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Middle Devonian-Early Carboniferous Conodont Faunas from the Khoshyeilagh Formation, Alborz Mountains, North Iran

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Abstract

Conodonts of Khoshyeilagh Formation, the most complete section of Devonian rocks in the Alborz Mountains, northern Iran, has been studied, and subspecies of the genera *Icriodus*, *Bipennatus*, *Polygnathus*, *Pelekysgnathus*, *Ancyrodella*, *Palmatolepis*, *Bispathodus*, *Scaphignathus*, *Clydagnathus*, *Gnathodus*, *Scaliognathus* and *Dollymae* have been obtained from the studied section. The faunas indicate an Eifelian to Tournaisian age. The *falsiovalis*, Late *rhomboidea*-Early *marginifera*, Latest *marginifera-trachytera*, Middle *expansa*-Middle *praesulcata*, *bouckaerti* and *anchoralis-latus* conodont zones have been identified in the formation. Six new species are described: *Icriodus ariaei*, *Ic. alborzensis*, *Ic. khoshyeilaghensis*, *Polygnathus klapperianus*, *Pelekysgnathus housei* and *Pe. talenti*.

Keywords: Conodonts; Devonian; Carboniferous; Iran; Alborz Mountains; Khoshyeilagh Formation

Introduction

The existence of Middle and Upper Devonian rocks in the eastern Alborz (Figs. 1 and 2) was firstly mentioned by Bozorgnia *et al*. [12] in an unpublished report of the Iranian National Oil Company; it was later named Khoshyeilagh Formation and described by Bozorgnia [13]. It consists of 1345 m of carbonates (mainly limestone), sandstone and shale with a rich fauna of brachiopods and less abundant tentaculitids and bryozoans. It is conformable with the Padeha Formation below and the Mobarak Formation above.

The Khoshyeilagh Formation was divided into six members and seventeen "Beds" by Bozorgnia [13]. Later workers have proposed their own division of the formation. For example Brice *et al*. [14] suggested seven members and twelve "Beds" within the formation. Comparison of previous studies and the current one is shown in Figure 3. In the present study the original subdivisions suggested by Bozorgnia [13] are used, though the explained proposal of Brice *et al*. [14] is perhaps a better representation of the sequence since it is distinguishable simply in the field.

Stratigraphy

The ages of members 1 and 6 of the formation have been challenged by previous researchers; the greatest

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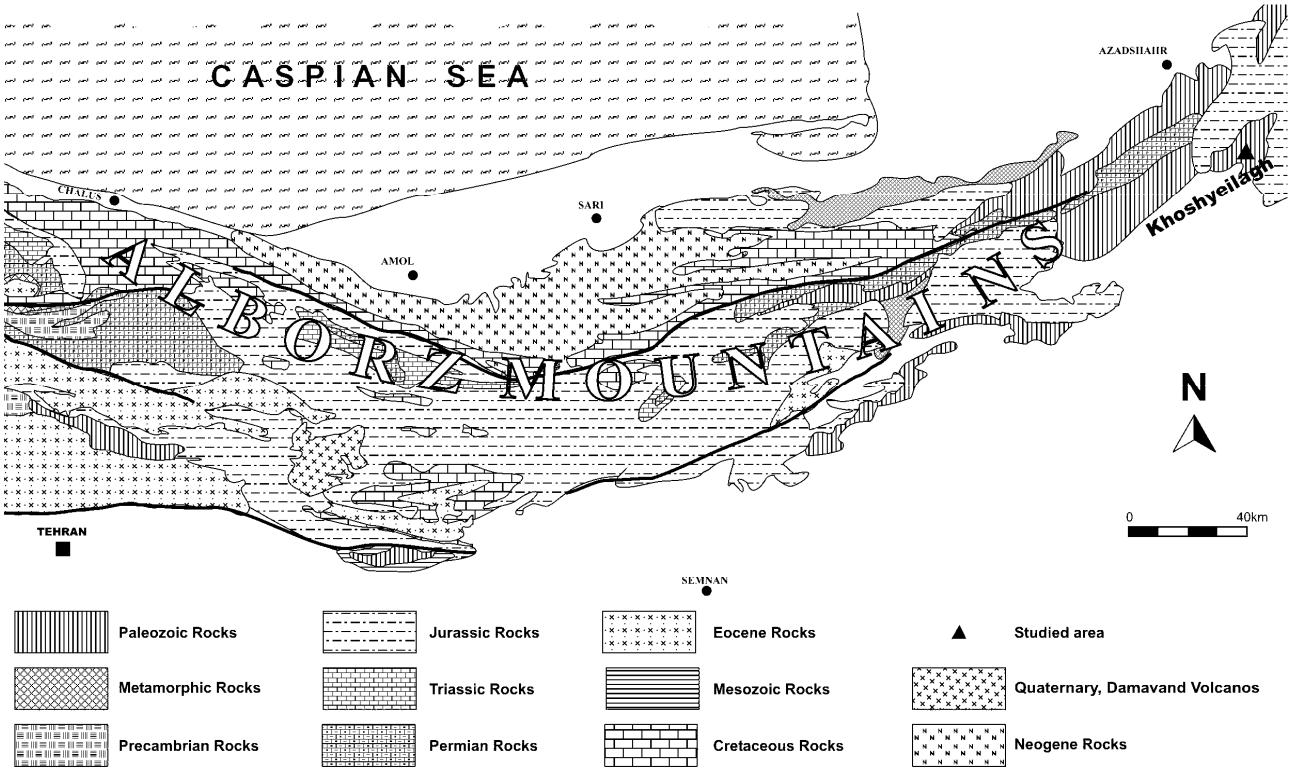

Figure 1. Simplified geological map of part of the Central and Eastern Alborz Mountains.

controversy is concern with Member 1. Age assignments were given to the members on the basis of brachiopods (Brice *in* [13]) as follows: Couvinian for Member 1, Givetian for Member 2, Frasnian for Member 3, Frasnian-Famennian for Member 4, Famennian for Member 5 and Late Famennian for Member 6. Bozorgnia [13] reported two algal intervals in the Khoshyeilagh Formation: *Trochiliscus* "Zone" from lower part of the section (Couvinian age according to brachiopods) and *Umberella "*Zone" an especially distinctive interval in the Upper Devonian of Iran; it is Frasnian-Famennian. Ahmadzadeh [2] studied conodont and brachiopod faunas from the lower part of the Khoshyeilagh Formation (Member 1 up to the lower part of Member 3 of [13]). He defined Early Devonian conodonts from the lower part of the Member 2; conodonts from the upper part of the Member 2 were thought to be not age-diagnostic. He discriminated two brachiopod biozones in the upper part of the formation, one thought to be Early Frasnian, the other Middle to Late Frasnian.

Brice *et al*. [14] reported on the brachiopod and bryozoan faunas but provided some information on corals and conodonts. On the basis of brachiopods, they suggested that most of Member 1 was Eifelian with, in its upper part, some early Givetian limestone beds. Members 2 and 3 and most of Member 4 were believed to be Givetian. The Givetian-Frasnian boundary occurs in the upper part of Member 4. The Famennian begins with Member 6 and includes a third of Member 7 as well. The upper two thirds of the Member 7 is Latest Famennian ("Strunian").

From conodont faunas and fish remains, [15] assigned an Early Devonian age to Beds 1-5 of [13] or Member 1 of [14]. They indicated a Givetian age for Member 3 and part of Member 4; Member 4 was assigned a Frasnian age, and a Famennian age was assigned to Members 5 to 7 of [14]. A question raised by Hamdi and Janvier [15] about the lower contact of the Khoshyeilagh Formation. They believed a sequence of 270 m overlain by the basal conglomerate of the Khoshyeilagh Formation of [13], should be regarded as the lower part of the formation. Shahrabi made a similar suggestion [5]. Brice *et al*. [14] considered the sequence underlying the Khoshyeilagh Formation to equate with the Padeha Formation, whereas Hamdi & Janvier [15] did not accept this because of the lack of dolomite and gypsiferous intervals at its type locality.

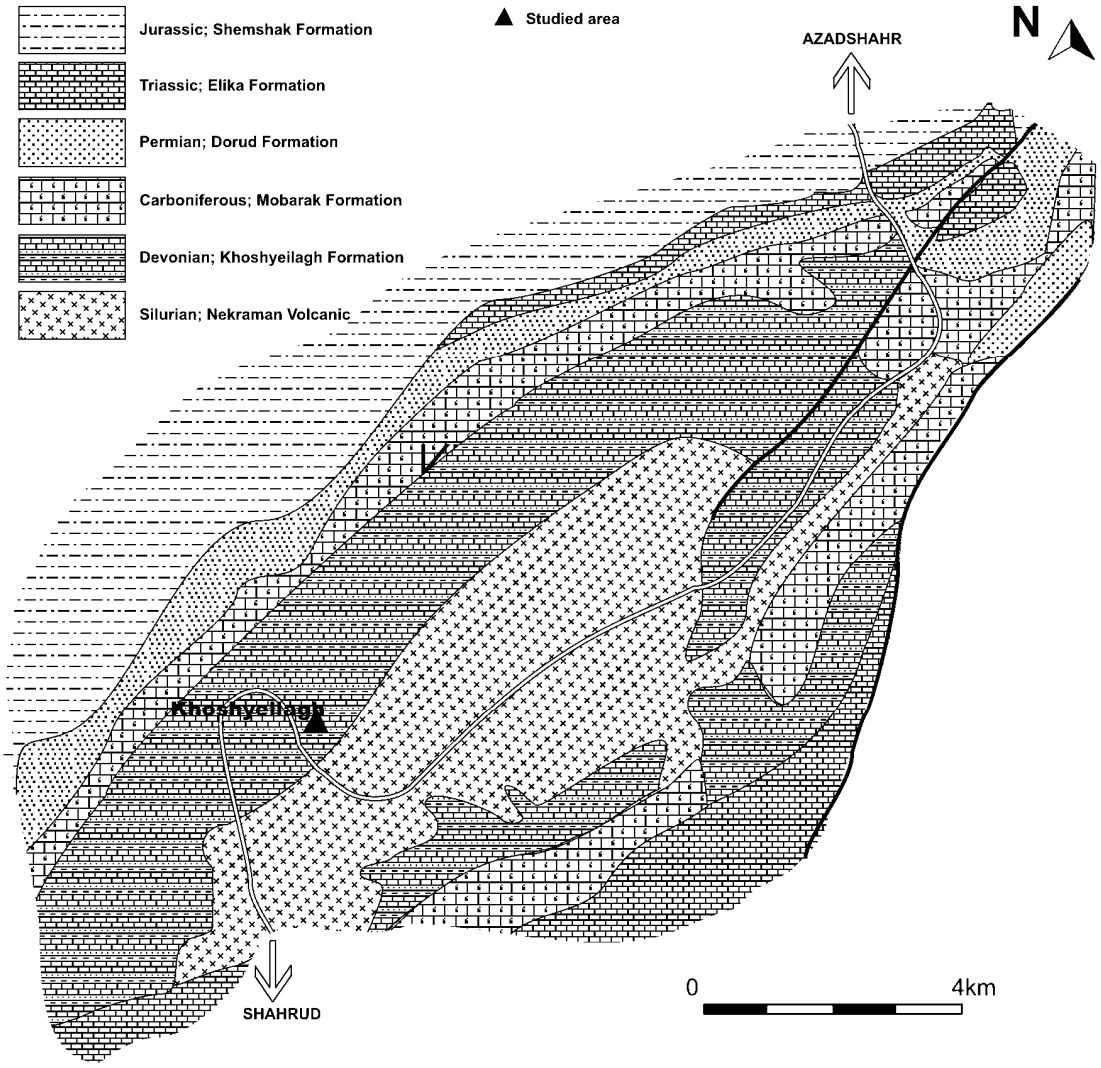

Figure 2. Index geological map showing the location of the studied area.

Previous Conodont Studies

Ahmadzadeh [1] examined the Devonian-Carboniferous boundary and Lower Carboniferous strata in the Central Alborz, northern Iran, on the basis of brachiopods and conodonts. An Ordovician-Devonian section S of Bojnurd in the eastern Alborz was studied by Ahmadzadeh [3], again on the basis of brachiopods and conodonts. His specimens have been reviewed by Weddige [16,17]. Ahmadzadeh *et al*. [4] gave a preliminary report on conodonts of the Khoshyeilagh Formation from the Mighan section SW of the type locality of the formation. Ashouri [6-11] studied Devonian-Carboniferous conodont faunas from the Khoshyeilagh Formation and, in recent years much unpublished research on conodonts from Iran has been undertaken by postgraduate students.

Biostratigraphy

Reported conodonts here from "Bed" 10 to the top of the formation are the first records of conodonts from these horizons. Previous records cover up to "Bed" 9 [2] and "Bed" 7 [15].

Conodonts from Member 1 (sample S. 205) include species of *Icriodus* and *Eognathodus*. *Eognathodus bipennatus* from "Bed" 2 of Member 1 probably indicates a Middle Devonian (pre-*varcus* Zone) age. Despite 17 samples from Member 2, the faunas were poor with only two samples (S.209 & S.210) producing species of *Icriodus* and *Polygnathus*, and another (S. 211) only conodont fragments. The predominant genera in Member 3 are *Icriodus* and *Polygnathus*. Of 19 samples from this member (S.226-S.244) the most important one (S. 241) has a rich fauna of *Ancyrodella*,

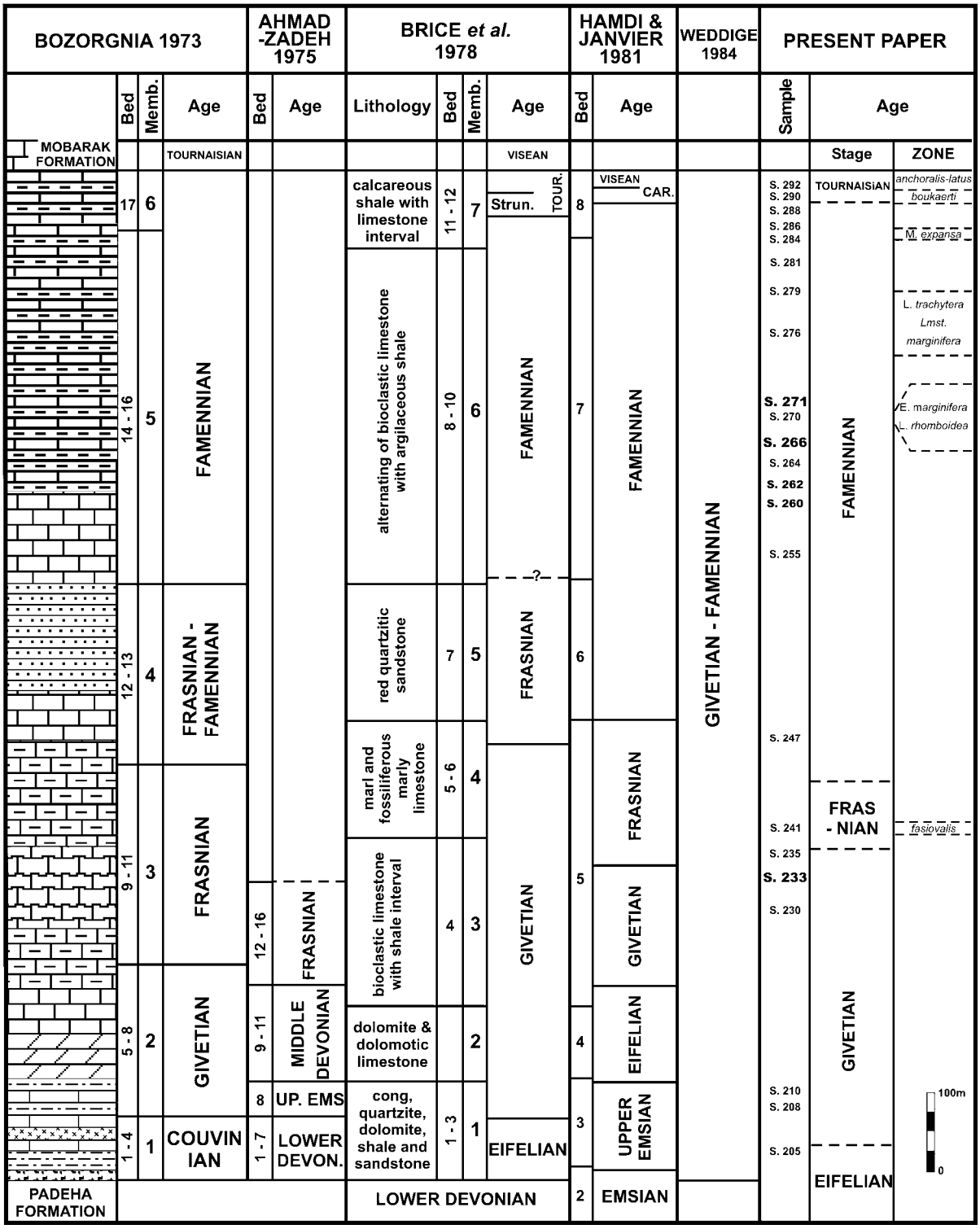

Figure 3. Comparison of previous studies of the Khoshyeilagh Formation and the present study. The section and the lithological description is based on Bozorgnia [13].

the species *A. binodosa* and *A. pristina* indicating the *fasiovalis* Zone (Lowermost *asymmetricus* Zone) of the latest Middle Devonian-Early Frasnian. Thus the Middle-Upper Devonian boundary lies beneath of this sample, possibly close to sample 240. The last sample from this member (S. 244) contains *Icriodus iowaensis iowaensis* indicating Early Famennian. Doubtless due to facies (mainly sandstones) only a few *Icriodus* and *Polygnathus* specimens were obtained, not sufficient to indicate precise horizons.

Bed 14 has no critical fauna; Beds 15 and 16 of [13] produced richer and a more diverse fauna including *Icriodus*, *Polygnathus*, *Pelekysgnathus*, *Palmatolepis* and, in its uppermost part, *Clydagnathus*. Sample 270 with *Palmatolepis quadrantinodosa inflexa* is the most important sample from this member. This species has a short range from the Upper *rhomboidea* to Lower *marginifera* Zone. *Scaphignathus*, mainly *S. velifer* (samples S. 276-S. 279), indicates the uppermost *marginifera-trachytera* zones for the upper part of Member 5.

The last member of the formation, Member 6, includes a single bed (Bed 17 of [13]), containing *Polygnathus* and *Bispathodus*. The uppermost strata of Member 6 produced species of *Polygnathus*, *Bispathodus*, *Gnathodus*, *Scaliognathus* and *Dollymae*. The most important fauna of the uppermost Devonian was from sample S. 286. It produced *Polygnathus delicatus* indicative of the old *costatus* Zone. Co-occurrence of *Bispathodus aculeatus aculeatus* indicates restriction to the Middle *expana* Zone. Despite lack of evidence of facies changes, no conodonts were found in the next three samples (S.287-S.289). These samples were from an interval with rich Late Devonian and middle Tournaisian faunas in the underlying and overlying samples. The Devonian-Carboniferous boundary thus lies somewhere in this interval.

A Carboniferous fauna was obtained from S. 290. It produced *Dollymae bouckaerti*, indicator of the *bouckaerti* Zone within the middle Tournaisian. A diverse conodont fauna from the last sample (S. 292), from the top of formation included species of *Polygnathus*, *Bispathodus*, *Scaliognathus* and *Gnathodus*. The presence of *Scaliognathus anchoralis europensis* indicates the *anchoralis-latus* Zone the uppermost biozone of the Tournaisian.

Taxonomy

Only pa elements have been described in the present study. The figured specimens herein are housed in the department of geology of Ferdowsi University of Mashhad, Mashhad, Iran with the prefix AFUM. Figure 4 displays distribution of conodont species and subspecies in the present study. All studied samples in this research, obtained from the type section of the Khoshyeilagh Formation, 105 km south of Khoshyeilagh village (Fig. 2).

Family ICRIODONTIDAE MÜLLER & MÜLLER, 1957
Genus *Icriodus* BRANSON & MEHL, 1938
Icriodus alborzensis n. sp.
Plate 1, Figures 14-19

Derivation of name: From the Alborz Mountains, northern Iran.

Holotype: AFUM270, the specimen illustrated on Plate 1, Figure 15 from sample S. 233.

Locus typicus and stratum typicum: The type locality of the Khoshyeilagh Formation (Fig. 2); bioclastic limestone, 402 m above the base of the formation (Fig. 3).

Diagnosis: A species of *Icriodus* with alternation of lateral and medial rows of rounded, discrete denticles of similar size. The basal cavity is extended on the lower margin of the posterior part and shows a spur. The medial row of denticles is extended posterior to the lateral rows and there is a posterior cusp.

Description: The middle row of denticles is extended posterior relative to the lateral rows of denticles by two to three denticles joined by a ridge; the most posterior denticle is the largest and forms a posterior cusp.

A single specimen (Pl. 1, Fig. 14) displays very uniform and openly spaced denticles. One specimen (Pl. 1, Fig. 15) has a more or less asymmetrical outline and a flaring lower margin. Two specimens show closely spaced denticles; one of them (Pl. 1, Fig. 16) has a well-extended basal cavity in the posterior part and the other (Pl. 1, Fig. 17) displays a distinct spur. Two specimens show a wide basal cavity in the posterior part; one of them (Pl. 1, Fig. 19) has a narrower spindle and narrow basal cavity. The other (Pl. 1, Fig. 18) is a broad form with a large basal cavity, well developed spur and lacks a medial row of denticles anteriorly.

Occurrence: Member 3 of the Khoshyeilagh Formation; age Late Givetian.

Material: 10 I elements.

Icriodus ariaei n. sp.
Plate 1, Figure 12

Derivation of name: In honor of Dr. Ali Asghar Ariaei, my first geological teacher who has spent about 50 years of his life on the geology of Iran.

Sample No.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.
TAXA	**205**	**208**	**210**	**211**	**227**	**228**	**229**	**230**	**232**	**233**	**234**	**235**	**237**	**239**	**240**	**241**	**247**	**250**	**255**	**259**	**260**	**261**	**262**	**264**	**266**	**269**	**270**	**271**	**275**	**276**	**277**	**279**	**281**	**286**	**288**	**290**	**292**
Bipennatus bipennatus	★	★																																			
Icriodus orri		★	★				★	★																													
Icriodus obliquimarginatus			★																																		
Icriodus regularicrescens			★																																		
Icriodus arkonensis			★																																		
Polygnathus ling. ling. delta			★																																		
Polygnathus cf. perbonus			★																																		
Polygnathus alveolus			★																																		
Polygnathus xylus xylus			★																																		
Icriodus brevis			★																																		
Icriodus difficilis						★	★			★		★					★																				
Icriodus alternatus alternatus							★																														
Icriodus alborzensis								★	★	★	★		★	★	★																						
Ancyrodella binodosa																★																					
Ancyrodella pristina																★																					
Polygnathus latus																	★																				
Icriodus subterminus																		★			★			★													
Icriodus iowaensis iowaensis																			★		★		★														
Icriodus costatus darbyensis																				★																	
Icriodus ariaei																					★																
Polygnathus brevilaminus																					★																
Pelekysgnathus housei																					★																
Ancyrognathus sinelamina																					★																
Icriodus expansus																						★	★														
Polygnathus communis communis																						★				★											
Polygnathus angustidiscus																							★														
Pelekysgnathus talenti																							★														
Polygnathus klapperianus																									★												
Pelekysgnathus inclinatus																										★											
Palmatolepis quadrantinodosa inflexa																											★										
Polygnathus semicostatus																												★									
Polygnathus perplexus																												★									
Palmatolepis wolskaja																												★									
Icriodus khoshyeilaghensis																												★									
Clydagnathus ormistoni																													★		★	★					
Scaphignathus velifer																														★		★					
Clydagnathus cavusformis																																★					
Clydagnathus darensis																																	★				
Polygnathus delicatus																																		★			
Bispathodus aculeatus aculeatus																																		★			
Polygnathus nodocostatus																																			★		
Pseudopolygnathus oxypageus																																				★	
Dollymae boukaerti																																				★	
Polygnathus bischoffi																																					★
Gnathodus typicus																																					★
Gnathodus pseudosemiglaber																																					★
Scaliognathus anchoralis anchoralis																																					★

Figure 4. Distribution of conodont species in the Khoshyeilagh Formation.

Holotype: AFUM262, the specimen illustrated on Plate 1, Figure 12 from sample S. 260.

Locus typicus and stratum typicum: The type locality of the Khoshyeilagh Formation (Fig. 2); bioclastic limestone, 910 m above the base of the formation (Fig. 3).

Diagnosis: A species of *Icriodus* characterized by an extremely large rounded basal cavity, tapering gradually anteriorly. The medial row of denticles is extended as a ridge posterior to the lateral denticles. Apart from the denticles in the three main rows, two further denticles are present aligned with the posterior denticles.

Description: The middle row of denticles extends as a ridge with a scalloped crest posteriorly continuing to the lower margin. The most posterior lateral row of denticles is aligned with two further denticles positioned on one side. The denticles of the medial row are offset posteriorly relative to the lateral rows of denticles in a closely spaced pattern. The unit is widest at the level of the most posterior lateral denticle.

Occurrence: Member 5 of the Khoshyeilagh Formation. According to the associated conodont fauna, its age is Upper Devonian, Famennian, *crepida* Zone.

Material: 6 I elements

Icriodus khoshyeilaghensis n. sp.
Plate 1, Figure 13

Derivation of name: Khoshyeilagh is the name of a village in the Alborz Mountains, northern Iran, from which the formation takes its name.

Holotype: AFUM259, the specimen illustrated on Plate 1, Figure 13 from sample S. 271.

Locus typicus and stratum typicum: The type locality of the Khoshyeilagh Formation (Fig. 2); limestone, 1050 m above the base of the formation (Fig. 3).

Diagnosis: A species of *Icriodus* with a well developed posterior cusp and two lateral ridges of denticles without an extended medial row of denticles. The basal cavity is moderately large.

Description: The species does not show a discrete medial row of denticles. Its first few left-side denticles converge anteriorly and form a "pseudo medial" row. The anteriormost three denticles of the lateral rows are fused with those of the medial row appear as crossed ridges.

Occurrence: The species comes from the upper part of Member 5 of the Khoshyeilagh Formation. On the basis of stratigraphical position, its age may be as young as the *crepida* Zone.

Material: 7 I elements

Genus *Pelekysgnathus* THOMAS, 1949
Pelekysgnathus housei n. sp.
Plate 3, Figure 1

Derivation of name: For Prof. Micheal House, my first conodont teacher who continually encouraged me and contributed greatly to knowledge of the Devonian.

Holotype: AFUM797, the specimen illustrated on Plate 3, Figure 1 from sample S. 260.

Locus typicus and stratum typicum: The type locality of the Khoshyeilagh Formation (Fig. 2); bioclastic limestone, 910 m above the base of the formation (Fig. 3).

Diagnosis: A species of *Pelekysgnathus* characterized by a relatively circular outline in its posterior two-thirds, rather sharply converging in the anterior third, and with a triangular outline denticulation consist of a relatively strong, short and reclined cusp and apparently six denticles, irregular in form and size. A thin ridge, visible on the left side of the cusp and just anterior of it, extends laterally downward nearly to one-third of the lower margin.

Description: The species differs from *Pe. furnishi* by having a more extended basal cavity and a small thin ridge from one side; it lacks distinct transverse ridges intersecting the main row. *Pe. glenisteri* has two well-developed denticulated accessory processes in the posterior end of the main row and intersected denticles in the main row.

Occurrence: Member 5 of the Khoshyeilagh Formation. Based on the associated fauna, the species can be referred to the Late *rhomboidea* to the Early *marginifera* zones.

Material: 8 I elements

Pelekysgnathus talenti n. sp.
Plate 3, Figure 2

Derivation of name: In honor of Prof. John Talent who has generously helped people around the world with knowledge of the Devonian.

Holotype: AFUM798, the specimen illustrated on Plate 3, Figure 2 from sample S. 262.

Locus typicus and stratum typicum: The type locality of the Khoshyeilagh Formation (Fig. 2); bioclastic limestone, 940.5 m above the base of the formation (Fig. 3).

Diagnosis: A species of *Pelekysgnathus* with a basal cavity of relatively quadrangular outline in its posterior two-thirds, becoming much narrower in the anterior third. The main row of denticles comprises a strong reclined cusp and only two strong denticles. Two thin

ridges just anterior to the cusp extend laterally nearly half way to the lower margin.

Description: This species is distinguished from *Pe. furnishi* by having a strong cusp and only two strong denticles in the main row with no intersecting transverse ridges. *Pe. glenisteri* has denticulated accessory processes and six or more denticles in the main row. The species differs from *Pe. housei* in its outline and the number of denticles in the main row.

Occurrence: Upper part of Member 5 of the Khoshyeilagh Formation. On the basis of the stratigraphical position an early Famennian age is assigned.

Material: 8 I elements

Family POLYGNATHIDAE BASSLER, 1925
Genus *Polygnathus* HINDE, 1879
Polygnathus klapperianus n. sp.
Plate 2, Figure 7

Derivation of name: In honour of Prof. Gilbert Klapper who has contributed importantly on Devonian conodonts.

Holotype: AFUM316, the specimen illustrated on Plate 2, Figure 7 from sample S. 266.

Locus typicus and stratum typicum: The type locality of the Khoshyeilagh Formation (Fig. 2); bioclastic limestone, 1001 m above the base of the formation (Fig. 3).

Diagnosis: A small species of *Polygnathus* with a large depression occupying the anterior aboral surface. Platform is rounded and flattened. Free carina distinctly developed in the posterior part of the platform.

Description: The specimen is fragmentary, missing small parts of the anterior end of the free blade. The platform is rounded and flattened, with upturned outer margin in the middle part. The ornament is shagreen-like on the outer margin. The carina bears strong denticles developed distinctly in the posterior part. The aboral depression bears concentric striae and a strong keel gradually disappearing about the centre of the depression. Large pit present at the conjunction of the platform anterior margin with the keel.

Occurrence: Upper part of Member 5 of the formation; not older than *marginifera* Zone.

Material: 6 Pa elements

EXPLANATION OF PLATES

Plate 1

Figures 1-3, 8, 15-18: ×100; Figures 4, 6, 7, 9, 10, 12, 14, 20, 21, 24, 26: ×80; Figures 5: ×50; Figures 11, 13, 19, 22, 23, 25: ×60.

***Icriodus brevis* STAUFFER, 1940**
Fig. 1. Upper view of AFUM103. S. 229.

***Icriodus obliquimarginatus* BISCHOFF & ZIEGLER, 1957**
Fig. 2. Upper view of AFUM111. S. 210.

***Icriodus* cf. *regularicrescens* BULTYNCK, 1970**
Fig. 3. Upper view of AFUM113. S. 210.

***Icriodus expansus* BRANSON & MEHL, 1934**
Fig. 4. Upper view of AFUM136. S. 261.

***Icriodus costatus darbyensis* KLAPPER, 1958**
Fig. 5. Upper view of AFUM126. S. 259.

***Icriodus difficilis* ZIEGLER & KLAPPER, 1976**
Fig. 6. Upper view of AFUM140. S. 235.

***Icriodus orri* KLAPPER & BARRICK, 1983**
Fig. 7. Upper view of AFUM156. S. 210.

***Icriodus arkonensis* STAUFFER, 1938**
Fig. 8. Upper view of AFUM166. S. 210.

***Icriodus* cf. *iowaensis iowaensis* YOUNGQUIST & PETERSON, 1947**
Fig. 9. Upper view of AFUM214. S. 255.

***Icriodus subterminus* YOUNGQUIST, 1947**
Fig. 10. Upper view of AFUM237. S. 264.

***Icriodus* cf. *raymondi* SANDBERG & ZIEGLER, 1979**
Fig. 11. Upper view of AFUM266. S. 266.

***Icriodus ariaei* n. sp.**
Fig. 12. Upper view of holotype, AFUM262. S. 260.

***Icriodus khoshyeilaghensis* n. sp.**
Fig. 13. Upper view of holotype, AFUM259. S. 271.

***Icriodus alborzensis* n. sp.**
Fig. 14. Upper view of AFUM267. S. 234.
Fig. 15. Upper view of holotype, AFUM270. S. 233.
Fig. 16. Upper view of AFUM271. S. 230.
Fig. 17. Upper view of AFUM274. S. 233.
Fig. 18. Upper view of AFUM267. S. 237.
Fig. 19. Upper view of AFUM275. S. 238.

***Icriodus alternatus alternatus* BRANSON & MEHL, 1934**
Fig. 20. Upper view of AFUM184. S. 229.

***Pelekysgnathus inclinatus* THOMAS, 1949**
Fig. 21. Upper view of AFUM514. S. 269.

***Bipennatus bipennatus* (BISCHOFF & ZIEGLER, 1957)**
Fig. 22. Upper view of AFUM508. S. 205.
Fig. 23. Upper view of AFUM504. S. 205.
Fig. 24. Upper view of AFUM505. S. 205.
Fig. 25. Upper view of AFUM506. S. 208.
Fig. 26. Upper view of AFUM511. S. 208.

Plate 2

Figures 1, 2, 13, 22: ×60; Figures 3, 7, 15: ×100; Figures 4, 5, 9, 11, 14, 24, 25: ×50; Figures 6, 12, 16,

18, 21: ×80; Figures 8, 10, 17, 19, 20, 23, 26: ×40.

***Polygnathus angustidiscus* YOUNGQUIST, 1945**
Fig. 1. Upper-lateral view of AFUM300. S. 262.
***Polygnathus linguiformis alveolus* WEDDIGE, 1977**
Fig. 2. Upper-lateral view of AFUM302. S. 210.
***Polygnathus weddigei* (CLAUSEN, LEUTERITZ & ZIEGLER, 1979)**
Fig. 3. Upper-lateral view of AFUM303. S. 210.
***Polygnathus linguiformis linguiformis gamma* morphotype KLAPPER, 1987**
Fig. 4. Side view of AFUM304. S. 210.
***Polygnathus* cf. *perbonus* (PHILIP, 1966)**
Fig. 5. Side view of AFUM308. S. 210.
***Polygnathus xylus xylus* STAUFFER, 1938**
Fig. 6. Oblique upper view of AFUM315. S. 234.
***Polygnathus klapperianus* n. sp.**
Fig. 7. Upper, side, oblique lower views of holotype, AFUM316. S. 266.
***Polygnathus brevilaminus* BRANSON & MEHL, 1934**
Fig. 8. Side view of AFUM326. S. 260.
***Polygnathus alatus* HUDDLE, 1934**
Fig. 9. Side view of AFUM337. S. 247.
***Polygnathus semicostatus* BRANSON & MEHL, 1934**
Fig. 10. Side view of AFUM378. S. 271.
***Polygnathus* cf. *nodocostatus* BRANSON & MEHL, 1934**
Fig. 11. Upper view of AFUM393. S. 288.
***Polygnathus bischoffi* RHODES, AUSTIN & DRUCE, 1969**
Fig. 12. Upper-lateral view of AFUM447. S. 292.
***Polygnathus perplexus* THOMAS, 1949**
Fig. 13. Side view of AFUM427. S. 271.
***Polygnathus communis communis* BRANSON & MEHL, 1934**
Fig. 14. Side view of AFUM449. S. 269.
Fig. 15. Side view of AFUM456. S. 291.
Fig. 16. Lower view of AFUM458. S. 229.
***Polygnathus delicatus* ULRICH & BASSLER, 1926**
Fig. 17. Upper view of AFUM465. S. 286.
***Polygnathus* sp. A**
Fig. 18. Upper view of AFUM491. S. 284.
***Polygnathus* sp. B**
Fig. 19. Upper view of AFUM497. S. 265.
***Clydagnathus cavusformis* RHODES, AUSTIN & DRUCE, 1969**
Fig. 20. Upper view of AFUM723. S. 279.
***Clydagnathus darensis* RHODES, AUSTIN & DRUCE, 1969**
Fig. 21. Upper view of AFUM724. S. 281.
***Clydagnathus ormistoni* BEINERT, KLAPPER, SANDBERG & ZIEGLER, 1971**
Fig. 22. Upper view of AFUM730. S. 279.
***Scaphignathus velifer* HELMS, 1959**
Fig. 23. Upper view of AFUM740. S. 276.
Fig. 24. Upper, lower views of. AFUM743. S. 279.
***Bispathodus aculatus aculatus* ZIEGLER, SANDBERG & AUSTIN, 1974**
Fig. 25. Upper view of AFUM688. S. 286.
Fig. 26. Upper view of AFUM679. S. 286.

Plate 3

Figures 1, 10, 16: ×40; Figures 2, 11, 13, 17: ×80; Figures 3, 4, 6-9, 12, 14: ×60; Figure 5: ×50; Figure 15: ×100.

***Pelekysgnathus housei* n.sp.**
Figs. 1. a, b. Upper and lateral views of holotype, AFUM797. S. 260.
***Pelekysgnathus talenti* n.sp.**
Figs. 2a, b. Upper and lateral views of holotype, AFUM798. S. 262.
***Ancyrognathus sinelamina* (BRANSON & MEHL, 1934)**
Fig. 3. Upper view of AFUM536. S. 260.
***Ancyrodella binodosa* UYENO, 1967**
Fig. 4. Side view of AFUM516. S. 241.
Fig. 5. Upper view of AFUM520. S. 241.
Fig. 6. Upper view of AFUM517. S. 241.
Fig. 7. Upper view of AFUM515. S. 241.
Fig. 8. Upper view of AFUM521. S. 241.
***Ancyrodella pristina* KHALYMBADZHA & CHERNYSHEVA, 1970**
Fig. 9. Upper view of AFUM540. S. 241.
***Palmatolepis* cf. *wolskajae* OVNATANOVA, 1969**
Fig. 10. Upper view of AFUM630. S. 271.
***Palmatolepis quadrantinodosa inflexa* MÜLLER, 1959**
Fig. 11. Upper view of AFUM552. S. 270.
***Pseudopolygnathus oxypageus* LANE, SANDBERG & ZIEGLER, 1980**
Fig. 12. Upper view of AFUM722. S. 290.
***Dollymae bouckaerti* GROESSENS, 1977**
Fig. 13. Upper view of AFUM768. S. 290.
***Gnathodus pseudosemiglaber* THOMAS & FELLOW, 1970**
Fig. 14. Upper view of AFUM767. S. 292.
Fig. 15. Upper view of AFUM766. S. 292.
Fig. 16. Upper view of AFUM761. S. 292.
***Scaliognathus anchoralis europensis* LANE & ZIEGLER, 1983**
Fig. 17. Upper, side and lower views of AFUM784. S. 292.

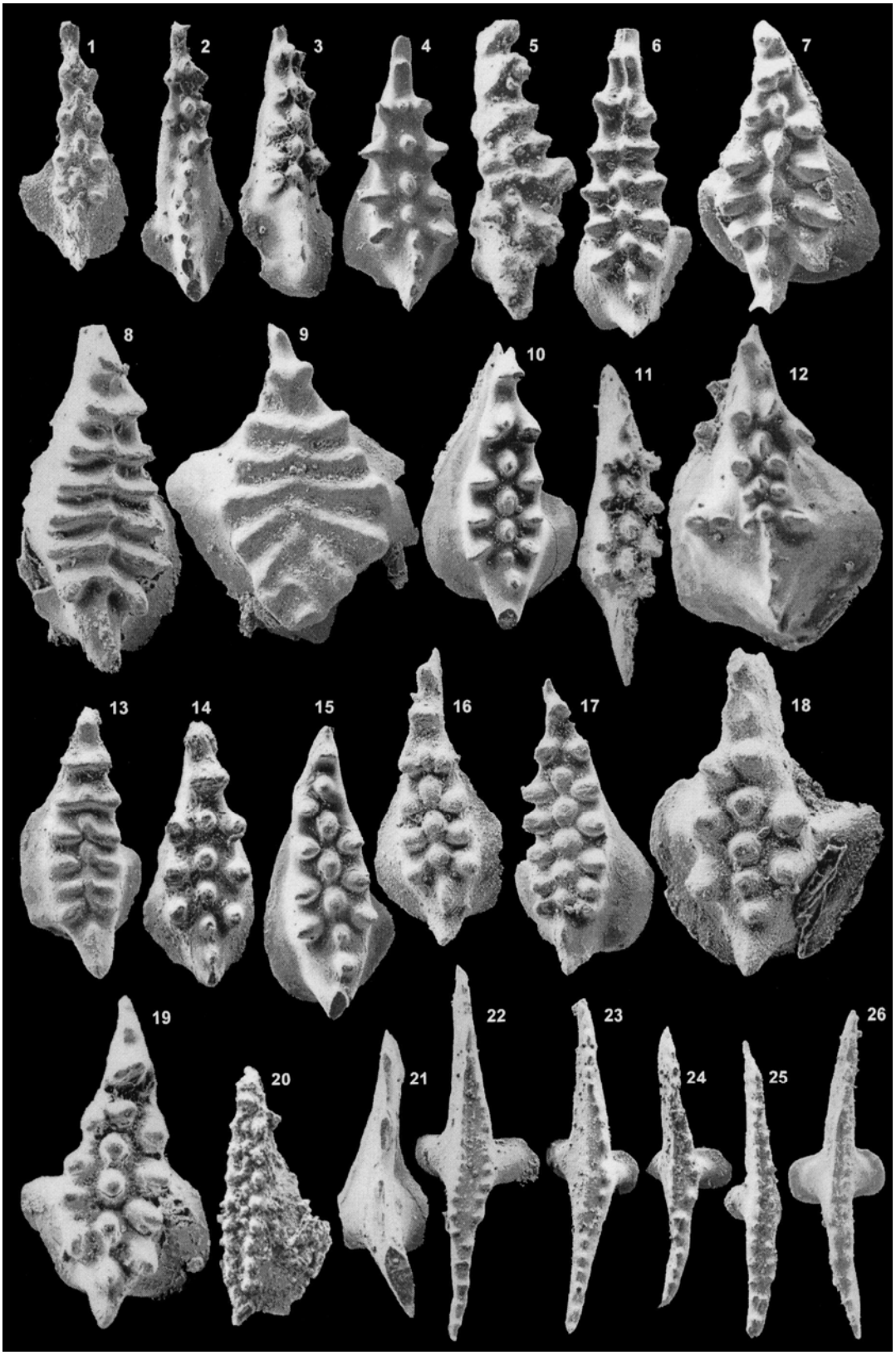

Plate 1

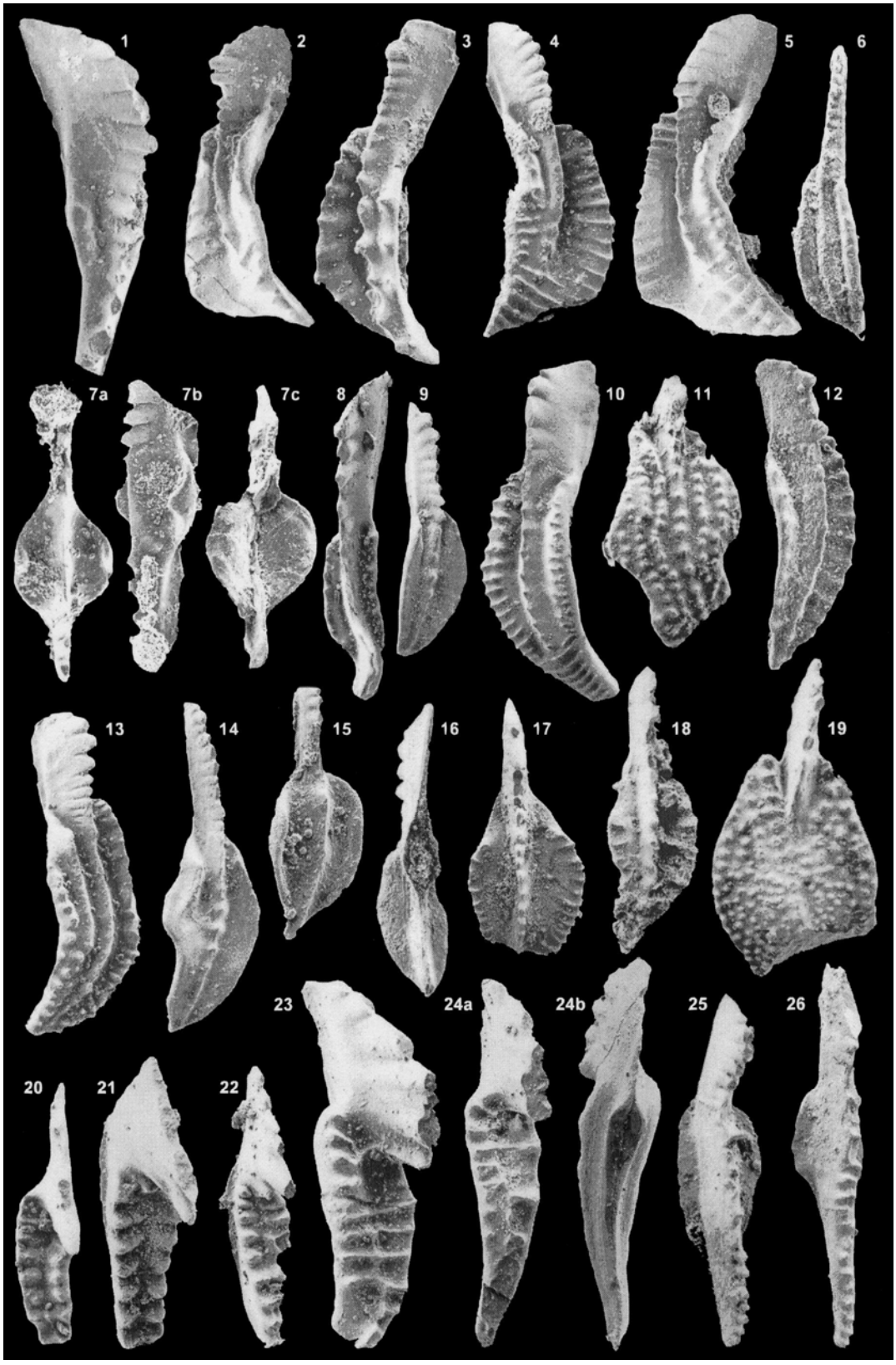
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Plate 2

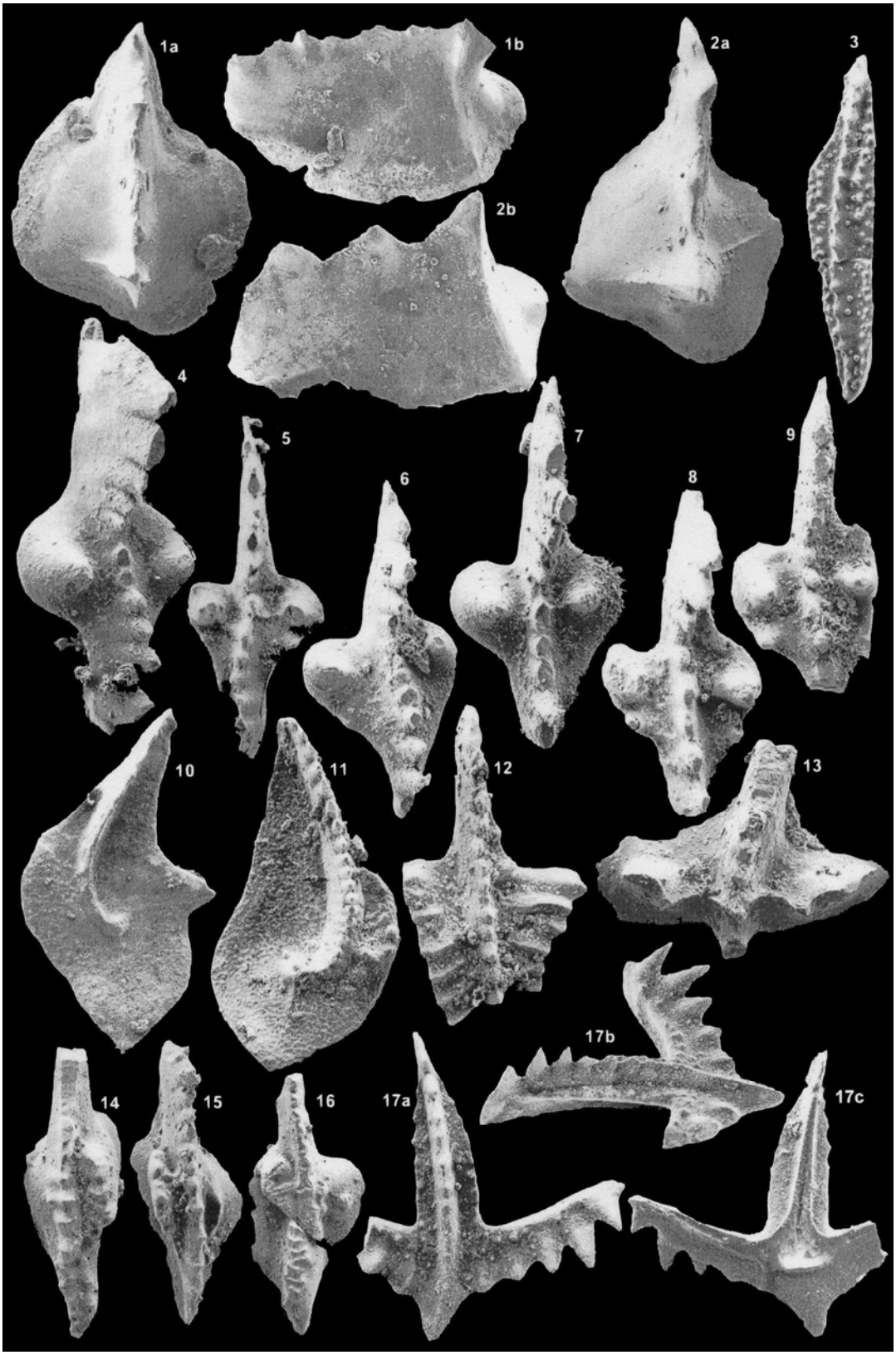

Plate 3

Acknowledgments

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