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Lower Ordovician (Volkhovian-Kundan) conodonts from Hagudden, northern Öland, Sweden

SVEND STOUGE*, GABRIELLA BAGNOLI**

KEY WORDS — Conodonts, Lower Ordovician, Taxonomy, Biostratigraphy, Öland, Sweden.

ABSTRACT — This paper presents taxonomical descriptions of Early Ordovician conodonts recovered from the limestones at Hagudden, in northern Öland (Sweden). 33 samples have been investigated and about 20.000 disjunct conodont elements have been collected.

18 genera and 36 species are described. Lenodus *Sergeeva and* Trapezognathus *Lindström are emended and redefined in terms of multielement taxonomy. The following new species are described:* Baltoniodus clavatus *and* Microzarkodina hagetiana. *Informal new species of the following genera are described:* Baltoniodus, Lenodus *and* Parapanderodus.

The fauna is typical for the Baltic region and the zonal system introduced by Lindström (1971) is used. The conodont zones are correlated with trilobite zones.

The faunas of the Volkhovian Stage and the Hunderumian Substage and Valastean Substage of the Kundan Stage are discussed.

The Arenigian-Llanvirnian boundary coincides closely with the expansus-«raniceps» *trilobite zonal boundary. It is within the large* Amorphognathus variabilis *conodont zone. Llanvirnian initiates with the appearance of* Lenodus pseudoplanus *and* Baltoniodus *n.sp.A.*

RIASSUNTO — Questo lavoro presenta descrizioni tassonomiche di conodonti dell'Ordoviciano Inferiore rinvenuti nei sedimenti calcarei di Hagudden, Öland settentrionale (Svezia). Sono stati esaminati 33 campioni e sono stati determinati più di 20.000 elementi di conodonti.

Vengono descritti 18 generi e 36 specie. Lenodus *Sergeeva e* Trapezognathus *Lindström sono stati emendati e ridefiniti in termini di tassonomia a più elementi. Sono descritte due specie nuove* (Baltoniodus clavatus *e* Microzarkodina hagetiana) *e nuove specie informali appartenenti ai generi* Baltoniodus, Lenodus *e* Parapanderodus.

La fauna è tipica delle regioni baltiche e viene usato il sistema zonale introdoto da Lindström (1971). Le zone a conodonti sono correlate con le zone a trilobiti.

Sono discusse le faune del Volkhoviano, dell'Hunderumiano e del Valasteano.

Il limite Arenigiano/Llanvirniano coincide con il limite tra le zone a trilobiti ad expansus *e a* «raniceps» *e cade nella zona a conodonti ad* Amorphognathus variabilis. *Il Llanvirniano inizia con la comparsa di* Lenodus pseudoplanus *e di* Baltoniodus *n.sp.A..*

* Geological Survey of Denmark, Copenhagen, Denmark.
** Dipartimento di Scienze della Terra dell'Università di Pisa, Italy.

INTRODUCTION

The Lower Ordovician (Oelandian) limestones at Hagudden, northern Öland, Sweden (Fig. 1) exhibit an unique association of graptolites, conodonts, acritarchs, chitinozoans, trilobites and other shelly fossils ranging in age from Middle Arenigian into early Llanvirnian.

The sequence includes the Arenigian-Llanvirnian boundary (Skevington, 1963, 1965) and the Volkhovian-Kundan boundary (Jaanusson, 1960b). The sequence currently is among the best documented limestone successions in northern Öland and it is the stratotype for the chronostratigraphic Hunderumian Substage of the Kundan Stage (Jaanusson, 1960b).

In this paper the conodont succession at Hagudden is described and the position of the Volkhovian-Kundan and Arenigian-Llanvirnian boundary is discussed.

Early geological investigations of the Ordovician stratigraphy and paleontology of the island were undertaken by Tullberg (1882), Holm (1882), Linnarsson (in Nathorst, 1881) and Moberg (1890). Bohlin (1949) reviewed much of the earlier studies, prepared a stratigraphy of the northern part of the island, revised some of the stratigraphy and documented the main aspects of the biostratigraphy. This work was followed by Jaanusson & Mutvei (1951), Bohlin (1955, 1960), Jaanusson (1957), Lindström (1971), Grahn (1980), Nordlund (1988) and Sturesson (1986, 1988). Grahn (1980) also listed the earlier paleontological work. The main recent studies of the Lower Ordovician faunas have been by van Wamel (1974) on conodonts, Bagnoli *et al.* (1988) on acritarchs and conodonts, Eisenack (1976) on acritarchs and chitinozoans, Grahn (1980) on chitinozoans and Berg-Madsen (1988) on cyclocystoids. Apart from Lindström (1971), van Wamel (1974) and Bagnoli *et al.* (1988) no previous systematic conodont studies of Öland have been published.

STRATIGRAPHY AND LOCATION

The island of Öland lies on the western part of the east Baltic platform. The sediments, mainly carbonates and shales, were deposited in the Baltic Syneclise (Störmer, 1967). The basin also includes strata of the East Baltic countries, subsurface of Gotland and the northern part of Poland (Männil, 1966).

The Lower Paleozoic sediments are bordered by basement rocks of the craton to the northeast and the Caledonian sediments to the west-southwest. The Caledonian Orogenesis did not effect the sediments which are *in situ* and the region was mainly affected by diagenetic changes.

In the Baltic Syneclise the Lower Ordovician strata consist of a condensed sequence of limestones and marls («Orthoceras» Limestones). Carbonate sedimentation was apparently continuos from the Early into the Middle Ordovician. Lithological evidence in the units indicates a continuation of mainly shallow water depositional environments that, due to eustatic changes, formed hiatus and/or nondeposition surfaces («Discontinuity surfaces»). The youngest Ordovician strata present on Öland are loose blocks of Middle to Late Ordovician age (Jaanusson & Mutvei, 1982). Öland is underlain by Lower to Upper Cambrian strata. The exposed dip is gently to the east-southeast at less than two degrees. In this way the oldest strata are exposed along the west coast and younger sequences succeed towards the east. Older strata underlie the Kalmar Sound to the west and basal Cambrian strata are exposed on the east shore of the Kalmar Sound. The oldest strata exposed on the island belong to Middle Cambrian (Paradoxides Series).

Stratigraphic nomenclature

The stratigraphical nomenclature used in Öland dates back to Moberg (1890). The division presented by Moberg (1890) was based upon trilobites and is basically a biostratigraphic zonation rather than lithological. Moberg (1890) used the following units:

Gigas Limestones	
Transition beds	
	Upper *Asaphus* Limestone
Asaphus Limestone	Sphaeronites Bed
	Lower *Asaphus* Limestone
Limbata Limestone	
Planilimbata Limestone	

Holm (1882) erected the *Vaginatum* Region for the beds with *Endoceras vaginatum*. The *Vaginatum* Region corresponds to the *Asaphus* to *Gigas* Limestones. Jaanusson (1960b, p. 300) referred the limestones with *Asaphus lepidurus* to *Lepidurus* Limestone, and it was placed between the *Limbata* Limestone and the *Asaphus* Limestone. Jaanusson (1960b) divided the overlying strata into the *Expansus* Limestone and *Raniceps* Limestone and they were placed in the *Asaphus* Limestone of Moberg (1890).

Van Wamel (1974) was the first to define lithological units on Öland based exclusively on lithological characters and with references to a type locality. Of the units introduced by van Wamel (1974) the Bruddesta Formation and the Horns Udde Formation have been observed at Hagudden. The two formations replace the upper part of the *Planilimbata* and the *Limbata* Limestones of Moberg (1890).

The strata involved in this study crop out as an arcuate band throughout the north part of northern Öland (Bohlin, 1949).

The Hagudden Section is located 5 km. south of Byxelkrok and is accessible by a gravelroad from the north (Fig. 1).

Bohlin (1949) initiated his investigation on the *Asaphus* Limestone at the Hagudden Section. According to Bohlin (1949), the *Limbata* Limestone, the *Lepidurus* Limestone, the *Asaphus* Limestone and the *Raniceps* Limestone are present.

Illaenid species and their vertical distribution in the section was demonstrated by Jaanusson (1957). Bohlin (1949, 1955) and Whittington & Bohlin (1960) described trilobite species from collections in northern Öland including the Hagudden Section. Skevington (1963, 1965) described graptolites dissolved from the limestones and indicated that the Arenigian-Llanvirnian boundary should be placed just below a local reference D surface (= D_1, between samples 689 and 690 in this paper, Fig. 2). Jaanusson (1960b, p. 300) choosed the Hagudden Section as the type for the chronostratigraphic Hunderumian Substage of the Kundan Stage. The Hunderumian Substage equates the *Asaphus expansus* trilobite Zone, which should extend from the «ooid horizon» to the local planar D-surface (Bohlin, 1949; Jaanusson, 1957).

The lower part of the section forms a flatlying terrasse that commonly is covered by sea water. The foot of the low cliff initiates approximately 30 cm. below the «ooid» layer (Fig. 2). The upper part of the section is partly covered by rubble and overgrown. It forms the gentle slope above sample 694 and weathers rubbly. The detailed measured section is given in Appendix 1.

The Upper Volkhovian to Lower Kundan (Lower Ordovician) marine sediments at the Hagudden Section display lithological and faunal characteristics and changes. These changes have been recently

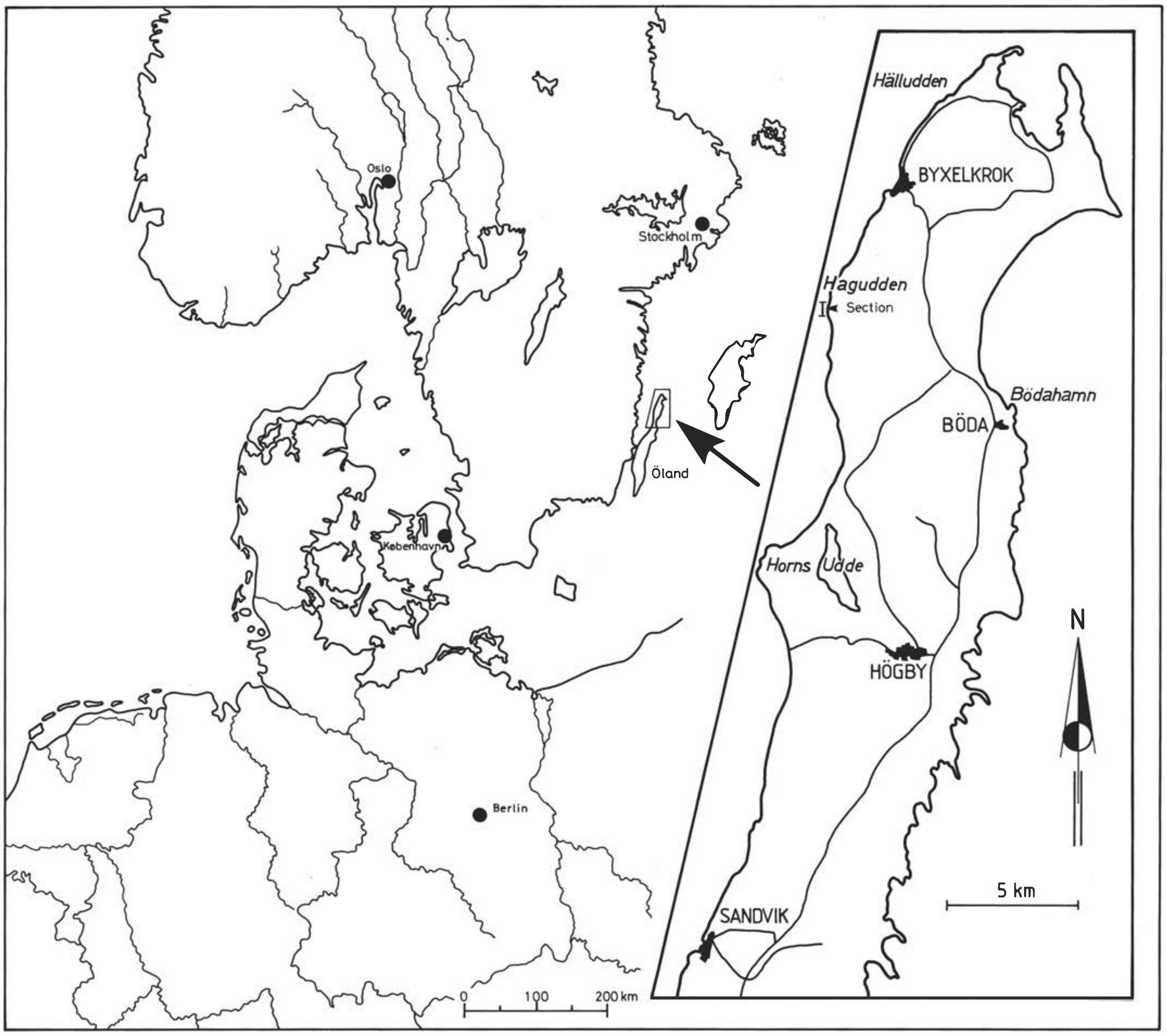

Fig. 1 - Location map.

described by Nordlund (1988). The lithostratigraphic division erected for the Early Ordovician sediments of Öland by van Wamel (1974) is followed together with an informal division.

Bruddesta Formation

The sediments of the stratigraphical lower part of the Hagudden Section characteristically display well developed decimetre-scale alternations of fossiliferous mudstone beds and minor indurated marls. The contrast between the two lithologies increases upwards from the base of the sequence, reflecting an overall increase in the clay/silt content of the sediments (van Wamel, 1974; Nordlund, 1988).

Distinctive red/green and yellow surfaces occur within the unit and the «Flowery Sheet» (in Swedish «Blomiga Bladet», cfr. Bohlin, 1949; Lindström, 1971) occur in the middle part of the unit.

The Bruddesta Formation can be traced all along the coast of northern Öland and is a laterally uniform unit with a thickness of about 4.0 - 4.5 m. The colour changes from deep red-brown into pale yellow to grey further to the south of the island.

Only the upper 0,1 m. of the Bruddestra Formation was sampled during the present study. Petrographically, these limestones are fossiliferous containing scattered bioclasts, principally dissociated prisms of calcitic brachiopod valves, trilobites and endoceratid fragments.

Horns Udde Formation

The lower part of the section above the Bruddesta Formation consists of bedded wackestones typical for the Horns Udde Formation (van Wamel, 1974). The most characteristic allochems are the orthocones at the base of the unit and trilobites.

Distinctive red surfaces occur at the base and within the unit. The basal series of 3 closely spaced red surfaces are known as «Bloody layers» (cfr. Bohlin. 1949) but similar red surfaces occur at horizons higher in the unit within the section. The Horn Udde Formation is 1,6 m. thick in the formational stratotype at Horns Udde (van Wamel, 1974) south of Hagudden. At Hagudden the formation is 1,3 m. thick.

Formation A

The bedded limestones with red bands («Bloody layers») of the Horns Udde Formation (Volkhovian) are overlain by a distinctive sequence of green to grey glauconitic limestones and sands (Fig. 2) which constitute the *Lepidurus*, *Expansus* and *Raniceps* (*partim*) Limestones.

Formation A is a new unit and it remains to be defined and assigned to a type section. Earlier the sediments have been referred to the *Lepidurus* Limestone and perhaps also includes the top of *Limbata* Limestone. It is the basal beds of the *Vaginatum* Limestone according to Jaanusson & Mutvei (1951). The unit consists of heterogeneous yellow green-grey limestones, often very rich in glauconite and it is characteristic for northern Öland.

Formation A is characterized by several horizons of «ooids» in northern Öland (Nordlund, 1988; Sturesson, 1989). At Hagudden the «ooid» bed forms the topmost bed (Fig. 2) in the formation. Formation A is 1,3 m. thick at the Hagudden Section.

Formation B

The sediments of Formation B overlie the «ooid» bearing Formation A. The limestones are micrites, wackestones to packstones with a high content of glauconite. The wackestone/packestone beds may become very glauconite rich. Bioclasts are trilobites, brachiopods, gastropods, bryozoans and ostracods. Graptolites and chitinozoans are present in the acid resistent residues and acritarchs are common.

Formation B is characterized by prominent discontinuity surfaces which can be traced all along the cliff at the Hagudden Section. The unit is 1,6 m. thick at this section.

Formation C

Formation C is characterized by light-grey to yellow micrite to wackestone interbedded with thin argillaceous stringers. Remains of trilobites are the most frequent allochems. Glauconitic grains are rare. Formation C is more than 1,15 m. thick at the Hagudden Section.

Formation C differs from Formation B by the absence of abundant glauconite and the presence of clay.

METHODS AND PROCEDURES

A program to study the conodont faunas of the Lower Ordovician of the island began in 1984, coordinated by S. Stouge. The authors collected most exposed Lower Ordovician formations with samples taken at approximately 20 cm. intervals and revisited the island in 1985, taking further collections, mainly from the southern region. In the present study, the «Orthoceras» Limestone was sampled at Hagudden on the northwestern side of the island (Figs. 1, 2). From this collection 27 samples of limestones were examined. Initial investigation indicated that the *Asaphus expansus* trilobite Zone based on conodonts extended above the reference D surface, where a hiatus otherwise has been indicated (e.g. Jaanusson, 1957; Skevington, 1965). The senior author returned to Öland with A.T. Nielsen and J.A. Rasmussen, Univ. of Copenhagen, in the early summer 1989 and collected additional 6 samples. At the same time A.T. Nielsen identified *Asaphus expansus* from the glauconitiferous Bed e *sensu* Bohlin (1949) (= sample 691 in this paper) which is situated 0,30-0,44 m. above the D reference surface.

A total of 33 samples were collected and examined. 500 gms. of each sample were dissolved in acetic acid. Concentrations of conodonts by means of heavy liquid was futile because the residue consisted of conodonts and glauconite in most samples. Because of the high number of conodonts not all samples were completely picked. The picking stopped when it was judged that no further species were recorded.

The occurrence, the range and abundance of the conodont species are recorded in Fig. 3 and Tab. 1.

BIOSTRATIGRAPHY

Conodont biostratigraphy

A collection of more than 20.000 conodont specimens has been recovered from the 33 samples at Hagudden Section (Tab. 1). The specimens are ranging from well preserved to heavely broken and their colour indicate a value of 1 in the CAI scale (Epstein *et al.*, 1977) reflecting little or no burial of the sediments (temperatures less than 50-80°).

35 species have been recognized. Species of the simple cone genera *Drepanoistodus* Lindström, *Paroistodus* Lindström and *Protopanderodus* Lindström numerically dominate the fauna in the lower half of the sequence whereas «*Semiacontiodus*» Miller and *Scalpellodus* Dzik dominate the upper half. The most abundant ramiform genera are *Baltoniodus* Lindström and *Microzarkodina* Lindström. The multielement genus *Lenodus* Sergeeva (emended herein) dominates in the middle part of the section.

TAB. 1 - *Total numeric distribution of conodont species.*

Species	Samples	673	674	675	676	678	679	677	677a	677b	680	680a	681	682	683	684	685	685a	686	687	687bis	688	689	690	690a	691	692	693	693a	694	694a	695	696	697	Total	
Baltoniodus davatus	Pa																							9	46	55	30	119	53	109	174				595	
	Pb																							4	5	7	18	46	18	28	131				257	
	M																							12	31	54	54	114	68	61	186				580	
	Sa																							6	8	15	7	41	20	31	37				165	
	Sb																							5	13	11	19	37	25	36	83				229	
	Sc																							3	8	12	20	53	42	48	89				275	
	Sd																							5	22	51	33	76	55	78	184				504	2605
Baltoniodus navis	Pa	25	17	34	27	43	57	12	10	7	15	5	5		4	2																			263	
	Pb	37	7	19	27	19	27	5	1			1			2																				145	
	M	35	14	29	27	36	42	17			20	3			6	2																			231	
	Sa	11	2	8	11	9	22	5	3	1	4	2	1			1																			80	
	Sb	15	6	14	17	20	27	7	5		5	2	2	2	2																				124	
	Sc	17	8	17	26	18	29	7			7	4	3		4	1																			141	
	Sd	28	16	23	7	30	70	10	7		11	6		2																					210	1194
Baltoniodus norrlandicus	Pa							38	22	35	38	22	17	65	25	25	44	53	66	55	80	133	30				4								752	
	Pb							18	6	6	4	8	4	40	12	6	19	21	23	10	14	22	5				1								219	
	M							46	45	33	30	19	22	99	56	22	67	61	68	57	105	123	31	2	3										889	
	Sa							13	14	4	13	8	8	21	13	5	13	12	26	9	20	42	9												230	
	Sb							23	25	11	3	7	11	58	21	13	21	41	49	48	29	63	12		2		1								438	
	Sc							24	32	20	25	13	15	41	31	12	24	19	37	33	59	92	15		1	1									494	
	Sd							55	34	30	44	19	26	70	30	23	46	54	58	40	77	182	29	2		1									820	3842
Baltoniodus n. sp. A	Pa																															15	62	66	143	
	Pb																															18	38	40	96	
	M																															25	57	81	163	
	Sa																															13	17	17	47	
	Sb																															23	43	36	102	
	Sc																															10	71	56	137	
	Sd																															26	100	51	177	865
Cornuodus longibasis		6	3	12	11	4	6	9	8	2	7	10	6	31	13	11	7	11	30	29	16	6	5									2	13	6		264
Dapsilodus mutatus																												1		1	5	11	20	6		44
Drepanodus planus	arcuat.			1											1				1																	3
Drepanodus arcuatus	arcuat.	3	1	12	6	9	6	20	9	10	25	11	14	10	22	6	6	12	29	6	12	16	6							4	2	3	3	7	270	
	sculp.			1		1		2				1		3						2	2	1												3	16	
	pipaf.	2		6	2	3	3	4	2	6	1	5	2	5	12	1	2	4	4	4		5								1	2	1	1	3	81	
	gracil.				1		1						1		1				1			1													6	373
Drepanoistodus basiovalis	oistod.							52	50	39	36	14	21	43	68	31	34	40	45	44	37	50	19	3	3	6	8	20	8	3	23	7	10	15	729	
	drepan.							164	109	54	70	60	62	150	146	83	124	92	171	83	60	80	26	9	12	7	8	42	4	9	49	13	35	39	1761	2490
Drepanoistodus cf. basiovalis	oistod.	15	20	67	26	24	27																												179	
	drepan.	32	67	289	85	74	79																												626	805
Drepanoistodus contractus	oistod.	11																																	11	
	drepan.	30																																	30	41
Drepanoistodus forceps	oistod.	91	9																																100	
	drepan.	217	37																																254	354
Drepanoistodus venustus	oistod.																							1	2	4	4	7	4	4	8	1	4	2	41	
	drepan.																									2		17	5	4	3				31	72
Lenodus pseudoplanus	Pa																														33	10	8	18	69	
	Pb																														18	4	4	3	29	
	M																														7				7	
	Sa																														4	1	2		7	
	Sb																														8	1	2	2	13	
	Sc																														1		1	2	4	
	Sd																														10		2		12	141
Lenodus n. sp. A	Pa																				1	1	1	1	4	18	8	43	26	4					107	
	Pb																							2	1	6	10	15	10	5					49	
	M																							1			1	5	1	1					9	
	Sa																								2	6		5	1	2					16	
	Sb																								1		1	6	2	1					11	
	Sc																							1			1	1	1	3					7	
	Sd																								1	7	2	11	5	5					31	230
Microzarkodina flabellum	P	105	28	4	6	2	1	6	3	4	4	7	5	22	3	6	5	3																	214	
	M	51	45																																96	
	Sa	25	9		1																														35	
	Sb	18	6		1																														25	
	Sc	56	10	1	2																														69	
	Sd	18	5																																23	462
Microzarkodina hagetiana	P																							1		1		1	2	1	4	3	12	2	27	
	M																							2	9	6	2	5	16	1	5	4	25	5	80	
	Sa																								2							1	1	1	5	
	Sb																													1	1		1		2	
	Sc																							1	2	1				1		1	3	1	11	
	Sd																												3				1		4	129
Microzarkodina parva	P	5	17	43	21	18	19	49	26	11	39	6	27	13	7	20	8	17	11	7	21	38	9												432	
	M			20	8	24	16	53	42	37	94	38	53	54	4	46	38	65	17	11	74	118	16												828	
	Sa			7	6	5	3	14	5	8	11		9	7		7	5	3	6		3	15	3												117	
	Sb			4	5	1		7	5	3	12	2	11	2	2	6	1		2	3	3	8	1												78	
	Sc			10	8	13	22	20	14	21	54	6	28	11	3	20	6	8	12	3	15	30	5												309	
	Sd			3	4	8	7	5	8	4	15		10	7		2	3	3	4	2	5	10	1												101	1865
Parapaltodus simplicissimus	drepan.																							1				6	2						9	
	scand.																											1		1					2	11
Parapaltodus sp.	scand.														2																					2
Parapanderodus n. sp. A	slender																					6	7												13	
	symm.																						4												4	17
Paroistodus originalis	oistod.	1	46	51	66	78	20	35		3	3		3	2								2													310	
	drepan.	4	151	138	274	141	68	43		16	16		6	11							2	4													874	1184
Periodon sp.	M														3																					3
Polonodus sp. A																								3			4	1								8
Polonodus? sp. B																											3			4						7
Protopanderodus rectus	acont.	44	97	40	19	34	32	4				49	54	27	55	39	19	22	29	32	19	28	4			4									651	
	scand.	17	17	7	11	15	15					5	13	16	14	9	5	2	17	7	7	6	1			1									185	836
Protopanderodus cf. varicostatus	acont.							15	7	10	1			3			2											5		6	2	8	7	5	71	
	scand.							3									1											1	1	1				3	10	81
Protopanderodus sp.	acont.							22	24	48	115		7	75	28	11	4	8																	342	
	scand.							10	12	20	22		5	29	11	2	2	2																	115	457
Scalpellodus gracilis	short dr.											1	2	3	2	2	1	3	5	31	21	23	1	1		1	3	1	8	1	6	6	16	22	160	
	long dr.											2	4	5	1	4	3	6	26	78	59	104	15	2	5	6	10	1	6	4	17	16	29	65	468	
	scand.											2	1	2	2	3	1	5	6	13	9	23	4				2	1	3	1	3	10	10	12	113	741
Scapellodus latus	short dr.		3	2		1	8	12	18	11	11	5	10	19	8	8	5		2	1															124	
	long dr.		4			1	13	16	22	19	13	11	15	13	14	23	6	1	11																182	
	scand.		1				2	9	6	3	3	2	2	7	10	7	3		5	1															61	367
Scolopodus rex		23	2	4			2	4					1	1																						37
«Scolopodus» peselephantis		17	24	7	9	1	8	3	8	3	3	1	9	4	1	3		1	1	5	10	5				1	1	2	1							128
«Semiacontiodus» cornuformis	symm.							1			2			3	4	2	1	3	7		15	21	5	8	8	4	7	23	9	17	22	27	9	17	215	
	asymm.							4	9	6	23	6	11	17	18	11	14	17	41	7	53	143	22	32	27	59	73	146	97	123	87	189	117	179	1531	1746
Trapezognathus quadrangulum	Pa	22		1	2	1	2				1			1																					30	
	Pb	8								1																									9	
	M	15	2	3	1			1		1						1																			24	
	Sa	7	1	4		1	1																												14	
	Sb	7		1			1	1		1	1					1																			13	
	Sc	15	1	3			1	1	1							1																			23	
	Sd	25	1	3	2				1		2	1				4																			39	152
Trapezognathus sp.	Pa																4	8		2	1	2	1												18	
	Pb																1	1	1	1	2		1												7	
	M																1	2		1	2														6	
	Sa																4	3	1		3	1	2												14	
	Sb																2	2		1	1	3	3												12	
	Sc																6	6	1	1	1	1													16	
	Sd																10	5	3	4	5	4	4												35	108
Trigonodus brevibasis	P		1	18	4	3	3	5	9																										43	
	M		2	17	5	2	1	8	4																										39	
	Sa	1	1	7	4	1	1	8																											23	
	Sb			7		2	1	4	3																										17	
	Sc	1	2	20	2	3		7	9																										44	
	Sd		2	12	1	1	1	1	2	1																									21	187
		1060	685	969	735	646	644	902	620	489	803	364	506	994	661	482	568	616	816	631	843	1412	297	117	218	347	335	853	496	596	1208	449	724	765	21851	

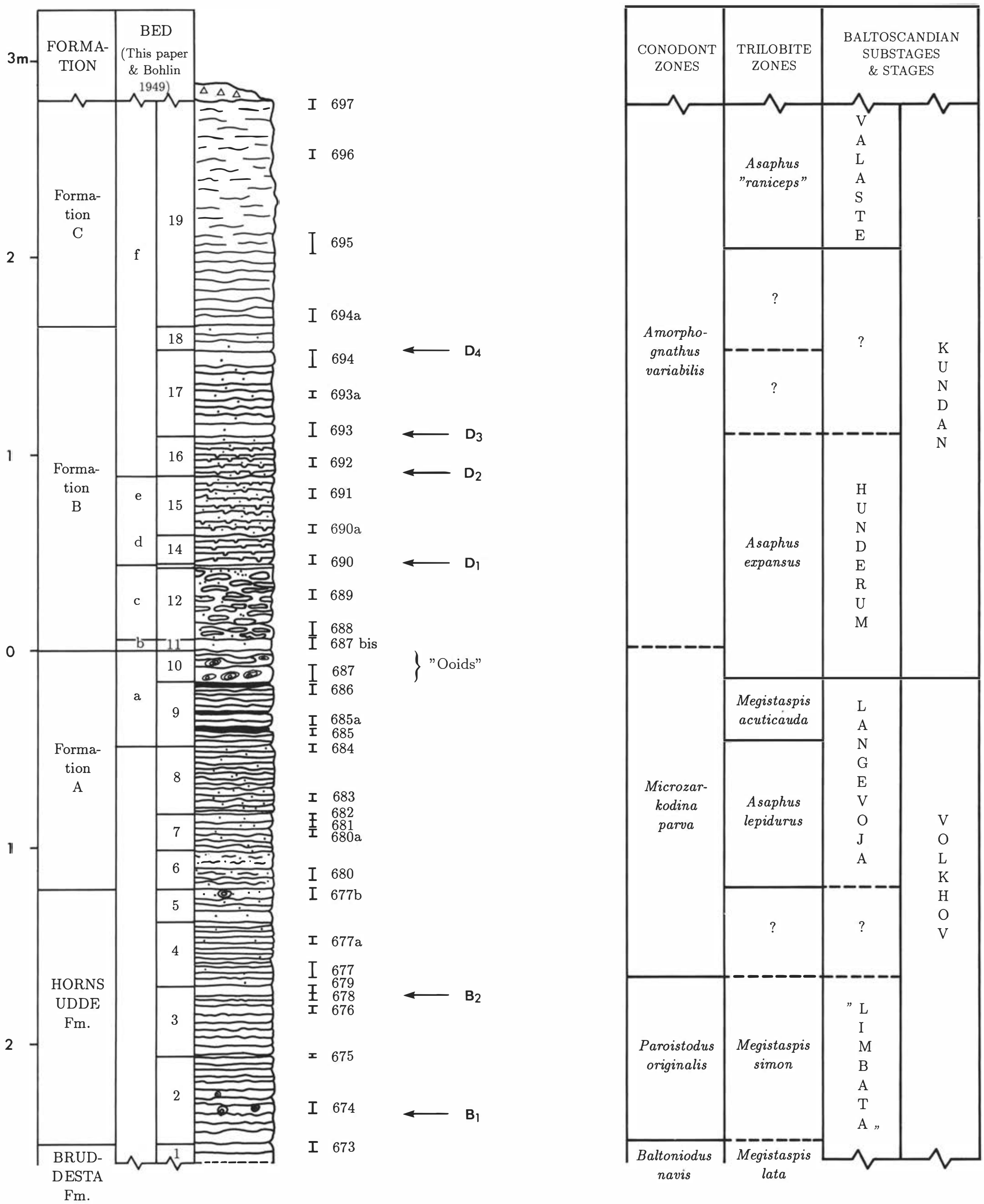

Fig. 2 - The Hagudden Section; D_1 - D_4 are prominent discontinuity surfaces. D_1 is reference level in Jaanusson (1957) and Skevington (1965). Base of Bed 11 is reference level in Bohlin (1949). Dots in limestones signify glauconite grains.

Two new species are proposed: *Baltoniodus clavatus* n.sp. and *Microzarkodina hagetiana*. A number of new informal species are also recognized: one in *Drepanoistodus*, one in *Baltoniodus*, one in *Lenodus*, one in *Parapanderodus* Stouge, and one in *Trapezognathus* Lindström.

The fauna is typical for the Baltic Region, but few taxa are well known from the american conti-

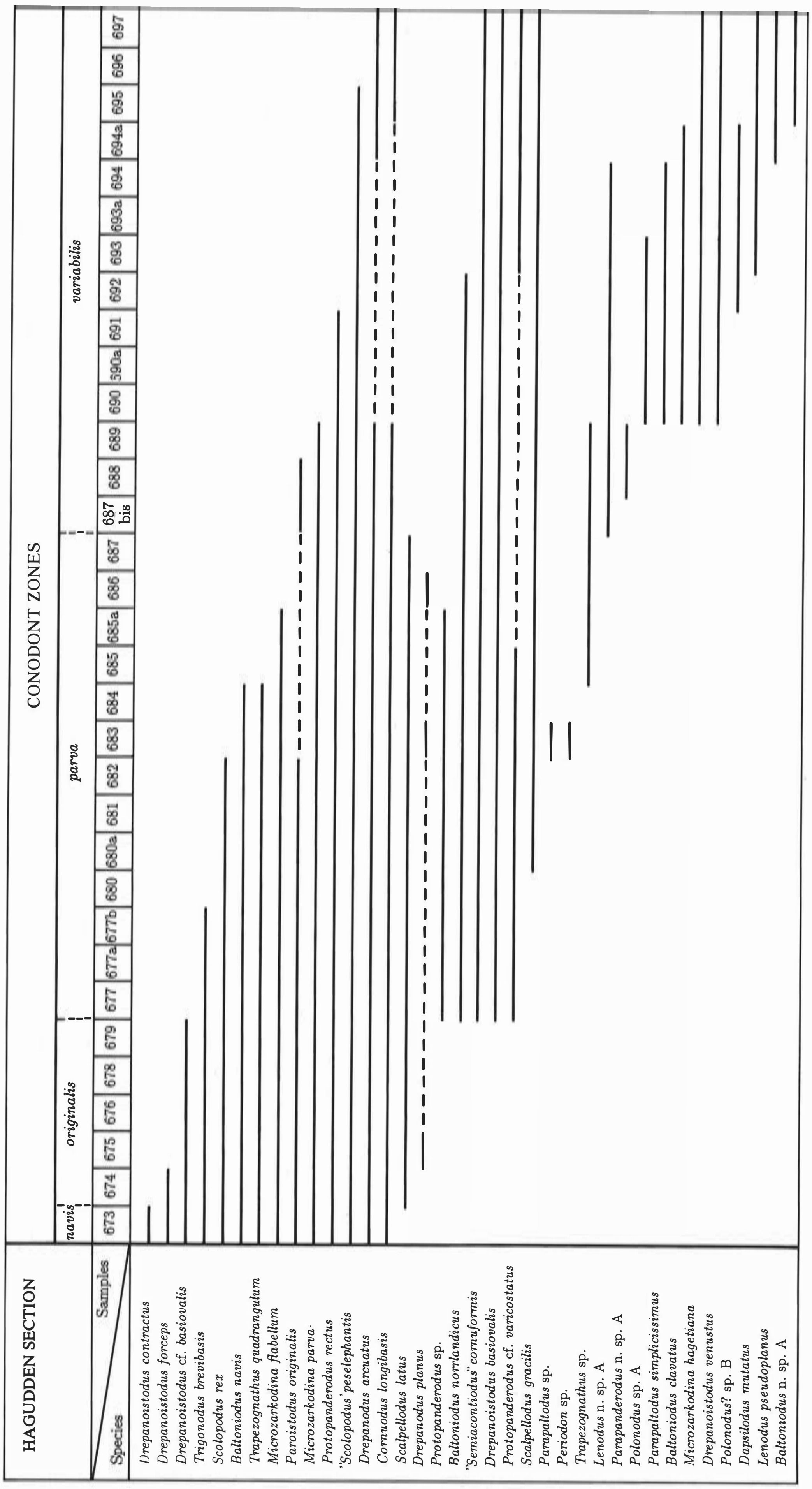

Fig. 3 - Ranges of conodont species.

nent (Stouge 1984, 1989): *Parapanderodus* sp.A and *Parapaltodus simplicissimus* Stouge. Also the sequence is well recognized in southern China although we were not able to positively identify the species.

Conodont Zones - Lindström (1955a) described Volkhovian conodonts from central Sweden and erected a zonation sheme. This scheme was expanded by Lindström (1960) to comprise the Lower-Middle Ordovician of the swedish successions and six faunas were introduced.

The conodont succession was divided into the zonation scheme (Lindström, 1971) that since has been applied as the standard reference for the Baltoscandic region. Van Wamel (1974) erected his own zonation scheme and focused on different taxa than those of Lindström (1971). Subsequently, Löfgren (1978, 1985) described the Jämtland sequence and made revisions to the scheme of Lindström (1971). In this paper the zonation of Lindström (1971) is used (Fig. 4).

BALTOSCANDIAN SERIES, STAGES & SUBSTAGES			CONODONT ZONES (Lindström 1971)
LOWER ORDOVICIAN or OELANDIAN	KUNDAN STAGE	B III $\alpha - \gamma$	*Amorphognathus variabilis* Zone
	LANNA VOLKHOV STAGE	B II γ	*Microzarkodina parva* Zone
		B II β	*Paroistodus originalis* Zone
		B II α	*Baltoniodus navis* Zone
			Baltoniodus triangularis Zone

Fig. 4 - Conodont zonation for the Baltoscandic Region (after Lindström, 1971).

Baltoniodus navis Zone - The *Baltoniodus navis* Zone occurs near the top (sample 673) of the Bruddesta Formation. It corresponds to the *Prioniodus* (*B.*) *triangularis-navis* Zone of Löfgren (1978) and the base of the *Triangulodus brevibasis* Zone of van Wamel (1974).

The fauna includes *Baltoniodus navis* (Lindström), *Drepanoistodus contractus* (Lindström), *Drepanoistodus forceps* Lindström, *Drepanoistodus* cf. *D. basiovalis* (Sergeeva), *Microzarkodina flabellum* (Lindström), *Microzarkodina parva* (Lindström), *Paroistodus originalis* (Sergeeva), *Protopanderodus rectus* (Lindström), *Trapezognathus quadrangulum* Lindström and *Trigonodus brevibasis* (Sergeeva). Of these only *Drepanoistodus contractus* has the upper range in the zone. The other species continue into the next zone.

Paroistodus originalis Zone - The base of this zone is placed where *Paroistodus originalis* and *Drepanoistodus* cf. *D. basiovalis* are abundant and dominate the fauna (Tab. 1). This occurs in sample 674 situated at the «Bloody Layer» (B_1 in Fig. 2) within the basal beds of Horns Udde Formation. The zone extends up to and includes sample 679 at the B_2 horizon (Fig. 2) and it is 0,7 (max. 0,8 m.) thick at the Hagudden Section.

The *Paroistodus originalis* Zone is approximately the same as it was interpreted by Löfgren (1985) but is a modification of the zone as outlined by Löfgren (1978). *Paroistodus originalis* Zone (and the top of *Baltoniodus navis* Zone at Hagudden Section) corresponds to the *Triangulodus brevibasis* Zone of van Wamel (1974).

Microzarkodina parva Zone - This zone is placed at the first appearance of *Baltoniodus norrlandicus* Löfgren, *Drepanoistodus basiovalis* (Sergeeva), *Protopanderodus* cf. *P. varicostatus* (Sweet & Bergström) and «*Semiacontiodus*» *cornuformis* (Sergeeva). In Hagudden Section the zone begins with sample 677 just above the B_2 horizon which is situated in the middle of the Horns Udde Formation. The zone may include sample 687 (see below). The concept of the *Microzarkodina parva* Zone in approximately the same as the *Microzarkodina flabellum parva* Zone of Löfgren (1978).

At the Hagudden Section, *Scalpellodus latus* (van Wamel), *Trigonodus brevibasis*, *Scolopodus rex* Lindström and *Microzarkodina flabellum* have their stratigraphical highest occurrence in or at the top of the zone, and *Protopanderodus* sp. is constricted to the zone. *Trapezognathus* sp. and *Scalpellodus gracilis* (Sergeeva) appear for the first time in the upper half of the zone. *Parapaltodus* sp. and *Periodon* sp. are present as exotics in the zone. *Microzarkodina flabellum* and *Microzarkodina parva* occur together but the latter is the numerically dominant of the two (Tab. 1). The zone is about 1,80 m. thick at the Hagudden Section.

Amorphognathus variabilis Zone - This zone was defined by the first appearence of platformal elements including *Amorphognathus variabilis* Sergeeva (Lindström, 1971). Löfgren (1978) tentatively referred the *variabilis* elements to *Eoplacognathus?* and hence renamed the zone *Eoplacognathus? variabilis* Zone. The *Eoplacognathus? variabilis* Zone was subdivided into *Eoplacognathus? variabilis-Microzarkodina flabellum* Subzone and *E.? variabilis-M. ozarkodella* Subzone (Löfgren, 1978).

Due to low recovery or taxonomical differences or perphaps a real difference in the faunal composition, we cannot precisely place the lower boundary of the *variabilis* Zone as it was defined by Lindström (1971) or by Löfgren (1978).

In this paper *Lenodus* n.sp.A has been chosen as a marker for the *variabilis* Zone. *Lenodus* n.sp.A appears in sample 687bis and the *variabilis* Zone extends to the top and probably beyond the top of the section. The strata are all included in *Eoplacognathus? variabilis - Microzarkodina flabellum* Subzone. The zone/subzone is more than 2,70 m. thick at the Hagudden Section.

Microzarkodina parva, *Paroistodus originalis*, *Baltoniodus norrlandicus* and *Trapezognathus* sp. have all their last occurrence in the lower half of the zone. *Baltoniodus clavatus* n.sp. and *Lenodus* sp. A are constricted to the zone, whereas *Parapanderodus* n.sp.A, *Parapaltodus simplicissimus*, *Polonodus* sp.A and *Polonodus*? sp. B have partial constricted ranges in the Zone.

Microzarkodina hagetiana n.sp., *Drepanoistodus venustus* (Stauffer), *Dapsilodus mutatus* (Branson & Mehl), *Lenodus pseudoplanus* (Viira) and *Baltoniodus* n.sp.A appear for the first time in this zone.

The faunal distribution in the zone is characteristic (Fig. 3, Tab. 1) and the faunal sequence at the Hagudden Section can be divided into three segments which may be of biostratigraphical value. The first and lower part is characterized by the appearance of *Lenodus* n.sp.A, the second level is the appearance of *Baltoniodus clavatus* and *Microzarkodina hagetiana*. The third horizon initiates either with the appearance of *Lenodus pseudoplanus* (Viira) (sample 694A) or *Baltoniodus* n.sp.A (sample 695).

Conodont-trilobite collation

Conodonts and trilobites occur in direct association at a number of levels within the Hagudden Section. These joint occurrences are discussed in this part. Trilobite data are compiled from Bohlin (1949, 1955, 1960), Whittington & Bohlin (1960), Jaanusson (1957) and A.T. Nielsen (pers. comm. 1989).

Sample 678 at the top of the *Paroistodus originalis* Zone contained *Niobe lindstroemi* suggesting *Megistaspis* (*M.*) *simon* Zone. The association of the *originalis* Zone with *M.* (*M.*) *simon* trilobite Zone is in accordance with data from Tjernvik & Johansson (1980) and Löfgren (1985) on the basis of the Finngrundet well section which is located in the Baltic Sea and north of Öland.

The lower part of *Microzarkodina parva* Zone brackets a trilobite fauna with *Megistaspis* (*M.*) *limbata* subsp. Tjernvik (at sample 677A) and *Megistaspis* (*M.*) *limbata* (according to Bohlin, 1949) in the interval from sample 677 to sample 680A. This combination indicates that the lower part of *M. parva* Zone may be correlated with the *M.* (*M.*) *simon* to *M.* (*M.*) *limbata* Zones.

The middle part of the *M. parva* Zone, i.e. from sample 681 to sample 684 brackets a trilobite fauna containing *Asaphus lepidurus*, *Dysplanus acutigenia* and *Ptychopyge* cf. *angustifrons*. This association occurs in the *Asaphus lepidurus* trilobite Zone typical of northern Öland and east Baltic area. In central Sweden, *A. lepidurus* occurs within *Megistaspis* (*M.*) *limbata* Zone (Tjernvik & Johansson, 1980).

The upper part of the *Microzarkodina parva* Zone brackets a trilobite fauna that initiates with *Megistaspis* (*M.*) *acuticauda* and *Asaphus* sp. It is succeeded stratigraphically by *Asaphus expansus*, *Asaphus raniceps* and *Megistaspis gibba*. This association suggests a transition from *A. lepidurus* trilobite Zone to the basal *A. expansus* trilobite Zone.

The *variabilis* Zone initiates with the association including *Asaphus raniceps*, *Ptychopyge angustifrons*, *Ptatillaenus ladogensis*. Other faunal elements are *Lychoporia nucella*, *Iru zonata*, Conularia and Bryozoans. This association is succeeded by *Illeanus sarsi* which continues together with *Asaphus expansus* as high as to Bed e of Bohlin (1949) or unit 14 in this paper (sample 691). This trilobite association is typical for *Asaphus expansus* trilobite Zone and it occurs with the conodont fauna characterized by *Lenodus* n.sp.A.

The strata of Beds 16 to 17 contains a rich trilobite fauna with *Asaphus raniceps*, *Illeanus esmarcki*, *Pterygometopus sclerops*, *Lichas coelorrhin*, *Megistaspis heroica* and *Pliomera fischeri*. This fauna may belong to *Asaphus expansus* Zone or *Asaphus* «*raniceps*» Zone. The fauna occurs together with abundant *Lenodus* n.sp.A, *Baltoniodus clavatus* and *Polonodus* spp. are present.

Jaanusson (1957) recorded *Illeanus aduncus* from Bed 19. Bohlin (1949) listed *Pliomera fischeri*, *Megistaspis heroica*, *Megistaspis rudis*, *Illeanus esmarcki*, and *Asaphus* cf. *raniceps* from strata belonging to Formation C. The trilobite fauna is contained within the *Asaphus* «*raniceps*» trilobite Zone and is associated with *Baltoniodus* n.sp.A.

Conodont-graptolite collation

Conodonts and graptolites occur in direct association at several levels within the Hagudden Section. The graptolite data are derived from Skevington (1965).

The stratigraphical lowest graptolite fauna with *Tetragraptus bigsbyi* and *Maendrograptus? geniculatus* occurs in *Microzarkodina parva* Zone and *Megistaspis* (*M.*) *limbata* trilobite Zone.

The small fauna with *Didymograptus formosus* and *Didymograptus* n.sp.B Skevington initiates in the *variabilis* Zone. It is succeeded by *Didymograptus* cf. n.sp.A, *Glyptograptus dentatus* and *Pseudoclimacograptus camptochilus*.

Skevington (1965) recorded *Glyptograptus austrodentatus oelandicus* Bulman and *Pseudoclimacograptus camptochilus* from unit 15. These species are present within the range of *Lenodus* sp.A and *Asaphus expansus* trilobite Zone.

The graptolite fauna in total correlates with the *Didymograptus hirundo* Zone of Great Britain.

CHRONOSTRATIGRAPHY

Jaanusson (1960a, b, c) reviewed the chronostratigraphic stages and substages of the Baltoscandic Region and his interpretation is followed herein.

Volkhovian Stage

The Volkhovian Stage (= Lanna/Volkhovian Stage in Tjernvik & Johansson, 1980 and Jaanusson & Mutvei, 1982) was introduced to Sweden by Jaanusson (1960b). It includes the *Megistaspis* (*M.*) *lata*, *Megistaspis* (*M.*) *simon*, *Megistaspis* (*M.*) *limbata* and *Asaphus lepidurus* trilobite Zones. It has been suggested by Tjernvik & Johansson (1980) that the *Megistaspis* (*M.*) *limbata* Zone replaces the *Asaphus lepidurus* Zone and marks the top of the Volkhovian Stage. The appearance of *Asaphus expansus* trilobite Zone assemblage is used as the marker for the Kundan Stage (Jaanusson, 1960a, b; Tjernvik & Johansson, 1980).

In the Hagudden Section the *limbata* (or *lepidurus*) Zone is known from Beds 6 to 8, while *Asaphus expansus* Zone is known from Bed 10. Thus Bed 9 which yielded *Megistaspis acuticauda* then is the top of the Volkhovian Stage.

Based on this material and supported by evidence from Finngrundet (Löfgren, 1985) the *Baltoniodus navis* Zone is confined to the *Megistaspis (M.) lata* Zone, the *Paroistodus originalis* Zone brackets the *Megistaspis* (*M.*) *simon* Zone whereas the *Microzarkodina parva* Zone compares with *Megistaspis* (*M.*) *limbata* and *A. lepidurus* Zones. The lower limit of the *M.* (*M.*) *limbata* Zone is not precisely placed in the section and the lower limit to the *M.* (*M.*) *limbata* Zone may be situated at the appearance of *Baltoniodus norrlandicus* and *Semiacotiodus cornuformis* (Bed 4) or at the disappearance of *Trigonodus brevibasis* (top of Bed 5).

The upper beds with *Megistaspis acuticauda* are included in the highest part of the *Microzarkodina parva* Zone in this paper.

Volkhovian-Kundan Stage Boundary

The Volkhovian-Kundan Stage boundary lies at the base of the *Asaphus expansus* trilobite Zone. The index species has been positively identified from Bed 10 or within the «ooid» bed (Bohlin, 1949). This gives a probable lower limit to the Kundan Stage. The conodont fauna changes in Bed 11 with the appearance of *Lenodus* n.sp.A. Hence, the base of *Amorphognatus variabilis* Zone lies slightly above the Stage boundary.

Hunderumian Substage

The Hunderumian Substage, the oldest of the Kundan Stage, has been assigned to the *Asaphus* Limestone. The Substage comprises the *A. expansus* trilobite Zone.

Asaphus expansus has been recorded from Beds 10-12 (Bohlin, 1949). It also occurs up to Bed 15 (A.T. Nielsen, pers. comm. 1989) and the Hunderumian Substage comprises the interval from Bed 10 to Bed 15. This interval is bracket by the total range of *Lenodus* n.sp.A and approximately to that of *Baltoniodus clavatus*. *Parapanderodus* n.sp.A is restricted to the lower part of the Substage. Following species have the upper ranges within the Substage: *Microzarkodina parva*, *Baltoniodus norrlandicus* and *Trapezognathus* sp. The following species appear within the Substage: *Parapaltodus simplicissimus*, *Polonodus* sp.A, *Baltoniodus clavatus*, *Microzarkodina hagetiana* and *Drepanoistodus venustus*.

The Hunderumian Substage includes the most dramatic change in the abundance and specific composition of the conodont fauna. This level appears with sample 690.

Valastean Substage

The Valastean Substage corresponds with the *raniceps* Limestone in Sweden (Jaanusson, 1960b). The trilobite fauna recorded from Bed 17 may belong to *Asaphus expansus* Zone or *Asaphus* «*raniceps*» Zone. The actual boundary between *A.* «*raniceps*» and *A. expansus* Zones can not be precisely placed in the Hagudden Section on the basis of trilobites. The trilobites which are diagnostic for the *Asaphus* «*raniceps*» Zone were collected from the top beds of the Hagudden Section, but were not referred to any horizon in the section (Bohlin, 1949). *Illeanus aduncus*, however, appears near the base of Bed 19 according to Jaanusson (1957). Thus the *expansus*-«*raniceps*» zonal boundary which is close to the Hunderumian/Valastean Substage boundary may lie at the base of Bed 16, or at the top of Bed 18, or at any level within these Beds.

The top of Bed 18 is marked by a lithological change and this change is associated with the appearance of *Lenodus pseudoplanus*. This change can be used as a marker for the boundary at the Hagudden Section. The base of Bed 18 is characterized by a prominent discontinuity surface (D_4 on Fig. 2).

Arenigian - Llanvirnian Boundary

Skevington (1965) discussed the possible position of the Arenigian-Llanvirnian boundary in the Hagudden Section. Skevington (1965) tentatively placed the boundary at the local discontinuity surface (D_1 of this paper, Fig. 2). Based on information on both conodonts and trilobites, this boundary would be placed too low. The data from Hälludden Section located north of Hagudden (Skevington, 1965) (fig. 1) demonstrate that the boundary is located at the Hunderumian-Valastean Substage boundary or at the *expansus*-«*raniceps*» zonal boundary. This zonal boundary correlation would place the *hirundo-latus* (= «*bifidus*») zonal boundary at the base of Bed 19. In this way the Llanvirnian initiates with the appearance of *Lenodus pseudoplanus*.

The position of the Arenigian-Llanvirnian boundary at the top of *expansus* Zone and base of «*raniceps*» Zone is in accordance with conodont/trilobite data from the Komstad Limestone in Scania. (A.T. Nielsen, pers. comm., 1989) and the «Orthoceras» limestone in the Oslo Region (J.A. Rasmussen, pers. comm., 1989).

SYSTEMATIC PALEONTOLOGY

The systematic paleontology is focused on the multielement approach. Quotation marks are placed around the names of previously identified taxa that are considered to be incorrectly named and in need of a later revision. Elements within an apparatus are referred to using the nomenclature from Treatise (Robinson, 1981) and Sweet (1988). The position of the elements within the apparatus is indicated following the procedure of Treatise (1981) for ramiforms and pectiniform types. Within apparatuses with coniform elements, the elements are referred to using the suffix — iform with the form generic or form specific name.

All figured specimens are kept at the Mineralogical Museum, Copenhagen (MGUH).

Genus *Baltoniodus* Lindström, 1971

Type species - *Prioniodus navis* Lindström, 1955.

Remarks - The multielement genus *Baltoniodus* Lindström, 1971 has a septimembrate apparatus. The elements are pectiniform, pastinate, alate, tertiopedate, bipennate, quadriramate and geniculate and they occupied the P (Pa and Pb), S (Sa, Sb, Sc and Sd) and M positions respectively. The apparatus has been interpreted as seximembrate, because the difference between Sb and Sc elements is minimal in some *Baltoniodus* species (Bergström, 1971; Lindström, 1971; Sweet & Bergström, 1972).

Baltoniodus Lindström, 1971 has been considered synonymous of *Prioniodus* Pander, 1856 by Bergström (1971), van Wamel (1974) and Dzik (1976). Serpagli (1974) and Löfgren (1978) interpreted *Baltoniodus* as a subgenus of *Prioniodus*. Stouge & Bagnoli (1988) demonstrated that the multielement genus *Prioniodus* had its own evolutionary history that completed with extinction in the early Arenigian and before the first appearance of *Baltoniodus*. *Baltoniodus* appeared for the first time in Balto-Scandic region during the Billingenian(?) — early Volkhovian and probably evolved independently from *Prioniodus* and with an ancestor which has to be found within the *Diaphorodus* Kennedy group. *Prioniodus* and *Baltoniodus* are members of Prioniodinidae Lindström.

Baltoniodus navis (Lindström), *Baltoniodus norrlandicus* Löfgren, *Baltoniodus clavatus* n.sp. and *Baltoniodus* n. sp. A are described in this paper. *Baltoniodus navis* is the earliest species recognized in this study and it includes specimens that we record from the *Paroistodus originalis* Zone, but probably an earlier species exists.

The Sd elements in our material never become symmetrical and with «two anterior - two posterior» processes (see Löfgren, 1978). This character however was assigned to *Baltoniodus triangularis* (Lindström) by earlier authors (Lindström, 1971; van Wamel, 1974; Löfgren, 1978). We refer these Sd elements to the redefined multielement genus *Trapezognathus* (Lindström) instead.

Baltoniodus navis (Lindström)
(Pl. 1, figs. 1-10)

Pa element

1955 *Prioniodus navis* n.sp. Lindström, p. 590 (*partim*), pl. 5, fig. 33 (only).
?1967 *Prioniodus* cf. *navis* Lindström - Viira, text-fig. 2:1.

Sd element

?1974 *Tetraprioniodus robustus* Lindström - Viira, pl. 6, fig. 5.

M element

?1963a *Falodus simplex* sp. nov. Sergeeva, pp. 104-105, pl. 8, figs. 8-10; text-fig. 9.

Multielement

1971 *Baltoniodus navis* (Lindström) - Lindström, p. 56 (*partim*), pl. 1, fig. 13 (only).
1974 *Prioniodus navis* Lindström - van Wamel, pp. 89-90 (*partim*), pl. 8, figs. 11, 12, 14, 16-18 (only).
1976 *Prioniodus navis* Lindström - Dzik, text-fig. 22a-i.
1977 *Baltoniodus navis* (Lindström) - Lindström (*in* Ziegler), pp. 73-74, *Baltoniodus* pl. 1, figs. 8, 9.
1978 *Prioniodus* (*Baltoniodus*) *navis* Lindström - Löfgren, pp. 83-84, pl. 12, figs. 8-16; pl. 14, figs. 1A-B, 3a-D.
non 1981 *Baltoniodus navis* (Lindström) - Cooper, p. 160, pl. 29, figs. 9, 10; pl. 30, fig. 2.
non 1983 *Baltoniodus navis* (Lindström) - Dzik, p. 74, text-fig. 7: F-M. (= *B. norrlandicus*).
?1985 *Baltoniodus navis* (Lindström) - An, Du & Gao, pl. 9, fig. 19.
1987 *Baltoniodus navis* (Lindström) - An, pp. 126-127 (*partim*), pl. 20, figs. 1, ?2, 3, 5-10, 12-16 (only).

Description - The Pa element has three denticulated processes that are almost equal in length. The denticles of the anterior and posterior processes are regular, apically free and erect. On the lateral process the denticles are inclined towards the cusp and they can be confluent. The anterior and the lateral processes are curved and downwards directed. The angle between the lateral and posterior processes is 100°-130°. The cusp is reclined. The basal sheath connects the processes.

The Pb element has three fully denticulated processes, the posterior of which is the longest one. The denticulation is similar to that of Pa element. The anterior process forms an angle with the posterior process of about 90° and the lateral process forms an angle of 160°-180° with the posterior process. The cusp is erect to slightly reclined. The basal sheath is well developed and has a prominent flare on the inner side. On the outer side, instead, the basal sheath of the anterior and lateral processes, just below the base of denticles, is bent inwards giving the impression of a thickened edge.

Some Pb elements in the lowermost samples have a larger and more flaring basal sheath, the posterior process is arched and the angle between the lateral and posterior processes is about 100°. Probably they represent Pb elements of an older undescribed species of *Baltoniodus*.

In the Sa element the cups is procurved, it has a straight posterior process and two posteriorly directed lateral processes. The denticles are commonly fused on the lateral processes, and free on the posterior one. The processes are connected by a thin and short basal sheath.

In the Sb element the cusp is procurved. The element has one lateral process-like costa and an anterior process. The denticulation of the posterior process can be confluent. The anterior process can carry mainly confluent denticles all along or distally. The lateral process is very prominent and in few specimens may carry denticles. The anterior process forms an angle with the posterior process of about 60°. The basal sheath is constricted below the processes.

In the Sc element the posterior process is denticulated and the anterior process may be or may be not denticulated. The aboral margin below the cusp forms a rounded extension. The anterior process forms an angle with the posterior process of 60°-65°. The cusp is procurved and the basal sheath and denticulation is similar to that of the Sb element.

In the Sd element the four asymmetrical processes are posteriorly directed and they are arranged as two posterior and two anterior. The posteriorly located processes carry apically free denticles. Of the two anteriorly located processes, the inner one carries numerous, confluent denticles, and the outer one carries only few confluent denticles. Also in these elements the basal sheath is constricted below the processes.

In the M element the denticulation of the anterior process, when present, is variably developed in size and number. The cusp is reclined and the angle between the cusp and the upper margin of the base is 80° or less.

All the elements have deep basal cavity. Most elements of this species are characterized by a restriction of the basal sheath below the processes, but a proper thickened edge is never present.

Remarks - *Baltoniodus navis sensu* Cooper, 1981 has a different denticulation than the material at hand, and also the M element has a different morphology.

In *Baltoniodus navis* the secondary basal cavity tips into the denticles (see Löfgren, 1978, p. 85) have not been observed.

Occurrence - From Sample 673 to Sample 684.

Material - 271 Pa elements, 146 Pb elements, 248 M elements, 82 Sa elements, 135 Sb elements, 138 Sc elements, 213 Sd elements.

Repository - MGUH 19760 - MGUH 19769.

Baltoniodus norrlandicus Löfgren
(Pl. 1, figs. 11-20)

M element
?1963a *Falodus simplex* sp. nov. Sergeeva, p. 104, pl. 8, figs. 8-10; text-fig. 9.

Sa element
1974 *Roundya minor* (Lindström) - Viira, pl. 4, figs. 27, 28; pl. 6, ?fig. 4.

Sb element
1974 *Volchodina costulata* gen. et sp. nov. Sergeeva, pp. 83-84, figs. 1, 5.
?1974 «*Prioniodina*» *densa* Lindström - Viira, pl. 6, fig. 2.

Sc element
1974 *Volchodina densa* (Lindström) - Sergeeva, pp. 82-83, figs. 2, 4.
?1974 «*Prioniodina*» *densa* Lindström - Viira, pl. 6, fig. 1.

Multielement
1971 *Baltoniodus navis* (Lindström) - Lindström, pl. 1, figs. 18, 19.
?1977 *Prioniodus* cf. *elegans* Pander - Gedik, pl. 2, fig. 17 (only).
?1977 *Baltoniodus triangularis* (Lindström) - Gedik, pl. 2, fig. 12 (only).
1978 *Prioniodus* (*Baltoniodus*) *prevariabilis norrlandicus* n. ssp. Löfgren, pp. 84-86, pl. 10, figs. 3a-e; pl. 12, figs. 17-26; pl. 14, figs. 2a-b.
1983 *Baltoniodus navis* (Lindström) - Dzik, text-fig. 7: F-M.
?1987 *Baltoniodus navis* (Lindström) - An, pp. 126-127 (*partim*), pl. 20, figs. 4, 11 (only).

Description - Pa element has three denticulated processes. The anterior process is relatively short and with confluent denticles. The posterior process is relatively short and with small denticles that can be confluent. The lateral process is long, commonly up to three times longer than the posterior process. Denticles are tall and confluent.

Pb element has three well denticulated processes. The anterior process is the shortest of the three processes. The lateral and posterior processes are almost of the same length. Denticles on the posterior process are erect, confluent and usually taller than the hight of the basal sheath mainly in large specimens. The angle between the anterior process and the posterior process is about 90°-100°, and the angle between the lateral and the posterior process is about 160°.

M element has an erect cusp which is reclined. The inner side of the base has a well developed bulge. The anterior extension is long and with denticles that are completely confluent in most specimens. The upper margin of the base is long and straight.

The Sa element is well denticulated on all processes. Denticles on lateral processes are tall and confluent. Denticles are confluent on the posterior process and anteriorly inclined.

Sb element has tall, fused denticles on the posterior process. The anterior process is variably denticulated from strongly confluent to few denticles. The angle between the anterior and posterior process is between 55° and 62°. The lateral costa extends beyond the aboral margin as a nondenticulate process.

Sc element has the same appearance as the Sb element and it differs only by the lack of the lateral process.

Sd element has confluent denticles. The processes are arranged as two anterior and two posterior and the unit is asymmetrical. This element has been fully described by Löfgren (1978).

All S elements have developed thickened edges on the processes. In the higher samples the elements may have inverted basal cavity.

Remarks - This species is characterized by a Pa element with a long lateral process as compared to the anterior and posterior ones, by a tall and confluent denticulation and by a prominent thickened edge in the S elements.

The basal sheath of the elements in this species is reduced when compared to corresponding elements of *Baltoniodus navis* (Lindström).

Short extensions of the basal cavity into the denticles are common in this species.

Occurrence - From Sample 677 to Sample 692.

Material - 752 Pa elements, 219 Pb elements, 889 M elements, 230 Sa elements, 438 Sb elements, 494 Sc elements, 820 Sd elements.

Repository - MGUH 19770 - MGUH 19779.

Baltoniodus clavatus n. sp.
(Pl. 2, figs. 1-12; pl. 3, figs. 1-2)

1971 *Baltoniodus navis* (Lindström) - Lindström, p. 56 (*partim*), pl. 1, ?fig. 23 (only).

1976 *Baltoniodus alatus parvidentatus* (Sergeeva) - Dzik, pp. 437, 442, text-fig. 22: k-q, ?r.

Derivation of name - After *clava* (latin) = club.

Type locality - The Hagudden Section, Öland.

Type stratum - 1,25 m. above the local reference D surface, Sample 694A, Kundan Stage.

Holotype - MGUH 19782, a Pb element (Pl. 2, fig. 3).

Diagnosis - *Baltoniodus clavatus* n.sp. has a Pb element with short, adenticulated to weakly denticulated anterior process, Pa element with distally expanded and upwards turned posterior process, adenticulate M element, S elements with irregular denticulation on the posterior process and usually anteriorly adenticulated, asymmetrical and fully denticulated Sd elements.

Description - Pa element has three well developed processes. On the posterior process the denticles are small, erect and almost equal sized. The denticles on the lateral and posterior processes are tall and inclined towards the anterior. They are often free and sawtooth-like. The lateral and posterior processes are approximately of the same length, while the anterior is the shortest. The lateral process is downwards directed and gently bowed. The posterior process is slightly laterally bent and twisted in the distal part. Typically the angle between anterior and lateral processes is about 180°, and the angle between the posterior process and the lateral one is 90°. The basal sheath is relatively better developed on posterior and lateral processes than on the anterior. The basal sheath becomes wider distally on the posterior process. The basal cavity excavates the elements and is open beneath the processes. The cusp is tall, reclined and with keeled edges. One prominent lateral costa is anteriorly located and continues into the lateral process. The aboral margin of the distal part of the posterior process is upwards turned.

Pb elements has three well developed processes. The posterior process is the longest, or as long as the lateral one. The anterior process is the shortest and thin. The angle between the lateral and posterior processes varies between 160° and 180°. Denticles on the posterior process are erect, mainly free and nearly of equal size or slightly irregular. In same specimens the distalmost denticle is the tallest. Denticles on the lateral process are pointed and usually free. The anterior process is short and adenticulated to distally denticulated; when observed, the denticles are tiny. The angle between the anterior and posterior processes is about 90°. The anterior process is curved and the distal part is directed to the posterior. The basal sheath is thin and has an inner flare located at midlength of the posterior process. The basal cavity is open beneath the whole element including the processes and the tip extends only to the base of the cusp. The cusp is erect to slightly reclined.

M element is robust, adenticulated with a prominent cusp and inner bulge/flare on the base. The anterior part is of variable length and in some specimens inside the anticusp the basal cavity displays secondary tips along the anterior edge with no corresponding denticles. The angle between the upper margin of the base and the cusp is 80°-90°.

Sa element has three long processes. The lateral processes have regular, basally confluent and tall denticles. Denticulation on the posterior process is irregular.

Sb element has a long anterior adenticulated process, a shorter and pointed lateral adenticulated process, which is about half the length of the anterior process, and a long posterior process with irregular denticulation. The angle between the posterior and anterior processes is 45°-50°.

Sc element is similar to Sb element but it has a rounded very short lateral extension of the aboral margin instead than a lateral costa and process. The angle between the posterior and anterior processes is 45°-50°. Both Sb and Sc elements have many small tips of the basal cavity along the edge of the anterior nondenticulated process. Occasionally there is a distally located denticle.

Sd element is asymmetrical. It has one anterior, two lateral and one posterior process. The denticulation of the posterior process is irregular. The lateral processes have long, pointed, apically free denticles. The anterior process has few, tall and confluent denticles. The cusp is proclined to erect.

All the S elements show thickened edges.

Remarks - We include in synonymy *Baltoniodus alatus parvidentatus sensu* Dzik, 1976, but we do not consider *Falodus parvidentatus* Sergeeva, 1963 to be part of this species because our M elements are adenticulated. According to Löfgren (1978) *Falodus parvidentatus* could be the oistodiform element of *Baltoniodus medius*.

The specimen depicted by Lindström (1971) in pl. 1, fig. 23 as *Baltoniodus navis* is broadly similar to the Pa elements of *Baltoniodus clavatus*.

Baltoniodus clavatus is clearly distinguished form *Baltoniodus norrlandicus* mainly for the different kind of denticulation, tall and confluent in *B. norrlandicus*, irregular in *B. clavatus*.

Baltoniodus clavatus initiates a new *Baltoniodus* lineage represented in this material by *Baltoniodus clavatus* and *Baltoniodus* n.sp.A.

Occurrence - From Sample 690 to Sample 694A.

Material - 595 Pa elements, 257 Pb elements, 580 M elements, 165 Sa elements, 229 Sb elements, 275 Sc elements, 321 Sd elements.

Repository - MGUH 19782 (Holotype), MGUH 19780, 19781, 19783-19791, 19801, 19802 (Paratypes).

Baltoniodus n.sp. A
(Pl. 2, figs. 13-21)

Description - Pa element has three processes of almost equal length. Denticles on the posterior process are small and fused. Denticles on the lateral process are mainly confluent and the anterior process is serrated to denticulated. The anterior and lateral processes are downwards and anteriorly directed. The posterior process widens distally and is upwards turned. The basal sheath is strongly reduced between the anterior and lateral processes and is wide at the junction between anterior/posterior and lateral/posterior processes.

In Pb elements the lateral process is long and fully denticulated. Denticles are confluent. Denticles on the anterior and posterior processes are small and fused. In some specimens the anterior process is short and adenticulated. The angle between the posterior and lateral processes is 90°-100°. The basal flare is small. The basal sheath is mainly developed between the lateral and posterior processes.

In Pa and Pb elements the basal cavity is open and excavates the processes.

M element is anteriorly extended and adenticulated. The cusp is suberect to slightly reclined. On the inner side there is a prominent flare.

Sa element is fully denticulated. Denticulation on the posterior process is irregular.

Sb and Sc elements are similar. In Sb elements the oral edge forms a short pointed extension, whereas in Sc element the extension is rounded. In both kinds of elements the anterior process is adenticulated.

The asymmetrical Sd element is denticulated on three processes, and the anterior one is adenticulated.

All S elements have thickened edges.

Remarks - *Baltoniodus* n.sp. A differs from *B. clavatus* n.sp. by having Pb elements with a smaller angle between posterior and lateral processes, anteriorly adenticulated Sd elements and Sb elements without a proper lateral process.

Baltoniodus n.sp. A is similar to *Baltoniodus medius* (Dzik) in having a Sb element with a short extension of the aboral margin, but the Sd element of *B. medius* is fully denticulated and the denticulation of the elements is different from the denticulation displayed by *B.* n.sp.A.

Occurrence - From Sample 695 to Sample 697.

Material - 143 Pa elements, 96 Pb elements, 163 M elements, 47 Sa elements, 102 Sb elements, 137 Sc elements, 177 Sd elements.

Repository - MGUH 19792 - MGUH 19800.

Genus *Cornuodus* Fåhræus, 1966

Type species - *Cornuodus erectus* Fårhæus, 1966.

Remarks - *Cornuodus* has an apparatus comprising nongeniticulate simple cones that form a symmetry transition series superposed by a curvature

Material - 264 specimens.

Repository - MGUH 19803 - MGUH 19807.

Genus *Dapsilodus* Cooper, 1976

Type species - *Distacodus obliquicostatus* Branson & Mehl, 1933.

Dapsilodus mutatus (Branson & Mehl)
(Pl. 9, figs. 19, 26, 27)

1933 *Belodus* (?) *mutatus* n.sp. Branson & Mehl, p. 126, pl. 10, fig. 17.
1978 *Acodus? mutatus* (Branson & Mehl) - Löfgren, pp. 44-46, pl. 2, figs. 9-21; text-fig. 23 (*cum syn*).

Remarks - The generic assignement of these elements is discussed under *Drepanoistodus venustus* (Stauffer).

Occurrence - From Sample 693 to Sample 697.

Material - 44 specimens.

Repository - MGUH 19946, MGUH 19953, MGUH 19954.

Genus *Drepanodus* Pander, 1856

Type species - *Drepanodus arcuatus* Pander, 1856.

Remarks - Stouge & Bagnoli (1988) revised the Early Arenigian species of *Drepanodus* Pander. According to them *Drepanodus arcuatus* and *Drepanodus planus* were two distinct species where the first species is distinguished from the second species by its lack of costae.

Drepanodus arcuatus Pander *sensu lato*
(Pl. 9, figs. 7-10)

1856 *Drepanodus arcuatus* sp.n. Pander, p. 20, pl. 1, fig. 2, 4, 5, 17.
1856 *Drepanodus flexuosus* sp.n. Pander, pp. 20-21, pl. 1, fig. ?6, 7, 8; pl. 3, figs. ?4, ?11, ?12; ?text-fig. 1.
1971 *Drepanodus arcuatus* Pander - Lindström, pp. 41-42, text-figs. 4-8.
1974 *Drepanodus arcuatus* Pander - van Wamel, pp. 61-62, pl. 1, figs. 10-13.
1977 *Drepanoistodus forceps* (Lindström) - Gedik, pl. 1, fig. 1 (only).
1978 *Drepanodus arcuatus* Pander - Löfgren, pp. 51-53, pl. 2, figs. 1, 2, 4-8 (*non* fig. 3 = *Drepanodus planus*).
1988 *Drepanodus arcuatus* Pander - Stouge & Bagnoli, pp. 115-116, pl. 2, figs. 1-6 (*cum syn*).

transition series. The elements are albid with striae and the elements may have up to two costae near the posterior margin of the cusp.

Cornuodus longibasis (Lindström)
(Pl. 3, figs. 3-7)

1955 *Drepanodus longibasis* n.sp. Lindström, p. 564, pl. 3, fig. 31.
1966 *Cornuodus erectus* n.sp. Fåhræus, p. 20, pl. 2, fig. 8a-b, text-fig. 2B.
1967 *Cornuodus erectus* Fårhæus - Serpagli, p. 57, pl. 12, figs. 5a-8b.
1967 *Cornuodus bergstroemi* n.sp. Serpagli, p. 57, pl. 12, figs. 1a-2c.
1967 *Scandodus? lanzaensis* n.sp. Serpagli, p. 95, pl. 26, figs. 4a-7d.
1970 *Cornuodus erectus* Fårhæus - Lee, p. 315, pl. 7, fig. 9.
1974 «*Cornuodus*» *longibasis* (Lindström) - Serpagli, p. 43, pl. 7, figs. 2a-b; pl. 20, fig. 12.
1974 *Protopanderodus longibasis* (Lindström) - van Wamel, p. 92, pl. 4, figs. 4-6.
1976 *Cornuodus longibasis* (Lindström) - Landing, p. 631, pl. 1, figs. 12, 13, 15.
1976 *Scalpellodus* (?*Cornuodus*) *laevis* sp. n. Dzik, p. 421, pl. 41, fig. 1; text-fig. 13a-c.
1978 *Cornuodus longibasis* (Lindström) - Löfgren, pp. 49-51, pl. 4, figs. 36, 38-42; text-fig. 25 A-C.
1978 *Cornuodus bergstroemi* Serpagli - Löfgren, p. 51, pl. 4, fig. 37; text-fig. 25 D.
1981 *Cornuodus longibasis* (Lindström) - Cooper, pp. 161-162, pl. 26, figs. 10, 11.
1983 *Cornuodus longibasis* (Lindström) - An *et al.*, pp. 89-90, pl. 13, figs. 1-7.
1984 *Cornuodus longibasis* (Lindström) - Stouge, p. 62, pl. 8, figs. 1-8.
1985 *Cornuodus longibasis* (Lindström) - An, Du & Gao, pl. 6, figs. 11, 12.
1988 *Cornuodus longibasis* (Lindström) - Stouge & Bagnoli, p. 114, pl. 1, figs. 20, 21.

Remarks - Löfgren (1978) recognized the following element types: symmetrical element A, symmetrical element B and asymmetrical elements. In addition we include in the apparatus also the characteristic shortbased *Cornuodus bergstroemi* Serpagli, 1967. The symmetrical element A is *Drepanodus longibasis* Lindström, 1955. The base of this element is in this material very long and slender. The symmetrical element B is rare. The asymmetrical elements and the symmetrical elements A are the most common elements recorded in this collection.

Occurrence - From Sample 673 to Sample 697.

Remarks - *Drepanodus arcuatus* Pander *sensu lato* is variably present in the Hagudden material. Most elements remain largely similar to the Hunnebergian/Billingenian types described by Stouge & Bagnoli (1988). The sculponeaform is different in morphology by the outline of its aboral margin which is gently curved rather than straight and parallel to the upper margin of the base. The drepanodiform illustrated by Gedik (1977, pl. 1, fig. 1) most certainly is a sculponeaform of *Drepanodus arcuatus*.

Occurrence - From Sample 673 to Sample 697.

Material - 270 arcuatiform elements, 85 pipaform elements, 16 sculponeaform elements, 6 graciliform elements.

Repository - MGUH 19934 - MGUH 19937.

Drepanodus planus (Pander)
(Pl. 9, fig. 11)

1856 *Machairodus planus* Pander, p. 24, pl. 2, fig. 39.
1988 *Drepanodus planus* (Pander) - Stouge & Bagnoli, pp. 116-117, pl. 2, figs. 7-10 (*cum syn.*).

Remarks - This species is rare in this collection.

Occurrence - From Sample 675 to Sample 686.

Material - 3 drepanodiform elements.

Repository - MGUH 19938.

Genus *Drepanoistodus* Lindström, 1971

Type species - *Oistodus forceps* Lindström, 1955.

Remarks - The multielement genus *Drepanoistodus* Lindström has up to five distinct elements in the apparatus (Van Wamel, 1974; Cooper, 1981; Stouge & Bagnoli, 1988). The elements include four nongeniculate (or drepanodiforms) elements (suberectiform, homocurvatiform, planiform, scandodiforum or acodiform) and a geniticulate element (or oistodiform). The apparatus of *Drepanoistodus* is characterized by elements that predominantly form a curvature transition series (Stouge, 1984; Fåhræus & Hunter, 1985).

The oistodiforms are considered as the diagnostic elements at specific level, whereas the drepanodiforms can be difficult to distinguish between different species.

Drepanoistodus basiovalis (Sergeeva)
(Pl. 5, figs. 18-24)

Oistodiform
1963a *Oistodus basiovalis* n.sp. Sergeeva, p. 96, pl. 7, figs. 6, 7; text-fig. 3.

Multielement
1973 *Drepanoistodus basiovalis* (Sergeeva) - Lindström (*in* Ziegler), p. 73, *Drepanodus* pl. 1, figs. 3, 4.
1976 *Drepanoistodus suberectus forceps* (Lindström) - Dzik, text-fig. 19:?b, ?c, ?d, e, ?k.
1978 *Drepanoistodus basiovalis* (Sergeeva) - Löfgren, pp. 55-56 (*partim*), pl. 1, figs. ?11, 13-16 (only).
?1981 *Paroistodus originalis* (Sergeeva) - An, pl. 3, fig. 14 (only).
1985 *Drepanoistodus basiovalis* (Sergeeva) - An, Du & Gao, pl. 13, figs. 17, 18, 20.

Remarks - The oistodiforms of *Drepanoistodus basiovalis* (Sergeeva) are characterized by a relatively long oral margin (almost 1/3 of the cusp length) and curved aboral margin.

The oistodiforms of *Drepanoistodus basiovalis* show a high degree of variability. Most specimens have an inner carina on the cusp which can be strongly reclined. The cusp is keeled and the keel in some specimens is prominently developed in the anterior part of the base similarly to one of the specimens depicted by Sergeeva (1963a, pl. 7, fig. 7). The strongly reclined types have usually inverted basal cavity. The antero-basal corner varies from rounded to pointed. The base can be asymmetrical.

The drepanodiforms include homocurvatiform, suberectiform, planiform and scandodiforms elements. The are generally flat, keeled, with relatively small basal cavity. Some of them have inverted basal cavity.

Occurrence - From Sample 677 to Sample 697.

Material - 729 oistodiform elements, 1761 drepanodiform elements.

Repository - MGUH 19848 - MGUH 19854.

Drepanoistodus cf. *D. basiovalis* (Sergeeva)
(Pl. 5, figs. 10-16)

Oistodiform
1967 *Oistodus originalis* Sergeeva - Viira, tex-fig. 1:10.
1974 *Oistodus originalis* Sergeeva - Viira, pl. 5, figs. 9, 10.

Drepanodiform
1967 *Drepanodus homocurvatus* Lindström - Viira, text-fig. 1:16.
1967 *Drepanodus planus* Lindström - Viira, text-fig. 1:17.

Multielement
1976 *Drepanoistodus suberectus forceps* (Lindström) - Dzik, text-fig. 19:?d, f, ?k (only).
1977 *Paroistodus parallelus* (Pander) - Gedik, pl. 1, fig. 8.

1978 *Drepanoistodus basiovalis* (Sergeeva) - Löfgren, pp. 55, 56, (*partim*), pl. 1, fig. 17 (only).
1984 *Drepanoistodus basiovalis* (Sergeeva) - Stouge, p. 53, pl. 3, figs. 18-20.
1984 *Drepanoistodus* cf. *basiovalis* (Sergeeva) - Stouge, p. 53, pl. 3, figs. 21-23.
?1985 *Drepanoistodus basiovalis* (Sergeeva) - An, Du & Gao, pl. 13,. fig. 19 (only).
1987 *Drepanoistodus basiovalis* (Sergeeva) - An, pp. 145-146, pl. 9, figs. 30, 31.

Description - The oistodiform of *Drepanoistodus* cf. *D. basiovalis* has a strongly reclined cusp and a small base. The keeled cusp varies from smooth to carinate. The antero-basal corner varies from rounded to pointed. Some specimens with rounded antero-basal corner have inverted basal cavity. The keeled oral edge is relatively short. The aboral margin is curved and the distal part is subparallel to the anterior margin of the cusp.

Drepanodiform elements are not costate, keeled and laterally compressed. They include homocurvatiforms, suberectiforms, planiforms and scandodiforms.

Remarks - Oistodiform elements of *Drepanoistodus* cf. *D. basiovalis* differ from the oistodiforms of *D. basiovalis* by having a shorter oral edge.

Drepanodiform elements are difficult to distinguish on a species level, but this species does not include in the apparatus acodiform elements characteristic of *Drepanoistodus forceps* (Lindström).

Occurrence - From Sample 673 to Sample 679.

Material - 179 oistodiform elements, 626 drepanodifrom elements.

Repository - MGUH 19840 - MGUH 19846.

Drepanoistodus contractus (Lindström)
(Pl. 5, figs. 1-5)

1955 *Oistodus contractus* n. sp. Lindström, p. 573, pl. 4, figs. 45, 46, text-fig. 3H.

Description - The oistodiform element is *Oistodus contractus* Lindström, 1955, characterized by an extremely short oral edge and rectangular outline of the base.

The drepanodiform elements resemble those of *Drepanoistodus basiovalis*, but they are less laterally compressed.

Remarks - Drepanoistodus contractus differs from *Drepanoistodus* cf. *D. basiovalis* by its very short oral edge.

Occurrence - Sample 673.

Material - 11 oistodiform elements, 30 drepanodiform elements.

Repository - MGUH 19831 - MGUH 19835.

Drepanoistodus forceps (Lindström)
(Pl. 5, figs. 6-9)

Suberectiform
1955 *Drepanodus suberectus* (Branson & Mehl) - Lindström, p. 568, pl. 2, figs. 21, 22.
1967 *Drepanodus suberectus* (Branson & Mehl) - Viira, text-fig. 1:24.
1974 *Drepanodus suberectus* (Branson & Mehl) - Viira, pl. 3, figs. 26-30.

Homocurvatiform
1955 *Drepanodus homocurvatus* n.sp. Lindström, p. 563, pl. 2, figs. 23, 24, 39; text-fig. 4d.
1969 *Drepanodus homocurvatus* Lindström - Bednarczyk, pl. 2, fig. 11.
1974 *Drepanodus homocurvatus* Lindström - Viira, pl. 3, figs. 19-20.

Planiform
1955 *Drepanodus planus* n.sp. Lindström, p. 565, pl. 2, figs. 35-37; text-fig. 4a.

Scandodiform/acodiform
1955 *Acodus gratus* n.sp. Lindström, p. 545, pl. 2, figs. 27-29.

Oistodiform
1955 *Oistodus forceps* n.sp. Lindström, p. 574, pl. 4, figs. 9-13; text-fig. 3m.
1960 *Oistodus forceps* Lindström - Lindström, text-fig. 2:7; text-fig. 3:9.
1961 *Oistodus forceps* Lindström - Wolska, p. 351, pl. 3, figs. 5, 6.
1964 *Oistodus forceps* Lindström - Lindström, text-fig.-10L.
1974 *Oistodus forceps* Lindström - Viira, pl. 4, figs. 1, 5-7, 11-14, 17.

Multielement
1971 *Drepanoistodus forceps* (Lindström) - Lindström, pp. 42-43, text-figs. 5, 8.
1973 *Drepanoistodus forceps* (Lindström) - Lindström (*in* Ziegler), p. 75, *Drepanodus* pl. 1, figs. 5, 6.
1974 *Drepanoistodus forceps* (Lindström) - Serpagli, p. 46, pl. 10, figs. 8a-12c; pl. 21, figs. 9-14.
1974 *Drepanoistodus forceps* (Lindström) - van Wamel, p. 64, pl. 2, figs. 14-22.
1976 *Drepanoistodus suberectus forceps* (Lindström) - Dzik, text-fig. 19:g, ?b, ?c, ?d.
non 1977 *Drepanoistodus forceps* (Lindström) - Gedik, pl. 1, figs. 2, 7.
1978 *Drepanoistodus forceps* (Lindström) - Löfgren, pp. 53-55, pl. 1, figs. 1-6; text-fig. 26 A.
1983 *Drepanoistodus forceps* (Lindström) - Dzik, text-fig. 8a (only).

1985 *Drepanoistodus forceps* (Lindström) - An, Du & Gao, pl. 8, figs. 3, 7.
1988 *Drepanoistodus forceps* (Lindström) - Bagnoli, Stouge & Tongiorgi, pl. 39, figs. 5-7.

Remarks - The elements of this species have been described by Lindström (1955). In this material the form species *Acodus gratus* Lindström, 1955 has not been observed. The corresponding element is somewhat twisted or «scandodiform» and the antero-basal corner has a prominent keel that is flexed to one side.

Drepanoistodus forceps is very common in the Billingenian Substage and ranges into the Lower Volkhovian in the Balto-Scandic region. It is documented also from China (An, 1981; An, Du & Gao, 1985), and Argentina (Serpagli, 1974).

Occurrence - From Sample 673 to Sample 674.

Material - 100 oistodiform elements, 254 drepanodiform elements.

Repository - MGUH 19836 - MGUH 19839.

Drepanoistodus venustus (Stauffer)
(Pl. 5, fig. 17)

Oistodiform
1935 *Oistodus venustus* n. sp. Stauffer, p. 146, pl. 12, fig. 12.

Multielement
1978 *Drepanoistodus? venustus* (Stauffer) - Löfgren, p. 57, pl. 1, figs. 9, 10 (*cum syn.*).
1984 *Drepanoistodus?* cf. *venustus* (Stauffer) - Stouge, p. 55, pl. 4, figs. 18-25.
1985 *Drepanoistodus?* cf. *venustus* (Stauffer) - An, Du & Gao, pl. 13, fig. 15.

Remarks - The elements of *Drepanoistodus venustus* (Stauffer) have been described by previous authors (e.g. Löfgren, 1978 and Stouge, 1984). The oistodiform is nearly identical with *Oistodus forceps* Lindström, 1955 and the two species are closely related.

Drepanodiforms are similar to other *Drepanoistodus* species and we have not been able to distinguish those from other species. Stouge (1984) recorded drepanodiforms with costae and associated those with *Oistodus venustus* Stauffer, 1935. Such elements have not been recorded in this material. It has been suggested (Barnes & Poplawski, 1973) that elements like those we refer to *Dapsilodus mutatus* (Branson & Mehl) should be associated with *Oistodus venustus* Stauffer, 1935. Like the material from Jämtland (Löfgren, 1978) and Finngrundet (Löfgren, 1985) the *venustus* elements appear stratigraphically earlier (sample 690) than the first *Dapsilodus* elements (sample 693) in the Hagudden Section. Thus we agree with and follow Löfgren (1985) and refer the oistodiforms to *Drepanoistodus venustus*.

Occurrence - From Sample 690 to Sample 697.

Material - 41 oistodiform elements, 31 drepanodiform elements.

Repository - MGUH 19847.

Genus *Lenodus* Sergeeva, 1963

Type species - *Lenodus clarus* Sergeeva, 1963.

Remarks - The type species of *Lenodus* Sergeeva, i.e. *Lenodus clarus* Sergeeva, 1963 has been considered as the holodontiform element of *Amorphognathus variabilis* Sergeeva by Lindström (*in* Ziegler, 1977) or as a genus with unknown apparatus (Robinson, 1981) but related to the multielement genus *Amorphognathus* Branson & Mehl. In our material are present some elements morphologically similar to but not identical with the type species of *Lenodus*. They are associated with ambalodiform (Pa), amorphognathiforms (Pb) and ramiform elements. Dextral and sinistral amorphognathiforms are mirror images of one another and ambalodiforms are represented by asymmetrical dextral and sinistral elements. S elements are similar to the S elements of *Trapezognathus* Lindström and do not show hindeodelloid denticulation. The M elements are not holodontus-like. We do not assigne these elements to the multielement genus *Amorphognathus* because left and right amorphognathiform elements are mirror pictures and because a proper holodontiform element is missing.

The apparatus of the type species of *Lenodus* is not yet reconstructed but, based on the morphological similarity between *Lenodus clarus* and our M elements, we assigne the Hagudden specimens to *Lenodus* Sergeeva, 1963.

The M and S elements of *Lenodus* are closely similar to the corresponding elements of *Trapezognathus* and it is likely that *Lenodus* derived from *Trapezognathus* by a differentiation of the P elements.

The P elements of this genus do not have any surface microstructure.

Lenodus pseudoplanus (Viira)
(Pl. 3, figs. 8-17)

Pa element
1974 *Ambalodus pseudoplanus* sp. n. Viira, pp. 54-56, pl. 6, figs. 25, 29, 31; text-figs. 43-46.

Description - In sinistral Pa elements the angle between the anterior and lateral processes is about 65°. The anterior process is flexed and downwards directed. The denticles of the anterior and lateral processes are regular and mostly confluent. On the posterior process they are more irregular and fused.

In dextral Pa elements the angle between the anterior and lateral processes varies between 40° and 45°, otherwise they are similar to the sinistral Pa elements.

Pb element has four denticulated processes. Of the two posterior process the inner one is shorter than the other, both having a denticle row. The two posterior processes are connected by the platform only in the proximal part. The lateral process and the long posterior process form almost a straight line when seen from above. The anterior process is offset from the lateral process with an angle of approximately 60°. The lateral process is narrow, straight and curves downwards. It carries well developed denticles, which are erect or slightly inclined to the outer side.

In P elements the basal sheath is large in small specimens and reduced in large ones. It is present a thickened edge along the aboral margin, more prominent in large specimens.

The M element has a wide cusp which is short and strongly reclined. The element has a long thin anterior process that carries denticles of moderate size. The base is wide and low with a moderate inner flare.

Sa element has long, free and posteriorly directed processes. Denticles may be present or are marked by an uneven edge.

Sb element is clearly asymmetrical with denticles most commonly on the anterior and upper margin of the base. Some specimens have denticles on all three edges. Processes are well defined and free.

Sc element is concave-convex with an anteriorly concave aboral margin. The convex side is strongly rounded to almost keeled giving a three edged cross section. The anterior and upper margin of the base are denticulated.

Sd element is asymmetrical. Some elements have three processes only.

Remarks - The sinistral Pa element differs from *Lenodus* n.sp. A due to the small angle between the lateral and anterior processes being about 65° instead of 90°. In the M elements we did not observe the ridge across the basal flare as in *Lenodus* n.sp. A.

Occurrence - From Sample 694A to Sample 697.

Material - 69 Pa elements; 33 Pb elements; 7 M elements; 7 Sa elements; 13 Sb elements; 4 Sc elements; 11 Sd elements.

Repository - MGUH 19808 - MGUH 19817.

Lenodus n.sp. A
(Pl. 4, figs. 1-13)

Pa element

?1960 *Ambalodus* n. sp. 1 Lindström, text-fig. 4:3.

?1960 *Ambalodus* n. sp. 2 Lindström, text-fig. 4:5.

1972 *Ambalodus planus* Sergeeva - Viira, pp. 45-46, text-figs. 1.

1974 *Ambalodus planus* Sergeeva - Viira, pp. 53-54, text-figs. 40-42; pl. 6, figs. 22-24, 27, 30.

Pb element

cf. 1960 *Amorphognathus* n. sp. 1 Lindström, text-fig. 4:4.

cf. 1964 *Amorphognathus* n. sp. 1 Lindström, text-fig. 33:B.

M element

cf. 1974 *Lenodus clarus* Sergeeva - Viira, p. 93, pl. 6, fig. 7.

Description - The Pa elements have three well developed and fully denticulated processes. The denticulation is highly variable, from regular to irregular, from only basally confluent to completely fused. The denticles of the anterior and lateral processes reach high into the cusp which is small. In small specimens the basal sheath is thin and large and connects the processes. In large specimens it is strongly reduced and the processes are free and with a concave aboral outline. In small specimens the aboral outline is straight. The large Pa elements develope a characteristic thickened edge along the aboral margin where the edge of the basal sheath is inwardly bent.

Sinistral Pa element is characterized by having the anterior and posterior process in one line when seen in upper view and the lateral process is perpendicular or nearly so to both. The three processes are almost of the same lenght. In upper view the unit is straight or gently bowed to the inner side.

In dextral Pa element the anterior process forms an angle of nearly 50° with the lateral process. The lateral and posterior process form a gentle curve in upper view.

Pb element has four processes. Of the two posterior processes the inner one is shorter than the outer one. The anterior process forms and angle of about 100° with the outer posterior process. The lateral process is almost on line with the long posterior process. The short posterior process does not start right from the cusp but a little posterior. The two posterior processes are partly connected by the platform. In large specimens is prominent the thickened edge of the aboral margin like in Pa elements. In small specimens there are not two posterior processes but a bilobate posterior process or a posterior process with the platform expanded on the inner side.

M element is extended anteriorly and posteriorly and has a prominent flare on the base. Some specimens have an adenticulated ridge across the basal flare. The anterior side is keeled to denticulated with fused denticles.

Sa, Sb and Sd elements can not be distinguished from the corresponding elements of *Trapezognathus* sp.

Sc element has a small bulge on the convex side of the element.

Remarks - *Lenodus* n. sp. A differs from *Lenodus pseudoplanus* (Viira) by the fact that the angle between the anterior and lateral processes is much less than 90° in *L. pseudoplanus* and the dextral Pa element is nearly a mirror picture of the sinistral Pa element. The specimens drawn by Lindström (1960, text-fig. 4:3-5) could also belong to *Lenodus pseudoplanus* (Viira).

Occurrence - From Sample 687bis to Sample 694.

Material - 99 Pa elements; 46 Pb elements; 8 M elements; 14 Sa elements; 10 Sb elements; 6 Sc elements; 30 Sd elements.

Repository MGUH 19818 - MGUH 19830.

Genus *Microzarkodina* Lindström, 1971

Type species - *Prioniodina flabellum* Lindström, 1955.

Remarks - The apparatus of *Microzarkodina* Lindström is sexi-membrate comprising carminate to angulate P elements, geniculate M elements and a series of S elements (alate, dygirate, dolobrate and quadriramate). The ramiforms, except for the Sc element, have a short upper margin of the base.

Microzarkodina flabellum (Lindström)
(Pl. 6, figs. 1-7)

P element

1955 *Prioniodina flabellum* n. sp. Lindström, pp. 587-588, pl. 6, figs. 23-25.
1960 *Prioniodina flabellum* Lindström - Lindström, text-fig. 3:10; text-fig. 4:12.
1961 *Prioniodina* cf. *flabellum* Lindström - Wolska, p. 354, pl. 4, figs. 4a-b.
1967 *Prioniodina flabellum* Lindström - Viira, text-fig. 1:28.
?1971 *Prioniodina? flabellum* Lindström - Sweet, Ethington & Barnes, p. 168, pl. 1, fig. 12.
1974 *Prioniodina flabellum* Lindström - Viira, p. 31, pl. 5, figs. 3, 4; text-fig. 14a, d.

M element

1955 *Oistodus linguatus* n. sp. var. *complanatus* nov. Lindström, p. 578, pl. 3, figs. 37-38.
1960 *Oistodus complanatus* Lindström - Lindström, text-fig. 4:11.
?1971 *Oistodus* sp. B - Sweet, Ethington & Barnes, p. 168, pl. 1, fig. 13.
1974 *Oistodus complanatus* Lindström - Viira, pl. 4, fig. 26; pl. 5, figs. 1, 2.

Sa element

1955 *Trichonodella alae* n.sp. Lindström, p. 599, pl. 6, figs. 38-40.
1960 *Trichonodella alae* Lindström - Lindström, text-fig. 3:5.
1967 *Trichonodella alae* Lindström - Viira, text-fig. 1:19.
1974 *Trichonodella alae* Lindström - Viira, pl. 5, fig. 5.

Sb element

1955 *Trichonodella? irregularis* n. sp. Lindström, p. 600, pl. 6, figs. 21, 22.
1974 *Trichonodella? irregularis* Lindström - Viira, pl. 5, fig. 6.

Sc element

1955 *Cordylodus perlongus* n. sp. Lindström, p. 552, pl. 6, figs. 36, 37.
1960 *Cordylodus perlongus* Lindström - Lindström, text-fig. 3:1.
1967 *Cordylodus perlongus* Lindström - Viira, pl. 5, figs. 7,8.

Sd element

1960 *Trichonodella? irregularis* Lindström - Lindström, text-fig. 3:2.
1967 *Trichonodella? irregularis* Lindström - Viira, text-fig. 1:20.

Multielement

1971 *Microzarkodina flabellum* (Lindström) - Lindström, p. 58, pl. 1, figs. 6-11.
1974 *Microzarkodina flabellum* (Lindström) - van Wamel, pp. 70-71, pl. 7, figs. 18-23.
1976 *Microzarkodina flabellum parva* Lindström - Dzik, text-fig. 35:a-g, ?h.
1978 *Microzarkodina flabellum* (Lindström) - Löfgren, pp. 61-62, pl. 11, figs. 27-36.
1981 *Microzarkodina flabellum* (Lindström) - Nowlan, p. 14, pl. 2, figs. 1-5.
1981 *Microzarkodina flabellum* (Lindström) - Robinson, p. W124, text-fig. 73: 1a-e.
1985 *Microzarkodina flabellum flabellum* (Lindström) - Löfgren, text-fig. 4:H-N.
?1987 *Microzarkodina flabellum* (Lindström) - An, p. 157, pl. 22, figs. 14, 16, 17; pl. 24, fig. 18; pl. 29, figs. 16-19.

Remarks - Elements of this species have been described by Lindström (1955). Van Wamel (1974) illustrated the complete apparatus.

P elements have a restricted basal cavity and the lateral face is swollen just above the basal cavity. Most of the S elements have denticles tall and of uneven size.

Occurrence - From Sample 673 to Sample 685A.

Material - 214 P elements, 96 M elements, 35 Sa elements, 25 Sb elements, 69 Sc elements, 23 Sd elements.

Repository - MGUH 19855 - MGUH 19861.

Microzarkodina hagetiana n. sp.
(Pl. 6, figs. 17-24)

P element
1974 *Prioniodina* sp. 1+2 Lindström - Viira, p. 112, text-fig. 14:b (only).

Multielement
1977 *Microzarkodina flabellum* (Lindström) - Gedik, p. 42, pl. 2, figs. 22-24.
1978 *Microzarkodina flabellum* (Lindström) - Löfgren, pp. 61-62 (*partim*), text-fig. 27:A, B (only).
1985 *Microzarkodina flabellum parva* Lindström - Löfgren, p. 147 (*partim*), text-fig. 4:A-G.

Derivation of name - After the section of Haget.

Type locality - The Hagudden Section, Öland.

Type stratum - 1,99 m. above the reference D surface, Sample 696, Kundan Stage.

Holotype - MGUH 19871, a P element (Pl. 6, fig. 17).

Diagnosis - P element with one anterior denticle and deep triangular basal cavity. The element is flat.

Description - P element of *Microzarkodina hagetiana* has a reclined, straight cusp with one posterior process and one anterior denticle. The reclined denticles of the posterior process decrease in size away from the cusp. The anterior edge of the base is straight. The basal cavity is deep and with the tip below the cusp. The outline of the basal cavity is triangular with straight upper edge and straight to concave anterior edge. The angle between the anterior edge of the base and the cusp is usually low.

M element has a reclined albid cusp. Cusp is flattened and sharp-edged, with a longitudinal costa. The anterior edge of the base is straight and meets the cusp in a sharp curve. The aboral margin is sinuous in lateral view and the upper keeled margin of the base is extended posteriorly as a thin elongation.

Sa element has two conspicuous lateral denticulated processes and a short keeled upper margin of the base.

Sb element is asymmetrical with two lateral processes of slightly different length. The anterior process is shorter and usually carries three denticles. The upper margin of the base is keeled and with a short denticulated extension.

Sc element has a long slightly arched posterior process with reclined denticles. The cusp is recurved and the denticles on the posterior process become higher distally. Basal cavity resembles that of the P element and continues in the processes as a small slit.

Sd element is skewed and asymmetrical with short anterior, posterior and inner lateral processes. The outer lateral process is the longest, curved and denticulated. The inner lateral process has few denticles, whereas the anterior and posterior processes are adenticulated.

All S elements have large and basally confluent denticles.

Remarks - Distinction between *Microzarkodina parva* Lindström and *Microzarkodina hagetiana* n.sp. is based on P elments; the basal cavity of the latter is triangular and with straight upper edge which is not typical for *Microzarkodina parva* which has a deeper basal cavity. Moreover, the anterior side of *M. hagetiana* is straight instead than flexed.

In this species are quite common secondary tips of the basal cavity into the denticles and into the anterior margin.

The P elements of *Microzarkodina flabellum parva* Lindström illustrated by Löfgren (1985, text-figs: 4:A, B) have a basal cavity outline identical with that of *Microzarkodina hagetiana*.

Occurrence - From Sample 690 to Sample 697.

Material - 27 P elements, 80 M elements, 5 Sa elements, 2 Sb elements, 11 Sc elements, 4 Sd elements.

Repository - MGUH 19871 (Holotype), MGUH 19872 - MGUH 19878. (Paratypes).

Microzarkodina parva Lindström
(Pl. 6, figs. 8-16)

1971 *Microzarkodina parva* sp. Lindström, p. 59, pl. 1, fig. 14.
?1976 *Microzarkodina flabellum parva* Lindström - Dzik, text-fig. 35:h (only).
1985 *Microzarkodina flabellum* (Lindström) - An, Du & Gao, pl. 15, figs. 5-10.

Description - P element has a denticulated posterior process and the anterior edge of the base carries one denticle. It has a reclined cusp with a weak lateral costa. The posterior process is commonly with four small reclined denticles, which decrease in size away from the cusp. The anterior part of the base is deflected to one side. Basal cavity is deep and extends under the whole unit which has a large basal sheath. The tip of the basal cavity is extending up into the cusp and the upper margin of the basal cavity is upwards concave. Cusp is albid above the basal cavity. The basal cavity is outlined by a thin hyaline area.

S elements have, when preserved, even sized denticles.

M element is morphologically similar to the M element of *Microzarkodina flabellum* (Lindström).

Remarks - P element of *Microzarkodina parva* is characterized by regular denticulation in contrast with the markedly taller and irregular denticles of P elements of *Microzarkodina flabellum*. Also the S elements show regular denticulation. The basal sheath and basal cavity are larger than in *M. flabellum* and the tip of basal cavity reaches into the cusp.

Occurrence - From Sample 673 to Sample 689.

Material - 432 P elements, 828 M elements, 117 Sa elements, 78 Sb elements, 309 Sc elements, 101 Sd elements.

Repository - MGUH 19862 - MGUH 19870.

Genus *Parapaltodus* Stouge, 1984

Type species - *Parapaltodus simplicissimus* Stouge, 1984.

Parapaltodus simplicissimus Stouge
(Pl. 7, figs. 13-14)

1984 *Parapaltodus simplicissimus* n.sp. Stouge, p. 48, pl. 1, figs. 20, 21, 26-28A (*cum syn.*).

Remarks - This species has been fully described by Stouge (1984) and is characterized by a deep basal cavity which is triangular in outline when seen in lateral view. The tip is located close to the anterior edge of the base.

This species occurs sporadic in the higher part of the Hagudden Section.

Occurrence - From Sample 690 to Sample 694.

Material - 9 drepanodiform elements, 2 scandodiform elements.

Repository - MGUH 19891 - MGUH 19892.

Parapaltodus sp.
(Pl. 7, fig. 15)

Remarks - This species is represented by elements that can be identified with *Scandodus flexuosus* Barnes & Poplawski *sensu lato*. It is possible however, that the elements are part of *Walliserodus* cf. *W. ethingtoni* (Fårhæus).

Occurrence - Sample 683.

Material - 2 scandodiform elements.

Repository - MGUH 19893.

Genus *Parapanderodus* Stouge, 1984

Type species - *Protopanderodus asymmetricus* Barnes & Poplawski, 1973.

Parapanderodus n.sp. A
(Pl. 7, figs. 1-4)

1978 *Scolopodus* aff. *gracilis* (Ethington & Clark) - Löfgren, p. 110, pl. 8, fig. 10 A-B.

1985 «*Scolopodus*» *gracilis* Ethington & Clark - Löfgren, text-fig. 4:AG-AJ, *non* AK.

Description - Slender elements are usually long, evenly procurved to proclined and without distinction between cusp and base. The aboral margin is nearly circular with a notch on the upper margin of the base due to the longitudinal posteriorly located groove. The aboral outline is nearly straight in lateral view. The posterior longitudinal groove extends throughout the element. Some elements are suberect and have a relatively shorter base than the procurved types.

The symmetrical element is narrow with almost a circular aboral margin. It has two lateral grooves and keels and a posterior round carina. The distal part of the base is slightly more constricted than the anterior part of the base. The element is procurved.

Remarks - This species can not be fully described because asymmetrical elements have not been recorded. Löfgren (1985, text-fig. 4: AH), however, illustrated an asymmetrical element that probably completes the *Parapanderodus* n.sp. A apparatus.

Parapanderodus n.sp. A differs from *P. paracornutiformis* (Ethington & Clark) *sensu* Stouge & Bagnoli, 1988 by the circular outline of the aboral margin of the symmetrical element. The long slender elements of *P.* n.sp. A are longer than those of *P. paracornutiformis*. *Parapanderodus* n. sp. A also resembles *Parapanderodus arcuatus* Stouge, but the aboral margin is different.

Occurrence - Samples 688 and 689.

Material - 13 slender elements, 4 symmetrical elements.

Repository - MGUH 19879 - MGUH 19882.

Genus *Paroistodus* Lindström, 1971

Type species - *Oistodus parallelus* Pander, 1856.

Remarks - Lindström (1971) erected this genus to include «drepanodid conodonts with drepanodiform and oistodiform elements». Van Wamel (1974) added slightly asymmetrical forms with a basal cavity opening to one side or scandodiform to the description of the genus. Subsequent workers generally agreed that such an element also is part of the apparatus and thus should be added to the diagnosis (Dzik, 1976; Löfgren, 1978; Stouge, 1984; Stouge & Bagnoli, 1988).

Paroistodus originalis (Sergeeva)
(Pl. 7, figs. 5-10)

Drepanodiform element

1963a *Oistodus originalis* n.sp. Sergeeva, pp. 98-99, pl. 7, figs. 8, 9; text-fig. 4.
1960 *Distacodus* sp. Lindström, text-fig. 3:6.
1967 *Oistodus originalis* Sergeeva - Viira, text-fig. 1:18.
1974 *Drepanodus originalis* (Sergeeva) - Viira, pp. 69-70, pl. 5, figs. 11-18; text-figs. 15 H-p, 72.

Oistodiform element

1960 *Oistodus parallelus* Pander - Lindström, text-fig. 3:3.
1967 *Oistodus parallelus* Pander - Viira, text-fig. 1:23.

Multielement

1971 *Paroistodus originalis* (Sergeeva) - Lindström, p. 48, text-figs. 8, 12.
1974 *Paroistodus parallelus* (Pander) - van Wamel, pp. 79-80 (*partim*), pl. 7, figs. 14-17 (*non* 12, 13 = *P. proteus*).
1974 *Paroistodus parallelus* (Pander) - Serpagli, pp. 61-62, (*partim*), pl. 8, figs. ?8, ?9; pl. 25, figs. ?1, 2, ?3.
1976 *Paroistodus parallelus originalis* (Sergeeva) - Dzik, p. 435, tex-fig. 18 g-h.
1978 *Paroistodus originalis* (Sergeeva) - Löfgren, pp. 69-71, pl. 1, figs. 22-25; text-fig. 28.
?1985 *Paroistodus originalis* (Sergeeva) - An, Du & Gao, pl. 5, figs. 4, 5, ?22.

Remarks - This species is difficult to distinguish from *Paroistodus proteus* (Lindström) (cfr. Löfgren, 1985; Stouge & Bagnoli, 1988). The elements of *Paroistodus originalis* tend to have inverted basal cavities, but the fact is that the two species are mainly distinguished by their stratigraphic distribution in the Baltic sequence rather than on morphological characters. Thus it is possible that *Paroistodus originalis* (Sergeeva) *sensu* An, Du & Gao, 1985 should be referred *P. proteus* (Lindström) (cfr. Stouge & Bagnoli, 1988).

Occurrence - From Sample 673 to Sample 688.

Material - 310 oistodiforms, 874 drepanodiforms.

Repository - MGUH 19883 - MGUH 19888.

Genus *Periodon* Hadding, 1913

Type species - *Periodon aculeatus* Hadding, 1913.

Periodon sp.
(Pl. 7, figs. 11-12)

cf. 1978 *Periodon flabellum* (Lindström) - Löfgren, pp. 72-74 (*partim*), pl. 11, figs. 6-11 (only); text-fig. 29.

Remarks - M elements with 2-? 3 denticles on the anterior edge of the base belong to *Periodon* Hadding. The elements resemble those depicted by Löfgren (1978) but a species identification is not possible with the material at hand. It is obvious however, that neither *Periodon flabellum* (Lindström) nor *Periodon aculeatus* (Hadding) can be present in this interval and a new species should be defined.

Occurrence - Sample 683.

Material - 3 M elements.

Repository - MGUH 19889 - 19890.

Genus *Polonodus* Dzik, 1976

Type species - *Ambalodus clivosus* Viira, 1974.

Remarks - *Polonodus* Dzik, 1976 was introduced for conodonts with «four lobes». Löfgren (1978) and Stouge (1984) discussed elements that were referred to *Polonodus* and it appears that the genus needs a revision. At present, it is not certain that the type species *Ambalodus clivosus* Viira, 1974 is part of an apparatus like that Dzik (1976) intended.

The Hagudden material includes platforms that have «tubercule» surface typical of *Ambalodus clivosus* (see Viira, 1974) and platforms with concentric ridges, i.e. *Polonodus clivosus* Viira *sensu* Dzik, 1976. At present we include the elements in *Polonodus* Dzik, but it should be noted that the two taxa may not belong to the same genus.

Polonodus sp. A
(Pl. 7, figs. 16-17)

Description - Platform elements with four lobes. The two posterior lobes are wide, flat and with uneven edge. This edge shows a pitted surface. The flatform surface is irregularly knobly and with radial crests from the denticle row. The elements are paired. The basal cavity is large and excavates the whole unit. The cusp is short and the denticles are small but distinct forming a ridge along the element.

Remarks - The posterior lobes have a surface ornamenture that corresponds to that of *Ambalodus clivosus* Viira, 1974. The elements of *Polonodus* sp. A do not display the contour-like pattern on the processes, which is typical for *Polonodus*? sp.B.

Occurrence - Samples 690, 692 and 693.

Material - 7 specimens (fragmentary).

Repository - MGUH 19894 - MGUH 19895.

Polonodus? sp. B
(Pl. 7, figs. 18-20)

1964 *Amorphognathus* n.sp. Lindström, p. 92, text-fig. 33C.
1976 *Polonodus clivosus* (Viira) - Dzik, p. 423, pl. 43, figs.?1a, b; text-figs. 29c, d.
1978 *Polonodus*? sp. B. Löfgren, pp. 77-78, pl. 16, figs. 7, 8; text-fig. 30.
cf. 1984 *Polonodus tablepointensis* n.sp. Stouge, pp. 72-73, pl. 12, fig. 13; pl. 13, figs. 1-5.

Remarks - The platform elements recorded from Hagudden resemble those depicted by Dzik (1976) in that they all carry prominent ridges across the processes and platforms. Apparently, the elements represent the types that Dzik (1976) included in his multielement genus *Polonodus* Dzik. Similarly to Löfgren (1978), we can not identify these elements with *Ambalodus clivosus* Viira, 1974 which was chosen as the type species for *Polonodus* Dzik. Therefore, we consider the apparatus with *Ambalodus clivosus* Viira, 1974 (i.e. *Polonodus clivosus*) as unknown (see also Löfgren, 1978). The elements referred to *Polonodus*? sp. B herein probably represent another genus instead (cfr. Stouge, 1984).

We are convinced that *Amorphognathus* n.sp. Lindström, 1964 and *Polonodus*? sp. B Löfgren, 1978 are representatives of the species recorded from Hagudden. *Polonodus tablepointensis* Stouge, 1984 also belong to this group of conodonts, but may represent another closely related species.

Occurrence - Samples 692 and 694A.

Material - 7 specimens.

Repository - MGUH 19806 - MGUH 19898.

Genus *Protopanderodus* Lindström, 1971

Type species - *Acontiodus rectus* Lindström, 1955.

Remarks - The apparatus of *Protopanderodus* Lindström, 1971 has been recently discussed in detail by McCracken (1989).

Protopanderodus rectus (Lindström)
(Pl. 8, figs. 1-5)

1955 *Acontiodus rectus* n.sp. Lindström, p. 549, pl. 2, figs. 7-11; text-fig. 3B.
1955 *Acontiodus rectus* n.sp. var. *sulcatus* nov. Lindström, p. 550, pl. 2, figs. 12, 13; text-fig. 3D.
1955 *Scandodus rectus* n.sp. Lindström, p. 593, pl. 4, figs. 21-25; text-fig: 3K.
1961 *Acontiodus rectus* Lindström - Wolska, p. 345, pl. 1, fig. 2.
1964 *Acontiodus rectus* Lindström - Lindström, p. 108, text-figs. 10(o), 47j.
1967 *Acontiodus rectus* Lindström - Viira, text-fig. 1:12.
1967 *Scandodus rectus* Lindström - Viira, text-fig. 1:13.
1969 *Acontiodus rectus* Lindström - Bednarczyk, pl. 1, fig. 7.
1969 *Acontiodus rectus sulcatus* Lindström - Bednarczyk, pl. 1, fig. 10.
1969 *Scandodus rectus* Lindström - Bednarczyk, pl. 1, fig. 9.
1974 *Acontiodus rectus* Lindström - Viira, p. 48, pl. 4, figs. 21-23; text-fig. 29.

Multielement
1971 *Protopanderodus rectus* (Lindström) - Lindström, p. 50.
1974 *Protopanderodus rectus* (Lindström) - van Wamel, p. 93, pl. 4, figs. 7-10.
1976 *Protopanderodus rectus* (Lindström) - Dzik, text-fig. 16:1.
1978 *Protopanderodus rectus* (Lindström) - Löfgren, pp. 90-91, pl. 3, figs. 1-7, 36A-B; text-fig. 31A-C.
1981 *Protopanderodus rectus* (Lindström) - Nowlan, p. 15, pl. 1, figs. 6, 7.

Description - *Acontiodus rectus* Lindström, 1955 is the symmetrical acontiodiform element with two lateral costae; this element vary in curvature from proclined to reclined and the base from short to long. Not all the elements have the sinuous outline of the aboral margin when seen in lateral view, but are gently curved. *Acontiodus rectus* var. *sulcatus* Lindström, 1955 is the asymmetrical acontiodiform element. It varies from types with one prominent lateral costa and an inner median costa to types with one lateral costa only. *Scandodus rectus* Lindström, 1955 is the scandodiform. Elements with a prominent inner groove have not been observed in this material. All elements have been fully described by Lindström (1955), van Wamel (1974) and Löfgren (1978).

Occurrence - From Sample 673 to Sample 691.

Material - 651 acontiodiform elements, 185 scandodiform elements.

Repository - MGUH 19899 - MGUH 19903.

Protopanderodus cf. *P. varicostatus* (Sweet & Bergström)
(Pl. 8, figs. 9-12)

1974 *Scolopodus varicostatus* Sweet & Bergström - Viira, p. 123 (*partim*), pl. 5, figs. 23, 24 (only).
1974 *Scandodus* cf. *unistriatus* Sweet & Bergström - Viira, p. 119 (*partim*), pl. 5, fig. 30 (only).
1978 *Protopanderodus* cf. *varicostatus* (Sweet & Bergstrom) - Löfgren, pp. 91-92, pl. 3, figs. 26-31.

non 1989 *Protopanderodus* cf. *varicostatus* (Sweet & Bergström) - McCraken, pp. 22-23, pl. 3, figs. 1-8, text-fig. 3F.

Remarks - This species includes symmetrical bicostate elements, asymmetrical elements with two costae and a groove in between on one side and one costa on the other side, asymmetrical unicostate elements and scandodiform elements with an inner anterior groove.

As noted by Löfgren (1978) the elements are variable and perhaps two species should be distinguished. From this material, although limited in number of specimens, it appears that the groove on the asymmetrical elements is relatively narrower in stratigraphically earlier types whereas it is wider in the younger ones. The elements from samples 693-697 are identical with those illustrated by Löfgren (1978).

McCracken (1989) carefully discussed the elements commonly referred to *Protopanderodus* cf. *P. varicostatus* (Sweet & Bergström) and largely we agree with the interpretation promoted by McCraken (1989) for *Protopanderodus*. It appears however that our specimens (and thus those of Löfgren, 1978) should be considered a distinct species rather than be a part of *P.* cf. *varicostatus* (Sweet & Bergström) *sensu* McCraken, 1989.

Occurrence - From Sample 677 to Sample 697.

Material - 71 acontiodiform elements, 10 scandodiform elements.

Repository - MGUH 19907 - MGUH 19910.

Protopanderodus sp.
(Pl. 8, figs. 6-8)

1978 *Protopanderodus* sp. Löfgren, p. 95, pl. 3, figs. 8-10.

Description - *Protopanderodus* sp. comprises symmetrical acontiodiforms, asymmetrical acontiodiforms and scandodiforms. All elements are albid.

Symmetrical acontiodiforms are slender and vary from proclined types with a long base and deep basal cavity to suberect types with a short base. The costae are located posteriorly on the cusp and extend to the base. The outline of the aboral margin is straight to convex in lateral view.

Asymmetrical costate elements have keeled edges and a lateral costa to carina on the inner side. The costa continues across the base and reaches the aboral margin. A wide groove separates the posterior keel from the inner costa/carina.

Scandodiforms are procurved to suberect, keeled and with a short base. The elements have a carina on the inner side.

Remarks - Löfgren (1978) described *Protopanderodus* sp. and noted the difference between *P. rectus* and *P.* sp. She did not however, recover scandodiforms, probably due to the small collection available to her. Similar to the Jämtland material, most of the specimens at hand are small, but also larger types occur in the Hagudden collection. Based on this material we agree with Löfgren (1978) that *Protopanderodus* sp. is a distinct taxon.

Protopanderodus sp. differs from *Protopanderodus rectus* by the outline of the aboral margin, which is straight to convex in lateral view, instead than having an indention. The presence of a lateral inner costa on the asymmetrical element is characteristic for this species. The scandodiform element can not be distinguished from the corresponding element of *Protopanderodus rectus*.

Occurrence - From Sample 677 to Sample 685A.

Material - 342 symmetrical and asymmetrical acontiodiform elements, 115 scandodiform elements.

Repository - MGUH 19904 - MGUH 19906.

Genus *Scalpellodus* Dzik, 1976

Type species - *Protopanderodus latus* van Wamel, 1974.

Remarks - Löfgren (1978) discussed the generic definition given by Dzik (1976) for *Scalpellodus* and we concur with Löfgren (1978) in her interpretation of the genus.

Scalpellodus Dzik has an apparatus composed of short based drepanodiforms, of longbased drepanodiforms forming a symmetry transition series and a twisted element (scandodiform). All elements are albid and have a conspicuous basal cavity.

Scalpellodus gracilis (Sergeeva)
(Pl. 8, figs. 20-29)

1967 *Scandodus* n. sp. A Viira, text-fig. 4:13.
1967 *Drepanodus* aff. *longibasis* Lindström - Viira, text-fig. 4: 18, 19.
1974 *Scandodus gracilis* sp. nov. Sergeeva, p. 80 (*partim*), pl. 1, figs. 6, 9.
1974 *Drepanodus* cf. *cavus* Webers - Viira, p. 68 (*partim*), fig. 67a.
1974 *Scandodus tortus* sp. n. Viira, p. 118 (*partim*), pl. 5, figs. 31-33; text-figs. 149, 150.
1974 *Drepanodus* aff. *longibasis* Lindström - Viira, p. 68 (*partim*), text-fig. 69.
1976 *Scalpellodus longibasis* (Lindström) - Dzik, text-fig. 13: d-f.
1977 *Scandodus* cf. *tortus* Viira - Gedik, pl. 2, figs. 9, ?14.
1978 *Scalpellodus gracilis* (Sergeeva) - Löfgren, pp. 100-102, pl. 5, figs. 3-6, 11-13, 15; pl. 6, figs. 5, 6, 8-20, 22, 23.

Remarks - This species has been fully described by Löfgren (1978).

Occurrence - From Sample 680A to Sample 697.

Material - 160 short base drepanodiform elements, 468 long base drepanodiform elements, 113 scandodiform elements.

Repository - MGUH 19918 - MGUH 19927.

Scalpellodus latus (van Wamel)
(Pl. 8, figs. 13-19)

1974 *Protopanderodus latus* n.sp. van Wamel, pp. 91-92, pl. 4, figs. 1-3.
1978 *Scalpellodus latus* (van Wamel) - Löfgren, pp. 99-100, pl. 5, figs. 10, 14; pl. 6, figs. 1-4, 7, 21.
1985 *Scalpellodus latus* (van Wamel) - Löfgren, text-fig. 4: AL-AP.
non 1981 *Scalpellodus latus* (van Wamel) - Cooper, p. 179, pl. 27, figs. 7-10, 13-15.

Remarks - This species has been fully described by van Wamel (1974) and Löfgren (1978).

Scalpellodus latus (van Wamel) *sensu* Cooper, 1981 does not belong to this taxon. The symmetrical element is «cornuform» and perhaps the element should be referred to «*Semiacontiodus*» *cornuformis sensu lato* instead.

Occurrence - From Sample 674 to Sample 687.

Material - 124 short base drepanodiform elements, 182 long base drepanodiform elements, 61 scandodiform elements.

Repository - MGUH 19911 - MGUH 19917.

Genus *Scolopodus* Pander, 1856

Type species - *Scolopodus sublaevis* Pander, 1856.

Remarks - *Scolopodus* Pander, 1856 was emended by Lindström (1971) and Pander's (1856) *Scolopodus* species were revised by Fåhræus (1982).

In this group we also place tentatively «*Scolopodus*» *peselephantis* Lindström. A new generic name may eventually be established to accomodate these characteristic small elements.

Scolopodus rex Lindström
(Pl. 9, figs. 1-6)

1955 *Scolopodus rex* n.sp. Lindström, pp. 595-596, pl. 3, fig. 32.
1955 *Scolopodus rex* n.sp. var. *paltodiformis* nov. Lindström, p. 596, pl. 3, figs. 33, 34.
1974 *Scolopodus rex* Lindström - Viira, pl. 3, figs. 22-23.
1974 *Scolopodus rex* Lindström - van Wamel, p. 94, pl. 5, fig. 18.
1977 *Protopanderodus* aff. *gradatus* Serpagli - Gedik, pl. 1, fig. 3.
1978 *Scolopodus rex* Lindström - Löfgren, pp. 109-110, pl. 1, figs. 38, 39.
?1982 *Scolopodus quadratus* Pander - Fåhræus, pp. 21, 22, pl. 2, figs. 1-14; pl. 3, figs. 1-8, 15.

Remarks - Fåhræus (1982) places *Scolopodus rex* Lindström in synonymy with *Scolopodus quadratus* Pander. This may be correct but our specimens can not easily be identified with Pander (1856) specimens. Instead they fit well with *Scolopodus rex* Lindström, 1955 and in our opinion *Scolopodus rex* Lindström is not conspecific with Pander species.

In the material at hand most of the elements have closely spaced costae like those depicted by Viira (1974), whereas the type of element figured by van Wamel (1974) has not been observed.

Occurrence - From Sample 673 to Sample 682.

Material - 37 specimens.

Repository - MGUH 19928 - MGUH 19933.

«*Scolopodus*» *peselephantis* Lindström
(Pl. 9, figs. 12, 13)

1955 *Scolopodus? peselephantis* n.sp. - Lindström, p. 595, pl. 2, figs. 19, 20; text-fig. 3Q.
1967 *Scolopodus? peselephantis* Lindström - Viira, text-fig. 1:22.
1974 *Scolopodus peselephantis* Lindström - van Wamel, p. 94, pl. 5, figs. 16, 17.
1974 *Scolopodus? peselephantis* Lindström - Viira, p. 124, text-fig. 162.
1978 *Scolopodus? peselephantis* Lindström - Löfgren, pp. 108-109, pl. 4, figs. 43-47.
1981 «*Scolopodus*» *peselephantis* Lindström - Ethington & Clark, pp. 102-103, pl. 11, fig. 26.
1985 *Scolopodus? peselephantis* Lindström - An, Du & Gao, pl. 10, figs. 6, 7.
1988 «*Scolopodus*» *peselephantis* Lindström - Stouge & Bagnoli, p. 139, pl. 15, fig. 18.

Remarks - These small cones form a well defined symmetry transition series. The cusp is proclined and multicostate. The cusp is completely white and the base is translucent and hyaline.

Occurrence - From Sample 673 to Sample 695.

Material - 132 specimens.

Repository - MGUH 19939 - MGUH 19940.

Genus *Semiacontiodus* Miller, 1969

Type species - *Acontiodus* (*Semiacontiodus*) *nogamii* Miller, 1969.

Remarks - Dzik (1976) applied the multielement genus *Semiacontiodus* Miller, 1969 for coniform albid elements that change from symmetrical to asymmetrical elements including *Scolopodus cornuformis* Sergeeva, 1963. Miller (1980) revised *Semiacontiodus* Miller, 1969 and on the basis of this revision it is obvious that the apparatus recorded in this paper needs a new generic name, but at present we retain the genus name «Semiacontiodus» for the Baltic elements.

«*Semiacontiodus*» *cornuformis* (Sergeeva)
(Pl. 9, figs. 14-18, 20-25)

1963a *Scolopodus cornuformis* sp. nov. Sergeeva, p. 93, pl. 7, figs. 1-3; text-fig. 1.
1978 *Scolopodus cornuformis* Sergeeva - Löfgren, pp. 105-107, pl. 7, figs. 1-6, 9-12; pl. 8, figs. 1, 2, 4-6 (*cum syn.*).
1987 *Scolopodus cornuformis* Sergeeva - An, pp. 183-184, pl. 7, fig. 10, 11, 13-16.

Remarks - Viira (1974) and Löfgren (1978) described the elements of «*Semiacontiodus*» *cornuformis* (Sergeeva). Both authors demonstrated that a large variety of elements is part of this species but they did not attempt to subdivide this taxon in more than one species.

In the Hagudden Section the stratigraphical oldest elements (*Microzarkodina parva* Zone) are characterized by a symmetrical (cornuform) element that has two posterior-lateral grooves which are vaguely developed and they do not reach the aboral margin.

The base is oval rather than circular. The asymmetrical (scandodiform) elements do not display the same variability as the corresponding elements do in the stratigraphically younger specimens.

The elements from the interval within the sample 685 to 689 have a cornuform with a median groove on the posterior prominent carina.

The cornuform from sample 690 up to sample 697 is identical with *Scolopodus cornuformis* Sergeeva 1963 *sensu stricto* and the apparatus displays the variability described by Löfgren (1978).

Occurrence - From Sample 677 to Sample 697.

Material - 215 symmetrical (cornuform) elements, 1531 asymmetrical (scandodiform) elements.

Repository - MGUH 19941 - MGUH 19945, MGUH 19947 - MGUH 19952.

Genus *Trapezognathus* Lindström, 1955

Type species - *Trapezognathus quadrangulum* Lindström, 1955.

Diagnosis (emended) - The *Trapezognathus* Lindström apparatus is septimembrate, with pectiniform P elements, geniculate M elements and a complete series of S elements (alate, tertiopedate, bipennate, quadriramate). P elements are adenticulated to weakly denticulated. M element is adenticulated to denticulated and the cusp forms an angle of about 90° with the upper margin of the base. S elements are stubby, with a base higher than the cusp, weakly denticulated to denticulated. All elements are albid and have deep basal cavity and large basal sheath.

Remarks - Based on this material it appears that the holotype of *Trapezognathus quadrangulum* Lindström, 1955 is a member of a lineage that includes also *Amorphognathus falodiformis* (Sergeeva) *sensu* Dzik, 1983. Other elements referred to *Trapezognathus quadrangulum* by Lindström (1955, pl. 5, figs. 41, 40) have been included in *Baltoniodus triangularis* by Lindström (1971). This species of *Baltoniodus* has not been recorded in this study.

The type species of *Trapezognathus* Lindström, i.e. *Trapezognathus quadrangulum* is the Sd element of the multielement species *T. quadrangulum*.

Trapezognathus first appeared in the Balto-Scandic region in the *Oepikodus evae* Zone of the Billingenian Substage. At that time it occurred together with «*Baltoniodus*» *crassulus* (Lindström). Van Wamel (1974) illustrated the earliest known elements belonging to *Trapezognathus* and included them in *Baltoniodus navis*. The genus is present in the Volkhovian where it occurs together with *Baltoniodus triangularis* and *Baltoniodus navis*. *Trapezognathus* apparently became extinct along with the first appearance of *Lenodus* Sergeeva, 1963 in the Kundan Stage.

The following species of *Trapezognathus* have been recognized in this study: *Trapezognathus quadrangulum* and *Trapezognathus* sp.

Trapezognathus quadrangulum Lindström, 1955
(Pl. 10, figs. 1-5, 7-10)

Pa element
1955 *Prioniodus triangularis* n.sp. - Lindström, pp. 591-592 (*partim*), pl. 5, fig. 45 (only).

Pb element
?1955 *Prioniodus navis* n.sp. Lindström, pp. 590-591 (*partim*), pl. 5, figs. 31, 32 (only).

M element
1963b *Lenodus falodiformis* sp.nov. Sergeeva, p. 140 (*partim*), text-fig. 2: b, v (only).
1974 *Lenodus falodiformis* Sergeeva - Viira, p. 93, pl. 6, fig. 6.

Sa element
1974 *Roundya longa* (Lindström) - Viira, pl. 6, fig. 3.

Sc element
?1963b *Lenodus falodiformis* sp.nov. Sergeeva, p. 140 (*partim*), text-fig. 2:a (only).

Sd element
1955 *Trapezognathus quadrangulum* n.sp. Lindström, p. 598 (*partim*), pl. 5, figs. 38, 39 (only).

Multielement
1974 *Prioniodus navis* Lindström - van Wamel, pp. 89-90 (*partim*), pl. 8, figs. 10, 11 (only).
1978 *Prioniodus* (*Baltoniodus*) *triangularis* Lindström - Löfgren, pp. 81-82, pl. 12, figs. 1-7.
?1981 *Baltoniodus communis* (Ethington & Clark) - An, pl. 4, fig. 22 (only).
?1987 *Baltoniodus communis* (Ethington & Clark) - An, pp. 125-126 (*partim*), pl. 19, fig. 10 (only) (*non* figs. 1-9, 11 = *Oepikodus intermedius*).

Diagnosis (emended) - The apparatus of *Trapezognathus quadrangulum* Lindström includes adenticulated to partly denticulated Pa and Pb elements, fully denticulated S elements and M elements with denticles anteriorly and in some specimens also posteriorly.

Description - Pa element has a wide cusp, an anteriorly extended base, and lateral and posterior processes. The cusp is robust, recurved, keeled and with a lateral costa that extends across the base to form a short lateral process. The anterior edge continues beyond the aboral margin as a short adenticulated process. Typically, the outline of the side is convex from the cusp and across the base, and concave at the base/process transition when seen in lateral view. The basal cavity is deep and covered by a large basal sheath. The upper margin of the base is keeled, short and adenticulated.

Pb element has a keeled suberect cusp with one lateral costa. The posterior edge of the cusp and the upper margin of the base form an angle of about 90°. The upper margin of the base is irregularly keeled because there are rudimentary and fused denticles. The posterior process, rarely preserved, is flared on the inner side and may have a low ridge across the base.

M element is characterized by having a robust cusp, a base with an inner flare and denticles on the anterior edge of the base. The upper margin of the base is keeled and may occasionally carry denticles. The upper margin of the base forms an angle of 90° with the cusp.

In Sa element the cusp is strongly curved. The edges are weakly serrated to denticulated. Basal sheath connects the three edges and free processes are short.

Sb elements has denticles on all three edges. The cusp is procurved and like in Sa unit the basal sheath is large. The element is identical with the Sa element except that it is slightly asymmetrical and more laterally compressed.

Sc element is curved in the manner that the outerside is convex and the inner side is concave and the denticulated edges are facing inwards. The cusp is procurved to proclined and slender. It is likely that one specimen that Sergeeva (1963, fig. 2a) included in *Lenodus falodiformis* is the Sc element of this species.

In Sd element the cusp is recurved and the four edges are denticulated. It is slightly asymmetrical because one of the posterior process is lower than the other. Denticles are small, free and present in all processes.

Remarks - The holotype of *Prioniodus triangularis* Lindström, 1955 (pl. 5, fig. 46) is a Sb element (see Löfgren, 1978) and is considered here as an element of an early *Baltoniodus* species (*B. triangularis*). The general outline of the element with the slender proclined cusp is not typical for any *Trapezognathus* element.

The holotype of *T. quadrangulum* Lindström is a typical element of *Trapezognathus* Lindström (emended herein), whereas the specimens illustrated in pl. 5, figs. 40, 41 are Sd elements of *Baltoniodus* (*B. triangularis*).

Material - 29 Pa elements; 9 Pb elements; 24 M elements; 14 Sa element; 13 Sb elements; 23 Sc elements; 39 Sd elements.

Occurrence - From Sample 673 to Sample 684.

Repository - MGUH 19955 - MGUH 19959, MGUH 19961 - MGUH 19964.

Trapezognathus sp.
(Pl. 10, figs. 6, 11-17)

?1983 *?Amorphognathus falodiformis* (Sergeeva) - Dzik, fig. 7: A-E.
?1984 *?Amorphognathus antivariabilis* An - An, pl. 18, fig. 18 (only).

Description - P elements have three denticulated processes. The denticles are low and irregular. Large basal sheath connects the processes. Pa and Pb elements are difficult to distinguish also because the material is fragmentary.

M element has a large robust and erect cusp, a keeled upper margin of the base and a long, slim and posteriorly directed anterior process. The anterior edge of the base and the anterior process is adenticulated to denticulated. The inner side of the base has a prominent flare. In some specimens is present a keel across the basal flare. The denticles, when present, are low and blunt.

Sa element is denticulate with low denticles and the processes are connected by the basal sheath.

Sb element is similar to the Sa element but is slightly asymmetrical. It is denticulated on two edges and one lateral edge is rarely denticulated.

Sc element is constantly denticulated on the upper margin of the base. Large elements may carry denticles on the two edges. Cusp is procurved. Aboral margin is concave on the inner side and with a small bulge on the outer side. Processes extend beyond the aboral margin as free processes.

Sd element is slightly asymmetrical with four posteriorly directed processes. The processes are denticulated and connected by thin basal sheath, but they are free distally. In some specimens one process is reduced to a sharply rounded costa.

Remarks - *Trapezognathus* sp. differs from *Trapezognathus quadrangulum* Lindström because the P elements are denticulated and with three well defined processes and the S elements have a concave outline of the aboral margin.

Material - 18 Pa elements; 7 Pb elements; 6 M elements; 14 Sa elements; 12 Sb elements; 16 Sc elements; 35 Sd elements.

Occurrence - From Sample 685 to Sample 689.

Repository - MGUH 19960, MGUH 19965 - MGUH 19971.

Genus *Trigonodus* Nieper, 1969

Type species - *Oistodus larapintinensis* Crespin, 1943.

Remarks - Cooper (1981) redefined *Trigonodus* Nieper, 1969 and placed *Triangulodus* van Wamel, 1974 in synonymy. Bergström (*in* Robinson, 1981) arrived to a similar conclusion, but speculated that the two genera were objective junior synonymies of *Eoneoprioniodus* Mound, 1965. Ethington & Clark (1981), however, in their revision of *Pteracontiodus* Harris & Harris, 1965 showed that the P elements have three branches and that *Pteracontiodus* is identical with *Eoneoprioniodus* and it has priority. Considering this, Sweet (1988) concluded that *Pteracontiodus* had priority over *Trigonodus*, *Eoneoprioniodus* and *Triangulodus*. Cooper (1981), in his discussion, noted that differences between the genera exist and one fundamental is in the configuration of the P elements. In *Pteracontiodus* (= *Eoneoprioniodus*) the P element has three edges whereas the comparable element in *Trigonodus* (= *Triangulodus*) has two. This difference is the reason for us to keep the two genera as indipendent units. In addition to this, the two genera evolved indipendently. *Trigonodus* evolved from *Scandodus* Lindström in the Australian-Chinese region and migrated to the Baltic in Volkhovian. *Pteracontiodus* instead evolved in North America and is so far unknown from the Baltic region.

Trigonodus brevibasis (Sergeeva)
(Pl. 10, figs. 18-26)

M element

1963a *Oistodus brevibasis* Sergeeva sp.nov. Sergeeva, pp. 95-96, pl. 7, figs. 4,5; text-fig. 2.

1974 *Oistodus brevibasis* Sergeeva - Viira, pl. 5, fig. 21, ?22.

Sa element

?1974 *Acontiodus* sp.n. A Viira, p. 50, pl. 5, figs. 19, 20.

Sd element

1960 *Scolopodus* n.sp. 1 Lindström, text-fig. 3:8.

1963a *Paltodus volkhovensis* Sergeeva sp.nov. Sergeeva, pp. 100-102, pl. 7, figs. 13, 14; text-fig. 6.

Multielement

1971 *Scandodus brevibasis* (Sergeeva) - Lindström, p. 39, pl. 1, figs. 24-27; text-fig. 3.

1974 *Scandodus brevibasis* (Sergeeva) - Serpagli, p. 82, pl. 18, figs. 5-7; pl. 27, figs. 10, 11; pl. 30, figs. 2, 3; text-fig. 21.

1974 *Triangulodus brevibasis* (Sergeeva) - van Wamel, pp. 96-97, pl. 5, figs. 1-7.

1976 *Triangulodus brevibasis* (Sergeeva) - Dzik, p. 444, text-fig. 20:a-e.

1978 *Scandodus brevibasis* (Sergeeva) - Löfgren, p. 104, pl. 1, figs. 30-35.

cf. 1981 *Trigonodus larapintinensi* (Crespin) - Cooper, p. 180, pl. 27, figs. 5, 6, 11, 12, 16, 17.

Description - Van Wamel (1974) fully described this species. P elements are present as two types which van Wamel (1974) referred to as erect-scandodiform. One kind is suberect with a very wide keeled cusp (van Wamel 1974, pl. 5, fig. 3) and the second is twisted and the base is flared (van Wamel, pl. 5, fig. 2).

M element is *Oistodus brevibasis* Sergeeva, 1963.

Sa element is symmetrical and with three edges on the base.

Sb element has three edges that reach the aboral margin.

Sd elements is *Paltodus volkhovensis* Sergeeva, 1963.

Remarks - *Acontiodus* sp.n. A Viira may be the Sa element of this species.

Trigonodus larapintinensis (Crespin) *sensu* Cooper, 1981 is similar to *Trigonodus brevibasis* and perhaps they are synonymous.

Roundya sp. Higgins, 1967 (p. 386, text-fig. 2:8) is probably not part of this species as otherwise indicated by Lindström (1971), van Wamel (1974) and Löfgren (1978). Instead we interprete it as an element of *Pteracontiodus*.

Occurrence - From Sample 673 to Sample 677B.

Material - 43 P elements, 39 M elements, 23 Sa elements, 17 Sb elements, 44 Sc elements, 21 Sd elements.

Repository - MGUH 19972 - MGUH 19980.

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PLATE 1

Figs. 1-10 *Baltoniodus navis* (Lindström). Hagudden Section. Öland.
1) Pa element, sample 673, lateral view, MGUH 19760, × 70.
2) Pa element, sample 675, anterior view, MGFUH 19761, × 80.
3) Pb element, sample 675, anterior view, MGUH 19762, × 100.
4) Pb element, sample 678, outer view, MGUH 19763, × 50.
5) Pb element, sample 673, inner view, MGUH 19764, × 50.
6) M element, sample 673, lateral view, MGUH 19765, × 85.
7) Sa element, sample 676, posterior view, MGUH 19766, × 80.
8) Sb element, sample 673, lateral view, MGUH 19767, × 55.
9) Sc element, sample 673, lateral view, MGUH 19768, × 70.
10) Sd element, sample 673, MGUH 19769. 10A) lateral view, × 75; 10B) posterior view, × 80.

Figs. 11-20 *Baltoniodus norrlandicus* Löfgren. Hagudden Section, Öland.
11) Pa element, sample 677A, lateral view, MGUH 19770, × 55.
12) Pa element, sample 686, lateral view, MGUH 19771, × 90.
13) Pb element, sample 685, MGUH 19772. 13A) outer view, × 55; 13B) anterior view, × 90.
14) M element, sample 677, lateral view, MGUH 19773, × 60.
15) Sc element, sample 677A, lateral view, MGUH 19774, × 65.
16) Sb element, sample 677A, lateral view, MGUH 19775, x 80.
17) Sb element, sample 677A, lateral view, MGUH 19776, × 65.
18) Sa element, sample 677, posterior view, MGUH 19777, × 55.
19) Sd element, sample 677A, posterior view, MGUH 19778, × 60.
20) Sd element, sample 677, posterior view, MGUH 19779, × 65.

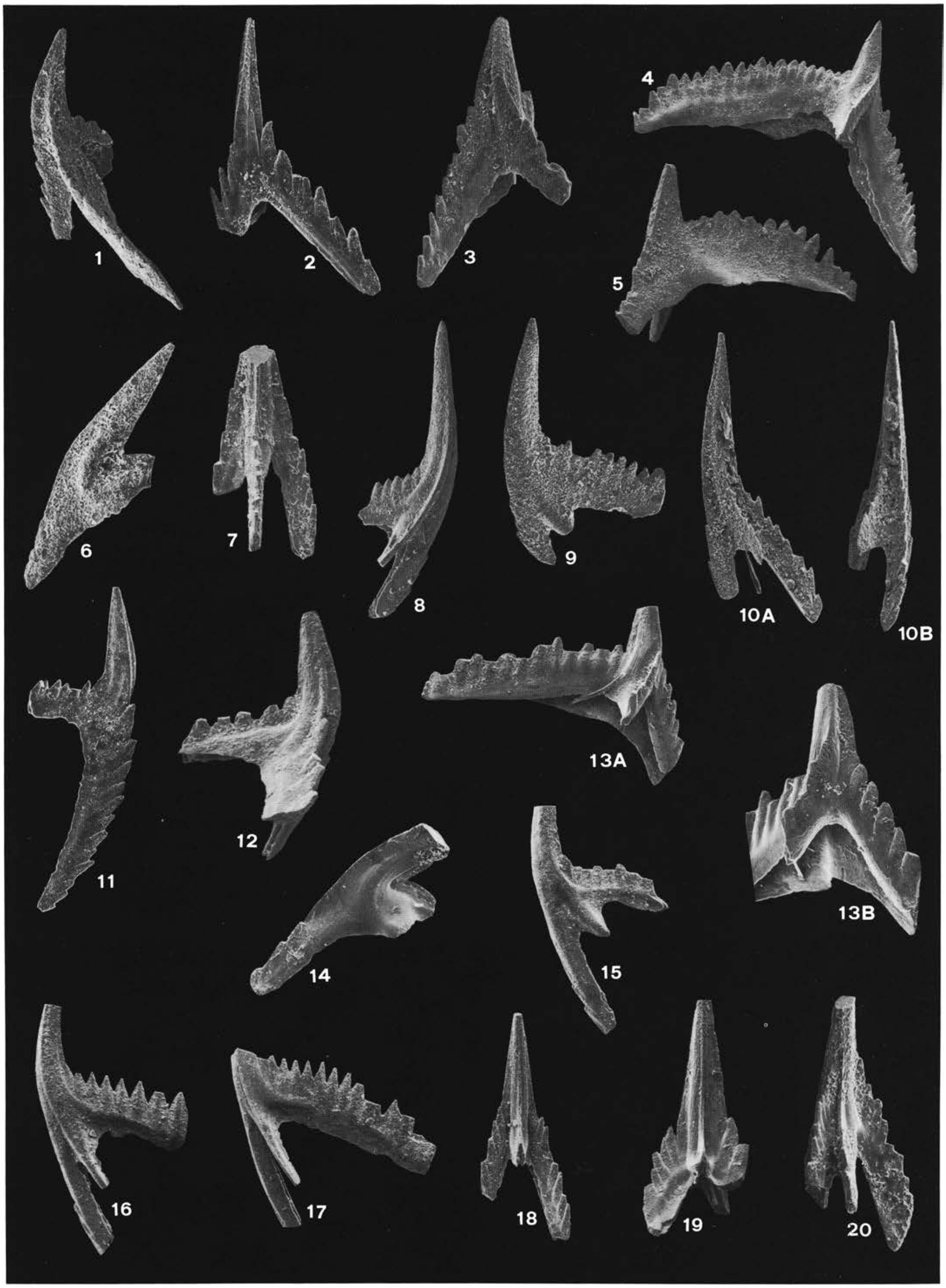

PLATE 1

PLATE 2

Figs. 1-12 *Baltoniodus clavatus* n.sp. Hagudden Section, Öland.
1) Paratype, Pa element, sample 694A, outer view, MGUH 19780, × 45.
2) Paratype, Pa element, sample 691, inner view, MGUH 19781, × 65.
3) Holotype, Pb element, sample 694A, outer view, MGUH 19782, × 70.
4) Paratype, Pb element, sample 694A, inner view, MGUH 19783, × 65.
5) Paratype, Sa element, sample 692, posterior view, MGUH 19784, × 90.
6) Paratype, Sa element, sample 691, lateral view, MGUH 19785, × 105.
7) Paratype, Sb element, sample 691, lateral view, MGUH 19786, × 80.
8) Paratype, M element, sample 693, lateral view, MGUH 19787, × 55.
9) Paratype, Sd element, sample 691, lateral view, MGUH 19788, × 125.
10) Paratype, Sd element, sample 692, MGUH 19789. 10A) posterior view, × 80; 10B) lateral view, × 85.
11) Paratype, Sc element, sample 691, lateral view, MGUH 19790, × 70.
12) Paratype, M element, sample 694A, lateral view, MGUH 19791, × 70.

Figs. 13-21 *Baltoniodus* n.sp. A. Hagudden Section, Öland.
13) Pa element, sample 695, lateral view, MGUH 19792, × 75.
14) Pa element, sample 697, anterior view, MGUH 19793, × 85.
15) Pb element, sample 697, inner view, MGUH 19794, × 90.
16) Pb element, sample 697, MGUH 19795. 16A) inner view, × 65; 16B) anterior view, × 90.
17) Sa element, sample 696, posterior view, MGUH 19796, × 70.
18) Sb element, sample 697, lateral view, MGUH 19797, × 80.
19) Sc element, sample 697, lateral view, MGUH 19798, × 85.
20) Sd element, sample 697, lateral view, MGUH 19799, × 100.
21) M element, sample 697, lateral view, MGUH 19800, × 110.

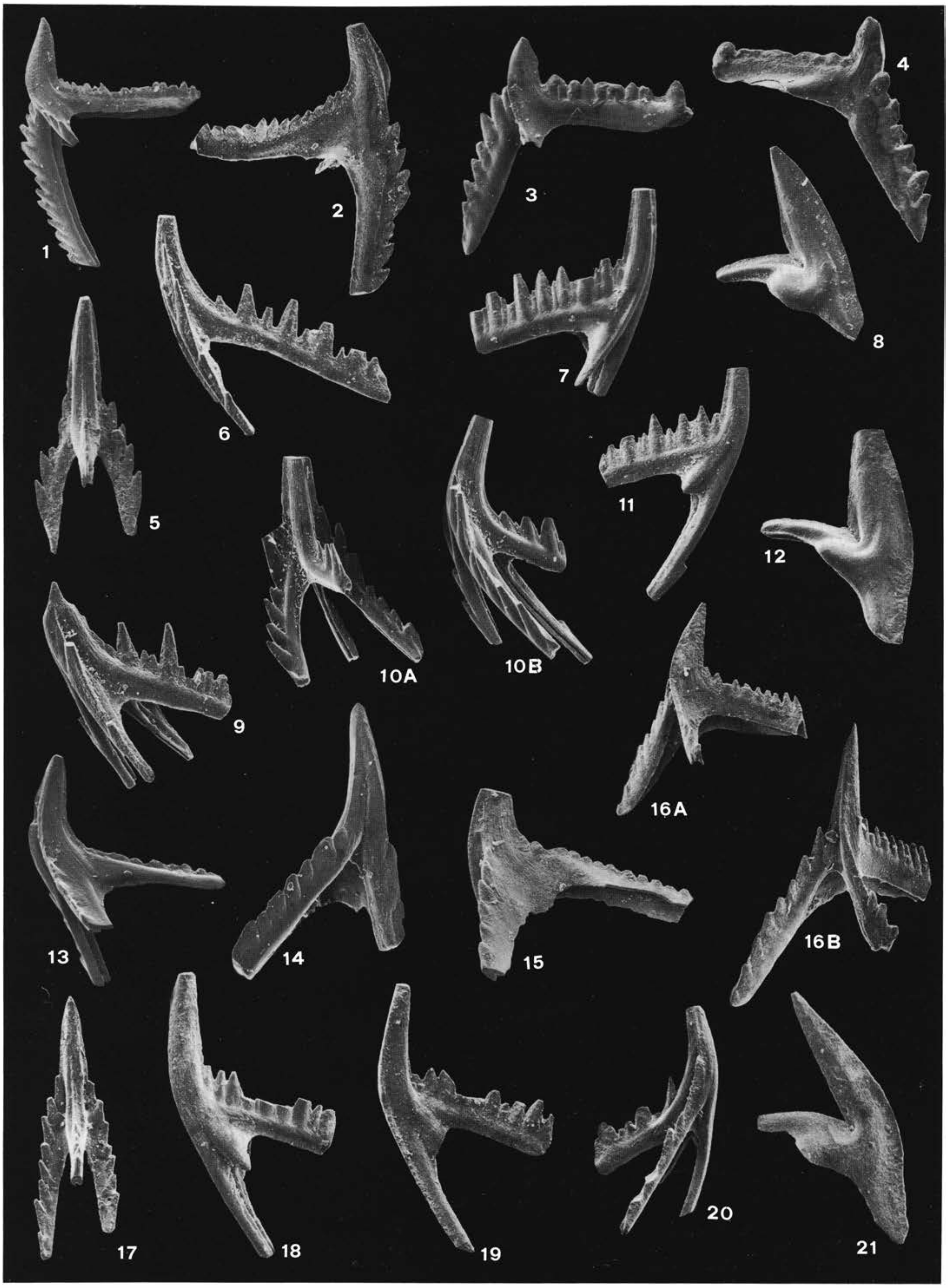

PLATE 2

PLATE 3

Figs. 1- 2 *Baltoniodus clavatus* n.sp. Hagudden Section, Öland.
1) Paratype, Pa element, sample 693, MGUH 19801. 1A) lateral view, × 70; 1B) anterior view, × 75.
2) Paratype, Pb element, sample 691, MGUH 19802. 2A) lateral view, × 65; 2B) anterior view, × 90.

Figs. 3- 7 *Cornuodus longibasis* (Lindström). Hagudden Section, Öland, Lateral view.
3) short-based symmetrical element, sample 677, MGUH 19803, × 145.
4) long-based symmetrical element, sample 675, MGUH 19804, × 80.
5) short- based asymmetrical element, sample 677, MGUH 19805, × 160.
6) bergstroemi element, sample 677, MGUH 19806, × 90.
7) asymmetrical element, sample 677, MGUH 19807, × 100.

Figs. 8-17 *Lenodus pseudoplanus* (Viira). Hagudden Section, Öland.
8) Sinistral Pa element, sample 694A, lateral view, MGUH 19808, x 75.
9) Dextral Pa element, sample 694A, lateral view, MGUH 19809, × 80.
10) Dextral Pa element, sample 694A, lateral view, MGUH 19810, × 125.
11) Sinistral Pa element, sample 696, upper view, MGUH 19811, × 135.
12) Pb element, sample 697, MGUH 19812. 12A) inner view, × 105; 12B) outer view, × 110; 12C) upper view, × 105.
13) M element, sample 694A, lateral view, MGUH 19813, × 100.
14) Sa element, sample 695, posterior view, MGUH 19814, × 100.
15) Sd element, sample 694A, postero-lateral view, MGUH 19815, × 110.
16) Sb element, sample 697, posterior view, MGUH 19816, × 120.
17) Sc element, sample 697, lateral view, MGUH 19817, × 100.

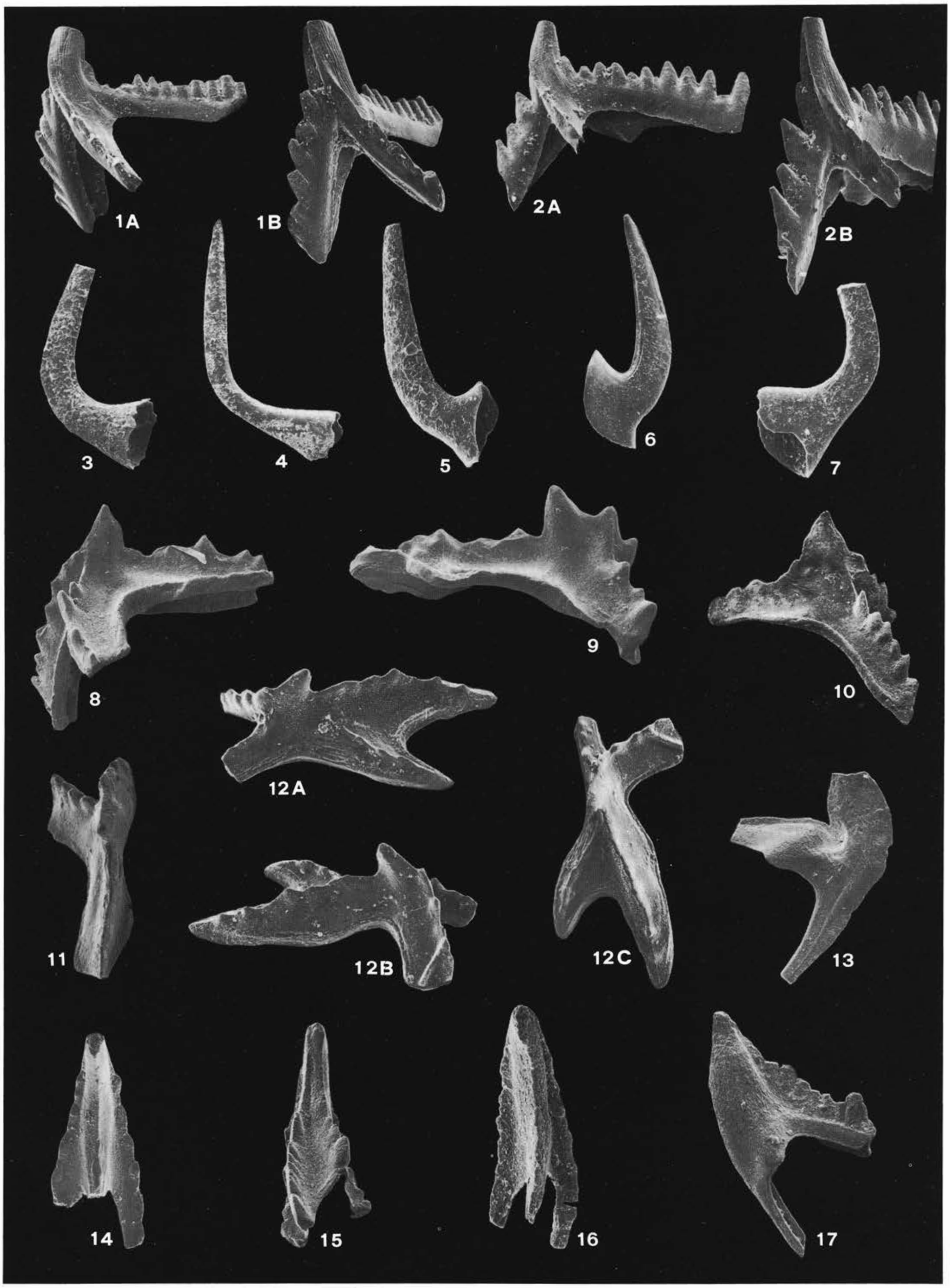

PLATE 3

PLATE 4

Figs. 1-13 *Lenodus* n.sp.A. Hagudden Section, Öland.

1) Sinistral Pa element, sample 693, MGUH 19818. 1A) Lateral view, × 60; 1B) upper view, × 55.
2) Sinistral Pa element, sample 691, lateral view, MGUH 19819, × 60.
3) Sinistral Pa element, small (?juvenile) specimen, lateral view, MGUH 19820, × 110.
4) Sinistral Pa element, sample 693, lateral view, MGUH 19821, × 55.
5) Dextral Pa element, sample 693, MGUH 19822. 5A) lateral view, × 60; 5B) upper view, × 60.
6) Pb element, small specimen, sample 692, MGUH 19823. 6A) upper view, × 110; 6B) outer view, × 105.
7) Dextral Pa element, sample 693, lateral view, MGUH 19824, × 75.
8) Pb element, sample 693, MGUH 19825. 8A) outer view, × 60; 8B) inner view, x 60; 8C) upper view, × 65.
9) M element, sample 692, lateral view, MGUH 19826, × 125.
10) Sa element, sample 691, posterior view, MGUH 19827, × 125.
11) Sb element, sample 693, posterior view, MGUH 19828, × 135.
12) Sc element, sample 690, lateral view, MGUH 19829, × 90.
13) Sd element, sample 691, postero-lateral view, MGUH 19830, × 100.

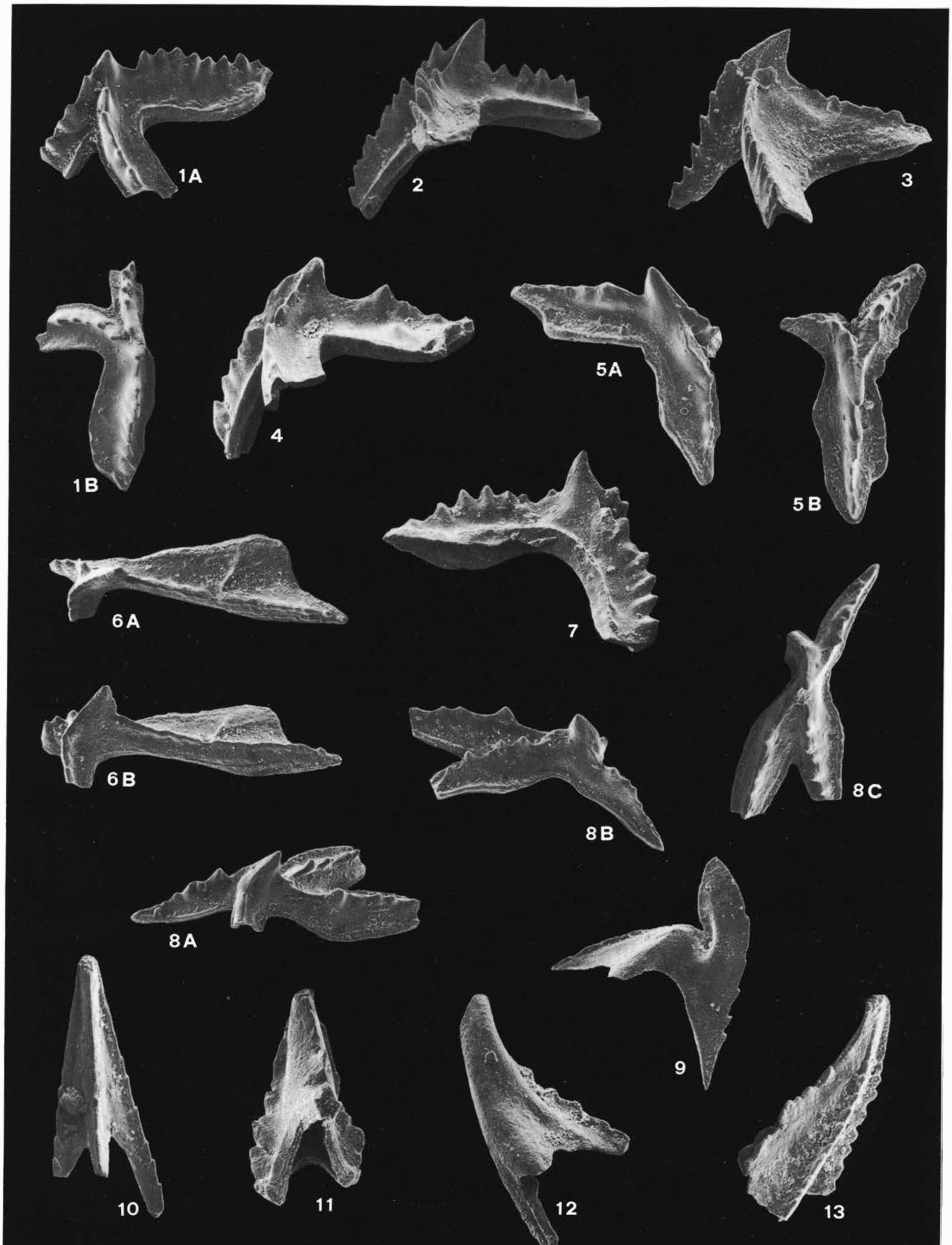

PLATE 4

PLATE 5

Figs. 1- 5 *Drepanoistodus contractus* (Lindström). Hagudden Section, Öland, Sample 673.
1) Oistodiform element, MGUH 19831, × 45.
2) Oistodiform element, MGUH 19832. 2A) × 40; 2B) Detail of the same, × 225.
3) Drepanodiform element, MGUH 19833, × 45.
4) Oistodiform element, MGUH 19834, × 45.
5) Drepanodiform element, MGUH 19835, × 50.
Figs. 6- 9 *Drepanoistodus forceps* (Lindström). Hagudden Section, Öland. Sample 673.
6) Drepanodiform element, MGUH 19836, × 50.
7) Oistodiform element, MGUH 19837, × 75.
8) Drepanodiform element, MGUH 19838, × 55.
9) Suberectiform element, MGUH 19839, × 45.
Figs. 10-16 *Drepanoistodus* cf. *D. basiovalis* (Sergeeva). Hagudden Section, Öland.
10) Planiform element, sample 675, MGUH 19840, × 50.
11) Homocurvatiform element, sample 675, MGUH 19841, × 60.
12) Scandodiform element, sample 675, MGUH 19842, × 50.
13) Suberectiform element, sample 675, MGUH 19843, × 60.
14) Oistodiform element, sample 674, MGUH 19844, × 90.
15) Oistodiform element, sample 675, MGUH 19845. 15A) × 45; 15B) Detail of the inverted basal cavity, × 210.
16) Oistodiform element, sample 674, MGUH 19846, × 100.
Fig. 17 *Drepanoistodus venustus* (Stauffer). Hagudden Section, Öland. Oistodiform element, sample 696, MGUH 19847, × 135.
Fig. 18-24 *Drepanoistodus basiovalis* (Sergeeva). Hagudden Section, Öland.
18) Planiform element, sample 677, MGUH 19848, × 65.
19) Scandodiform element, sample 677, MGUH 19849, × 70.
20) Homocurvatiform element, sample 677, MGUH 19850, × 70.
21) Suberectiform element, sample 677, MGUH 19851, × 65.
22) Oistodiform element, sample 677, MGUH 19852, × 80.
23) Oistodiform element, sample 677B, MGUH 19853, × 100.
24) Oistodiform element, sample 677A, MGUH 19854. 24A) × 45; 24B) Detail of the inverted basal cavity, × 210.
(All specimens shown in lateral view).

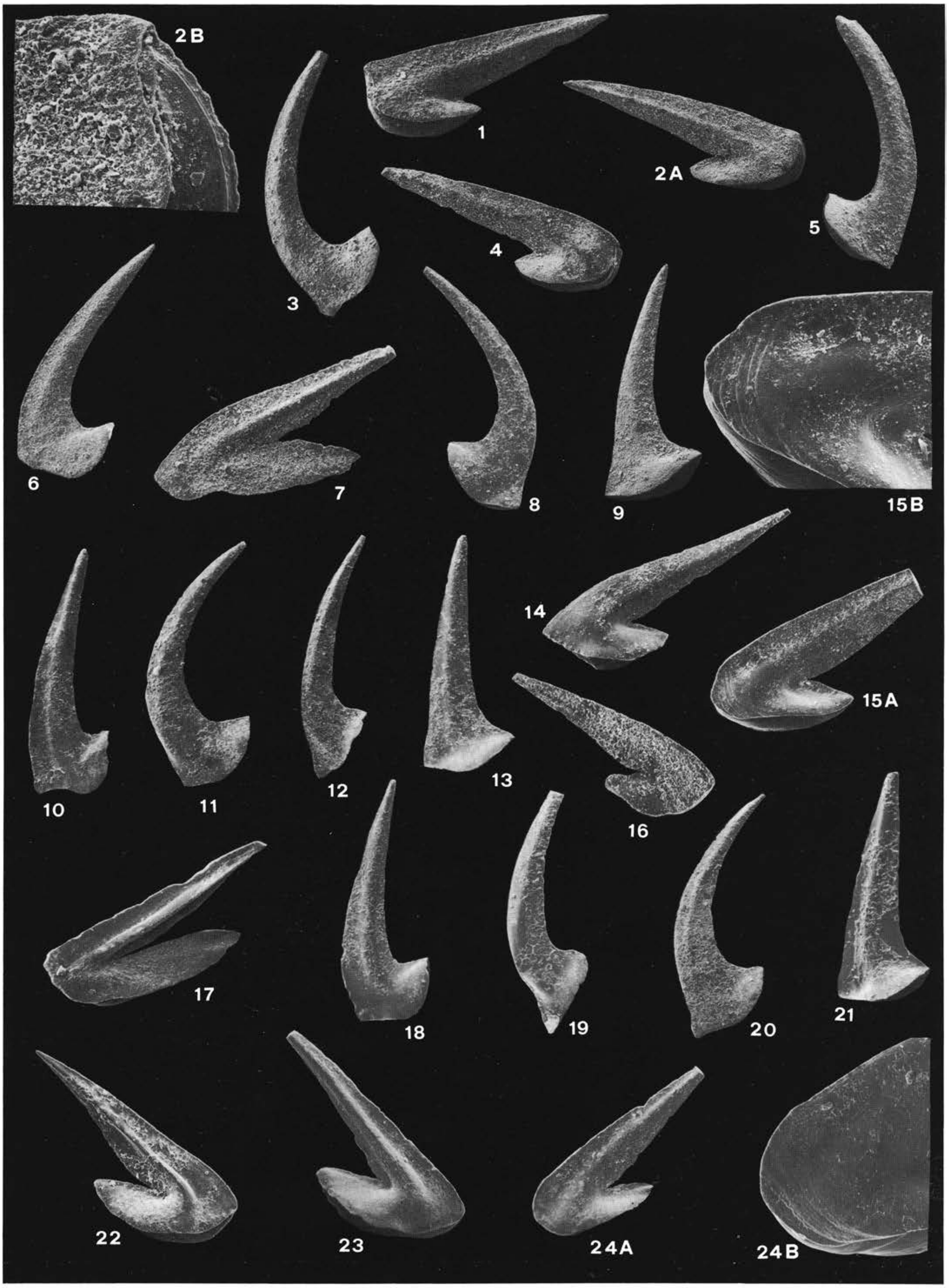
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PLATE 5

PLATE 6

Figs. 1- 7 *Microzarkodina flabellum* (Lindström). Hagudden Section, Öland. Sample 673.
1) P element, outer view, MGUH 19855, × 100.
2) P element, inner view, MGUH 19856, × 85.
3) M element, lateral view, MGUH 19857, × 85.
4) Sd element, lateral view, MGUH 19858, × 90.
5) Sc element, lateral view, MGUH 19859, × 90.
6) Sa element, posterior view, MGUH 19860, × 85.
7) Sb element, posterior view, MGUH 19861, × 140.

Figs. 8-16 *Microzarkodina parva* Lindström. Hagudden Section, Öland. Sample 676.
8) P element, outer view, MGUH 19862, × 85.
9) P element, inner view, MGUH 19863, × 95.
10) M element, lateral view, MGUH 19864, × 85.
11) M element, lateral view, MGUH 19865, × 80.
12) Sa element, posterior view, MGUH 19866, × 130.
13) Sb element, inner view, MGUH 19867, × 115.
14) Sd element, postero-lateral view, MGUH 19868, × 125.
15) Sb element, outer view, MGUH 19869, × 120.
16) Sc element, lateral view, MGUH 19870, × 80.

Figs. 17-24 *Microzarkodina hagetiana* n.sp. Hagudden Section, Öland.
17) Holotype, P element, sample 696, inner view, MGUH 19871, × 125.
18) Paratype, P element, sample 696, inner view, MGUH 19872, × 135.
19) Paratype, P element, sample 696, outer view, MGUH 19873, × 155.
20) Paratype, Sb element, sample 696, lateral view, MGUH 19874, × 150.
21) Paratype, Sc element, sample 696, lateral view, MGUH 19875, × 130.
22) Paratype, M element, sample 696, lateral view, MGUH 19876, × 110.
23) Paratype, Sa element, sample 697, posterior view, MGUH 19877, × 165.
24) Paratype, Sd element, sample 696, postero-lateral view, MGUH 19878, × 220.

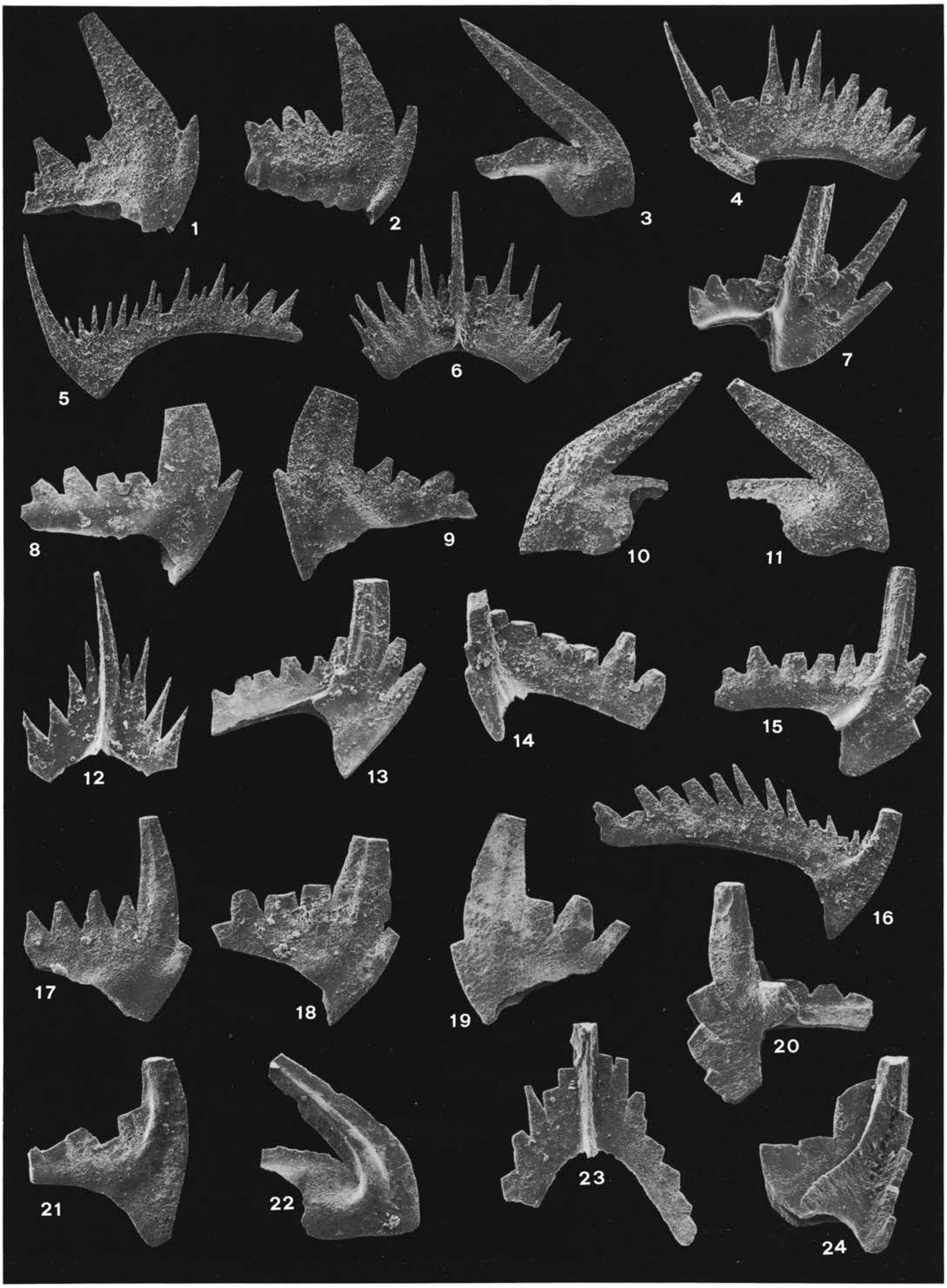

PLATE 6

PLATE 7

Figs. 1- 4 *Parapanderodus* n.sp. A. Hagudden Section, Öland. Sample 689.
1A) Postero-lateral view, × 70; 1B) lateral view, × 55; MGUH 19879.
2) Lateral view, MGUH 19880, × 115.
3) Symmetrical element, posterior view, MGUH 19881, × 100.
4A) Postero-lateral view, × 110; 4B) lateral view, × 100, MGUH 19882.
Figs. 5-10 *Paroistodus originalis* (Sergeeva). Hagudden Section, Öland.
5) Oistodiform element, sample 675, MGUH 19883, × 55.
6) Drepanodiform element, sample 675, MGUH 19884, × 55.
7) Drepanodiform element, sample 675, MGUH 19885, × 60.
8) Drepanodiform element, sample 674, MGUH 19886, × 80.
9) Drepanodiform element, sample 675, MGUH 19887, × 60.
10) Drepanodiform element, sample 674, MGUH 19888, × 105.
Figs. 11-12 *Periodon* sp. Hagudden Section, Öland. Sample 683.
11) M element, MGUH 19889, × 90.
12) M element, MGUH 19890, × 70.
Figs. 13-14 *Parapaltodus simplicissimus* Stouge. Hagudden Section, Öland.
13) Scandodiform element, sample 694, MGUH 19891, x 100.
14) Drepanodiform element, sample 690, MGUH 19892, × 45.
Fig. 15 *Parapaltodus* sp. Hagudden Section, Öland. Sample 683, MGUH 19893, × 110.
Figs. 16-17 *Polonodus* sp.A. Hagudden Section, Öland. Sample 690.
16A) Lateral view, x 75; 16B) upper view, x 70; MGUH 19894.
17A) Upper view, × 75; 17B) detail of the same, × 310; MGUH 19895.
Figs. 18-20 *Polonodus*? sp. B. Hagudden Section, Öland. Sample 694A.
18A) lateral view, MGUH 19896, × 55; 18B) upper view of the same, × 55.
19) Upper view, MGUH 19897, × 65.
20) Upper view, MGUH 19898, × 110.
(Specimens shown in lateral view, if not specified).

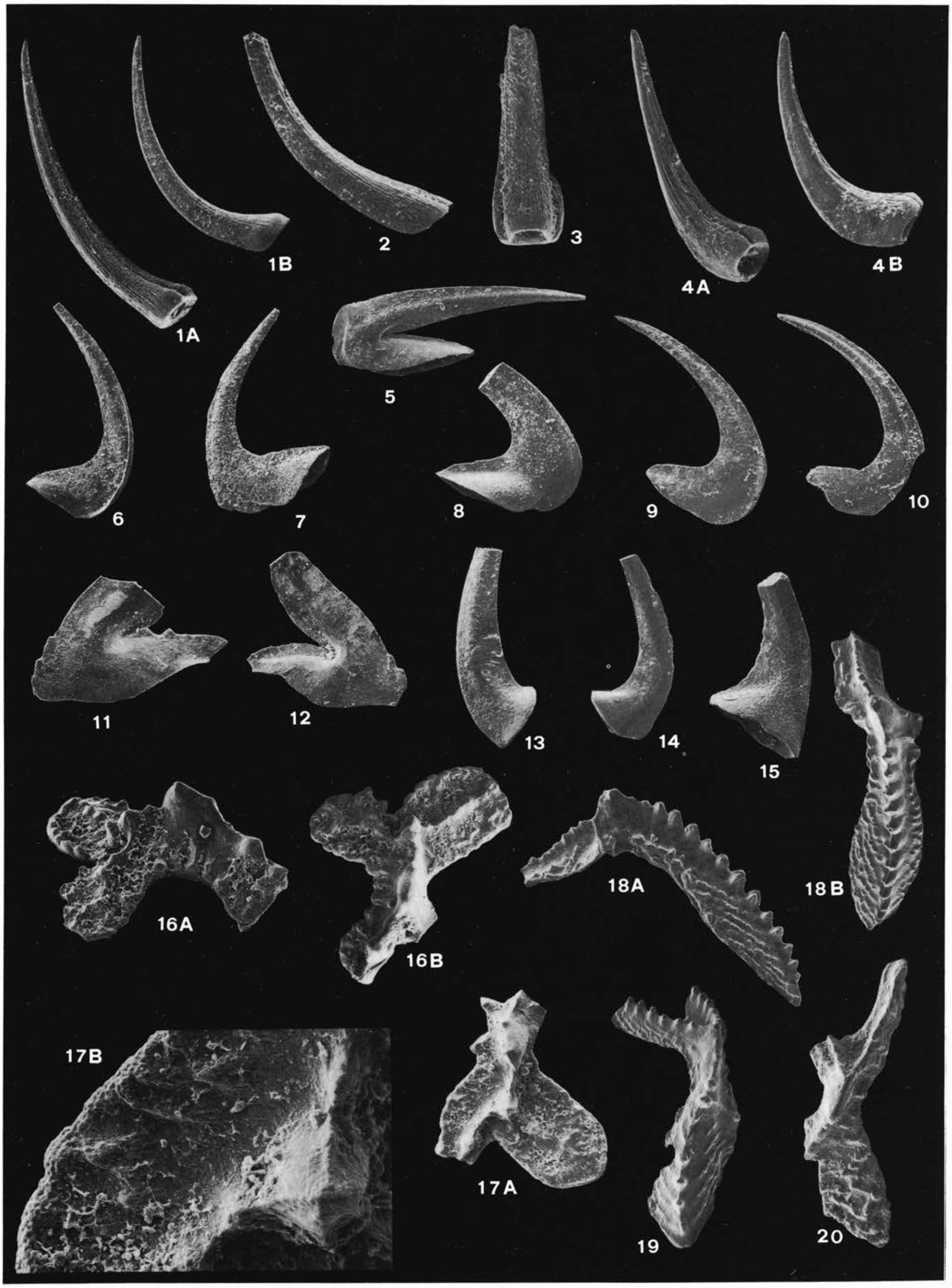

PLATE 7

PLATE 8

Figs. 1- 5 *Protopanderodus rectus* (Lindström). Hagudden Section, Öland.
1) Subsymmetrical acontiodiform element; sample 678, MGUH 19899, × 55.
2) Symmetrical acontiodiform element, sample 674, MGUH 19900, × 65.
3) Asymmetrical acontiodiform element, sample 674, MGUH 19901, × 120.
4) Scandodiform element, sample 675, MGUH 19902, × 80.
5) Unicostate acontiodiform element, sample 673, MGUH 19903, × 65.

Figs. 6- 8 *Protopanderodus* sp. Hagudden Section, Öland. Sample 681.
6) Symmetrical bicostate acontiodiform element, MGUH 19904, × 110.
7) Nearly symmetrical acontiodiform element, MGUH 19905, × 90.
8) Scandodiform element, MGUH 19906, × 125.

Figs. 9-12 *Protopanderodus* cf. *P. varicostatus* (Sweet & Bergström), Hagudden Section, Öland.
9) Asymmetrical acontiodiform element, sample 677, MGUH 19907, × 50.
10) Symmetrical acontiodiform element, sample 677B, MGUH 19908, × 50.
11) Asymmetrical acontiodiform element, sample 677, MGUH 19909, × 60.
12) Scandodiform element, sample 685, MGUH 19910, × 45.

Figs. 13-19 *Scalpellodus latus* (van Wamel). Hagudden Section, Öland.
13) Drepanodiform element, sample 674, MGUH 19911, × 100.
14) Drepanodiform element, sample 677B, MGUH 19912, × 90.
15) Drepanodiform element, sample 677B, MGUH 19913, × 95.
16) Scandodiform element, sample 677A, MGUH 19914, × 100.
17) Drepanodiform element, sample 677A, MGUH 19915, × 80.
18) Drepanodiform element, sample 677B, MGUH 19916, × 135.
19) Drepanodiform element, sample 677B, MGUH 19917, × 95.

Figs. 20-29 *Scalpellodus gracilis* (Sergeeva). Hagudden Section, Öland.
20) Drepanodiform element, sample 687bis, MGUH 19918, × 80.
21) Drepanodiform element, sample 687bis, MGUH 19919, × 100.
22) Drepanodiform element, sample 697, MGUH 19920, × 75.
23) Drepanodiform element, sample 697, MGUH 19921, × 120.
24) Drepanodiform element, sample 687bis, MGUH 19922, × 150.
25) Drepanodiform element, sample 697, MGUH 19923, × 90.
26) Drepanodiform element, sample 687bis, MGUH 19924, × 105.
27) Scandodiform element, sample 688, MGUH 19925, × 130.
28) Scandodiform element, sample 687bis, MGUH 19926, × 130.
29) Scandodiform element, sample 697, MGUH 19927, x 90.

(All specimens shown in lateral view).

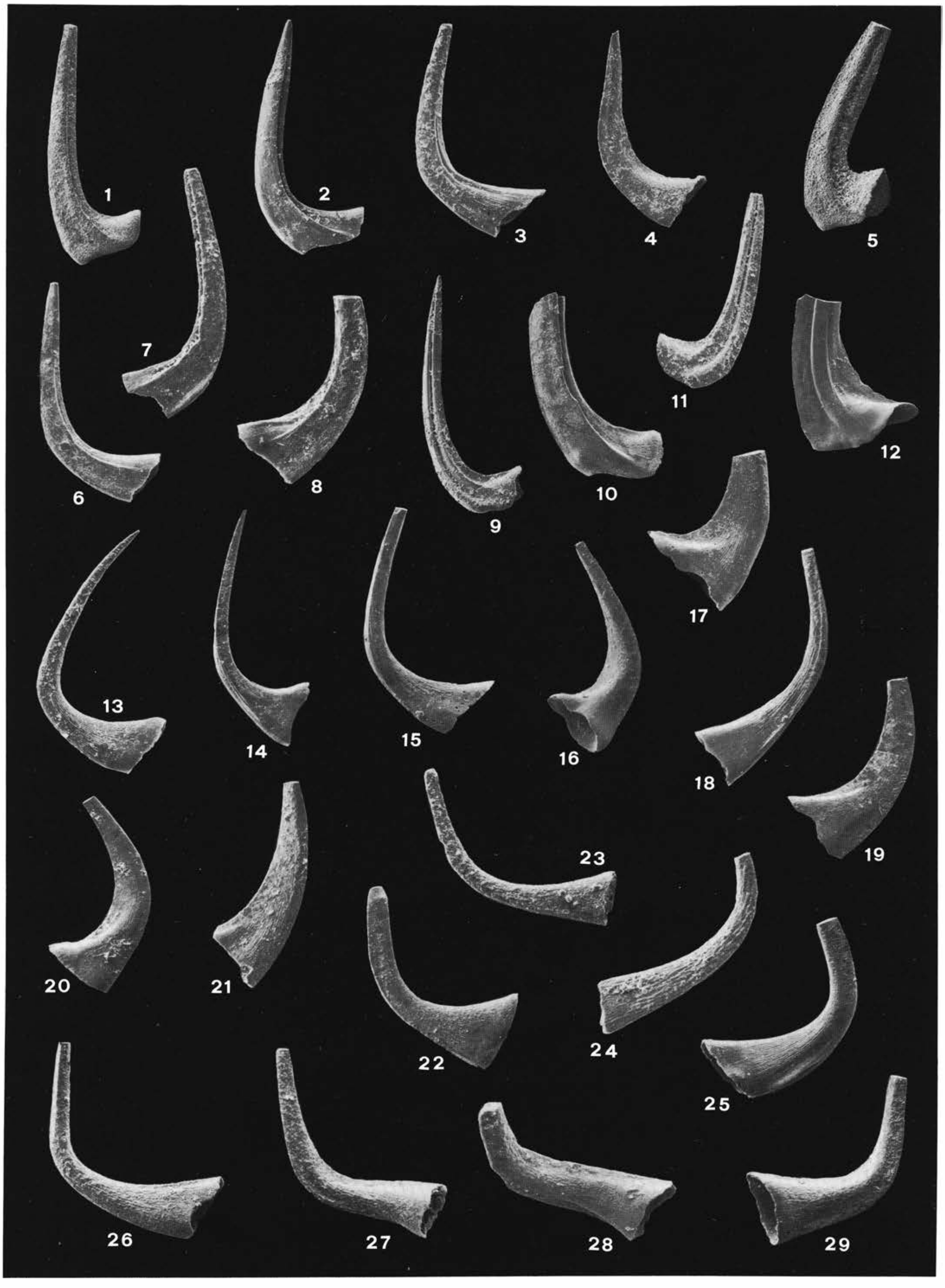

PLATE 8

PLATE 9

Figs. 1- 6 *Scolopodus rex* Lindström. Hagudden Section, Öland.
1) Symmetrical element, sample 674, MGUH 19928, × 25.
2) Asymmetrical element, sample 673, MGUH 19929, × 55.
3) Asymmetrical element, sample 673, MGUH 19930, × 80.
4) Asymmetrical element, sample 674, MGUH 19931, × 40.
5) Asymmetrical element, sample 673, MGUH 19932, × 40.
6) Asymmetrical element, sample 673, MGUH 19933, × 45.

Figs. 7-10 *Drepanodus arcuatus* Pander. Hagudden Section, Öland. Sample 675.
7) Arcuatiform element, MGUH 19934, × 60.
8) Graciliform element, MGUH 19935, × 45.
9) Pipaform element, MGUH 19936, × 55.
10) Sculponeaform element, MGUH 19937, × 25.

Fig. 11 *Drepanodus planus* (Pander). Hagudden Section, Öland. Arcuatiform element, sample 675, MGUH 19938, × 30.

Figs. 12-13 «*Scolopodus*» *peselephantis* Lindström. Hagudden Section, Öland. Sample 674.
12) Asymmetrical element, MGUH 19939, × 105.
13) Symmetrical element, MGUH 19940, × 110.

Figs. 14-18, 20-25 «*Semiacontiodus*» *cornuformis* (Sergeeva). Hagudden Section, Öland.
14) Scandodiform element, sample 683, MGUH 19941, × 95.
15) Long-based reclined element, sample 683, MGUH 19942, × 80.
16) Symmetrical element, sample 677, posterior view, MGUH 19943, × 95.
17) Short-based proclined element, sample 683, MGUH 19944, × 110.
18) Symmetrical element, sample 689, posterior view, MGUH 19945, × 80.
20) Long-based reclined element, sample 693, MGUH 19947, × 85.
21) Short-based proclined element, sample 694A, MGUH 19948, × 80.
22) Symmetrical element, sample 693, MGUH 19949, × 100.
23) Symmetrical element, sample 693, posterior view, MGUH 19950, × 80.
24) Short-based reclined element, sample 693, MGUH 19951, × 75.
25) Long-based proclined element, sample 693, MGUH 19952, × 85.

Figs. 19, 26, 27 *Dapsilodus mutatus* (Branson & Mehl). Hagudden Section, Öland, sample 695.
19) MGUH 19946, × 90.
26) MGUH 19953, × 105.
27) MGUH 19954, × 120.

(Specimens shown in lateral view, if not specified).

PLATE 9

PLATE 10

Figs. 1-5, 7-10 *Trapezognathus quadrangulum* Lindström. Hagudden Section, Öland.
1) Pa element, sample 673, MGUH 19955, × 80.
2) Pb element, sample 673, MGUH 19956, × 90.
3) M element, sample 676, MGUH 19957, × 95.
4) M element, sample 673, MGUH 19958, × 90.
5) Sa element, sample 673, posterior view, MGUH 19959, × 125.
7) Sb element, sample 673, posterior view, MGUH 19961, × 100.
8) Sd element, sample 673, posterior view, MGUH 19962, × 125.
9) Sc element, sample 673, MGUH 19963, × 105.
10) Sc element, sample 673, MGUH 19964, × 95.

Figs. 6, 11-17 *Trapezognathus* sp. Hagudden Section, Öland.
6) M element, sample 687bis, MGUH 19960, × 110.
11) M element, sample 685A, MGUH 19965, × 70.
12) Pa element, sample 685, MGUH 19966, × 65.
13) Sa element, sample 685, posterior view, MGUH 19967, × 135.
14) Sd element, sample 685A, posterior view, MGUH 19968, × 80.
15) Sb element, sample 685, MGUH 19969, × 115.
16) Sc element, sample 690, MGUH 19970, × 105.
17) Sd element, sample 685, postero-lateral view, MGUH 19971, × 105.

Figs. 18-26 *Trigonodus brevibasis* (Sergeeva). Hagudden Section, Öland.
18) P element, sample 675, MGUH 19972, × 50.
19) P element, sample 675, MGUH 19973, × 110.
20) Sd element, sample 675, MGUH 19974, × 60.
21) P element, sample 679, MGUH 19975, × 95.
22) Sd element, sample 675, MGUH 19976, × 50.
23) M element, sample 675, MGUH 19977, × 55.
24) Sb element, sample 675, MGUH 19978, × 60.
25) Sa element, sample 675, posterior view, MGUH 19979, × 55.
26) Sc element, sample 675, MGUH 19980, × 50.

(Specimens shown in lateral view, if not specified).

PLATE 10

Appendix I

Stratigraphic section from Hagudden

Bed no.	Description	Thickness m	Cumulative thickness m
	Bruddesta Formation (> 0,10 m)		
1.	Micrite, redbrown argillaceous, hematite and limonite. Trilobites and cephalopods are the most common bioclasts # 673: 0,05-0,10 m.	0,10	0,10
	Horns Udde Formation (1,30 m)		
2.	Micrite to wackestone. Grey to violet, red stringers due to hematite/limonite impregnations. Bloody layer (= B_1 on fig. 2) 15 cm above base of formation. Cephalopods and trilobites abundant. # 674: 0,15-0,20 m.	0,44	0,54
3.	Wackestone, grey to yellow. Red to redbrown stringers. Near top is prominent hematitic layer at 0,32 m above base of unit. (= B_2 on fig. 2). # 675: 0,00-0,05 m # 676: 0,21-0,26 m # 678: 0,29-0,32 m # 679: 0,32-0,36 m Trilobites: *Niobe lindstroemi* 0,29 m above base of unit.	0,36	0,90
4.	Wackestone, grey; minor glauconite; finely bedded # 677: 0,04-0,12 m # 677a: 0,22-0,26 m	0,32	1,22
5.	Wackestone, grey to yellow, minor glauconite; medium bedded. Cephalopods and trilobites common. # 677b: 0,13-0,18 m.	0,18	1,40
	Formation A (1,29 m)		
6.	Wackestone, grey to green, glauconitic and glauconite sand, wavy bedded. # 680: 0,40-0,10 m.	0,20	1,60
7.	Wackestone-packstone, green to grey, glauconitic, medium bedded. # 680a: 0,08-0,13 m # 681: 0,13-0,18 m # 682: 0,18-0,20 m	0,20	1,80
8.	Wackestone, glauconitic, fine-medium bedded. Brachiopods and trilobites common. # 683: 0,06-0,10 m # 684: 0,30-0,34 m	0,34	2,14
9.	Micrite to wackestone, darkgrey, argillaceous and with interbeds of (2-3 cm) siltstone, black, organic rich, minor glauconite. Base with limonite impregnated fossils (brachiopods). # 685: 0,04-0,08 m # 685a: 0,10-0,15 m # 686: 0,28-0,32 m Trilobites: *Megistaspis acuticauda* Graptolites: *Tetragraptus bigsbyi* *Maerandrograptus? geniculatus*	0,34	2,48

Bed no.	Description	Thickness m	Cumulative thickness m
10.	«Ooid» Beds, limonitic impregnated. Two beds. The lower with limonitic yellow brown «ooids». Upper 8 cm is dark grey limestone with ooids in argillaceous matrix. Limonitic ostracodes. # 687: 0,00-0,08 m	0,21	2,69
	Formation B (1,60 m)		
11.	Wackestone, grey to darkgrey. The bed forms a local bank along the cliff (= Bed b in Bohlin 1949). # 687 bis.	0,06	2,75
12.	Limestone nodules, light yellow glauconitic in glauconite sandy matrix. Rich in brachiopods, trilobites, bryozoans, conularians, ostracodes (cfr. Bohlin, 1949), graptolites. Trilobites: *Asaphus expansus* *Asaphus raniceps* *Ptychophyge angustifrons* *Platillaenus ladogensis* Graptolites: *Didymograptus formosus* *Didymograptus* n.sp. B Skevington 1965	0,38	3,13
13.	Two thin beds of limestone, silty, light grey, redspotted. Top is the straight discontinuity surface. (= D_1 in fig. 2).	0,02	3,15
14.	Limestone, light grey glauconitic burrows. Brachiopods common. Graptolites: *Didymograptus* n. sp. B Skevington *Didymograptus* n. sp. A. aff. *gracilis* *Glyptograptus dentatus* *Pseudoclimacograptus amptochilus* Trilobites: *Illeanus sarsi* # 690: 0,00-0,05 m.	0,15	3,30
15.	Wackestone, nodular grey, undular bedded, glauconitic. Surface is a prominent discontinuity surface. Brachiopods common. Graptolites: *Pseudoclimacograptus camptochitus* *Glyptograptus austrodentatus oelandicus* Trilobites: *Illeanus sarsi* *Asaphus expansus* # 690a: 0,0-0,05 m # 691: 0,18-0,22 m	0,30	3,60
16.	Wackestone, massive, glauconitic vertical burrows. Top 3 cm is a single prominent bed. Upper surface is a local prominent discontinuity surface. # 692: 0,07-0,12 m	0,20	3,80
17.	Wackestone, lightgrey to yellow. Beds 3-5 cm, glauconite variably present. Load pressure surfaces. Upper surface of unit 17 is a prominent local discontinuity surface. Trilobites: *Pliomera fischeri* *Lichas coelorrhina* *L. verrucosus* *Megistaspis heres* *M. rudis* *M. cf. gibba*	0,44	4,24

Bed no.	Description	Thickness m	Cumulative thickness m
	Illeanus esmarcki *I.* cf. *ladogensis* *Trinodus* cf. *glabratus* *Pterygmetopus sclerops* *Asaphus raniceps* *Illeanus aduncus* # 693: 0,00-0,07 m # 693a: 0,20-0,23 m # 694: 0,37-0,44 m		
18.	Wackestone, bedded, glauconite green to yellow. Base and top are well developed discontinuity surfaces. Trilobites: *Illeanus aduncus* *Platillaenus* sp. a.	0,15	4,39
	Formation C (> 1,15 m)		
	Top covered by debris and plants.		
19.	Wackestone, ondular bedded. Beds 2-3 cm, with thin shaly partings. Unit partly covered. Bioclasts dominantly are trilobites. Base of unit it a discontinuity surface. Samples: # 697: 1,0 m # 696: 0,85-0,90 m # 695: 0,30-0,40 m # 694a: 0,00-0,06 m Trilobites: *Pliomeria fischeri* *Megistaspis heroica* *M. rudis* *Illeanus esmarcki* *Illeanus aduncus* *Bredaspis ensifer* *Asaphus* cf. *raniceps* *(? = Asaphus «raniceps»)* Bohlin 1949, 1955; Jaanusson 1957; Whittington & Bohlin 1960.	> 1,15	5,54

REFERENCES

AN T. (1981): Recent Progress in Cambrian and Ordovician conodont Biostratigraphy of China. *Geol. Soc. Am. Sp. Pap.*, 187, 209-226, 4 pls., Boulder.

AN T. (1987): The Lower Paleozoic conodonts of South China. 1-238, 35 pls., Peking Univ. Publ. House, Beijing.

AN T., ZHANG F., XIANG W., ZHANG Y., XU W., ZHANG H., JIANG D., YANG C., LIN L., CUI Z. & YANG X. (1983): The conodonts of North China and adjacent regions (in chinese with english abstract), 1-223, 33 pls., Beijing.

AN T., DU G. & GAO Q. (1985): Ordovician conodonts from Hubei, China *Geol. Publ. House*, (in chinese, with english abstract), 64 pp, 18 pls., Beijing.

ANDERSSON J.G. (1985): Om öländska raukar. *Bih. K. Sven. Vetenskapsakad. Handl.*, 21, avd. 2 no. 4, 1-15. Stockholm.

BAGNOLI G., STOUGE S., & TONGIORGI M. (1988): Acritarchs and conodonts from the Cambro-Ordovician Furuhall (Köpingsklint) Section (Öland, Sweden). *Riv. It. Paleont. Strat.*, 94 (2), 163-248, pls. 25, 31, Milano.

BARNES C.R. & POPLAWSKI M.L.S. (1973): Lower and Middle Ordovician conodonts from the Mystic Formation, Quebec, Canada. *J. Paleont.*, 47, 760-790, 5 pls. Tulsa.

BEDNARCZYK W. (1969): The Ordovician from the boreholes Dobre 1 and Sokolow Podlaski 1 (Western part of the Podlasie Basin). *Acta geol. Polon.*, 19, 779-791, 2 pls., Warszawa.

BERG-MADSEN V. (1987): A new cyclocystoid from the Lower Ordovician of Öland, Sweden. *Palaeontology* 30(1), 105-116. London.

BERGSTRÖM S.M. (1971): Conodont biostratigraphy of the Middle and Upper Ordovician of Europe and Eastern North America. *Geol. Soc. America Mem.*, 127, 83-161, 2 pls., Boulder.

BOHLIN B. (1949): The Asaphus Limestone in northernmost Öland. *Bull. Geol. Inst. Uppsala*, 33, 529-570, Uppsala.

BOHLIN B. (1955): The Lower Ordovician Limestone between the *Ceratopyge* Shale and the *Platyurus* Limestone of Böda Hamn. *Bull. Geol. Inst. Uppsala*, 35, 111-151, Uppsala.

BOHLIN B. (1960): Trilobites of the genus *Megistaspis* from the Vaginatum Limestone of Scandinavia. *Bull. Geol. Inst. Uppsala*, 38 (2), 156-205, 12 pls., Uppsala.

BRANSON E.B. & MEHL M.G. (1933): Conodont studies. *Missouri Univ. Studies* 8, 1-349, Columbia, Missouri.

COOPER B.J. (1976): Multielement conodonts from the St. Clair Limestone (Silurian) of Southern Illinois. *J. Paleont.* 50, 205-217, Tulsa, Oklahoma.

COOPER B.J. (1981): Early Ordovician conodonts from the Horn Valley Silststone, central Australia. *Palaeontology*, 24, 147-183, pls. 26-32, London.

CRESPIN I. (1943): Conodonts from the Waterhouse Range, Central Australia. *Trans. R. Soc. S. Aust*, 67, 231-233.

DZIK J. (1976): Remarks on the evolution Ordovician conodonts. *Acta Palaeont. Polon.*, 21, 395-455, 2 pls., Warszawa.

DZIK J. (1983): Relationships between Ordovician Baltic and North American Midcontinent conodont faunas. *Fossils and Strata*, 15, 59-85, 12 figs., Oslo.

EISENACK A. (1976): Microfossilien aus dem Vaginatenkalk von Hälluden, Öland, *Palaeontographica*, 154 Abt. A, 181-203, Stuttagart.

EPSTEIN A.G., EPSTEIN J.B. & HARRIS L. (1977): Conodont color alteration - and index to organic metamorphism. *U.S. Geol. Surv. Prof. Paper* 995, 1-27, Washington D.C.

ETHINGTON R.L. & CLARK D.L. (1981): Lower and Middle Ordovician conodonts from the Ibex area, western Millard County, Utah. *Brigham Young Univ. Geol. Studies*, 28 (2) 155 pp. 14 pls., Provo.

FÅHRÆUS L.E. (1966): Lower Viruan (Middle Ordovician) conodonts from the Gullhögen Quarry, southern central Sweden. *Sver. Geol. Unders.* C:610, 1-40, Stockholm.

FÅHRÆUS L.E. (1982): Recognition and redescription of PANDER's (1856) *Scolopodus* (form-)species - constituents of multi-element taxa (Conodontophorida, Ordovician). *Geologica et Palaeontologica*, 16, 19-28, 3 pls., Marburg.

FÅHRÆUS L.E. & HUNTER D.R. (1985): The curvature-transition series: Integral part of some simple-cone conodont apparatuses (Panderodontacea, Distacodontacea, Conodontata). *Acta Palaeont. Polon.*, 30 (3-4), 177-189, Warszawa.

GEDIK I. (1977): Orta Toroslar'da konodont biyostratigrafisi (Conodont biostratigraphy in the Middle Taurus). *Turk. Jeol. Kurumu Bul.*, 20, 35-48, 2 pls., Ankara.

GRAHN Y. (1980): Early Ordovician Chitinozoa from Öland. *Geol. Surv. Sweden, Ser. C*, 775, 41 pp., Uppsala.

HADDING A.R. (1913): Undre dicellograptus-skiffern i Skåne jämte några därmed ekvivalenta bildningar. *Lunds univ. Årsskr. N.F.* Avd. 2, 9-15, 1-90, Lund.

HARRIS R.W. & HARRIS B. (1965): Some West Spring Creek (Ordovician Arbuckle) conodonts from Oklahoma. *Okla. Geol. Notes*, 25, 34-37.

HOLM G. (1882): Om de vigtigaste resultaten från en sommaren 1882 udförd geologisk-palaeontologisk resa på Öland. *Oversigt k. Sven. Vetenskapsakad. Förhandl.* 7, 1882, 63-73, Stockholm.

HOLM G. (1893): Sveriges kambrisk-siluriska Hyolithidae och Conulariidae. *Sver. Geol. Unders.* Ser. C112, 1-173, Stockholm.

JAANUSSON V. (1957): Unterordovizische *Illaeniden* aus Skandinavien. *Bull. Geol. Inst. Uppsala*, 37, 153-174, Uppsala.

JAANUSSON V. (1960)a: On the Series of the Ordovician System. *Proc. 21st. Int. Geol. Congr. Copenhagen. 1960*, VII, 78-81, Copenhagen.

JAANUSSON V. (1960)b: The Viruan (Middle Ordovician) of Öland. *Bull. Geol. Inst. Uppsala*, 38, 207-288, Uppsala.

JAANUSSON V. (1960)c: Graptoloids from the Ontikan and Viruan (Ordov.) Limestones of Estonia and Sweden. *Bull. Geol. Inst. Uppsala*, 38, 206-366, Uppsala.

JAANUSSON V. & MUTVEI H. (1951): Ein Profil durch den *Vaginatum* -Kalkstein im Siljan-Gebiet, Dalarna. *Geol. Fören. Stockolm Förh*, 73, 630-636, Stockholm.

JAANUSSON V. & MUTVEI H. (1982): Ordovician of Öland. *IV Intern. Symp. on the Ordovician System*, 23 pp., Oslo Universitetet, Oslo.

LANDING E. (1976): Early Ordovician (Arenigian) conodont and graptolite biostratigraphy of the Taconic allochthon, eastern New York. *J. Palaeont*. 50, 614-646, Tulsa, Oklahoma.

LEE, HA-YOUNG (1970): Conodonten aus der Choson-Gruppe (Unteres Ordovizium) von Korea. *Neues Jahrb. Geol. Paläont. Abh.* 136, 303-344, Stuttgart.

LINDSTRÖM M. (1955): Conodonts from the lowermost Ordovician strata of south-central Sweden. *Geol. Fören. Stockholm Förh*, 76 pp. 517-604, 7 pls., Stockholm.

LINDSTRÖM M. (1960): A Lower-Middle Ordovician succession of conodont faunas. *Int. Geol. Congr. 21th sess. Sect* 7, 88-96.

LINDSTRÖM M. (1964): Conodonts, 1-196, Elsevier, Amsterdam.

LINDSTRÖM M. (1971): Lower Ordovician Conodonts of Europe. *Geol. Soc. Am. Mem.*, 127, 21-61, 1 pl., Boulder.

LÖFGREN A. (1978): Arenigian and Llanvirnian conodonts from Jämtland, northern Sweden. *Fossils and Strata*, 13, 129 pp., 16 pls., Oslo.

LÖFGREN A. (1985): Early Ordovician conodont biozonation at Finngrundet, south Bothnian Bay, Sweden. *Bull. Geol. Inst. Univ. Uppsala*, 10, 115-128, 4 figs., Uppsala.

MÄNNIL R.M. (1966): Evolution of the Baltic Basin during the Ordovician. *Eesti Tead. Akad. Geol. Inst.*, 200 pp., Tallinn.

MERRILL G.K. (1980): Ordovician conodonts from the Åland Islands, Finland. *Geol. Fören, Stockholm Förh.*, 101, 329-341, Stockholm.

MILLER J.F. (1969): Conodont fauna of the North Peak Limestone (Cambro-Ordovician), House Range, Utah. *J. Paleont.*, 43, 413-439, Tulsa.

MILLER J.F. (1980): Taxonomic revisions of some Upper Cambrian and Lower Ordovician conodonts with comments on their evolution. *Univ. of Kansas. Paleont. Contr.*, 99, 39 pp., Lawrence, Kansas.

MOBERG J.C. (1890): Antekningar om Ölands octocerkalk. *Sver. Geol. Unders. Ser. C*, 109, 11-22.

MCCRACKEN A.D. (1989): *Protopanderodus* (Conodonta) from the Ordovician Road River Group, northern Yukon territory, and the evolution of the genus. *Bull. Geol. Surv. Canada*, 388, 39 pp., 3 pls., Ottawa.

NATHORST A.G. (1881): Om Gustaf Linnarsson och hans bidrag till de svenska kanbrisk-siluriska formationernas geologi och paleontologi. *Geol. Fören. Stockholm Förh.* 5, 575-609.

NIEPER C.M. (1969): Conodonts of Nora Fm., Toko Range, Glenormiston. In: HILL D., PLAYFORD G. & WOODS T.T. (eds.) - Ordovician and Silurian fossils of Quensland, *Quensland Palaeont. Soc.*, pp. 02-015, S2-S18.

NORDLUND U. (1988): Lateral facies changes in the Lower Ordovician of northern Öland. Sweden. Acta Univ. Ups., *Comprehensive summaries of Uppsala Dissertations from the Faculty of Science* 170, 18 pp., 10 textfigs.

NOWLAN G.S. (1981): Some Ordovician conodont faunules from the Miramichi Anticlinorium, New Brunswick. *Bull. Geol. Surv. Canada*, 345, 35 pp., 5 pls. Ottowa.

PANDER C.H. (1856): Monographie der fossilen Fische des Silurischen Systems der russisch-baltischen Gouvernements. *Akad. Wiss. St. Petersburg*, 91 pp., 7 pls., St. Petersburg.

ROBISON R.A. (Ed.) (1981): Treatise on Invertebrate Paleontology. Pt. W: Miscellanea, Suppl. 2, Conodonta, 202 pp., Boulder.

SERGEEVA S.P. (1963)a: Conodonts from the Lower Ordovician in the Leningrad region. *Akad. Nauk. SSSR, Paleont. Zh.*, 1963 (2), 93-108, pls. 7-8, Moscow. (in Russian).

SERGEEVA S.P. (1963)b: A new Early Ordovician conodont genus of the family Prioniodinidae. *Akad. Nauk. SSSR, Paleont Zh.*, 1963 (4), 138-140, 2 figs., Moscow (in Russian).

SERGEEVA S.P. (1974): Some new conodonts from Ordovician strata in the Leningrad region. *Palaeont. Sb.*, 1974, 79-84, 1 pl., L'vov.

SERPAGLI E. (1967): I conodonti dell'ordoviciano superiore (Ashgilliano) delle Alpi Carniche. *Boll. Soc. Paleont. It.*, 6, 30-111, Modena.

SERPAGLI E. (1974): Lower Ordovician conodonts from Precordilleran Argentina. (Province of San Juan). *Boll. Soc. Paleont. It.*, 13, 17-98, pls. 7-31, Modena.

SKEVINGTON D. (1963): Graptolites from the Ontikan Limestones (Ordovician) of Öland, Sweden. I. Dendroidea, Tuboidea, Camaroidea and Stolonoidea. *Bull. Geol. Inst. Uppsala*, 42, pp. 1-62, Uppsala.

SKEVINGTON D. (1965): Graptolites from the Ontikan Limestones (Ordovician) of Öland, Sweden. II. Graptolidea and Graptovermida. *Bull. Geol. Inst. Uppsala*, 53 (3), pp. 1-74, Uppsala.

STAUFFER C.A. (1935): Conodonts of the Glenwood beds. *Geol. Soc. Am. Bull.*, 46, 125-168, Boulder, Colorado.

STOUGE S.S. (1984): Conodonts of the Middle Ordovician Table Head Formation, western Newfoundland. *Fossils and Strata*, 16, 145 pp. 18 pls., Oslo.

STOUGE S.S. (1989): Lower Ordovician (Ontikan) conodont biostratigraphy in Scandinavia. *Proc. Acad. Sci. Estonia SSR Geol.*, 38 (2), pp. 68-72, Tallinn.

STOUGE S. & BAGNOLI G. (1988): Early Ordovician conodonts from Cow Head Peninsula, western Newfoundland. *Palaeontographia Italica*, 75, 89-179, 16 pls., Pisa.

STÖRMER L. (1967): Some aspects of the Caledonian geosyncline and foreland west of the Baltic Sheild. *Quart. J. Geol. Soc. London*, 123, 183-214, London.

STURESSON U. (1986): Lower Ordovician ooids from northern Öland, Sweden. *Geol. Fören. Stockholm Förh.*, 108 (4), 331-348, Stockholm.

STURESSON U. (1988): Chemical composition of Lower Ordovician ooids from northern Öland, Sweden, and their sedimentary host matrix. *Geol. Fören. Stockholm Forh.*, 110 (1), 29-38, Stockholm.

SWEET W.C. (1988): The Conodonta: Morphology, taxonomy, paleoecology and evolutionary history of a long-extinct Animal Phylum. *Oxford monographs on geology and geophysics*, 10, 212 pp. New York, Oxford Clavendon Press, Oxford.

SWEET W.C. & BERGSTRÖM S.M. (1972): Multielement taxonomy and Ordovician conodonts. *Geol. Palaeontol.* SB1, 29-42, Marburg.

SWEET W.C., ETHINGTON R.L. & BARNES C.R. (1971): North American Middle and Upper Ordovician conodont faunas *Geol. Soc. Am. Mem.* 127, 163-193, Boulder, Colorado.

TJERNVIK T.E. (1956): On the early Ordovician of Sweden, Stratigraphy and fauna. *Bull. Geol. Inst. Uppsala*, 36, 107-284, 11 pls., Uppsala.

TJERNVIK T.E. & JOHANSSON J.V. (1980): Description of the upper portion of the drill-core from Finngrundet in the South Bothnian Bay. *Bull. Geol. Inst. Univ. Uppsala* N.S., 8, 173-204, Uppsala.

TULLBERG S.A. (1882): Förelöpende redogörelse för geologiske resor på Öland. *Sver. Geol. Unders. Ser. C*, 53, 220-236, Stockholm.

VIIRA V. (1967): Ordovicikskiye konodonty iz akvazhiny Ohlesaare. *Eesti NSV Tead. Akad. Toimetised*, 16, 391-327, 5 figs., Tallinn.

VIIRA V. (1972): On symmetry of some Middle Ordovician Conodonts. *Geologica et Palaeontologica*, 6, 45-49, 10 figs., Marburg.

VIIRA V. (1974): Ordovician conodonts of the east Baltic. *Institut Geologii akademii Nauk Estonskoi SSR.* 1-142, 13 pls., Tallinn.

VAN WAMEL W.A. (1974): Conodont biostratigraphy of the Upper Cambrian and Lower Ordovician of North-Western Öland, southeastern Sweden. *Utrecht micropal. Bull.*, 10, 126 pp., 8 pls, Utrecht.

WHITTINGTON H.B. & BOHLIN B. (1960): New Lower Ordovician Odontopleuridae (Trilobita) from Öland *Bull. Geol. Inst. Univ. Uppsala*, 38, 37-45, 3 pls., Uppsala.

WOLSKA Z. (1961): Konodonty z Ordowickich Glazow Narzytowych Polski. *Acta Paleont. Polonica*, 6, 339-365, 4 pls. Warszawa.

ZIEGLER W. (Ed.) (1973): Catalogue of Conodonts, 1, 504 pp., Schweizerbart'sche Verlag, Stuttgart.

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