

Conodonts from the Dumugol Formation (Lower Ordovician), South Korea

Ha-Young Lee¹⁾

ABSTRACT: Twenty form species, referable to seven form genera, have been yielded from the Dumugol Formation exposed in both two areas Samcheok- and Yeongweol-Gun, Kangweon-Do, South Korea. The stratigraphic range of the Dumugol Fauna may correspond to the Latorpian Stage ranging from the base of *Prioniodus elegans* Zone to the lower part of *P. evae* Zone in age. This study confirms the age-determination of the Dumugol Fauna by the writer's previous work (H.Y. Lee, 1970).

1. INTRODUCTION

During the last several decades the Ordovician conodonts have been intensively studied in Europe and North America, so that some significant results on the biostratigraphic zonation and on the bioprovincialism might be established. Recently, particularly since last ten years, the Ordovician faunas have been known also from other continents.

In Asia the Ordovician conodonts were described, for the first time, from South Korea (Müller, 1964) and then two faunas have been reported from Siberia (Moskalenko, 1967) and Malaya (Igo and Koike, 1967 and 1968) respectively. In succession the writer (1970, 1975a) has identified the conodonts from the Lower and Middle Ordovician in South and North Korea, and Moskalenko (1970, 1972 and 1973 a, b) and Müller (1973) have also added the description of the Ordovician conodonts from Siberia and Iran.

This study has been carried out as a part of the stratigraphic research on the Cambro-Ordovician Sequences, the so-called Great Limestone Series, distributed in the east-central part of South Korea, which was performed by a team work of the Faculty Members of Geology Department, Yonsei University in Seoul from 1970 to 1973, and its stratigraphic results were already published in several articles (H.Y. Lee, & Lee, J.D., 1971, O.J. Kim, et al., 1973, Kim, O.J. & H.Y. Lee, 1973).

In this paper, therefore, the writer intends only to describe the conodont fauna systematically and to comment on the more defined

stratigraphic range of the formation with regard to the conodont fauna.

The conodont fauna from the Dumugol Formation described in this paper is a part of conodonts which were obtained from nearly all the formations of "The Great Limestone Series" in connection with the above-mentioned stratigraphic research.

The sampling has been carried out by the writer, Jong Deock Lee and Min Soo Oh, graduate students at Department of Geology, Yonsei University at that time (1970-1971) with assistances of several senior students of the undergraduate course at the same university.

Twenty six samples were collected at about 10m-20m intervals from the Dumugol Formation in the two geographically separated sections and the sampling lines were nearly perpendicular to the strikes of the formation. Each composite sample weighed 1 kg was digested by acetic acid of 15% solution. The writer has followed the so-called Pander's principle in describing the fauna owing to the rarity of the represented specimens, and all specimens with the illustrated forms are deposited in Department of Geology, Yonsei University.

2. ACKNOWLEDGMENT

The writer wishes to express his appreciation to Prof. Dr. O.J. Kim, Yonsei University who has organized the stratigraphic research project on "The Great Limestone Series" and kindly stimulated him during his work.

The writer is also greatly indebted to Prof. Dr. K.J. Müller, Universität Bonn in Germany for his constructive comments on the present

1) Department of Geology, Yonsei University, Seoul, Korea.

work and for his kind providing of all possibilities in carrying out this work in Germany. Prof. Dr. D.S. Lee and Prof. S.K. Yun, Yonsei University have given the writer many effective comments regarding to the stratigraphic problems. Mr. Jong Deock Lee, Jeon Bug University has greatly helped the writer in collecting and in treatment of the samples in field and laboratory.

The stereoscan photographs for the illustration were prepared by Mrs. C. Hemmer in "Paläontologischem Institut der Universität Bonn".

3. STRATIGRAPHIC SUMMARY

The Dumugol Formation (Syn. Tomkol Shale by Yamanari) was denominated by Yamanari (1923) after the name of small village "Dumugol" located on the southern slope of Mt. Duwibong in Sangdong-myeon, Yeongweol-Gun. As natively the village name is pronounced not Tomkol, but Dumugol, the spelling of the stratigraphic name should be changed to Dumugol.

The Formation is distributed on both southern and northern limbs of the Baegunsan Syncline basin, particularly well outcropped along its southern limb, that is, Sangdong and Dongjeom-ri districts. It overlies the Dongjeom Quartzite and is underlain by the Maggol Limestone with conformity respectively. It is estimated about 150-180m in average thickness (about 180m in Dongjeom-ri and about 160m in Sangdong district).

The formation consists mainly of tan-coloured calcareous shales which are frequently alternated with layers of light grey limestones and light green shales.

Kobayashi (1966) has recognized two fossil zones in the formation; *Asaphellus* Zone in the lower part and *Protopliomerops* Zone in the upper part, and he concluded, on the basis of the megafauna, that the formation must be correlated to Tremadocian in Europe. The writer (1970) has shown, however, through the conodont work that the formation should be equivalent not to Tremadocian but to Arenigian in age (see H.Y. Lee, 1970. p. 305).

4. SAMPLE-COLLECTING LOCALITIES

The sampling localities are as follows (see Text-fig. 1).

Locality 1: Dongjeom-ri District

(Myeonsan, Sangjang-myeon, Samcheok-Gun, Kangweon-Do)

13 samples were collected along the

gorge between the Dongjeom Primary School and the village Myeonsan. The sites of sampling points are represented on the columnar section (see Text-fig. 2).

Sample No. 6: Grey vermiculated limestone with alternated dark grey shale, collected at the boundary between the Dumugol Formation and the Dongjeom Quartzite. It yielded some conodonts.

Sample No. 7: Grey to dark grey vermiculated limestone with alternated dark grey shale. No conodonts have been obtained.

Sample No. 8: Light grey massive limestone with faintly colored light yellow tint. No conodonts.

Sample No. 9: Dark grey massive limestone with alternated tan-colored marls. No conodonts.

Sample No. 10-15: Light grey thinly bedded limestones with alternated shales. The limestones partly show vermiculated structures. The samples were collected from 60m above the base at interval of 15m-20m. No conodonts.

Sample No. 16: Light pink massive limestone. It yielded some conodonts.

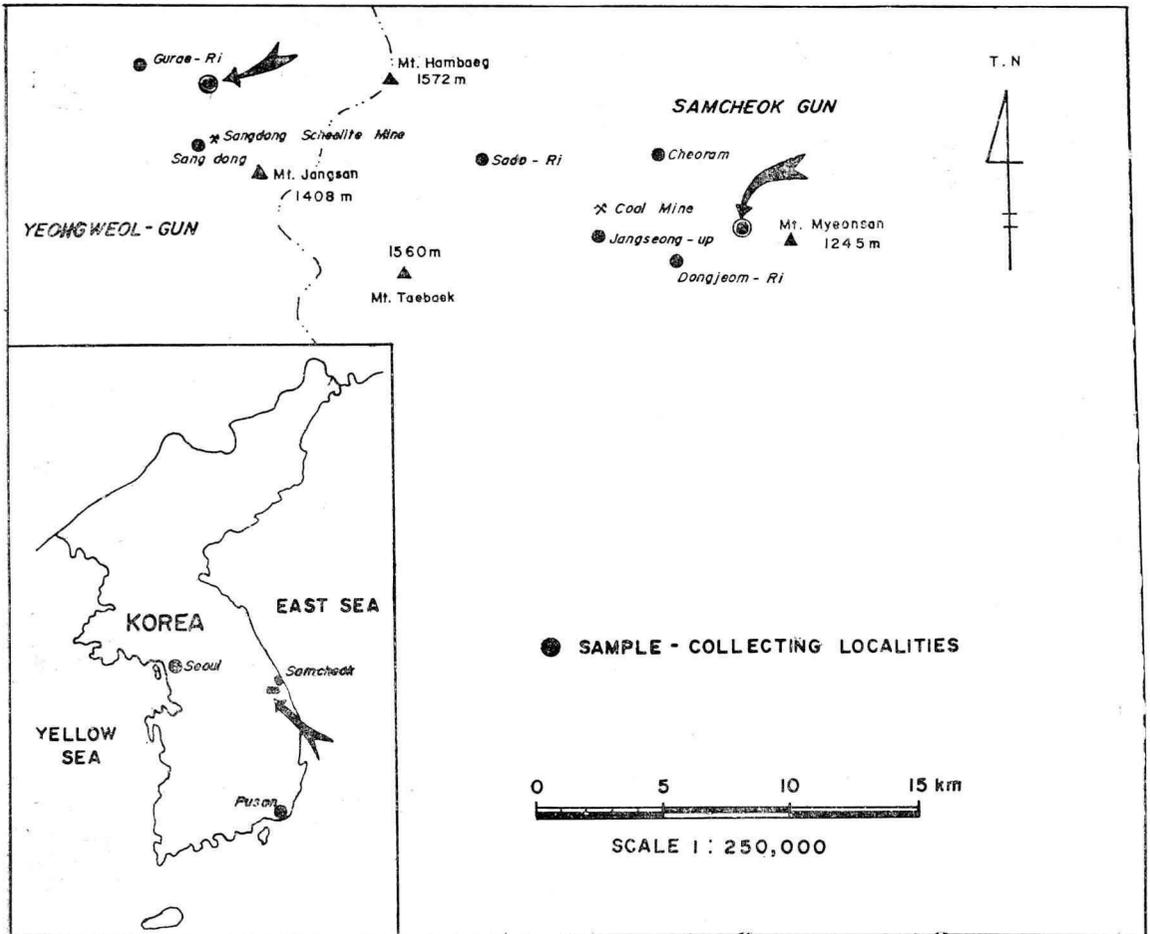
Sample No. 17: Dark grey limestone with alternated yellowish shales. The limestones partly show vermiculated structure. It yielded relatively abundant conodonts.

Sample No. 18: Dark grey limestone with alternated yellowish shales. No conodonts.

Sample No. 19: Dark grey limestone with alternated yellowish shales. It yielded some conodonts.

Locality 2: Sangdong, Sangdong-myeon, Yeongweol-Gun, Kangweon-Do (North side of Sangdong Scheelite Mine).

13 samples were collected at intervals of 5-10m along the southern slope of Mt. Baegun, which is located at north side of the Sangdong Scheelite Mine. The sites of sampling points are shown on the columnar section (see Text-fig. 2).



Text-fig. 1: Index Map showing the sample-collecting localities.

- Sample No. 179: Light grey thinly bedded limestone. No conodonts have been produced.
- Sample No. 180: Light grey thinly bedded limestone, as No. 179. No conodonts have been yielded.
- Sample No. 181: Light grey vermiculated fine crystalline limestone. No conodonts.
- Sample No. 182: Light grey poorly vermiculated limestone. No conodonts.
- Sample No. 183: Light grey poorly vermiculated limestone. Some conodonts have been produced.
- Sample No. 184: Light grey poorly vermiculated limestone. No conodonts.
- Sample No. 185: Light grey poorly vermiculated limestone. No conodonts.

- Sample No. 186: Light grey silicified limestone. No conodonts.
- Sample No. 187: Dark grey silicified limestone. No conodonts.
- Sample No. 188-191: Dark grey poorly vermiculated limestone. No conodonts.

5. CONODONT FAUNA

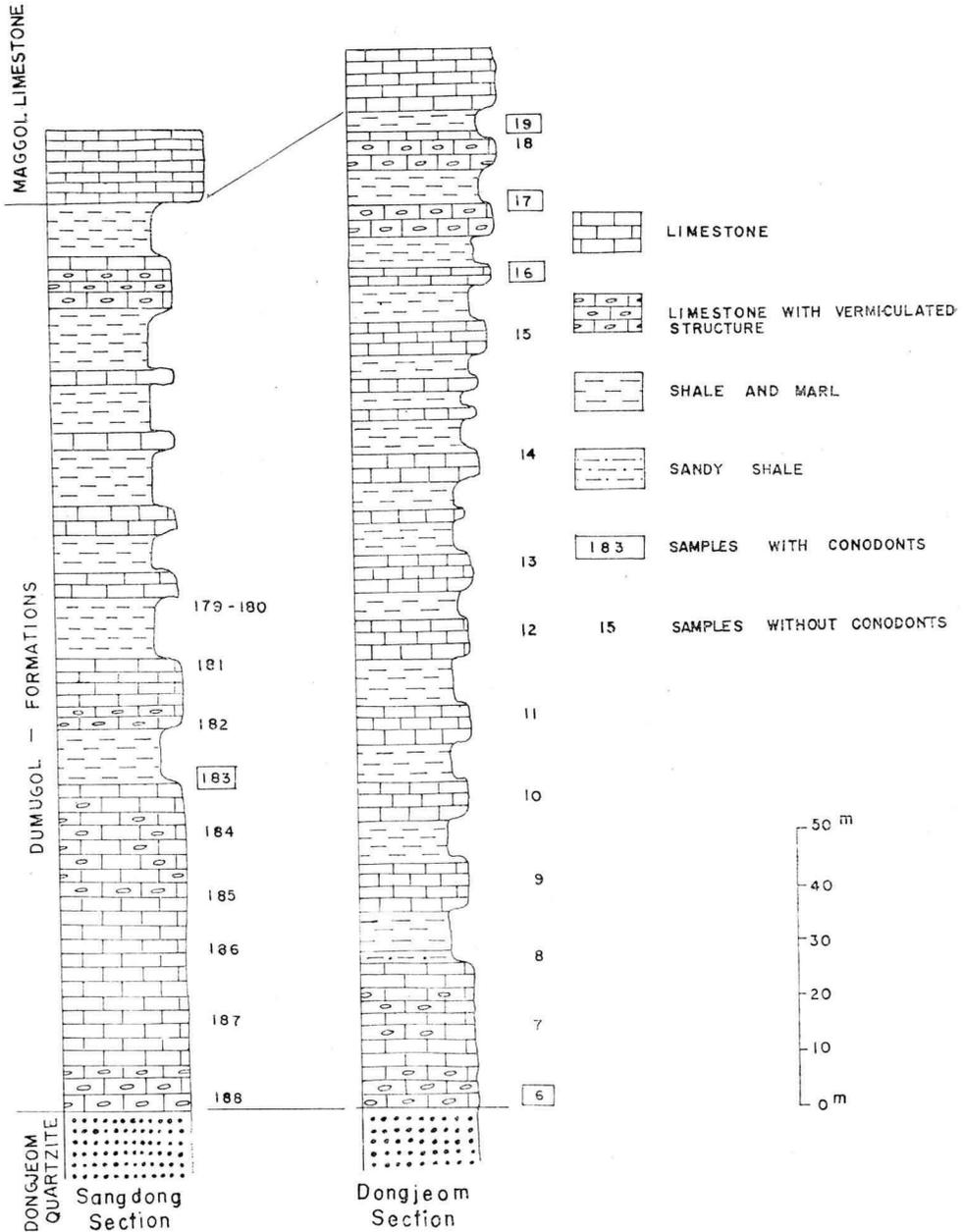
Only five of the collected samples have yielded conodonts and they are assigned to seven form genera with 20 form species as shown in Table 1.

The fauna is composed entirely of distacodids elements whose stratigraphic ranges are mostly of Lower Ordovician.

Acodus deltatus Lindström and *A. tetrahedron* Lindström obtained from the basal part of the

Formation have been reported from the Lower Ordovician ranging from the Upper Tremadocian to Arenigian in Balto-Scanian Province (Lindström, 1955, 1960, Viira et al., 1970), in North America (Ethington & Clark, 1965, Longwell & Mound, 1967, Mound, 1968, Ethington &

Clark, 1971) and in Australia (McTavish, 1973). *Acodus oneotensis* Furnish, *Acontiodus iowaensis* Furnish and *Paltodus variabilis* Furnish originally were described from the lowermost Ordovician Oneota Formation, which may be correlated to Tremadocian in northern Europe.



Text-fig. 2: Stratigraphic section of the Dumugol Formation in the sample-collected localities with the sampling intervals.

CONODONTS FROM THE DUMUGOL FORMATION (LOWER ORDOVICIAN), SOUTH KOREA

Form-Species	Sampling Numbers					Total
	6	16	17	19	183	
<i>Acodus deltatus</i> Lindström	3					3
<i>A. oneotensis</i> Furnish			2			2
<i>A. tetrahedron</i> Lindström	2					2
<i>Acontiodus rectus</i> Lindström	2					2
<i>A. iowaensis</i> Furnish			2			2
<i>A. nov. sp.</i> Ethington & Clark	1					1
<i>Distacodus rhombicus</i> Lindström			10			10
<i>D. stolus</i> Lindström			6			6
<i>Drepanodus arcuatus</i> Pander	4		8			12
<i>D. bisymmetricus</i> Viira			2			2
<i>D. gracilis</i> Branson & Mehl		1	2			3
<i>D. homocurvatus</i> Lindström			8	3	2	13
<i>D. parallelus</i> Branson & Mehl			2			2
<i>D. suberectus</i> Branson & Mehl			4			4
<i>Oistodus inaequalis</i> Pander			9	1		10
<i>O. parallelus</i> Pander			3			3
<i>Paltodus inconstans</i> Lindström			9			9
<i>P. variabilis</i> Furnish			13			13
<i>Scolopodus nogamii</i> Lee		6	42			48
<i>Scolopodus rex</i> Lindström				6		6
	12	7	122	10	2	153

Table 1. Distribution of conodont fauna provided from the Dumugol Formation in this work.

It has been known, however, that the stratigraphic range of the species are extended somewhat to higher level, that is, to Arenigian (Ethington & Clark, 1964, Mound, 1968, Barnes & Tukes, 1970 and Jones, 1971)

Drepanodus parallelus Branson & Mehl, *Oistodus inaequalis* Pander, *Acontiodus rectus* Lindström and *Drepanodus arcuatus* Pander have been also reported from the stratigraphic level ranging from Tremadocian to Arenigian.

According to the writer's knowledge about the stratigraphic distribution on the Ordovician conodonts none of this fauna have been known as a typical indicator or zone fossil of Tremadocian or the equivalent age. Recently *Drepanodus bisymmetricus* Viira has been newly reported from the Upper Tremadocian Varangu Member in Estonia (Viira, 1970), the stratigraphic range of the species, however, can not be fixed owing to its deficient occurrences. On the contrary, such species as *Distacodus stolus* Lindström, *Paltodus inconstans* Lindström and *Scolopodus rex* Lindström have been described only from Arenigian and the equivalent stage.

Inferring from the mutual occurrence of *Acodus deltatus* Lindström, *Distacodus stolus* Lindström, *Oistodus inaequalis* Pander, *Oistodus parallelus* Pander, *Paltodus inconstans* Lindström and *Scolopodus rex* Lindström the stratigraphic range of the Dumugol fauna may correspond to the Latorpian Stage ranging from base of *Prioniodus elegans* Zone to the lower part of *P. evae* Zone (see Lindström, 1971, Fig. 2; Bergström et al., 1972, Fig. 3).

This conclusion confirms not only the age-determination of the Dumugol fauna by the writer's previous work (H.Y. Lee, 1970), but also defines its stratigraphic level to more narrow interval.

The Dumugol fauna is also very similar to Fauna D Zone in North America, which has been established by Ethington & Clark (1971). Such 6 species as *Acodus deltatus* Lindström (= *Acodus* sp. by Ethington & Clark, 1971), *Distacodus stolus* Lindström, *Drepanodus parallelus* Branson & Mehl (= *D. subarcuatus* by Ethington & Clark), *Drepanodus homocurvatus* Lindström and *D. suberectus* (Branson & Mehl) are common

in both the faunas.

The Dumugol fauna also resembles the fauna of Ninemile Formation, Central Nevada (Ethington, 1972), and fourteen species are common in both the faunas. Regretfully and noticeably any compound elements, such fossils as *Prioniodus elegans* and *P. evae* have not been

found from the Dumugol Formation. The answer on the problem would be given by further detailed works.

Table 2 shows the correlation of conodont distribution between the Dumugol Formation and other Lower Ordovician Formations in Asia, Europe, North America and Australia.

SYSTEMATIC DESCRIPTION

Genus *Acodus* Pander, 1856

Type species-Acodus erectus Pander, 1856

Acodus deltatus Lindström, 1955

(Pl. 1, Fig. 2, Text-fig. 3-B)

- 1955 *Acodus deltatus* Lindström, Lindström, Geol. Fören Förhandl. 76:544, Pl. 3, Fig. 30.
 1955 *Acodus deltatus* var. *altior* Lindström, Lindström, *Ibid.*, 544, Pl. 3, Figs. 27-29.
 1965 *Acodus deltatus* Lindström, Ethington & Clark, Brigham Young Univ. Geol. Stud., 12; 187, Pl. 1, Fig. 3.
 1967 *Acodus deltatus* Lindström, Longwell & Mound, Geol. Soc. Amer. Bull., 78; 408, Pl. 1.
 1967 *Acodus* aff. *deltatus* Lindström, Moskalenko, Acad. Sci. USSR, Siberian Div.; 101, Pl. 22, Figs. 2-4.
 1968 *Acodus deltatus* Lindström, Mound, Micropaleont., 4; 406, Pl. 1, Figs; 1-2.
 1970 *Acodus deltatus* Lindström, Viira & Kivimagi & Loog, Eesti NSV Tead. Akad. Toimet. 19; 154.
 1971 *Gothodus costulatus* Lindström, Lindström, Geol. Soc. Amer. Mem., 127; 54. Pl. 1, Fig. 1, (non Pl. 1, Figs. 2-5).
 1971 *Acodus* sp. Ethington & Clark, Geol. Soc. Amer. Mem., 127; 67, Pl. 2, Fig. 17.
 1972 *Acodus deltatus deltatus* Lindström, Ethington, Geol. et Paleont., SB. 1; 20, Pl. 1, Fig. 11.
 1972 *Acodus deltatus altior* Lindström, Ethington, *Ibid.*, 20, Pl. 1, Fig. 12.
 1973 *Acodus deltatus deltatus* Lindström, McTavish, Geol. et Paleont., 7; 39, Pl. 1, Fig. 1-2, 6-7, ? 12, (non, Figs. 3-5, 8-9, 13-14).
 1973 *Acodus deltatus longibasis* McTavish, McTavish, *Ibid.*, 40, Pl. 1, Fig 22, (non, Pl. 1, Figs. 16, 20, 23, 25, 26, Pl. 2, Fig. 14).
 1973 *Acodus deltatus tortus* McTavish, McTavish, *Ibid.*, 40, Text-fig. 3, a-b, (non. Pl. 1, Fig. 18).

Remarks: Ethington and Clark (1965, p. 187) considered that the angle formed by the opposite margins of the base is variable in this species. The three Dumugol specimens show a variability of the angle as indicated by those authors.

The posterior margins of the represented specimens diverge not at a right angle from the basal part of the anterior margin, but at an

angle of about 30 like *A. deltatus altior*. The lateral costae in the Dumugol-specimens are not also constant, in one specimen it is highly emerged whereas other specimens carry a weakly developed costa.

Occurrence: Dumugol Formation (No. 6).

Materials: 3 specimens.

Acodus oneotensis Furnish, 1938

(Pl. 1, Fig. 1, Text-fig. 3-A)

- 1938 *Acodus oneotensis* Furnish, Furnish, Jour. Paleont. 12; 325, Pl. 42, Figs. 26-29.
 1964 *Acodus oneotensis* Furnish, Ethington and Clark, Jour. Paleont. 38; 686-687.
 1964 *Acodus oneotensis* Furnish, Müller, N. Jb. Geol. Paläont. Abh., 119; 95-96, Pl. 13, Figs. 1a-b, 8.
 1967 *Acodus oneotensis* Furnish, Longwell and Mound, Geol. Soc. Amer. Bull., 78; 408, Pl. 1.
 1967 *Acodus oneotensis* Furnish, Igo and Koike, Geol. Paleont. Southeast Asia, 3; 13, Pl. 3, Figs. 3a, b, Text-fig. 4-D.
 1968 *Acodus oneotensis* Furnish, Mound, Micropaleont., 4; 406, Pl. 1, Fig. 4.

Table 2. Correlation of the Conodont fauna of the Dumugol Formation with other Lower Ordovician Faunas from Asia, Europe, North America and Australia.

Lower Ordovician Formations Form-Species of the Dumugol Formations	Asia	Europe	North America	Australia
	Dumugol Fm. (Lee, 1970)	Chunya Stage (Moskalenko, 1967)	Baltic (Pander, 1856)	Jefferson City Fm. (Branson & Mehl, 1933)
Siberian Platform (Moskalenko, 1973)	Mila Group (Müller, 1973)	South Central Sweden (Lindström, 1955)	Prairie du Chien Beds (Furnish, 1938, Clark & Babcock, 1971)	Bonapart Gulf Bs. (Jones, 1971)
		Massebo etc., (Lindström, 1957)	Marathon Fm. (Graves & Ellison, 1941)	Emanuel Fm. (McTavish, 1973)
		Ravengil (Lamont & Lindström 1957)	El Paso Fm. (Ethington & Clark, 1964)	
		Öland (Lindström, 1960)	Columbia Ice Fields (Ethington & Clark, 1965)	
		Polen (Wolska, 1961)	Monocline Valley (Longwell & Mound, 1967)	
		Polen (Bednarczyk, 1969)	Lower Arbuckle Gr. (Mound, 1968)	
		Varangu Mem. (Viira & Kivimagi & Loog, 1970)	St. George Fm. (Barnes & Tuke, 1970)	
		Durine Mem. (Higgins, 1967)	St. Peter Sandstone (Clark & Miller, 1971)	
			Ninemile Fm. (Ethington, 1972)	
			Hamburg Klippe (Bergström et al., 1972)	
			Baumann Fiord Fm. (Barnes, 1973)	
<i>Acodus deltatus</i> Lindström	×	×		×
<i>A. oneotensis</i> Furnish	×		×	×
<i>A. tetrahedron</i> Lindström		×		×
<i>Acontiodus iowaensis</i> Furnish	×			×
<i>A. rectus</i> Lindström		×	×	
<i>A. nov. sp.</i> Ethington & Clark		×	×	
<i>Distacodus rhombicus</i> Lindström				
<i>D. stolus</i> Lindström	×	×		
<i>Drepanodus arcuatus</i> Pander	×	×	×	
<i>D. bisymmetricus</i> Viira		×		
<i>D. gracilis</i> Branson & Mehl		×		
<i>D. homocurvatus</i> Lindström	×	×	×	
<i>D. parallelus</i> Branson & Mehl	×	×	×	
<i>D. suberectus</i> (Branson & Mehl)	×	×	×	
<i>Oistodus inaequalis</i> Pander	×	×	×	
<i>O. parallelus</i> Pander	×	×	×	
<i>Paltodus inconstans</i> Lindström	×	×	×	
<i>P. variabilis</i> Furnish	×		×	
<i>Scolopodus nogamii</i> Lee				
<i>S. rex</i> Lindström	×	×	×	

- 1971 *Acodus oneotensis* Furnish, Druce and Jones, Bur. Miner. Resour. Aust. Bull., 110; 56-57, Pl. 12, Figs. 3a-7c, Text-fig. 20.
 1971 *Acodus oneotensis* Furnish, Jones, Bur. Miner. Resour. Aust. Bull., 117; 44, Pl. 1, Figs. 5a-7c, Pl. 7, Figs. 1a-c.
 1971 *Acodus oneotensis* Furnish, Ethington and Clark, Geol. Soc. Amer. Mem., 127: 67, Pl. 1, Figs. 3, 6, 8.
 1973 *Acodus oneotensis*. Furnish, Müller, Geol. Surv. Iran, Report, 30; 26, Pl. 7, Figs. 1a-c, 3-5, 6a-c, 7a-b, 8.

Remarks: The represented specimens agree well with the holotype described and illustrated by Furnish (1968, p. 325), particularly in having a strong median costa on one lateral face and a

subcircular aboral outline.

Occurrence: Dumugol Formation (No. 17).

Materials: 2 specimens.

***Acodus tetrahedron* Lindström, 1955**

(Pl. 1, Fig. 3, Text-fig. 3-C)

- 1955 *Acodus tetrahedron* Lindström, Lindström, Geol. Fören. Förhandl., 76; 546, Pl. 4, Figs. 1-2.
 ?1965 *Acodus tetrahedron* Lindström, Mound, Tulane Univ. Studies in Geol., 4; 9-10, Pl. 1, Figs. 7, 8.
 1967 *Acodus tetrahedron* Lindström, Longwell and Mound, Geol. Soc. Amer. Bull., 78; 408, Pl. 1.
 1968 *Acodus tetrahedron* Lindström, Mound, Micropaleont., 4; 407, Pl. 1, Figs. 11, 15.
 1970 *Acodus tetrahedron* Lindström, Viira, Eesti NSV Tead. Akad. Toimet., 19; Pl., Figs. 15, 21, 22.
 1973 *Acodus tetrahedron* Lindström, McTavish, Geol. et Paleont., 7; 41, Pl. 3, Figs. 21-23, Text-figs. 3 u, v.

Remarks: The represented specimens are assigned to this species on the basis of the lateral costa which extends from the aboral margin, close to the anterior edge, onto one third of the cusp where it merges with the anterior edge. The posterior edge of the Dumugol

specimens is smoothly curved toward the oral margin of the base, whereas in the holotype of the species from Sweden the oral edge is relatively sharply bent from the posterior edge.

Occurrence: Dumugol Formation (No. 6).

Materials: 2 specimens.

Genus *Acontiodus* Pander, 1856

***Type species-Acontiodus latus* Pander, 1856**

***Acontiodus iowaensis* Furnish, 1938**

(Pl. 1, Fig. 8, 12, Text-fig. 3-G)

- 1938 *Acontiodus iowaensis* Furnish, Furnish, Jour. Paleont., 12; 325-326, Pl. 42, Figs. 16-17.
 1964 *Acontiodus iowaensis* Furnish, Ethington and Clark, Jour. Paleont., 38; 687, Pl. 113, Fig. 3.
 1964 *Acontiodus* cf. *propinquus* Furnish, Müller, N. Jb. Geol. Paleont. Abh., 119; 96, Pl. 12, Fig. 8.
 1968 *Acontiodus iowaensis* Furnish, Mound, Micropaleont., 14; 407, Pl. 1, Figs. 20-27.
 1970 *Acontiodus* sp. cf. *A. iowaensis* Furnish, Barnes and Tuke, Geol. Surv. Canada Bull., 187; 84, Pl. 18, Fig. 10.
 1971 *Scolopodus iowaensis* (Furnish), Druce and Jones, Bur. Miner. Resour. Aust. Bull., 110; 93, Pl. 16, Figs. 1a-7e, Text-fig. 30 d, e.
 1971 *Scolopodus iowaensis* (Furnish), Jones., Bur. Miner. Resour. Aust. Bull., 117; 64, Pl. 6, Figs. 3a-c, 4a-c, Pl. 9, Figs. 5a-c.
 1971 *Scolopodus* sp. cf. *S. iowaensis* (Furnish), Jones, *Ibid.*, 65, Pl. 5, Figs. 5a-c.

Remarks: According to the original description of the species (Furnish, 1938) it is a small stumpy *Acontiodus latus*-like conodont which bears a broadly rounded anterior side, sharply keeled lateral portions and a rounded posterior carina flanked by two prominent grooves. The

Dumugol specimens agree favorably with these features.

The Dumugol specimens are, however, somewhat different from the latter through the laterally more expanded basal sheath and the more prominently configured posterior carina.

CONODONTS FROM THE DUMUGOL FORMATION (LOWER ORDOVICIAN), SOUTH KOREA

Posterior side of one specimen at hand is longitudinally striated. However this character is probably restricted to a minority of specimens

and does not justify taxonomic separation.
Occurrence: Dumugol Formation (No. 17).
Materials: 2 specimens.

***Acontiodus rectus* Lindström, 1955**

(Pl. 1, Fig. 5, Text-fig. 3-E)

- 1955 *Acontiodus rectus* Lindström, Lindström, Geol. Fören. Förhandl., 76; 549, Pl. 2, Figs. 7-11, Text-fig. 2, k-m, Text-fig. 3, B.
 1957 *Acontiodus rectus* Lindström, Lamont and Lindström, Edinburgh Geol. Soc. Trans., 17;61.
 1957 *Acontiodus rectus* Lindström, Lindström, Geol. Fören. Förhandl., 79;164.
 1960 *Acontiodus rectus* Lindström, Lindström, Int. Geol. Congress, 21st Sess., Rep., Pt. 7;90, Text-figs. 2-3, 8, 10.
 1961 *Acontiodus rectus* Lindström, Wolska, Acta Paleont. Polonica, 6;345, Pl. 1, Fig. 1.
 1964 *Acontiodus rectus* Lindström, Hamar, Norsk Geol. Tidsskr., 44;258, Pl. 1, Figs. 10, 12, 13, 17, Text-fig. 4, No. 4a-b.
 ?1965 *Acontiodus rectus* Lindström, Mound, Tulane Univ. Studies in Geol., 4;12, Pl. 1, Fig. 23.
 1965 *Acontiodus rectus rectus* Lindström, Ethington and Clark, Brigham Young Univ. Geol. Studies, 12; 188, Pl. 1, Fig. 15.
 1966 *Acontiodus rectus* Lindström, Hamar, Norsk Geol. Tidsskr., 46; Pl. 1, Fig. 5.
 1967 *Acontiodus rectus* Lindström, Longwell and Mound, Geol. Soc. Amer. Bull., 78; 408, Pl. 1.
 1968 *Acontiodus rectus* Lindström, Mound, Micropaleont., 14; 408, Pl. 1, Figs. 32, 35.
 1969 *Acontiodus rectus* Lindström, Bednarczyk, Acta Geol. Polonica, 19; Pl. 1, Fig. 7.
 1972 *Acontiodus rectus* Lindström, Ethington, Geol. et Paleont., SB.1; 20.
 1972 *Protopanderodus* cf. *rectus* (Lindström), Bergström and Epstein and Epstein, U.S. Geol. Surv. Prof. Paper, 800-D; 38, Fig. 1-f, Fig.3 (non Scolopodiform element).

Remarks: The specimens from the Dumugol Formation agree well with the original specimens described and illustrated by Lindström (1955) from South Central Sweden, therefore

it needs not to add any description.
Occurrence: Dumugol Formation (No. 6).
Materials: 2 specimens.

***Acontiodus* nov. sp. Ethington & Clark, 1965.**

(Pl. 1, Fig. 4, Text-fig. 3-D)

- 1965 *Acontiodus* nov. sp. Ethington and Clark, Brigham Young Univ. Geol. Studies, 12; 188. Pl. 1, Fig. 14.

Remarks: The single, relatively well preserved specimen at hand agrees well with the specimen identified as *A. nov. sp.* by Ethington and Clark (1965) from the Columbia Ice Fields Section. The cusp of the represented specimen is some-

what more widely and straightly extended from apex to base in antero-posterior view than the latter's.
Occurrence: Dumugol Formation (No. 6).
Material: 1 specimen.

Genus *Distacodus* (Pander, 1856)

***Type species-Machairodus incurvus incurvus* Pander, 1856**

***Distacodus rhombicus* Lindström, 1955**

(Pl. 1, Fig. 6-7, Text-fig. 3-F)

- 1955 *Distacodus rhombicus* Lindström, Lindström, Geol. Fören. Förhandl. 76; 556, Pl. 3, Figs. 35, 36.
 1970 *Distacodus rhombicus* Lindström, Barnes and Tuke, Geol. Surv. Canada Bull., 187; 84, Pl. 19, Figs. 1, 4, Text-fig. 6 H.

Remarks: The species is characterized by a small cusp with weak lateral costae and a long basal sheath, facets of which between the costae

are little or not at all depressed. The Dumugol specimens agree fundamentally with the descriptions of the original form except for the

length of the cusp and the strength of the costae. The Dumugol specimens bear a long and slender cusp, and are variable in the strength of the costae. The small cusp in the holotype may be probably due to its rejuvenacy.

The specimen from the St. George Formation in Canada (Barnes and Tuke, 1970) has relatively long cusp like those in Korean specimens.

Occurrence: Dumugol Formation (No. 17).

Materials: 10 specimens.

***Distacodus stola* Lindström, 1955**

(Pl. 1, Fig. 9-11, Text-fig. 3-H,I)

- 1955 *Distacodus stola* Lindström, Lindström, Geol. Fören. Förhandl., 76; 556-557, Pl. 3, Fig. 16.
 1969 *Distacodus stola* Lindström, Bednarczyk, Acta Geol. Polonica, 19; Pl. 1, Fig. 12.
 1970 *Distacodus stola stola* Lindström, Lee, N. Jb. Geol. Paläont. Abh., 136; 316, Pl. 7, Fig. 10.
 1971 *Distacodus stola* Lindström, Ethington and Clark, Geol. Soc. Amer. Mem., 127; 67, Pl. 2, Fig. 16.
 1972 *Distacodus stola* Lindström, Ethington, Geol. et Paleont., SB. 1:20, Pl. 1.1, Fig. 13.
 1972 *Stolodus stola* (Lindström) Bergström and Epstein and Epstein U.S. Geol. Surv. Prof. Paper, 800-D, 38, Fig. 3.
 Further synonyms, see Lee (1970).

Remarks: The Dumugol specimens conform in all respects to the type figure and the descriptions of the original forms from south-central

Sweden (Lindström, 1955)

Occurrence: Dumugol Formation (No. 17).

Materials: 6 specimens.

Genus *Drepanodus* Pander, 1856

Type species-*Drepanodus arcuatus* Pander, 1856

***Drepanodus arcuatus* Pander, 1856**

(Pl. 1, Fig. 13, Text-fig. 3-L)

- 1856 *Drepanodus arcuatus* Pander, Pander, Mono. Geognostisch. Beschreib. Russ. Balt. Gouvernm. St. Petersburg, 27, Pl. 2, Fig. 37.
 non 1969 *Drepanodus arcuatus* Pander, Bednarczyk, Acta Geol. Polonica, 19; 791, Pl. 2, Fig. 10.
 1970 *Drepanodus arcuatus* Pander, Lee, N. Jb. Geol. Paläont. Abh., 36; 319, Pl. 7, Fig. 15, Pl. 8, Fig. 11.
 1970 *Drepanodus arcuatus* Pander, Fahraeus, Geol. Soc. Amer. Bull., 81; 2070, Fig. 2.
 1970 *Drepanodus arcuatus* Pander, Viira and Kivimagi and Loog, Eesti NSV Tead. Akad. Toimet., 19; 154.
 1971 *Drepanodus arcuatus* Pander, Lindström, Geol. Soc. Amer. Mem., 127; 41, Fig. 4, 8 (non *Scandodus pipa* Lindström).
 1972 *Drepanodus* cf. *D. arcuatus* Pander sensu Lindström, Ethington, Geol. et Paläont., SB. 1; 20, 22.
 1972 *Drepanodus arcuatus* Pander, Bergström and Epstein and Epstein, U.S. Geol. Surv. Prof. Paper, 800-D., 38, Fig. 3.
 Further synonyms, see Lee (1970).

Remarks: The Dumugol specimens conform well, in the morphology, to the Baltic specimens which were described and illustrated by Pander (1856) and Lindström (1955).

Occurrence: Dumugol Formation (No. 6, No. 17).

Materials: 12 specimens.

***Drepanodus bisymmetricus* Viira, 1970**

(Pl. 1, Fig. 15, Text-fig. 3-K)

- 1970 *Drepanodus bisymmetricus* Viira, Viira, Eesti NSV Tead. Akad. Toimet., 19; 226, Pl. Figs. 1-5, Text-figs. 3-4.
 1970 *Drepanodus bisymmetricus* Viira, Viira, Kivimagi and Loog, Eesti NSV Tead. Akad. Toimet., 19; 154.

Description: Unit simple, erect, and bilaterally symmetrical with a shape of equilateral triangle

form in lateral view. Anterior and posterior margins sharply edged and lateral faces slightly

convexed equally with a lensform cross section at midpoint of unit. Basal cavity rather shallow and cone-like. Aboral margin lens-shaped in outline.

Remarks: The species is characterized by the similarity of the anterior and posterior parts of

the lateral faces. The Dumugol specimens are well in agreement with the specimens from the Varangu Member, Estonian Upper Tremadocian (Viira, 1970).

Occurrence: Dumugol Formation (No. 17).

Materials: 2 specimens.

***Drepanodus gracilis* (Branson & Mehl, 1933)**

(Pl. 1, Fig. 14, Text-fig. 3-J)

1933 *Oistodus gracilis* Branson & Mehl, Branson and Mehl, Univ. Misso. Studies, 8; 60, Pl. 4, Fig. 20.

1975 *Drepanodus gracilis* (Branson & Mehl), Lee, Paläontographica Abt. A (in printing).

Further synonyms, see Lee (1975a, in printing).

Remarks: The specimens from the Dumugol Formation agree well with the holotype from Jefferson City Formation, North America (Branson & Mehl, 1933), except for the lateral flexure of cusp. The cusp of the former is not laterally twisted, whereas that of the latter is

slightly flexed laterally, but the twisting of cusp may be not the characteristic feature of the species.

Occurrence: Dumugol Formation (No. 16, No. 17).

Materials: 3 specimens.

***Drepanodus homocurvatus* Lindström, 1955**

(Pl. 2, Fig. 1, Text-fig. 4-A)

1933 *Oistodus curvatus* Branson & Mehl, Branson and Mehl. Univ. Misso. Studies, 8; 110-111, Pl. 9, Fig. 4, 10, 12.

1955 *Drepanodus homocurvatus* Lindström, Lindström, Geol. Fören. Förhandl., 76; 565-566, Pl. 2, Fig. 35-37.

1955 *Drepanodus amoenus* Lindström, Lindström, Geol. Fören. Förhandl., 76; 558, Pl. 2, Figs. 25, 26, Text-fig. 4b.

1969 *Drepanodus planus* Lindström, Bednarczyk, Acta Geol. Polonica, 19; 790, Pl. 1, Fig. 3.

1969 *Drepanodus homocurvatus* Lindström, Bednarczyk, *Ibid.*, 791, Pl. 2, Fig. 11.

1970 *Drepanodus homocurvatus* Lindström, Spassov, Bulgarian Geol. Soc. Rev., 31; 180, Pl. 3, Fig. 6, 7.

1970 *Drepanodus homocurvatus* Lindström, Viira and Kivimagi and Loog, Eesti NSV Tead. Akad. Toimet., 19; 154.

?1973 *Drepanodus homocurvatus* Lindström, Moskalenko, Acad. Sci. USSR Siberian Branch, Transactions from the Institute of Geology and Geophysics, 47; Pl. 15, Fig. 6, Pl. 21, Fig. 6.

1975 *Drepanodus homocurvatus* Lindström, Lee, Paläontographica Abt. A (in printing).

Further synonyms, see Lee (1970, 1975a).

Remarks: As noted in the writer's last work (Lee, 1975a) the species *D. homocurvatus* in this work include the form-species *D. homocurvatus* S. str., *D. planus* and *D. amoenus*.

Occurrence: Dumugol Formation (No. 17, No. 19, No. 183).

Materials: 13 specimens.

***Drepanodus parallelus* Branson & Mehl, 1933**

(Pl. 1, Fig. 16, Text-fig. 3-M)

1933 *Drepanodus parallelus* Branson & Mehl, Branson & Mehl. Univ. Misso. Stud., 8; 59, Pl. 4, Fig. 17.

1933 *Drepanodus arcuatus* Pander, Branson & Mehl, *Ibid.*, 58, Pl. 4, Figs. 7, 8, 13, 16.

1938 *Drepanodus subarcuatus* Furnish, Furnish, Jour. Paleont., 12; 328-329, Pl. 41, Figs. 25-32, Pl. 42, Figs. 2, 3.

1941 *Drepanodus parallelus* Branson & Mehl, Graves and Ellison, Misso. Univ. School, Min. Metall. Bull., Tech. Ser., 14; 3, 7, Pl. 1, Fig. 13.

- 1955 *Drepanodus* cf. *subarcuatus* Furnish, Lindström, Geol. Fören. Förhandl., 76:568, Pl. 2, Figs. 41, 44, 50.
- 1964 *Drepanodus subarcuatus* Furnish, Ethington and Clark, Jour. Paleont., 38; 689, Pl. 113, Figs. 15, 20.
- 1964 *Drepanodus subarcuatus* Furnish, Müller, N. Jb. Geol. Paläont. Abh., 119:96—97, Pl. 13, Figs. 5, 6.
- 1965 *Drepanodus subarcuatus* Furnish, Ethington and Clark, Brigham Young Univ. Geol. Studies, 12:191.
- 1965 *Drepanodus subarcuatus* Furnish, Mound, Tulane Univ. Studies in Geol., 4:19, Pl. 2, Figs. 14, 18, 19.
- 1965 *Drepanodus subarcuatus* Furnish, Merrill, Texas J. Sci., 17:375-376, Pl. 1, Fig. 13, Text-figs. 2-12, 13.
- 1967 *Drepanodus subarcuatus* Furnish, Higgins, Scott. Jour. Geol., 3:384.
- 1967 *Drepanodus subarcuatus* Furnish, Longwell and Mound, Geol. Soc. Amer. Bull., 78:409, Pl. 1.
- 1968 *Drepanodus parallelus* Branson & Mehl, Mound, Micropaleont., 14:412, Pl. 2, Figs. 44-49, Pl. 3, Figs. 1-11, 58, 60.
- 1970 *Drepanodus simplex* Branson & Mehl, Barnes and Tuke, Geol. Surv. Can. Bull., 187:86, Pl. 19, Figs. 8, 12, 13(?)
- 1971 *Drepanodus subarcuatus* Furnish, Druce and Jones, Bur. Miner. Resour. Aust. Bull., 110; 74-75, Pl. 20, Figs. 1a-4c, Text-fig. 24c.
- 1971 *Drepanodus parallelus* Branson & Mehl, Jones, Bur. Miner. Resour. Aust. Bull., 117, Pl. 8, Figs. 5a-c.
- 1971 *Drepanodus subarcuatus* Furnish, Ethington and Clark, Geol. Soc. Amer. Mem., 127:67.
- 1971 *Drepanodus subarcuatus* Furnish, Clark and Miller, Wisconsin Univ. Inform. Circ., 19; 14.
- 1973 *Drepanodus subarcuatus* Furnish, Müller, Geol. Surv. Iran, Report, 30:37, Pl.5, Figs. 8a, b, 9-11.

Description: Unit simple, long and slender, tapering gradually towards apex. Cusp joined with base through high degree of curvature at one forth of unit and then nearly straight. Anterior and posterior margins sharply edged. Both lateral faces equally swelled transversely with lanceolate cross section at middle point of cusp. Basal sheath moderately extended posteriorly. Oral margin poorly edged, and makes an angle of 45-50 with aboral margin which is straight in lateral view and makes nearly a right angle with anterior edge. Aboral outline ellipsoid-shaped with longer diameter antero-posteriorly. Basal cavity could not be observed owing to the internal filling.

Remarks: According to the original illustration

of *D. subarcuatus* from the Prairie Du Chien Beds (Furnish, 1938), it has a variability in the curvature and degree of tapering of the cusp, which falls within the characters of *D. parallelus* (particularly Pl.41, Fig. 32), therefore the writer has the same intention as expressed by Jones (Jones, 1971), who decided that *D. parallelus* and *D. subarcuatus* are conspecific. The Dumugol specimens agree well particularly with the specimen of Pl.41, Fig. 30 from the Prairie Du Chien Beds and the specimens from the Jinduckin Formation in north western Australia (Jones, 1971).

Occurrence: Dumugol Formation (No. 17).

Materials: 2 specimens.

Drepanodus suberectus (Branson & Mehl, 1933)

(Pl. 2, Fig. 8, Text-fig. 4-F)

- 1933 *Oistodus suberectus* Branson & Mehl, Branson and Mehl, Univ. Misso. Stud., 8:111, Pl.9, Fig. 7.
- 1955 *Drepanodus suberectus* (Branson & Mehl), Lindström, Geol. Fören. Förhandl., 76; 568, Pl.2, Figs. 21, 22.
- 1969 *Drepanodus suberectus* (Branson & Mehl), Bednarczyk, Acta Geol. Polonica, 19:791, Pl.2, Fig. 5.
- 1970 *Drepanodus suberectus* (Branson & Mehl), Lee, N. Jb. Geol. Paläont. Abh., 136:322-323, Pl.

7, Fig. 18.

- 1970 *Drepanodus suberectus* (Branson & Mehl), Viira and Kivimagi and Loog, Eesti NSV Tead. Akad. Toimet., 19;154.
 1973 *Drepanodus suberectus* (Branson & Mehl), Müller, Geol. Surv. Iran, Report, 30;38, Pl.5, Figs. 3, 6a-b, 7a-b.
 1973 *Drepanodus suberectus* (Branson & Mehl), Moskalenko, Acad. Sci. USSR, Siberian Branch, Transactions from the Institute of Geology and Geophysics, 47; Pl. 21, Fig. 5.
 1973 *Drepanodus suberectus* (Branson & Mehl), Moskalenko, *Ibid.*, 137;33, Pl.1, Fig. 4.
 1973 *Drepanodus suberectus* (Branson & Mehl), Fahraeus, Canadian Jour. Earth Sci., 10; 1830.
 1975 *Drepanodus suberectus* (Branson & Mehl), Lee, Paläontographica Abt. A (in printing).
 Further synonyms, see Lee (1970, 1975a).

Remarks: As the represented specimens are well in agreement with the description and illustrations of the previous works, it needs not to add any description about the species

in this work.

Occurrence: Dumugol Formation (No. 17).

Materials: 4 specimens.

Genus *Oistodus* Pander, 1856

***Type species-Oistodus lanceolatus* Pander, 1856**

***Oistodus inaequalis* Pander, 1856**

(Pl. 2, Fig. 2-3, Text-fig. 4-B,C)

- 1856 *Oistodus inaequalis* Pander, Pander, Mono. Geognostisch. Beschreib. Russ. Balt. Governm. Petersburg, 27, Pl. 2, Fig. 37.
 1970 *Oistodus inaequalis* Pander, Lee, N. Jb. Geol. Paläont. Abh., 136; 327 -328. Pl.7, Figs. 22, 24, Pl.8, Fig. 12.
 1970 *Oistodus inaequalis* Pander, Viira and Kivimagi and Loog, Eesti NSV Tead. Akad. Toimet., 19;154.
 1970 *Oistodus inaequalis* Pander, Barnes and Tuke. Geol. Surv. Can. Bull., 187;89, Pl.20, Figs. 2, 3, 7.
 1971 *Oistodus inaequalis* Pander, Druce and Jones. Bur. Min. Resour. Aust. Bull., 110;76, Pl.12. Figs. 10a-13b, Text-fig. 25a.
 1973 *Oistodus inaequalis* Pander, Müller, Geol. Surv. Iran, Report, 30;40, Pl.8, Figs. 6, 7.
 Further synonyms, see Lee (1970).

Remarks: The species is characterized by the asymmetrical transverse convexity of the cusp, therefore one lateral face is slightly swelled and smooth, whereas the other is broadly transversely convexed and bears a carina on the mid-part of the face, and the basal sheath is laterally flared (Pander, 1856, and Lindström, 1955). The Dumugol specimens agree well with the Baltic forms in these features, in the

Korean specimens, however, the anterior edge is variable in its curvature whereas the illustrated specimens of the Baltic conodonts bear straight anterior edges. The curved anterior edges are also found in the Australian specimens (Druce and Jones, 1971).

Occurrence: Dumugol Formation (No.17, No. 19).

Materials: 10 specimens.

***Oistodus parallelus* Pander, 1856**

(Pl. 2, Fig. 4,6, Text-fig. 4-D)

- 1856 *Oistodus parallelus* Pander, Pander, Mono. Geognost. Beschreib. Russ. Balt. Gouvernm. Petersburg, 27, Pl.2, Fig. 40.
 1970 *Oistodus parallelus* Pander, Lee, N. Jb. Geol. Paläont. Abh., 136; 328, Pl.7, Fig. 23.
 1970 *Oistodus parallelus* Pander, Viira and Kivimagi and Loog, Eesti NSV Tead. Akad. Toimet., 19;154.
 1971 *Oistodus parallelus* Pander, Ethington and Clark, Geol. Soc. Amer. Mem., 127;67, Pl. 2, Fig.23
 1971 *Oistodus parallelus* Pander, Atkinson, Wisconsin Univ. Inform. Circ., 19;25.
 1971 *Oistodus parallelus* Pander, Froming, *Ibid.*, 49.

- 1972 *Oistodus parallelus* Pander, Ethington, Geol. et Paläont., SB. 1;23, Pl.1, Fig.21.
 1972 *Paroistodus proteus* (Lindström), Bergström and Epstein and Epstein, U.S. Geol. Surv. Prof. Paper, 800-D;38, Fig. 1-c,d(non a,e), Fig. 3.
 1973 *Oistodus* aff. *parallelus* Pander, Moskalenko, Acad. Sci. USSR, Siberian Branch, Transactions from the Institute of Geology and Geophysics, 47; Pl.15, Fig.10.
 1973 *Oistodus parallelus* Pander, Müller, Geol. Surv. Iran, Report, 30;41, Pl.8, Figs. 1a-b, 2a-b. Further synonyms, see Lee (1970).

Remarks: The Dumugol specimens at hand conform essentially to the figures and descriptions of the species from South Central Sweden, particularly to such forms as illustrated by Lindström (1955b) as figs. 28, 29 in plate 4. The only minor difference is that one of the Korean materials bears asymmetrically vaulted lateral

faces, that is, one smooth planar and other strongly carinated face, whereas both the lateral faces of Baltic forms carry transversely strongly rounded symmetrical carinae.

Occurrence: Dumugol Formation (No.17).

Materials: 3 specimens.

Genus *Paltodus* Pander, 1856

***Type species-Paltodus subaequalis* Pander, 1856**

***Paltodus inconstans* Lindström, 1955**

(Pl. 2, Fig. 5,7,10, Text-fig. 4-E,J)

- 1955 *Paltodus inconstans* Lindström, Geol. Fören. Förhandl., 76; 583-584, Pl.4, Figs.3-8.
 1972 *Paltodus inconstans* Lindström, Bergström and Epstein and Epstein, U.S. Geol. Surv. Prof. Paper, 800-D, 38, Fig.3.
 1973 *Paltodus* aff. *P. inconstans* Lindström, Barnes and Poplawski, Jour. Paleont., 47; 778, Pl.3, Figs. 9,12,15,16, Text-fig. 21.
 1975 *Paltodus inconstans* Lindström, Lee, Paläontographica, Abt. A (in printing). Further synonyms, see Lee (1970, 1975a).

Remarks: The species is characterized by the unequal number of the costae on the inner and outer lateral faces of the cusp. The Dumugol specimens agree well with the specimens from the South Central Sweden in this character. The Korean specimens at hand carry four costae in maximum on the outer lateral face, of which the posteriorly located costa is conspicuously

drawn out like a knife edge and faces towards posteriorly. The inner face is smooth or bears only one costa like the original description (Lindström, 1955). In the represented specimens the basal sheath is somewhat longer than those in the Baltic forms.

Occurrence: Dumugol Formation (No. 17).

Materials: 9 specimens.

***Paltodus variabilis* Furnish, 1938**

(Pl. 2, Fig. 9,12, Text-fig. 4-G, H)

- 1938 *Paltodus variabilis* Furnish, Furnish, Jour. Paleont., 12;331, Figs. 9,10.
 1967 *Paltodus variabilis* Furnish, Higgins, Scott. Jour. Geol., 3;384, Fig. 2-7.
 1970 *Paltodus variabilis* Furnish, Fahraeus, Geol. Soc. Amer. Bull., 81;2069, 2071, Fig. 2.
 1970 *Paltodus variabilis* Furnish, Lee, N. Jb. Geol. Paläont. Abh., 136;331, Pl. 7, Fig. 31.
 1971 *Paltodus variabilis* Furnish, Miller and Melby, Wisconsin Univ. Inform. Circ., 19;9, Pl.2, Figs. 13-15.
 Further synonyms, see Lee (1970).

Remarks: The species is characterized by its asymmetrical cusp with a prominent longitudinal lateral and a postero-lateral grooves. The Dumugol specimens are fundamentally in agreement with the specimens from the Prairie Du Chien Beds in these features. As noted by Furnish (1938), however, in the represented specimens

a considerable variability in the configuration of costae can be observed, particularly irregular fine costae are developed in all surface of some specimens. Druce and Jones (1971) and Jones (1971) noticed that the species should be placed in the genus *Scolopodus*. But the Korean specimens assigned here to *P. variabilis* are

distinctly distinguished from the genus *Scolopodus* through asymmetrical character of the unit.

Occurrence: Dumugol Formation (No. 17).
Materials: 13 specimens.

Genus *Scolopodus* Pander, 1856

***Type species-Scolopodus sublaevis* Pander, 1856**

***Scolopodus nogamii* Lee, 1974**

(Pl. 2, Fig. 11, 14, Text-fig. 4-K)

1975 *Scolopodus nogamii* Lee, Lee, Paläontographica Abt. A (in printing).

?1967 *Scolopodus* cf. *bassleri* (Furnish), Igo and Koike, Geol. Palaeont. Southeast Asia, 3;23, Pl. 3, Figs. 7, 8, Text-fig. 6-B.

Diagnoseis: A *Scolopodus* with a moderately long, erect cusp, which is longitudinally grooved in both antero-lateral sides and provided with longitudinal fine striae on all the surfaces.

Description: Unit simple and symmetrical, moderately long, tapering gradually towards distal part. Cusp nearly erect or slightly recurved above curved base. Anterior face rounded with sharply or bluntly edged antero-lateral costae. Posterior face rounded but on some specimens sharply keeled on its distal part. Lateral faces longitudinally grooved antero-laterally. Basal sheath moderately expanded posteriorly. Oral margin strongly curved from posterior margin of cusp, broadly rounded and nearly straight in lateral view, making an angle of 40-70° with aboral margin, which is, viewed laterally, straight or slightly convexed downwards. Basal cavity moderately deep, and

its apex directed upwards and reaches the point of curvature between cusp and basal sheath. On all the surface fine longitudinal striae are developed, particularly on the lower part of the unit.

Remarks: As described by the writer's last work (Lee, 1975a) the new species are distinguished from the previously described species through its symmetrically furrowed antero-lateral grooves and the fine longitudinal striae. The species are similar to *S. warendensis* Druce & Jones in the cross section of the unit. The latter does not bear, however, the fine longitudinal striae. The specimen, which was described by Igo and Koike (1967) as *S. cf. bassleri*, probably belongs to this species.

Occurrence: Dumugol Formation (No. 16, No. 17).

Materials: 48 specimens.

***Scolopodus rex* Lindström, 1955**

(Pl. 2, Fig. 13, Text-fig. 4-I)

1955 *Scolopodus rex* Lindström, Lindström, Geol. Fören. Förhandl., 76;595, Pl. 3, Fig. 32.

1969 *Scolopodus rex* Lindström, Bednarczyk, Acta Geol. Polonica, 19;791, Pl. 1, Fig. 11.

1971 *Scolopodus rex* Lindström, Lindström, Geol. Soc. Amer. Mem., 127;28.

1972 *Scolopodus rex* Lindström, Ethington, Geol. et Palaeont., SB. 1;20, 22, Pl. 1, Fig. 17.

1972 *Scolopodus rex* Lindström, Bergström and Epstein and Epstein, U.S. Geol. Surv. Prof. Paper, 800-D, 38, Fig. 1-b, Fig. 3.

Further synonyms, see Lee (1970).

Remarks: The Dumugol specimens are well in agreement with the description and illustration of the original specimens from South-Central Sweden (Lindström, 1955). The species is similar to *Scolopodus cornutiformis* Branson & Mehl, but it is distinguished from the latter through the costae which extend from the basal

margin to the apex. In *S. cornutiformis* the costae do not extend far above mid-height of the unit, or only a half of the costae runs to the distal portion of the cusp. (Ethington & Clark, 1964, p. 698)

Occurrence: Dumugol Formation (No. 19).

Materials: 6 specimens.

斗務洞層으로부터 產出된 코노돈트化石群

李 河 榮

延世大學校 理工大學 地質學科

〈要 約〉

本研究는 延世大學校 地質學科(金玉準, 尹碩奎, 李大聲, 李河榮)에 의하여 實施된 바 있는 “南韓 江原道에 分布된 大石灰岩統의 層序와 地質構造”의 研究中에 얻어진 斗務洞層 코노돈트 化石群의 再分類와 記載를 目的으로 착수되었으며 이 化石群에 의한 새로운 同層의 層序細分을 試圖하였다.

코노돈트 化石은 三陟郡 銅店里와 寧越郡 上東面에 分布된 斗務洞層으로부터 채취된 總 26 個의 標品中 5 個標品에서 鑑定可能한 153 個體가 產出되었다. 이 코노돈트 化石群은 7 屬(Form-Genera), 20 種(Form-Species)으로 分類되었으며, 이들은 이미 알려진 北西部유럽地域과 北美大陸의 오오도비스系 아레니지안(Arenigian) 化石群에 對比된다. 特히 斗務洞化石群은 *Prionidus elegans* Zone의 基底部로부터 *Prionidus evae* Zone의 下部에 屬하는 化石群과 一致된다. 그러므로 斗務洞層의 時代는 오오도비스紀 아레니지안의 下部~中部에 해당되는 것으로 생각된다. 本研究에 의하여 1970年 筆者에 의해서 行하여진 斗務洞層의 코노돈트 化石群에 對한 層序研究 結果가 再確認되었으며 同時에 그의 時代가 더 限定되었다.

REFERENCES

- Ash, S.R., 1961, Bibliography and index of conodonts, 1949-1958: *Micropaleontology*, v. 7, p. 213-244. New York.
- , 1963, Bibliography and index of conodonts, 1959-1963: *Brigham Young Univ., Geol. Studies*, v. 10, p. 1-50.
- Atkinson, R.F., 1971, Conodonts and biostratigraphy of the Wisconsin Paleozoic (Platteville Formation): *Wisconsin Univ. Inform. Circ.*, no. 19, p. 18-33, 4 pls. Madison.
- Barnes, C.R. and Poplawski, M.L.S., 1973, Lower and Middle Ordovician conodonts from the Mystic Formation, Quebec, Canada: *Jour. Paleont.*, v. 47, p. 760-790, 5 pls. 1 text-fig. 3 tables.
- , and Tuke, M.F., 1970, Conodonts from the St. George Formation (Ordovician), Northern Newfoundland: *Geol. Surv. Canada, Bull.*, 187, p. 79-97, 3 pls. 2 text-figs. 1 table. Ottawa.
- Bednarczyk, W., 1969, The Ordovician from boreholes Dobre 1 and Sokolow Podlaski 1 (Western part of the Podlasie depression): *Acta Geol. Pol.*, v. 19, p. 779-791, 2 pls. 2 text-figs.
- Bergström, S.M. & Epstein, A.G. & Epstein, J.B., 1972, Early Ordovician north atlantic province conodonts in eastern Pennsylvania: *U.S. Geol. Surv. Prof. Paper* 800-D, p. 37-44, 1 pl. 3 text-figs. 1 table.
- Branson, E.B. & Mehl, M.G., 1933, Conodont studies: *Univ. Miss. Stud.*, v. 8, p. 1-167, 12 pls. Columbia.
- Clark, D.L. and Miller, J.F., 1971, Conodonts and biostratigraphy of the Wisconsin Paleozoic (St. Peter Sandstone): *Wisconsin Univ. Inform. Circ.*, no. 19, p. 14. Madison.
- Druce, E.C. & Jones, P.J. 1971, Cambro-Ordovician conodonts from the Burke River structural belt, Queensland: *Bur. Miner. Resour. Australia, Bull.*, v. 110, p. 1-117, 20 pls. 33 text-figs. Melbourne.
- Ethington, R.L., 1972, Lower Ordovician (Arenigian) conodonts from the Pogonip Group, Central Nevada: *Geol. et Palaeont.*, SB. 1, p. 17-28, 1 pl. 3 text-figs. 1 table. Marburg.
- , Clark, D.L., 1964, Conodonts from the El Paso Formation (Ordovician) of Texas and Arizona: *Jour. Paleont.*, v. 38, p. 685-704, 3 pls. 2 text-figs. Menasha.
- , & ——, 1965, Lower Ordovician conodonts and other microfossils from the Columbia Ice Fields Section, Alberta, Canada: *Brigham Young Univ. Geol. Stud.*, v. 12, p. 185-205, 2 pls.
- , & ——, 1971, Lower Ordovician conodonts in North America: *Geol. Soc. Amer. Mem.*, 127, p. 63-82, 2 pls. 2 text-figs. Boulder.
- Fahraeus, L.E., 1970, Conodont-based correlations of Lower and Middle Ordovician Strata in western Newfoundland: *Geol. Soc. Amer. Bull.*, v. 81, p. 2061-2076, 4 text-figs. 2 tables.
- Froming, G.T., 1971, Conodonts and biostratigraphy of the Wisconsin Paleozoic (Maquoketa Shale): *Wisconsin Univ. Inform. Circ.* no.

CONDONTS FROM THE DUMUGOL FORMATION (LOWER ORDOVICIAN), SOUTH KOREA

- 19, p. 42-52, 4 text-figs. Madison.
- Furnish, W.M., 1938, Conodonts from the Prairie Du Chien (Lower Ordovician) Beds of the upper Mississippian valley: *Jour. Paleont.*, v.12, p.318-340, 2 pls. 2 text-figs. 1 table.
- Geol. Soc. Korea, 1962, Geological Atlas of Taebaegsan Region: The geological investigation corps of Taebaegsan region, 17 Geologic maps. Seoul.
- Graves, R.N.jr. & Ellison, S., 1941, Ordovician conodonts of the Marathon Basin, Texas: *Missouri Univ., School Mines and Met. Bull.*, Techn. Ser., v.14, p.1-26, 3 pls.
- Hamar, G., 1964, The Middle Ordovician of the Oslo region, Norway, 17 conodonts from the lower Middle Ordovician of Ringerike: *Norsk Geol. T.*, v. 44, p.243-292, 6 pls. 3 text-figs., Bergen.
- _____, 1966, The Middle Ordovician of the Oslo region, Norway, 22 preliminary report on conodonts from the Oslo, Asker and Ring-erike districts: *Norsk Geol. T.*, v. 46, p.27-83, 7 pls. 6 text-figs. Bergen.
- Higgins, A.C., 1967, The age of the Durine Member of the Durness Limestone Formation at Durness: *Scott. Jour. Geol.*, v.3, p.382-388, 2 text-figs.
- Igo, H. & Koike, T., 1967, Ordovician and Silurian conodonts from the Langkawi Islands, Malaya: *Geology and Paleontology of South-east Asia*, v.3, p.1-29. 3 pls. 6 text-figs.
- Jones, P.J., 1971, Lower Ordovician conodonts from the Bonaparte Gulf Basin and the Daly River Basin, Northwestern Australia: *Bur. Miner. Resour. Australia, Bull.*, v. 117, p.1-80, 9 pls. 16 text-figs. 2 tables. Moonah.
- Kim, O.J. & Lee, H.Y., 1973, The stratigraphy and geologic structure of the Great Limestone Series in Kangweon-Do, South Korea: *Jour. National Academy of Sciences, Korea, Natural Sciences Series* v. 12, p.139-170, 7 text-figs. 5 tables. Seoul.
- Kobayashi, T., 1966, Stratigraphy of the Chosen Group in Korea and South Manchuria and its relation to the Cambro-Ordovician formations of other areas, Sect. A, The Chosen Group of South Korea: *J. Fac. Sci., Univ. Tokyo, Sec. 2*, v. 16, p.1-73. Tokyo.
- _____, 1969, Stratigraphy of the Chosen Group in Korea and South Manchuria and its relation to the Cambro-Ordovician Formations of other areas, Sect. D, The Ordovician of Eastern Asia and other parts of the continent: *J. Fac. Sci. Univ. Tokyo, Sect 2*, v. 17, p.163-316. Tokyo.
- Kohut, J.J., 1972, Conodont biostratigraphy of the Lower Ordovician Orthoceras and Stein Limestones (3c), Norway: *Norsk Geol. T.*, v. 52, p.427-445, 4 text-figs. Bergen.
- Lamont, A. & Lindström, M., 1957, Arenigian and Llandeilian Cherts identified in the southern uplands of Scotland by means of conodonts, etc.: *Trans. Edin. Geol. Soc.*, v. 17, p.60-70, 5 pls. 1 text-fig.
- Lee, H.Y., 1970, Conodonten aus der Chosen-Gruppe (Unteres Ordovizium) von Korea: *N. Jb. Geol. Paläont. Abh.*, v. 136, p.303-344, 2 pls. 1 text-fig. 3 tables. Stuttgart.
- _____, 1975, Conodonten aus der Unteren und Mittleren Ordovizium von Nordkorea: *Paläontographica Abt. A*. (in printing)
- _____, & Lee, J.D., 1971, Conodont fauna from the Great Limestone Series in Dongjeom District, Samcheok-Gun, Kangweon-Do and its stratigraphical significance: *Jour. Geol. Soc. Korea*, v. 7, p.89-101, 2 text-figs. 4 tables. Seoul.
- Lindström, M., 1955, Conodonts from the lowermost Ordovician strata of South-Central Sweden: *Geol. Fören. Förh.*, v.76, p.517-604, 10 pls. 5 text-figs. Stockholm.
- _____, 1957, Two Ordovician conodont faunas found with zonal graptolites: *Geol. Fören. Förh.*, v. 79, p.161-178, 2 pls. 2 text-figs. Stockholm.
- _____, 1960, A Lower-Middle Ordovician succession of conodont faunas: *Internat. Geol. Congr. 21 Sess., Norden 1960, Rept. Part 7*. (Ordovician and Silurian Stratigraphy and Correlations); p.88-96, 8 text-figs. Copenhagen.
- _____, 1971, Lower Ordovician conodonts of Europe: *Geol. Soc. Amer. Mem.*, 127, p.21-61, 1 pl. 20 text-figs. Boulder.
- Longwell, C.R. & Mound, M.C., 1967, A new Ordovician Formation in Nevada dated by conodonts: *Geol. Soc. Amer. Bull.*, v. 78, p.405-412, 1 pl.
- McTavish, R.A., 1973, Prioniodontacean conodonts from the Emanuel Formation (Lower Ordovician) of Western Australia: v. 7, p.27-58, 3 pls. 7 text-figs. 5 tables. Marburg.
- Merril, G.K., 1965, Conodonts from the Burnam Limestone of central Texas: *Texas J. Sci.*, v. 17, p.345-403, 4 pls. 3 text-figs. 1 table.
- Miller, J.F. & Melby, J.H., 1971, Conodonts and biostratigraphy of the Wisconsin Paleozoic (Trempealeuan conodonts): *Wisconsin Univ. Inform. Circ.*, no. 19, p. 4-11, 2 pls. 2 text-figs. 1 table. Madison.
- Moskalenko, T.A., 1967, Conodonts from the Chunya Stage (Lower Ordovician) of the Rivers Molero and Podkamennaia Tungeska; NEW data on the biostratigraphy of the Lower Paleozoic of the Siberian Platform: *Acad. Sci. USSR. Siberian Div.*, p.98-116. 2pls.

- 16 text-figs.
- _____, 1973, Distribution of the Ordovician conodonts on Siberian Platform, General survey: Acad. Sci. USSR, Siberian Div., Transactions from the Institute of Geology and Geophysics, v. 47, p. 87-107, 23 pls.
- Mound, M.C., 1965, A conodont fauna from the Joins Formation (Ordovician), Oklahoma: Tulane Stud. Geol., v. 4, p. 1-46, 4 pls. 1 text-fig. New Orleans.
- _____, 1968, Conodonts and biostratigraphy of the Lower Arbuckle Group (Ordovician), Arbuckle Mountains, Oklahoma: Micropaleontology, v. 14, p. 393-434, 6 pls.
- Müller, K.J., 1964, Conodonten aus dem Unteren Ordovizium von Südkorea: N. Jb. Geol. Paläont. Abh., v. 119, p. 93-102, 2 pls. 1 text-fig. Stuttgart.
- _____, 1973, Late Cambrian and Early Ordovician conodonts from Northern Iran: Geol. Surv. Iran, Report 30, p. 5-53, 11 pls. 11 text-figs. 3 charts. Tehran.
- Pander, C.H., 1856, Monographie der fossilen Fisch des Silurischen Systems der russisch-baltischen Gouvernements: Königl. Akad. Wiss., St. Petersburg, p. 1-91, 9 pls. 10 text-figs. Petersburg.
- Spassov, Chr., 1970, Conodontes des fragmentes calcaires du Conglomerat Carbonifère près de Falkovetz: Bulgarian Geol. Soc. Rev. v. 31, p. 177-185, 3 pls.
- Viira, V., 1970, Conodonts of the Varangu Member (Estonian Upper Tremadoc): Eesti NSV Tead. Akad. Toimet., v. 19, p. 224-233, 1 pl. 10 text-figs.
- _____, & Kivimägi, E. & Loog, A., 1970, On the lithology and age of the Varangu Member (Tremadocian, North-Estonia): Eesti NSV Tead. Akad. Toimet., v. 19, p. 147-155, 4 text-figs. 1 table.
- Wolska, Z., 1961, Conodonts from Ordovician erratic boulders of Poland: Acta Palaeontologica Polonica, v. 6, p. 339-365, 6 pls. 1 text-fig. 2 tables.
(Manuscript received November 20, 1974.)

EXPLANATION OF PLATES

All figures x70, unless otherwise indicated. YSUG means that the figured specimens are deposited at "Department of Geology, Yonsei University", Seoul, Korea.

Plate I

- Fig. 1** *Acodus oneotensis* Furnish, 1938
Lateral side of cusp. YSUG 00038, Sample No. 17.
Myeonsan, Sangjang-myeon, Samcheok-Gun, Kangweon-Do.
Dumugol Formation.
- Fig. 2** *Acodus deltatus* Lindström, 1955
Lateral side of cusp. YSUG 00039, Sample No. 6.
Myeonsan, Sangjang-myeon, Samcheok-Gun, Kangweon-Do.
Dumugol Formation.
- Fig. 3** *Acodus tetrahedron* Lindström, 1955
Lateral side of cusp. YSUG 00040, Sample No. 6.
Locality and Formation: The same as Fig. 2.
- Fig. 4** *Acontiodus* nov. sp. Ethington & Clark, 1965
Posterial side of cusp. YSUG 00041, Sample No. 6.
Locality and Formation: The same as Fig. 2.
- Fig. 5** *Acontiodus rectus* Lindström, 1955
Lateral side of cusp. YSUG 00042, Sample No. 6.
Locality and Formation: The same as Fig. 2.
- Fig. 6-7.** *Distacodus rhombicus* Lindström, 1955
Lateral side of cusp. Fig. 6: YSUG 00043,
Fig. 7: YSUG 00044. Sample No. 17.
Locality and Formation: The same as Fig. 1.
- Fig. 8, 12** *Acontiodus iowaensis* Furnish, 1938
Posterial side of cusps. Fig. 8: YSUG 00045,
Fig. 12: YSUG 00046. Sample No. 17.
Locality and Formation: The same as Fig. 1.
- Fig. 9-11** *Distacodus stollus* Lindström, 1955
Lateral side of cusps showing different shapes of basal sheath. Fig. 9: YSUG 00047, x60., Fig. 10:

CONODONTS FROM THE DUMUGOL FORMATION (LOWER ORDOVICIAN), SOUTH KOREA

YSUG 00043, Fig. 11: YSUG 00049. Sample No. 17.

Locality and Formation: The same as Fig. 1.

Fig. 13 *Drepanodus arcuatus* Lindström, 1955

Lateral side of cusp. YSUG 00050. Sample No. 17.

Locality and Formation: The same as Fig. 1.

Fig. 14 *Drepanodus gracilis* (Branson & Mehl, 1933)

Lateral side of cusp. YSUG 00051. Sample No. 17.

Locality and Formation: The same as Fig. 1.

Fig. 15 *Drepanodus bisymmetricus* Viira, 1970

Lateral side of cusp. YSUG 00052. Sample No. 17.

Locality and Formation: The same as Fig. 1.

Fig. 16 *Drepanodus parallelus* Branson & Mehl, 1933

Lateral side of cusp. YSUG 00053. Sample No. 17.

Locality and Formation: The same as Fig. 1.

Plate 2

Fig. 1 *Drepanodus homocurvatus* Lindström, 1955

Lateral side of cusp. YSUG 00054. ×60, Sample No. 183. Sangdong, Sangdong-myeon, Yeongweol-Gun, Kangweon-Do. Dumugol Formation.

Fig. 2-3 *Oistodus inaequalis* Pander, 1856

Lateral side of cusps. Fig. 2: YSUG 00055, Fig. 3: YSUG 00056. Sample No. 17. Myeonsan, Sangjang-myeon, Samcheok-Gun, Kangweon-Do, Dumugol Formation.

Fig. 4, 6 *Oistodus parallelus* Pander, 1856

Lateral side of cusps. Fig. 4: YSUG 00057, ×60, Fig. 6: YSUG 00058. ×60, Sample No. 17. Locality and Formation: The same as Fig. 2.

Fig. 5, 7, 10 *Paltodus inconstans* Lindström, 1955

Lateral side of cusps showing two or three lateral costae. Fig. 5: YSUG 00059, Fig. 7: YSUG 00060, ×60, Fig. 10: YSUG 00061. Sample No. 17. Locality and Formation: The same as Fig. 2.

Fig. 8 *Drepanodus suberectus* (Branson & Mehl, 1933)

Lateral side of cusp. YSUG 00062, Sample No. 17.

Locality and Formation: The same as Fig. 2.

Fig. 9, 12 *Paltodus variabilis* Furnish, 1938

Lateral side of cusps. Fig. 9: YSUG 00063, Fig. 12: 00064. Sample No. 17.

Locality and Formation: The same as Fig. 2.

Fig. 11, 14 *Scolopodus nogamii* Lee, 1975

Lateral side of cusps. Fig. 11: YSUG 00065, Fig. 14: YSUG 00066. Sample No. 17.

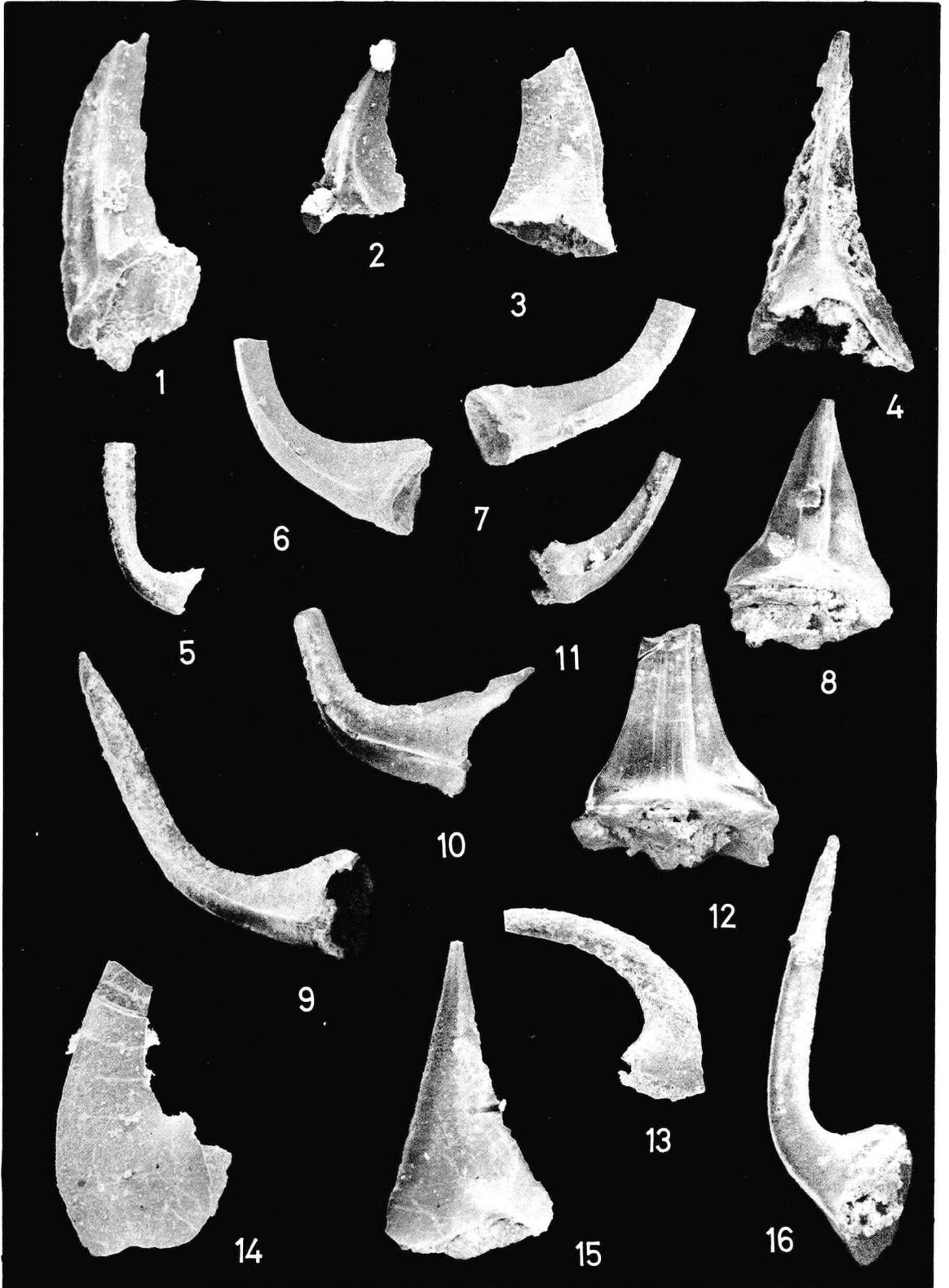
Locality and Formation: The same as Fig. 2.

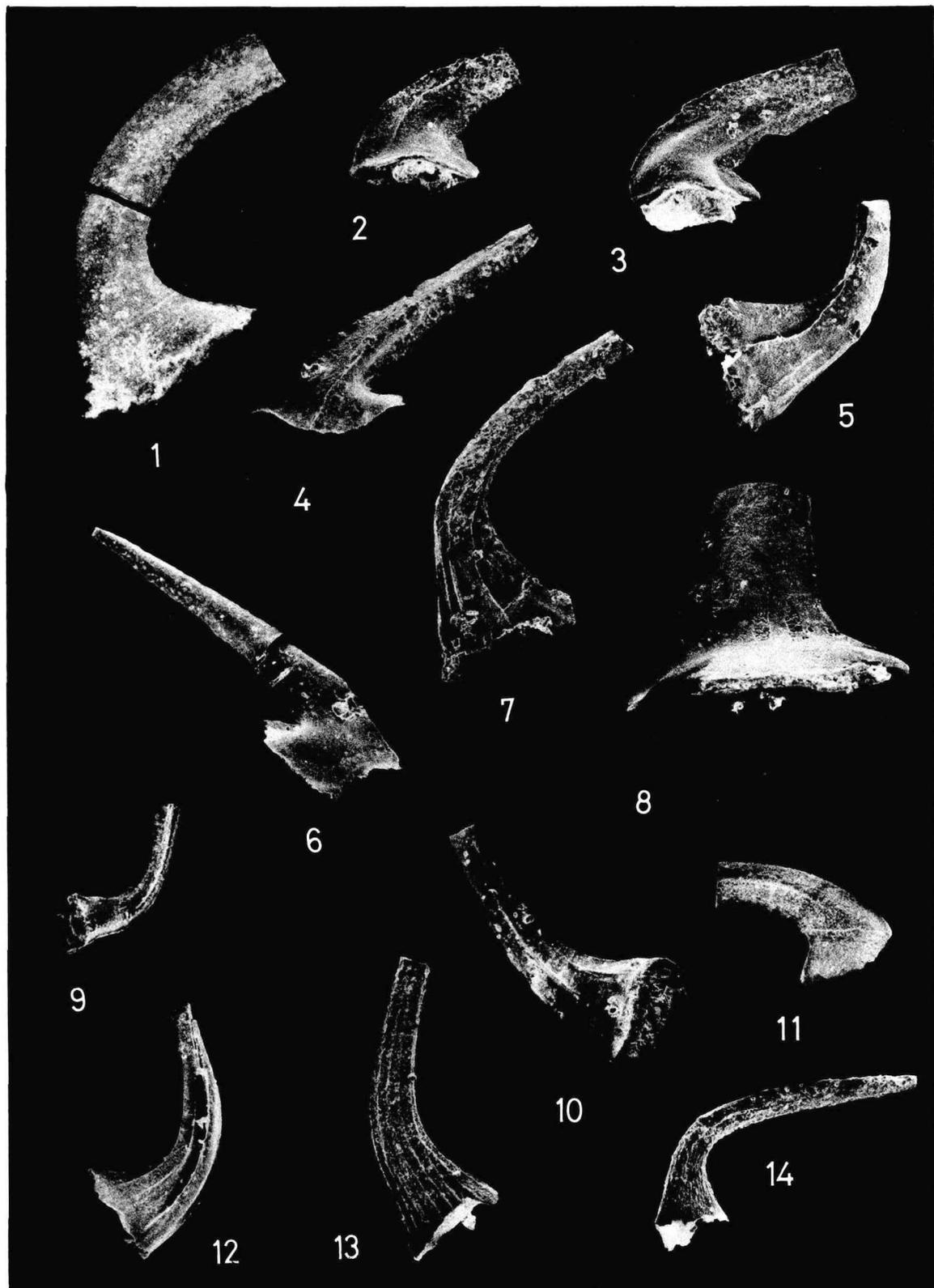
Fig. 13 *Scolopodus rex* Lindström, 1955

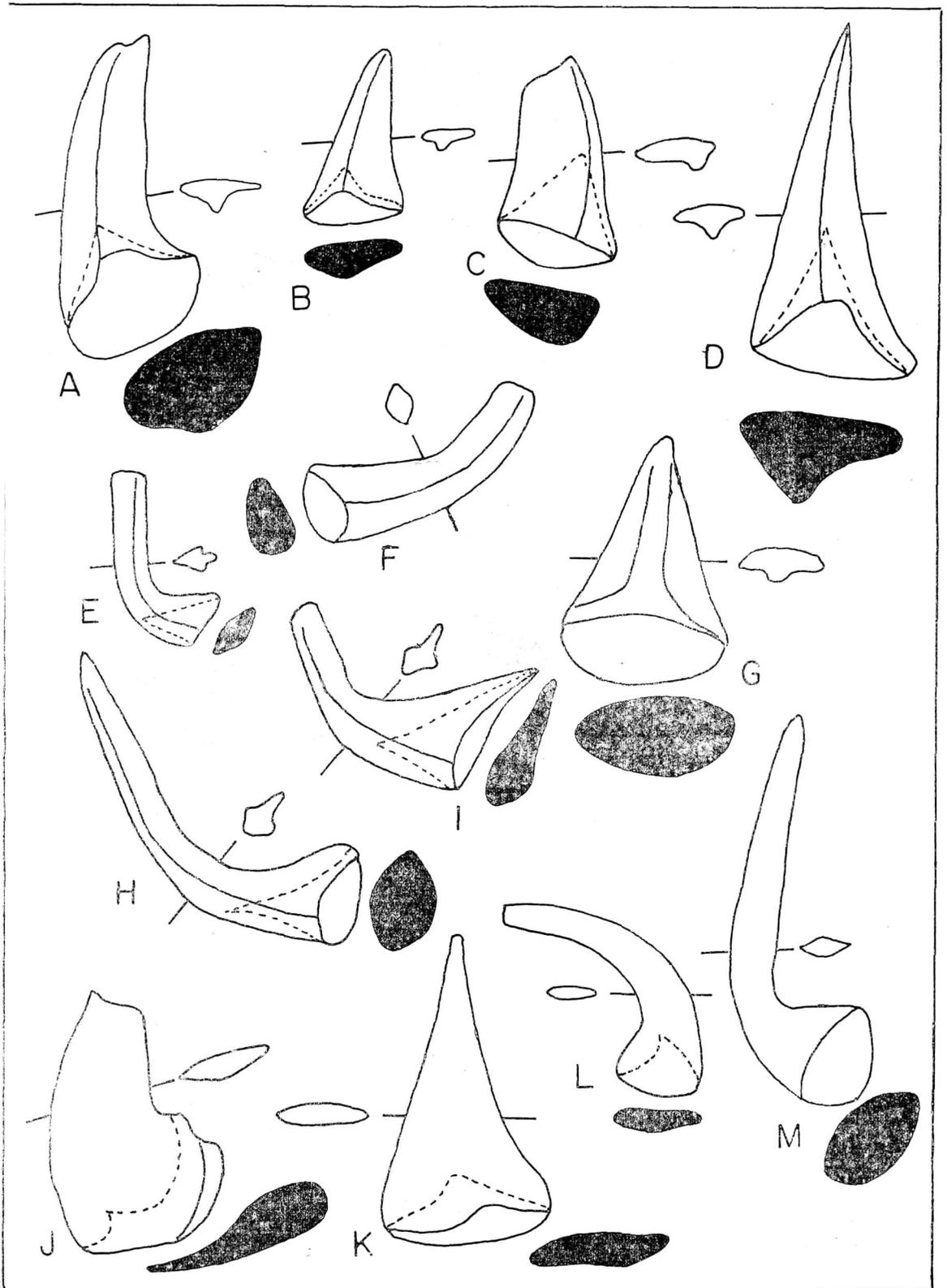
Lateral side of cusp. YSUG 00067, Sample No. 19.

Locality and Formation: The same as Fig. 2.

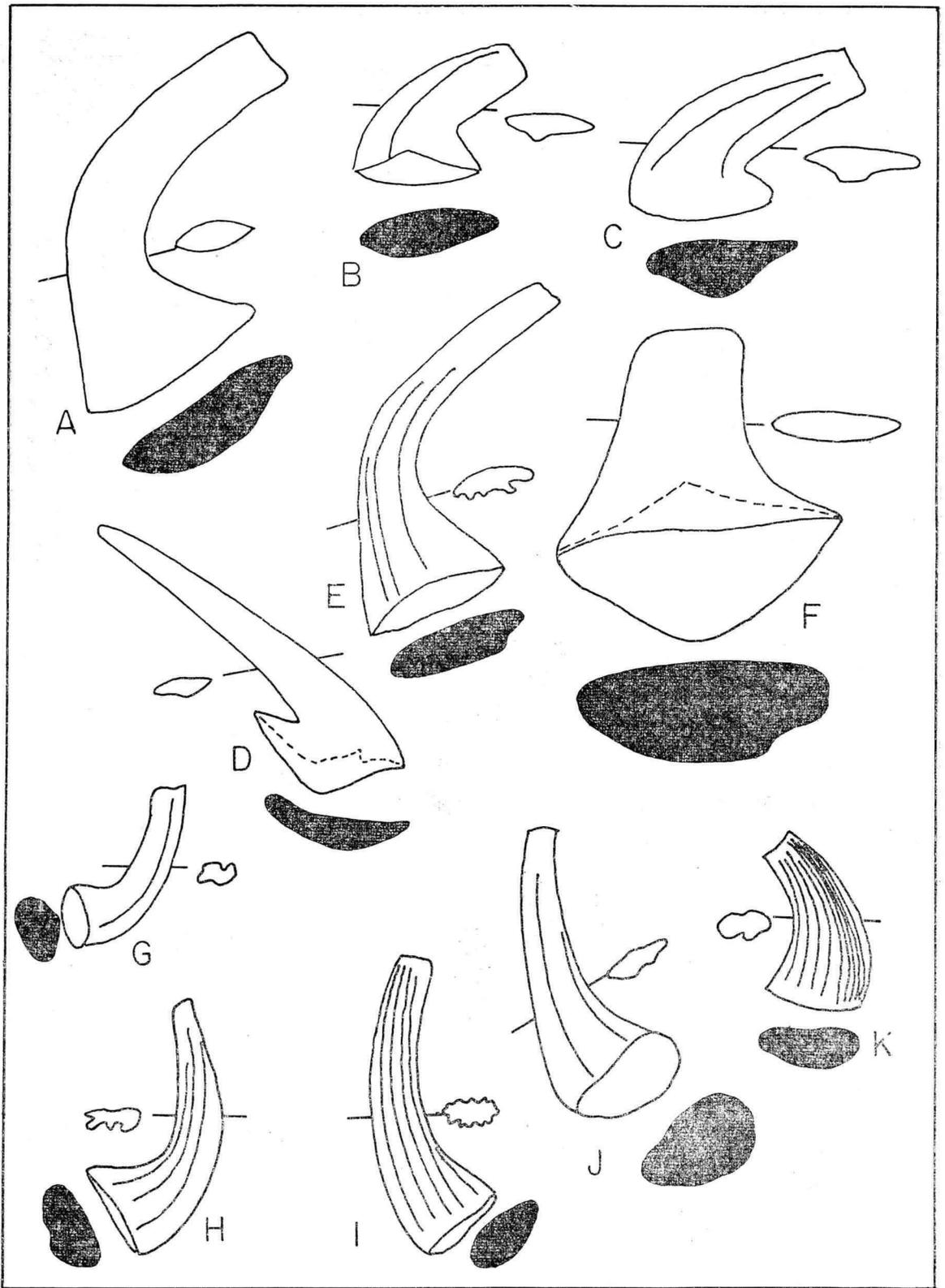
공 백







Text-fig 3 : Illustrated specimens showing aboral outline and cross section of cusps (Plate I)



Text - fig 4 : Illustrated specimens showing aboral outline and cross section of cusps (Plate 2)