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MICROPALEONTOLOGICAL
BULLETINS

W. A. VAN WAMEL

CONODONT BIOSTRATIGRAPHY OF THE UPPER CAMBRIAN AND LOWER ORDOVICIAN OF NORTH-WESTERN ÖLAND, SOUTH-EASTERN SWEDEN

10

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Printed in the Netherlands by Krips Repro Meppel
December 20, 1974

CONODONT BIOSTRATIGRAPHY OF THE UPPER CAMBRIAN AND LOWER ORDOVICIAN OF NORTH-WESTERN ÖLAND, SOUTH-EASTERN SWEDEN

W. A. VAN WAMEL

CONTENTS

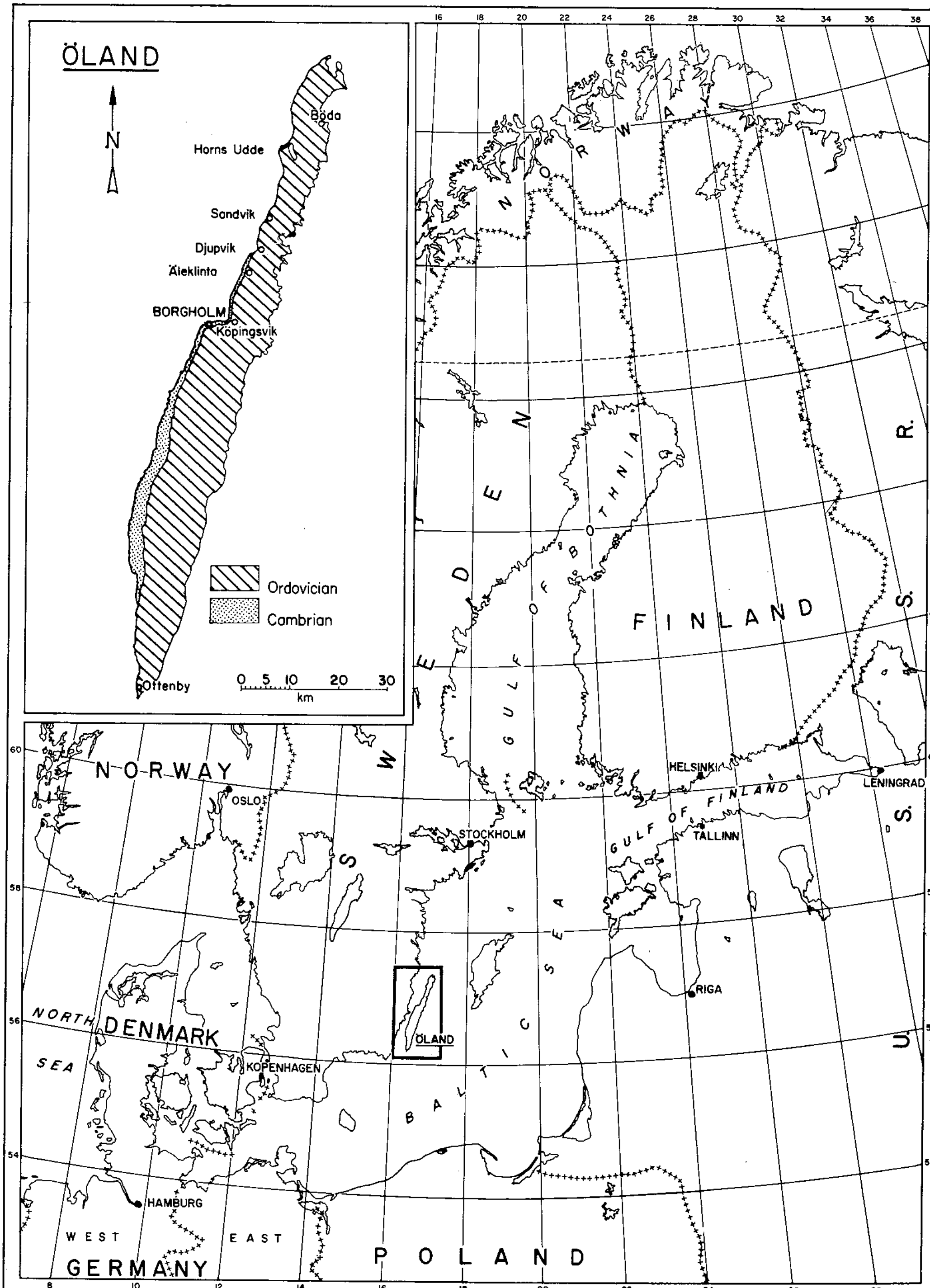


Fig. 1 Location of Öland.

PREFACE

This paper forms part of the author's thesis "Lithostratigraphy, environmental interpretation and conodont biostratigraphy of the Upper Cambrian and Lower Ordovician of north-western Öland, south-eastern Sweden".

The purpose of this investigation was to unravel the lithogenesis and the history of the Upper Cambrian and Lower Ordovician rocks along the north-western coast of Öland (figs. 1 and 2).

To obtain a picture of the sedimentary environments of these deposits a close investigation was carried out into their lithologic characteristics; the rocks were classified lithostratigraphically on the basis of these characteristics.

Considering the amount of detail of the resulting subdivision it appeared necessary to find a method of comparable refinement for the biostratigraphic correlation of the lithostratigraphic units. None of the existing biozonations suited this purpose and therefore a detailed conodont-zonation has been established. Lindström (1963) has shown that these fossils occur in enormous quantities in the strata of Öland and they proved to be extremely suitable for detailed biozonation.

After a short introduction into the lithostratigraphy this paper will deal especially with the conodont-biostratigraphy, the chronostratigraphic position of the lithostratigraphic and biostratigraphic units and with the conodont systematics.

The lithostratigraphy, the sedimentary environments and the sedimentary history of the area will be treated in a separate paper under the title "Lithostratigraphy and environmental interpretation of the Upper Cambrian and Lower Ordovician of north-western Öland, south-eastern Sweden."

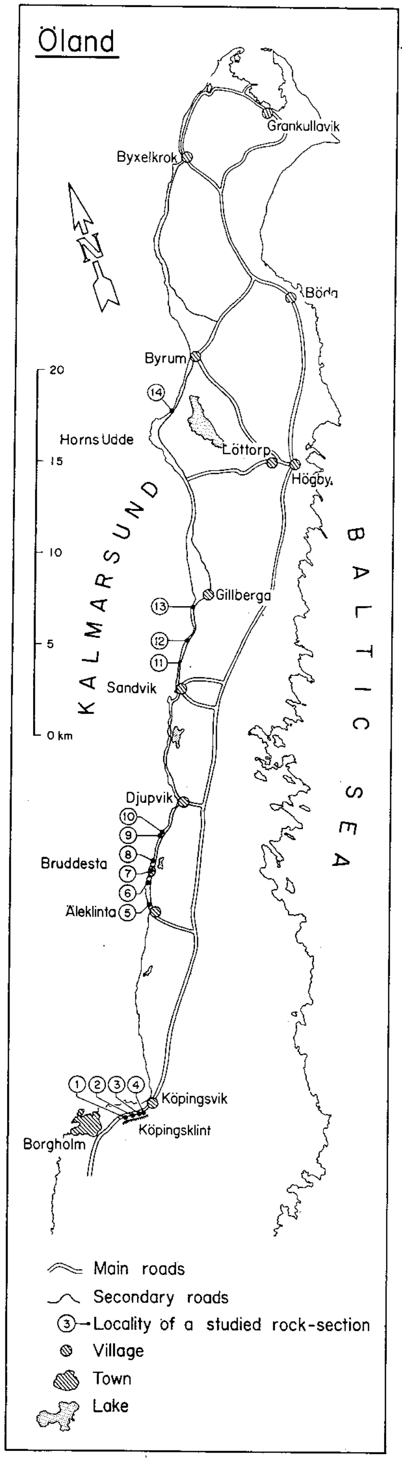


Fig. 2 Map o‸ ‸ area of investigation with the locations of the studied rock-sections.

Chapter I

LITHOSTRATIGRAPHY

I.1. INTRODUCTION

The Cambrian-Ordovician sequence considered is delimited by the "Tessini sandstone" at the base and the "Limbata limestone" at the top (see chart I). It includes red and green fossiliferous limestones, black shales, bituminous limestones, calcareous sandstones and conglomerates (chart I). The total thickness of this sequence is slight, in the order of some 10 m. Beds are thin and especially in the upper fossiliferous limestones innumerable disconformities are present.

The occurrence of a great variety of lithological types in the basal part of the column, and the very homogeneous lithology of the upper part of the sequence, are the most striking features.

The gross lithological characteristics were studied in the field in 14 rock-sections (fig. 2) at a scale of 1:10. For detailed sedimentpetrographic investigations a great number of thin-sections was studied with microscope equipment. This investigation was concentrated on three of the rock-sections, in the south (section 1), middle (section 6) and north (section 14) of the area respectively (fig. 2). The fossiliferous limestones were classified according to Dunham's (1962) classification and microscopic data were gathered concerning the disconformities, allochems, sorting, fauna and iron compounds. The composition of the latter were established by X-ray analysis of powder samples. Combination of the field observations and the results of the laboratory research allowed a lithostratigraphic subdivision into four formations and ten members of the lower two. In the correct order of superposition these units are:

- Horns Udde Formation
- Bruddesta Formation
- Köpingsklint Formation with the informal members K_{k1}, K_{k2}, K_{k3}, $K_{ä\text{-}d1}$ and $K_{ä\text{-}d2}$
- Djupvik Formation with the informal members $D_{ä\text{-}d1}$, $D_{ä\text{-}d2}$, $D_{ä\text{-}d3}$, D_{h1} and D_{k1}.

1.2.1. **Djupvik Formation** (after the hamlet of Djupvik, fig. 2).

1.2.1.1. *Diagnosis*

The formation is characterized by the occurrence in sequence of many different rock-types, which contain a relatively high proportion of terrigenous clastic material: conglomerates, calcareous sandstones, black shales, bituminous limestones and glauconite sands. It contains much pyrite and/or glauconite, whereas fauna is relatively sparsely present.

This formation was subdivided into five informal members, which were named by combination of the following abbreviations:

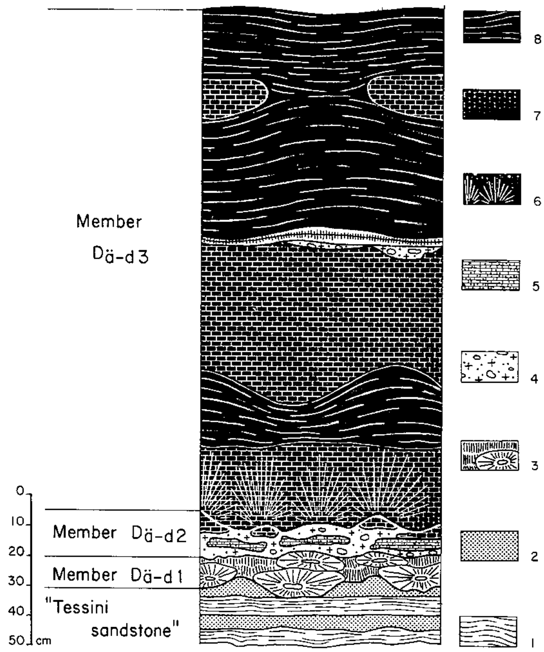
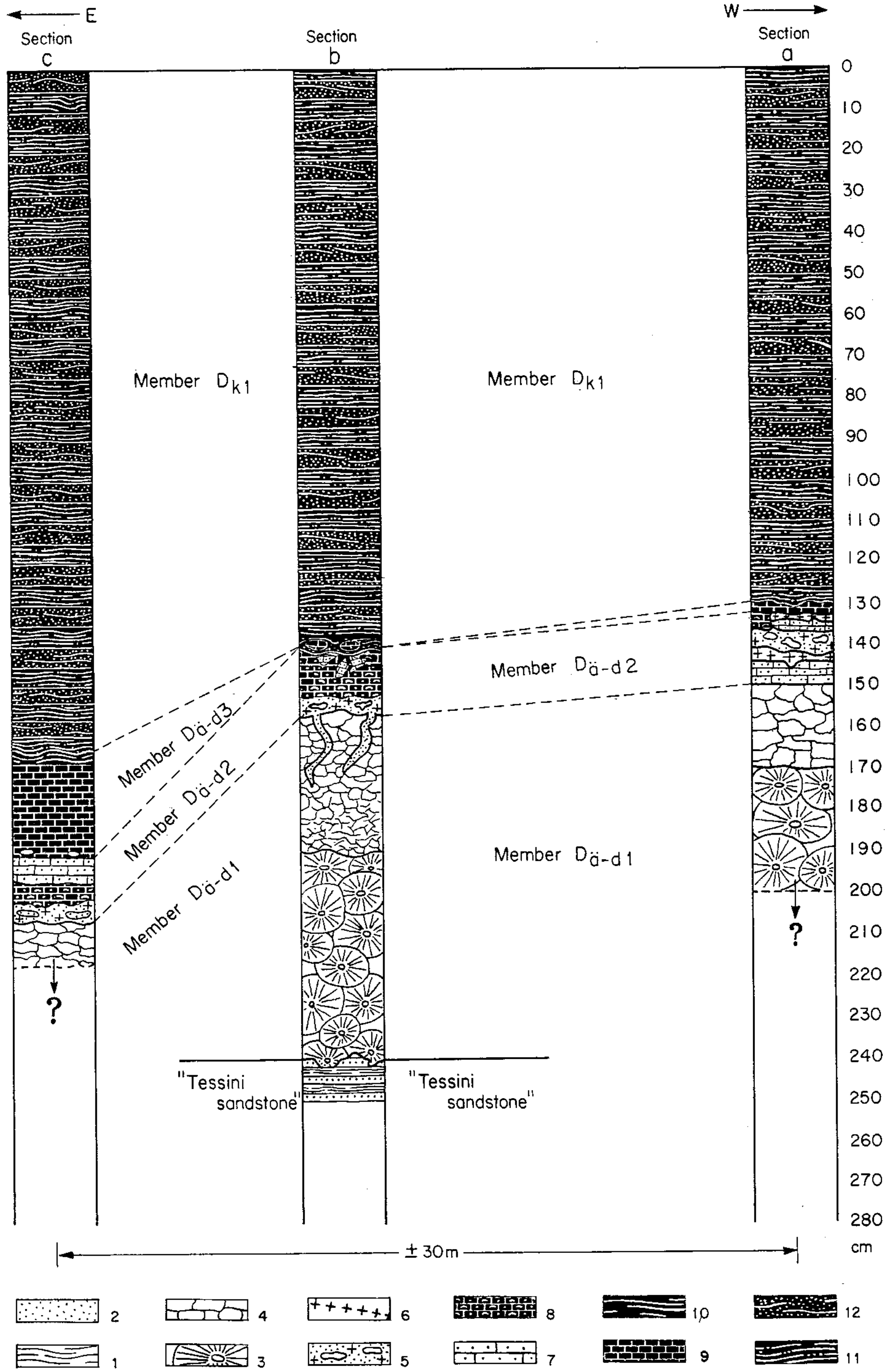


Fig. 3 The type-section of the Djupvik Formation and its subdivision at about 2 km. south-west of Djupvik (section 9, (fig. 2). Legend: 1 = light green shale. 2 = light green sandstone. 3 = green columnar calcite crystals; radiating from centres of different lithology and forming nodules, or vertically arranged in discontinuous layers. 4 = polymict breccious conglomerate with bright coloured calcite cement. 5 = calcareous sandstone. 6 = brown bituminous calcite crystals, radiating from centres of different lithology. 7 = brown bituminous and sparritic limestone. 8 = black shale.

Fig. 4 The development of the Djupvik Formation in three small rock-sections at Köpingsklint, located at 20 to 50 m. west of section 1.
Legend: 1 = light green shale. 2 = light green sandstone. 3 = green calcite prisms, radiating from centres of different lithology and forming nodules. 4 = green calcite prisms that are irregularly oriented. 5 = breccious conglomerate with bright coloured sparritic calcite cement. 6 = laminae of grey-green sparritic limestone. 7 = calcareous sandstone. 8 = brown bituminous and sparritic limestone with angular fragments of calcareous sandstone, concretions of phosphorite and pyrite and numerous small carapaces of trilobites. 9 = brown bituminous and sparritic limestone. 10 = black shale. 11 = slightly glauconitic black shale. 12 = glauconite sand with a black shale matrix.


E
W
Section c
Section b
Section a
Member Dk1
Member Dk1
Member Dä-d3
Member Dä-d2
Member Dä-d1
Member Dä-d2
Member Dä-d1
"Tessini sandstone"
"Tessini sandstone"
0
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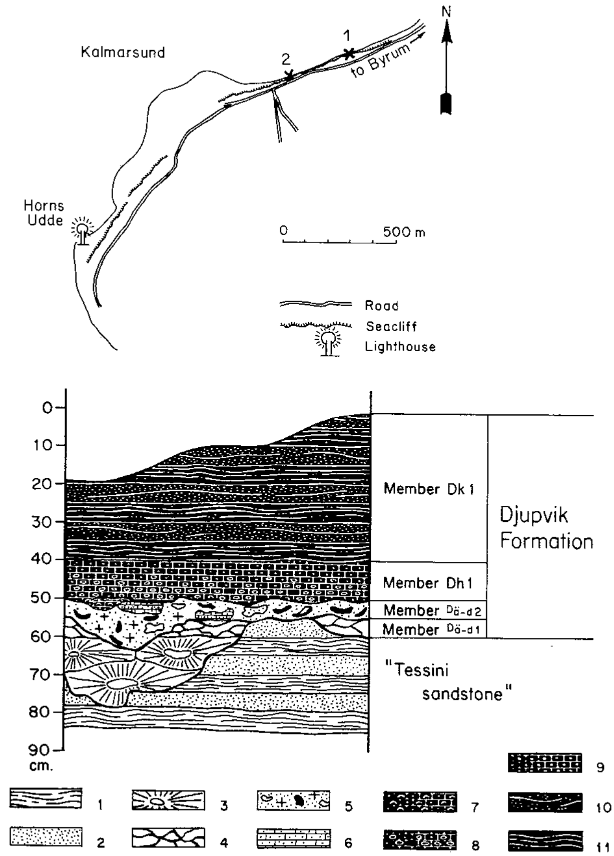

Fig. 5 Map of the Horns Udde area, showing the situation of two localities where rock-sections have been studied (above). The Djupvik Formation at locality 1, situated at about 1.5 km. north-east of cape Horns Udde (below).
Legend: 1 = light green shale. 2 = light green sandstone. 3 = green calcite crystals, radiating from centres of different lithology and forming nodules. 4 = green calcite prisms, that are irregularly oriented. 5 = polymict breccious conglomerate, rich in pyrite components, with bright coloured sparry calcite cement. 6 = calcareous sandstone. 7 = brown bituminous and sparritic limestone with innumerous amounts of small carapaces of trilobites. 8 = a breccious conglomerate with brown bituminous calcite cement and many pyrite components. 9 = glauconite sand with a bituminous and sparritic calcite cement. 10 = glauconite sand with a black shale matrix. 11 = slightly glauconitic black shale.

D: meaning Djupvik Formation,
k, ä-d or h: referring to the sections in which they are considered most typical, i.e., Köpingsklint, the coast between Äleklinta and Djupvik, and Horns Udde, respectively. 1,2,3: for the order of superposition of the members, from below upwards.

The typical section of the Djupvik Formation and its subdivision are shown in fig. 3. Its composition at Köpingsklint and near Horns Udde is given in figs. 4 and 5.

I.2.1.2. *Type-locality and type-section*

The coastal cliff at about 2 km. south-west of Djupvik, section 9 (fig. 2).

I.2.1.3. *Differential diagnosis*

The Djupvik Formation can be distinguished from the underlying "Tessini sandstone" by the much greater variety of its lithology. It can be differentiated from the overlying Köpingsklint Formation by its high content of terrigenous clastics.

I.2.2. **Köpingsklint Formation** (after the raised sea-cliff between Borgholm and Köpingsvik, fig. 2).

I.2.2.1. *Diagnosis*

A unit characterized by red-brown, violet and green micritic to sparritic limestones, containing remains of fossils, glauconite grains and pyrite crystals. Intercalations of marl and calcareous glauconite sand occur. Glauconite grains are the most frequently occurring allochems.

This formation is subdivided into five informal members, which are named by combination of the following abbreviations:

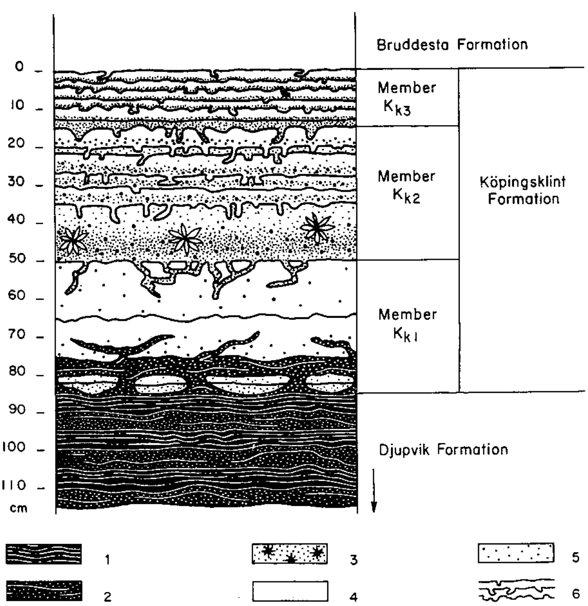

Fig. 6 The type-section of the Köpingsklint Formation and its subdivision at Köpingsklint (section 1, fig. 2).
Legend: 1 = slightly glauconitic black shale. 2 = glauconite sand with a black shale matrix. 3 = highly calcareous glauconite sand with a cement of sparry calcite, often arranged in rosette-like structures. 4 = fossiliferous limestone. 5 = glauconitic limestone. 6 = disconformities.

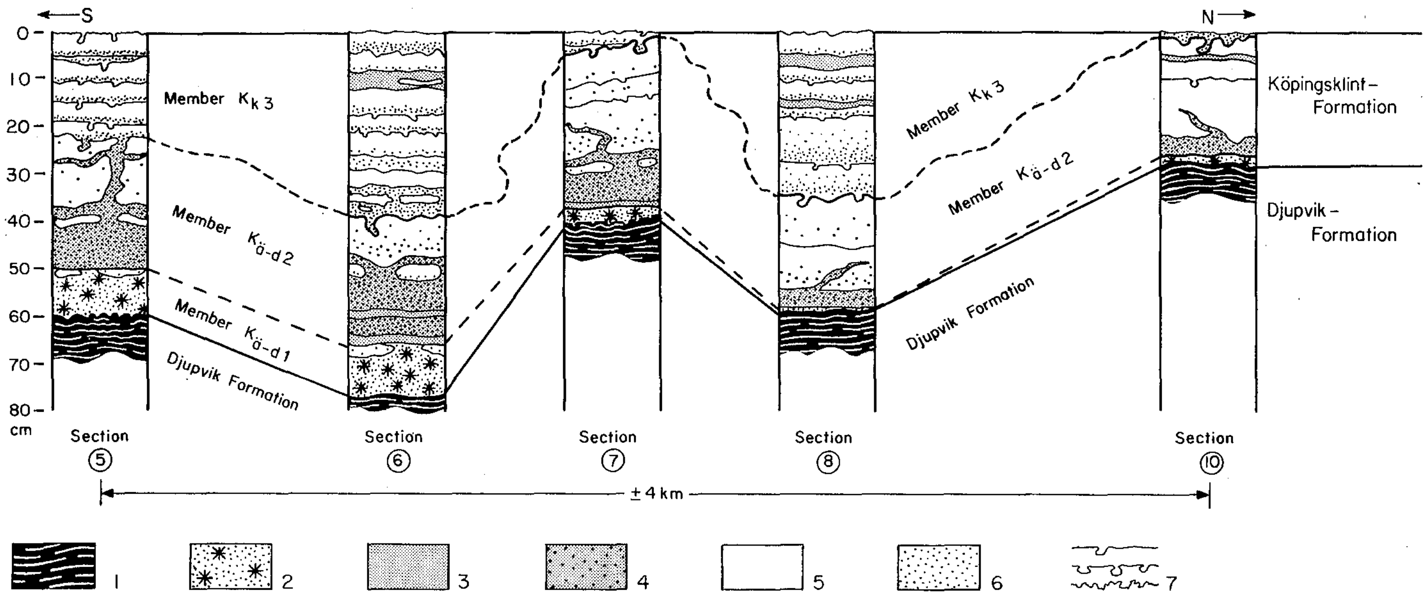

Fig. 7 The lateral development of the Köpingsklint Formation along the coast between Åleklinta and Djupvik.
Legend: 1 = black shale. 2 = marly glauconite sand, locally with a cement of sparry calcite which may be arranged in rosette-like structures. 3 = marl. 4 = glauconite sand with a marly matrix. 5 = fossiliferous limestone. 6 = glauconitic limestone. 7 = disconformities.

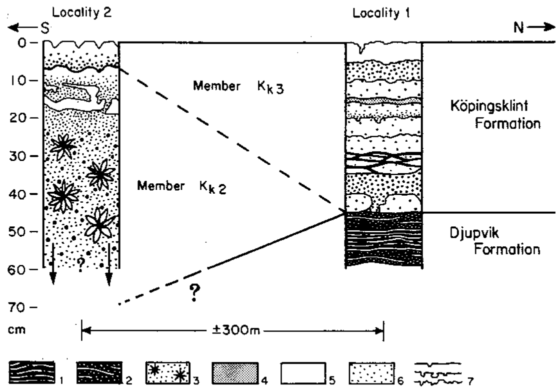

Fig. 8 The Köpingsklint Formation in two rock-sections north-east of cape Horns Udde. For the situation of these sections see localities 1 and 2 of fig. 5.
Legend: 1 = slightly glauconitic black shale. 2 = glauconite sand with a black shale matrix. 3 = highly calcareous glauconite sand with a cement of sparry calcite, often arranged in rosette-like structures. 4 = marl. 5 = fossiliferous limestone. 6 = glauconitic limestone. 7 = disconformities.

K means the Köpingsklint Formation.
k or ä-d indicates that the member is considered to be most typical at Köpingsklint or along the coast between Äleklinta and Djupvik respectively.
1,2, 3 indicates the order of superposition from below upwards.

The typical development of this formation is shown in fig. 6. The Köpingsklint Formation at the coast between Äleklinta and Djupvik, and near Horns Udde are shown in figs. 7 and 8 respectively.

I.2.2.2. *Type-locality and type-section*

Köpingsklint, section 1 (fig. 2).

I.2.2.3. *Differential diagnosis*

The Köpingsklint Formation may be distinguished from the underlying Djupvik Formation by the predominance of fossiliferous limestones in the former and of terrigenous clastics in the latter formation. It differs from the overlying Bruddesta Formation by its high content of glauconite grains and its relative paucity of fragments of fossils. Moreover, the Köpingsklint Formation includes fossiliferous and glauconitic grainstones, which are absent in the overlying Bruddesta Formation.

I.2.3. **Bruddesta Formation** (after the small fishery harbour Bruddesta, fig. 2)

I.2.3.1. *Diagnosis*

This formation contains predominantly red to brown, slightly marly fossiliferous limestones with many internal disconformities. The basal part may have pale red and green colours. Marl intercalations are commonly present, except in the upper portion. Remains of fossils are the most frequently occurring allochems; occasional glauconite grains are present.

The composition of the Bruddesta Formation in its type-section, at Köpingsklint and near Horns Udde is shown in fig. 9 and in the charts II and IV, respectively.

I.2.3.2. *Type-locality and type-section*

Section 6 at about 0.7 km. south of Bruddesta (fig. 2).

I.2.3.3. *Differential diagnosis*

The Bruddesta Formation contains more fragments of fossils and less glauconite grains than the Köpingsklint Formation. In contrast with the latter formation, it lacks grainstones. The Bruddesta Formation may be differentiated from the overlying Horns Udde Formation by its higher content of clay, which occurs concentrated in the marl intercalations and admixed to the limestone beds. Moreover, the Horns Udde Formation does not contain fossiliferous mudstones, contrary to the Bruddesta Formation.

I.2.4. **The Horns Udde Formation** (after cape Horns Udde, fig. 2).

I.2.4.1. *Diagnosis*

The formation is characterized by greenish red, or green and red variegated highly fossiliferous limestones. It is interspersed by innumerable disconformities with brown-yellow (= goethitic) conversion zones. Remains of fossils are the most frequent allochems; they are often brown-yellow, red-brown or green stained. Orthoceratids are relatively abundant, glauconite grains are rare.

The type-section of the Horns Udde Formation is given in fig. 10; the composition of the formation at Köpingsklint and in section 6 is shown in charts II and III.

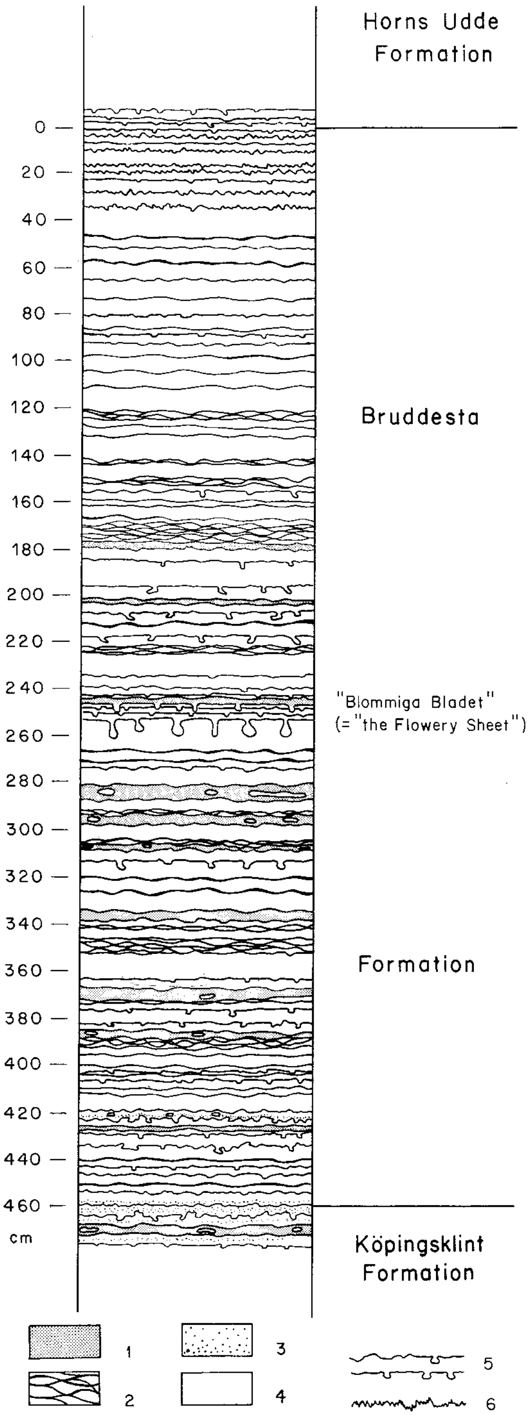

Fig. 9 The type-section of the Bruddesta Formation, situated at about 0.7 km. south of Bruddesta (section 6, fig. 2). Legend: 1 = marl. 2 = nodular, marly limestone. 3 = glauconitic limestone. 4 = fossiliferous limestone. 5 = disconformities. 6 = stylolith planes.

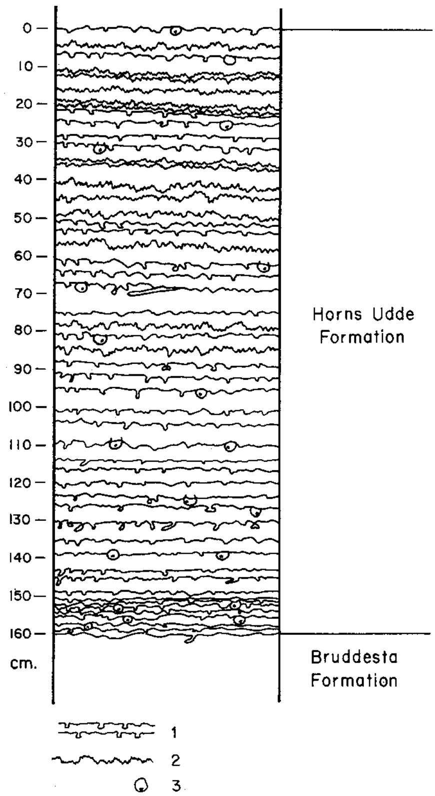

Fig. 10 The type-section of the Horns Udde Formation at about 1.5 km. north-east of cape Horns Udde (section 14, fig. 2; and locality 1, fig. 5).
Legend: 1 = disconformities. 2 = stylolith plane. 3 = cross section of an orthoceratid.

I.2.4.2. *Type-locality and type-section*

The sea-cliff at about 1.5 km. north-east of cape Horns Udde, section 14 (fig. 2 and fig. 5 locality 1).

I.2.4.3. *Differential diagnosis*

The Horns Udde Formation differs from the Bruddesta Formation by the absence of fossiliferous mudstones and of clay. It may be distinguished from the overlying rocks by its lower content of glauconite grains and by the greyish green colour of the overlying rocks.

Chapter II

BIOSTRATIGRAPHY

II.1. PREVIOUS BIOZONATIONS

Figure 11 summarizes the biozonations of part of the generalized lithostratigraphic column of Sweden, covering the "Olenid shale", the "Dictyonema shale", the "Ceratopyge shale", the "Ceratopyge limestone", the "Planilimbata limestone" and the "Limbata limestone" of the literature (compare chart I).

In Öland the "Olenid shale", the "Dictyonema shale" and the "Ceratopyge shale" (together covering the Djupvik Formation of this paper) were investigated biostratigraphically by Holm (1882), Tullberg (1882), Westergård (1922, 1947) and Hadding (1927, 1932).

From Köpingsklint and from the coast S.W. of Djupvik, Westergård (1922) described two rock-sequences and their faunal contents. In figures 12 and 13 Westergård's lithostratigraphic classification, the lithostratigraphic classification used in this paper, the faunas and their probable position in the Swedish biozonation (fig. 11) were put in juxtaposition. In a comparable way, Holm's (1882) description of a rock-sequence near Horns Udde is treated in figure 14.

Tjernik (1956) studied the Lower Ordovician of Sweden, together with its trilobite- and graptolite-zonation. Figures 16, 17 and 18 summarize the lithostratigraphic units and their biozonation, as he recognized them at Köpingsklint, Äleklinta and Horns Udde. To these, the lithostratigraphic and biostratigraphic classifications used in this paper have been added for comparison.

Neither from the remaining part of the Bruddesta Formation, nor from the Horns Udde Formation, an earlier detailed biozonation is known to the author.

Figures 12, 13, 14 and 16, 17 and 18 clearly show that the previously used biozonations of the strata of N.W. Öland, lack the detail for an adequate chronostratigraphic positioning of the lithostratigraphic units recognized in this paper. A more detailed biozonation will be attempted, based on conodonts. Lindström found them in enormous quantities in the Lower

Lithostratigraphy		Westergård (1909, 1944, 1947)	Hede (1951)	Moberg and Segerberg (1906)	Lindström (1955a) (Conodonts)	Tjernvik (1956). Shale facies (Graptolites)	Tjernvik (1956) Shelly facies (Trilobites)	Lindström (1960)	Lindström (1971) (Conodonts)
Limbata limestone	"Bloody Layer" "Flowery Sheet"				Zone with *Prioniodina densa* and *Prioniodus navis*	Zone of *Isograptus gibberulus.*		Zone with Conodont fauna IV	Zone of *Paroistodus originalis* Zone of *Baltoniodus navis* Zone of *Baltoniodus triangularis*
Planilimbata limestone (Tjernvik 1952)	Upper: Billingen group (Tjernvik 1956)				Zone with *Oepikodus smithensis, Oistodus lanceolatus, Oistodus triangularis* and *Prioniodus evae*	Zone of *Phyllograptus angustifolius elongatus* Zone of *Phyllograptus densus*	Zone of *Plesiomegalaspis estonica* Zone of *Megalaspides dalecarlicus*	Zone with Conodont fauna III	Zone of *Prioniodus evae* Zone of *Prioniodus elegans*
	Lower: Hunneberg group (Tjernvik 1956)				Zone with *Drepanodus proteus* and *Paltodus inconstans*	Zone of *Didymograptus balticus* Zone of *Tetragraptus phyllograptoides*	Zone of *Plesiomegalaspis planilimbata*	Zone with Conodont fauna II	Zone of *Paroistodus proteus*
				b) Zone of *Apatokephalus serratus*	Zone with *Acodus tetrahedron, Cordylodus angulatus, C. rotundatus* and *Oneotodus variabilis*	Underscribed dichograptids	Zone of *Plesiomegalaspis armata*		
Ceratopyge limestone							Zone of *Apatokephalus serratus*	Zone with Conodont fauna I	Zone of *Paltodus deltifer*
Ceratopyge shale				a) Zone of *Shumardia*		Zone of *Clonograptus heres*	"*Shumardia* Zone"		
Dictyonema shale		c) Subzone of *Dictyonema fabelliforme norvegicum* and *Bryograptus kjerulfi*	4) Zone of *Dictyonema norvegicum* and *Bryograptus kjerulfi.*						Zone of *Cordylodus angulatus*
		b) Subzone of *Clonograptus tenellus* with varieties and *Adelograptus hunnebergensis*	Brachiopod beds 3) Zone of *Adelograptus hunnebergensis.*						
		a) Subzone of *Dictyonema flabelliforme f. typica*	2) Zone of *Dictyonema flabelliforme.* 1) Zone of *Dictyonema sociale.*						
Olenid shale		6) Zone of *Acerocare* and *Parabolina* of the *heres* group							
		5) Zone of *Peltura, Sphaerophthalmus* and *Ctenopyge*							
		4) Zone of *Leptoplastus* & *Eurycare*							
		3) Zone of *Parabolina spinulosa* & *Orusia lenticularis*							
		2) Zone of *Olenus*							
		1) Zone of *Agnostus pisiformis*							

Fig. 11 Some previously proposed lithostratigraphic units and their biozonations of the Upper Cambrian and Lower Ordovician of Sweden.

Ordovician limestones of Sweden (1955a) and on Öland (1963), and already proved the suitability of these microfossils for detailed biozonation (1955a and 1971).

II.2. CONODONT–BIOSTRATIGRAPHY

II.2.1. Technique

From each of the rock-sections 1, 6 and 14, about 50 samples were used. They were digested in 15% acetic acid solutions of 50°–70°C. The limestone samples were 100–200 gr., whilst those of the Djupvik Formation weighed up to 1000 gr. After washing the residues, the fractions between 50μ and 1.5 mm. were dried. Further isolation of the conodonts was attained by using the magnetic properties of the anorganic constituents of the residues. The conodonts were concentrated by a magnetic separator in the a-magnetic fraction. If separation by this method was insufficient, the conodonts were afterwards isolated by treatment with bromoform of 2.87 specific gravity.

All samples of the Köpingsklint Formation, the Bruddesta Formation, and the Horns Udde Formation were usually rich in conodonts. Once 12.000 conodont specimens were calculated to be present in a 150 gr. sample of the Bruddesta Formation. By using a microsplit, a representative portion of the total fauna was isolated and studied under binocular microscope. Finally, approximately 300 conodont specimens were collected and determined from each sample. To avoid selective collection of these 300 specimens, the representative portions of the faunas were strewn in a tray with a lineated bottom and the conodonts were searched systematically along the lines.

II.2.2. Method

Charts II, III and IV show the distribution of the conodont species in the rock-sections 1, 6 and 14, respectively. The distribution charts are composed on the basis of the bottom method.

In every rock-section conodont assemblages were distinguished, mainly using the first appearances of species. In some cases, however, the disappearance of one or more species was used for zonal boundaries as well. The assemblage zones of sections 1, 6 and 14 first got a preliminary notation. After comparison of these three zonations every zone was given an official name. The zonation was much facilitated by the presence of many discon-

Lithostratigraphic units used in this paper	Lithostratigraphic units Westergård (1922) (chart I)	Strata Westergård (1922)	Fauna Westergård (1922)	Probable position in the Swedish biozonation (fig. 11)
Basal portion of the Bruddesta Formation Member K_{k3} Member K_{k2}	Planilimbata kalk (= limestone)	1) Red glauconitic Planilimbata limestone 1.00 m		
Member K_{k1}	Ceratopyge kalk (=limestone)	2) Red brown Ceratopyge limestone 0.50 m		Zone of *Apatokephalus serratus*
Member D_{k1}	Ceratopyge skiffer (= shale)	3) Glauconitic shale with small limestone lenses in the top, alternating with thin alum shale layers. 1.60 m	*Obolus salteri*, *Lingulella ferruginea*, *L. lepis*, *Acrothele borgholmensis*, *Acrotreta seebachi* and *Eoorthis cristianiae*	Zone of *Shumardia*
Uppermost alum shale bed of member $D_{\ddot{a}-d3}$ (see fig.4 section c)	Dictyograptus skiffer (= Dictyonema shale)	4) Alum shale 0.05 m	*Dictyograptus flabelliformis norvegicus* (= *Dictyonema flabelliforme norvegicum*)	Subzone of *Dictyonema flabelliforme norvegicum* and *Bryograptus kjerulfi*
The main portion of member $D_{\ddot{a}-d3}$ Member $D_{\ddot{a}-d2}$ Member $D_{\ddot{a}-d1}$		5) Limestone bed, chiefly bituminous limestone, between two conglomerate beds. The lowest portion of the bed consists of grey, green columnar or coarse grained limestone. 0.30 - 1.10 m	*Agnostus pisiformis*, *A. pisiformis obesus*, *Olenus gibbosus*, *Orusia lenticularis*, *Hyolithus* sp. and *Acrochephalites stenometopus*.	?
"Tessini sandstone"		6) Thin bedded sandstone Base	*Paradoxides tessini* BRONGNIART (=*Paradoxides paradoxissimus* (WAHLENBERG))	Zone of *Paradoxides paradoxissimus*

Fig. 12 A rock-sequence described by Westergård (1922) from Köpingsklint. The lithostratigraphic classification used in this paper and the probable position of Westergård's faunas in the Swedish biozonation are put in juxtaposition.

Lithostratigraphic units used in this paper	Lithostratigraphic units Westergård (1922) (chart I)	Strata Westergård (1922)	Fauna Westergård (1922)	Probable position in the Swedish biozonation (fig. 11)
	Planilimbata kalk (= limestone)	1) Planilimbata limestone, in the lower beds grey green and glauconitic		
Member $K_{ä-d1}$		2) Glauconite sand 0.04 m		
Member $D_{ä-d3}$	Ceratopyge skiffer (= shale)	3) Alum shale with some lenses of bituminous limestone		
	Dictyograptus skiffer (= Dictyonema shale)	1.00 m	Lower 0.10 m : *Dictyograptus flabelliformis norvegicus* (= *Dictyonema flabelliforme norvegicum*)	Subzone of *Dictyonema flabelliforme norvegicum* and *Bryograptus kjerulfi*
	The Obolus conglomerate, after Westergård, 1947 1)	4) Bituminous limestone bed, which in the top portion contains a discontinuous conglomerate	The conglomerate: *Orusia lenticularis*, *Sphaerophtalmus major*, *Peltura scarabaeoides*, *Hyolithus* sp., *Agnostus pisiformis*, *Olenus gibbosus* and *Dictyograptus* sp. (= *Dictyonema* sp.)	Conglomerate: Subzone of *Dictyonema flabelliforme typica*
	Olenid skiffer (= shale)	0.50 m	The limestone bed: *Agnostus pisiformis*, *Schmalenseeia amphionura*	Zone of *Agnostus pisiformis*
		5) Alum shale of variable thickness 0.15 m		
		6) A limestone bed, chiefly containing bituminous columnar limestone, whilst the base is composed of grey green limestone. These are separated by a discontinuous conglomerate 0.40 m		
Member $D_{ä-d2}$	Exporrecta conglomerate		The conglomerate: *Agnostus pisiformis*, *Acrothele* sp. and *Hyolithus* sp.	
Member $D_{ä-d1}$	Paradoxides skiffer (= shale)			
"Tessini sandstone"		7) Thin bedded sandstone Base	*Paradoxides tessini* BRONGNIART (= *Paradoxides paradoxissimus* (WAHLENBERG))	Zone of *Paradoxides paradoxissimus*

1) According to Westergård (1947) this thin conglomerate contains *Dictyonema flabelliforme* and an *Obolus* (probably *Obolus apollinis*, according to this author), which would place this conglomerate in the Subzone of *Dictyonema flabelliforme typica*.

Fig. 13 A rock-sequence described by Westergård (1922) from the sea-cliff south-west of Djupvik. The lithostratigraphic classification used in this paper and the probable position of Westergård's faunas in the Swedish biozonation are put in juxtaposition.

Lithostratigraphic units used in this paper	Lithostratigraphic units Holm (1882) (chart I)	Strata Holm (1882)	Fauna Holm (1882)	Probable position in the Swedish biozonation (fig. 11)
Horns Udde Formation - - - - - - Bruddesta Formation	Orthocer kalk	g) Red Orthocer kalk more than 3.50 m		
Member K_{k3} - - - - - - Member K_{k2}		f) At the base green-sand, which grades upwards into more or less glauconitic limestone. 0.45 m	*Megalaspis planilimbata*, *Symphysurus breviceps*, *Orthis* sp.	
Member $D_{\ddot{a}-d2}$		e) A conglomerate with fragments of bituminous limestone and of calcareous sandstone. Also phosphorite grains. The matrix is bituminous calcite. 1) 0.18 m	*Paradoxides tessini* BRONGNIART (=*Paradoxides paradoxissimus* (WAHLENBERG), *Olenus gibbosus*, *Agnostus pisiformis*, *A. laevigatus*, *Obolus* sp.	Subzone of *Dictyonema flabelliforme typica*
Member $D_{\ddot{a}-d1}$		d) Green crystalline limestone. 0.18–0.23 m		
		c) A layer of calcareous sandstone. 0.07 m	*Paradoxides tessini* BRONGNIART (= *Paradoxides paradoxissimus* (WAHLENBERG))	Zone of *Paradoxides paradoxissimus*
		b) Green columnar limestone 0.13 m		
"Tessini sandstone"		a) Thin bedded sandstone Base. more than 0.15 m.		

1) From the conglomerate of stratum e) Westergård (1947) collected *Obolus apollinis*, which brachiopod would be indicative for the Subzone of *Dictyonema flabelliforme typica* according to that author.

Fig. 14 A rock-sequence described by Holm (1882) from the Horns Udde area. The lithostratigraphic classification used in this paper and the probable position of Holm's faunas in the Swedish biozonation are put in juxtaposition.

formities in the rock-sections. By recording the elements of the multi-element species separately, the boundaries of the conodont assemblage zones tend to be accentuated. The boundaries of the assemblage zones were drawn at the base (boundaries defined on first appearances) or at the top (boundaries defined on disappearences) of fossiliferous samples, and not within the barren intervals.

The distribution of the conodonts indicates that no clear correlation exists between the occurrence of any conodont species and a certain rock-type. Evidently, the conodonts were rather independent of environment within the area of study. The assumption that conodont species had a wide distribution all over the area and that assemblages of similar composition were of about synchronous origin therefore seems justified.

This enables the establishing of the chronological sequence of all conodont assemblages within the area. The ultimate succession of the conodont assemblage zones, given in fig. 15, made it possible to reconstruct the ranges of the conodont species in the regional rock-sequence.

In the composite range chart of fig. 15, the arrangement of the conodont species from left to right corresponds with the order of their first appearances in the regional rock-sequence. Species that appear simultaneously were arranged according to length of deduced ranges, the species with the shortest ranges being entered first. The reader may be shocked by the inflation in zonal names, based on one or a few samples, especially in the lower portion of the column. After long and serious consideration the author thought it preferable to enter into extreme splitting. The predominance of gaps in the basal portion of the record over intervals really represented by rocks is apparent from the considerable differences in faunal succession in the lower portions of the three sections. As a consequence it is considered probable, that every observed notable difference in faunal composition might stand for a longer period, that is worth a separate zone. After all it is better, if necessary, to lump some of the present zones on the basis of more continuous sections, found in future work, than to neglect considerable differences in faunal composition. To lump now the zones we recognized would give the resulting zones a distinctly heterogeneous character from one section to the other.

Chart V illustrates the regional extent of the conodont assemblage zones, according to their presence in sections 1, 6 and 14. The assemblage zones found in the three small rock-sections of the Djupvik Formation at Köpingsklint (fig. 4) were placed below section 1. Section 9, containing the *Cordylodus angulatus/C.prion* Assemblage Zone, was placed below section 6. The rock-section studied at locality 2 (see fig. 5) near Horns Udde and its constituent assemblage zones were placed besides section 14.

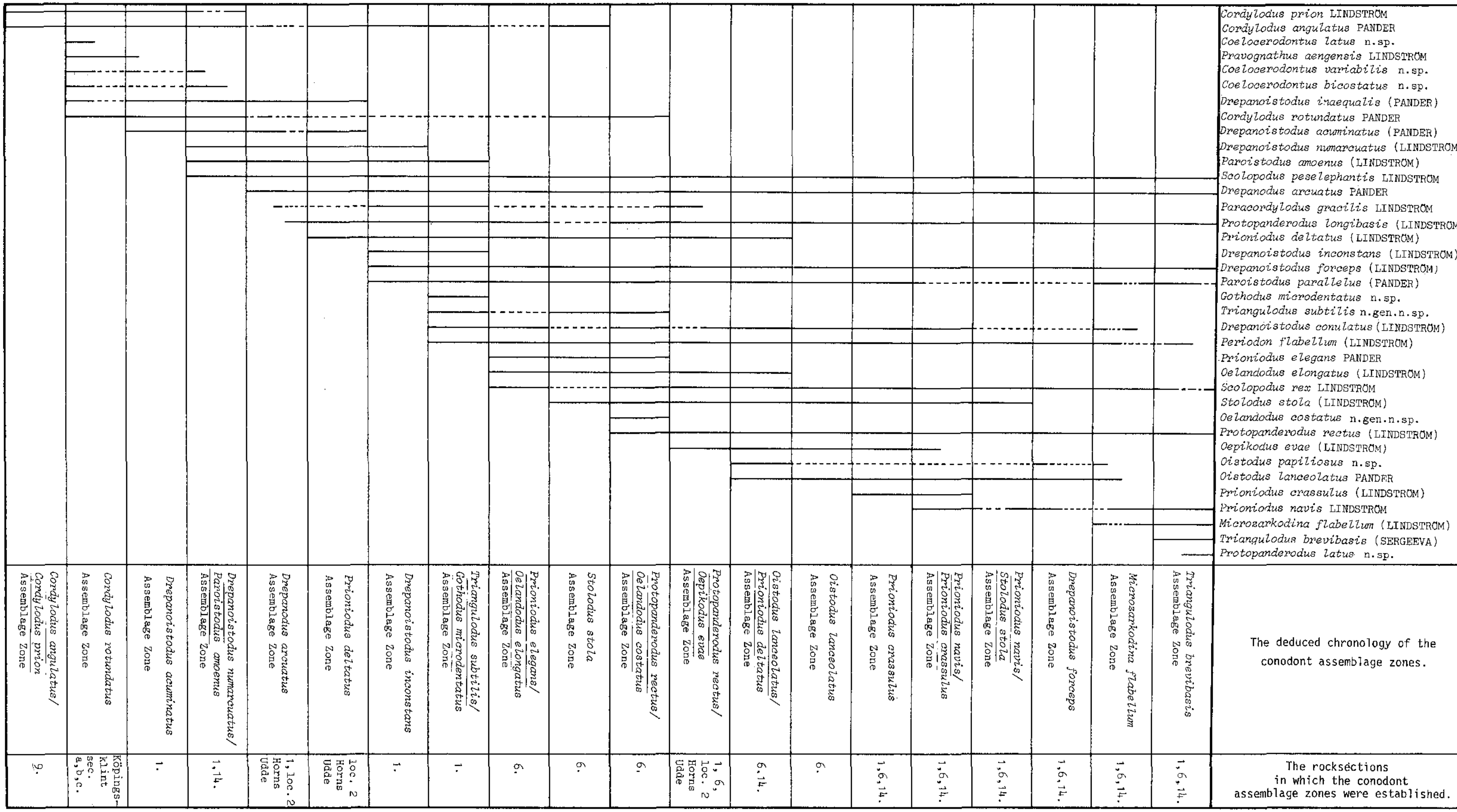

Fig. 15 The regional ranges of the conodont species and the chronology of the conodont assemblage zones, proposed in this paper.

II.2.3. Remarks on the conodont assemblage zonation

The highly discontinuous character of the sedimentation in the area, as clearly demonstrated by the enormous amount of disconformities in all sections, strongly influenced our conodont assemblage zonation.

Chart V shows, that below the *Protopanderodus rectus/Oepikodus evae* Zone none of the assemblage zones is present in all parts of the area, and many of them are confined to only one of the studied sections. Moreover, the assemblage zones under the *Protopanderodus rectus/Oepikodus evae* Zone were usually based on the first appearances of more than one species (charts II, III and IV, and fig. 15). This phenomenon may be caused by barren intervals between the studied samples in some cases, but in many instances it must be due to gaps in the rock-sequences, at disconformities which corresponded to considerable periods of non-deposition and/or erosion.

One has to conclude that the conodont assemblage zonation, presented now, is probably incomplete for the time-interval between the *Protopanderodus rectus/Oepikodus evae* Zone and our lowermost zone. The boundaries between some assemblage zones are uncertain due to the barren intervals, whereas many others coincide with important periods of non-deposition and/or erosion.

The conodont assemblage zones might be considered in many instances as concurrent range zones, as may be seen from the following enumeration.

II.2.4. The description of the conodont assemblage zones

II.2.4.1. The *Cordylodus angulatus/Cordylodus prion* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the occurrence of *Cordylodus angulatus* together with *Cordylodus prion* before the first appearance of *Cordylodus rotundatus* (fig. 15).

Description: Cordylodus angulatus and *C.prion* are the only species found in this zone, which is based on a single sample of section 9 (see sample 1, chart III).

Type-locality: The coastal cliff at about 2 km. S.W. of Djupvik (fig. 2, section 9).

Type-stratum: The conglomerate at about the middle of member $D_{ä\text{-}d3}$ in the type-section of the Djupvik Formation. The assemblage was not recognized in this member at Köpingsklint.

Remarks: The boundaries of this zone are unknown, because of the barren intervals over and under the sample, on which this zone was based.

The paucity of species and the abundance of individuals in the fauna is remarkable. This might be indicative for some kind of extreme environmental conditions (e.g. brackish water or super-saline conditions), in which comparable faunas are known to exist. The assumption that the conodonts were rather independent of environment in this area may not apply to this fauna. Hence we are possibly not dealing with the oldest conodont assemblage of the Öland succession; it might be an impoverished fauna of one of the three next assemblages.

II.2.4.2. The *Cordylodus rotundatus* Assemblage Zone

Diagnosis: A conodont assemblage zone, characterized by the occurrence of *Cordylodus rotundatus* before the first appearance of *Drepanoistodus acuminatus* (chart II and fig. 15).
Description: Cordylodus rotundatus, C.angulatus, C.prion and *Pravognathus aengensis* were found together in this assemblage zone. The record of *Coelocerodontus latus, C.bicostatus, C.variabilis* and *Drepanoistodus inaequalis* is discontinuous in this zone.
Type-locality: Köpingsklint (see sections a, b and c, fig. 4).
Type-strata: Member $D_{\text{ä-d}2}$ at Köpingsklint.
Remarks: This assemblage zone is based on two samples, obtained from calcareous sandstone. Sample 1 of chart II originates from the calcareous sandstone layer at the base of member $D_{\text{ä-d}2}$ in section a (fig. 4). Sample 2 is from the calcareous sandstone layer at the top of member $D_{\text{ä-d}2}$ in section c (fig. 4). The fauna of the latter sample is rather poor and the absence of relatively small conodont specimens like the coelocerodonts and *Drepanoistodus inaequalis,* might be caused by selective winnowing during the deposition of the calcareous sandstone.

II.2.4.3. The *Drepanoistodus acuminatus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the occurrence of *Drepanoistodus acuminatus* before the first appearance of *Drepanoistodus numarcuatus* and *Paroistodus amoenus* (chart II and fig. 15).
Description: Together with *Drepanoistodus acuminatus,* also *Cordylodus angulatus, C.rotundatus* and *Drepanoistodus inaequalis* were found in both samples of this assemblage zone at Köpingsklint. *Pravognathus aengensis, Coelocerodontus variabilis* and *Cordylodus prion* were discontinuously encountered in this zone.

Type-locality: Köpingsklint, section 1.
Type-strata: The basal portion of member $D_{k\,1}$.
Remarks: This conodont assemblage zone was based on two samples (3 and 4) of section 1 (chart II). *Coelocerodontus bicostatus* was not actually found in this zone, but it might form part of the assemblage to judge from its regional range (fig. 15).

II.2.4.4. The *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the occurrence of *Drepanoistodus numarcuatus* and *Paroistodus amoenus* before the first appearance of *Drepanodus arcuatus* (charts II and IV, fig. 15).
Description: In the rock-sequence of N.W. Öland, *Drepanoistodus numarcuatus* and *Paroistodus amoenus* start their range together. They were found with *Cordylodus angulatus, C.rotundatus, Drepanoistodus inaequalis* and *D.acuminatus* in all assemblages of this zone. *Cordylodus prion* and *Coelocerodontus variabilis* were discontinuously encountered in this zone in section 14. At Köpingsklint *Coelocerodontus bicostatus* and *C. variabilis* were not found in this zone; these species seem to end their ranges in this zone, together with *Cordylodus prion* (fig. 15).
Type-locality: Horns Udde, section 14, locality 1, see fig. 5.
Type-strata: Member $D_{h\,1}$ and member $D_{k\,1}$ of section 14 (chart IV).
Remarks: This zone was based on two rich faunas of section 14 and one poor fauna in section 1. In contrast with section 14, *Scolopodus peselephantis* and the coelocerodonts were not encountered in the fauna of section 1, but these small conodonts may have escaped the author's attention during the examination of the residue, which was rich in terrigenous clastics.

In section 14 the lower boundary of this zone coincides with the disconformity at the top of member $D_{ä\text{-}d\,2}$, as a sample taken from the latter only contained a few fragments of westergaardodinas and coelocerodonts, most probably reworked and of Cambrian age.

II.2.4.5. The *Drepanodus arcuatus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the occurrence of *Drepanodus arcuatus* before the first appearance of *Prioniodus deltatus* (charts II and IV, fig. 15).
Description: In rock-section 1 and in the small rock-section of locality 2 near Horns Udde (see fig. 5 and chart IV the inset) *Drepanodus arcuatus* was found together with *Drepanoistodus inaequalis, D. numarcuatus, Paroistodus*

amoenus and *Scolopodus peselephantis. Paracordylodus gracilis* and *Protopanderodus longibasis* start their range in the higher part of this zone in section 1. *Cordylodus angulatus, C.rotundatus* and *Drepanoistodus acuminatus* were discontinously found in this zone.
Type-locality: Köpingsklint, section 1.
Type-strata: Member $K_{k\,1}$ (chart II, samples 6 to 10).
Remarks: This zone was based on five samples of section 1 and on one sample of the small rock-section, studied at locality 2 near Horns Udde (see fig. 5 and chart IV, sample I from member $K_{k\,2}$).

II.2.4.6. The *Prioniodus deltatus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the occurrence of *Prioniodus deltatus* before the first appearances of *Drepanoistodus forceps* and *Paroistodus parallelus* (chart IV and fig. 15).
Description: Together with *Prioniodus deltatus* we found *Cordylodus angulatus, Drepanoistodus inaequalis, D.acuminatus, D.numarcuatus, Paroistodus amoenus, Scolopodus peselephantis, Drepanodus arcuatus* and *Protopanderodus longibasis* in the sample that represents this zone. *Drepanoistodus inaequalis* and *D.acuminatus* seem to end their range in this zone.
Type-locality: Locality 2, near Horns Udde (see fig. 5).
Type-stratum: The glauconitic bed from which sample II was taken, see the small rock-section of locality 2, fig. 5, and chart IV the inset.
Remarks: This assemblage zone was based on one single sample and except for the occurrence of *Prioniodus deltatus* its fauna is similar to that of the *Drepanodus arcuatus* Assemblage Zone. *Cordylodus rotundatus* and *Paracordylodus gracilis* both were not actually found in this assemblage, their regional ranges indicate, however, that they might form part of it.

II.2.4.7. The *Drepanoistodus inconstans* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the occurrence of *Drepanoistodus inconstans* before the first appearance of *Gothodus microdentatus* and *Triangulodus subtilis* (chart II and fig. 15).
Description: In the rock-sequence of Köpingsklint *Drepanoistodus inconstans, D.forceps, Paroistodus parallelus* and *Prioniodus deltatus* start their range together. They were found together with *Cordylodus angulatus, Drepanoistodus numarcuatus, Paroistodus amoenus, Scolopodus peselephantis, Drepanodus arcuatus, Paracordylodus gracilis,* and *Protopanderodus longibasis.*
Type-locality: Köpingsklint, section 1.

Type-stratum: The limestone bed in member K_{k2} from which sample 12 was taken, see chart II.
Remarks: This assemblage zone was based on one single sample (12, section 1, chart II). *Cordylodus rotundatus* was not actually found in this zone, but it might form part of it, according to its deduced regional range (fig. 15). *Drepanoistodus numarcuatus* was not found anymore above this zone.

II.2.4.8. The *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the total range of *Gothodus microdentatus* and by the occurrence of *Triangulodus subtilis* before the first appearances of *Scolopodus rex* and *Oelandodus elongatus* (chart II and fig. 15).
Description: In the rock-sequence of Köpingsklint *Gothodus microdentatus, Triangulodus subtilis, Drepanoistodus conulatus* and *Periodon flabellum* start their range together in this zone. They were found together with *Cordylodus angulatus, Paroistodus amoenus, P.parallelus, Scolopodus peselephantis, Drepanodus arcuatus, Paracordylodus gracilis, Protopanderodus longibasis, Prioniodus deltatus, Drepanoistodus inconstans* and *D.forceps.*
Type-locality: Köpingsklint, section 1.
Type-strata: The two upper limestone beds of member K_{k2}.
Remarks: This assemblage zone was recognized in only one sample (13 in section 1, see chart II). *Paroistodus amoenus* and *Gothodus microdentatus* seem to terminate their range at the top of this zone. *Cordylodus rotundatus* was not actually found in this zone, but it might occur in it according to its regional range (fig. 15).

II.2.4.9. The *Prioniodus elegans/Oelandodus elongatus* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the occurrence of *Prioniodus elegans* and *Oelandodus elongatus* before the first appearance of *Stolodus stola* (chart III and fig. 15).
Description: In the rock-sequence of section 6 *Prioniodus elegans, Oelandodus elongatus* and *Scolopodus rex* start their range with a considerable number of species, known from the previous zones at Köpingsklint and near Horns Udde: *Scolopodus peselephantis, Drepanodus arcuatus, Protopanderodus longibasis, Prioniodus deltatus, Drepanoistodus forceps, D.conulatus, Paroistodus parallelus* and *Periodon flabellum.*
Type-locality: The coastal cliff between Äleklinta and Djupvik, section 6.
Type-stratum: The basal glauconitic bed of member $K_{ä\text{-}d1}$, sample 2, chart III.

Remarks: This assemblage zone was based on only one sample. The sudden appearance of a large group of species in the single sample of this zone must be due to a considerable gap in the record of section 6, between sample 1 and sample 2 (chart III). *Cordylodus angulatus, C.rotundatus, Paracordylodus gracilis* and *Triangulodus subtilis* were not actually found in this zone, but they might occur in it, according to their regional ranges (fig. 15).

II.2.4.10. The *Stolodus stola* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the occurrence of *Stolodus stola* before the first appearances of *Oelandodus costatus* and *Protopanderodus rectus* (chart III and fig. 15).
Description: In the rock-sequence between Äleklinta and Djupvik *Stolodus stola* makes its first appearance together with *Cordylodus rotundatus* and *Triangulodus subtilis.* Other constituent species of this zone are: *Cordylodus angulatus, Prioniodus deltatus, P.elegans, Drepanoistodus forceps, Paroistodus parallelus, Periodon flabellum* and *Oelandodus elongatus.*
Type-locality: The coastal cliff between Äleklinta and Djupvik, section 6.
Type-stratum: The thin and discontinuous limestone bed in the top portion of member $K_{ä\text{-}d1}$.
Remarks: This zone is again based on one assemblage, obtained from section 6, sample 3.

Paracordylodus gracilis, Protopanderodus longibasis, Drepanoistodus conulatus and *Scolopodus rex* were not actually found in this zone, but they might form part of it, according to their deduced regional ranges (fig. 15). *Cordylodus angulatus* seems to have its highest occurrence in this zone.

II.2.4.11. The *Protopanderodus rectus/Oelandodus costatus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the concurrence of the ranges of *Oelandodus costatus* and *Protopanderodus rectus* (chart III and fig. 15).
Description: This zone contains the total range of *Oelandodus costatus.* It also contains the overlap of the early part of the range of *Protopanderodus rectus* with the final part of the ranges of *Cordylodus rotundatus, Triangulodus subtilis* and *Prioniodus elegans.* In addition the assemblage comprises several species, known from previous zones (chart III and fig. 15).
Type-locality: The coastal cliff between Äleklinta and Djupvik, see section 6.
Type-strata: Member $K_{ä\text{-}d2}$ of the Köpingsklint Formation.
Remarks: This zone was based on three successive samples (4, 5 and 6) of

section 6. *Paracordylodus gracilis* was only found in the uppermost sample, but according to its decuded regional range, it might be found throughout this zone.

II.2.4.12. The *Protopanderodus rectus/Oepikodus evae* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the concurrence of the ranges of *Protopanderodus rectus* and *Oepikodus evae* prior to the first occurrence of *Oistodus lanceolatus* (charts II, III and IV, fig. 15).
Description: In the small rock-section of locality 2 near Horns Udde (see figs. 5 and 15) *Protopanderodus rectus* and *Oepikodus evae* were found together with *Scolopodus peselephantis, Drepanodus arcuatus, Protopanderodus longibasis* and *Prioniodus deltatus,* the latter four species being known from lower zones in this section. In the same sample *Drepanoistodus forceps, Paroistodus parallelus, Paracordylodus gracilis, Periodon flabellum, Oelandodus elongatus, Scolopodus rex* and *Stolodus stola* appear for the first time in the rock-section near Horns Udde (chart IV). The latter seven species were already known from older assemblages elsewhere in the area and they were found throughout this zone (charts II, III and IV, fig. 15).
Type-locality: Locality 2 near Horns Udde (see fig. 5).
Type-stratum: A limestone bed from the upper part of member $K_{k\,2}$ from which sample III was obtained (see chart IV the inset).
Remarks: This zone was primarily based on the fauna of sample III from the small rock-section near Horns Udde (see chart IV the inset). It was subsequently recognized in section 6 and 1. *Paracordylodus gracilis* is absent in sample 7 of section 6 and in sample 14 of section 1, both were taken from the basal glauconitic layer of member $K_{k\,3}$. *Drepanoistodus conulatus* does occur in sample 14 of section 1, contrary to the assemblage typical for this zone near Horns Udde. *Paracordylodus gracilis* seems to end its range within this zone (see fig. 15).

II.2.4.13. The *Oistodus lanceolatus/Prioniodus deltatus* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the overlap of the ranges of *Oistodus lanceolatus* and *Prioniodus deltatus* (charts III and IV, fig. 15).
Description: In one sample (no. 9) of section 6 *Oistodus lanceolatus* and *O.papiliosus* start their ranges, whereas *Prioniodus deltatus* and *Oelandodus elongatus* occur for the last time. A similar overlap was found near Horns Udde in the sample suite IV to 7b (chart IV). The only difference is that *Oelandodus elongatus* stops before the top of the zone here. In addition,

Drepanoistodus conulatus makes its first appearance in the rock-sequence near Horns Udde (chart IV). *Scolopodus peselephantis, Drepanodus arcuatus, Protopanderodus longibasis, Drepanoistodus forceps, Paroistodus parallelus* and *Stolodus stola* are additional species in all faunas of this zone in both localities. *Scolopodus rex, Protopanderodus rectus, Periodon flabellum, Drepanoistodus conulatus, Oelandodus elongatus* and *Oepikodus evae* were discontinuously encountered in this zone.
Type-locality: The coastal cliff north-east of Horns Udde.
Type-strata: Member $K_{k}3$ near Horns Udde (see samples IV, 3a, 3b, 4, 5, 7a and 7b in chart IV).
Remarks: This zone was found in sample 9 of section 6 (chart III) and in samples IV, 3a, 3b, 4, 5, 7a and 7b of the rock-sequence near Horns Udde (chart IV). See also the remarks of chapter II.2.4.16.

II.2.4.14. The *Oistodus lanceolatus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the occurrence of *Oistodus lanceolatus* before the first appearance of *Prioniodus crassulus* and after the last occurrence of *Prioniodus deltatus* (chart III and fig. 15).
Description: Scolopodus peselephantis, Drepanodus arcuatus, Protopanderodus longibasis, P.rectus, Drepanoistodus forceps, Periodon flabellum, Stolodus stola and *Oepikodus evae,* all long ranging species, were found throughout this assemblage zone. *Oistodus lanceolatus, Scolopodus rex, Drepanoistodus conulatus* and *Paroistodus parallelus* were discontinuously encountered in this zone.
Type-locality: The coastal cliff between Äleklinta and Djupvik, see section 6.
Type-strata: Some 50 cm. of limestone in the top portion of member $K_{k}3$ and the basal part of the Bruddesta Formation in section 6, see samples 11 to 14, chart III.
Remarks: Oistodus papiliosus was not actually found in this zone, but its deduced regional range (fig. 15) enables its occurrence in this zone.

The *Oistodus lanceolatus* Assemblage differs from the next younger *Prioniodus crassulus* Assemblage only in the presence of *Prioniodus crassulus.* The relative rareness of both marker species strongly hampers the differentiation between these assemblages, which thus may lose their independence in future work. Another reason for doubt concerning the independence of the *Oistodus lanceolatus* and *Prioniodus crassulus* Assemblage Zones will be mentioned in the remarks of chapter II.2.4.16.

II.2.4.15. The *Prioniodus crassulus* Assemblage Zone

Diagnosis: A conodont assemblage zone characterized by the occurrence of *Prioniodus crassulus* prior to the first appearance of *Prioniodus navis* (charts II, III and IV, fig. 15).
Description: The addition of *Prioniodus crassulus,* often in small numbers, is the only difference with the faunal composition of the *Oistodus lanceolatus* Assemblage Zone.
Type-locality: Köpingsklint, section 1.
Type-stratum: The basal limestone bed of the Bruddesta Formation in section 1.
Remarks: In sections 1 and 14 the first appearance of *Prioniodus crassulus* coincides with maxima in the occurrence of *Oepikodus evae* in the basal portions of the Bruddesta Formation. It is possible, that in section 6 the appearance of *Prioniodus crassulus* coincides with the acme of *Oepikodus evae* in the basal part of the Bruddesta Formation as well. This would make the lower boundary of the *Prioniodus crassulus* Zone coincide with the lower boundary of the Bruddesta Formation throughout the area (chart V). *Oistodus papiliosus* was not actually found in this zone, but it might occur according to its deduced regional range. See also the remarks of chapters II.2.4.14 and II.2.4.16.

II.2.4.16. The *Prioniodus navis/Prioniodus crassulus* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the concurrence of the ranges of *Prioniodus crassulus* and *Prioniodus navis* (charts II, III and IV, fig. 15).
Description: In the rock-sequence of N.W. Öland the overlap zone of *Prioniodus navis* and *P.crassulus* contains in addition: *Scolopodus peselephantis, Protopanderodus longibasis, P.rectus, Drepanoistodus forceps, Stolodus stola* and *Oistodus lanceolatus,* throughout. *Oepikodus evae* seems to end its range in the lower portion of this zone. *Paroistodus parallelus, Scolopodus rex, Drepanodus arcuatus,* ~~*Drepanoistodus conulatus*~~ and *Periodon flabellum* were discontinuously encountered in this zone.
Type-locality: Köpingsklint, section 1.
Type-strata: Some 35 cm. of limestone beds in the lower portion of the Bruddesta Formation, samples 17 to 22, section 1 (chart II).
Remarks: Oistodus papiliosus was not found in this zone, but it might form part of the assemblage according to its deduced regional range.

The boundary between this zone and the underlying *Prioniodus crassulus* Zone is of dubious character, because of the rareness of both marker species.

The upper boundary is also difficult to establish exactly, as it is only based on the last occurrence of *Prioniodus crassulus,* and because barren intervals are present towards the top of the zone in all sections (see charts II, III and IV).

If there really will be a transition from *Prioniodus deltatus* into *Prioniodus navis* (see chapter IV, pp. 86, 87), there must be a hiatus in the present knowledge of the regional ranges of both species (fig. 15). An important consequence of this possible transition could be, that the upper boundary of the *Oistodus lanceolatus/Prioniodus deltatus* Zone and the lower boundary of the *Prioniodus navis/Prioniodus crassulus* Zone are coinciding, which would mean the ultimate elimination of the intermediate *Oistodus lanceolatus* and *Prioniodus crassulus* Assemblage Zones (fig. 15).

II.2.4.17. The *Prioniodus navis/Stolodus stola* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by the concurrence of the ranges of *Prioniodus navis* and of *Stolodus stola,* after the last occurrence of *Prioniodus crassulus* (charts II, III and IV, fig. 15).
Description: The long ranging *Scolopodus peselephantis, S.rex, Drepanodus arcuatus, Protopanderodus longibasis, P.rectus, Drepanoistodus forceps, Periodon flabellum* and *Oistodus lanceolatus* are the common constituents of the fauna of this zone. The range of *Paroistodus parallelus* is discontinuous in this zone, and the same is true for the characteristic species *Prioniodus navis.*
Type-locality: The coastal cliff between Äleklinta and Djupvik, section 6.
Type-strata: Approximately 10 cm. of limestone at about 1.00 m. above the base of the Bruddesta Formation in section 6 (samples 20 and 21, chart III).
Remarks: For reasons mentioned before, the boundary with the underlying *Prioniodus navis/P.crassulus* Zone is not very pronounced. The upper boundary of the *Prioniodus navis/Stolodus stola* Zone is also very difficult to draw with certainty, due to its dependence on the last occurrence of one species, *Stolodus stola,* and because of the presence of barren intervals in all three sections.

After the distribution chart of section 1 had been made (chart II), sample 24 was searched for the occurrence of *Stolodus stola, Prioniodus crassulus* and *Prioniodus navis.* It was found to contain *Prioniodus navis* and *Stolodus stola,* but *Prioniodus crassulus* was absent. For this reason, this zone was placed in the "barren" interval in chart II.

Drepanoistodus conulatus and *Oistodus papiliosus* were not actually found in this zone, but they both might form part of the assemblage according to their regional ranges.

II.2.4.18. The *Drepanoistodus forceps* Assemblage Zone

Diagnosis: A conodont assemblage zone defined by part of the long range of *Drepanoistodus forceps,* after the last occurrence of *Stolodus stola* and before the first appearance of *Microzarkodina flabellum* (charts II, III and IV, fig. 15).
Description: In the rock-sequence of N.W. Öland there is an interval which may be characterized by *Drepanoistodus forceps,* one of the common long ranging species, in between the level of disappearance of *Stolodus stola* and the start of *Microzarkodina flabellum. Prioniodus navis* appeared to be rare or absent in this interval. Frequent species in this zone are: *Scolopodus peselephantis, S.rex, Drepanodus arcuatus, Protopanderodus longibasis, P.rectus, Drepanoistodus forceps, Periodon flabellum* and *Oistodus lanceolatus. Oistodus papiliosus* was sporadically found in this zone.
Type-locality: Locality 1 (fig. 5) near Horns Udde.
Type-strata: Some 35 cm. of limestone beds at 1.60 to 1.95 m. above the base of the Bruddesta Formation in section 14, sample 18 and 19 chart IV.
Remarks: Drepanoistodus conulatus and *Paroistodus parallelus* were not actually found in this zone, but they might be present according to their regional ranges.

As stated earlier, the lower boundary is not sharp. The upper boundary equally lacks a pronounced character, because *Microzarkodina flabellum* is often rare in the basal portion of the overlying *Microzarkodina flabellum* Assemblage Zone.

II.2.4.19. The *Microzarkodina flabellum* Assemblage Zone

Diagnosis: A conodont assemblage zone based on the range of *Microzarkodina flabellum,* before the first appearance of *Triangulodus brevibasis* (charts II, III and IV, fig. 15).
Description: Scolopodus peselephantis, Protopanderodus rectus and *Drepanoistodus forceps* were found throughout this zone. *Microzarkodina flabellum, Paroistodus parallelus, Drepanoistodus conulatus, Scolopodus rex, Drepanodus arcuatus, Protopanderodus longibasis, Prioniodus navis* and *Periodon flabellum* are discontinuously present in this zone. *Oistodus papiliosus* has its highest stratigraphic occurrence in the lower portion of the *Microzarkodina flabellum* Zone. In all sections this highest occurrence of *Oistodus papiliosus* is associated with "the Flowery Sheet".
Type-locality: The coastal cliff between Äleklinta and Djupvik, section 6.
Type-strata: The rock-interval from a level at about 1.65 m. up to about 4.35 m. above the base of the Bruddesta Formation in section 6.

Remarks: As the lower boundary of this zone is based on the relatively rare occurrence of *Microzarkodina flabellum* and the upper boundary only depends on the first appearance of *Triangulodus brevibasis,* it can be hard to recognize them exactly.

II.2.4.20. The *Triangulodus brevibasis* Assemblage Zone

Diagnosis: A conodont assemblage zone based on the occurrence of *Triangulodus brevibasis* (charts II, III and IV, fig. 15).
Description: In the rock-sequence of N.W. Öland, the marker species occurs together with remnants of the earlier fauna: *Scolopodus peselephantis, Drepanodus arcuatus, Protopanderodus longibasis, P.rectus, Drepanoistodus forceps, Prioniodus navis* and *Microzarkodina flabellum. Periodon flabellum, Scolopodus rex* and *Paroistodus parallelus* were discontinuously encountered in this zone. Except for the basal portion of this zone, *Protopanderodus latus* is commonly associated with *Triangulodus brevibasis* in the zone.
Type-locality: The coastal cliff between Äleklinta and Djupvik, section 6.
Type-strata: The upper 0.25 m. of the Bruddesta Formation and the entire Horns Udde Formation of section 6.
Remarks: There might have been possibilities for subdivision of this zone, for instance because *Protopanderodus latus* appears slightly after the marker species in two of the sections; or on the basis of the abrupt end of the range of *Paroistodus parallelus* in the section near Horns Udde and possibly in that of Köpingsklint. These features not being constant in all three sections, we ignored these possibilities.

The lower boundary of this zone is based on the first appearance of only one species, *Triangulodus brevibasis,* so its exact fixation in a section may be difficult. The upper boundary of this zone was not reached during this investigation. At Horns Udde this zone was found with an unaltered faunal composition up to the level at 3.60 m. above the base of the Horns Udde Formation.

Chapter III

BIOSTRATIGRAPHIC AND CHRONOSTRATIGRAPHIC CORRELATIONS

III.1. INTRODUCTION

The type-sequences of the Upper Cambrian and Ordovician in Great Britain are for the greater part composed of dark shales and other terrigenous clastical rocks. Their subdivision and correlation are mainly based on graptolites and trilobites.

The scarcity of graptolites in the shelly limestone facies of the Baltoscandian Ordovician and the lack of well documented chronostratigraphic units in Britain always hindered detailed correlations with the type-Ordovician of Great Britain.

As a consequence, a regional chronostratigraphic scale of the Baltic region, based on type-sections from the shelly sequences of Estonia, was established by Rõõmusoks (1960), and introduced in Sweden by Jaanusson (1960a, b). In the author's opinion, the use of regional chronostratigraphic classifications must be limited as much as possible and be restricted to those regions, which have hardly any fossil in common with the internationally accepted chronostratigraphic units. The latter condition is certainly not true for the shelly limestone facies of the Lower Ordovician of Sweden, as may be seen from the successful investigations of Tjernvik (1956). This author succeeded in correlating important parts of the Swedish Lower Ordovician with the British type-sequences, especially where these shelly sediments contain graptolitic shale intercalations. Fig. 19 compares the chronostratigraphic and some of the biostratigraphic units of the Cambro-Ordovician of Great Britain with some of the biostratigraphic units distinguished in Sweden.

In his original definition of the Ordovician System, Lapworth (1879) excluded the Tremadoc Series from the Ordovician, according to Whittington and Williams (1964). Most British geologists still consider the Tremadoc as part of the Upper Cambrian (Whittington & Williams, 1964), but according to Whittard (1956) and most Swedish geologists the Tremadoc Series belongs to the Ordovician, following Moberg (1900).

In this chapter, first the zonations of Tjernvik (1956) and our conodont-zonation will be correlated on the basis of the Öland data; they will be placed against the background of the British chronostratigraphic scale (fig. 19). This procedure will give an idea of the approximate chronostratigraphic position of the conodont-biozones of N.W. Öland. Subsequently, our conodont-zonation will be compared with Lindström's (1971) conodont-zonation of the Lower Ordovician of Europe; with Sergeeva's (1964, 1966) conodont-zonation of the Ordovician of the Leningrad region; and with the conodont faunas of the Ordovician of Estonia, reported by Viira, Kivimägi and Loog (1970).

III.2., BIOSTRATIGRAPHIC AND CHRONOSTRATIGRAPHIC CORRELATIONS OF THE ÖLANDIAN CONODONT- AND TRILOBITE-ZONATIONS

As the *Paradoxides* fauna is generally accepted to be indicative for the Middle Cambrian, the presence of *Paradoxides paradoxissimus* (WAHLENBERG) (= *Paradoxides tessini* BROGNIART, 1822 = *Entomostracites paradoxissimus* WAHLENBERG, 1821) proves the Middle Cambrian age of the "Tessini sandstone".

The chronostratigraphic position of the Zone of *Agnostus pisiformis,* reported by Westergård (1922) from member $D_{ä\text{-}d2}$ and the lower portion of member $D_{ä\text{-}d3}$ between Äleklinta and Djupvik (figs. 11 and 13), is not quite certain. Westergård considered this zone to be the lowermost zone of the Swedish "Olenid shale" (= Upper Cambrian). According to Stubblefield (1956, p. 33) the Zone of *Agnostus pisiformis* has not been found in the type-area of the Upper Cambrian in Britain.

Between Äleklinta and Djupvik the *Cordylodus angulatus/C.prion* Zone has been found in the conglomerate of member $D_{ä\text{-}d3}$, which would correspond with the *Dictyonema flabelliforme typica* Zone according to Westergård (1947, see fig. 13); which in turn, is approximately correlative with both Hede's (1951) Zone of *Dictyonema flabelliforme* and the British Zone of *Dictyonema flabelliforme* as given in the International Stratigraphical Lexicon, 1956, vol. I, fasc. 2a and fasc. 3a IV (see also figs. 11 and 19).

The *Cordylodus rotundatus* Zone is more difficult to place in the macrofossil-zonations. It was found at Köpingsklint below the Subzone of *Dictyonema flabelliforme norvegicum* and *Bryograptus kjerulfi* (compare fig. 12 and chart II) whereas the *Cordylodus rotundatus* Zone is thought to be younger than the Zone of *Cordylodus angulatus/C.prion.* In Hede's (1951) biozonation (see figs. 11 and 19) the *Cordylodus rotundatus* Zone thus might be approximately equivalent to part of, or the entire Zone of *Adelograptus hunnebergensis* and/or part of his Zone of *Dictyonema flabelliforme* *norvegicum* and *Bryograptus kjerulfi*. According to the data given by the International Stratigraphical Lexicon, 1956, vol. I, fasc. 3a IV, Hede's (1951) Zone of *Adelograptus hunnebergensis* is correlative with part of the British Zone of *Bryograptus* (fig. 19).

At Köpingsklint the *Drepanoistodus acuminatus* Zone and the *Drepanoistodus numarcuatus/Paroistodus amoenus* Zone together cover member $D_{k\,1}$, which is the "Ceratopyge shale" or the Zone of *Shumardia* according to Tjernvik (1956) (see figs. 16 and 19). Near Horns Udde, in section 14, the *Drepanoistodus numarcuatus/Paroistodus amoenus* Zone coincides with Tjernvik's "Ceratopyge shale" and thus with his Zone of *Shumardia* as well (fig. 18). According to Tjernvik (1956) the Zone of *Shumardia* is equivalent to the Swedish Zone of *Clonograptus heres*. According to the data given by the International Stratigraphical Lexicon, 1956, vol. I, fasc. 3a IV, the Zone of *Shumardia* might be equivalent to part of the British Zone of *Bryograptus* (fig. 19).

The *Drepanodus arcuatus* Zone in member $K_{k\,1}$ at Köpingsklint would be equivalent to the Zone of *Apatokephalus serratus* (fig. 16), which is considered by Tjernvik (1956, p. 177) to be the uppermost part of the Tremadocian in Sweden. The Zone of *Apatokephalus serratus* could not be correlated with the graptolite-zonations.

Neither the *Drepanodus arcuatus* Zone, nor the *Prioniodus deltatus* Zone in member $K_{k\,2}$ near Horns Udde (see locality 2, fig. 5) can be correlated with Tjernvik's (1956) zonation, as this rock-sequence was not studied by that author.

The *Drepanoistodus inconstans* Zone and the *Triangulodus subtilis/Gothodus microdentatus* Zone together cover the main part of member $K_{k\,2}$ at Köpingsklint and thus correspond to Tjernvik's Zone of *Plesiomegalaspis armata* (fig. 16). Elsewhere in Sweden the limestones with the *Plesiomegalaspis armata* Zone were found together with shales, from which Tjernvik collected a graptolite fauna, possibly correlative with the British Zone of *Dichograptus*, which is at the base of the Ordovician Arenig Series (fig. 19).

Between Äleklinta and Djupvik, the *Prioniodus elegans/Oelandodus elongatus* Zone, the *Stolodus stola* Zone, the *Protopanderodus rectus/Oelandodus costatus* Zone, the *Protopanderodus rectus/Oepikodus evae* Zone and the *Oistodus lanceolatus/Prioniodus deltatus* Zone together seem to correspond to Tjernvik's Zone of *Plesiomegalaspis planilimbata* (fig. 17). At Köpingsklint the *Protopanderodus rectus/Oepikodus evae* Zone is the only one of the Åleklinta suite that is present. It forms here part of Tjernvik's Zone of *Plesiomegalaspis planilimbata* also (fig. 16). The *Protopanderodus rectus/Oepikodus evae* Zone from the upper portion of member

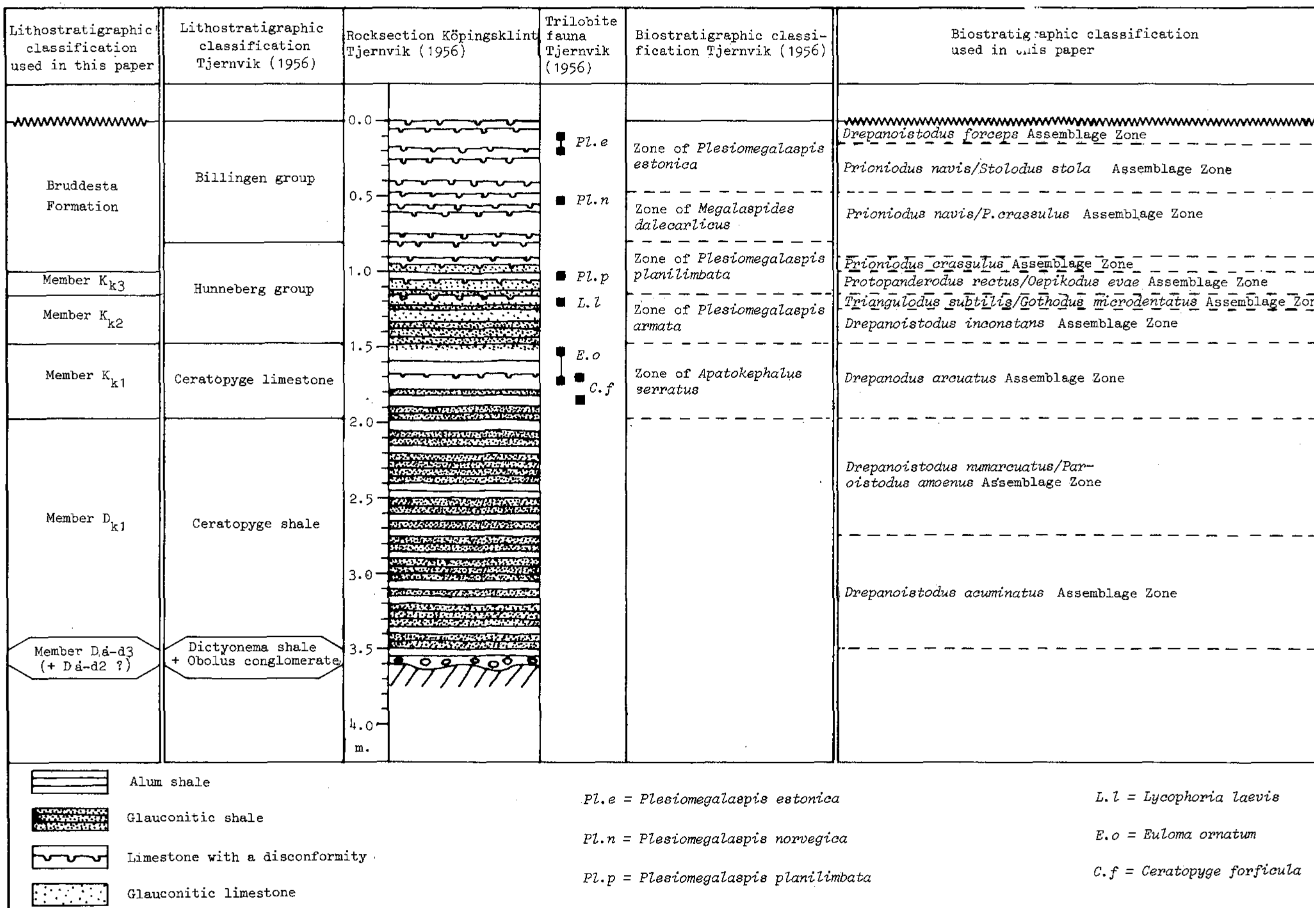

Fig. 16 A rock-sequence from Köpingsklint and its trilobite-zonation, described by Tjernvik (1956). The lithostratigraphic and conodont – biostratigraphic classifications used in this paper are put in juxtaposition.

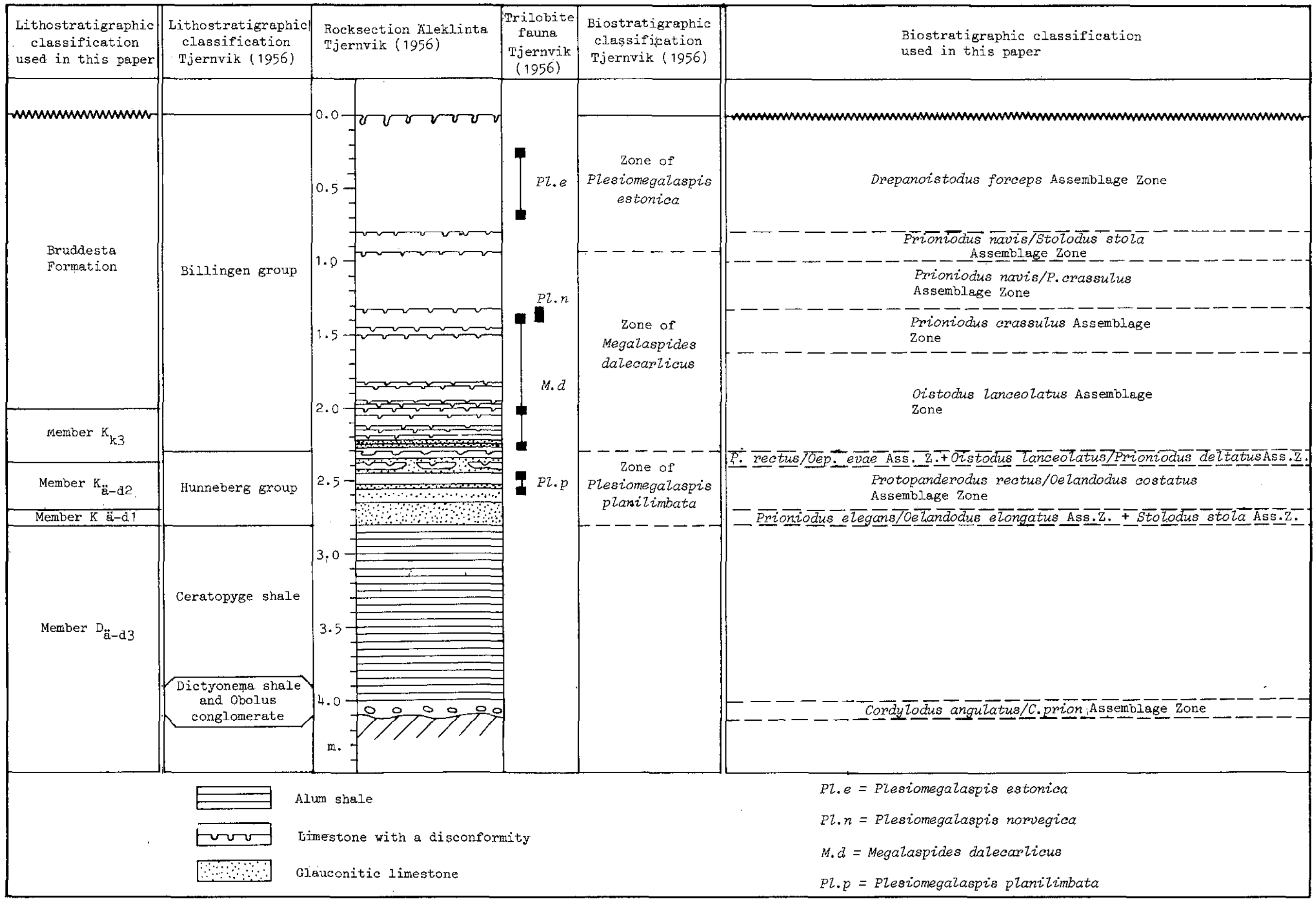

Fig. 17 A rock-sequence from the sea-cliff north of Äleklinta and its trilobite-zonation, described by Tjernvik (1956). The lithostratigraphic and conodont- biostratigraphic classifications used in this paper are put in juxtaposition.

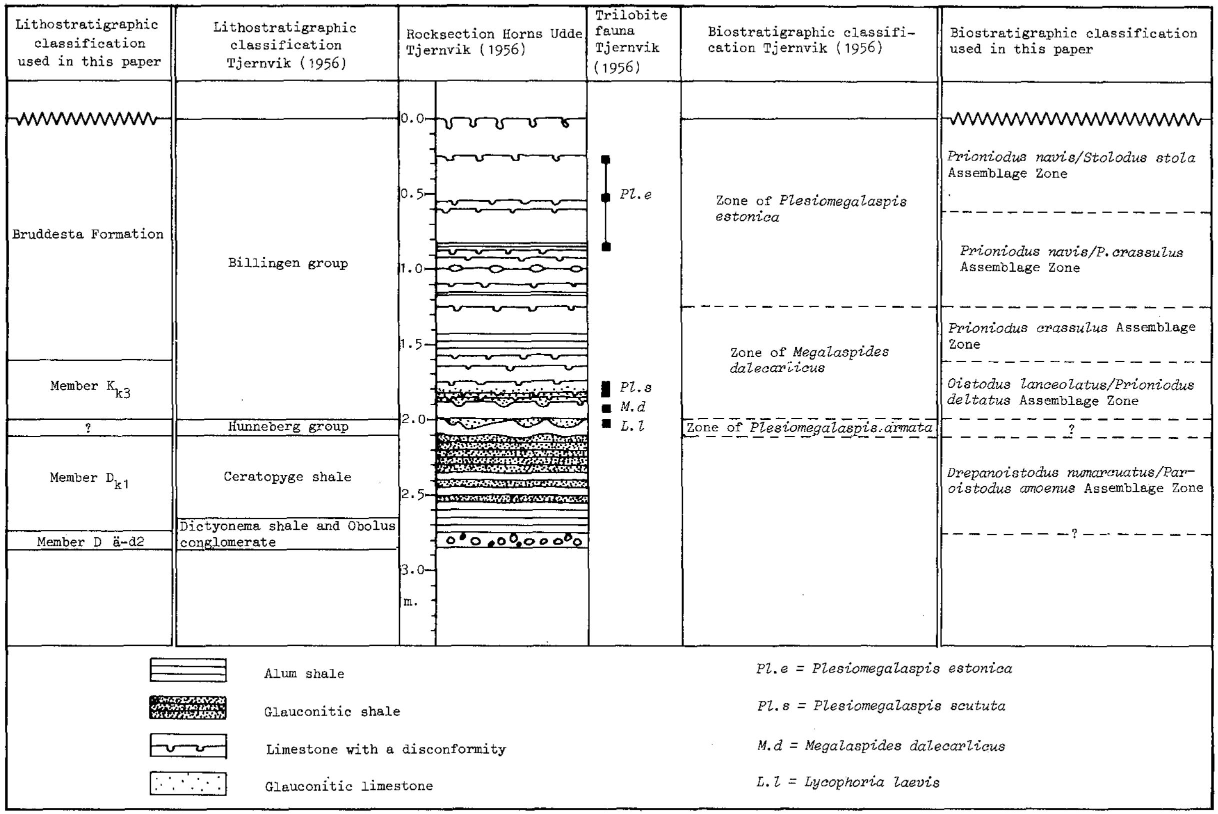

Fig. 18 A rock-sequence from the Horns Udde area and its trilobite-zonation, described by Tjernvik (1956). The lithostratigraphic and conodont-biostratigraphic classifications used in this paper are put in juxtaposition.

K_{k2} near Horns Udde (see locality 2, fig. 5) can not be correlated with Tjernvik's zonation as this rock-section was not described by that author. From the Äleklinta suite mentioned above, only the *Oistodus lanceolatus/ Prioniodus deltatus* Zone is present in member K_{k3} of section 14 near Horns Udde; but here it would correspond to Tjervik's next higher Zone of *Megalaspides dalecarlicus* (fig. 18). The latter correlation seems to disagree with the position of the *Oistodus lanceolatus/Prioniodus deltatus* Zone at the top of Tjernvik's Zone of *Plesiomegalaspis planilimbata* in section 6 (fig. 17). However, the boundary between both trilobite-zones at Äleklinta was drawn rather arbitrarily by Tjernvik (fig. 17), and it is quite possible that this boundary may be placed at a slightly lower level. It might well coincide with the boundary between the *Protopanderodus rectus/Oepikodus evae* Zone and the *Oistodus lanceolatus/Prioniodus deltatus* Zone. This would imply, that in the area between Äleklinta and Djupvik the *Protopanderodus rectus/Oepikodus evae* Zone forms the top part of Tjernvik's Zone of *Plesiomegalaspis planilimbata.* The *Oistodus lanceolatus/Prioniodus deltatus* Zone would thus be part of Tjernvik's Zone of *Megalaspides dalecarlicus* in this area, as is the case in section 14 near Horns Udde.

According to Tjernvik, the lower portion of his Zone of *Plesiomegalaspis planilimbata* corresponds with the Zone of *Tetragraptus phyllograptoides,* and its upper portion corresponds with the Zone of *Didymograptus balticus* of the Swedish shale facies. According to the same author (1956, p. 182), the Zone of *Tetragraptus phyllograptoides* would be correlative with the Upper Subzone of *Tetragraptus* of the British zonation, and the Zone of *Didymograptus balticus* would correspond to the British Subzone of *Didymograptus deflexus* (fig. 19).

On the basis of the considerations mentioned above, and according to fig. 17, the *Oistodus lanceolatus/Prioniodus deltatus* Zone, the *Oistodus lanceolatus* Zone, the *Prioniodus crassulus* Zone, the *Prioniodus navis/ P.crassulus* Zone, the *Prioniodus navis/Stolodus stola* Zone and part of the *Drepanoistodus forceps* Zone together seem to correspond to Tjernvik's Zone of *Megalaspides dalecarlicus* plus his Zone of *Plesiomegalaspis estonica* at Äleklinta.

In section 14 near Horns Udde, Tjernvik's Zone of *Megalaspides dalecarlicus* together with his Zone of *Plesiomegalaspis estonica* seem to cover the rock-interval with the *Oistodus lanceolatus/Prioniodus deltatus* Zone, the *Prioniodus crassulus* Zone, the *Prioniodus navis/P.crassulus* Zone and the *Prioniodus navis/Stolodus stola* Zone (fig. 18), thus within the conodont-zone interval of Äleklinta. According to fig. 16, however, the *Prioniodus crassulus* Zone from the base of the Bruddesta Formation at Köpingsklint would be out op step. It would correspond to the upper part of Tjernvik's Zone of *Plesiomegalaspis planilimbata,* i.e. it would be relatively too low. As, however, Tjernvik drew the upper boundary of the latter zone rather arbitrarily, and as elsewhere on Öland the *Prioniodus crassulus* Zone forms part of Tjernvik's *Megalaspides dalecarlicus* Zone (figs. 17 and 18), it seems quite probable that at Köpingsklint the upper boundary of the Zone of *Plesiomegalaspis planilimbata* had better be placed at the base of the Bruddesta Formation, which corresponds to the lower boundary of the *Prioniodus crassulus* Zone. If this is correct, the Zone of *Megalaspides dalecarlicus* and the Zone of *Plesiomegalaspis estonica* at Köpingsklint together would cover the rock-interval with the *Prioniodus crassulus* Zone, the *Prioniodus navis/P.crassulus* Zone, the *Prioniodus navis/Stolodus stola* Zone and part of the *Drepanoistodus forceps* Zone (fig. 16).

At Köpingsklint part of our *Prioniodus navis/Prioniodus crassulus* Zone seems to correspond to part of Tjernvik's Zone of *Megalaspides dalecarlicus* (fig. 16). In section 14 near Horns Udde part of the *Prioniodus navis/ Prioniodus crassulus* Zone seems to correspond to part of Tjernvik's Zone of *Plesiomegalaspis estonia* (fig. 18). The boundary between Tjernvik's Zones of *Megalaspides dalecarlicus* and *Plesiomegalaspis estonica* thus may be situated somewhere within our *Prioniodus navis/Prioniodus crassulus* Zone (fig. 19).

According to Tjernvik (1956, pp. 181, 185) his Zone of *Megalaspides dalecarlicus* and his Zone of *Plesiomegalaspis estonica* correspond with the Zone of *Phyllograptus densus* and the Zone of *Phyllograptus angustifolius elongatus* of the Swedish shale facies, respectively. In turn, the latter two zones would represent the Subzone of *Didymograptus nitidus* of the British graptolite-zonation (fig. 19).

By lack of a detailed macrofossil-biozonation of the remaining portion of the rock-sequence of N.W Öland, a more or less justified biostratigraphic correlation with the British graptolite-zonation can not be given. Only indirect information is availabe, concerning the approximate stratigraphic position of the "Limbata limestone", which contains our upper two conodont-zones. Tjernvik (1956, pp. 181, 183, 185) reported, that the basal portion of the "Limbata limestone" at Hällekis on Kinnekulle corresponds with shales, containing *Didymograptus hirundo* and *Phyllograptus* cf. *nobilis.* These graptolites are characteristic for the basal portion of the Swedish Zone of *Isograptus gibberulus.* In turn, this Zone of *Isograptus gibberulus* would be correlative with the Subzone of *Isograptus gibberulus* together with the Zone of *Didymograptus hirundo* of the British graptolite-zonation (fig. 19).

III.3. CORRELATION WITH LINDSTRÖM'S CONODONT–ZONATION OF THE LOWER ORDOVICIAN OF EUROPE

In fig. 19 Lindström's (1971) conodont-zonation of the Lower Ordovician of Europe is tentatively correlated with the conodont-zonation presented in this paper. A correlation of Lindström's zonation and Tjernvik's (1956) trilobite- and graptolite-zonation (based on the data from Lindström (1971)) was already given in fig. 11.

The oldest conodont-zone mentioned by Lindström (1971) is the *Cordylodus angulatus* Zone, which he correlated with the British Zone of *Dictyonema flabelliforme* and with the Estonian Pakerortian Stage. As Lindström gave no exact faunal composition of his *Cordylodus angulatus* Zone, its correlation is difficult to make. If, however, *Cordylodus angulatus* is considered characteristic for Lindström's oldest zone and *Paltodus deltifer* (= *Drepanoistodus inaequalis* emend. herein) is considered typical for Lindström's next following Zone of *Paltodus deltifer* (fig. 19), the *Cordylodus angulatus* Zone must be correlative with our *Cordylodus angulatus/C.prion* Assemblage Zone (figs. 15 and 19). If so, the *Cordylodus angulatus* Zone is correlative with at least part of the British Zone of *Dictyonema flabelliforme* (fig. 19).

The *Paltodus deltifer* Zone of Lindström (1971) seems to be characterized by the occurrence of *Paltodus deltifer* (= *Drepanoistodus inaequalis* emend. herein), together with the genus *Cordylodus*, *Oneotodus variabilis* (= elements of *Drepanoistodus acuminatus* emend. herein) and *Paroistodus numarcuatus* (= elements of *Drepanoistodus numarcuatus* emend. herein plus elements of *Paroistodus amoenus* emend. herein). If *Paltodus deltifer* is considered characteristic for this zone and *Paroistodus proteus* (= elements of *Paroistodus parallelus* emend. herein) is typical for Lindström's next younger zone (fig. 19), then the *Paltodus deltifer* Zone must correspond to a rock-interval containing the *Cordylodus rotundatus* Zone, up to and including the *Prioniodus deltatus* Zone of north-western Öland (figs. 15 and 19). It would imply, that at least part of Lindström's *Paltodus deltifer* Zone corresponds to the British Zone of *Bryograptus* (fig. 19).

Lindström's Zone of *Paroistodus proteus* would contain *Paroistodus proteus* (= elements of our *Paroistodus parallelus*) and *Paltodus inconstans* (= elements of our *Drepanoistodus inconstans*) as "leading species". Because of the range of the latter species (fig. 15), this zone would be correlative with the rock-interval on north-western Öland, containing the *Drepanoistodus inconstans* Zone and the *Triangulodus subtilis/Gothodus microdentatus* Zone (fig. 19). This would imply, that Lindström's Zone of *Paroistodus proteus* corresponds to Tjernvik's Zone of *Plesiomegalaspis armata* on N.W.

Öland and possibly with the British Zone of *Dichograptus*. Lindström (1971), however, correlated his *Paroistodus proteus* Zone with the higher Swedish Zone of *Tetragraptus phyllograptoides* and with the basal portion of the British Zone of *Didymograptus extensus* (see fig. 1 of that author).

According to Lindström (1971, p. 27), *Prioniodus elegans* and *Oistodus lanceolatus* both would form part of the fauna, that is characteristic for his Zone of *Prioniodus elegans*. In the rock-sequence of N.W. Öland, however, the range of *Prioniodus elegans* seems to end before *Oistodus lanceolatus* appears (fig. 15). If only *Prioniodus elegans* is considered as the typical species of Lindström's Zone of *Prioniodus elegans*, the latter would correspond to the rock-interval on N.W. Öland, comprising our *Prioniodus elegans/Oelandodus elongatus*, *Stolodus stola* and *Protopanderodus rectus/Oelandodus costatus* Zones (figs. 15 and 19). Fig. 19 shows, that this interval corresponds to the lower portion of Tjernvik's Zone of *Plesiomegalaspis planilimbata* and with the Swedish Zone of *Tetragraptus phyllograptoides* together with part of the Zone of *Didymograptus balticus*. Instead, Lindström correlates (1971, fig. 1) his Zone of *Prioniodus elegans* with the Swedish Zone of *Didymograptus balticus*.

The *Prioniodus evae* Zone, described by Lindström (1971, pp. 29 and 30) would be divisible into a lower part in which *Prioniodus evae* (= *Oepikodus evae* emend. herein) is abundantly present and an upper part "in which this species is scarce or absent". *Prioniodus evae* would be abundant in the lower part of the *Prioniodus evae* Zone, except for its basal portion. In the lower part of Lindström's *Prioniodus evae* Zone *Scolopodus rex*, *Periodon flabellum* and *Protopanderodus rectus* would appear for the first time; moreover, it would contain *Drepanoistodus forceps* (= part of *Drepanoistodus forceps* emend. herein) and *Paroistodus parallelus* (= part of *Paroistodus parallelus* emend. herein). The data of N.W. Öland (fig. 15) indicate, that all these species appear prior to the first appearance of *Oepikodus evae*. The acme of the occurrence of *Oepikodus evae* is not confined to one of the Ölandian assemblage zones. In charts II, III and IV this acme is found in the upper part of the *Oistodus lanceolatus/Prioniodus deltatus* Zone (chart IV), in the *Oistodus lanceolatus* Zone (chart III), in the *Prioniodus crassulus* Zone (charts II and IV) and in the *Prioniodus navis/P.crassulus* Zone (chart II). If the base of the lower part of Lindström's *Prioniodus evae* Zone is characterized by the first appearance of *Prioniodus evae* and if the upper boundary of this lower part is based upon the stratigraphically highest occurrence of the *Prioniodus evae* acme, this lower part would be correlative with a rock-interval on Öland, containing our *Protopanderodus rectus/Oepikodus evae* Zone, up to and including even the basal portion of the *Prioniodus* *navis/P.crassulus* Zone (figs. 15 and 19).

The upper part of Lindström's *Prioniodus evae* Zone, in which *Prioniodus evae* is scarce or absent, can be correlated approximately with the middle part of the *Prioniodus navis/P.crassulus* Zone of N.W. Öland (charts II, III and IV). In fig. 19, Lindström's entire *Prioniodus evae* Zone then seems to be correlative with the uppermost part of Tjernvik's Zone of *Plesiomegalaspis planilimbata* together with Tjernvik's Zone of *Megalaspides dalecarlicus* and possibly with part of his zone of *Plesiomegalaspis estonica,* i.e. with the uppermost portion of the Swedish Zone of *Didymograptus balticus* together with the Zone of *Phyllograptus densus* and possibly with part of the Zone of *Phyllograptus angustifolius elongatus.*

Lindström (1971, fig. 1) himself correlated his Zone of *Prioniodus evae* with the Swedish Zone of *Phyllograptus densus* together with the Zone of *Phyllograptus angustifolius elongatus,* or to the upper part of his Billingen Substage. According to Lindström (1971, p. 30), the upper boundary of this substage is marked "by a bed containing brightly coloured discontinuity surfaces and amphora-shaped borings". Obviously, Lindström meant what was called "the Flowery Sheet" in this paper, and the fact should be remarked, that on Öland *Oepikodus evae* was not found higher than a level at about 1.20 m. below "the Flowery Sheet" (chart III).

In Lindström's next younger *Baltoniodus triangularis* Zone, *Baltoniodus triangularus* (= elements referred to *Prioniodus navis* emend. herein) is the leading new element and *Microzarkodina flabellum* is another diagnostic species. Furthermore, *Drepanoistodus forceps* (= part of *Drepanoistodus forceps* emend. herein) and *Protopanderodus rectus* would be abundantly present. As the base of the *Baltoniodus triangularis* Zone is characterized by the first appearance of *Baltoniodus triangularis,* this boundary must be correlated with the base of the *Prioniodus navis/P.crassulus* Assemblage Zone (figs. 15 and 19). This implies, that the upper portion of Lindström's *Prioniodus evae* Zone and the basal portion of his *Baltoniodus triangularis* Zone show overlap in our zonation (fig. 19). *Baltoniodus triangularis* would be succeeded by *Baltoniodus navis* (= part of *Prioniodus navis* emend. herein) according to Lindström (1971, p. 31), the latter species being characteristic for his Zone of *Baltoniodus navis.* The upper boundary of the latter zone is marked by the first appearances of *Paroistodus originalis* (= part of *Paroistodus parallelus* emend. herein), and of *Oistodus brevibasis* (= element of *Triangulodus brevibasis* emend. herein), both species being typical for Lindström's next younger Zone of *Paroistodus originalis.* This indicates, that the upper boundary of the *Baltoniodus navis* Zone is correlative with the upper boundary of the *Microzarkodina flabellum* Zone of N.W. Öland. Thus the *Baltoniodus triangularis* Zone and the *Baltoniodus navis* Zone together correspond with the rock-interval, containing our *Prioniodus navis/P.crassulus, Prioniodus navis/Stolodus stola, Drepanoistodus forceps* and *Microzarkodina flabellum* Zones of N.W. Öland. According to Lindström (1971, pp. 30–31 and fig. 1), the *Baltoniodus triangularis* Zone and the *Baltoniodus navis* Zone together cover the rock-interval between "the Flowery Sheet" and "the Bloody layer". On N.W. Öland, however, the base of Lindström's *Baltoniodus triangularis* Zone is situated well below "the Flowery Sheet", and the top of the *Baltoniodus navis* Zone does not coincide with the base of "the Bloody layer" neither in section 1, nor in section 6 (chart V).

In fig. 19, the *Baltoniodus triangularis* Zone and the *Baltoniodus navis* Zone together would correspond to a rock-interval containing at least the Zone of *Plesiomegalaspis estonica* (= the Zone of *Phyllograptus angustifolius elongatus*) and the lower portion of the Zone of *Isograptus gibberulus*. It is even possible that part of Tjernvik's Zone of *Megalaspides dalecarlicus* forms part of this rock-interval (fig. 19). This interval corresponds in turn with the upper portion of the British Subzone of *Didymograptus nitidus* together with part of the Subzone of *Isograptus gibberulus*. According to Lindström (1971, fig. 1), his *Baltoniodus triangularis* Zone and *Baltoniodus navis* Zone together would correspond to the Scandinavian Zone of *Isograptus gibberulus* and to the basal portion of the British Zone of *Didymograptus hirundo*, instead.

The zone of *Paroistodus originalis* of Lindström (1971, p. 31). contains *Paroistodus originalis* (= part of *Paroistodus parallelus* emend. herein), *Drepanoistodus basiovalis* (= part of *Drepanoistodus forceps* emend. herein) and *Oistodus brevibasis* (= element of *Triangulodus brevibasis* emend. herein). The latter species would be characteristic for this zone. This implies, that the lower boundary of Lindström's Zone of *Paroistodus originalis* is correlative with the lower boundary of the *Triangulodus brevibasis* Zone of N.W. Öland. The upper boundary of the *Paroistodus originalis* Zone could not be located in the rock-sequence of N.W. Öland, as *Microzarkodina parva*, the typical species of Lindström's next younger Zone of *Microzarkodina parva*, was not encountered in the studied faunas.

III.4. CORRELATION WITH SERGEEVA'S CONODONT-ZONATION OF THE LOWER ORDOVICIAN FROM THE LENINGRAD AREA

The conodont faunas, characterizing Sergeeva's (1964, 1966) zones could be compared with the conodont assemblages of north-western Öland. In fig. 19 Sergeeva's conodont zones are correlated with the conodont zones proposed now. The chronostratigraphic units from which Sergeeva obtained her conodont faunas were put in this table as well.

Sergeeva's Zone of *Cordylodus angulatus* is characterized by the occurrence of *Cordylodus angulatus* together with *Cordylodus rotundatus, Drepanodus arcuatus* and *Drepanoistodus acuminatus,* before the first appearance of *Paroistodus parallelus, Drepanoistodus forceps,* and *Drepanoistodus inconstans;* all these species except *Cordylodus angulatus* and *Cordylodus rotundatus* being named as emended in this paper. This Zone of *Cordylodus angulatus* is correlative with the rock-interval on north-western Öland, containing our *Cordylodus rotundatus* up to *Prioniodus deltatus* Zones inclusive (figs. 15 and 19). Part of Sergeeva's Zone of *Cordylodus angulatus* thus appears to correspond to the Zone of *Shumardia* and the Zone of *Apatokephalus serratus* as described by Tjernvik (1956) from Köpingsklint (see fig. 19).

Sergeeva's Subzone of *Drepanodus proteus* seems to be characterized by the concurrence of the ranges of our *Paroistodus parallelus, Drepanodus arcuatus, Drepanoistodus forceps* and *Drepanoistodus inconstans.* Thus defined, the Subzone of *Drepanodus proteus* corresponds with the *Drepanoistodus inconstans* Zone together with the *Triangulodus subtilis/Gothodus microdentatus* Zone of Köpingsklint (see chart II and fig. 15). The latter two zones are equivalent to the Zone of *Plesiomegalaspis armata,* defined by Tjernvik (1956) at Köpingsklint (see figs. 16 and 19).

The *Prioniodus elegans* Subzone of Sergeeva seems to be characterized by the total range of *Prioniodus elegans* emend. herein. Thus defined, this subzone is correlative with the *Prioniodus elegans/Oelandodus elongatus* Zone together with the *Stolodus stola* Zone and the *Protopanderodus rectus/Oelandodus costatus* Zone of section 6 (see chart III and figs. 15 and 19). These zones are equivalent to the lower portion of the Zone of *Plesiomegalaspis planilimbata,* defined by Tjernvik (1956) at Äleklinta (fig. 17 and 19).

Sergeeva's Subzone of *Prioniodus evae* seems to be characterized by the concurrence of the ranges of *Oepikodus evae* emend. herein, *Paroistodus parallelus* emend. herein, *Stolodus stola* emend. LINDSTRÖM, *Protopanderodus rectus* emend. LINDSTRÖM, *Oistodus lanceolatus* emend. herein, *Drepanoistodus forceps* emend. herein, *Scolopodus rex* LINDSTRÖM and *Prioniodus crassulus* emend. herein. In the rock-sequence of north-western Öland only *Oistodus lanceolatus* and *Prioniodus crassulus* appear after the first occurrence of *Oepikodus evae* (fig. 15). If, however, Sergeeva's Subzone of *Prionoidus evae* is considered to be characterized by the total range of

Oepikodus evae emend. herein, this subzone corresponds with the rock-interval, containing our *Protopanderodus rectus/Oepikodus evae* up to and including the lower portion of our *Prioniodus navis/Prioniodus crassulus* Zone (fig. 15). This interval corresponds to the upper portion of Tjernvik's (1956) *Plesiomegalaspis planilimbata* Zone, together with his *Megalaspides dalecarlicus* Zone and possibly part of Tjernvik's Zone of *Plesiomegalaspis estonica* (fig. 19 and chapter III.2.).

From the species that would characterize Sergeeva's Subzone of *Oistodus parallelus,* only *Oistodus originalis* (= element referred to *Paroistodus parallelus* emend. herein), *Triangulodus brevibasis* emend. herein and *Microzarkodina flabellum* emend. LINDSTRÖM are found in the rock-sequence of north-western Öland, after the disappearance of *Oepikodus evae* emend. herein. Another typical species, *Prioniodus navis* (= element of *Prioniodus navis* emend. herein) occurs together with *Oepikodus evae* in the basal portion of our *Prioniodus navis/P. crassulus* Zone. To facilitate a correlation between Sergeeva's Subzone of *Oistodus parallelus* with the conodont-zonation of Öland, the base of this Subzone of *Oistodus parallelus* is considered to be defined by the first appearance of *Prioniodus navis* emend. herein. The upper boundary of this subzone can not be located on Öland, as the typical species of Sergeeva's next younger Subzone of *Falodus simplex,* were not encountered. Thus defined, the Subzone of *Oistodus parallelus* is correlative with at least the rock-interval containing the *Prioniodus navis/P.crassulus* Zone up to and including the *Triangulodus brevibasis* Zone (figs. 15 and 19). If the base of the Subzone of *Oistodus parallelus* is defined by the first appearance of *Prioniodus navis* emend. herein, the basal portion of this subzone and the upper portion of Sergeeva's next older Subzone of *Prioniodus evae* have an overlap in the *Prioniodus navis/P.crassulus* Zone of Öland (fig. 19). For this reason Sergeeva's Subzone of *Oistodus parallelus* may include the upper portion of Tjernvik's Zone of *Megalaspides dalecarlicus.* The Zone of *Plesiomegalaspis estonica* certainly forms part of it.

III.5. A COMPARISON BETWEEN THE ÖLANDIAN CONODONT ASSEMBLAGES AND SOME CONODONT FAUNAS OF ESTONIA

Viira, Kivimägi and Loog (1970) described the conodont fauna of the Varangu Member (= $A_{III}V$) of northern Estonia and also gave the faunal composition of the units $A_{II}M$, $B_{I}a$ and $B_{I}b$ of the Estonian stratigraphical scheme.

These conodont faunas are comparable with the conodont assemblages found on Öland, and in fig. 19 a biostratigraphical correlation of the conodont faunas of these two regions has been given. In addition, the lithostratigraphic and chronostratigraphic units, from which the Estonian faunas originate, are entered in fig. 19.

The fauna of unit $A_{II}M$ is very similar to that of the Ölandian *Cordylodus rotundatus* Zone.

From the Varangu Member (= $A_{III}V$) Viira et al. (1970) described two conodont faunas. The older one is very similar to that of the *Drepanoistodus acuminatus* Zone at Köpingsklint. The younger fauna of the Varangu Member is quite comparable with that of the *Drepanoistodus numarcuatus/ Paroistodus amoenus* Zone of Öland. This would imply, that the Varangu Member is time equivalent to the "Ceratopyge shale" (= the Zone of *Shumardia*), distinguished by Tjernvik (1956) in north-western Öland (figs. 16, 18 and 19).

In the fauna from unit $B_I a$, reported by Viira et al. (1970, p. 154), two conodont assemblages may be distinguished. Most probably, the older of these assemblages is correlative with the *Prioniodus deltatus* Assemblage, and the younger one with the *Drepanoistodus inconstans* Assemblage of north-western Öland. The *Drepanoistodus inconstans* Assemblage Zone was proved to be equivalent with the lower portion of the Zone of *Plesiomegalaspis armata,* defined by Tjernvik (1956) at Köpingsklint (see chapter III.2., figs. 16 and 19).

The conodont fauna of unit $B_I b$, given by Viira et al. (1970, p. 154), also permits the distinction of two assemblages. The correlation of these assemblages with our assemblages is more difficult, because of the occurrence of *Oistodus lanceolatus.* With the exception of *Oistodus lanceolatus,* the older fauna of unit $B_I b$ is similar to the younger fauna of unit $B_I a$ and almost equivalent to the fauna of the *Drepanoistodus inconstans* Zone at Köpingsklint. On north-western Öland *Oistodus lanceolatus* emend. herein appears at a much higher stratigraphic level and in a conodont assemblage of quite different composition. It seems quite possible, therefore, that *Oistodus lanceolatus* as reported by Viira et al. is not synonymous with our *Oistodus lanceolatus* emend. herein.

Compared to the older fauna of unit $B_I b$, the younger fauna of this unit only lacks *Distacodus peracutus, Paltodus inconstans* (both elements of *Drepanoistodus inconstans* emend. herein) and *Acodus deltatus* (= element of *Prioniodus deltatus* emend. herein). The occurrence of *Cordylodus angulatus* and the absence of *Drepanoistodus inconstans* emend. herein in this younger assemblage of unit $B_I b$ might indicate, that it is younger than the *Triangulodus subtilis/Gothodus microdentatus* Zone and older than the

<table>
<tr><th colspan="5">Great Britain</th><th colspan="2">Sweden</th></tr>
<tr><th>Systems</th><th>Sub-systems</th><th>Series</th><th colspan="2">Graptolitic zones 2)</th><th>Graptolitic zones Tjernvik (1956)</th><th>Trilobite-zonation N.W. Öland Tjernvik (1956).</th></tr>
<tr><td rowspan="7">Ordo-vician</td><td rowspan="7">Lower Ordo-vician</td><td rowspan="7">Arenig</td><td colspan="2">Zone of Didymograptus hirundo</td><td rowspan="2">Zone of Isograptus gibberulus</td><td rowspan="2"></td></tr>
<tr><td rowspan="5">Zone of Didymograptus extensus</td><td>Subzone of Isograptus gibberulus</td></tr>
<tr><td rowspan="2">Subzone of Didymograptus nitidus</td><td>Zone of Phyllograptus angustifolius elongatus</td><td>Zone of Plesiomegalaspis estonica</td></tr>
<tr><td>Zone of Phyllograptus densus</td><td>Zone of Megalaspides dalecarlicus</td></tr>
<tr><td>Subzone of Didymograptus deflexus</td><td>Zone of Didymograptus balticus</td><td rowspan="2">Zone of Plesiomegalaspis planilimbata</td></tr>
<tr><td>Upper Subzone of Tetragraptus</td><td>Zone of Tetragraptus phyllograptoides</td></tr>
<tr><td colspan="2">Zone of Dichograptus</td><td>Undescribed dichograptids</td><td>Zone of Plesiomegalaspis armata</td></tr>
<tr><td rowspan="6">? Cambrian</td><td rowspan="6">? Upper Cambrian</td><td rowspan="6">Tremadoc</td><td colspan="2">?</td><td>?</td><td>Zone of Apatokephalus serratus</td></tr>
<tr><td colspan="2" rowspan="3">Zone of Bryograptus</td><td>Zone of Clonograptus heres</td><td>Zone of Shumardia</td></tr>
<tr><td>Zone of Dictyonema flabelliforme norvegicum and Bryograptus kjerulfi 1)</td><td rowspan="4"></td></tr>
<tr><td>Zone of Adelograptus hunnebergensis</td></tr>
<tr><td colspan="2" rowspan="2">Zone of Dictyonema flabelliforme</td><td>Zone of Dictyonema flabelliforme</td></tr>
<tr><td>Zone of Dictyonema sociale</td></tr>
<tr><td colspan="7">1) The biozonation of the "Dictyonema shale" according to Hede (1951).</td></tr>
</table>

Fig. 19 A correlation of some Upper Cambrian and Lower Ordovician biostratigraphic units from Great Britain and from the Baltic area; with a comparison between the chronostratigraphic units they originate from.

Sweden	Europe	Leningrad region		Estonia	
Conodont-biozonation of N.W. Öland. This paper.	Lower Ordovician conodont-zonation. Lindström (1971).	Conodont-biozonation. Sergeeva (1964, 1966).	Chronostratigraphic classification.	Conodont faunas. Viira, Kivimägi and Loog (1970).	Chronostratigraphic classification.
Triangulodus brevibasis Ass.Z.	Zone of *Paroistodus originalis*				
Microzarkodina flabellum Ass.Z.	Zone of *Baltoniodus navis* + Zone of *Baltoniodus triangularis*	Subzone of *Oistodus parallelus*	$B_{II}\beta$ + $B_{II}\alpha$ Volkhov Stage		
Drepanoistodus forceps Ass.Z.					
Prioniodus navis/Stolodus stola Ass.Z.					
Prioniodus navis/P. crassulus Ass.Z	overlap	overlap			—
Prioniodus crassulus Ass.Z.					
Oistodus lanceolatus Ass.Z.	Zone of *Prioniodus evae*	Subzone of *Prioniodus evae*			
Oistodus lanceolatus/Prioniodus deltatus Ass.Z.					
Protopanderodus rectus/Oepikodus evae Ass.Z.			$B_I b$ Leetse Stage		
Protopanderodus rectus/Oelandodus costatus Ass.Z.	Zone of *Prioniodus elegans*	Subzone of *Prioniodus elegans*			
Stolodus stola Ass.Z.				Upper fauna of $B_I b$?	?
Prioniodus elegans/ Oelandodus elongatus Ass.Z.					
Triangulodus subtilis/Gothodus microdentatus Ass.Z.	Zone of *Paroistodus proteus*	Subzone of *Drepanodus proteus*	$B_I a$		Leetse Stage
Drepanoistodus inconstans Ass.Z.				Upper fauna of $B_I a$	
?*Prioniodus deltatus* Ass.Z.				Lower fauna of $B_I a$	?
Drepanodus arcuatus Ass.Z.	Zone of *Paltodus deltifer*	Zone of *Cordylodus angulatus*	Upper portion of the "*Obolus-Dictyonema* horizon" (= part of the Pakerort Stage).	?	Pakerort Stage
Drepanoistodus numarcuatus/Paroistodus amoenus Ass.Z.				Upper fauna of the Varangu Member (= $A_{III}V$)	
Drepanoistodus acuminatus Ass.Z.				Lower fauna of the Varangu Member (= $A_{III}V$)	
?				?	
Cordylodus rotundatus Ass.Z.				Fauna of $A_{II}M$	
?	?				
Cordylodus angulatus/C. prion Ass.Z.	Zone of *Cordylodus angulatus*				

2) The Tremadocian Zones according to the Int. Strat. Lex. 1956, vol. I, fase 3a IV (see text). The Arenigian Zones after Tjernvik (1956).

Protopanderodus rectus/Oelandodus costatus Zone of Öland (fig. 15). The incertainty about the systematic position of the *Oistodus lanceolatus* in this fauna, makes this assumption rather speculative, however.

The approximate position of our conodont zones in the British chronostratigraphy being known, the foregoing correlations with the conodont-zonations of the Leningrad region and Estonia would enable the comparison between the chronostratigraphic classifications of Great Britain, Estonia and the Leningrad region.

Chapter IV

CONODONT SYSTEMATICS

IV.1. INTRODUCTION

Wherever possible, the conodont specimens were arranged into their supposed natural (i.e. multi-element) species. The reconstruction of such assemblages was based on the combination of some or all of the following indications:

– The similarity of the stratigraphic range of the elements.
– Comparable relative frequencies of the elements per sample.
– Similarities in colour and/or mineral composition.
– The similarity of one or more morphologic features of different elements.
– The elemental composition of already described "natural species".

The "natural species" were named according to the rules of the I.C.Z.N. Code. Also the suggestions of the Pander Society Document 3 were followed.

The names of the separate elements within the multi-element species were derived from comparable form genera or species. The terminology of the morphologic features has been adopted from Lindström (1964, p. 11).

All material is stored in the collections of the Micropaleontology Department of the Geological Institute of the State University of Utrecht, coll. nrs. T191–198 and CH1141–1306.

IV.2. THE SYSTEMATIC DESCRIPTION OF THE CONODONTS

Genus **Coelocerodontus** ETHINGTON, 1959

Type species: Coelocerodontus trigonius ETHINGTON, 1959.

Definition: "Hollow horn-shaped cones. Lateral walls are thin and enclose a central cavity which extends to the tip of the tooth. Edges of the tooth are keeled. Species are identified on the basis of the shape of the cross section."

Coelocerodontus bicostatus n. sp.
(Pl. 1, figs. 1a, b)

Derivatio nominis: bicostatus, Lat. = carrying two costae.
Holotype: see Pl. 1, figs. 1a, b, cat. nr. T191–13.

Unfigured paratypoids: cat. nrs. T191–14 and 15.
Type-stratum: The lowermost part of member $D_{ä\text{-}d\,2}$ at Köpingsklint; see fig. 4, section b and chart II, sample 1.
Diagnosis: A bilaterally symmetrical *Coelocerodontus* with a costa on each of the lateral sides.
Description: Both the anterior and posterior edges are keeled. The posterior edge has a keel which is about as high as the basal cavity. The anterior keel is much lower and about as high as the lateral costae. The keels and costae run from the aboral margin to the tip of the cusp.

The basal cavity is deep and extends nearly the whole unit. In cross section it is diamond-shaped. The basal sheath is thin and nearly plane between the costae and keels. The cusp is proclined.
Differential diagnosis: Coelocerodontus bicostatus n. sp. differs from *Coelocerodontus tetragonius* ETHINGTON in having a strongly keeled posterior edge and in the position of the plane of symmetry which passes through this keel.
Regional occurrence: The species was found in member $D_{ä\text{-}d\,2}$ at Köpingsklint, from which also the holotype has been obtained. Furthermore it occurs in members $D_{h\,1}$ and $D_{k\,1}$ near Horns Udde.
Biostratigraphic range: Coelocerodontus bicostatus n. sp. was found in the *Cordylodus rotundatus* Assemblage Zone and in the *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone. It was not encountered in the *Drepanoistodus acuminatus* Assemblage Zone, but it could form part of this zone, according to its deduced regional range (fig. 15).

Coelocerodontus latus n. sp.
(Pl. 1, figs. 2a, b)

Derivatio nominis: latus, Lat. = broad, wide.
Holotype: Pl. 1, figs. 2a, b, cat. nr. T192–13.
Unfigured paratypoids: cat. nrs. T192–14 and 15.
Type-stratum: The lowermost part of member $D_{ä\text{-}d\,2}$ at Köpingsklint; see fig. 4, section b and chart II, sample 1.
Diagnosis: A laterally compressed *Coelocerodontus* with a wide (high) base and strongly recurved cusp.
Description: The entire unit is slightly asymmetrical with a convex and a concave lateral side. The base is laterally compressed. The basal stretches of the anterior and posterior edges are both inconspicuously keeled. The anterior edge is slightly deflected to the concave side of the unit. A longitudinal depression runs to both sides of the entire base, these do not

reach the cusp. Where the depressions meet the aboral margin, the latter is undulated.

The basal cavity is very deep and extends throughout the unit.

The cusp is strongly recurved and its cross section is subcircular.

Differential diagnosis: Coelocerodontus latus n. sp. differs from *Furnishina primitiva* MÜLLER, 1959, in having a laterally compressed base, a strongly recurved cusp and in having a deflected anterior edge.

It differs from *Acodus primitivus* NOGAMI, 1967, and from *Hertzina (?) tricarinata* NOGAMI, 1967, by the lack of pronounced lateral carinae, the strong curvature of the cusp and the deflected anterior edge.

Regional occurrence: This species was only found in member $D_{\text{ä-d}2}$ at Köpingsklint.

Biostratigraphic range: Coelocerodontus latus n. sp. was only found in the *Cordylodus rotundatus* Assemblage Zone.

Coelocerodontus variabilis n. sp.
(Pl. 1, figs. 3a, b and 4a, b)

Derivatio nominis: variabilis, Lat. = variable.

Holotype: Pl. 1, figs. 4a, b, cat. nr. T 193–13.

Figured paratypoid: Pl. 1, figs. 3a, b, cat. nr. T 193–15.

Unfigured paratypoid: cat. nr. T 193–14.

Type-stratum: The lowermost part of member $D_{\text{ä-d}2}$ at Köpingsklint; see fig. 4, section b and chart II, sample 1.

Diagnosis: A slender, nearly straight and hardly ornamented *Coelocerodontus* with both symmetrical and asymmetrical forms.

Description: Two symmetry variations occur within this species.

In asymmetrical forms (see Pl. 1, figs. 3a, b) one of the lateral faces is convex and the other is plane to somewhat concave. The posterior edge is angular to inconspicuously keeled. The anterior edge is subrounded and it is deflected to the concave side of the unit.

The basal cavity is deep and extends throughout the unit. Its cross section is widest antero-laterally. The cusp gradually passes into the base and it is proclined.

In the symmetrical forms both lateral sides are slightly convex and the base is widest anteriorly. The anterior edge is unkeeled and well rounded. The basal stretch of the posterior edge is rounded, towards the cusp it may become angular or inconspicuously keeled.

Differential diagnosis: This species differs from *Coelocerodontus latus* n. sp. in the slight height of the base and the orientation of its cusp. *Coelocerodon-*

tus variabilis n. sp. differs from *Coelocerodontus burkei* DRUCE & JONES, 1971, by the lack of "knife-edges" and by the cross-section of the base, being widest anteriorly.
Regional occurrence: At Köpingsklint the species was found in member $D_{\ddot{a}\text{-}d\,2}$ (a.o. the holotype) and $D_{k\,1}$, near Horns Udde in member $D_{h\,1}$.
Biostratigraphic range: Coelocerodontus variabilis n. sp. was found from the *Cordylodus rotundatus* Assemblage Zone up to and including part of the *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone (fig. 15).

Genus **Cordylodus** PANDER, 1856
Type species: Cordylodus angulatus PANDER, 1856.
Definition: (translated from Pander, 1856, p. 33) "Compound teeth with very long, compressed and high base. A big, rather flat, smooth cusp with evenly curved lateral faces and almost flat anterior and posterior margins arises from the base, at first more or less vertically, always, however, curved towards the point. Several small teeth emerge from the basis at the concave margin of the big tooth, beneath one another and side by side.

To judge from the superficial appearance, one might mistake this genus for *Belodus.* The microscopical structure is, however, quite different."

Cordylodus angulatus PANDER, 1856
(Pl. 1, figs. 5, 6 and 7)

Cordylodus angulatus PANDER, 1856, p. 33, Pl. 2, figs. 27–31, 34, Pl. 3, fig. 10. LINDSTRÖM, 1955a, p. 551, Pl. 5, fig. 9; Figs. 3G, E. DRUCE & JONES, 1971, p. 66, Pl. 3, figs. 4a–7b; Text-figs. 23a, b. JONES, 1971, p. 45, Pl. 8, figs. 3a-e.
Cordylodus intermedius FURNISH, 1938, p. 338, Pl. 42, fig. 31, Text-fig. 2C. DRUCE & JONES, 1971, p. 68, Pl. 3, figs. 1a–3b; Text-figs. 23f, g. JONES, 1971, p. 46, Pl. 2 figs. 2a–3c.
Cordylodus proavus MÜLLER, 1959, p. 448, Pl. 15, figs 11, 12, 18; Fig. 3B.
Cordylodus caseyi DRUCE & JONES, 1971, p. 67, Pl. 2, figs. 9a–12c; Text-figs. 23d, e. JONES, 1971, p. 46, Pl. 2, figs. 1a-c.

Remarks: The illustrated specimens show the variation of some features within this species. Variation is wide in:
a) Both the bending and the extention of the basal stretch of the anterior edge.
b) The sidewards bending of the entire unit; almost straight as well as twisted forms occur (cf. Pl. 1, figs. 6 and 7).
c) The shape of the basal cavity and the location of its tip. The cavity may or it may not extend into the cusp and/or the denticles.

d) The denticulation. Sometimes the second denticle is much bigger then the others. There is no regularity in relative size of the denticles.

The connection between the basal parts of the cusp and the first denticle, or between the first and second denticles is frequently very thin. This often causes the units to break at these places.

Cordylodus caseyi DRUCE & JONES seems to be a sidewards bent variant of *Cordylodus angulatus* PANDER. This variant occurs together with straight forms in sample 1 of chart III.

The author fully agrees with Lindström (1955a, p. 552) that *Cordylodus intermedius* FURNISH "falls well within the range of variation on *Cordylodus angulatus*". Druce & Jones' statement, that the basal cavity would be distinctive for differentiation between *Cordylodus angulatus* PANDER and *Cordylodus intermedius* FURNISH seems not to be confirmed by their text-figures 23f and g. The anterior margin of the basal cavity of the specimen figured in their figure 23g is not "gently concave" and its apex is not "directed toward the anterior margin of the cusp", although these criteria are used by these authors (p. 68) as distinctive features of the basal cavity of *Cordylodus intermedius* FURNISH. Moreover, the shape of the basal cavity of *Cordylodus angulatus* figured by Pander (1856, Pl. 3, fig. 10a) is about intermediate between those of *Cordylodus intermedius* FURNISH figured by Druce & Jones, 1971, in their text-figures 23f and g.

The description of *Cordylodus proavus* by Müller (1959) entirely fits to the more symmetrical and small specimens of *Cordylodus angulatus* (see Pl. 1, fig. 5 of this paper).

Regional occurrence: At Köpingsklint this species occurs from the base of member $D_{ä\text{-}d\,2}$ up to the top of member $K_{k\,2}$. Between Äleklinta and Djupvik, from the conglomerate halfway member $D_{ä\text{-}d\,3}$ up to the top of member $K_{ä\text{-}d\,1}$. Near Horns Udde, from member $D_{h\,1}$ up to and including part of member $K_{k\,2}$.

Biostratigraphic range: Cordylodus angulatus PANDER was found from the *Cordylodus angulatus/Cordylodus prion* Assemblage Zone up to and including the *Stolodus stola* Assemblage Zone (fig. 15).

Cordylodus prion LINDSTRÖM, 1955.
(Pl. 1, figs. 8 and 9)

Cordylodus prion LINDSTRÖM, 1955a, p. 552, Pl. 5, figs. 14–16.

Cordylodus oklahomensis MÜLLER, 1959, p. 447, Pl. 15, figs. 15, 16; Fig. 3A. DRUCE & JONES, 1971, p. 69, Pl. 5, figs. 6a–7c; Text-fig. 23j. JONES, 1971, p. 47, Pl. 2, figs. 5a–8b.

Cordylodus lindströmi DRUCE & JONES, 1971, p. 68, Pl. 1, figs. 7a–9b; Pl. 2, figs. 8a-c; Text-fig. 23h. JONES, 1971, p. 47, Pl. 2, figs. 4a-c.

Remarks: In our material this species shows a variation similar to that mentioned for *Cordylodus angulatus* PANDER (see p. 58). Especially the sidewards bending of the cusp and the number of denticles may vary strongly. As *Cordylodus oklahomensis* differs only from *Cordylodus prion* by its sideward bending and the fact that it has only three denticles (according to Müller, 1959) the former species name is considered to be a junior synonym of the latter. Druce & Jones (1971, p. 69) remarked that *Cordylodus oklahomensis* would be distinguishable from *Cordylodus prion* by the "lateral flaring of the inner cavity lip" of the former species. As Lindström (1955a, p. 553) stated already, that the base of *Cordylodus prion* "may be widened at the inner side", also this feature seems to lose diagnostic value for a differentiation.

Cordylodus lindströmi, according to its type description "is very similar to *Cordylodus angulatus* and *Cordylodus prion*" (Druce & Jones, 1971, p. 69) and only the presence of additional apices below the denticles of the posterior process would be distinctive. In one of our samples, however, variation of *Cordylodus prion* was found to include variants with and others without additional apices (see Pl. 1, fig. 8 and 9). Both these forms are considered to be within the range of variation of the species *Cordylodus prion* LINDSTRÖM.

As in *Cordylodus angulatus,* specimens of *Cordylodus prion* are frequently broken between the cusp and first denticle or between the first and second denticle.

Regional occurrence: At Köpingsklint the species was found from the base of member $D_{ä\text{-}d2}$ up to the top of member D_{k1}. Between Äleklinta and Djupvik, in the conglomerate halfway member $D_{ä\text{-}d3}$, near Horns Udde in member D_{h1}.

Biostratigraphic range: Codylodus prion LINDSTRÖM was found from the *Cordylodus angulatus/Cordylodus prion* Assemblage Zone up to and including the *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone (fig. 15).

Cordylodus rotundatus PANDER, 1856
(Pl. 1, fig. 14)

Cordylodus rotundatus PANDER, 1856, p. 33, Pl. 2, figs. 32, 33. LINDSTRÖM, 1955a, p. 553, Pl. 5, figs. 17–20, Fig. 3F.

Regional occurrence: At Köpingsklint the species occurs from the base of member $D_{ä\text{-}d2}$ up to and including the basal portion of member K_{k1}. In section 6 from member $K_{ä\text{-}d1}$ up to the top of member $K_{ä\text{-}d2}$. Near Horns

Udde from member D_{h1} up to the top of member D_{k1}.
Biostratigraphic range: Cordylodus rotundatus PANDER was found from the *Cordylodus rotundatus* Assemblage Zone up to and including the *Protopanderodus rectus/Oelandodus costatus* Assemblage Zone (fig. 15).

Genus **Drepanodus** PANDER, 1856, emend. LINDSTRÖM, 1971
Type species: Drepanodus arcuatus PANDER, 1856.
Emended definition: A multi-element genus with drepanodiform elements and "a Scandoduslike oistodiform element" (see Lindström, 1971, p. 41).

Drepanodus arcuatus PANDER, 1856, emend. VAN WAMEL, herein
(Pl. 1, figs. 10–13)

Drepanodus arcuatus PANDER, 1856, p. 20, Pl. 1, figs. 2, 4, 5, 17, not 30, 31. LINDSTRÖM, 1955a, p. 558, Pl. 2, figs. 30–33; Fig. 3J.
Drepanodus arcuatus PANDER, emend. LINDSTRÖM, 1971, p. 41, figs. 4, 8.
Drepanodus cf. arcuatus PANDER. LINDSTRÖM, 1955a, p. 560, Pl. 2, figs. 45, 46; Fig. 4c.
Drepanodus flexuosus PANDER, 1856, p. 20, Pl. 1, figs. 6–8.
Drepanodus sculponea LINDSTRÖM, 1955a, p. 567, Pl. 4, fig. 40; Fig. 3L.
Drepanodus ? gracilis (BRANSON & MEHL, 1933). LINDSTRÖM, 1955a, p. 562, Pl. 4, fig. 44, Pl. 5, figs. 6, 7.
Acontiodus arcuatus LINDSTRÖM, 1955a, p. 547, Pl. 2, figs. 1–4; Fig. 3A.
Scandodus pipa LINDSTRÖM, 1955a, p. 593, Pl. 4, figs. 38–42; Fig. 3P.

Remarks: Instead of the drepanodiform and oistodiform elements mentioned by Lindström (1971, p. 41), this multi-element species is thought to comprise four types of elements. In this paper these elements will be called the arcuatiform element (Pl. 1, fig. 10), the sculponeaform element (Pl. 1, fig. 11), the graciliform element (Pl. 1, fig. 13) and the pipaform element (Pl. 1, fig. 12), after the formspecies names, which were formerly given to these elements.

Acontiodus arcuatus is a rare variant of *Drepanodus arcuatus,* with two costae running parallel beside the posterior edge. Similarity in morphology and stratigraphic range make it highly probable, that *Drepanodus sculponea* also is part of this multi-element species. Furthermore, there appear to be transitional forms between *Scandodus pipa* and *Drepanodus ? gracilis,* all occurring together in one sample. The graciliform element is relatively rare.
Regional occurrence: At Köpingsklint the species was found from the base of member K_{k1} up to the top of the Horns Udde Formation. In section 6 from member $K_{\ddot{a}\text{-}d1}$ up to the top of the Horns Udde Formation. Near Horns Udde from member K_{k2} up to the top of the Horns Udde Formation.
Biostratigraphic range: This species was found from the *Drepanodus arcuatus*

Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone.

Genus **Drepanoistodus** LINDSTRÖM, 1971, emend. VAN WAMEL, herein
Type species: Oistodus forceps LINDSTRÖM, 1955.
Definition: See emended genus definition under *Remarks.*
Synonym: Paltodus emend. LINDSTRÖM, 1971, p. 44 (not *Paltodus* PANDER, 1856).
Remarks: The species that were referred to *Drepanoistodus* and *Paltodus* by Lindström (1971) do not only contain drepanodiform and oistodiform elements but also suberectiform (after *Drepanodus suberectus* (BRANSON & MEHL)), acodiform (after *Acodus* LINDSTRÖM, 1955) and scandodiform (after *Scandodus* LINDSTRÖM, 1955) elements. The elemental composition of the species of *Drepanoistodus* LINDSTRÖM and *Paltodus* emend. LINDSTRÖM being similar, these genera are considered synonymous. Since the type species of *Paltodus* PANDER, 1856 has not yet been placed in a multi-element species, *Drepanoistodus* is the valid name for this multi-element genus.

The following redefinition of the genus *Drepanoistodus* LINDSTRÖM, 1971 is proposed:
Drepanoistodus is a multi-element genus with drepanodiform, acodiform, suberectiform, scandodiform and oistodiform elements. Except for the oistodiform elements, all element types may carry costae, thus forming paltodiform (after the form genus *Paltodus* PANDER, 1856) elements. The oistodiform elements have an antero-posteriorly extended base, which may open to one side. Cusp and base of the oistodiform elements meet at a sharp angle and in most specimens there is no inverted base anteriorly. Both white and hyaline forms occur.

Drepanoistodus acuminatus (PANDER), emend. VAN WAMEL, herein
(Pl. 2, figs. 1–6)

Oistodus acuminatus PANDER, 1856, p. 27, Pl. 2, fig. 20.
Oneotodus variabilis LINDSTRÖM, 1955a, p. 582, Pl. 2, figs. 14–18, 46; Pl. 5, figs. 4, 5; Fig. 6.
Distacodus peracutus LINDSTRÖM, 1955a, p. 555, Pl. 3, figs. 1, 2; *not* fig. 5d.

Remarks: Similarity in colour, composition and morphology are the main indications to put these form species together in one multi-element species.

The oistodiform elements (see Pl. 2, figs. 1a, b and 2a, b) most probably are identical with *Oistodus acuminatus* PANDER. The shape is rather characteristic and Pander's drawing is very realistic. The following may be added to Pander's description:

The whole unit is rather translucent, almost straight, or slightly bent sidewards. The base is not high compared to the width of the cusp; its oral edge is convex and carries a high keel. The basal cavity is shallow and slightly convex in oral direction below the oral edge, whereas it is concave under the basal stretch of the cusp. The aboral margin is almost straight or slightly undulating in side view. The cusp is wide and strongly keeled. The anterior keel is almost straight, the posterior keel is convex. If bent, the outer side of the cusp usually is flat, whilst a carina runs to its inner side. Where the latter meets the aboral margin there may be a weak parapet-like extension.

The suberectiform elements (= *Distacodus peracutus* LINDSTRÖM) have a short oral edge and two prominent lateral costae (Pl. 2, figs. 3a, b). These prominent costae enable differentiation from the suberectiform elements of *Drepanoistodus inaequalis* (PANDER), figured at Pl. 2, fig. 8. The suberectiform elements of *Drepanoistodus inconstans* (LINDSTRÖM) (Pl. 3, fig. 12) are less proclined and carry less prominent costae.

Within the intraspecific form variation of the form species *Oneotodus variabilis* LINDSTRÖM, the acodiform-, the scandodiform- and the almost symmetrical drepanodiform elements can be recognized (see Pl. 2, figs. 6, 5, 4 respectively).

Regional occurrence: At Köpingsklint this species occurs from the lowermost part of member D_{k1} up to halfway member K_{k1}. Near Horns Udde from member D_{h1} up to and including part of member K_{k2}.

Biostratigraphic range: Drepanoistodus acuminatus was found from the *Drepanoistodus acuminatus* Assemblage Zone up to and including the *Prioniodus deltatus* Assemblage Zone (fig. 15).

Drepanoistodus conulatus (LINDSTRÖM), emend. VAN WAMEL, herein (Pl. 3, figs. 1–4)

Drepanodus conulatus LINDSTRÖM, 1955a, p. 561, Pl. 2, fig. 34; Pl. 4, fig. 34
Scandodus furnishi LINDSTRÖM, 1955a, p. 592, Pl. 5, fig. 3.
Scandodus furnishi LINDSTRÖM, emend. LINDSTRÖM, 1971, p. 39.
Drepanodus cyranoicus LINDSTRÖM, 1955a, p. 561, Pl. 5, fig. 8.

Remarks: According to the emended definition of *Drepanoistodus,* this probably is another multi-element species of that genus.

The suberectiform element (see Pl. 3, fig. 2) is *Drepanodus cyranoicus* LINDSTRÖM.

The drepanodiform element is *Drepanodus conulatus* LINDSTRÖM, whereas slightly asymmetrical variants of the latter form the scandodiform elements (Pl. 3, figs. 4a, b).

Acodiform elements were not found in the studied material.

The oistodiform element (see Pl. 3, figs. 1a, b) has been described as *Scandodus furnishi* LINDSTRÖM and this is the type-species of the form genus *Scandodus* LINDSTRÖM. However, the shape of the base and its orientation with regard to the cusp are rather typical for the oistodiform elements of other species of the genus *Drepanoistodus* (see for instance the more erect types of the oistodiform elements of *Drepanoistodus inaequalis* (PANDER), emend. herein, see Pl. 2, fig. 7. The lack of acodiform elements and the rareness of oistodiform elements make the generic position of this multi-element species doubtful.

Regional occurrence: At Köpingsklint this species occurs from the top of member K_{k2} up to a level at about 2.20 m. above the base of the Bruddesta Formation. In section 6 it was found from member $K_{ä\text{-}d1}$ up to a level at about 2.10 m. above the base of the Bruddesta Formation. Near Horns Udde from the base of the member K_{k3} up to a level at about 3.80 m. above the base of the Bruddesta Formation.

Biostratigraphic range: Drepanoistodus conulatus was found from the *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone up to and including part of the *Microzarkodina flabellum* Assemblage Zone (see fig. 15).

Drepanoistodus forceps (LINDSTRÖM), emend. LINDSTRÖM, 1971
(Pl. 2, figs. 14–22)

Oistodus forceps LINDSTRÖM, 1955a, p. 574, Pl. 4, figs. 9–13; Fig. 3M.
Drepanoistodus forceps (LINDSTRÖM). LINDSTRÖM, 1971, p. 42, figs. 5, 8.
Oistodus basiovalis SERGEEVA, 1963, p. 96, Pl. VII, figs. 6, 7.
Drepanoistodus basiovalis (SERGEEVA). LINDSTRÖM, 1971, p. 43, figs. 6, 8.
Drepanodus suberectus (BRANSON & MEHL). LINDSTRÖM, 1955a, p. 568, Pl. 2, figs. 21, 22.
Drepanodus planus LINDSTRÖM, 1955a, p. 565, Pl. 2, figs. 35–37; Fig. 4a.
Drepanodus homocurvatus LINDSTRÖM, 1955a, p. 563, Pl. 2, figs. 23, 24, 39; Fig. 4d.
Acodus gratus LINDSTRÖM, 1955a, p. 545, Pl. 2, figs. 27–29.

Remarks: Oistodiform and drepanodiform elements are most common in the assemblage.

Amongst the scandodiform elements there are asymmetrical variants of *Drepanodus planus* (see Pl. 2, fig. 20) and forms which carry a lateral carina and obviously occupy a position intermediate between *Drepanodus homocurvatus* and *Acodus gratus* (see Pl. 2, fig. 21). These scandodiform elements were never described as separate form species.

The oistodiform elements are highly variable. Forms described as *Oistodus basiovalis* SERGEEVA occur together with forms described as *Oistodus forceps* LINDSTRÖM and intermediate forms. From below upwards in the stratigraphic sequence, there is a gradual increase of the relative amount of *Oistodus basiovalis* forms per fauna.

The acodiform elements seem to make out a greater part of the multi-element assemblages in the lower portion of the sequence, than higher up. This change in the composition of the multi-element assemblage is very gradual.

According to Lindström (1971), the species *Drepanoistodus basiovalis* evolved from *Drepanoistodus forceps*. The former species would have *Oistodus basiovalis* SERGEEVA as oistodiform element; it would lack acodiform elements but the drepanodiform elements would be comparable to those of *Drepanoistodus forceps*. However, differentiation between these two species is thought to be possible only on the basis of biometrical data and statistical methods. As long as these are not available, separation can not be made between these species.

Regional occurrence: At Köpingsklint this species was found from member $K_{k\,2}$ up to the top of the Horns Udde Formation inclusive. In section 6 from member $K_{ä\text{-}d\,1}$ up to the top of the sequence. Near Horns Udde from member $K_{k\,2}$ up to and including the top of the Horns Udde Formation.

Biostratigraphic range: Drepanoistodus forceps was found from the *Drepanoistodus inconstans* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Drepanoistodus inaequalis (PANDER), emend. VAN WAMEL, herein (Pl. 2, figs. 7–13)

Oistodus inaequalis PANDER, 1856, p. 27, Pl. 2, fig. 37. LINDSTRÖM, 1955a, p. 576, Pl. 3, figs. 52, 55, 56, *not* 53, 54, 57.
Scandodus varanguensis VIIRA, 1970, p. 230, Pl. 1, figs. 11, 12; Text-figs. 8, 9.
Machairodus (sic) *ensiformis* PANDER, 1856, p. 23, Pl. 2, fig. 36, *not* Pl. 1, figs. 25–28.
Drepanodus deltifer LINDSTRÖM, 1955a, p. 562, Pl. 2, figs. 42, 43.
Paltodus deltifer (LINDSTRÖM), emend. LINDSTRÖM, 1971, p. 44, figs. 7, 8.
Drepanodus cf. *subarcuatus* FURNISH. LINDSTRÖM, 1955a, p. 568, Pl. 2, figs, 41, 44, 50.
Drepanodus bisymmetricus VIIRA, 1970, p. 226, Pl. 1, figs. 1–5; Text-figs. 3, 4.
Drepanodus pristinus VIIRA, 1970, p. 227, Pl. 1, figs. 7, 8; Text-figs. 5, 6.
Acodus tetrahedron LINDSTRÖM, 1955a, p. 546, Pl. 4, figs. 1, 2.

Remarks: There is a wide form variation in the drepanodiform elements, due to differences in curvature and cross section of the cusp and in the shape of the base (see Pl. 2, figs. 9, 10). In one assemblage, drepanodiform elements with unkeeled and rounded cusps may occur together with keeled ones and flat ones; while the base can be laterally compressed to widely flaring sidewards. The robust forms with rounded cusps and rather wide bases were described as *Drepanodus* cf. *subarcuatus* by Lindström (1955a). The laterally compressed units were called *Drepanodus deltifer* by this author.

The variation in the shape of the oistodiform element (see Pl. 2, fig. 7) is wide too; almost erect (= *Scandodus varanguensis* VIIRA) to strongly reclined forms (= *Oistodus inaequalis* PANDER) may occur together. The oistodiform elements of *Drepanoistodus inaequalis* strongly resemble comparable elements of *Drepanoistodus inconstans* emend. herein (see Pl. 3, fig. 11). The latter elements have a more pronounced rounded costa to the innerside of the cusp and they have a parapet-like extension of the base to this side.

The scandodiform elements (see Pl. 2, figs. 11, 12) are asymmetrical variants of the drepanodiform elements. They have one prominent carina and the base opens to one side of the unit. These forms take an intermediate position between the drepanodiform and the acodiform elements (= *Acodus tetrahedron* LINDSTRÖM, see Pl. 2, fig. 13 herein). Other scandodiform elements are slightly bent sidewards, with the basal sheath of the outer side extended in aboral direction (see Pl. 2, fig. 12 and *Machairodus ensiformis*).

The suberectiform element (see Pl. 2, fig. 8) was described earlier as *Drepanodus bisymmetricus* VIIRA and as *Drepanodus pristinus* VIIRA. It is a bilaterally symmetrical unit, without a sharp distinction between the base and the cusp. The basal cavity is wide sidewards and its tip penetrates into the basal portion of the erect cusp. In side view the outline of the basal cavity is concave posteriorly and convex anteriorly. The aboral margin is faintly sinuous and slightly extended in antero-aboral direction. It is indented where the two lateral carinae meet the aboral margin. The cusp is sharply pointed and it has a lanceolate cross section. The lack of anterolateral costae enables differentiation of these suberectiform elements from those of *Drepanoistodus acuminatus* (PANDER) (see Pl. 2, figs. 3a, b) and of the suberectiform elements of *Drepanoistodus inconstans* (LINDSTRÖM) (see pl. 3, fig. 12).

Regional occurrence: At Köpingsklint this species occurs from the base of member $D_{ä\text{-}d\,2}$ up to the top of member $K_{k\,1}$. In section 6 this species was not found with certainty. Near Horns Udde it occurs from member $D_{h\,1}$ up to and including part of member $K_{k\,2}$.

Biostratigraphic range: Drepanoistodus inaequalis was found from the *Cordylodus rotundatus* Assemblage Zone up to and including the *Prioniodus deltatus* Assemblage Zone (fig. 15).

Drepanoistodus inconstans (LINDSTRÖM), emend. VAN WAMEL, herein (Pl. 3, figs. 11–15)

Paltodus inconstans LINDSTRÖM, 1955a, p. 583, Pl. 4, figs. 3–8.
Paltodus inconstans LINDSTRÖM, emend. LINDSTRÖM, 1971, p. 45, fig. 8.
Oistodus inaequalis LINDSTRÖM, 1955a, *not* PANDER 1856. LINDSTRÖM, 1955a, p. 576, Pl. 3, figs. 53, 54, 57, *not* figs. 52, 55, 56.
Distacodus peracutus LINDSTRÖM, 1955a, p. 555, Fig. 5d, *not* Pl. 3, figs. 1, 2.

Remarks: The oistodiform elements (see Pl. 3, fig. 11) are very similar to those of *Drepanoistodus inaequalis* (PANDER) (see Pl. 2, fig. 7). However, the latter lack the prominently rounded costa at the inner side of the cusp and the parapet-like extension of the base at this side.

The suberectiform elements of *Drepanoistodus inconstans* and *Drepanoistodus inaequalis* are very much alike as well. The presence of anterolateral costae on the suberectiform elements of *Drepanoistodus inconstans* (see Pl. 3, fig. 12) allows differentiation. The suberectiform element of *Drepanoistodus inconstans* seems to be identical with the less prominently costate variant of *Distacodus peracutus* LINDSTRÖM, whereas the suberectiform elements of *Drepanoistodus acuminatus* are the more prominently costate variants of *Distacodus peracutus* LINDSTRÖM.

The almost symmetrical forms of *Paltodus inconstans* LINDSTRÖM have a carina on one side and a costa on the other, or they carry a costa on every side (see Pl. 3, figs. 13a, b).

There are typical acodiform elements with a costa on one side (see Pl. 3, figs. 15a, b).

Finally there are scandodiform elements which are deflected sidewards and the basal cavity of which opens to one side (see Pl. 3, figs. 14a, b). The convex outer side can carry up to four costae and the inner side usually has one.

Regional occurrence: At Köpingsklint this species was found in member $K_{k\,2}$. In section 6 and near Horns Udde it was not established with certainty.

Biostratigraphic range: Drepanoistodus inconstans was found from the *Drepanoistodus inconstans* Assemblage Zone up to and including the *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone (fig. 15).

Drepanoistodus numarcuatus (LINDSTRÖM), emend. VAN WAMEL, herein (Pl. 3, figs. 5–10)

Drepanodus numarcuatus LINDSTRÖM, 1955a, p. 564, Pl. 2, figs. 48, 49; Fig. 3I.
Acodus pulcher LINDSTRÖM, 1955a, p. 546, Pl. 2, fig. 38.
Paroistodus numarcuatus (LINDSTRÖM) pars, LINDSTRÖM, 1971, p. 46, fig. 8.

Remarks: The association of the oistodiform and suberectiform elements with the drepanodiform-, acodiform- and the scandodiform elements is a little speculative, due to the sporadic presence of the two first mentioned elements.

The oistodiform, suberectiform and scandodiform elements of this species have not been described earlier.

The oistodiform element (see Pl. 3, figs. 5 and 6) is either almost straight or it may be slightly bent sidewards. The base is laterally compressed and its aboral margin is evenly curved, convex in aboral direction. The oral edge is rather short, it is keeled and convex upwards. The basal cavity is relatively deep and its oral outline is convex upwards. The tip of the basal cavity is situated rather far anteriorly and only a small and shallow extension runs anterior of it. The cusp is relatively wide and a carina is present to both lateral sides, the one at the inner side being slightly more pronounced. The anterior and posterior edges are sharp and evenly curved, convex outwards. The angle between the posterior edge and the oral edge varies between 20°–50° and the angle between the anterior edge and the aboral margin is variable too. The anterior and posterior basal angles are rounded.

The suberectiform element (see Pl. 3, figs. 7a, b) is wide antero-posteriorly and it is laterally compressed. It may be slightly bent sidewards. No distinction between cusp and base can be drawn; there is no oral edge. The basal cavity is shallow and triangular in side view. Its tip is very sharp and points anteriorly and upwards. To the outer side of the unit the base can flare a little and its aboral margin can have an indentation. The cusp is blade-like, with keeled anterior and posterior edges. These are both recurved. The growth axis is accompanied by a rounded costa on either sides of the cusp.

Lindström's (1971) description of the drepanodiform element (see Pl. 3, fig. 8) is fully adequate.

In the scandodiform elements (see Pl. 3, figs. 9a, b) the cusp is bent sidewards. The basal sheath is convex to the outside of the unit and its aboral margin may be inflected. In side view, the outline of the basal cavity is quite similar to that of the drepanodiform element.

Nothing needs to be added to the original description of the acodiform element (see Pl. 3, figs. 10a, b). As the antero-basal costa of the acodiform elements usually is very faint, it can be difficult to distinguish these elements from the scandodiform elements.

Lindström (1971) put *Drepanodus numarcuatus* LINDSTRÖM, *Drepanodus amoenus* LINDSTRÖM and *Oistodus parallelus* PANDER together in one multi-element species called *Paroistodus numarcuatus* (LINDSTRÖM). However, according to the data available now, the stratigraphic ranges of

Drepanodus amoenus and *Oistodus parallelus* do not coincide with that of *Drepanodus numarcuatus.* Furthermore, there seems to be a fair correlation in the frequency of occurrence between *Drepanodus amoenus* and *Oistodus parallelus,* whereas such correlation is much less clear or absent between these elements and *Drepanodus numarcuatus.* The clear association of *Drepanodus numarcuatus* with acodiform and scandodiform elements is a strong indication that the former element belongs to a species of the multi-element genus *Drepanoistodus.*

Regional occurrence: At Köpingsklint the species occurs from the top of member D_{k1} up to and including part of member K_{k2}. In section 6 it is absent. Near Horns Udde it was found from member D_{h1} up to and including part of member K_{k2}.

Biostratigraphic range: Drepanoistodus numarcuatus was found from the *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone up to and including the *Drepanoistodus inconstans* Assemblage Zone (fig. 15).

Genus **Gothodus** LINDSTRÖM, 1955

Type species: Gothodus costulatus LINDSTRÖM, 1955.

Definition: "The genus *Gothodus* realizes the combination three processes or definite costae, two of which are undenticulated. The third costa runs into the denticulated oral margin." (op. cit. Lindström, 1955a, p. 569).

Gothodus microdentatus n. sp.

(Pl. 5, figs. 14a, b and 15a, b)

Derivatio nominis: micro, Gr. = small, dentatus, Lat. = denticulated. Referring to the small, subequal denticles on the posterior process.

Holotype: P1. 5, figs. 15a, b, cat. nr. T 194–13.

Figured paratypoid: Pl. 5, figs. 14a, b, cat. nr. T 194–14.

Type-stratum: The upper limestone bed of member K_{k2} at Köpingsklint; see chart II, sample 13.

Diagnosis: A *Gothodus* species with a relatively high base and a posterior process with many subequal, small denticles.

Description: The entire unit is slightly bent sidewards and laterally compressed. The base is relatively high. The basal cavity is deep and its oral outline is almost straight, while the tip is situated far anteriorly. The basal sheath is thin.

The posterior process carries many (7–11 counted) small, subequal denticles. These are flat and have rounded tips. The first denticles are erect, whereas the following tend to be reclined.

The cusp is slightly proclined. Its anterior and posterior edges are sharp. The anterior edge is deflected and extended basally, to form an antero-lateral process. On this process some vague denticle-like structures may occur. On the outer side of the cusp there is a sharp costa which continues over the base to form a lateral process, where it meets the aboral margin. This process is keeled and not denticulated.

Differential diagnosis: This species differs from *Gothodus costulatus* LINDSTRÖM in the sidewards bending of the unit, the orientation of the denticles and their flatness.

Remarks: Most probably this is the gothodiform element of a multi-element species. For the time being, *G.microdentatus* is considered to be a form species.

Regional occurrence: This species was only found in the top portion of member K_{k2} at Köpingsklint (chart II).

Biostratigraphic range: Gothodus microdentatus was found only in the *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone (fig. 15).

Genus **Microzarkodina** LINDSTRÖM, 1971

Type species: Prioniodina flabellum LINDSTRÖM, 1955.

Definition: "Microzarkodina includes multi-element conodonts in which the ozarkodiniform element is relatively short and high and has few denticles, particularly in front of the cusp. Multiramiform elements include cordylodiform and trichonodelliform elements, which are provided with high, slender, subequal, and conspicuously divergent denticles. The oistodiform elements lack an anterior extension. Basal cavity is shallow in all elements. Cusp and denticles consist of white matter" (op. cit. Lindström, 1971, p. 57).

Microzarkodina flabellum (LINDSTRÖM), emend. LINDSTRÖM, 1971
(Pl. 7, figs. 18–23)

Prioniodina flabellum LINDSTRÖM, 1955a, p. 587, Pl 6, figs. 23–25.
Microzarkodina flabellum (LINDSTRÖM). LINDSTRÖM, 1971, p. 58, Pl. 1, figs. 6–11; Figs. 19, 20.
Cordylodus perlongus LINDSTRÖM, 1955a, p. 552, Pl. 6, figs. 36, 37.
Trichonodella alae LINDSTRÖM, 1955a, p. 599, Pl. 6, figs. 38–40. LINDSTRÖM, 1964, p. 87, fig. 31L.
Trichonodella? irregularis LINDSTRÖM, 1955a, p. 600, Pl. 6, figs. 21, 22. LINDSTRÖM, 1964, p. 87, fig. 31N.
"Sannemannula element", LINDSTRÖM, 1964, p. 87, fig. 31M.
Oistodus linguatus complanatus LINDSTROM, 1955a, p. 578, Pl. 3, fig. 37, 38.

Remarks: Nothing needs to be added to Lindström's (1971) description of the species.

Regional occurrence: At Köpingsklint this species occurs from a level at about 1.50 m. above the base of the Bruddesta Formation up to the top of the sequence. In section 6 from a level at about 1.70 m. above the base of the Bruddesta Formation up to the top of the section. Near Horns Udde from a level at about 2.10 m. above the base of the Bruddesta Formation up to the top of the Horns Udde Formation.
Biostratigraphic range: Microzarkodina flabellum was found from the *Microzarkodina flabellum* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Genus **Oelandodus** n. gen.
Type species: Oistodus elongatus LINDSTRÖM, 1955.
Derivatio nominis: After Öland.
Definition: A multi-element genus with oistodiform (after *Oistodus* PANDER emend. LINDSTRÖM, 1955a), elongatiform (after *Oistodus elongatus* LINDSTRÖM) and triangulariform (after *Oistodus triangularis* LINDSTRÖM) elements.
Differential diagnosis: The only multi-element genus for which this genus could possibly be mistaken is *Oistodus* PANDER, emend. VAN WAMEL herein, from which genus it differs in having an elongatiform element instead of a deltaform element.

Oelandodus elongatus (LINDSTRÖM), emend. VAN WAMEL, herein
(Pl. 7, figs. 1–4)

Oistodus elongatus LINDSTRÖM, 1955a, p. 574, Pl. 4, figs.32, 33; Fig. 5b.

Description: In the original description of *Oistodus elongatus* Lindström's Pl. 4, figs. 32, 33 represent our elongatiform element, his fig. 5b the triangulariform element.

The oistodiform element has not been described yet.

To Lindström's description of the elongatiform element the following can be added (see Pl. 7, figs. 1, 2):

In lateral view the outline of the basal cavity is rounded. Its tip is bent in antero-basal direction and it is situated at the place where two lateral costae or carinae have their origin on the base. The keel of the oral edge is evenly convex outwards.

The cusp is very wide and flat. Its posterior keel can have a faint sinuous curvature. The angle between the oral edge and the posterior keel varies between 70°–100°. The whole unit is usually slightly bent sidewards. The carina or costa on the outer side is prominent. The antero-basal angle is strongly extended antero-aborally.

The oistodiform elements (see Pl. 7, fig. 4) are strongly compressed laterally and almost straight. The base is lower than the width of the cusp.

The basal cavity is shallow and its oral outline is slightly convex orally. The aboral margin is practically straight in side view. The oral edge is keeled and convex outwards. The antero- and postero-basal angles are rounded.

The cusp is wide and thin. A rounded costa runs along both lateral sides. The anterior and posterior edges are both keeled. The anterior edge is convex outwards, whereas the posterior one has a sickle-shaped curvature. The angle between the oral and posterior edges varies between 20°–50°.

The triangulariform elements (see Pl. 7, figs. 3a, b) are asymmetrical and have two prominent, process-like edges, one lateral and one antero-lateral. The basal ends of these lateral edges protrude as undenticulated processes.

The basal cavity extends into these process-like edges and its oral outline is straight. The oral edge is highly keeled and convex. Usually it is rather strongly twisted outwards and sidewards. The lateral edge forms a costa up on the cusp; basally it bends evenly in posterior-aboral direction. The antero-lateral edge is evenly convex outwards. The posterior and oral edges meet at an angle of approximately 70°. The facet between the antero-lateral and lateral edges is convex outwards high up to the cusp, towards the base it becomes flat to slightly concave. The cross-section of the cusp is triangular at mid-height, whereas it is subcircular at the top. It may be hard to distinguish this element from the corresponding element of *Oelandodus costatus* n. gen. n. sp. However, the latter has a rounded costa to both sides of the base of the oral keel.

Regional occurrence: At Köpingsklint the species was not found. In section 6 it occurs from the base of member $K_{ä\text{-}d1}$ up to and including the basal portion of member K_{k3}. Near Horns Udde from the topmost portion of member K_{k2} up to halfway member K_{k3}.

Biostratigraphic range: This species was found from the *Prioniodus elegans/Oelandodus elongatus* Assemblage Zone up to and including the *Oistodus lanceolatus/Prioniodus deltatus* Assemblage Zone (fig. 15).

Oelandodus costatus n. sp.

(Pl. 7, figs. 5–7)

Derivatio nominis: costatus, Lat. = with costae.

Holotype: The elongatiform element, figured on Pl. 7, figs. 5a, b, cat. nr. T 195–13.

Figured paratypoids: The triangulariform element (Pl. 7, figs. 6a, 6b) and the

oistodiform element (Pl. 7, figs. 7a, 7b). Cat. nrs. T 195–14 and 15.
Type-stratum: The upper limestone bed of member $K_{ä\text{-}d\,2}$ in section 6; see chart III, sample 6.
Diagnosis: A species of *Oelandodus* in which all three elements have a rounded costa on both lateral faces of the basal sheath. The elongatiform and oistodiform elements carry a costa on both sides of the cusp and on the antero-basal extension. The costae on the latter may be inconspicuous.
Description: The oistodiform elements (Pl. 7, figs. 7a, b) have a long, antero-posteriorly extended base, which is remarkably straight. The basal cavity is very shallow. Its tip is situated near the basal termination of the costae of the cusp. The aboral margin is straight. The opening of the basal cavity is narrow, except for a slight lateral extension below its tip. The oral edge is keeled and more or less parallel to the aboral margin. The antero-basal portion is strongly extended anteriorly, to form a flange. Halfway the height of the base a prominent rounded costa runs along either lateral side, continuing on the antero-basal flange.

The cusp is reclined and the angle between the oral- and posterior edge is about 30°-40°. The anterior and posterior edges are both keeled. These keels are almost straight, apart from a slight sidewards undulation. On both sides of the cusp there is a rounded costa.

The elongatiform elements (Pl. 7, figs. 5a, b) are quite similar to the oistodiform elements, but the antero-basal flange is antero-aborally extended and evenly recurved, as are the anterior edge and the aboral margin. The oral edge is convex upwards and the angle with the posterior edge is up to 50°. The units may be somewhat flexed sidewards.

The cusp of the triangulariform elements (see Pl. 7, figs. 6a, b) carries prominently keeled lateral and antero-lateral edges, continuing basally as undenticulated processes, whereas higher up to the cusp they constitute prominent costae. The posterior edge is very sharp as well, which causes the cross-section of the cusp to be triangular. The facet between the lateral and antero-lateral edge is flat to slightly convex outwards. The oral edge is highly keeled and may be twisted sidewards. The angle between the oral and posterior edges varies between 45°-70°. The basal cavity is shallow and extends into the basal extremes of the lateral and antero-lateral edges. Along the base of the oral keel a rounded costa is present to both sides. This feature allows differentiation with the triangulariform element of *Oelandodus elongatus* (LINDSTRÖM) emend. herein (see Pl. 7, figs. 3a, b).
Differential diagnosis: The rounded costae on the lateral faces of the basal sheath of all three elements allows differentiation with all corresponding elements of other species.

Regional occurrence: At Köpingsklint and Horns Udde only reworked specimens of this species were found. In section 6 it is confined to member $K_{\text{ä-d 2}}$.

Biostratigraphic range: Oelandodus costatus was found only in the *Protopanderodus rectus/Oelandodus costatus* Assemblage Zone (fig. 15).

Genus **Oepikodus** LINDSTRÖM, emend. VAN WAMEL, herein

Type species: Oepikodus smithensis LINDSTRÖM, 1955.

Remarks: Oepikodus smithensis LINDSTRÖM is part of a multi-element species together with *Prioniodus evae* LINDSTRÖM and *Oistodus longiramis* LINDSTRÖM. This multi-element species was called *Prioniodus evae* LINDSTRÖM, emend. LINDSTRÖM, 1971. The type species of the form genus *Prioniodus* i.c. *Prioniodus elegans* PANDER, will appear to be part of a multi-element assemblage with an element composition fundamentally different from that of *Prioniodus evae* LINDSTRÖM, emend. LINDSTRÖM. So the latter multi-element species has to be placed in another genus: *Oepikodus*. For this genus the following redifinition is proposed: *Oepikodus* is a multi-element genus with oepikodiform (after *Oepikodus* LINDSTRÖM), prioniodiform (after *Prioniodus* PANDER) and longiramiform (after *Oistodus longiramis* LINDSTRÖM) elements.

Oepikodus evae (LINDSTRÖM), emend. VAN WAMEL, herein
(Pl. 6, figs. 15–17)

Prioniodus evae LINDSTRÖM, 1955a, p. 589, Pl. 6, figs. 4–10.
Prioniodus evae LINDSTRÖM, emend. LINDSTRÖM, 1971, p. 52, figs. 13, 14.
Oepikodus smithensis LINDSTRÖM, 1955a, p. 570, Pl. 5, figs. 36, 37.
Oistodus longiramis LINDSTRÖM, 1955a, p. 579, Pl. 4, figs. 35–37

Remarks: Apart from the change in generic position, no further comments need to be given to Lindström's (1971) adequate description of this multi-element species.

Regional occurrence: At Köpingsklint this species was found from the base of member K_{k3} up to a level at about 0.45 m. above the base of the Bruddesta Formation. In section 6 from the base of member K_{k3} up to a level at about 0.75 m. over the base of the Bruddesta Formation. Near Horns Udde from the upper portion of member K_{k2} up to a level at about 0.65 m. above the base of the Bruddesta Formation.

Biostratigraphic range: Oepikodus evae was found from the *Protopanderodus rectus/Oepikodus evae* Assemblage Zone up to and including part of the *Prioniodus navis/Prioniodus crassulus* Assemblage Zone (fig. 15).

Genus **Oistodus** PANDER, emend. VAN WAMEL, herein

Type species: Oistodus lanceolatus PANDER, 1856.

Synonyms: Oistodus PANDER, 1856, p. 27.
Oistodus PANDER, emend. LINDSTRÖM, 1955a, p. 572.
Oistodus PANDER, emend. LINDSTRÖM, 1971, p. 35.

Remarks: According to Lindström's (1971) last redefinition of the genus, only hyaline conodonts should be included. However, hyaline specimens of the type species often occur together with partially white or almost entirely white individuals. Furthermore, the symmetry transitions characteristic for *Oistodus lanceolatus* PANDER emend. LINDSTRÖM, 1971, appear to be present in an entirely white coloured conodont species i.c. *Oistodus papiliosus* n. sp.. As a consequence, it is suggested to redefine the genus *Oistodus* as:

A multi-element genus including both hyaline and white conodonts with symmetry transitions from simple forms without any lateral costa (oistodiform elements), through forms with a strongly developed costa on one side (triangulariform elements), to symmetrical forms with two antero-lateral costae and no anterior edge (deltaform elements).

Oistodus lanceolatus PANDER. emend. VAN WAMEL, herein
(Pl. 1, figs. 15–17)

Oistodus lanceolatus PANDER, 1856, p. 27, Pl. 2, figs. 17–19. LINDSTRÖM, 1955a, p. 577, Pl. 3, figs. 58–60.
Oistodus lanceolatus PANDER, emend. LINDSTRÖM, 1971, p. 38.
Oistodus triangularis LINDSTRÖM, 1955a, p. 591, Pl. 5, figs. 45, 46.
Oistosus delta LINDSTRÖM 1955a, p. 573, Pl. 3, figs. 3–9

Remarks: In all elements of this species hyaline specimens were found associated with identical individuals, partially or almost entirely composed of "white matter". In most casses, the "white matter" is confined to the cusp. The triangulariform elements may have one or two additional costae, usually running postero-laterally of the main costa (see Pl. 1, fig. 16).

Regional occurrence: At Köpingsklint the species occurs in the basal 2.40 m. of the Bruddesta Formation. In section 6 from the base of member K_{k3} up to a level at 3.00 m. above the base of the Bruddesta Formation. Near Horns Udde from the base of member K_{k3} up to a level at 2.30 m. above the base of the Bruddesta Formation.

Biostratigraphic range: Oistodus lanceolatus was found from the *Oistodus lanceolatus/Prioniodus deltatus* Assemblage Zone up to and including part of the *Microzarkodina flabellum* Assemblage Zone (fig. 15).

Oistodus papiliosus n. sp.
(Pl. 1, figs. 18–20)

Derivatio nominis: papiliosus, Lat. = like a butterfly. Referring to the shape of the triangulariform element, seen in side view.

Holotype: The triangulariform element, figured in Pl. 1, figs. 19a, b, cat. nr. T 196 – 13.

Figured paratypoids: The oistodiform element (Pl. 1, figs. 18a, 18b) and the deltaform element (Pl. 1, figs. 20a, 20b). Cat. nrs. T 196 –14 and 15.

Type-stratum: "Blommiga Bladet" or "the Flowery Sheet" at about half height the Bruddesta Formation in section 6; see chart III, sample 27.

Diagnosis: A relatively very small species of *Oistodus* with a butterfly-like appearance of the triangulariform elements.

Description: All our elements contain "white matter" and are completely white.

The oistodiform elements (see Pl. 1, figs. 18a, b) are bent sidewards and have a concave inner and a convex outer side. The base is about as long as the cusp. The basal cavity is shallow, laterally compressed and its oral outline is convex orally. The aboral margin is almost straight. The oral edge is keeled and convex outwards. The antero- and basal angles both are sub-rounded. The cusp is reclined with a sharp anterior edge which is convex outwards. The posterior edge is keeled and has a faint sinuous curvature. A prominent costa runs along the anterior part of the outer side of the cusp. This costa does not reach the aboral margin.

The triangulariform element (Pl. 1, figs. 19a, b) has a base with the shape of a butterfly's wing. It is strongly compressed laterally and the basal sheath is very thin. The basal cavity is only a groove. The aboral margin is concave outwards. The oral edge is highly keeled and straight. The angle between the oral edge and the posterior edge of the cusp is rounded. The entire unit is slightly bent to one side. The cusp is reclined to recurved. The anterior edge is sharp and bent to the inner side of the unit. The outer side of the cusp carries a prominent costa. The latter reaches the aboral margin and forms a flange-like extension there.

The deltaform elements (Pl. 1, figs. 20a, b) are bilaterally symmetrical. The base is reduced to a denticle-like extension at the posterior side of the cusp. Between the oral and posterior edges there is a very sharp angle. The antero-lateral edges are strongly extended laterally; the cusp lacks an anterior edge. Aborally the base and the lateral edges are flange-like in which the basal cavity is present as a groove.

Differential diagnosis: The very small size of all elements of this species and their bright white colour differentiate them from all corresponding elements of other species.

Regional occurrence: At Köpingsklint this species was found in one sample only, at 1.85 m. above the base of the Bruddesta Formation (just above "the Flowerly Sheet"). In section 6 it is rare in the basal portion of member K_{k3} and it was found in a sample just above the lowermost disconformity of "the Flowery Sheet". Near Horns Udde it was found rarely in member K_{k3} and in a sample just above the lowermost disconformity of "the Flowery Sheet".
Biostratigraphic range: Oistodus papiliosus was discontinuously found from the *Oistodus lanceolatus/Prioniodus deltatus* Assemblage Zone up to and including part of the *Microzarkodina flabellum* Assemblage Zone (fig. 15).

Genus **Paracordylodus** LINDSTRÖM, emend. VAN WAMEL, herein
Type species: Paracordylodus gracilis LINDSTRÖM, 1955.
Remarks: As the type species of the form genus *Paracordylodus* LINDSTRÖM appears to be part of a multi-element assemblage it is suggested to redefine the multi-element genus *Paracordylodus* as follows:

Paracordylodus is a multi-element genus with paracordylodiform (after *Paracordylodus* LINDSTRÖM), cordylodiform (after *Cordylodus* PANDER) and oistodiform elements.

Paracordylodus gracilis LINDSTRÖM, emend. VAN WAMEL, herein
(Pl. 4, figs. 11–13)

Paracordylodus gracilis LINDSTRÖM, 1955a, p. 584, Pl. 6, figs. 11, 12.
Oistodus gracilis LINDSTRÖM, 1955a, p. 576, Pl. 5, figs. 1, 2.

Remarks: Nothing needs to be added to Lindström's (1955a) original descriptions of the oistodiform (Pl. 4, fig. 11) and the paracordylodiform elements (Pl. 4, fig. 13).

The cordylodiform element (see Pl. 4, fig 12) has as yet not been described. The whole unit is laterally compressed. The posterior process carries 3–4 flat denticles (the third denticle of the figured specimen is broken off) which are reclined and sharply pointed. The basal sheath is very thin. The basal cavity is a shallow groove, running parallel to the aboral margin. The latter is concave posteriorly but in anterior direction it is curved more strongly and convex outwards. In the antero-basal region the rim of the aboral margin is deflected outwards, to form an outward flaring lip. The cusp is wide and flat. The anterior edge is evenly recurved, whereas the posterior edge is straight and reclined. On both lateral sides of the cusp a costa is present; neither of these costae reaches the aboral margin.
Regional occurrence: At Köpingsklint this species was found from halfway

member K_{k1} up to the top of member K_{k2}. In section 6 it is confined to the top of member $K_{ä\text{-}d2}$. Near Horns Udde it was only found in the top portion of member K_{k2}.
Biostratigraphic range: Paracordylodus gracilis was found from the upper part of the *Drepanodus arcuatus* Assemblage Zone up to and including the basal portion of the *Protopanderodus rectus/Oepikodus evae* Assemblage Zone (fig. 15).

Genus **Paroistodus** LINDSTRÖM, 1971
Type species: Oistodus parallelus PANDER, 1856.
Definition: "Paroistodus includes drepanodid conodonts with drepanodiform and oistodiform elements. The basal cavity tends to become inverted anteriorly. Drepanodiform elements tend to develop a sharp, low costa on each side. Base of oistodiform elements is roughly square in side view and does not extend very far anteriorly" (op. cit. Lindström, 1971, p. 46).
Remarks: In addition to drepanodiform and oistodiform elements, slightly asymmetrical forms with a basal cavity opening to one side (= scandodiform elements) are also part of the species of this genus.

Paroistodus amoenus (LINDSTRÖM)
(Pl. 7, figs. 8–11)

Drepanodus amoenus LINDSTRÖM, 1955a, p. 588, Pl. 2, figs. 25, 26; Fig. 4b.
Oistodus parallelus PANDER. LINDSTRÖM, 1955a, p. 579, Pl. 4, figs. 27–29; Fig. 3N, *not* Pl. 4, figs. 26, 30, 31; Fig. 30.
Paroistodus numarcuatus (LINDSTRÖM) pars, emend. LINDSTRÖM, 1971, p. 46, fig. 8.

Remarks: The oistodiform element (see Pl. 7, figs. 10, 11) is very similar to that of *Paroistodus parallelus* (PANDER) (see Pl. 7, figs. 13, 15, 17). In the former the base/cusp proportion is relatively smaller, the angle between the posterior and the oral edge is larger and the antero-basal part of the base is seldom inverted.

As shown in figs. 8 and 9 of Pl. 7, the base of the drepanodiform elements is roughly triangular or quadrangular in lateral view. Usually, the lower parts of the anterior and posterior edges are prominently keeled. This is an important feature to differentiate the form species *Drepanodus amoenus* LINDSTRÖM from *Drepanodus sculponea* LINDSTRÖM or from *Drepanodus proteus* LINDSTRÖM. In the drepanodiform elements the anterior stretch of the aboral margin may be open. In these forms the basal cavity flares and may open to one side (= scandodiform elements). The latter types resemble the form species *Scandodus pipa* LINDSTRÖM (= the scandodiform element

of *Drepanodus arcuatus* PANDER, emend. herein, see Pl. 1, fig. 12).
Regional occurrence: At Köpingsklint this species occurs from the top of member $D_{k\,1}$ up to the top of member $K_{k\,2}$. In section 6 this species was not found. Near Horns Udde it occurs from member $D_{h\,1}$ up to half height member $K_{k\,2}$.
Biostratigraphic range: This species was found from the *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone up to and including the *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone (fig. 15).

Paroistodus parallelus (PANDER), emend. VAN WAMEL, herein (Pl. 7, figs. 12–17)

Oistodus parallelus PANDER, 1856, p. 27, Pl. 2, fig. 40.
Paroistodus parallelus (PANDER), emend. LINDSTRÖM, 1971, p. 47, figs. 8, 11.
Drepanodus proteus LINDSTRÖM, 1955a, p. 556, Pl. 3, figs. 18–21; Figs. 2a-f, j.
Paroistodus proteus (LINDSTRÖM), emend. LINDSTRÖM, 1971, p. 46, figs. 8, 10.
Oistodus originalis SERGEEVA, 1963, p. 98, Pl. 7, figs. 8, 9.
Paroistodus originalis (SERGEEVA), emend. LINDSTRÖM, 1971, p. 48, figs. 8, 12.
Distacodus expansus (GRAVES & ELLISON). LINDSTRÖM, 1955a, p. 555, Pl. 3, figs. 13–17; Figs. 2g-i.

Remarks: The oistodiform elements (Pl. 7, figs. 13, 15, 17) are identical with *Oistodus parallelus* PANDER, 1856.

The drepanodiform elements (see Pl. 7, figs. 12, 14, 16) were previously called *Drepanodus proteus* LINDSTRÖM, *Distacodus expansus* (GRAVES & ELLISON) or *Oistodus originalis* SERGEEVA, which types often occur together in the Öland material. According to their original descriptions, the difference between *Drepanodus proteus* and *Distacodus expansus* would be the absence of lateral costae in the former. There are intermediate variants, however, with sharp carinae or rounded costae, which intergradation devaluates this criterion of differentiation. *Oistodus originalis* SERGEEVA is rounded antero-basally and lacks an antero-basal flange; its posterior edge and the oral edge together form a single, evenly recurved line. In the Öland marerial, the latter forms are present in the lower samples, together with the other drepanodiform variants. Higher up in the rock-sequence the *Oistodus originalis* SERGEEVA-like elements form a larger part of the multi-element assemblage, which fact might enable the distinction of a multi-element species *Paroistodus originalis* (SERGEEVA), emend. LINDSTRÖM, 1971. Biometrical data and statistical methods are required to define the boundary between these two multi-element species. For the time being, *Oistodus originalis* SERGEEVA is considered to be part of *Paroistodus parallelus* (PANDER), emend. VAN WAMEL,herein.

Scandodiform variants of the drepanodiform elements also occur. These very much resemble the comparable elements of *Drepanodus arcuatus* PANDER, emend. herein and of *Paroistodus amoenus* (LINDSTRÖM). However, the anterior-posteriorly extended base of the scandodiform elements of *Paroistodus parallelus* (PANDER) emend. herein is very characteristic.

Regional occurrence: At Köpingsklint this species occurs from member $K_{k\,2}$ up to the top of the sequence. In section 6 from member $K_{ä\text{-}d\,1}$ to the top of the section. Near Horns Udde from member $K_{k\,2}$ up to the top of the Horns Udde Formation.

Biostratigraphic range: *Paroistodus parallelus* (PANDER) emend. herein was found from the *Drepanoistodus inconstans* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Genus **Periodon** HADDING, emend. BERGSTRÖM & SWEET, 1966

Type species: Periodon aculeatus HADDING, 1913.

Definition: "*Periodon* embraces, multi-element conodont species that include cordylodus-, ligonodina-, cladognathodus-, roundya-, prioniodina-, and falodus-like conodont elements." (op cit. Bergström & Sweet, 1966, p. 361).

Remarks: According to the emended diagnosis "falodus-like" elements form part of the multi-element genus *Periodon*. Instead of "falodus-like" elements only oistodiform elements, with extended antero-basal edges, were found to belong to this genus in the Öland material. Therefore, the following addition to the emended genus definition is suggested: The "falodus-like" elements may be replaced by oistodus-like elements with an extended and undenticulated antero-basal edge.

The endings -us-like, used by Bergström & Sweet (1966) will be replaced by -form or by -iform in this paper. The elements of the *Periodon* transition series, described by Lindström (1964, p. 82), will be called the multiramiform elements.

Periodon flabellum (LINDSTRÖM), emend. LINDSTRÖM, 1971
(Pl. 4, figs. 14–20)

Trichonodella flabellum LINDSTRÖM, 1955a, p. 599, Pl. 6, figs. 28–30.
Periodon flabellum (LINDSTRÖM). LINDSTRÖM, 1964, p. 83, figs. 28 A-D.
Periodon flabellum (LINDSTRÖM), emend. LINDSTRÖM, 1971, p. 57, fig. 18.
Prioniodina? deflexa LINDSTRÖM, 1955a, p. 586, Pl. 6, figs. 31–35
Prioniodina inflata LINDSTRÖM, 1955a, p. 588, Pl. 6, figs. 26, 27.
Oulodus inflatus (LINDSTRÖM). LINDSTRÖM, 1964, p. 85, figs. 30 A-B.
Oistodus selene LINDSTRÖM, 1955a, p. 580, Pl. 4, figs. 19, 20.

Remarks: Throughout the Öland sections, the oistodiform element remained very constant in shape, whereas both the ozarkodinaform element (= the *Prioniodina inflata*-like elements, Pl. 4, figs. 18–20) and the multiramiform elements (= the elements of the *Periodon* transition series of Lindström 1964; see for instance Pl. 4, figs. 15–17) underwent considerable changes in shape.

The older forms of the ozarkodinaform elements had a short and undenticulated base (Pl. 4, fig. 18). They also lacked the oulodus-like bending, described by Lindström (1964). The anterior process was hardly developed and undenticulated. The illustrations of plate 4, figs. 18 to 20, show the gradual change to the ozarkodinaform elements described as *Prioniodina inflata* LINDSTRÖM, 1955.

The early forms of the multiramiform elements were hardly denticulated if at all (Pl. 4, fig. 15). The basal sheath was higher and the cusp wider and flatter, compared to the later forms (Pl. 4, figs. 16 and 17). The change to the more conspicuously denticulated forms was very gradual.

Biometrical and statistical data probably will enable the distinction of several species within this lineage. For the time being, they are all placed in one multi-element species.

Regional occurrence: At Köpingsklint the species occurs from the top of member K_{k2} up to and including the top portion of the Bruddesta Formation. In section 6 from member $K_{ä\text{-}d1}$ up to and including the lowermost portion of the Horns Udde Formation. Near Horns Udde from the top of member K_{k2} up to a level at about 2.80 m. over the base of the Bruddesta Formation.

Biostratigraphic range: Periodon flabellum was found from the *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone up to and including the lower portion of the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Genus **Pravognathus** STAUFFER, 1936

Type species: Heterognathus idoneus STAUFFER, 1935.

Definition: "Base thin, long, slender, straight or slightly arched and twisted just anterior to the middle; under side of base with narrow groove extending entire length, slightly widening and deepening beneath the arch or beneath the more prominent denticles; the upper edge of base bears 2, 3 or 5, possibly more, large, long, pointed, orally flattened, aborally rounded denticles on the arched or twisted portion; these may incline in various directions. Anterior limb or portion of base bears 4 or 5, possibly more, denticles of decreasing size; posterior limb bears 10 to 12, possibly more, small laterally flattened, sharppointed denticles, the edges of which may be partly confluent near base" (op. cit. Stauffer, 1935, pp. 606–607).

Pravognathus aengensis LINDSTRÖM, 1955
(Pl. 2, fig. 23)

Pravognathus aengensis LINDSTRÖM, 1955a, p. 585, Pl. 5, figs. 10–13.

Regional occurrence: At Köpingsklint this species was found in member $D_{ä\text{-}d2}$ and D_{k1}. In section 6 and near Horns Udde it was not encountered.
Biostratigraphic range: Pravognathus aengensis was found in the *Cordylodus rotundatus* and in the *Drepanoistodus acuminatus* Assemblage Zone (fig. 15).

Genus **Prioniodus** PANDER, emend. VAN WAMEL, herein
Type species: *Prioniodus elegans* PANDER, 1856.
Synonyms: *Prioniodus* PANDER, 1856, p. 29
Prioniodus PANDER, emend. LINDSTRÖM, 1971, p. 51
Baltoniodus LINDSTRÖM, 1971, p. 55
Gothodus LINDSTRÖM, emend. LINDSTRÖM, 1971, P. 54.
Remarks: Lindström (1971) distinguished a "*Prioniodus* group" with the genus *Prioniodus* and a "*Baltoniodus* group" with the genera *Baltoniodus* and *Gothodus*. The main differences between these groups are the absence of an inner lateral flare and the lack of branches departing from the posterior process of the prioniodiform elements in the "*Prioniodus* group". In addition, these elements have no deep and wide basal cavity. However, we prefer, for generic definition of multi-element associations, to use the element composition rather than differences in shape between corresponding elements. From our investigations *Prioniodus elegans* PANDER appeared to be part of a multi-element assemblage with an elemental composition similar to that of the multi-element genera *Gothodus* LINDSTRÖM, emend. LINDSTRÖM, 1971 and *Baltoniodus* LINDSTRÖM. As a consequence, the latter two genera are considered synonymous with the multi-element genus *Prioniodus*, for which the following redefinition is suggested:
Prioniodus is a multi-element genus with prioniodiform elements (after *Prioniodus* PANDER, 1856); prioniodinaform elements (after *Prioniodina* ULRICH & BASSLER, 1926); gothodiform elements (after *Gothodus* LINDSTRÖM, 1955); tetraprioniodiform elements (after *Tetraprioniodus* LINDSTRÖM, 1955) which are considered equivalent with oepikodiform elements (after *Oepikodus* LINDSTRÖM, 1955) and/or trapezognathiform

elements (after *Trapezognathus* LINDSTRÖM, 1955); roundyaform elements (after *Roundya* HASS, 1953); oistodiform elements (after *Oistodus* PANDER, 1856) and/or falodiform elements (after *Falodus* LINDSTRÖM, 1955). Those multi-element species with undenticulated- or barely denticulated-elements, which each have a construction similar to that of the denticulated elements mentioned above, must also be referred to this genus *Prioniodus*.

From this definition it appears, that tetraprioniodiform (= oepikodiform) and trapezognathiform elements may occur together in one multi-element species. This is also true for the oistodiform and falodiform elements.

Prioniodus crassulus (LINDSTRÖM), emend. VAN WAMEL, herein
(Pl. 6, figs. 7–14)

Oepikodus crassulus LINDSTRÖM, 1955a, p. 570, Pl. 5, fig. 36, *not* Pl. 5, fig. 37.
Gothodus costulatus LINDSTRÖM, emend. LINDSTRÖM, 1971, Pl. 1, figs. 4, 5 *not* p. 54, Pl. 1, figs. 1, 2, 3.
? *Prioniodus acodiformis* LINDSTRÖM, 1955a, p. 591, Pl. 5, fig. 42.

Remarks: The prioniodiform elements (Pl. 6, figs. 7, 8) are badly preserved. As this is also the case with *Prioniodus acodiformis* figured by Lindström (1955a) it is uncertain whether or not they are identical.
The cusp is triangular in cross section. The facets between the anterior, posterior and lateral edges are almost flat. The cusp is erect to sligthly proclined. The anterior and posterior edges are straight to recurved. The lateral edge is straight and diverges only slightly from the anterior edge. Aborally this lateral edge bends strongly outwards. The anterior and lateral edges may be undenticulated. The posterior process carries some erect denticles and it is almost straight.

The basal cavity is wide and a thin basal sheath connects the anterior and lateral edges with the posterior process. The tip of the basal cavity penetrates into the basal portion of the cusp.

This prioniodiform element is very similar to that of *Prioniodus deltatus* (LINDSTRÖM), emend. herein (Pl. 8, fig. 1) and to that of *Prioniodus navis* LINDSTRÖM, emend. herein (see Pl. 8, fig. 10). The triangular cross section of the cusp, the straight anterior and lateral edges and the slight divergence of the lateral edge from the anterior edge, however, are typical features of the prioniodiform elements of *Prioniodus crassulus* (LINDSTRÖM), emend. herein.

The prioniodinaform element (Pl. 6, figs. 9a, b) is characterized by a long cusp and a long posterior process.

The cusp is proclined and the sides are well rounded. The anterior and posterior edges are not sharp. The anterior edge is extended antero-basally to form an anterior process which is undenticulated and may be bent sidewards. The posterior process is low and tapers gradually in posterior direction. It carries many subequal denticles which are fused at their bases. The posterior stretch of the aboral margin is almost straight but it curves gradually downwards in anterior direction. The oral outline of the basal cavity is nearly straight. The same is true for its anterior outline, which runs very close to the anterior edge. The tip of the basal cavity penetrates into the base of the cusp.

The gothodiform element (Pl. 6, figs. 10a, b) is quite similar to the prioniodinaform element. It has a sharp costa to one side of the cusp, which extends over the base and forms a bulge-like extension of the aboral margin. The anterior denticles of the posterior process are proclined, like the cusp, and they may be entirely isolated from each other. The basal sheath is remarkably thin between the lateral costa and the anterior and posterior processes.

The oepikodiform element (Pl. 6, figs. 11a, b) was described by Lindström (1955a) and illustrated by the same author (1971) as part of his multi-element species *Gothodus costulatus*.. Most of the other elements referred to this multi-element species by Lindström (1971), form part of a species described herein as *Prioniodus deltatus* (LINDSTRÖM), emend. herein (Pl. 8, figs. 1–9).

The roundyaform element (Pl. 6, figs. 12a, b) has a proclined cusp. Anteriorly it is rounded and the posterior edge of the cusp is sharp. Antero-laterally there are two costae which gradually pass into antero-basal processes. The posterior process is denticulated with proclined denticles, which are only fused at their extreme bases. The basal sheath is thin and flat. It connects the antero-basal and the posterior processes, which therefore are not true processes as they are not free. The basal cavity is deep, pyramidal and triangular in cross section. Its tip penetrates into the base of the cusp.

The oistodiform element (Pl. 6, figs. 13, 14) is slightly bent sidewards. The cusp is robust, bladelike, reclined and almost straight. Only the basal stretch of the anterior edge is recurved and a little extended antero-basally. The posterior edge is reclined and meets the oral edge at an angle of about 50°. The oral edge is straight to slightly convex. It is keeled. The base bulges on the inner side of the unit. The basal cavity is rather shallow. The aboral margin is straight posteriorly and curves downwards in anterior direction. At both lateral sides the aboral margin shows a sinuous curvature at the point of its downwards inflexion. The one of the outer side is less prominent than the other. This oistodiform element is very similar to that of *Prioniodus deltatus*

(LINDSTRÖM), emend. herein (see Pl. 8, fig. 9). It differs from the latter in the following points:

– The cusp is more strongly reclined and straighter.
– The antero-basal extension is relatively smaller.
– The oral edge is much longer and less convex.

Regional occurrence: At Köpingsklint the species was found from the base of the Bruddesta Formation up to a level at about 0.50 m. over that base. In section 6 it was found in an interval from 0.50 m. up to 1.00 m. above the base of the Bruddesta Formation. Near Horns Udde it occurs in an interval from 0.10 m. up to about 0.90 m. above the base of the Bruddesta Formation.

Biostratigraphic range: Prioniodus crassulus was found in the *Prioniodus crassulus* Assemblage Zone and in the *Prioniodus navis/Prioniodus crassulus* Assemblage Zone (fig. 15).

Prioniodus deltatus (LINDSTRÖM), emend. VAN WAMEL, herein
(Pl. 8, figs. 1–9)

Acodus deltatus LINDSTRÖM, 1955a, p. 544, Pl. 3, fig. 30.
Drepanodus latus LINDSTRÖM, 1955a, p. 564, Pl. 3, figs. 22, 23.
Acodus deltatus altior LINDSTRÖM, 1955a, p. 544, Pl. 3, figs. 27–29.
Distacodus rhombicus LINDSTRÖM, 1955a, p. 556, Pl. 3, figs. 35, 36.
Trichonodella longa minor LINDSTRÖM, 1955a, p. 601, Pl. 6, figs. 16–19.
Oistodus linguatus LINDSTRÖM, 1955a, p. 577, Pl. 3, figs. 39–41.
Prioniodina diprion LINDSTRÖM, 1955a, p. 587, Pl. 5, fig. 43.

Remarks: This multi-element species is usually composed of undenticulated elements. Their basic plans are quite comparable with those of the denticulated elements of other species of the genus *Prioniodus* PANDER, emend. herein. Occasionally, denticle-like configurations of the keels may occur. See for example Pl. 8, figs. 3, 5a, b and 7.

The prioniodiform element (see Pl. 8, fig. 1) is *Acodus deltatus* LINDSTRÖM, 1955. The form variation in this element is rather large. For a differential diagnosis with the prioniodiform element of *Prioniodus crassulus* (LINDSTRÖM), emend. herein, see the description of the latter species on page 83.

The prioniodinaform element (Pl. 8, fig. 2) is *Drepanodus latus* LINDSTRÖM, 1955. *Prioniodina diprion* LINDSTRÖM, 1955, is considered as a rather sparse variant of the prioniodinaform element, with denticle-like modifications of the oral keel (Pl. 8, fig. 3).

The gothodiform element (Pl. 8, fig. 4) is *Acodus deltatus altior* LINDSTRÖM, 1955.

The oepikodiform element (Pl. 8, figs. 6, 7) is identical with *Distacodus rhombicus* LINDSTRÖM, 1955. Together with these also trapezognathiform elements (see Pl. 8, figs. 5a, b) occur which have never been described as a separate form species. These are quite similar to *Distacodus rhombicus* LINDSTRÖM, 1955, but one of the lateral costae is situated more anteriorly, and the other more posteriorly.

The roundyaform element (Pl. 8, fig. 8) is identical with *Trichonodella longa minor* LINDSTRÖM, 1955.

Oistodus linguatus LINDSTRÖM, 1955 is the oistodiform element (Pl. 8, fig. 9). It strongly resembles the oistodiform element of *Prioniodus crassulus* (LINDSTRÖM), emend. herein (see Pl. 6, figs. 13a, b). The differential diagnosis is given with the latter species (page 85).

The undenticulated elements of *Prioniodus deltatus* are quite comparable with the denticulated elements of *Prioniodus navis*, found in the higher parts of our sections (charts II, III and IV, fig. 15). The oldest elements of *Prioniodus navis* are sporadically denticulated and they seem to transform gradually into well denticulated forms later. It therefore seems quite possible that *Prioniodus deltatus* gradually transformed into *Prioniodus navis*. *Drepanodus latus* LINDSTRÖM seems to transform into *Prioniodina densa* LINDSTRÖM, 1955 (Pl. 8, fig. 12). In a comparable way, *Acodus deltatus altior* LINDSTRÖM, 1955 (Pl. 8, fig. 4) seems to develop denticles on its oral edge transforming into *Prioniodus triangularis* LINDSTRÖM, 1955 (Pl. 8, fig. 14). *Distacodus rhombicus* LINDSTRÖM, 1955 (Pl. 8, figs. 6, 7) seems to grade into *Tetraprioniodus denticulatus* LINDSTRÖM, 1955 (Pl. 8, fig. 15), and the trapezognathiform element (Pl. 8, figs. 5a, b) into *Trapezognathus quadrangulum* LINDSTRÖM, 1955 (Pl. 8, fig. 16). Finally, the roundyaform element (Pl. 8, fig. 8) seems to change into a form with denticles, named *Trichonodella longa* LINDSTRÖM, 1955 (Pl. 8, fig. 17). The oistodiform element (Pl. 8, fig. 9) develops denticles on the antero-basal edge only, transforming it into a falodiform element (Pl. 8, fig. 18, 19).

This apparent development of the elements of *Prioniodus deltatus* (LINDSTRÖM) emend. herin to the elements of *Prioniodus navis* (LINDSTRÖM) emend. herein (Pl. 8, figs. 10–19) is the main reason to place the former species into the genus *Prioniodus* PANDER emend. herein. For the time being, the boundary between both species is chosen in such way, that the undenticulated forms and the forms with denticle-like modifications of the edges belong to *Prioniodus deltatus* (LINDSTRÖM) emend. herein, and the denticulated forms to *Prioniodus navis* LINDSTRÖM emend. herein. Only biometrical and statistical data may provide a better specific differentiation. This lineage would form a connection between the so called "simple conodonts" and the "complex conodonts". Lindström (1964, p. 91 etc.) already showed a later development from the "complex conodonts" towards the "platform conodonts".

Regional occurrence: At Köpingsklint this species is found in member $K_{k\,2}$ and $K_{k\,3}$. In section 6 it occurs from member $K_{\ddot{a}\text{-}d\,1}$ up to and including the basal portion of member $K_{k\,3}$. Near Horns Udde it was found from member $K_{k\,2}$ up to the top of member $K_{k\,3}$.

Biostratigraphic range: Prioniodus deltatus was found from the *Prioniodus deltatus* Assemblage Zone up to and including the *Oistodus lanceolatus/ Prioniodus deltatus* Assemblage Zone (fig. 15).

If the assumption is correct, that *Prioniodus deltatus* gradually transformed into *Prioniodus navis*, there must be a hiatus in our present knowledge of the regional ranges of both species in the area. The latter appears from fig. 15, which shows a gap between the last occurrence of *Prioniodus deltatus* and the appearance of *Prioniodus navis*.

Further information about the actual ranges of *Prioniodus deltatus* and *Prioniodus navis* may have important consequences for the conodont-zonation of the area (see chapters II.2.4.13 to II.2.4.16).

Prioniodus elegans PANDER, emend. VAN WAMEL, herein (Pl. 6, figs. 1–6)

Prioniodus elegans PANDER, 1856, p. 29, Pl. 2, figs. 22, 23, Pl. 3, fig. 9. LINDSTRÖM, 1955a, p. 589, Pl. 5, figs. 26–29; Fig. 5a.
Prioniodus elegans PANDER, (pars), emend. LINDSTRÖM, 1971, p. 51.
Belodus gracilis PANDER, 1856, (pars), Pl. 3, fig. 8, *not* p. 30, Pl. 2, fig. 21.
Gothodus costulatus LINDSTRÖM, 1955a, p. 569, Pl. 5, figs. 23–25.
Prioniodus carinatus PANDER, 1856, Pl. 3, fig. 7, *not* p. 30, Pl. 2, fig. 25.
Falodus prodentatus (GRAVES & ELLISON). LINDSTRÖM, 1955a, p. 569, Pl. 5, figs. 21, 22, 30; *not Oistodus prodentatus* GRAVES & ELLISON, 1941, p. 13, Pl. 2, figs. 16, 22, 23, 28.

Remarks: Nothing needs to be added to Pander's and Lindström's descriptions of the prioniodiform element (see Pl. 6, fig. 1).

The prioniodinaform element was illustrated by Pander (1856) in his Pl. 3, fig. 9 and he called it *Prioniodus elegans*. Pander's Pl. 3, fig. 8 shows a similar prioniodinaform element, which in this case he refers to *Belodus gracilis*, a species defined by a holotype illustrated in his Pl. 2, fig. 21. It appears, however, that this holotype can not be included in our multi-element species *Prioniodus elegans*.

The prioniodinaform element (Pl. 6, fig. 2) has a robust and proclined cusp, with well rounded sides and sharp anterior and posterior edges. Only the anterior part of the posterior process is preserved in the figured specimen. It is straight and crowded with subequal denticles, which are almost totally fused. The denticles are erect to reclined and subcircular in cross section. The bases of the first two denticles are somewhat elevated above those of the succeeding denticles. The first one is fused to the cusp. The antero-basal process is long and slightly sinuously curved. It carries some denticles, which are fused to the process on their posterior sides. The basal cavity intrudes both processes as a shallow groove. It is roughly triangular in side view and the oral and anterior outlines are both straigth. The aboral margins of the posterior and anterior processes make an angle of about 80°. Where they meet there is a bulge in the aboral margins on both sides of the unit. Fine striation is present all over the cusp and the anterior process.

The gothodiform element (Pl. 6, fig. 3) is quite similar to the prioniodinaform element, it only has a lateral costa to one side of the cusp. This costa forms an undenticulated, short and free process where it meets the aboral margin.

The oepikodiform element (Pl. 6, fig. 4) has two lateral costae but otherwise it is quite similar to the prioniodinaform element. The costae form two short and undenticulated processes where they meet the aboral margin.

The roundyaform element (Pl. 6, fig. 5) has a proclined cusp. Its cross section is subcircular at the top. Downward there are two faint lateral costae, which gradually pass into the lateral processes. These are well developed and carry some subequal, straight and almost entirely fused denticles. The posterior process is straight and has a similar denticulation as the prioniodinaform element. The basal cavity extends as a very shallow groove into the processes.

The falodiform element (Pl. 6, fig. 6) has a blade-like and reclined cusp. At the boundary of the anterior edge of the cusp and the anterior process there is a very faint inflection. The denticles on the anterior process are almost entirely fused. The basal cavity extends into the processes as shallow grooves. It has already been figured by Pander (1856, Pl. 3, fig. 7) and by Lindström (1955a, Pl. 5, figs. 21, 22, 30). Pander called his specimen *Prioniodus carinatus* but most probably the holotype of that form species does not belong to the multi-element species under consideration, because the denticles on the anterior process of the holotype of *Prioniodus carinatus* PANDER (1856, Pl. 2, fig. 25) are not fused. According to Lindström (1955a, p. 569) this falodiform element would have been described by Graves & Ellison (1941) as *Oistodus prodentatus*. In the Öland material, however, the anterior edge of the cusp and the anterior process are almost straight and reclined, in contrast with the specimens figured by Graves & Ellison.

Regional occurrence: Not reworked remnants of this species were only found

in member $K_{\ddot{a}\text{-}d1}$ and $K_{\ddot{a}\text{-}d2}$ of section 6. Reworked material has been encountered in the basal portion of member K_{k3} at Köpingsklint as well as near Horns Udde.
Biostratigraphic range: Prioniodus elegans was found from the *Prioniodus elegans/Oelandodus elongatus* Assemblage Zone up to and including the *Protopanderodus rectus/Oelandodus costatus* Assemblage Zone (fig. 15).

Prioniodus navis LINDSTRÖM, emend. VAN WAMEL, herein (Pl. 8, figs. 10–19).

Prioniodus navis LINDSTRÖM, 1955a, p. 590, Pl. 5, figs. 31–35.
Baltoniodus navis (LINDSTRÖM), emend. LINDSTRÖM, 1971, p. 56, Pl. 1, fig. 13, *not* Pl. 1, figs. 18–23.
Prioniodina densa LINDSTRÖM, 1955a, p. 586, Pl. 6, fig. 20.
Prioniodus triangularis LINDSTRÖM, 1955a, p. 591, Pl. 5, fig. 46, *not* Pl. 5, fig. 45.
Baltoniodus triangularis (LINDSTRÖM), emend. LINDSTRÖM, 1971, p. 55, Pl. 1, fig. 12.
Tetraprioniodus denticulatus LINDSTRÖM, 1955a, p. 596, Pl. 5, fig. 44.
Trapezognathus quadrangulum LINDSTRÖM, 1955a, p. 598, Pl. 5, figs. 38–41.
Gothodus costulatus LINDSTRÖM, pars, emend. LINDSTRÖM, 1971, p. 54, Pl. 1, figs. 1, 2, 3, *not* Pl. 1, figs. 4, 5.
Trichonodella longa LINDSTRÖM, 1955a, p. 600, Pl. 6, figs. 47, 48.
Oistodus linguatus extenuatus LINDSTRÖM, 1955a, p. 578, Pl. 3, fig. 42.

Remarks: This multi-element species comprises elements that are either sporadically or well denticulated. Contrary to the denticle-like modifications on some elements of *Prioniodus deltatus* (LINDSTRÖM), emend. herein (Pl. 8, figs. 1–9) the denticles of *Prioniodus navis* are distinct tooth-like structures, which are never fused completely. All elements have been described earlier as separate form species.

The prioniodiform element (Pl. 8, figs. 10, 11) is *Prioniodus navis* LINDSTRÖM, 1955. To this form species belong well denticulated forms and others with occasional denticles, as follows from the illustrations which accompany the original description. The sporadically denticulated forms (Pl. 8, fig. 10) seem to take an intermediate position between forms called *Acodus deltatus* LINDSTRÖM, 1955 and those called *Prioniodus navis* LINDSTRÖM, 1955.

The prioniodinaform element is *Prioniodina densa* LINDSTRÖM, 1955 (Pl. 8, fig. 12), which may be sporadically denticulated in the older faunas.

Prioniodus triangularis LINDSTRÖM, 1955, is the gothodiform element (Pl. 8, figs. 13, 14). In fact, it is not quite comparable with the form genus *Gothodus* LINDSTRÖM as it sometimes carries denticles on its anterior edge (process). But on the other hand, it is not a real *Prioniodus* either, because the lateral edge (process) is undenticulated and there are no real free processes.

Trapezognathus quadrangulum LINDSTRÖM, 1955 is the trapezognathiform element (Pl. 8, fig. 16). In the older faunas it may be found together with tetraprioniodiform elements, called *Tetraprioniodus denticulatus* LINDSTRÖM (Pl. 8, fig. 15).

Trichonodella longa LINDSTRÖM, 1955 is the roundyaform element (see Pl. 8, fig. 17).

The oistodiform elements were called *Oistodus linguatus extenuatus* LINDSTRÖM, 1955. In the older forms the antero-basal edge is rarely denticulated, whereas later on denticles are usually present on this edge (= falodiform elements) (Pl. 8, figs. 18, 19).

Some elements included in *Baltoniodus navis* (LINDSTRÖM), emend. LINDSTRÖM (1971, Pl. 1, figs. 18–23) are different from the elements here included in *Prioniodus navis*. The former seem to be futher developed elements of the lineage from *Prioniodus deltatus* (LINDSTRÖM), emend. herein to *Prioniodus navis* LINDSTRÖM, emend. herein and they originate from higher stratigraphic levels.

Regional occurrence: At Köpingsklint this species occurs from a level at about 0.10 m. over the base of the Bruddesta Formation up to the top of the studied sequence. In section 6 from a level at about 0.75 m. above the base of the Bruddesta Formation up to the top of the section. Near Horns Udde from a level at about 0.40 m. above the base of the Bruddesta Formation up to the top of the Horns Udde Formation.

Biostratigraphic range: Prioniodus navis was found from the *Prioniodus navis/Prioniodus crassulus* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

See also the remarks concerning the ranges of *Prioniodus deltatus* and *Prioniodus navis*, mentioned in the description of the biostratigraphic range of *Prioniodus deltatus* (p. 87).

Genus **Protopanderodus** LINDSTRÖM, emend. VAN WAMEL, herein

Type species: Acontiodus rectus LINDSTRÖM, 1955.

Remarks: The following minor change of Lindström's (1971) original definition of the genus is proposed:

Protopanderodus includes conodonts with longitudinal striation and a cusp that is higher than the base. The striation of the cusp may be inconspicuous. The cross section of the cusp may be subcircular, commashaped, lanceolate or acontiodus-like. Most species include symmetrical as well as asymmetrical elements, but there are no oistodiform elements. In all elements the entire base or part of it is more translucent (= hyaline) than the cusp.

Protopanderodus latus n. sp.

(Pl. 4, figs. 1–3)

Derivatio nominis: latus, Lat. = broad, wide.
Type-stratum: A level at about 1.40 m. above the base of the Horns Udde Formation near Horns Udde section 14; see also sample 46, chart IV.
Holotype: Pl. 4, figs. 2a, b, cat. nr. T 197 – 13.
Figured paratypoids: Pl. 4, figs. 1a, b and 3a, b. Cat. nrs. T 197 – 14 and 15.
Diagnosis: A *Protopanderodus* with three types of elements, i.c.:

- Symmetrical elements which are recurved and have a wide cusp and a wide base (see the holotype).
- Symmetrical elements which are proclined or erect and have a long and narrow base (Pl. 4, figs. 1a, b).
- Asymmetrical, sidewards twisted elements which have a fairly wide cusp and a base that opens to one side (=scandodiform elements) (Pl. 4, figs. 3a, b).

All elements are clearly striated, except for a narrow band parallel to the aboral margin.

Description: In the wide, symmetrical elements there is hardly any distinction between the cusp and the base. The posterior and oral edge form a continuously curved line. The anterior edge is evenly recurved as well. The oral edge carries a small keel, which does not reach the aboral margin. The anterior edge is well rounded basally and sharper higher up to the cusp. The aboral margin is almost straight in side view. The oral outline of the basal cavity is slightly concave upwards, whereas the anterior outline is nearly straight. The opening of the basal cavity is wide and rounded. The cross section of the cusp is lanceolate near its tip to become ovoid downwards, widest anteriorly. Around the basal cavity all specimens are translucent and brown (hyaline).

The symmetrical elements with a long base and cusp are proclined to erect (see Pl. 4, figs. 1a, b). The cusp gradually passes into the base. The cross section of the base is subcircular, and the basal cavity is conical. The base is sometimes barely wider than the cusp, sometimes it widens in aboral direction. The aboral margin is almost straight in side view. Where the base passes into the cusp, the cross section is subcircular but higher up it gradually becomes lanceolate. Due to a slight twist of the cusp relative to the base, the anterior and posterior edges of the cusp may have a more lateral position. These edges may continue over the base as faint costae. A band of hyaline material runs parallel to the aboral margin.

The cusps of the scandodiform elements (Pl. 4, figs. 3a, b) are rather strongly twisted sidewards and their bases open to one side. The base is

slightly compressed laterally and passes into the cusp. The basal cavity is conical and its cross section is oval. The edges are situated slightly laterally and they are sub-angular to slightly rounded. They do not reach the aboral margin. A hyaline band occurs parallel to the aboral margin.
Remarks: Sometimes the symmetrical elements with elongated bases may resemble comparable elements of *Protopanderodus longibasis* (LINDSTRÖM), emend. herein (Pl. 4, fig. 4) The latter are much less prominently striated, however.
Regional occurrence: In all sections, studied biostratigraphically, this species is confined to the Horns Udde Formation.
Biostratigraphic range: Protopanderodus latus is confined to the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Protopanderodus longibasis (LINDSTRÖM), emend. VAN WAMEL, herein
(Pl. 4, figs. 4–6)

Drepanodus longibasis LINDSTRÖM, 1955a, p. 564, Pl. 3, fig. 31.

Remarks: The illustrated specimens show the intra-specific form variation of the elements within this multi-element species. There are erect to slightly proclined forms with bases approximately as long as the cusp or slightly shorter (Pl. 4, fig. 4). The base passes smoothly into the cusp. Other elements are reclined, whereas the base is much shorter, widening in aboral direction (Pl. 4, fig. 5). Finally there are twisted units. These have a relatively wide base, which may be slightly asymmetrical and can open to one side (Pl. 4, fig. 6). In well preserved specimens the whole unit is finely striated and the base appears to be hyaline. The striation may be inconspicuous on the cusp and it is much less prominent than it is in *Protopanderodus latus* n. sp.
Regional occurrence: At Köpingsklint this species was found from halfway member K_{k1} up to the top of the sequence investigated. In section 6 from member $K_{ä\text{-}d1}$ up to the top of the section. Near Horns Udde from halfway member K_{k2} up to the top of the Horns Udde Formation.
Biostratigraphic range: Protopanderodus longibasis was encountered from the upper portion of the *Drepanodus arcuatus* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Protopanderodus rectus (LINDSTRÖM), emend. LINDSTRÖM, 1971
(Pl. 4, figs. 7–10)

Acontiodus rectus LINDSTRÖM, 1955a, p. 549, Pl. 2, figs. 7–11; Fig. 2k-m, Fig. 3B.
Protopanderodus rectus (LINDSTRÖM), emend. LINDSTRÖM, 1971, p. 50.
Acontiodus rectus sulcatus LINDSTRÖM, 1955a, p. 550, Pl. 2, figs. 12, 13; Fig. 3D.
Scandodus rectus LINDSTRÖM, 1955a, p. 593, Pl. 4, figs. 21–25; Fig. 3K.

Remarks: The symmetrical elements clearly show the same form variation as those of *Protopanderodus longibasis* (LINDSTRÖM). Some proclined forms have bases nearly as long as the cusp (Pl. 4, fig. 7). Erect to reclined forms have a base that is about half as long as the cusp (Pl. 4, fig. 8), whereas reclined forms have a relatively very small base (Pl. 4, fig. 9). A differentiation in the shape of the aboral margin, from almost straight in the proclined units to sinuous in the reclined ones, also occurs. In all elements the entire base usually is hyaline.

Acontiodus rectus sulcatus and *Scandodus rectus* are asymmetrical variants of *Acontiodus rectus.* The former has an additional groove to one side. The latter usually lacks grooves: its anterior edge is twisted laterally and its base opens to one side (= the scandodiform element, Pl. 4, fig. 10).

Regional occurrence: At Köpingsklint this species occurs from the base of member K_{k3} to the top of the sequence studied. In section 6 from the base of member $K_{ä\text{-}d2}$ to the top of the section. Near Horns Udde from the top of member K_{k2} to the top of the Horns Udde Formation.

Biostratigraphic range: Protopanderodus rectus was found from the *Protopanderodus rectus/Oelandodus costatus* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Genus **Scolopodus** PANDER, emend. VAN WAMEL, herein

Type species: *Scolopodus sublaevis* PANDER, 1856.

Synonyms: *Scolopodus* PANDER, 1856, p. 25.
Scolopodus PANDER, emend. LINDSTRÖM, 1955a, p. 594.
Scolopodus PANDER, emend. LINDSTRÖM, 1971, p. 40.

Remarks: As asymmetrical and symmetrical forms belong to this genus, and because hyaline as well as partly white conodonts answer to the original description, the following redefinition of the genus is suggested:

Scolopodus includes both symmetrical and asymmetrical elements, usually with a rounded cross section. A posterior and/or anterior keel may be present. The sides of the elements commonly are finely costate. The base is not greatly expanded, and it is small relative to the cusp. Hyaline and partly white conodonts belong to this genus.

Scolopodus peselephantis LINDSTRÖM, 1955
(Pl. 5, figs. 16, 17)

Scolopodus peselephantis LINDSTRÖM, 1955a, p. 595, Pl. 2, figs. 19, 20; Fig. 3Q.

Remarks: As shown by the figured specimens, the curvature of the cusp is rather variable. The posterior edge may be sharp or even keeled and it may be accompanied by two posterior-lateral grooves.
Regional occurrence: At Köpingsklint this species occurs from the base of member $K_{k\,1}$ up to the top of the studied sequence. In section 6 it was found from the base of member $K_{\ddot{a}\text{-}d\,1}$ up to the top of the section. Near Horns Udde from member $D_{h\,1}$ up to the top of the Horns Udde Formation.
Biostratigraphic range: Scolopodus peselephantis was found from the *Drepanoistodus numarcuatus/Paroistodus amoenus* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Scolopodus rex LINDSTRÖM, 1955
(Pl. 5, fig. 18)

Scolopodus rex LINDSTRÖM, 1955a, p. 595, Pl. 3, fig. 32. LINDSTRÖM, 1971, pp. 40, 41.
Scolopodus rex paltodiformis LINDSTRÖM, 1955a, p. 596, Pl. 3, fig. 33, 34.

Regional occurrence: At Köpingsklint this species was found from the base of member $K_{k\,3}$ up to and including the top portion of the Bruddesta Formation. In section 6 it occurred from member $K_{\ddot{a}\text{-}d\,1}$ up to a level at about 0.20 m. above the base of the Horns Udde Formation. Near Horns Udde from the top of member $K_{k\,2}$ up to a level at 1.05 m. above the base of the Horns Udde Formation.
Biostratigraphic range: This species was found from the *Prioniodus elegans/ Oelandodus elongatus* Assemblage Zone up to and including the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Genus **Stolodus** LINDSTRÖM, 1971
Type species: Distacodus stola LINDSTRÖM, 1955.
Definition: "*Stolodus* includes conodonts with wide and deep, thin sheathed base, small sub-erect cusp, and prominent costae reaching the rim of the basal cavity. There is an intraspecific symmetry transition. White matter is spread throughout the unit. The costae may possibly become denticulated" (op. cit. Lindström, 1971, p. 51).
Remarks: As the type species of the genus *Stolodus* LINDSTRÖM is not ornamented with striae, as it has no rounded cross section of the base and as

it is not thickened towards the rim of the basal cavity, Lindström's (1971) suggestion, to consider this genus as part of this "Panderodids" (Lindström, 1971, p. 49–51) will not be followed.

Stolodus stola (LINDSTRÖM), emend. LINDSTRÖM, 1971 (Pl. 8, figs. 20–24)

Distacodus stola LINDSTRÖM, 1955a, p. 556, Pl. 3, figs. 43–49.
Distacodus stola latus LINDSTRÖM, 1955a, p. 557, Pl. 3, figs. 50, 51.
Coelocerodontus stola (LINDSTRÖM). LINDSTRÖM, 1964, p. 84, fig. 29.
Stolodus stola (LINDSTRÖM). LINDSTRÖM, 1971, p. 51.

Remarks: The illustrations show the extreme fragility of all elements. Their colour is white and they are translucent if moistened. The basal sheath and the keels are very thin, the cusp usually is broken. In addition to symmetrical distacodiform elements there are two different types of asymmetrical form variants, with elongated bases.

In one of these variants (Pl. 8, figs. 22a, b), one side has a costa which is confined to the cusp; the anterior and posterior keels are deflected to the same side of the unit. A costa of the opposite side runs from the cusp all over the base to reach the aboral margin. To this side of the unit an additional costa is confined to the oral-lateral side of the base. Through this, the cross section of the base is approximately an equilateral trapezium with the parallel sides in vertical position.

In the other asymmetrical element (Pl. 8, figs. 21a, b) the basal stretches of the anterior and posterior keels are twisted relatively to the cusp as well as to the lateral costae. As a consequence, the anterior and oral keels are situated close to the lateral costae and the anterior and oral sides are flat basally. The cross section of the base is approximately a parallelogram with the largest laterals oriented orally and antero-basally.

Nothing needs to be added to the original description of the symmetrical distacodiform elements (Pl. 8, figs. 20 and 24).

Pl. 8, fig. 23 shows that the keels can have denticle-like modifications. Such elements resemble similar elements of the species *Prioniodus deltatus* (LINDSTRÖM), emend. herein (Pl. 8, figs. 5a, b and 7). The elements of *Stolodus stola* are much more fragile, they are coloured more intensely white, they have thinner keels and basal sheaths and a different intraspecific symmetry-variation of the elements.

Regional occurrence: At Köpingsklint this species occurs from the base of member K_{k3} up to a level at about 0.70 m. above the base of the Bruddesta Formation. In section 6 from the top of member $K_{\ddot{a}\text{-}d1}$ up to a level at about 1.20 m. above the base of the Bruddesta Formation. Near Horns Udde

it was found from the top of member K_{k2} up to a level at 1.60 m. above the base of the Bruddesta Formation.
Biostratigraphic range: This species was encountered from the *Stolodus stola* Assemblage Zone up to and including the *Prioniodus navis/Stolodus stola* Assemblage Zone (fig. 15).

Genus **Triangulodus** n. gen.
Type species: Paltodus volchovensis SERGEEVA, 1963.
Derivatio nominis: triangulum, Lat. = triangle, referring to the triangular cross section of the base of both the acodiform and roundyaform elements.
Diagnosis: Triangulodus is a multi-element genus with drepanodiform, scandodiform or paltodiform, acodiform, roundyaform, oistodiform and erect-scandodiform elements. Both, hyaline conodonts and conodonts composed of "white matter" belong to this genus.
Differential diagnosis: The only multi-element genus with which this one could possibly be confused is *Drepanoistodus.* It differs from the latter in the occurrence of roundyaform elements and in the *Scandodus*-like assymetry of the erect elements.

Triangulodus brevibasis (SERGEEVA), emend. VAN WAMEL, herein
(Pl. 5, figs. 1–7)

Oistodus brevibasis SERGEEVA, 1963, p. 95, Pl. 7, figs. 4, 5.
Scandodus brevibasis (SERGEEVA), emend. LINDSTRÖM, 1971, p. 39, Pl. 1, figs. 24–27; Fig. 3.
Paltodus volchovensis SERGEEVA, 1963, p. 100, Pl. 7, figs. 13, 14.
Scolopodus n. sp. 1. LINDSTRÖM, 1960, p. 91, fig. 3; 8.
Roundya sp. HIGGINS, 1967, p. 386, fig. 2; 8.

Remarks: Lindström (1971, pp. 39–40) already mentioned the presence of drepanodiform, acodiform, trichonodellaform (= roundyaform) and oistodiform elements in *Scandodus brevibasis* (SERGEEVA).

According to this author also distacodiform elements would occur, but in the Öland material studied now, such elements had better be called paltodiform elements, because their anterior edge is flexed to one side, whereas on the convex opposite side two additional costae are found. The oral-lateral one of these costae is prominent, whilst the antero-lateral one is less conspicuous, disappearing rather quickly towards the cusp (Pl. 5, figs. 6a, b).

Drepanodiform elements occur with a prominent convex outer side (Pl. 5, fig. 4).

The erect-scandodiform elements are strongly asymmetrical, as the base and the anterior edge are twisted laterally (Pl. 5, figs. 2, 3). The base is flaring and opens to the least convex side of the unit. The basal cavity is equilaterally triangular in side view. The oral edge may be absent and then the base is hardly distinct from the cusp. If present, it is highly keeled, just like the basal stretch of the anterior edge.

The acodiform elements (Pl. 5, figs. 5a, b) have sharp antero-lateral, lateral and posterior edges. These continue over the base and reach the aboral margin. The facets between the edges are flat or convex outwards. The base as well as the cusp are well rounded anteriorly as the anterior edge is flexed sidewards. The basal cavity is an equilateral triangle in lateral view. The aboral margin is slightly convex outwards between the edges. Like all elements of this species this one is hyaline and a straight growth axis runs visibly from the tip of the basal cavity to the tip of the cusp. The cusp is slightly reclined to erect.

The roundyaform element (Pl. 5, figs. 7a, b) is quite similar to the acodiform element. This unit is bilaterally symmetrical, however; its anterior side is rounded and both lateral costae are anteriorly located.

The oistodiform element (see Pl. 5, fig. 1) was figured and described by Sergeeva (1963).

Regional occurrence: At Köpingsklint as well as in section 6 this species was found in the topmost 0.20 m. of the Bruddesta Formation and in the remaining upper portion of the sequences studied. Near Horns Udde it is confined to the Horns Udde Formation.

Biostratigraphic range: Triangulodus brevibasis was found in the *Triangulodus brevibasis* Assemblage Zone (fig. 15).

Triangulodus subtilis n. sp.
(Pl. 5, figs. 8–13)

Derivatio nominis: subtilis, Lat. = fine (not coarse).

Holotype: The acodiform element of this multi-element species, Pl. 5, figs. 12a, b, cat. nr. T 198–13.

Figured paratypoids: The oistodiform element (Pl. 5, figs. 8, 9), the erect-scandodiform element (Pl. 5, figs. 10a, b), the drepanodiform element (Pl. 5, fig. 11) and the roundyaform element (Pl. 5, figs. 13a, b). Cat. nrs. T198–14 to 18.

Type-stratum: The uppermost limestone bed of member K_{k2} at Köpingsklint section 1; see also sample 13, chart II.

Diagnosis: A *Triangulodus* species with relatively small and fine elements of white colour.

Description: So far, the scandodiform or paltodiform elements are unknown and thus may not exist.

The drepanodiform element (Pl. 5, fig. 11) is laterally compressed. The cusp is blade-like with sharp anterior and posterior edges. It is proclined, whereas the anterior and posterior edges are evenly curved. These edges pass into the antero-basal edge and the oral edge respectively, which are both keeled. The antero-basal edge may be flexed sidewards. The basal sheath is thin. The basal cavity is triangular in lateral view, the tip close to the anterior edge. The oral outline of the basal cavity is straight, the anterior outline is slightly concave. The aboral margin is straight or a little convex outwards.

The erect-scandodiform element (Pl. 5, figs. 10a, b) is slightly bent sidewards. The base opens to the inner side of the unit. There is no real distinction between the cusp and the base. The anterior edge is straight to slightly recurved, whereas the posterior edge is evenly recurved. This element lacks an oral edge. The basal cavity is triangular in lateral view. The aboral margin has a bulge-like extension to the inner side of the unit. The cross section of the cusp is lanceolate with sharp anterior and posterior edges.

The acodiform element (Pl. 5, figs. 12a, b) is erect to slightly recurved. The anterior edge is flexed sidewards and forms a sharp, basally keeled antero-lateral edge. The posterior edge is nearly in one plane with the antero-lateral edge and passes into the oral edge. The oral edge is concave anteriorly to become convex posteriorly. The lateral costa is strongly keeled basally. The facets between the edges all are almost flat. All edges reach the aboral margin, which is convex outwards between them. The basal cavity is triangular in side view as well as in cross section. The oral outline of the basal cavity is concave and its anterior outline is almost straight.

The roundyaform elements (see Pl. 5, figs. 13a, b) are bilaterally symmetrical and the antero-lateral edges are nicely keeled. The anterior side is a curved plane. The posterior edge passes into the oral edge, which is keeled. The facets between the keeled edges are flat or little concave. The basal cavity is triangular in side view. The aboral margin is straight or it may be concave between the edges, which gives the latter a process-like appearance.

The oistodiform element (Pl. 5, figs. 8, 9) is relatively very small and laterally compressed. The cusp is wide and flat, carrying a rounded costa to either side. The anterior and posterior edges are both almost straight or they may be slightly convex outwards. The posterior edge and the oral edge meet at about 30°. The oral edge is convex and keeled. The base is about as high as the width of the cusp. The aboral margin is convex outwards. The antero-basal and postero-basal angles are rounded. The basal cavity is shallow and its oral outline is practically straight.

Differential diagnosis: The drepanodiform and acodiform elements resemble the corresponding elements of *Drepanoistodus inaequalis* (PANDER), emend. herein (Pl. 2, figs. 9, 10). The former have a more delicate appearance, the cusp of the drepanodiform element is flatter and the keels of the acodiform elements are much more prominent.

The roundyaform elements are easily mistaken for broken off roundyaform elements of the primitive *Periodon flabellum* (LINDSTRÖM) or for the roundyaform elements of *Prioniodus deltatus* (LINDSTRÖM), emend. herein (Pl. 8, fig. 7). It differs from both by its fragility.

Regional occurrence: This species is rare in the sequence investigated. At Köpingsklint it is confined to the topmost portion of member K_{k2}. In section 6 it was found from the top of member $K_{ä\text{-}d1}$ up to the top of member $K_{ä\text{-}d2}$. Near Horns Udde it was not encountered.

Biostratigraphic range: Triangulodus subtilis was found from the *Triangulodus subtilis/Gothodus microdentatus* Assemblage Zone up to and including the *Protopanderodus rectus/Oelandodus costatus* Assemblage Zone (fig. 15).

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PLATE 1

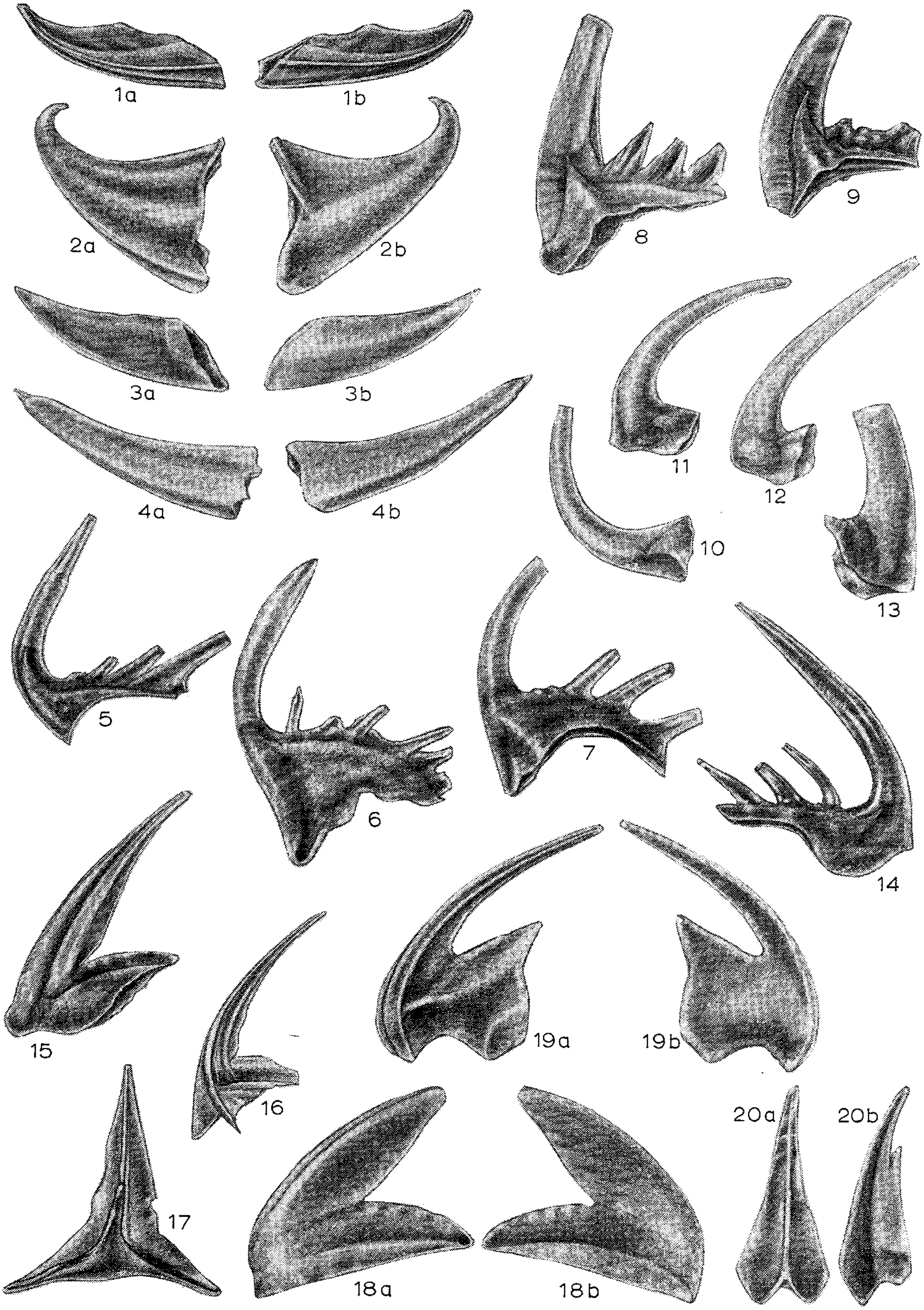
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Plate 1

Figs. 1a and 1b *Coelocerodontus bicostatus* n. sp. Holotype. Chart II, sample 1, X 65, T 191–13.

Figs. 2a and 2b *Coelocerodontus latus* n. sp. Holotype. Chart II, sample 1, X 65, T 192–13.

Figs. 3a and 3b *Coelocerodontus variabilis* n. sp. Paratypoid. Chart II, sample 1, X 100, T 193–15.

Figs. 4a and 4b. *Coelocerodontus variabilis* n. sp. Holotype. Chart II, sample 1, X 65, T 193–13.

Figs. 5–7 *Cordylodus angulatus* PANDER. Fig. 5, chart II, sample 1, X 65, CH 1183–14. Fig. 6, chart III, sample 1, X 65, CH 1183–13. Fig. 7, chart II, sample 1, X 65, CH 1183–15.

Figs. 8–9 *Cordylodus prion* LINDSTRÖM. Fig. 8, chart III, sample 1, X 65, CH 1141–13. Fig. 9, chart III, sample 1, X 32, CH 1141–14.

Figs. 10–13 *Drepanodus arcuatus* PANDER. Fig. 10, the arcuatiform element, section 1, sample 13, X 65, CH 1143–13. Fig. 11, the sculponeaform element, section 1, sample 12, X 65, CH 1143–14. Fig. 12, the pipaform element, section 1, sample 13, X 65, CH 1143–15. Fig. 13, the graciliform element, section 1, sample 12, X 65, CH 1143–16.

Fig. 14 *Cordylodus rotundatus* PANDER. Chart II, sample 2, X 35, CH 1142–13.

Figs. 15–17 *Oistodus lanceolatus* PANDER. Fig. 15, the oistodiform element, section 6, sample 16, X 50, CH 1153–13. Fig. 16, the triangulariform element, section 6, sample 16, X 32, CH 1153–14. Fig. 17, the anterior-oral view of the deltaform element, section 1, sample 17, X 100, CH 1153–15.

Figs. 18–20 *Oistodus papiliosus* n. sp. Figs. 18a, b, the oistodiform element, section 6, sample 27, X 150, T 196–14. Figs. 19a, b, the triangulariform element, section 6, sample 27, X 150, T 196–13. Figs. 20a, b, the deltaform element, section 6, sample 27, X 150, T 196–15. Fig. 20a, posterior view. Fig. 20b, lateral view.

PLATE 2


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Plate 2

Figs. 1–6 *Drepanoistodus acuminatus* (PANDER). Figs. 1a and 1b, the oistodiform element, section 14, sample 1, X 65, CH 1144–13. Figs. 2a and 2b, the oistodiform element, section 14, sample 1, X 65, CH 1144–14. Figs. 3a and 3b, the suberectiform element, section 14, sample 1, X 65, CH 1144–15. Fig. 4, the drepanodiform element, section 14, sample 1, X 65, CH 1144–16. Fig. 5, the scandodiform element, section 14, sample 1, X 100, CH 1144–17. Fig. 6, the acodiform element, section 14, sample 1, X 65, CH 1144–18.

Figs. 7–13 *Drepanoistodus inaequalis* (PANDER). Fig. 7, the oistodiform element, section 14, sample 1, X 65, CH 1147–13. Fig. 8, the suberectiform element, section 14, sample 1, X 150, CH 1147–14. Fig. 9, the drepanodiform element, section 1, sample 6, X 65, CH 1147–15. Fig. 10, the drepanodiform element, section 14, sample 1, X 65, CH 1147–16. Fig. 11, the scandodiform element, section 14, sample 1, X 65, CH 1147–17. Fig. 12, the scandodiform element, chart II, sample 1, X 32, CH 1147–18. Fig. 13, the acodiform element, section 14, sample 1, X 65, CH 1147–19.

Figs. 14–22 *Drepanoistodus forceps* (LINDSTRÖM). Fig. 14, the oistodiform element, section 14, sample 13, X 65, CH 1146–13. Fig. 15, the suberectiform element, section 1, sample 25, X 65, CH 1146–14. Fig. 16, the suberectiform element, section 1, sample 22, X 65, CH 1146–15. Fig. 17, the drepanodiform element (planus-type), section 6, sample 20, X 65, CH 1146–16. Fig. 18, the drepanodiform element (homocurvatus-type), section 6, sample 20, X 32, CH 1146–17. Fig. 19, the drepanodiform element (planus-homocurvatus intermediate type), section 1, sample 25, X 32, CH 1146–18. Fig. 20, the scandodiform element, section 6, sample 20, X 65, CH 1146–19. Fig. 21, the scandodiform element, section 6, sample 20, X 65, CH 1146–20. Figs. 22a and 22b, the acodiform element, section 14, sample 10, X 65, CH 1146–21.

Fig. 23 *Pravognathus aengensis* LINDSTRÖM. Chart II, sample 1, X 100, CH 1158–13.

PLATE 3

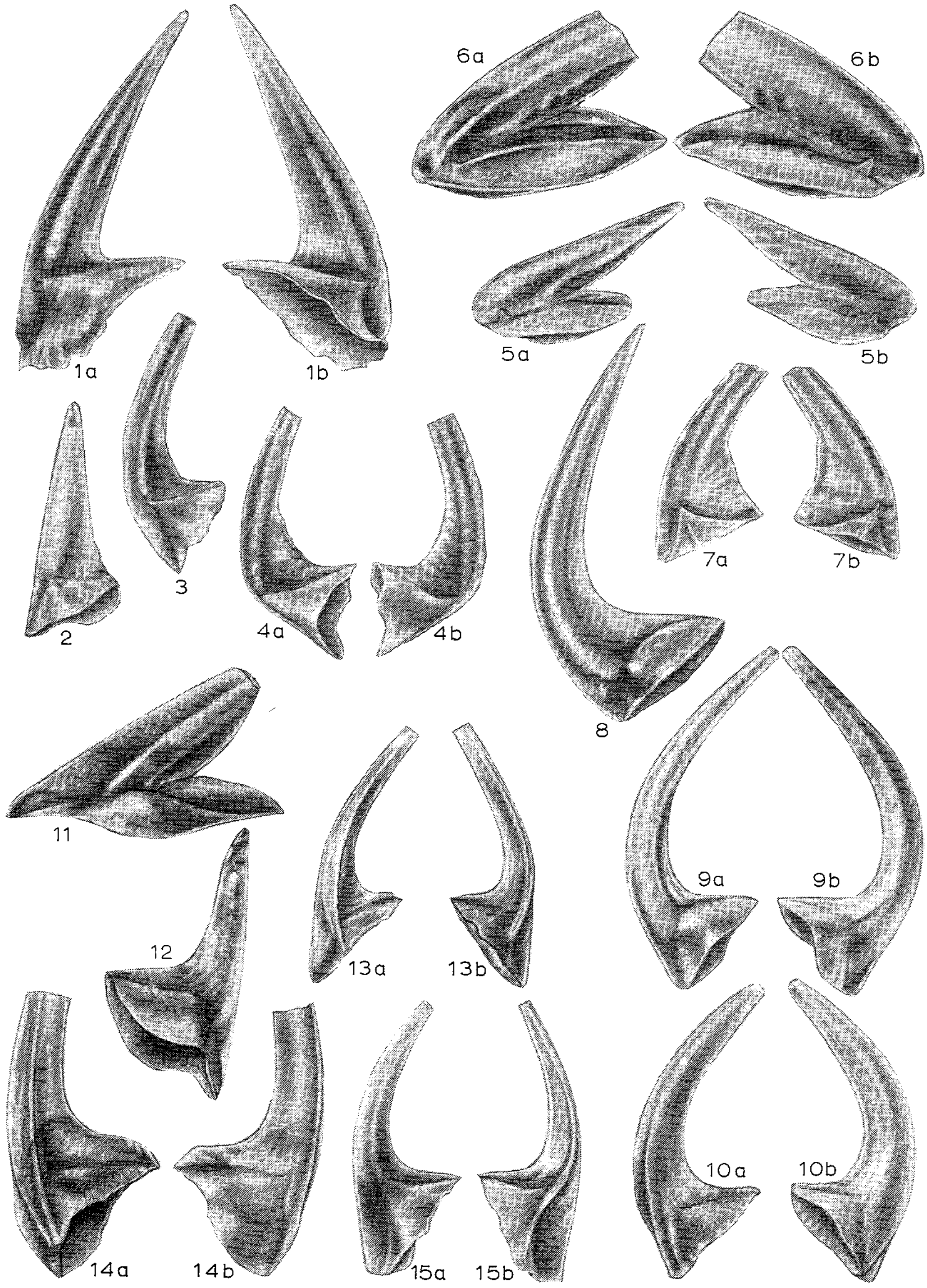
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Plate 3

Figs. 1–4 *Drepanoistodus conulatus* (LINDSTRÖM). Figs. 1a and 1b, the oistodiform element, section 14, sample 11, X 50, CH 1145–13. Fig. 2, the suberectiform element, section 14, sample 11, X 65, CH 1145–14. Fig. 3, the drepanodiform element, section 14, sample 3b, X 32, CH 1145–15. Figs. 4a and 4b, the scandodiform element, section 14, sample 3b, X 65, CH 1145–16.

Figs. 5–10 *Drepanoistodus numarcuatus* (LINDSTRÖM). Figs. 5a and 5b, the oistodiform element, section 1, sample 6, X 100, CH 1149–13. Figs. 6a and 6b, the oistodiform element, section 1, sample 6, X 100, CH 1149–14. Figs. 7a and 7b, the suberectiform element, section 14, sample 1, X 65, CH 1149–15. Fig. 8, the drepanodiform element, section 1, sample 8, X 65, CH 1149–16. Figs. 9a and 9b, the scandodiform element, section 1, sample 6, X 65, CH 1149–17. Figs. 10a and 10b, the acodiform element, section 1, sample 8, X 65, CH 1149–18.

Figs. 11–15 *Drepanoistodus inconstans* (LINDSTRÖM). Fig. 11, the oistodiform element, section 1, sample 12, X 65, CH 1148–13. Fig. 12, the suberectiform element, section 1, sample 13, X 100, CH 1148–14. Figs. 13a and 13b, the drepanodiform element, section 1, sample 13, X 65, CH 1148–15. Figs. 14a and 14b, the scandodiform element, section 1, sample 13, X 65, CH 1148–16. Figs. 15a and 15b, the acodiform element, section 1, sample 13, X 65, CH 1148–17.

PLATE 4

Plate 4

Figs. 1–3 *Protopanderodus latus* n. sp. Figs. 1a and 1b the proclined to erect narrow element, section 14, sample 37b, X 100, T 197–14. Figs. 2a and 2b, the recurved wide element (= the Holotype), section 14, sample 46, X 50, T 197–13. Figs. 3a and 3b, the scandodiform element, section 6, sample 44, X 100, T 197–15.

Figs. 4–6 *Protopanderodus longibasis* (LINDSTRÖM). Fig. 4, the proclined to erect element with a base, about as long as the cusp, section 14, sample 37b, X 65, CH 1163–13. Fig. 5, the reclined element with a base, shorter than the cusp and widening in aboral direction, section 14, sample 33, X 65, CH 1163–14. Fig. 6, the scandodiform element, section 14, sample 41, X 100, CH 1163–15.

Figs. 7–10 *Protopanderodus rectus* (LINDSTRÖM). Fig. 7, the proclined element with a base, about as long as the cusp, section 6, sample 20, X 50, CH 1164–13. Fig. 8, the erect to reclined element with a base, about half as long as the cusp, section 6, sample 26, X 32, CH 1164–14. Fig. 9, the reclined element with a small base, section 6, sample 21, X 50, CH 1164–15. Fig. 10, the scandodiform element, section 6, sample 21, X 65, CH 1164–16.

Figs. 11–13 *Paracordylodus gracilis* LINDSTRÖM. Fig. 11, the oistodiform element, section 1, sample 13, X 100, CH 1154–13. Fig. 12, the cordylodiform element, section 1, sample 13, X 100, CH 1154–14. Fig. 13, the paracordylodiform element, section 1, sample 13, X 100, CH 1154–15.

Figs. 14–20 *Periodon flabellum* (LINDSTRÖM). Fig. 14, the oistodiform element, section 1, sample 13, X 65, CH 1157–13. Fig. 15, the cordylodiform element (early form), section 6, sample 7, X 100, CH 1157–14. Fig. 16, the cordylodiform element (intermediate form), section 6, sample 13, X 150, CH 1157–15. Fig. 17, the cordylodiform element (late form), section 6, sample 16, X 65, CH 1157–16. Fig. 18, the ozarkodinaform element (early form), section 1, sample 13, X 65, CH 1157–17. Fig. 19, the ozarkodinaform element (intermediate form), section 6, sample 13, X 65, CH 1157–18. Fig. 20, the ozarkodinaform element (late form), section 6, sample 16, X 50, CH 1157–19.

PLATE 5

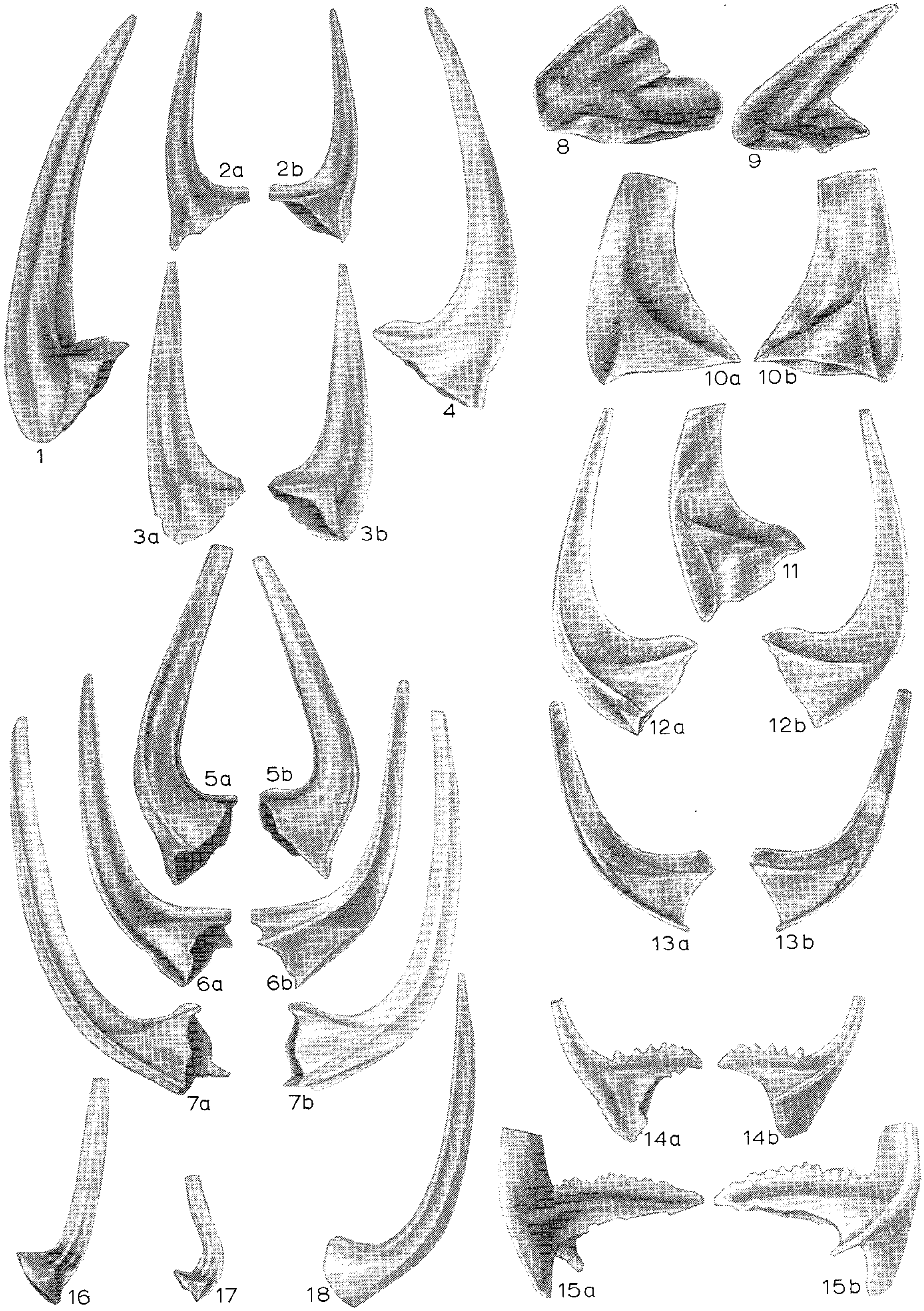
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Plate 5

Figs. 1–7	*Triangulodus brevibasis* (SERGEEVA). Fig. 1, the oistodiform element, section 14, sample 46, × 65, CH 1168–13. Figs. 2a and 2b, the erect-scandodiform element, section 14, sample 38, × 65, CH 1168–14. Figs. 3a and 3b, the erect-scandodiform element, section 1, sample 50, × 65, CH 1168–15. Fig. 4, the drepanodiform element, section 6, sample 43, × 50, CH 1168–16. Figs. 5a and 5b, the acodiform element, section 14, sample 40, × 32, CH 1168–17. Figs. 6a and 6b, the paltodiform element, section 1, sample 49, × 100, CH 1168–18. Figs. 7a and 7b, the roundyaform element, section 6, sample 47, × 65, CH 1168–19.
Figs. 8–13	*Triangulodus subtilis* n. sp. Fig. 8, the oistodiform element, section 1, sample 13, × 150, T 198–17. Fig. 9, the oistodiform element, section 6, sample 3, × 150, T 198–18. Figs. 10a and 10b, the erect-scandodiform element, section 6, sample 5, × 150, T 198–15. Fig. 11, the drepanodiform element, section 6, sample 5, × 100, T 198–16. Figs. 12a and 12b, the acodiform element (= the Holotype), section 1, sample 13, × 100, T 198–13. Figs. 13a and 13b, the roundyaform element, section 6, sample 3, × 150, T 198–14.
Figs. 14a and 14b	*Gothodus microdentatus* n. sp., section 1, sample 13, × 65, T 194–14.
Figs. 15a and 15b	*Gothodus microdentatus* n. sp.. Holotype, section 1, sample 13, × 65, T 194–13.
Fig. 16	*Scolopodus peselephantis* LINDSTRÖM, section 1, sample 12, × 65, CH 1165–13.
Fig. 17	*Scolopodus peselephantis* LINDSTRÖM, section 1, sample 53, × 65, CH 1165–14.
Fig. 18	*Scolopodus rex* LINDSTRÖM, section 14, sample 13, × 65, CH 1166–13.

PLATE 6

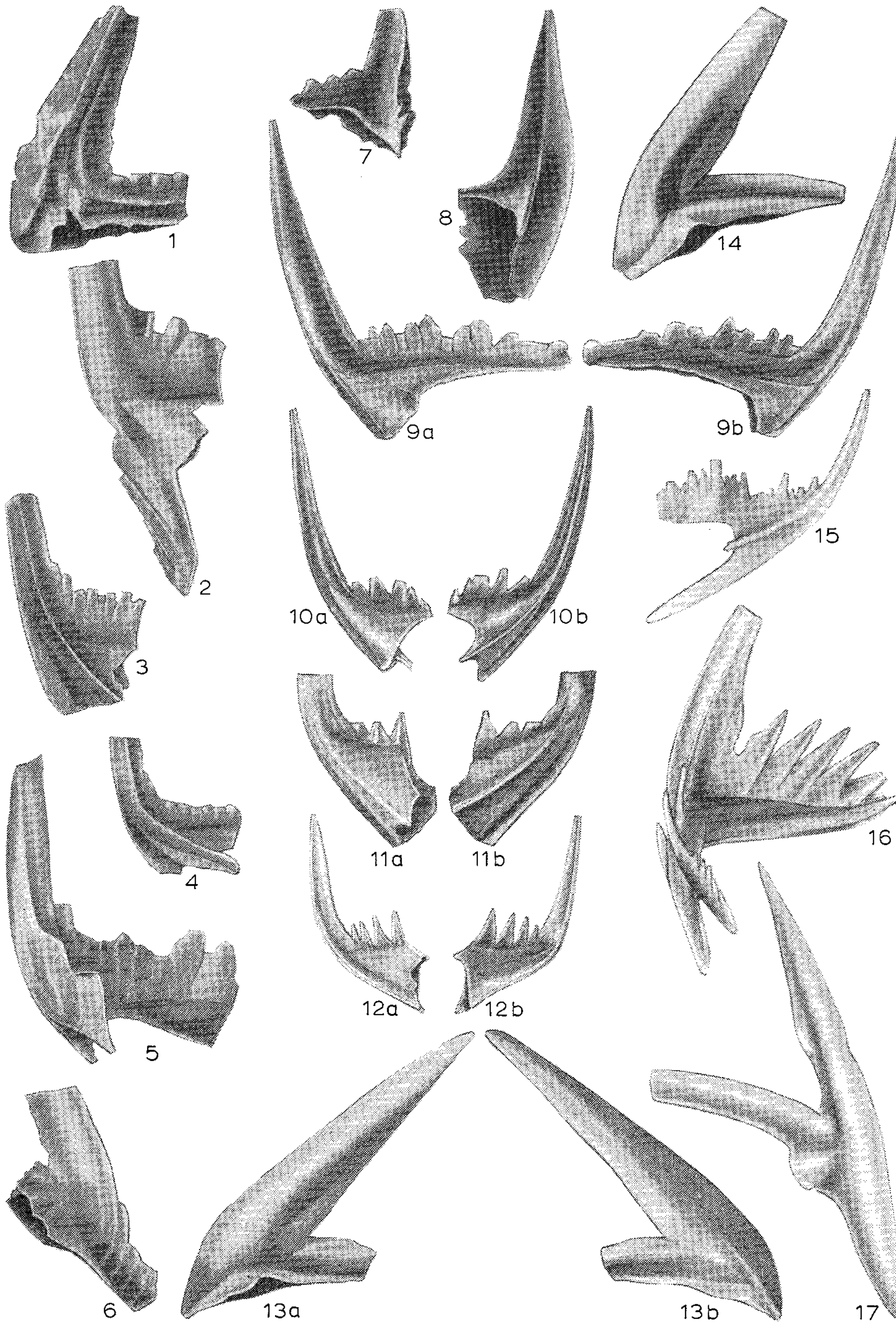


Plate 6

Figs. 1–6 *Prioniodus elegans* PANDER. Fig. 1, the prioniodiform element, section 6, sample 2, × 65, CH 1161–13. Fig. 2, the prioniodinaform element, section 6, sample 5, × 65, CH 1161–14. Fig. 3, the gothodiform element, section 6, sample 2, × 65, CH 1161–15. Fig. 4, the tetraprioniodiform element (= the oepikodiform element), section 6, sample 2, × 65, CH 1161–16. Fig. 5, the roundyaform element, section 6, sample 5, × 65, CH 1161–17. Fig. 6, the falodiform element, section 6, sample 3, × 65, CH 1161–18.

Figs. 7–14 *Prioniodus crassulus* (LINDSTRÖM). Fig. 7, the prioniodiform element, section 6, sample 17, × 100, CH 1159–13. Fig. 8, the prioniodiform element, section 1, sample 17, × 65, CH 1159–14. Figs. 9a and 9b, the prioniodinaform element, section 1, sample 17, × 65, CH 1159–15. Figs. 10a and 10b, the gothodiform element, section 14, sample 10, × 65, CH 1159–16. Figs. 11a and 11b, the oepikodiform element (= the tetraprioniodiform element), section 6, sample 16, × 65, CH 1159–17. Figs. 12a and 12b, the roundyaform element, section 14, sample 10, × 65, CH 1159–18. Figs. 13a and 13b, the oistodiform element, section 6, sample 16, × 65, CH 1159–19. Fig. 14, the oistodiform element, section 6, sample 17, × 65, CH 1159–20.

Figs. 15–17 *Oepikodus evae* (LINDSTRÖM). Fig. 15, the oepikodiform element, section 6, sample 13, × 65, CH 1152–13. Fig. 16, the prioniodiform element, section 6, sample 13, × 65, CH 1152–14. Fig. 17, the longiramiform element, section 1, sample 17, × 65, CH 1152–15.

PLATE 7

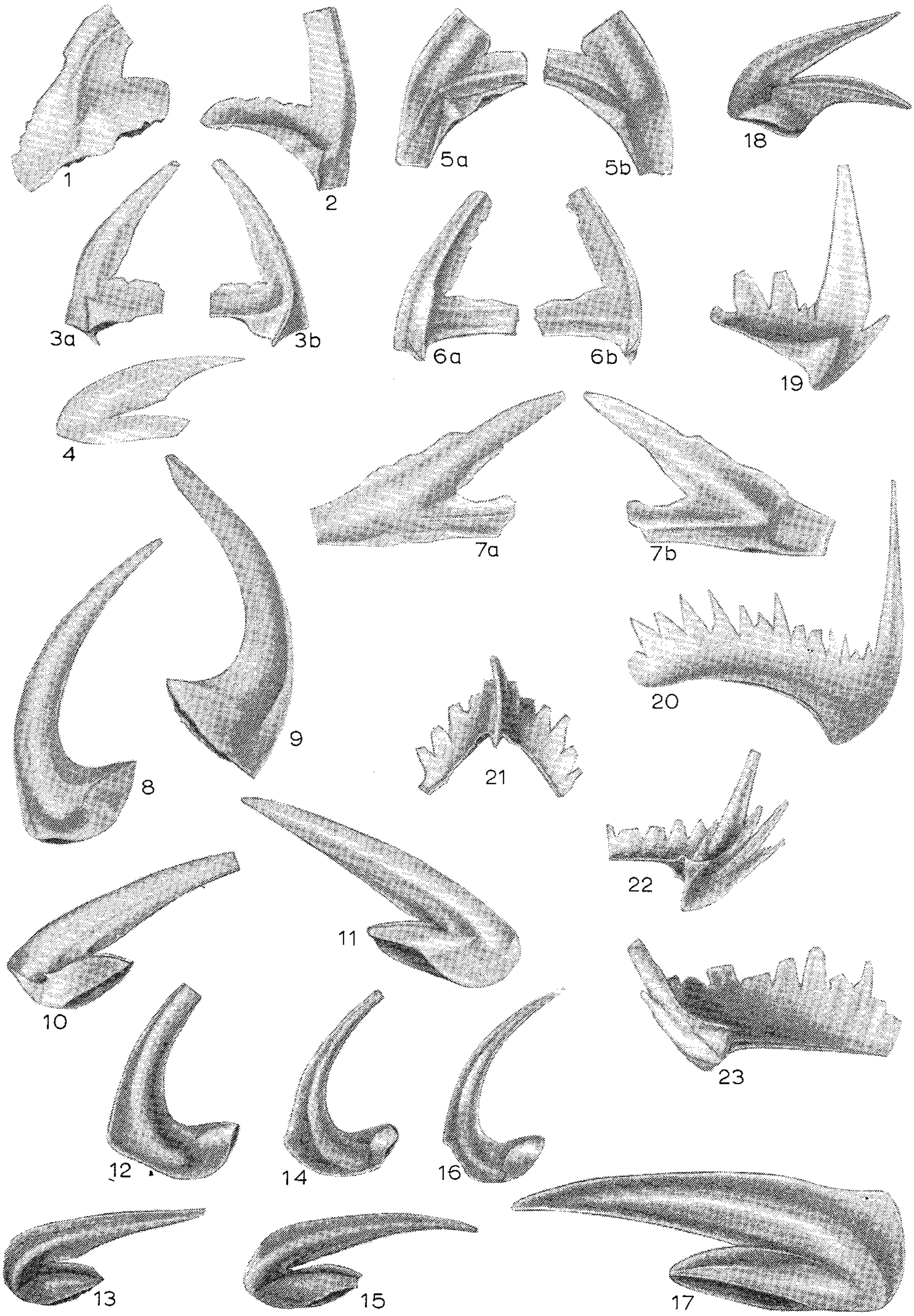


Plate 7

Figs. 1—4 *Oelandodus elongatus* (LINDSTRÖM). Fig. 1, the elongatiform element, section 6, sample 5, X 65, CH 1151—12. Fig. 2, the elongatiform element, section 6, sample 6, X 65, CH 1151—14. Figs. 3a and 3b, the triangulariform element, section 6, sample 5, X 65, CH 1151—15. Fig. 4, the oistodiform element, section 6, sample 3, X 100, CH 1151—16.

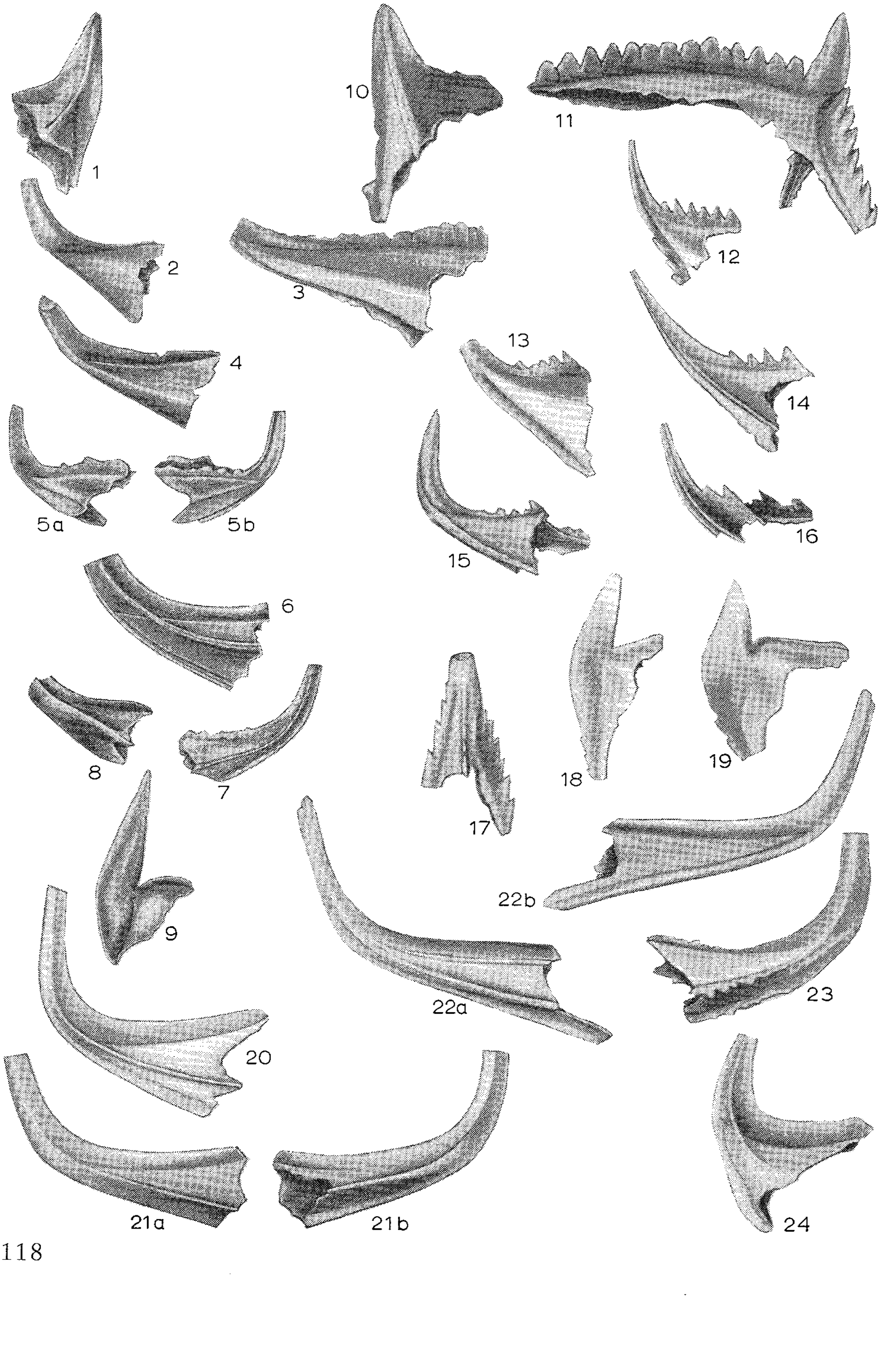
Figs. 5—7 *Oelandodus costatus* n. gen. n. sp.. Figs. 5a and 5b, the elongatiform element (= the Holotype), section 6, sample 5, X 65, T 195—13. Figs. 6a and 6b, the triangulariform element, section 6, sample 5, X 65, T 195—14. Figs. 7a and 7b, the oistodiform element, section 6, sample 5, X 65, T 195—15.

Figs. 8—11 *Paroistodus amoenus* (LINDSTRÖM). Fig. 8, the drepanodiform element, section 1, sample 7, X 65, CH 1155—13. Fig. 9, the drepanodiform element, section 1, sample 6, X 65, CH 1155—14. Fig. 10, the oistodiform element, section 14, sample 1, X 65, CH 1155—15. Fig. 11, the oistodiform element, section 14, sample 1, X 65, CH 1155—16.

Figs. 12—17 *Paroistodus parallelus* (PANDER). Fig. 12, the drepanodiform element, section 1, sample 13, X 65, CH 1156—13. Fig. 13, the oistodiform element, section 1, sample 13, X 65, CH 1156—14. Fig. 14, the drepanodiform element, section 1, sample 48, X 65, CH 1156—15. Fig. 15, the oistodiform element, section 1, sample 48, X 65, CH 1156—16. Fig. 16, the drepanodiform element, section 1, sample 50, X 65, CH 1156—17. Fig. 17, the oistodiform element, section 1, sample 50, X 65, CH 1156—18.

Figs. 18—23 *Microzarkodina flabellum* (LINDSTRÖM). Fig. 18, the oistodiform element, section 6, sample 35, X 65, CH 1150—13. Fig. 19, the prioniodinaform (= ozarkodinaform) element, section 1, sample 38, X 65, CH 1150—14. Fig. 20, the cordylodiform element, section 14, sample 34, X 65, CH 1150—15. Fig. 21, the trichonodellaform element, section 6, sample 35, X 65, CH 1150—16. Fig. 22, the irregulariform element, section 6, sample 33, X 65, CH 1150—17. Fig. 23, the sannemannula element, section 6, sample 33, X 65, CH 1150—18.

PLATE 8


1
10
11
2
3
12
4
13
14
5a
5b
15
16
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18
19
8
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17
9
22b
22a
23
20
21a
21b
24

Plate 8

Figs. 1–9 *Prioniodus deltatus* (LINDSTRÖM). Fig. 1, the prioniodiform element, section 1, sample 12, × 65, CH 1160–13. Fig. 2, the prioniodinaform element, section 1, sample 13, × 65, CH 1160–14. Fig. 3, the prioniodinaform element with denticle-like modifications of the oral keel, section 14, sample 7b, × 65, CH 1160–15. Fig. 4, the gothodiform element, section 1, sample 13, × 65, CH 1160–16. Figs. 5a and 5b, the trapezognathiform element, section 1, sample 12, × 65, CH 1160–17. Fig. 6, the oepikodiform element (= the tetraprioniodiform element), section 1, sample 13, × 65, CH 1160–18. Fig. 7, the oepikodiform element (= the tetraprioniodiform element), section 1, sample 12, × 65, CH 1160–19. Fig. 8, the roundyaform element, section 1, sample 12, × 65, antero-lateral view, CH 1160–20. Fig. 9, the oistodiform element, section 1, sample 12, × 65, CH 1160–21.

Figs. 10–19 *Prioniodus navis* LINDSTRÖM. Fig. 10, the prioniodiform element (early form), section 6, sample 30, × 100, CH 1162–13. Fig. 11, the prioniodiform element (late form), section 6, sample 44, × 65, CH 1162–14. Fig. 12, the prioniodinaform element (late form), section 6, sample 46, × 65, CH 1162–15. Fig. 13, the gothodiform element (early form), section 6, sample 19, × 65, CH 1162–16. Fig. 14, the gothodiform element, section 6, sample 30, × 65, CH 1162–17. Fig. 15, the trapezognathiform element (early form), section 6, sample 19, × 65, CH 1162–18. Fig. 16, the trapezognathiform element (late form), section 6, sample 44, × 65, CH 1162–19. Fig. 17, the roundyaform element, section 6, sample 44, × 65, CH 1162–20. Fig. 18, the falodiform element, section 6, sample 46, × 65, CH 1162–21. Fig. 19, the falodiform element, section 6, sample 30, × 65, CH 1162–22.

Figs. 20–24 *Stolodus stola* (LINDSTRÖM). Fig. 20, the *Distacodus stola*-form element, section 14, sample 5, × 65, CH 1167–13. Figs. 21a and 21b, the asymmetrical element with a parallelogram-like cross section of the base, section 14, sample 13, × 65, CH 1167–14. Figs. 22a and 22b, the asymmetrical element with an equilateral trapezium-like cross section of the base, section 14, sample 5, × 65, CH 1167–15. Fig. 23, a *Distacodus stola*-form element, with denticle-like modifications of the keels, section 14, sample 13, × 65, CH 1167–16. Fig. 24, the *Distacodus stola latus*-form element, section 14, sample 13, × 65, CH 1167–17.

LEGEND TO CHARTS II, III AND IV.

Light green shale.

Light green sandstone.

Green calcite crystals radiating from centres of different lithology.

Green calcite crystals,that are irregularly oriented.

Calcareous sandstone.

Breccious conglomerate with a bright coloured sparritic calcite cement.

Brown bituminous and sparritic limestone.

Brown bituminous and sparritic limestone with phosphorite and pyrite components and innumerous amounts of small carapaces of trilobites.

Breccious conglomerate with a brown bituminous and sparritic calcite cement and many pyrite components.

Glauconite sand with a bituminous and sparritic calcite cement.

Black shale.

Slightly glauconitic black shale.

Glauconite sand with a black shale matrix.

Marl./ Glauconitic marl.

Marly glauconite sand,locally with a cement of sparritic calcite which may be arranged in rosette-like structures.

Nodular marly limestone.

Highly calcareous glauconite sand with a cement of sparry calcite,often arranged in rosette-like structures.

Fossiliferous limestone.

Glauconitic limestone.

Disconformities.

Stylolith plane.

Orthoceratid.

<u>The relative abundances of the conodont specimens per sample.</u>

• = < 1 % .

/ = at least 1 % but < 5 %.

× = at least 5 % but < 10 %.

⧗ = at least 10 % but < 20 %.

■ = at least 20 %.

Chart I

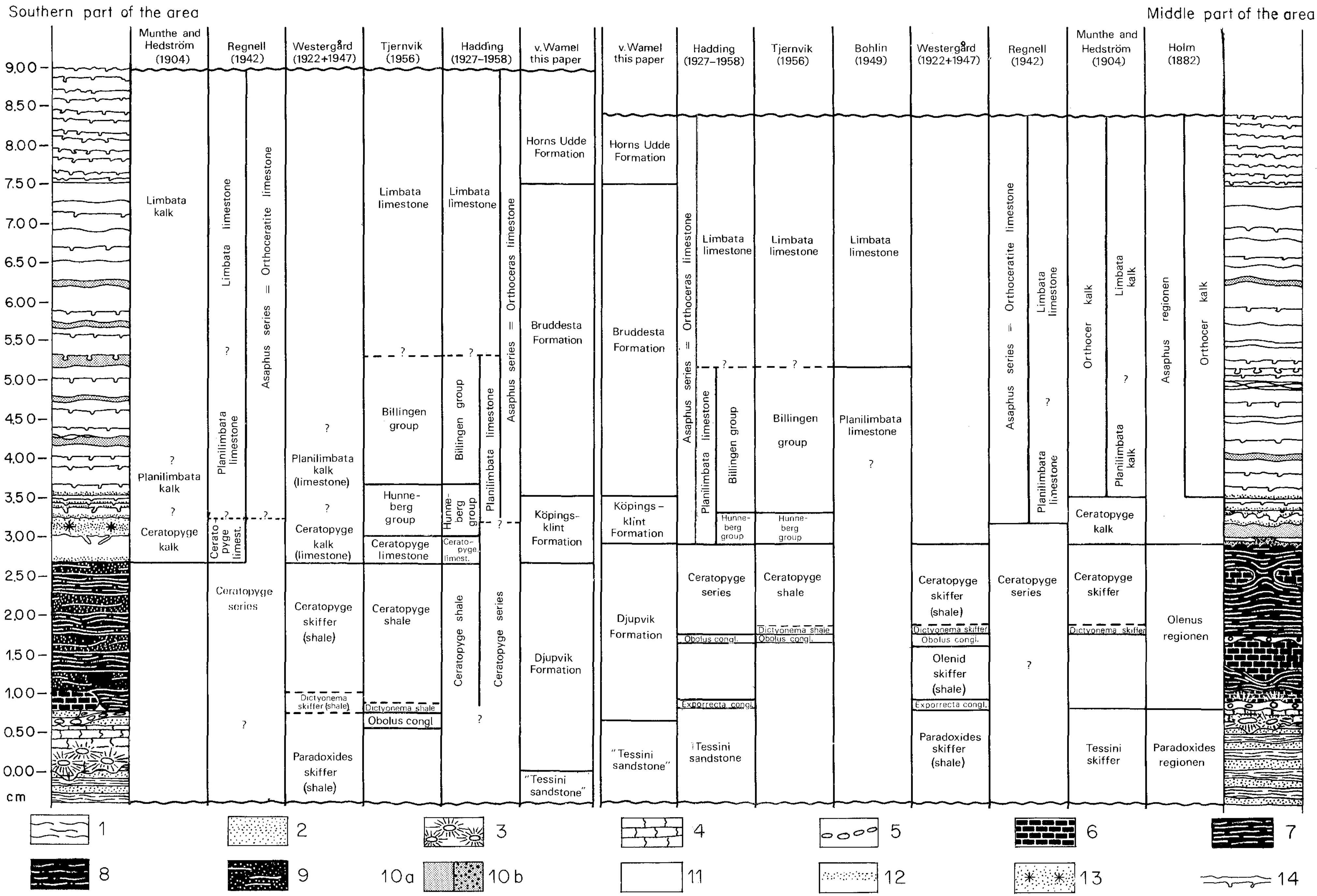

Chart I. Comparison between the lithostratigraphic classification proposed in this paper and the lithostratigraphic classifications previously established in the southern and middle part of the area. *Legend:* 1 = light green shale. 2 = light green sandstone. 3 = green calcite crystals, radiating from centres of different lithology and forming nodules. 4 = green calcite crystals, that are irregularly oriented. 5 = conglomerate. 6 = brown bituminous limestone. 7 = black shale. 8 = slightly glauconitic black shale. 9 = glauconite sand with a black shale matrix. 10a = marl. 10b = marly glauconite sand. 11 = fossiliferous limestone. 12 = glauconitic limestone. 13 = highly calcareous glauconite sand with a cement of sparry calcite, often arranged in rosette-like structures. 14 = disconformities.

Names of conodont elements.

ac	acodiform	oz	ozarkodinaform
ar	arcuatiform	pac	paracordylodiform
cd	cordylodiform	pp	pipaform
dr	drepanodiform	pra	prioniodinaform
dt	deltaform	pri	prioniodiform
el	elongatiform	rd	roundyaform
e.s	erect scandodiform	sc	scandodiform
fl	falodiform	sp	sculponeaform
gt	gothodiform	se	suberectiform
gr	graciliform	sn	sannemannula
ir	irregulariform	s/p	scandodiform/paltodiform
lr	longiramiform	trc	trichonodellaform
mr	multiramiform	trg	triangulariform
oep	oepikodiform	t/t	tetraprioniodiform/ trapezognathiform
o/f	oistodiform/falodiform		
ois	oistodiform		

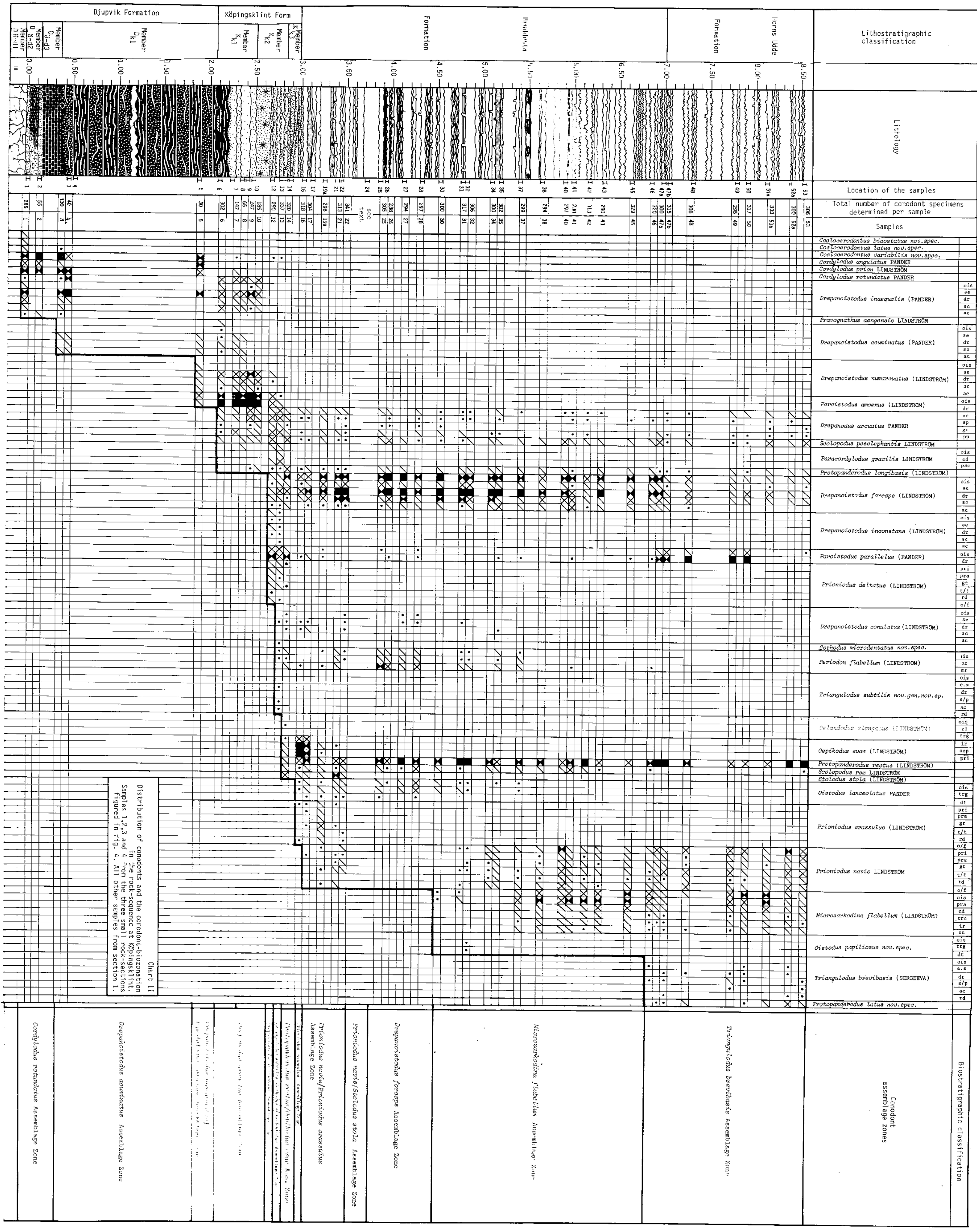

Chart II
Distribution of conodonts and the conodont-biozonation in the rock-sequence at Köpingsklint. Samples 1,2,3 and 4 from three small rock-sections figured in fig. 4. All other samples from section 1.

Names of conodont elements.

ac	acodiform	oz	ozarkodinaform
ar	arcuatiform	pac	paracordylodiform
cd	cordylodiform	pp	pipaform
dr	drepanodiform	pra	prioniodinaform
dt	deltaform	pri	prioniodiform
el	elongatiform	rd	roundyaform
e.s	erect scandodiform	sc	scandodiform
fl	falodiform	sp	sculponeaform
gt	gothodiform	se	suberectiform
gr	graciliform	sn	sannemannula
ir	irregulariform	s/p	scandodiform/paltodiform
lr	longiramiform	trc	trichonodellaform
mr	multiramiform	trg	triangulariform
oep	oepikodiform	t/t	tetraprioniodiform/ trapezognathiform
o/f	oistodiform/falodiform		
ois	oistodiform		

Chart III

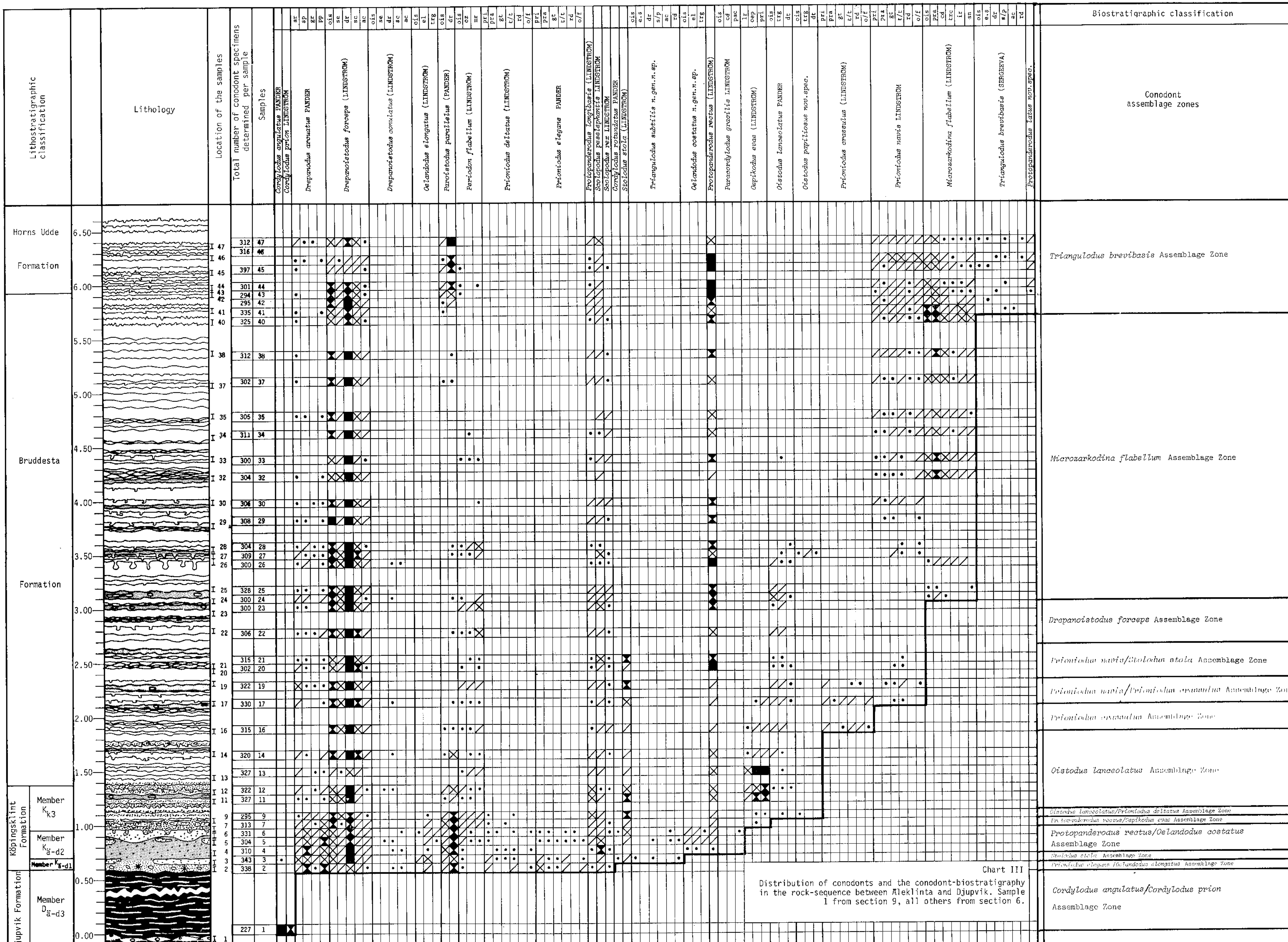

Chart III

Distribution of conodonts and the conodont-biostratigraphy in the rock-sequence between Äleklinta and Djupvik. Sample 1 from section 9, all others from section 6.

Names of conodont elements.

ac	acodiform	oz	ozarkodinaform
ar	arcuatiform	pac	paracordylodiform
cd	cordylodiform	pp	pipaform
dr	drepanodiform	pra	prioniodinaform
dt	deltaform	pri	prioniodiform
el	elongatiform	rd	roundyaform
e.s	erect scandodiform	sc	scandodiform
fl	falodiform	sp	sculponeaform
gt	gothodiform	se	suberectiform
gr	graciliform	sn	sannemannula
ir	irregulariform	s/p	scandodiform/paltodiform
lr	longiramiform	trc	trichonodellaform
mr	multiramiform	trg	triangulariform
oep	oepikodiform	t/t	tetraprioniodiform/ trapezognathiform
o/f	oistodiform/falodiform		
ois	oistodiform		

Chart IV

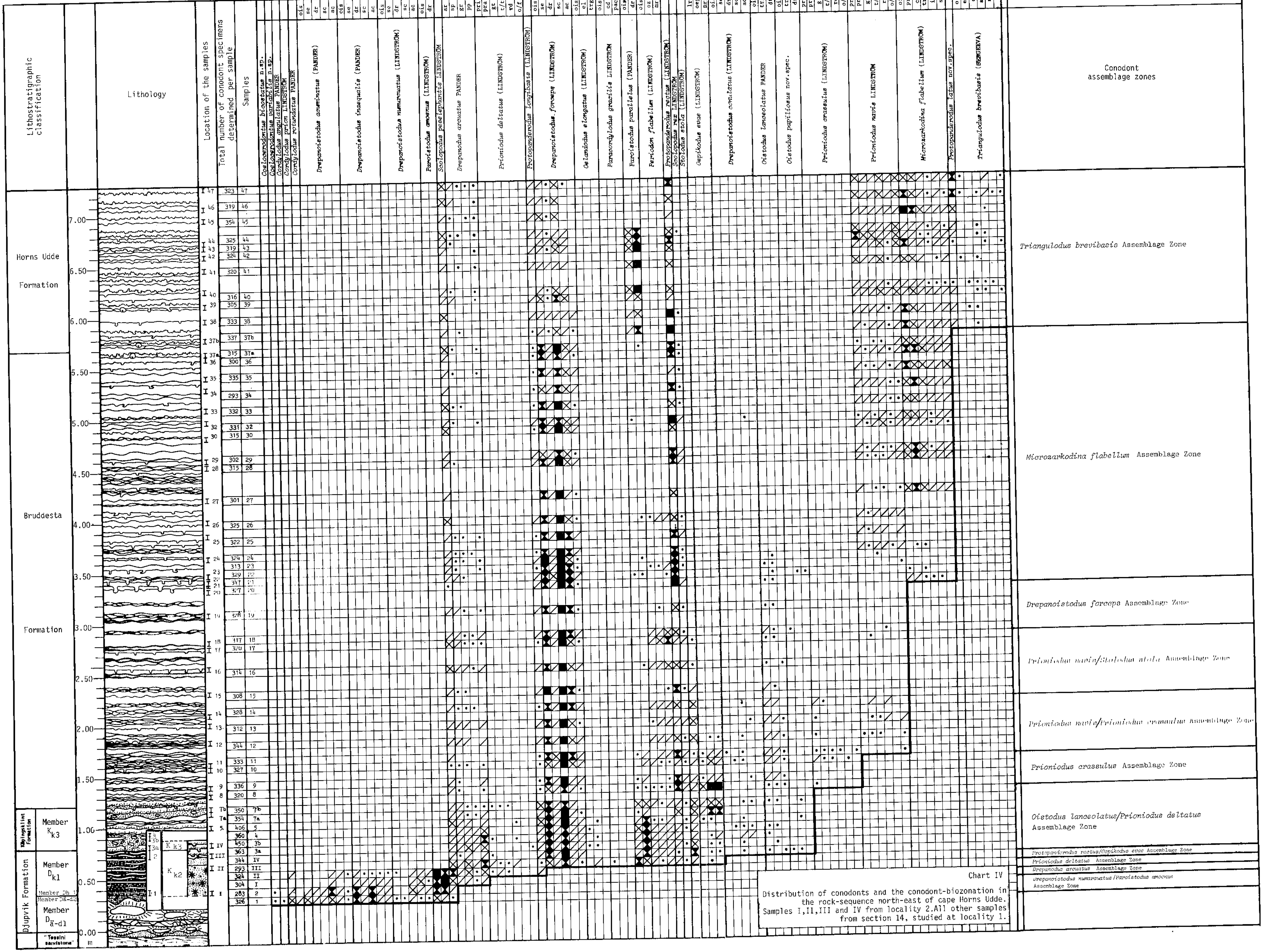

Chart IV

Distribution of conodonts and the conodont-biozonation in the rock-sequence north-east of cape Horns Udde. Samples I, II, III and IV from locality 2. All other samples from section 14, studied at locality 1.

Chart V

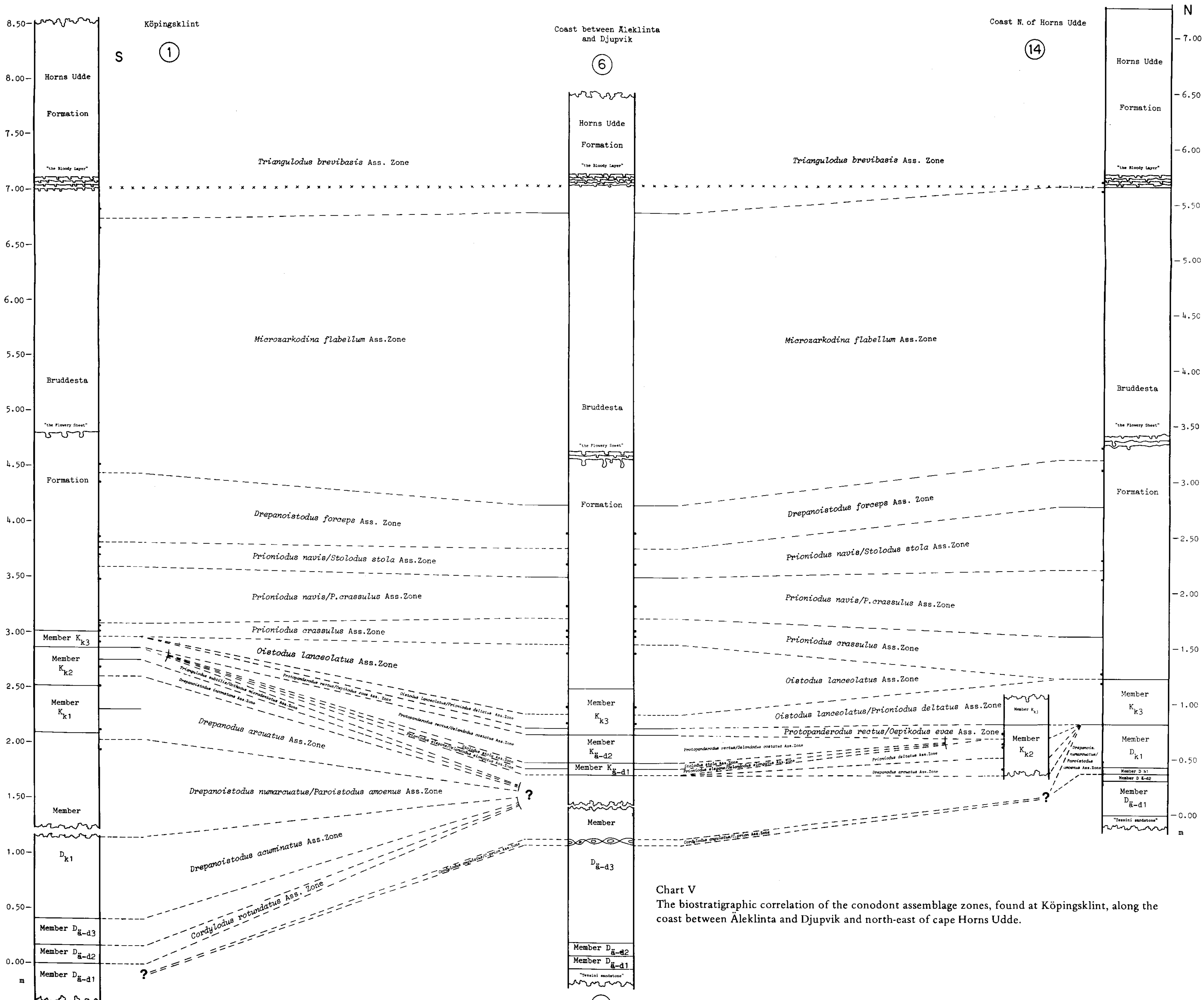

Chart V
The biostratigraphic correlation of the conodont assemblage zones, found at Köpingsklint, along the coast between Äleklinta and Djupvik and north-east of cape Horns Udde.