

## STRATIGRAPHY AND FUSULINIDS OF THE MOSCOVIAN STAGE (MIDDLE CARBONIFEROUS) IN THE SOUTHWESTERN DARVAZ (PAMIR)

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**Riassunto.** Viene proposta una classificazione biostratigrafica fondata sulle fusulinidi del Moscoviano del Darvaz sudoccidentale. Sono distinte sette biozone locali, di cui tre nel Moscoviano inferiore e quattro nel Moscoviano superiore. Queste zone sono correlate con gli schemi zonali della Piattaforma dell'Europa orientale e dell'Asia centrale. Lo studio in sezione sottile ha permesso l'identificazione di centoquarantatré tra specie e sottospecie, appartenenti a 29 generi e 13 famiglie di fusulinidi. Tra queste vengono proposti come nuovi taxa un genere (*Undatafusulina*) e 16 specie e cioè *Taitzeoella compacta*, *Ovatella panjensis*, *Aljutovella darvasica*, *Undatafusulina asiatica*, *Citronites panjensis*, *C. reticulatus*, *Beeaina darvasica*, *B. dutkevichi*, *Putrella admiranda*, *Hemifusulina orientalis*, *Fusulinella (Moellerites) subundulata*, *F. (M.) jucunda*, *F. (M.) orientalis*, *F. (Fusulinella) crassitectoria*, *F. (F.) bogushi* e *F. (F.) pamirensis*.

**Abstract.** A refined subdivision, based on fusulinids, of the Moscovian stage in southwestern Darvaz is proposed. Seven local zones, three in the Lower Moscovian substage and four in the Upper Moscovian substage were established, based on investigations of three stratigraphic sections. The zones were correlated with those of the Eastern European and Middle Asian stratigraphic schemes. One hundred and forty-three species and subspecies, which belong to 29 genera and 13 families of fusulinids, were identified in the Middle Carboniferous of Darvaz. Among them, one genus (*Undatafusulina*) and 16 species, i.e. *Taitzeoella compacta*, *Ovatella panjensis*, *Aljutovella darvasica*, *Undatafusulina asiatica*, *Citronites panjensis*, *C. reticulatus*, *Beeaina darvasica*, *B. dutkevichi*, *Putrella admiranda*, *Hemifusulina orientalis*, *Fusulinella (Moellerites) subundulata*, *F. (M.) jucunda*, *F. (M.) orientalis*, *F. (Fusulinella) crassitectoria*, *F. (F.) bogushi*, and *F. (F.) pamirensis* are new.

### Introduction.

The fossil material discussed in this paper was collected by the author in the summer of 1969, during field work on the Kuhifrush Ridge, in the southern part of the southwestern Darvaz. Moscovian deposits were followed along the Darvaz Ridge to the Obihingou River (Fig. 1). These deposits were not studied in detail because, at the time, the Permian of Darvaz was the focus of the investigations. However, it was observed that the lithologic and paleontologic features of this stage re-

main similar throughout the region under study and the section of the Kuhifrush Ridge was chosen as reference. Seven hundred thin-sections with oriented fusulinid tests, collected from 60 stratigraphic levels from three complementary sections of the Moscovian in the Kuhifrush Ridge, were studied. In addition, a comparative study was performed on several hundred thin-sections from other Darvaz stratigraphic sequences, described and collected by V. I. Davydov (VSEGEI, St. Petersburg) and by the author.

### Historical background.

The occurrence of Middle Carboniferous deposits in Darvaz was reported first by Dutkevich & Kalmykova (1937), who discovered Moscovian fusulinids in the lower part of the carbonate Shagon Series, near the village of Shagon. Afterwards, the Moscovian and the Upper Carboniferous were combined as an independent unit and collectively named the Kalaikuhna Formation (Davydov, 1984). Vlasov & A. D. Miklukho-Maclay (Vlasov, 1961; Vlasov & Miklukho-Maclay, 1959) dated the lower part of the Kalaikuhna Formation to the upper Moscovian and described its transgressive deposition on the underlying deposits of the Bashkirian stage and lower Moscovian substage. Subsequently, the presence of the lower Moscovian substage was reported at the base of the Kalaikuhna Formation, and the first attempt was made to identify fusulinid zones and correlate them to the main zones of the type sections of the Eastern European Platform (Leven, 1974; Leven & Scherbovich, 1978; Leven et al., 1978). A large quantity of paleontologic material and fusulinids from the Middle Carboniferous of Darvaz has not yet been studied to date.

### Geologic setting and stratigraphic sections.

The region under study includes the southwestern Darvaz, from the Panj River to the south, to the Obi-

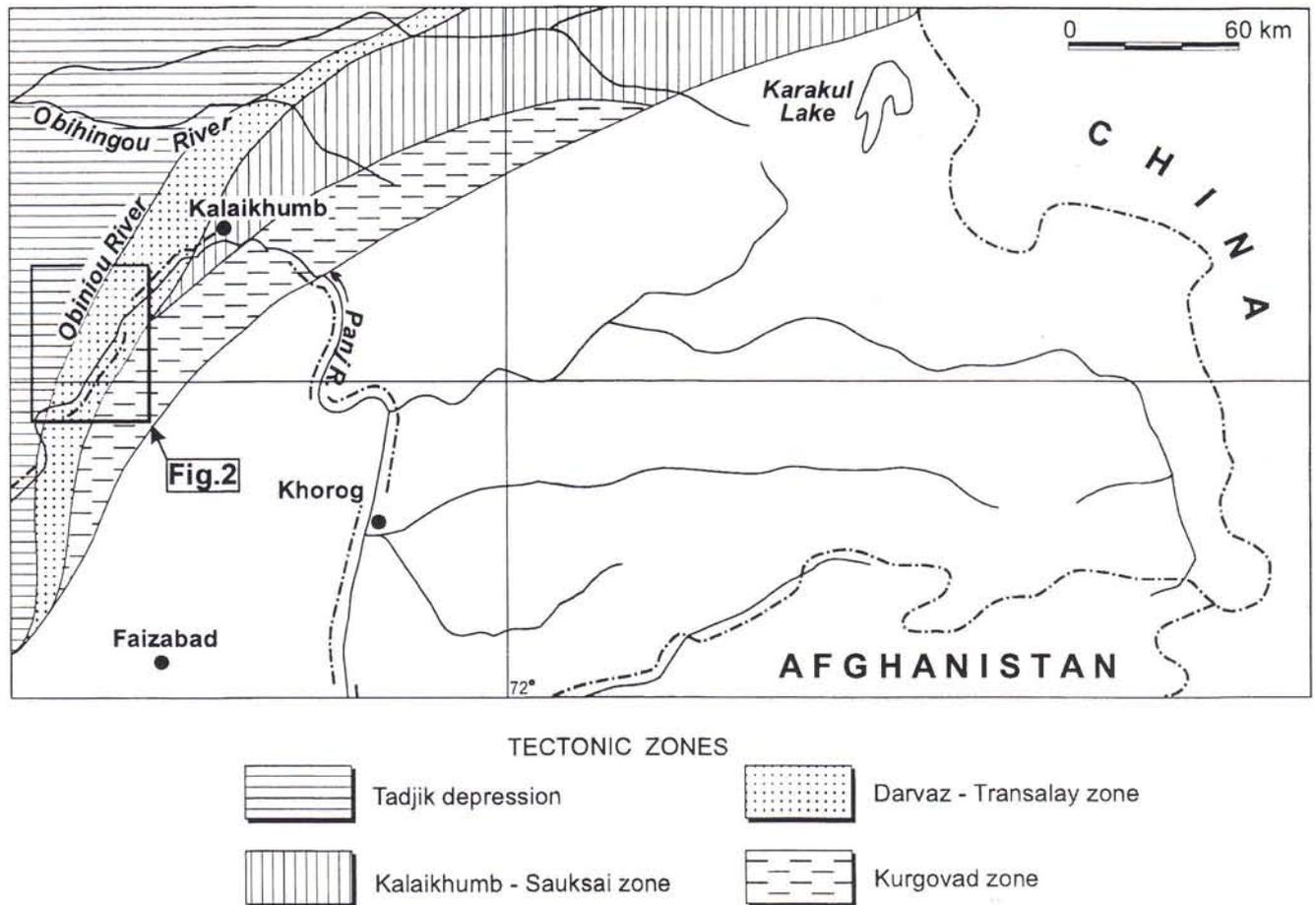


Fig. 1 - Outline map of Pamir showing the study Area (southeast Darvaz).

hingou River to the north. It belongs structurally to the Darvaz-Transalay tectonic zone of the northern Pamirs (Fig. 1) and is delimited by faults from the Tadjik depression to the WNW and from the Kurgovad and Kalaikhumb-Sauksai zones to the ESE.

The Middle Carboniferous deposits stretch almost continuously throughout the entire Darvaz-Transalay zone, overlain locally by Neogene conglomerates or delimited by faults. The Moscovian limestone, together with the Lower Carboniferous greenstones and the Upper Carboniferous-Permian carbonates-siliciclastics, form a large monocline dipping WNW. As mentioned above, the Moscovian forms the basal portion of the carbonate Kalai-kuhna Formation that rests transgressively on the eroded underlying deposits. Moscovian deposits predominantly composed of mudstones, fill locally the underlying depressions of paleotopography and may be considered as an independent unit, called the Kuhifrush Formation (here introduced). Both units are substituted by predominantly siliciclastic deposits in the northern region of the Darvaz, in the upper reaches of the Charymdara River.

The well-exposed and richly fossiliferous, yet not thoroughly studied, Moscovian of the Darvaz offers a unique opportunity for investigations in specific geologic fields. Only three complementary sections in the ex-

treme south of the Kuhifrush Ridge are described in this paper (Fig. 2). Nevertheless, they seem to represent the Moscovian adequately because their characteristics persist laterally and are consistent with those of the northern Darvaz region (data from V. I. Davydov and E. Ja. Leven).

The sections described below are located along the eastern slope of the Kuhifrush Ridge, (i.e. the watershed between the Obiniou and Panj rivers), in the uppermost reaches of the region where the Kalai-kuhna River flows into the Panj River. The peaks at 3165 m and 3697 m above sea level, located respectively slightly to the south and to the north of the sections studied, can serve as landmarks.

The basal portion of the southernmost section (no.1005) is composed of the siliciclastics of the Kuhifrush Formation, which overlie, with poorly defined contact, Lower Carboniferous basalts and a cobble-size conglomerate/breccia, whose clasts are composed of the same basalts (Fig. 3). The Kuhifrush Formation tapers off northward, where the Middle Carboniferous deposits begin with the limestones of the overlying Kalai-kuhna Formation (see section 1004). The limestones are in sharp contact, with a small angular unconformity of 5-7°, with the underlying sequence, which consists of

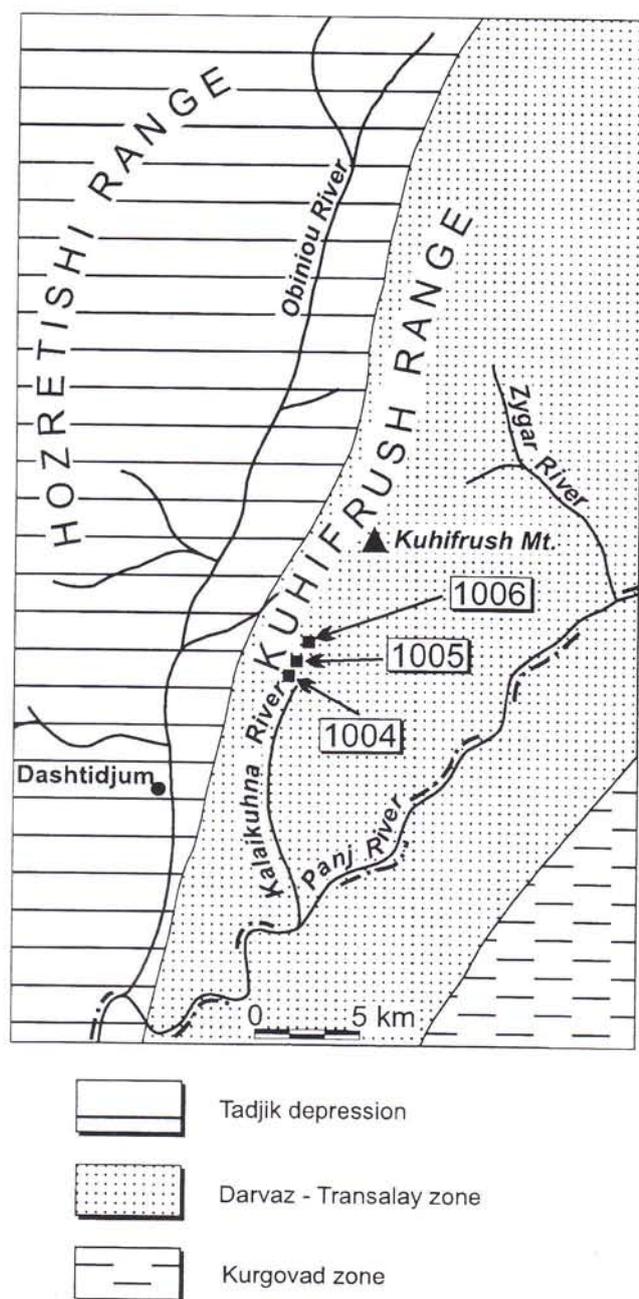


Fig. 2 - Index-map with location of the studied sections.

sandstones, limestones and, in its lower part, of the carbonate and volcanogenic conglomerates and breccias of the Zidadara Formation. The Zidadara Formation lies on basalts. Foraminifers found in the upper part of the Zidadara Formation are referred either to the Serpukhovian (Lower Carboniferous) or to the lowermost Bashkiran (Middle Carboniferous).

The Kuhifrush Formation crops out again further northward between the Lower Carboniferous volcanics and the Kalaikuhna Formation (section no. 1006 at 3697 m). Overall, section 1006 is similar to section 1005. The lithology of the Moscovian in the sections studied is briefly described below. Stratigraphic ranges of fusulinids are shown in Table 1.

#### Section no. 1005.

##### Kuhifrush Formation.

In this section, the Kuhifrush Formation represents the lower portion of the Moscovian. The poorly exposed contact between this unit and the underlying volcanics and conglomerate-breccia seems to be stratigraphic. The Kuhifrush Formation includes three distinct members. The lower member is distinguished by coarser clastic rocks, whereas the two upper members, separated by an erosional contact, are lithologically similar. The Kuhifrush Formation has a maximum thickness of 50-60 m and tapers off rapidly both northward and southward.

##### Member 1.

Loose, light-green polymictic sandstones and conglomerates with well rounded pebbles of limestones, cherts, shales, and volcanogenic rocks. Thin interbeds of calcareous mudstones and clayey limestones are present. Brachiopods (*Productida*) and unidentifiable plant remains were found in the limestones and in the sandstones/conglomerates, respectively. Small foraminifers of Early Carboniferous age were identified in the limestone pebbles. 20 m.

##### Member 2.

Dark-gray mudstones with interbeds (up to 2 m thick) of biogenic and clayey limestones. The lower interbeds yielded abundant fusulinids while the upper interlayers are very rich in brachiopods. 12.4 m.

##### Member 3.

Mudstones with thin (10-20 cm) interbeds of fusuline limestones. Greenish, loose sandstones and gravel-size conglomerates, lying on the eroded top of Member 2, are present at the base. The sandstones include unidentifiable plant remains; the limestones contain fusulinids, abundant brachiopods (*Choristites*), and large rugose corals. 19 m.

The total thickness of the Kuhifrush Formation is 52 m.

##### Kalaikuhna Formation.

The formation is represented mainly by several layers of limestones with a middle portion composed only of cherty beds. Therefore, three members may be identified, i.e. two calcareous (upper and lower) and one siliceous (middle). The incomplete thickness of the Kalaikuhna Formation is 75 m.

##### Member 1. Top to bottom:

1. Thick-bedded limestones with calcareous conglomerate-breccias at the base. Fusulinids, brachiopods (*Choristites*), and large rugose corals are abundant. The limestones rest on the eroded top of the underlying deposits. 10 m.
2. Distinctly bedded limestones with thin interlayers of calcareous mudstones. There are abundant fusulinids and scarce, poorly preserved rugose corals and brachiopods. 3 m.
3. Pebble-size conglomerate, with clasts made of limestone, passing to sandstones and mudstones towards the top of the section. This layer lies on the distinctly eroded top of the level 4. 2.5 m.
4. Thick-bedded limestones containing fusulinids and large rugose corals. 7 m.
5. Mudstones. 2 m.
6. Fusuline limestones. 1.7 m.

**Member 2.**

1. Black siliceous mudstones and cherts. A thin interbed of fusuline limestones is present in the lower part. 10 m.

2. Frequent alternation of thin-bedded dark-gray limestones and brown siliceous shales. The lower part contains crinoids and fusulinids. 10 m.

**Member 3.**

Light-colored limestones, which are thick-bedded at the base and massive at the top. They contain rare fusulinids. 25-30 m.

The overlying part of the section is poorly exposed and therefore cannot be described.

**Section no. 1004.**

The section is located 1 km to the north of section 1005 (Fig. 2). An unconformable contact between the Kalaikuhna Formation and the Lower Carboniferous or Lower Bashkirian (?) deposits is clearly visible. The Kuhifrush Formation is missing.

The Kalaikuhna Formation section begins with bedded limestones rich in diverse faunal remains, i.e. fusulinids, brachiopods, rugose corals, tabulates, bryozoans, crinoids, and gastropods. The limestones may be correlated with level 1 of Member 1 of the Kalaikuhna Formation (section no. 1005) based on the fusulinid assemblages. The limestones rest on platy sandstones up to 10 m thick or limestones bearing Early Carboniferous (Serpukhovian) or lower Bashkirian foraminifers, among which *Howchinia gibba longa* (Brazhnikova), *Eolasiodiscus transitorius* Brazhnikova & Jarzeva, *Asteroarchaediscus bashkirikus* (Krestovnikov & Teodorovich), *Globivalvulina bulloides* (Brady), and *Eostaffella parastruvei* Rauzer were identified. The contact is distinct and sharp. The eroded surface is emphasized by a hematite crust.

The basal limestones of the Kalaikuhna Formation are overlain by the bedded limestones with mudstone interbeds corresponding to level 2 of Member 1 of section no. 1005. Upward, the section is poorly exposed.

**Section no. 1006.**

The section is located 1.5, 2 km to the north of section 1004 (Fig. 2).

It is generally similar to section no. 1005, but its upper part is more complete (Fig. 3).

**Kuhifrush Formation.**

The lower part is represented by sandstones and conglomerates and the upper part by mudstones and limestones, as in section no. 1005. However, a distinct three-member structure is not recognizable due to poor exposure. The formation is in tectonic contact with the underlying basalts along a fault. Thickness of Kuhifrush Formation is 30-40 m.

**Kalaikuhna Formation.**

This formation is composed of different limestones, as in section no. 1005, which divide it into four members. Member 4 differs from Member 3 in having a more distinct bedding and wider variety of limestones.

**Member 1.**

1. Thick-bedded limestones very rich in brachiopods (*Choristites*). 6-7 m

2. Thin-bedded limestones. 2 m.

3. Green and pink conglomerates, sandstones, and mudstones. 3 m.

4. Limestones, massive in the lower part, and bedded in the upper part. The bedded limestones are packed with fusulinids. 7 m.

**Member 2.**

1. Black and brownish siliceous-calcareous argillites. 10 m.

2. Massive fusuline limestones. 2 m.

3. Alternation of brownish and black cherts, clayey limestones, and mudstones. 10 m.

**Member 3.**

Coarse-bedded and massive light limestones containing fusulinids throughout. The fusulinids were collected from 20 levels. 46 m.

**Member 4.**

1. Distinctly bedded limestones. Its lower part contains siliceous interbeds. Rare crinoids, brachiopods and tabulates occur. 7 m.

2. Coarse-bedded, light-colored crinoidal limestones with rare fusulinids. 6 m.

3. Bedded, brecciated limestones with large rugose corals, crinoids and fusulinids. 4 m.

4. Limestones that are bedded in the lower part and massive in the upper portion. They contain rare fusulinids. 4 m.

5. Brecciated limestones with chaetetid colonies and rare fusulinids. Visible thickness is about 10-15 m.

The total thickness of the Kalaikuhna Formation is 130 m.

Upward, a small portion of the slope is not exposed, likely because of a fault. Thick-bedded limestones, with fusulinids of the middle zone of the Kasimovian stage (*Obsoletes* sp., *Triticites expressus* Amosova) in the lower part, are exposed above.

**Moskovian biozones and their correlation.**

The sections described above are well characterized by fusulinids distributed throughout. All samples from the sections studied were collected from about 60 stratigraphic levels. The distribution of fusulinids throughout the sections allowed seven fusulinid zones to be distinguished (from top to bottom).

**Upper Moscovian substage.**

*Beedeina consobrina* - *B. dutkevichi* Zone

*Fusulinella (Fusulinella) schwagerinoides* - *Beedeina darvasica* Zone

*Beedeina samarica* - *B. elegans* Zone

*Putrella brazhnikovae* - *Undatafusulina asiatica* Zone.

Fusulinids	Moscovian						
	Lower				Upper		
	A.z. -O.c.	H.s. - D.t.	B. r. - P.s.	P.l. - U.a.	B.s. - B.e.	F.s. - B.d.	B.c. - B.d.
	Kuhifrush Fm.			Kalaikuhna Fm.			
M.b. 2	Mb. 3		Mb. 1	Mb. 2	Mb. 3	Mb. 4	
<b>Eostaffella</b> sp.			x			x	
<i>acuta</i>	x	x	x				
<i>quasiample</i>			x				
<i>mutabilis</i>			x				
<b>Novella pulchra</b>	x						
<b>Ozawainella</b> sp.	x	x	x	x	x	x	x
<i>fragilis</i>	aff.						
<i>pogorevichi</i>	x						
<i>mosquensis</i>			x	cf.			
<i>turgida</i>				x		aff.	
<i>digitalis</i>	x		x				
<i>vozhgalica</i>			x				
<i>lisichanica</i>				aff.		x	x
<i>kumpani</i>				x	x		
<i>kurakhovensis</i>							x
<b>Pseudostaffella</b> sp	x	x	x	x	x		x
<i>confusa</i>	x						
<i>compressa</i>			x				
<i>vozhgalica</i>			aff.				
<b>Neostaffella</b> sp..		x	x		x	x	x
<i>ozawai</i>		x	x				
<i>rotundata</i>			x	x			
<i>sphaeroidea cuboides</i>				x	x	x	x
<i>umbilicata</i>				x			
<i>subquadrata</i>				x			
<i>larionovae</i>							x
<b>Eoschubertella</b> sp.	x		x	x		x	
<i>pseudoglobulosa</i>	aff.		x			x	
<i>obscura</i>	aff.	x	x				
<i>subglobosa</i>			x				
<i>gracilis</i>	x	x	x				
<i>znensis</i>	x		x				
<b>Schubertella</b> sp.			x			x	
<i>acuta</i>			x				
<i>magna</i>			x				
<i>mjachkovensis</i>				cf			x
<i>subkingi</i>				x.			
<i>kingi</i>				aff.		aff.	
<b>Fusiella lancetiformis</b>				x			
<i>typica</i>				x	x		x
<b>Profusulinella</b> sp.			x				
<i>convoluta</i>	cf.		x				
<i>parafitzi</i>		cf.					
<i>rhomboides</i>		x	x				
<i>primitiva</i>			x				
<i>arta</i>		x					
<i>pseudorhomboides</i>			cf.				
<b>Taitzehoella</b> sp.		x	x	x		x	x
<i>pseudolibrovichi</i>	x	x	x				
<i>mutabilis</i>	x	x	x	x			
<i>syzranica</i>		x	x				
<i>praelibrovichi</i>		x					
<i>librovitchi</i>			x	x	x	x	x

<i>compacta</i>				X	X	X	
<b>Depratina sp.</b>	X						
<i>paraprisca</i>	aff.	X	X				
<i>parva</i>	cf.	X					
<i>timanica</i>		X					
<i>priscoidea</i>			X				
<i>prisca</i>			X				
<b>Ovatella constans</b>	X		X				
<i>ovata</i>			X				
<i>meridiana</i>			X				
<i>nytvica</i>			X				
<i>ferganensis</i>			X				
<i>panjensis</i>			X				
<b>Aljutovella sp.</b>		X	X				
<i>znensis</i>	X						
<i>postaljutovica dilucida</i>		X	X				
<i>devexa</i>			X				
<i>aljutovica</i>			X				
<i>darvasica</i>			X				
<b>Fusulina quasicylindrica</b>						cf.	
<i>conspecta</i>							aff.
<i>cylindrica</i>							cf.
<i>mjachkovensis mjachkovensis</i>							cf.
<i>mjachkovensis peskensis</i>							cf.
<b>Undatafusulina asiatica</b>				X			
<b>Citronites sp.</b>			X				
<i>reticulatus</i>			X				
<i>apokensis</i>			X				
<i>panjensis</i>			X				
<b>Beedeina sp.</b>				X	X		X
<i>lanceolata</i>			X				
<i>schellwieni</i>			X				
<i>rhomboidalis</i>			X				
<i>timanica</i>				X			
<i>samarica</i>				X	X		
<i>pseudokonnoi</i>				X	X		
<i>elegans</i>				X	X		
<i>bona</i>				X	X		
<i>ulitinensis</i>				X	cf.	X	
<i>darvasica darvasica</i>						X	cf.
<i>darvasica elongata</i>						X	
<i>pseudokayi</i>						X	
<i>isvariensis</i>						X	
<i>pseudoelegans keltmensis</i>						X	
<i>carbonica</i>						X	X
<i>ozawai</i>						X	X
<i>yangi</i>							X
<i>angelinae</i>							X
<i>crassa</i>							aff.
<i>dutkevichi</i>							X
<i>consobrina</i>							X
<b>Putrella sp.</b>				X			
<i>susini</i>			X				
<i>brazhnikovae</i>				X			
<i>admiranda</i>				X			
<b>Eofusulina sp.</b>			X				
<i>binominata</i>			X				
<b>Paraeofusulina sp.</b>			X				

<i>subtilissima</i>			X				
<b>Hemifusulina sp.</b>				X			
? <i>splendida</i>		X	X				
<i>volgensis intermedia</i>	X						
<i>orientalis</i>			X				
<i>paraelliptica</i>			X				
<i>consobrina</i>			aff.				
<i>moelleri</i>			cf.				
<b>Fusulinella (Moellerites) sp.</b>		X					
<i>jucunda</i>		X					
<i>subundulata</i>		X	X				
<i>paracolaniae</i>			X				
<i>praebocki</i>			X				
<i>jamesensis</i>			X				
<i>schubertellinoides</i>			X				
<i>praecolaniae</i>			X				
<i>nytvica</i>			X				
<i>orientalis</i>			X				
<b>Fusulinella (Fusulinella) sp</b>			X	X	X	X	X
<i>delepinei</i>			X				
<i>ginkeli</i>			X				
<i>gerasimovi</i>			X				
<i>bogushi</i>						X	X
<i>bocki</i>			X	X			
<i>intermedia</i>				X			
<i>helenae</i>				X			
<i>fluxa</i>				X	X		
<i>gigantea</i>				X			
<i>aravanensis</i>				X			
<i>alvaradoi</i>				X			
<i>lancetiformis</i>				X			
<i>lata</i>				X			
<i>pseudobocki</i>				X	X	X	
<i>crassitectoria</i>				X	aff.		
<i>schwagerinoides</i>						X	X
<i>podolskensis</i>							X
<i>valida</i>						X	
<i>kamensis</i>						X	
<i>pamirensis</i>							X
<i>borealis</i>						aff.	
<i>mosquensis</i>							X
<i>permica</i>							aff.
<i>loresae</i>							X
<b>Protriticites ? sp.</b>							X
<b>Pulchrella sp.</b>	X	X	X				
<i>eopulchra</i>			X				
<b>Wedekindellina subovata</b>					cf.		
<b>Palaeostaffella sp.</b>							
<i>moelleri</i>							X
<b>Reitlingerae sp.</b>			X				
<i>rezvoi</i>			X				
<b>Parastaffelloides sp.</b>			X				
<i>pseudosphaeroidea</i>			X				
<i>dagmarae</i>				X			

Tab. 1 - List of fusulinids from the sections 1004, 1005 and 1006.

	Darvaz (in this paper)	East European Platform (Solovieva, 1986)	Middle Asia (Bensh et al., 1989)
1	<i>Beedeina consobrina</i> , <i>B. dutchkevichi</i>	<i>Fusulina cylindrica</i> <i>Fusulinella bocki</i> <i>F. podolskensis</i>  (Myachkovian Horizon)	<i>Fusulinella schwagerinoides</i> (Shunkmazarian Horizon)
	<i>Fusulinella schwagerinodes</i> <i>Beedeina darvasica</i>		
	<i>Beedeina samarica</i> , <i>B. elegans</i>		
	<i>Putrella brazhnikovae</i> , <i>Undatafusulina asiatica</i>	<i>F-lla colaniae</i> , <i>Bedeeina kamensis</i> (Podolian Horizon)	<i>Fusulina kamensis</i> (Aktekerian Horizon)
2	<i>Citronites reticulatus</i> <i>Paraeofusulina subtilissima</i>	<i>Moellerites lopasniensis</i> , <i>Beedeina pseudoelegans</i>  <i>Fusulinella subpulchra</i> (Kashirian Horizon)	<i>Moellerites cylindricus</i> , <i>M. bedakensis</i>  <i>Fusulinella subpuchra</i> (Ettysaian Horizon)
	<i>Hemifusulina (?) splendida</i> , <i>Depratina timanica</i>		
	<i>Aljutovella znensis</i> <i>Ovatella constans</i>	<i>Aljutovella priscoidea</i> , <i>A. znensis</i> (Tsnian Horizon)	<i>Aljutovella priscoidea</i> , <i>A. znensis</i> (Nuratin Horizon)

1 - Upper Moscovian, 2 - Lower Moscovian

Tab. 2 - Correlation of the Middle Carboniferous (Moscovian) fusulinid-zones of Darvaz with the zones of East European Platform and Middle Asia.

Lower Moscovian substage.

*Citronites reticulatus* - *Paraeofusulina subtilissima* Zone  
*Hemifusulina (?) splendida* - *Depratina timanica* Zone  
*Aljutovella znensis* - *Ovatella constans* Zone.

*Aljutovella znensis* - *Ovatella constans* Zone.

This zone corresponds to Member 2 of the Kuhlfrush Formation in section 1005, even though only the lower portion of Member 2 yielded fusulinids. The composition of the fusulinid assemblage is shown in Tab. 1.

The assemblage is relatively poor. The most abundant and characteristic species are *Aljutovella znensis* and *Ovatella constans*, which occur in different facies. There are also frequent *Depratina*, which is similar to *D. parva* and *D. parapriscas*, primitive *Taitzeoella* (*T. pseudolibrovichi* type), and rare *Eostaffella*, *Novella*, *Eoschubertella*, *Ozawainella*, *Pseudostaffella*, *Pulchrella*, and *Hemifusulina* (*H. volgensis* group).

The assemblage described shows a close similarity with the assemblage of the *Aljutovella priscoidea*, *A. znensis*, *Hemifusulina volgensis* Zone, characteristic of the Tsnian Horizon established by Solovieva (1986) between the Vereian and Kashirian Horizons of the Eastern European Platform (Tab. 2). There are common species, such as *A. znensis* and associated species of *Depratina*, *Taitzeoella*, and *Ovatella* such as *D. parapriscas*, *T.*

*pseudolibrovichi* and *O. constans*. The last species is similar to *O. ovata*, characteristic of the stratotype of the Tsnian Horizon. This assemblage is similar also to the assemblage of the *Aljutovella priscoidea* - *A. znensis* Zone or the Nuratin Horizon of the Carboniferous regional scale of Middle Asia. Almost all of the most characteristic fusulinid species and genera present in the Nuratin Horizon (Bensh et al., 1989) occur in the *Aljutovella znensis* - *Ovatella constans* Zone of Darvaz.

*Hemifusulina (?) splendida* - *Depratina timanica* Zone.

This zone corresponds to most of the lower part of Member 3 of the Kuhlfrush Formation in section 1005. The fusulinid assemblage is renewed considerably in comparison with the assemblage of the former zone. The renewal may be related to a short gap at the base of Member 3. The dominant species in the underlying level, i.e. *O. constans* and *A. znensis*, are replaced by the newly appearing *Hemifusulina (?) splendida* and primitive forms of *Fusulinella*, whose wall is transitional between the three-layered form typical of *Profusulinella* and the four-layered form of *Fusulinella* proper. M. N. Solovieva (1986) referred such forms to the genus *Moellerites*. However, this genus shows a high degree of similarity with the true *Fusulinella* and therefore is considered herein to be its subgenus. *Depratina timanica*, whose stratigraphic range is limited to the *Depratina timanica*

zone by its association with *Hemifusulina* (?) *splendida*, makes a first appearance in this assemblage. *Neostaffella ozawai* and abundant species of *Eoschubertella*, i.e. *E. obscura* and *E. gracilis*, appear in this zone or in the uppermost beds of the previous zone. Numerous *Profusulinella* persist from the underlying deposits.

Different interpretations of the fusulinid zonation of the Kashirian Horizon make the correlation between the *Hemifusulina* (?) *splendida* - *Depratina timanica* Zone and the Moscovian subdivisions of the Eastern European Platform ambiguous. For example, Rauser-Chernousova & Reitlinger (1954) reported the appearance of *H. (?) splendida* in the *Hemifusulina kashirica* - *H. moelleri* Zone, which is considered to be the upper zone of the Kashirian Horizon. According to Solovieva (1986), this zone is the lowest of the Kashirian Horizon, and *H. (?) splendida* appears in the middle part of the Kashirian Horizon. In both cases, *H. (?) splendida* is reported to be associated with the earliest representatives of the genus *Beedeina*, which appear at the base of the succeeding zone in the Darvaz sections. Taking this fact into consideration, that the latter zone also should be correlative of the Kashirian Horizon, the underlying *H. (?) splendida* - *D. timanica* Zone most likely to correspond the lower half of this horizon. It cannot be excluded that the lowermost beds of the Kashirian Horizon might be missing in this described section. The correspondence between the *Hemifusulina* (?) *splendida*, *Depratina timanica* Zone of Darvaz and the lower part of the Kashirian Horizon is supported by the appearance of abundant *Fusulinella* (*Moellerites*), *Neostaffella ozawai*, and *Schubertella gracilis*, which become dominant along with *H. (?) splendida*.

According to the Carboniferous regional scale of Middle Asia, the Kashirian Horizon corresponds to the Ettysaian Horizon, or to the *Moellerites cylindricus*, *M. bedakensis*, *Fusulinella subpulchra* Zone (Bensh et al., 1989). The *Hemifusulina* (?) *splendida* - *Depratina timanica* Zone under consideration may be correlated to the lower part of the Ettysaian Horizon.

#### *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone.

This zone comprises the upper part of Member 3 of the Kuhifrush Formation in section 1005 and the lower part of the Kalaikuhna Formation, including the lower third of level 4 of Member 1 in sections 1005 and 1006, as well as the lower limestone beds the calcareous part of the Kalaikuhna Formation in section 1004.

The lower boundary of the *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone is set by the simultaneous appearance of *Citronites*, *Beedeina* and *Paraeofusulina*. The true *Fusulinella*, belonging to the subgenus *Fusulinella*, appears slightly above. Abundant representatives of the genus *Citronites* belong to the species

*C. apokensis* (Rauser-Chernousova), *C. panjensis* n. sp., and *C. reticulatus* n. sp. The genus *Beedeina* is represented by three species, i.e. *B. lanceolata* found at the base of the zone and *B. schellwieni* and *B. rhomboidalis* found in its uppermost part. *Fusulinella* (*F.*) *delepinei* and *F. (F.) ginkeli* are the most abundant representatives of the subgenus *Fusulinella*. In addition, several species of the subgenus *Moellerites*, i.e. *F. (M.) jamesensis*, *F. (M.) paracolaninae*.

The *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone is mainly characterised by *P. subtilissima*, which are usually accompanied by large *Eofusulina binominata*. *Neostaffella ozawai* should also be mentioned among the characteristic species. It is noteworthy that *Putrella*'s first appearance in the zone under examination is represented by a single specimen of *P. susini*. *Pulchrella eopulchra* appears slightly below. Nearly all genera listed in the previous zones continue from the underlying deposits up to the lower part of this zone. The most characteristic species among them are *Ovatella panjensis*, *O. ovata*, and *Aljutovella postaljutovica dilucida*.

The age of the fusulinid assemblage of the *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone may be considered, in general, to be transitional between the early and late Moscovian. On one hand, this zone still contains numerous genera and species persisting from the underlying deposits; on the other hand, genera and species typical of the upper Moscovian substage appear. No definite correlation may be established comparing the assemblage of this zone with those of the Moscovian type sections of the Eastern European Platform. Consequently, this part of the section may correspond both to the upper part of the Kashirian Horizon and to the lower part of the Podolian Horizon. The appearance of *Beedeina elegans*, *B. samarica*, *Taitzeoella librovitchi* and the earliest representatives of *Putrella* makes this zone a correlative of the Vaskino Formation, the lowermost formation of the Podolian Horizon in the type section of the Moscovian Basin (Rauser-Chernousova and Reitlinger, 1954; Solovieva, 1986). However, since the Vaskino Formation overlies the clays of the Rostislavl Formation of the Kashirian Horizon (which lacks in fusulinids), it is difficult to pinpoint in the type section the first appearance of the genera and species mentioned, which might occur during the deposition of the Kashirian Horizon.

The *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone may be correlated more reliably to the Formation C2-6 (L) of the Donetz Basin, which corresponds to the upper part of the Kashirian Horizon of the Eastern European Platform (Resolution..., 1990). The correlation suggested is based on the co-occurrence of *Paraeofusulina subtilissima*, *Eofusulina binominata*, *Taitzeoella librovitchi* and the earliest *Beedeina* in the Donetz Basin

and Darvaz sections (Putrja, 1956). For these reasons, the *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone may be referred, albeit dubiously, to the uppermost part of the lower Moscovian substage.

According to the Carboniferous regional scale of Middle Asia, the *Citronites reticulatus* - *Paraeofusulina subtilissima* Zone is correlative with the upper part of the Etyysaian Horizon (Bensh et al., 1989).

*Putrella brazhnikovae* - *Undatafusulina asiatica* Zone.

This zone corresponds to the upper part of Member 1 of the Kalaiukhna Formation in sections no 1005 and no 1006.

The most characteristic events of this zone are the first appearance of *Fusiella*, the abundance of advanced forms of *Putrella*, such as *P. brazhnikovae* and *P. admiranda*, and the presence of *Undatafusulina*, represented by *U. asiatica*. *Neostaffella* is represented by the typical late Moscovian *N. sphaeroidea cuboides* and *N. umbilicata*, which replace the dominant *N. ozawai*. *Profusulinella*, *Depratina*, *Ovatella*, *Aljutovella*, *Citronites*, *Eofusulina*, *Paraeofusulina*, and *Fusulinella* (*Moellerites*) totally disappear. In addition to the index species, the dominant taxa consist of abundant and diverse *Beedeina* and *Fusulinella* (*Fusulinella*), represented most frequently by *B. pseudokonnoi*, *F. (F.) bocki*, *F. (F.) helenae*, and *F. (F.) aravanensis*, typical of the upper Moscovian substage.

The *Putrella brazhnikovae* - *Undatafusulina asiatica* Zone is correlated reliably with the Podolian Horizon of the Eastern European Platform, specifically with its middle part which contains abundant *Putrella brazhnikovae* and *Fusulina pankouensis*. The latter species shows striking similarity of all its main features with *Undatafusulina asiatica* which was assigned to a new genus on the basis of a highly undulated wall. Both subdivisions contain *Fusiella typica*, *Neostaffella sphaeroidea cuboides* and abundant *Beedeina* and *Fusulinella* of the *F. bocki* group (Rauser-Chernousova and Reitlinger, 1954; Solovieva, 1986).

According to the Carboniferous regional scale of Middle Asia, the *Putrella brazhnikovae* - *Undatafusulina asiatica* Zone corresponds approximately to the Akterekian Horizon, or to the *Fusulina kamensis* Zone with *Putrella* and abundant *Fusulinella* and *Beedeina* (Bensh et al., 1989).

*Beedeina samarica* - *B. elegans* Zone.

This zone corresponds to Member 2 and to the lower half of Member 3 of the Kalaiukhna Formation in sections 1005 and 1006.

The lower boundary of this zone is drawn at the disappearance of *Putrella*, *Undatafusulina*, and *Hemifusulina*. The dominant taxa belong to the *Beedeina samarica-elegans* group persisting from the underlying deposits.

A general impoverishment of the faunas, compared to the previous assemblages, is due to the lithology of the zone, which is dominated by clayey-siliceous deposits lacking in fusulinids. It is difficult to correlate this zone with the type section of the Eastern European Platform because of local differences in fusulinid assemblages. For example, the stratigraphic beds considered, i.e. the Novlinsk Formation in the Eastern European Platform, are characterised by the dominant *Fusulinella* of the *F. bocki* group that appears in the upper beds of the Podolian Horizon. The same fusulinids occur also in the *Putrella brazhnikovae*-*Undatafusulina asiatica*, *Beedeina samarica*, *B. elegans* Zone of the Darvaz sections, which correspond to the Podolian Horizon, but in the *Beedeina samarica*, *B. elegans* Zone of Darvaz they are represented by a single poorly preserved specimen of *F. pseudobocki*. On the contrary, the latter *Beedeina samarica* - *B. elegans* Zone of Darvaz contains abundant *Beedeina*, which are rare in the Novlinsk Formation (Belskaya et al., 1975; Solovieva, 1986) but are predominant in the underlying deposits of the Podolian Horizon. Nevertheless, based on its position above the beds with abundant *Putrella*, the *Beedeina samarica* - *B. elegans* Zone in the Darvaz, may be correlated with the basal portion of the Myachkovian Horizon, which is referred to the *Fusulinella bocki* Zone (Rauser-Chernousova & Reitlinger, 1954) or to the *Fusulinella bocki*, *F. rara*, *Beedeina samarica* Zone (Solovieva, 1986).

According to the Carboniferous regional scale of Middle Asia (Bensh et al., 1989), the *Beedeina samarica* - *B. elegans* Zone corresponds approximately to the lower part of the Shunkmazarian Horizon or the *Fusulinella schwagerinoides* Zone, where *Beedeina samarica* appears.

*Fusulinella schwagerinoides* - *Beedeina darvasica* Zone.

This zone corresponds to the upper part of Member 3 of the Kalaiukhna Formation in sections 1005 and 1006.

The zone is identified by the appearance and predominance of the index species and related forms. Associated taxa are represented by scarce species of *Fusulinella* and *Beedeina*, as well as *Ozawainella*, *Taitzeoella*, *Eoschubertella* and *Schubertella*. The occurrence of *Taitzeoella librovitchi* and *T. compacta* is noteworthy.

The position of this zone in the section allows it to be correlated with the middle part of the Myachkovian Horizon of the Eastern European Platform and with part of the Shunkmazarian Horizon of Middle Asia.

*Beedeina consobrina* - *B. dutkevichi* Zone.

This zone corresponds to Member 4 of the Kalaiukhna Formation (section no. 1006). The assemblage is dominated by large *Beedeina* (i.e. *B. crassa* and *B. angeli*).

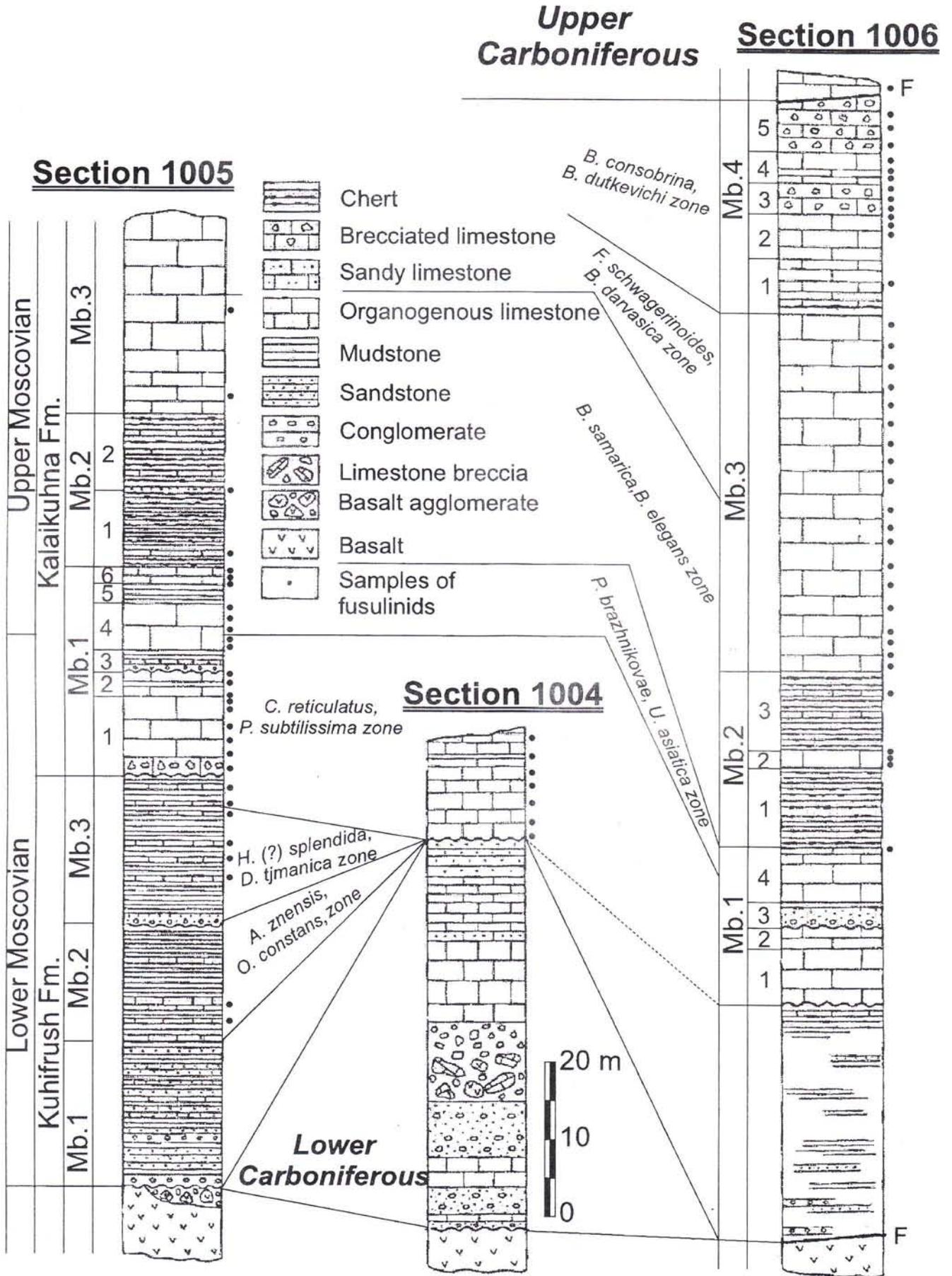


Fig. 3 - Correlation chart of measured stratigraphic sections.

nae, besides the index species) which differ generally in having longer tests than the specimens of the underlying beds of the Moscovian. There are abundant *Fusulina*, *Taitzeoella*, *Ozawainella*, and *Neostaffella* as well as *Fusulinella* of the *Fusulinella mosquensis* group. *Protriticites* (?) appears in the uppermost beds of the zone. The *Beedeina consobrina* - *B. dutkevichi* Zone may be correlated with the upper portion of the Myachkovian Horizon or with the *Fusulina cylindrica* Zone in the Moscow Basin. Although *Fusulina cylindrica* was not found in the Darvaz sections, this zone was established based on the presence of *Beedeina* of the *B. mjachkovensis* and *B. crassa* type, which together with the zonal species characterise the sections of this zone of the Platform. According to the Carboniferous regional scale of Middle Asia, this zone is likely to correspond to the upper part of the Shunkmazarian Horizon. Taking into consideration the tectonic contact between the Moscovian and Kasimovian stages in the Darvaz sections, it is reasonable to believe that the uppermost part of the Moscovian stage is missing in that area.

### Conclusions.

The following conclusions may be drawn from the data presented. The sections described encompass the major part of the Moscovian stage and may be divided into seven fusulinid zones. The Moscovian of Darvaz, complete and rich in fossils, especially fusulinids, may be considered one of the best Tethyan sections for this time-interval. The fusulinid assemblages of the Darvaz sections show a great similarity with coeval assemblages of the sections in the Eastern European Platform, Donetz Basin, Middle Asia, and South China. The main subdivisions of the Moscovian Stage recognized in the Eastern European Platform, such as the Tsnian, Kashirian, Podolian, and Myachkovian Horizons, may be readily distinguished in the Darvaz section since the fusulinid fauna does not show any evidence of provinciality. Although the general changes in the fusulinid assemblages may be followed throughout the section, the zonal subdivisions cannot be correlated with such confidence, because of local facies distribution.

The section studied is composed mostly of limestones accumulated in the typical shallow-water carbonate platform environment. The limestones are substituted by mudstones, siltstones, and sandstones only in the northern part of the region, in the Charymdara River basin. The stable platform environments have existed in Darvaz since the time of the Kalaikuhna limestone deposition. The Kalaikuhna Formation lies transgressively on the eroded surfaces of the Lower Moscovian, Bashkiran, and Lower Carboniferous carbonate-clastic sequences, of variable composition and thickness, which accumulated under an unstable tectonic regime.

### Palaeontological descriptions of Fusulinids.

Except a few points, the author uses the fusulinid systematics of recently published Guide on the Paleozoic foraminifer systematics (Rauser-Chernousova et al., 1996).

Order *Ozawainellida* Solovieva, 1980

Family *Eostaffellidae* Mamet, 1970

*Eostaffella* Rauser-Chernousova, 1948

***Eostaffella acuta*** Grozdilova et Lebedeva, 1950

Pl. 1, fig. 1, 2

1950 *Eostaffella acuta* Grozdilova & Lebedeva, pp. 15-16, pl. 1, fig. 13, 14.

**Material.** 3 axial and several tangential sections.

**Distribution and age.** East European Platform, Donetz Basin, Middle Asia, Spain, North Africa, Japan, USA; Middle Carboniferous.

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, members 2 and 3; Kalaikuhna Formation, member 1, level 1.

***Eostaffella mutabilis*** Rauser-Chernousova, 1951

Pl. 1, fig. 3

1951 *Eostaffella mutabilis* Rauser-Chernousova in Rauser-Chernousova et al., pp. 56-57, pl. 1, fig. 23-25.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Middle Asia, Spain, China, USA; Middle Carboniferous, Lower Moscovian and lower part of Upper Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 1.

***Eostaffella quasiample*** Sheng, 1958

Pl. 1, fig. 4

1958 *Eostaffella quasiample* Sheng, p.12-13 (Chinese), 71 (English), pl. 1, fig.13-18.

**Material.** 1 axial section.

**Distribution and age.** China, Middle Asia, Japan; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 2.

*Novella* Grozdilova et Lebedeva, 1950

***Novella pulchra*** Potievskaja, 1964

Pl. 1, fig. 5

1964 *Novella pulchra* Potievskaja, pp. 50-51, pl. 3, fig. 19-21.

**Material.** 1 subaxial and several tangential sections.

**Distribution and age.** Donetz Basin, Middle Asia, North Africa; Middle Carboniferous.

**Occurrence.** Section 1005, Kuhifrush Formation, member 2.

Family *Ozawainellidae* Thompson et Foster, 1937

*Ozawainella* Thompson, 1935

***Ozawainella digitalis*** Manukalova, 1950

Pl. 1, fig. 10

1950 *Ozawainella digitalis* Manukalova, pp. 177-178, pl. 1, fig. 2.

Material. 2 subaxial sections.

Distribution and age. Donetz Basin, Middle Asia, Ural, Spain, China; Middle Carboniferous.

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 2.

***Ozawainella vozhgatica*** Safonova, 1951

Pl. 1, fig. 8

1951 *Ozawainella vozhgatica* Safonova in Rauser-Chernousova et al., pp. 138-139, pl. 11, fig. 3, 4.

Material. 3 axial sections.

Distribution and age. East European Platform, Middle Asia, China, Spain, Japan; Middle Carboniferous.

Occurrence. Section 1004, Kalaikuhna Formation.

***Ozawainella magna*** Sheng, 1958

Pl. 1, fig. 9

1958 *Ozawainella magna* Sheng, p. 15 (Chinese), 74 (English), pl. 2, fig. 2-3.

Material. 2 subaxial sections.

Distribution and age. China, Darvaz, Spain; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 6.

***Ozawainella turgida*** Sheng, 1958

Pl. 1, fig. 7

1958 *Ozawainella turgida* Sheng, pp. 14 (Chinese), 72-73 (English), pl. 1, fig. 25-28.

Material. 1 axial and 3 oblique sections.

Distribution and age. China, Darvaz, Japan, Thailand; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kalaikuhna Formation, member 1, level 6; section 1006, Kalaikuhna Formation, member 1, level 4 and member 3.

***Ozawainella lisichanica*** Manukalova, 1956

Pl. 1, fig. 11

1956 *Ozawainella lisichanica* Manukalova, p. 91, pl. 1, fig. 4.

Material. 4 axial section.

Distribution and age. Donetz Basin, Middle Asia; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 3 (upper part) and member 4, levels 2, 3 and 5.

***Ozawainella* aff. *fragilis*** Safonova, 1951

Pl. 1, fig. 6

1951 *Ozawainella fragilis* Safonova in Rauser-Chernousova et al., p. 139, pl. 11, fig. 5.

Material. 1 axial section.

Distribution and age. East European Platform, Middle Asia, Spain, China, Viet Nam; Middle Carboniferous, Moscovian.

Occurrence. Section 1005, Kuhifrush Formation, member 2.

***Ozawainella* (?) sp.**

Pl. 1, fig. 12

Remarks. The figured specimen has a spiral coiling abnormal for *Ozawainella*. Much similar to the genus *Reichelina* of the Upper Permian *Ozawainellidae*. Such spiral coiling in the Middle Carboniferous *Ozawainellidae* is here mentioned for the first time.

Occurrence. Section 1006, Kalaikuhna Formation, member 2, level 2.

Family *Pseudostaffellidae* Putrja, 1956

*Neostaffella* A. Miklukho-Maclay, 1959

***Neostaffella ozawai*** (Lee et Chen, 1930)

Pl. 1, fig. 13-14

1930 *Staffella ozawai* Lee, Chen & Chu, pp. 116-117, pl. 7, fig. 5-11.

Material. 6 axial and 9 subaxial sections.

Distribution and age. China, Middle Asia, East European Platform, Donetz Basin, Spain, Viet Nam; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian.

Occurrence. Section 1005, Kuhifrush Formation, member 3; Kalaikuhna Formation, member 1, level 2.

***Neostaffella rotundata*** (Bensh, 1969)

Pl. 1, fig. 20

1969 *Pseudostaffella rotundata* Bensh, pp. 108-109, pl. 1, fig. 4, 5.

Material. 6 axial sections.

Distribution and age. Middle Asia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, levels 2 and 6.

***Neostaffella umbilicata*** (Putrja et Leontovich, 1948)

Pl. 1, fig. 15

1948 *Staffella umbilicata* Putrja & Leontovich, p. 30, pl. 2, fig. 12-13.

Material. 2 axial sections.

Distribution and age. Donetz Basin, East European Platform, Middle Asia, Spain, Japan; Middle Carboniferous, Lower Moscovian (upper part), Upper Moscovian (lower part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 6.

***Neostaffella sphaeroidea cuboides*** (Rauser-Chernousova, 1951)

Pl. 1, fig. 16, 19

1951 *Pseudostaffella sphaeroidea* var. *cuboides* Rauser-Chernousova in Rauser-Chernousova et al., p. 129, pl. 9, fig. 6, 7.

Material. 12 axial and subaxial sections.

Distribution and age. East European Platform, Donetz Basin, Middle Asia, Spain, China; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1, levels 4 and 6; member 2, levels 1 and 2; member 3; section 1006, members 3 and 4.

***Neostaffella larionovae*** (Rauser-Chernousova et Safonova, 1951)

Pl. 1, fig. 17

1951 *Pseudostaffella larionovae* Rauser-Chernousova & Safonova in Rauser-Chernousova et al., p. 115, pl. 7, fig. 1, 2.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Middle Asia, Spain, China; Middle Carboniferous, upper part of Lower Moscovian and Upper Moscovian.

**Occurrence.** Section 1006, Kalaikuhna Formation, member 4, level 2.

**Neostaffella subquadrata** (Grozdilova et Lebedeva, 1950)

Pl. 1, fig. 18

1950 *Pseudostaffella subquadrata* Grozdilova & Lebedeva, p. 38-39, pl. 4, fig. 9, 10.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Donetz Basin, Middle Asia, Spain, Japan, China, Malaya; Middle Carboniferous.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 6.

Order *Schubertellida* Skinner, 1931

Family *Schubertellidae* Skinner, 1931

*Eoschubertella* Thompson, 1937

**Eoschubertella obscura** (Lee et Chen, 1930)

Pl. 1, fig. 21-22

1930 *Schubertella obscura* Lee, Chen & Chu, pp. 112-113, pl. 6, fig. 12-22.

**Material.** 7 axial and subaxial sections.

**Distribution and age.** Many regions of Tethys, East European Platform, Donetz Basin, Middle Asia; Middle Carboniferous.

**Occurrence.** Section 1005, Kuhifrush Formation, members 2 and 3; Kalaikuhna Formation, member 1, level 2.

**Eoschubertella znensis** (Rauser-Chernousova, 1951)

Pl. 1, fig. 25-26

1951 *Schubertella gracilis* var. *znensis* Rauser-Chernousova in Rauser-Chernousova et al., p. 74-75, pl. 2, fig. 31, 32.

**Material.** 4 axial and subaxial sections.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Moscovian.

**Occurrence.** Section 1005, Kuhifrush Formation, member 2; Kalaikuhna Formation, member 1, level 1.

**Eoschubertella pseudoglobulosa** Safonova, 1951

Pl. 1, fig. 27-28

1951 *Schubertella pseudoglobulosa* Safonova in Rauser-Chernousova et al., pp. 77-78, pl. 3, fig. 3, 4.

**Material.** 1 axial and 1 tangential sections.

**Distribution and age.** East European Platform, Middle Asia, China, Indochina, Spain; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1005, Kuhifrush Formation, member 2; Kalaikuhna Formation, member 1, level 1; section 1006, Kalaikuhna Formation, member 3.

**Eoschubertella subglobulosa** (Dzhentchuraeva, 1979)

Pl. 1, fig. 29-31

1979 *Schubertella subglobulosa* Dzhentchuraeva, pp. 70-71, pl. 1, fig. 9, 10.

**Material.** 5 axial and subaxial sections.

**Distribution and age.** Middle Asia; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Sections 1004 and 1005, Kalaikuhna Formation, member 1, level 1.

*Schubertella* Staff et Wedekind, 1910

**Schubertella gracilis** Rauser-Chernousova, 1951

Pl. 1, fig. 23, 24

1951 *Schubertella gracilis* Rauser-Chernousova in Rauser-Chernousova et al., p. 74, pl. 2, fig. 29-30.

**Material.** 15 axial and subaxial sections.

**Distribution and age.** Many regions of Tethys, East European Platform, Donetz Basin, Middle Asia; Middle Carboniferous, Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, members 2 and 3.

**Schubertella subkingi** Putrja, 1939

Pl. 1, fig. 36

1939 *Schubertella subkingi* Putrja, pp. 109-110, pl. 1, Fig. 1.

**Material.** 2 subaxial sections.

**Distribution and age.** Donetz Basin, East European Platform, Middle Asia, Spain, China, Thailand; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 6.

**Schubertella acuta** Rauser-Chernousova, 1951

Pl. 1, fig. 33

1951 *Schubertella acuta* Rauser-Chernousova in Rauser-Chernousova et al., pp. 79-80, pl. 3, fig. 8, 9.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Middle Asia, China; Middle Carboniferous, Lower Moscovian and lower part of Upper Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 1.

**Schubertella magna** Lee et Chen, 1930.

Pl. 1, fig. 35

1930 *Schubertella magna* Lee, Chen & Chu, p. 113, pl. 6, fig. 24, 25.

**Material.** 1 axial section.

**Distribution and age.** Many regions of Tethys, East European Platform, Donetz Basin, Middle Asia; Middle Carboniferous, Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation.

**Schubertella** cf. **mjachkovensis** Rauser-Chernousova 1951

Pl. 1, fig. 34

1951 *Schubertella mjachkovensis* Rauser-Chernousova in Rauser-Chernousova et al., pp. 84-85, pl. 3, fig. 21; pl. 4, fig. 1.

**Material.** 1 subaxial section.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 6.

**Schubertella** aff. **kingi** Dunbar et Skinner, 1937

Pl. 1, fig. 32

1937 *Schubertella kingi* Dunbar & Skinner, pp. 610-611, pl. 45, fig. 10-15.

**Material.** 1 axial and 1 subaxial sections.

**Distribution and age.** North America, many regions of Tethys, Western Europe, Ural, Middle Asia; Upper Moscovian to Lower Permian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 6; Section 1006, Kalaikuhna Formation, member 3.

*Fusiella* Lee et Chen, 1930

**Fusiella typica** Lee et Chen, 1930

Pl. 1, fig. 37-38

1930 *Fusiella typica* Lee, Chen & Chu, pp. 107-108, pl. 6, fig. 1-6.

**Material.** 6 axial and subaxial sections.

**Distribution and age.** China, Middle Asia, Japan, Viet Nam, Spain, East European Platform; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, levels 4 and 6; section 1006, Kalaikuhna Formation, members 2 and 4.

**Fusiella lancetiformis** Putrja, 1939

Pl. 1, fig. 39

1939 *Fusiella lancetiformis* Putrja, pp. 110-112, pl. 1, fig. 2-6.

**Material.** 2 subaxial sections.

**Distribution and age.** Donetz Basin, East European Platform, Timan, Middle Asia; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1005, member 1, level 4.

Order Fusulinida Fursenko, 1958

Family *Profusulinidae* Solovieva, 1996

*Profusulinella* Rauser-Chernousova et Beljaev, 1936

**Profusulinella rhomboides** (Lee et Chen 1930),

Pl. 1, fig. 40, 42

1930 *Fusulinella* (*Neofusulinella*) *rhomboides* Lee, Chen & Chu, pp. 119-121, pl. 8, fig. 3-6.

**Material.** 1 axial and several subaxial and tangential sections.

**Distribution and age.** East European Platform, Middle Asia, China, Japan, Spain; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 3; Kalaikuhna Formation, member 1, level 1.

**Profusulinella primitiva** Sosnina, 1954

Pl. 1, fig. 41

1954 *Profusulinella primitiva* Sosnina in Grozdilova & Lebedeva, p. 153-154, pl. 16, fig. 13.

**Material.** 1 subaxial section.

**Distribution and age.** Donetz Basin, Darvaz; Middle Carboniferous.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 1.

**Profusulinella convoluta** (Lee et Chen, 1930)

Pl. 1, fig. 44

1930 *Fusulinella* (*Neofusulinella*) *parva* var. *convoluta* Lee, Chen & Chu, p. 119, pl. 8, fig. 1, 2.

**Material.** 3 axial sections.

**Distribution and age.** China, Middle Asia, East European Platform; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 2, Kalaikuhna Formation, member 1, level 2.

**Profusulinella arta** Leontovich, 1951

Pl. 1, fig. 45

1951 *Profusulinella arta* Leontovich in Rauser-Chernousova et al., p. 180, pl. 19, fig. 4-6.

**Material.** 1 subaxial section.

**Distribution and age.** East European Platform, Middle Asia, China; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1005, Kuhifrush Formation, member 3.

*Taitzeoella* Sheng, 1951

**Taitzeoella pseudolibrovichi** (Safonova, 1951)

Pl. 1, fig. 43, 52

1951 *Profusulinella pseudolibrovichi* Safonova in Rauser-Chernousova et al., p. 176, pl. 18, fig. 5-9.

**Material.** 4 axial sections.

**Distribution and age.** East European Platform, Ural, Donetz Basin, Middle Asia, Spain, Libia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, members 2 and 3.

**Taitzeoella praelibrovichi** (Safonova, 1951)

Pl. 1, fig. 49

1951 *Profusulinella praelibrovichi* Safonova in Rauser-Chernousova et al., pp. 178-179, pl. 18, fig. 16, 17.

**Material.** 1 subaxial section.

**Distribution and age.** East European Platform, Middle Asia, China, Spain; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1005, Kuhifrush Formation, member 3 (lower part).

**Taitzeoella librovitchi** (Dutkevich, 1934)

Pl. 1, fig. 46

1934 *Fusulinella librovitchi* Dutkevich, p. 43-46, pl. 5, fig. 1-5.

**Material.** 4 axial and 6 tangential sections.

**Distribution and age.** East European Platform, Ural, Donetz Basin, Middle Asia, China, Spain, Greenland, Spitzbergen; Middle Carboniferous, lower Moscovian (upper part) and upper Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1; section 1006, Kalaikuhna Formation, members 1 (upper part) to 4.

1951 *Profusulinella syzranica* Rauser-Chernousova in Rauser-Chernousova et al., pp. 181-182, pl. 19, fig 10-11.

**Taitzeoella syzranica** (Rauser-Chernousova, 1951)

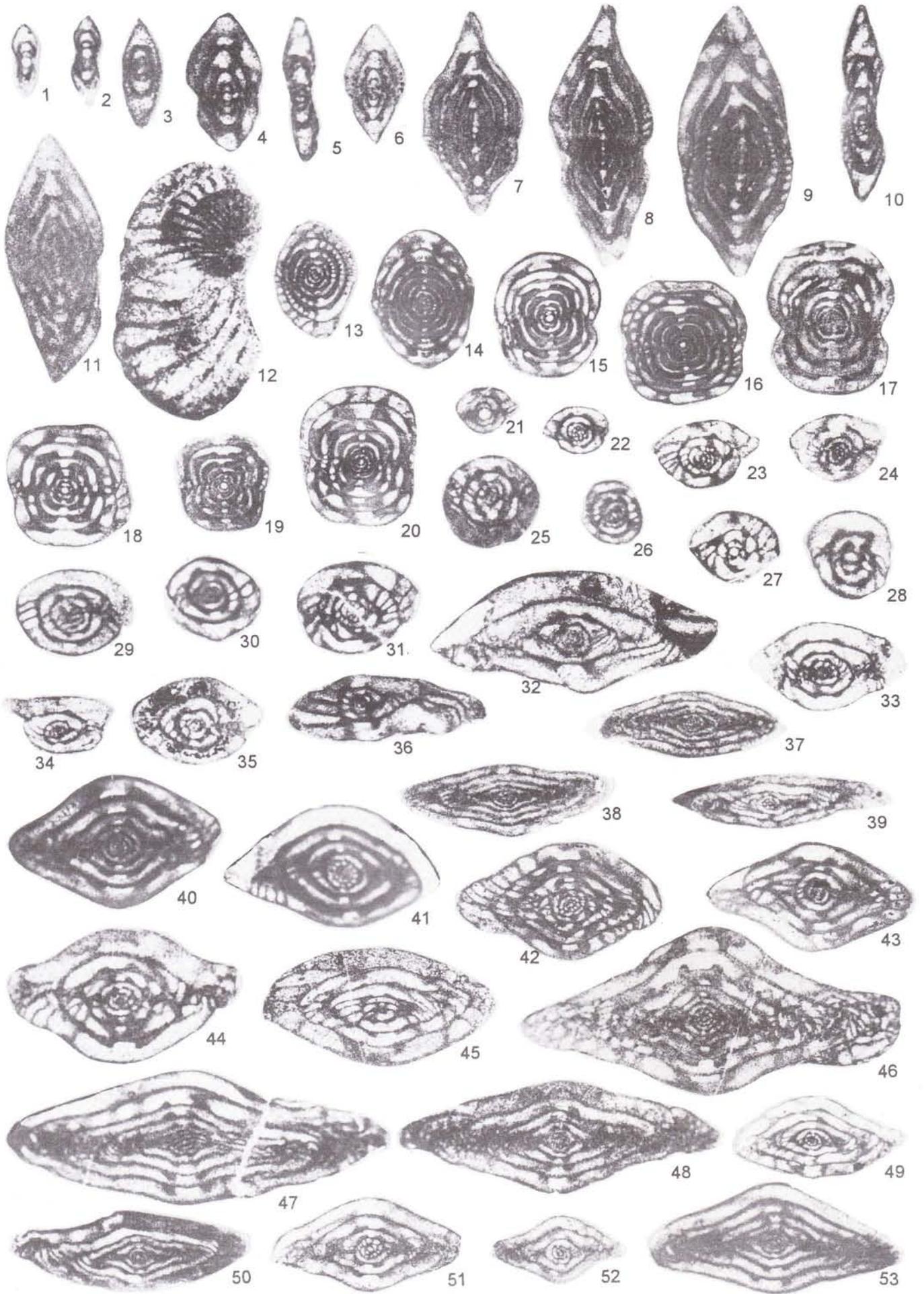
Pl. 1, fig. 50

Material. 3 axial sections.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

PLATE 1

- Fig. 1, 2 - *Eostaffella acuta* Grozdilova et Lebedeva. X 60. 1) Axial section, GIN 4767/1. 2) Axial section, GIN 4767/2. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 3 - *Eostaffella mutabilis* Rauser-Chernousova. Subaxial section, GIN 4767/3. Section 1005, Kalaikuhna Formation, member 1, level 1. x 60.
- Fig. 4 - *Eostaffella quasiampila* Sheng. Axial section, GIN 4767/4. Section 1005, Kalaikuhna Formation, member 1, level 2. x 60.
- Fig. 5 - *Novella pulchra* Potievskaja. Subaxial section, GIN 4767/5. Section 1005, Kuhifrush Formation, member 2. x 60.
- Fig. 6 - *Ozawainella* aff. *fragilis* Safonova. Axial section, GIN 4767/6. Section 1005, Kuhifrush Formation, member 2. x 40.
- Fig. 7 - *Ozawainella turgida* Sheng. Subaxial section, GIN 4767/7. Section 1004, Kalaikuhna Formation. x 40.
- Fig. 8 - *Ozawainella vozbgalica* Safonova. Axial section, GIN 4767/8. Section 1004, Kalaikuhna Formation. x 40.
- Fig. 9 - *Ozawainella magna* Sheng. Subaxial section, GIN 4767/9. Section 1005, Kalaikuhna Formation, member 1, level 6. x 40.
- Fig. 10 - *Ozawainella digitalis* Manukalova. Subaxial section, GIN 4767/10. Section 1004, Kalaikuhna Formation. x 60.
- Fig. 11 - *Ozawainella lisisbanica* Manukalova. Subaxial section, GIN 4767/11. Section 1006, Kalaikuhna Formation, member 4, level 2. x 40.
- Fig. 12 - *Ozawainella* (?) sp. Sagittal section, GIN 4767/12. Section 1006, Kalaikuhna Formation, member 2, bed 2. x 40.
- Fig. 13, 14 - *Neostaffella ozawai* (Lee et Chen). Section 1005, Kuhifrush Formation, member 3. x 40. 13) Subaxial section, GIN 4767/13. 14) Subaxial section, GIN 4767/14.
- Fig. 15 - *Neostaffella umbilicata* (Putrja et Leontovich). Axial section, GIN 4767/15. Section 1005, Kalaikuhna Formation, member 1, level 6. x 40.
- Fig. 16, 19 - *Neostaffella sphaeroidea* cuboides (Rauser-Chernousova). x 40. 16) Axial section, GIN 4767/16. Section 1006, Kalaikuhna Formation, member 1 bed 4. 19) Axial section, GIN 4767/17. Section 1005, Kalaikuhna Formation, member 2, level 1.
- Fig. 17 - *Neostaffella larionovae* (Rauser et Safonova). Subaxial section, GIN 4767/18. Section 1006, Kalaikuhna Formation, member 4, level 2. x 40.
- Fig. 18 - *Neostaffella subquadrata* (Grozdilova et Lebedeva). Axial section, GIN 4767/19. Section 1005, Kalaikuhna Formation, member 1, bed 6. x 40.
- Fig. 20 - *Neostaffella rotundata* (Bensh). Axial section GIN 4767/20. Section 1005, Kalaikuhna Formation, member 1, bed 6. x 40.
- Fig. 21, 22 - *Eoschubertella obscura* (Lee et Chen). x 40. 21) Axial section, GIN 4767/21. Section 1005, Kalaikuhna Formation, member 1, bed 2. 22) Axial section, GIN 4767/22. Section 1005, Kuhifrush Formation, member 3.
- Fig. 23, 24 - *Schubertella gracilis* Rauser-Chernousova x 40. 23) Axial section, GIN 4767/23. Section 1005, Kuhifrush Formation, member 3. 24) Axial section, GIN 4767/24. Section 1004, Kalaikuhna Formation.
- Fig. 25, 26 - *Eoschubertella znensis* (Rauser-Chernousova). x 40. 25) Axial section, GIN 4767/25. Section 1005, Kuhifrush Formation, member 2. 26) Subaxial section, GIN 4767/26. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 27, 28 - *Eostaffella pseudoglobulosa* (Safonova). x 40. 27) Axial section, GIN 4767/27. Section 1005, Kalaikuhna Formation, member 1, bed 1. 28) Subaxial section, GIN 4767/28. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 29-31 - *Eoschubertella subglobulosa* (Dzhentchuraeva). x 40. 29) Subaxial section, GIN 4767/29. Section 1005, Kalaikuhna Formation, Member 1, bed 1. Subaxial section, GIN 4767/30. Section 1005, Kalaikuhna Formation, member 1, bed 1. 31) Axial section, GIN 4767/31. Section 1004, Kalaikuhna Formation.
- Fig. 32 - *Schubertella* aff. *kingi* Dunbar et Skinner. Axial section, GIN 4767/32. Section 1006, Kalaikuhna Formation, member 3. x 40.
- Fig. 33 - *Schubertella acuta* Rauser-Chernousova. Axial section, GIN 4767/33. Section 1005, Kalaikuhna Formation, member 1, level 1. x 40.
- Fig. 34 - *Schubertella* cf. *mjachkovensis* Rauser-Chernousova. Subaxial section, GIN 4767/34. Section 1005, Kalaikuhna Formation, member 1, level 6. x 40.
- Fig. 35 - *Schubertella magna* Lee et Chen. Axial section, GIN 4767/35. Section 1004, Kalaikuhna Formation. x 40.
- Fig. 36 - *Schubertella subkingi* Putrja. Subaxial section, GIN 4767/36. Section 1005, Kalaikuhna Formation, member 1, level 6. x 40.
- Fig. 37, 38 - *Fusiella typica* Lee et Chen. x 30. 37) Axial section, GIN 4767/37. Section 1006, Kalaikuhna Formation, member 4, level 2. 38) Axial section, GIN 4767/38. Section 1006, Kalaikuhna Formation, member 2, level 2.
- Fig. 39 - *Fusiella lancetiformis* Putrja. Subaxial section, GIN 4767/39. Section 1005, member 1, level 4. x 30.
- Fig. 40, 42 - *Profusulinella rhomboides* (Lee et Chen). x 30. 40) Axial section, GIN 4767/40. Section 1004, Kalaikuhna Formation. 42) Subaxial section, GIN 4767/41. Section 1005, Kuhifrush Formation, member 3.
- Fig. 41 - *Profusulinella primitiva* Sosnina. Axial section, GIN 4767/30. Section 1005, Kalaikuhna Formation, member 1, level 1. x 40.
- Fig. 43, 52 - *Taitzeoella pseudolibrovichi* (Safonova). x 30. Section 1005, Kuhifrush Formation, member 2. 43) Subaxial section, GIN 4767/44. 52) Axial section, GIN 4767/43.
- Fig. 44 - *Profusulinella convoluta* (Lee et Chen). Axial section, GIN 4767/24. Section 1004, Kalaikuhna Formation. x 40.
- Fig. 45 - *Profusulinella arta* Leontovich. Subaxial section, GIN 4767/44. Section 1005, Kuhifrush Formation, member 3. x 30.
- Fig. 46 - *Taitzeoella librovitichi* (Dutkevich). Axial section, GIN 4767/45. Section 1006, Kalaikuhna Formation, member 1, level 4. x 30.
- Fig. 47, 48, 53 - *Taitzeoella compacta* n. sp. x 30. Section 1006, Kalaikuhna Formation, member 3. 47) Subaxial section, GIN 4767/46. 48) Axial section, GIN 4767/47. Axial section of the holotype, GIN 4767/48.
- Fig. 49 - *Taitzeoella praelibrovichi* (Safonova). Axial section, GIN 4767/49. Section 1005, Kuhifrush Formation, member 3. x 20.
- Fig. 50 - *Taitzeoella syzranica* (Rauser-Chernousova). Axial section, GIN 4767/50. Section 1005, Kalaikuhna Formation, member 1, level 4. x 30.
- Fig. 51 - *Taitzeoella mutabilis* (Safonova). Axial section, GIN 4767/51. Section 1005, Kuhifrush Formation, member 3. x 30.



Occurrence. Section 1005, Kuhifrush Formation, member 3; Kalaikuhna Formation, member 1, bed 4.

**Taitzeoella mutabilis** (Safonova, 1951)

Pl. 1, fig. 51

1951 *Profusulinella mutabilis* Safonova in Rauser-Chernousova et al., pp. 179-180, pl. 19, fig. 1-3.

Material. 2 axial and 3 tangential sections.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian and lower part of Upper Moscovian.

Occurrence. Section 1005, Kuhifrush Formation, members 2 and 3; Kalaikuhna Formation, member 1, level 1.

**Taitzeoella compacta** n. sp.

Pl. 1, fig. 47, 48, 53

Holotype. GIN 4767/48; Darvaz, Kalaikuhna, section 1006, member 3 (upper part); Middle Carboniferous, upper Moscovian.

Material. 4 axial and 5 subaxial sections.

Description. Shell small, fusiform, with nearly straight to slightly concave lateral slopes and sharply pointed poles. Mature shell have 6 to 7 volutions and measure 1.6 to 2.7 mm. in length and 0.75 to 1 mm. in diameter; form ratio 2.2 to 3. Thin spirotheca composed of tectum and primatheca, 0.025 to 0.03 mm in thickness in sixth whorl. Septa plane. Proloculus minute with outside diameter 0.03 to 0.04 mm. Tunnel narrow, about half as high as chamber. Chomata narrow and high.

Discussion. *Taitzeoella compacta* resembles *T. librovitchi* (Dutkevich) in general appearance, but differs in having more compact spiral coiling and more elongate shell.

Occurrence and age. Section 1005, Kalaikuhna Formation, member 1, level 6; section 1006, Kalaikuhna Formation, member 2, level 2; member 3; Middle Carboniferous, upper Moscovian.

*Depratina* Solovieva, 1996

**Depratina prisca** (Deprat, 1912)

Pl. 2, fig. 1, 5

1912 *Schwagerina prisca* Deprat, p. 41-42, pl. 4, fig. 10-14.

Material. 1 axial and several subaxial sections.

Distribution and age. Many regions of Tethys, Middle Asia, East European Platform, Greenland; Middle Carboniferous, Lower Moscovian.

Occurrence. Section 1004, Kalaikuhna Formation.

**Depratina timanica** (Kireeva, 1951)

Pl. 2, fig. 6

1951 *Profusulinella prisca* var. *timanica* Kireeva in Rauser-Chernousova et al., pp. 166-167, pl. 15, fig. 5, 6.

Material. 3 subaxial section.

Distribution and age. East European Platform, Middle Asia, China; Middle Carboniferous, Lower Moscovian.

Occurrence. Section 1005, Kuhifrush Formation, member 3 (lower part).

**Depratina parapriscas** (Bensh, 1969)

Pl. 2, fig. 3

1969 *Profusulinella parapriscas* Bensh, pp. 117-118, pl. 3, fig. 3.

Material. 8 subaxial sections.

Distribution and age. Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1005, Kuhifrush Formation, members 2 and 3, Kalaikuhna Formation, member 1, level 1.

**Depratina parva** (Lee et Chen, 1930)

Pl. 2, fig. 2-4

1930 *Fusulinella (Neofusulinella) parva* Lee, Chen & Chu, p. 118-119, pl. 7, fig. 22-27.

Material. 1 axial and several subaxial and tangential sections.

Distribution and age. China, Middle Asia, East European Platform, Spain, Thailand, Viet Nam; Middle Carboniferous, Lower Moscovian.

Occurrence. Section 1005, Kuhifrush Formation, members 2 and 3.

*Ovatella* Solovieva, 1996

**Ovatella constans** (Safonova, 1951)

Pl. 2, fig. 7-8

1951 *Profusulinella constans* Safonova in Rauser-Chernousova et al., pp. 164-165, pl. 14, fig. 8-9.

Material. 18 axial and subaxial sections.

Distribution and age. East European Platform, Middle Asia, China, Spain; Middle Carboniferous, lower Moscovian (upper part).

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 2.

**Ovatella meridiana** (Bensh, 1969)

Pl. 2, fig. 11

1969 *Profusulinella ovata* subsp. *meridiana* Bensh, pp. 114-115, pl. 2, fig. 2, pl. 3, fig. 1.

Material. 4 axial sections.

Distribution and age. Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1004, Kalaikuhna Formation.

**Ovatella nytvica** (Safonova, 1951)

Pl. 2, fig. 9

1951 *Profusulinella ovata* var. *nytvica* Safonova in Rauser-Chernousova et al., p. 163-164, pl. 14, fig. 4.

Material. 1 axial and 2 tangential sections.

Distribution and age. East European Platform, Middle Asia, Spain, China; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kalaikuhna Formation, member 1, level 1.

**Ovatella ferganensis** (Bogush, 1963)

Pl. 2, fig. 10

1963 *Profusulinella rhombiformis* var. *ferganensis* Bogush, p. 75, pl. 3, fig. 15.

Material. 2 axial sections.

Distribution and age. Middle Asia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kalaikuhna Formation, member 1, level 1.

**Ovatella panjensis** n. sp.

Pl. 2, fig. 12-13

**Holotype.** GIN 4767/61; Darvaz, Kalaikuhna, section 1004, Kalaikuhna Formation; Middle Carboniferous, Lower Moscovian (upper part).

**Material.** 3 axial sections.

**Description.** Shell large, fusiform, with convex lateral slopes and rather bluntly pointed poles. Mature individuals 6 to 6.5 volutions and measure 3.2 mm. in length and 1.3 to 1.5 mm. in diameter; form ratio 2.1 to 2.45. Spirotheca very thin, composed of tectum, protheca and outer tectorium and tectum and protheca in outer volution. Septa nearly plane across middle of shell and only moderately folded in polar regions. Proloculus usually quite small, its outside diameter 0.04 to 0.045 mm. Tunnel about half as high as chamber, narrow in inner whorls and rather wide in last one-two whorls. Chomata narrow, usually not more than half as high as chambers.

**Discussion.** *Ovatella panjensis* is similar to *O. ovata* Rauser-Chernousova-Chernousova, but differs in its larger size and thin spirotheca.

**Occurrence and age.** The same as holotype.

Family *Aljutovellidae* Solovieva,  
*Aljutovella* Rauser-Chernousova, 1951

**Aljutovella aljutovica** (Rauser-Chernousova, 1938)

Pl. 2, fig. 17

1938 *Profusulinella aljutovica* Rauser-Chernousova, pp. 97-98 (Russian), 153 (English), pl. 1, fig. 10, 12.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation.

**Aljutovella znensis** Rauser-Chernousova, 1951

Pl. 2, fig. 14-15

1951 *Aljutovella znensis* Rauser-Chernousova in Rauser-Chernousova et al., pp. 209-210, pl. 38, fig. 3-4.

**Material.** 20 axial and subaxial sections.

**Distribution and age.** East European Platform, Timan, Middle Asia, Chona, Viet Nam, North Africa; Middle Carboniferous, Lower Moscovian (middle and upper part).

**Occurrence.** Section 1005, Kuhifrush Formation, member 2.

**Aljutovella postaljutovica dilucida** Leontovich, 1951

Pl. 2, fig. 18-19

1951 *Aljutovella postaljutovica dilucida* Leontovich in Rauser-Chernousova et al., pp. 206-207, pl. 27, fig. 1-2.

**Material.** 3 axial sections.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

**Occurrence.** Section 1005, Kuhifrush Formation, member 3 (upper part); Kalaikuhna Formation, member 1, level 2.

**Aljutovella devexa** Safonova, 1951

Pl. 2, fig. 16

1951 *Aljutovella devexa* Safonova in Rauser-Chernousova et al., pp. 207-208, pl. 27, fig. 3, 4.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 2.

**Aljutovella darvasica** n. sp.

Pl. 2, fig. 20

**Holotype.** GIN 4767/68; Darvaz, Kalaikuhna, section 1004, Kalaikuhna Formation; Middle Carboniferous, Lower Moscovian (upper part).

**Material.** 1 axial section.

**Description.** Shell ellipsoidal, with bluntly rounded poles. Holotype has 7 volutions and measure 3.2 mm. in length and 2.1 mm in diameter; form ratio 1.6. Spirotheca composed of tectum, primatheca and outer tectorium. Septa nearly plane across middle of shell, becoming gently folded near poles. Proloculus small. Tunnel low and narrow in the inner volutions and wide in the outer one. Chomata weak and low.

**Discussion.** *Aljutovella darvasica* bear a general resemblance to *A. parasaratovica* Safonova. It can be readily distinguished from that species by its larger size, more intensively septal fluting, more thick spirotheca and weak chomata.

**Occurrence and age.** The same as holotype.

Family *Fusulinidae* Moeller, 1878

Subfamily *Fusulininae* Moeller, 1878

*Fusulina* Fischer, 1829

**Fusulina cf. mjachkovensis mjachkovensis**

Rauser-Chernousova, 1951

Pl. 2, fig. 23

1951 *Fusulina mjachkovensis* Rauser-Chernousova in Rauser-Chernousova et al., pp. 308-309, pl. 53, fig. 4, 5.

**Material.** 1 subaxial section.

**Distribution and age.** East European Platform, Western Europe, Middle Asia; Middle Carboniferous, Upper Moscovian (upper part).

**Occurrence.** Section 1006, Kalaikuhna Formation, member 4, level 5.

**Fusulina cf. mjachkovensis peskensis** Rauser-Chernousova, 1951

Pl. 2, fig. 22

1951 *Fusulina mjachkovensis peskensis* Rauser-Chernousova in Rauser-Chernousova et al., p. 309, pl. 53, fig. 6, pl. 54, fig. 1.

**Material.** 1 oblique section.

**Discussion.** Described specimen could not be accurately identified with the type forms because its shell is less elongate and septal fluting is not so high.

**Distribution and age.** East European Platform, Darvaz; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1006, Kalaikuhna Formation, member 4, level 3.

**Fusulina aff. conspecta** Rauser-Chernousova, 1951

Pl. 2, fig. 21

1951 *Fusulina conspecta* Rauser-Chernousova in Rauser-Chernousova et al., p. 310, pl. 54, fig. 3-4.**Material.** 1 subaxial section.**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, upper part of Upper Moscovian.**Occurrence.** Section 1006, Kalaikuhna Formation, member 4, level 5.*Undatafusulina* Leven, n. gen.Type-species: *Undatafusulina asiatica* Leven, n. sp.

**Description.** Shell of moderate size, fusiform to subcylindrical, with straight or curved axis and sharply to bluntly rounded poles. Mature specimens usually possess 5.5 to 6.5 whorls and are bilaterally symmetrical at all stages of growth. Proloculus small to moderate. Volutions commonly are tightly coiled especially two or three of them. Spirotheca uneven and undulate; undulations or furrows aligned both axially and equatorially so that exterior of shell has pebbled appearance much like that of surface of cobble-stone pavement. Spirotheca consist of tectum, clear diaphanotheca and irregularly inner and outer tectorium. Thickness of spirotheca irregularly variable, even within same volution. Septa fluted from pole to pole; septal arcs are not high and regular. Chomata present on proloculus and in first two-three volutions. More or less clear axial fillings present.

**Discussion.** *Undatafusulina* differs from the *Fusulina* in having a undulated spirotheca. In this respect our genus close resembles to Permian genera *Rugosofusulina* and *Rugosochuselella* but differs in having a four-layers spirotheca with the clear diaphanotheca. Differs from *Hidaella* by the stronger septal fluting.

**Distribution and age.** Darvaz, Donetz Basin; Middle Carboniferous, Upper Moscovian.

Besides type species, described genus includes also *U.* (*Fusulina* in original) *tumulosa* Rjazanov, 1958.

**Undatafusulina asiatica** n. sp.

Pl. 3, fig. 1, 2, 4

**Holotype.** GIN 4767/72; axial section; Darvaz, Kalaikuhna, section 1005, Kalaikuhna Formation, member 1, bed 6; Middle Carboniferous, Upper Moscovian (lower part).

**Material.** 5 axial and several tangential and oblique sections.

**Description.** Shell fusiform to subcylindrical, with bluntly rounded to bluntly pointed poles. Mature shells have 5.5 to 6 volutions and measure 4.6 to 5.5 mm in length and 1.4 to 1.6 mm. in diameter; form ratio 2.87 to 3.9. Coiling is uniform and rather compact. Spirotheca undulate and consist of tectum, diaphanotheca and irregularly inner and outer tectorium, its thickness in the fourth whorl is 0.045 to 0.05 mm. Septa thin, irregularly and not intensely fluted from pole to pole. Septal folds low and have irregular shape and size. Proloculus moderately large, spherical or subspherical, its outside diameter 0.18 to 0.22 mm. Tunnel irregular, narrow in inner volutions and wide in outer volutions. Chomata weak, present only on proloculus and in inner two to three volutions. Narrow, discontinuous band of secondary material deposited along axis, particularly in first 3 to 4 volutions.

**Discussion.** In many respect the described species resembles to *Undatafusulina tumulosa* (Rjazanov) but the latter has more elongated shell, and stronger axial filling.

**Occurrence and age.** Section 1005 Kalaikuhna Formation, member 1, levels 4 and 6; section 1006, Kalaikuhna Formation, member 1.

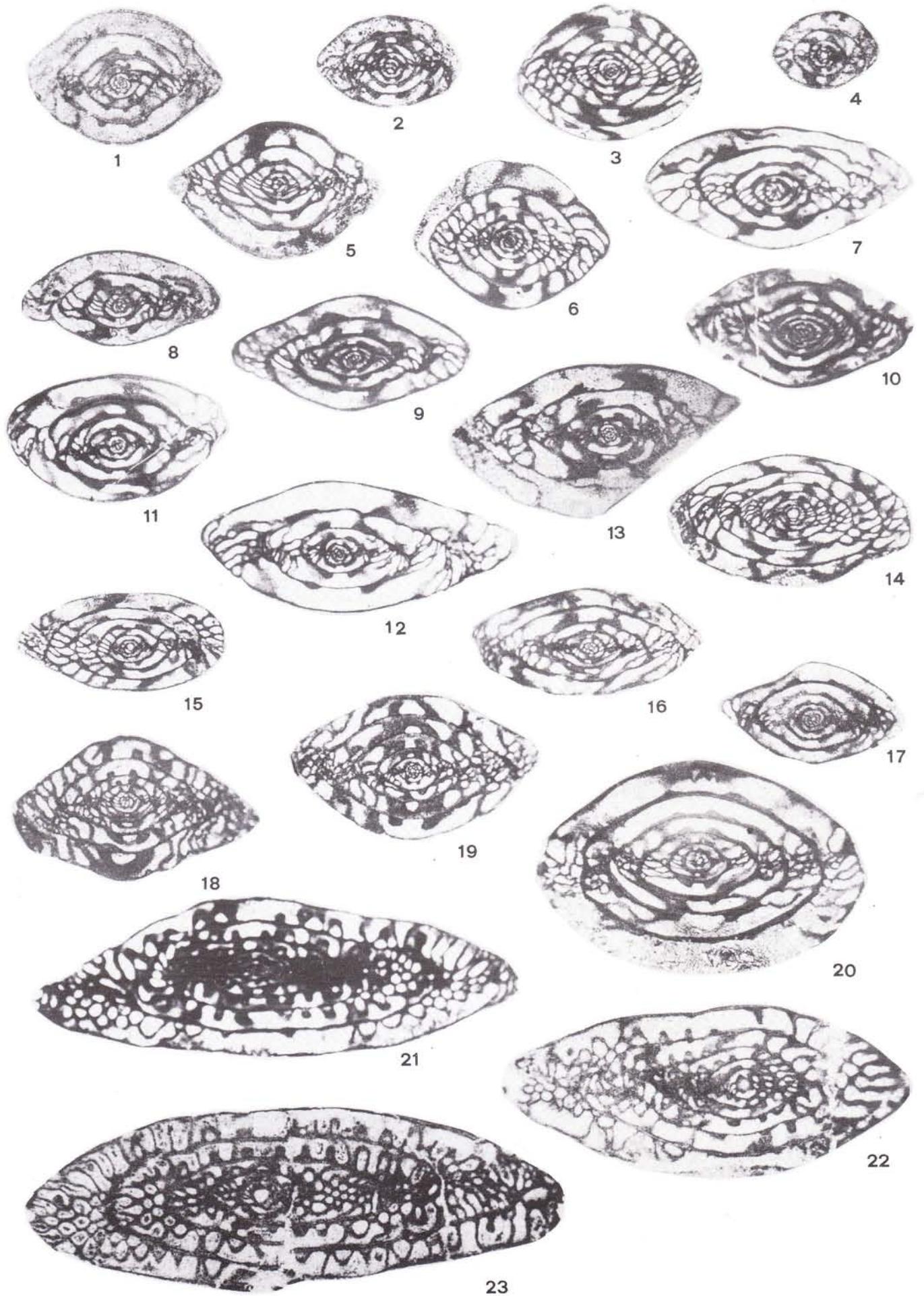
Subfamily *Beedeininae* Solovieva, 1996*Citronites* Solovieva, 1996**Citronites apokensis** (Rauser-Chernousova, 1951)

Pl. 3, fig. 3, 5

1951 *Fusulina schellwieni* var. *apokensis* Rauser-Chernousova in Rauser-Chernousova et al., p. 281, pl. 44, fig. 5-6.**Material.** 3 axial and 2 subaxial sections.

## PLATE 2

- Fig. 1, 5 - *Depratina prisca* (Deprat). x 20. Section 1004, Kalaikuhna Formation. 1) Axial section, GIN 4767/52; 5) subaxial section, GIN 4767/53.
- Fig. 2, 4 - *Depratina parva* (Lee et Chen) - x 30. Section 1005, Kuhifrush Formation, member 3. 2) Axial section, GIN 4767/54; 4) axial section, GIN 4767/49.
- Fig. 3 - *Depratina parapriscia* (Bensh) - Subaxial section, GIN 4767/55. x 20. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 6 - *Depratina timanica* (Kireeva) - Subaxial section, GIN 4767/56. x 20. Section 1005, Kuhifrush Formation, member 3.
- Fig. 7, 8 - *Ovatella constans* (Safonova) - x 20. 7) Axial section, GIN 4767/57. Section 1004, Kalaikuhna Formation. 8) Axial section, GIN 4767/58. Section 1005, Kuhifrush Formation, member 2.
- Fig. 9 - *Ovatella nytvica* (Safonova) - Axial section, GIN 4767/59. x 20. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 10 - *Ovatella ferganensis* (Bogush) - Axial section, GIN 4767/29. x 20. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 11 - *Ovatella meridiana* (Bensh) - Axial section, GIN 4767/60. x 20. Section 1004, Kalaikuhna Formation.
- Fig. 12, 13 - *Ovatella panjensis* n. sp. - x 20. Section 1004, Kalaikuhna Formation. Axial section of the holotype, GIN 4767/61. 13) Axial section, GIN 4767/62.
- Fig. 14, 15 - *Aljutovella znensis* Rauser-Chernousova. Axial sections, GIN 4767/63. x 20. Section 1005, Kuhifrush Formation, member 2.
- Fig. 16 - *Aljutovella devexa* Safonova. Axial section, GIN 4767/64. x 20. Section 1005, Kalaikuhna Formation, member 1, level 2.
- Fig. 17 - *Aljutovella aljutovica* (Rauser-Chernousova) - Axial section, GIN 4767/65. x 20. Section 1004, Kalaikuhna Formation.
- Fig. 18, 19 - *Aljutovella postaljutovica* dilucida Leontovich. x 20. 18) Axial section, GIN 4767/66. Section 1005, Kuhifrush Formation, member 3; 19) axial section, GIN 4767/67. Section 1005, Kalaikuhna Formation, member 1, level 2.
- Fig. 20 - *Aljutovella darvasica* n. sp. - Axial section of the holotype, GIN 4767/68. x 20. Section 1004, Kalaikuhna Formation.
- Fig. 21 - *Fusulina* aff. *conspecta* Rauser-Chernousova. Subaxial section, GIN 4767/69. x 20. Section 1006, Kalaikuhna Formation, member 4, level 5.
- Fig. 22 - *Fusulina* cf. *mjachkovensis peskensis* Rauser-Chernousova. Subaxial section, GIN 4767/70. x 20. Section 1006, Kalaikuhna Formation, member 4, level 3.
- Fig. 23 - *Fusulina* cf. *mjachkovensis mjachkovensis* Rauser-Chernousova. Subaxial section, GIN 4767/71. x 20. Section 1006, Kalaikuhna Formation, member 4, level 5.



Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1005, Kuhifrush Formation, member 3 (upper part); Kalaikuhna Formation, member 1, level 2.

**Citronites panjensis** n. sp.

Pl. 3, fig. 7-8

Holotype. GIN 4767/78; axial section; Darvaz, Kalaikuhna, section 1004, Kalaikuhna Formation; Middle Carboniferous, Lower Moscovian (upper part).

Material. 4 axial sections.

Description. Shell small, inflated fusiform, with straight to slightly convex lateral slopes and bluntly pointed poles. Mature shells possess 6.5 to 7 volutions and measure 1.7 to 2.4 mm. in length and 1.2 to 1.4 mm. in diameter; form ratio 1.4 to 1.6. Proloculus quite small spherical, its diameter 0.08 to 0.1 mm. The chambers increase slowly and gradually. Spirotheca composed of tectum, unstable outer tectoria and protheca; in some volutions unclear diaphanotheca appears. In outer volutions spirotheca measures 0.03 to 0.04 mm. in thickness. Septa intensively and regularly fluted. Arcs are high and rounded. Tunnel narrow and stable. High chomata presence in the inner fifth volutions.

Discussion. *Citronites panjensis* n. sp. differs from the *C. apokensis* (Rausser-Chernousova) in having a small size of shell, a more intensively septal fluting and a more developed chomata. In this respect our species close resembles to some species of genus *Beedeina* but differs in having a more primitive spirotheca without clear diaphanotheca.

Occurrence and age. Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 3 (upper part); Middle Carboniferous, Lower Moscovian (upper part).

**Citronites reticulatus** n. sp.

Pl. 3, fig. 10

Holotype. GIN 4767/80; axial section; Darvaz, Kalaikuhna, section 1005, Kalaikuhna Formation, member 1, bed 2; Middle Carboniferous, Lower Moscovian (upper part).

Material. 1 axial and several subaxial and tangential sections.

Description. The shell is inflated fusiform to subspherical; the lateral slopes vary from slightly plane to moderately convex, and the poles are bluntly pointed; the inner volutions are short fusiform to subrhombic in shape. The length varies from 2 to 3 mm. and the width 1.4 to 1.95 mm. giving a form ratio from 1.3 to 1.65. Number

of volutions are 5.5 to 7. The proloculus is spherical; the average outside diameter is 0.13 mm. The chambers mean increases slowly but uniformly; in some specimens the increasing of the outer one-two volutions is more rapid. The spirotheca consists of tectum and inner and outer tectoria in the inner volutions; in the outer volutions sometimes the dull and wide diaphanotheca appears. The average thickness of spirotheca is 0.03 mm in the outer volutions. Septa thin, and its fluting is high and intense but not regular; the folds divide the major chambers vertically into numerous chamberlets of a netform nature. The tunnel is narrow and its path is rather irregular. The chomata are present in the inner volutions.

Discussion. The described species differs from *Citronites panjensis* n. sp. in having average greater and more elongated shell, irregularly septal fluting, less developed chomata. In many respect our species resembles some beedeinas of the group *Beedeina schellwieni* Staff, but differs in having a more primitive spirotheca without clear diaphanotheca.

Occurrence and age. Section 1005, Kuhifrush Formation, member 3 (upper part); Kalaikuhna Formation, member 1, level 2; Middle Carboniferous, Lower Moscovian (upper part).

*Beedeina* Galloway, 1933

**Beedeina schellwieni** (Staff, 1912)

Pl. 3, fig. 9

1912 *Girtyina schellwieni* Staff, p. 165, pl. 18, fig. 1.

Material. 1 axial section.

Distribution and age. Donetz Basin, East European Platform, Middle Asia, Spain, China; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 2.

**Beedeina rhomboidalis** (Rausser-Chernousova, 1951)

Pl. 3, fig. 6

1951 *Hemifusulina* (?) *splendida* var. *rhomboidalis* Rausser-Chernousova in Rausser-Chernousova et al., pp. 262-263, pl. 41, fig. 6, 7.

Material. 1 axial section.

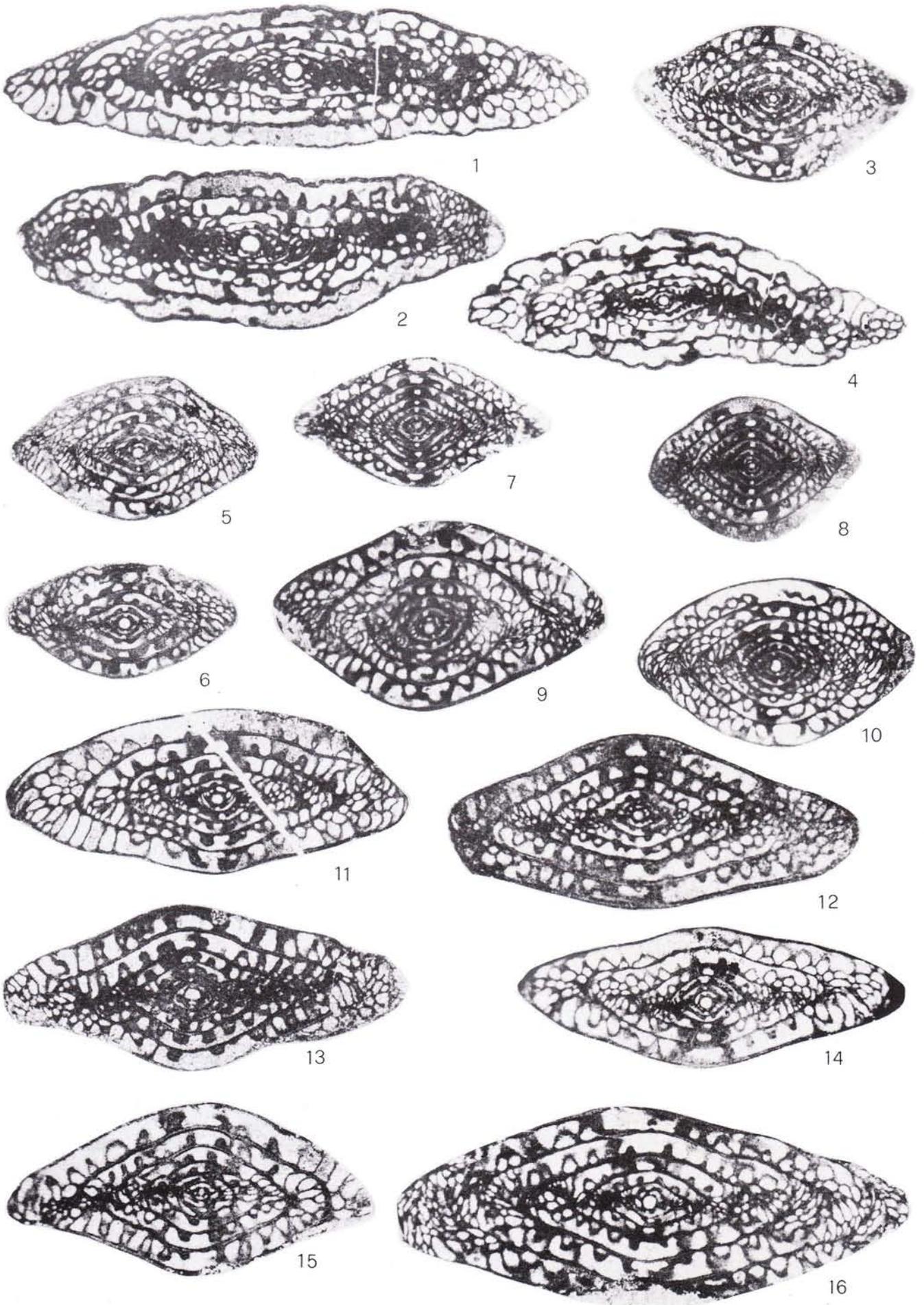
Distribution and age. East European Platform, Darvaz; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1005, Kuhifrush Formation, member 3 (upper part).

PLATE 3

All x 20

- Fig. 1, 2, 4 - *Undatafusulina asiatica* n. sp. Section 1005, Kalaikuhna Formation, member 1, bed 4. 1) Axial section of the holotype, GIN 4767/72; 2) axial section, GIN 4767/73; 4) subaxial section, GIN 4767/34.
- Fig. 3, 5 - *Citronites apokensis* (Rausser-Chernousova). Section 1005, Kalaikuhna Formation, member 1, bed 2. 3) Axial section, GIN 4767/74; 5) axial section, GIN 4767/75.
- Fig. 6 - *Beedeina rhomboidalis* (Rausser-Chernousova). Axial section, GIN 4767/76. Section 1005, Kuhifrush Formation, member 3.
- Fig. 7, 8 - *Citronites panjensis* n. sp. Section 1004, Kalaikuhna Formation. 7) Axial section, GIN 4767/77; 8) axial section of the holotype, GIN 4767/78.
- Fig. 9 - *Beedeina schellwieni* (Staff). Axial section, GIN 4767/79. Section 1005, Kalaikuhna Formation, member 1, level 2.
- Fig. 10 - *Citronites reticulatus* n. sp. Axial section of the holotype, GIN 4767/80. Section 1005, Kalaikuhna Formation, member 1, level 2.
- Fig. 11, 14 - *Beedeina pseudokonnoi* (Sheng). Section 1005, Kalaikuhna Formation, member 1, level 6. 11) Axial section, GIN 4767/81; 14) axial section, GIN 4767/82.
- Fig. 12, 16 - *Beedeina elegans* (Rausser-Chernousova et Beljaev). Section 1006, Kalaikuhna Formation, member 2, level 2. 12) Axial section, GIN 4767/82a; 16) axial section, GIN 4767/83.
- Fig. 13, 15 - *Beedeina samarica* (Rausser-Chernousova et Beljaev). Section 1006. Kalaikuhna Formation, member 2, level 2. 13) Axial section, GIN 4767/84; 15) axial section, GIN 4767/85.



**Beedeina samarica** (Rausser-Chernousova et Beljaev, 1940)

Pl. 3, fig. 13, 15

1940 *Fusulina samarica* Rausser-Chernousova, Beliaev & Reitlinger, p. 19-21 (Russian), 72 (English), pl. 3, fig. 4-9; pl. 4, fig. 1-3.**Material.** 12 axial sections.**Distribution and age.** East European Platform, Donetz Basin, Middle Asia, China; Middle Carboniferous, Upper Moscovian (lower part).**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kalaikuhna Formation, member 1, level 4 and 6; section 1006, Kalaikuhna Formation, member 2, level 2 and member 3 (lower part).**Beedeina pseudokonnoi** (Sheng, 1958)

Pl. 3, fig. 11, 14

1958 *Fusulina pseudokonnoi* Sheng, p. 42-43 (Chinese), 102 (English), pl. 13, figs. 4-10.**Material.** 8 axial sections.**Distribution and age.** China, Middle Asia; Middle Carboniferous, Upper Moscovian (lower part).**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 4 and 6; section 1006, Kalaikuhna Formation, members 1 and 3.**Beedeina elegans** (Rausser-Chernousova et Beljaev, 1940)

Pl. 3, fig. 12, 16

1940 *Fusulina elegans* Rausser-Chernousova, Beliaev & Reitlinger, p. 18-19 (Russian), 71 (English), pl. 2, fig. 8-11.**Material.** 7 axial sections.**Distribution and age.** East European Platform, Donetz Basin, Middle Asia, Spain; Middle Carboniferous, Upper Moscovian.**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 4; section 1006, Kalaikuhna Formation, member 2, level 2.**Beedeina carbonica** (Dalmatskaia, 1961)

Pl. 4, fig. 2-3

1961 *Fusulina carbonica* Dalmatskaia, p. 28-29, pl. 2, fig. 3-4.**Material.** 5 axial sections.**Distribution and age.** Donetz Basin, Darvaz; Middle Carboniferous, Upper Moscovian (lower part).**Occurrence.** Section 1006, Kalaikuhna Formation, member 3 (upper part) and member 4, level 5.**Beedeina ulitinensis** (Rausser-Chernousova, 1951)

Pl. 4, fig. 4

1951 *Fusulina ulitinensis* Rausser-Chernousova in Rausser-Chernousova et al., pp. 295-296; pl. 49, fig. 4-5.**Material.** 3 axial sections.**Distribution and age.** East European Platform, Middle Asia, China; Middle Carboniferous, Upper Moscovian (lower part).**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 6; section 1006, Kalaikuhna Formation, member 3.**Beedeina timanica** (Rausser-Chernousova, 1951)

Pl. 4, fig. 5

1951 *Fusulina elshanica timanica* Rausser-Chernousova in Rausser-Chernousova et al., p. 285, pl. 46, fig. 2.**Material.** 8 axial sections.**Distribution and age.** Timan, China, Ural; Middle Carboniferous, Upper Moscovian (lower part).**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 4.**Beedeina bona** (Chernova et Rausser-Chernousova, 1951)

Pl. 4, fig. 1

1951 *Fusulina bona* Chernova & Rausser-Chernousova in Rausser-Chernousova et al., p. 281-282, pl. 44, fig. 7-9.**Material.** 3 axial sections.**Distribution and age.** East European Platform, Middle Asia, Japan; Middle Carboniferous, uppermost part of Lower Moscovian and lower part of Upper Moscovian.**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 6; section 1006, Kalaikuhna Formation, member 2, level 2.**Beedeina ozawai** (Rausser-Chernousova et Beljaev, 1940)

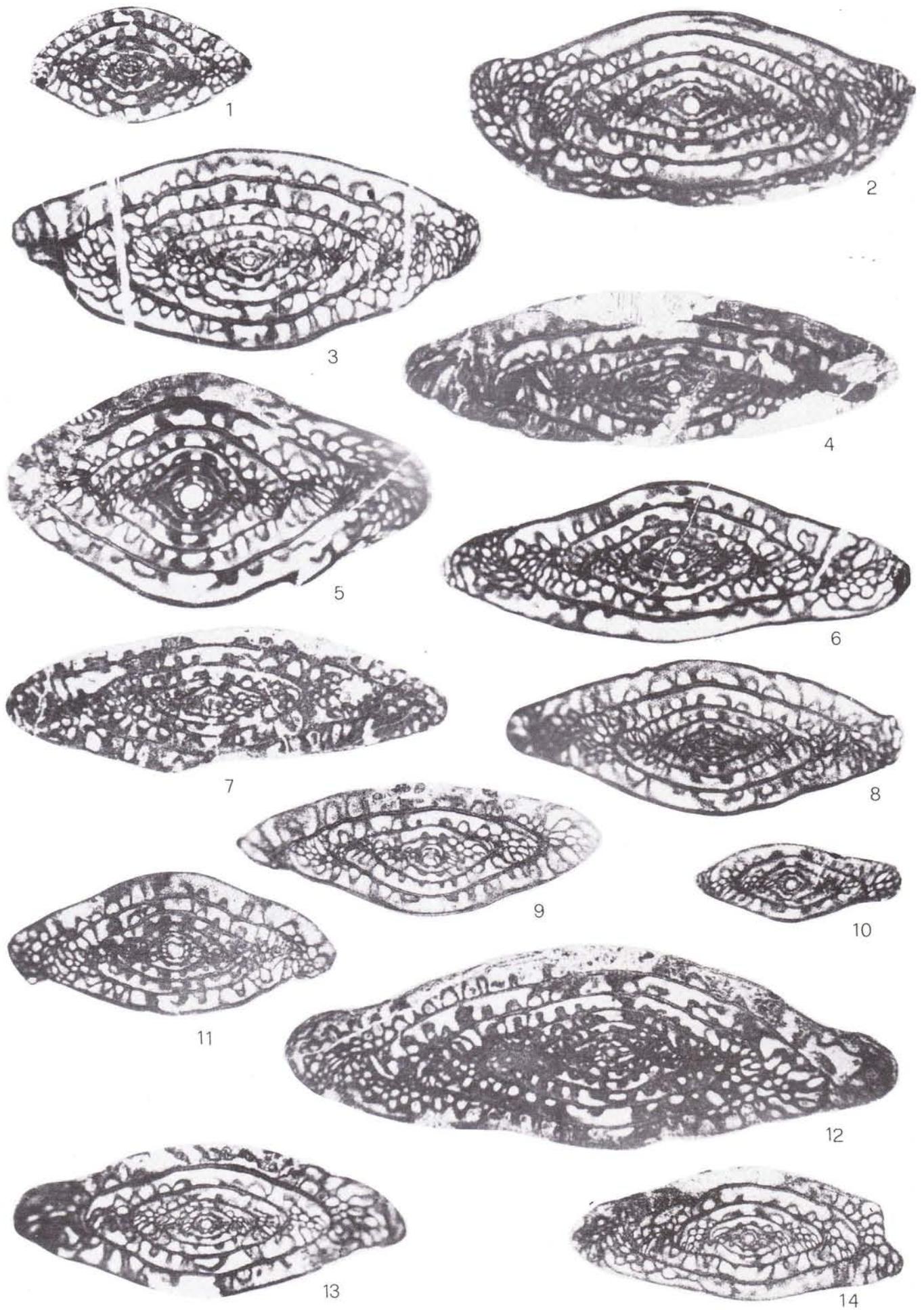
Pl. 4, fig. 7

1940 *Fusulina ozawai* Rausser-Chernousova, Beliaev & Reitlinger, pp. 14-16, pl. 3, fig. 5-8.

## PLATE 4

All x 20

- Fig. 1 - *Beedeina bona* (Chernova et Rausser-Chernousova). Axial section, GIN 4767/86. Section 1006, Kalaikuhna Formation, member 2, level 2.
- Fig. 2, 3 - *Beedeina carbonica* (Dalmatskaia). Section 1006, Kalaikuhna Formation, member 3. 2) Axial section, GIN 4767/87; 3) axial section, GIN 4767/88.
- Fig. 4 - *Beedeina ulitinensis* (Rausser-Chernousova). Axial section, GIN 4767/89. Section 1006, member 3.
- Fig. 5 - *Beedeina timanica* (Rausser-Chernousova). Axial section, GIN 4767/90. Section 1005, Kalaikuhna Formation, member 1, level 4.
- Fig. 6 - *Beedeina pseudoelegans keltmensis* (Rausser). Axial section, GIN 4767/91. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 7 - *Beedeina ozawai* (Rausser-Chernousova et Beljaev). Axial section, GIN 4767/92. Section 1006, Kalaikuhna Formation, member 4, level 2.
- Fig. 8 - *Beedeina isvariensis* (Putrja). Axial section, GIN 4767/93. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 9, 11 - *Beedeina angelinae* (Putrja). Section 1006, Kalaikuhna Formation, member 4, level 3. 9) axial section, GIN 4767/94; 11) axial section, GIN 4767/95.
- Fig. 10 - *Beedeina pseudokayi* (Putrja). Axial section, GIN 4767/96. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 12 - *Beedeina* aff. *crassa* (Putrja). Axial section, GIN 4767/97. Section 1006, Kalaikuhna Formation, member 4, level 3.
- Fig. 13, 14 - *Beedeina darvasica darvasica* n. sp. et subsp. Section 1006, Kalaikuhna Formation, member 3. 13) Axial section of the holotype, GIN 4767/98; 14) axial section, GIN 4767/99.



Material. 2 subaxial sections.

Distribution and age. East European Platform, Ural, Middle Asia, China, Spain; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 3 and member 4, level 2.

**Beedeina (Beedeina) pseudoelegans keltmensis**

(Rausser-Chernousova, 1951)

Pl. 4, fig. 6

1951 *Fusulina pseudoelegans keltmensis* Rausser-Chernousova in Rausser-Chernousova et al., p. 283, pl. 45, fig. 4.

Material. 1 axial section.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Upper Moscovian (lower part).

Occurrence. Section 1006, Kalaikuhna Formation, member 3 (upper part).

**Beedeina isvariensis** (Putrja, 1956)

Pl. 4, fig. 8

1956 *Fusulina isvariensis* Putrja, p. 451-452, pl. 13, fig. 4, 7, 8.

Material. 1 axial section.

Distribution and age. Donetz Basin, Darvaz; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 3 (upper part).

**Beedeina angelinae** (Putrja, 1940)

Pl. 4, fig. 9-11

1940 *Fusulina angelinae* Putrja, p. 130-131, pl. 3, fig. 6.

Material. 3 axial sections.

Distribution and age. Donetz Basin, lowermost part of Upper Carboniferous; Darvaz, Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 4, level 3.

**Beedeina pseudokayi** (Putrja, 1956)

Pl. 4, fig. 10

1956 *Fusulina pseudokayi* Putrja, pp. 449-450, pl. 13, fig. 1-2.

Material. 4 axial sections.

Distribution and age. Donetz Basin, Darvaz; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 3 (upper part).

**Beedeina aff. crassa** (Putrja, 1939)

Pl. 4, fig. 12

1939 *Fusulina cymljanica crassa* Putrja, p. 125-127, pl. 2, fig. 6.

Material. 1 subaxial section.

Discussion. Described specimen closely resembles to the holotype of *Beedeina crassa*, having the same size and shape of shell, spiral coiling, and small axial fillings. But septal fluting of our specimen is not so complicated as holotype has. In addition, the age of our specimen is more ancient.

Distribution and age. Donetz Basin, lowermost part of Upper Carboniferous; Darvaz, Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 4, level 3.

**Beedeina darvasica darvasica** n. sp.

Pl. 4, fig. 13-14; Pl. 5, fig. 1-2

Holotype. GIN 4767/98; axial section; Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 3 (upper part); Middle Carboniferous, Upper Moscovian.

Material. 27 axial and subaxial sections.

Description. The shell is fusiform; middle portion vaulted, poles sharply or bluntly pointed, lateral slopes vary from slightly plane to moderately convex. Mature specimens contain 5 or 6 volutions. The length varies from 3 to 3.7 mm and the width from 1.2 to 1.45 mm, giving form ratio from 2.3 to 2.9. The proloculus is spherical with a diameter of 0.11 to 0.15 mm. Spirotheca consist of tectum, thick not clear diaphanotheca and inner tectoria; the outer tectoria usually are absent. The average thickness of spirotheca is 0.04 mm in the outer volutions. Septa rather thinner than spirotheca, gently and not regularly folded. The simple meshwork is only seen in the polar regions. Small chomata developed in the inner three-four volutions. Tunnel narrow and rather high in the inner volutions, but wider in the outer ones.

Discussion. This species closely resembles *Beedeina pseudokonoi* (Sheng, 1958) but differs from the latter in having a less regularly septal fluting, and small chomata.

Occurrence and age. The same as holotype.

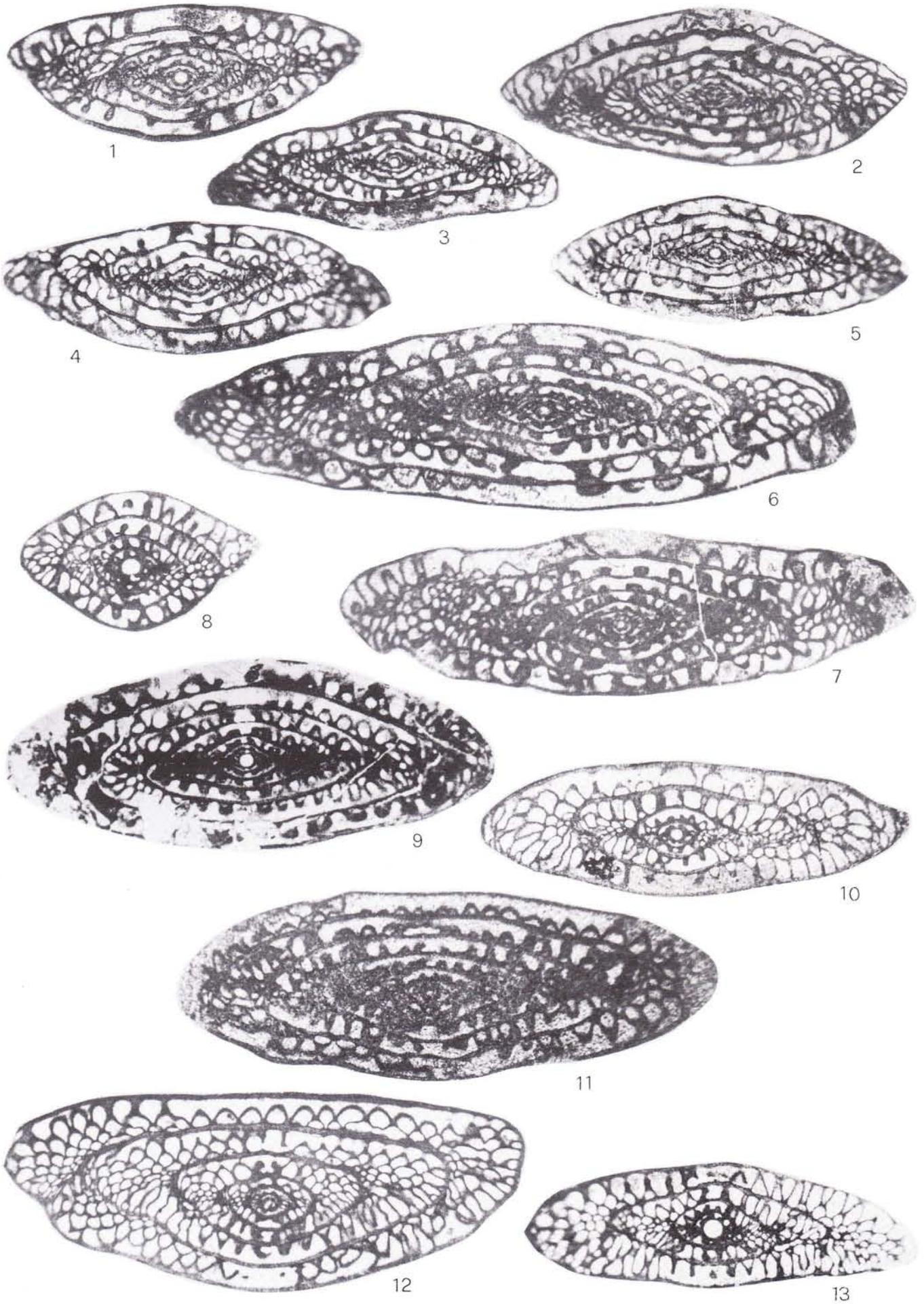
**Beedeina darvasica elongata** n. subsp.

Pl. 5, fig. 3-5

PLATE 5

All x 20

- Fig. 1, 2 - *Beedeina darvasica darvasica* n. sp. et subsp. Section 1006, Kalaikuhna Formation, member 3. 1) axial section, GIN 4767/100; 2) subaxial section, GIN 4767/101.
- Fig. 3-5 - *Beedeina darvasica elongata* n. sp. et subsp. Section 1006, Kalaikuhna Formation, member 3. 3) Axial section of the holotype, GIN 4767/102; 4) axial section, GIN 4767/103; 5) axial section, GIN 4767/104.
- Fig. 6, 7 - *Beedeina consobrina* (Safonova). Section 1006, Kalaikuhna Formation, member 4, level 4. 6) Axial section, GIN 4767/105; 7) axial section, GIN 4767/106.
- Fig. 8 - *Putrella susini* (Putrja). Axial section, GIN 4767/106a. Section 1005, Kuhifrush Formation, member 3.
- Fig. 9, 11 - *Beedeina dutkevichi* n. sp. 9) axial section of the holotype, GIN 4767/107. Section 1006, Kalaikuhna Formation, member 4, level 3; 11) axial section, GIN 4767/108. Section 1006, Kalaikuhna Formation, member 4, level 4.
- Fig. 10, 13 - *Putrella brazhnikovae* (Putrja). Section 1005, Kalaikuhna Formation, member 1, bed 6. 12) Axial section, GIN 4767/109; 13) axial section, GIN 4767/110.
- Fig. 12 - *Putrella admiranda* n. sp. Axial section of the holotype, GIN 4767/111. Section 1005, member 1, level 6.



Holotype. GIN 4767/102; axial section; Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 3 (upper part); Middle Carboniferous, Upper Moscovian.

Material. 5 axial sections.

Discussion. This subspecies is identical with the *Beedeina darvasica darvasica* n. sp. but differs in having a more elongate shape (L = 3.2 to 3.5 mm, D = 1.1 to 1.2 mm, L:D = 2.9 to 3.1).

Occurrence and age. The same as holotype.

**Beedeina consobrina** (Safonova, 1951)

Pl. 5, fig. 6, 7.

1951 *Fusulina consobrina* Safonova in Rauser-Chernousova et al., pp. 293-294, pl. 48, fig. 8; pl. 49, fig. 1.

Material. 3 axial and 2 subaxial sections.

Distribution and age. East European Platform, Middle Asia, Japan; Middle Carboniferous, upper part of Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 4, levels 4 and 5.

**Beedeina dutkevichi** n. sp.

Pl. 5, fig. 9, 11.

Holotype. GIN 4767/107; Darvaz, Kalaikuhna, section 1006, member 4, level 3; Middle Carboniferous, Upper Moscovian (Upper part).

Material. 2 axial sections.

Description. Shell fusiform, with bluntly rounded poles. Mature specimens have 6 to 6.5 volutions and measure 9.8 to 10.7 mm in length and 3.7 to 3.8 mm in width; form ratio 2.6 to 2.9. Spirotheca thin and composed of tectum, clear diaphanotheca and inner tectorium. Septa strongly and regularly fluted throughout shell. Septal folds about 0.5 as high as chambers. Proloculus sphaerical with outside diameter 0.2 to 0.3 mm. Tunnel narrow and about 0.45 as high as chambers. Chomata weak, present in first one-two volutions. Narrow band of secondary material follows the axis in first 3 to 4 volutions.

Discussion. *Beedeina dutkevichi* differs from *B. consobrina* in its shorter shell and more regularly and strongly septal fluted.

Occurrence and age. Section 1006, Kalaikuhna Formation, member 4, levels 3 and 4; Middle Carboniferous, Upper Moscovian (upper part).

*Putrella* Rauser-Chernousova, 1951

**Putrella brazhnikovae** (Putrja, 1948)

Pl. 5, fig. 10, 13

1948 *Pseudotriticites brazhnikovae* Putrja, pp. 98-99, pl. 1, fig. 1-3.

Material. 4 axial sections.

Distribution and age. Donetz Basin, East European Platform, Middle Asia; Middle Carboniferous, Upper Moscovian (lower part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 6; section 1006, Kalaikuhna Formation, member 1.

**Putrella susini** (Putrja, 1938)

Pl. 5, fig. 8

1938 *Fusulina* (?) *susini* Putrja, pp. 71-72, pl. 1, fig. 14.

Material. 1 axial section.

Distribution and age. Donetz Basin, Darvaz; Middle Carboniferous, Lower Moscovian, (upper part).

Occurrence. Section 1005, Kuhifrush Formation, member 3 (upper part).

**Putrella admiranda** n. sp.

Pl. 5, fig. 12

Holotype. GIN 4767/ 111; Darvaz, Kalaikuhna, section 1005, member 1, level 6; Middle Carboniferous, Upper Moscovian (lower part).

Description. Shell moderately large, fusiform with bluntly rounded poles. Mature individuals have 5 volutions and measure 5.25 mm. in length and 2 mm. in width; form ratio 2.6. Thick spirotheca composed of tectum and protheca with thin pores; thickness in fourth volution varies from 0.05 to 0.07 mm. Thin septa strongly fluted from pole to pole. Septal folds rounded, «multi-storeyed» and affecting almost all the chamber space. Proloculus spherical with a diameter 0.2 mm. Tunnel narrow in the first 3 volutions, whilst is wide and low in the fourth volution. Chomata weak, present only on proloculus.

Discussion. *Putrella admiranda* differs from other species of *Putrella* having large shell, bluntly rounded poles and «multi-storeyed» septal folds.

Occurrence and age. The same as holotype.

Subfamily *Eofusulininae* Rauser-Chernousova et

Rosovskaya, 1959

*Eofusulina* Rauser-Chernousova, 1951

**Eofusulina binominata** Putrja, 1956

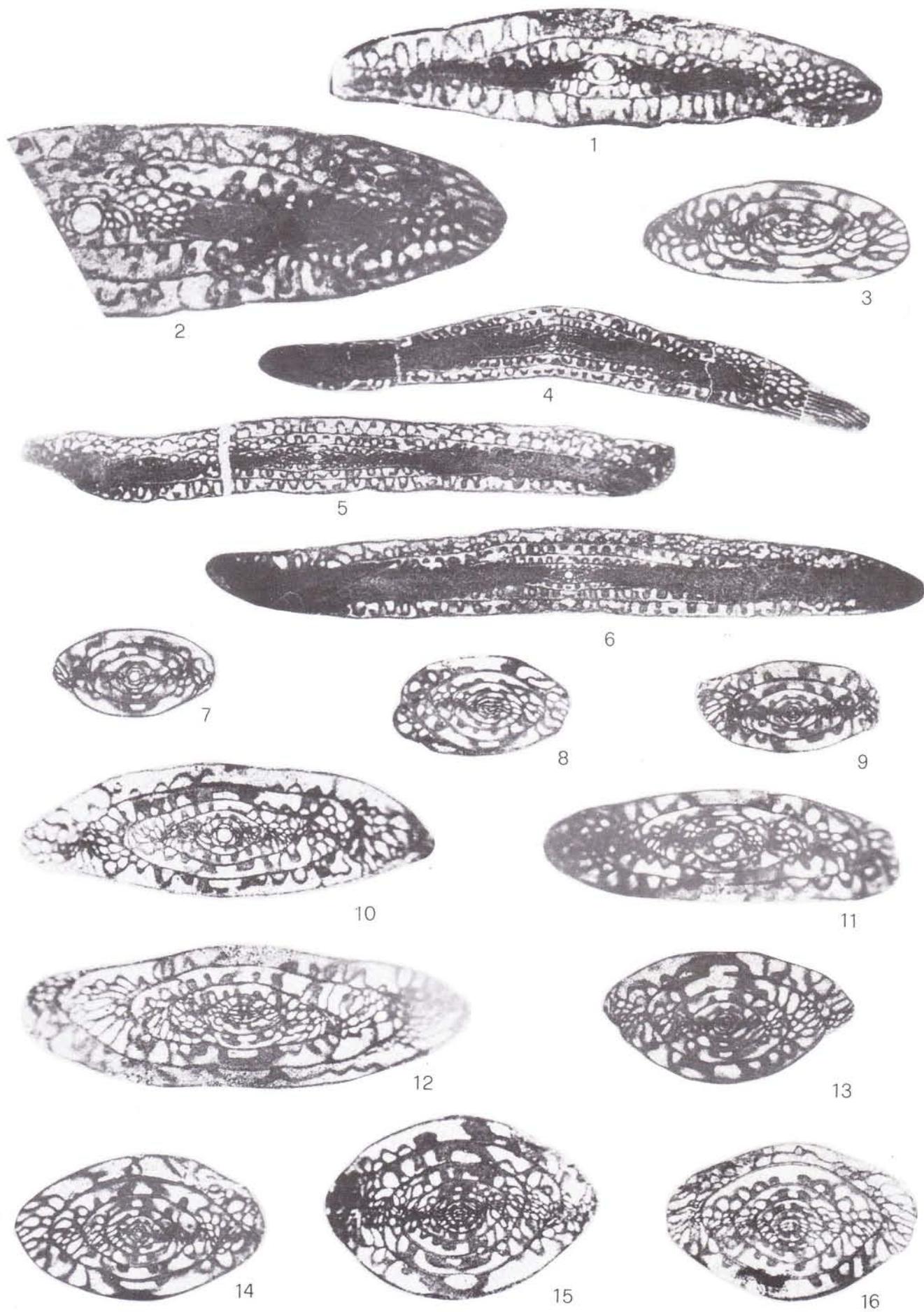
Pl. 6, fig. 1-2

1956 *Eofusulina binominata* Putrja, pp. 457-458, pl. 15, fig. 4-6.

Material. 6 axial sections.

PLATE 6

- Fig. 1, 2 - *Eofusulina binominata* Putrja. x 20. 1) Axial section, GIN 4767/112. Section 1004, Kalaikuhna Formation. 2) Axial section, GIN 4767/113. Section 1005, Kalaikuhna Formation, member 1, bed 2.
- Fig. 3 - *Hemifusulina* cf. *moelleri* Rauser-Chernousova. Subaxial section, GIN 4767/114. x 20. Section 1005, Kuhifrush Formation, member 3.
- Fig. 4-6 - *Paraeofusulina subtilissima* Putrja. x 15. Section 1004, Kalaikuhna Formation. 4) Axial section, GIN 4767/115; 5) axial section, GIN 4767/116; 6) axial section, GIN 4767/117.
- Fig. 7 - *Hemifusulina volgensis* intermedia Safonova. Axial section, GIN 4767/118. x 20. Section 1005, Kuhifrush Formation, member 2.
- Fig. 8 - *Hemifusulina* aff. *consobrina* Rauser-Chernousova. Subaxial section, GIN 4767/119. x 20. Section 1006, Kalaikuhna Formation, member 1.
- Fig. 9 - *Hemifusulina paraelliptica* Rauser-Chernousova. Axial section, GIN 4767/120. x 20. Section 1005, Kuhifrush Formation, member 3.
- Fig. 10-12 - *Hemifusulina orientalis* n. sp. x 20. Section 1005, Kuhifrush Formation, member 3. 10) axial section of the holotype, GIN 4767/121; 11) axial section, GIN 4767/122; 12) axial section, GIN 4767/123.
- Fig. 13-16 - *Hemifusulina* (?) *splendida* Safonova. x 20. Section 1005, Kuhifrush Formation, member 3. 13) Axial section, GIN 4767/41; 14) axial section, GIN 4767/22; 15) subaxial section, GIN 4767/66; 16) subaxial section, GIN 4767/124.



Distribution and age. Donetz Basin, Darvaz; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kalaikuhna Formation, member 1, level 2.

*Paraeofusulina* Putrja, 1956, emend Leven, 1979

***Paraeofusulina subtilissima* Putrja, 1956**

Pl. 6, fig. 4-6

1956 *Eofusulina (Paraeofusulina) subtilissima* Putrja, pp. 459-460, pl. 15, fig. 9.

1979 *Paraeofusulina subtilissima (partim)* - Leven, p.142, pl. 1, fig. a, b and d.

Material. 7 axial sections.

Distribution and age. Donetz Basin, Spain, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 3 (upper part), Kalaikuhna Formation, member 1, level 2.

Family *Hemifusulinidae* Putrja, 1956

*Hemifusulina* Moeller, 1877

***Hemifusulina volgensis intermedia* Safonova, 1951**

Pl. 6, fig. 7

1951 *Hemifusulina volgensis* var. *intermedia* Safonova in Rauser-Chernousova et al., pp. 249-250, pl. 37, fig. 10.

Material. 1 axial and 3 tangential sections.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1005, Kuhifrush Formation, member 2.

***Hemifusulina* cf. *moelleri* Rauser-Chernousova, 1951**

Pl. 6, fig. 3

1951 *Hemifusulina moelleri* Rauser-Chernousova in Rauser-Chernousova et al., pp. 252-254, pl. 38, fig. 3-6.

Material. 1 subaxial section

Distribution and age. East European Platform, Middle Asia, China, Spain, North Africa; Middle Carboniferous, Lower Moscovian (upper part).

Occurrence. Section 1005, Kuhifrush Formation, member 3 (upper part).

***Hemifusulina* aff. *consobrina* Rauser-Chernousova, 1951**

Pl. 6, fig. 8

1951 *Hemifusulina consobrina* Rauser-Chernousova in Rauser-Chernousova et al., p. 252, pl. 37, fig. 16; pl., 38, fig. 1-2.

Material. 1 subaxial section.

Distribution and age. East European Platform, Middle Asia, China; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1006, Kalaikuhna Formation, member 1.

***Hemifusulina paraelliptica* Rauser-Chernousova, 1951**

Pl. 6, fig. 9

1951 *Hemifusulina paraelliptica* Rauser-Chernousova in Rauser-Chernousova et al., p. 258, pl. 40, fig. 4-5.

Material. 1 axial section.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1005, Kuhifrush Formation, member 3 (upper part).

***Hemifusulina orientalis* n. sp.**

Pl. 6, fig. 10-12

Holotype. GIN 4767/121; axial section; Darvaz, Kalaikuhna, section 1005, Kuhifrush Formation, member 3 (upper part); Lower Moscovian (upper part).

Material. 2 axial and 1 subaxial sections.

Description. Shell elongate fusiform to subcylindrical with bluntly rounded poles. Mature individuals have 5 to 5.5 volutions and measure about 4 to 4.3 mm. in length and 1.3 to 1.4 mm. in diameter; form ratio 3. Spirotheca thin and has two or three layers; sometimes thin and not clear diaphanotheca appears. Septa strongly and more or less regularly fluted throughout the shell. Septal folds about 0.5 as high as chambers. Proloculus large and irregular subspherical. Tunnel moderately wide and about half as high as chamber. Narrow chomata present in first two whorls, but replaced in next volutions by pseudochomata.

Discussion. This species is similar to *Hemifusulina pseudoboclei* (Putrja & Leontovich) but differs in its irregular septal fluting and large proloculus.

Occurrence and age. The same as holotype.

***Hemifusulina* (?) *splendida* Safonova, 1951**

Pl. 6, fig. 13-16

1951 *Hemifusulina* (?) *splendida* Safonova in Rauser-Chernousova et al., pp. 261-262, pl. 41, fig. 1-3.

Material. 25 axial sections.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 3 (lower part), Kalaikuhna Formation, member 1, level 2.

Family *Fusulinellidae* Staff et Wedekind, 1910

Subfamily *Fusulinellinae* Staff et Wedekind, 1910

*Fusulinella* Moeller, 1877

Subgenus *Moellerites* Solovieva, 1986

***Fusulinella (Moellerites) praecoloniae* Safonova, 1951**

Pl. 7, fig. 1, 5

1951 *Fusulinella praecoloniae* Safonova in Rauser-Chernousova et al., pp. 215-216, pl. 29, fig. 4-5.

Material. 2 axial section.

Distribution and age. East European Platform, Middle Asia, China, Japan, Spain; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, levels 1 and 4.

**Fusulinella (Moellerites) paracolaniae** Safonova, 1951

Pl. 7, fig. 2-4

1951 *Fusulinella paracolaniae* Safonova in Rauser-Chernousova et al., p. 219, pl. 30, fig. 7-9.

**Material.** 3 axial sections.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

**Occurrence.** Section 1005, Kuhifrush Formation, member 3 (upper part); Kalaikuhna Formation, member 1, level 1.

**Fusulinella (Moellerites) jamesensis**

Thompson, Pitrat et Sanderson, 1953

Pl. 7, fig. 8

1953 *Fusulinella jamesensis* Thompson, Pitrat & Sanderson, pp. 548-550, pl. 57, fig. 8-31.

**Material.** 1 axial and 1 tangential sections.

**Distribution and age.** West Canada, Darvaz, Japan; Middle Carboniferous, Lower Moscovian (upper part).

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 1.

**Fusulinella (Moellerites) praebocki** Rauser-Chernousova, 1951

Pl. 7, fig. 12-13

1951 *Fusulinella praebocki* Rauser-Chernousova in Rauser-Chernousova et al., pp. 226-227, pl. 32, fig. 6-7.

**Material.** 3 axial sections.

**Distribution and age.** East European Platform, Middle Asia, Spain; Middle Carboniferous, upper part of Lower Moscovian and lower part of Upper Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation.

**Fusulinella (Moellerites) subundulata** n. sp.

Pl. 7, fig. 6-7

**Holotype.** GIN 4767/129; axial section; Darvaz, Kalaikuhna, section 1005, Kuhifrush Formation, member 3 (upper part); Middle Carboniferous, Lower Moscovian (upper part).

**Material.** 2 axial sections.

**Description.** Shell slender fusiform to subcylindrical, with bluntly rounded poles. Mature specimens have 6 volutions and measure 3.4 to 3.7 mm. in length and 1.7 mm. in diameter; form ratio 2 to 2.17. Spirotheca subundulate, mostly composed of tectum, protheca and outer tectorium; dim diaphanotheca appears in forth and fifth whorls here and there; only tectum and protheca are observed in the outer whorl. Thickness of spirotheca 0.03 to 0.04 mm. in last two whorls. Septa nearly plane, except for slight folding near poles. Proloculus very small. Tunnel wide and low. Chomata massive and triangular, becoming inconspicuous or absent in outermost volutions.

**Discussion.** The described species differs from other species of subgenus *Moellerites* having subundulate spirotheca, subcylindrical shape of shell, and less developed chomata in outer volutions. It differs from similar species of subgenus *Fusulinella* in insufficiently developed diaphanotheca.

**Occurrence and age.** Section 1005, Kuhifrush Formation, member 3 (lower part); Kalaikuhna Formation, member 1, level 1; Middle Carboniferous, Lower Moscovian (upper part).

**Fusulinella (Moellerites) jucunda** n. sp.

Pl. 7, fig. 9

**Holotype.** GIN 4767/132; Darvaz, Kalaikuhna, section 1005, Kuhifrush Formation, member 3 (lower part); Middle Carboniferous, Lower Moscovian (upper part).

**Material.** 1 axial section.

**Description.** Shell elongate ellipsoidal, with bluntly rounded poles. Mature specimens have 6 volutions, and measure 3.6 mm. in length and 1.9 mm. in diameter; form ratio 1.89. Coiling loose after first 3 whorls. Spirotheca mostly composed of tectum, protheca and outer tectorium, whilst an unclear diaphanotheca appears here and there; the outer two volutions are 0.03 to 0.04 mm thick. Septa plane. Proloculus small with a diameter 0.065 mm. Tunnel wide and low. Low and wide chomata present except in the last 1.5 whorl.

**Discussion.** Our species differs from other *Moellerites* having loose coiled spiral and elongate ellipsoidal shape of shell.

**Occurrence and age.** The same as holotype.

**Fusulinella (Moellerites) orientalis** n. sp.

Pl. 7, fig. 10, 11

**Holotype.** GIN 4767/134; Darvaz, Kalaikuhna, section 1004, Kalaikuhna Formation; Middle Carboniferous, Lower Moscovian (upper part).

**Material.** 3 axial sections.

**Description.** Shell short fusiform to ellipsoidal, with convex lateral slopes and rather bluntly pointed poles. Mature individuals have 6 to 6.5 volutions and measure 3.3 to 3.5 mm. in length and 1.75 to 1.9 mm. in diameter; form ratio 1.75 to 2. Spirotheca composed of tectum, primatheca and unstable outer tectorium; unclear diaphanotheca appears in last volutions; thickness of spirotheca 0.03 to 0.056 mm in the fifth-sixth volution. Septa nearly plane, except for slight folding near poles. Proloculus small, its outside diameter being 0.025 to 0.03 mm. Tunnel narrow in inner volutions and wide in outer. Chomata narrow and low.

**Discussion.** Our species rather closely resembles *P. (M.) bedakensis* Solovieva but differs in its less elongate shell and narrow chomata.

**Occurrence and age.** The same as holotype.

Subgenus *Fusulinella* Staff et Wedekind, 1910

**Fusulinella (Fusulinella) bocki** Moeller, 1878

Pl. 7, fig. 15, 16

1878 *Fusulinella bocki* Moeller, pp. 104-107, pl. 5, fig. 3a-g; pl. 14, fig. 1-4.

**Material.** 7 axial sections.

**Distribution and age.** East European Platform, Timan, Spitzbergen, Donetz Basin, Spain, Turkey, Middle Asia, China, Japan, Viet Nam; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kalaikuhna Formation, member 1, levels 4 and 6; section 1006 Kalaikuhna Formation, member 1.

**Fusulinella (Fusulinella) pseudobocki** Lee et Chen, 1930

Pl. 7, fig. 14

1930 *Fusulinella (Neofusulinella) pseudobocki* Lee, Chen & Chu, pp. 122-123, pl. 9, fig. 10-14; pl. 10, fig. 1-7.

**Material.** 4 axial and subaxial sections.

Distribution and age. China, Middle Asia, Viet Nam, Spain, East European Platform, Timan; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1, levels 4 and 6; section 1006, Kalaikuhna Formation, members 1, 2 and 3.

**Fusulinella (Fusulinella) intermedia** Rauser-Chernousova, 1951

Pl. 7, fig. 17

1951 *Fusulinella bocki* var. *intermedia* Rauser-Chernousova in Rauser-Chernousova et al., p. 225, pl. 32, fig. 2-3.

Material. 5 axial and subaxial sections.

Distribution and age. East European Platform, Darvaz; Middle Carboniferous, Upper Moscovian (upper part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, levels 4 and 6.

**Fusulinella (Fusulinella) crassitectoria** n. sp.

Pl. 7, fig. 18

Holotype. GIN 4767/139; Darvaz, Kalaikuhna, section 1006, member 1; Middle Carboniferous, Upper Moscovian.

Material. 1 axial section.

Description. Shell large, fusiform, inflates in the middle part, with concave lateral slopes and bluntly pointed poles. Inner four volutions subspherical. Mature shells have 6.5 volutions and measures 5 mm in length and 2 mm in diameter; form ratio 2.5. Spirotheca thick, composed of tectum, thin diaphanotheca, thick inner tectorium and irregularly outer tectorium; its thickness in sixth whorl is 0.05 to 0.075 mm. Septa thin and plane. Proloculus small, its outside diameter being 0.075 mm. Tunnel narrow in the first 4 volutions and wide and low the next ones. Chomata round and massive in the first four volutions and weak or absent in the last two volutions.

Discussion. The described species resembles *Fusulinella fluxa* Lee & Chen but differs having larger shell, very thick spirotheca and smaller chomata.

Occurrence and age. The same as holotype.

**Fusulinella (Fusulinella) fluxa** Lee et Chen, 1930

Pl. 8, fig. 1

1930 *Fusulinella (Neofusulinella) fluxa* Lee et Chen in Lee, Chen & Chu, pp. 123-124, pl. 10, fig. 8-10.

Material. 5 axial sections.

Distribution and age. China, East European Platform, Middle Asia, Japan, Thailand, Carnic Alps; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, members 1 and 3 (lower part).

**Fusulinella (Fusulinella) helenae** Rauser-Chernousova, 1951

Pl. 8, fig. 2-4

1951 *Fusulinella helenae* Rauser-Chernousova in Rauser-Chernousova et al., pp. 229-230, pl. 33, fig. 4-5.

Material. 3 axial sections.

Distribution and age. East European Platform, Middle Asia, China; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 6; section 1006, Kalaikuhna Formation, member 1 and member 4, level 4.

**Fusulinella (Fusulinella) alvaradoi** Ginkel, 1965

Pl. 8, fig. 6

1965 *Fusulinella schwagerinoides* subsp. *alvaradoi* Ginkel, pp. 152-153, pl. 42, fig. 13-15; pl. 43, fig. 1-11.

Material. 4 axial and 2 subaxial sections.

Distribution and age. Spain, Darvaz; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 4.

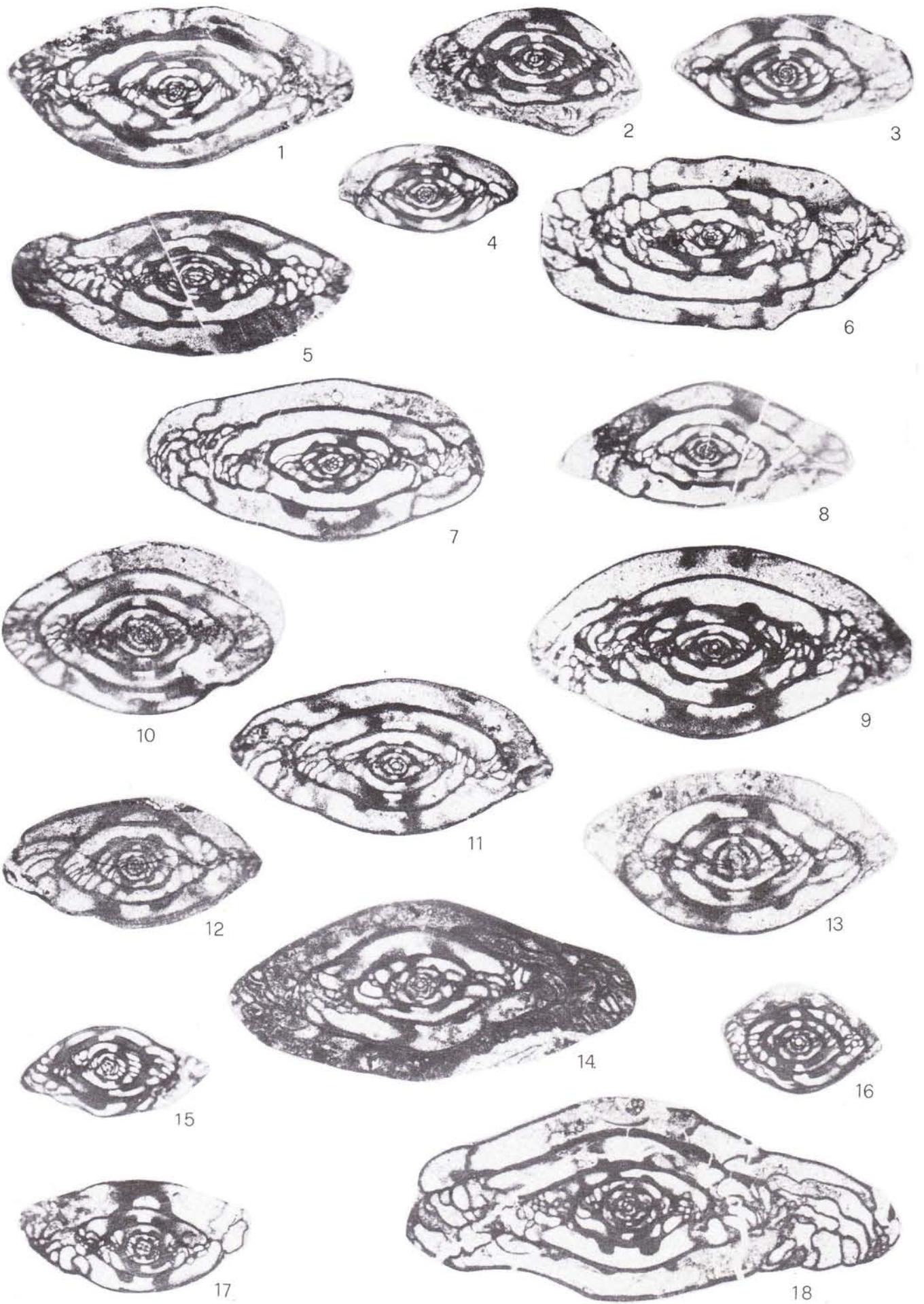
**Fusulinella (Fusulinella) gigantea** Pogrebnjak, 1958

Pl. 8, fig. 5

PLATE 7

All x 20

- Fig. 1, 5 - *Fusulinella (Moellerites) praecoloniae* Safonova. 1) Axial section, GIN 4767/125. Section 1005, Kalaikuhna Formation, member 1, bed 1. 5) Axial section, GIN 4767/128. Section 1005, Kalaikuhna Formation, member 1, level 4.
- Fig. 2-4 - *Fusulinella (Moellerites) paracoloniae* Safonova. 2) Axial section, GIN 4767/41. Section 1005, Kuhifrush Formation, member 3. 3) Axial section, GIN 4767/126. Section 1005, Kalaikuhna Formation, member 1, level 1. 4) Axial section, GIN 4767/127. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 5 - *Fusulinella (Moellerites) bedakensis* Solovieva. Subaxial section, GIN 4767/128. Section 1005, Kalaikuhna Formation, member 1, level 4.
- Fig. 6, 7 - *Fusulinella (Moellerites) subundulata* n. sp. 6) Axial section of the holotype, GIN 4767/129. Section 1005, Kuhifrush Formation, member 3. 7) Axial section, GIN 4767/130. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 8 - *Fusulinella (Moellerites) jamesensis* Thompson, Pitrat et Sanderson. Axial section, GIN 4767/131. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 9 - *Fusulinella (Moellerites) jucunda* n. sp. Axial section of the holotype, GIN 4767/132. Section 1005, Kuhifrush Formation, member 3.
- Fig. 10, 11 - *Fusulinella (Moellerites) orientalis* n. sp. Section 1004, Kalaikuhna Formation. 10) Axial section, GIN 4767/133. 11) Axial section of the holotype, GIN 4767/134.
- Fig. 12, 13 - *Fusulinella (Moellerites) praeboccki* Rauser-Chernousova. Section 1004, Kalaikuhna Formation. 12) Axial section, GIN 4767/135. 13) Axial section, GIN 4767/136.
- Fig. 14 - *Fusulinella (Fusulinella) pseudoboccki* (Lee et Chen). Axial section, GIN 4767/137. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 15, 16 - *Fusulinella (Fusulinella) bocki* Moeller. Axial section, GIN 4767/39. Section 1005, Kalaikuhna Formation, member 1, level 4.
- Fig. 17 - *Fusulinella (Fusulinella) intermedia* Rauser-Chernousova. Subaxial section, GIN 4767/138. Section 1005, Kalaikuhna Formation, member 1, level 4.
- Fig. 18 - *Fusulinella (Fusulinella) crassitectoria* n. sp. Axial section of the holotype, GIN 4767/139. Section 1006, Kalaikuhna Formation, member 1.



1958 *Fusulinella gigantea* Pogrebnjak, p. 76, pl. 1, fig. 7.

**Material.** 1 axial section.

**Distribution and age.** Donetz Basin, Darvaz; Middle Carboniferous, Upper Moscovian (lower part).

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 4.

***Fusulinella (Fusulinella) schwagerinoides* (Deprat, 1913)**

Pl. 8, fig. 7

1913 *Neofusulinella schwagerinoides* Deprat, pp. 42-44, pl. 7, fig. 17-22.

**Material.** 10 axial sections.

**Distribution and age.** East European Platform, Donetz Basin, Middle Asia, China, Indochina, Japan; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1006, Kalaikuhna Formation, member 3 (upper part) and member 4 (rare).

***Fusulinella (Fusulinella) bogushi* n. sp.**

Pl. 8, fig. 8-10

1963 *Fusulinella adjuncta* Bogush, pp. 94-95, pl. 7, fig. 5-6; pl. 11, fig. 8.

**Holotype.** GIN 4767/148; Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 4, bed 2; Middle Carboniferous, Upper Moscovian (upper part).

**Description.** Shell fusiform, with straight to slightly convex lateral slopes and moderately pointed poles. Mature specimens have 5.5 to 6 volutions and measure 3.8 to 4.5 mm. in length and 1.3 to 1.5 mm. in diameter; form ratio 3. Spirotheca consists of tectum, diaphanotheca, inner and irregular outer tectorium beginning from the third whorl; its thickness is 0.04 to 0.055 mm. in the fifth volution. Septa thin and plane. Proloculus small, its outside diameter being 0.07 to 0.08 mm. Tunnel low, narrow in the inner volutions and wide in the following volutions. Chomata low and narrow, becoming inconspicuous or absent in the most external volutions.

**Discussion.** Specimens very similar to described ones, have been identified by Bogush (1963) under the name *Fusulinella adjuncta* Shlykova. But they are included in our new species because they have larger size, more elongate shell and thicker spirotheca.

**Distribution and age.** Middle Asia; Middle Carboniferous, Upper Moscovian (upper part).

**Occurrence.** Section 1006, Kalaikuhna Formation, member 3 (upper part) and 4.

***Fusulinella (Fusulinella) aff. borealis* Rauser-Chernousova, 1951**

Pl. 8, fig. 12

1951 *Fusulinella colaniae* var. *borealis* Rauser-Chernousova in Rauser-Chernousova et al., p. 218, pl. 30, fig. 3-4.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Darvaz; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1006, Kalaikuhna Formation, member 3 (upper part).

***Fusulinella (Fusulinella) pamirica* n. sp.**

Pl. 8, fig. 13

**Holotype.** GIN 4767/154; Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 4, level 4.

**Material.** 1 axial section.

**Description.** Shell fusiform, with convex lateral slopes and rather sharply pointed poles. Mature shells have 6 volutions and measure 4.5 mm. in length and 1.55 mm. in diameter; form ratio 2.9. The first 4 whorls are tightly coiled and followed by abrupt expansion into loosely coiled adult stage. Spirotheca thin (0.05 mm.) with clear diaphanotheca. Septa nearly plane except for slight wavy near poles. Proloculus spherical and small (0.07 mm.). Tunnel narrow in inner fourth volutions and wide in last 1.5 volutions. Chomata massive and wide in the inner volutions and narrow and rounded in the outer ones.

**Discussion.** *Fusulinella (Fusulinella) pamirica* is similar to *F. (F.) colanii* Lee et Chen (*sensu* Rauser-Chernousova) in many aspects but differs having the loosely coiled spiral in the outer volutions.

**Occurrence and age.** The same as holotype.

***Fusulinella (Fusulinella) mosquensis***

Rauser-Chernousova et Safonova, 1951

Pl. 8, fig. 11, 14, 16

1951 *Fusulinella mosquensis* Rauser-Chernousova & Safonova in Rauser-Chernousova et al., p. 230-231, pl. 34, fig. 1-2

**Material.** 6 axial and subaxial sections.

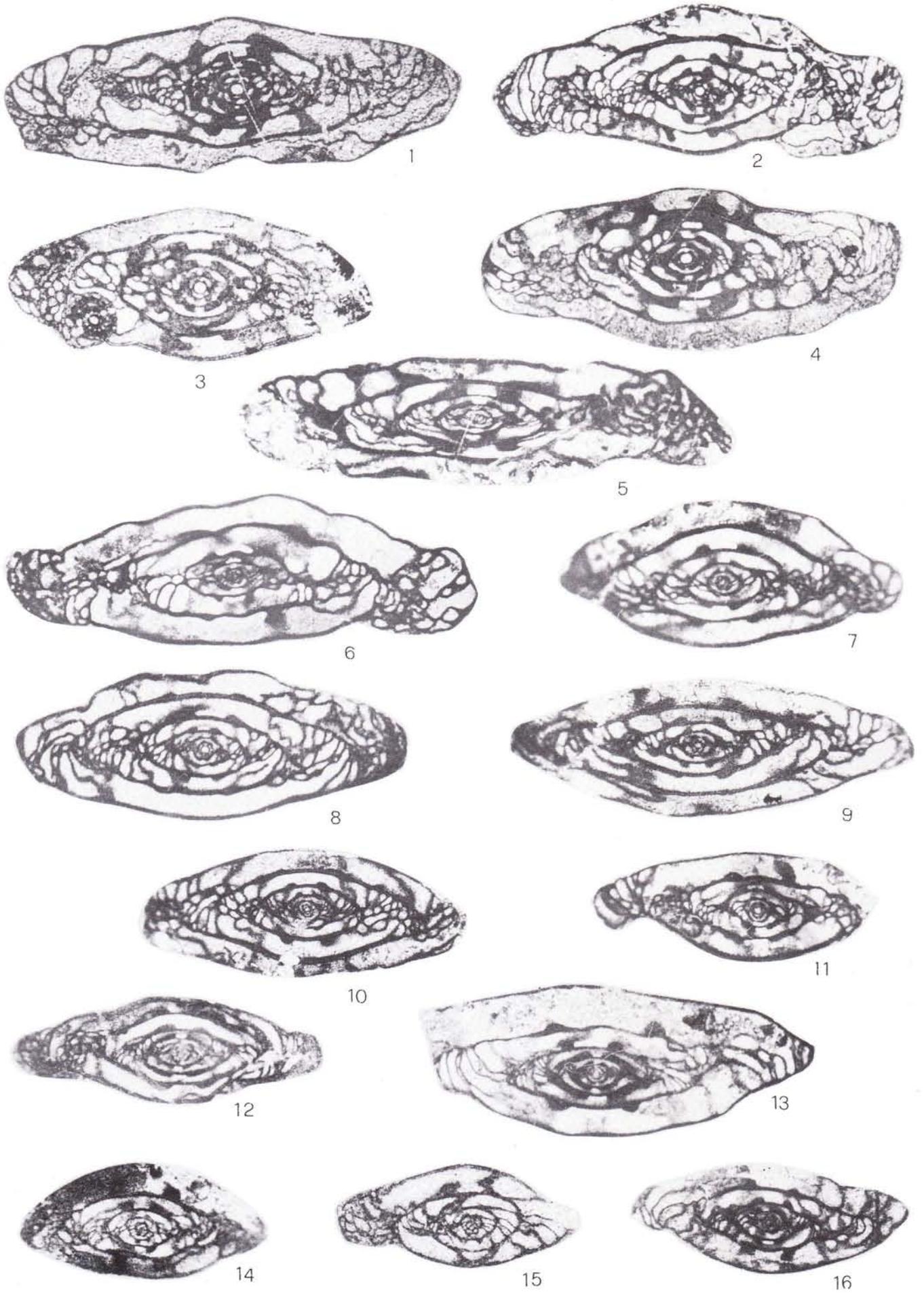
**Distribution and age.** East European Platform, Spain, Darvaz, China; Middle Carboniferous, Upper Moscovian (upper part).

**Occurrence.** Section 1006, Kalaikuhna Formation, member 4.

PLATE 8

All x 20

- Fig. 1 - *Fusulinella (Fusulinella) fluxa* Lee et Chen. Axial section, GIN 4767/140. Section 1006, Kalaikuhna Formation, member 1.  
 Fig. 2-4 - *Fusulinella (Fusulinella) helenae* Rauser-Chernousova. 2) Axial section, GIN 4767/141. Section 1006, Kalaikuhna Formation, member 1. 3) Axial section, GIN 4767/142. Section 1006, Kalaikuhna Formation, member 1. 4) Axial section, GIN 4767/143. Section 1005, Kalaikuhna Formation, member 1, level 6.  
 Fig. 5 - *Fusulinella (Fusulinella) gigantea* Pogrebnjak. Axial section, GIN 4767/144. Section 1005, Kalaikuhna Formation, member 1, level 4.  
 Fig. 6 - *Fusulinella (Fusulinella) alvaradoi* Ginkel. Axial section, GIN 4767/145. Section 1005, Kalaikuhna Formation, member 1, level 4.  
 Fig. 7 - *Fusulinella (Fusulinella) schwagerinoides* (Deprat). Axial section, GIN 4767/146. Section 1006, member 3.  
 Fig. 8-10 - *Fusulinella (Fusulinella) bogushi* n. sp. Section 1006, Kalaikuhna Formation, member 3. 8) Axial section, GIN 4767/147. 9) Axial section of the holotype, GIN 4767/148. 10) Axial section, GIN 4767/149.  
 Fig. 11, 14, 16 - *Fusulinella (Fusulinella) mosquensis* Rauser-Chernousova et Safonova. Section 1006, Kalaikuhna Formation, member 4, level 5. 11) Axial section, GIN 4767/150. 14) Axial section, GIN 4767/151. 16) Axial section, GIN 4767/153.  
 Fig. 12 - *Fusulinella (Fusulinella) aff. borealis* Rauser-Chernousova. Axial section, GIN 4767/153. Section 1006, Kalaikuhna Formation, member 3.  
 Fig. 13 - *Fusulinella (Fusulinella) pamirica* n. sp. Axial section, GIN 4767/154. Section 1006, Kalaikuhna Formation, member 4, level 4.  
 Fig. 15 - *Fusulinella (Fusulinella) podolskensis* Rauser-Chernousova. Subaxial section, GIN 4767/155. Section 1006, Kalaikuhna Formation, member 4, level 4.



**Fusulinella (Fusulinella) podolskensis** Rauser-Chernousova, 1951

Pl. 8, fig. 15

1951 *Fusulinella* (?) *podolskensis* Rauser-Chernousova in Rauser-Chernousova et al., pp. 233-234, pl. 35, fig. 1.

Material. 1 axial and 3 subaxial sections.

Distribution and age. East European Platform, Darvaz; Middle Carboniferous, Upper Moscovian (upper part).

Occurrence. Section 1006, Kalaikuhna Formation, member 4, level 4.

**Fusulinella (Fusulinella) oksana** Rosovskaya, 1975

Pl. 9, fig. 1

1963 *Fusulinella valida* Bogush, pp. 90-92, pl. 6, fig. 6.1975 *Fusulinella oksana* (*nom. nov.*) Rosovskaia, p. 145.

Material. 3 axial and subaxial sections.

Distribution and age. Middle Asia; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 3 (upper part).

**Fusulinella (Fusulinella) ginkeli** Villa, 1989

Pl. 9, fig. 2, 3, 5

1989 *Fusulinella ginkeli*: Villa, pp. 204-206, pl. 25, fig. 3-7; pl. 26, fig. 1-8; pl. 27, fig. 1-5.

Material. 1 axial section.

Distribution and age. Spain, Darvaz; Middle Carboniferous, Lower Moscovian (upper part) and Upper Moscovian (lower part).

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 1.

**Fusulinella (Fusulinella) kamensis** Rauser-Chernousova, 1961

Pl. 9, fig. 4

1961 *Fusulinella pseudoschwagerinoides* var. *kamensis* Rauser-Chernousova in Rauser-Chernousova et al., p. 215, pl. 1, fig. 8-9.

Material. 1 axial section.

Distribution and age. East European Platform, Middle Asia; Middle Carboniferous, Upper Moscovian.

Occurrence. Section 1006, Kalaikuhna Formation, member 3 (upper part).

**Fusulinella (Fusulinella) delepinei** Gubler, 1943,

emend Van Ginkel, 1965

Pl. 9, fig. 8-9

1943 *Fusulinella bocki delepinei* Gubler (Gubler in Delepine, 1943), p. 102-103, pl. 2, fig. 1-7.1965 *Fusulinella delepinei* Ginkel, p. 155-156, pl. 45, fig. 1-15.

Material. 2 axial sections.

Distribution and age. Spain, Darvaz; Middle Carboniferous, Lower Moscovian.

Occurrence. Section 1005, Kalaikuhna Formation, member 1, level 1.

**Fusulinella (Fusulinella) lata** Reitlinger, 1961

Pl. 9, fig. 7

1961 *Fusulinella praebocki* var. *lata* Reitlinger, p. 241, pl. 3, fig. 10.

Material. 1 axial section.

Distribution and age. East European Platform, Darvaz; Middle Carboniferous, Lower Moscovian (upper part), Upper Moscovian (lower part).

Occurrence. Section 1006, Kalaikuhna Formation, member 1.

*Protriticites* Putrja, 1948**Protriticites** (?) sp.

Pl. 9, fig. 16, 17

Discussion. There are two specimens in our collection, which differs from *Fusulinella* in the structure of spirotheca because the diaphanotheca is present only in inner volutions; in outer ones the spirotheca consists of tectum and inner and outer tectorium. Such spirotheca is typical for the genus *Protriticites*. But our specimens differs from actual *Protriticites* having a plane septa.

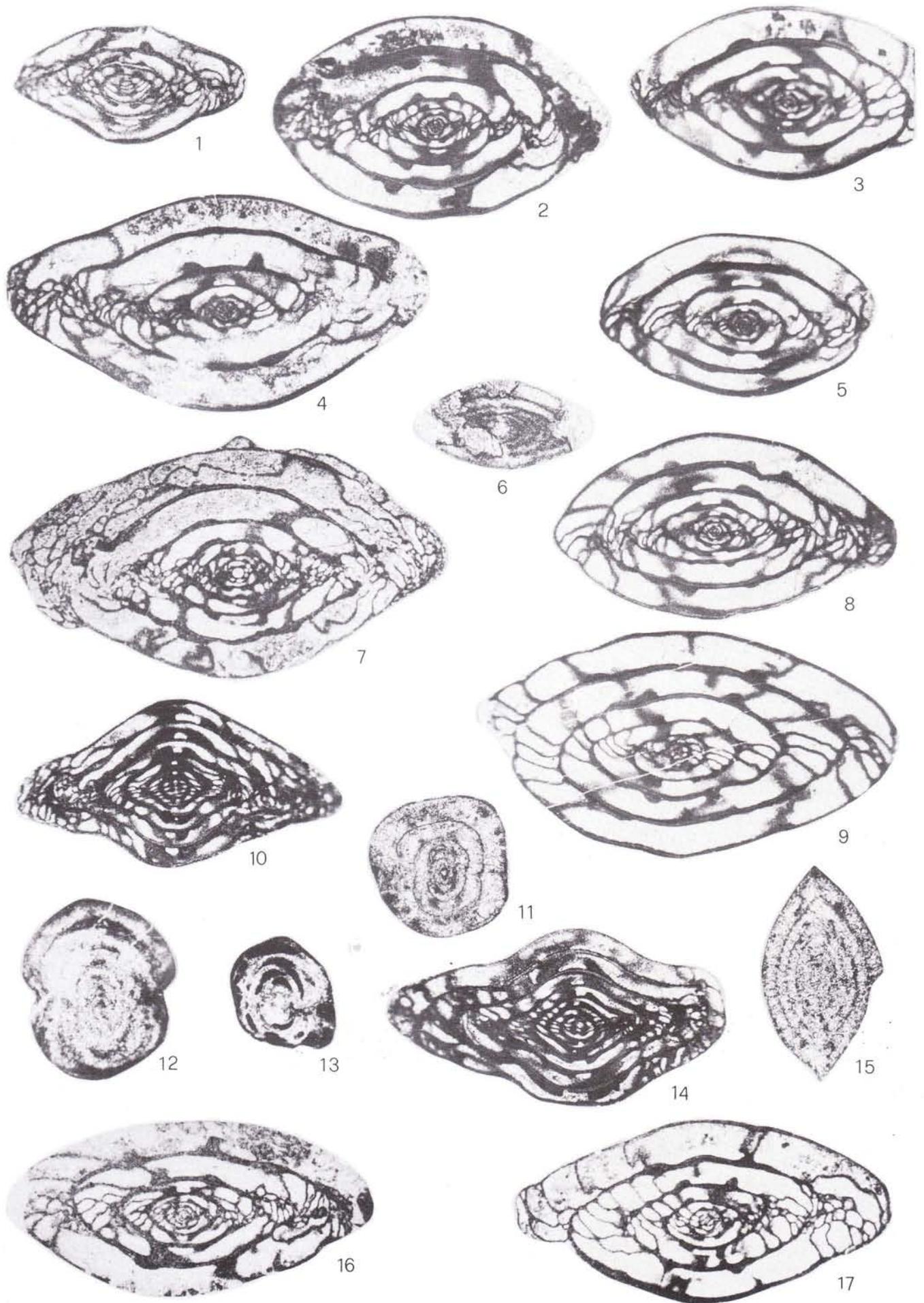
Occurrence and age. Section 1006, Kalaikuhna formation, member 4, level 5.

Subfamily *Pulchrellinae* Solovieva, 1983*Pulchrella* Solovieva, 1983**Pulchrella eopulchra** (Rauser-Chernousova, 1951)

Pl. 9, fig. 10, 14

## PLATE 9

- Fig. 1 - *Fusulinella (Fusulinella) oksana* Rosovskaya. Subaxial section, GIN 4767/156. x 20. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 2, 3, 5 - *Fusulinella (Fusulinella) ginkeli* Villa. Section 1005, Kalaikuhna Formation, member 1, level 1. x 20. 2) Axial section, GIN 4767/157. 3) Axial section, GIN 4767/158. 5) Axial section, GIN 4767/159.
- Fig. 4 - *Fusulinella (Fusulinella) kamensis* Rauser-Chernousova. Axial section, GIN 4767/160. x 20. Section 1006, Kalaikuhna Formation, member 3.
- Fig. 6 - *Wedekindellina* (?) cf. *subovata* Safonova. Axial section, GIN 4767/161. x 30. Section 1005, Kalaikuhna Formation, member 3.
- Fig. 7 - *Fusulinella (Fusulinella) lata* Reitlinger. Axial section, GIN 4767/142. x 20. Section 1006, Kalaikuhna Formation, member 1.
- Fig. 8, 9 - *Fusulinella (Fusulinella) delepinei* Gubler. Section 1005, Kalaikuhna Formation, member 1, level 1. x 20. 8) Axial section, GIN 4767/162. 9) Subaxial section, GIN 4767/163.
- Fig. 10, 14 - *Pulchrella eopulchra* (Rauser-Chernousova). x 20. 10) Subaxial section, GIN 4767/164. Section 1005, Kalaikuhna Formation, member 1, level 2 14) Axial section, GIN 4767/165. Section 1005, Kuhifrush Formation, member 3.
- Fig. 11 - *Parastaffelloides pseudosphaeroidea* (Dutkevich). Axial section, GIN 4767/166. x 20. Section 1005, Kalaikuhna Formation, member 1, level 1.
- Fig. 12 - *Palaeostaffella moelleri* (Ozawa). Axial section, GIN 4767/167. x 20. Section 1006, Kalaikuhna Formation, member 4, level 4.
- Fig. 13 - *Parastaffelloides dagmarae* (Dutkevich). Subaxial section, GIN 4767/168. x 20. Section 1005, Kalaikuhna Formation, member 1, level 4.
- Fig. 15 - *Reitlingerina rezwoi* (Bogush). Subaxial section, GIN 4767/169. x 20. Section 1005, Kuhifrush Formation, member 3.
- Fig. 16, 17 - *Protriticites* (?) sp. Section 1006, Kalaikuhna Formation, member 4, level 5. x 20. 16) Axial section, GIN 4767/170. 17) Subaxial section, 4767/171.



1951 *Fusulinella eopulchra* Rauser-Chernousova in Rauser-Chernousova et al., p. 235, pl. 35, fig. 5-8.

**Material.** 6 axial and subaxial sections.

**Distribution and age.** East European Platform, Donetz Basin, Spitzbergen, Greenland, Middle Asia, China, Japan; Middle Carboniferous, Lower Moscovian (upper part), Upper Moscovian.

**Occurrence.** Section 1004, Kalaikuhna Formation; section 1005, Kuhifrush Formation, member 3 (upper part); Kalaikuhna Formation, member 1, level 2.

Family *Wedekindellinidae* F. Kahler et G. Kahler, 1966  
*Wedekindellina* Dunbar et Henbest, 1933

**Wedekindellina (?) cf. subovata** Safonova, 1951

Pl. 9, fig. 6

1951 *Wedekindellina subovata* Safonova in Rauser-Chernousova et al., pp. 238-239, pl. 36, fig. 4-7.

**Material.** 1 axial section.

**Distribution and age.** East European Platform, Middle Asia; Middle Carboniferous, Upper Moscovian.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 3.

Order *Staffellida* A. Miklukho-Maclay, 1949

Family *Pseudoendothyridae* Mamet, 1970  
*Palaeostaffella* Liem, 1966

**Palaeostaffella moelleri** (Ozawa, 1925)

Pl. 9, fig. 12

1925 *Staffella moelleri* Ozawa, pp.19-20, pl. 2, fig. 9.

**Material.** 1 axial section.

**Distribution and age.** Japan, China, Middle Asia, Viet Nam, Spain, East European Platform; Middle Carboniferous, Moscovian.

**Occurrence.** Section 1006, Kalaikuhna Formation, member 4, level 4.

Family *Nankinellidae* A. Miklukho-Maclay, 1963  
*Reitlingerina* Rauser-Chernousova, 1985

**Reitlingerina rezwoi** (Bogush, 1963)

Pl. 9, fig. 15

1963 *Pseudoendothyra rezwoi* Bogush, p. 70, pl. 3, fig. 10.

**Material.** 3 subaxial sections.

**Distribution and age.** Middle Asia; Middle Carboniferous, Lower Moscovian and lower part of Upper Moscovian.

**Occurrence.** Section 1005, Kuhifrush Formation, Member 3 (upper part).

Family *Staffellidae* A. Miklukho-Maclay, 1949

*Parastaffelloides* Reitlinger, 1963

**Parastaffelloides pseudosphaeroidea** (Dutkevich, 1934)

Pl. 9, fig. 11

1934 *Staffella pseudosphaeroidea* Dutkevich, pp.17-22 (Russian), p. 66-68 (English), pl. 3, fig. 2-10.

**Material.** 2 axial sections.

**Distribution and age.** East European Platform, Greenland, Spain, Turkey, Middle Asia, China Indochina; Middle Carboniferous.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 1.

**Parastaffelloides dagmarae** (Dutkevich, 1934)

Pl. 9, fig. 13

1934 *Staffella dagmarae* Dutkevich, pp. 22-27 (Russian), 68-71 (English), pl. 3, fig. 11-15.

**Material.** 2 subaxial sections.

**Distribution and age.** East European Platform, Middle Asia, China, Indochina; Middle Carboniferous.

**Occurrence.** Section 1005, Kalaikuhna Formation, member 1, level 4.

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