostly

rounded. The right and left specimens are quite different. (Pl. 6, figs. 3 and 6).

The aboral margin is narrow, and basal filling is common. The cross-section is typically "polyplacognathoid".

Some of my specimens differ from *P. elongata* in that they have a better developed posterior platform. The central part of the posterior process is laterally expanded on the side where the elongated lobe of the bilobate process is situated. The extension has no ridge or denticles on its oral side.

*Occurrence:* Kullerud, Gomnæs, Ildjernet.

*Material:* 25 specimens (14 dextral, 8 sinistral, 3 fragments).

### *Polyplacognathus ringerikensis* n.sp.

Pl. 6, figs. 1—2, 11—12; Text-fig. 5, no. 8.

*Type specimen:* PMO 69650, paratypes: PMO 69704, PMO 69752.

*Diagnosis:* A *Polyplacognathus* with five processes, one anterior, one posterior, both lying on the same axis which is straight or slightly flexed in its posterior distal part, and on one side of this axis there is a unilobate process, on the other side there is a bilobate process and finally a postero-lateral process.

*Description:* The anterior process bears about 6—10 laterally compressed, fused, orally pointed denticles of unequal size. The third or fourth denticle from the distal end is the highest. The distal part of the process is flexed downwards.

The posterior process is a little longer than the anterior process and has orally 8—10 rounded denticles which rest on a median ridge. The posterior process is generally flexed laterally — but not always — at the point where the short postero-lateral process supports its denticle row. The distal end of the posterior bar is narrow but is not pointed.

The unilobate lateral process is as long as the anterior process and makes an angle of about 75° with it. The process carries about 5—7 small rounded denticles, orally.

The anterior lobe of the bilobate process is shorter than the anterior process, and it is strongly deflexed at its distal end. Orally there are about 8 not very high, laterally compressed denticles on the median ridge. The median ridge continues in a curve to the ridge of the elong-

ated bilobate process. The elongated, posterior lobe of the bilobate process is incomplete in all of my specimens but it seems to be similar to that of *P. elongata* (BERGSTRÖM). The lobe makes an angle of about 100°—120° with the anterior process.

The posterior lateral process is situated about 2—3 denticles away from the connection of the bilobate process with the main axis. It is always on the bilobate side of the specimens, and it is short. The postero-lateral process on the oral side has a median ridge upon which are 1—3 small denticles. The ridge is sub-parallel with the posterior lobe of the bilobate process.

The aboral margin runs along all of the processes, and it is generally narrow. The basal cavity is small. The cross-section of the lobes is "polyplacognathoid".

*Remarks:* *P. ringerikensis* n.sp. and *P. elongata* can be readily distinguished by the absence of the posterior lateral process on *P. elongata*.

*Occurrence:* Kullerud, Gomnæs, Ildjernet.

*Material:* 14 specimens, only dextral (10 specimens from Ildjernet).

## Genus *Prioniodina* ULRICH & BASSLER.

*Type species:* *P. subcurvata* ULRICH & BASSLER, 1926.

### ? *Prioniodina aflexa* n.sp.

Pl. 3, figs. 15, 18—19; Text-fig. 5, no. 5a—b.

? Indeterminate fragment sp. RHODES, 1955, Q. Journ. Geol. Soc. London, v. CXI, pl. 9, fig. 7.

*Description:* A short base supporting orally, a large central denticle. Around this large denticle there are a few, small, laterally rounded, basally fused and irregular denticles. The base is not flexed and is incomplete. The lateral faces of the base are smooth, convex and basally flexed inwards. The species is probably symmetrical. The basal cavity is small and narrow along the base except below the main denticle where it is deep.

*Remarks:* It is difficult to refer these specimens to any previously described species.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 17 specimens.

*Prioniodina macrodentata* (GRAVES & ELLISON).

Pl. 3, fig. 28; Text-fig. 4, no. 19.

*Ozarkodina macrodentata*, GRAVES & ELLISON, 1941, Missouri Univ. School of Mines & Metall. Bull. Techn. ser. v. 14, pp. 5, 7, 14, pl. 2, figs. 33, 35, 36. For literature before 1962 see SWEET & BERGSTRÖM.

*Prioniodina macrodentata* SWEET & BERGSTRÖM. 1962. Journ. Paleont. v. 36, p. 1240, pl. 171, figs. 7, 8.

*Remarks:* The specimens from Ringerike resemble the specific description in all respects.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 12 specimens.

Genus *Prioniodus* PANDER.

*Type species: P. elegans* PANDER, 1856.

*Prioniodus alatus* HADDING.

Pl. 4, fig. 15, pl. 5, figs. 17, 22; Text-fig. 6, no. 7.

*Prioniodus alatus* HADDING, 1913, Lunds Univ. Årsskr. N.F. ser. 2, Bd. 9, no. 15, pp. 32, 87, pl. 1, figs. 9—10; LINDSTRÖM, 1955, Journ. Paleont. v. 29, p. 11, pl. 22, figs. 26, 28—34; WOLSKA, 1961, Acta Paleont. Polonica. v. VI, no. 4, p. 355, pl. IV, figs. 5a—b.

*Description:* The species has reclined and laterally striated cusp and three denticulated processes, the posterior one of which flares out laterally on the outer side and orally carries numerous, large basally fused denticles. The lateral bar is directed anteriorly and makes an angle of about 160° with the posterior process. Orally the lateral bar carries denticles the same size as on the posterior process. The anterior process makes an angle of about 90° with the posterior process and has very small denticles orally. Near the aboral margin there is occasionally a conspicuous ledge except on the anterior bar and the distal part of the posterior process on the outer side. There are three well developed costae on the cusp.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 8 specimens.

### *Prioniodus variabilis* BERGSTRÖM.

Pl. 5, figs. 2—3, 6.

*Prioniodus variabilis* BERGSTRÖM, 1961, Arkiv. f. Min. Geol. Bd. 3, no. 1, p. 51, pl. 2, figs. 1—7; LINDSTRÖM, 1959, Micropaleont. v. 5, no. 4, p. 444, pl. 3, figs. 17—19.

*Prioniodius* cf. *variabilis* WOLSKA, 1961, Acta Paleont. Polonica. v. VI, p. 56, pl. 5, figs. 2a—b.

*Remarks:* It is typical of my specimens that denticles on the posterior bar are always smaller than those on the lateral bar. The cusp is proclined or suberect, and laterally is finely striated. Denticles on the anterior process are very small. The ledge a little above the aboral margin is not always present as it is in the specimens from the Twären Area. (BERGSTRÖM, 1961).

*Occurrence:* Kullerud, Gomnæs.

*Material:* 31 specimens.

## Genus *Pygodus* LAMONT & LINDSTRÖM.

*Type species: P. anserinus* LAMONT & LINDSTRÖM, 1957.

### *Pygodus anserinus* LAMONT & LINDSTRÖM.

Pl. 4, figs. 1—4, 11.

*Pygodus anserinus* LAMONT & LINDSTRÖM, 1957, Edinburg Geol. Soc. Trans. v. 17, pp. 67—69, pl. 5, figs. 12—13, text-figs. 1a—d; ETHINGTON, FURNISH & MARKEVICZ, 1958, Journ. Paleont. v. 32, p. 769; LINDSTRÖM, 1960, XXI Int. Geol. Congr. Part. VII, pp. 91, 95, figs. 7, 1 and 7,3; NILSSON 1960. Geol. Fören. Förh. Bd. 82, pp. 219—220; BERGSTRÖM, 1961, Ark. f. Min. Geol. Bd. 3, no. 1, p. 20; WOLSKA, 1961, Acta Paleont. Polonica, v. 6, p. 357, pl. 5, figs. 4—5; Tret. Invert. Paleont. 1962, Part W, p. W248, fig. 153, 1a—b; SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1241, pl. 171, figs. 11—12, text-fig. 4.

*Remarks:* 181 dextral and 171 sinistral units studied. Three groups appear to be present. One group is characterised by strongly arched inner and outer margins (37 specimens). The next is a typically transitional group with a slightly bowed outer margin and a straight inner margin (231 specimens). The third group has straight margins (84 specimens).

*Occurrence:* Kullerud, Gomnæs.

*Material:* 352 specimens.

*Pygodus* sp. LINDSTRÖM.

Pl. 4, figs. 5—8; Text-fig. 6, no. 8.

*Pygodus* n.sp. LINDSTRÖM, 1960, XXI Intern. Geol. Congr. Part VII, p. 91, fig. 7, no. 1.

*? Pygodus anserinus* WOLSKA, 1961, Acta Paleont. Polonica. v. VII, p. 357, pl. V, figs. 4—5.

*Description: Pygodus* sp. has three ridges which are united with concave sheaths. The cusp is small. A short anterior ridge runs anteriorly from the cusp and on the posterior side of the cusp is a denticulated posterior ridge. The outer ridge is without exact denticles but the ridge is crossed by numerous small grooves. The inner marginal ridge is smooth. The posterior ridge carries rounded, low, small denticles. Between the outer ridge and the posterior ridge are weak cross-ridges on the sheath, which are strongly concave. The sheath between the inner and posterior ridges is slightly concave and has also cross-ridges which are well developed.

The aboral margin is V-shaped and is narrowest below the cusp.

*Remarks:* My material is too limited and too poorly preserved to give a fuller description of the species, and its variants.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 19 specimens (15 dextral and 4 sinistral).

Genus *Roundya* HASS.

*Type species: R. barnettana* HASS, 1953.

*Roundya pyramidalis* SWEET & BERGSTRÖM.

Pl. 5, figs. 15—16, 20—21; Text-fig. 4, no. 12.

*R. pyramidalis* SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1243, pl. 170, figs. 7—9.

*Remarks:* The cusp is slender, small and proclined. Below the cusp there are three denticulated processes which diverge at small angles. The two antero-lateral processes are minutely denticulated, the denticles of the posterior process are better developed. Anteriorly the sheath is planar or slightly concave, the other two sheaths are strongly concave. The Ringerike specimens have generally smaller cusps and a weaker denticulation than the Pratt Ferry specimens.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 35 specimens.

*Roundya* sp.

Pl. 3, fig. 16; Text-fig. 4, no. 11.

*Description:* A *Roundya* with a robust cusp which is reclined and its rounded faces carry three sharp costae. The posterior bar is straight or slightly arched and laterally compressed. Its faces are convex and orally carry a series of irregular basally-fused and apically-pointed denticles. A specimen with a more complete posterior bar shows "hindeodellid" denticulation. The two lateral bars each continue with a smooth curve into the cusp. The bars are strongly flexed posteriorly. Oral faces of the lateral bars carry more than 4 rounded denticles which are about as big as the denticles on the posterior bar.

*Remarks:* The specimens resemble *Roundya* sp. BERGSTRÖM (1961) and *R. inclinata* RHODES. They differ from the latter species in the development of the cusp, as pointed out by BERGSTRÖM. The Ringerike collection of *Roundya* is too small and fragmentary to permit a satisfactory description.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 8 specimens.

*Scandodus* LINDSTRÖM.

*Type species: Scandodus furnishi* LINDSTRÖM, 1954.

*Scandodus lunatus* n.sp.

Pl. 2, figs. 16—17.

*Type specimen:* PMO 69715.

*Diagnosis:* A *Scandodus* which is asymmetrical, curved and laterally strongly flexed. On the inner side anterior to, and parallel with, the carina is a groove. On the outer side posteriorly is a crescent-shaped depression.

*Description:* The cone is curved and laterally flexed. The aboral margin on the outer side is straight, or slightly convex, on the inner side strongly flares out laterally. The outline of the aboral margins is lunate.

Between the anterior keel and the lateral carina on the inner side is a narrow groove which extends from near the aboral margin to the top of the cone. The outer side carries a crescent-shaped depression

in the posterior basal region. The aboral margin makes an angle of about 90° with the anterior keel and about 45° with the oral edge. Anterior and posterior edges are sharp.

*Remarks:* The species is without definite costae thus can be included with the genus *Scandodus*.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 9 specimens.

### *Scandodus rectus* LINDSTRÖM.

Pl. 2, figs. 6—7; Text-fig. 6, no. 9, 11.

*Scandodus rectus* LINDSTRÖM, 1954. Geol. Fören. Förh. Bd. 76, p. 593, pl. 4, figs. 21—25, text-fig. 3 K; ASH, 1961, Micropaleont. v. 7, no. 2, p. 236.

*Remarks:* A few badly preserved specimens can be referred to this species.

*Occurrence:* Kullerud.

*Material:* 3 specimens.

### *Scandodus* sp.

Pl. 2, figs. 10—11.

*Description:* Pear shaped aboral margin with the inner lateral side produced downwards. The cone is erect, and on the inner lateral face is a carina with a groove anterior to it. The carinate outer lateral face is ornamented with 2—3 weak grooves. The anterior keel is sharp, its basal part flexed to the inner side, and there is also a small "inverted basal cavity". The oral edge — which is very short — makes an angle with the aboral margin of about 75°. The anterior aboral margin continues on to the anterior edge.

The basal cavity is not very deep.

*Remarks:* These fragmentary specimens resemble *S. lunatus* n.sp. but are more ornamented on the lateral faces, and have a rounded posterior aboral margin.

*Occurrence:* Kullerud.

*Material:* 3 specimens.

## Genus *Scolopodus* PANDER.

*Type species: S. sublaevis* PANDER, 1856.

### *Scolopodus ? peselephantis* LINDSTRÖM

Pl. 1, fig. 11.

*S. ? peselephantis* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 595, pl. 2, figs. 19—20, text-fig. 3a.

*Description:* Cusp is proclined and has a very small basal cavity with its apex directed anteriorly. Aboral margin is oval. The upper two-thirds of the cone is finely striated. Posteriorly there is a strong costa or posterior keel with deep grooves on both sides. These specimens also have a definite anterior costa. The specimens a little twisted.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 4 specimens.

### *Scolopodus tuatus* n.sp.

Pl. 2, figs. 5, 9; Text-fig. 4, no. 13.

*Type specimen:* PMO 69717.

*Diagnosis:* A *Scolopodus* with erect cusp and circular cross-section and aboral margin. It has many irregular costae on the posterior and lateral faces. Anterior face is smooth.

*Description:* A symmetrical or subsymmetrical cone. The cusp is erect. It has several irregularly-developed costae on the posterior and basal posterior lateral faces. The anterior part of the lateral faces and the anterior face are smooth. On the upper part of the cone the costae swing towards the anterior so only the lower part of the anterior face is smooth.

There are about six conspicuous costae running from the aboral margin to the apex and on the basal part of the cone one or two smaller shorter costae are intercalated between the main costae.

The aboral margin and the cross-section of the cusp are circular or subcircular. The basal cavity is wide but not very deep.

*Remarks:* The species resembles *S. cornutiformis* BRANSON & MEHL, 1933, (p. 62) but the latter is more proclined, more costate, and tapers more quickly than *S. tuatus* n.sp.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 4 specimens.

*Scolopodus varicostatus* SWEET & BERGSTRÖM.

Pl. 1, figs. 1—2; Text-fig. 4, no. 7a—b.

*S. varicostatus* SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1247, pl. 168, figs. 4—9, text-fig. 1 A, C, K.

*Remarks:* My specimens show the same variations described by SWEET & BERGSTRÖM. They have remarkably short costae basally on both sides of the posterior costa. The posterior basal part is occasionally very extended but it occurs in all three specific varieties as described by SWEET and BERGSTRÖM (1962). A weak groove can be observed occasionally on the anterior lateral faces. (Pl. 1, fig. 1).

*Occurrence:* Kullerud, Gomnes.

*Material:* 50 specimens (asymmetrical: dextral 14, sinistral 13; slightly asymmetrical: dextr. 2, sinistr. 3; symmetrical: 18 specimens)

## Genus *Tetraprioniodus* LINDSTRÖM

*Type species: Tetraprioniodus robustus* LINDSTRÖM, 1954.

*Definition:* "Compound conodonts with a cusp and four denticulate edges or processes, viz. one anterior, two lateral, one on each side, and one posterior. At least the anterior edge may occasionally be undenticulated".

*Remarks:* The last sentence of the definition must be stressed, because the absence of denticles on processes other than the anterior process has been accepted in this genus (SWEET & BERGSTRÖM 1962). I propose to revise the last part of the definition to read: "The denticulation can be lacking on one or various of the processes". — In this case the genus *Oepicodus* is identical with the genus *Tetraprioniodus* (See also Treatise on Invert. Paleont. Part W. p. W52).

*Tetraprioniodus asymmetricus* BERGSTRÖM.

Pl. 5, fig. 19.

*T. assymmetricus* BERGSTRÖM, 1961, Arkiv. f. Min. & Geol. Bd. 3, no. 1, p. 55, pl. 2, figs. 15—17.

*Remarks:* The assymetrically arranged processes are characteristic of two different species. In my material I have elements with asymmetrically arranged processes, but one of these has a rounded cusp cross-section, the other trapezoidal. Most of the specimens

lacked the posterior process so it was difficult to refer them to *Tetraprioniodus asymmetricus* or *Trapezognathus quadrangulum*. A few specimens are well enough preserved to show that both species occur in the Ampyx Limestone. I refer all these specimens with trapezoidal cusp cross-section to *Trapezognathus* and those with rounded cusp-cross-section to *Tetraprioniodus asymmetricus*. The specimens with the two different cusp cross-sections are about the same size.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 25 specimens.

### *Tetraprioniodus crassulus* (LINDSTRÖM).

Pl. 5, figs. 13—14, 18; Text-fig. 6, no. 14.

*Oepicodus crassulus* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 570, pl. 5, figs. 36—37; ASH, 1961, Micropaleont. v. 7, no. 2, p. 233; 1962, Tret. Invert. Paleont. Part W, p. W52, (*Oepicodus* = *Tetraprioniodus*)

*Remarks:* A few fragmentary specimens resemble this species. No more can be added to the description.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 9 specimens.

### *Tetraprioniodus lindstroemi* SWEET & BERGSTRÖM.

Pl. 6, figs. 4—5; Text-fig. 4, no. 14.

*T. lindstroemi* SWEET & BERGSTRÖM, 1962, Journ. Paleont. v. 36, p. 1248, pl. 170, figs. 5—6.

*Remarks:* The resemblance is striking between specimens from the Ampyx Limestone and the Pratt Ferry Formation. Denticulation on the lateral processes is always lacking in my specimens. The aboral margin is quite asymmetrical as is shown in text-figure 4, no. 14.

*Occurrence:* Kullerud, Gomnæs.

*Material:* 22 specimens.

## Genus *Trapezognathus* LINDSTRÖM.

*Type species: T. quadrangulum* LINDSTRÖM, 1954.

### *Trapezognathus quadrangulum* LINDSTRÖM.

Pl. 4, figs. 12, 17—19; Text-fig. 4, no. 17.

*T. quadrangulum* LINDSTRÖM, 1954, Geol. Fören. Förh. Bd. 76, p. 598, pl. 5, figs. 38—41.

*Description:* An asymmetrical species with proclined, small cusp, which has trapezoidal cross-section. From the cusp diverge four denticulated processes, which are connected partly with sheaths. The angle between the different processes are as follows: between the two posterior processes about 5°—10°, between the anterior and posterior processes, on one side 45°, on the other side, about 20°, and between the two anterior processes about 20°. All processes are the same length but they are always longer than the cusp. The denticulation varies between different specimens. There are specimens with minute denticulation on the processes, but mostly there are only a few, widely separated, small denticles on the processes. The aboral margin is also trapezoidal in cross-section and the basal cavity is deep.

*Remarks:* The specimens resemble *Tetraprioniodus asymmetricus* BERGSTRÖM but differ in the cusp cross-section and the denticulation. The differences between *T. quandrangulum* LINDSTRÖM and my specimens are within the specific variation.

*Occurrence:* Gomnæs.

*Material:* 8 specimens.

## REFERENCES

ASH, S. R., 1961, Blibliography and index of conodonts, 1949—1958; Micropaleont. v. 7, no. 2, pp. 213—244.

BERGSTRÖM, S. M., 1961, Conodonts from the Ludibundus Limestone (Middle Ordovician) of the Twären area (SE Sweden); Ark. f. Min. Geol. Bd. 3, no. 1, pp. 1—64, pls. 1—5.

BRANSON, E. B. & MEHL, M. G., 1933—1934, Corodont studies; Missouri Univ. Studies, v. 8, 349 pp. 28 pls.

— — , 1943, Ordovician conodont faunas from Oklahoma, Journ. Paleont. v. 17, pp. 374—387, pls. 63—64.

— — , 1944, Conodonts; in Shimer, H. W. & Shrok, R.R., Index fossils of North America, pp. 235—246, pls. 93—94.

— — & BRANSON, C. C., 1951, Richmond conodonts of Kentucky and Indiana; Journ. Paleont. v. 25, pp. 1—7, pls. 1—4.

CARLSON, C. G., 1960, Stratigraphy of the Winnipeg and Deadwood Formations in North Dakota; North Dakota Geol. Surv. Bull. 35, 149 pp, 2 pls.

DUBOIS, E. P., 1943, Evidence on the nature of conodonts; Journ. Paleont. v. 17, pp. 155—159, pl. 25.

ECKERT, R., HAY, W. W., LORENTZ, G. & VOGT, P., 1961, The magnetic separator as a tool in micropaleontology; Journ. Paleont. v. 35, p. 876.

ELLISON, S., 1946, Conodonts as Paleozoic guide fossils; Amer. Assoc. Petr. Geol., Bull, v. 30, pp. 93—110.

ETHINGTON, R. L., 1959, Conodonts of the Galena Formation; Journ. Paleont. v. 33, pp. 257—292, pls. 40—41.

— , FURNISH, W. W. & MARKEWICZ, F. J., 1958, Ordovician conodonts in New Jersey; Journ. Paleont. v. 32, 763—765.

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

FURNISH, W. M., 1938, Conodonts from the Prairie du Chien (Lower Ordovician) beds of the Upper Mississippi Valley; Journ. Paleont. v. 12, pp. 318—340, pls. 41—42.

GLENISTER, A. T., 1957, The Conodonts of the Ordovician Maquoketa Formation in Iowa; Journ. Paleont. v. 31, pp. 715—736, pls. 85—88.

GRAVES, R. W. & ELLISON, S., 1941, Ordovician conodonts of the Marathon Basin, Texas; Univ. Missouri, Sch. Min. & Mat. Techn. Ser. v. 14, pp. 1—16, pls. 1—3.

HADDING, A., 1913, Undre Dicellograptusskiffern i Skåne jämte några därmed ekvivalenta bildningar; Lunds Univ. Årsskr., N.F. Afd. 2, Bd. 9, no. 15, pp. 1—90, pls. 1—8.

HASS, W. H., 1962, Conodonts; In Tret. Invert. Paleont. Part W, pp. W3—W69.

LAMONT, A. & LINDSTRÖM, M., 1957, Arenigian and Llandeilian cherts identified in the southern uplands of Scotland by means of conodonts, etc.; Edinburgh Geol. Soc., Trans. v. 17, Pt. 1, pp. 60—70, pl. 5.

LINDSTRÖM, M., 1954, Conodonts from the lowermost Ordovician strata of south-central Sweden; Geol. Fören. Förh. Bd. 76, hft. 4, pp. 517–604, pls. 1—10.

— , 1955, The Conodonts described by A. R. Hadding, 1913; Journ. Paleont. v. 29, pp. 105—111, pl. 22.

— , 1957, Two Ordovician conodont faunas found with zonal graptolites; Geol. Fören. Förh. Bd. 79, hft. 2, pp. 161—178, pls. 1—2.

— , 1959, Conodonts from the Crug Limestone (Ordovician, Wales); Micropal. v. 5, no. 4, pp. 427—452, pls. 1—4.

— 1960, A Lower-Middle-Ordovician succession of conodont faunas; XXI Int. Geol. Congr. Reports, pt., VII, (Proc., sec. 7), pp. 88—96.

MOORE, R. C., 1962, Conodont Classification and Nomenclature; in Tret. Invert. Paleont. Pt. W. pp. W92—W98.

MÜLLER, K. J., 1959, Kambrische Conodonten; Zeitschr. deutsch, geol. Ges. Bd. 111, pp. 434—485, pls. 11—15.

— , 1962, Taxonomy, Evolution, and Ecology of Conodonts; in Tret. Invert. Paleont. Pt. W, pp. W83—W91.

— , 1962, Supplement to Systematics of Conodonts; in Tret. Invert. Paleont. Pt. W, pp. W246—W249.

NILSSON, R., 1951, To the knowledge of the Ordovician of south-eastern Scania, (with English summary); Geol. Fören. Förh. Bd. 73, pp. 682—694.

— , 1960, A Preliminary Report on a Boring through Middle Ordovician Strata in Western Scania (Sweden); Geol. Fören. Förh. Bd. 82, pp. 218—226.

PANDER, C. H., 1856, Monographie der Fossilen Fische des Silurischen Systems der Russisch-Baltischen Gouvernements; K. Akad. Wiss. St. Petersb., pp. 1—91, 7 pls.

PULSE, P. R. & SWEET, W. C., 1960, The American Upper Ordovician Standard. III, Conodonts from the Fairview and McMillan Formation of Ohio, Kentucky, and Indiana; Journ. Paleont. v. 34, pp. 237—264, pls. 35—37.

REGNELL, G., 1960, The Lower Paleozoic of Scania, XXI Int. Geol. Congr. Guidebook to excursions A22 and C17. Geol. Surv. Sweden, pp. 3—43.

RHODES, F. T. H., 1953, Some British Lower Paleozoic conodont faunas; Phil. Trans. Roy. Soc. London, ser. B. no. 647, v. 237, pp. 261—334, pls. 20—23.

— , 1954, The zoological affinities of the conodonts; Cambridge Philos. Soc., Biol. Reviews, v. 29 pp. 419—452.

— , 1955, The Conodont Fauna of the Keisley Limestone; Quart. Journ. Geol. Soc. London, v, 111, pp. 117—142, pls. 7—10.

— , 1962, Recognition, Interpretation, and Taxonomic position of Conodont Assemblages; in Tret. Invert. Paleont. Pt. W, pp. W70—W83.

SCOTT, H. W., 1942, Conodont assemblages from the Heath Formation Montana; Journ. Paleont. v. 16, pp. 293—300, pls. 37—40.

STAUFFER, C. R., 1935a, Conodonts of the Glenwood beds; Geol. Soc. Am., Bull. v. 46, pp. 125—168, pls. 9—12.

— , 1935b, The Conodont fauna of the Decorah shale (Ordovician); Journ. Paleont. v. 9, pp. 596—620, pls. 71—75.

STØRMER, L., 1953, The Middle Ordovician of the Oslo Region, Norway, 1. Introduction to Stratigraphy; Norsk Geol. Tidsskr. v. 31, pp. 37—141.

SWEET, W. C., TURCO, C. A., WARNER, E. & WILKIE, L. C., 1959, The American Upper Ordovician Standard, I: Eden Conodonts from the Cincinnati region of Ohio, and Kentucky; Journ. Paleont. v. 33, pp. 1029—1068 —pls. 130—133.

— & BERGSTRÖM, S. M., 1962, Conodonts from the Pratt Ferry Formation (Middle Ordovician) of Alabama; Journ. Paleont. v. 36, pp. 1214—1252, pls. 168—171, text-figs. 1—5.

WOLSKA, Z., 1961, Konodonty z Ordowickich glazow nerzutowych Polski; Acta Paleont. Polonica, v. 6, no. 4, pp. 339—365, pls. 1—4.

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Text-figs. 4—6. 39 of the Ampyx Limestone specimens drawn with the use of Abbe's apparatus. All figures about x 68.

Abbreviations: ant. — anterior; lat. — lateral; post. — posterior; sect. — section; proc. — process; out. — outer; bilob. — bilobate; a.p. — anterior process; p.p. — posterior process; l.u.p. — lateral unilobate process; a.l.b.p. — anterior lobe of the bilobate process; p.l.b.p. — posterior lobe of the bilobate process; marg. — margin, marginal.

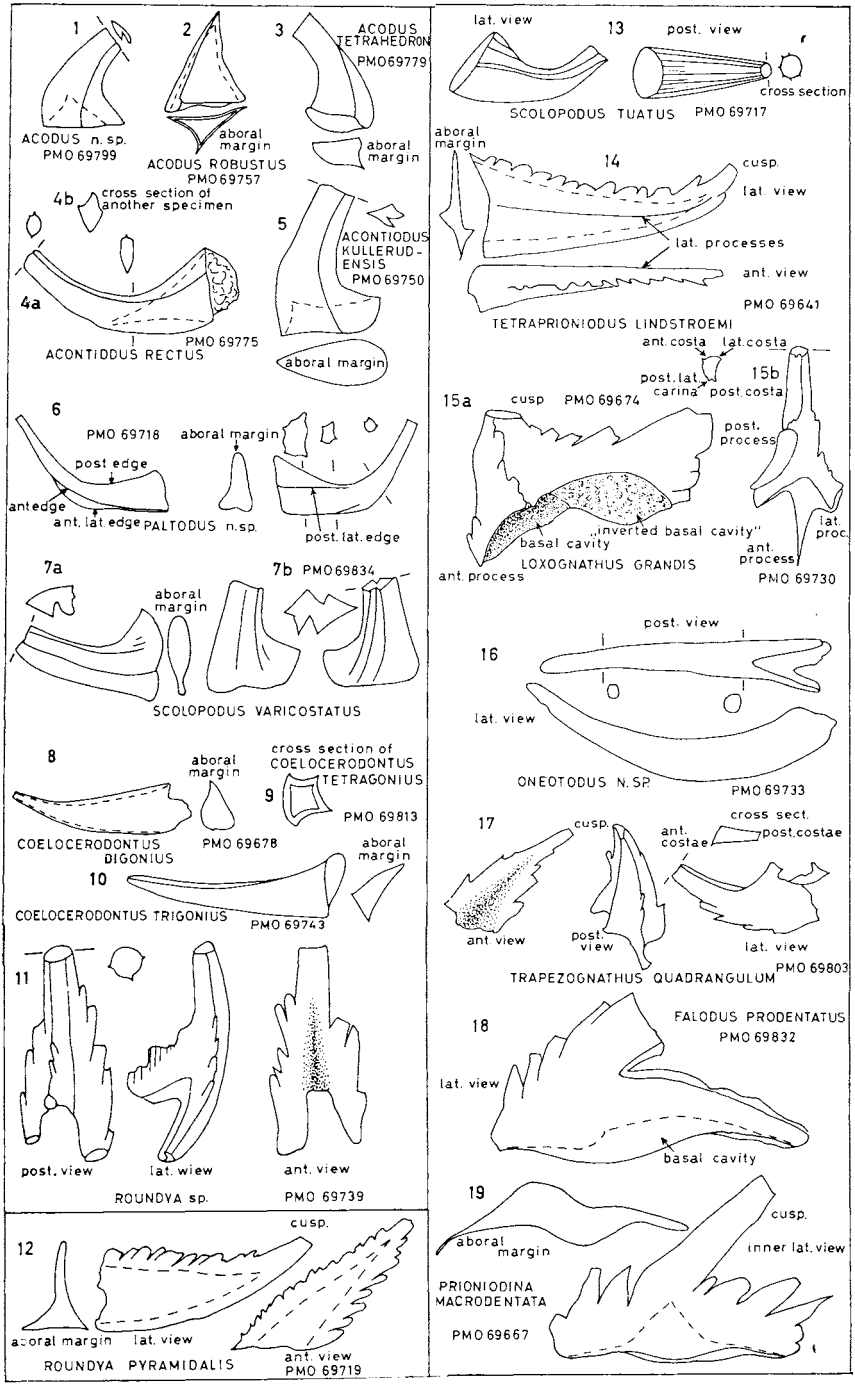

1
ACODUS n. sp.
PMO 69799
2
aboral margin
ACODUS ROBUSTUS
PMO 69757
3
ACODUS TETRAHEDRON
PMO 69779
aboral margin
4b
cross section of another specimen
4a
PMO 69775
ACONTIODUS RECTUS
5
ACONTIODUS KULLERUDENSIS
PMO 69750
aboral margin
6
PMO 69718
aboral margin
post edge
ant edge
ant. lat. edge
PALTODUS n.sp.
post. lat. edge
7a
aboral margin
7b
PMO 69834
SCOLOPODUS VARICOSTATUS
8
aboral margin
COELOCERODONTUS DIGONIUS
PMO 69678
cross section of COELOCERODONTUS TETRAGONIUS
9
PMO 69813
10
aboral margin
COELOCERODONTUS TRIGONIUS
PMO 69743
11
post. view
lat. wiew
ant. view
ROUNDYA sp.
PMO 69739
12
cusp.
aboral margin
lat. view
ROUNDYA PYRAMIDALIS
ant. view
PMO 69719
lat. view
13
post. view
cross section
SCOLOPODUS TUATUS PMO 69717
aboral margin
14
cusp.
lat. view
lat. processes
ant. view
PMO 69641
TETRAPRIONIODUS LINDSTROEMI
ant. costa
lat. costa
post. lat. carina
post. costa
15b
15a
cusp
PMO 69674
post. process
basal cavity
„inverted basal cavity"
ant. process
LOXOGNATHUS GRANDIS
ant. process
lat. proc.
PMO 69730
post. view
16
lat. view
ONEOTODUS N. SP.
PMO 69733
17
cusp.
cross sect.
ant. costae
post. costae
ant. view
post. view
lat. view
TRAPEZOGNATHUS QUADRANGULUM
PMO 69803
18
FALODUS PRODENTATUS
PMO 69832
lat. view
basal cavity
19
cusp.
aboral margin
inner lat. view
PRIONIODINA MACRODENTATA
PMO 69667

Fig. 4.

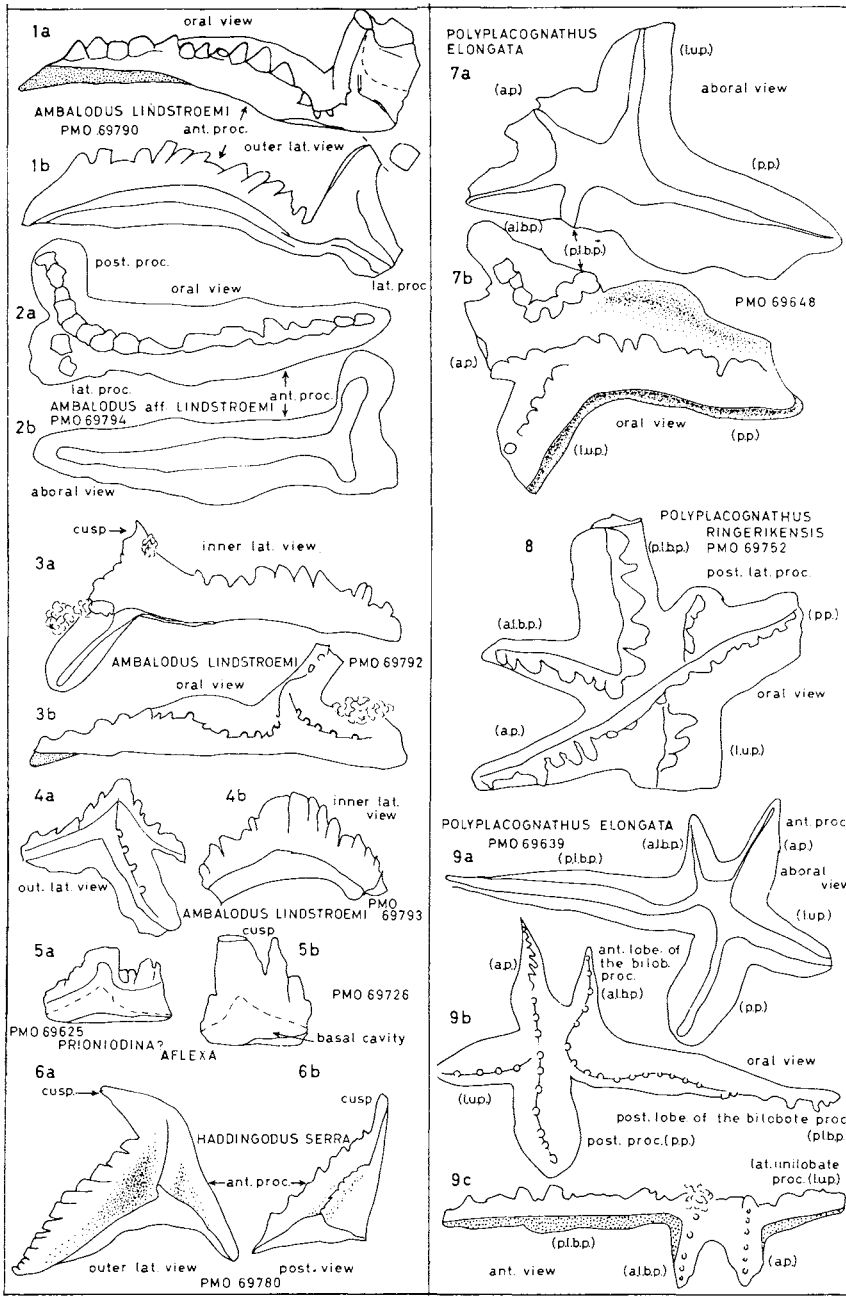
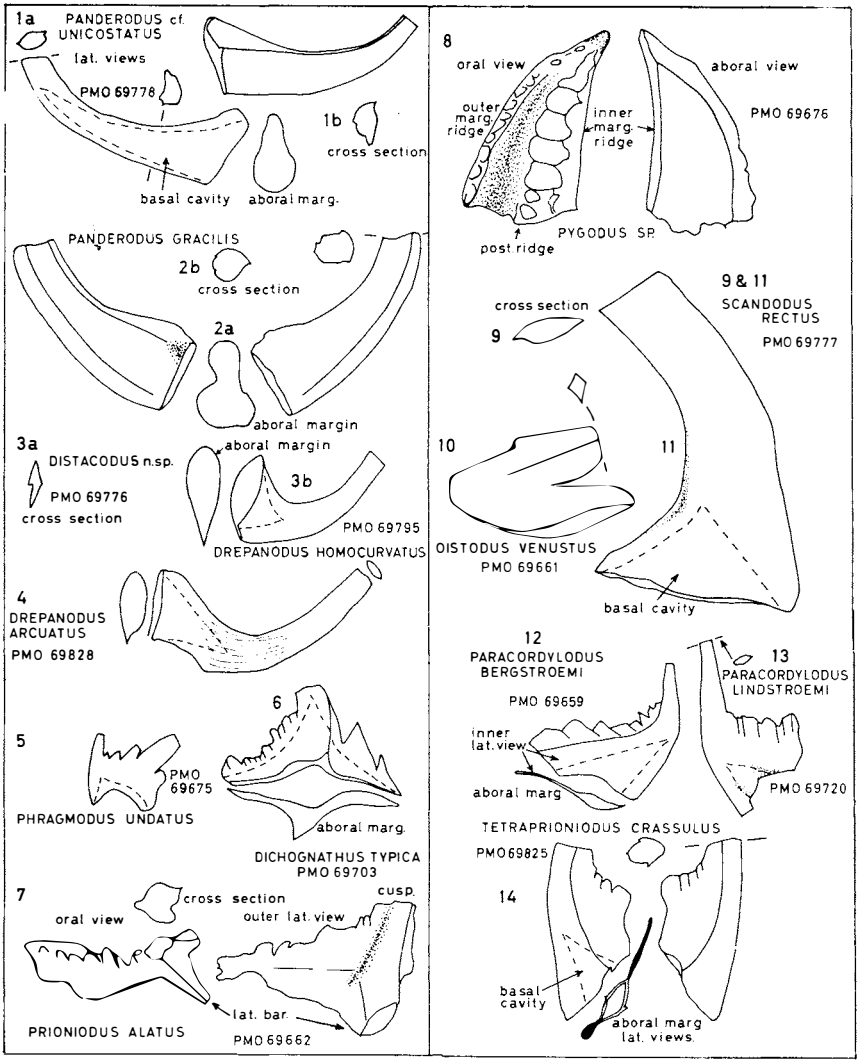

1a
oral view
AMBALODUS LINDSTROEMI
PMO 69790
ant. proc.
1b
outer lat. view
post. proc.
lat. proc.
2a
oral view
lat. proc.
ant. proc.
AMBALODUS aff. LINDSTROEMI
PMO 69794
2b
aboral view
cusp
3a
inner lat. view
AMBALODUS LINDSTROEMI
PMO 69792
oral view
3b
4a
4b
inner lat. view
out. lat. view
AMBALODUS LINDSTROEMI
PMO 69793
cusp
5a
5b
PMO 69726
PMO 69625
PRIONIODINA?
AFLEXA
basal cavity
6a
6b
cusp
cusp
HADDINGODUS SERRA
ant. proc.
outer lat. view
post. view
PMO 69780
POLYPLACOGNATHUS ELONGATA
7a
(a.p.)
(l.u.p.)
aboral view
(p.p.)
(a.l.b.p.)
(p.l.b.p.)
7b
PMO 69648
(a.p.)
oral view
(p.p.)
(l.u.p.)
POLYPLACOGNATHUS RINGERIKENSIS PMO 69752
8
(p.l.b.p.)
post. lat. proc.
(a.l.b.p.)
(p.p.)
oral view
(a.p.)
(l.u.p.)
POLYPLACOGNATHUS ELONGATA
PMO 69639
(a.l.b.p.)
(p.l.b.p.)
9a
ant. proc.
(a.p.)
aboral view
(l.u.p.)
(a.p.)
ant. lobe of the bilob. proc.
(a.l.b.p.)
(p.p.)
9b
oral view
(l.u.p.)
post. lobe of the bilobate proc.
(p.l.b.p.)
post. proc.(p.p.)
lat. unilobate proc.(l.u.p.)
9c
(p.l.b.p.)
ant. view
(a.l.b.p.)
(a.p.)

Fig. 5.


1a
PANDERODUS cf.
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lat. views
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1b
cross section
basal cavity
aboral marg.
PANDERODUS GRACILIS
2b
cross section
2a
aboral margin
3a
DISTACODUS n.sp.
PMO 69776
cross section
aboral margin
3b
PMO 69795
DREPANODUS HOMOCURVATUS
4
DREPANODUS
ARCUATUS
PMO 69828
5
PMO
69675
PHRAGMODUS UNDATUS
6
aboral marg.
DICHOGNATHUS TYPICA
PMO 69703
7
cross section
cusp.
oral view
outer lat. view
lat. bar.
PRIONIODUS ALATUS
PMO 69662
8
oral view
aboral view
outer
marg.
ridge
inner
marg.
ridge
PMO 69676
post ridge
PYGODUS SP.
9 & 11
SCANDODUS
RECTUS
PMO 69777
cross section
9
10
11
OISTODUS VENUSTUS
PMO 69661
basal cavity
12
PARACORDYLODUS
BERGSTROEMI
PMO 69659
13
PARACORDYLODUS
LINDSTROEMI
inner
lat. view
aboral marg
PMO 69720
TETRAPRIONIODUS CRASSULUS
PMO69825
14
basal
cavity
aboral marg
lat. views

Fig. 6.

PLATES 1—6.

The photographs, which were taken by Mr. O. Brynhildsrud in collaboration with the author, are not retouched. Some of the specimens were given a light coating of ammonium chloride before being photographed. These specimens are listed below. Plate 5 — fig. 8, specimen not whitened, and fig. 11, same specimen whitened. The photographs have been taken with a Leica camera, bellows 50 cm, and lens Summar 42 mm.

## Plate 1.

Figs. 3, 5, 9, 14 specimens whitened, all magnifications 68 x.

1, 2. *Scolopodus varicostatus* SWEET & BERGSTRÖM, 1962, lateral views, 1. PMO 69679, 2. PMO 69680.

3, *Acodus similaris* RHODES, 1953, lateral view, PMO 69756.

4, 5, 9, *Acodus* n.sp. all shown in lateral view, 4. PMO 69799, 5. same, 9. PMO 69798.

6, 7, 14, 18, *Acontiodus kullerudensis* n.sp. all shown in lateral view, 6. PMO 69771, 7. PMO 69772, 14. same as fig. 6; 18. PMO 69800.

8, *Oistodus* aff. *delta* LINDSTRÖM, 1954, lateral view, PMO 69714.

10, 12, 13, 17, *Acontiodus rectus* LINDSTRÖM, 1954, all shown in lateral view. 10. PMO 69774, 12. PMO 69773, 13. PMO 69775, 17. same same as fig. 12.

11, *Scolopodus ? peselephantis* LINDSTRÖM, 1954, lateral view, PMO 69647.

15—16, *Gothodus costulatus* LINDSTRÖM, 1954, lateral views, 15. PMO 69831, 16, PMO 69659.

19—20, *Distacodus* n.sp., lateral views. PMO 69776.

21—22, *Paltodus* n.sp. lateral views. PMO 69718.

23—24, *Acodus robustus* (RHODES), 1953, PMO 69757, 23. lateral view, 24. same, oral view.

25—26. *Panderodus gracilis* (BRANSON & MEHL), 1933, PMO 69662, lateral views.

27, *Oneotodus simplex* (FURNISH), 1938, PMO 69822, lateral view.

28—29, *Panderodus* cf. *unicostatus* (BRANSON & MEHL), 1933, PMO 69666, lateral views.

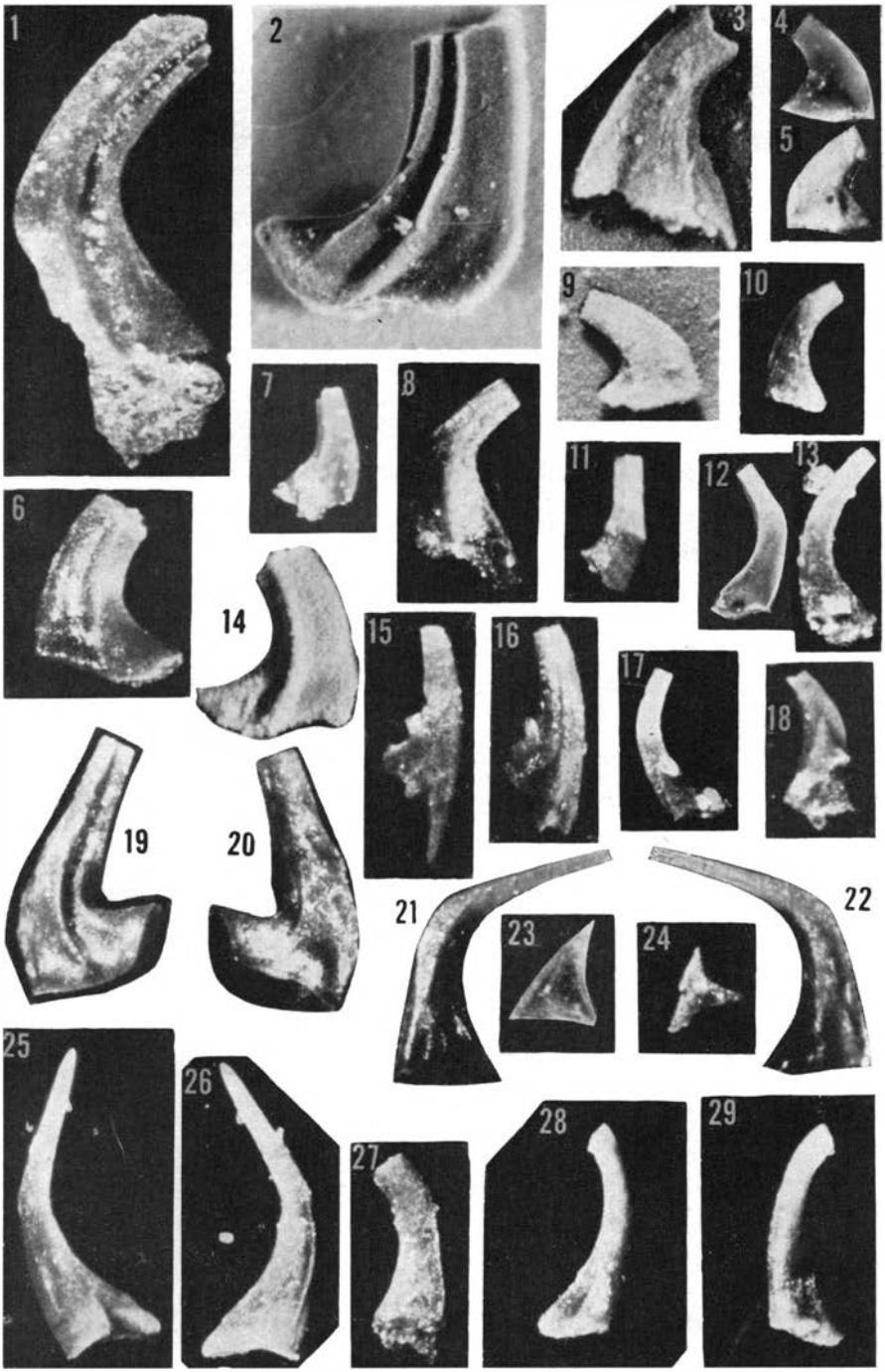
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Plate 2.

Fig. 16 specimen whitened, all magnifications 68 x.

1—2, *Drepanodus arcuatus* PANDER, 1856, PMO 69828, lateral views.

3—4. *Drepanodus homocurvatus* LINDSTRÖM, 1954, PMO 69795, lateral views.

5, 9, *Scolopodus tuatus* n.sp. PMO 69717, 5. lateral view, 9. posterior view.

6—7, *Scandodus rectus* LINDSTRÖM, 1954, 6. PMO 69677, 7. PMO 69777, lateral views.

8, 12, *Oneotodus* n.sp. PMO 69733, 8. lateral view, 12. same, posterior view.

10—11, *Scandodus* sp. PMO 69716, lateral views.

13, *Coelocerodontus digonius* SWEET & BERGSTRÖM, 1962, PMO 69678, lateral view.

14, *Coelocerodontus tetragonius* ETHINGTON, 1959, PMO 69813, lateral view.

15, *Coelocerodontus trigonius* ETHINGTON, 1959, PMO 69814, lateral view.

16—17, *Scandodus lunatus* n.sp. 16, 17. PMO 69715, lateral views.

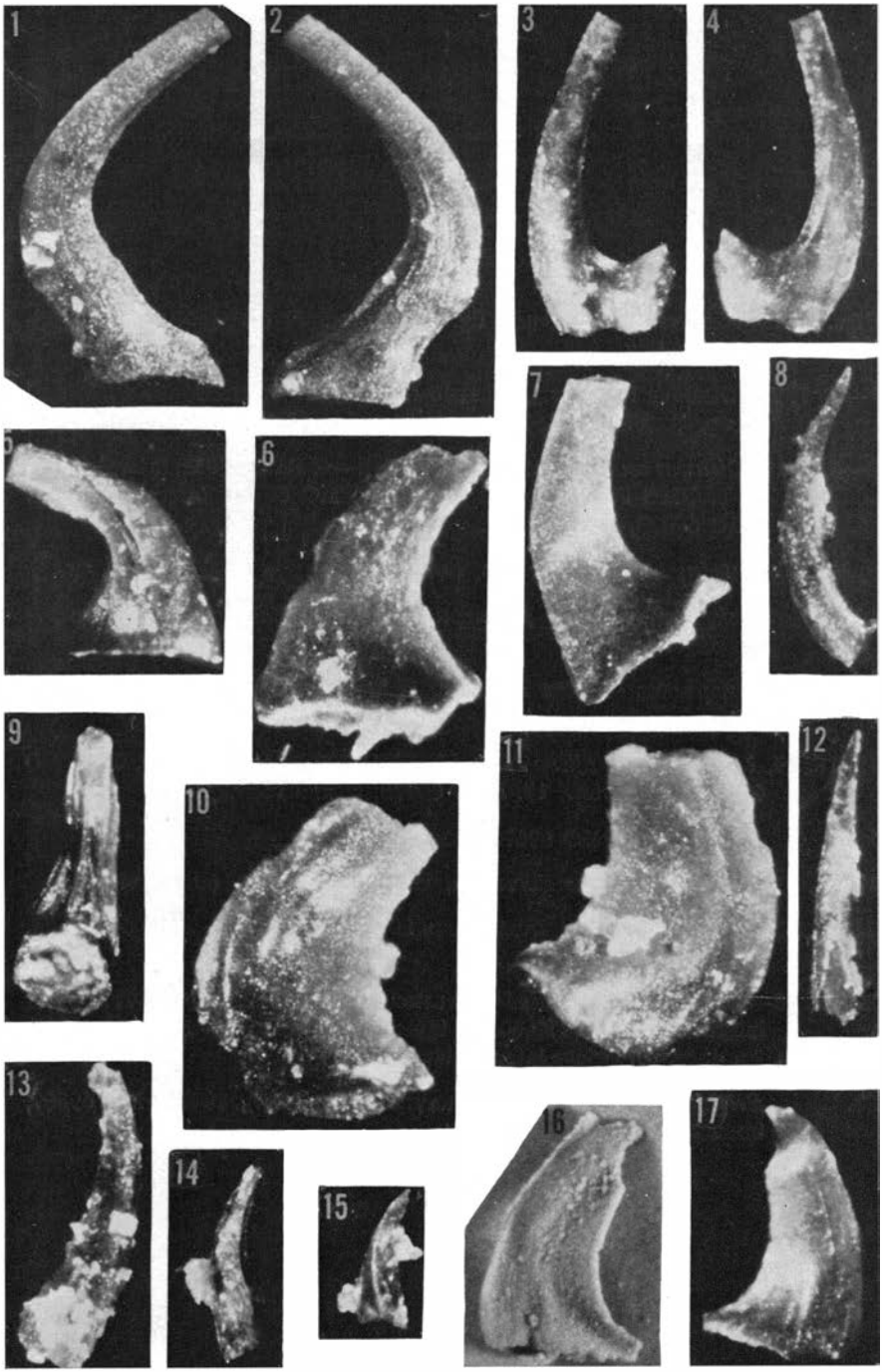
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Plate 3.

Figs. 14, 24, 26 specimens whitened, fig. 10 photographed in glycerol, all magnifications 68x.

1—2, 7, 14, *Oistodus robustus* BERGSTRÖM, 1961, 1—2, PMO 69758, lateral views, 7. PMO 69754, lateral view, 14. PMO 69759, lateral view.

3—6, 9, 11, *Oistodus venustus* STAUFFER, 1935, 3—4. PMO 69651, lateral views, 5—6. PMO 69824, lateral views, 9. PMO 69760, lateral view, 11. PMO 69823, lateral view.

8, 13, *Oistodus* sp. lateral views, both specimens lost.

10, *Dichognathus typica* BRANSON & MEHL, 1933, PMO 69640, outer lateral view.

12, *Phragmodus undatus* BRANSON & MEHL, 1933, PMO 69675, lateral view.

15, 18, 19, ? *Prioniodina aflexa* n.sp. 15. PMO 69721, lateral view, 18. PMO 69787 lateral view, 19. PMO 69722, lateral view.

16, *Roundya* sp. PMO 69672, lateral view.

17, 21, *Periodon aculeatus* HADDING, 1913, PMO 69658, lateral views.

20, 23, 25 *Paracordylodus bergstroemi* n.sp. 20. PMO 69659, 23. PMO 69657, 25. 69742, lateral views.

22, 24, 26—27. *Loxognathus grandis* ETHINGTON, 1959, 22. PMO 69771, outer lateral view, 23. PMO 69729, inner lateral view, 26—27. PMO 69730, 26. outer- 27. inner lateral views.

28. *Prioniodina macrodentata* (GRAVES & ELLISON), 1941, PMO 69667, inner lateral view.

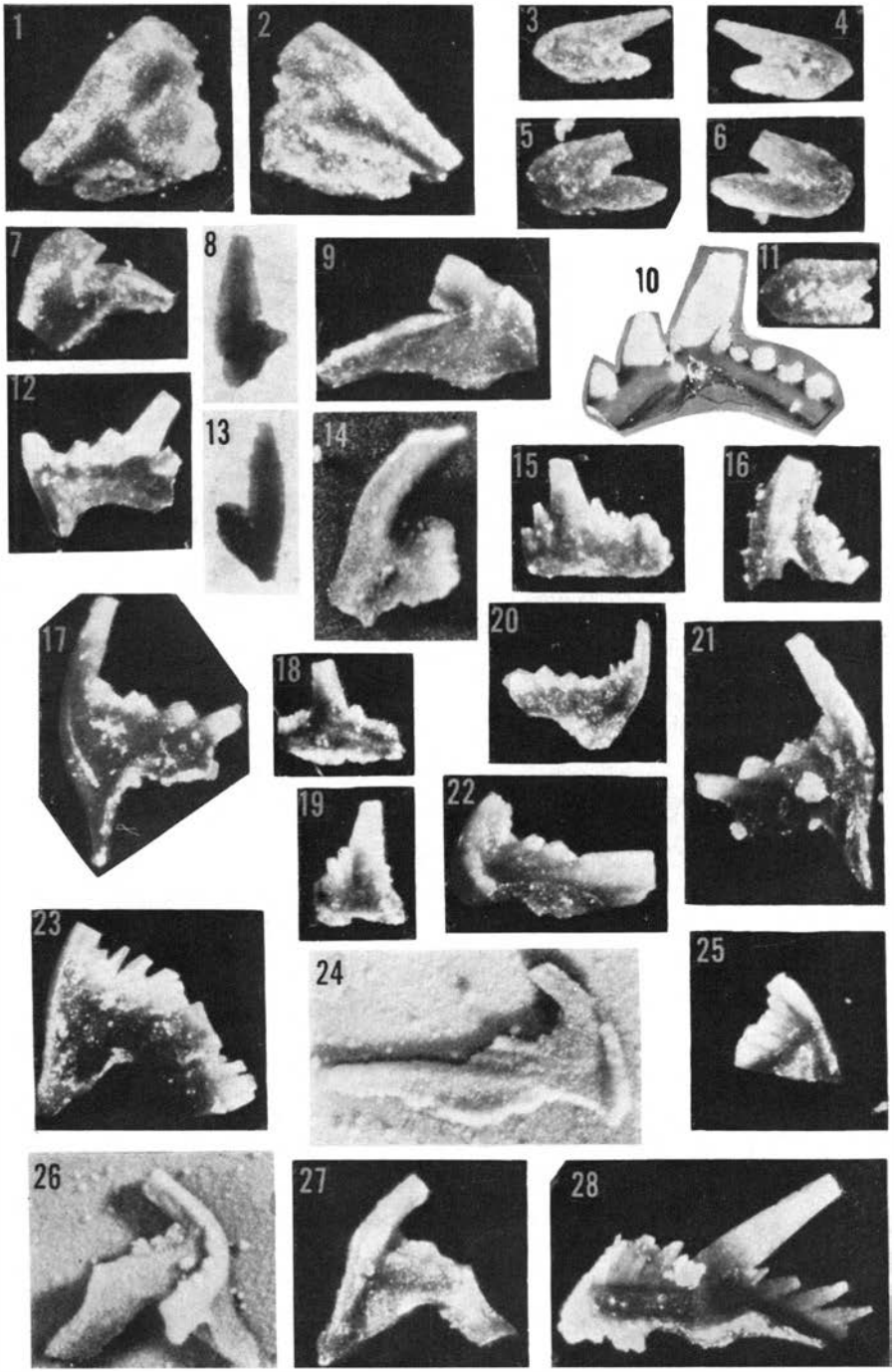
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Plate 4.

Fig. 11 specimen whitened, figs. 9, 10, 13, 14, 16, 20, photographed in glycerol, all magnifications 68x.

1—4, 11, *Pygodus anserinus* LAMONT & LINDSTRÖM, 1957, 1—2. variety I, PMO 69643, 1. oral view, 2. aboral view; 3—4. variety II, PMO 69644, 3. oral view, 4. aboral view; 11. variety III, PMO 69645, oral view.

5—8. *Pygodus* sp. LINDSTRÖM, 1960, 5—6. PMO 69723, 5. oral view, 6. aboral view, 7—8. PMO 69676, 7. oral view, 8. aboral view.

9—10. *Falodus prodentatus* GRAVES & ELLISON, 1941, 10. PMO 69832, 9. PMO 69833, both specimens shown in lateral view.

12, 17—19, *Trapezognathus quadrangulum* LINDSTRÖM, 1954, 12, 18. PMO 69737, lateral views, 17, 19. PMO 69724, 17. posterior view, 19. lateral view.

13, 16, *Haddingodus serra* (HADDING), 1913, 13. PMO 69656, 16. PMO 69654, both in lateral view.

14, *Chirognathus* sp. PMO 69669, lateral view.

15, *Prioniodus alatus* HADDING, 1913, PMO 69707, inner lateral view.

20, *Cordylodus elongatus* RHODES, 1953, PMO 69670, lateral view.

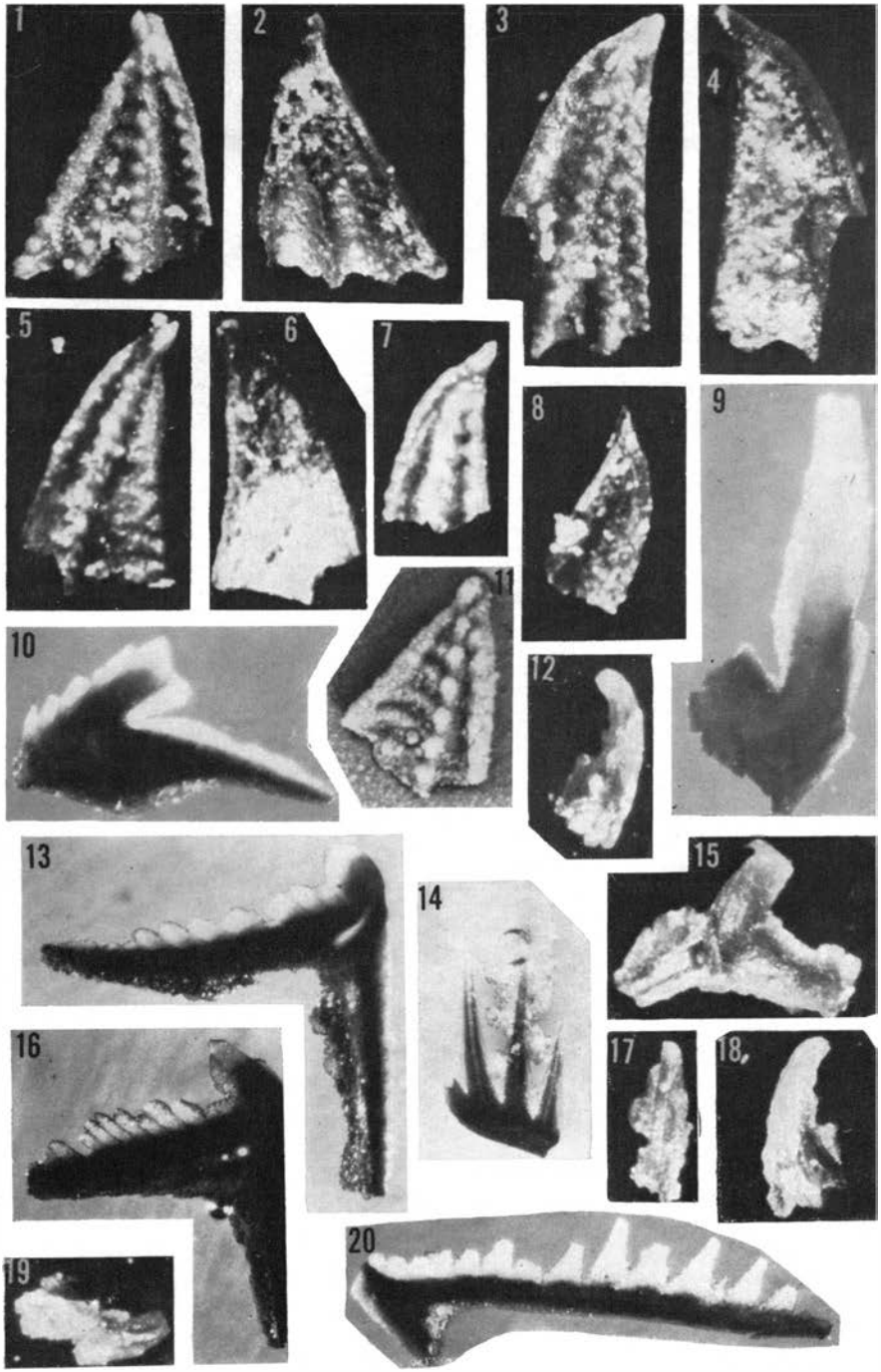
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Plate 5.

Figs. 1, 4, 5, 7, 10, 11, 12, specimens whitened, all magnifications 68x.

1, 4, 7, 8, 10, 11, *Ambalodus lindstroemi* n.sp. 1. PMO 69790 oral view, 4. same, inner lateral view, 7. PMO 69792, oral view, 8, 11. PMO 69791, whitened and not whitened oral views, 10. PMO 69793, oral view.

5, 12, *Ambalodus* aff. *lindstroemi* n.sp. 5. PMO 69636, 12. PMO 69794, oral views.

2—3, 6, *Prioniodus variabilis* BERGSTRÖM, 1961, 2, 6. PMO 69663, 2. inner lateral view, 6. outer lateral view, 3. PMO 69646, inner lateral view.

9, *Paracordylodus lindstroemi* BERGSTRÖM, 1961, PMO 69673, outer lateral view.

13, 14, 18, *Tetraprioniodus crassulus* LINDSTRÖM, 1954, 13. PMO 69825, 14. PMO 69827, 18. PMO 69826, all specimens shown as lateral views.

15—16, 20—21, *Roundya pyramidalis* SWEET & BERGSTRÖM, 1962, 15—16. PMO 69815, 20—21. PMO 69819; 16, 20. posterior views, 15, 21. lateral views.

19, *Tetraprioniodus asymmetricus* BERGSTRÖM, 1961, PMO 69668, lateral view.

17, 22, *Prioniodus alatus* HADDING, 1913, PMO 69662, 17. oral view 22. inner lateral view.

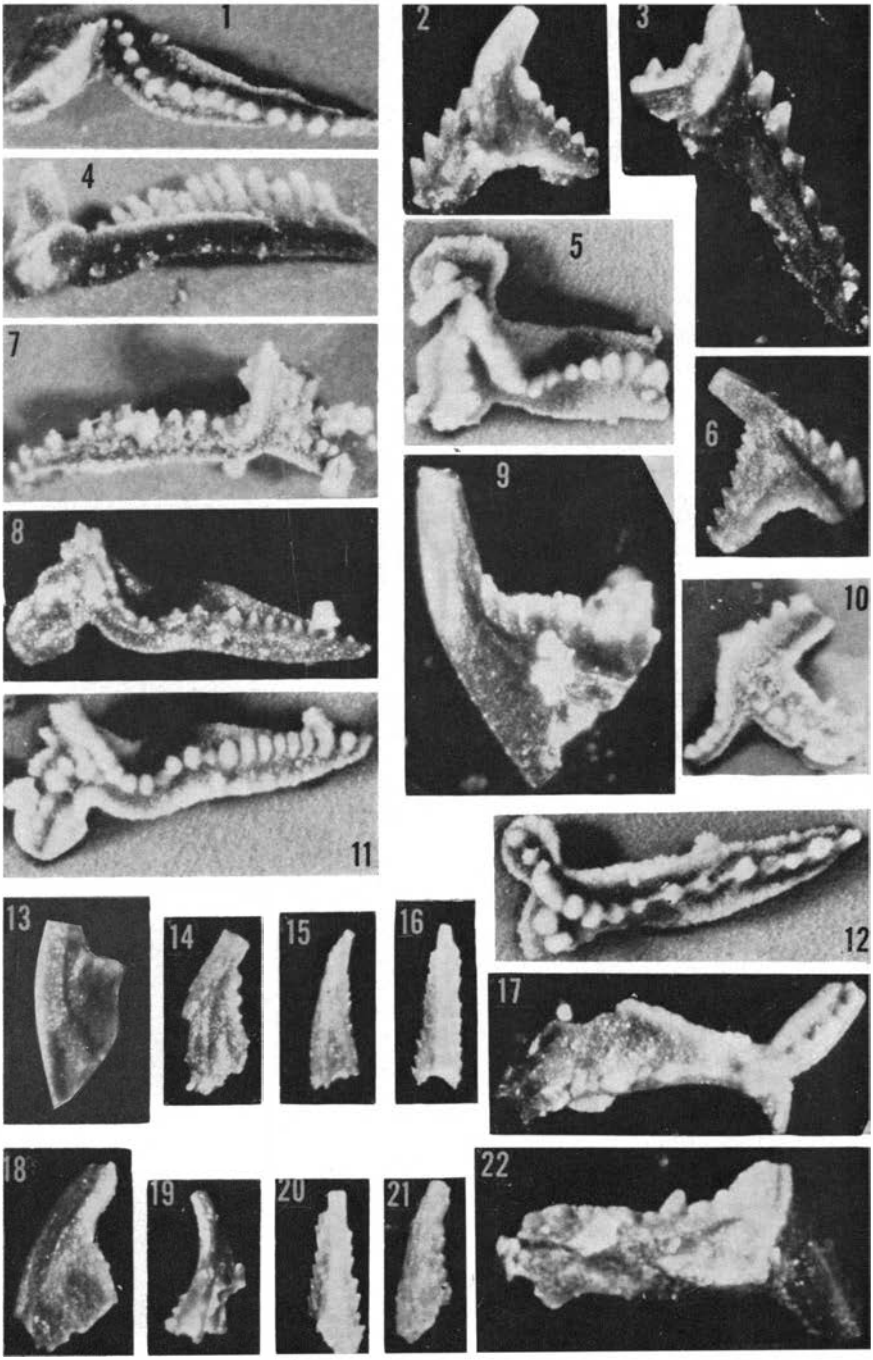
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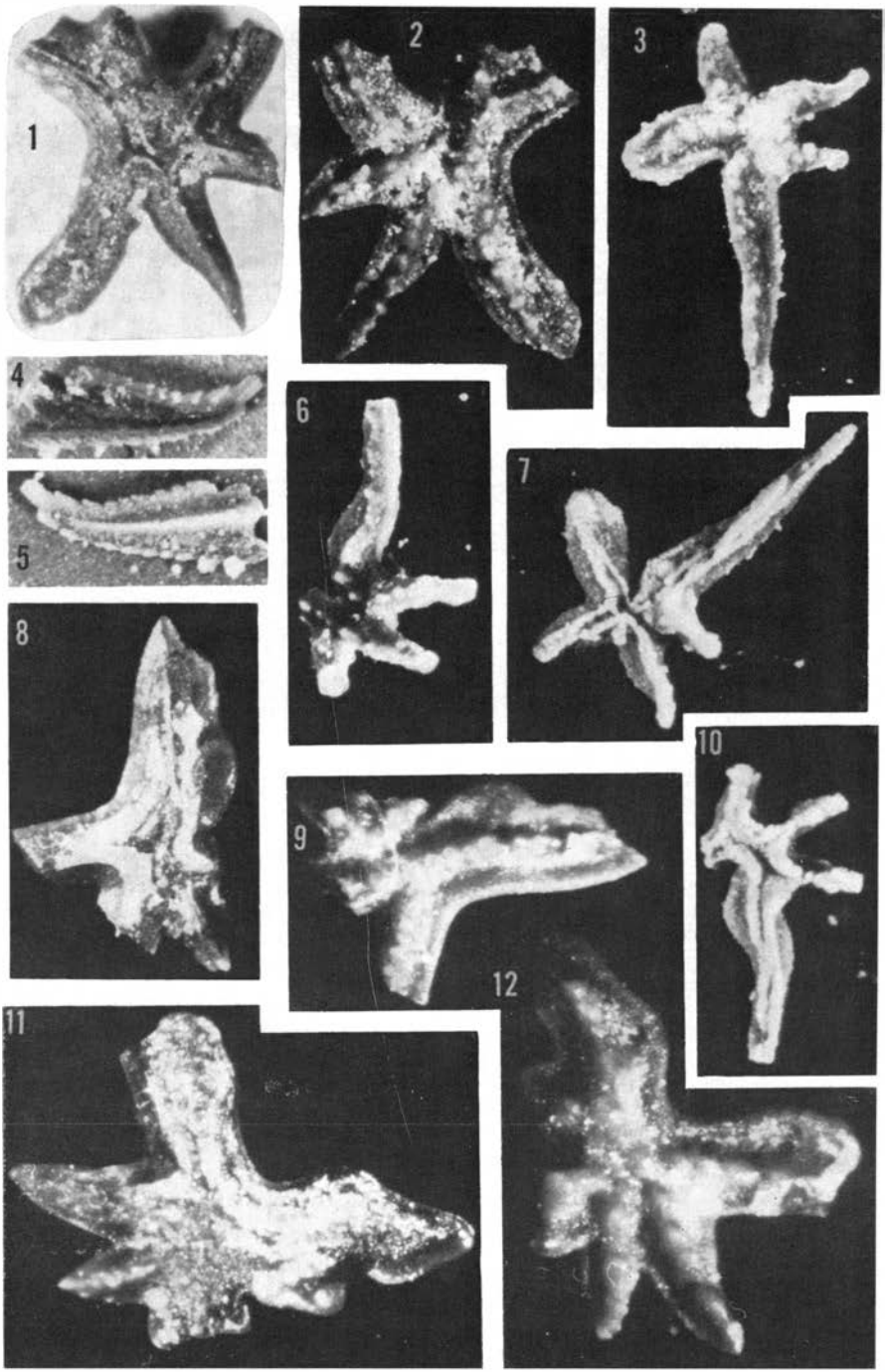
Plate 6.

Figs. 3, 5—7, 10, specimens whitened, all magnifications 68x.

1—2, 11—12, *Polyplacognathus ringerikensis* n.sp. 1. PMO 69650, aboral view, 2. same, oral view; 11. PMO 69704, aboral view, 12. same, oral view.

3, 6—10, *Polyplacognathus elongata* (BERGSTRÖM), 1961, 3. PMO 69639, oral view, 7. same, aboral view; 6. PMO 69649, oral view, 10. same, aboral view, 8. PMO 69648, aboral view, 9. same, oral view.

4—5, *Tetraprioniodus lindstroemi* SWEET & BERGSTRÖM, 1962, PMO 69641, lateral views.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