

***Icriodus* and *Polygnathus* (Conodonts) from the Late Devonian of Eastern Iran, and Middle-Late Devonian of Northern Iran**

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Abstract

Icriodus and *Polygnathus* faunas from the Late Devonian of the Tabas region of eastern Iran, and from the Middle-Late Devonian of the Alborz Mountains, northern Iran, are documented. Twenty three species and/or subspecies of *Icriodus* and 33 of *Polygnathus* are described and illustrated. Among them are five new species of *Icriodus*: *Ic. housei*, *Ic. talenti*, *Ic. bultyncki*, *Ic. walliseri* and *Ic. jafari*.

Keywords: Conodonts, Middle Devonian, Late Devonian, Iran, *Icriodus*, *Polygnathus*.

Introduction

Icriodus and *Polygnathus* are major components of conodont faunas from the Late Devonian of the Tabas region, eastern Iran, and the Middle-Late Devonian in the Alborz Mountains, northern Iran (Figs. 1-2). The Late Devonian faunas from the Tabas region discussed here came from parts of the type section of the Shishtu Formation (Ruttner *et al.* 1960) in the Ozbak-Kuh Mountains and its reference section (Stöcklin *et al.* 1965) in the Shotori range (Fig. 2). Late Devonian conodont faunas from the Cephalopod "Bed" (Stöcklin *et al.* 1965), a distinctive highly fossiliferous "marker" sequence (less than 50 m thick) occurring as disconnected outcrops along the western flank of the

Shotori range from its southern end to immediately east of Tabas, have been studied by Weddige (1984), Ashouri (1990, 2001a, 2001b, 2002, 2004), Yazdi (1996, 1999) and Wendt *et al.* (1997, 2005).

Conodont faunas with *Icriodus* and *Polygnathus* from the Khoshyeilagh Formation of the central Alborz Mountains (Bozorgnia 1973, Brice *et al.* 1978) discussed here came from 1300 m of its type section (where its total thickness is 1345 m). Conodont faunas from this unit were previously examined by Ahmadzadeh (1975), Weddige (1984) and Ashouri (1990, 1994, 2001a, 2001b). A total of 23 species of *Icriodus* (including five new forms) and 33 of *Polygnathus* are documented herein.



Fig. 1. Locality map of the studied areas.

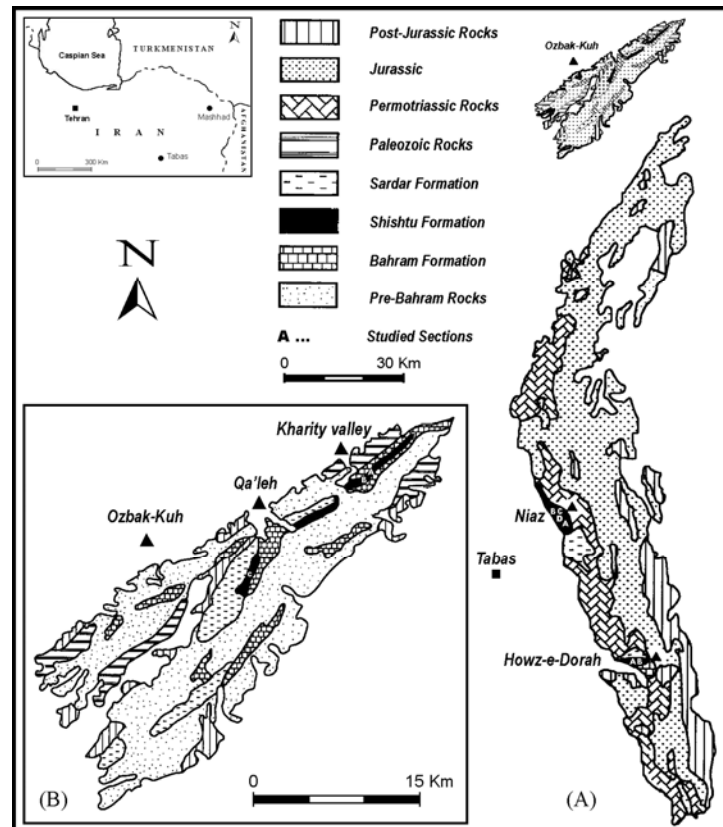


Fig. 2. Simplified geological map of the Shotori range (A) and the Ozbak-Kuh Mountains (B).

Species of *Palmatolepis* (Ashouri 2002) and other salient conodonts fauna, exclusive of *Palmatolepis* from the Khoshyeilagh Formation, have been discussed elsewhere (Ashouri 2002, 2004). The present communication focuses only on species of the genera *Icriodus* and *Polygnathus*.

The studied stratigraphical column sections have been shown in Figs. 3-5. Conodont distribution of the studied sections has been displayed in Tabs. 1-4.

Taxonomy

The figured specimens herein are housed in the department of geology of Ferdowsi University of Mashhad, Mashhad, Iran with the prefix AFUM.

Family ICRIODONTIDAE Müller & Müller 1957

Genus *Icriodus* Branson & Mehl 1938

Icriodus alternatus alternatus Branson & Mehl
1934

Pl. 2, Figs. 1-21

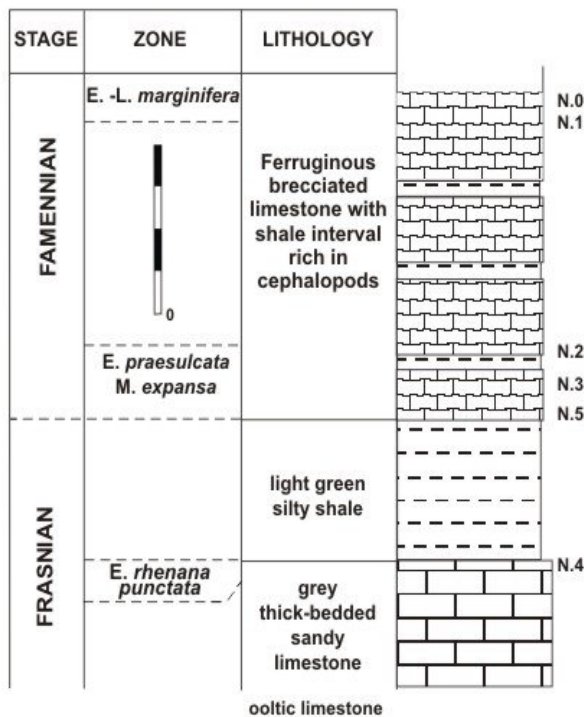
1999 *Icriodus alternatus alternatus* Branson & Mehl 1934-Yazdi Pl. 2, Figs. 5-10.

Synonymy: Over & Rhodes (2000, p. 109).

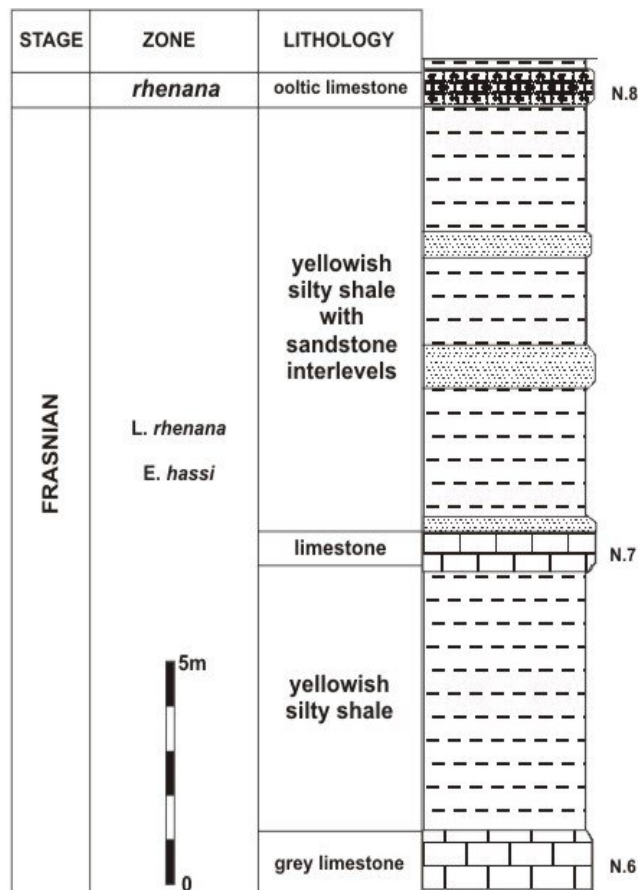
Remarks: The subspecies is one of the most abundant forms of *Icriodus* encountered in the

regions studied. Two morphotypes are discriminated: a laterally compressed form, and one with a narrow medial row of denticles. Specimens of the former have a median row of denticles and display a distinct posterior cusp and expanded basal cavity; the cavity may be broadly expanded (Pl. 2, Fig. 1) or moderately expanded (Pl. 2, Figs. 2-4). Most specimens belong to the latter morphotype whose denticles in the medial row are rounded and noticeably variable, and the size of the basal cavity is generally reduced. Some specimens (Pl. 2, Figs. 5-7) have very weak denticles in the medial row, particularly posteriorly where they are incipient. Some specimens (Pl. 2, Figs. 8-9) have a larger basal cavity, and have rounded denticles in the medial and side rows; the denticles are clearly isolated from each other. A single specimen (Pl. 2, Fig. 10) is less regular, and is rather similar to a specimen illustrated by Sandberg & Dreesen (1984, Pl. 2, Fig. 5).

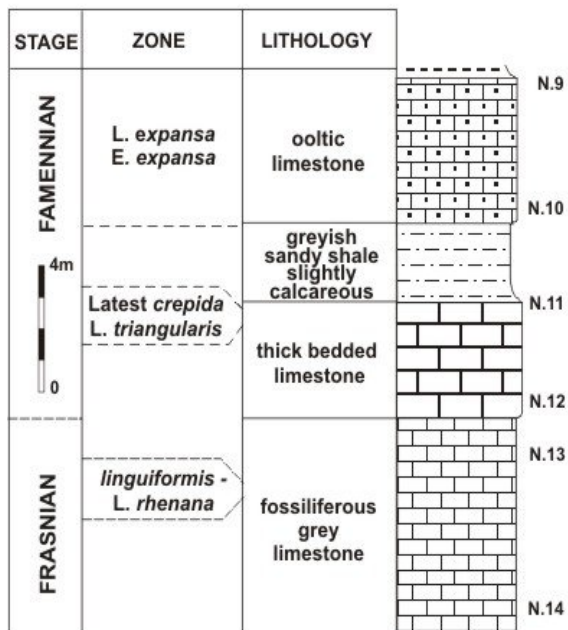
Range and Occurrence: Howz-e-Dorah and Niaz areas, Ozbak-Kuh and Alborz Mountains, ranging from, at, or slightly above, the base of the Late *rhenana* zone and extending as high as the Latest *crepida* zone.



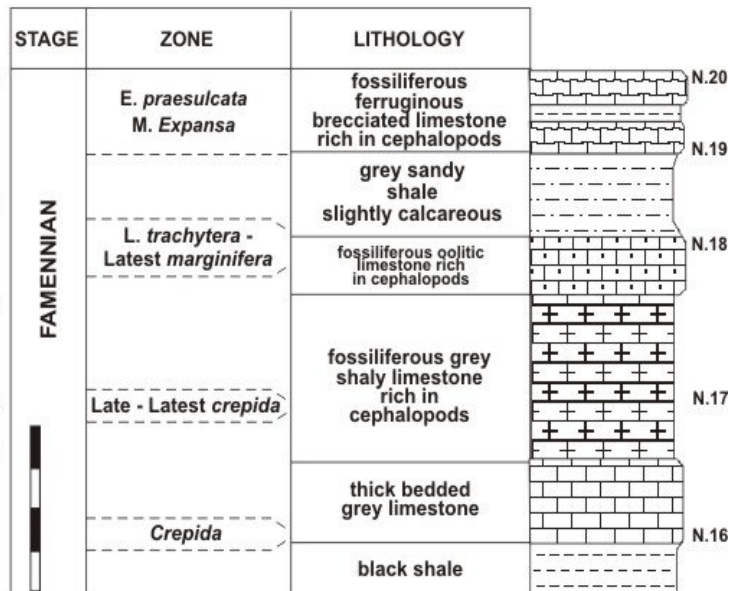
Part of the Cephalopod Bed overthrust by Frasnian strata in the Niaz area (Section A).



Part of the Cephalopod Bed in the Niaz area (Section B).

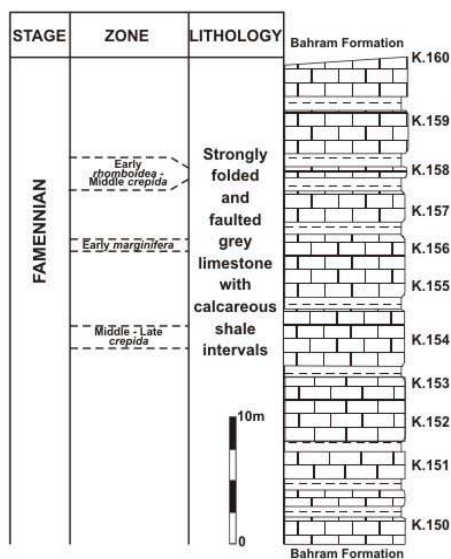


Overtumed section part of the Cephalopod Bed in the Niaz area (Section C).

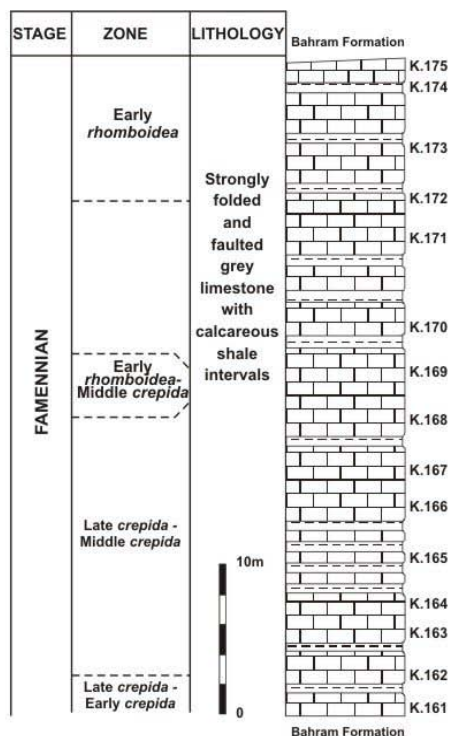


Part of the Cephalopod Bed in the Niaz area (Section D).

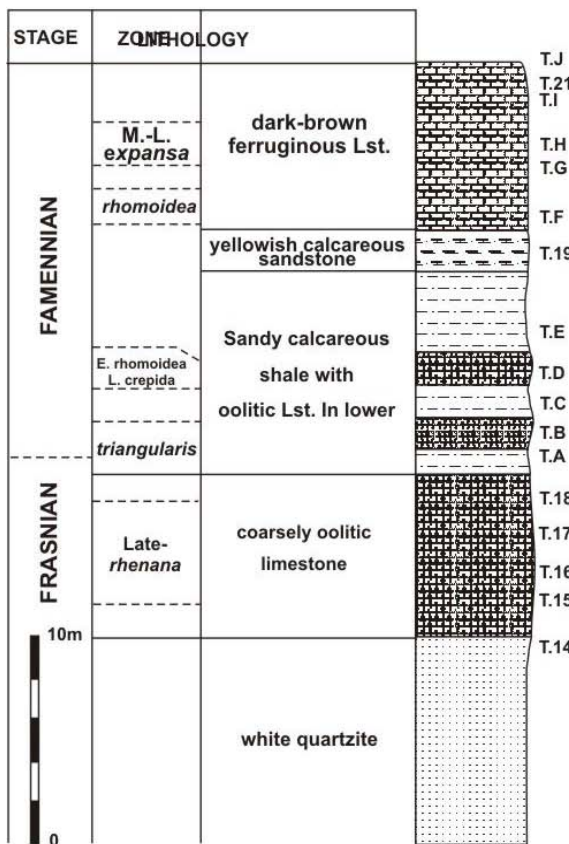
Fig. 3. Studied sections.



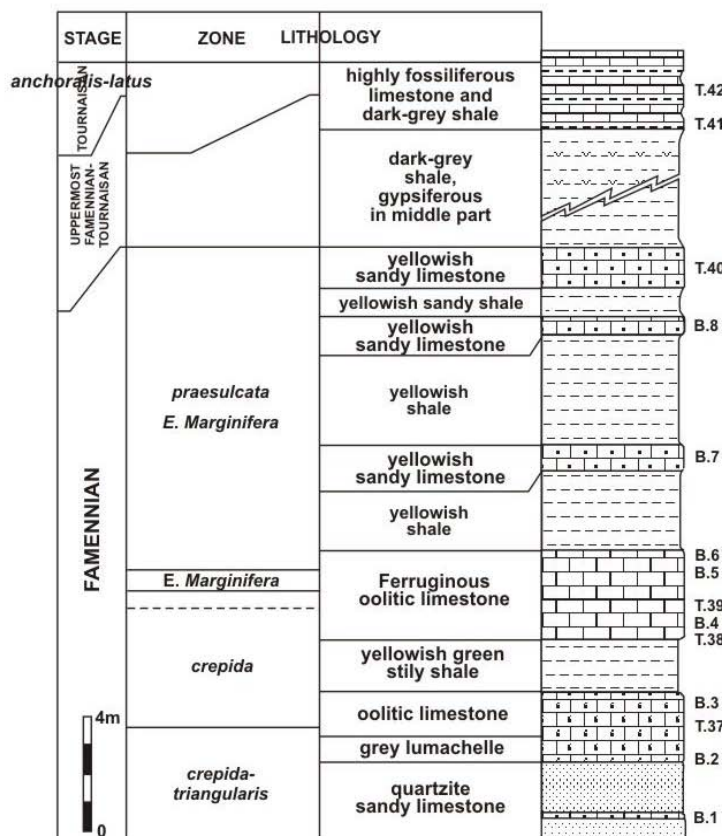
Part of the Shishtu Formation in the Kharity valley, OzbaK-Kuh Mountains (Section B).



Part of the Shishtu Formation in the Kharity valley, OzbaK-Kuh Mountains (Section C).



The Cephalopod Bed in the howz-e-Dorah area (Section B).



Part of the Cephalopod Bed and overlying strata in the Howz-e-Dorah area (Section A).

Fig. 4. Studied sections.

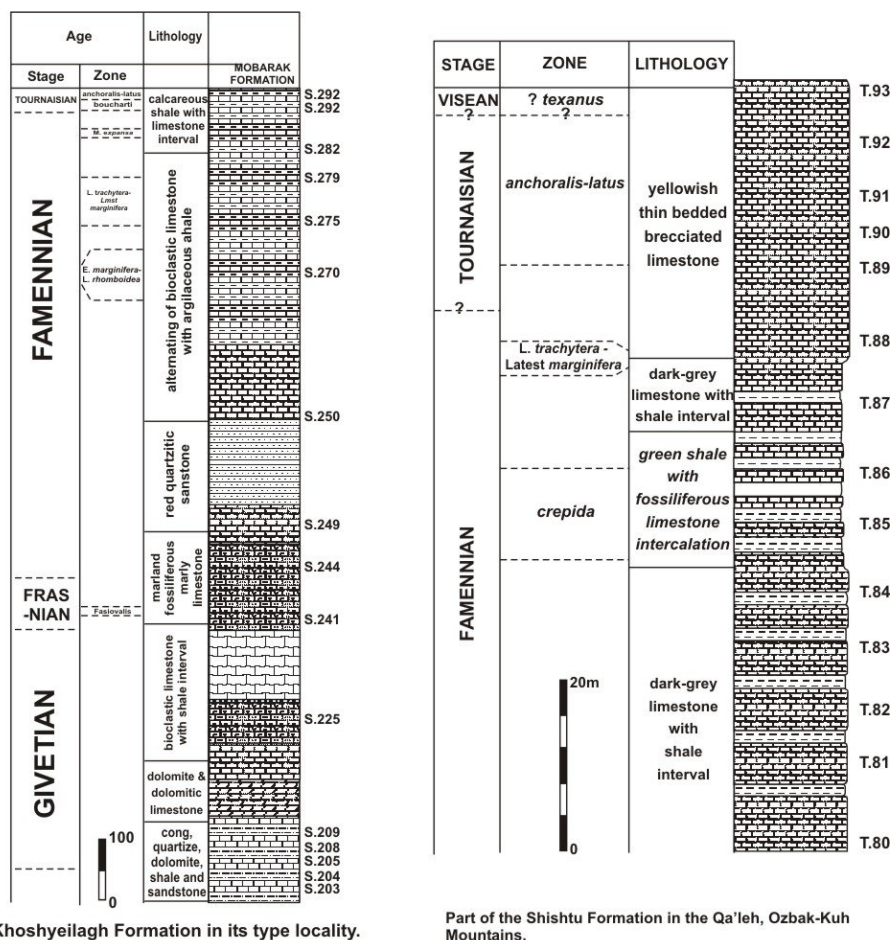


Fig. 5. Studied sections.

Tab. 1. Distribution of *Icriodus* and *Polygnathus* species in the Howz-e-Dorah area sections.

Taxa	Sample Number		A					B						
	B.2	T.36	T.39	B.5	B.6	T.14	T.15	T.16	T.17	T.D	T.E	T.G	T.22	
<i>Icriodus alter. alternathus</i>	*													
<i>Polygnathus com. communis</i>		*	*											
<i>Polygnathus brevilaminus</i>			*											
<i>Icriodus housei</i>			*											
<i>Polygnathus lagowiensis</i>			*											
<i>Icriodus talenti</i>			*											
<i>Icriodus iow. iwoaensis</i>			*			*				*				
<i>Icriodus bultyncki</i>			*	*										
<i>Polygnathus parawebbi</i>						*								
<i>Polygnathus xylus ensensis</i>						*								
<i>Polygnathus timorensis</i>							*							
<i>Polygnathus pacificus</i>							*							
<i>Polygnathus evidens</i>							*							
<i>Polygnathus alatus</i>			*	*			*			*	*			
<i>Polygnathus webbi</i>							*		*			*	*	
<i>Polygnathus varcus</i>								*						
<i>Polygnathus dentatus</i>										*				
<i>Icriodus expansus</i>										*				
<i>Polygnathus pseudofoliathus</i>										*				
<i>Polygnathus semicostatus</i>			*	*						*	*			
<i>Polygnathus nodocostatus</i>			*	*						*	*	*		
<i>Polygnathus hommoirregularis</i>												*		
<i>Polygnathus decorosus</i>												*		
<i>Polygnathus preplexus</i>				*										
<i>Icriodus walliseri</i>				*										
<i>Polygnathus experlexus</i>					*									
<i>Icriodus cornutus</i>					*									

Tab. 2. Distribution of *Icriodus* and *Polygnathus* species in the Niaz area sections.

Sample Number Taxa	A			B	C				D		
	N.0	N.1	N.2	N.8	N.9	N.10	N.11	N.13	N.16	N.17	N.19
<i>Polygnathus praehassi</i>	*										
<i>Polygnathus medius</i>	*										
<i>Polygnathus margaritatus</i>	*	*									
<i>Polygnathus nodocostatus</i>	*	*									
<i>Polygnathus lagowiensis</i>	*	*									
<i>Polygnathus perplexus</i>	*	*			*						
<i>Polygnathus experplexus</i>	*				*						
<i>Polygnathus fallax</i>	*						*				
<i>Polygnathus obliquicostatus</i>			*								
<i>Polygnathus brevilaminus</i>										*	
<i>Polygnathus com. communis</i>			*			*					*
<i>Icriodus jafariani</i>				*							
<i>Icriodus expansus</i>						*					
<i>Polygnathus subirregularis</i>							*				
<i>Icriodus alter. alternatus</i>							*	*	*	*	*
<i>Polygnathus evidens</i>				*				*			
<i>Polygnathus webbi</i>								*			

Tab. 3. Distribution of *Icriodus* and *Polygnathus* of species in the Ozbak-Kuh Mountains sections.

Sample Number Taxa	A					B						C						
	T. 81	T. 82	T. 83	T. 86	T. 88	K. 151	K. 153	K. 154	K. 156	K. 158	K. 159	K. 160	K. 161	K. 162	K. 163	K. 165	K. 169	K. 173
<i>Icriodus brevis</i>													*					
<i>Icriodus cornutus</i>						*		*				*						
<i>Icriodus alter. alternatus</i>	*			*			*	*						*	*		*	
<i>Icriodus iow. iowaensis</i>	*							*	*							*		
<i>Polygnathus aequalis</i>		*													*			
<i>Polygnathus webbi</i>		*																
<i>Polygnathus parawebbi</i>		*																
<i>Icriodus subterminus</i>			*															
<i>Icriodus expansus</i>				*														
<i>Polygnathus com. communis</i>					*													
<i>Polygnathus robustatus.</i>								*										
<i>Polygnathus semicostatus</i>									*									
<i>Polygnathus brevilaminus</i>										*					*			
<i>Polygnathus alatus</i>															*			
<i>Icriodus cos. costatus</i>																*		
<i>Polygnathus subirregularis</i>																		*

Tab. 4. Distribution of *Icriodus* and *Polygnathus* species in the Khoshyeilagh Formation type locality.

Sample Number Taxa	S. 210	S. 211	S. 227	S. 228	S. 229	S. 230	S. 234	S. 235	S. 237	S. 239	S. 240	S. 241	S. 247	S. 250	S. 255	S. 259	S. 260	S. 261	S. 262	S. 264	S. 266	S. 269	S. 270	S. 271	S. 288
<i>Icriodus obliquimarginatus</i>	*																								
<i>Icriodus regularicrescens</i>	*																								
<i>Icriodus arkonensis</i>	*																								
<i>Polygnathus ling. alveolus</i>	*																								
<i>Polygnathus ling. ling. delta</i>	*																								
<i>Polygnathus ling. ling. gamma</i>	*																								
<i>Polygnathus cf. perbonus</i>	*																								
<i>Icriodus brevis</i>	*	*	*	*	*																				
<i>Icriodus orri</i>	*				*	*																			
<i>Icriodus difficilis</i>				*	*		*	*				*													
<i>Polygnathus com. communis</i>					*													*				*			
<i>Icriodus alborzensis</i>							*		*	*															
<i>Polygnathus xylus xylus</i>							*				*														
<i>Icriodus expansus</i>											*							*	*						
<i>Polygnathus alatus</i>													*						*	*					
<i>Icriodus subterminus</i>														*				*			*				
<i>Icriodus iow. iwoensis</i>															*		*			*					
<i>Icriodus costatus darbyensis</i>																*									
<i>Icriodus ariaei</i>																	*								
<i>Polygnathus brevilaminus</i>																	*		*	*			*		
<i>Polygnathus angustidiscus</i>																			*						
<i>Icriodus cf. raymondi</i>																						*			
<i>Polygnathus klapperianus</i>																						*			
<i>Icriodus khoshyeilaghensis</i>																									*
<i>Icriodus talenti</i>																									*
<i>Polygnathus semicostatus</i>																									*
<i>Polygnathus delicatulus</i>																									*
<i>Polygnathus nodocostatus</i>																									*

Icriodus arkonensis Stauffer 1938

Pl. 3, Figs. 17-21

Synonymy: Sparling (1995, p. 1129).

Remarks: All available specimens have a well-developed posterior cusp, but their denticles have a different configuration. A single specimen (Pl. 3, Fig. 17) shows weak denticles in the medial row and more or less laterally compressed denticles in the side rows. Another specimen (Pl. 3, Fig. 18) has, in the posterior part of the specimen, lateral denticles that are distinctly larger on one side than the other and have a drop-shaped form. Three other specimens have rather laterally compressed denticles. In one of these (Pl. 3, Fig. 19), denticles in the medial row are rounded and clearly separated from the corresponding lateral denticles; in another specimen (Pl. 3, Fig. 20), the lateral row has denticles that are more laterally compressed producing a ridge-form; in the third specimen (Pl. 3, Fig. 21) the lateral and medial row denticles are

aligned and were united to form a continuous cross-ridge.

Range and Occurrence: Member 2 of the Khoshyeilagh Formation. Its age assigned as Givetian.

Icriodus brevis Stauffer 1938

Pl. 1, Figs. 1-9.

Synonymy: Sparling (1995, p. 1129).

Remarks: Denticles tend to alternate in the specimens available for study. Denticles of the medial row are closer to the denticles of the lateral rows anteriorly. In some specimens (Pl. 1, Figs. 1-3), denticles of both the lateral and medial rows are rounded; in others (Pl. 1, Figs. 4-7), denticles of the lateral rows are laterally compressed but denticles of the medial row are rather rounded. A single specimen (pl.1, Fig. 8) has laterally compressed denticles in the lateral rows and almost in the medial row. A single specimen (Pl. 1, Fig. 9) has a much longer blade with more discrete lateral denticles

similar to the specimen illustrated by Ziegler *et al.* (1976, Pl. 1, Fig. 15).

Range and Occurrence: Ozbak-Kuh Mountains and Khoshyeilagh Formation. It ranges from the upper part of the Early *varcus* Zone to the top of the Early *hermani* Zone.

Icriodus cornutus Sannemann 1955

Pl. 1, Figs. 14-22

Synonymy: Schülke (1995, p. 67).

1999 *Icriodus cornutus* Sannemann, 1955-Yazdi Pl. 2, Fig. 14.

Remarks: Available specimens conform generally to some illustrated by Weddige (1984, Pl. 4, Figs. 70, 71, 76 & 77). Some display (Pl. 1, Fig. 15) alternation of medial and lateral rounded denticles; others (Pl. 1, Figs. 16-17) have ridge-like denticles, particularly in the median row, with pronounced regular alternation of lateral and medial row denticles. A single specimen (pl.1, Fig. 18) has only two lateral denticles on each side; they are very close anteriorly to the medial row of denticles. Two specimens (Pl. 1, Figs. 19-20) are slightly arched and are less regular in denticle position. A single specimen (Pl. 1, Fig. 21) has a larger cusp than any of the above specimens. A single specimen (Pl. 1, Fig. 22) is assigned doubtfully to this species.

Range and Occurrence: Mostly from the Ozbak-Kuh Mountains; some from the Howz-e-Dorah area. Its range is from within the Middle *triangularis* Zone to the top of the *marginifera* Zone, with rare occurrence through the Late *trachytera* Zone.

Icriodus excavatus Weddige 1984

Pl. 3, Figs. 7-12.

Synonymy: Sparling (1995, p. 1129).

Remarks: The specimens assigned here to *Ic. excavatus* differ in denticulation and in size of the basal cavity. The largest specimen (pl.3, Fig. 7) has the largest basal cavity; the spindle has a bifurcated posterior cusp. Its lateral denticles in the middle third of the unit join each other and produce cross-ridges. No distinct medial row of denticles is present. Two specimens (Pl. 3, Figs. 8-9) have very large basal cavities and display a few weak denticles in the medial row; one with a robust posterior cusp. A single specimen (Pl. 3, Fig. 10) has a strong posterior cusp and three medial row denticles more or less connected by lateral row denticles. One

specimen (Pl. 3, Fig. 11) has only a single medial row denticle in the posterior part; it is followed by a depression formed by two subsequent lateral row denticles anteriorly.

Range and Occurrence: Ozbak-Kuh Mountains. Its range is from the *varcus* Zone to the *Ancyrognathus triangularis* Zone.

Icriodus expansus Branson & Mehl, 1934

Pl. 1, Figs. 25-33

Synonymy: (Over & Rhodes 2000, p. 109).

1999 *Icriodus expansus* BRANSON & MEHL, 1934-Yazdi pl.2, Figs. 11-12.

Remarks: The specimens display considerable morphological variation. A single specimen (Pl. 1, Fig. 25) is closely related to one illustrated by Morzadec & Weyant (1982, Pl. 4, Fig. 67). Two specimens (Pl. 1, Figs. 26-27) are rather similar morphologically to a form illustrated by Weddige (1984, Pl. 4, Fig. 67). Three specimens (Pl. 1, Figs. 28-30) have a very distinct biconvex platform with flaring lower margin, and have a more or less symmetrical outline to the basal cavity. A single specimen (Pl. 1, Fig. 31) shows very uniformly spaced denticles—both the compressed lateral denticles of the side rows and the rounded denticles of the median row. It has a distinct posterior cusp and flared lower margin produced into a symmetrical outline of the basal cavity. A single specimen (Pl. 1, Fig. 32) resembles the original hypotype of Stauffer (1940), later photographed by Klapper (*in*: Ziegler 1975, Pl. 1, Fig. 1)

Range and Occurrence: Howz-e-Dorah and Niaz areas, Ozbak-Kuh Mountains and Khoshyeilagh Formation. The species range is from the late Middle Devonian (Givetian) through the Upper Devonian (Frasnian).

Icriodus iowaensis iowaensis Youngquist &

Peterson 1947

Pl. 4, Figs. 1-15

Synonymy: Schülke (1995, p. 68).

1999 *Icriodus iowaensis iowaensis* Youngquist & Peterson, 1947-Yazdi pl.1, Figs. 1-9.

Remarks: The subspecies is common in the areas of study. One specimen (Pl. 4, Fig. 1) has a rather broad platform and extremely expanded basal cavity is assigned to the broad morphotype of the subspecies. Several specimens have a moderately broad platform but the basal cavity is not large

enough to be assigned to the broad morphotype (Pl. 4, Figs. 2-3).

A single specimen (Pl. 4, Fig. 4) has a bifurcate cusp. Three specimens (Pl. 4, Figs. 5-7) have a strong posterior cusp with a ridge on its upper surface. A single specimen (Pl. 4, Fig. 8) is similar to one illustrated by Dreesen & Houllberghs (1980, Pl. 1, Fig. 2). A group of specimens (pl.4, Figs. 9-13) has a narrow platform with zigzag medial row characteristic of the narrow morphotype of the subspecies.

Range and Occurrence: Howz-e-Dorah and Niaz areas, Ozbak-Kuh Mountains and Khoshyeilagh Formation. It is known to extend from the base of the Middle *triangularis* Zone into the Early *rhomboidea* Zone.

Icriodus obliquimarginatus Bischoff & Ziegler 1957
Pl. 1, Figs. 10-11

Synonymy: Sparling (1995, p. 1133).

Remarks: Only two specimens were available; they correspond precisely to the diagnosis of the species. One (Pl. 1, Fig. 10), with a posterior blade about two-thirds of the length of the conodont, has a faint indication of a spur. The posterior blade is about half of the length of the other specimens (Pl. 1, Fig. 11).

Range and Occurrence: Member 2 of the Khoshyeilagh Formation. The species ranges from a little above the base of the *ensensis* Zone to almost the top of the Middle *varcus* Zone.

Icriodus orri Klapper & Barrick 1983
Pl. 3, Figs. 13-16

Synonymy: Uyeno & Lespérance (1997, p. 156).

1989 *Icriodus orri* Klapper & Barrick, 1983-
Mawson & Talent, pl.1, Figs. 13-15.

Remarks: All available specimens have a well developed posterior cusp. The lateral denticles are laterally compressed and are generally fairly large. Two of the specimens (Pl. 3, Figs. 13-14)

1983, pl.9, Figs AF, AG) in general outline. One of them (pl.3, Fig. 13) has a rather well developed medial row of denticles. The other (pl. 3, Fig. 14) has a strong posterior cusp, and the denticles are less developed in the lateral and medial rows. Two other specimens (pl.3, Figs. 15-16) display a well developed medial row of denticles about the same height as the lateral-row denticles. The denticles of the medial row are connected by a longitudinal

ridge. These two specimens conform in every way with morphotype 2 of the species.

Range and Occurrence: Upper part of the Member 1 to lower part of Member 3 of the Khoshyeilagh Formation. The species was recorded by Klapper & Barrick (1983) from the Late Eifelian, but its range, globally, may have been greater.

Icriodus cf. raymondi Sandberg & Ziegler, 1979
Pl. 3, Figs. 17-21

Remarks: The specimens show alternation of side and medial row denticles. The posterior cusp is well developed and bears a ridge on the upper surface.

Range and Occurrence: "Cephalopod Bed" at Howz-e-Dorah area and upper part of Member 5 of the Khoshyeilagh Formation. *I. raymondi* was recorded from the Late *marginifera* Zone to the Middle *expansa* Zone.

Icriodus regularicrescens Bultynck, 1970
Pl. 1, Figs. 12-13

Synonymy: Sparling (1995, p. 1134).

Remarks: The two specimens available conform with the original diagnosis of the species. One (Pl. 1, Fig. 12) is similar to a specimen illustrated by Weddige (1977, Pl. 2, Fig. 32); the other is close to a specimen illustrated by Orchard (1978, Pl. 107, Fig. 31).

Range and Occurrence: Member 2 of the Khoshyeilagh Formation. The species ranges from within the early Eifelian (*costatus* Zone) into the Givetian (Middle *varcus* Subone).

Icriodus subterminus Youngquist, 1947
Pl. 2, Figs. 22-27

1989 *Icriodus subterminus* Youngquist, 1947- Ji Pl. 4, Figs. 16-18.

Remarks: Two well-preserved specimens (Pl. 2, Figs 22-23) conform to the original diagnosis. A single specimen (Pl. 2, Fig 24) with broader platform and broad expanded basal cavity displays less uniformity in distance between the lateral denticles. A single fragmentary specimen (pl.2, Fig. 25) has rounded medial-row denticles alternating with the laterally compressed, uniformly spaced denticles of the side rows. Two other specimens (pl.2, Figs 26-27) show an alternation of lateral compressed denticles with round, closely spaced medial-row denticles.

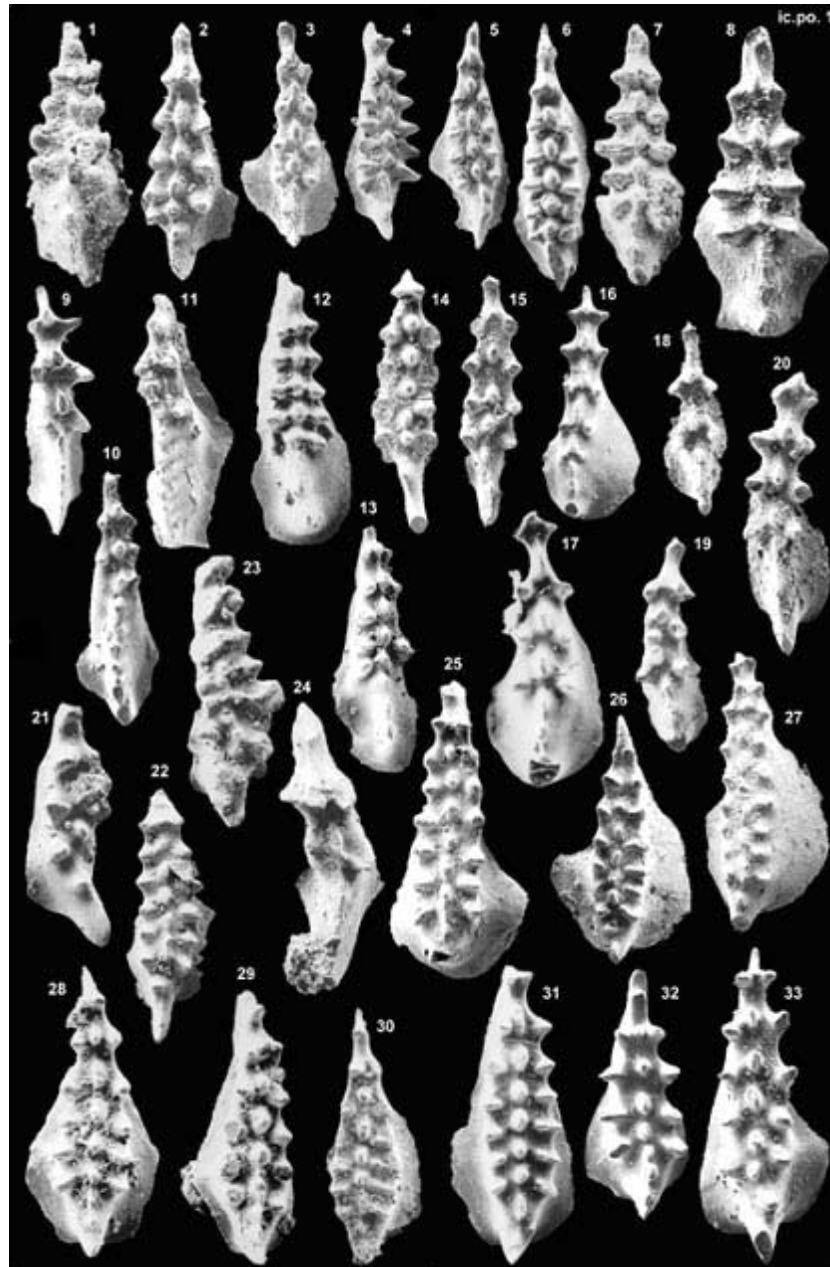


Plate 1. Figs. 1-9. *Icriodus brevis* Stauffer 1940: Fig. 1. Upper view of AFUM101. S. 228, Khoshyeilagh area. Fig. 2. Upper view of AFUM102. S. 227, Khoshyeilagh area. Fig. 3. Upper view of AFUM103. S. 229, Khoshyeilagh area. Fig. 4. Upper view of AFUM104. S. 210, Khoshyeilagh area. Fig. 5. Upper view of AFUM105. S. 210, Khoshyeilagh area. Fig. 6. Upper view of AFUM106. S. 210, Khoshyeilagh area. Fig. 7. Upper view of AFUM107. S. 228, Khoshyeilagh area. Fig. 8. Upper view of AFUM108. S. 211, Khoshyeilagh area. Fig. 9. Upper view of AFUM109. K. 161, Ozbak-Kuh Mountains. Figs. 10-11. *Icriodus obliquimarginatus* Bischoff & Ziegler 1957: Fig. 10. Upper view of AFUM111. S. 210, Khoshyeilagh area. Fig. 11. Upper view of AFUM110. S. 210, Khoshyeilagh area. Figs. 12-13. *Icriodus regularicrescens* Bultynck 1970: Fig. 12. Upper view of AFUM112. S. 210, Khoshyeilagh area. Fig. 13. Upper view of AFUM113. S. 210, Khoshyeilagh area. Figs. 14-22. *Icriodus cornutus* Sannemann 1955. Fig. 14. Upper view of AFUM117. K. 172, Ozbak-Kuh Mountains. Fig. 15. Upper view of AFUM118. K. 167, Ozbak-Kuh Mountains. Fig. 16. Upper view of AFUM119. K. 154, Ozbak-Kuh Mountains. Fig. 17. Upper view of AFUM120. K. 163, Ozbak-Kuh Mountains. Fig. 18. Upper view of AFUM121. K. 151, Ozbak-Kuh Mountains. Fig. 19. Upper view of AFUM122. K. 160, Ozbak-Kuh Mountains. Fig. 20. Upper view of AFUM123. K. 167, Ozbak-Kuh Mountains. Fig. 21. Upper view of AFUM124. K. 159, Ozbak-Kuh Mountains. Fig. 22. Upper view of AFUM125. B. 6, Howz-e-Dorah area. Figs. 23-24. *Icriodus costatus darbyensis* Klapper 1958. Fig. 23. Upper view of AFUM126. S259, Khoshyeilagh area. *Icriodus costatus costatus* (THOMAS 1949) Morphotype 2. Fig. 24. Upper view of AFUM127. K. 165, Ozbak-Kuh Mountains. Figs. 25-33. *Icriodus expansus* Branson & Mehl 1934. Fig. 25. Upper view of AFUM128. S. 262, Khoshyeilagh area. Fig. 26. Upper view of AFUM129. T. 86, Ozbak-Kuh Mountains. Fig. 27. Upper view of AFUM130. T. D, Howz-e-Dorah area. Fig. 28. Upper view of AFUM131. S. 240, Khoshyeilagh area. Fig. 29. Upper view of AFUM132. S. 240, Khoshyeilagh area. Fig. 30. Upper view of AFUM133. N. 10, Niaz area. Fig. 31. Upper view of AFUM134. K. 163, Ozbak-Kuh Mountains. Fig. 32. Upper view of AFUM136. S. 261, Khoshyeilagh area. Fig. 33. Upper view of AFUM135. S. 262, Khoshyeilagh area. Fig. 23x50; Figs. 21, 26-27, 30x60; Figs. 1-2, 4-5, 7, 15, 18, 20, 22, 24-25, 31-33x80; Figs. 3, 6, 8-14, 17, 19, 28-29x100; Fig. 16x120.

Range and Occurrence: Member 5 of the Khoshyeilagh Formation and Ozbak-Kuh Mountains. Its range as presently understood begins within the Lowermost *asymmetricus* Zone, extending into the Early *rhenana* Zone.

Icriodus ariaei Ashouri, in press
Pl. 5, Fig. 12

Occurrence: This species, from Member 5 of the Khoshyeilagh Formation, is from the *crepida* Zone according to the associated conodont fauna and its stratigraphic position.

Icriodus alborzensis Ashouri, in press
Pl. 5, Figs. 13-16

Occurrence: The species, from Member 3 of the Khoshyeilagh Formation, is interpreted as being Late Givetian in age.

Icriodus housei n. sp.
Pl. 5, Figs. 1-3

Derivation of name: For Prof. Michael House for greatly furthering knowledge of the Devonian.

Holotype: AFUM270, the specimen illustrated on Pl. 1, Fig. 15 from sample S. 233.

Diagnosis: A species of *Icriodus* with a large cusp at the posterior end and an acute and strongly developed spur. The lateral row denticles vary from rounded to slightly transverse ridges. Denticles of the middle row are conspicuous.

Remarks: The cusp is slightly inclined posteriorly. The middle-row denticles are rounded and alternate with the lateral ones (Pl. 5, Figs. 2-3) or form nodes and ridges (Pl. 5, Fig. 1). The spur is very strongly developed. The present form is readily distinguished from the other Famennian forms—*Ic. costatus*, *Ic. raymondi* and *Ic. pectinatus*—by having a more developed platform and basal cavity and by the presence of a strong spur.

Range and Occurrence: “Cephalopod Bed” in the Howz-e-Dorah area. Based on the associated conodont fauna, the form is inferred to be from the *expansa* Zone.

Icriodus khoshyeilaghensis Ashouri, in press
Pl. 5, Fig. 11

Occurrence: The species, from the upper part of Member 5 of the Khoshyeilagh Formation, is from the *crepida* Zone according to the associated conodont fauna and its stratigraphic position.

Icriodus talenti n. sp.
Pl. 5, Figs. 4-6

Derivation of name: For Prof. John Talent for greatly furthering knowledge of the Devonian.

Holotype: AFUM270, the specimen illustrated on pl.1, Fig. 15 from sample S. 233.

Diagnosis: A species of *Icriodus* with a long posterior cusp, a rather large basal cavity and a well-developed spur. Both the medial and side row denticles are rounded and closely alternating.

Remarks: This species is similar to those illustrated by Dreesen & Houleberghs (1980, Pl. 4, Figs. 2, 3) as *Ic. alternatus*, but differs in having a long posterior cusp and closely alternating denticles.

Range and Occurrence: “Cephalopod Bed” in the Howz-e-Dorah area. Based on the associated conodont fauna, the form is inferred to be from the *postera* Zone.

Icriodus bultyncki n. sp.
Pl. 5, Figs. 9-10

Derivation of name: For Prof. P. Bultynck for greatly furthering knowledge of Middle Devonian conodonts.

Holotype: AFUM270, the specimen illustrated on Pl. 1, Fig. 15 from sample S. 233.

Diagnosis: A species of *Icriodus* characterized by distinctly rounded and discrete denticles both in the medial and lateral rows, alternating evenly. A posterior cusp is present, aligned with the medial row. The basal cavity is large.

Remarks: This species is closely related to *Ic. alternatus*, particularly forms illustrated by Dreesen & Houleberghs (1980, Pl. 2, Figs. 6, 8) as being *Ic. alternatus* Morphotype 1. The new species differs by having a well developed medial row of denticles and a posterior cusp aligned with the medial row.

Occurrence: Upper part of Member 5 of the Khoshyeilagh Formation, and also in the Howz-e-Dorah area. On the basis of stratigraphic position and conodont faunas from underlying samples, its age is inferred to be *crepida* to *rhomboidea* zones.

Holotype: AFUM270, the specimen illustrated on pl.1, Fig. 15 from sample S. 233.

Diagnosis: A species of *Icriodus* with a moderately large posterior cusp (with a ridge on the upper surface), with a spur and ridge-forming lateral denticles, with rounded denticles in the medial row, and with a well developed basal cavity.



Plate 2. Figs. 1-21. *Icriodus alternatus alternatus* Branson & Mehl 1934. Fig. 1. Upper view of AFUM169. T. 81, Niaz area. Fig. 2. Upper view of AFUM172. N. 13, Niaz area. Fig. 3. Upper view of AFUM174. T. 16, Howz-e-Dorah area. Fig. 4. Upper view of AFUM175. N. 17, Niaz area. Fig. 5. Upper view of AFUM177. N. 11, Niaz area. Fig. 6. Upper view of AFUM183. K. 162, Ozbak-Kuh Mountains. Fig. 7. Upper view of AFUM187. N. 17, Niaz area. Fig. 8. Upper view of AFUM190. K. 163, Ozbak-Kuh Mountains. Fig. 9. Upper view of AFUM194. K. 163, Niaz area. Fig. 10. Upper view of AFUM195. N. 19, Niaz area. Fig. 11. Upper view of AFUM171. N. 13, Niaz area. Fig. 12. Upper view of AFUM176. T. 86, Ozbak-Kuh Mountains. Fig. 13. Upper view of AFUM169. T. 81, Ozbak-Kuh Mountains. Fig. 14. Upper view of AFUM163. K. 163, Ozbak-Kuh Mountains. Fig. 15. Upper view of AFUM169. N. 17, Niaz area. Fig. 16. Upper view of AFUM211. N. 17, Niaz area. Fig. 17. Upper view of AFUM206. K. 153, Ozbak-Kuh Mountains. Fig. 18. Upper view of AFUM207. K.169, Ozbak-Kuh Mountains. Fig. 19. Upper view of AFUM197. K. 154, Ozbak-Kuh Mountains. Fig. 20. Upper view of AFUM201. N. 17, Niaz area. Fig. 21. Upper view of AFUM202. B. 2, Howz-e-Dorah area. Figs. 22-27. *Icriodus subterminus* Youngquist 1947. Fig. 22. Upper view of AFUM243. S. 264, Khoshyeilagh area. Fig. 23. Upper view of AFUM245. S. 260, Khoshyeilagh area. Fig. 24. Upper view of AFUM244. S. 260, Khoshyeilagh area. Fig. 25. Upper view of AFUM246. T. 831, Ozbak-Kuh Mountains. Fig. 26. Upper view of AFUM247. S. 260, Khoshyeilagh area. Fig. 27. Upper view of AFUM248. S. 250, Khoshyeilagh area. Fig. 28. *Icriodus* sp. Upper view of AFUM281. S. 250, Khoshyeilagh area. Fig. 29. *Icriodus* sp. Upper view of AFUM298. K. 162, Ozbak-Kuh Mountains. Fig. 30. *Icriodus* sp. Upper view of AFUM295. S. 266, Khoshyeilagh area. Figs. 4, 6, 7, 9-10, 12, 14-16, 20, 24, 26, 28x60; Figs. 1-3, 5, 11, 13, 19, 21-23, 27, 29x80; Figs. 8, 17-18, 25, 30x100.

Remarks: The middle row of denticles (alternating with the lateral denticles) occurs only in the posterior two-thirds of the platform. The species is discriminated from *Ic. raymondi* by having a moderately large basal cavity with a spur.

Range and Occurrence: "Cephalopod Bed" in the Howz-e-Dorah area. Based on the associated conodont fauna, the age is inferred to be *expansa* Zone.

Icriodus jafari n. sp.

Pl. 5, Fig. 17

Derivation of name: In honour of Prof. Mohammad Ali Jafarian who contributed significantly to the palaeontology of Iran.

Holotype: AFUM270, the specimen illustrated on pl.1, Fig. 15 from sample S. 233.

Diagnosis: A slender species of *Icriodus* with only one pair of lateral denticles.

Remarks: The species readily discriminated by its lateral denticulation, namely, only to one denticle on each side, and these being located in the anterior half of the conodont. The basal cavity is crescentic.

Range and Occurrence: "Cephalopod Bed" in the Howz-e-Dorah area. Based on the associated conodont fauna the form is assigned to the *rhenana* to *linguiformis* Zone.

Family Polygnathidae Bassler, 1925

Genus *Polygnathus* Hinde, 1879

Polygnathus aequalis Klapper & Lane 1985

Pl. 6, Figs. 27-28

Synonymy: Klapper & Lane (1985, p. 930).

1999 *Polygnathus aequalis* Klapper & Lane, 1985-Yazdi Pl. 6, Figs. 16, 23.

Remarks: Of four specimens available, one (Pl. 6, Fig. 27) conforms in every way with the holotype (Klapper & Lane 1985, Pl. 16, Fig. 13).

Range and Occurrence: Howz-e-Dorah area and in the Ozbak-Kuh Mountains. The holotype came from Frasnian strata, but the precise range of the species has not been established.

Polygnathus alatus Huddle 1934

Pl. 6, Figs. 16-21

Synonymy: Bender & Piecha (1991, p. 42).

Remarks: All specimens assigned here to *Po. alatus* lack ornament on the upper surface except for one (Pl. 6, Fig. 16) which has some transverse ridges on its posterior end. Some of these specimens

(Pl. 6, Figs. 17-19) are close to one illustrated by Metzger (1989, Pl. 15, Fig. 1).

Range and Occurrence: Howz-e-Dorah area, Ozbak-Kuh Mountains and Member 4 of the Khoshyeilagh Formation. The species is known from the Frasnian, but the precise range of the species has not been established.

Polygnathus angustidiscus Youngquist 1945

Pl. 6, Figs. 1-2

Synonymy: Schülke (1995, p. 57).

1997 *Polygnathus angustidiscus* Youngquist, 1945-Molloy *et al.* Pl. 4, Fig. 13.

Remarks: One of the studied specimens (Pl. 6, Fig. 1) is closely related to the one illustrated by Bultynck (1982, Pl. 3, Fig. 6). It has a large aboral cavity which occupies the entire part of the unit underneath the platform. The cavity extends as a narrow groove for a distance both anteriorly and posteriorly. The second specimen (Pl. 6, Fig. 2) displays a large and markedly asymmetrical platform.

Range and Occurrence: Member 5 of the Khoshyeilagh Formation. The range of the species has indicated from the Middle *asymmetricus* Zone to the Early *rhenana* Zone.

Polygnathus brevilaminus Branson & Mehl, 1934

Pl. 8, Figs. 15-24

Synonymy: Schülke (1995, p. 58).

Remarks: The available specimens display considerable variation. Some show a long and straight and/or almost straight blade-carina; the platform is asymmetrical and narrow with, marginally, short transverse ridges. Some forms have a long and well denticulated carina posterior of a long platform (Pl. 8, Fig. 15) or a short platform (Pl. 8, Fig. 16). The carina posterior of the platform may be smoothly denticulated (Pl. 8, Fig. 17) or show only a single denticle (Pl. 8, Fig. 22).

The second group differs from the previous one in having a curved posterior carina (Pl. 8, Figs 19-20). Some specimens have a very distinct asymmetrical platform with a straight carina (Pl. 8, Fig. 18) or curved posterior carina (Pl. 8, Fig. 24). One specimen (Pl. 8, Figs 23) has a simple platform and non-denticulate posterior carina. A single fragmentary specimen (Pl. 8, Fig. 21) is close to one illustrated by Wang & Yin (1988, Pl. 31, Fig. 7).

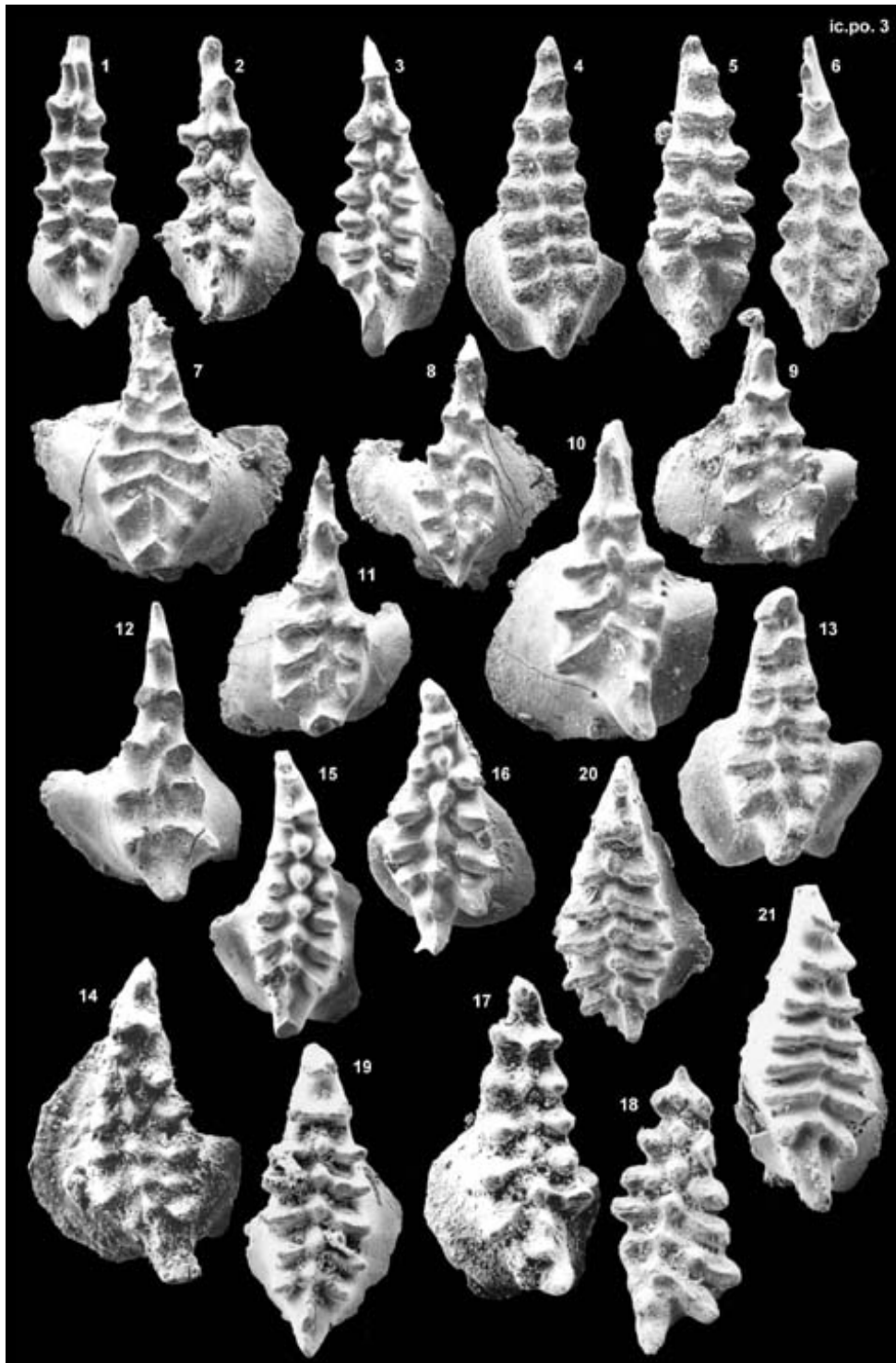


Plate 3. Figs. 1-6. *Icriodus difficilis* Ziegler & Klapper 1976. Fig. 1. Upper view of AFUM140. S. 235, Khoshyeilagh area. Fig. 2. Upper view of AFUM1415. S. 241, Khoshyeilagh area. Fig. 3. Upper view of AFUM143. S. 233, Khoshyeilagh area. Fig. 4. Upper view of AFUM144. S. 229, Khoshyeilagh area. Fig. 5. Upper view of AFUM142. S. 228, Khoshyeilagh area. Fig. 6. Upper view of AFUM146. S. 229, Khoshyeilagh area. Figs. 7-12. *Icriodus excavatus* Weedige 1984. Fig. 7. Upper view of AFUM145. T. 82, Ozbak-Kuh Mountains. Fig. 8. Upper view of AFUM147. T. 82, Ozbak-Kuh Mountains. Fig. 9. Upper view of AFUM148. T. 82, Ozbak-Kuh Mountains. Fig. 10. Upper view of AFUM149. T. 82, Ozbak-Kuh Mountains. Fig. 11. Upper view of AFUM150. T. 82, Ozbak-Kuh Mountains. Fig. 12. Upper view of AFUM151. T. 82, Ozbak-Kuh Mountains. Figs. 13-16. *Icriodus orri* Klapper & Barrick 1983. Fig. 13. Upper view of AFUM153. S. 229, Khoshyeilagh area. Fig. 14. Upper view of AFUM155. S. 230, Khoshyeilagh area. Fig. 15. Upper view of AFUM154. S. 210, Khoshyeilagh area. Fig. 16. Upper view of AFUM156. S. 210, Khoshyeilagh area. Figs. 17-21. *Icriodus arkonensis* Stauffer 1938. Fig. 17. Upper view of AFUM162. S. 210, Khoshyeilagh area. Fig. 18. Upper view of AFUM163. S. 210, Khoshyeilagh area. Fig. 19. Upper view of AFUM164. S. 210, Khoshyeilagh area. Fig. 20. Upper view of AFUM165. S. 210, Khoshyeilagh area. Fig. 21. Upper view of AFUM166. S. 210, Khoshyeilagh area. Figs. 1-6, 10, 12-17, 18x80; Fig. 7x50; Figs. 8-9, 11x60; Figs. 19-21x100.

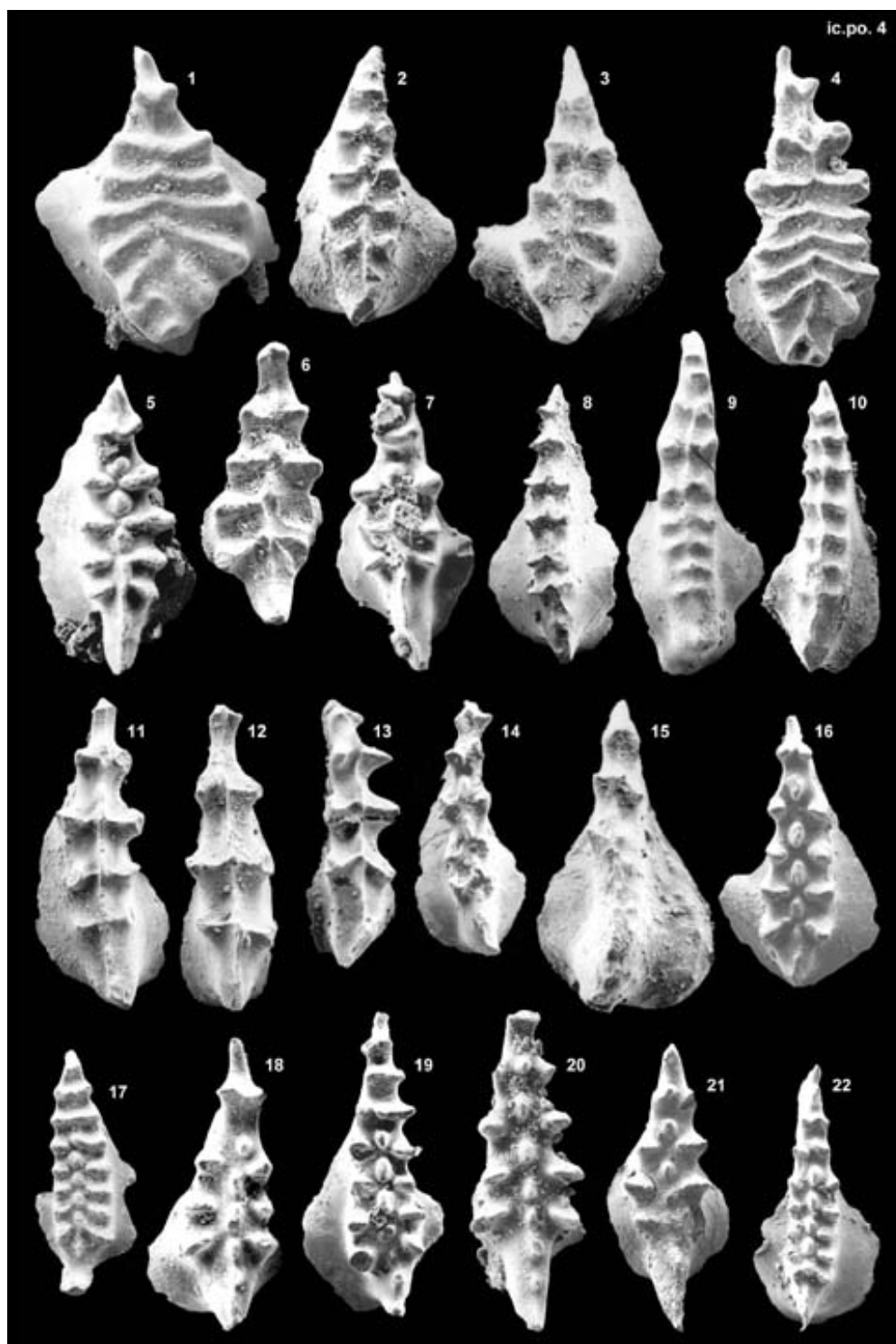


Plate 4. Figs. 1-15. *Icriodus iowaensis iowaensis* Youngquist & Peterson 1947. Fig. 1. Upper view of AFUM214. S. 255, Khoshyeilagh area. Fig. 2. Upper view of AFUM216. K.154, Ozbak-Kuh Mountains. Fig. 3. Upper view of AFUM218. K. 165, Ozbak-Kuh Mountains. Fig. 4. Upper view of AFUM219. T. 81, Ozbak-Kuh Mountains. Fig. 5. Upper view of AFUM220. S. 262, Khoshyeilagh area. Fig. 6. Upper view of AFUM221. T. 14, Howz-e-Dorah area. Fig. 7. Upper view of AFUM222. S. 260, Khoshyeilagh area. Fig. 8. Upper view of AFUM223. T. 86, Ozbak-Kuh Mountains. Fig. 9. Upper view of AFUM224. T. D, Howz-e-Dorah area. Fig. 10. Upper view of AFUM225. K. 156, Ozbak-Kuh Mountains. Fig. 11. Upper view of AFUM226. K. 154, Ozbak-Kuh Mountains. Fig. 12. Upper view of AFUM227. K. 154, Ozbak-Kuh Mountains. Fig. 13. Upper view of AFUM228. K. 154, Ozbak-Kuh Mountains. Fig. 14. Upper view of AFUM233. T. 86, Ozbak-Kuh Mountains. Fig. 15. Upper view of AFUM241. K. 165, Ozbak-Kuh Mountains. Fig. 16. *Icriodus* sp. 1. Upper view of AFUM287. T. 15, Howz-e-Dorah area. Fig. 17. *Icriodus* sp. 2. Upper view of AFUM292. B. 5, Howz-e-Dorah area. Fig. 18. *Icriodus* sp. 3. Upper view of AFUM290. K. 161, Ozbak-Kuh Mountains. Fig. 19. *Icriodus* sp. 4. Upper view of AFUM285. T. 37, Howz-e-Dorah area. Fig. 20. *Icriodus* sp. 5. Upper view of AFUM139. S. 259, Khoshyeilagh area. Fig. 21. *Icriodus* sp. 6. Upper view of AFUM297. N. 16, Niaz area. Fig. 22. *Icriodus* sp. 7. Upper view of AFUM138. S. 262, Khoshyeilagh area. Figs. 1, 3, 5-7, 12, 15, 18, 20-21x80; Figs. 2, 4, 8, 11, 13-14, 16, 19, 22x60; Figs. 9-10, 17x50.

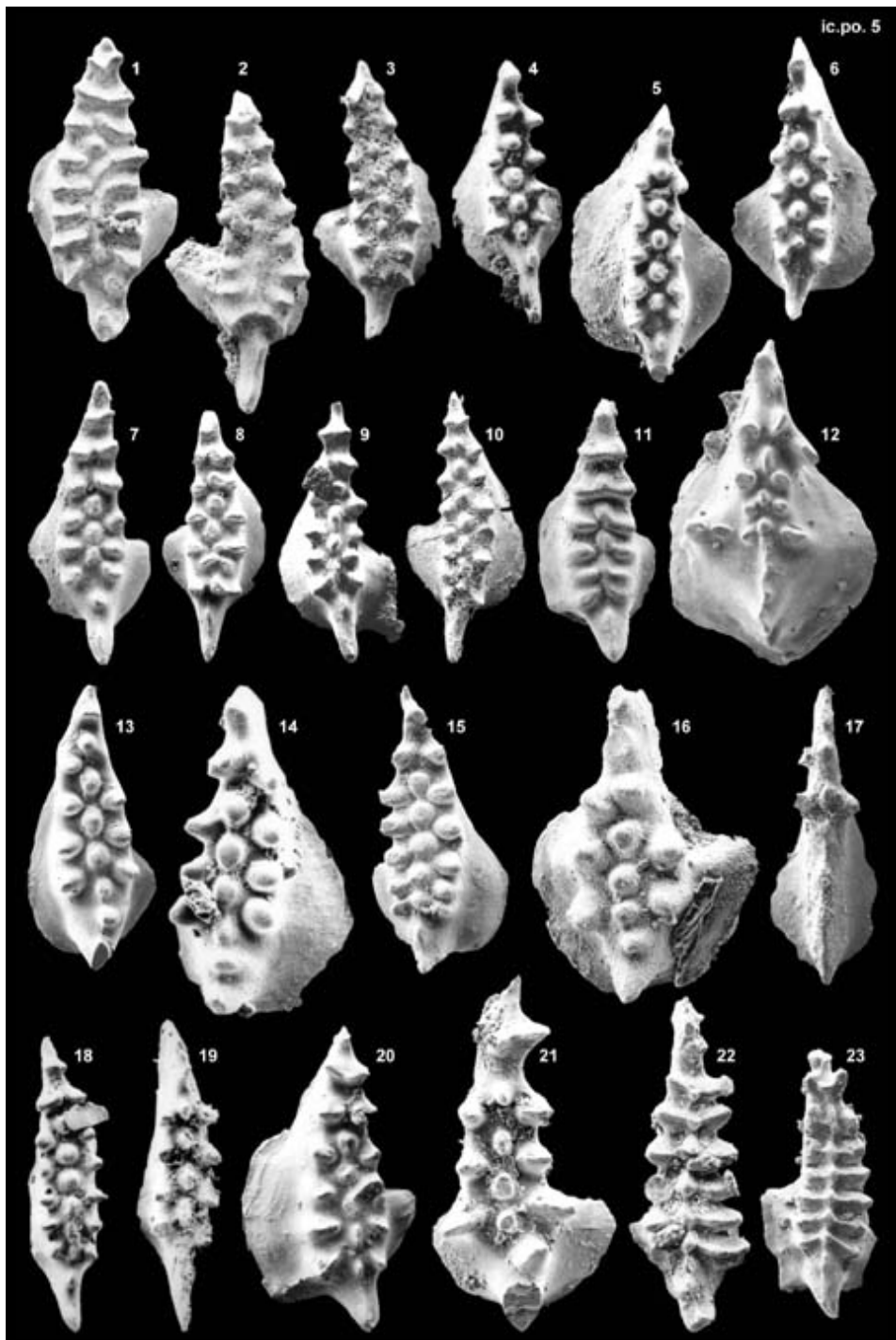


Plate 5. Figs. 1-3. *Icriodus housei* n. sp. fig. 1. Upper view of holotype, AFUM249. T. 31, Howz-e-Dorah area. Fig. 2. Upper view of AFUM250. T. 39, Howz-e-Dorah area. Fig. 3. Upper view of AFUM252. T. 39, Howz-e-Dorah area.. Figs. 4-6. *Icriodus talenti* n. sp. Fig. 4. Upper view of AFUM254. T. 39, Howz-e-Dorah area. Fig. 5. Upper view of AFUM255. T. 39, Howz-e-Dorah area. Fig. 6. Upper view of holotype, AFUM256. S. 271, Khoshyeilagh area. Figs. 7-8. *Icriodus walliseri* n. sp. Fig. 7. Upper view of AFUM257. B. 5, Howz-e-Dorah area. Fig. 8. Upper view of holotype, AFUM258. B. 5, Howz-e-Dorah area. Figs. 9-10. *Icriodus bultyncki* n. sp. Fig. 9. Upper view of AFUM260. T. 39, Howz-e-Dorah area. Fig. 10. Upper view of holotype, AFUM261. B. 5, Howz-e-Dorah area. Fig. 11. *Icriodus khoshyeilaghensis* ASHOURI, in pressc. Upper view of holotype, AFUM259. S. 271, Khoshyeilagh area. Fig. 12. *Icriodus ariaei* ASHOURI, in press c. Upper view of holotype, AFUM262. S. 260, Khoshyeilagh area. Figs. 13-16. *Icriodus alborzensis* ASHOURI, in press c. Fig. 13. Upper view of AFUM270. S. 233, Khoshyeilagh area. Fig. 14. Upper view of AFUM269. S. 239, Khoshyeilagh area. Fig. 15. Upper view of AFUM274. S. 233, Khoshyeilagh area. Fig. 16. Upper view of AFUM276. S. 237, Khoshyeilagh area. Fig. 17. *Icriodus Jafariani* n. sp. Upper view of holotype, AFUM277. N. 8, Niaz area. Fig. 18-19. *Icriodus* cf. *raymondi* Sandberg & Ziegler 1979. Fig. 18. Upper view of AFUM263. T. 39, Howz-e-Dorah area. Fig. 19. Upper view of AFUM266. S. 266, Khoshyeilagh area. Fig. 20. *Icriodus* sp. Upper view of AFUM278. S. 272, Khoshyeilagh area. Fig. 21. *Icriodus* sp. Upper view of AFUM279. S. 265, Khoshyeilagh area. Fig. 22. *Icriodus* sp. Upper view of AFUM115. S. 226, Khoshyeilagh area. Fig. 23. *Icriodus* sp. Upper view of AFUM116. S. 211, Khoshyeilagh area. Figs. 1-4, 7, 9, 11, 20, 23x60; Figs. 5, 6, 12, 15, 18, 19x80; Figs. 8, 10, 22x50; Figs. 13, 16, 21x100.

Range and Occurrence: Howz-e-Dora and Niaz areas, Ozbak-Kuh Mountains and Member 5 of the Khoshyeilagh Formation. The precise range of the species globally is uncertain. It has been reported mainly from the Late Devonian but was reported by Wang & Yin (1988) from the lowermost Carboniferous.

Polygnathus communis communis Branson & Mehl
1934

Pl. 8, Figs. 1-14

Synonymy: Chauffe & Guzman (1997, p. 231).

1997 *Polygnathus communis communis* Branson & Mehl, 1934–Mawson & Talent, p. 212, Figs 10: 9-11, 11: 7

1997 *Polygnathus communis communis* Branson & Mehl, 1934–Molloy *et al.* Pl. 8, Figs. 4-5.

1999 *Polygnathus communis communis* Branson & Mehl, 1934–Yazdi Pl. 7, Figs. 7-13, 15.

Remarks: The subspecies, the most abundant form of *Polygnathus* encountered in the present study, is very variable. Some specimens (Pl. 8, Figs 1-5) have a thick and upturned platform at the anterior end with an adcarina; in others this may continue close to the posterior end. The carina may be smooth or display slight nodes. The basal cavity is small. The second group (Pl. 8, Figs. 6-9) is similar to the previous group except that the anterior platform is not distinctly upturned and the outline is leaf-like. These two groups consist mostly of large specimens. The third form (Pl. 8, Fig. 10) has a distinctly depressed platform abruptly upturned at the lateral margin. It resembles the morphology illustrated by Matyja (1987, Pl. 22.4, Fig. 5). The aboral depression and basal cavity are large. One specimen (Pl. 8, Fig. 12) is characterized by a narrow platform and a large pit located just anterior to the platform and blade junction. It has a long free blade and lacks an aboral cavity. A single specimen (Pl. 8, Fig. 11) has a large and deep aboral depression which shows a concentric feature.

Range and Occurrence: Howz-e-Dora and Niaz areas and the Khoshyeilagh Formation. This form begins in the Middle *crepida* Zone and extends through the *Doliognathus latus* Zone.

Polygnathus delicatulus Ulrich & Bassler 1926
Pl. 7, Figs. 21-22

Synonymy: Klapper *in:* Ziegler (1975, p. 277).

Remarks: Only two specimens were available. One (Pl. 7, Fig. 21) with a long free blade and typical lanceolate platform, conforms in all aspects to one illustrated by Matyja (1987, Pl. 22.6, Fig. 1).

Range and Occurrence: Member 6 of the Khoshyeilagh Formation. The species ranges from the Early *expansa* Zone to the Early *preasulcata* Zone.

Polygnathus evidens Klapper & Lane 1985

Pl. 8, Figs. 28-31

Synonymy: Klapper & Lane (1985, p.)

Remarks: Four specimens (two questionable) were available. One (Pl. 8, Fig. 28) has a large, more or less strongly arched platform, with the carina terminating about mid-length of the platform. Two specimens (Pl. 8, Figs. 29-30) are close to one illustrated by Klapper & Lane (1985, Pl. 20, Fig. 1). A single specimen (Pl. 8, Fig. 31) is questionably assigned to the species; its carina is formed by discrete openly spaced nodes.

Range and Occurrence: “Cephalopod Bed” in the Howz-e-Dora and Niaz areas. The range of the species globally is not well established. The holotype came from the Twin Fall Formation, Northwestern Territories, Canada.

Polygnathus experplexus Sandberg & Ziegler, 1979

Pl. 9, Figs. 11-13

Synonymy: Mawson & Talent (1997, p. 214).

Remarks: Three large and fragmentary specimens were available. One (Pl. 9, Fig. 11) with an even pattern of nodes is similar to one illustrated by Metzger (1989, Pl. 15, Fig. 25). Another (Pl. 9, Fig. 12) has a concavity in the middle of the inner platform and is ornamented by irregular weak transverse ridges. The third specimen (Pl. 9, Fig. 13) has a weak carina, an even pattern of nodes and/or weak ridges, and a distinct concavity in the middle of the right platform.

Range and Occurrence: Howz-e-Dora and Niaz areas. According to Sandberg & Ziegler (1979) the species range is *expansa* Zone.

Polygnathus fallax Helms & Wolska 1967

Pl. 7, Figs. 25-26

Synonymy: Klapper *in:* Ziegler (1975, p. 282).

Remarks: Of the three available specimens (one questionable), one (Pl. 7, Fig. 26) conforms in all aspects to the original diagnosis. The second specimen (Pl. 7, Fig. 25), with a trough on one side, has smaller nodes on the carina.

Range and Occurrence: Niaz area. The range is restricted to the Early *marginifera* Zone. It has been reported only from Germany and Poland.

Polygnathus glaber medius Helm & Wolska 1967
Pl. 7, Fig. 29

Remarks: The only available specimen is close to the holotype (Helms & Wolska 1967, Text-Fig. 4).

Range and Occurrence: "Cephalopod Bed" in the Niaz area. The species ranges from the Early to Late *marginifera* Zone.

Polygnathus lagowiensis Helms & Wolska 1967
Pl. 10, Figs. 14-17

Synonymy: Klapper *in*: Ziegler (1975, p. 300).

Remarks: The available specimens differ from *Po. fallax* by lack of transverse ridges and having an undifferentiated platform. Two of the specimens (Pl. 10, Figs. 14-15) present a shagreen-like platform and well developed carina with discrete nodes in the posterior end. The third specimen (Pl. 10, Fig. 16) has a more flattened platform.

Range and Occurrence: Howz-e-Dorah and Niaz areas. It has a short time span: Late to Latest *marginifera* Zone.

Polygnathus linguiformis linguiformis Morphotype
gamma Klapper 1987
Pl. 6, Figs. 5-6

1990 *Polygnathus linguiformis linguiformis*
Morphotype gamma Klapper, 1987-Lazreq Pl. 1,
Figs. 14-18

Remarks: One of the studied specimens (Pl. 6, Fig. 5) is closely related to one illustrated by Feist *et al.* (1985, Pl. 1, Fig. 12). The second (Pl. 6, Fig. 6) is close to one illustrated by Klapper (1971, Pl. 2, Fig. 22).

Range and Occurrence: Member 2 of the Khoshyeilagh Formation. The range is the late Early Devonian (Late Emsian) to the early Middle Devonian (Eifelian).

Polygnathus linguiformis linguiformis Morphotype
cf. delta Ziegler & Klapper 1976

Pl. 6, Fig. 4

Synonymy: Klapper *in*: Ziegler (1977, p. 464).

Remarks: Only a single specimen was available. Because of weak development of the inner platform and the less flattened anterior of the outer platform, it cannot be confidently assigned to this morphotype. It is rather similar to a specimen illustrated by Bardshev & Ziegler (1985, Pl. 1, Fig. 14).

Range and Occurrence: Member 2 of Khoshyeilagh Formation. Its range is a late Middle Devonian, Middle *varcus* Zone.

Polygnathus linguiformis alveolus Weddige 1977
Pl. 6, Fig. 3

Synonymy: Uyeno & Lespérance (1997, p. 158).
1995 *Polygnathus linguiformis alveolus* Weddige
1977- Sloan *et al.* Pl. 6, Figs. 7-9.

Remarks: Only a single specimen was available. It resembles one illustrated by Weddige (1977, Pl. 5, Fig. 86).

Range and Occurrence: Member 2 of the Khoshyeilagh Formation. This subspecies ranges from the Late *costatus* Zone into the Late *kockelianus* Zone.

Polygnathus margaritatus Schäffer 1976
Pl. 7, Figs. 18-20

Synonymy: Ziegler (1981, p. 299).

Remarks: Among the five available specimens is one (Pl. 7, Fig. 18) almost identical to the holotype.

Range and Occurrence: Niaz area. It has a rather short range as *expansa* Zone.

Polygnathus nodocostatus Branson & Mehl 1934
Pl. 10, Figs. 1-12

Synonymy: Schülke (1995, p. 61).

1997 *Polygnathus nodocostatus* Branson & Mehl
1934, Mawson & Talent, p. 218; Fig. 13: 4.

Remarks: *Po. nodocostatus* occurs rather abundantly and is very variable. One specimen (Pl. 10, Fig 1) is similar to one illustrated by Glenister & Klapper (1966, Pl. 94, Figs. 14, 15).

In some specimens (Pl. 10, Figs. 2-4) the upper surface is ornamented by even, closely spaced nodes: the carina is raised and clearly differentiated. Some specimens (Pl. 10, Figs. 5-6) have developed nodes of the same size as those of the carina and have them arranged in rows.

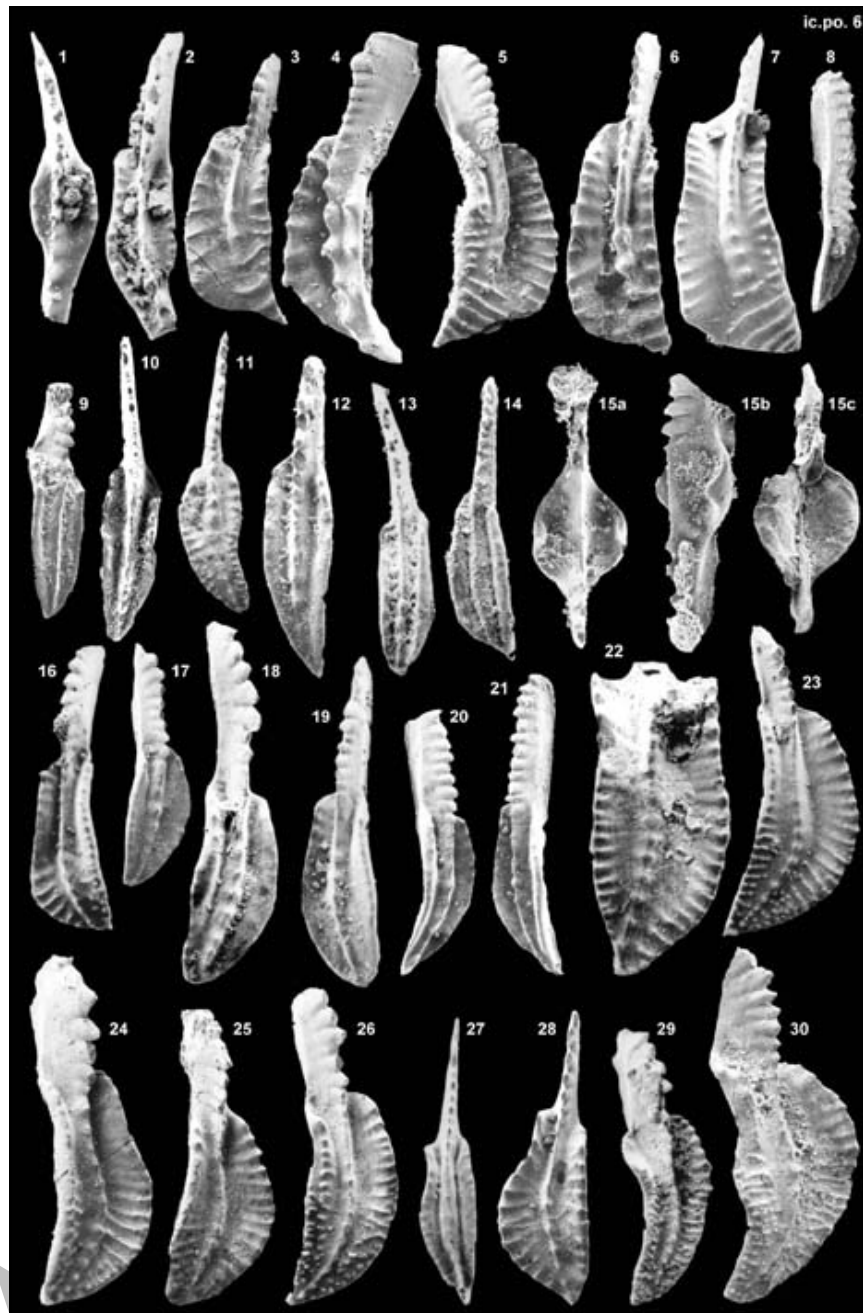


Plate 6. Figs. 1-2. *Polygnathus angustidiscus* Youngquist 1945. Fig. 1. Upper view of AFUM300. S. 262, Khoshyeilagh area. Fig. 2. Upper view of AFUM301. S. 262, Khoshyeilagh area. Figs. 3. *Polygnathus linguiformis alveolus* Weddige 1977. Upper view of AFUM302. S. 210, Khoshyeilagh area. Fig. 4. *Polygnathus weddigi* Ziegler & Klapper 1976. Side view of AFUM303. S. 210, Khoshyeilagh area. Figs. 5-6. *Polygnathus linguiformis linguiformis* Morphotype gamma Klapper 1987. Fig. 5. Side view of AFUM304. S. 210, Khoshyeilagh area. Fig. 6. Upper view of AFUM305. S. 210, Khoshyeilagh area. Fig. 7. *Polygnathus cf. perbonus* (PHILIP 1966). Upper view of AFUM308. S. 210, Khoshyeilagh area. Fig. 8. *Polygnathus varcus* Stauffer 1940. Lateral view of AFUM309. T. 16, Howz-e-Dorah area. Fig. 9. *Polygnathus xylus ensensis* Ziegler & Klapper 1976. Side view of AFUM317. T. 14, Howz-e-Dorah area. Fig. 10. *Polygnathus timorensis* Klapper, Philip & Jackson 1970. Upper view of AFUM310. T. 15, Howz-e-Dorah area. Fig. 11. *Polygnathus pseudofoliatus* Wittekindt 1966. Upper view of AFUM486. T. D. Howz-e-Dorah area. Fig. 12. *Polygnathus pacificus* Savage & Funai 1980. Oblique upper view of AFUM307. T. 15, Howz-e-Dorah area. Fig. 13-14. *Polygnathus xylus xylus* Stauffer 1940. Fig. 13. Upper view of AFUM314. S. 240, Khoshyeilagh area. Fig. 14. Upper view of AFUM315. S. 234, Khoshyeilagh area. Figs. 15. *Polygnathus klapperianus* Ashouri, in press c. Upper, side, lower views OF AFUM316. S. 266, Khoshyeilagh area. Figs. 16-21. *Polygnathus alatus* Huddle 1934. Fig. 16. Side view of AFUM336. T. 15, Howz-e-Dorah area. Fig. 17. Side view of AFUM337. S. 247, Khoshyeilagh area. Fig. 18. Side view of AFUM338. K. 163, Ozbak-Kuh Mountains. Fig. 19. Side view of AFUM339. K. 163, Ozbak-Kuh Mountains. Fig. 20. Side view of AFUM343. K. 163, Ozbak-Kuh Mountains. Fig. 21. Side view of AFUM342. K. 163, Ozbak-Kuh Mountains. Figs. 22-26. *Polygnathus webbi* Stauffer 1938. Fig. 22. Upper view of AFUM359. T. 22, Howz-e-Dorah area. Fig. 23. Side view of AFUM361. T. 17, Howz-e-Dorah area. Fig. 24. Side view of AFUM364. T. 82, Ozbak-Kuh Mountains. Fig. 25. Side view of AFUM360. T. 82, Ozbak-Kuh Mountains. Fig. 26. Side view of AFUM362. T. 15, Howz-e-Dorah area. Fig. 27-28. *Polygnathus aequalis* Klapper & Lane 1985. Fig. 27. Upper view of AFUM345. K. 163, Howz-e-Dorah area. Fig. 28. Upper view of AFUM346. T. 82, Ozbak-Kuh Mountains. Figs. 29-30. *Polygnathus normalis* Miller & Youngquist 1947. Fig. 29. Side view of AFUM441. T. G, Howz-e-Dorah area. Fig. 30. Side view of AFUM442. N. 13, Niaz area. Figs. 1, 5, 7, 16-19, 24-25, 30x50; Figs. 2, 11, 25x40; Figs. 3, 10, 20-23, 27-29x60; Figs. 6, 8-9, 12-14x80; Figs. 4, 15x100.

Nevertheless, the carina is distinct and is separated from the rest of the platform by a clearly defined trough on each side. A single specimen (Pl. 10, Fig. 7) has a lanceolate and narrow platform. Three fragmentary specimens resemble in outline a form illustrated by Boukaert & Ziegler (1965, Pl. 4, Fig. 3). In these the platform becomes narrow in the middle due to a concavity on the side; the carina is formed by nodes the same size as those forming the rows. One of these specimens (Pl. 10, Fig. 8) has a scalloped free blade consisting of two ridges. Another (Pl. 10, Fig. 9) has a missing free blade and the third one (Pl. 10, Fig. 10) has a denticulate free blade. Another specimen (Pl. 10, Fig. 11) is questionably assigned to the species. It has a scalloped free blade and a smooth carina not reaching the posterior end; additionally there are two smooth ridges parallel to the carina, terminating in the same region as does the carina. The basal cavity is rather small. A single specimen (Pl. 10, Fig. 12) has a rather quadr-angular platform ornamented very irregularly with nodes and short ridges.

Range and Occurrence: Howz-e-Dorah and Niaz areas, Ozbak-Kuh Mountains and Member 5 of the Khoshyeilagh Formation. It appears at the base of the Early *crepida* Zone and extends to the Early *expansa* Zone.

Polygnathus normalis Miller & Youngquist 1947
Pl. 6, Figs. 29-30

Remarks: The two specimens available resemble those illustrated by Glenister & Klapper (1966, Pl. 95, Figs. 6, 21, 22).

Range and Occurrence: "Cephalopod Bed" in both the Howz-e-Dorah and Niaz areas. The species ranges from the Middle Devonian to the *trachytera* Zone.

Polygnathus obliquicostatus Ziegler 1962
Pl. 10, Fig. 13

Synonymy: Sandberg & Ziegler 1979.

Remarks: Only a single fragmentary specimen was available, similar to the holotype (Ziegler 1962, Pl. 11, Fig. 10-2).

Range and Occurrence: Niaz area. According to Sandberg & Ziegler (1979) this species ranges from the Early *postera* Zone to the Late *expansa* Zone.

Polygnathus pacificus Savage & Funal 1980

Pl. 6, Fig. 12

Synonymy: Klapper & Lane (1985, p. 941).

Remarks: A single specimen fairly similar to the one illustrated by Klapper & Lane (1985, Pl. 21, Fig. 7).

Range and Occurrence: Howz-e-Dorah area. The species is broadly Frasnian in age.

Polygnathus parawebbi Chatterton 1974
Pl. 8, Figs. 26-27

Synonymy: Johnson *et al.* (1980, p. 102).

1995 *Polygnathus parawebbi* Chatterton 1974-Sloan *et al.* Pl. 6, Figs. 10-17

Remarks: Two specimens were available. One (Pl. 8, Fig. 27) is morphologically similar to the holotype (Chatterton 1974, Pl. 1, Fig. 18), the other (Pl. 8, Fig. 26) has its outer platform strongly constricted anteriorly.

Range and Occurrence: Howz-e-Dorah area and Ozbak-Kuh Mountains. The species is said to range from early Middle Devonian to as young as the Early *varcus* Zone.

Polygnathus cf. perbonus (Philip 1966)
Pl. 6, Fig. 7

Synonymy: Klapper *in:* Ziegler 1977, p. 487.

Remarks: Two specimens with the upper surface characters of the species were available, but they differ from typical *Po. perbonus* at the posterior end of the basal cavity; it runs close to the posterior tip whereas characteristically in *Po. perbonus* it terminates anterior of the sharp inward deflection. It cannot therefore be confidently assigned to *Po. perbonus*.

Range and Occurrence: Member 2 of the Khoshyeilagh Formation. The range of the species within the Emsian (above *Po. dehiscens* and below *Po. inversus*).

Polygnathus perplexus Thomas 1949
Pl. 9, Figs. 1-10

Synonymy: Sandberg & Ziegler 1979, P. 418.

1999 *Polygnathus perplexus* Thomas 1949-Yazdi pl.8, Figs. 6-17.

Remarks: The available specimens are nicely preserved. Some have a large platform in which the row of nodes adjacent to the carina does not reach the posterior end. They display either a relatively large basal cavity (Pl. 9, Fig. 1) or a small one (Pl. 9, Fig. 2).



Plate 7. Figs. 1-15. *Polygnathus semicostatus* Morphotype 3 Dressen & Drchard 1974. Fig. 1. Side view of AFUM374. T. D, Howz-e-Dorah area. Fig. 2. Side view of AFUM376. K. 158, Ozbak-Kuh Mountains. Fig. 3. Side view of AFUM377. S. 271, Khoshyeilagh area. Fig. 4. Side view of AFUM378. S. 271, Khoshyeilagh area. Fig. 5. Side view of AFUM379. B. 4, Howz-e-Dorah area. Fig. 6. Upper view of AFUM387. T. 39, Howz-e-Dorah area. Fig. 7. Side view of AFUM386. T. 39, Howz-e-Dorah area. Fig. 8. Side view of AFUM384. B. 5, Howz-e-Dorah area. Fig. 9. Upper view of AFUM381. K. 158, Ozbak-Kuh Mountains. Fig. 10. Oblique upper view of AFUM385. B.7, Howz-e-Dorah area. Fig. 11. Oblique upper view of AFUM435. T. 39, Howz-e-Dorah area. Fig. 12. Upper view of AFUM436. T. 39, Howz-e-Dorah area. Fig. 13. Upper view of AFUM437. T. E, Howz-e-Dorah area. Fig. 14. Upper view of AFUM438. T. D, Howz-e-Dorah area. Fig. 15. Side view of AFUM439. B. 5, Howz-e-Dorah area. Figs 16-17. *Polygnathus robustus* Klapper & Lane 1985. Fig. 16. Side view of AFUM444. K. 154, Ozbak-Kuh Mountains. Fig. 17. Upper view of AFUM443. K. 154, Ozbak-Kuh Mountains. Figs. 18-20. *Polygnathus margaritatus* Schäffer 1976. Fig. 18. Side view of AFUM412. N. 0, Niaz area. Fig. 19. Side view of AFUM413. N. 1, Niaz area. Fig. 20. Side view of AFUM414. N. 1, Niaz area. Figs. 21-22. *Polygnathus delicatulus* Ulrich & Bassler 1926. Fig. 21. Side view of AFUM464. S. 286, Khoshyeilagh area. Fig. 22. Upper view of AFUM465. S. 286, Khoshyeilagh area. Fig. 23. *Polygnathus praeassisi* Schäffer. 1976. Upper view of AFUM410. N. 0, Niaz area. Fig. 24. Side view of AFUM418. N. 15, Niaz area. *Polygnathus fallax* Helms & Wolska 1967. Fig. 25. Side view of AFUM467. N. 0, Niaz area. Fig. 26. Upper view of AFUM466. N. 1, Niaz area. Fig. 27. *Polygnathus dentatus*. Side view of AFUM487. T. D, Howz-e-Dorah area. Fig. 28. *Polygnathus homoirregularis* Sandberg & Ziegler 1979. Upper view of AFUM488. T. G, Howz-e-Dorah area. Fig. 29. *Polygnathus glaber medius* Helms & Wolska 1967. Upper view of AFUM404. N. 0, Niaz area. Figs. 1-2, 8, 10, 15, 19-21, 24, 26x50; Figs. 3-4, 16, 25, 27x60; Fig. 12x30; Figs. 5-7, 9, 11, 13-14, 18, 22, 28x40; Figs. 17, 23x80; Fig. 29x100.

In the second group (Pl. 9, Figs. 3-4) with a narrow platform, the row of nodes adjacent to the carina is developed to the posterior end. A single specimen (Pl. 9, Fig. 5) displays an anteriorly strong rostral ridge in the outer platform. Two specimens (ol. 9, Figs. 6,7) differ from the other described specimens in having a large blade. Two other specimens (Pl. 9, Figs. 2, 8) are closely related to one illustrated by Matyja (1987, Pl. 22, Fig. 10). In these specimens both the carina and the adjacent feature is formed by ridges with delicate nodes. A single specimen (Pl. 9, Fig. 10) has a smooth ridge-form carina in its anterior two-thirds. Two smooth ridge forms are present adjacent to the carina in the anterior part. Both the carina and the adjacent ridge converge to nodes in the posterior end.

Range and Occurrence: Howz-e-Dorah and Niaz areas, and Member 5 of the Khoshyeilagh Formation. The species in USA and Germany, extends from the Early *trachytera* Zone through to the Late *expansa* Zone.

Polygnathus praehassi Schäffer 1976

Pl. 7, Figs. 23-24

Synonymy: Ziegler (1981, p. 301).

Remarks: Of the four available specimens, one (Pl. 7, Fig. 23) has similar morphology to a specimen illustrated by Metzger (1989, Pl. 15, Fig. 16).

Range and Occurrence: Howz-e-Dorah area. Range is *expansa* Zone.

Polygnathus robustus KLAPPER & LANE, 1985

Pl. 7, Figs. 16-17

Synonymy: Klapper & Lane (1985, p. 943).

Remarks: Available specimens are fairly similar to the specimen illustrated by Klapper & Lane (1985, Pl. 21, Fig. 11).

Range and Occurrence: Ozbak-Kuh Moun-tains. Klapper & Lane (1985) recorded the species from Frasnian strata of the North Western Territories, Canada.

Polygnathus semicostatus Branson & Mehl 1934

Pl. 7, Figs. 1-15

Synonymy: Mawson & Talent (1997, p. 222).

1997 *Polygnathus semicostatus* Branson & Mehl 1934 –Molloy *et al.* pl.4, Fig. 14; Pl. 5, Figs. 4-7.

1999 *Polygnathus semicostatus* Branson & Mehl 1934-Yazdi Pl. 8, Figs. 8-11.

Remarks: *Po. semicostatus* is one of the most abundant species of *Polygnathus*. Considerable variation is apparent. One group (Pl. 7, Figs. 1, 2) has a very narrow and elongate form, and the platform margin is strongly upturned and as high as the carina. It is ornamented by a short ridge in the anterior part, gradually tapering posteriorly. In the second group (Pl. 7, Figs. 3-5, 8-10) the platform is wider in the anterior part, but narrower in the posterior part which is ornamented by unbroken ridges. The platform tapers abruptly behind the carina. The anterior platform is ornamented by more distinct transverse ridges. The third form (Pl. 7, Figs. 6-7) is wide, tapers rather gradually, and has a strongly arched platform. The anterior platform is ornamented mainly by delicate, short and long transverse ridges associated with scattered small nodes.

A single specimen (Pl. 7, Fig. 11) has a wavy pattern of delicate transverse ridges; the free blade consists of two extremely large denticles. Previously described specimens have a rather symmetrical platform, but the following three groups have a distinctly asymmetrical platform. One of these forms (Pl. 7, Fig. 12) is ornamented mainly by small nodes associated with delicate transverse ridges in the anterior platform. Posterior to the carina, the platform is ornamented mainly by unbroken transverse delicate ridges associated with broken transverse ridges.

A single specimen (Pl. 7, Fig. 13) has a laterally curved platform; it has an inner lobe form in the middle of the anterior platform joining the platform at an acute angle anteriorly. A single fragmentary specimen (Pl. 7, Fig. 14) has a very distinct asymmetrical platform; the outer platform joins the free blade much further anteriorly.

The free blade consists of three strong and distinctly differently sized denticles with the highest one posteriorly. The free blade is followed by three denticles, the highest one in the middle displaying much less height than the free blade.

The inner platform joins the free blade just posterior to the sixth denticle. A single specimen (Pl. 7, Fig. 15) is morphologically close to a form illustrated by Sandberg & Ziegler (1979, Pl. 5, Fig. 5).

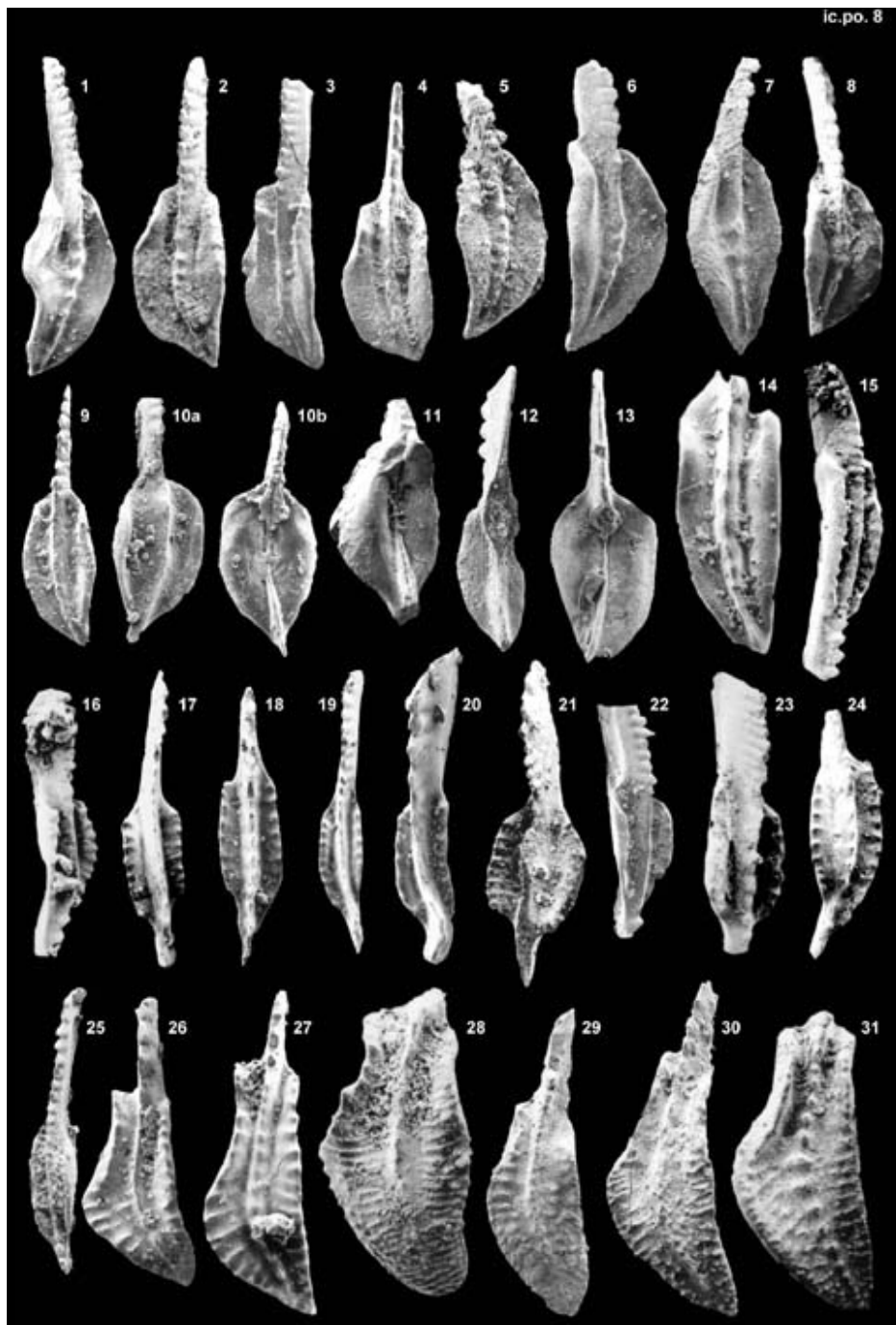


Plate 8. Figs. 1-14. *Polygnathus communis communis* Branson & Mehl 1934. Fig. 1. Side view of AFUM449. S. 269, Khoshyeilagh area. Fig. 2. Side view of AFUM450. N. 19, Niaz area. Fig. 3. Side view of AFUM451. N. 2, Niaz area. Fig. 4. Upper view of AFUM452. N. 10, Niaz area. Fig. 5. Side view of AFUM462. T. 88, Ozbak-Kuh Mountains. Fig. 6. Side view of AFUM453. N. 2, Niaz area. Fig. 7. Upper view of AFUM453. N. 2, Niaz area. Fig. 8. Side view of AFUM455. N. 2, Niaz area. Fig. 9. Upper view of AFUM463. T. 39, Howz-e-Dorah area. Fig. 10. Upper, lower views of AFUM456. S. 269, Khoshyeilagh area. Fig. 11. Lower view of AFUM461. S. 261, Khoshyeilagh area. Fig. 12. Lower view of AFUM458. S. 229, Khoshyeilagh area. Fig. 13. Lower view of AFUM457. N. 15, Niaz area. Fig. 14. Upper view of AFUM478. T. 36, Howz-e-Dorah area. Figs. 15-24. *Polygnathus brevilaminus* Branson & Mehl 1934. Fig. 15. Lateral view of AFUM319. N. 17, Niaz area. Fig. 16. Lateral view of AFUM320. S. 262, Khoshyeilagh area. Fig. 17. Upper view of AFUM322. K. 163, Ozbak-Kuh Mountains. Fig. 18. Upper view of AFUM327. S. 270, Khoshyeilagh area. Fig. 19. Upper view of AFUM324. K. 163, Ozbak-Kuh Mountains. Fig. 20. Side view of AFUM326. S. 260, Khoshyeilagh area. Fig. 21. Side view of AFUM331. N. 17, Niaz area. Fig. 22. Side view of AFUM323. S. 264, Khoshyeilagh area. Fig. 23. Side view of AFUM329. K. 159, Ozbak-Kuh Mountains. Fig. 24. Side view of AFUM328. T. 39, Howz-e-Dorah area. Fig. 25. *Polygnathus decorosus* Stauffer 1938. Side Upper view of AFUM489. T. G, Howz-e-Dorah area. Figs. 26-27. *Polygnathus parawebbi* Chatterton 1947. Fig. 26. Upper view of AFUM365. T. 82, Ozbak-Kuh Mountains. Fig. 27. Upper view of AFUM366. T. 14, Howz-e-Dorah area. Figs. 28-31. *Polygnathus evidens* Klapper & Lane 1985. Fig. 28. Upper view of AFUM371. N. 8, Niaz area. Fig. 29. Upper view of AFUM369. T. 15, Howz-e-Dorah area. Fig. 30. Upper view of AFUM370. T. 15, Howz-e-Dorah area. Fig. 31. Upper view of AFUM368. N. 13, Niaz area. Figs. 1, 15, 17, 19, 23, 27, 28, 31x50; Figs. 2, 4, 5, 6, 7, 8, 9, 16, 18, 21, 24, 25, 29, 30x60; Figs. 3, 20, 26 x40; ; Figs. 10, 11 x100. Figs. 12, 13, 14, 22 x80.

Range and Occurrence: Howz-e-Dorah area, Ozbak-Kuh Mountains and Member 5 of the Khoshyeilagh Formation. The species ranges from the Middle *crepida* Zone, extending into the Late *expansa* Zone.

Polygnathus timorensis Klapper, Philip & Jackson 1970
Pl. 6, Fig. 10

Synonymy: Sparling (1999, p. 900).

Remarks: The outer anterior margin of the available specimen is not distinctly bowed outward. Thus it cannot be confidently assigned to *Po. timorensis*. It may, however, be a transitional form between *Po. timorensis* and *Po. xylus ensensis*.

Range and Occurrence: Howz-e-Dorah area. The species given a Givetian age (*varcus* Zone), but the conodont fauna associated with it indicates an age not earlier than the Late *asymmetricus* Zone.

Polygnathus varcus Stauffer 1940
Pl. 6, Fig. 8

Synonymy: Klapper (1973, p. 391).

1995 *Polygnathus varcus* STAUFFER, 1940-Sloan *et al.* Pl. 7, Fig. 19

Remarks: A single specimen conforming to the original diagnosis.

Range and Occurrence: Howz-e-Dorah area. *Po. varcus* is a long-ranging form starting in the *varcus* Zone and extending to the Lowermost *asymmetricus* Zone but the present form is Late Frasnian (*linguiformis* Zone).

Polygnathus webbi Stauffer 1938
Pl. 6, Figs. 22-26

Synonymy: Over (1997, p. 174).

1997 *Polygnathus webbi* Stauffer 1938-Molloy *et al.* Pl. 5, Fig. 8.

1999 *Polygnathus webbi* Stauffer 1938-Yazdi Pl. 9, Figs. 13-15.

Remarks: One of the specimens (Pl. 6, Fig. 22) is closely related to one illustrated by Uyeno (1974, Pl. 5, Fig. 8). There are other specimens not certainly referable to the species (Pl. 6, Figs. 23-26) because of differences in height of the free blade denticles and/or lack of a trough in the posterior platform.

Range and Occurrence: Howz-e-Dorah and Niaz areas, and Ozbak-Kuh Mountains. A range of Early *asymmetricus* to *velifer* Zone given for the species.

Polygnathus xylus xylus Stauffer 1940

Pl. 6, Figs. 13-14

1997 *Polygnathus xylus xylus* Stauffer 1940-Molloy *et al.* Pl. 5, Figs. 10-11.

Synonymy: Sparling (1999, p. 900).

Range and Occurrence: Howz-e-Dorah and Niaz areas, Ozbak-Kuh Mountains, and Khoshyeilagh Formation. The range given is not higher than Early *asymmetricus* Zone, but some of the specimens (from sample N 17) are from the *crepida* Zone.

Polygnathus ensensis Ziegler & Klapper 1976
Pl. 6, Fig. 9

Synonymy: Sparling (1999, p. 900).

Range and Occurrence: Howz-e-Dorah area. The range of the subspecies does not extend above the Middle *varcus* Subzone, but the associated conodont fauna indicates an age not older than Late *asymmetricus* Zone.

Polygnathus klapperianus Ashouri, in press
Pl. 6, Fig. 15

Remarks: The specimens are fragmentary, missing small parts from the anterior end of the free blade. The platform is rounded and flattened, upturned marginally in the middle part. The ornament is shagreen-like only in outer margin. The carina bears strong denticles developed distinctly on the posterior of the platform. The aboral depression bears concentric striae and a strong keel, gradually disappearing about the centre of the depression.

Occurrence: Member 5 of the Khoshyeilagh Formation. Based on its stratigraphical position its age is not older than *marginifera* Zone.

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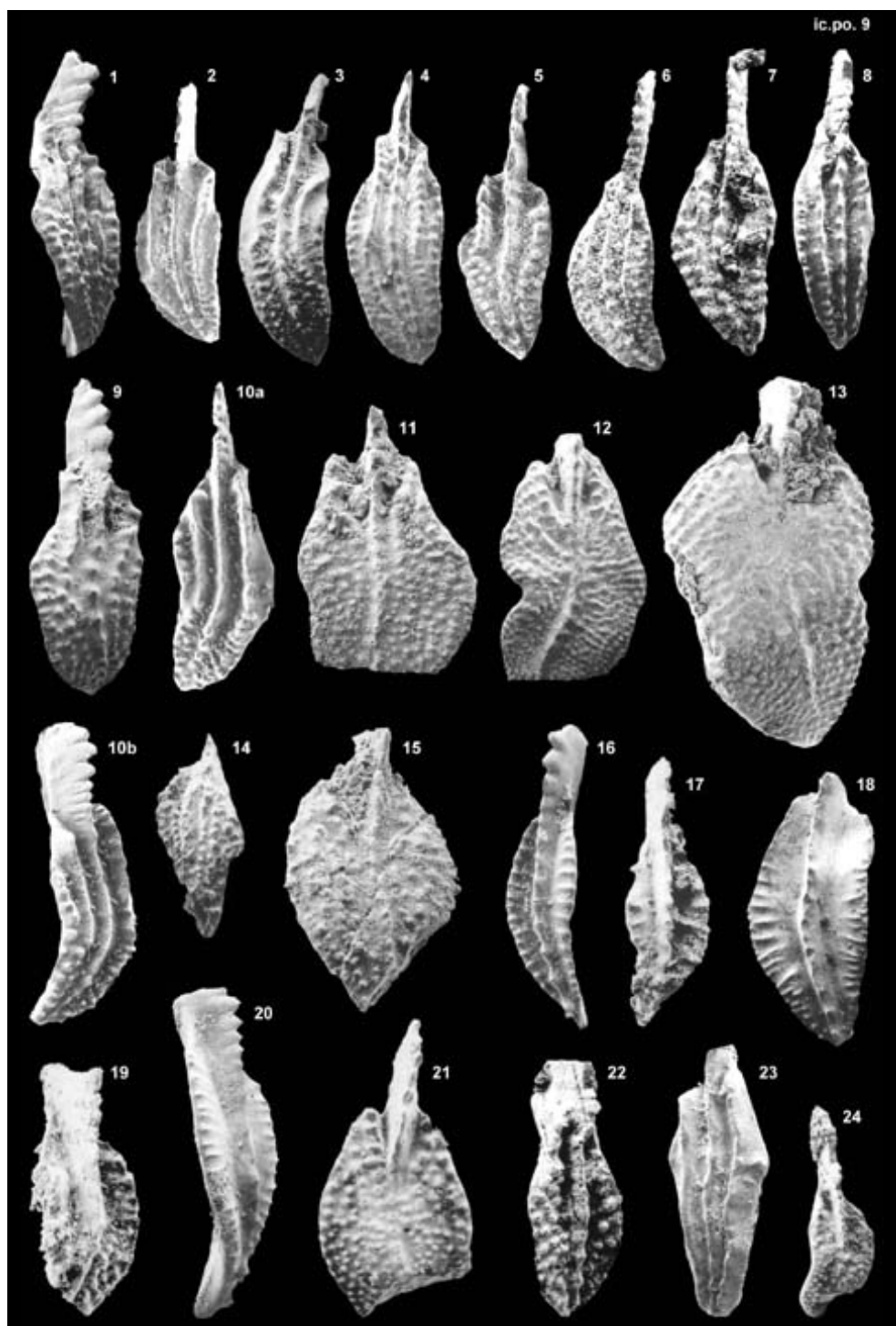


Plate 9. Figs. 1-10. *Polygnathus perplexus* Thomas 1949. Fig. 1. Side view of AFUM432. N. 1, Niaz area. Fig. 2. Upper view of AFUM433. N. 1, Howz-e-Dorah area. Fig. 3. Upper view of AFUM420. N. 0, Niaz area. Fig. 4. Upper view of AFUM424. N. 1, Niaz area. Fig. 5. Upper view of AFUM431. N. 0, Niaz area. Fig. 6. Upper view of AFUM425. N. 0, Niaz area. Fig. 7. Upper view of AFUM426. N. 9, Niaz area. Fig. 8. Upper view of AFUM421. B. 5, Howz-e-Dorah area. Fig. 9. Side view of AFUM423. N. 1, Niaz area. Fig. 10. Upper, side views of AFUM427. S. 271, Khoshyeilagh area. Figs. 11-13. *Polygnathus experplexus* Sandberg & Ziegler 1979. Fig. 11. Upper view of AFUM429. B. 6, Howz-e-Dorah area. Fig. 12. Upper view of AFUM434. N. 0, Niaz area. Fig. 13. Upper view of AFUM430. N. 9, Niaz area. *Polygnathus subirregularis* Sandberg & Ziegler 1979. Fig. 14. Upper view of AFUM484. K. 173, Howz-e-Dorah area. Fig. 15. Upper view of AFUM485. N. 11, Niaz area. Fig. 16. *Polygnathus* sp. Side view of AFUM490. B. 5, Howz-e-Dorah area. Fig. 17. *Polygnathus* sp. Upper view of AFUM491. S. 284, Khoshyeilagh area. Fig. 18. *Polygnathus* sp. Upper view of AFUM494. T. 39, Howz-e-Dorah area. Fig. 19. *Polygnathus* sp. Side view of AFUM496. K. 153, Ozbak-Kuh Mountains. Fig. 20. *Polygnathus* sp. Side view of AFUM495. T. 39, Howz-e-Dorah area. Fig. 21. *Polygnathus* sp. Upper view of AFUM497. S. 265, Howz-e-Dorah area. Fig. 22. *Polygnathus* sp. Side view of AFUM492. K. 158, Ozbak-Kuh Mountains. Fig. 23. *Polygnathus* sp. Upper view of AFUM493. N. 9, Niaz area. Fig. 24. *Polygnathus* sp. Side view of AFUM498. K. 153, Ozbak-Kuh Mountains. Figs. 1-2, 5, 7-8, 10, 16x60; Figs. 3-4, 6, 9, 11, 15, 20x50; Fig. 12x30; Figs. 13-14, 18, 21x40; Figs. 17, 22, 23, 24x80; Fig. 19x70.

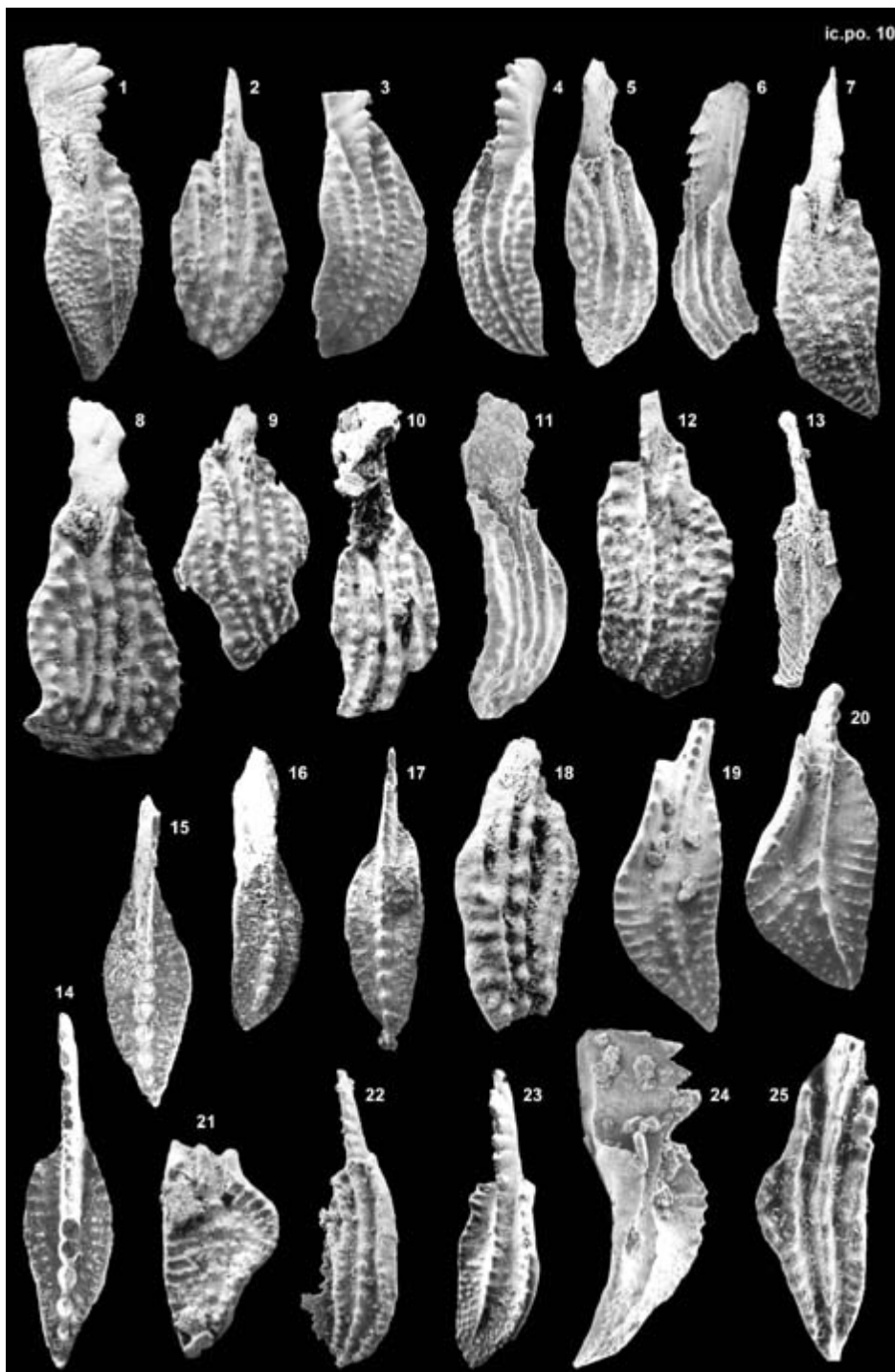


Plate 10. Figs. 1-12. *Polygnathus nodocostatus* Branson & Mehl 1934. Fig. 1. Side view of AFUM397. N. 1, Niaz area. Fig. 2. Upper view of AFUM398. N. 1, Niaz area. Fig. 3. Side view of AFUM400. B. 5, Howz-e-Dorah area. Fig. 4. Side view of AFUM401. B. 5, Howz-e-Dorah area. Fig. 5. Side view of AFUM389. T. E, Howz-e-Dorah area. Fig. 6. Side view of AFUM390. T. E, Howz-e-Dorah area. Fig. 7. Upper view of AFUM391. T. G, Howz-e-Dorah area. Fig. 8. Side view of AFUM392. N. 0, Niaz area. Fig. 9. Upper view of AFUM393. S. 288, Khoshyeilagh area. Fig. 10. Side view of AFUM394. T. 39, Howz-e-Dorah area. Fig. 11. Side view of AFUM395. B. 5, Howz-e-Dorah area. Fig. 12. Upper view of AFUM396. N. 1, Niaz area. Figs. 13-17. *Polygnathus obliquicostatus* Ziegler 1962. Fig. 13. Upper view of AFUM417. N. 2, Niaz area. Figs. 14-17. *Polygnathus lagowiensis* Helms & Wolska, 1967. Fig. 14. Upper view of AFUM405. N. 0, Niaz area. Fig. 15. Upper view of AFUM406. N. Niaz area. Fig. 16. Side view of AFUM407. N. 1, Niaz area. Fig. 17. Upper view of AFUM409. T. 39, Howz-e-Dorah area. Fig. 18. *Polygnathus* sp. Upper view of AFUM350. T. 39, Howz-e-Dorah area. Fig. 19. *Polygnathus* sp. Upper view of AFUM356. T. 17, Howz-e-Dorah area. Fig. 20. *Polygnathus* sp. Upper view of AFUM372. T. 15, Howz-e-Dorah area. Fig. 21. *Polygnathus* sp. Upper view of AFUM352. S. 230, Khoshyeilagh area. Fig. 22. *Polygnathus* sp. Upper view of AFUM357. B. 5, Howz-e-Dorah area. Fig. 23. *Polygnathus* sp. Upper view of AFUM502. T. 15, Howz-e-Dorah area. Fig. 24. *Polygnathus* sp. Side view of AFUM349. N. 8, Niaz area. Fig. 25. *Polygnathus* sp. Upper view of AFUM351. K. 168, Ozbak-Kuh Mountains. Figs. 1, 3, 6, 13, 23, 24x40; Figs. 4, 7-9, 12, 15, 16, 21x50; Figs. 2, 5, 10-11, 17, 19-20, 22x60; Figs. 14, 18, 25 x80.

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