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Conodont fauna and biostratigraphy of the Famennian of Büyükada, Istanbul, Northwestern Turkey

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KEY WORDS – Conodonts, Taxonomy, Biostratigraphy, Late Devonian (Famennian), Istanbul, Turkey.

ABSTRACT – A Famennian conodont fauna, restricted generally to palmatolepid biofacies, is obtained from Ayine Burnu in the southwest of Büyükada, Istanbul. A total of 31 species and subspecies are identified and figured, three of which are new: *Mehlina arcuata* n.sp., *Palmatolepis glabra angusta* n. subsp., *Polygnathus longiusculus* n.sp.; one species (*Polygnathus* n.sp.A) is not formally named.

This fauna represents the Upper rhomboidea and Lower marginifera Zones, and its age range corresponds to middle Famennian.

RIASSUNTO – [Fauna a conodonti e biostratigrafia del Famenniano (Devoniano sup.) di Büyükada, Istanbul, Turchia nord occidentale] – Viene descritta una fauna a conodonti, per lo più ristretta alla biofacies a palmatolepidi; proveniente da una sequenza di calcari nodulari appartenente al membro Ayineburnu della Formazione Tuzla (Eifeliano - Famenniano), nell'area sud ovest di Büyükada, Istanbul. Sono state identificate e figurate complessivamente 31 specie e sottospecie, 3 delle quali sono qui proposte come nuove (*Mehlina arcuata* n.sp., *Palmatolepis glabra angusta* n. subsp., *Polygnathus longiusculus* n.sp.) mentre una quarta (*Polygnathus* n.sp.A) è lasciata a nomenclatura aperta. Questa fauna rappresenta le zone Upper rhomboidea e Lower marginifera ed ha quindi una età corrispondente al Famenniano medio.

INTRODUCTION

The Istanbul Zone of the Pontides is subjected to a number of studies (Baykal & Kaya, 1963; Abdüsselâmoğlu, 1963; Haas, 1968a, 1968b; Gedik, 1975; Kaya, 1971, 1973, 1978a, 1978b; Sayar, 1978, 1979; Önal, 1982, 1988; Görür *et al.*, 1993; Okay, 1987; Okay *et al.*, 1994; Seymen, 1995 etc.), but few works on conodonts have been published. The first paper containing conodont is the study of Abdüsselâmoğlu, (1963), but in that paper, the illustrated conodonts have not been systematically searched. Haas (1968b), who studied the Devonian of Bithynia, stated some Silurian and Devonian conodonts determined by Ziegler. Gedik (1975) studied the Triassic conodonts from the Kocaeli Peninsula. A Famennian conodont fauna has been obtained from a nodular limestone sequence belonging to the Ayineburnu member of the Eifelian-Famennian Tuzla Formation in the southwestern part of Büyükada, Istanbul (Text-fig. 1). The purpose of this study is to describe the taxonomy and biostratigraphy of this conodont fauna.

LITHOSTRATIGRAPHY

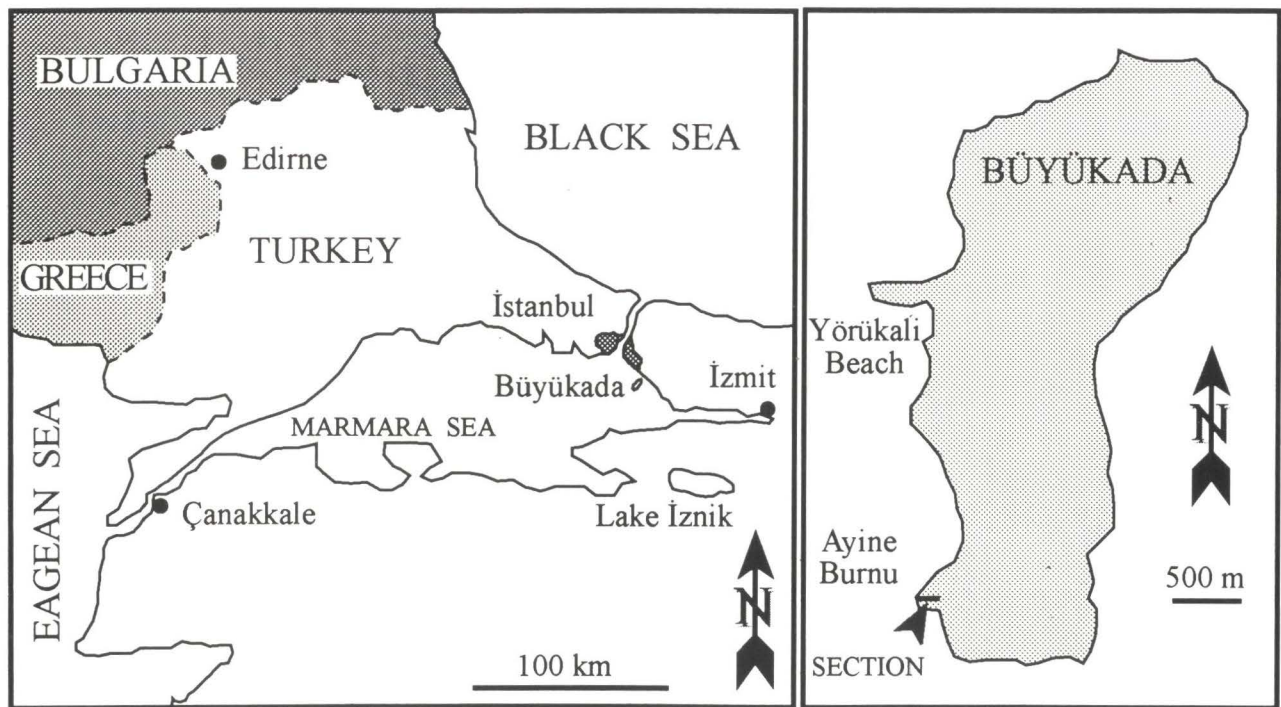
The Istanbul Zone of the Pontides is characterized by a thick and well-developed middle Ordovician to Viséan (Lower Carboniferous) transgressive sedimentary sequence of passive continental margin affinity (Okay, 1987; Görür *et al.*, 1993;

Okay *et al.*, 1994). This sequence comprising many formations and members is strongly affected by the Hercynian and Alpine tectonic movements, therefore, complete stratigraphic sections are not present. The investigated stratigraphic section, 12.40 m thick, is a part of the Eifelian-Famennian Tuzla Formation (Text-fig. 2), and it is known as the Ayineburnu Member (Önal, 1982, 1988). Its type locality is Ayine Burnu in the southwest of Büyükada, Istanbul (Text-fig. 1). The entire section is overturned, and its lower contact is of fault. The upper part lies in the Sea of Marmara. Lithology consists mainly of thin, nodular limestone with beige, thin mudstone nodules, and a yellowish light-brown, clay-rich matrix. The stylolitic structures with iron-oxides are common in many samples. Fossil constituents are low both in diversity and abundance, and consist mainly of ostracod shells. Their abundance is less than 10 percent but in some samples it can attain 10 percent.

Similar rocks are attributed SMF-3 by Wilson (1975) who considered a basin (FZ-1) or slope environment (FZ-3) for their deposition. The conodont fauna representing the palmatolepid biofacies obtained from this section also supports this.

BIOSTRATIGRAPHY

The conodont faunas of the investigated section are dominated by species and subspecies of



Text-fig. 1 - Locality map of the studied stratigraphic section.

Palmatolepis. Therefore, they can be correlated directly with the standard zonation, which is based on species of *Palmatolepis* (Ziegler, 1962a; Sandberg & Ziegler, 1973; Ziegler in Kapper & Ziegler, 1979; Ziegler & Sandberg, 1984; Ziegler & Sandberg, 1990). The conodont faunas from 36 samples (İ-1 to İ-36) are listed in Table 1. These 36 collections represent the Upper *rhomboidea* and the Lower *marginifera* Zones and their age corresponds to the middle Famennian.

UPPER *rhomboidea* ZONE

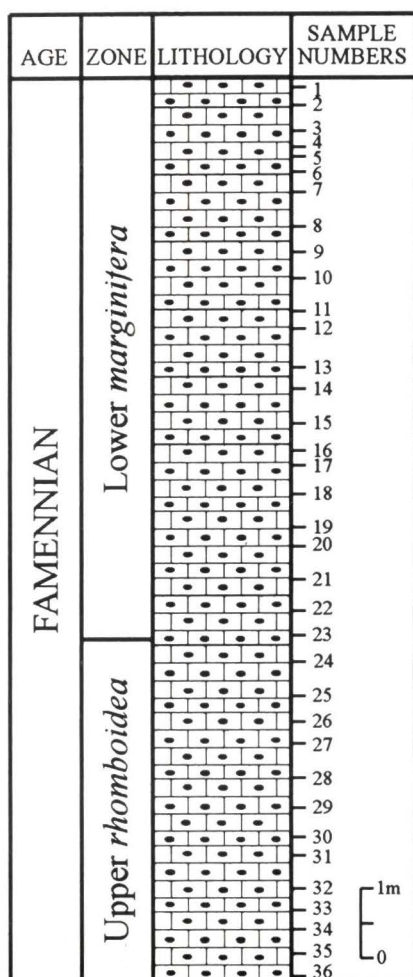
The Upper *rhomboidea* Zone is characterized by the relatively abundant occurrence of *Palmatolepis rhomboidea* after the disappearance of *Palmatolepis poolei* and before the first appearance of *Palmatolepis marginifera marginifera* (Sandberg & Ziegler, 1973). The diagnostic form *Palmatolepis poolei* does not occur in the investigated section. However this boundary can be defined by the lowest appearance of *Palmatolepis gracilis gracilis* that first appears at the base of the Upper *rhomboidea* Zone (Ziegler in Kapper & Ziegler, 1979, text-fig. 6). According to this, the interval between the lowest occurrences of *Palmatolepis gracilis gracilis* and *Palmatolepis marginifera marginifera* belongs to the Upper *rhomboidea* Zone (Table 1; Samples from İ-36 to İ-24).

LOWER *marginifera* ZONE

The association of *Palmatolepis marginifera marginifera*, *Palmatolepis quadrantinodosa inflexa*, and *Palmatolepis quadrantinodosa inflexoidea* characterizes the Lower *marginifera* Zone (Ziegler & Sandberg, 1984). According to this, the top 6 meters of the studied stratigraphic section overlying the Upper *rhomboidea* Zone is assigned to the Lower *marginifera* Zone (Text-fig. 2; Table 1; Samples İ-23 to İ-1). *Palmatolepis marginifera marginifera* defining the upper boundary of this zone and the lower boundary of the overlying Lower *marginifera* Zone first appears in sample İ-23. The diagnostic of the upper boundary, *Palmatolepis marginifera utahensis*, is not seen in the studied section. Therefore the upper boundary of the studied section could not correspond to the upper boundary of the Lower *marginifera* Zone.

SYSTEMATIC PALEONTOLOGY

The suprageneric classification in this paper follows that of Sweet (1988). The conodonts discussed belong to Icriodontidae, Polygnathidae, Palmatolepidae and Spathognathodontidae families. The most abundant conodont genera is *Palmatolepis* (Tab. 1). Although ramiform elements are also



Text-fig. 2 - Lithostratigraphic section from the Ayine Burnu, Büyükada, Istanbul. Location of conodont samples are shown on the right.

present in the collection, the platform elements are the focus of this study. Figured specimens and faunal slides are repositied at Karadeniz Teknik Üniversitesi, Jeoloji Mühendisliği Bölümü (Trabzon, Turkey), under the numbers ranging from İ-1 to İ-36.

Phylum CONODONTA Pander, 1856

Class CONODONTI Branson, 1938

Order OZARKODINIDA Dzik, 1976

Family PALMATOLEPIDAE Sweet, 1988

Genus PALMATOLEPIS Ulrich & Bassler, 1926

Type species - *Palmatolepis perlobata* Ulrich & Bassler, 1926

PALMATOLEPIS GLABRA Ulrich & Bassler, 1926

PALMATOLEPIS GLABRA ACUTA Helms, 1963

Pl. 1, figs. 1-6

1963 *Palmatolepis (Panderolepis) serrata acuta* HELMS, pp. 468-469, pl. 3, figs. 1-4, 6.

1977 *Palmatolepis glabra acuta* Helms - Ziegler in ZIEGLER (ed.), *Palmatolepis*-pl. 6, figs. 2, 3 (cum syn.).

Remarks - The Pa element is distinguished from other subspecies of *Palmatolepis glabra* by the acute angle between parapet crest and blade, and by the narrow, elongate, usually large platform.

Range - From about the start of the Uppermost *crepida* Zone into the Upper *marginifera* Zone (Ziegler & Sandberg, 1984, fig. 3, p. 183; Ziegler & Sandberg, 1990, p. 25).

Material - 84 Pa elements.

PALMATOLEPIS GLABRA ANGUSTA n. subsp.

Pl. 2, figs. 8-15

1959 *Palmatolepis glabra* Ulrich & Bassler, Beta morphotype - SCOTT & COLLINSON, pl. 75, figs. 11-13, 16 (only).

1968 *Palmatolepis glabra* Ulrich & Bassler - HUDDLE, pl. 14, fig. 11 (only).

Derivatio nominis - From Latin *angustus*, narrow, referring to extremely narrow anterior inner platform.

Holotype - The specimen illustrated on Pl. 2, fig. 11.

Locus typicus - Ayine Burnu, the southwest of Büyükada, Istanbul (Text-fig. 1).

Stratum typicum - Bed of beige and yellowish light-brown, thin, nodular limestone (mudstone), 0.90 m above the base of the studied section (Text-fig. 2; sample İ-33).

Diagnosis - A *Palmatolepis glabra* subspecies characterized by a Pa element with an extremely narrow anterior inner platform, the outer margin of which is nearly parallel to the blade-carina. The free blade is absent or very short.

Description - The Pa element has a narrow and extended platform with a sharply pointed posterior end. The anterior inner platform is greatly reduced, and its outer margin is parallel to the blade-carina. The posterior part of the platform is flexed upward after the central node. The blade-carina is sigmoidal. The free blade is absent or very short.

Remarks - Some specimens are transitional to *Palmatolepis glabra lepta* (Pl. 2, figs. 8-10), but the latter differs from the new subspecies by having a triangular inner parapet. The Pa element of

ZONE	Upper rhomboidea													Lower marginifera																							
SAMPLE WEIGHT (Kg)	.70	.75	?	.35	.70	.60	.60	.65	?	1.0	?	?	.80	?	.30	.55	.50	.45	.70	.70	.60	.35	.60	.65	.50	.90	.70	.55	.75	.75	1.0	.70	.60	?	.70	?	
SAMPLE NUMBER (I)	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
<i>Icriodus cornutus</i>					7								1	1												1											
<i>Palmatolepis glabra acuta</i>		1	1	3	2	5	5	1	5	14	4	3		1					1?	1	3	1		3	1	2		4	4	2	1	2	9		2	3	
<i>Pa. glabra angusta</i> n. subsp.	3			8	3	6	4	10	2	5	11	3	7	1	3	11		1		3?	3			3	3		2	2					18	1			
<i>Pa. glabra distorta</i>																														2	5	2	11		4		
<i>Pa. glabra lepta</i>			2						1	2	4				1	2				2					5	2	2	1	2					12	1		5
<i>Pa. glabra pectinata</i>		2	2				3	1	2					1		1	1			1	1		7	2	2	7	2	2	5	6	10	22	20	8	5	18	
<i>Pa. glabra prima</i>	20	8	34	23	43	23	18	16	21	53	24	4	30	5	2	15	2	1	10	7	2	18	18	12	5	18	12	4	3	6	16	14	11	5	9	25	
<i>Pa. gracilis gracilis</i>	10	3	18	6	13	5	13	7	4	11	16		4	4	4	5	2	5		5	5	4	1	1	4	2	7	1	11	20	13	21	23	12	42	19	
<i>Pa. aff. Pa. gracilis gracilis</i>								1?		2			1			1	1																				
<i>Pa. marginifera marginifera</i>														1	1	8	4		3	2	2	4	3	3	6		2	10	15	12	31	14	31	10	32	30	
<i>Pa. minuta minuta</i>	14	7	3	6	20	6	8	8	20	15	3		8	5	11	7	2	7	11	11	5	6	5	6	2	5	20	4	14	2	6	3	6	3	6	3	
<i>Pa. perlobata schindewolfi</i>	1							1	2	2	3	1	2	1			1						1	1		2		2	1		1	7	2	6	10		
<i>Pa. quadrantinodosa inflexa</i>	1?	3	4	3	2	4	12	9	3	12	14	1	14	5	20	26	16	9	5	8	9	19	12	9	12	7	18	8	4	5	12	13	5	4	17	5	
<i>Pa. quadrantinodosa inflexoidea</i>																2	1					1	1		2			2	4		2	1			1		
<i>Pa. rhomboidea</i>	11	5	8	7	14	6	10	8	2	4	2		1	3																							
<i>Pa. subperlobata helmsi</i>									2																												
<i>Polygnathus brevilaminus</i>						1	4		2										1							1										2	
<i>Po. diversus</i>																															1		1				
<i>Po. fallax</i>																																				1	
<i>Po. glaber glaber</i>	1	3			1	6			1	4	2		2	1	2			4	2	2		3	3	7	4	1		2	2	2							
<i>Po. glaber medius</i>																										1			2	11	4	25		1	17		
<i>Po. longiusculus</i> n. sp.																													10					7			
<i>Po. nodocostatus nodocostatus</i>										2																								1	1	1?	
<i>Po. nodocostatus ovatus</i>	1																																				
<i>Po. semicostatus</i>		1						2																													
<i>Po. subnormalis</i>								1																1			2		2	3	8			4			
<i>Po. triphyllatus</i>										1																				1			4				
<i>Po. n. sp. A</i>																																					
<i>Po. cf. Po. pennatuloides</i>							2																														
<i>Mehlina arcuata</i> n. sp.	5	1	5	11	6	5	10	3		20		2	1									2		1													
<i>Mehlina strigosa</i>														3?		4	3	1	6	2		33				3	1	1	8	13	8	10	90	2	42	84	
indet. "spathognathid"																					2		4		1		4										

Tab. 1 - Distribution of conodont taxa within the studied stratigraphic section.

Palmatolepis glabra prima with a similar platform outline is distinguished by its wider anterior inner platform, the outer margin of which is not parallel to the blade-carina.

Occurrence – Upper *rhomboidea* to Lower *marginifera* zones (see Tab. 1).

Material – 113 Pa elements.

PALMATOLEPIS GLABRA DISTORTA
Branson & Mehl, 1934
Pl. 1, figs. 12, 13

1934 *Palmatolepis distorta* BRANSON & MEHL, pp. 237-238, pl. 18, figs. 13, 14.

1963 *Palmatolepis distorta* Branson & Mehl - ABDÜSSELAMOĞLU, pl. 1, fig. 6.

1977 *Palmatolepis glabra distorta* Branson & Mehl - Ziegler in ZIEGLER, pp. 297-300, *Palmatolepis*-pl. 6, figs. 4-6 (*cum syn.*).

Remarks – The Pa element has a prominent bulge anterior of the central node, and a strongly sigmoidal blade-carina. The inner parapet with a denticulate or sharp crest is parallel to the blade-carina.

The anterior outer platform is flat in the Pa element of *Palmatolepis glabra pectinata* with a platform outline similar to that of *Palmatolepis glabra distorta*.

Range – From the base of the Lower *marginifera* Zone into the upper part of the Lower *trachytera* Zone (Ziegler & Sandberg, 1984, fig. 2).

Material – 24 Pa elements.

PALMATOLEPIS GLABRA LEPTA Ziegler & Huddle,
1969
Pl. 1, figs. 7-11

1969 *Palmatolepis glabra lepta* ZIEGLER & HUDDLE, pp. 380-381.

1977 *Palmatolepis glabra lepta* Ziegler & Huddle - Ziegler in ZIEGLER (ed.), pp. 301-303, *Palmatolepis*-pl. 7, figs. 1-3 (*cum syn.*).

Remarks – The Pa element of this subspecies has an extremely slender, elongate platform with a triangular anterior inner part that is slightly to strongly curved upward. They correspond to «early» and «typical» forms of Sandberg & Ziegler (1973).

Range – «Early forms» range from within the Upper *crepida* Zone through the *rhomboidea* Zone, and «typical forms» from the base of the Lower *marginifera* Zone into the upper part of the Upper *trachytera* Zone (Ziegler in Ziegler, ed., 1977; Ziegler

& Sandberg, 1984, fig. 3; Ziegler & Sandberg, 1990, p. 24).

Material – 44 Pa elements.

PALMATOLEPIS GLABRA PECTINATA Ziegler, 1962b
Pl. 1, figs. 14-19

1962b *Palmatolepis glabra pectinata* ZIEGLER, pl. 2, figs. 3-5.

1977 *Palmatolepis glabra pectinata* Ziegler - Ziegler in ZIEGLER (ed.), pp. 305-307, *Palmatolepis*-pl. 6, figs. 7-11 (*cum syn.*).

Remarks – The Pa elements of this subspecies have an inner margin parapet with a denticulate or sharp crest parallel the carina. One morphotype has been differentiated by Sandberg & Ziegler (1973). Many Pa elements correspond to typical specimens, but a few specimens show close similarities to Morphotype 1 with a short, high parapet on the anterior inner platform. Some specimens show characteristics transitional to *Palmatolepis glabra acuta*.

Range – From the base of the Uppermost *crepida* Zone through the Upper *marginifera* Zone; Morphotype 1 accompanies the typical forms up to the upper part of the Upper *rhomboidea* Zone (Ziegler in Ziegler, ed., 1977, pp. 307-308; Ziegler & Sandberg, 1990).

Material – 131 Pa elements.

PALMATOLEPIS GLABRA PRIMA Ziegler & Huddle,
1969
Pl. 2, figs. 1-7

1963 *Palmatolepis glabra* Ziegler & Huddle - ABDÜSSELAMOĞLU, p. 1, fig. 4.

1969 *Palmatolepis glabra prima* ZIEGLER & HUDDLE, pp. 379-380.

1977 *Palmatolepis glabra prima* Ziegler & Huddle - Ziegler in ZIEGLER (ed.), pp. 309-312, *Palmatolepis*-pl. 7, figs. 4-7 (*cum syn.*).

Remarks – The Pa elements are characterized by having a rounded convex, inner platform margin parapet. Sandberg & Ziegler (1973) described two morphotypes of this subspecies. Many specimens correspond to typical specimens, but a few specimens show close similarities to morphotype 1, which is distinguishable from the typical specimens by the greater width of platform.

Range – From the base of the Upper *crepida* Zone to the end of the Upper *marginifera* Zone. Morphotype 1: from within the Upper *crepida* Zone through the *rhomboidea* Zone. Morphotype 2: from high in the Upper *crepida* Zone through the Lower

rhomboidea Zone (Ziegler in Ziegler, ed., 1977, pp. 310-311; Ziegler & Sandberg, 1984, fig. 3; Ziegler & Sandberg, 1990).

Material – 537 Pa elements.

PALMATOLEPIS GRACILIS Branson & Mehl, 1934

PALMATOLEPIS GRACILIS GRACILIS

Branson & Mehl, 1934

Pl. 2, figs. 16-18

1934 *Palmatolepis gracilis* BRANSON & MEHL, p. 238, pl. 18, fig. 8 (only).

1977 *Palmatolepis gracilis gracilis* Branson & Mehl - Ziegler in ZIEGLER (ed.), pp. 315-317, *Palmatolepis*-pl. 7, figs. 8-10 (*cum syn.*).

Remarks – A relatively short, narrow platform, the anterior margins of which generally terminate at about midlength of the blade, and a high carina are the most characteristic features of the Pa elements of *Palmatolepis gracilis gracilis*. Furthermore, platform margins form a raised rounded rim (Sandberg & Ziegler, 1979).

Range – From the Upper *rhomboidea* Zone through the Upper *praesulcata* Zone and barely into the *Siphonodella sulcata* Zone of the Lower Carboniferous (Sandberg & Ziegler, 1979, p. 177; Ziegler & Sandberg, 1984, fig. 3, p. 185).

Material – 322 Pa elements.

PALMATOLEPIS aff. PALMATOLEPIS GRACILIS GRACILIS

Branson & Mehl, 1934

(*sensu* Metzger, 1994)

Pl. 2, figs. 22-24

1994 *Palmatolepis* aff. *Palmatolepis gracilis gracilis* Branson & Mehl - METZGER, p. 629, figs., 17.4, 17.5.

Remarks – The Pa element has an inner platform with a convex outline and an outer platform with a

weak lobe. The outer platform margin meets the free blade somewhat farther anteriorly than the inner margin. The carina extending to the posterior end of the platform, is strongly deflected the posterior of the central node. Metzger (1994) indicates that specimens assigned to *Palmatolepis* aff. *P. gracilis gracilis* appear to be morphologically intermediate between *Palmatolepis minuta minuta* and *Palmatolepis gracilis gracilis*.

Occurrence – Samples İ-29, İ-27, İ-24, İ-21, İ-20 (Tab. 1).

Material – 6 Pa elements.

PALMATOLEPIS MARGINIFERA Helms, 1959

PALMATOLEPIS MARGINIFERA MARGINIFERA

Helms, 1959

Pl. 3, figs. 1-10

1959 *Palmatolepis quadrantinodosa marginifera* Ziegler (sic.) - HELMS, p. 649, Pl. 5, figs. 22, 23.

1963 *Palmatolepis inflexa* Müller - ABDÜSSELÂMOĞLU, pl. 1, fig. 8.

1977 *Palmatolepis marginifera marginifera* Helms - Ziegler in ZIEGLER (ed.), pp. 327-330, *Palmatolepis*-pl. 7, figs. 17, 18; pl. 8, figs. 1, 2 (*cum syn.*).

Remarks – The shape of the platform is generally rounded to oval, but may also be narrow and elongate. A few specimens have a nodose anterior outer platform (Pl. 3, figs. 1-4). The parapet with denticulate or generally sharp crest may or may not extend to the posterior tip of the platform, and it is parallel to the carina. In some small specimens, the parapet is formed by the crenulation of the inner platform margin (Pl. 3, fig. 4).

Range – From the base of the Lower *marginifera* Zone into the lowermost part of the Lower *trachytera* Zone (Ziegler & Sandberg, 1984, fig. 2).

Material – 224 Pa elements.

EXPLANATION OF PLATE 1

All figures are upper views of Pa elements.

Figs. 1-6 - *Palmatolepis glabra acuta* Helms, 1963.

1) Sample İ-2, x40. 2) Sample İ-35, x33. 3) Sample İ-14, x34. 4) Sample İ-26, x34. 5) Sample İ-27, x50. 6) Sample İ-12, x52.

Figs. 7-11 - *Palmatolepis glabra lepta* Ziegler & Huddle, 1969.

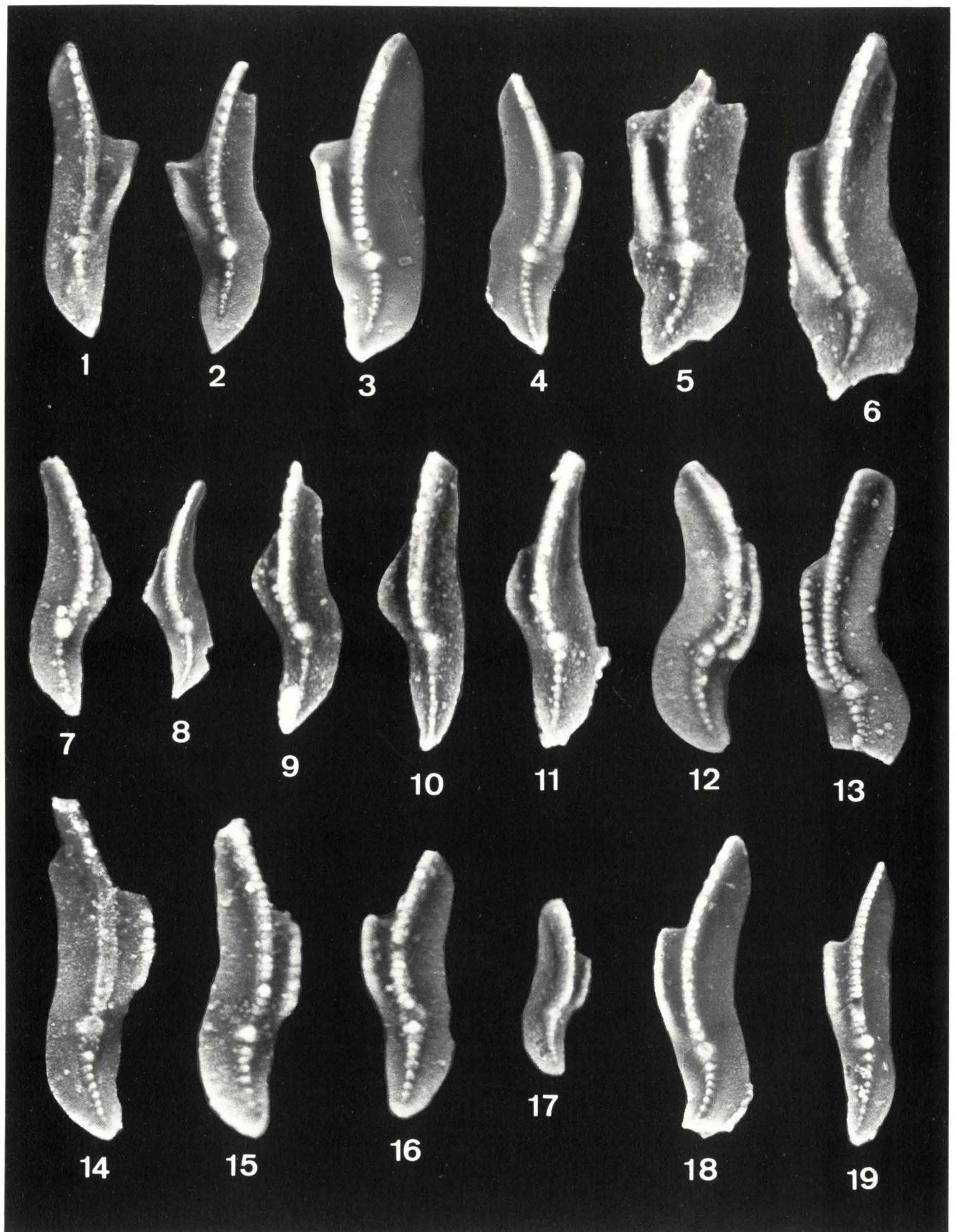
7) Sample İ-10, x51. 8) Sample İ-9, x32. 9) Sample İ-27, x50. 10) Sample İ-26, x52. 11) Sample İ-34, x52.

Figs. 12, 13 - *Palmatolepis glabra distorta* Branson & Mehl, 1934.

12) Sample İ-6, x60. 13) Sample İ-4, x35.

Figs. 14-19 - *Palmatolepis glabra pectinata* Ziegler, 1962.

14) Sample İ-1, x52. 15) Sample İ-6, x62. 16) Sample İ-6, x60. 17) Sample İ-8, x50. 18) Sample İ-17, x45. 19) Sample İ-30, x45.



PALMATOLEPIS MINUTA Branson & Mehl, 1934

PALMATOLEPIS MINUTA MINUTA

Branson & Mehl, 1934

Pl. 2, figs. 19-21

- 1934 *Palmatolepis minuta* BRANSON & MEHL, pp. 236-237, pl. 18, figs. 1, 6, 7.
 1963 *Palmatolepis minuta* Branson & Mehl - ABDÜSSELÂMOĞLU, pl. 1, fig. 3.
 1977 *Palmatolepis minuta minuta* Branson & Mehl - Ziegler in ZIEGLER (ed.), pp. 335-338, *Palmatolepis*-pl. 9, figs. 1-5 (cum syn.).

Remarks – The platform, which is the widest in the central node position, is generally subovate to elongate. It is very reduced in some specimens. Some of them show an incipient outer lobe development. The carina, variable in height, is generally weakly developed, and in many specimens, it disappears in a longitudinal depression. It may or may not extend to the posterior end of the platform. A few specimens show morphological similarity to *Palmatolepis minuta schleizia* having the raised platform margins.

Range – From the base of the Upper *triangularis* Zone to the upper part of the Upper *trachytera* Zone (Ziegler in Klapper & Ziegler, 1979, text-figs. 5-6; Ziegler & Sandberg, 1984, fig. 3; Ziegler & Sandberg, 1990, p. 23).

Material – 268 Pa elements.

PALMATOLEPIS PERLOBATA Ulrich & Bassler, 1926

PALMATOLEPIS PERLOBATA SCHINDEWOLFI

Müller, 1956

Pl. 4, figs. 23-26

- 1956 *Palmatolepis (Palmatolepis) schindewolfi* MÜLLER, pp. 27-28, pl. 8, figs. 22-31; pl. 9, fig. 33.
 1963 *Palmatolepis perlobata* Sannemann - ABDÜSSELÂMOĞLU, pl. 1, figs. 9, 11.
 1977 *Palmatolepis perlobata schindewolfi* Müller - Ziegler in ZIEGLER (ed.), pp. 361-364, *Palmatolepis*-pl. 11, figs. 1-7 (cum syn.).

Remarks – The Pa elements of this subspecies show a quite widely morphological variety as indicated and illustrated by many authors (Müller, 1956; Sandberg & Ziegler, 1979). Variation is observed especially in the platform outline and in the development of the outer lobe (see pl. 4, figs. 23-26).

Range – From the uppermost part of the Upper *crepida* Zone to the end of the Upper *expansa* Zone (Ziegler & Sandberg, 1984, fig. 3; Ziegler & Sandberg, 1990, p. 24).

Material – 47 Pa elements.

PALMATOLEPIS QUADRANTINODOSA

Branson & Mehl, 1934

PALMATOLEPIS QUADRANTINODOSA INFLEXA

Müller, 1956

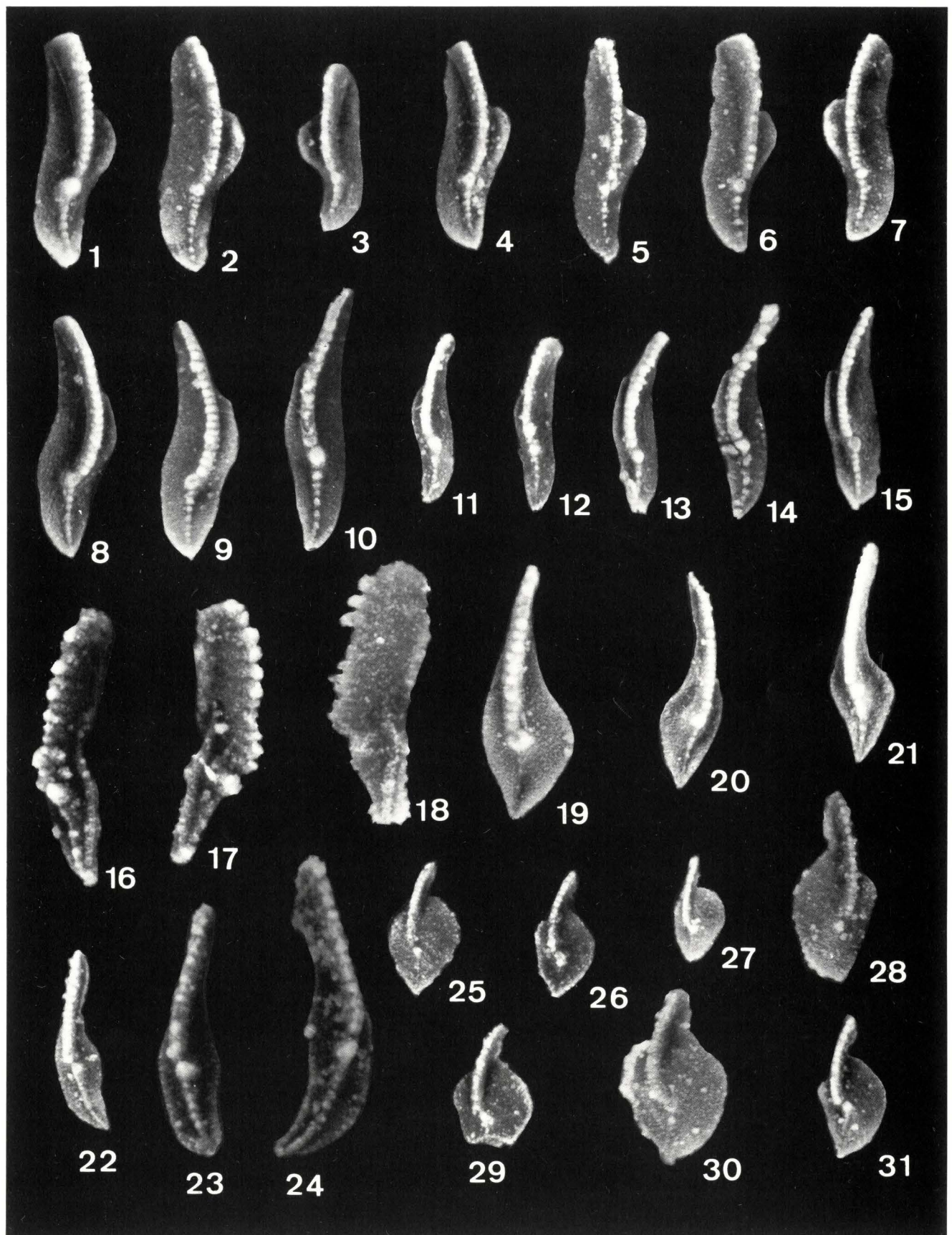
Pl. 3, figs. 11-20

- 1956 *Palmatolepis (Palmatolepis) inflexa* MÜLLER, pp. 30-31, pl. 10, fig. 5 (only).
 1977 *Palmatolepis quadrantinodosa inflexa* Müller - Ziegler in ZIEGLER (ed.), pp. 377-379, *Palmatolepis*-pl. 12, figs. 3-10 (cum syn.).

Remarks – Ziegler (in Ziegler, ed., 1977) indicated that at least three morphotypes are recognizable near the top of the uppermost *rhomboidea* Zone.

EXPLANATION OF PLATE 2

- Figs. 1-7 - *Palmatolepis glabra prima* Ziegler & Huddle, 1969. Upper views of Pa elements.
 1) Sample I-34, x52. 2) Sample I-11, x50. 3) Sample I-20, x52. 4) Sample I-26, x52. 5) Sample I-23, x50. 6) Sample I-28, x50. 7) Sample I-11, x50.
 Figs. 8-15 - *Palmatolepis glabra angusta* n. subsp. Upper views of Pa elements.
 8) Sample I-33, x51. Paratype. 9) Sample I-30, x60, Paratype. 10) Sample I-33, x51. Paratype. 11) Sample I-21, x50, Holotype. 12) Sample I-26, x50. Paratype. 13) Sample I-33, x50, Paratype. 14) Sample I-19, x60. Paratype. 15) Sample I-33, x50, Paratype.
 Figs. 16-18 - *Palmatolepis gracilis gracilis* Branson & Mehl, 1934. Oblique lateral views of Pa elements.
 16) Sample I-5, x70. 17) Sample I-5, x70. 18) Sample I-7, x107.
 Figs. 19-21 - *Palmatolepis minuta minuta* Branson & Mehl, 1934. Upper views of Pa elements.
 19) Sample I-10, x50. 20) Sample I-22, x50. 21) Sample I-19, x50.
 Figs. 22-24 - *Palmatolepis* aff. *Palmatolepis gracilis gracilis* Branson & Mehl, 1934 (*sensu* Metzger, 1994). Upper views of Pa elements.
 22) Sample I-24, x60. 23) Sample I-27, x70. 24) Sample I-27, x70.
 Figs. 25-31 - *Palmatolepis rhomboidea* Sannemann, 1955a. Upper views of Pa elements.
 25) Sample I-36, x50. 26) Sample I-35, x50. 27) Sample I-34, x50. 28) Sample I-30, x63. 29) Sample I-36, x52. 30) Sample I-32, x62. 31) Sample I-33, x50.



The specimens under study correspond partly to the short, oval morphotype in which the inner platform is flat, and the morphotype with a round-topped short bulge on the anterior inner platform.

Range – From the uppermost part of the Upper *rhomboidea* Zone through the Lower *marginifera* Zone (Sandberg & Ziegler, 1973; Ziegler & Sandberg, 1984, fig. 2).

Material – 330 Pa elements.

PALMATOLEPIS QUADRANTINODOSA INFLEXOIDEA
Ziegler, 1962a
Pl. 3, figs. 21-24

1962a *Palmatolepis quadrantinodosa inflexoidea* ZIEGLER, pp. 74-75, pl. 5, figs. 14-18.

1977 *Palmatolepis quadrantinodosa inflexoidea* Ziegler - Ziegler in ZIEGLER (ed.), pp. 383-384, *Palmatolepis*-pl. 13, figs. 1-5 (cum syn.).

Remarks – The Pa element has a more elongate platform and a central node with a more posterior position than the other subspecies.

Range – From the uppermost part of the Upper *rhomboidea* Zone through the Lower *marginifera* Zone (Ziegler in Klapper & Ziegler, 1979, text-fig. 6; Ziegler & Sandberg, 1984, fig. 2).

Material – 17 Pa elements.

PALMATOLEPIS RHOMBOIDEA Sannemann, 1955a
Pl. 2, figs. 25-31

1955a *Palmatolepis rhomboidea* SANNEMANN, p. 329, pl. 24, fig. 14.

1973 *Palmatolepis rhomboidea* Sannemann - Ziegler in ZIEGLER (ed.), pp. 299-301, *Palmatolepis*-pl. 1, figs. 6, 7 (cum syn.).

Remarks – The platform of the Pa element is variable from generally oval to rhomboidal. Many

specimens are small. The carina is either not developed or weakly developed posterior of the central node.

Range – From the base of the Lower *rhomboidea* Zone into the Lower *marginifera* Zone and in the Lower *marginifera* Zone only few specimens have been observed as yet (Sandberg & Ziegler, 1973, p. 106; Ziegler in Ziegler, ed., 1973, p. 300; Ziegler in Klapper & Ziegler, 1979, text-fig. 6).

Material – 81 Pa elements.

PALMATOLEPIS SUBPERLOBATA Branson & Mehl, 1934
PALMATOLEPIS SUBPERLOBATA HELMSI
Ovnatanova, 1976
Pl. 3, fig. 25

1963 *Palmatolepis* (Pand.) *subperlobata* n.subsp. a HELMS, pl. 1, fig. 19; pl. 2, figs. 23, 24; pl. 3, fig. 10; text-fig. 2, fig. 17.

1967 *Palmatolepis subperlobata* Branson & Mehl - WOLSKA, p. 407, pl. XII, fig. 10 (only).

1970 *Palmatolepis subperlobata* Branson & Mehl - OLIVIERI, pp. 53-55, pl. 18, fig. 13 (only).

1976 *Palmatolepis subperlobata* subsp. a Helms - DRUCE, p. 171, pl. 58, figs. 2, 3, 5.

1976 *Palmatolepis subperlobata helmsi* OVNATANOVA, pp. 216-217, pl. 9, fig. 7.

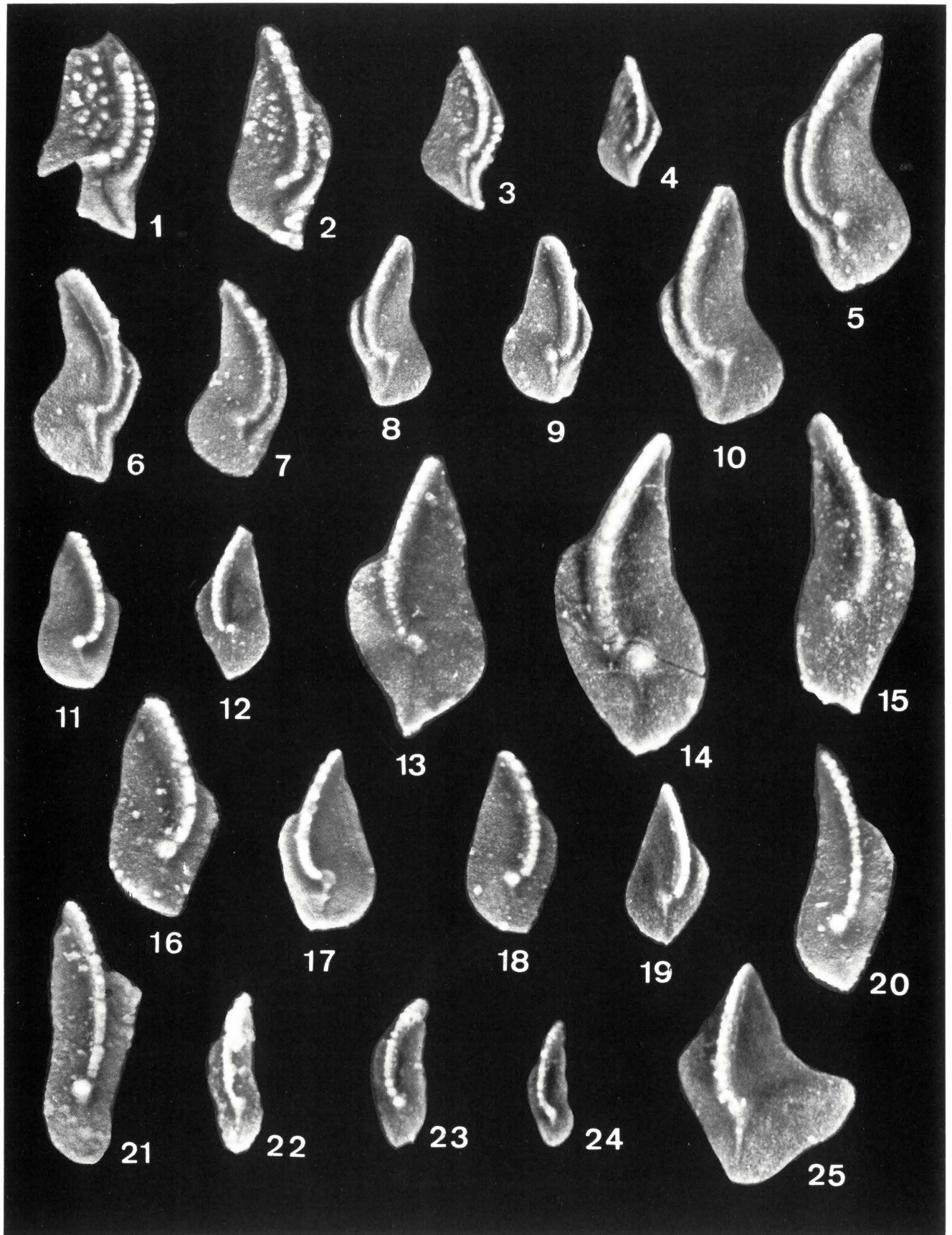
1987 *Palmatolepis subperlobata helmsi* Ovnatanova - BARSKOV, ALEKSEEV, KONONOVA & MIGDISOVA, p. 29, pl. 4, figs. 23-30, text-fig. 3A-12.

Remarks – The Pa element has a prominent transverse bulge on the outer lobe with an anterior margin of deep sinus and a straight or slightly concave posterior margin. The carina is weakly developed posterior of the central node and does not reach to posterior end.

This subspecies is distinguished from the nominate subspecies by having a prominent transverse bulge on the outer lobe. The latter has a more prominent outer lobe with a flat upper surface that is differentiated from the platform by deep sinuses in its anterior and posterior sides.

EXPLANATION OF PLATE 3

- All figures are upper views of Pa elements.
- Figs. 1-10 - *Palmatolepis marginifera marginifera* Helms, 1959.
1) Sample I-8, x60. 2) Sample I-8, x60. 3) Sample I-6, x50. 4) Sample I-8, x52. 5) Sample I-5, x52. 6) Sample I-6, x52. 7) Sample I-6, x52. 8) Sample I-2, x35. 9) Sample I-2, x35. 10) Sample I-2, x50.
- Figs. 11-20 - *Palmatolepis quadrantinodosa inflexa* Müller, 1956.
11) Sample I-15, x60. 12) Sample I-23, x50. 13) Sample I-21, x50. 14) Sample I-26, x50. 15) Sample I-26, x50. 16) Sample I-24, x60. 17) Sample I-15, x60. 18) Sample I-24, x60. 19) Sample I-19, x50. 20) Sample I-9, x50.
- Figs. 21-24 - *Palmatolepis quadrantinodosa inflexoidea* Ziegler, 1962a.
21) Sample I-2, x60. 22) Sample I-5, x50. 23) Sample I-12, x50. 24) Sample I-12, x50.
- Fig. 25 - *Palmatolepis subperlobata helmsi* Ovnatanova, 1976.
Sample I-28, x50.



Range – From the base of the Lower *crepida* Zone into the Lower *marginifera* Zone (Barskov, Alekseev, Kononova & Migdisova, 1987, p. 29, text-fig. 2).

Material – 2 Pa elements.

Family POLYGNATHIDAE Bassler, 1925

Genus POLYGNATHUS Hinde, 1879

Type species – *Polygnathus dubius* Hinde, 1879

POLYGNATHUS BREVILAMINUS Branson & Mehl, 1934

Pl. 4, fig. 8

- 1934 *Polygnathus brevilamina* BRANSON & MEHL, p. 246, pl. 21, figs. 3-6.
 1955b *Polygnathus brevilamina* Branson & Mehl - SANNEMANN, pl. 3, fig. 13.
 1968 *Polygnathus brevilamina* Branson & Mehl - ANDERSON & OZIAS, p. 264, pl. 1, figs. 1-15; pl. 2, figs. 1-16; pl. 3, figs. A-K.
 1976 *Polygnathus brevilaminus* Branson & Mehl - DRUCE, pp. 183-184, pl. 70, figs. 3-5.
 1985 *Polygnathus brevilaminus* Branson & Mehl - KLAPPER & LANE, p. 934.

Remarks – All the Pa elements are within the range of variation indicated by Anderson & Ozias (1968). The illustrated specimen has a weakly ornamented platform terminating before reaching the posterior tip of the unit (small and weakly ornamented platform type of Anderson & Ozias, 1968).

Range – Probably from the Upper *varcus* Subzone and/or *hermanni-cristatus* Zone to do V (Uyeno in Norris, Uyeno & McCabe, 1982).

Material – 11 Pa elements.

POLYGNATHUS DIVERSUS Helms, 1959

Pl. 5, fig. 15

- 1959 *Polygnathus diversa* HELMS, pp. 650-651, pl. 5, figs. 5-8; text-fig. 2.
 1961a *Polygnathus diversa* Helms - HELMS, p. 681, pl. 1, figs. 4-6; pl. 2, figs. 2-5; text-figs. 2a-c.
 1966 *Polygnathus diversa* Helms - GLENISTER & KLAPPER, p. 828, pl. 94, fig. 7.
 1967 *Polygnathus diversa* Helms - WOLSKA, p. 412, pl. 16, figs. 6, 7.
 1985 *Polygnathus diversus* Helms - OLIVIERI, pl. 7, figs. 2-5.
 1990 *Polygnathus diversus* Helms - PERRI & SPALLETTA, pp. 64-65, pl. 4, figs. 8a-b.

Remarks – The free blade of the Pa element is offset from the carina, and the upper platform surface is ornamented with fine, needlelike denticles. The free blade is partly broken.

Range – Lower and Upper *marginifera* Zones, and may occur slightly higher (Ziegler in Klapper & Ziegler, 1979, text-fig. 6).

Material – One and one questionably assigned Pa elements.

POLYGNATHUS FALLAX Helms & Wolska, 1967

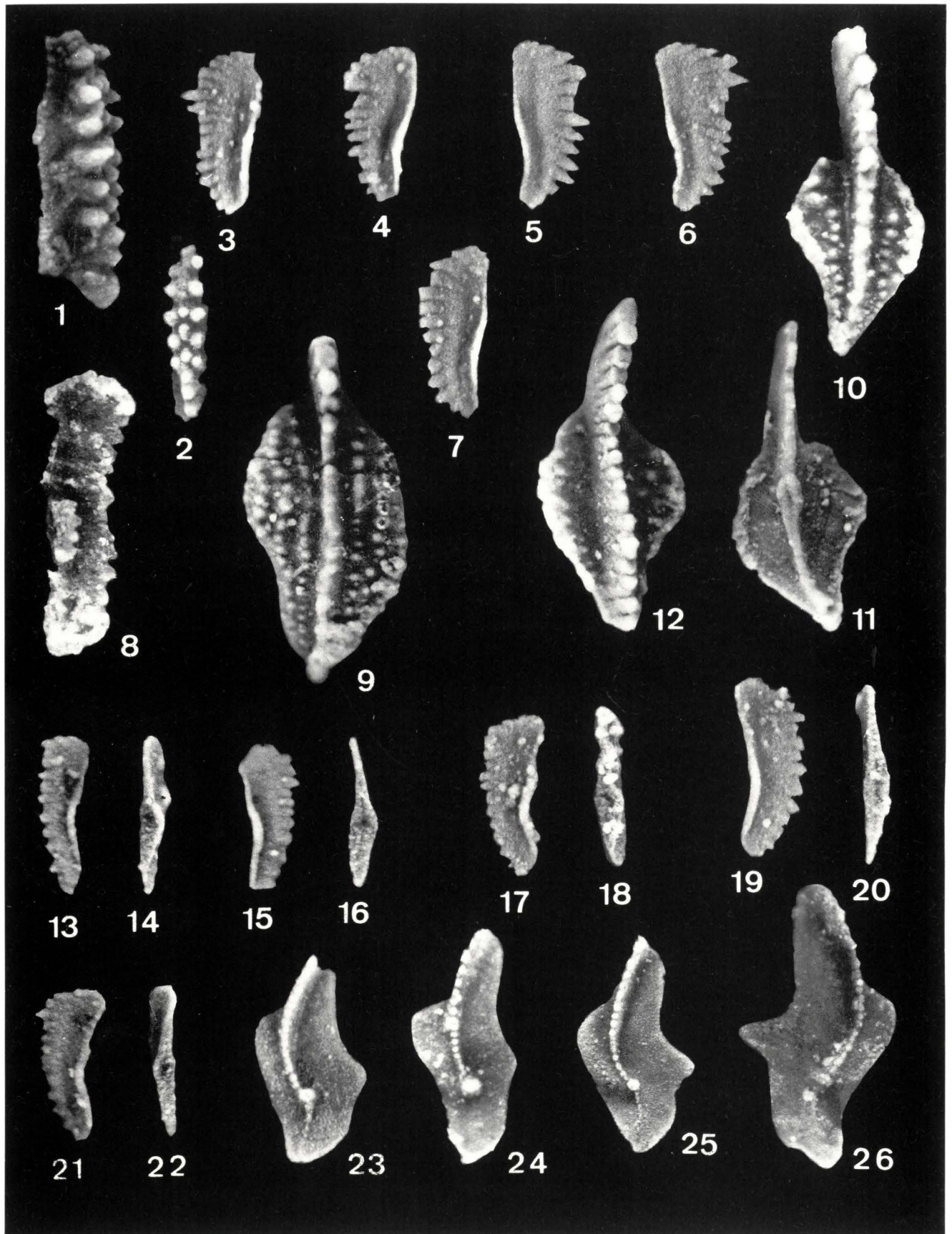
Pl. 5, fig. 10

- 1967 *Polygnathus fallax* HELMS & WOLSKA, pp. 231-233, fig. 3a-b.
 1976 *Polygnathus fallax* Helms & Wolska - DRUCE, pp. 186-187, pl. 72, figs. 4-5.

Remarks – The anterior part of the specimen is missing; however, it is still assignable to this species because of the characteristic upper surface ornamentation. The platform ornament consists mainly of irregular transverse ridges that are replaced by

EXPLANATION OF PLATE 4

- Figs. 1, 2 - *Icriodus cornutus* Sannemann, 1955b.
 1) Lateral view of Pa element, sample I-32, x70. 2) Upper view of Pa element, sample I-32, x60.
 Figs. 3-7 - *Mehlina strigosa* (Branson & Mehl, 1934). Side views of Pa elements.
 3) Sample I-4, x63. 4) Sample I-15, x63. 5) Sample I-2, x63. 6) Sample I-2, x63. 7) Sample I-7, x63.
 Fig. 8 - *Polygnathus brevilaminus* Branson & Mehl, 1934. Side view of Pa element, sample I-10, x40.
 Fig. 9 - *Polygnathus* cf. *Polygnathus pennatuloides* Holmes, 1928. Upper view of Pa element, sample I-30, x50.
 Figs. 10-12 - *Polygnathus* n. sp. A.
 10, 11) Upper and lower views of Pa element, sample I-7, x50. 12) Upper view of Pa element, sample I-4, x50.
 Figs. 13-22 - *Mehlina arcuata* n. sp.
 13, 14) Side and lower views of Pa element (paratype), sample I-15, x63. 15, 16) Outer lateral and lower views of Pa element (paratype), sample I-32, x63. 17, 18) Side and lower views of Pa element (paratype), sample I-33, x63. 19, 20) Outer lateral and lower views of Pa element (holotype), sample I-33, x63. 21, 22) Outer lateral and lower views of Pa element (paratype), sample I-32, x63.
 Figs. 23-26 - *Palmatolepis perlobata schindewolfi* Müller, 1956. Upper views of Pa elements.
 23) Sample I-2, x50. 24) Sample I-8, x50. 25) Sample I-7, x32. 26) Sample I-3, x42.



nodes, especially in the posterior outer side of the platform.

Range – Lower *marginifera* Zone (Helms & Wolska, 1967; Klapper in Ziegler ed., 1975, p. 282).

Material – 1 Pa element.

POLYGNATHUS GLABER Ulrich & Bassler, 1926

POLYGNATHUS GLABER GLABER

Ulrich & Bassler, 1926

Pl. 5, figs. 1-4

- 1926 *Polygnathus glaber* ULRICH & BASSLER, p. 46, pl. 7, fig. 13.
 1955b *Polygnathus glaber* Ulrich & Bassler - SANNEMANN, p. 149, pl. 3, fig. 14.
 1967 *Polygnathus glabra glabra* Ulrich & Bassler - WOLSKA, p. 413, pl. 15, fig. 1a-b.
 1968 *Polygnathus glabra* Ulrich & Bassler - HUDDLE, p. 39, pl. 15, figs. 13-17.
 1970 *Polygnathus glaber glaber* Ulrich & Bassler - OLIVIERI, pp. 122-123, pl. 21, figs. 1-5.
 1976 *Polygnathus glaber glaber* Ulrich & Bassler - DRUCE, pp. 190-191, pl. 74, figs. 4-5 (only).
 1985 *Polygnathus glaber glaber* Ulrich & Bassler - OLIVIERI, pl. 8, figs. 1-3.
 1994 *Polygnathus glaber glaber* Ulrich & Bassler - METZGER, pp. 639-640, figs. 20.1-20.21.

Remarks – See under *Polygnathus glaber medius*.

Range – From the base of the Upper *rhomboidea* Zone into the Lower *trachytera* Zone (Ziegler in Klapper & Ziegler, 1979, text-fig. 6).

Material – 55 Pa elements.

POLYGNATHUS GLABER MEDIUS

Helms & Wolska, 1967

Pl. 5, figs. 5-9

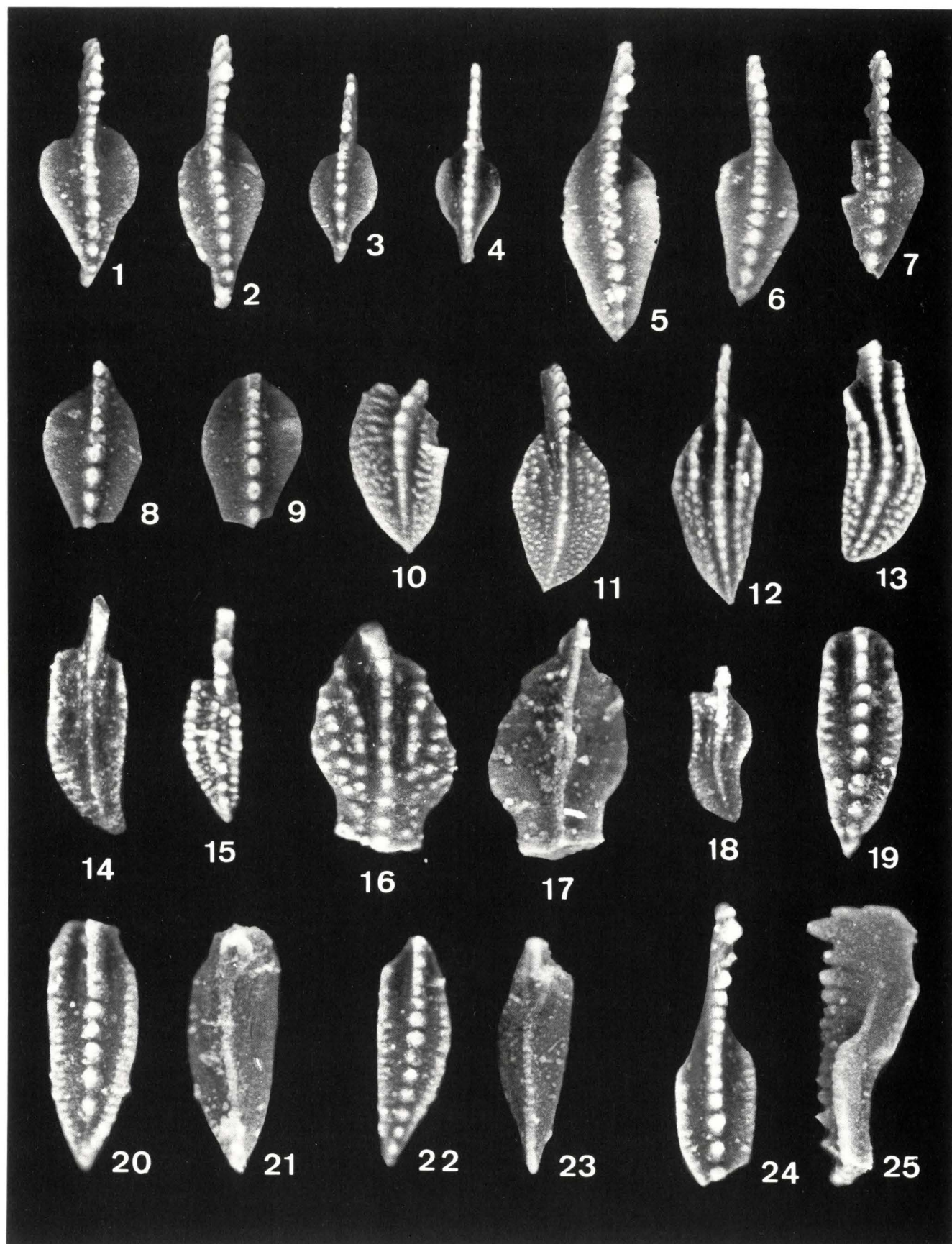
- 1962a *Polygnathus glabra glabra* Ulrich & Bassler - ZIEGLER, p. 89, pl. 10, figs. 18-20.
 1967 *Polygnathus glabra media* HELMS & WOLSKA, pp. 233-234, text-fig. 4.
 1967 *Polygnathus glabra media* Helms & Wolska - WOLSKA, pl. 15, figs. 2, 3.
 1976 *Polygnathus glaber glaber* Ulrich & Bassler - DRUCE, pp. 190-191, pl. 76, fig. 1 (only).
 1990 *Polygnathus glaber medius* Helms & Wolska - PERRI & SPALLETTA, p. 65, pl. 5, figs. 3a-b.

Remarks – Distinctions based on the arrangement of the carina and the shape of the posterior platform have been used to establish *Polygnathus glaber medius* by Helms & Wolska (1967). According to their remarks, *Polygnathus glaber medius* has a carina consisting of closely spaced nodes, and a flattened or shallowly depressed upper platform surface the posterior of the pit. Furthermore, Klapper (in Ziegler, ed., 1975) noted that the platform is characteristically constricted near the posterior end in the nominate subspecies, but this feature is not present in all Pa elements.

In this paper, the deflection pattern downward of the anterior part of the platform is considered the main diagnostic criterion. In the Pa elements of *Polygnathus glaber medius*, the anterior third of the platform is more strongly deflected downwards in contrast to the nominate subspecies, and this deflection line generally forms a moderately sharp ridge on the upper surface of the platform that is especially more definite in the inner side. The

EXPLANATION OF PLATE 5

- Figs. 1-4 - *Polygnathus glaber glaber* Ulrich & Bassler, 1926. Upper views of Pa elements.
 1) Sample I-27, x60. 2) Sample I-13, x50. 3) Sample I-19, x60. 4) Sample I-12, x50.
 Figs. 5-9 - *Polygnathus glaber medius* Helms & Wolska, 1967. Upper views of Pa elements.
 5) Sample I-6, x50. 6) Sample I-6, x50. 7) Sample I-1, x50. 8) Sample I-4, x50. 9) Sample I-4, x50.
 Fig. 10 - *Polygnathus fallax* Helms & Wolska, 1967. Upper view of broken Pa element, sample I-2, x60.
 Fig. 11 - *Polygnathus nodocostatus ovatus* Helms, 1961. Upper view of Pa element, sample I-36, x33.
 Figs. 12, 13 - *Polygnathus nodocostatus nodocostatus* Branson & Mehl, 1934.
 12) Upper view of Pa element, sample I-26, x50. 13) Upper view of Pa element with broken free blade, sample I-2, x50.
 Fig. 14 - *Polygnathus semicostatus* Branson & Mehl, 1934. Upper view of broken Pa element, sample I-35, x50.
 Fig. 15 - *Polygnathus diversus* Helms, 1959. Upper view of Pa element, sample I-6, x60.
 Figs. 16, 17 - *Polygnathus triphyllatus* (Ziegler, 1960). Upper and lower views of broken Pa element, sample I-27, x60.
 Fig. 18 - *Polygnathus subnormalis* Vorontzova & Kuzmin, 1984. Upper view of broken Pa element, sample I-5, x50.
 Figs. 19-25 - *Polygnathus longiusculus* n. sp.
 19) Upper view of Pa element with broken free blade (paratype), sample I-8, x60. 20, 21) Upper and lower views of Pa element with broken free blade (paratype), sample I-3, x60. 22, 23) Upper and lower views of Pa element with broken free blade (holotype), sample I-3, x60. 24, 25) Upper and inner lateral views of Pa element with unbroken free blade (paratype), sample I-8, x60.



corresponding part of the nominate subspecies is in a convex curve.

Range – Lower to Upper *marginifera* Zones (Klapper in Ziegler, ed., 1975).

Material – 61 Pa elements.

POLYGNATHUS LONGIUSCULUS n. sp.
Pl. 5, figs. 19-25

Derivatio nominis – From Latin *longiusculus*, rather long, referring to the narrow and elongate platform.

Holotype – The specimen illustrated on Pl. 5, figs. 22, 23.

Locus typicus – Ayine Burnu, the southwest of Büyükkada, İstanbul (Text-fig. 1).

Stratum typicum – Bed of beige and yellowish light-brown, thin, nodular limestone, 12.00 m above the base of the studied section (Text-fig. 2; sample İ-3).

Diagnosis – Platform narrow, elongate, and slightly asymmetrical; posterior end sharply pointed; upper surface ornamented with weak nodes which are restricted to platform margins; shallow adcarinal grooves; carina consists of fused denticles anteriorly which are replaced by discrete nodes posteriorly; unit nearly straight longitudinally; small, elliptical pit located just on anterior end of platform.

Description – The slightly asymmetrical platform is narrow and elongate, three times as long as wide. The inner platform margin is generally straight, but the outer one is slightly convex. Posterior end is sharply pointed. The upper surface of the platform is ornamented with weak nodes which are restricted to platform margins, and have shallow adcarinal grooves. The unit is nearly straight longitudinally and has a moderately arched lower margin profile. The carina consists of fused denticles in the anterior third, and in the remaining part it consists of isolated nodes which are more discrete posteriorly. The free blade is moderately high, slightly shorter than platform, and highest anteriorly. Small and elliptical pit is located just on the anterior end of the platform.

Remarks – A relatively narrow and long platform with a sharply pointed posterior end, an upper surface ornamented with weak nodes which are

restricted to platform margins, and a carina consisting of fused denticles anteriorly and isolated nodes posteriorly are the most characteristic features of the Pa element of *Polygnathus longiusculus* n. sp. In all specimens except for one (Pl. 5, figs. 24, 25), the free blade is broken, but also in this specimen, the posterior part of the platform is missing. The free blade is shorter than the platform.

The Pa element of this species is closely similar to that of *Polygnathus procerus* Sannemann but their free blades, and the upper margin profiles of the platform show some differences. The Pa element of *Polygnathus procerus* has a high free blade that shows an irregular denticulation with the largest one in the midlength. Furthermore, in the lateral view, the upper margin of the platform is in a convex curve. However, the Pa element of the new species has a free blade with more regular denticulation consisting of denticles nearly of equal size, and in lateral view, the upper margin of the platform is nearly straight.

Occurrence – Lower *marginifera* Zone. Samples İ-3 and İ-8 (Tab. 1).

Material – 17 Pa elements.

POLYGNATHUS NODOCOSTATUS
Branson & Mehl, 1934
POLYGNATHUS NODOCOSTATUS NODOCOSTATUS
Branson & Mehl, 1934
Pl. 5, figs. 12, 13

- 1934 *Polygnathus nodocostatus* BRANSON & MEHL, pp. 246-247, pl. 20, figs. 9-13; pl. 21, fig. 15.
1961a *Polygnathus nodocostatus nodocostatus* Branson & Mehl - HELMS, pp. 687-688, pl. 1, figs. 17, 21, 23; pl. 2, figs. 16-20, 22, text-fig. 6.
1961b *Polygnathus nodocostatus nodocostatus* Branson & Mehl - HELMS, pl. 3, fig. 11.
1966 *Polygnathus nodocostatus nodocostatus* Branson & Mehl - GLENISTER & KLAPPER, p. 829, pl. 94, figs. 8, 9, 14, 15.
1994 *Polygnathus nodocostatus nodocostatus* Branson & Mehl - METZGER, p. 640, figs. 21.1-21.17.

Remarks – Helms (1961) recognized three subspecies of *Polygnathus nodocostatus*: *nodocostatus nodocostatus*, *nodocostatus ovatus*, and *nodocostatus incurvus*. The Pa elements with a moderately arched platform, that is ornamented with longitudinally aligned nodes, are assigned to *Polygnathus nodocostatus nodocostatus* Branson & Mehl.

Range – From the base of the Lower *crepida* Zone to the end of the Uppermost *marginifera* Zone and/or into the Uppermost *marginifera* Zone (Ziegler in Klapper & Ziegler, 1979, text-fig. 6).

Material – 5 Pa elements.

POLYGNATHUS NODOCOSTATUS OVATUS Helms, 1961
Pl. 5, fig. 11

1961a *Polygnathus nodocostatus ovatus* HELMS, pp. 688-690, pl. 1, figs. 25, 26; pl. 2, figs. 24, 27, 28; text-fig. 7.

Remarks – The Pa element of *Polygnathus nodocostatus ovatus* has a more nearly symmetrical, less highly arched platform displaying an irregular arrangement of nodes on the upper surface, in contrast to the nominate subspecies (Glenister & Klapper, 1966; p. 829). The most significant difference from the nominate subspecies is the irregular arrangement of nodes on the upper surface. The Pa elements of *Polygnathus nodocostatus incurvus* Helms with a similar platform outline show an X-shaped arrangement of nodes on the upper surface. This taxon is accepted as the synonymy of *Polygnathus nodocostatus nodocostatus* by Glenister & Klapper (1966).

Range – From the base of the Upper *crepida* Zone into the Upper *rhomboidea* Zone (Ziegler in Klapper & Ziegler, 1979, text-fig. 6).

Material – 1 Pa element.

POLYGNATHUS SEMICOSTATUS Branson & Mehl, 1934
Pl. 5, fig. 14

1934 *Polygnathus semicostatus* BRANSON & MEHL, pp. 247-248, pl. 21, figs. 1, 2.

1974 *Polygnathus semicostatus* Branson & Mehl - DREESSEN & ORCHARD, pp. 3-5, pl. 1, figs. 1-8; pl. 2, figs. 1-25.

1975 *Polygnathus semicostatus* Branson & Mehl - Klapper in ZIEGLER, ed., pp. 317-319, *Polygnathus*-pl. 5, fig. 6 (*cum syn.*).

1979 *Polygnathus semicostatus* Branson & Mehl - SANDBERG & ZIEGLER, p. 187, pl. 5, figs. 1-5.

1989 *Polygnathus semicostatus* Branson & Mehl - METZGER, p. 521, figs. 15.17-15.19, 15.3?.

Remarks – The Pa elements fall within the range of variation indicated by Dreesen & Orchard (1974) and Sandberg & Ziegler (1979).

Range – From within the Middle *crepida* Zone into the Lower *praesulcata* Zone (Dreesen & Orchard, 1974; Sandberg & Ziegler, 1979, p. 187).

Material – 3 Pa elements.

POLYGNATHUS SUBNORMALIS
Vorontzova & Kuzmin, 1984
Pl. 5, fig. 18

1970 *Polygnathus* sp. nov. SEDDON, pl. 16, figs. 15, 16.

1984 *Polygnathus subnormalis* VORONTZOVA & KUZMIN, p. 62, pl. 1, figs. 6-10.

1984 *Polygnathus argutus* VORONTZOVA & KUZMIN, pp. 62-63, pl. 1, figs. 11-13.

1990 *Polygnathus subnormalis* Vorontzova & Kuzmin - KUZMIN, pp. 67-68, pl. 4, figs. 7, 10.

1994 *Polygnathus subnormalis* Vorontzova & Kuzmin - METZGER, pp. 640, 644, figs. 19.10-19.22.

Remarks – The Pa element has a platform ornamented with short, generally weak transverse ridges posteriorly and nodes anteriorly. The anterior platform margins are strongly upturned. The deep adcarinal grooves of the anterior platform shallow posteriorly. Sinistral and dextral Pa elements have different platform outlines. In the sinistral Pa elements, the outer platform margin shows an anterior constriction and a posterior expansion. The dextral Pa elements have a lanceolate platform that is the widest at the anterior end.

Polygnathus buzmakovi Kuzmin by having a more symmetrical platform, and *Polygnathus valentinae* Kuzmin by having anterior platform margins that are distinctly serrated differ from *Polygnathus subnormalis* Vorontzova & Kuzmin.

Range – From the base of the Lower *rhomboidea* Zone into the *trachytera* Zone (Kuzmin, 1990).

Material – 21 Pa elements.

POLYGNATHUS TRIPHYLLATUS Helms, 1961a
Pl. 5, figs. 16, 17

1961a *Polygnathus triphyllatus* (Ziegler) - HELMS, pp. 696-697, pl. 1, figs. 2, 3; pl. 3, figs. 12, 15-17, text-fig. 13.

1961b *Polygnathus triphyllatus* (Ziegler) - HELMS, pl. 2, fig. 5.

1962a *Polylophodonta? triphyllatus* Ziegler - ZIEGLER, p. 97, pl. 9, fig. 15.

1962b *Polylophodonta? triphyllatus* Ziegler - ZIEGLER, pp. 402-403, pl. 1, fig. 5; pl. 2, figs. 1, 2.

1967 *Polygnathus triphyllatus* (Ziegler) - WOLSKA, pp. 417-418, pl. 17, fig. 4.

1970 *Polygnathus triphyllatus* (Ziegler) - OLIVIERI, pp. 130-131, pl. 23, fig. 1.

1976 *Polygnathus triphyllatus* (Ziegler) - DRUCE, pp. 203-204, pl. 81, figs. 4-6.

Remarks – The free blade, and the posterior part of the platform of the Pa element are broken. However, the distinct constriction in the middle part of the platform, which is the most characteristic feature of the Pa element, is still distinguishable. Furthermore, the anterior part of the platform is covered with coarser nodes in contrast to posterior part.

This species was first defined in the preprint of Ziegler (1962b) that was not published until 1962.

However, as Metzger (1994) pointed out, the name of the species was first validated by Helms (1961a).

Range – The upper part of the Upper *rhomboidea* Zone and probably the lowermost part of the Lower *marginifera* Zone (Ziegler in Klapper & Ziegler, 1979, text-fig. 6).

Material – 1 Pa element.

POLYGNATHUS n. sp. A
Pl. 4, figs. 10-12

[cf.] 1985 *Polygnathus* sp. a OLIVIERI, pl. 7, figs. 8, 9.

Description – The platform has a heart-shaped outline. The outer margin is strongly convex, and the inner margin is strongly sigmoidal. The posterior end is pointed. The unit is moderately arched, and slightly curved. The upper platform surface is flat or nearly flat, and is ornamented with random or slightly aligned nodes that are generally restricted to platform margins. The carina is highly fused, and distinctly sets above the platform level. In lateral view it has an upper margin that is straight in the anterior part and descends after the anterior half to third. The free blade is slightly shorter than the platform. It is the highest anteriorly and gradually declines posteriorly. A small and extremely narrow pit is located on the anterior third of the platform.

Remarks – The platform outline of this species is similar to that of *Polygnathus* sp. a of Olivieri (1985), but the latter has a more densely nodose platform, and a carina and keel strongly deflected laterally at the posterior third.

Occurrence – Lower *marginifera* Zone. Samples İ-4 and İ-7 (Tab. 1).

Material – 5 Pa elements.

POLYGNATHUS cf. POLYGNATHUS PENNATULOIDEA
Holmes, 1928
Pl. 4, fig. 9

[cf.] 1928 *Polygnathus pennatuloidea* HOLMES, pp. 32-33, pl. 11, fig. 14.

[cf.] 1961a *Polygnathus pennatuloidea* Holmes - HELMS, pp. 691, 692; pl. 1, fig. 22; pl. 2, fig. 25; text-fig. 9.

Remarks – The Pa element has an oval platform ornamented with weakly aligned nodes. The outer platform margin is strongly convex, whereas the inner platform margin is sigmoidal. The posterior end is sharply pointed. The carina is nearly straight and

extends to the posterior end of the platform.

The Pa element of *Polygnathus* cf. *Polygnathus pennatuloidea* Holmes has a platform outline that is similar to that of *Polygnathus* n. sp. A but differs in having a longer and more densely nodose platform.

Occurrence – Upper *rhomboidea* Zone. Sample İ-30 (See Tab. 1).

Material – 2 Pa elements.

Family SPATHOGNATHODONTIDAE Hass, 1925

Genus MEHLINA Youngquist, 1945

Type species – *Mehlina irregularis* Youngquist, 1945 (= *Mehlina gradata* Youngquist, 1945)

MEHLINA ARCUATA n. sp.
Pl. 4, figs. 13-22

Derivatio nominis – From Latin *arcus*, arch, curve, referring to arching of the lower margin.

Holotype – The specimen illustrated on Pl. 4, figs. 19, 20.

Locus typicus – Ayine Burnu, the southwest of Büyükkada, İstanbul (Text-fig. 1).

Diagnosis – Lower margin moderately arched and upper margin convex; unit slightly curved laterally, thickest at anterior end and thinner gradually posteriorly; basal cavity narrow, long, nearly, symmetrical and with small lateral flare.

Stratum typicum – Bed of beige and yellowish light-brown, thin, nodular limestone, 90 cm above the base of the studied section (Text-fig. 2; sample İ-33).

Remarks – This species has some resemblance to *Mehlina strigosa* but they are distinguished by their lower margin profiles. The Pa element of *Mehlina arcuata* n. sp. has a moderately arched lower margin profile and a longer basal cavity. The Pa element of *Mehlina strigosa* has a lower margin profile that is straight in the anterior half and moderately arched in the posterior half.

Occurrence – Upper *rhomboidea* and Lower *marginifera* Zones (see Tab. 1).

Material – 72 Pa elements.

MEHLINA STRIGOSA (Branson & Mehl, 1934)
Pl. 4, figs. 3-7

- 1934 *Spathodus strigosus* BRANSON & MEHL, p. 187, pl. 17, fig. 17.
 1962a *Spathognathodus strigosus* (Branson & Mehl) - ZIEGLER, pp. 111-112, pl. 12, figs. 21, 23 (*cum syn.*).
 1967 *Spathognathodus strigosus* (Branson & Mehl) - WOLSKA, pp. 428-429, pl. 18, figs. 9-15.
 1976 *Spathognathodus strigosus* (Branson & Mehl) - DRUCE, pp. 216-217, pl. 89, figs. 4, 8, 9, 11; pl. 90, figs. 1-3.
 1989 *Mehlina strigosa* (Branson & Mehl) - METZGER, p. 517, figs. 14.13, 14.15.

Remarks – The lower margin of the Pa element is straight in the anterior half and moderately arched in the posterior half. The unit is straight or slightly curved laterally. The denticles are subequal, and inclined progressively backward toward the posterior end. The lenticular basal cavity with slight lateral flare extends from somewhat anterior of the midlength to somewhat anterior of the posterior tip of the unit.

Range – From the base of the Lower *marginifera* Zone to the end of the Middle *praesulcata* Zone or probably higher (Ziegler & Sandberg, 1984, text-fig. 4).

Material – 314 Pa elements.

Order PRIONIODONTIDA Dzik, 1976

Family ICRIODONTIDAE Müller & Müller, 1957

Genus ICRIODUS Branson & Mehl, 1938

Type species – *Icriodus expansus* Branson & Mehl, 1938

ICRIODUS CORNUTUS Sannemann, 1955b

Pl. 4, figs. 1, 2

1955b *Icriodus cornutus* SANNEMANN, p. 130, pl. 4, figs. 19-21.

1984 *Icriodus cornutus* Sannemann - SANDBERG & DRESEN, pp. 162, 163, pl. 2, fig. 8; pl. 4, figs. 19, 20 (*cum syn.*).

Remarks – The Pa elements, assigned to this species, have a strongly reclined posterior cusp, an alternated upper surface denticulation, a narrow and elongate platform, and a symmetrical basal cavity. In a few specimens cusp is not so strongly reclined, but the other characteristics are similar to *Icriodus cornutus*.

Range – From within the Middle *triangularis* Zone at least to the top of the Upper *marginifera* Zone. Rare individuals of a late morphotype or descendant species occur through the Upper *trachytera* Zone (Sandberg & Dreesen, 1984, p. 163).

Material – 10 Pa elements.

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