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CARBONIFEROUS-PERMIAN STRATIGRAPHY AND FUSULINIDS OF EASTERN IRAN. THE PERMIAN IN THE BAG-E-VANG SECTION (SHIRGESHT AREA)

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Abstract. The Jamal Formation of the Bag-e-Vang section near Shirgesht is described. The lower part of the formation (Bag-e-Vang Member) is composed of shales and marls with interbeds of shallow-water bioclastic limestones. It contains abundant fusulinids indicative of the uppermost Yakhtashian-basal Kubergandian. The upper part of the Jamal Formation is represented by micritic and finely detrital limestones and dolomites. The age of this part of the formation is based on rare fusulinids and smaller foraminifers and cannot be defined more precisely than the Kubergandian-Dorashamian of the Upper Permian. The formation has visible conformable contacts with the underlying Sardar and overlying Sorkh Shale Formations. However, there may be unobservable stratigraphic hiatuses of indefinite scope at the formation boundaries. Forty-one species and subspecies, which belong to 27 genera and subgenera and 9 families of fusulinids, were identified in the Permian of the section described. Among them, two genera (*Iranella, Paraleeina*), one subgenus (*Cuniculina*) and 8 species, i. e. *Yangchienia compressaeformis, Paradoxiella insueta, Darvasites minutus, Skinnerella chusenellaeformis, Iranella bella, I. longa, I. orbiculata,* and *I. pauca,* are new.

Riassunto. Viene descritta in questo articolo la Formazione Jamal della sezione Bag-e-Vang presso Shirgesht. La parte inferiore della formazione (Membro Bag-e-Vang) è composta da argilliti e marne con intercalazioni di calcari bioclastici di acque basse. Contiene abbondanti fusulinidi di età Yakhtashiano sommitale – Kubergandiano basale. La parte superiore della Formazione Jamal è rappresentata da calcari micrutici o finemente detritici e da dolomie. L'età di questa parte della formazione è basata su rare fusulinidi e piccoli foraminiferi, per cui non può essere attribuita con precisione, se non all'intervallo Kubergandiano-Dorashamiano del Permiano superiore. I contatti della formazione sono conformi sia con la sottostante Fm. Sardar che con la soprastante Fm. Sorkh Shale. Tuttavia non sono da escludere lacune di ampiezza indefinita ai limiti formazionali. I fusulinidi identificati appartengono a 41 specie e sottospecie, 27 generi e sottogeneri e 9 famiglie. Tra di essi, due generi (*Iranella, Paraleeina*), un sottogenere (*Cuniculina*) e 8 specie sono nuovi, i. e. *Yangchienia compressaeformis, Paradoxiella insueta, Darvasites minutus, Skinnerella chusenellaeformis, Iranella bella, I. longa, I. orbiculata,* e *I. Pauca.*

Introduction

Relevant Carboniferous-Permian deposits and the history of their studies are briefly described in the paper by Leven & Taheri (2003) on the Carboniferous-Permian stratigraphy of eastern Central Iran. It should only be reminded that the Carboniferous-Permian deposits are subdivided into the Sardar (Carboniferous-lower Lower Permian) and Jamal (upper Lower Permian-Upper Permian) formations. We also remind that we use the latest variant of the Permian scale for the Tethys (Leven 2001a), in which the Permian System consists of two subsystems (Cisuralian and Tethysian) and four series (Uralian with Asselian and Sakmarian stages; Darvasian with Yakhtashian and Bolorian stages; Yangsingian with Kubergandian, Murgabian and Midian stages; and Lopingian with Dzhulfian and Dorashamian stages).

The present paper describes the Jamal Formation exposed to the south of Shirgesht. The formation was first distinguished in the south part of the Shotori Mountains (Stöcklin et al. 1965), where it is represented by a limestone-dolomite sequence 500 m thick. The basal thin bed of coaly shales lies with sharp contact on the uppermost quartzitic sandstones of the Sardar Formation. The Jamal Formation is overlain without visible unconformities by Lower Triassic red shales (the Sorkh Shale Formation). Based on its stratigraphic position and the occurrence of rare corals and foraminifers, the formation was assigned to the Permian System. Later, based on investigations of areas to the north of Tabas, Stöcklin (1971) considered the formation to be mostly Late Permian. This was confirmed by Jenny-Deshusses (1983), who found typical Kubergandian fusulinids of the *Armenina* (*Neoschwage-*

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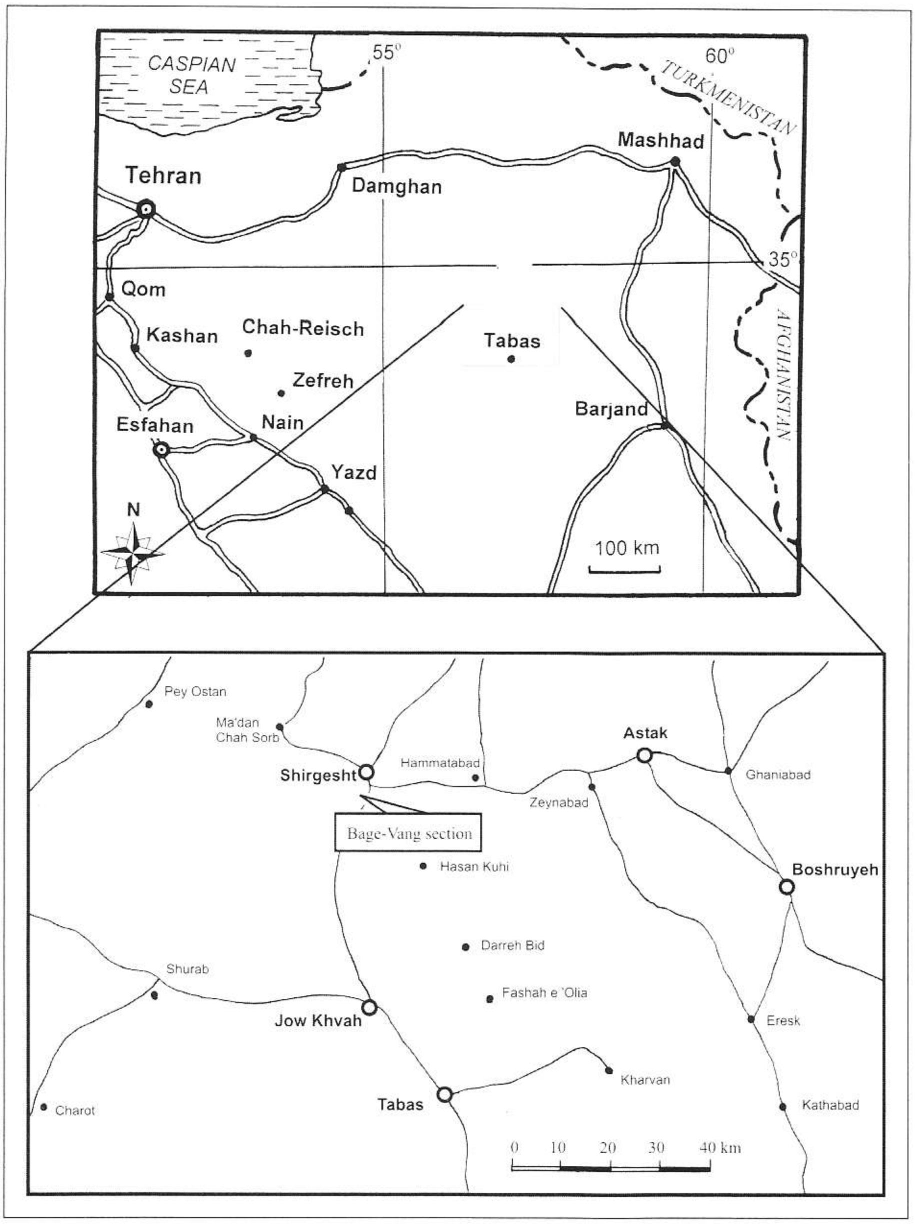

Fig. 1 - Index map with location of the studied section.

rina of Jenny) genus in the lower third of the formation stratotype section.

The Jamal Formation of the Shirgesht area was characterized most comprehensively by Ruttner (in Ruttner et al. 1968). As in the type section, the formation is composed mainly of limestones and dolomites of 100-700 m overall thickness. So called "basal beds" (50-60 m) of alternating mudstones, marls and bioclastic limestones were distinguished in some sections, including the Bag-e-Vang section under study. They rest with sharp but conformable contact on siltstones and sandstones of the Sardar Formation. These beds contain an abundant and diverse fauna (conodonts, fusulinids, ammonoids, corals, brachiopods, and other), which has not been studied yet. Kahler (1974) described only several fusulinid species of the *Misellina* Zone, i.e., the Bolorian Stage of the Lower Permian. This assignment of the basal beds was supported by preliminary identifications of other fossils. The beds lying above yielded only rare smaller late Permian foraminifers.

Partoazar (1995) recognized the "basal beds" of the Bag-e-Vang section as the independent Bag-e-Vang Formation. Probably, he did not know that Kahler (1974) had identified Bolorian fusulinids in these beds. Not being an expert, Partoazar made incorrect identifications, which resulted in attributing the formation to the Asselian-Sakmarian. Examination of the plates of his monograph can easily reveal the incorrectness of his identifications. For example, "*Pseudostaffella* sp." (pl. 2, fig. 2) is really *Misellina (Brevaxina)* sp., "*Pseudofusulina tabasensis* n. sp." (pl. 3, fig. 2) is a younger synonym of *Paraleeina postkraffti* (Leven). Both forms are typical of the Bolorian. *Toriyamaia laxiseptata* (pl. 2, fig. 1) and *Mesoschubertella thompsoni* (pl. 4, fig. 3) are of Yakhtashian-Bolorian age. Because of the supposed Asselian-Sakmarian age of the Bag-e-Vang Formation, Partoazar considered the beds of the Zaladu section, which we interpret as the Zaladu Member (Leven & Taheri 2003), as part of this formation. Although the beds contain Asselian and Gzhelian fusulinids, they do not belong to the Bag-e-Vang Formation, but they top the Sardar Formation.

In 2000 one of the authors (H. Vaziri) restudied the Jamal Formation of the Bag-e-Vang section and collected samples with microfauna. The samples were taken from 47 levels, and more than 400 thin sections were prepared. The fusulinid collection is stored in the Geological Institute (GIN) of the Russian Academy of Sciences, collection number GIN 4774. The foraminiferal analysis provided an unambiguous age interpretation of the whole Jamal Formation. Its lower part is called Bag-e-Vang Formation by Partoazar and Bag-e-Vang Member of the Jamal Formation by us.

The Bag-e-Vang section

The Bag-e-Vang section is located on the western slope of the Kuh-e-Bag-e-Vang, 4 km to the south-southwest of Shirgesht (Ruttner et al. 1968) (Fig. 1). The green-grey shaly mudstones and sandstones of the Sardar Formation are overlain with sharp contact by the Jamal Formation. There is no visible unconformity, although a stratigraphic hiatus is probable. The following stratigraphic sequence was recognized in the Jamal Formation (from bottom to top) (Fig. 2):

Unit 1. Grey intraclastic and bioclastic, cross-bedded limestones with quartzitic grains and fragments of fusulinids, crinoids and bryozoans (Sample B47). Thickness 1 m.

Unit 2. Intraformational conglomerate with calcareous pebble. Thickness 1 m.

Unit 3. Red shales. Thickness 3 m.

Unit 4. Marls with grey marly limestones (Samples B50 to B53). Thickness 15 m.

Unit 5. Shales with thin beds of grey biomicritic, oomicritic and fusulinid limestones (Samples B54 to B59). Thickness 30 m.

Unit 6. Massive bioclastic limestones (Samples B60 to B65). Thickness 10 m.

We interpret Units 1-6 (60 m thick) as the Bag-e-Vang Member of the Jamal Formation. As mentioned above, Partoazar identified these units as an independent formation with the same name. They differ from the overlying beds in their content of abundant and diverse organic remains. Preliminary identifications of conodonts, ammonoids, corals and brachiopods were given in Ruttner et al. (1968).

Unit 7. Grey, distinctly bedded, micritic and finely bioclastic limestones, almost devoid of identifiable fossils (Samples B66 to 113). Thickness 120 m.

Unit 8. Light yellowish-grey massive dolomitic limestones and dolomites with siliceous concretions. Thickness 30 m.

Unit 9. Dark grey distinctly bedded limestones (biomicrite and biosparite). Organic intraclasts increase in size upward in the section and more identifiable foraminifers are present accordingly (Samples B134 to B155). Thickness 80 m.

Unit 10. Light grey thickly-bedded dolomites and dolomitic limestones. Thickness 10 m.

In the Bag-e-Vang section, the Jamal Formation (including the Bag-e-Vang Member) has an overall thickness of 300 m. The topmost dolomites are overlain by shaly limestones and mudstones of the Lower Triassic Sorkh Shale Formation. The absence of observable signs of unconformity does not exclude a latent stratigraphic hiatus.

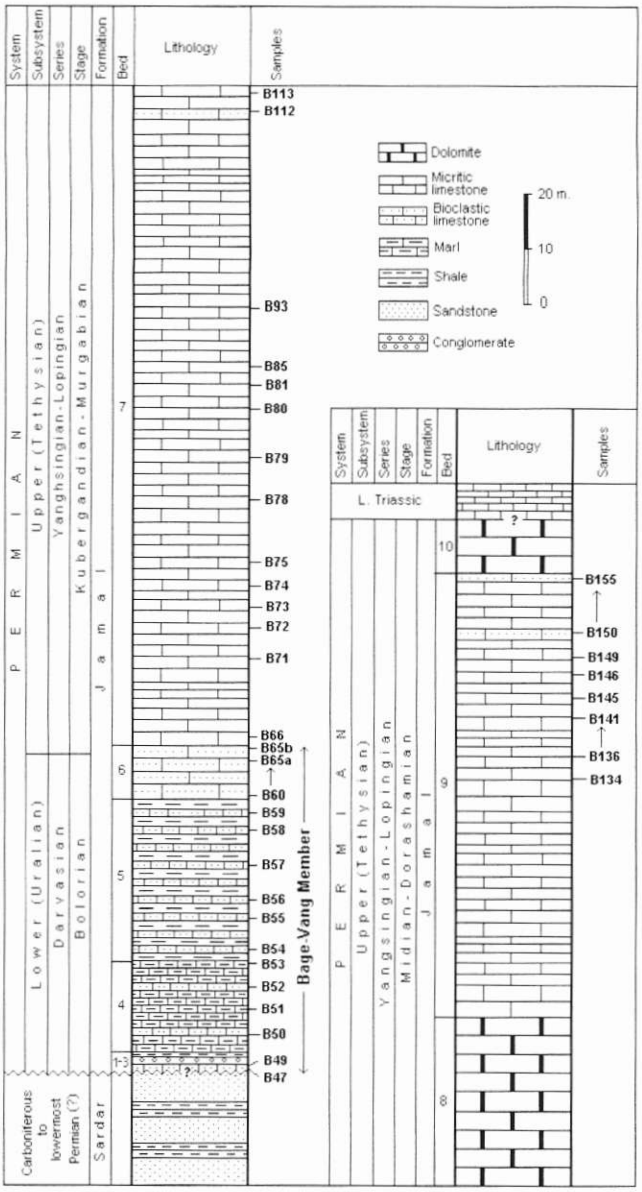

Fig. 2 - Bag-e-Vang section with location of the studied samples.

Foraminiferal assemblages and ages

The facies-dependent fusulinids have irregular distribution throughout the Jamal Formation (Table 1). They are most abundant and diverse in shallow-water bioclastic, locally oolitic, limestones of the Bag-e-Vang Member (60 m). Fusulinid samples were collected at 17 stratigraphic levels (B47-B65; Fig. 2), and 200 oriented sections were prepared. Higher in the section, beginning from unit 7, limestones and dolomites (240 m) are micritic, finely detrital and, probably, from a deeper-water environment. Samples (B66-B155; Fig. 2) were collected at 30 stratigraphic levels and 210 thin sections were prepared. Fusulinids were found only in few samples. Although more abundant, the smaller foraminiferal assemblage is oppressed and acquires relatively high abundance and diversity in the coarsely detrital limestones, beginning from sample B134 (Table 2).

In terms of both diversity and abundance, fusulinids are irregularly distributed throughout the Bag-e-Vang Member: a sample may contain a single specimen or be

	47	50	51	52	53	54	55	56	57	58	59	60	61	62	63	65a	65b	80	112	134	138	140	141	149	150	152	153	154	155
Reichelina sp.																													
pulchra K. M.-Maclay																		?					+			+			
turgida Sheng																				+	+			+			+	+	
Rauserella sp.																						+						+	+
Pamirina (Levenella) sp.				?	+													?					+						
leveni Kobayashi					aff.																								
Pamirina (Pamirina) sp.			+						+	+																			
darvasica Leven	+																												
Schubertella sp.				+	+		+		+		+																		
longiuscula Leven											+				+														
Mesoschubertella sp.			+																										
thompsoni Kan. et Sak.	+						+				cf.																		
Biwaella sp.			+																										
europae K-Dev. et Milan.	+																												
Toriyamaia																													
laxiseptata Kanmera							+		+																				
Neofusulinella sp.											+																		
lantenoisi Deprat																	+												
Yangchienia																													
primaris Leven	+																												
compressaeformis n. sp.														+															
Paradoxiella sp.																													
insueta n. sp.																												+	+
Darvasites																									+	+			
ordinatus (Chen)							+																						
minutus n. sp.							+																						
Acervoschwagerina																													
endoi Hanzawa															cf.														
Chalaroschwagerina																													
(Cuniculina) sp.						+																							
vulgarisiformis (Morikawa)							+	+								+													
hawkinsi (Dunb. et Skinn.)								+																					
globosaeformis (Leven)								+																					
Pseudofusulina																													
edelshteini Kalmykova	cf.																												
incomparabilis Leven	cf.																												
oingaroni Leven							aff.																						
Praeskinnerella																													
pseudogruperaensis Leven		+					+																						
Skinnerella																													
schucherti (Dunb. et Skinn.)								+																					
diversiformis (Dunb. et Skinn.)								+																					
japonica deprati Leven								aff.																					
chusenellaeformis n. sp.								+																					
Iranella																													
bella n. sp.								+																					
longa n. sp.								+																					
orbiculata n. sp.								+																					
pauca n. sp.								+																					
Leeina sp.																													
fusiformis (Schelw. et Dyhr.)							+	+																					
Paraleeina																													
postkraffti (Leven)								+								+													
edoensis (Ozawa)																			+										
Chusenella																													
schwagerinaeformis Sheng																			+										
Pseudochusenella																													
pavlovi (Leven)		+											+																
Rugosochusenella																													
davalensis Leven																+													
Misellina (Brevaxina)																													
dyhrenfirthi (Dutkevich)		+														+													
Misellina (Misellina) sp.																													
parvicostata (Deprat)												+		+		+													
claudiae (Deprat)																	aff.												
caucasica Leven												+		+			+												
megalocula Wang et Sun																	+												
termieri (Deprat)														aff.															
Armenina sp.																	+												
urtzensis Leven																	+												
Neoschwagerina sp.																			+										
Afghanella																													
schencki Thompson																			+										
Sumatrina sp.																			+										

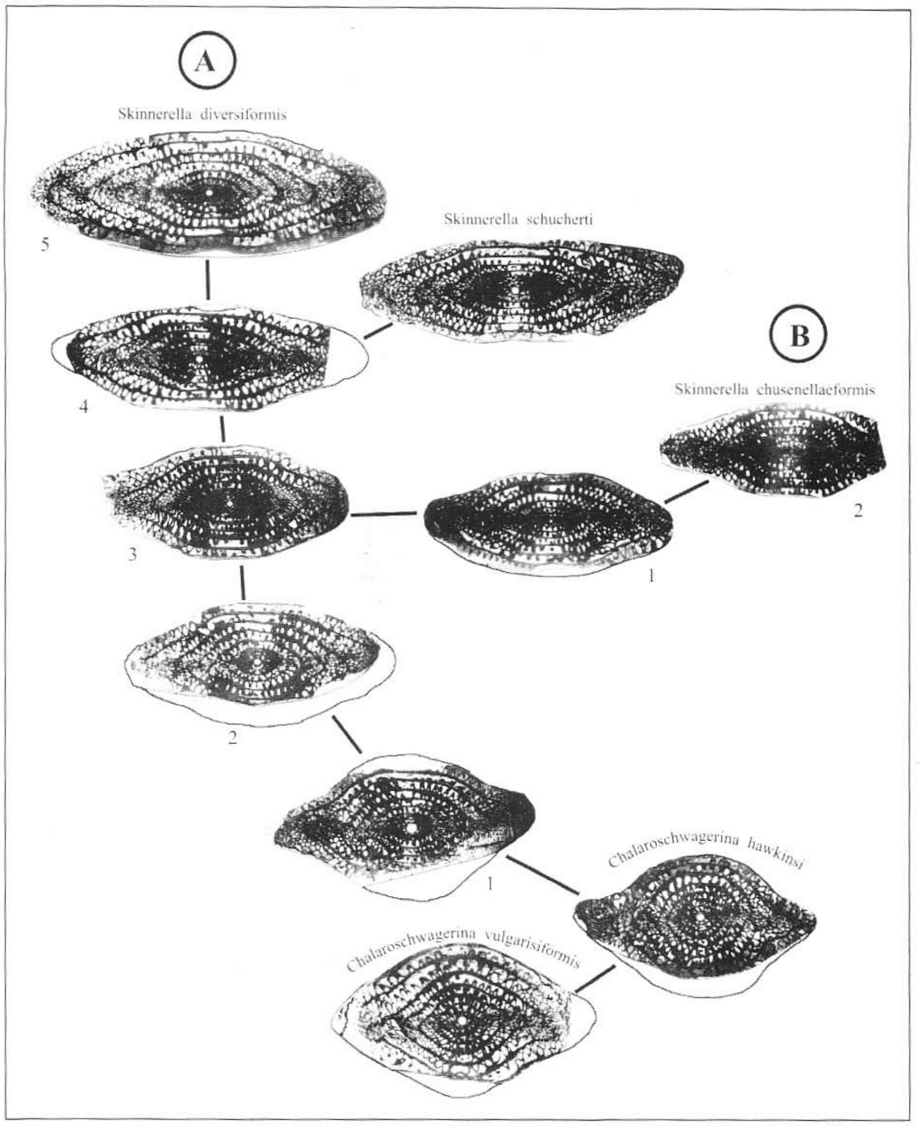

Fig. 3 - Morphological successions of *Skinnerella*-type and intermediate forms allied to *Chalaroschwagerina vilgarisiformis* from sample B56.

Therefore the assemblage cannot be dated more precisely than Yakhtashian-early Bolorian.

The most representative *Misellina-Chalaroschwagerina-Paraleeina* assemblage (samples B50-B65a) is undoubtedly of Bolorian age, as indicated by the occurrence of *Misellina*, which are represented by the *Brevaxina* subgenus in the lower part of the interval (the *Brevaxina dyhrenfurthi* Zone of the Bolorian Stage) and by species of the *Misellina* subgenus, such as *M.* (*M.*) *parvicostata* (Deprat), *M.* (*M.*) *termieri* (Deprat), and others (?), in the upper part (the *M. parvicostata* Zone of the Bolorian Stage). The associated set of genera and species, first of all *Toriyamaia laxiseptata* Kanmera, *Darvasites ordinatus* (Chen), *Leeina fusiformis* (Schellwien et Dyhrenfurth), *Paraleeina postkraffti* (Leven), and *Chalaroschwagerina vulgarisiformis* (Morikawa) (the complete list is given in Table 1) is also common in the Bolorian Stage.

The *Misellina-Armenina* assemblage was found only in sample B65b. It is distinguished from the preceding assemblage by the presence of the earliest *Armenina* and *Neofusulinella*, the higher diversity of *Misellina*, among which *Misellina* (*Misellina*) aff. *claudiae* (Deprat) and *M.* (*M.*) *megalocula* Wang et Sun appear, and the absence of all the typical Bolorian genera and species listed above. According to these peculiarities, the assemblage can be unambiguously referred to the base of the Kubergandian Stage of the Upper Permian (Tethysian), i.e. to the *Armenina-Misellia* Zone.

The fusulinid association detected in sample B56 is worth special consideration. Although belonging to the *Misellina-Chalaroschwagerina-Paraleeina* assemblage, it shows some peculiar features, which are described below.

Fusulinids of the bed marked by Sample B56 (0.2 m thick) are rock-forming. Tests overfilling form the

overcrowded with them (B56). Three successive fusulinid assemblages can be distinguished in stratigraphic succession from bottom to top: 1) *Pamirina-Mesoschubertella*, 2) *Misellina-Chalaroschwagerina-Paraleeina*, and 3) *Misellina-Armenina*.

The *Pamirina-Mesoschubertella* assemblage was detected in sample B47 and consists of *Pamirina (Pamirina) darvasica* Leven, *Mesoschubertella thompsoni* Kanuma et Sakagami, *Biwaella europae* Kochansky-Devidé et Milanovič, *Yangchienia primaris* Leven, *Sphaerulina* (?) sp., *Pseudofusulina* cf. *edelshteini* Kalmykova, and *P.* cf. *incomparabilis* Leven. All species are characteristic of the Yakhtashian type sections of Darvaz (Leven et al. 1992), but they are present also in the Bolorian deposits.

Tab. 1 - List of fusulinids from the studied section.

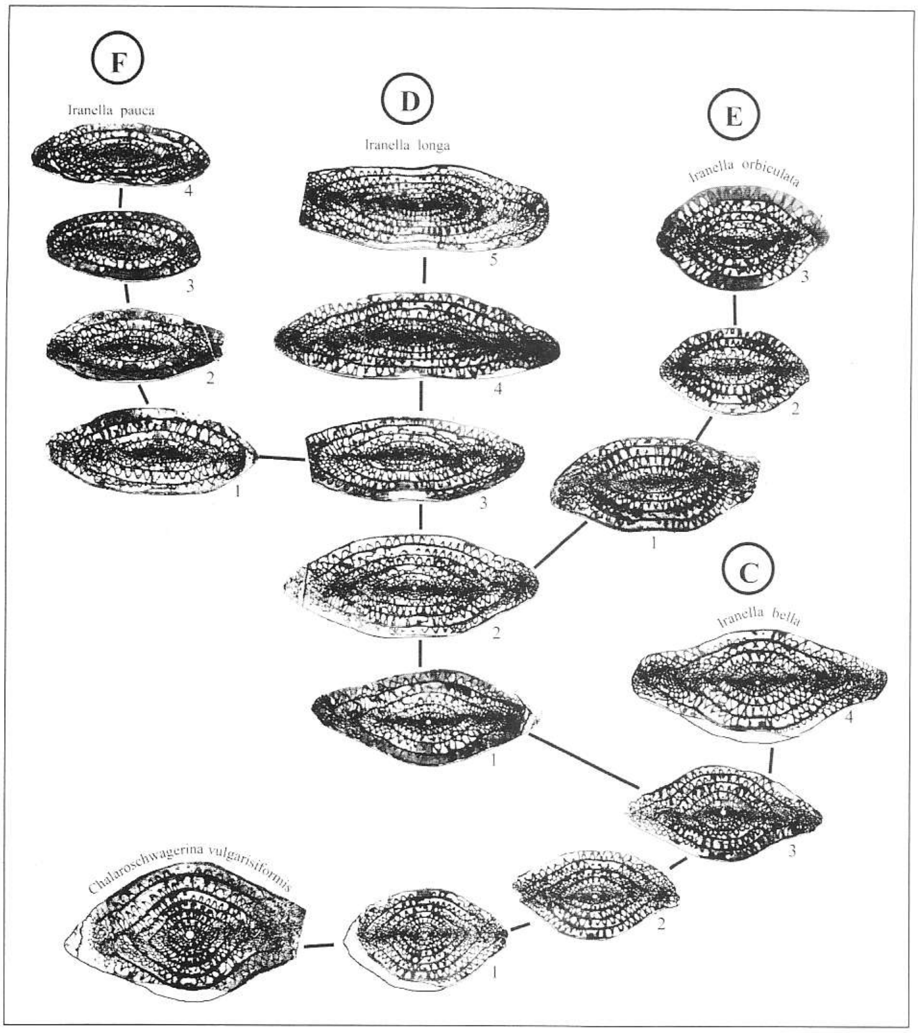

Fig. 4 - Morphological successions of *Iranella*-type and intermediate forms allied to *Chalaroschwagerina vulgarisiformis* from sample B56.

frame of the sample and can be easily separated. Oriented sections were prepared for approximately one hundred tests in good state of preservation. The prevailing, typically Bolorian, *Leeina*, *Paraleeina* and *Chalaroschwagerina* are accompanied by numerous tests which are different in shape and other morphological characters, but similar in intensive and relatively regular septal fluting and the presence of cuniculi in the two last whorls. All tests are somehow related to *Chalaroschwagerina*. It is obvious that the highly advanced *Ch. vulgarisiformis,* showing a large test, intensive septal fluting and cuniculi, gave rise to different lines (referred to by letters A to F) of radiation of morphological characters. This led to the appearance of new forms different from each other and from the initial species *Ch. vulgarisiformis*. These forms have many characters close to those of species of *Skinnerella, Parafusulina, Paraschwagerina*, and even *Chusenella*. Some lines of the morphological radiation are traced below (Figs. 3, 4).

The succession *Chalaroschwagerina vulgarisiformis-Ch. hawkinsi - A1 - A2 - A3 - A4 - A5* (Fig. 3) is characterized by gradual elongation of the test, more regular septal fluting and lateral thickening of septa with secondary calcite. The last three forms of the succession fully correspond to the diagnosis of the North American genus *Skinnerella* Coogan, 1960 and therefore we refer them to this genus. We are aware that by doing so we acknowledge the heterogeneity of this genus. It is unlikely that independently originated Iranian *Skinnerella* could migrate into Texas from the western Tethys in the late Early Permian, when the North American basin was isolated. Their migration in opposite direction is also improbable. Nevertheless, the Iranian and Texas *Skinnerella* show considerable specific similarity. Therefore in the description of *Skinnerella* from Iran we have to use the names of the American species, being unable to distinguish between them. As a result, the succession takes the following form: *Chalaroschwagerina vulgarisiformis - Ch. hawkinsi* - forms *A1-A3* similar to *Ch. hawkinsi* but with more elongate tests (Ross 1962, pl. 4, fig. 6) - *Skinnerella diversiformis* (Dunbar et Skinner) sensu Williams (1963) (*A4, A5*). The latter species is close to the forms virtually identical to a co-type of *Skinnerella schucherti* (Dunbar et Skinner, 1937), the type species of the genus *Skinnerella*.

All forms of the succession have a large proloculus. However, the branch *A3-B1-B2* demonstrates its decreasing to a small size. Form *B2* resembles some representatives of *Chusenella*, such as *Ch. conicocylindrica* (Chen). However, it cannot be excluded that this form is a microsphaeric specimen of form *A3*. We described it as *Skinnerella chusenellaeformis* n. sp.

The next succession *Chalaroschwagerina vulgarisiformis – C1 – C2 – C3 – C4* (Fig. 4) shows septal thinning and separation of tightly coiled juvenarium with no changes in general test outlines. Form *C4* resembles *Paraschwagerina,* comparable with the American *Paraschwagerina shuleri* Williams, 1963. However, *Paraschwagerina* has no cuniculi and does not occur in deposits younger than the Sakmarian. For these reasons, we recognize forms *C3* and *C4* as representatives of *Iranella bella* n. gen, n. sp.

The succession *C3 – D1 – D2 – D3 – D4 – D5* can also be attributed to the same genus. This succession is characterized by test elongation up to a subcylindrical form, separate juvenarium, and thin intensively fluted septa. The forms similar to *D2-D4,* but without cuniculi, are usually referred to *Paraschwagerina*, less frequently to *Schwagerina* or *Pseudofusulina*. From the neighboring section Kahler (1974) described a form similar to *D5,* but more elongate, and identified it with *Schwagerina hyperborea* (Salter). The extreme members of the succession (*D4* and *D5*) represent the new species *Iranella longa.*

Opposite to the test elongation recorded in succession D, the succession *D2 – E1 – E2 – E3* shows the shortening of the test to a round shape. We describe such forms as *Iranella orbiculata* n. sp. Finally, the succession *D3 – F1 – F2 – F3 – F4* is characterized by some shortening and decreasing in size of the test. The last members of the succession are described as *Iranella pauca* n. sp.

All forms of the successions C, D, E, and F (except for *C1*), which constitute the *Iranella* genus, show a great similarity to *Paraschwagerina* species, but they have cuniculi, less distinct juvenarium and they are younger in age. With the exception of transitional forms, the representatives of the new genus (for example, *C4, D5, E3* and *F4*) differ from each other so essentially that we have to refer them to different species, thus ignoring the principle of competitive exclusion. According to this principle, similar species are in competitive relationships and cannot exist together for a long time in the same biotope. In our case, all forms considered above are derived from a single thin (0.2 m.) bed. Certainly, we could refer them to one, very variable species rather than to different genera (*Chalaroschwagerina, Skinnerella, Iranella*) and species. In this case the systematics of fusulinids, that is based solely on morphological characters, should be revised. This cannot be done, especially if frequently heterochronous homeomorphism is taken into consideration. Therefore we preferred the traditional approach in spite of its formal character.

As mentioned above, the identifiable fusulinids from unit 7 (samples B66 to B112) were found only in sample B112. This sample contains *Neoschwagerina, Afghanella*, and *Sumatrina* that are typical Murgabian genera. According to their morphology, these genera can be referred to the middle part of the Murgabian. *Paraleeina edoensis* (Ozawa) and *Chusenella schwageriniformis* (Sheng) are characteristic of the lower half of the Murgabian Stage of Japan and China (Toryiama 1958; Sheng 1963). Rare smaller foraminifers from unit 7 are represented by 12 genera of wide stratigraphic range (Table 2). The stratigraphic position of unit 7 suggests its upper Kubergandian-Murgabian age.

Regretfully, no thin sections of samples B114-B133 from unit 8 and the lower part of unit 9 were prepared. Therefore we were unable to define foraminiferal assemblages from this interval. Field observations do not suggest an increased abundance and diversity of the assemblages because the interval is mostly composed of dolomites. The overlying interval, from sample B134 up to sample B155, is composed of detrital limestones containing numerous foraminifers (Tables 1 and 2). Fusulinids are represented almost exclusively by species of *Reichelina*. A specimen resembling *Rauserella* was found in sample B141. Beginning from sample B150, rare *Paradoxiella* forms that constitute a new species *Paradoxiella insueta* appear. Among smaller foraminifers, it is worth mentioning the presence of abundant *Colaniella,* represented by the advanced *C. parva* (Colani) and *C. inflata* Wang. The species *Rectostipulina* sp., *Paraglobivalvulina mira* Reitlinger, *Hemigordiopsis renzi* Reichel, *Multidiscus padangensis* (Lange), *Frondina permica* Civrieux et Dessauvagie, *Langella perforata langei* Civrieux et Dessauvagie, *Pseudolangella dzhagadzurensis* Pronina are of interest for the purpose of dating.

The composition of the assemblage does not permit dating it with confidence. Undoubtedly, the assemblage is not older than the Dzhulfian. However, most of the listed species occur also in younger deposits up to the Dorashamian. Consequently, up to recent times some *Colaniella* species were considered to be peculiar to the Dorashamian deposits (the *Colaniella parva* Zone; Ishii et al. 1975). Today, stratigraphic ranges of *Colaniella*, including the characteristic Dorashamian species (Jenny-Deshusses & Baud 1989), tend to be extended down to the Dzhulfinian and even Midian stages. However, this tendency is not based on correct data. In all the instances when the beds with *Colaniella parva* are precisely dated by means of conodonts and ammonoids (South China), they appear to be confined to the Dorashamian (Changhsingian) Stage. This suggests that the upper part of unit 9 is of Dorashamian age. This is especially true for the topmost dolomites of the Bag-e-Vang section (unit 10), which are overlain without a visible unconformity by Lower Triassic deposits.

Correlation

Problems in the correlation of the Jamal Formation, as well as in its lower part, the Bag-e-Vang Member, were considered in the paper on the Gzhelian-Asselian deposits of the Ozbak-Kuh area (Leven & Taheri 2003). The present paper discusses these problems in detail. The Bag-e-Vang Member can be reliably recognized only in the Shirgesht area. According to Ruttner et al. (1968), it can be correlated with the so called "basal beds" (65.1 m thick) of the neighboring Kuh-e-Shesht Agosht section. The correlation is based on similarities in lithological composition and fusulinid content (Kahler 1974). The thickness of the Jamal Formation increases eastward. In the Deh Mohammad section, located 20 km to the east

	66 -69	71	72	73	74	75	78	79	80	81	85	93	134	136	137	138	139	140	141	145	146	149	150	151	152	153	154	155
Eotuberitina sp.			+				+	+																				
Tuberitina sp.		+	+	+	+	+	+			+		+				+	+				+				+			
Rectostypulina sp.														+						+								
Lasiodiscus sp.																			?								?	
Glomospira sp.				+	+	+	+	+	+					+		+			+		+	+				+	+	
Cornuspira sp.		+																										
Agathammina sp.							+																					
Globivalvulina sp.					+	+	+									+	+		+		+							
Paraglobivalvulina																												
mira Reitlinger																					+							
Hemigordius sp.														?									+		+	+		
Hemigordiopsis																												
renzi Reichel																							+	+				
Kamurana sp.																								?				
Multidiscus																												
padangensis (Lange)																									+			
Baisalina sp.																									+	?		
consueta Sosnina																												
Pseudobaisalina sp.																									+		+	
Calcivertellinae gen. indet.																			+									
Nodosaria sp.					+	+				+	+			+	+	+					+						+	
dozenkoae Sosnina																	+											
primoriensis Sosnina																	+		+									
Frondina sp.																+	+											
permica S. de C. et Dess.																			+									
Pseudolangella																												
dzhagadzurensis Pronina																												+
Langella																												
perforata langei S. de. C.. et Dess.																												+
Pachyphloia sp.							+						+			+							+		+		+	
minutissima Sosnina																							+					
Geinitzina sp.				+	+	+			+		+				+	+			+									
richteri K. M.-Maclay																							+					
Astacolus sp.																?												
Colaniella sp.															+		+					+		+	+	+		
media K. M.-Maclay													cf.															
parva (Colani)																												+
inflata Wang																						cf.						
Reitlingeria																												
vediensis Pronina																						+	+					
Dagmarita sp.						?		?	+		+			+		+	+		+					+	+			
chanakchiensis Reitlinger													+				+										+	
Textularidae gen. indet.									+																			
Climacammina sp.																								+				
Cribrogenerina sp.																	+						+					
Endothyridae gen. indet.		+					+		+																			
Bradyina sp.		+												?	?		?		?									
Neoendothyra sp.																	+						+	+			+	
reicheli Reitlinger																									+		+	+
Partizania sp.											+		+															

Tab. 2 - List of small foraminifers from the studied section.

of the section under consideration, the formation is up to 735 m in overall thickness. The lower third of the formation is supposed to be correlative with the Bag-e-Vang Member. It is also represented by shallow-water biogenic limestones with abundant and diverse fossils including fusulinids, which, unfortunately, have not been identified. There are still fewer data to recognize the Bag-e-Vang Member outside the Shirgesht area. It is not excluded that this stratigraphic unit corresponds to the lower third of the Jamal Formation of the stratotype section in the Shotori Range area to the east of Tabas. At the top of this interval, Jenny-Deshusses (1983) found the early Kubergandian *Armenina* (*Misellina*? sp. and *Neoschwagerina schuberti* of Jenny) characteristic of the uppermost beds of the Bag-e-Vang Member of the Bag-e-Vang section.

Being well characterized by abundant typical Bolorian fusulinids, the age equivalents of the Bag-e-Vang Member are readily recognized throughout the Tethys, from the Transcaucasia in the west to Japan in the east. In Central Iran (the Abadeh area) these are the basal beds of the Surmaq Formation with *Misellina, Chalaroschwagerina*, and *Darvasites* (Taraz 1974; Kobayashi and Ishii 2001). The Davaly Formation of Armenia contains the same fusulinid genera. Everywhere the fusulinid-bearing beds occur at the base of thick carbonate sequences lying transgressively on Devonian, Carboniferous and Lower Permian deposits. The lower surface of the limestones is diachronous and the Bolorian deposits corresponding to the Bag-e-Vang Member are missing in some sections, which begin with the Kubergandian limestones. This pattern observable in the Transcaucasia (Leven 1998) is quite probable in eastern Central Iran as well.

This pattern of the Permian successions generally characterizes the southern Peri-Gondwana regions of the Tethys. The Bolorian (and probably, upper Yakhtashian) deposits begin the transgressive carbonate platforms of South Afghanistan (Leven 1997) and the southern Pamirs (Leven 1967). Bolorian fusulinids were found at the base of many transgressive series of China and Japan (Leven 1994). The Bag-e-Vang Member corresponds to the Luodinian Stage of China (Sheng & Jin 1994) and to the upper part of the Sakamotozawa Stage in Japan (Kanmera & Mikami 1965).

The correlation of the Bag-e-Vang Member inside the Tethyan regions does not present any difficulties in contrast to the remaining, larger part of the Jamal Formation which is poorly characterized by fossils. The interval above the Bag-e-Vang Member can be correlated to the Surmaq, Abadeh and Hambast Formations of Central Iran (Iranian-Japanese Group 1981), the Ruteh and Nesen Formations of Alborz (Jenny-Deshusses 1983), the Asni, Gnishik, Arpa, Khachik and Akhura Formations of the Transcaucasia (Leven 1998), and the Chohan Group of Central Afghanistan (Leven 1997).

The data provided in this article are of great importance for correlations of Tethyan and North American stages. The Bolorian Stage of the Tethyan scale is commonly considered to be correlative to the Cathedralian Stage of the North American scale because conodonts characteristic of the Cathedralian of Texas (*Neostreptognathodus exculptus, N. idahoensis*) were detected in the Bolorian beds of the southeastern Pamirs. In addition, the basal beds of the Kubergandian Stage of the southeastern Pamirs (the *Armenina-Misellina ovalis* Zone) contain ammonoids typical of the Roadian Stage of Texas, which succeeds the Cathedralian Stage (Leven 2001b). Roadian ammonoids are known also from the Upper Kubergandian beds of Afghanistan (Termier et al. 1972). Because the direct fusulinid-based correlation of the Tethyan and North American sections is hampered by provincial differences, the correlation is usually based on ammonoids and conodonts. However, the fusulinid evidence offers different conclusions. No fusulinid species resembling to some extent the Bolorian species of the Tethys were found in the Cathedralian Stage of Texas. They occur, though, in the underlying Hessian and Lenoxian deposits. Many of them (*Chalaroschwagerina hawkinsi, Skinnerella schucherti, S. diversiformis* and some other) are present in the Bag-e-Vang Member. The same or morphologically similar forms are known from the Hess Formation of the Glass Mountains, the Alacran Mountain Formation of the Hueco Mountains, and the lower part of the Bone Spring Formation of the Siera Diablo Mountains (Ross 1962; Williams 1963; Dunbar & Skinner 1937). So, if heterochronous homeomorphism is excluded, the Bolorian Stage, as well as Yakhtashian and Kubergandian, appear to be older than the correlative American stages when the correlation is based on fusulinids but not on conodonts and ammonoids. This conclusion is directly related to the usage of the recently accepted Global Chronostratigraphic Scale in the Permian studies of the Tethys. The Artinskian and Kungurian Stages of the Scale are correlated to the Yakhtashian and Bolorian Stages of the Tethyan scale by reference to the American ammonoid- and conodont-based subdivisions. However, the data on these faunal groups are in disagreement with those on fusulinids. It is not clear yet what should be preferred. This is a problem that needs additional studies.

Conclusions

1. The Permian deposits in the Bag-e-Vang section of the Shirgesht area are represented by the Jamal Formation. Its lower part, named the Bag-e-Vang Member, is rich in diverse fossils and can be related to the Bolorian-lowest Kubergandian (probably, with basal Yakhtashian beds). The larger, upper part is poorly characterized by faunal content and cannot be dated more precisely than the Kubergandian-Dorashamian.

2. A gap is probable between the Bag-e-Vang Member and the underlying Sardar Formation. To the south, in the Ozbak-Kuh area, the uppermost limestones of the Sardar Formation (the Zaladu Member) bear Gzhelian and Asselian fusulinids. These limestones are missing in the section under study. This would prove a supposed gap between the Sardar Formation and the Bag-e-Vang beds. However, it is not excluded that in this section the Gzhelian-Asselian limestones were replaced by sandstones and shales of the Sardar Formation. In this case the probability of a gap is diminished or it is minor.

3. The Jamal Formation is correlated to the transgressive carbonate platforms of Central Iran, Elburz, Transcaucasia and southern Afghanistan. Everywhere they begin with the Bolorian deposits.

4. The similarity between many fusulinid forms of the Bage-Member and those of Texas, USA, calls for to either modify the accepted correlation between Tethyan and American stages by lowering the position of the former, or admit a heterochronous homeomorphism of some fusulinid taxa.

Descriptions of fusulinids

Order **Ozawainellida** Solovieva, 1980

Family Ozawainellidae Thompson et Foster, 1937

Genus *Reichelina* Erk, 1942

Reichelina pulchra K. Miklukho-Maclay, 1954

Pl. 1, figs 1-5

1954 *Reichelina pulchra* K. Miklukho-Maclay, p. 74-75, pl.16, fig. 6, 7, 9, 11.

Material. 12 axial and tangential sections.

Distribution and age. North Caucasus, Iran, Pamir, China, Indochina, Japan, New-Zealand; Late Permian (Tethysian), Lopingian.

Occurrence. Bag-e-Vang, upper part of the Jamal Formation, samples B134, B138, B149, B153, B154.

Reichelina turgida Sheng, 1963

Pl. 1, figs 6, 7

1963 *Reichelina turgida* Sheng, p.148, pl.1, fig. 17, 18.

Material. 1 axial, 2 subaxial and 5 tangential sections.

Distribution and age. China, Iran; late Permian (Tethysian), Lopingian.

Occurrence. Bag-e-Vang, upper part of the Jamal Formation, samples B140, B154 and B155.

Genus *Pamirina* Leven, 1970

Subgenus *Levenella* Ueno, 1991, emend Ueno, 1994

Pamirina (Levenella) aff. **leveni** Kobayashi, 1977

Pl. 1, fig. 8

1977 *Pamirina leveni* Kobayashi, p.11-14, pl.1, fig.13-38.

Material. 1 axial and 3 tangential sections.

Distribution and age. Japan, China, Thailand, Darvaz, Iran; Early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B53.

Subgenus *Pamirina* Leven, 1970

Pamirina (Pamirina) darvasica Leven, 1970

Pl. 1, fig. 9

1970 *Pamirina darvasica* Leven, p. 23-24, pl. 1, fig. 1-12, 23, 24.

Material. 1 axial and several oblique sections.

Distribution and age. Darvaz, China, Indochina, Japan, Afghanistan, Iran, Turkey, Carnic Alps; Early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang member, sample B47.

Order **Schubertellida** Skinner, 1931

Family Schubertellidae Skinner, 1931

Genus *Schubertella* Staff et Wedekind, 1910

Schubertella longiuscula Leven, 1992

Pl. 1, fig. 10

1992 *Schubertella longiuscula* Leven in Leven et al., p. 65-66, pl. 1, fig. 17, 18.

Material. 1 axial and 1 subaxial sections.

Distribution and age. Darvaz, Afghanistan, Iran; Early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B59 and B63.

Genus *Mesoschubertella* Kanuma et Sakagami, 1957

Mesoschubertella thompsoni Kanuma et Sakagami, 1957

Pl. 1, figs 11-15

1957 *Mesoschubertella thompsoni* Kanuma et Sakagami, p. 43-44, pl. 8, fig 1-10.

Material. 7 axial and subaxial sections.

Distribution and age. Japan, Indochina, Darvaz, Iran; Early Permian, (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B47 and B55.

Family Biwaellidae Davydov, 1984

Genus *Biwaella* Morikawa et Isomi, 1960

Biwaella europae Kochansky-Devidé et Milanovič, 1962

Pl. 1, figs 16, 17

1962 *Biwaella europae* Kochansky-Devidé et Milanovič, p. 206-207, 225, pl. 1, fig.7-12.

Material. 1 axial and 2 subaxial sections.

Distribution and age. Slovenia, Austria, Hungary, Darvaz, Iran; Early Permian (Cisuralian), Sakmarian and Yakhtashian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B47.

Genus *Toriyamaia* Kanmera, 1956

Toriyamaia laxiseptata Kanmera, 1956

Pl. 1, fig. 20

1956 *Toriyamaia laxiseptata* Kanmera, p. 252-255, pl. 36, fig. 1-14

Material. 2 subaxial sections.

Distribution and age. Japan, China, Indochina, Sumatra, Darvaz, Afghanistan, Iran, Turkey; early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B55 and B57.

Genus *Neofusulinella* Deprat, 1912

Neofusulinella lantenoisi Deprat, 1913

Pl. 1, fig. 18, 19

1913 *Neofusulinella lantenoisi* Deprat, p. 41-42, pl. 7, fig 23-25

Material. 3 subaxial sections.

Distribution and age. China, Indochina, Sumatra, Japan, Pamir, Afghanistan, Iran, Transcaucasus, Crimea, Turkey; late Permian (Tethysian), Kubergandian and Murgabian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B65b.

Family Yangchienidae Leven, 1987

Genus *Yangchienia* Lee, 1933

Yangchienia primaris Leven, 1992

Pl. 1, fig. 21

1992 *Yangchienia primaris* Leven in Leven et al., p. 69, pl. 1, fig. 30.

Material. 1 axial section.

Distribution and age. Darvaz, Iran; Early Permian (Cisuralian), Yakhtashian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B47.

Yangchiensis compressaeformis Leven, n. sp.

Pl. 1, figs 22, 23

Holotype. GIN 4774/23, subaxial section; Iran, Bag-e-Vang, Bag-e-Vang Member, sample B62; Early Permian (Cisuralian), Bolorian.

Material. 2 subaxial sections.

Description. Shell small, fusiform, with convex lateral slopes and bluntly pointed poles. Mature individuals have 5 to 5.5 whorls and measure 0.92 to 1.0 mm in length and 0.5 mm in diameter; form ratio 1.84 to 2.00. First 1.5 to 2 whorls evolute and coiled at large angle to outer ones. Spirotheca thin (not more 0.01 mm) and undeterminated. Septa unfluted. Proloculus very small; its outside diameter 0.04 mm. Tunnel low and rather wide. Chomata massive, extending almost to polar ends.

Discussion. *Yangchienia compressaeformis* Leven, n. sp., as well as *Y. primaris* Leven, is the oldest and most primitive representative of the *Yangchienia* genus and distinguished from other species by smaller size, few whorls and poorly structurated spirotheca. The described specimens differ from *Y. primaris* for their more compact coiling of spiral and less inflated shell.

Occurrence and age. Bag-e-Vang, Bag-e-Vang Member, sample B62; Early Permian (Cisuralian), Bolorian.

Family Palaeofusulinidae A. Miklukho-Maclay, 1963

Genus *Paradoxiella* Skinner et Wilde, 1955

Paradoxiella insueta Leven, n. sp.

Pl. 1, figs 24, 25

Holotype. GIN 4774/23, subaxial section; Bag-e-Vang, upper part of Jamal Formation; Late Permian (Tethysian), Lopingian.

Etymology. *Insuetus* (lat.) - uncommon, extraordinary.

Material. 1 subaxial and 2 sagittal sections.

Description. Shell minute; first 1 to 1.5 whorls coiled at large angle to next 1 to 1.5 planispiral and fusiform whorls. Wide and fan-shaped whorl embraces all preceding whorls. The axial section of a mature test looks like a butterfly with extended wings. Its length 2.3 mm, diameter 1 mm, form ratio 2:3. Spirotheca thin and composed of tectum and protheca (?). Septa thin and intensely fluted throughout.

Discussion. *Paradoxiella insueta* n. sp. differs from *P. pratti* Skinner et Wilde, which has a different morphology and from *P. skinneri* Lys by the smaller size.

Occurrence. The same as holotype.

Order **Schwagerinida** Solovieva, 1985

Remarks. The existing systematics of the Order Schwagerinida, including the systematics of Rauzer-Chernousova et al. (1996) accepted herein, are to great extent of formal character. They are based on separate morphological characters (or their combination) without due regard for phylogenetic relationships between taxa and frequent homeomorphism. The formal approach results in that allied species are attributed to different genera and even families and vice verse. The example is provided by fusulinids from the sample B56 that are allied to *Chalaroschwagerina vulgarisiformis*. Their attribution even to different genera (*Chalaroschwagerina, Skinnerella, Iranella*) is disputable. Moreover, according to the formal diagnoses, they fall into different families: the two former genera belong to Pseudofusulinidae and Polydiexodinidae respectively and the latter one, to Schwagerinidae (Rauzer-Chernousova et al. 1996). Because the identification of several species and genera among allied forms of the same population is doubtful, their attribution to different families seems still more risky. Taking this into account and being unable to divide the Order Schwagerinida into families, we describe the genera without assigning to certain families.

Genus *Darvasites* A. Miklukho-Maclay, 1959

Darvasites ordinatus (Chen, 1934)

Pl. 1, fig. 26

1934 *Triticites ordinatus* Chen, p. 38-39, pl. 7, fig. 5-7.

Material. 1 subaxial section.

Distribution and age. China, Japan, Viet-Nam, Pamir, Afghanistan, Iran, Armenia, Turkey; Early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B55.

Darvasites minutus Leven n. sp.

Pl. 1, figs 27, 28

Holotype. GIN 4774/26, axial section; early Permian (Cisuralian), Bolorian; Bag-e-Vang, Bag-e-Vang Member, sample B55.

Etymology. *Minutus* (lat.) - small.

Material. 3 axial and several tangential and oblique sections.

Description. Shell small, subcylindrical, with bluntly rounded poles. Mature individuals have 5.5 to 7 volutions, and measure 2.15 to 2.45 mm in length and 0.9 to 1.0 mm in diameter; form ratio 2.4 to 2.45. Spirotheca composed of tectum and fine alveolar keriotheca, 0.04 mm in thickness in last volution. Septa regularly fluted from pole to pole. Septal folds low leaving upper part of each septum nearly plane. Proloculus rather small, its outside diameter 0.1 to 0.15 mm. Tunnel wide and about 0.5 as high as chambers. Clear chomata present in all volutions.

Discussion. *Darvasites minutus* n. sp. differs from other *Darvasites* in combination of its small size, subcylindrical shell, not intensive septal fluting and clear chomata.

Occurrence and age. The same as holotype.

Genus *Acervoschwagerina* Hanzawa, 1949

Acervoschwagerina cf. **endoi** Hanzawa, 1949.

Pl. 2, fig.1

1949 *Paraschwagerina (Acervoschwagerina) endoi* Hanzawa, p. 205-209, pl. 43, fig.1-3.

Material. 1 sagittal section.

Remarks. The described specimen differs from the holotype and topotype of *Acervoschwagerina endoi* Hanzawa in its thicker spirotheca.

Distribution and age. Japan, Koryak Range, Iran; early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B63.

Genus *Chalaroschwagerina* Skinner et Wilde, 1965

Remarks. In the Permian deposits of the Tethys there are many forms with distinct cuniculi, which are almost undistinguishable from *Chalaroschwagerina*, although the initial diagnosis of this genus (Skinner & Wilde 1965) did not indicate the presence of cuniculi. In addition, such forms show more regular fluting of septa, which are frequently thickened with secondary calcite. Morikawa (1952) who was the first to describe these forms, referred them conventionally to the genus *Parafusulina* (*Parafusulina ? vulgarisiformis* Morikawa). Analogous forms were later detected in southeastern Pamirs (Leven 1967) and Darvaz (Leven et al. 1992) and attributed to *Chalaroschwagerina*. Their evolution after the earliest *Chalaroschwagerina* suggests a higher evolutionary level, which permits us to establish an independent subgenus *Chalaroschwagerina (Cuniculina)* Leven subgen. nov. with type species *Ch. (C.) vulgarisiformis* (Morikawa). The presence of cuniculi distinguishes it from the subgenus *Chalaroschwagerina (Chalaroschwagerina)* Skinner et Wilde, 1965. In addition to the type species, the new subgenus consists of *Ch. (C.) kushlini* (Leven, 1967), *Ch. (C.) globosaeformis* (Leven, 1967) and, probably, *Ch. (C.) hawkinsi* (Dunbar et Skinner, 1937).

Chalaroschwagerina (Cuniculina)

vulgarisiformis (Morikawa, 1952)

Pl. 2, figs 2-6

1952 *Parafusulina ? vulgarisiformis* Morikawa, p. 31, pl. 1, fig. 1-4.

Material. 5 axial, 7 tangential and oblique sections.

Distribution and age. Japan, China, Indochina, Pamir, Darvaz, Afghanistan, Iran; Early Permian (Cisuralian), Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B55, B56 and B65a.

Chalaroschwagerina (Cuniculina)

globosaeformis (Leven, 1967)

Pl. 2, fig. 7

1967 *Parafusulina globosaeformis* Leven, p.176-177, pl. 27, fig 2, 3 and 5.

Material. 1 axial section.

Distribution and age. SE Pamir, Iran; early Permian (Cisuralian), Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B56.

Chalaroschwagerina (Cuniculina?)

hawkinsi (Dunbar et Skinner, 1937)

Pl. 2, fig. 8

1937 *Schwagerina hawkinsi* Dunbar and Skinner, p. 632, 633, pl. 59, fig. 56, fig. 15, 16.

Material. 1 axial section.

Remarks. The descriptions of representatives of the species from North America, including the type ones, do not indicate the presence of cunicula. This does not justify their assignment to the *Cuniculina* subgenus. However, cunicula are only observable in tangential sections and cannot be noticed if not specially looked for.

Distribution and age. U.S.A. (Texas), Japan, Iran; early Permian (Cisuralian), Bolorian in the Tethys and Hessian in the Texas.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B56.

Genus *Praeskinnerella* Bensh, 1987

Praeskinnerella pseudogruperaensis Leven, 1992

Pl. 2, fig. 9; pl 3, fig. 2

1992 *Praeskinnerella pseudogruperaensis* Leven in Leven et al., p. 104-105, pl. 25, fig. 1, 2.

Material. 2 axial sections.

Distribution and age. Darvaz, Iran; Early Permian (Cisuralian), Yakhtashian, Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B50 and B55.

Genus *Skinnerella* Coogan, 1960

Skinnerella schucherti (Dunbar et Skinner, 1937)

Pl. 3, figs 1, 3

1937 *Parafusulina schucherti* Dunbar et Skinner, p. 672-674, pl. 64, fig. 9-12.

Material. 2 axial sections.

Distribution and age. Texas (the lower part of the Bone Spring Formation), Iran; Early Permian (Cisuralian), Hessian, Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B56.

Skinnerella diversiformis

(Dunbar et Skinner, 1937) sensu Williams, 1963

Pl. 3, figs 4, 5

1937 *Schwagerina diversiformis* Dunbar et Skinner, p. 647-648, pl. 60, fig. 1-7.

1960 *Schwagerina diversiformis* Williams, p. 54-55, pl. 13, fig 1-4.
1974 *Parafusulina* cf. *formosa* Kahler, p. 97-98, pl. 2, fig 8.

Material. 3 axial sections.

Remarks. The species diagnosis does not include the presence of cunicula, probably because they are difficult to find out. The *Schwagerinidae* forms with intensive, high and regular septal fluting that are peculiar to the species under description have cunicula, which are only observable in certain sections and most frequently in oriented sections.

Distribution and age. Texas (the Alacran Mountain Formation of the Hueco Limestone), Iran; Early Permian (Cisuralian), Hessian, Bolorian. Some forms, very similar to *S. diversiformis*, were described from the different part of Tethys from the Bolorian, Kubergandian and Murgabian deposits. There are *Schwagerina multiseptata* Schellwien sensu Deprat, 1912, *Parafusulina iwasensis* Morikawa et Isomi sensu Igo, 1965, *P. yabei* Hanzawa, 1942 and others. But there is not confidence in belonging all of these forms to single species.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B56.

Skinnerella aff. **japonica deprati** Leven, 1998

Pl. 3, fig. 8

1914 *Fusulina japonica* Deprat (part), pl. 1, fig. 1.
1998 *Parafusulina (Skinnerella) japonica deprati* Leven in Leven & Campbell, p. 151, 153; fig. 3, A, B, G-K.

Material. 2 axial sections.

Distribution and age. Japan, New Zealand, Iran; early Permian (Cisuralian), Bolorian; late Permian (Tethysian), Kubergandian and Murgabian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B56.

Skinnerella chusenellaeformis Leven, n. sp.

Pl. 3 fig. 7; pl. 4, fig. 1

Holotype. GIN 4774/42; axial section; Iran, Bag-e-Vang, Bag-e-Vang Member, sample B56; Early Permian (Cisuralian), Bolorian.

Etymology. Similar in shape to *Chusenella*.

Material. 2 axial sections.

Description. Shell inflated fusiform, central portion thickly cylindrical, with bluntly pointed, conical poles. Mature specimens have 8 to 8.5 volutions and measure 10 to 11 mm in length and 3.8 to 4.5 mm in diameter; form ratio 2.4 to 2.6. First 2 to 2.5 whorls tightly coiled, after which coiling becomes moderately loose. Spirotheca composed of tectum and finely alveolar keriotheca 0.1 to 0.15 mm thick in eight volution. Septa strongly and regular fluted from pole to pole. Septal folds narrow and high, extending to tops of septa, which are thickened throughout most of shell by deposits of secondary material; this is particularly conspicuous in polar regions of third to six volutions where it nearly fills shell. Cuniculi observed in last three volutions; phrenothecae developed at times. Proloculus small, its outside diameter 0.112 to 0.150 mm. Tunnel low and narrow. Chomata very weak, present only on proloculus.

Discussion. *Skinnerella chusenellaeformis* n. sp. differs from the other *Skinnerella* in its small proloculus and test coiling of first volutions.

Occurrence and age. The same as holotype.

Genus *Iranella* Leven, n. gen.

Type-species: *Iranella bella* Leven, n. sp.

Description. Shell of moderate to large size, inflated fusiform to subcylindrical, with straight axis and sharply to bluntly rounded poles. Mature specimens usually possess 6.5 to 8 whorls and are bilaterally symmetrical at all stages of growth. Proloculus small. First 2 to 3.5 whorls constitute tightly coiled juvenarium, which is terminated by abrupt expansion into loosely coiled adult stage. Spirotheca composed of tectum and keriotheca. Septa strongly but somewhat irregularly fluted throughout shell. Septal folds high, extending to top septa. Low cuniculi developed from four or five volutions. Phrenothecae weak or absent. Weak axial filling present only in juvenarium. Tunnel low and narrow. Small chomata sometimes present on the proloculus.

Discussion. *Iranella* n. gen is very similar to *Paraschwagerina* Dunbar et Skinner in many aspects, but the latter has not cuniculi. Besides, the age of true *Paraschwagerina* is older (Asselian and Sakmarian). In addition to the species described in this article, the genus includes a specimen derived from the Bolorian deposits of Japan and referred by Morikawa & Isomi (1961) to the American species *Paraschwagerina gigantea* (White). All species of the genus *Iranella* described below are connected by transitional forms with *Iranella bella* n. sp., which is gradually changed to *Chalaroschwagerina (Cuniculina) vulgarisiformis* (Morikawa) (Fig. 4).

Distribution and age. Iran, Darvaz, Japan (?); Early Permian (Cisuralian), Bolorian.

Iranella bella Leven n. sp.

Pl. 4, figs 2, 3

Holotype. GIN 4774/47; axial section; Iran, Bag-e-Vang, Bag-e-Vang Member; early Permian (Cisuralian), Bolorian.

Etymology. Bellus (lat.) - beautiful.

Material. 2 axial sections.

Description. Shell medium of size, inflate fusiform, with concave lateral slopes and bluntly pointed poles. Mature individuals 6.5 to 7 volutions, all except first 2 to 2.5 loosely coiled. Such specimens measure 9 to 12 mm in length and 4.2 to 5.2 mm in diameter; form ratio varies from 2.1 to 2.3. Spirotheca composed of tectum and moderately coarse keriotheca, its thickness in sixth whorl is 0.1 to o.15 mm. Weak phrenothecae present. Septa strongly fluted from pole to pole; septal folds broad and high, extending to tops of septa. Proloculus small, its outside diameter is 0.25 mm. Tunnel low and narrow. Weak secondary deposits observed in juvenarium.

Discussion. *Iranella bella* n. sp. is similar to *Paraschwagerina shuleri* Williams from the Hueco Mountais of Texas but differs in its cuniculi and more intensively and regularly septal fluted. Besides, *I. bella* is younger than the American species. The species under description is an extreme member of the C morphological succession. It is connected with *Chalaroschwagerina (Cuniculina)* by transitional forms C1 and C2 (Fig. 4).

Occurrence and age. The same as holotype.

Iranella longa Leven n. sp.

Pl. 4, figs 4-6

1974 *Schwagerina hyperborea* (Salter) sensu Kahler, p. 95-96, pl. 1, fig. 10.

Holotype. GIN 4774/48; axial section; Iran, Bag-e-Vang, Bag-e-Vang Member; Early Permian (Cisuralian), Bolorian.

Etymology. Longus (lat.) - long.

Material. 5 axial sections.

Description. Shell rather large, elongate fusiform to subcylindrical, with convex lateral slopes and bluntly pointed poles. Adult individuals have 7.5 to 8 volutions and measure 11 to 15 mm in length and 3.3 to 4.4 mm in diameter; form ratio 3.3 to 3.5. First 2 to 2.5 whorls constitute tightly coiled juvenarium. Spirotheca composed of tectum and fine-textured keriotheca, thickness in seventh volution 0.075 to 0.10 mm. Septa thin, strongly and more or less regularly fluted throughout shell; septal folds high, extending to tops of septa. Low cuniculi present in last two or three volutions. Proloculus small, its outside diameter is 0.18 to 0.2 mm. Tunnel narrow and low. Chomata absent. Weak secondary deposits developed in juvenarium.

Discussion. This species is an extreme member of the D morphological succession and is connected by transitional forms (D1, D2, and D3) with *Iranella bella* n. sp. (Fig. 4).

Distribution and age. Iran, Bag-e-Vang and Kuh-e-Shesh-Agnosht (both Shirgesht area), Bag-e-Vang Member; Early Permian (Cisuralian), Bolorian.

Occurrence. The same as holotype.

Iranella orbiculata Leven n. sp.

Pl. 5, figs 1, 2

Holotype. GIN 4774/51, axial section, Iran, Bag-e-Vang, Bag-e-Vang Member; Early Permian (Cisuralian), Bolorian.

Etymology. Orbicularis (lat.) - rounded.

Material. 3 axial sections.

Description. Shell moderately large, inflated fusiform, with bluntly pointed poles; inner two or three volutions elongate fusiform. Adult shells have 6.5 to 7.5 volutions and measure 6.7 to 7.7 mm in length and 3.9 to 4.7 mm in diameter; form ratio varies from 1.6 to 1.7. First 2 to 3 whorls constitute the tightly coiled juvenarium. Spirotheca composed of tectum and fine alveolar keriotheca; 0.08 to 0.1 mm in sixth whorl. Phrenothecae weak or absent. Septa intensely and irregularly fluted from pole to pole. Septal folds high, extending to tops of septa. Axial filling absent. Proloculus small, its outside diameter is 0.125 to 0.15 mm. Tunnel low and narrow. Chomata very weak, sometimes present on proloculus.

Discussion. *Iranella orbiculata* n. sp. differs from another *Iranella* in its shorter and rounded shell. This species is an extreme member of the E morphological succession and is connected by the transitional form E1 with the D succession (Fig. 4).

Occurrence and age. The same as holotype.

Iranella pauca Leven n. sp.

Pl. 5, figs 3-5

Holotype. GIN 4774/54, axial section; Bag-e-Vang, Bag-e-Vang Member; Early Permian (Cisuralian), Bolorian.

Etymology. Paucus (lat.) - little, few.

Material. 7 axial section.

Description. Shell rather small, fusiform to subcylindrical, with bluntly pointed poles. Mature specimens 6 to 6.5 volutions and measure 7.5 to 8.3 mm in length and 2.5 to 3 mm in diameter; form ratio 2.5 to 3.3. First 2.5 to 4 whorls rather tightly coiled but later ones loose. Spirotheca composed of tectum and rather fine textured keriotheca 0.08 to o.1 mm thick in last two whorls. Septa strongly but irregularly fluted from pole to pole. Low cuniculi are common in the outer 2 or 3 whorls. Phrenotecae weak or absent. Proloculus small, its outside diameter 0.15 to 0.2 mm. Tunnel low and narrow. Weak chomata present on proloculus.

Discussion. *Iranella pauca* n. sp. is similar by many characters to *Parafusulina spissiseptata* Ross from the upper part of the Hessian Stage of the Glass Mountains section of Texas. However, because this species has no relation to true *Parafusulina*, it cannot be identified with the American species.

Occurrence and age. The same as holotype.

Genus *Leeina* Galloway, 1933

Leeina fusiformis (Schellwien et Dyhrenfurth, 1909)

Pl. 6, figs 1, 2

1909 *Fusulina vulgaris* var. *fusiformis* Schellwien et Dyhrefurth, s. 165-168, pl. 15, fig. 1-4.

Material. 4 axial sections.

Distribution and age. Darvaz, Karakorum, China, Indochina, Japan, Afghanistan, Iran, Carnic Alps; early Permian (Cisuralian), Yakhtashian and Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B55 and B56.

Genus *Paraleeina* Leven, n. gen.

Type-species: *Leeina postkraffti* (Leven, 1967).

Description. Shell moderate to large size, thick fusiform, nearly horizontal to slightly concave median portion, stright to convex lateral slopes, and bluntly pointed poles. Mature individuals usually possess 7 to 8 whorls. Coiling is uniform. Spirotheca thick composed of tectum and coarsely alveolar keriotheca. Septa are rather regularly and intensely fluted throughout shell, but in median part low septa loops developed. Phrenothecae slightly developed, but may be absent. Cuniculi present. Proloculus usually large, sphaerical or subsphaerical in shape. Weak chomata present only on proloculus. Massive secondary deposits fill much of shell between tunnel area and poles except in outermost whorl. Tunnel low and not very wide.

Discussion. *Paraleeina* n. gen. differs from *Leeina* Galloway primarily in its possession of cuniculi. It differs from *Parafusulina* Dunbar et Skinner and *Skinnerella* Coogan in its less regular fluting of the septa, and presence of massive secondary deposits.

Distribution and age. Everywhere in Tethys, Koryak Range, California; Early Permian (Cisuralian), Bolorian; Late Permian (Tethysian), Kubergandian and Murgabian.

Paraleeina postkraffti (Leven, 1967)

Pl. 5, figs 7-9

1967 *Parafusulina postkraffti* Leven, p.157-158, pl. 15, fig. 4 and 5.

Material. 5 axial and 4 subaxial sections.

Distribution and age. Pamir, Darvaz, Karakorum, China, Indochina, Japan, Koryak Range, Afghanistan, Armenia, Iran; Early Permian (Cisuralian), Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B56 and B 65a.

Paraleeina edoensis (Ozawa, 1925)

Pl. 6, figs 5, 6, 11

1925 *Schellwienia edoensis* Ozawa, p. 30, 31, pl. 6, fig. 1b, 2, 3.

Material. 5 axial and 2 tangential sections.

Distribution and age. Japan, Indochina, China, Pamir, Transcaucasia, Iran; Late Permian (Tethysian), Early Murgabian.

Occurrence. Bag-e-Vang, Jamal Formation, sample B112.

Genus *Chusenella* Hsu, 1942

Chusenella schwagerinaeformis Sheng, 1963

Pl. 3, fig. 6

1963 *Chusenella schwagerinaeformis* Sheng, p. 81-82 (in Chinese), p. 211 (in English), pl. 23, fig. 1-6.

Material. 1 axial section.

Distribution and age. China, Indochina, Japan, Pamir, Afghanistan, Iran, Armenia; Late Permian (Tethysian), from late Kubergandian to early Midian.

Occurrence. Bag-e-Vang, Jamal Formation, sample B112.

Genus *Pseudochusenella* Bensh, 1987

Pseudochusenella (?) **pavlovi** (Leven, 1967)

Pl. 5, fig. 6

1967 *Pseudofusulina pavlovi* Leven, p. 150, pl. 12, fig. 3 and 4

Material. 2 axial sections

Distribution and age. SE Pamir, China, Armenia, Iran; Early Permian (Cisuralian), Bolorian and Late Permian (Tethysian), Kubergandian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B50 and B61.

Genus *Rugosochusenella* Skinner et Wilde, 1965

Rugosochusenella davalensis Leven, 1998

Pl. 3, fig. 9

1998 *Rugosochusenella davalensis* Leven, p.325, pl. 5, fig. 7, 11 and 12.

Material. 1 axial section.

Distribution and age. Armenia, Iran; Early Permian (Cisuralian), Bolorian and Late Permian (Tethysian), early Kubergandian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample 65a.

Order **Neoschwagerinida** Minato et Honjo, 1966

Family Misellinidae A. Miklukho-Maclay, 1958

Genus *Misellina* Schenck et Thompson, 1940

Subgenus *Brevaxina*, Schenck et Thompson, 1940

Misellina (Brevaxina) dyhrenfurthi (Dutkevich, 1939)

Pl. 5, figs 10, 11

1939 *Doliolina dyhrenfurthi* Dutkevich in Licharew, 1939, p. 42, pl. 4, fig. 3-5.

Material. 2 axial sections.

Distribution and age. Darvaz, China, Indochina, Japan, Afghanistan, Iran, Turkey; Early Permian (Cisuralian), Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B50 and B65a.

Genus *Misellina*, Schenck et Thompson, 1940

Subgenus *Misellina*, Schenck et Thompson, 1940

Misellina (Misellina) parvicostata (Deprat, 1915)

Pl. 6, figs 4, 8-10

1915 *Doliolina parvicostata* Deprat, p. 16-17, pl. 3, fig. 7-9.

Material. 8 subaxial sections.

Distribution and age. China, Laos, Japan, Pamir, Darvaz, Afghanistan, Armenia; Early Permian (Cisuralian), Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B60, B62, B65a.

Misellina (Misellina) aff. **claudiae** (Deprat, 1912)

Pl. 6, fig. 3

1912 *Doliolina claudiae* Deprat, p. 44-45, pl. 4, fig. 5-9.

Material. 1 axial section.

Remarks. The described specimen is very similar to holotype of *Misellina claudiae* but differs in its less number of volutions and, accordingly, in small size of shell.

Distribution and age. China, Thailand, Japan, Pamir, Darvaz, Afghanistan, Pakistan, Iran, Armenia; Late Permian (Tethysian), early Kubergandian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B65.

Misellina (Misellina) aff. **termieri** (Deprat, 1915)

Pl. 6, fig. 7

1915 *Doliolina termieri* Deprat, p. 17, pl. 3, fig. 15-20.

Material. 1 subaxial section.

Distribution and age. China, Thailand, Japan, Pamir, Darvaz, Afghanistan, Iran, Armenia; Early Permian (Cisuralian), late Bolorian.

Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B62.

Misellina (Misellina) caucasica Leven, 1998

Pl. 6, figs 12-15

1998 *Misellina (Misellina) caucasica* Leven, p. 325, pl. 8, fig 20, 21.

Material. 3 axial and 5 subaxial and tangential sections.
Distribution and age. Armenia, Iran; Early Permian (Cisuralian), Bolorian; Late Permian (Tethysian), early Kubergandian.
Occurrence. Bag-e-Vang, Bag-e-Vang Member, samples B60, B62 and B65b.

Misellina (Misellina) megalocula Wang et Sun, 1973

Pl. 6, figs 16, 17

1973 *Misellina megalocula* Wang and Sun, p. 155-156, 174-175, pl. 2, fig. 11, 12, 14, 16-19; pl. 3, fig. 12-14.

Material. 2 axial sections.
Distribution and age. China, Japan, Pamir, Afghanistan, Iran; Late Permian (Tethysian), early Kubergandian.
Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B65b.

Genus *Armenina* A. Miklukho-Maclay, 1955

Armenina urtzensis Leven, 1992

Pl. 6, fig. 19

1992 *Armenina urtzensis* Leven in Leven et al., p. 76, pl. 4, figs 5-7.

Material. 1 axial and 2 subaxial sections.
Distribution and age. Darvaz, Armenia, Iran; Late Permian (Tethysian), early Kubergandian.
Occurrence. Bag-e-Vang, Bag-e-Vang Member, sample B65b.

Family Neoschwagerinidae Dunbar et Condra, 1927

Genus *Neoschwagerina* Yabe, 1903

Neoschwagerina sp. indet.

Pl. 6, figs 18, 21

Material. 1 tangential and 1 oblique sections.
Distribution and age. Everywhere in Tethys, Korjakian Range, New Zealand; Late Permian (Tethysian), Murgabian and Midian.
Occurrence. Bag-e-Vang, Jamal Formation, sample B112.

Family Sumatrinidae Silvestri, 1933

Genus *Sumatrina* Volz, 1904

Sumatrina sp. indet.

Pl. 6, fig. 21

Material. 1 tangential section.
Distribution and age. Everywhere in Tethys; Late Permian (Tethysian), Murgabian and Midian.
Occurrence. Bag-e-Vang, Jamal Formation, sample B112.

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PLATE 1

Fig. 1-5 - *Reichelina pulchra* K. Miklukho-Maclay. x 50. 1-4) Axial sections, GIN 4774/1, 4774/2, 4774/3 and 4774/4; samples B134, B138, B154 and B153 accordingly; 5) sagittal section, GIN 4774/5, sample B152. Fig. 6, 7 - *Reichelina turgida* Sheng. x50. 6) Subaxial section, GIN 4774/6, sample B140; 7) axial section, GIN 4774/7, sample B154. Fig. 8 - *Pamirina (Levenella)* aff. *leveni* Kobayashi. x30. Axial section, GIN 4774/8, sample B53. Fig. 9 - *Pamirina (Pamirina) darvasica* Leven. x30. Axial section, GIN 4774/9, sample B47. Fig. 10 - *Schubertella longiuscula* Leven. x30. Axial section, GIN 4774/10, sample B63. Fig. 11-15 - *Mesoschubertella thompsoni* Kanuma et Sakagami. x20. 11,13-15) Subaxial sections, GIN 4774/11, 4774/ 13, and 4774/14, sample B47; 12) axial section, GIN 4774/12, sample B47. Fig. 16, 17 - *Biwaella europae* Kochansky-Devidé et Milanovič. x30. 16) Axial section, GIN 4774/15, sample B47; 17) subaxial section, GIN 4774/16, sample B47. Fig. 18, 19 - *Neofusulinella lantenoisi* Deprat. x20. Axial sections, GIN 4774/17 and 4774/18, sample B65. Fig. 20 - *Toriyamaia laxiseptata* Kanmera. x30. Subaxial section, GIN 4774/19, sample B55. Fig. 21 - *Yangchienia primaris* Leven. x40. Subaxial section, GIN 4774/20, sample B47. Fig. 22, 23 - *Yangchienia compressaeformis* Leven n. sp. x40. Subaxial sections, GIN 4774/21 and 4774/22 (holotype), sample B62. Fig. 24, 25 - *Paradoxiella insueta* Leven n. sp. x30. 24) Subaxial section, GIN 4774/23 (holotype), sample B152; 25) sagittal section, GIN 4774/24, sample B150. Fig. 26 - *Darvasites ordinatus* (Chen). x10. Subaxial section, GIN 4774/25, sample B55. Fig. 27, 28 - *Darvasites minutus* Leven n. sp. Axial sections, GIN 4774/26 (holotype) and GIN 4774/27 accordingly, sample B55.


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PLATE 2

All x 10

Fig. 1 - *Acervoschwagerina* cf. *endoi* Hanzawa. Sagittal section, GIN 4774/28, sample B63. Fig. 2-6 - *Chalaroschwagerina (Cuniculina) vulgarisiformis* (Morikawa). 2, 3, 6) axial sections, GIN 4774/29, 4774/30, 4774/31; 4, 5) tangential sections showing cuniculi, GIN 4774/32 and 4774/26; 2-4, 6 - sample B55, 5 - sample B56. Fig. 7 - *Chalaroshwagerina (Cuniculina) globosaeformis* (Leven). Axial section, GIN 4774/33, sample B56. Fig. 8 - *Chalaroschwagerina (Cuniculina) hawkinsi* (Dunbar et Skinner). Axial section, GIN 4774/34, sample B56. Fig. 9 - *Praeskinnerella pseudogruperaensis* Leven. Axial section, GIN 4774/35, sample B55.

PLATE 3

All x 10

Fig. 1, 3 - *Skinnerella schucherti* (Dunbar et Skinner). Axial sections, GIN 4774/36 and 4774/37, sample B56. Fig. 2 - *Praeskinnerella pseudogruperaensis* Leven. Axial section 4774/38, sample B50. Fig. 4, 5 - *Skinnerella diversiformis* (Dunbar et Skinner). Axial sections, GIN 4774/39 and 4767/40, sample B56. Fig. 6 - *Chusenella schwagerinaeformis* Sheng. Axial section, GIN 4774/41, sample B112. Fig. 7 - *Skinnerella chusenellaeformis* Leven n. sp. Axial section of the holotype, GIN 4774/42, sample B56. Fig. 8 - *Skinnerella* aff. *japonica deprati* Leven. Axial section, GIN 4774/43, sample B56. Fig. 9 - *Rugosochusenella davalensis* Leven. Axial section, GIN 4774/44, sample B50.

PLATE 4

All x 10

Fig. 1 - *Skinnerella chusenellaeformis* Leven n. sp. Axial section, GIN 4774/45, sample B56. Fig. 2, 3 - *Iranella bella* Leven n. sp. Axial sections, GIN 4774/46 and 4774/47 (holotype), sample B56. Fig. 4-6 - *Iranella longa* Leven n. sp. Axial sections GIN 4767/48 (holotype), 4774/49 and 4767/50 accordingly, sample B56.

PLATE 5

All x 10, except 10 and 11

Fig. 1, 2 - *Iranella orbiculata* Leven n. sp. Axial sections, GIN 4774/51 (holotype) and 4774/52, sample B56; Fig. 3-5 - *Iranella pauca* Leven n. sp. Axial sections, GIN 4774/53, 4774/54 (holotype) and 4774/55 accordingly, sample B56. Fig. 6 - *Pseudochusenella* (?) *pavlovi* (Leven). Axial section, GIN 4774/56, sample B50. Fig. 7-9 - *Paraleeina postkraffti* (Leven). Axial sections, GIN 4774/57, 4774/58 and 4774/59 accordingly, sample B56. Fig. 10, 11 - *Misellina (Brevaxina) dyhrenfurthi* (Dutkevich). x15. Axial sections, GIN 4774/60 and 4774/61, samples B50 and B65a, accordingly.

PLATE 6

Fig. 1, 2 - *Leeina fusiformis* (Schellwien et Dyhrenfurth). x10. Axial sections, GIN 4774/62 and 4774/63, sample B56. Fig. 5, 6, 11 - *Paraleeina edoensis* (Ozawa). x10. Axial sections, GIN 4774/64, 4774/65 and 4767/66 accordingly, sample B112. Fig. 3 - *Misellina (Misellina)* aff. *claudiae* (Deprat). x15. Axial section, GIN 4774/67, sample B65b. Fig. 4, 8-10 - *Misellina (Misellina) parvicostata* (Deprat). x15. Subaxial sections, GIN 4774/68, 4774/69, 4774/70 and 4774/71 accordingly, samples B65a and B60 (4774/71). Fig. 7 - *Misellina (Misellina)* aff. *termieri* (Deprat). x15. Subaxial section, 4774/72, sample B62. Fig. 12-15 - *Misellina (Misellina) caucasica* Leven. x15. Axial sections, GIN 4774/73, 4774/74, 4774/75 and 4774/76, samples B62, B65b, B62 and B59, accordingly. Fig. 16, 17 - *Misellina (Misellina) megalocula* Wang et Sun. x15. Axial sections, GIN 4774/77 and 4774/78, sample B65b. Fig.18, 21 - *Neoschwagerina* sp. x15. Sagittal and tangential sections, GIN 4774/79 and 4774/80, sample B112. Fig. 19 - *Armenina urtzensis* Leven. x15. Axial section, GIN 4774/81, sample B65b. Fig. 20 - *Armenina* sp. x15. Sagittal section, GIN 4774/82, sample B65b. Fig. 22 - *Sumatrina* sp. x15. Tangential section, GIN 4774/83, sample B112.

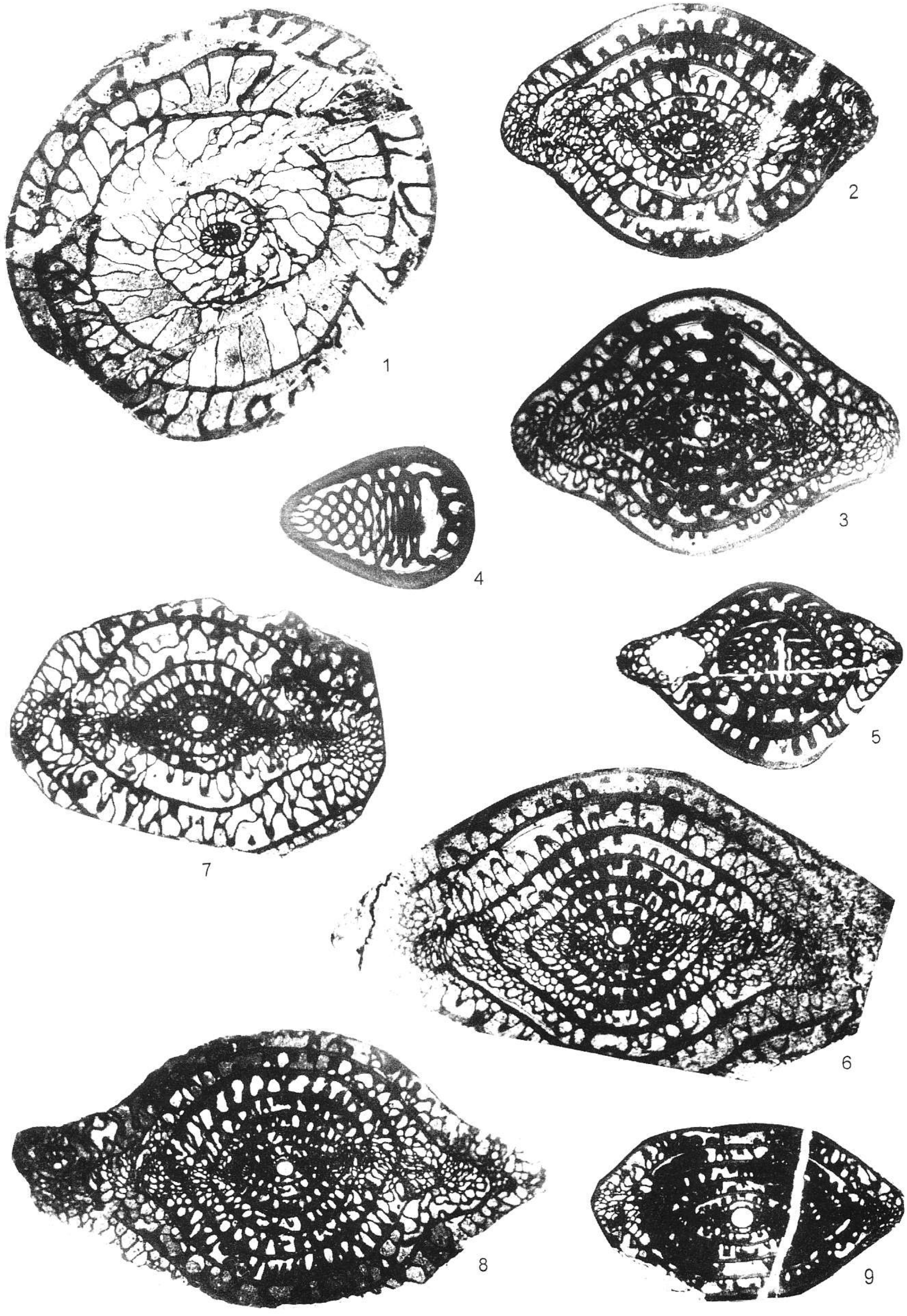
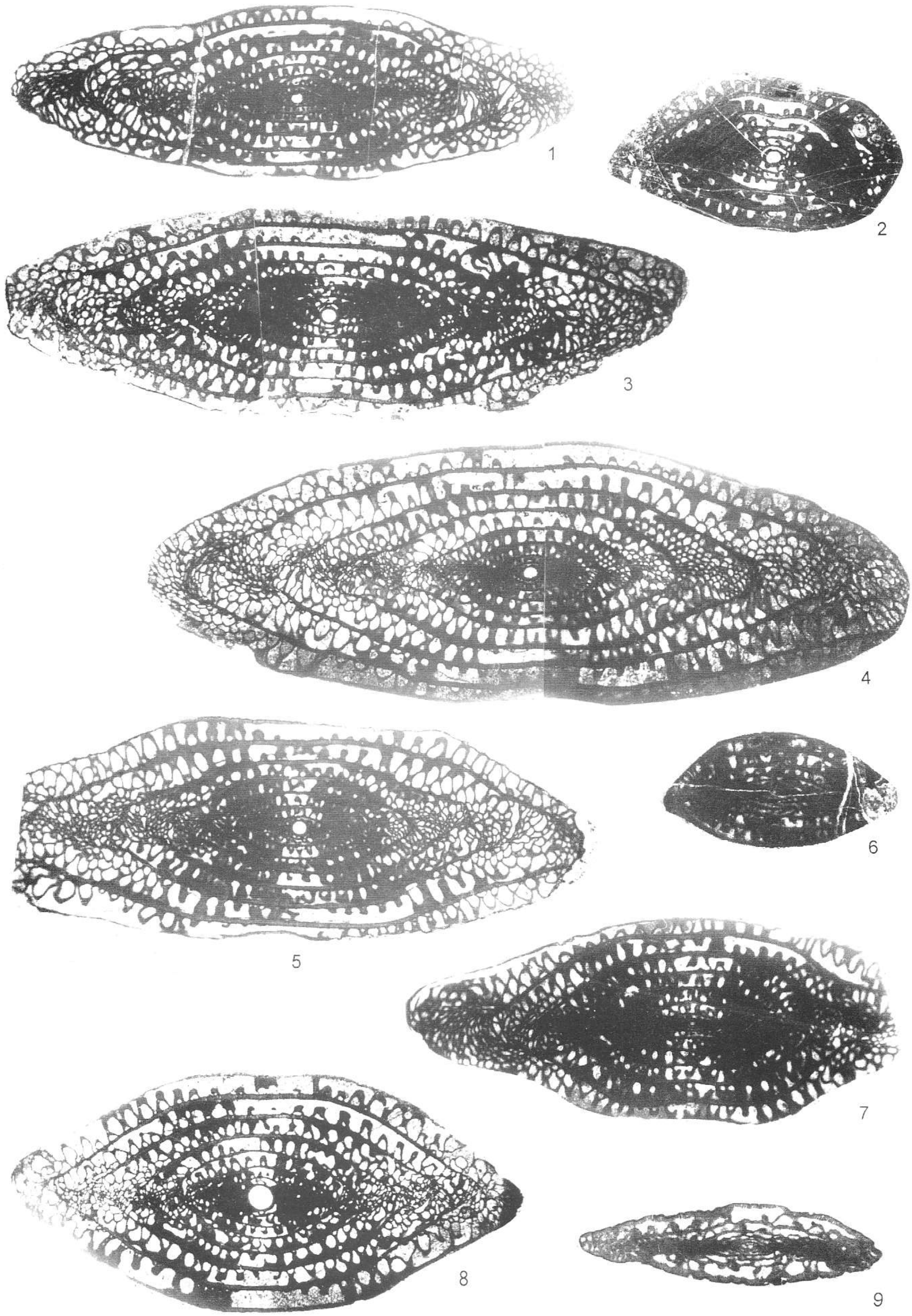


PLATE 2



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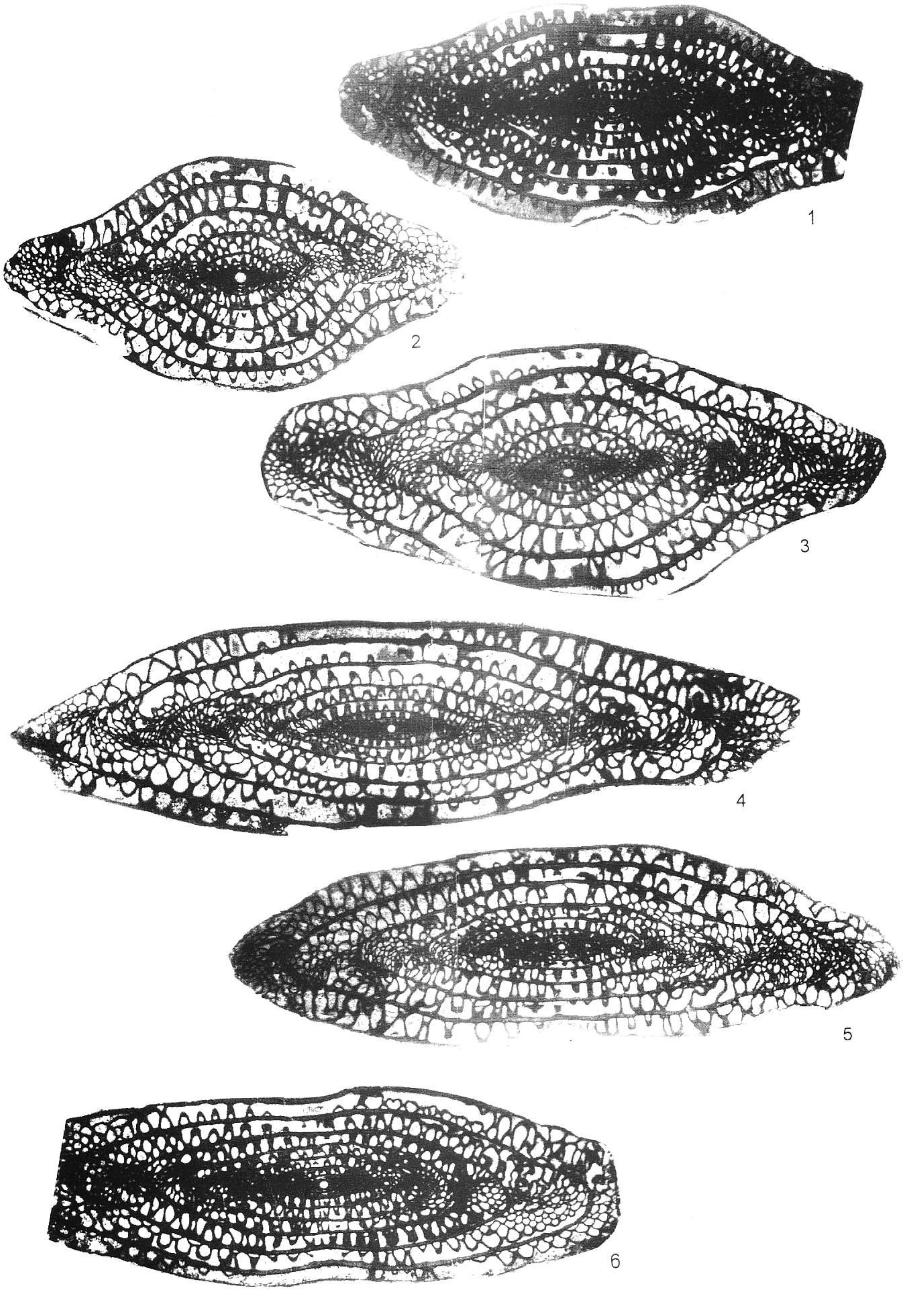

PLATE 4

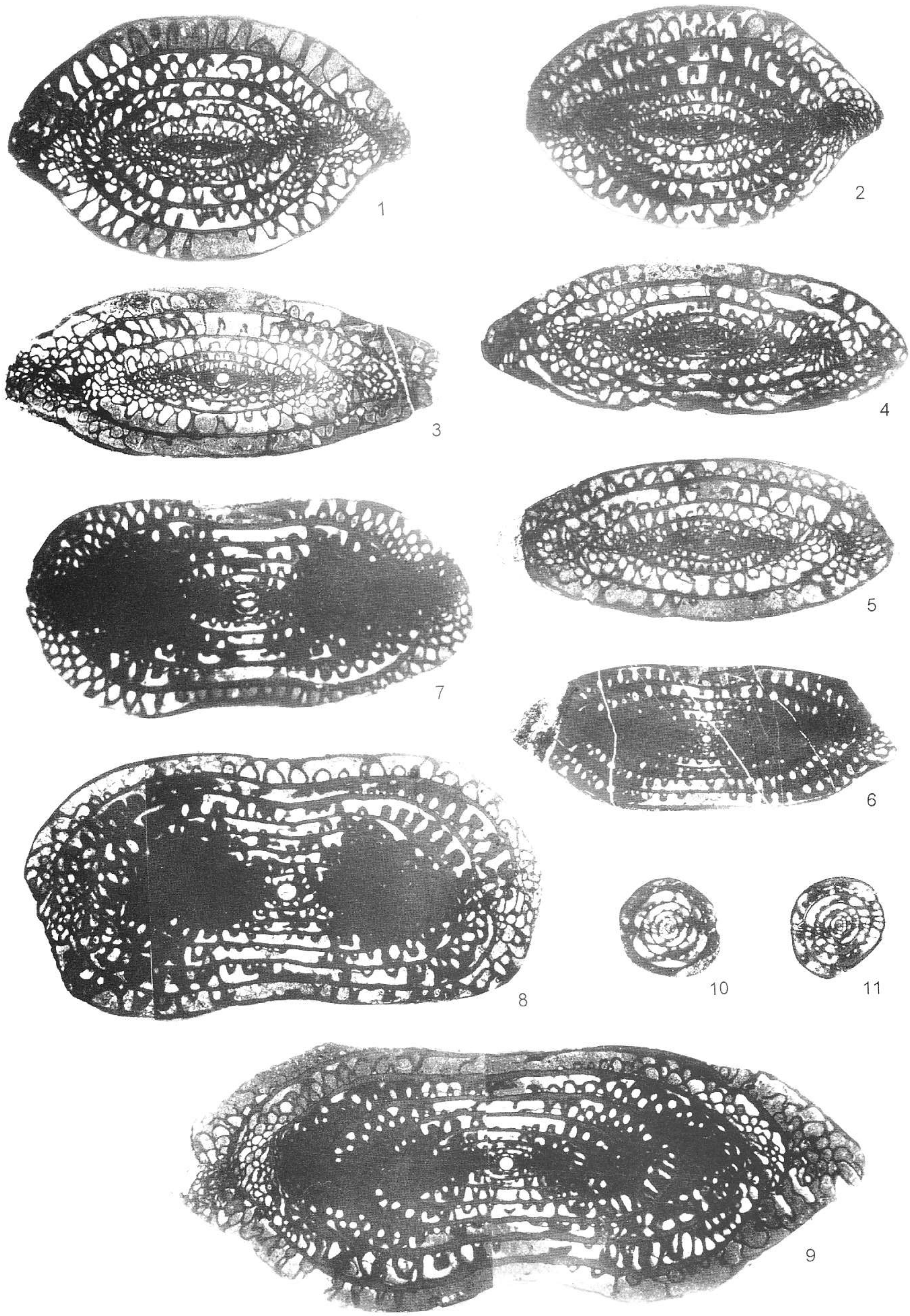

PLATE 5

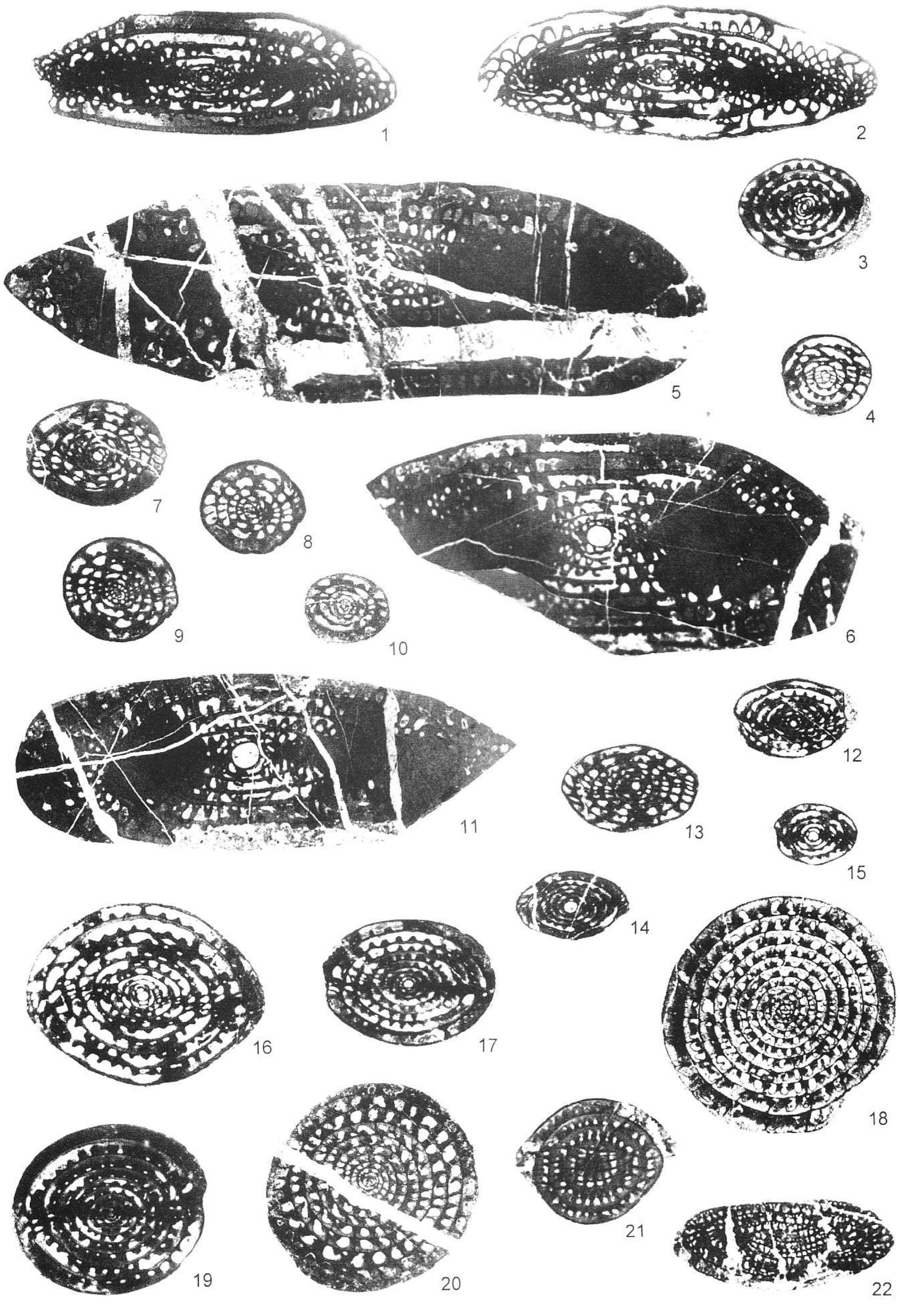

PLATE 6

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