Stratigraphy and fusulinids of the kasimovian and lower gzhelian (upper carboniferous) in the Southwestern Darvaz (pamir)

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STRATIGRAPHY AND FUSULINIDS OF THE KASIMOVIAN AND LOWER GZHELIAN (UPPER CARBONIFEROUS) IN THE SOUTHWESTERN DARVAZ (PAMIR)

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Riassunto. In questo articolo viene presentata una zonazione aggiornata del Kasimoviano e Gzheliano basale nel Darvaz sud-occidentale (Pamir) sulla base dei fusulinidi. Vengono individuate cinque biozone di associazione locale nell'ambito di cinque sezioni stratigrafiche. Queste biozone si possono correlare con gli equivalenti cronostratigrafici della Piattaforma est-europea, degli Urali, delle regioni artiche (Timan e Spitzbergen) e delle Alpi Carniche. Nel Darvaz sud-occidentale, entro gli strati attribuiti al Kasimoviano ed allo Gzheliano basale, sono state riconosciute 87 specie e şottospecie di fusulinidi, appartenenti a 18 generi e 7 famiglie. Tra questi, due generi (*Kushanella* e *Darvasoschwagerina*), un sottogenere (*Tumefactus*), e 24 specie sono considerate come nuove, in particolare *Fusiella segyrdashtiensis*, *Quasifusulina pseudotenuissima*, *Protriticites putrjai*, *P. compactus*, *Obsoletes darvasicus*, *Schwagerinoides (Schwagerinoides) pamiricus*, *Schw. (Tumefactus) oblisus*, *Montiparus kushanicus*, *M. rauserae*, *M. pigmaeus*, *M. memorabilis*, *M. citreum*, *M. hirsutus*, *M. dubius*, *M. stuckenbergiformis*, *M. desinens*, *Triticites umbonoplicatiformis*, *T. licis*, *Rauserites concinnus*, *R. jucundus*, *R. darvasicus*, *Kushanella globosa*, *K. insueta*, *Darvasoschwagerina donbasica*.

Abstract. A detailed fusulinid biostratigraphic zonation of the Kasimovian and lowermost Gzhelian in southwestern Darvaz is proposed. Based on the investigation of five stratigraphic sections, five local fusulinid zones were established. These zones correlate with their chronostratigraphic equivalents in the East-European Platform and in the Urals, Arctic and Carnic Alps regions. Eighty-seven species and subspecies, which belong to 18 genera and 7 families of fusulinids, were identified in the Kasimovian and lowermost Gzhelian of Darvaz. Among them, two genera (*Kushanella* and *Darvasoschwagerina*), one subgenus (*Tumefactus*), and 24 species are new (i. e. *Fusiella segyrdashtiensis*, *Quasifusulina pseudotenuissima*, *Protriticites putrjai*, *P. compactus*, *Obsoletes darvasicus*, *Schwagerinoides* (*Schwagerinoides*) *pamiricus*, *Schw.* (*Tumefactus*) *oblisus*, *Montiparus kushanicus*, *M. rauserae*, *M. pigmaeus*, *M. memorabilis*, *M. citreus*, *M. hirsutus*, *M. dubius*, *M. stuckenbergiformis*, *M. desinens*, *Triticites umbonoplicatiformis*, *T. licis*, *Rauserites concinnus*, *R. jucundus*, *R. darvasicus*, *Kushanella globosa*, K. *insueta*, *Darvasoschwagerina donbasica*).

Introduction.

The material described in this paper was collected by the authors in the late sixties - early seventies during field studies of Carboniferous and Permian units of the Kuhifrush Ridge, southwestern Darvaz, and northern Pamir. Most of the results concerning the Moscovian, Gzhelian and Lower Permian stages have been published already in a series of papers and monographs (Leven 1974, 1980, 1981, 1982, 1998; Leven, Leonova & Dmitriev 1992; Leven & Scherbovich 1978, 1980; Leven & Davydov 1986, 1991; Davydov 1982, 1984, 1986, 1990). Some of the preliminary characteristics of Kasimovian fusulinid biostratigraphy were presented in these publications. However, comprehensive data on the stratigraphy of the Kasimovian stage and the taxonomy of its fusulinids is presented now for the first time. The material described was collected primarily from three sections at the top of the Kuhifrush Ridge(i.e. the Kalaikuhna sections 1006 and 1007 and Safetgyr section D-172 (=1016) (Fig. 1, 2). Additional material from sections D-10 and D-200, located on the right bank of the Panj River, and from section D-157, located on the left bank of the Vozgina River, was analyzed and included in our study (Fig. 2). The general characteristics of these sections were described in a monograph and two papers (Leven & Scherbovich 1978; Davydov 1984; Leven & Davydov 1986). The Moscovian portion of section 1006 and its fusulinids were described in another publication by Leven (1998). The Kasimovian and early Gzhelian fusulinids described in the present paper were collected from more than 20 levels. Seven hundred oriented thin-sections were prepared. This fusulinid collection No. 12678 is housed in the Central Geological Museum (CGM) in St. Petersburg (Russia).

Geological setting and previous studies.

The area studied is located in southwestern Darvaz (southern Tadzhikistan) and belongs structurally to

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Fig. 1 - Outline map of Pamir showing the studied area (southwest Darvaz).

the Darvaz-Transalay tectonic zone of Northern Pamir (Fig. 1, 2). The sections are located near the top of the Kuhifrush Ridge, on its eastern slope. The ridge is formed by a thick succession of Carboniferous and Permian units folded into a large Kuhifrush anticline. The eastern margin of this anticline is faulted and the oldest Carboniferous rocks represented by thick volcanogenic sequences are exposed at the core of the Kuhifrush anticline and on the eastern slope of the Kuhifrush Ridge on the hanging wall of the reverse fault (Leven & Scherbovich 1978; Davydov 1984). Lower Carboniferous volcanogenic sediments are overlain unconformably (sometimes with angular unconformity) by olistostromes and carbonates of the Vozgina Fm. and Zidadara Fm. of Bashikirian age. Bashkirian sediments are also unconformably overlain by thick, generally pure, carbonates of the Shagon Group, which are exposed along the Kuhifrush Ridge. The Shagon Group consists of the following formations (bottom to top):

1. Kuhifrush Fm. of Moscovian age;
2. Kalaikuhna Fm. of late Moscovian, Kasimovian, Gzhelian and Orenburgian age;
3. Sebisurkh Fm. of Asselian age.

On the western slope of the Kuhifrush Ridge, the Sebisurkh Fm. is overlaid by mixed siliciclastic-volcanogenic-carbonate sequences spanning the entire Permian, up to 3000-4000 m thick (Leven 1974; Leven & Scherbovich 1978; Leven et al. 1992; Leven 1998; Davydov 1984). The total thickness of Carboniferous and Permian sediments in the area is 6000-7000 m. with the Upper Carboniferous (Kasimovian, Gzhelian and Orenburgian Stages) approximately 150 m and the Kasimovian 40 to 50 m thick. In spite of such insignificant thickness, the facies of the Upper Carboniferous sediments is quite persistent and may be traced laterally over more than 150 km, from the Panj River in the South to the Peter the First Ridge in the North.

Upper Carboniferous sediments in the sense of modern stratigraphy were discovered in the region by Dutkevich & Kalmykova (1937). They established the carbonate Shagon Group and divided it into several stratigraphic units (horizons). Moreover, they included the horizon with *Triticites* and the immediately overlying horizon with large Rugose corals into the Upper Carboniferous. In the Shagon Group they suggested the existence of an unconformity between Middle and Upper Carboniferous, marked by quartz sandstones and conglomerates. Based on the occurrence of fusulinids, corals and brachiopods, Vlasov & Miklukho-Maclay (1959) proved that both *Triticites* and Rugose horizons belong to the Upper Carboniferous. Kasimovian sediments in the Darvaz region were distinguished from Upper Carboniferous units by Leven (1974), who studied two sections (1006 and 1007) in the upper course of the Kalaikuhna River. Leven & Scherbovich (1978) found the analogues of all the three fusulinid zones established in the Kasimovian of the East-European Platform. The Moscovian/Kasimovian boundary, i.e the base of the Upper Carboniferous was placed about l0 m below the beds with quartz sandstones and conglomerates. This is somewhat lower than the position suggested by Dutkevich & Kalmykova (1937).

Leven & Scherbovich (1978) divided the Kasimovian deposits of Darvaz into three members. The lowermost, 10 m thick, is characterized by algae-foraminiferal limestones with *Obsoletes*, *Montiparus* and "*Triticites*" (= *Schwageriniformis*) *expressus*. The second (middle) member, 11 m thick, is composed of sandy limestone

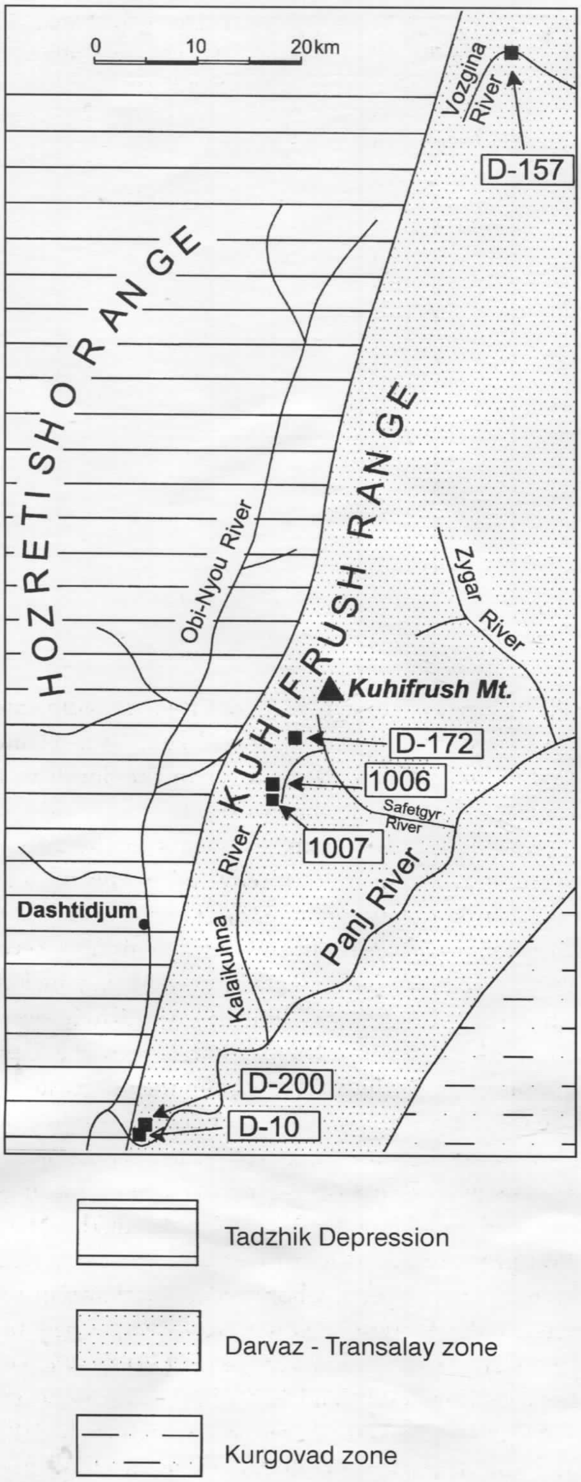


Fig. 2 - Index-map with location of the studied sections.

interbedded with quartz sandstones and conglomerates, containing the fusulinid "*Triticites*" (= *Schwageriniformis*) *gissaricus*. The third, upper member, 11 m thick, is represented by crinoidal and algae limestones with "*Triticites*" (= *Rauserites*) ex gr. *quasiarcticus* and "*Triticites*" (= *Rauserites*) ex gr. *rossicus*. Leven & Scherbovich correlated the first member with the lower, middle and partly with the upper Kasimovian of the East-European Platform and both second and third members with the upper Kasimovian.

This scheme of subdivision of the Kasimovian, established in the Kalaikuhna River sections by Leven & Scherbovich, was generally confirmed by Davydov (1984, 1986, 1990) in detailed studies on the Vozgina, Kuhifrush, Shohkazak and Safetgyr sections of the Darvaz region. The Safetgyr section, rich with well-preserved fusulinids, was the most thoroughly studied. Davydov (1986) divided the Upper Carboniferous of the Safetgyr section into 10 lithological units, with units 5, 6 and 7 considered of Kasimovian age. Three standard fusulinid zones of the Kasimovian of the East-European Platform were recognized in the section. Davydov (1986, 1990) suggested the existence of a gradual transition between Moscovian and Kasimovian, based on the occurrence of fusulinids identified at that time as *Obsoletes*. The base of the Kasimovian in the Safetgyr section was placed between beds 43 and 44. It was recognized later that in the Safetgyr section there are very few true *Obsoletes* and most of the fusulinids previously assigned to *Obsoletes* belong to the genus *Praeobsoletes*, introduced by Remizova in 1992, with a stratigraphic range mostly bounded to the uppermost Moscovian. After this taxonomical revision, the base of Kasimovian was placed between beds 66 and 67 (Davydov 1997; Krainer & Davydov 1998).

Description of the sections and lithostratigraphic subdivisions of the Kasimovian-Gzhelian succession

Sections 1006 and 1007 are located at the top of the Kuhifrush Ridge near the pass between the Kalaikuhna and Obiniou Rivers, right tributaries of the Panj River (Fig. 2). Section 1006 is immediately to the south of peak 3697 m a.s.l. Section 1007 is located on the eastern slope of peak 3165 m a.s.l., 1 km to the south of section 1006. The Middle Carboniferous in section 1006, including the upper part of the lower Moscovian and the entire upper Moscovian, was described by Leven (1998). The Moscovian succession was divided lithologically into 4 members which form the lower portion of the Kalaikuhna Formation. The upper portion of the formation belongs instead to the Kasimovian, Gzhelian and Orenburgian stages.

The boundary between the Moscovian and the Kasimovian is complicated in section 1006 by a fault which affects the uppermost Moscovian and the lowermost Kasimovian. The section described here starts above that fault. Because this section is the continuation of the section described by Leven (1998) the numbers of the members follow the numbers used in the previous publication. The complete list of the fusulinid species identified in each sample is given in Table 1.

Fusulinids	*P.v.-O.p* zone	*M.u.-T.k* zone	*T.e.-P.c.* zone	*S.f.- S.p* zone	*R. r.* zone
Parastaffelloides sp.		x	x	x	
pseudosphaeroidea				x	
Palaeostaffella sp.		x	x	x	
moelleri		x			
mochaensis			x		
Pseudoendothyra sp.				x	
Ozawainella sp.		x	x		x
cf. *angulata*		x			
Eoschubertella sp.		x	x		
sphaerica staffelloides		x			
lata		x	x	x	
procera	x	x	x		
obscura	x		x		
Schubertella *sp.*	x	x	x	x	x
galinae			x		
mjachkovensis			x		
elliptica	x		x	x	
Fusiella sp.	x	x		x	
typica	x	x	x		
lancetiformis		x			
segyrdashtiensis		x			
Quasifusulinoides sp.		x	x	x	
fusulinoides		x			
juvenatus		x			
Quasifusulina sp.		x	x	x	
longissima		x			
aff. *popensis*		x			
pseudotenuissima		x			x
brevis		x			
Fusulinella sp.	x				
schwagerinoides	x				
Protriticites sp.	x				
aff. *pseudomontiparus*			x		
turkestanicus			x		
aff. *sphaericus*			x		
variabilis	x				
subschwagerinoides inflatus	x				
putrjai			x		
plicatus	x		x		
compactus			x		
formosus			x		
Obsoletes sp.	x	x	x		
paraovoides	x		x		
minutus asiaticus	x				
aff. *ovoides*	x				
darvasicus	x		x		
Schwageriniformis (Schw.) sp.			x	x	x
minor			x	x	
fusiformis				x	
gissaricus compactus				x	
crebrius			x		
baisunensis			x	x	
nanus				x	
parallelos			x		
pamiricus			x	x	x

Fusulinids	*P.v.-O.p* zone	*M.u.-T.k* zone	*T.e.-P.c.* zone	*S.f.- S.p* zone	*R. r.* zone
Schw. (Tumefactus) sp.		x	x		
expressus		x	x		
oblisus			x		
Montiparus sp.		x	x		
montiparus		x			
umbonoplicatus umbonoplicatus		x			
umbonoplicatus longus		x			
umbonoplicatus inflatus		x			
sinuosus sinuosus		x			
sinuosus alaicus		x			
priscus		x			
kushanicus		x			
rauserae		x			
pigmaeus		x			
memorabilis		x			
citreus		x			
paramontiparus mesopachus		x			
hirsutus		x			
dubius		x		x	
stuckenbergiformis		x			
desinens		x			
Triticites sp.		x			
kurshabensis		x			
simplex		x			
umbonoplicatiformis		x			
licis		x			
noinskyi		x			
aff. *irregularis annulifera*		x		x	
Ferganites *isfarensis*				x	x
ferganensis					x
Rauserites sp.				x	x
rossicus rossicus					x
rossicus macilentus					x
henbesti					x
rugosus				x	x
fortissimus					x
kuibyshevi					x
triangulus orientalis					x
concinnus					x
jucundus					x
darvasicus					x
Kushanella sp.		x			
daixiniformis		x			
globulus globosa		x			
(?) *insueta*		x			
Darvasoschwagerina sp.					x
archaica					x
Jigulites sp.					x
Daixina sp.					x
Rugosofusulina sp.					x

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

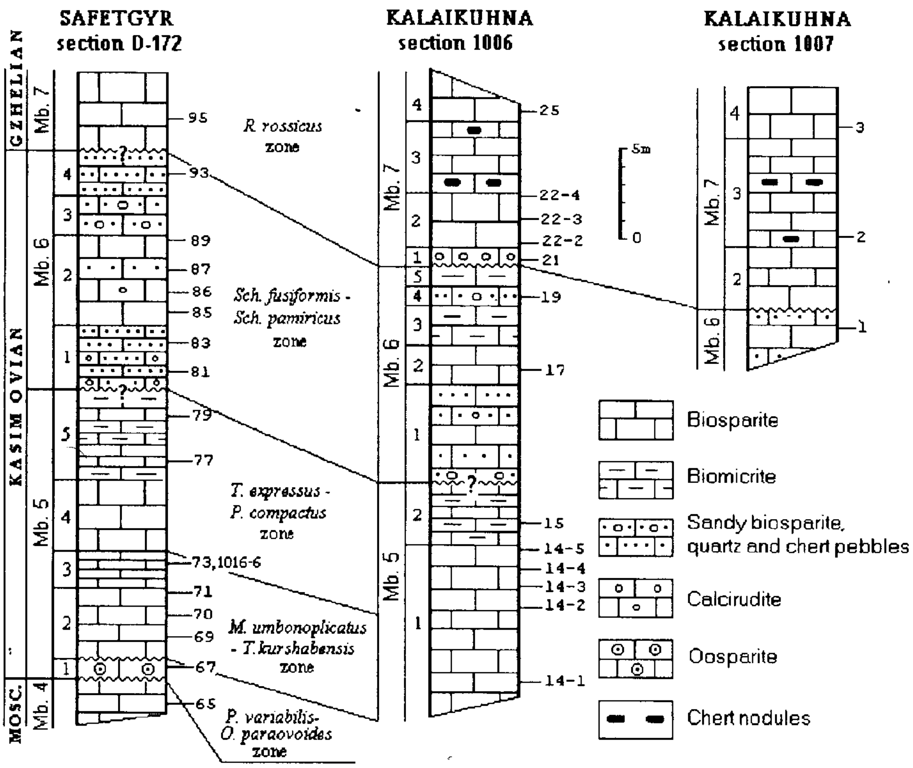


Fig. 3 - Correlation chart of the major stratigraphic section.

Section 1006 (Kalaikuhna)

The following stratigraphic sequence was recognized in section 1006 (bottom to top) (Fig. 3):

Member 5 (carbonates):

Unit 1. Light-colored, compact, coarse-bedded foraminiferal-algal packstone-grainstone with rare fragments of gastropods, crinoids and pelmatozoans. The limestone is rich in fusulinids. Five levels were sampled (in ascending order): a) sample 14-1 (2 m above the base of the unit); b) sample 14-2 (7 m above the base); c) sample 14-3 (8 m above the base); d) sample 14-4 (9 m above the base); and e) sample 14-5 (at the top of the unit). Total thickness of unit 1: 10 m.

Unit 2. Grey or dark-colored, sparse biomicritic limestone with fragments of ostracods, algae, and rare fusulinids, predominantly *Staffellidae* - sample 15. Thickness 3.5 m.

Member 6 (carbonate-siliciclastic):

Unit 1. Coarse-bedded, striped as a result of interbedding of light-colored and hematite-rich, crinoid-foraminiferal biosparite, mixed with poorly sorted and partly rounded quartz grains. The limestones are interbedded with thin horizons of quartz sandstones and gravel conglomerates with carbonate matrix. Thickness 5 m.

Unit 2. Massive light-colored grainstones consisting of rounded fragments of foraminifers, crinoids and algae - sample 17. Thickness 2 m.

Unit 3. Massive light-colored algal wackestone. Thickness 2 m.

Unit 4. Light-colored packstone-wackestone interbedded with thin horizons of quartz sandstone and gravel conglomerate with carbonate matrix - sample 19. Thickness 1 m.

Unit 5. Light-colored wackestone. Thickness 1 m.

Member 7 (carbonate):

Unit 1. Dark-colored to black, crinoid-foraminiferal packstone-grainstone overlying the light-colored wackestone of member 6 with an abrupt, erosional contact. Small poorly rounded debris of the above-mentioned light-colored limestone occur within black limestones near the base of unit 1 of member 7. The packstone-grainstone of unit 1 contain fragments of crinoids, bryozoans, algae and fusulinids - sample 21. Thickness 1 m.

Unit 2. Light-colored massive grainstone with abundant fusulinids, fragments of algae, crinoid plates, and rare bryozoans. Fusulinids were collected from 3 levels (upwards): a) sample 22-2 (1 m above the base of the unit); b) sample 22-3 (1.5 meters above the base); and c) sample 22-4 (at the top of the unit). Thickness 3 m.

Unit 3. Grey, coarse-bedded grainstone with abundant crinoid plates, and rare small foraminifers, fusulinids, fragments of algae, bryozoans, ostracods and echinoderms. Thin layers and nodules of cherts occur in this bed. Fusulinids were collected from a single layer - sample 23. Thickness 4 m.

Unit 4. Light-colored massive crinoid-fusulinid wackestone-packstone (lower portion of the bed); predominantly fusulinid grainstone (upper portion)- sample 25. Incomplete thickness 3 m.

Above unit 4 of Member 7, section 1006 is covered. The succession overlying unit 4 is exposed in section 1007, where the entire Upper Carboniferous and Asselian are represented (Leven & Scherbovich 1978, fig. 5). The lower part of section 1007 may be easily traced laterally and correlates with Member 7 of section 1006. Two fusulinid samples were collected from the equivalent of unit 3 of Member 7 (sample 1007-2) and the lower portion of unit 4 (sample 1007-3). Unit 4 in section 1007 is 10 m thick. The overlying Member 8 is represented by thin to medium-bedded packstone-grainstone containing numerous thin layers and nodules of cherts, giving to this member a characteristic banded look. Member 8 is a distinct lithologic marker throughout the entire Darvaz region. Abundant fusulinids recovered from Member 8 belong to the middle Gzhelian and were in part described previously (Davydov 1984; Leven & Davydov 1986).

Section D-172 (Safetgyr)

This section is located near the top of the Kuhifrush Ridge, 3 km south of the Kuhifrush Peak and approximately 5 km north of section 1006 (Fig. 2). The carbonate sequence in this section belongs to the Moscovian, Kasimovian, Gzhelian, Orenburgian and Asselian. Carboniferous portions of the section are exposed perfectly at the very head of the Safetgyr River, right tributary of the Panj River, on the southeast slope and at the top of the Kuhifrush Ridge. The Asselian is exposed on the northwest slope of the Kuhifrush Ridge. A short description of this section was given by Davydov and Leven (Davydov 1984; Leven & Davydov 1986). Davydov subdivided the Carboniferous succession into 10 members, with members 5, 6 and 7 assigned to the Kasimovian (Davydov 1984). These members correspond to members 5, 6, and partly member 7 (units 1 and 2) of section 1006, respectively. In the present paper the Safetgyr section is described adopting the lithological members established in section 1006.

Carbonate member 5 is slightly thicker than member 5 of section 1006, because the lowermost portion of this member in section 1006 is faulted and therefore the member is incomplete. The following lithostratigraphic units were found in Member 5 in the Safetgyr section (upwards) (Fig. 3):

Unit 1. Grey, coarse-bedded oolitic grainstone-packstone composed of rounded fragments of algae, foraminifers, gastropods, corals and crinoids. These fragments often form the nucleus of oolites. Numerous well-preserved fusulinids were recovered from this unit - sample 67. This unit is underlaid by an algal - foraminiferal packstone with abundant fusulinids typical of the Myachkovsky Horizon of the uppermost Moscovian. No significant evidence of unconformity between unit 1 and the underlaying limestone was found. However, based on the characteristics of the limestones of unit 1 (rounded fragments of organic debris) and analysis of fusulinid assemblage, a hidden unconformity at this level cannot be excluded. Total thickness 2 m.

Unit 2. Grey, coarse-bedded fusulinid grainstone. Three fusulinid samples were collected in this unit (upper part): a) - sample 69 (at the base of the unit); b) - sample 70 (1.5 m above the base); and- sample 71 (at the top of the unit). The analysis of fusulinid assemblages suggests the presence of a hidden unconformity between unit 1 and unit 2. Thickness 4 m.

Unit 3. Grey, platy fusulinid-foraminiferal packstone-wackestone with rare plates of crinoids, fragments of bryozoans and brachiopods - samples 73 and 1016-6. Thickness 2 m.

Unit 4. Dark-colored, algal-foraminiferal wackestone. Thickness 4 m.

Unit 5. Dark-colored to black, platy packstone-wackestone with rare Staffellidae fusulinids. The occurrence of Staffellidae correlates this unit with unit 2 of member 5 in section 1006. Two samples were collected: sample 77 (1 m above the base of the unit) and sample D-79 (4 m above the base of the unit). Thickness 5 m.

Member 6 (carbonate-siliciclastic):

Unit 1. Grey, platy grainstone-packstone with abundant coarse quartz grains. Detrital components of grainstone are represented by whole and broken fusulinid tests, crinoid ossicles and fragments of algae. This unit includes many thin layers of coarse quartz sandstone transitional to gravel-sized conglomerates with carbonate matrix. Sometimes at the base of sandy layers there is evidence of erosion of the underlying beds. Two samples were collected in this unit: sample 81 (2 m above the base) and sample 83 (3 m above the base). Thickness 3.5 m

Unit 2. Grey, massive crinoid-algae-fusulinid grainstone-packstone is interbedded with quartz sandstones. Four samples were collected in this unit: sample 85 (1 meter above the base), sample 86 (2 m above the base), sample 87 (3 m above the base) and sample 89 (at the top of the unit). Thickness 5 m.

Unit 3. Grey, quartz gravel-sized conglomerates and sandstone interbedded with sandy grainstone-packstone. Thickness 2 m.

Unit 4. Black, massive packstone-wackestone with very abundant coarse quartz grains. Bioclastic components of packstone are represented by crinoidal ossicles, fragments of algae, bryozoans, gastropod and brachiopod shells - sample 93. Thickness 2.5 m.

Member 7 (carbonate):

Unit 1. Grey, massive fusulinid packstone-grainstone with large fusulinid tests and partly rounded fragments of crinoids, algae, bryozoans, gastropods and brachiopods - sample 95. Thickness 2.5 m.

The rest of *Member 7*, approximately 18 m thick, belongs to the middle Gzhelian and will not be described in this paper, except for *Darvasoschwagerina archaica*, which occurs in the uppermost portion of Member 7.

Biostratigraphic subdivisions of the Kasimovian-lower Gzhelian

Fusulinids are the most abundant fossils in the Kasimovian and Gzhelian of Darvaz. They are distributed quite homogeneously throughout the succession, being most abundant and diverse in members 5 and 7 of the Kalaikuhna Formation. The fusulinids in member 6 are less diverse taxonomically.

Members 5, 6 and 7, which belong to the Kasimovian and lower Gzhelian, were subdivided by the authors into the following local fusulinid assemblage-zones, from bottom to top:

1. *Protriticites variabilis-Obsoletes paraovoides* zone
2. *Montiparus umbonoplicatus-Triticites kurshabensis* zone
3. *Schwageriniformis expressus-Protriticites compactus* zone
4. *Schwageriniformis fusiformis-Schwageriniformis pamiricus* zone
5. *Rauserites rossicus* zone

Protriticites variabilis-Obsoletes paraovoides zone

The zone is established in the Safetgyr section where it encompasses the entire unit 1 of member 5. This zone is characterized by fusulinids from only one sample (D-172/67), which was collected at the base of the 2 m-thick carbonate horizon which we attribute to this zone based on analogy in lithology. The fusulinids are represented by *Obsoletes paraovoides* Bensh, *O. darvasicus* sp. nov., *O. minutus asiaticus* Bogush, *Protriticites variabilis* Bensh, *Pr. plicatus* Manukalova, *P.* aff. *sphaericus* Volozhanina, rare *Fusulinella* aff. *schwagerinoides* (Deprat), *Eoschubertella obscura* (Lee & Chen), *Schubertella elliptica* Putrja, *Sch.* aff. *procera* Rauser. Beds immediately below this zone do not contain fusulinids. Taxa typical of the upper Myachkovsky Horizon (Peskovskaya Formation of the Moscow Basin) fusulinids were recovered 1.8 m below sample D-172/67, i.e.at the base of the *Protriticites variabilis-Obsoletes paraovoides* zone. They are *Fusulinella helenae* Rauser, *F. bocki* Moeller, *F. podolskiensis* Rauser, *F. pamirica* Leven, *F.* aff. *pseudocolaniae* Putrja, *F. kamensis* Rauser, numerous *Praeobsoletes* and primitive *Protriticites* (Davydov 1997; Leven 1998).

The relationship between beds with Moscovian and Kasimovian fusulinids in the section described is not clear. However, because of the oolitic composition of the limestone of the *Protriticites variabilis-Obsoletes paraovoides* zone and its exceptionally reduced thickness (2 m) a gap between the Moscovian and Kasimovian, characterized by the absence of a portion of the Moscovian and most of the lower Kasimovian, is suggested in the Safetgyr section, with a portion of Moscovian and most of Lower Kasimovian being absent.

Montiparus umbonoplicatus-Triticites kurshabensis zone

This zone is best represented in the Safetgyr section (D-172), where it corresponds to units 2 and 3 of member 5. The fusulinid assemblage there is quite different from that of the previous zone and is characterized by the dominance of *Montiparus*, with *M. umbonoplicatus* (Rauser & Belyaev) subspecies being particularly numerous. Numerous and diverse primitive forms of *Triticites* with poorly developed keriotheca typify the assemblage of this zone. Specific to this assemblage is the appearance of the new genus *Kushanella*, including several species, and the appearance of *Schwageriniformis*. The latter includes the nominotypical subgenus *Schwageriniformis* and the new subgenus *Tumefactus* described in this paper. *Obsoletes* is completely absent in this zone. Other fusulinids of the assemblage include rare species of *Parastaffelloides*, *Palaeostaffella*, *Ozawainella*, *Eoschubertella*, *Schubertella*, *Fusiella*, *Quasifusulina*, *Quasifusulinoides* and *Protriticites*.

Schwageriniformis expressus-Protriticites compactus zone

This zone is established in the Safetgyr and Kalaikuhna sections. In the Safetgyr section, the *Schwageriniformis expressus-Protriticites compactus* zone corresponds to units 4 and 5 of member 5. In the Kalaikuhna section the zone extends to the upper portion of units 1 and 2 of member 5. The relationship between this zone and the underlying beds is not clear because no fusulinids were recovered from unit 4 of the Safetgyr section. However, unit 5 of the Safetgyr section and unit 2 of the Kalaikuhna section contain similar fusulinids and correlate precisely. Therefore, unit 4 of the Safetgyr section is most probably equivalent to the upper portion of unit 1 in the Kalaikuhna section. The fusulinids recovered from unit 1 in the Kalaikuhna section belong also to *Schwageriniformis expressus-Protriticites compactus* zone.

Numerous species of the subgenera *Schwageriniformis* and *Tumefactus* are predominant in the assemblage of this zone. A few beds near the bottom of this zone contain *Protriticites*, which become rare upwards in the succession and are completely absent near the top of the zone. *Montiparus* and *Triticites*, numerous in the underlying beds, are rare in this zone. *Parastaffelloides*, *Palaeostaffella*, *Ozawainella*, *Eoschubertella*, *Schubertella*, *Fusiella*, and *Quasifusulina* are very rare.

Schwageriniformis fusiformis-Schwageriniformis pamiricus zone

This zone corresponds to member 6 in both Safetgyr and Kalaikuhna sections and it is poorly characterized by fusulinids, probably because of facies control. Numerous *Schwageriniformis (Schwageriniformis)* are predominant in this zone. Rare *Schwageriniformis (Tumefactus)* occur throughout the zone and range into the younger *Rauserites rossicus* zone. First *Ferganites* and *Rauserites* were found near the very top of the *Schwageriniformis fusiformis-Schw. pamiricus* zone. Rare accompanying taxa are represented by *Parastaffelloides, Palaeostaffella, Pseudoendothyra, Schubertella, Quasifusulina, Montiparus* and *Triticites*.

The comparison between the assemblages of the *Schwageriniformis fusiformis-Schw. pamiricus* and *Tumefactus expressus-Protriticites compactus* zones shows that there is no significant difference in their taxonomical composition. Based on this conclusion we think that there is not enough biostratigraphic evidence for a large unconformity at the base of member 6, as suggested by Dutkevich & Kalmykova (1937) and Vlasov & Miklukho-Maclay (1959). However, the occurrence of sandstone and conglomerates may indicate a local, small-scale unconformity, which cannot be recognized biostratigraphically.

Rauserites rossicus zone

This zone corresponds to units 1-3 and to the lower portion of unit 4 of member 7 in sections 1006 and 1007 of the Kalaikuhna valley and to the lower portion of member 7 in the Safetgyr section. The fusulinid assemblage in this zone is quite different from the assemblage of the *Schwageriniformis fusiformis-Schw. pamiricus* zone and is composed of numerous *Rauserites* with *Rauserites rossicus* (Schellwien), *Rauserites henbesti* (Igo), *Rauserites jucundus* sp. nov., *Rauserites triangulus orientalis* subsp. nov. being the most characteristic species. In this zone in Darvaz, *Rauserites* have a relatively thin spirotheca with poorly developed (or poorly visible) keriotheca, which usually becomes obvious only in two-three outer volutions. The spirotheca of some species, for example *Rauserites henbesti* (Igo), includes a discontinuous outer tectorium, as noted by Igo (1957) in his original description of the species.

The strong difference between the assemblage of the *Rauserites rossicus* zone and that of the underlying beds suggests the existence of an unconformity at the base of the *Rauserites rossicus* zone, which is also indicated by the erosional surface between members 6 and 7 in the Kalaikuhna section (see description of the section). *Rugosofusulina, Darvasoschwagerina, Daixina, Jigulites, Shagonella,* and *Biwaella*, genera characteristic of the lower Gzhelian appear in the upper part of member 7. Numerous more advanced *Rauserites* with thick well-developed keriotheca were found in cherty-carbonatic beds of member 8. Most of them belong to new species closely related to the species characteristic of the *Rauserites stuckenbergi* zone of the Gzhelian of the East-European Platform.

Correlation between sections and age definition of the described subdivisions.

The sections studied in the Darvaz region are located within a short distance from one another and therefore both lithological and biostratigraphic correlations between sections were possible. One of the best units for local correlation is the horizon of quartz sandstone and gravel-sized conglomerates of member 6. On the contrary, correlation of the sections studied with the Upper Carboniferous of the type region of East-European Platform facies is more problematic. The first problem is the provincialism of the Darvaz fusulinids both at the species and genus level. For example, in the upper Kasimovian of Darvaz and other regions of Central Asia (Gissar, Fergana) the predominant fauna consists of abundant *Schwageriniformis*, which are very rare in this interval in the sections of the East-European Platform. Very characteristic and specific to the fauna of Darvaz are *Ferganites, Schwageriniformis (Tumefactus)* and *Kushanella*. These genera were never found up to now in the type sections of the Kasimovian and Gzhelian in the Moscow Basin. Even higher provincialism was noticed at the species level. In general, the species from the sections of the East-European Platform differ from those of the same genera of Darvaz having larger shells, more massive chomata, and a thicker wall with better defined structure.

For these reasons, the identification of East-European species in the Darvaz material is difficult and made the description of a large number of new species necessary. Moreover, some forms, which were referred to well known species of the East-European Platform still show some minor differences from the typical ones.

The other cause, which makes correlation difficult, is the poor fusulinid content and definition of the Kasimovian and its boundaries in the type sections in the Moscow Basin. The Kasimovian in the Moscow Basin is represented by alternating carbonatic and siliciclastic sediments with sharp contacts. A series of obvious and hidden unconformities indicates abrupt changes in environments, with loss of time in the sedimentary record. All these factors are strongly reflected in the distribution of fusulinids and bias the real picture of fusulinid evolution. A similar sedimentation pattern and several abrupt changes in environments may be observed in the Kasimovian succession in Darvaz. Consequently, it is difficult to achieve high precision when correlating the Kasimovian of Darvaz and other regions in Central

Asia (Bensh 1969, 1972) with the sections in the type area. Because common species in the Kasimovian of Darvaz and the Moscow Basin are rare, our correlation is based mostly on similar tendency in fusulinid evolution, especially on common trends in the development of wall structure.

The lower boundary of the Kasimovian in the type section of the Moscow Basin is established at the base of the «Garnasha» unit of the Suvorovskaya Fm., coinciding with the base of the Krevyakinsky Horizon and the fusulinid zone *Protriticites pseudomontiparus-Obsoletes obsoletus* (Ivanova & Khvorova 1955; Ivanova & Rozovskaya 1967; Rauser-Chernousova & Scherbovich 1974; Alekseev et al. 1995). This fusulinid zone is characterized by the appearance and development of *Obsoletes*. The spirotheca of the representatives of this genus is transitional between the four-layered spirotheca of typical middle Carboniferous *Fusulinella* and the two-layered keriothecal spirotheca of upper Carboniferous *Schwageriniformis* and *Triticites*. The latter appears in the middle Kasimovian *Montiparus montiparus* fusulinid zone.

Protriticites pseudomontiparus-Obsoletes obsoletus zone may be correlated with the Darvaz local zone *Protriticites variabilis-Obsoletes paraovoides*. However, the absence of both *Protriticites pseudomontiparus* and *Obsoletes obsoletus* indexes and the rather modest role of other *Protriticites* species in the fusulinid assemblage of the *Protriticites variabilis-Obsoletes paraovoides* zone makes this correlation somewhat conventional. As was mentioned earlier, the *Protriticites variabilis-Obsoletes paraovoides* zone corresponds only to the uppermost portion of the *Protriticites pseudomontiparus-Obsoletes obsoletus* zone. There is a large unconformity at the base of the Kasimovian in the Darvaz region, and most of the lower Kasimovian is thought to be missing (erosion or non-sedimentation).

The *Montiparus umbonoplicatus-Triticites kurshabensis* and *Schwageriniformis expressus-Protriticites compactus* zones of the Darvaz region may be correlated with the *Montiparus montiparus* zone and the Khamovnichesky Horizon of the middle Kasimovian in the Moscow Basin. All three zones are characterized by numerous *Montiparus* with characteristic three-layered keriothecal spirotheca, the appearance of the first primitive *Triticites* with yet poorly developed keriotheca and also the appearance of the first *Quasifusulina*. In spite of the presence of some common species in the fusulinid assemblages of the Darvaz region, endemic species predominate.

The occurrence of evolute *Montiparus*, such as *M. sinuosus* and some other species, make possible the correlation of the *Montiparus umbonoplicatus-Triticites kurshabensis* zone and *Schwageriniformis expressus-Protriticites compactus* zone of the Darvaz region only with the upper Khamovnichesky Horizon of the Moscow Basin. The equivalent of the lower Khamovnichesky Horizon is absent in Darvaz, due to an unconformity between beds 1 and 2 in the Safetgyr section.

Most important in the assemblages of the *Montiparus umbonoplicatus-Triticites kurshabensis* and *Schwageriniformis expressus-Protriticites compactus* zones of the Darvaz region is the appearance of *Schwageriniformis*, particularly its subgenus *Tumefactus*, and of the very noticeable *Kushanella* genus. The latter is known from the Donets Basin and Pricaspian, but was never found in the Moscow Basin.

There are no sufficient data to correlate the upper Kasimovian of the Moscow Basin (*Rauserites quasiarcticus-R. acutus* zone or Dorogomilivskyi and Yauzskyi Horizons) with equivalent deposits in the Darvaz sections, because they have very few fusulinid species in common. Conventionally, we correlate the *Rauserites quasiarcticus-R. acutus* zone of the Moscow Basin with the local Darvaz zone *Schwageriniformis fusiformis-Schw. pamiricus* (Fig. 4). Although the fusulinid assemblages of the zones under discussion are quite different, probably this correlation is valid, firstly because of the presence in the Darvaz sections of rare *Rauserites* aff. *rugosus* characteristic of upper Kasimovian in the Moscow Basin, and secondly because the stratigraphic position of the *Schwageriniformis fusiformis-Schw. pamiricus* zone in the Darvaz region, located between middle Kasimovian and lower Gzhelian beds, is the same position of the *Rauserites quasiarcticus-R. acutus* zone in the upper Kasimovian of the Moscow Basin.

Some problems arise when trying to define the top of the Kasimovian or the Kasimovian/Gzhelian boundary in the Darvaz sections. In the type area of the Moscow Basin, the Kasimovian/Gzhelian boundary is defined at the base of the *Rauserites rossicus-R. paraarcticus* (*Rauserites rossicus-R. stuckenbergi*) fusulinid zone (Ivanova & Rozovskaya 1967; Kagramanov & Donakova 1990). This boundary in Darvaz is likely to be coeval to the base of the local *Rauserites rossicus* zone. However, careful analyses of fusulinid distribution in the Moscow Basin indicate that the simultaneous appearance of *Rauserites rossicus* in the Moscow Basin and in the Darvaz region is uncertain. In the Moscow Basin, *Rauserites rossicus* first occurs in the Rusavkinsky Formation of the basal Gzhelian (Fig. 4). In the underlaying Troshkovsky Formation (upper Kasimovian) no fusulinids were found because this formation consists of clays, unsuitable for fusulinids. However, we cannot exclude that in the time when the Troshkovsky beds were formed, *Rauserites rossicus* was present in environments favourable to fusulinids. This possibility is suggested by data from Samarskaya Luka, where Rozovskaya (1958) reported the occurrence of *Rauserites rossicus* from upper Kasimovian beds. However, Rozovskaya reported the occurrence of typical early Gzhelian fusulinids in deposits she considers as upper Kasimovian (*Rauserites paraarcticus*, *R. stuckenbergi*, *Jigulites proculomensis*,

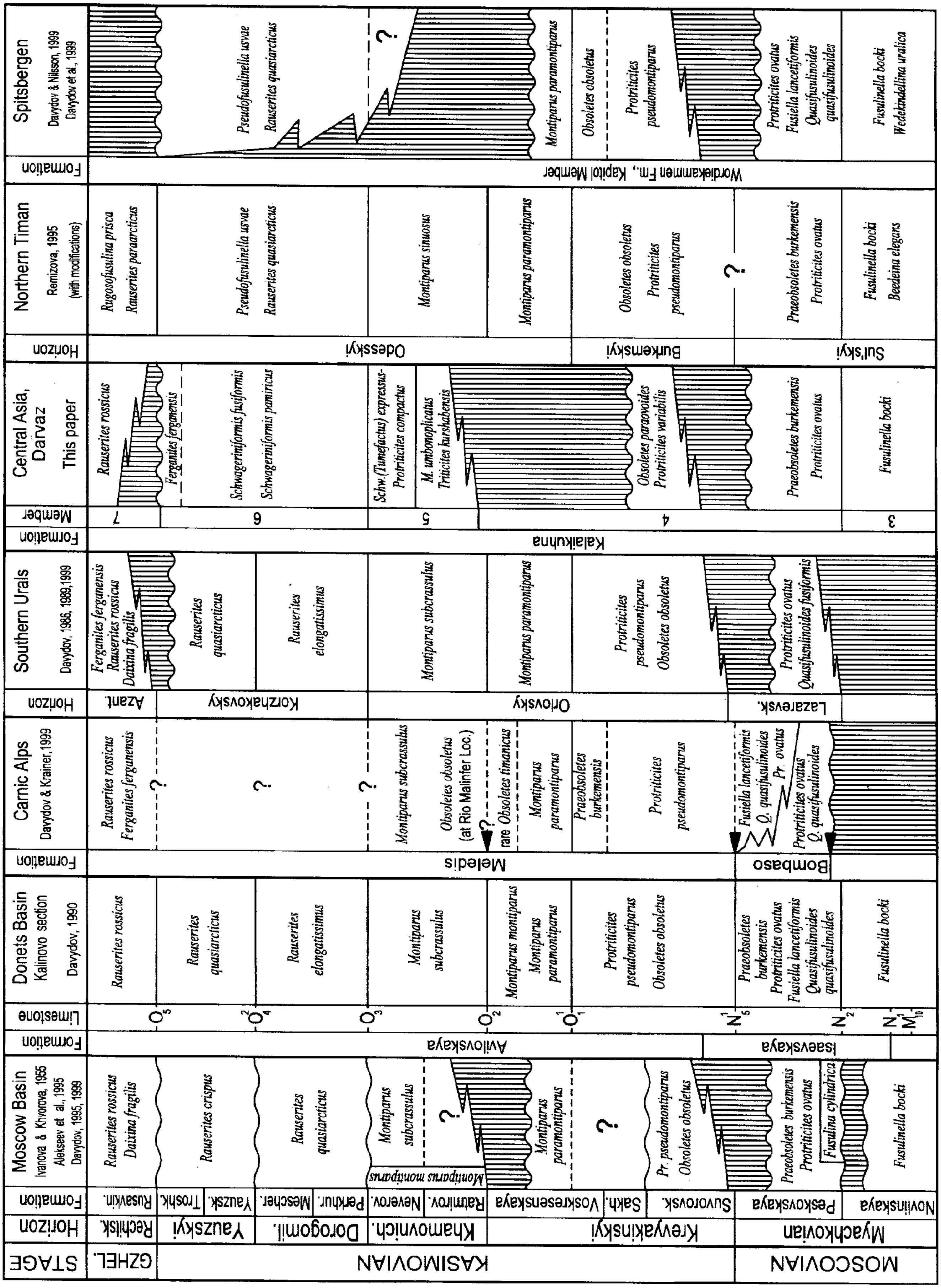


Fig. 4 - Correlation chart of measured stratigraphic sections.

Daixina crispa etc.) and therefore the "upper Kasimovian" in Samarskaya Luka most probably includes both upper Kasimovian and lower Gzhelian.

In the Darvaz sections, *Rauserites rossicus* occurs suddenly, as it happens in the Moscow Basin. It is possible that such sudden occurrence in both regions is the result of a brief hiatus. Therefore, our correlation of the local *Rauserites rossicus* fusulinid zone of Darvaz with the base of the Gzhelian is conventional.

Conclusions.

1. The succession of Kasimovian and lower Gzhelian in the Darvaz region is one of the best shallow carbonate successions in the western Tethys and surrounding areas. The sections described are relatively complete and contain well preserved, abundant and diverse fusulinids and other fossils. This succession is very significant because it is part of a predominantly carbonatic, excellently exposed marine succession, continuous from the Moscovian (Middle Carboniferous) to the top of the Cisuralian (Lower Permian). This succession definitely deserves additional and more detailed investigation, particularly addressing its sedimentology.

2. Kasimovian fusulinid assemblages in the Darvaz region are significantly different from those in the Eastern-European Platform, which makes the correlation between the two regions somewhat difficult. However, the evolutionary trend during the Moscovian-Kasimovian-early Gzhelian time, specifically the development of *Fusullinella* into *Protriticites* and *Obsoletes*, then to *Montiparus* and *Triticites* and next from *Montiparus* to *Rauserites* in the Darvaz region is the same as in classical sections of the Moscow Basin. A thorough study of Kasimovian fusulinids in Darvaz showed that differences in fusulinid distribution in Darvaz and other sections in Central Asia as compared with the Eastern-European Platform are more significant than previously thought (Bensh 1969, 1972; Leven & Scherbovich 1978; Davydov 1984). Therefore, a local fusulinid zonation is suggested in order to highlight the provincialism of the fusulinid distribution in Darvaz.

3. Fusulinid assemblages of Kasimovian and lower Gzhelian age in the Darvaz region contain elements of both classical sections of the East-European Platform and species and genera only known in the Tethys. Therefore, the Darvaz section has a particular significance in the correlation between East-European Platform and Tethys.

4. Fusulinid assemblages at both the base and the top of the Kasimovian in Darvaz change sharply, suggesting the presence of undetectable unconformities which did not leave any significant lithological signature. Consequently, a detailed sedimentological analysis of the Moscovian-Gzhelian sequence in Darvaz is necessary.

Paleontological Appendix
Descriptions of fusulinids

Superorder **Fusulinoida** Fursenko, 1958
Order **Staffellida** A. Miklukho-Maclay, 1949
Family Staffellidae A. Miklukho-Maclay, 1949
Parastaffelloides Reitlinger, 1963
Parastaffelloides pseudosphaeroidea (Dutkevich, 1934)
Pl. 1, fig. 4

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

Material. 1 axial and 2 oblique sections.
Distribution and age. East European Platform, Greenland, Spitsbergen, Spain, Italy, Hungary, Turkey, Middle Asia, China, Indochina, Japan; Middle Carboniferous-Lower Permian.
Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 4, sample 93.

Palaeostaffella Liem, 1966
Palaeostaffella moelleri (Ozawa, 1925)
Pl. 1, fig. 2, 3

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

Material. 2 axial sections.
Distribution and age. Japan, Viet Nam, East European Platform, Greenland, Spitsbergen, Spain, Italy, Slovenia, Darvaz, China; Middle Carboniferous-Lower Permian.
Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71.

Palaeostaffella mochaensis (van Ginkel, 1965)
Pl. 1, fig. 1

1965 *Staffella mochaensis* van Ginkel, p. 17-18, pl. 7, figs. 1-7; pl. 8, figs. 1-9, pl. 9, fig. 1.

Material. 1 subaxial section.
Distribution and age. Spain, Darvaz; Upper Carboniferous, Kasimovian.
Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-4.

Order **Ozawainellida** Solovieva, 1980
Family Ozawainellidae Thompson et Foster, 1937
Subfamily Ozawainellinae Thompson et Foster, 1937
Ozawainella Thompson,1935
Ozawainella cf. **angulata** (Colani, 1924)
Pl. 1, fig. 5, 6

Material. 4 tangential and oblique sections.
Distribution and age. East European Platform, many regions of Tethys from Croatia to Viet Nam; from Moscovian of Middle Carboniferous to Asselian of Lower Permian.
Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 70 and 71.

Order **Schubertellida** Skinner, 1931

Family Schubertellidae Skinner, 1931

Eoschubertella Thompson, 1937

Eoschubertella sphaerica staffelloides (Suleimanov, 1949)

Pl. 1, fig. 7

1949 *Schubertella sphaerica* var. *staffelloides* Suleimanov, p. 28, pl. 1, figs. 2, 2a.

Material. 1 axial section.

Distribution and age. East European Platform, China, Darvaz; from Upper Carboniferous to Lower Permian (Sakmarian)

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 70.

Eoschubertella lata (Lee & Chen, 1930)

Pl. 1, fig. 10, 11

1930 *Schubertella lata* Lee & Chen in Lee et al., p.111, pl. 6, fig. 9-11

Material. 8 axial sections.

Distribution and age. China, Darvaz; from Middle Carboniferous, Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalikuhna Formation, member 5, unit 2 (sample 71), unit 5 (sample 77) and member 6, unit 1 (sample 83).

Eoschubertella procera (Rauser, 1951)

Pl. 1, fig. 13, 14

1951 *Schubertella obscura* var. *procera* Rauser in Rauser-Chernousova et al., p. 73-74, pl. 2, fig. 27, 28.

Material. 10 axial sections.

Distribution and age. East European Platform, Donets Basin, Viet Nam, Turkey, Serbia, Darvaz; from Middle Carboniferous, Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1 (sample 67), unit 2 (samples 69 and 71), and unit 5 (sample 77).

Schubertella Staff et Wedekind, 1910

Schubertella galinae Safonova, 1951

Pl. 1, fig. 8

1951 *Schubertella galinae* Safonova in Rauser-Chernousova et al., p. 81-82, pl. 3, figs.15-16.

Material. 1 axial section.

Distribution and age. East European Platform, Darvaz, China, Viet Nam; from Middle Carboniferous, Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 5, sample 77.

Schubertella mjachkovensis Rauser, 1951

Pl. 1, fig. 9

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

Material. 1 axial section.

Distribution and age. East European Platform, Darvaz; from Middle Carboniferous, Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 5, sample 77.

Schubertella elliptica Putrja, 1956

Pl. 1, fig. 12

1956 *Schubertella elliptica* Putrja, p. 411, pl. 6, fig. 10.

Material. 4 axial sections.

Distribution and age. Donets Basin, Urals, Darvaz; from Middle Carboniferous, Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample14-4; Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67; member 6, unit 2, sample 85.

Fusiella Lee & Chen, 1930

Fusiella typica Lee & Chen, 1930

Pl. 1, figs. 15-17

1930 *Fusiella typica* Lee & Chen in Lee et al., p. 107-108, pl. 6, figs. 1-6.

Material. 3 axial and several tangential sections.

Distribution and age. China, Middle Asia, Japan, Donets Basin, Urals, Viet Nam, Greenland, Spitsbergen, Spain, Serbia, East European Platform; from Middle Carboniferous, Upper Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Kalaikuhna, section 1006; Kalaikuhna Formation, member 5, unit 1, sample 14-4; Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1 (sample 67), and unit 2 (sample 71).

Fusiella lancetiformis Putrja, 1939

Pl. 1, fig. 18

1939 *Fusiella lancetiformis* Putrja, p. 110-112, pl. 1, figs. 2-6.

Material. 7 tangential sections.

Distribution and age. Donets Basin, East European Platform, Urals, Greenland, Spitsbergen, Spain, Middle Asia; from Middle Carboniferous, Upper Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 70.

Fusiella segyrdashtiensis Davydov n. sp.

Pl. 1, fig. 19, 20

1997 *Fusiella* Davydov, pl. 1, fig. 5 (nomen nudum).

Nomenclatural note. The name *F. segyrdashtiensis* was used the first time by Davydov (1982) in his doctoral thesis. Later, Davydov (1997) still used this name for some specimens of the Moscow basin, without any description and designation of types. Therefore this name should be considered up to now as a *nomen nudum*.

Holotype. CGM 179a/12678. Darvaz, Vozgina, section D-157, Kalaikuhna Formation, bed 33; Upper Carboniferous, Kasimovian, zone *Montiparus umbonoplicatus* - *T. kurshabensis*.

Material. 6 axial and 10 subaxial sections.

Description. Shell rather large, subrhombical, with sharply pointed poles. Coil is tight and regularly screws troughout the shell. The first to first and half volutions have a short axis of coiling disposed at 90° angle to that of the outer volutions. Mature specimens of 7-8 volutions possess an average of 1.9 to 2.85 mm in length and 0.55 to 0.9 mm in diameter; form ratios 3.1 to 4.1. Spirotheca composed of thin dense tectum and structureless light primatheca. Thickness of spirotheca 0.01-0.02 mm. Septa in all volutions are straigh. Axial fillings massive, particularly in first 4 volutions. Proloculus is minute, subsphaerical with outside diameter of about 0.04 to 0.07 mm. Tunnel low and rather narrow. Chomata small and asymmetrical occur throughout the all volutions.

Discussion. *Fusiella segyrdashtiensis* differs from the all known species of *Fusiella* by large, eight volutions test. From closest species *F. lancetiformis* Putrja, 1939 it is differs by larger test and greater number of volutions and by subrhombical test outline. *F. segyrdashtiensis* is similar to *Kwantoella fujimotoi* Sakagami & Omata, 1957, but differs in coiling of first 1or 2 volutions at large angle to outer fusiform volutions. Besides, *F. sagyrdashtiensis* has straigh septa; septa of *K. fujimotoi* slightly fluted in polar regions.

Occurrence and age. Vozgina, section 157, Kalaikuhna Formation, member 5; Moscow Basin, Domodedovo section, bed 21a (Davydov, 1997), Uppermost Moscovian-middle Kasimovian.

Order **Fusulinida** Fursenko, 1958

Family Fusulinidae Moeller, 1878

Subfamily Fusulininae Moeller, 1878

Quasifusulinoides Rauser et Rozovskaya in Rauser-Chernousova & Fursenko, 1959

Quasifusulinoides fusulinoides (Putrja, 1940)

Pl. 1, figs. 21, 22

1940 *Pseudotriticites fusulinoides* Putrja, p. 62-64, pl. 3, figs. 12-13; pl. 4, figs. 1-3.

Material. 5 axial sections.

Distribution and age. Urals, Donets Basin, East European Platform, Middle Asia; from Middle Carboniferous, uppermost Moscovian to Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-1.

Quasifusulinoides juvenatus Kireeva, 1963

Pl. 1, fig. 26

1963 *Quasifusulinoides juvenatus* Kireeva in Bogush, p. 119-120, pl. 11, figs. 3, 7.

Material. 1 axial and several tangential sections.

Distribution and age. Ferghana, Darvaz; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 71.

PLATE 1

Fig. 1 - *Palaeostaffella mochaensis* (van Ginkel). x 20. Subaxial section, CGM 1a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 2, 3 - *Palaeostaffella moelleri* (Ozawa). x 20. Axial sections, CGM 2a/12678 and CGM 3a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *Sch. expressus - P. compactus.*

Fig. 4 - *Parastaffelloides pseudosphaeroidea* (Dutkevich). x 20. Axial section CGM 4a/12678. Section D-172, Kalaikuhna Formation, member 6, unit 4, zone *Sch.fusiformis - Sch. pamiricus.*

Fig. 5, 6 - *Ozawainella* cf. *angulata* (Colani). x 50. Tangential sections CGM 5a/12678 and CGM 6a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 7 - *Eoschubertella sphaerica staffelloides* (Suleimanov). x 50. Axial section CGM7a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 8 - *Schubertella galinae* Safonova. x 50. Axial section CGM 8a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

Fig. 9 - *Schubertella mjachkovensis* Rauser. x 50. Axial section CGM 9a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

Fig. 10, 11 - *Eoschubertella lata* (Lee et Chen). x 50. 10) Axial section CGM 10a/12678. 11) Subaxial section CGM 11a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 12 - *Schubertella elliptica* Putrja. x 50. Axial section CGM 12a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 13, 14 - *Eoschubertella procera* (Rauser). x 50. Axial sections CGM 13a/12678 and CGM 14a/12678. Section D-172, Kalaikuhna Formation, member 5,unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 15-17 - *Fusiella typica* Lee et Chen. x 40. 15, 16) Axial sections CGM 15a/12678 and CGM 16a/12678. Section 1006, member 5, unit 1, zone *Sch. expressus -P. compactus.* 17) Axial section CGM 17a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.*

Fig. 18 - *Fusiella lancetiformis* Putrja. x 40. Tangential section CGM 18a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

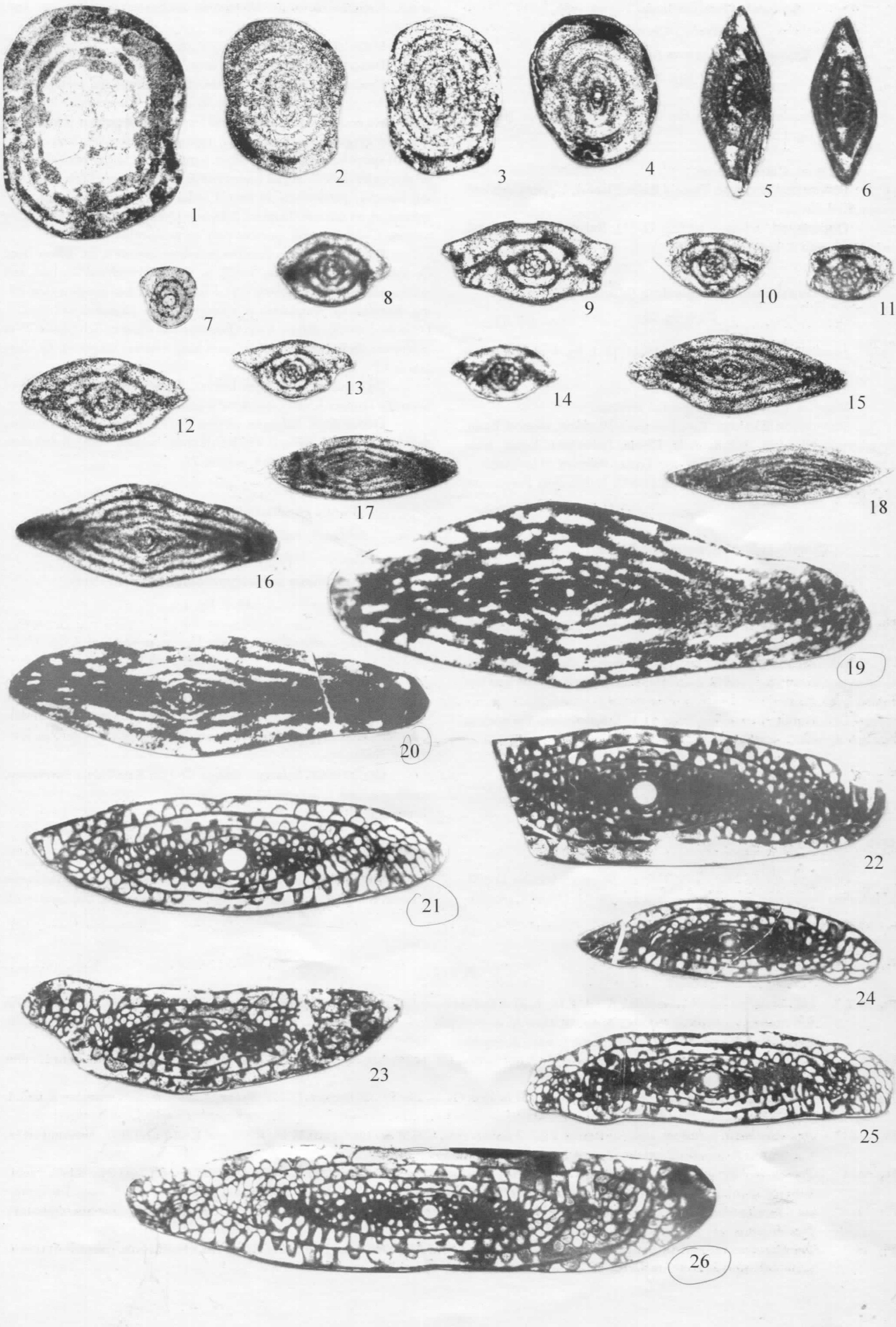
Fig. 19, 20 - *Fusiella segyrdashtiensis* Davydov n. sp. x 40. 19) Subaxial section CGM 180a/12678; 20) Axial section of the holotype CGM 179a/12678. Vozgina, section D-157, Kalaikuhna Formation, member 5, zone *Montiparus umbonoplicatus-Triticites kurshabensis.*

Fig. 21, 22 - *Quasifusulinoides fusulinoides* (Putrja). x 15. Axial sections CGM 19a/12678 and CGM 20a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 23, 24 - *Quasifusulina brevis* Brazhnikova. x 15. Axial sections CGM 21a/12678 and CGM 22a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 25 - *Quasifusulina longissima* (Moeller). x 15. Axial section CGM 23a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 26 - *Quasifusulinoides juvenatus* Kireeva. x 15. Axial section of the holotype CGM 24a/12678. Section D-172, Kalaikuhna Formation, memder 5, unit 2, zone *umbonoplicatus - T. kurshabensis.*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Subfamily Quasifusilininae Putrja, 1956

Quasifusulina Chen, 1934

Quasifusulina brevis Brazhnikova, 1939

Pl. 1, figs. 23, 24

1939 *Quasifusulina longissima* var. *brevis* Brazhnikova, p. 263-264, pl. 4, fig. 1 and 1a.

Material. 6 axial sections.

Distribution and age. Donets Basin, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 69 and 70.

Quasifusulina longissima (Moeller, 1878)

Pl. 1, fig. 25

1878 *Fusulina longissima* Moeller, p. 59-61, pl. 1, fig. 4; pl. 2, figs.1 a-c; pl. 8, figs. 1 a-c.

Material. 1 axial and 2 tangential sections.

Distribution and age. East European Platform, Donets Basin, Spitsbergen, Slovenia, Middle Asia, China, Indochina, Japan; from Upper Carboniferous (Kasimovian) to Lower Permian (Asselian).

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 69.

Quasifusulina aff. **popensis** Thompson, 1965

Pl. 2, fig. 3

Material. 1 axial section.

Distribution and age. British Columbia (Canada), Darvaz; Upper Carboniferous.

Discussion. Described specimen differs from typical *Quasifusulina popensis* Thompson in thinner spirotheca and thinner and less folded septa.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 3, sample 73.

Quasifusulina pseudotenuissima n. sp.

Pl. 2, figs. 1, 2, 5

1940 *Quasifusulina tenuissima* Putrja, p. 71-72, pl. 5, fig. 6.

Holotype. CGM 25a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 3, sample 73; Upper Carboniferous, Kasimovian, zone *Montiparus umbonoplicatus-Triticites kurshabensis*.

Material. 4 axial and 1 subaxial sections.

Description. Shell rather large, subcylindrical, with bluntly rounded poles. Mature specimens about 6 volutions and average 8 to 9 mm in length and 2.3 to 2.6 mm in diameter; form ratio 3.5 to 4. Spirotheca composed of tectum and fine-textured porous primatheca; thin and irregular inner tectorium appears in inner volutions. Thickness of spirotheca 0.056 mm. Septa strongly and rather regularly fluted throughout shell. Septal folds rounded and not very high. Axial filling massive, particularly in first 4 volutions. Proloculus large, subsphaerical; its outside diameter 0.35 to 0.37 mm. Tunnel low and rather narrow. Chomata weak, present only on proloculus.

Discussion. *Quasifusulina pseudotenuissima* n. sp. differs from *Q. tenuissima* (Schellwien, 1898) in its subcylindrical outline, less intensively and less regularly septal fluting, and less massive axial filling. Besides, *Q. tenuissima* is younger in age (Asselian-Sakmarian). Described species differs from *Quasifusulina elongata* Schlykova, 1948 in shorter shell which is 3.5-4.0 mm long whereas length of *Q. elongata* is 4.7-6.2 mm.

Distribution and age. Darvaz, Donets Basin, right bank of Seversky Donets River, Limestone 6 under O4;

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 3, sample 73; Kalaikuhna, section 1006, Kalaikuhna Formation, member 7, unit 1, sample 21.

Family Fusulinellidae Staff et Wedekind, 1910

Subfamily Fusulinellinae Staff et Wedekind, 1910

Fusulinella Moeller, 1878

Fusulinella schwagerinoides (Deprat, 1913)

Pl. 2, fig. 4

1913 *Neofusulinella schwagerinoides* Deprat, p. 42-44, pl. 7, figs. 17-20.

Material. 2 axial sections.

Distribution and age. East European Platform, Donets Basin, Spain, Hungary, Middle Asia, China, Indochina, Japan; mostly Middle Carboniferous, Upper Moscovian, rarely Upper Carboniferous, lowermost Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67.

Protriticites Putrja, 1948

Discussion. In original diagnosis the main feature of the genus is structure of spirotheca: four layered with tectum, diaphanotheca,

PLATE 2

Fig. 1, 2, 5 - *Quasifusulina pseudotenuissima* n. sp. x 15. 1, 2) Axial sections CGM 25a/12678 (holotype) and CGM 26a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 3, zone *M. umbonoplicatus - T. kurshabensis*. 5) Axial section CGM 27a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 1, zone *R. rossicus*.

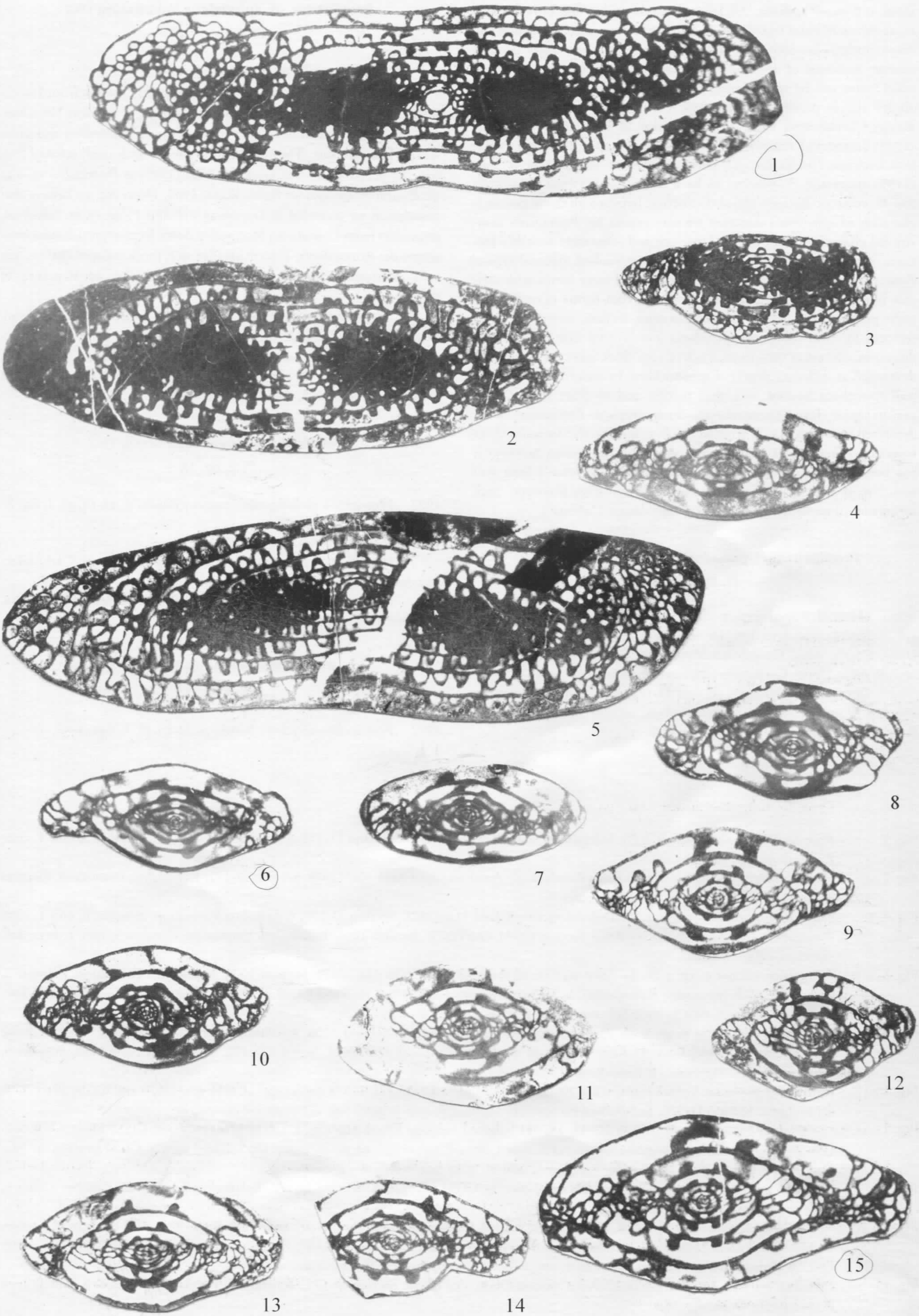
Fig. 3 - *Quasifusulina* aff. *popensis* Thompson. x 15. Axial section CGM 28a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 3, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 4 - *Fusulinella schwagerinoides* (Deprat). x 20. Axial section CGM 29a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides*.

Fig. 6-8 - *Protriticites* aff. *pseudomontiparus* Putrja. x 20. Axial sections CGM 8a/12678, CGM 30/12678 and CGM 31/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus*.

Fig. 9-14 - *Protriticites* aff. *sphaericus* Volozhanina. x 20. 9-11) Axial sections CGM 32a/12678, CGM 33a/12678 and CGM 34a/12678. 12-14) Subaxial sections CGM 35a/12678 and CGM 36a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus*. 14) Axial section CGM 37a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus*.

Fig. 15 - *Protriticites turkestanicus* Bensh. x 15. Subaxial section CGM 38a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus*.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inner and outer tectoria. All layers penetrated by fine pores, which more coarse in inner tectorium. In outer volutions inner tectorium and diaphanotheca become joint and pores there simultaneously become coarser. Structure of spirotheca in outermost volution of most developed forms can be two layered; however pores in the spirotheca are always simple parallel (Putrja 1948; Chen 1963; Rozovskaya 1975; Rauser-Chernousova et al. 1996; Davydov & Krainer 1999). Putrja (1948) considered *Protriticites* as transitional step in fusulinid evolution between *Fusulinella* and *Triticites* whereas Van Ginkel & Villa (1999) suggested *Protriticites* to be a transition between *Fusulinella* and *Montiparus*. Because major distinction between all these genera is character of spirotheca structure we may expect for *Protriticites* transitional character of spirotheca structure and somewhat unstable features of that spirotheca. Indeed, we found in studied material typical *Protriticites* with four-layered wall structure and some forms with variable in ontogenesis structure of spirotheca. That forms in early volutions possess three layered spirotheca with tectum, inner and outer tectoria. In outer volutions spirotheca four-layered with tectum, thin discontinuous outer tectorium, thick to very thick inner tectorium and developed at different degree diaphanotheca. In outermost volutions wall spirotheca layered with thin tectum and medium in thickness porous inner layer (primatheca). Such atypical *Protriticites* were described by Bensh (1972) from South Fergana. We also includes these forms into *Protriticites* as they most similar to this genus, however it has been done at certain degree conventionally. In case where wall structure of some of the forms was too different from holotype such forms identified with sign of open nomenclature ("*affinis*").

Protriticites aff. **pseudomontiparus** Putrja, 1948

Pl. 2, figs. 6-8

Material. 3 axial sections.

Distribution and age. Donets Basin, East European Platform, Urals, Carnic Alps, Cantabrian Mountains, Spitsbergen, Greenland, Middle Asia; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 5, sample 77; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-2.

Protriticites aff. **sphaericus** Volozhanina, 1962

Pl. 2, figs. 9-14

Material. 4 axial and 3 subaxial sections.

Discussion. Described specimens of this species from Darvaz differ from typical representatives of *Protriticites sphaericus* Volozhanina, 1962 from Timan in smaller proloculus, tighter coiling and often less globular outline. They likely quite similar with small inflated *Protriticites* described by Van Ginkel & Villa (1999) as *Protriticites* sp. 6 ex gr. *P. subschwagerinoides* Rozovskaya, 1950. However, we believe that population we recorded in Darvaz as well this *P.* sp. ex gr. *subschwagerinoides* from Cantabrian Mountains differ from typical *P. subschwagerinoides* Rozovskaya, 1950 in smaller size, more inflated outline, less well developed chomata and different character of structure of spirotheca.

Distribution and age. Timan, Urals, Spitsbergen, Greenland, Darvaz; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section 172, Kalaikuhna Formation, member 5, unit 5, sample 77; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-2

Protriticites turkestanicus Bensh, 1972

Pl. 2, fig. 15

1972 *Protriticites globulus turkestanicus* Bensh, p. 18-19, pl. 1, fig. 7

Material. 1 subaxial section.

Distribution and age. Ferghana, Darvaz; Upper Carboniferous, lower Kasimovian.

Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-2.

Protriticites variabilis Bensh, 1972

Pl. 3, fig. 1

1972 *Protriticites variabilis* Bensh, p. 22-23, pl. 1, figs. 1-4.

PLATE 3

Fig. 1 - *Protriticites variabilis* Bensh. x 20. Subaxial section CGM 39a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.*

Fig. 2 - *Protriticites subschwagerinoides inflatus* Bensh. x 20. Axial section CGM 40a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis -O. paraovoides.*

Fig. 3, 4 - *Protriticites plicatus* Kireeva. x 20. 3) Axial section CGM 41a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.* 4) Axial section CGM 42a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 5, 6, 9 - *Protriticites putrjai* n. sp. x 20. 5) Axial section of the holotype CGM 43a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus*. 6, 9) Axial sections CGM 44a/12678 and CGM 45a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

Fig. 7, 8 - *Protriticites compactus* n. sp. x 20. 7) Axial section CGM 46a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.* 8) Axial section of the holotype CGM 47a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

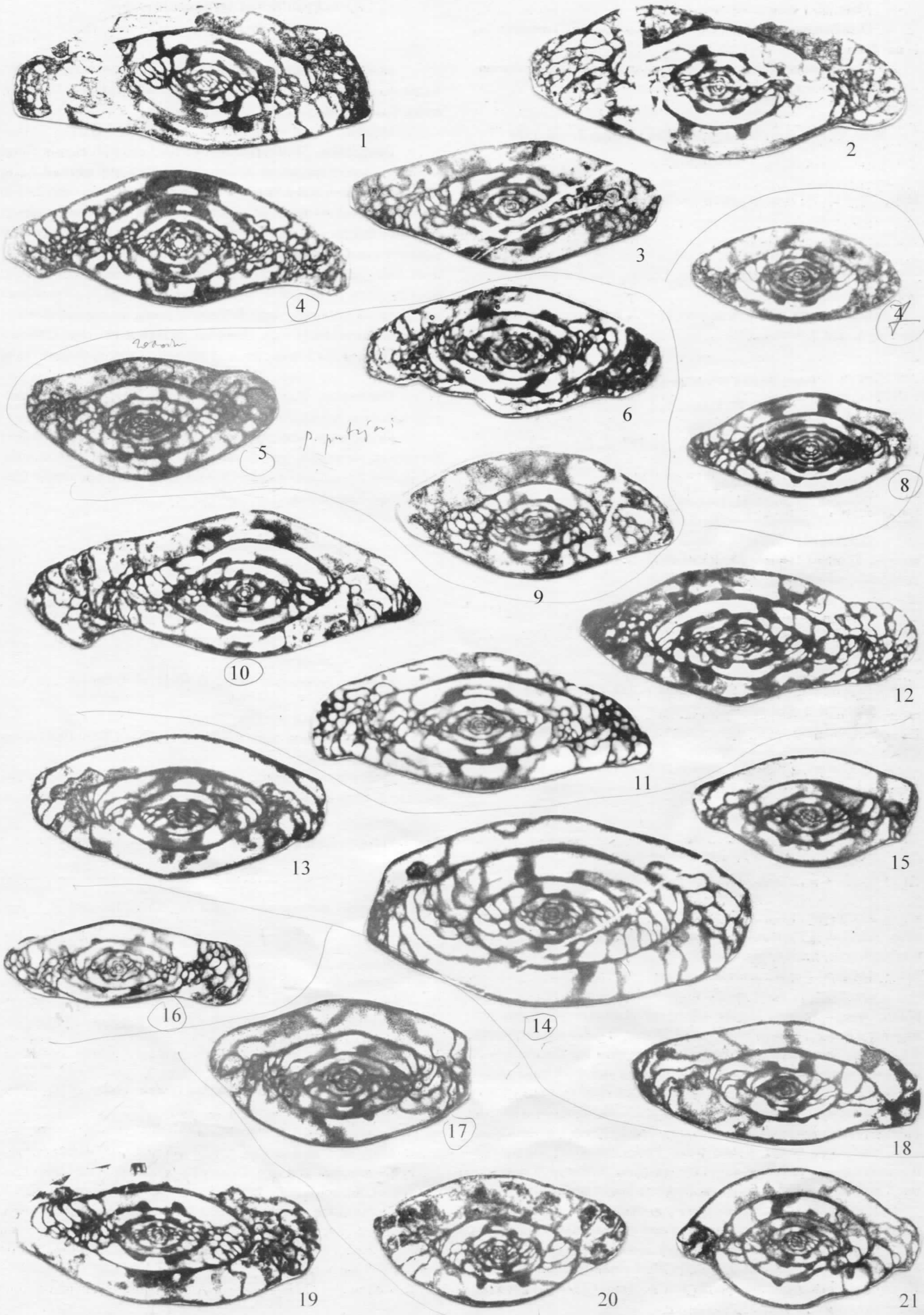
Fig. 10-12 - *Protriticites formosus* Volozhanina. x 20. 10-12) Axial sections CGM 48a/12678 (~~holotype~~), CGM 49a/12678 and CGM 50a/12678, accordingly. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

Fig. 13-15, 18 - *Obsoletes paraovoides* Bensh. x 20. 13, 14, 18) Subaxial sections CGM 51a/12678, CGM 52a/12678 and CGM 53a/126778. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.* 15) Subaxial section CGM 54a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

Fig. 16 - *Obsoletes minutus asiaticus* Bogush. x 20. Axial section CGM 55a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.*

Fig. 17, 20, 21 - *Obsoletes darvasicus* n. sp. x 20. 17, 20) Axial section CGM 56a/12678 (holotype) and subaxial section CGM 53a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.* 21) Subaxial secton CGM 57a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 5, zone *Sch. expressus - P. compactus.*

Fig. 19 - *Obsoletes* aff. *ovoides* (Putrja). x 20. Axial section CGM 58a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 1, zone *P. variabilis - O. paraovoides.*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Material. 1 subaxial section.

Distribution and age. Fergana, Darvaz; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67.

Protriticites subschwagerinoides inflatus Bensh, 1972

Pl. 3, fig. 2

1972 *Protriticites subschwagerinoides inflatus* Bensh, p. 21-22, pl. 3, figs. 2-3.

Material. 1 axial section.

Distribution and age. Fergana, Darvaz; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67.

Protriticites plicatus Kireeva , 1950

Pl. 3, figs. 3, 4

1950 *Protriticites plicatus* Kireeva, p. 196-197, pl. 1, figs. 2-3.

Material. 2 axial sections.

Distribution and age. Donets Basin, East European Platform, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-2.

Protriticites formosus Volozhanina, 1962

Pl. 3, figs. 10-12

1962 *Protriticites formosus* Volozhanina, p. 128-129, pl. 2, fig. 4.

Material. 3 axial sections.

Distribution and age. East-European Platform, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 5, samples 77 and 79; Upper Carboniferous, Kasimovian.

Protriticites putrjai n. sp.

Pl. 3, figs. 5, 6, 9

Holotype. CGM 43a/12678. Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-2; Upper Carboniferous, Kasimovian.

Material. 3 axial sections.

Description. Shell small, ellipsoidal to short fusiform, with bluntly rounded poles. Mature specimens possess 6 volutions, and measure 2.6 to 2.8 mm in length and 1.25 mm in diameter; form ratio 2.1 to 2.25. Spirotheca composed of tectum, thin and discontinuous outer tectorium, poorly defined diaphanotheca and thick inner tectorium. In outermost volution spirotheca composed of thin tectum and structureless light layer with thin parallel pores. Thickness of spirotheca in the fifth volution 0.04 to 0.05 mm. Septa wavy across middle of shell, moderately fluted toward poles. Proloculus small, its outside diameter 0.056 mm. Tunnel rather narrow about half as high as chamber. Chomata well pronounced, moderate in height and width.

Discussion. *Protriticites putrjai* is similar to *P. ovatus* Putrja, but differs from the latter in its smaller size and less massive chomata.

Occurrence and age. Safetgyf, section D-172, Kalaikuhna Formation, member 5 unit 5, sample 77; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-2; Upper Carboniferous, Kasimovian.

Protriticites compactus n. sp.

Pl. 3, figs. 7, 8

Holotype. CGM 47a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 5 sample 77; Upper Carboniferous, Kasimovian.

Material. 2 axial sections.

Description. Shell small, inflated-fusiform with bluntly pointed poles. Mature specimens possess 6 volutions and measure 2.2 to 2.25 mm in length and 0.95 to 1.0 mm in diameter; form ratio 2.25 to 2.3. Early 4 volutions coiled tightly, following volutions by abrupt expansion into loosely coiled adult stage. Spirotheca in two outer volutions composed of thin tectum and thick, structureless and light inner layer with thin parallel pores. Structure of spirotheca in inner volutions is poorly recognizable. Septa moderately fluted in polar regions and plane across entire shell. Proloculus small, its outside diameter 0.07 mm. Tunnel fairly wide, about half as high as chamber. Chomata low and wide in the juvenarium, and low and narrow in the outermost volution.

Discussion. Described species differs from most of *Protriticites* species in having skewed coiling juvenarium.

Occurrence and age. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 5, sample 77; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-5; Upper Carboniferous, Kasimovian.

Order **Schwagerinida** Solovieva, 1985

Family Triticitidae Davydov in Chuvashev et al., 1986

Obsoletes Kireeva, 1950

Obsoletes paraovoides Bensh, 1972

Pl. 3, figs. 13-15, 18

1972 *Obsoletes paraovoides* Bensh, p. 30-31, pl. 4, fig. 4-6.

Material. 6 axial sections.

Distribution and age. Ferghana, Darvaz; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna formation, member 5, units 1 and 5, samples 67 and 79.

Obsoletes minutus asiaticus Bogush, 1963

Pl. 3, fig. 16

1963 *Obsoletes minutus* var. *asiatica* Bogush, p. 100-101, pl. 9, figs. 3-5.

Material. 2 axial sections.

Distribution and age. Middle Asia; Upper Carboniferous, lower Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67.

Obsoletes aff. **ovoides** (Putrja, 1940)

Pl. 3, fig. 19

Material. 1 axial section.

Distribution and age. Donets Basin, Middle Asia; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1, sample 67.

Obsoletes darvasicus n. sp.

Pl. 3, figs. 17, 20, 21

Holotype. CGM 56a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 1; Upper Carboniferous, Kasimovian.

Material. 4 axial and subaxial sections.

Description. Shell small, inflated fusiform, with bluntly pointed poles. Mature individuals have 5.5 to 6 volutions and measure 2.4 to 2.6 mm in length and 1.3 to 1.4 mm in diameter; form ratio 1.78 to 1.9. Early 4 to 4.5 tightly coiled volutions are followed by abrupt expansion into loosely coiled adult stage. Spirotheca composed of thin dense tectum and inner layer with the thin parallel pores; thickness of spirotheca in final volution is 0.04 to 0.05 mm. Poorly defined and discontinuous diaphanotheca can be recognized in early volutions. Septa thin and nearly plane, except for slight folding near poles. Proloculus very small, its outer diameter is 0.04 to 0.06 mm. Tunnel narrow in the early volutions and wide in the two outer one. Well pronounced, moderate in height and width chomata occur in all but final volution, where chomata completely absent.

Discussion. The described species differs from all known species of *Obsoletes* in specific inflated fusiform outline and loosely coiled two outer volutions.

Occurrence and age. Safetgyr, section D-172, Kalaikuhna Formation, member 5 unit 1, sample 67 (abundant) and unit 5, sample 77 (rare); Upper Carboniferous, Kasimovian.

Schwageriniformis Bensh in Rauser-Chernousova et al, 1996

Remarks. *Schwageriniformis* genus composed of large group of Upper Carboniferous and Asselian fusulinids earlier identified as *Triticites*. From true *Triticites* however this group differs in plane or almost plane septa, small proloculus and tight coiling. *Schwageriniformis* appears in middle Kasimovian as terminal stage in phylogenetic lineage *Fusulinella* - *Obsoletes* (Davydov, 1990). Numerous *Schwageriniformis* species are not homogenous. Very particular group of relatively large inflated, subglobular forms with loose coiling in outer volutions forming around species "*Triticites*" expressus Anosova in Bensh, 1969 can be recognized. The author of the last species based on its specific morphology assumed that it could be described as independent subgenus or even genus (Anosova & Ektova, 1972). We found the idea of Anosova to be true as these subglobular and loosely coiling forms characterized in particular morphology and stratigraphic range (upper Kasimovian). We suggest to divide *Schwageriniformis* genus into two subgenera: *Schwageriniformis* and *Tumefactus* with the type species "*Triticites*" expressus Anosova, in Anosova & Ektova, 1972.

Schwageriniformis (*Schwageriniformis*) Bensh in
Rauser-Chernousova et al., 1996

Schwageriniformis (Schwageriniformis) minor

(Rozovskaya, 1950)

Pl. 4, figs. 1-3

1950 *Triticites (Triticites) schwageriniformis minor* Rozovskaya, p.25, pl. 5, fig. 11, 12.

Material. 7 axial sections.

Distribution and age. Urals, Darvaz; Upper Carboniferous - Lower Permian (Asselian).

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 1, sample 81; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-3.

Schwageriniformis (Schwageriniformis) fusiformis (Bensh, 1972)

Pl. 4, figs. 5, 6

1972 *Triticites fusiformis* Bensh, p. 48, 49, pl. 7, fig. 12; pl. 8, figs. 9-10.

Material. 4 axial sections.

Distribution and age. Ferghana, Darvaz, Donets Basin southern Urals; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 2, samples 87 and 89.

Schwageriniformis (Schwageriniformis) gissaricus compactus

(Bensh, 1969)

Pl. 4, fig. 7

1969 *Triticites gissaricus forma compacta* Bensh, p. 156, pl. 17, figs. 3-5.

Material. 14 axial sections.

Distribution and age. Tadjikistan (South Gissar and Darvaz regions); Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 2, samples 85 and 87.

Schwageriniformis (Schwageriniformis) crebrius

(Alekseeva, 1960)

Pl. 4, figs. 8, 9

1960 *Triticites incantus* var. *crebrius* Alekseeva, p. 178, pl. 9, figs. 1-2.

Material. 2 axial sections.

Distribution and age. East-European Platform, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-5.

Schwageriniformis (Schwageriniformis) baisunensis

(Bensh, 1969)

Pl. 4, figs. 10, 12

1969 *Triticites schwageriniformis baisunensis* Bensh, p.151-152, pl. 16, fig 1, 2.

Material. 2 subaxial sections.

Distribution and age. South Gissar, Darvaz, southern Urals; Upper Carboniferous, Kasimovian.

Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-4; Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 1, sample 81.

Schwageriniformis (Schwageriniformis) nanus

(Rozovskaya, 1950)

Pl. 4, fig. 4

1950 *Triticites (Triticites) schwageriniformis nanus* Rozovskaya, p. 24-25, pl. 5, fig. 9,10.

Material. 1 axial section.

Distribution and age. southern Urals, Darvaz, China; Upper Carboniferous, Kasimovian and lower Gzhelian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 1, sample 83.

Schwageriniformis (Schwageriniformis) parallelos

(Scherbovich, 1969)

Pl. 4, fig. 11

1969 *Triticites schwageriniformis parallelos* Scherbovich, p.9-10, pl. 2, fig. 6-10.

Material. 2 axial sections.

Distribution and age. Precaspian, southern Urals, Donets Basin, Darvaz; Upper Carboniferous.

Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-4.

Schwageriniformis (Schwageriniformis) pamiricus n. sp.

Pl. 4, figs. 13-19

Holotype. CGM 70a/12678. Kalaikuhna, section 1006, Kalaikukna Formation member 5, unit 1, sample 14-4; Upper Carboniferous, Kasimovian.

Material. 15 axial sections.

Description. Shell small, fusiform to elongate ellipsoidal, with slightly convex lateral slopes and pointed or bluntly rounded poles. Mature specimens possess of 6.5 to 7 volutions and measure 2.9 to 4 mm in length and 1.2 to 1.6 mm in diameter; form ratio 2.3 to 2.55. Coiling in two early volutions tight and endothiroidal in succeeding volutions planispiral. Final volution coiled loosely. Spirotheca composed of thin tectum and fine-textured keriotheca. Thickness of spirotheca in final volution 0.05 to 0.06 mm. Septa thin, plane or slightly wavy across middle of shell, becoming slightly folded in extreme polar ends. Proloculus very small; its outside diameter 0.04 to 0.075 mm. Chomata small, but well pronounced, mound shaped, present only in earlu 3.5 to 4 volutions. Tunnel rather wide and low.

Discussion. The described species is very similar to *Schwageriniformis gissaricus* (Bensh) but differs from the latter in its ellipsoidal shell with bluntly rounded poles and a slightly more compact coiled volutions.

Occurrence and age. Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, samples 14-4 and 14-5; member 6, unit 4, sample 19; member 7, unit 1, sample 21; Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 1, sample 83; Upper Carboniferous, Kasimovian - to lowermost Gzhelian.

Schwageriniformis (Tumefactus) n. subgen.

Type species: *Schwageriniformis (Tumefactus) expressus* (Anosova in Bensh, 1969).

Diagnosis. Shell of medium size, inflated fusiform to subglobular. Proloculus minute. Coiling in early 3-4 volutions tight, in succeeding volutions loose to very loose. Spirotheca of medium thickness composed of thin and dense tectum and thick, structureless and light primatheca. The latter in one-two outer volutions replaced by fine keriotheca. Septa almost plane or slightly wavy except for extreme polar ends where septa form narrow interlacing. Often occur phrenotheca. Tunnel low and narrow in early volutions, and wide in succeeding volutions. Small and well pronounced chomata occur only in 3-4 early volutions.

Discussion. New subgenus *Tumefactus* differs from its close relative subgenus *Schwageriniformis* in its inflated or subglobular shell and loose coiling in late volutions.

Occurrence and age. Middle Asia (South Gissar, Fergana, Darvaz), Carnic Alps, Cantabrian Mountains, southern Urals; middle Kasimovian-lower Gzhelian.

Schwageriniformis (Tumefactus) expressus

(Anosova in Bensh, 1969)

Pl. 4, figs. 20-24

1969 *Triticites ? expressus* Anosova in Bensh, p. 157-158, pl. 17, fig. 9; pl. 18, figs. 1-3.

1972 *Triticites expressus* Anosova in Bensh, p. 42-43, pl. 7, figs. 9-10.

Material. 10 axial sections.

Distribution and age. Middle Asia (Ferghana, Gissar, Darvaz), Cantabrian Mountains, Carnic Alps; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5 units 2 and 5, samples 70 and 77; Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, samples 14-3 and 14-4.

PLATE 4

Fig. 1-3 - *Schwageriniformis (Schwageriniformis) minor* (Rozovskaya). x 15. 1, 2) Axial sections CGM 59a/12678 and CGM 60a/12678. Section D-172, Kalaikuhna Formation, member 6, unit 1, zone *Sch. fusiformis - Sch. pamiricus.* 3) Axial section CGM 15a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 4 - *Schwageriniformis (Schwageriniformis) nanus* (Rozovskaya). x 15. Axial section CGM 61a/12678. Section D-172, member 6, unit 1, zone *Sch. fusiformis - Sch. pamiricus.*

Fig. 5, 6 - *Schwageriniformis (Schwageriniformis) fusiformis* (Bensh). x 15. Axial sections CGM 62a/12678 and CGM 63a/12678. Section D-172, Kalaikuhna Formation, member 6, unit 2, zone *Sch. fusiformis - Sch. pamiricus.*

Fig. 7 - *Schwageriniformis (Schwageriniformis) gissaricus compactus* (Bensh). x 15. Axial section CGM 64a/12678. Section D-172, Kalaikuhna Formation, member 6, unit 2, zone *Sch. fusiformis - Sch. pamiricus.*

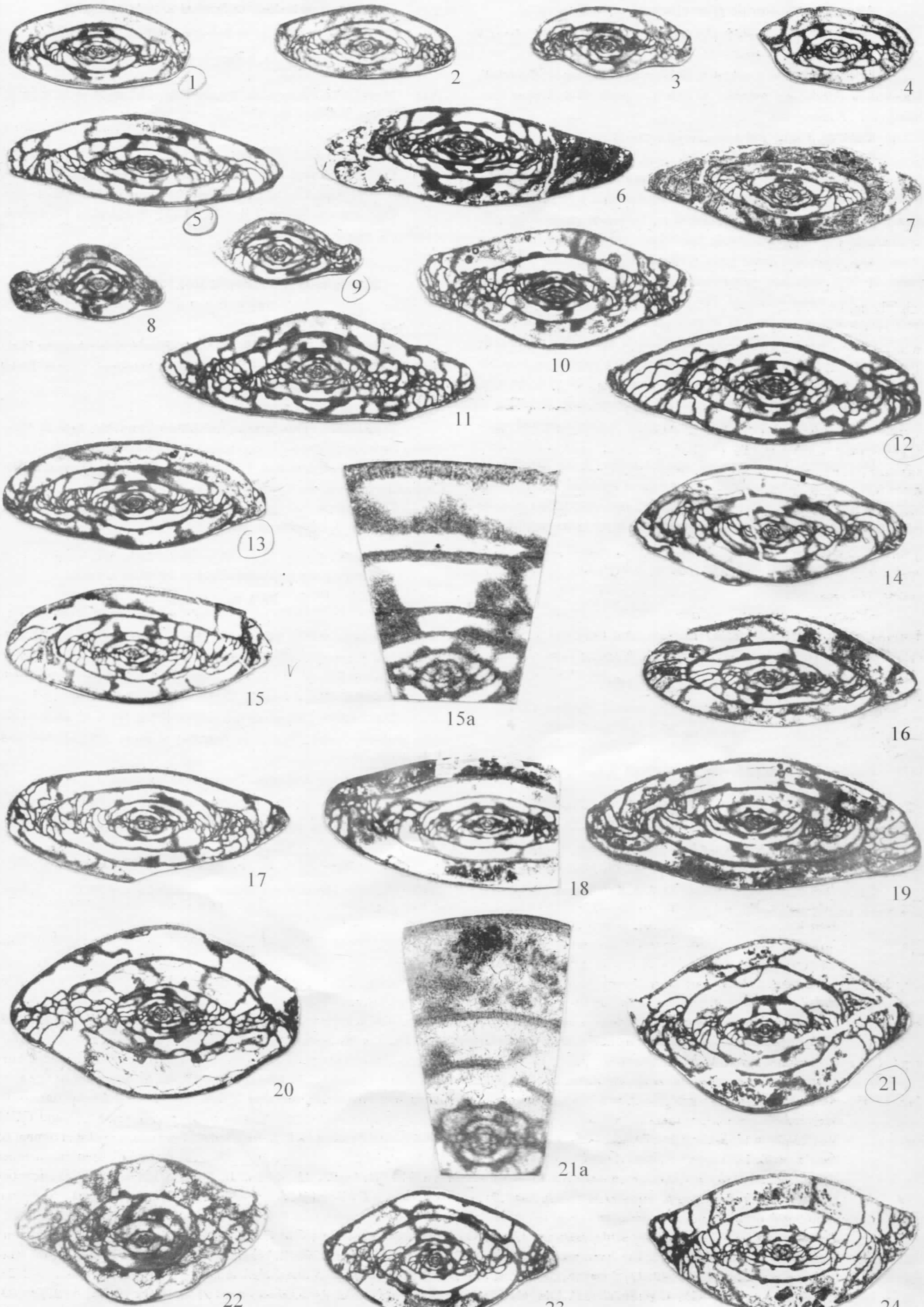
Fig. 8, 9 - *Schwageriniformis (Schwageriniformis) crebrius* (Alekseeva). x 15. Axial sections CGM 65a/12678 and CGM 66a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 10, 12 - *Schwageriniformis (Schwageriniformis) baisunensis* (Bensh). x 15. Axial sections CGM 67a/12678 and CGM 68a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 11 - *Schwageriniformis (Schwageriniformis) parallelos* (Scherbovich). x 15. Axial section CGM 69a/12678. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.*

Fig. 13-19 - *Schwageriniformis (Schwageriniformis) pamiricus* n. sp. 13) Axial section of the holotype CGM 70a/12678. x 15. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.* 14, 15) Axial sections CGM 71a/12678 and CGM 72a/12678. x 15. Section D-172, Kalaikuhna Formation, member 6, unit 1, zone *Sch. fusiformis - Sch. pamiricus.* 15a) Enlargement of fig. 15. x 40. 16, 17) Subaxial sections CGM 73a/12678 and CGM 74a/12678. x 15. Secction 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus.* 18) Axial section CGM 75a/12678. x 15. Section 1006, Kalaikuhna Formation, member 6, unit 4, zone *Schw. fusiformis - Schw. pamiricus.* 19) Axial section CGM 76a/12678. x 15. Section 1006, Kalaikuhna Formation, member 7, unit 1, zone *R. rossicus.* Tumefactus

Fig. 20-24 - *Schwageriniformis* (~~*Schwageriniformis*~~) *expressus* (Anosova). 20) Subaxial section CGM 77a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 5. 21) Axial section CGM 78a/12678. x 15. Section 1006, Kalaikuhna Formation, member 5, unit 1. 21a) Enlargement of fig. 15. x 40. 22) Axial section CGM 79a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 2. 23, 24) Axial sections CGM 12a/12678 and CGM 80a/12678. x 15. Section 1006, Kalaikuhna Formation, member 5, unit 1. 20, 21, 23, and 24 - zone *Sch. expressus - P. compactus*; 22 - zone *M. umbonoplicatus - T. kurshabensis.*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Schwageriniformis (Tumefactus) oblisus n. sp.

Pl. 5, figs. 1-3, 3a

Holotype. CGM 83a/12678. Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 5, unit 1, sample 14-4; Upper Carboniferous, Kasimovian.

Material. 3 axial and 2 tangential sections.

Description. Shell ellipsoidal, with bluntly rounded poles. Mature individuals have 6 to 7.5 volutions, and measure 2.5 to 3.7 mm in length and 1.3 to 2.1 mm in diameter; form ratio 1.76 to 2.0. Early 4 to 4.5 volutions coiled tightly, rate of expansion in succeeding volutions changed abruptly into loose. Spirotheca composed of thin dense tectum and thick less dense layer (primatheca) penetrated with thin pores in final volution; sometimes discontinuous outer tectorium present in two outer volutions. No true keriotheca is recognized and only prominent pores present in two outer volutions. Thickness of spirotheca in final volution 0.035 to 0.07 mm. Septa thin and nearly plane, except for polar regions. Rare phrenotheca present in 3 outher volutions. Proloculus minute, its outside diameter 0.04 to 0.056 mm. Tunnel narrow and low in inner volutions, significantly widening in succeeding volutions. Chomata weak in early 4 volutions and completely absent in outer volutions.

Discussion. The described species differs from the *Schwageriniformis (Tumefactus) expressus* Anosova in its much greater form ratios. In this aspect it similar to *"Triticites" expressus* forma *pressula* Anosova in Bensh, 1969, but differs from the latter in its smaller size and ellipsoidal outline.

Occurrence and age. The same as holotype.

Order **Schwagerinida** Solovieva, 1985

Family Schwagerinidae Dunbar et Henbest,1930

Montiparus, Rozovskaya, 1950

Montiparus montiparus (Ehrenberg, emend. Moeller, 1878)

Pl. 5, fig. 5

1878 *Fusulina montipara* Moeller, p. 94-99, pl. 3, figs. 2 a-f, pl. 8, figs. 2 a-c.

Material. 2 axial sections.

Distribution and age. East European Platform, Donets Basin, Middle Asia, Japan; Upper Carboniferous, middle Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 70.

Montiparus umbonoplicatus umbonoplicatus

(Rauser et Belyaev, 1940),

Pl. 5, figs. 4, 4a, 6

1940 *Triticites umbonoplicatus* Rauser-Chernousova et al., p. 9-10, pl. 2, figs. 1-5; text-fig. 1.

Material. 5 axial sections.

Distribution and age. East European Platform, Donets Basin, Darvaz, Carnic Alps, China; Upper Carboniferous, middle Kasimovian.

Occurrence. Safetgyr section D-172, Kalaikuhna Formation, member 5, unit 2, sample 70.

Montiparus umbonoplicatus longus n. subsp.

Pl. 5, figs. 7-9

Holotype. *Triticites umbonoplicatus* Rauser-Chernousova et al., 1940, p. 9-10, pl. 2, fig. 4;. East European Platform, Samara Bend; Upper Carboniferous, middle Kasimovian.

Material. 7 axial sections.

Discussion. This subspecies differs from the typical *Montiparus umbonoplicatus umbonoplicatus* in more elongate shell.

Distribution and age. East European Platform, Darvaz; Upper Carboniferous, middle Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 69, 70 and 71.

Montiparus umbonoplicatus inflatus n. subsp.

Pl. 5, figs. 10, 10a

Holotype. CGM 89a/12678; Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 3, sample 73; Upper Carboniferous, Kasimovian.

Material. 1 axial section.

Discussion. Described subspecies differs from *M. umbonoplicatus umbonoplicatus* (Rauser et Belyaev) in more inflated shell and thicker spirotheca.

Occurrence and age. The same as holotype.

Montiparus sinuosus sinuosus Rozovskaya, 1950

Pl. 6, fig. 19, 20

1950 *Triticites (Montiparus)sinuosus* Rozovskaya, p.18-19, pl. 3, figs. 6-9.

PLATE 5

Fig.1-3, 3a - *Schwageriniformis (Tumefactus) oblisus* n. sp. Axial section CGM 81a/12678. x 15. 2) Subaxial section CGM 82a/12678. x 15. 3) Axial section of the holotype CGM 83a/12678. x 15. 3a) Enlargement of fig. 3. x 40. Section 1006, Kalaikuhna Formation, member 5, unit 1, zone *Sch. expressus - P. compactus*.

Fig. 4, 4a, 6- *Montiparus umbonoplicatus umbonoplicatus* (Rauser et Beljaev). 4) Axial section CGM 84a/12678. x 15. 4a) Enlargement of fig. 4. x 40. 6) Axial section CGM 85a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

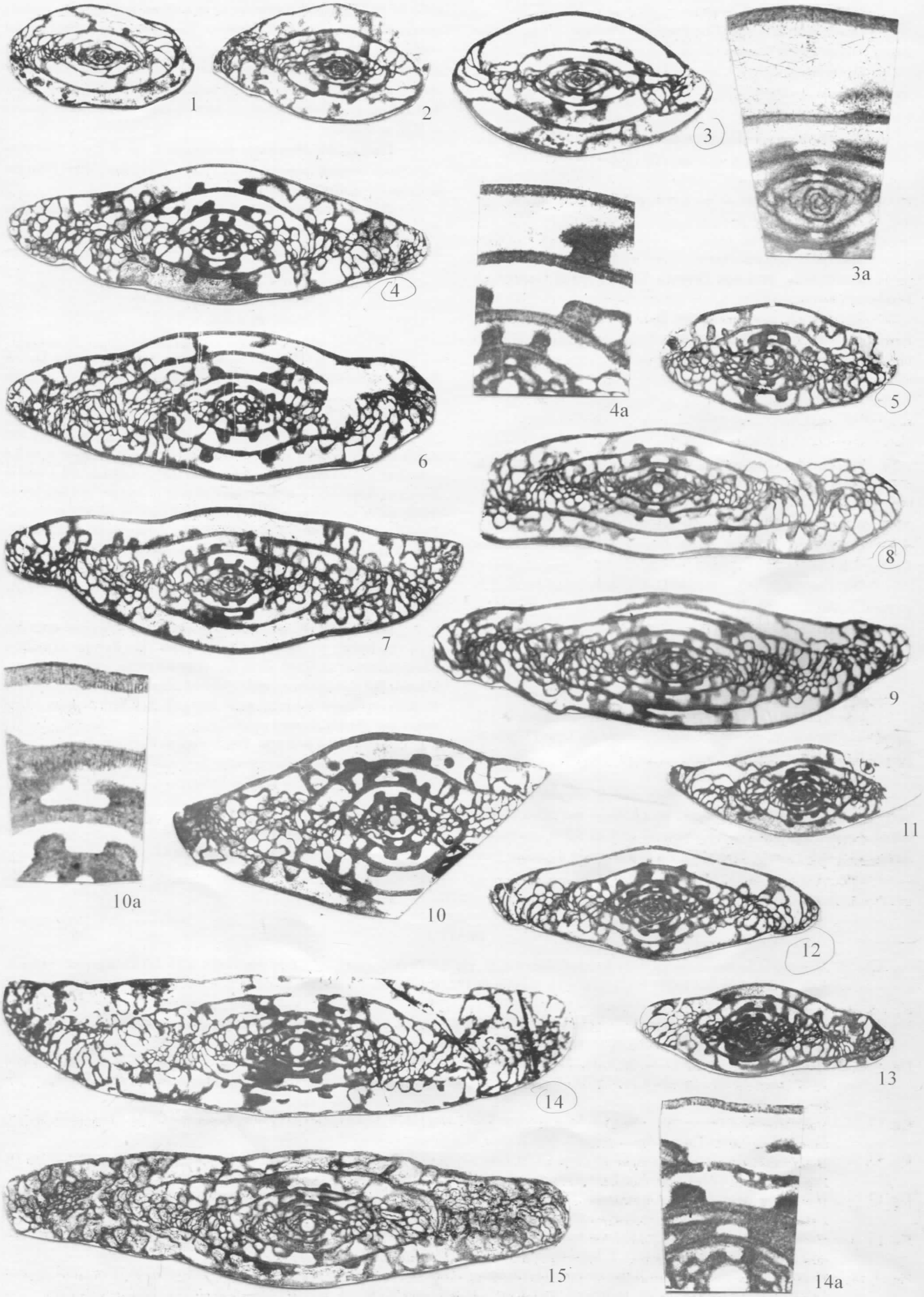
Fig. 5 - *Montiparus montiparus* (Ehrenberg). x 15. Axial section CGM 86a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *T. umbonoplicatus - T. kurshabensis*.

Fig. 7-9 - *Montiparus umbonoplicatus longus* n. subsp. x 15. Axial sections CGM 87a/12678, CGM 88a/12678 and CGM 6a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 10, 10a- *Montiparus umbonoplicatus inflatus* n. subsp. 10) Axial section of the holotype CGM 89a/12678. x 15. 10a) Enlargement of fig. 10. x 40. Section D-172, Kalaikuhna Formation, member 5, unit 3, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 11-13 - *Montiparus priscus* Villa. x 15. 11) Axial sections CGM 90a/12678 and.CGM 91a/12678. 13) Subaxial section CGM 92a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

Fig.14, 14a, 15 - *Montiparus sinuosus alaicus* Bensh. 14) Axial section CGM 93a/12678. x 15. 14a) Enlargement of fig. 14. x 40. 15) Axial section CGM 94a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.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Material. 2 subaxial section.

Distribution and age. East European Platform, Urals, Donets Basin, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 1016-6.

Montiparus sinuosus alaicus Bensh, 1972

Pl. 5, figs. 14, 14a, 15

1972 *Montiparus sinuosus alaicus* Bensh, p. 49-40, pl. 6, figs. 6, 7; pl. 7, fig.1.

Material. 2 axial sections.

Distribution and age Fergana, Darvaz, Spain; Upper Carboniferous, Kasimovisn.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, units 2 and 3, samples 70 and 1016-6; Upper Carboniferous, Kasimovian.

Montiparus priscus Villa, 1989

Pl. 5, figs. 11-13

1989 *Triticites (Montiparus) priscus* Villa, p. 241-244, pl. 40, figs. 1-8; pl. 41, figs. 1-9.

Material. 3 axial and subaxial sections.

Distribution and age. Spain, Darvaz; Upper Carboniferous, Kasimovian

Occurrence. Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 71.

Montiparus kushanicus n. sp.

Pl. 6, figs. 1-3

Holotype. CGM 95a/12678. Darvaz, Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 70; Upper Carboniferous, Kasimovian.

Material. 6 axial section.

Description. Shell fusiform, with slightly angular equatorial periphery, straight to slightly concave lateral slopes and rather bluntly rounded poles. Mature specimens possess of 5 to 5.5 volutions and measure 4.3 to 5.2 mm in length and 1.6 to 1.8 mm in diameter; form ratio 2.7 to 2.9. Spirotheca consist of tectum and fine keriotheca; outer tectorium present in early 3 volutions. Thickness of spirotheca in final volution 0.045 to 0.055 mm. Septa thin, moderately fluted in polar regions and slightly and broadly across entire of shell. Proloculus spherical, its outside diameter 0.11 to 0.13 mm. Tunnel narrow, about half as high as chamber. Chomata narrow, about half to three-quarter as high as chamber.

Discussion. *Montiparus kushanicus* n. sp. is close similar to *Montiparus sinuosus sinuosus* (Rozovskaya, 1950), but differs from the latter in its smaller size and less intensively septal fluted.

Occurrence and age. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 69, 70 and 71; Upper Carboniferous, Kasimovian.

Montiparus rauserae n. sp.

Pl. 6, figs. 4, 5

Holotype. CGM 99a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 70; Upper Carboniferous, Kasimovian.

Material. 2 axial and several subaxial sections.

Description. Shell fusiform, with concave lateral slopes and rather sharply pointed poles. Mature specimens possess of 5 to 5.5 volutions and measure 5.1 to 5.5 mm in length and 1.5 to 1.6 mm in diameter; form ratio 3.4. Spirotheca consist of tectum and fine keriotheca; outer tectorium can be recognized only in early 3 volutions. Thickness of spirotheca 0.06 mm in final volution. Septa thin, moderately fluted in polar regions but plane or broadly wavy across entire of shell. Proloculus spherical, its outside diameter 0.08 to 0.09 mm. Tunnel narrow, about half as high as chamber. Chomata massive in early volutions decreasing in size outwords.

Discussion. A specimen very similar to described ones has been included by Rauser-Chernousova et Belyaev (Rauser-Chernousova et al., 1940, pl. 2, fig. 4) under name *Triticites umbonoplicatus.* But this specimen and described ones differ from holotype of *M. umbonoplicatus* in having more elongate shell with concave lateral slopes and sharply pointed poles.

Distribution and age. East European Platform, Darvaz; Upper Carboniferous, middle Kasimovian.

Occurrence. The same as holotype.

Montiparus pigmaeus n. sp.

Pl. 6, figs. 6-9, 11,14

PLATE 6

Fig. 1-3 - *Montiparus kushanicus* n. sp. 1, 2) Axial sections CGM 95a/12678 (holotype) and CGM 96a/12678. x 15. 2a) Enlargement of fig. 2. x 40. 3) Axial section CGM 97a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 4, 5 - *Montiparus rauserae* n. sp. x 15. Axial sections CGM 98a/12678 and CGM 99a/12678 (holotype). Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 6-9, 11,14 - *Montiparus pigmaeus* n. sp. x 15. Axial sections CGM 100a/12678 (holotype), CGM 101a/12678, CGM 5a/12678, CGM 102a/12678, CGM 13a/12678 and CGM 103a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

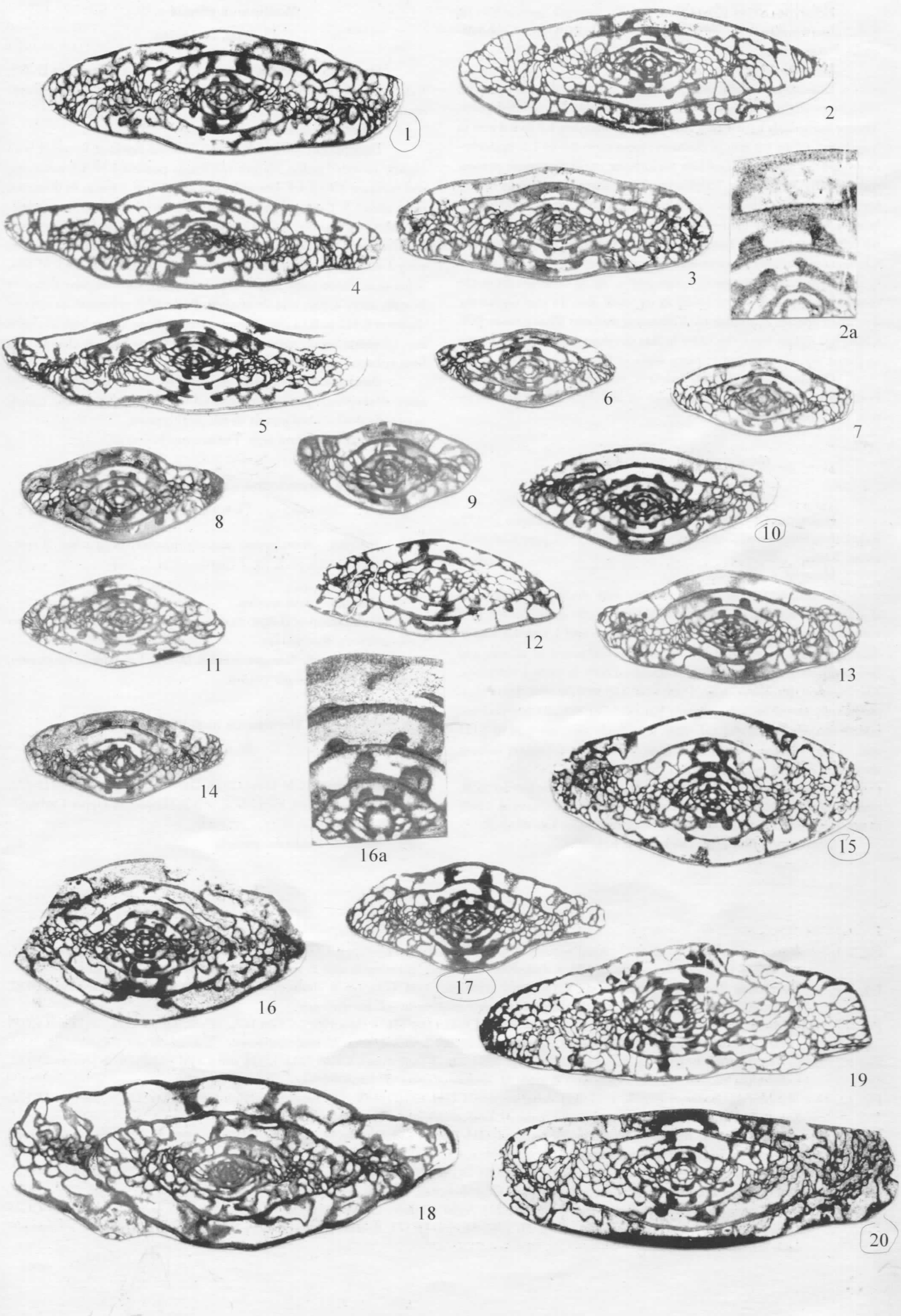
Fig. 10, 12, 13 - *Montiparus memorabilis* n. sp. x 15. Axial sections CGM 17a/12678 (holotype), CGM 104a/12678 and CGM 105a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 15, 16, 16a - *Montiparus citreus* n. sp. Axial sections CGM 106a/12678 (holotype) and CGM 107a/12678. x 15. 16a) Enlargement of fig. 16. x 40. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus -T. kurshabensis.*

Fig. 17 - *Montiparus paramontiparus mesopachus* Rozovskaya. x 15. Axial section CGM 108a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig. 18 - *Montiparus hirsutus* n. sp. x 15. Axial section of the holotype CGM 109a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*

Fig.19, 20 - *Montiparus sinuosus sinuosus* Rozovskaya. x 15. 19) Subaxial section CGM 110a/12678. 20) Axial section CGM 111a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis.*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Holotype. CGM 100a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 15 axial sections.

Description. Shell small, fusiform to inflated-fusiform, with straight to slightly convex lateral slopes and bluntly rounded poles. Mature individuals have 4 to 5 volutions and measure 1.7 to 2.8 mm in length and 1.0 to 1.3 mm in diameter; form ratio 2.0 to 2.6. Spirotheca composed of tectum and fine keriotheca; outer tectorium present only in early 3 volutions. Thickness of spirotheca 0.04 to 0.06 mm in last volution. Septa thin, moderately fluted in polar regions and broadly wavy across entire of shell. Proloculus spherical, its outside diameter 0.098 to 0.125 mm. Tunnel narrow, about half as high as chamber. Chomata moderately massive throughout.

Discussion. *Montiparus pigmaeus* n. sp. is different from the most of the species of the genus in its small size. In this aspect the described species is similar to *Montiparus minutus* Zhang from NW China but differs from the latter in less developed chomata and wavy to fluted septa as opposed to plane septa in *Montiparus minutus*.

Occurrence and age. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 69 and 71; Upper Carboniferous, Kasimovian.

Montiparus memorabilis n. sp.

Pl. 6, figs. 10, 12, 13

Holotype. CGM 17a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 6 axial sections.

Description. Shell small, fusiform, with slightly concave lateral slopes and bluntly rounded poles. Mature individuals have 4 to 5 volutions and measure 3.2 to 3.5 mm in length and 1.3 to 1.5 mm in diameter; form ratio 2.3 to 2.5. Spirotheca composed of tectum and fine keriotheca; outer tectorium is observed only in early 3 volutions. Thickness of spirotheca in final volution 0.05 to 0.06 mm. Septa thin, moderately fluted in polar regions but plane or broadly wavy across middle of shell. Proloculus spherical; its outside diameter 0.09 to 0.125 mm. Tunnel narrow, about half as high as chamber. Chomata narrow, about 0.4 to 0.5 as high as chamber.

Discussion. *Montiparus memorabilis* n.sp. is close similar to *M. umbonoplicatus* (Rauser & Belyaev, in Rauser-Chernousova et al. 1940) in many aspects but differs from the latter in smaller size of shell.

Occurrence and age. The same as holotype.

Montiparus citreus n. sp.

Pl. 6, fig. 15, 16, 16a

Holotype. CGM 106a/12678. Darvaz, Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 2 axial sections.

Description. Shell rather large, inflated-fusiform to ovoid, with bluntly rounded poles. Mature specimens possess 5 to 5.5 volutions, and measure 4.4 to 4.5 mm in length and 2.3 to 2.4 mm in diameter; form ratio 1.9. Coiling is uniform in three early volutions, in succeeding volutions chamber height increased abruptly. Spirotheca composed of tectum and fine keriotheca; irregular outer tectorium is observed in early 3-4 volutions. Thickness of spirotheca in final volution 0.05 mm. Septa thin, moderately fluted in polar regions but irregular fluted or broadly wavy across middle of shell. Proloculus spherical; its outside diameter 0.112 to 0.14 mm. Tunnel narrow, about half as high as chamber. Chomata small, narrow, about 0.4 to 0.5 as high as chamber. In final volution chomata often completely absent.

Discussion. *Montiparus citreus* n. sp. differs from most of the know *Montiparus* specie in its inflated-fusiform outline, loose coiling in outer volutions and poorly developed chomata.

Occurrence and age. The same as holotype.

Montiparus paramontiparus mesopachus Rozovskaya, 1950

Pl. 6, fig. 17

1950 *Triticites (Montiparus) paramontiparus mesopachus* Rozovskaya, p. 15, pl. 2, fig. 1 (part).

Material. 1 axial section.

Distribution and age. East European Platform, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 1016-6.

Montiparus hirsutus n. sp.

Pl. 6, fig. 18

Holotype. CGM 109a/12678. Darvaz, Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 1 subaxial section.

PLATE 7

Fig. 1-4, 7 - *Montiparus dubius* n. sp. x 15. Axial sections CGM 112a/12678 (holotype), CGM 86a/12678, CGM 2a/12678, CGM 101a/12678, and CGM 113a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 5, 6 - *Montiparus stuckenbergiformis* n. sp. x 15. Axial sections CGM 114a/12678 (holotype), and CGM 115a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 8, 9, 11, 14 - *Montiparus desinens* n. sp. x 15. 8) Axial sections CGM 116a/12678 (holotype), CGM 117a/12678, CGM 118a/12678 and CGM 119a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

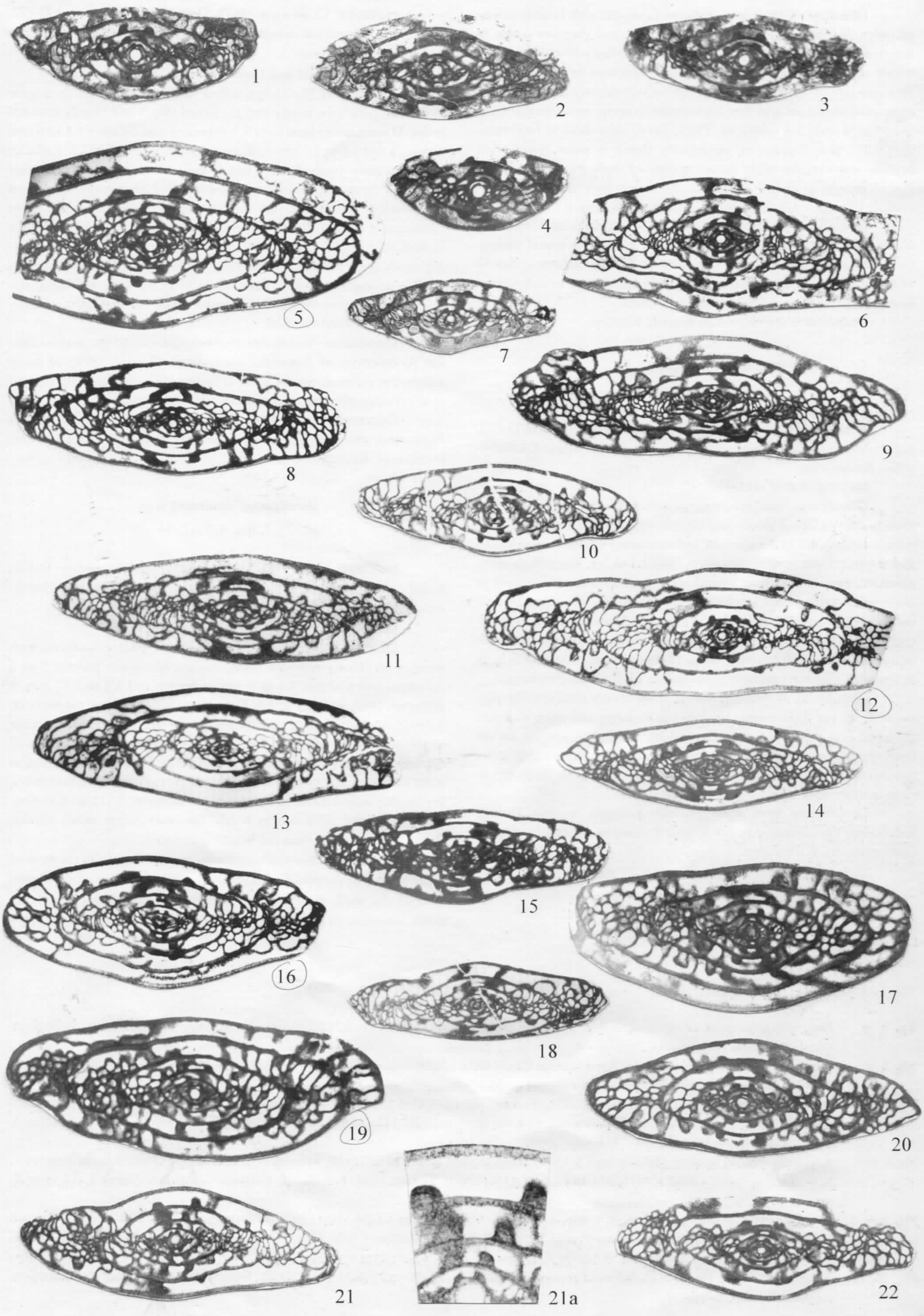
Fig. 10, 15, 18 - *Triticites licis* n. sp. x 15. Axial sections CGM 120a/12678 (holotype), CGM 121a/12678 and CGM 122a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus -T. kurshabensis*.

Fig. 12, 13 - *Triticites kurshabensis* Bensh. x 15. 12) Axial section CGM 123a/12678. 13) Subaxial section CGM 124a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 16 - *Triticites noinskyi* Rauser. x 15. Subaxial section CGM 125a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.

Fig. 17, 19 - *Triticites simplex* (Schellwien). x 15. Subaxial sections CGM 126a/12678 and CGM 127a/12678. Section D-172, Kalaikuhna Formation member 5, unit 2, zone *M. umbonoplicatus -T. kurshabensis*.

Fig. 20-22,21a - *Triticites umbonoplicatiformis* n. sp. 20, 21, 22) Axial sections CGM 128a/12678, CGM 129a/12678 (holotype), and CGM 130a/12678. x 15. 21a) Enlargement of fig. 21. x 40. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus - T. kurshabensis*.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Description. Shell large, inflated fusiform, with bluntly pointed poles. Mature specimen has 5.5 volutions, and measure 6 mm in length and 2.5 mm in diameter; form ratio 2.4. Early 3 volutions constitute tightly coiled juvenarium, which is followed by abrupt expansion into loosely coiled adult stage. Spirotheca slightly undulating. Its composed of tectum and fine keriotheca; irregular outer tectorium is observed in early 3-4 volutions. Thickness of spirotheca in final volution 0.075 mm. Septa thin, moderately fluted in polar regions but broadly and irregular wavy across middle of shell. Proloculus small. Tunnel narrow in early 3 volutions and rather wide and low in succeeding volutions. Chomata weak, occur only in early 4 volutions.

Discussion. *Montiparus hirsutus* n. sp. differs from *Montiparus subcrassulus varians* Bensh, 1972 in its less intensively septal fluting. Described species bears many similarity to *Triticites gusanicus* Bensh, 1972 but differs from the latter in its wavy spirotheca, less elongated juvenarium and in presence of outer tectorium.

Occurrence and age. The same as holotype.

Montiparus dubius n. sp.

Pl. 7, figs. 1-4, 7

Holotype. CGM 112a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 9 axial sections.

Description. Shell moderate in size, fusiform, with straight to slightly convex lateral slopes and bluntly rounded poles. Mature individuals possess 4.5 to 5 volutions and measure 3 to 3.6 mm in length and 2.4 to 1.5 mm in diameter; form ratio 2.4 to 3.5. Spirotheca composed of tectum and fine keriotheca; irregular outer tectorium is observed in early 3 to 3.5 volutions. Thickness of spirotheca in final volution 0.04 to 0.05 mm. Septa thin, moderately fluted in polar regions and broadly wavy across entire of shell. Proloculus spherical; its outside diameter 0.12 to 0.17 mm. Tunnel narrow, about half as high as chamber. Chomata narrow, about half as high as chamber height.

Discussion. *Montiparus dubius* n. sp. is very similar to *M. pigmaeus* n. sp. but differs from the latter in its larger and more elongate shell and less developed outer tectorium. Described species differs from the primitive *Rauserites (R. primitivus* Rozovskaya, 1950) in its less intensive septal fluting and in occurrence of irregular outer tectorium in inner volutions.

Occurrence and age. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 70 and 71; Upper Carboniferous, Kasimovian.

Montiparus stuckenbergiformis n. sp.

Pl. 7, figs. 5, 6

Holotype. CGM 114a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation member 5, unit 2, sample 1016-6; Upper Carboniferous, Kasimovian.

Material. 3 axial and 1 subaxial sections.

Description. Shell large, inflate fusiform, with slightly angular equatorial periphery, nearly straight lateral slopes and bluntly rounded poles. Mature individuals have 5.5 volutions and measure 5.4 to 6 mm in length and 1.8 to 2.6 mm in diameter; form ratio 2.3 to 2.8. Early 3.5 volutions constitute relatively tightly coiled juvenarium, which is followed by abrupt expansion into loosely coiled adult stage. Spirotheca composed of tectum and very thin alveolar keriotheca; irregular outer tectorium is developed in two early volutions. Thickness of spirotheca in final volution 0.085 mm. Septa wavy across middle of shell, becoming moderately folded toward poles. Proloculus relatively large, its outside diameter 0.18 mm. Tunnel narrow in the early volutions, significantly widening outwards. Chomata small, low and narrow, developed in all but final volution.

Discussion. *Montiparus stuckenbergiformis* n. sp. is close similar to holotype of *Rauserites stuckenbergi* (Rauser, 1938) in many aspect, but differs from the latter in its less intensive septal fluting and in occurrence of outer tectorium in early volutions.

Occurrence and age. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 71 and 1016-6; Upper Carboniferous, Kasimovian.

Montiparus desinens n. sp.

Pl. 7, figs. 8, 9, 11, 14

Holotype. CGM 116a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 4 axial and several subaxial sections.

Description. Shell moderate in size, elongate-fusiform, with pointed to bluntly rounded poles. Mature specimens possess 5 to 6 volutions and measure 4.6 to 6 mm in length and 1.4 to 1.75 mm in diameter; form ratio 2.9 to 3.4. Rate of expansion gradual throughout. Spirotheca composed of tectum and fine keriotheca; irregular outer tectorium can be observed in early 2 or 3 volutions. Thickness of spirotheca in final volution 0.05 to 0.055 mm. Septa plane or irregular wavy across middle of shell becoming moderately fluted toward poles. Proloculus moderate in size; its outside diameter 0.112 to 0.14 mm. Tunnel low and moderate in width. Chomata rather small, narrow, about half as high as chamber height.

Discussion. *Montiparus desinens* n. sp. differs from the most of other species of the genus in its elongate outline, gradual rate of expansion of the shell, poorly developed chomata and in occurremce of outer tectorium in early volution.

PLATE 8

Fig. 1 - *Ferganites ferganensis* (A. Miklukho-Maclay). x 15. Axial section CGM 181a/12678. Section D-10 (Shagon), Kalaikuhna Formation, member 7, zone *R. rossicus*.

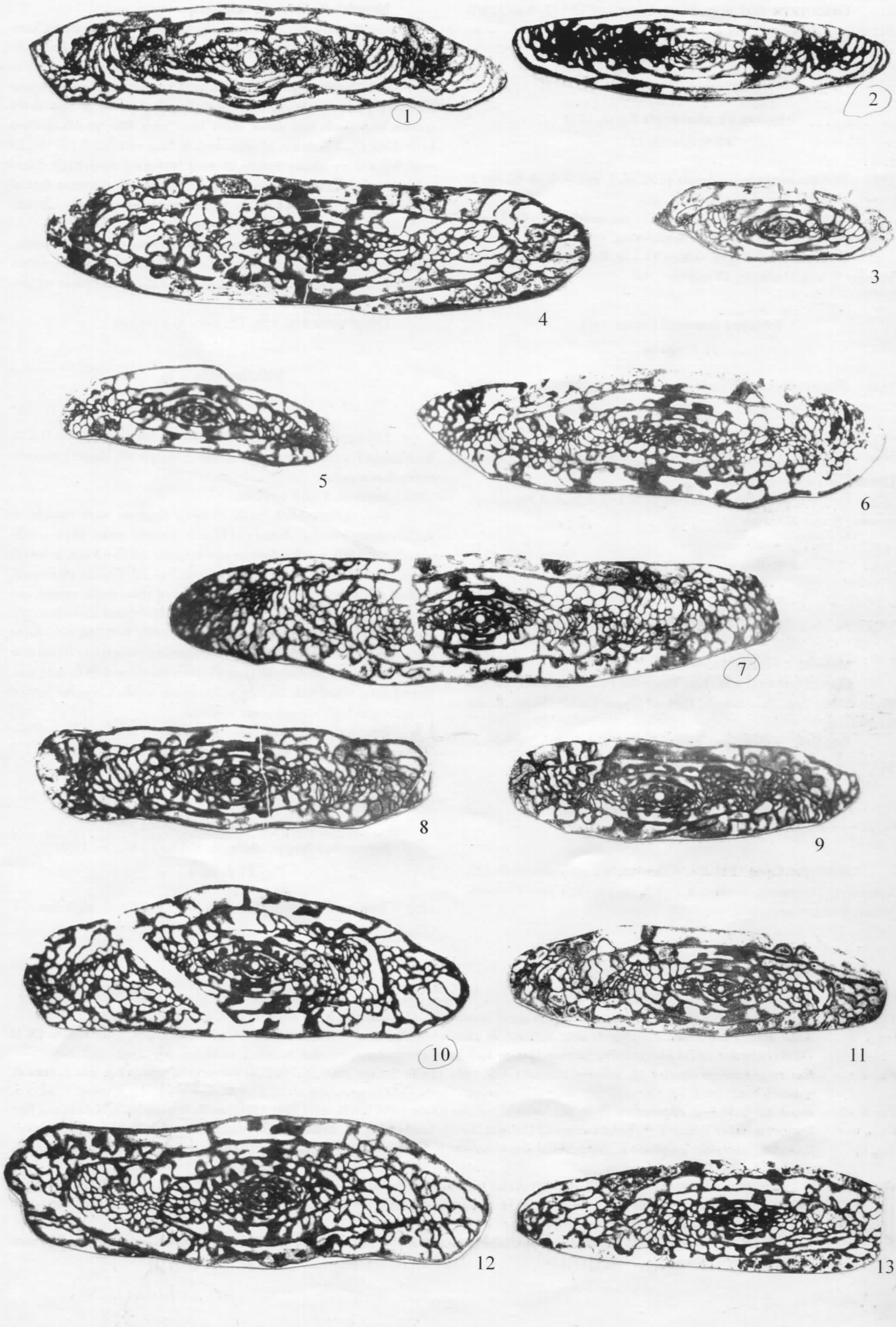
Fig. 2 - *Ferganites isfarensis* (Bensh). x 15. Axial section CGM 182a/12678. Section D-200 (Shokhkazak), Kalaikuhna Formation, member 6, unit 4, zone *Sch. fusiformis-Sch. pamiricus* (upper part).

Fig. 3, 5 - *Triticites aff. irregularis annulifera* Rauser. x15. 3) Axial section CGM 131a/126787. Section D-172, Kalaikuhna Formation, member 6, unit 2, zone *Sch. fusiformis - Sch. pamiricus*. 5) Axial section CGM 132a/12678. Section D-172, Kalaikuhna Formation, member 5, unit 2. Zone *M. umbonoplicatus - T. kurshabensis*.

Fig.4, 6, 7 - *Rauserites rossicus rossicus* (Schellwien). x 15. 4) Axial section CGM 133a/12678. Section D-172, Kalaikuhna Formation, member 7. 6, 7) Axial sections CGM 134a/12678 and CGM 135a/12678. Section 1007, Kalaikuhna Formation, member 7, unit 2. All zone *R. rossicus*.

Fig. 8, 9, 11, 13 - *Rauserites rossicus macilentus* n. subsp. x 15. 8, 9) Axial sections CGM 136a/12678 (holotype) and CGM 137a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 2. 11, 13) Subaxial sections CGM 138a/12678 and CGM 139a/12678. Section D-172, Kalaikuhna Formation, member 7. All zone *R. rossicus*

Fig. 10, 12 - *Rauserites henbesti* (Igo). x 15. Subaxial sections CGM 140a/12678 and CGM 141a/12678. Section D-172, Kalaikuhna Formation, member 7, zone *R. rossicus*.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Occurrence and age. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 70 and 71; Upper Carboniferous, Kasimovian.

Triticites Girty, 1904

Triticites kurshabensis Bensh, 1972

Pl. 7, figs. 12, 13

1972 *Triticites kurshabensis* Bensh, p. 50, pl. 9, figs. 7, 8; pl. 10, fig. 1.

Material. 4 axial sections.

Distribution and age. Fergana, Darvaz, southern Urals; Upper Carboniferous, middle and upper Kasimovian.

Occurrence. Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, samples 69 and 70.

Triticites noinskyi Rauser, 1938

Pl. 7, fig. 16

1938 *Triticites noinskyi* Rauser-Chernousova, p. 109-110, pl. 3, figs. 5, 6.

Material. 4 subaxial and tangential sections.

Distribution and age. East European Platform, Urals, Darvaz; Upper Carboniferous, Kasimovian.

Occurrence. Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 71.

Triticites simplex (Schellwien, 1908)

Pl. 7, figs. 17, 19

1908 *Fusulina simplex* Schellwien, p. 179-182, pl. 18, figs. 4-6, 12.

Material. 2 subaxial sections.

Distribution and age. East European Platform, Urals, Donets Basin, Carnic Alps, Spitsbergen, Darvaz; Upper Carboniferous, upper Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71.

Triticites umbonoplicatiformis n. sp.

Pl. 7, figs. 20-22

Holotype. CGM 129a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 71; Upper Carboniferous, Kasimovian.

Material. 6 axial and 5 tangential sections.

Description. Shell small, fusiform, with slightly concave lateral slopes and bluntly to sharply pointed poles. Mature individuals possess 4 to 5.5 volutions and measure 3.4 to 4.6 mm in length and 1.3 to 1.6 mm in diameter; form ratio 2.6 to 2.9. The height of volutions increases gradually throughout. Spirotheca composed of thin dense tectum and thick, less dense inner layer with fine, poorly defined keriotheca (?). Thickness of spirotheca in final volution 0.056 to 0.07 mm. Septa wavy across middle of shell becoming moderately fluted towards poles. Proloculus medium in size; its outside diameter 0.12 to 0.19 mm. Tunnel narrow, and low, slightly widening outwards. Chomata massive in early volutions slightly decrease in size outwards.

Discussion. *Triticites umbonoplicatiformis* n. sp. close resembles *Montiparus umbonoplicatus* Rauser et Belyaev, 1940, but differs from the latter in its smaller size of shell and absence of outer tectorium in all volutions.

Occurrence and age. The same as holotype.

Triticites licis n. sp.

Pl. 7, figs. 10, 15, 18

Holotype. CGM 120a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, sample 69; Upper Carboniferous, Kasimovian.

Material. 5 axial sections.

Description. Shell small, elongate-fusiform with straight to slightly convex lateral slopes and bluntly pointed poles. Mature individuals possess 4.5 to 5 volutions and measure 3.5 to 4.3 mm in length and 1.1 to 1.3 mm in diameter; form ratio 3 to 3.2. Coiling planispiral, gradual throughout. Spirotheca composed of thin, dense tectum and thick, less dense inner layer with fine, poorly defined keriotheca (?). Thickness of spirotheca in final volution 0.050 to 0.056 mm. Septa plane to wavy across middle of shell becoming moderately fluted near poles. Proloculus medium of size; its outer diameter 0.09 to 0.14 mm. Tunnel narrow and low, slightly widening outwards. Chomata narrow, decreasing in high toward outer volution.

Discussion. *Triticites licis* n. sp. is closely similar to *T. umbonoplicatiformis* n. sp. but differs from the latter in its smaller size and more elongate outline.

Ferganites A. Miklukho-Maclay, 1959

Ferganites ferganensis (A. Miklukho-Maclay, 1950)

Pl. 8, fig. 1

1950 *Triticites ferganensis* Miklukho-Maclay, p. 59-60, pl. 7, figs. 1-4.

PLATE 9

Fig. 1, 3-7 - *Rauserites rugosus* (Rozovskaya). x 15. 1) Subaxial section CGM 142a/12678. 3) Axial section CGM 143a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 4, zone *R. rossicus*. 4-7) Axial sections CGM 145a/12678, CGM 146a/12678, CGM 147a/12678 and CGM 148a/12678. Section D-172, Kalaikuhna Formation, member 6, unit 2, zone *Sch. fusiformis - Sch. pamiricus*.

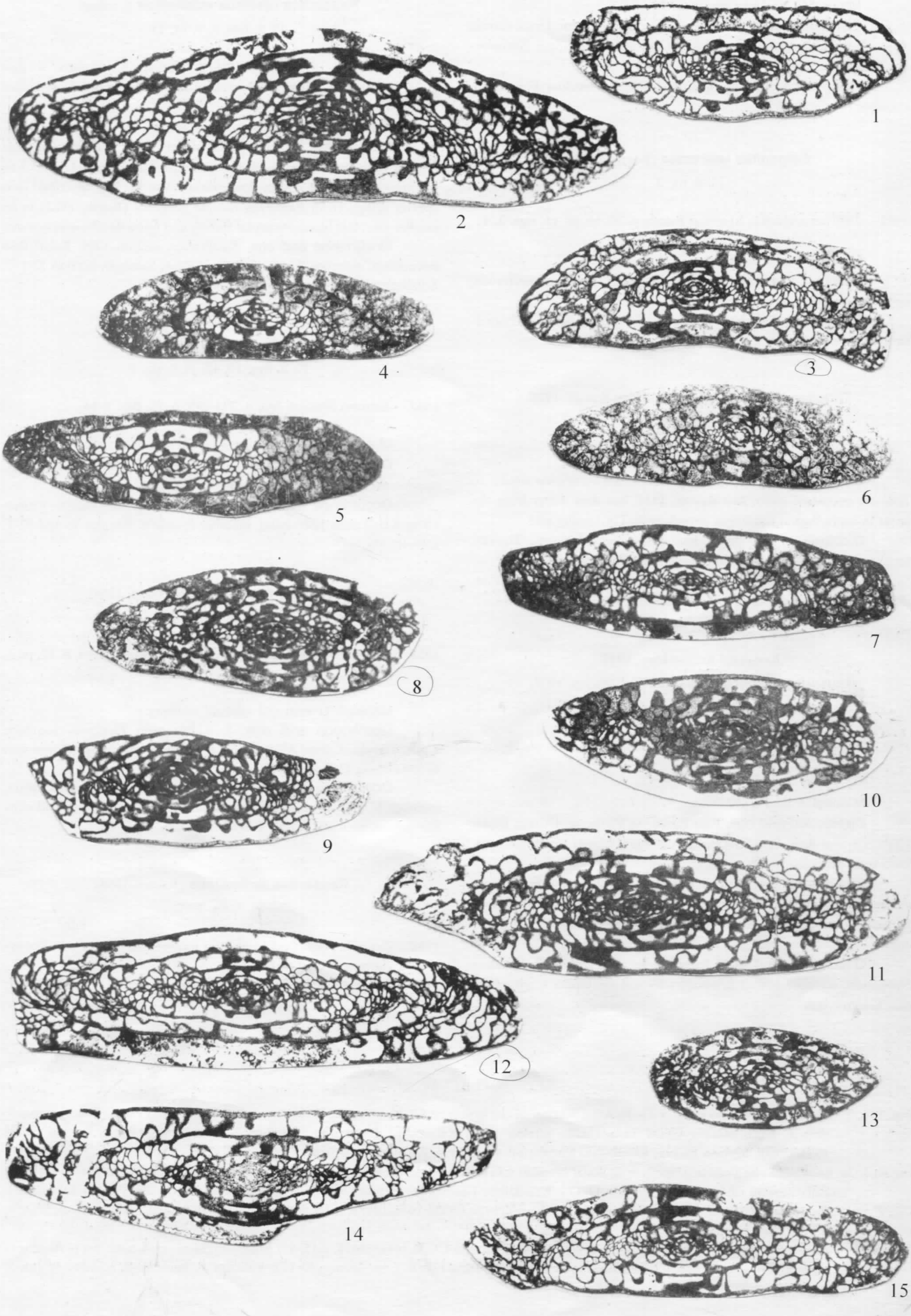
Fig. 2 - *Rauserites henbesti* (Igo). x 15. Subaxial section CGM 144a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 2, zone *R. rossicus*.

Fig. 8-10 - *Rauserites fortissimus* (Rauser). x 15. 8, 10) Subaxial sectons CGM 149a/12678 and CGM 150a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 2. 9) Axial section CGM 151a/12678. Section D-172, Kalaikuhna Formation, member 7. All zone *R. rossicus*.

Fig. 11 - *Rauserites triangulus orientalis* n. subsp. Axial section of the holotype CGM 152a/12678. x 15. Section 1006, Kalaikuhna Formation, member 7, unit 2, zone *R. rossicus*.

Fig. 12, 14, 15 - *Rauserites concinnus* n. sp. x 15. 12, 14) Axial sections CGM 153a/12678 (holotype) and CGM 154a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 4. 15) Axial section CGM 155a/12678. Section 1007, Kalaikuhna Formation, member 7, unit 3. All zone *R. rossicus*.

Fig. 13 - *Rauserites kuibyshevi* (Rauser). Subaxial section CGM 156a/12678 x15. Section 1006, Kalaikuhna Formation, member 7, unit 4, zone *R. rossicus*.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Material. 2 axial sections.

Distribution and age. Fergana, Darvaz, southern Urals, Carnic Alps, Cantabrian Mountains; Upper Carboniferous, upper Kasimovian-Gzhelian.

Occurrence. Shagon, section D-10; Kalaikuhna Formation, member 7, sample 25.

Ferganites isfarensis (Bensh, 1972)

Pl. 8, fig. 2

1972 *Triticites primarius isfarensis* Bensh, p. 55-56, pl. 11, figs. 3, 4.

Material. 3 axial sections.

Distribution and age. Fergana, Darvaz; Upper Carboniferous, upper Kasimovian- lower Gzhelian.

Occurrence. Shokhkazak, section D-200; Kalaikuhna Formation, member 6, unit 4, sample 57.

Triticites aff. irregularis annulifera Rauser, 1938

Pl. 8, figs. 3, 5

Material. 2 axial sections.

Discussion. The described specimens are somewhat similar to *Triticites irregularis annulifera* Rauser, 1938, but they differ from the latter in more flatten equatorial periphery and in smaller size.

Distribution and age. East-European Platform, Darvaz, southern Urals; Upper Carboniferous, upper Kasimovian.

Occurrence. Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, sample 1016-6 and member 6, unit 2, sample 86.

Rauserites Rozovskaya, 1948

Rauserites rossicus rossicus (Schellwien, 1908)

Pl. 8, figs. 4, 6, 7

1908 *Fusulina alpina* var. *rossica* Schellwien, p. 171-172, pl. 15, figs. 5-13; pl. 16, figs. 1, 2.

Material. 6 axial sections.

Distribution and age. East European Platform, Donets Basin, Urals, Central Asia, Carnic Alps, Spitsbergen; Upper Carboniferous, lowermost Gzhelian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 7, sample 97; Kalaikuhna, sections 1006 and 1007, Kalaikuhna Formation, member 7, unit 2, samples 1006-22-4 and 1007-2, accordingly.

Occurrence and age. Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, samples 69 and 71; Upper Carboniferous, Kasimovian.

Rauserites rossicus macilentus n. subsp.

Pl. 8, figs. 8, 9, 11, 13

Holotype. CGM 136a/12678. Darvaz, Kalaikuhna, section 1006; Kalaikuhna Formation, member 7, bed 2, sample 22-4; Upper Carboniferous, lowermost Gzhelian.

Material. 7 axial and subaxial sections.

Discussion. This subspecies differs from *Rauserites rossicus rossicus* (Schellwien) in its smaller size and tighter coiling (L=5.3 to 6.2 mm; D=1.5 to 1.7 mm; form ratio 5.5 to 4). The described subspecies differs from *Rauserites rossicus gzhelicus* (Bensh, 1962) in its smaller size, less intensive septal fluting and more developed chomata.

Occurrence and age. Kalaikuhna, section 1006, Kalaikuhna Formation, member 7, unit 2, sample 22-4; Safetgyr, section D-172, Kalaikuhna Formation, member 7, sample 95.

Rauserites henbesti (Igo, 1957)

Pl. 8, figs. 10, 12; pl. 9, fig. 2

1957 *Triticites henbesti* Igo, p. 243-245, p. 18, figs. 6-14.

Material. 5 subaxial and tangential sections.

Distribution and age. Japan, Darvaz; Upper Carboniferous, uppermost Kasimovian to lowermost Gzhelian.

Occurrence. Safetgyr, section D-172; Kalaikuhna, section 1006; Kalaikuhna Formation, member 7, unit 2, samples 95 and 22-2, accordingly.

Rauserites rugosus (Rozovskaya, 1958)

Pl. 9, figs. 1, 3-7

1958 *Triticites (Triticites) irregularis rugosus* Rozovskaya, p. 87, pl. 3, fig. 7-9.

Material. 11 axial and subaxial sections.

Distribution and age. East European Platform, southern Urals, Darvaz, Carnic Alps; Upper Carboniferous, upper Kasimovian to lowermost Gzhelian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 6, unit 2, sample 86; Kalaikuhna, section 1006, Kalaikuhna Formation, member 7, unit 4, sample 25.

Rauserites fortissimus (Rauser, 1958)

Pl. 9, fig. 8-10

1958 *Triticites (Triticites) fortissimus* Rauser-Chernousova in Rozovzkaya, p. 90, pl. 4, figs.7-9.

1958 *Triticites fortissimus* Rauser-Chernousova, p. 134-135, pl. 1, fig. 6.

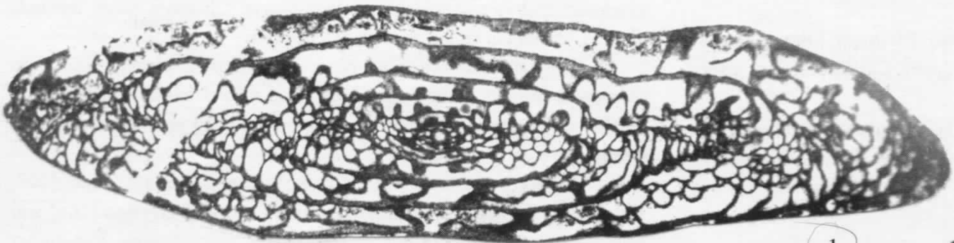
PLATE 10

Fig. 1, 4, 5 - *Rauserites jucundus* n. sp. x 15. 1) Axial section of the holotype CGM 157a/12678. Section 1006, Kalaikuhna Formation, member 7, unit 4. Axial section CGM 158a/12678. Section 1007, Kalaikuhna Formation, member 7, unit 2. 5) Subaxial section CGM 159a/12678. Section D-172, Kalaikuhna Formation, member 7. All zone *R. rossicus*.

Fig. 2, 3, 3a, 6 - *Kushanella globosa* n. sp. 2, 3, 6) Axial sections CGM 160a/12678, CGM 161a/12678 (holotype) and CGM 162a/12678. x 15. 3a) Enlarhement of fig. 3. x 40. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonopliccatus* - *T. kurshabensis*.

Fig. 7 - *Rauserites darvasicus* n. sp. Axial section of the holotype CGM 163a/12678. x 15. Section 1006, Kalaikuhna Formation, member 7, unit 2, zone *R. rossicus*.

Fig. 8-11 - *Kushanella daixiniformis* (Izotova & Vevel). 8) Axial section CGM 164a/12678. x 15. 8a) Enlargement of fig. 8. x 40. 9-11) Axial sections CGM 165a/12678, CGM 166a/12678 and CGM 167a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus* - *T. kurshabensis*.



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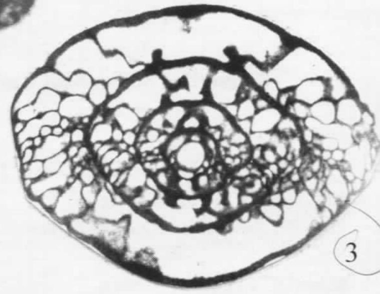

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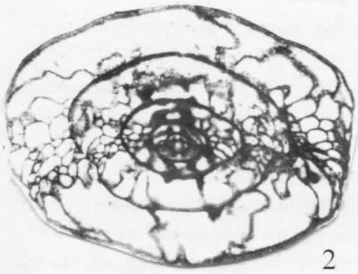

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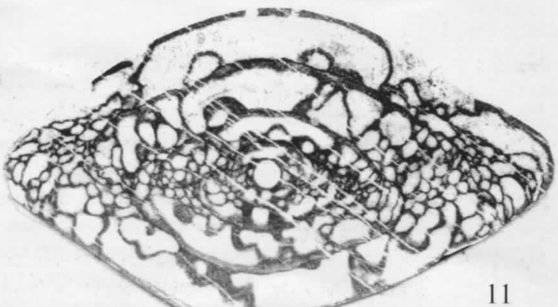

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Material. 3 axial sections.

Distribution and age. East European Platform, Darvas, southern Urals, Donets Basin, Spitsbergen; Upper Carboniferous, upper Kasimovian and lowermost Gzhelian.

Occurrence. Kalaikuhna, section 1006, Kalaikuhna Formation, member 7, unit 2, sample 22-4; Safetgyr, section D-172, Kalaikuhna Formation, member 7, sample 95.

Rauserites kuibyshevi Rauser, 1958

Pl. 9, fig. 13

1958 *Triticites (Rauserites) kuibyshevi* Rauser-Chernousova in Rozovskaia, p. 98, pl. 8, figs. 7, 8.

1958 *Triticites kuibyshevi* Rauser-Chernousova, p. 134, pl. 1, fig. 5.

Material. 1 subaxial section.

Distribution and age. East European Platform, Darvaz, southern Urals, Donets Basin, Spitsbergen; Upper Carboniferous, upper Kasimovian and lowermost Gzhelian.

Occurrence. Kalaikuhna, section 1006, member 7, unit 4; Upper Carboniferous, Kasimovian.

Rauserites triangulus orientalis n. subsp.

Pl. 9, fig. 11

Holotype. CGM 152a/12678. Darvaz, Kalaikuhna, section 1006; Kalaikuhna Formation, member 7, unit 2, sample 22-4; Upper Carboniferous, lowermost Gzhelian.

Material. 1 axial section.

Discussion. Described subspecies is very similar to *Triticites (Triticites) triangulus* Rozovskaya (1958, pl. 5, fig. 2 and 3), but differs from the latter in its more elongate early volutions and thinner spirotheca.

Occurrence and age. The same as holotype.

Rauserites concinnus n. sp.

Pl. 9, figs. 12, 14, 15

Holotype. CGM 153a/12678. Darvaz, Kalaikuhna, section 1006; Kalaikuhna Formation, member 7, unit 4, sample 25; Upper Carboniferous, lowermost Gzhelian.

Material. 5 axial sections.

Description. Shell large, very elongate fusiform, with bluntly rounded poles. Mature specimens have 5.0 to 6 volutions and measure 7.5 to 8.0 mm in length and 1.8 to 2.0 mm in diameter; form ratio 4.0. Spirotheca composed of tectum and fine alveolar keriotheca. Thickness of spirotheca in fifth volutions 0.06 to 0.07 mm. Septa wavy to irregularly fluted across middle part of shell, becoming moderately fluted toward poles. Proloculus medium in size; its outside diameter varies from 0.14 to 0.16 mm. Tunnel low and narrow in early volutions gradually and slowly widening throughout. Chomata small, mound-shaped, about 0.3 to 0.5 as high as chamber.

Discussion. *Rauserites concinnus* n. sp. is closely similar to *Rauserites rossicus* (Schellwien, 1908), but differs from the latter in its smaller chomata, which however develop in the all volutions, and thinner septa in early volutions.

Occurrence and age. Kalaikuhna, sections 1006 and 1007; Kalaikuhna Formation, member 7, unit 4, sample 25 (section 1006) and unit 4, sample 3 (section 1007); Upper Carboniferous, lowermost Gzhelian.

Rauserites jucundus n. sp.

Pl. 10, figs. 1, 4, 5

Holotype. CGM 157a/12678. Darvaz, Kalaikuhna, section 1006; Kalaikuhna Formation, member 7, unit 4, sample 25; Upper Carboniferous, lowermost Gzhelian.

Material. 3 axial and 2 subaxial sections.

Description. Shell large, subcylindrical, with bluntly rounded poles. Mature specimens possess 5.5 to 6 volutions and measure 5.6 to 8.5 mm in length and 1.5 to 2.15 mm in diameter; form ratio 3.7 to 4.0. Spirotheca composed of tectum and fine alveolar keriotheca. Thickness of spirotheca, in sixth volution varies from 0.045 to 0.06 mm. Septa wavy or irregularly fluted across middle of shell, becoming moderately folded toward poles. Proloculus medium with outside diameter of 0.12 to 0.18 mm. Tunnel narrow in the early volutions significantly widening outwards. Small and narrow chomata developed only in early 3 volutions.

Discussion. *Rauserites jucundus* n. sp. is closely similar to *Rauserites rossicus* (Schellwien) particularly to the form figured on pl. 15, fig. 5 of Schellwien's monograph (1908), and to «*T. acutus*" of Rauser-Chernousova, 1938, pl. 4, fig. 10. Described species differs from both *Rauserites rossicus* and «*T. acutus*" (sensu Rauser) in its smaller size, thinner spirotheca, less massive chomata, and more elongated early volutions. *R. jucundus* differs from *R. concinnus* n. sp. in its subcylindrical outline of shell.

Occurrence and age. Kalaikuhna, sections 1006 and 1007; Kalaikuhna Formation, member 7, units 2 and 4, samples 22-3 and 25 (section 1006), unit 2, sample 2 (section 1007); Safetgyr, section D-172, Kalaikuhna Formation, member 7, sample 95; Upper Carboniferous, lowermost Gzhelian.

Rauserites darvasicus n. sp.

Pl. 10, fig. 7

Holotype. CGM 163a/12678. Darvaz, Kalaikuhna, section 1006, Kalaikuhna Formation, member 7, unit 2, sample 22-4; Upper Carboniferous, lowermost Gzhelian.

Material. 1 axial and 3 subaxial sections.

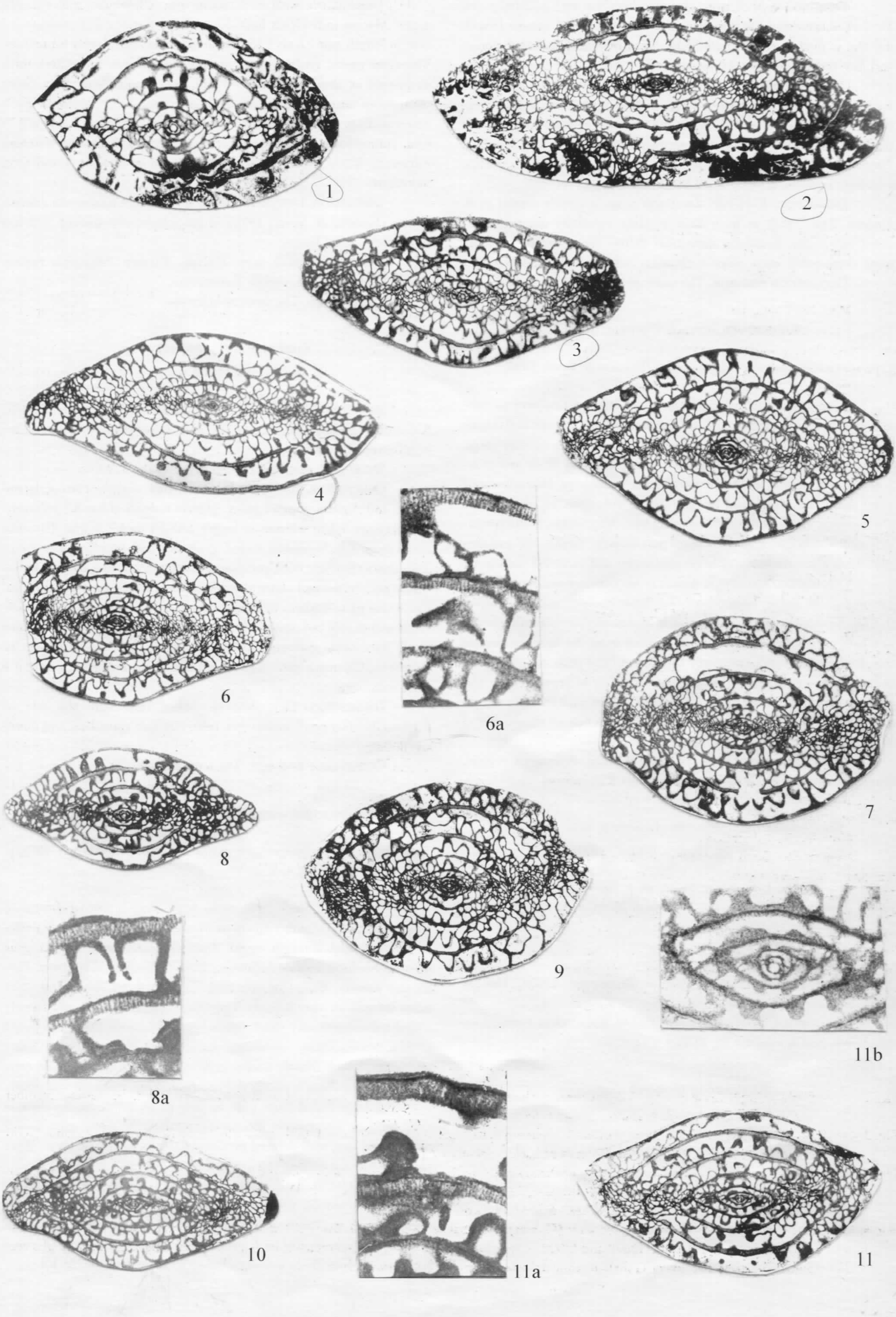
PLATE 11

Fig. 1 - *Kushanella* (?) *insueta* n. sp. Axial section of the holotype CGM 168a/12678. x 15. Section D-172, Kalaikuhna Formation, member 5, unit 2, zone *M. umbonoplicatus* - *T. kurshabensis*.

Fig. 2-4 - *Darvasoschwagerina archaica* (Leven & Scherbovich). x 10 Axial sections CGM 169a/12678, CGM 170a/12678 and CGM 171a/12678. Section D-172, Kalaikuhna Formation, member 7 (upper part).

Fig. 5-7, 9 - *Darvasoschwagerina donbasica* n. sp. 5, 6) Axial sections CGM 172a/12678 (holotype) and CGM 173a/12678. x 10. 6a) Enlargement of fig. 6. x 40. 7, 9) Axial sections CGM 174a/12678 and CGM 175a/12678. x 10. Donetz Basin, Kalinovo section, Limestone P2 ; lower Gzhelian, zone *Schagonella minor* - *Sch. proimplexa*.

Fig. 8, 8a, 10, 11, 11a, 11b - *Darvasoschwagerina satoi* (Ozawa). 8) Axial section CGM 176a/12678. x 10. 8a) Enlargement of fig. 8. x 40. 10, 11) Axial sections CGM 177a./12678 and CGM 178a/12678. x 10. 11 a, b) Enlargement of fig. 11. x 40. Donetz Basin, Kalinovo section, Limestone P2, lower Gzhelian, zone *Schagonella minor* - *Sch. proimplexa*.


1
2
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8a
11b
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11a
11

Description. Shell large, elongate-fusiform with pointed poles. Described specimen has 6 volutions and measures 7.1 mm in length, 2.0 mm in diameter; form ratio 3.55. Spirotheca composed of tectum and fine alveolar keriotheca; discontinuous outer tectorium occurs in early volutions. Thickness of spirotheca in final volution vary from 0.028 to 0.035 mm. Septa wavy across middle of shell, becoming irregularly fluted toward poles. Proloculus medium in size, with outside diameter 0.084 mm. Phrenotheca sporadically occurs in final volution. Tunnel narrow in early 3 volutions, slightly widening outwards. Chomata massive, develop in all volutions.

Discussion. *Rauserites darvasicus* n. sp. is closely similar to *R. henbesti* (Igo, 1957) as both have in early volutions discontinuous outer tectorium. *Rauserites darvasicus* differs from the latter in its more sharp poles, more massive chomata and less fluted septa.

Occurrence and age. The same as holotype.

Kushanella Leven & Davydov, n. gen.

Type species: *Kushanella daixiniformis* (Izotova & Vevel, 1998)

Diagnosis. Shell of moderate size, inflated fusiform to subglobular, with rounded to bluntly pointed poles. Mature individuals possess 3.5 to 5.5 volutions. Proloculus usually large to very large. Volutions coiled loosely throughout. Spirotheca very thick and composed of tectum and fine to coarse alveolar keriotheca. Discontinuous outer tectorium, developed in early 2 to 3 volutions, clearly indicate phylogenetic relationship of *Kushanella* with *Montiparus*. Septa irregularly and widely fluted to wavy from pole to pole. Tunnel low and narrow. Weak chomata occur only on proloculus and early 2-3 volutions.

Discussion. *Kushanella* differs from *Triticites* and *Rauserites* in its subglobular shape, large proloculus, loose coiling, and weak septal fluting. *Kushanella* at certain degree is homeomorphologically similar to *Chalaroschwagerina*, but is distinguished from the latter in smaller size, less regularly and intensively fluted septa and presence of chomata and occurrence of upper tectorium. Character of septal fluting and inflated-fusiform outline make *Kushanella* similar with *Daixina*. However *Kushanella* differs from the latter in presence of chomata and occurrence of upper tectorium.

Distribution and age. Darvaz, Eastern Pricaspian region, Donets Basin; Upper Carboniferous, middle Kasimovian.

Kushanella daixiniformis (Izotova & Vevel, 1998)

Pl. 10, figs. 8-11

1940 *Triticites* sp. 1, Putrja, p. 83-84, pl. 6, fig. 7.

1998 *Montiparus daixiniformis* Izotova & Vevel, p. 334, pl. 1, figs. e-h (pars).

Material. 8 axial sections.

Distribution and age. Eastern Pricaspian region, Donets Basin, Darvaz; Upper Carboniferous, middle Kasimovian.

Occurrence. Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 70, 71 and 1016-6.

Kushanella globosa n. sp.

Pl. 10, figs. 2, 3, 3a, 6

1998 *Montiparus daixiniformis* Izotova and Vevel, p. 334, pl. 1, fig. j (pars).

Holotype. CGM 161a/12678. Darvaz, Safetgyr, section D-172, Kalaikuhna Formation, member 5, unit 2, samples 70; Upper Carboniferous, Kasimovian.

Material. 5 axial sections.

Description. Shell moderate in size, subglobular, with rounded poles. Mature individuals have 3.5 to 5.5 volutions and measure 3.5 mm in length and 2.6 to 2.65 mm in diameter; form ratio 1.3 to 1.35. Volutions coiled gradually and loosely throughout. Spirotheca thick composed of thin, dense tectum and fine alveolar keriotheca. Septa thin, wavy across middle of shell and intensively fluted in polar extreme. Proloculus medium to large, its outside diameter 0.1 to 0.29 mm. Tunnel low and narrow in early volutions, significantly widening outwards. Weak chomata always present on proloculus 3 and early volutions.

Discussion. Described species differs from *Kushanella daixiniformis* (Izotova & Vevel, 1998) in its subglobular outline and less intensively septal fluting.

Distribution and age. Darvaz, Eastern Pricaspian region; Upper Carboniferous, middle Kasimovian.

Occurrence. The same as holotype.

Kushanella (?) **insueta** n. sp.

Pl. 11, fig. 1

Holotype. CGM 168a/12678. Darvaz, Safetgyr, section D-172; Kalaikuhna Formation, member 5, unit 2, samples 70; Upper Carboniferous, Kasimovian.

Material. 1 axial and 2 subaxial sections.

Description. Shell subglobular, with slightly convex lateral slopes and slightly pointed poles. Mature individual has 5.5 volutions and measure 4.3 to 4.5 mm in length and 2.5 to 4.7 mm in diameter; form ratio 1.7. Volutions coiled gradually and loosely throughout. Spirotheca relatively thin, composed of tectum and fine alveolar keriotheca; poorly defined outer tectorium observed in early 3 volutions. Thickness of spirotheca in final volution 0.06 mm. Septa thin, intensively and deeply but irregularly fluted from poles to poles. Proloculus small, its outside diameter 0.112 mm. Tunnel low and narrow in all volutions. Chomata narrow and high and occur on proloculus and 3 early volutions.

Discussion. Described species differs from the rest of *Kushanella* in its small proloculus, relatively thin spirotheca and intensively fluted septa.

Occurrence and age. The same as holotype.

Darvasoschwagerina Leven & Davydov, n. gen.

Type species: *Paraschwagerina archaica* Leven & Scherbovich, 1978, p. 111, pl. 21, fig.4, 5.

Diagnosis. Shell medium to large, very inflated-fusiform to almost subglobular with slightly to strongly, sometimes sharply pointed poles. Initial volution ovoid. Shell elongates gradually attaining inflated-fusiform outline beginning from second-third volution. Proloculus minute. Early 3-4 volutions coiled tightly, succeeding volutions loosely to very loosely. Transitin between tightly and loosely coiled volutions is very short. Spirotheca moderately thick, composed of thin, dense tectum, fine alveolar keriotheca and discontinuous outer tectorium, which usually occurs only in 3-4 inner volutions. In early volutions keriotheca is poorly defined. Septa thin, intensely and deeply but irregularly fluted from pole to pole in all volutions, forming in axial sections continuous interlacing particularly along axis. Tunnel narrow and low, well defined predominantly in early volutions. Weak chomata present only in the juvenarium.

Discussion. Basic morphological features of *Darvasoschwagerina* are very similar to those of *Paraschwagerina*, to where *Darvasoschwagerina* was previously assigned (Leven & Scherbovich, 1978). *Darvasoschwagerina* differs from *Paraschwagerina* in its three-layered structure of spirotheca and occurrence of chomata in early 3-4 volutions. Besides stratigraphic ranges of *Darvasoschwagerina* (lower Gzhelian) and *Paraschwagerina* (middle Asselian-Sakmarian) are quite different.

From *Carbonoschwagerina* Ozawa, Watanabe & Kobayashi, 1992 the described genus differs in intensy fluted septa in all volutions and less well developed chomata. *Carbonoschwagerina* and *Darvasoschwagerina* possess different geographical areas and possibly formed two independent phylogenic lineages developed from common ancestor. Most possibly the ancestor is the species, misinterpreted by Watanabe (1991, fig. 22-10; figs. 24 and 25) as «*Schwagerina*» *satoi* (Ozawa) from lower Hikawan (=upper Kasimovian) of Japan. Fusulinid of *Darvasoschwagerina* lineage developed in a way of transitional reduction of upper tectoria, increasing intensity and complication of septal fluting, absence of chomata and looser coiling at maturity. Fusulinids of *Carbonoschwagerina* lineage developed with reduction of upper tectoria and looser coiling at maturity. However, the reduction of chomata in this lineage proceeded slower. Most important difference is the decreasing of intensity of septal fluting in evolution of *Carbonoschwagerina*

Darvasoschwagerina is somewhat similar with *Likharevites* Davydov (in Popov et al.,1987) as both possess inflated-fusiform to globular outline of the test, minute proloculus, looselly coiled at maturity volutions and small chomata at juvenile stade. However, *Darvasoschwagerina* differs from *Likharevites* in three-layered wall structure in all volutions as opposed to two-layered wall in early volutions of *Likharevites*, in more developed chomata and in more intensely and less regularly fluted septa. *Darvasoschwagerina* also differs from *Likharevites* in character of ontogeny in test outline. *Darvasoschwagerina* possess in early volutions elongate-fusiform to fusiform outline and inflated-fusiform to subglobular outline in late volutions.Therefore form ratio of *Darvasoschwagerina* in ontogeny is decreasing. Early volutions of *Likharevites* are ovoid or globular and form ratio in ontogeny almost does not changed or increasing what is quite opposite to development of *Darvasoschwagerina*. The phylogeny of *Darvasoschwagerina* and *Likharevites* is quite different. As it was mentioned above, most probable ancestor of *Darvasoschwagerina* is «*Schwagerina*» *satoi* (Ozawa, 1925, sensu Watanabe, 1991). *Darvasoschwagerina* extinct very quickly in early Gzhelian. First *Likharevites* appeared in Orenburgian from probably some inflated *Schwageriniformis* (*Schw. vulgaris* Miklukho-Maclay group) and developed up through the Sakmarian.

Darvasoschwagerina the type-species includes a described below new species and "*Schellwienia*" *satoi* Ozawa, 1925.

Darvasoschwagerina archaica (Leven & Scherbovich, 1978)
Pl. 11, fig. 2-4

1978 *Paraschwagerina archaica* Leven & Scherbovich, p. 111, pl. 21, figs. 4, 4a, 5, 5a.

Material. 15 axial and subaxial sections.

Distribution and age. Darvaz, Donets Basin; Upper Carboniferous, lower Ghzelian.

Occurrence. Safetgyr, sections D-172 and 1016; Shokhkazak, section D-200, Kalaikuhna Formation, member 7, unit 4, sample 1016-14, sample D-172/62, and sample D-200/62, accordingly.

Darvasoschwagerina satoi (Ozawa, 1925)
Pl. 11, figs. 8, 8a, 10, 11, 11a, 11b

1925 *Schellwienia satoi* Ozawa, p. 44-45, pl. 8, figs. 4, 6a, 8.

Material. 6 axial sections.

Discussion. Some specimens we found are quite identical to specimen on Pl. 8, fig. 8 of Ozawa (1925), which was assigned by Toriyama (1958) as a lectotype of the described species. Lectotype and paratypes possess 3-layred spirotheca with outer tectorium. It was not noted and described by Ozawa (1925) or Toriyama (1958) but outer tectorium is clearly visible of photo in publications of these authors. Three-layred spirotheca is described by Watanabe (1991) in forms he assigned as «*Schwagerina*?» *satoi* (Ozawa, 1925) and included later in *Carbonoschwagerina* genus (Ozawa et al., 1992). We should note, however, that «*Schwagerina*?» *satoi* (sensu Watanabe) looks more primitive compare with lectotype of the «*Schellwienia*» *satoi* Ozawa, 1925, as they posses less intensely fluted septa and more developed and conspicuous chomata. Therefore we deny to include «*Schwagerina* ?» *satoi* (Ozawa, 1925 sensu Watanabe, 1991) into *Darvasoschwagerina satoi* (Ozawa, 1925). As it was suggested above, we believe that «*Schwagerina*?» *satoi* (Ozawa sensu Watanabe) is most probably ancestral form for both *Carbonoschwagerina* and *Darvasoschwagerina* and is taking a position transitional between *Montiparus* and *Carbonoschwagerina* in one phylogenetic lineage and between *Montiparus* and *Darvasoschwagerina* in another.

Distribution and age. Japan, Donets Basin; Upper Carboniferous, upper Kasimovian (?), lower Gzhelian.

Occurrence. Kalinovo section, Limestone P2, sample A-3/31a, lower Gzhelian, *Schagonella minor-Sch. proimplexa* fusulinid zone (Davydov, 1990).

Darvasoschwagerina donbasica n. sp.
Pl. 11, fig. 5-7, 9

Holotype. CGM 172a/12678. Donets Basin, Kalinovo section, Limestone P2, sample A-3/31a, lower Gzhelian, *Schagonella minor-Sch. proimplexa* fusulinid zone.

Description. Shell medium, very inflated-fusiform to subglobular with slightly pointed to bluntly rounded poles. Mature specimens possess of 6.5 to 7.5 volutions and measure 5.5 to 6.0 mm in length and 3.5 to 4.15 mm in diameter; form ratios 1.3-1.65. Proloculus minute, its outside diameter does not exceeds 0.08 mm. Early 3-4 volutions coiled tightly, succeeding loosely to very loosely. Rate of expansion between early and late volutions changed rapidly but relatively gradually. Spirotheca relatively thin, 3-layered, composed of tectum, fine alveolar keriotheca and outer tectorium which is wide in early volutions and gradually become thinner and discontinuous in late volutions. Thickness of spirotheca in final volution 0.07 mm. Septa thin, intensively, deeply and irregularly fluted from poles to poles. Tunnel low and narrow in early volutions and poorly defined in succeeding volutions. Small and prominent chomata occur only in early 3-4 volutions.

Discussion. The described species closely resembles *Darvasoschwagerina archaica* (Leven & Scherbovich, 1978) but differs from the latter in more rounded shell and particularly in presence of upper tectorium in its spirotheca structure. *Darvasoschwagerina donbasica* is somewhat similar with *Darvasoschwagerina satoi* (Ozawa, 1925) but differs in more inflated outline, more intensive septal fluting and less developed outer tectorium.

Occurrence and age. Donets Basin, Kalinovo section, Limestone P2, sample A-3/31a, lower Gzhelian, *Schagonella minor-Sch. proimplexa* fusulinid zone (Davydov, 1990).

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REFERENCES

Alekseev A. C., Goreva N. V., Makhlina M. Kh., Isakova T. N., Barskov I. C., Lazarev S. S., Kabanov P. B., Lebedev O. A., Shkolin A. V. & Kononova L. I. (1995) - Biostratigraphy of Middle-Upper Carboniferous boundary beds of Moscow Basin. In Klenina L. N. (Ed.) - Biostratigraphy of Middle-Upper Paleozoic of the Russian Platform, Urals and Tian-Shan, pp. 88-99, Moscow (in Russian).

Alekseeva G. E. (1960) - New species of fusulinids from the Upper Carboniferous of the Kuibyshev region. *Trudy Kuibyshevskogo Gosudarstvennogo Nauchno-issledovatelskogo Instituta Neftianoi Promyshlennosti*, 1: 175-188, Kuibyshev (in Russian).

Anosova N. A., Ektova L. A. (1972) - New Middle and Late Carboniferous *Fusulinida* from the Middle Asia. In: New species of the ancient plant and invertebrates of the USSR. Part 2. Publishing House "*Nauka*", pp. 5-19, Moscow (in Russian).

Bensh F. R. (1969) - Stratigraphy and foraminifers from the Carboniferous of the Southern Gissar. Publishing House "*FAN*", pp. 1-174, Tashkent (in Russian).

Bensh F. R. (1972) - Stratigraphy and fusulinids of the Upper Paleozoic of the South Fergana. Publishing House "*FAN*", pp. 1-147, Tashkent (in Russian).

Bogush O. I. (1963) - Foraminifers and Middle-Upper Carboniferous stratigraphy of the east part of Alay Range. Izd. Academii Nauk SSSR, pp. 1-132, Moscow (in Russian).

Brazhnikova N. E. (1939) - Studies of the foraminifers from the middle region of the Donets Basin. *Akad. Nauk USSR, Geologicheskyi Zhurnal*, 6/1-2: 252-265, Kiev (in Ukrainian).

Chen S. (1934) - Fusulinidae of South China. Pt. 1. *Paleontol. Sinica*, B, 4/ 2: 1-185. Peiking.

Chen Z. (1963) - On morphology and systematic of the genera *Protriticites*, *Quasifusulinoides* and *Obsoletes* from the middle/upper Carboniferous boundary beds. *Voprosy mikropaleontologii*, 7: 71-84, Moscow (in Russian).

Colani M. (1924) - Nouvelle contribution a l'étude des Fusulinidés de l'Extreme-Orient. *Mém. Serv. Géol. Indochine*, 11/ 1: 1-191, Hanoi.

Davydov V. I. (1982) - Zonal and stage units based on the Upper Carboniferous fusulinids of Southwestern Darvas. *Ph. D. Abstract*, p. 1-20 Leningrad (in Russian).

Davydov V. I. (1984) - Zonal subdivision of the Upper Carboniferous in Southwestern Darvaz. *Bull. Moskovskogo obshestva ispytatelei prirody. Otdel geologicheskyi*, 59/ 3: 41-57, Moscow (in Russian).

Davydov V. I. (1986a) - Fusulinids of Carboniferous/Permian boundary beds of Darvaz. In Chuvashov et al. (Eds.) - Carboniferous/Permian boundary beds of the Urals, Pre-Urals and central Asia. Publishing House. "*Nauka*", pp. 103-125, Moscow (in Russian).

Davydov V.I. (1986b) - On phylogenetic criteria of evaluation of features in systematics of foraminifera (exemplified on fusulinids). Third Intern. Symp. Benthic Foraminifera, Abstr., p. 35, Genève.

Davydov V. I. (1989) - On the correlation of the Upper Carboniferous fusulinid and ammonoid scales. *Izvestia Akademii Nauk SSSR. Geol. Ser.*, 5: 123-126, Moscow (in Russian).

Davydov V. I. (1990) - The precision of the phylogenetic origin of *Triticites* and the problem of Middle-Upper Carboniferous boundary. *Paleontologicheskyi Zhurnal*, 2:. 13-25, Moscow (in Russian).

Davydov V. I. (1995) - Middle/ Upper Carboniferous boundary: the problem of definition and correlation. *Abstr. XIII Intern. Congress on the Carboniferous and Permian*, pp. 28-29. Krakow.

Davydov V. I. (1997) - Middle/Upper Carboniferous Boundary: the problem of definition and correlation. *Proc. XIII International Congress on the Carboniferous and Permian*, pp. 113-122. Krakow.

Davydov V. I. (1999) - Still contradictions: Moscovian-Kasimovian boundary problems. *Newsletter on Carboniferous stratigraphy*, 17: 18-22, Armidale.

Davydov V. I.& Krainer K. (1999) - Fusulinid assemblages and facies of the Bombaso Formation and basal Meledis Formation (Moscovian - Kasimovian) in the Central Carnic Alps (Austria/ Italy). *Facies*, 40: 157-196, Erlangen.

Davydov V. I. & Nilsson I. (1999) - Fusulinids in the Middle-Upper Carboniferous Boundary Beds on Spitsbergen, Artctic Norway. *Paleontologia Electronica*, 2, 1, http://www-odp.tamu.edu/paleo/index.html.

Deprat J. (1913) - Étude des Fusulinidés de Chine et d'Indochine. Les Fusulinidés des calcaires carbonifériens et permiens du Tonkin, du Laos et du Nord-Annam. *Service géol. Indochine, Mém.*, 2: 1-74, Hanoi-Haiphong.

Dunbar C. O., Henbest L. G. (1930) - The fusulinid genera *Fusulina*, *Fusulinella* and *Wedekindella*. *Am. Jour. Sci, ser.* 5, 20: 357-364, New Haven.

Dutkevich G. A. (1934) - On some new species of Middle and Late Carboniferous fusulinidis from the Verhne-Chusovskie Gorodki (Chusovaja River, west Ural). *Trudy Neftianogo Geologo-razvedochnogo Instituta*, 36: 3-98, Leningrad (in Russian).

Dutkevich G. A. & Kalmykova M. A. (1937) - New data on the Upper Paleozoic stratigraphy of the North Pamir and Darvaz. In: Tadzhiksko-Pamirskaia ekspeditsia 1935 goda. *Izd. Akademii Nauk SSSR*, p. 801-830 (in Russian). Moscow-Leningrad.

Fursenko A. V. (1958) - Main stages of foraminiferal evolution on the geological past. *Trudy Instituta geologicheskyh nauk Akademii Nauk Belorusskoi SSR*, 1: 10-29, Minsk (in Russian).

Ginkel A. C. van (1965) - Carboniferous fusulinids from the Cantabrian Mountains (Spain). *Leidse Geol. Meded.*, 34: 1-223, Leiden.

Ginkel A. C. van & Villa E. (1999) - Late fusulinellid and early schwagerinid foraminifera: relationships and occurrences in the Las Llacerias section (Moscovian/Kasimovian, Cantabrian Mountains, Spain). *Journ. Foraminiferal Research*, 29/3: 263-290, Cambridge.

Girty G. H. (1904) - *Triticites*, a new genus of Carboniferous Foraminifera. *Amer. J. Sci, ser. 4*, 17: 234-240, New Haven.

Igo H. (1957) - On a remarkable *Triticites* from the pebbles of the Sorayama conglomerate, Fukuji, south-eastern part of the Hida Massif, Central Japan. Japanese Journ. *Geol. Geogr.*, 28/4: 239-246, Tokyo.

Ivanova E. A. & Khvorova I. V. (1955) - Stratigraphy of the Middle and Upper Carboniferous of the western part of Moscowian Syneclize. *Acad. Sci. USSR. Paleontological Institute, Transactions*, 53/1: 1-278, Moscow (in Russian).

Ivanova E. A. & Rozovskaya S. E. (1967) - On biostratigraphy of the Upper Carboniferous of Russian Platform in the light of stratotype's study. *Bull. Moskovskogo obshestva ispytatelei prirody. Otdel geologicheskyi*, 42/5: 86-99, Moscow (in Russian).

Izotova M. N. & Vevel Ya. A. (1998) - New species of fusulinoids from the Eastern Caspian Sea region. *Paleontologicheskyi Zhurnal*, 32/4: 11-14, Moscow (in Russian).

Kagramanov A.Kh. & Donakova L.M. (Eds.) (1990) - Resolution of the Interdipartmental regional stratigraphic meeting on the Middle and Upper Paleozoic of the Russian Platform. Carboniferous System. VSEGEI, pp. 3-40, Leningrad (in Russian).

Kireeva G. D. (1950) - New species of fusulinids from the limestone-formations C31 and C32 in the Donets Basin. Publishing House "*Ugletekhizdat*", pp. 193-218, Moscow-Khar'kov (in Russian),

Krainer K. & Davydov V.I. (1998) - Facies and biostratigraphy of the Late Carboniferous/Early Permian sedimentary sequence in the Carnic Alps (Austria/Italy), in Crasquin-Soleau, S., Izart, D., & De Wever, P. (Eds.) - Peri-Tethys stratigraphic correlation 2, *Geodiversitas*, 20/4: 643-662, Paris.

Lee J. S., Chen S. & Chu S. (1930) - The Huanglung Limestone and its fauna. *Nat. Research Inst. Geol., Mem.*, 19: 85-143. Nanking.

Leven E. Ja. (1974) - Biostratigraphy of the Upper Paleozoic of southwestern Darvaz. *Izvestia Akademii Nauk SSSR, Ser. Geol.*, 3: 55-62, Moscow (in Russian).

Leven E. Ja. (1980) - The Bolorian Stage of the Permian System: establishment, characteristics, and correlation. *Int. Geol. Rev.*, 22/5: 587-597. (English edition).

Leven E. Ja. (1981) - Upper Paleozoic of the Charymdara, Gundara and Zidadara valleys (SE Darvaz). *Bull. Moskovskogo obshestva ispytateley prirody. Otdel geologicheskyi*, 56/4: 40-52, Moscow (in Russian).

Leven E. Ja. (1982) - The Permian Yakhtashian Stage: its basis, characteristics, and correlation. *Int. Geol. Rev.*, 24/ 8: 945-954, Moscow. (English edition).

Leven E. Ja. (1998) - Stratigraphy and fusulinids of the Moscovian (Middle Carboniferous) in the southwestern Darvaz. *Riv. It. Paleont. Strat.*, 104/1: 3-42, Milano.

Leven E. Ja.& Davydov V. I. (1986) - Upper Carboniferous and the Carboniferous/Permian boundary beds in Darvaz. In: Chuvashov et al.(Eds.) - Carboniferous/Permian boundary beds of the Urals, Pre-Urals and Central Asia. Publishing House "*Nauka*", pp.33-48, Moskow (in Russian).

Leven E. Ja & Davydov V. I. (1991) - The boundaries and the volume of the lower Asselian fusulinid zone. *Izvestia Academii Nauk SSSR, geol. ser.*, 12: 61-73, Moscow (in Russian).

Leven E. Ja., Leonova T. B. & Dmitriev V. Yu. (1992) - The Permian System in the Darvaz-Transalay zone of Pamir: fusulines, ammonoids, stratigraphy. *Acad. Sci. USSR. Paleontological Institute. Transactions*, 253: 1-203, Moscow (in Russian).

Leven E. Ja. & Scherbovich S. F. (1978) - Fusulinids and stratigraphy of the Asselian Stage of Darvaz. Publishing House "*Nauka*", p. 1-162, Moscow (in Russian).

Leven E. Ja. & Scherbovich S. F. (1980) - Fusulinid assemblages from the Sakmarian Stage of Darvaz. *Voprosy micropaleontologii*, 23: 71-85, Moscow (in Russian).

Liem N. V. (1966) - New Fusulinids from Quy Dat, Central Vietnam. *Acta Sci. Vietnam. Sect. Biol., Geogr., Geol.*, 1: 45-48, Hanoi.

Miklukho-Maclay A. D. (1948) - Significance of foraminifera for Upper Paleozoic stratigraphy of the Tethys. *Scientific Bulletin of Leningrad State University*, 21: 15-21, Leningrad (in Russian).

Miklukho-Maclay A. D. (1949) - Upper Paleozoic fusulinids of Middle Asia (Fergana, Darvaz and Pamir). *Izd. Leningradskogo Gosudarstvennogo Universiteta*, pp. 1-126, Leningrad (in Russian).

Miklukho-Maclay A. D. (1950) - *Triticites ferganensis* sp. nov. from the Upper Carboniferous of the Karachatyr range (Southern Fergana). *Uchenye zapiski Leningradskogo Universiteta, Ser. Geol.*, 1/102: 59-69, Leningrad (in Russian).

Miklukho-Maclay A. D. (1959) - Systematic and philogeny of fusulinids. (*Triticites* and its relative genera). *Vestnik Leningradskogo Gosudarstvennogo Universiteta*, 1/16: 6-21, Leningrad (in Russian).

Moeller V. von (1878) - Spiral-coiled foraminifers from the Carboniferous limestone of Russia. *Materialy dlia geologii Rossii*, 8: 1-207, St. Petersbourg (in Russian).

Nilsson I. & Davydov V. I. (1993) - Middle Carboniferous-Lower Permian fusulinid stratigraphy in Spitsbergen, Arctic Norway - A framework for correlation in the Arctic. *Abstr. Progr. Pangea Conference*, p. 223, Calgary.

Ozawa Y. (1925) - On the classification of Fusulinidae. *J. Coll. Sci. Imp. Univ. Tokyo*, 45/ 4: 1-26, Tokyo.

Ozawa T., Watanabe K. & Kobayashi F. (1992) - Morphologic evolution in some schwagerinid and schubertellid lineages and the definition of the Carboniferous-Permian boundary. In: Takayanagi Y. & Saito T. (Eds.) - Studies in Benthic Foraminifera. *Proc. IV Intern. Symp. Benthic Foraminifera*, pp. 389-401, Sendai.

Popov A. V., Davydov V. I.& Kosovaya O. L. (1987) - Stratotypes and fauna of unified horizons of the Upper Carboniferous/ Lower Permian in Central Asia. *Publ. All-Union Scient. Inst. Information*, n. 2434-V-87, pp. 1-221, Moscow (in Russian).

Putrja F. S. (1939) - The materials on stratigraphy of the

Upper Carboniferous of eastern part of Donets Basin. *Azovo-Chernomorsky Geological Department. Materials on Geology and Mining*. 10: 97-156, Rostov na Donu (in Russian).

Putrja F. S. (1940) - Foraminifers and stratigraphy of the Upper Carboniferous deposits of the east part of Donets Basin. *Materialy po geologii i poleznym iskopaemym*, 11: 1-146, Rostov na Donu (in Russian).

Putrja F. S. (1948) - *Protriticites* - a new genus of fusulinids. *Trudy L'vovskogo Geologicheskogo obshestva pri Gosudarstvennom universitete imeni I. Franko, Pal. Ser.*, 1: 89-96, L'vov (in Russian).

Putrja F. S. (1956) - Stratigraphy and foraminifers of the Middle Carboniferous deposits of the east Donets Basin. Microfauna SSSR, t. 8, *Trudy VNIGRI, Gostoptehizdat*, pp.333-485, Leningrad (in Russian).

Rauser-Chernousova D. M. (1938) - The Upper Paleozoic Foraminifera of the Samara Bend and the Trans-Volga Region. *Acad. Sci. USSR, Geological Institute, Transactions*, 7: 69-167, Moscow (in Russian).

Rauser-Chernousova D. M. (1958) - Experience of superdetail subdivision of the Upper Carboniferous section in the Kuibyshev Hydro-electric power-station (HEPS) area. *Acad. Sci. USSR, Geological Institute, Transactions*, 13: 121-138 Moscow (in Russian).

Rauser-Chernousova D. M., Belyaev G. M. & Reitlinger E. A. (1940) - On Carboniferous Foraminifera from the Samara Bend. *Trudy Neftianogo Geologo-Razvedochnogo Instituta*, nov. ser., v. 7, Publishing House "Gostoptekhizdat", p. 1-88, Leningrad-Moscow (in Russian).

Rauser-Chernousova D. M., Bensh F. R., Vdovenko M. V. et al. (1996) - Reference-book on the systematics of Paleozoic foraminifera (Endothyroida, Fusulinoida). Publishing House "*Nauka*", pp. 1-207, Moscow (in Russian).

Rauser-Chernousova D. M., Grozdilova N. D., Kireeva G. D., Leontovich G. E., Safonova T. P. & Chernova E. I. (1951) - Middle Carboniferous fusulinids of the Russian Platform and neighbouring regions. *Izd. Akademii Nauk SSSR*, pp. 1-280, Moscow (in Russian).

Rauser-Chernousova D. M.& Fursenko A. V. (eds.) (1959) - Foundations of paleontology. T. 1, *Izd. Akademii Nauk SSSR*, pp. 1-482, Moscow (in Russian).

Rauser-Chernousova D. M. & Scherbovich S. F. (1974) - Some problems of Kasimovian Stage in light of fusulinid investigation. *Izvestia Akademii Nauk SSSR, Ser. Geol.*, 6: 100-108, Moscow (in Russian).

E. A. (1963) - One major paleontological criteria examplified on foraminifera for establishing of the base of lower Carboniferous Series. *Voprosy micropaleontologii* , 7: 22-57, Moscow (in Russian).

Remizova S. T. (1992) - Micropaleontological definition of the boundary between the Middle and the Late Carboniferous. Scient. Rep. *KOMI sect. Russian Ac. Sciences*, 285: 3-19, Syktyvkar (in Russian).

Remizova S. T. (1995) - Foraminifers and biostratigraphy of Upper Carboniferous of Nort Timan. *Kom. Scientific Center of Uralian branch of Russian Acad. Sci.*, pp. 3-128. Syktyvkar (in Russian).

Rozovskaya S. E. (1948) - Classification and systematic features of *Triticites* genus. *Doklady Akademii Nauk SSSR*, 59/ 9: 1635-1638, Moscow (in Russian).

Rozovskaya S. E. (1950) - Genus *Triticites*, its development and stratigraphic significance. *Acad. Sci. USSR, Paleontological Institute, Transactions*, 26: 1-79, Moscow-Leningrad (in Russian).

Rozovskaya S. E. (1952) - Upper Carboniferous and Lower Permian fusulinids of Southern Ural. *Acad. Sci. USSR, Paleontological Institute, Transactions*, 40: 1- 50, Moscow (in Russian).

Rozovskaya S. E. (1958) - Fusulinids and biostratigraphy of the Upper Carboniferous deposits of the Samara Bend. *Acad. Sci. USSR, Geological Institute, Transactions*, 13: 57-120, Moscow (in Russian).

Rozovskaya S. E. (1975) - Composition, phylogeny and system of the order Fusulinida. *Acad. Sci. USSR, Paleontological Institute, Transactions*, 149: 1-267, Moscow (in Russian).

Sakagami S., Omata T. (1957) - Lower Permian fusulinids from Shiraiwa, northwestern part of Ome, Nishitama-Gun, Tokyo-To, Japan. *Journ. Geol. Geogr.*, 28/ 4: 247-264, Tokyo.

Schellwien E. (1898) - Die Fauna des karnischen Fusulinenkalks. Teil. 2: Foraminifera. *Paleontographica*, 44: 237-282, Stuttgart.

Schellwien E. (1908) - Monographie der Fusulinen. Teil 1: Die Fusulinen des russisch-arktischen Meeresgebietes. *Palaeontographica*, 55: 145-194, Stuttgart.

Scherbovich S. F. (1969) - Late Gzhelian and Asselian fusulinids of the Cis-Caspian Syneclise. *Acad. Sci.USSR, Geological Institute, Transactions*, 176: 1-82, Publishing House "*Nauka*", Moscow (in Russian).

Schlykova G. N. (1948) - Upper Carboniferous fusulinids of Samara Bend. *Trudy Vsesoiuznogo Neftianogo Nauchno-issledovatelskogo Geologorazvedochnogo Instituta (VNIGRI). n. ser.*, 31/1: 109-135, Publishing House "Gostoptehizdat", Moscow-Leningrad (in Russian).

Skinner J. W. (1931) - Primitive fusulinids of the Mid-Continent region. *Jour. Paleontol.*, 5: 253-259, Lawrence.

Solovieva M. N. (1980) - Mutation as an field described by discordant correlation and some problems of foraminifera systematic. *Voprosy mikropaleontologii*, 23: 3-22, Moscow (in Russian).

Solovieva M. N. (1985) - Curator report. Report of commission on micropaleontology. Preprint, *Acad. Sci. USSR, Geological Institute*, p. 1-47, Moscow (in Russian).

Staff H. & Wedekind R. (1910) - Der obercarbonische Foraminiferen-Sapropelit Spitzbergens. *Uppsala Univ. Geol. Inst. Bull.*, 10: 81-123, Uppsala.

Suleimanov I. S. (1949) - New species of the fusulinids of the subfamily Schubertellinae Skinner from the Carboniferous and Lower Permian deposits of the Bashkirian Cis-Ural. *Acad. Sci.USSR, Geological Institute, Transactions*, v. 105, *Geol. Ser.*, 35: 22-43, Moscow (in Russian).

Thompson M. L. (1935) - The Fusulinid genus *Staffella* in America. *J. Paleont.*, 9/2: 113-115, Lawrence.

Thompson M. L. (1937) - Fusulinids of the subfamily *Schubertellinae*. *J. Paleont.*, 11/2: 118-125, Lawrence.

Thompson M. L. (1965) - Pennsylvanian and Early Permian fusulinids Fort St. James area, British Columbia. *J. Paleont.*, 39/2: 126-144, Tulsa.

Toriyama R. (1958) - Geology of Akiyoshi. Part 3. Fusulinids of Akiyoshi. *Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology*, 7: 1-264, Fukuoka.

Villa E. (1989) - Fusulinaceos carboniferos del este de Asturias (Norte de Espana). *Servicio de Publicaciones, Universidad de Oviedo, Tesis Doctorales*, pp. 1-378.

Vlasov N. G. & Miklukho-Maclay A. D. (1959) - New data on the Carboniferous stratigraphy of the southwest Darwaz. *Dokl. Akad. Nauk SSSR*, 129/ 5: 1110-1113, Moscow (in Russian).

Volozhanina P. P. (1962) - Fusulinids from the Timan-Petchora Region. *Voprosy mikropaleontologii*, 6: 116-146, Moscow (in Russian).

Watanabe K. (1991) - Fusuline biostratigraphy of the Upper Carboniferous and Lower Permian of Japan, with special reference to the Carboniferous-Permian boundary. *Paleont. Soc. Japan, Special paper*, 32: 1-150, Fukuoka.