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FUSULINOIDEAN FAUNAS FROM THE UPPER CARBONIFEROUS AND LOWER PERMIAN PLATFORM LIMESTONE IN THE HADIM AREA, CENTRAL TAURIDES, TURKEY

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Abstract. Sixty-one species assignable to 31 genera of Late Carboniferous and Early Permian fusulinoideans were distinguished from the Hadim area, central Taurides, Turkey. They are biostratigraphically divided into eleven zones in ascending order: *Protriticites variabilis*, *Montiparus umbonoplicatus* and *Schwageriniformis schwageriniformis* zones in the Kasimovian; the *Jigulites* aff. *formosus*, *Daixina asiatica* and *Rugosofusulina* sp. A zones in the Gzhelian; *Paraschwagerina* sp. and *Dutkevichia complicata* zones in the Asselian; *Paraschwagerina pseudomira* and *Robustoschwagerina nucleolata* zones in the Sakmarian; and the *Dunbarula*? sp. zone of possible Artinskian age. Basal Kasimovian strata, Kasimovian-Gzhelian boundary strata and lower Asselian strata are missing due to erosion and/or non-deposition on the basis of faunal analysis of these fusulinoideans.

Among the described species, newly proposed herein are *Eoparafusulina brevis*, *Robustoschwagerina hadimensis*, *Pseudoschwagerina globosa*, and *Pseudoschwagerina ozguli*. *E. brevis* is thought to be phylogenetically related to the *Monodiexodina* lineage along with *E. ferganica*. *R. hadimensis* represents a small form of the genus. *P. globosa* showing *Sphaeroschwagerina*-like appearance has a distinct *Triticites*-type juvenarium suggesting a specialized descendant derived from an Asselian *Pseudoschwagerina*. *P. ozguli* is distinguished from most of known species of *Pseudoschwagerina* by its smaller test and its occurrence from the Sakmarian.

Riassunto. Sessantuno specie di fusulinoidea riferibili a 31 generi del Carbonifero superiore o del Permiano inferiore sono state identificate in due sezioni misurate nell'area di Hadim, nei Tauridi centrali, in Turchia. Sono stati classificati biostratigraficamente in 11 zone. In ordine ascendente esse sono: le zone a *Protriticites variabilis*, *Montiparus umbonoplicatus* e *Schwageriniformis schwageriniformis* del Kasimoviano; le zone a *Jigulites* aff. *formosus*, *Daixina asiatica* e *Rugosofusulina* sp. A riferite allo Gzheliano; le zone a *Paraschwagerina* sp. e *Dutkevichia complicata* per l' Asseliano; le zone a *Paraschwagerina pseudomira* e *Robustoschwagerina nucleolata* per il Sakmariano; e infine la zona a *Dunbarula*? sp. forse riferibile all'Artinskiano. Sulla base dei fusulinoidea, risultano assenti per erosione o mancata deposizione i livelli riferibili al Kasimoviano basale, all'intervallo intorno al limite tra Kasimoviano e Ghzeliano e quelli dell' Asseliano inferiore.

Tra le specie descritte, sono qui proposte come nuove *Eoparafusulina brevis*, *Robustoschwagerina hadimensis*, *Pseudoschwagerina globosa*, e *Pseudoschwagerina ozguli*. *E. brevis* viene ritenuta filogeneticamente connessa con la linea evolutiva di *Monodiexodina* insieme a *E. ferganica*. *R. hadimensis* rappresenta una forma piccola per il genere. *P. globosa* che ha aspetto di *Sphaeroschwagerina*, tuttavia contiene uno juvenarium del tipo *Triticites*, suggerendo una derivazione specializzata da una *Pseudoschwagerina* di età Asseliana. *P. ozguli* si distingue dalla maggior parte delle specie conosciute di *Pseudoschwagerina* per la sua theca più piccola e la sua distribuzione nel Sakmariano.

Introduction

The Tauride Block in Turkey is generally composed of a south-vergent nappe pile comprising the Paleozoic and Mesozoic carbonates intercalated with terrigeneous rocks. Pre-Triassic rocks were deposited on the Gondwana margin facing the Paleo-Tethys Ocean, and later Mesozoic ones on a continental block drifting through the Neo-Tethys until its enclosure which lasted from Late Cretaceous to Miocene times. In the central part of the Tauride Block (Figs. 1, 2), Özgül distinguished a four-layered nappe structure consisting of an autochthonous and three allochthonous tectonic units of different ages from Late Cambrian to Early Cretaceous, dominantly made up of carbonate platform-type limestones (Özgül 1976, 1984, 1997; Altiner & Özgül 2001).

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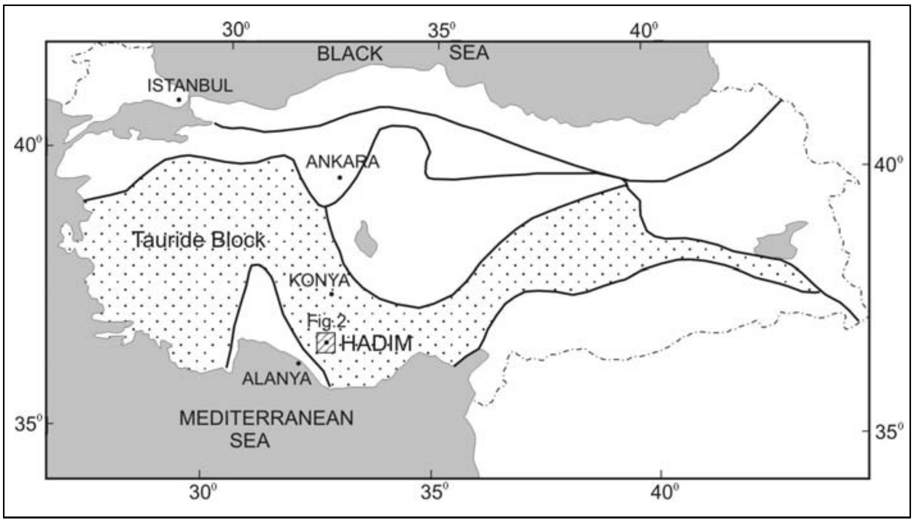


Fig. 1 - Index map showing the Neo-Tethyan sutures in Turkey and the location of the studied area (Hadim) in the Tauride Block.

Late Paleozoic fossils of the Tauride Block have particular paleogeographic and tectonic implications in close relation to Gondwana glaciation from the Moscovian to Asselian and plate movements of Neo-Tethyan terranes (Kobayashi & Altiner 2008). We have studied the stratigraphy and fusulinoideans of the Upper Carboniferous-Lower Permian strata in the Hadim area, central part of the Tauride Block (Fig. 2). The Kasimovian to possibly Artinskian limestone sequences are biostratigraphically divided into eleven fusulinoidean zones according to the chronostratigraphy based on fusulinoideans of 61 species in 31 genera (Kobayashi & Altiner 2008).

This paper is focused on the systematic paleontology of fusulinoideans from the Hadim area. Prior to the description and discussion of these species, biostratigraphy, correlation, and age of each zone are summarized. Among the described species, *Eoparafusulina brevis*, *Robustoschwagerina hadimensis*, *Pseudoschwagerina globosa*, and *Pseudoschwagerina ozguli* are newly proposed herein. *Robustoschwagerina regularis* (Ciry, 1943) is redescribed on the basis of well-preserved specimens. More than 2,000 limestone thin sections used in this study are registered and stored in the Museum of Nature and Human Activities, Hyogo, Japan (Fumio Kobayashi Collection).

Biostratigraphy, correlation, and age assignment

Based on the stratigraphic distribution of 61 species in 31 genera, the Units A to E of the A-A' section in the Hadim area are biostratigraphically divided into nine fusulinoidean zones, all of which are defined by the first occurrence of the zonal species (Fig. 3). *Robustoschwagerina nucleolata* and *Dunbarula*? sp. zones are designated for the Units F to H of the B-B' section (Fig.4). Faunas of the Hadim area were compared and correlated with those of the stratotype regions of the Moscow Basin in the Upper Carboniferous and of the Southern Urals in the Lower Permian, and of other regions including the Carnic Alps, Timan-Pechora Basin, southern Fergana and southwest Darvas by the use of many important literatures (e.g., Rauser-Chernousova & Scherbovich 1958; Rozovskaya 1958; Grozdilova & Lebedeva 1961; Grozdilova 1966; Bensh 1972; Rauser-Chernousova et al. 1979; Davydov 1986; Popov et al. 1989; Kahler & Krainer 1993; Forke 2002). Age assignment of each zone was based on the biostratigraphy by fusulinoideans, though it is occasionally somewhat different from that by conodonts (Kobayashi & Altiner 2008).

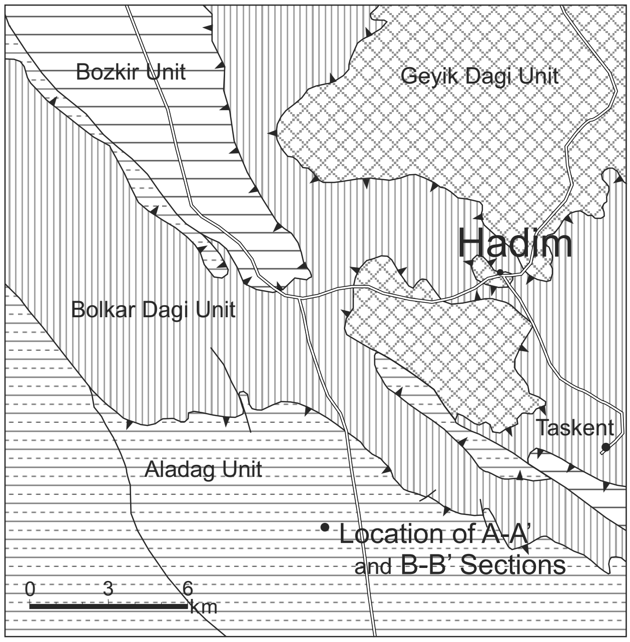


Fig. 2 - Index map showing the location of the investigated A-A' and B-B' sections and the structural relation of four thrust-bounded tectonic units (after Altiner & Özgül 2001).

Upper Carboniferous

The ***Protriticites variabilis* Zone** in the lowest part of the A-A' section is marked by the exclusive occurrence of the zonal species in this zone and is early Kasimovian in age. *Protriticites variabilis* was originally described by Bensh (1972) from the *Protriticites pseudomontiparus-Obsoletes obsoletus* Zone of southern Fergana that corresponds to the Lower Kasimovian in the stratotype region. The basal part of the A-A' section, however, possibly does not attain to the Moscovian-Kasimovian boundary because of the absence of *Obsoletes obsoletus* in this zone and the section is not extended to the bed with typical Moscovian fusulinoideans.

The ***Montiparus umbonoplicatus* Zone** is dated to be the middle Kasimovian and correlated to the *Montiparus montiparus* Zone throughout the Tethyan regions because of the occurrence of the zonal species and its association with *M. montiparus* and *M. paramontiparus*.

The ***Schwageriniformis schwageriniformis* Zone** is characterized by the occurrence of the zonal species, and by *Schwageriniformis asiaticus* and *Rauserites sinuosus* both of which are restricted to calcarenite and calcareous sandstone facies of the middle part of this zone (Fig. 3). The late Kasimovian age of this zone is highly probable based on the original description of *S. schwageriniformis* from the middle and upper parts of the Kasimovian of Samara Bend (Rauser-Chernousova 1938) and *S. asiaticus* and its synonymous species from the upper Kasimovian to lower Gzhelian of southern Fergana (Bensh 1962; 1972), and *R. sinuosus* from the middle and upper parts of the Kasimovian in the Murom area of the Moscow Basin (Rozovskaya 1950).

Schubertella donetzica and *Ozawainella rhomboidalis* are restricted to the Kasimovian. *Fusiella lancetiformis* and *Quasifusulina longissima* occur in the lower part, and middle and upper parts of the Kasimovian, respectively (Fig. 3).

Ferganites ferganensis (Miklukho-Maklay, 1950) is common in arenaceous limestones in Central Asia (Bensh 1972; Leven & Davydov 2001), the Carnic Alps (Krainer & Davyvov 1998) and the Cantabrian Mountains (Villa & Bahamonde 2001). *Rauserites rossicus* is widespread in the lowest Gzhelian in Europe and Central Asia. These two species are not found in the Hadim area. The Kasimovian-Gzhelian boundary strata, corresponding biostratigraphically to the *Rauserites irregularis* and *Rauserites rossicus* zones in the Moscow Basin (Rauser-Chernousova et al. 1979) are probably missing in the studied section (fig. 5 in Kobayashi & Altiner 2008). Faunal similarity among the Hadim area, European Russian, and Central Asian to the Mediterranean Sea regions decreases in the Gzhelian. Forms referrable to *Jigulites jigulensis, Daixina sokensis, D. robusta*, and *D. bosbytauensis*, diagnostic in the middle and upper parts of the Gzhelian of European Russia were not distinguished in the studied section.

The ***Jigulites* aff. *formosus*** and the ***Daixina asiatica* Zones** in the Hadim area are poor in fusulinoideans and in species diversity of schwagerinids. The former zone is correlated to the *Rauserites stuckenbergi* Zone and the *Jigulites jigulensis-J. longus* Zone of the Moscow Basin (fig. 5 in Kobayashi & Altiner 2008) and is thought to be early Gzhelian in age on the co-existence of *J.* aff. *formosus* and *R. stuckenbergi* in the basal part and *J.* aff. *formosus* in the upper part of this zone (Fig. 3). The latter zone is possibly equivalent to the upper part of the *D. asiatica* Zone of southern Fergana (Bensh 1972) and is correlatable to the middle Gzhelian of the Moscow Basin in spite of poor biostratigraphic data in the Hadim area.

Correlation of the ***Rugosofusulina* sp. A Zone** is not easy. This zone is, however, tentatively correletive to the uppermost Gzhelian *Daixina robusta* Zone in the Moscow Basin based on the distribution of schwagerinids in the studied section and on the occurrence of *Rugosochusenella shagoniensis* that was originally described by Davydov (1986) from the *Daixina bosbytauensis-D. robusta* Zone of southwest Darvas. *Quasifusulina nimia*, highly prolific in the Hadim area, first appears in this zone.

Some of the identified Carboniferous species in the Hadim area are well-known and widespread in the stratotype regions of the Moscow Basin and important localities of Timan-Pechora Basin, Southern Urals, Carnic Alps, southern Fergana, and southwest Darvas. On the other hand, characteristic species reliable for biostratigraphic correlation between the studied section and the Upper Carboniferous stratotype are restricted in our materials and chronostratigraphic calibration within the Gzhelian Stage is not easy.

Lower Permian

Further decrease of faunal similarities in the Asselian and Sakmarian than in the Gzhelian results more difficulties of correlation and detailed age assignment between the Hadim area and stratotype region of the Southern Urals (Rozovskaya 1952; Davydov 1986). In general, fusulinoidean faunas in the Hadim area are still similar to those of other Mediterranean Sea and Central Asian regions.

Taxonomic diversity and abundance of foraminifers gradually increase in the ***Paraschwagerina* sp. Zone**. This zone is marked by the first appearance of the inflated schwagerinid genera of *Paraschwagerina* and *Pseudoschwagerina*. *Paraschwagerina* sp., *Pseudoschwagerina robusta* and *Paraschwagerina kokpectensis* are restricted to this zone. They are unlike most species in these genera reported from the stratotype area of the

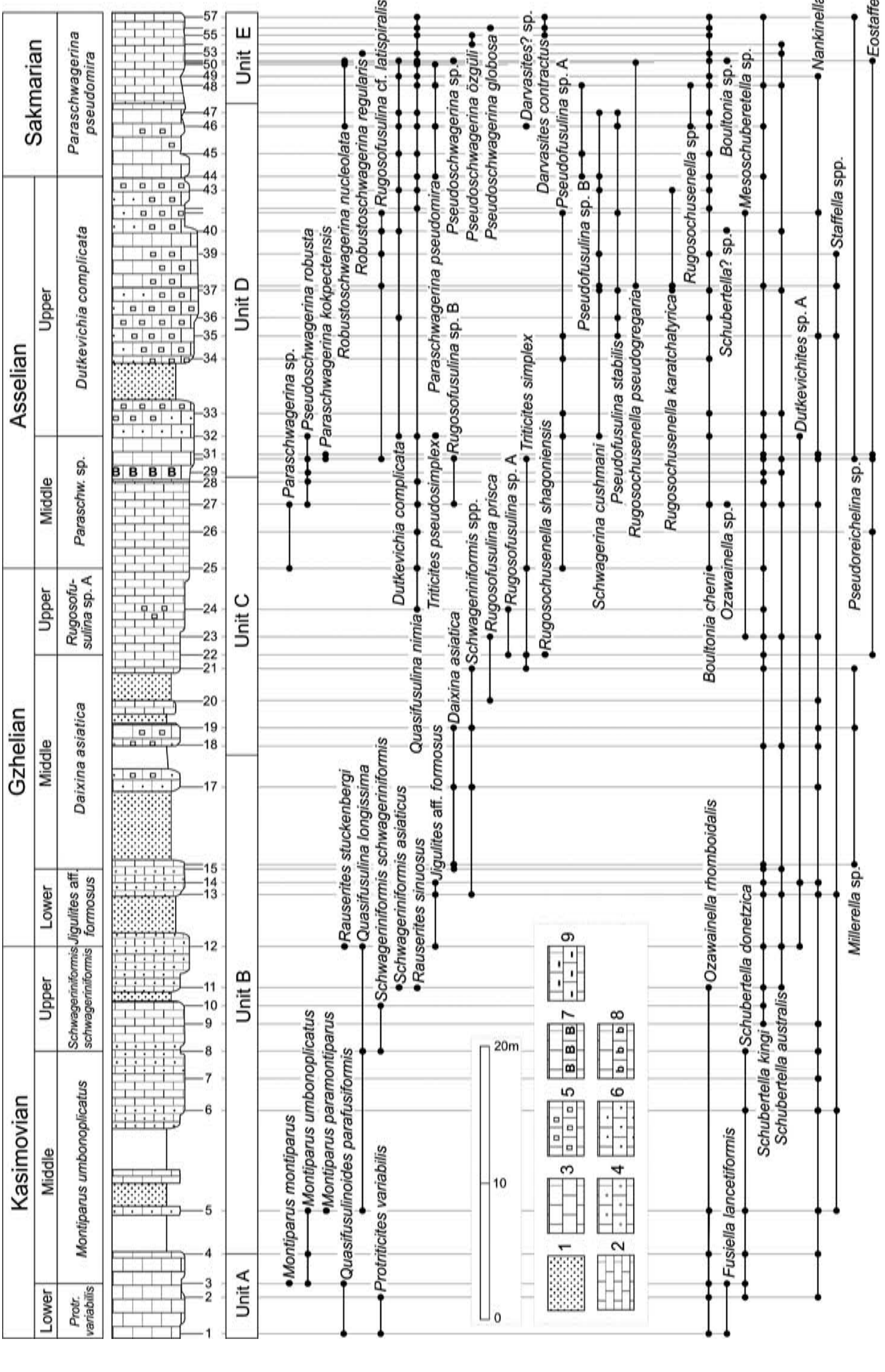


Fig. 3 - Stratigraphic division, and biostratigraphic zonation based on stratigraphic distribution of fusulinoideans in the A-A' section. 1: sandstone, 2: thinly bedded limestone, 3: thickly bedded limestone, 4: oolitic limestone, 5: oncoidal limestone, 6: limestone containing detrital quartz grains, 7: brachiopod limestone, 8: bivalve limestone, 9: lime-mudstone nearly barren in fossils. Numbers 1 to 57 on the right side of the columnar section show the sample numbers (after Kobayashi & Altiner 2008).

Asselian (e.g. Rauser-Chernousova & Scherbovich 1949). Species similar to *Paraschwagerina* sp. and *Pseudoschwagerina robusta* are known from the Grenzland Formation (Asselian to Sakmarian) of the Carnic Alps and the Dovamova soteska Formation of the Slovenian Southern Karavanke Mountains (Kahler & Kahler 1937; Kahler 1983; Forke 2002), Asselian of Croatia (Kochansky-Devidé 1959) and middle Asselian of southern Fergana (Bensh 1972). Four specimens assigned to *Pseudoschwagerina robusta* (Meek), emend. Thompson, Wheeler, and Hazzard, 1946 from the middle Asselian of the eastern part of Kazakhstan (Scherbovich 1969) are the closest to the present material. Based on the occurrence of *Paraschwagerina kokpectensis* from the middle Asselian of Kokpekty in Kazakhstan (Scherbovich 1969) and of southern Fergana (Bensh 1972), this zone is thought to be middle Asselian in age. We have no definitive evidence for the presence of lower Asselian strata in our studied section. *Sphaeroschwagerina* that are useful for the correlation of the Asselian, though some of them range up into Sakmarian in the Carnic Alps and Karavanke Mountains (Forke 2002), are completely absent in our studied sections.

Although age-diagnostic species are few, the late Asselian age of the ***Dutkevichia complicata* Zone** is suggested by its occurrence between underlying Middle Asselian and overlying Sakmarian units. The late Asselian age of this zone might be supported by occurrences of *Rugosochusenella karatchatyrica* named by Bensh (1972) from southern Fergana. This age assignment is consistent with the stratigraphic range of *Dutkevichia*, whose acme zone is concentrated in the late Asselian in southwest Darvas (Leven & Scherbovich 1978) and southern Fergana (Bensh 1972). *Dutkevichia* ranges down into the Upper Gzhelian *Daixina sokensis* Zone in these two regions (Bensh 1972; Davydov 1986), and extends up to the Sakmarian in northern Afghanistan (Leven 1971) and southwest Darvas (Leven & Scherbovich 1980). The possibility of early Sakmarian age remains unresolved in this zone. The lack of inflated schwagerinids such as *Pseudoschwagerina* and *Paraschwagerina* in the lower and upper parts of this zone is possibly due to the facies control associated with oncoidal limestone (Fig. 3). *Rugosofusulina* cf. *latispilaris* and *Pseudofusulina* sp. A are dominant along with *Dutkevichia complicata* in this zone.

Precise biostratigraphic correlation of the ***Paraschwagerina pseudomira* Zone** and ***Robustoschwagerina nucleolata* Zone** with the three Sakmarian zones (*Schwagerina moelleri, S. verneuili,* and *Zigarella urdalensis* zones from lower to upper) in the Southern Urals (Davydov 1986) is difficult because of faunal differences. The Sakmarian age of these two zones in the Hadim area, however, is supported by the occurrence of *Paraschwagerina pseudomira*. This species, originally described from the upper part of the "*Schwagerina* Horizon" in southern Fergana by Miklukho-Maklay (1949), is one of the index species of the Sakmarian in southern Fergana (Bensh 1972). *Paraschwagerina inflata* is also known from the Sakmarian of northern Afghanistan (Leven 1971) and of southwest Darvas (Leven & Scherbovich 1980), and the upper Sakmarian to lower Artinskian Zweikofel Formation (Upper "*Pseudoschwagerina*" Limestone) of the Carnic Alps (Forke 2002). The latter is found from the upper part of the Grenzland Formation (lower Sakmarian) of Carnic Alps (Forke 2002).

Both *Robustoschwagerina nucleolata* and *R. regularis* were originally described from the "Artinskian" of the region north of Adana, eastern Taurides, by Ciry (1943). Traditionally, most species of *Robustoschwagerina*, including these two species, are thought to be very characteristic in the Sakmarian. The Yakhtashian, the Tethyan time-scale equivalent to the Artinskian, is defined by the first appearance of *Pamirina* according to the correlation and calibration within the Lower Permian by fusulinoideans in the Tethyan faunal province.

Quasifusulina nimia is abundant both in the *Paraschwagerina pseudomira* and *Robustoschwagerina nucleolata* zones (Figs. 3, 4). Based on conodont assemblages, Forke (1995) revealed the Artinskian age of the Upper "*Pseudoschwagerina*" Limestone in the Carnic Alps that was formerly thought to be Sakmarian. *Robustoschwagerina geyeri*, *Quasifusulina nimia*, *Paraschwagerina dlakshanensis* (possibly synonymous with *P. pseudomira*) and others are known from the Upper "*Pseudoschwagerina*" Limestone. Based on the associated conodonts, Forke (2002) also showed the Artinskian age of the Trogokofel Limestone having *Robustoschwagerina* and overlying the Upper "*Pseudoschwagerina*" Limestone. Kobayashi & Altiner (2008) thought the Sakmarian age of both the *Paraschwagerina pseudomira* and *Robustoschwagerina nucleolata* zones in the Hadim area, indicating the possibility of age reassignment of these two and other three Permian zones according to the conodont biostratigraphy.

The ***Dunbarula*? sp. Zone** conformably overlies the *Robustoschwagerina nucleolata* Zone. Although this zone was tentatively assigned to the Artinskian in age, its correlation and age assignment are difficult because of the local absence of schwagerinid and other age-diagnostic taxa.

In spite of low biostratigraphic validities, *Quasifusulina nimia* and *Boultonia cheni* are noteworthy because of their dominant occurrences in many stratigraphic levels (Figs. 3, 4). Unidentified species in *Dutkevichites, Mesochubertella, Millerella, Eostaffella*, and *Pseudoreichelina* occur in the *Jugulites* aff. *formosus* Zone to the *Paraschwagerina pseudomira* Zone in the A-A' section.

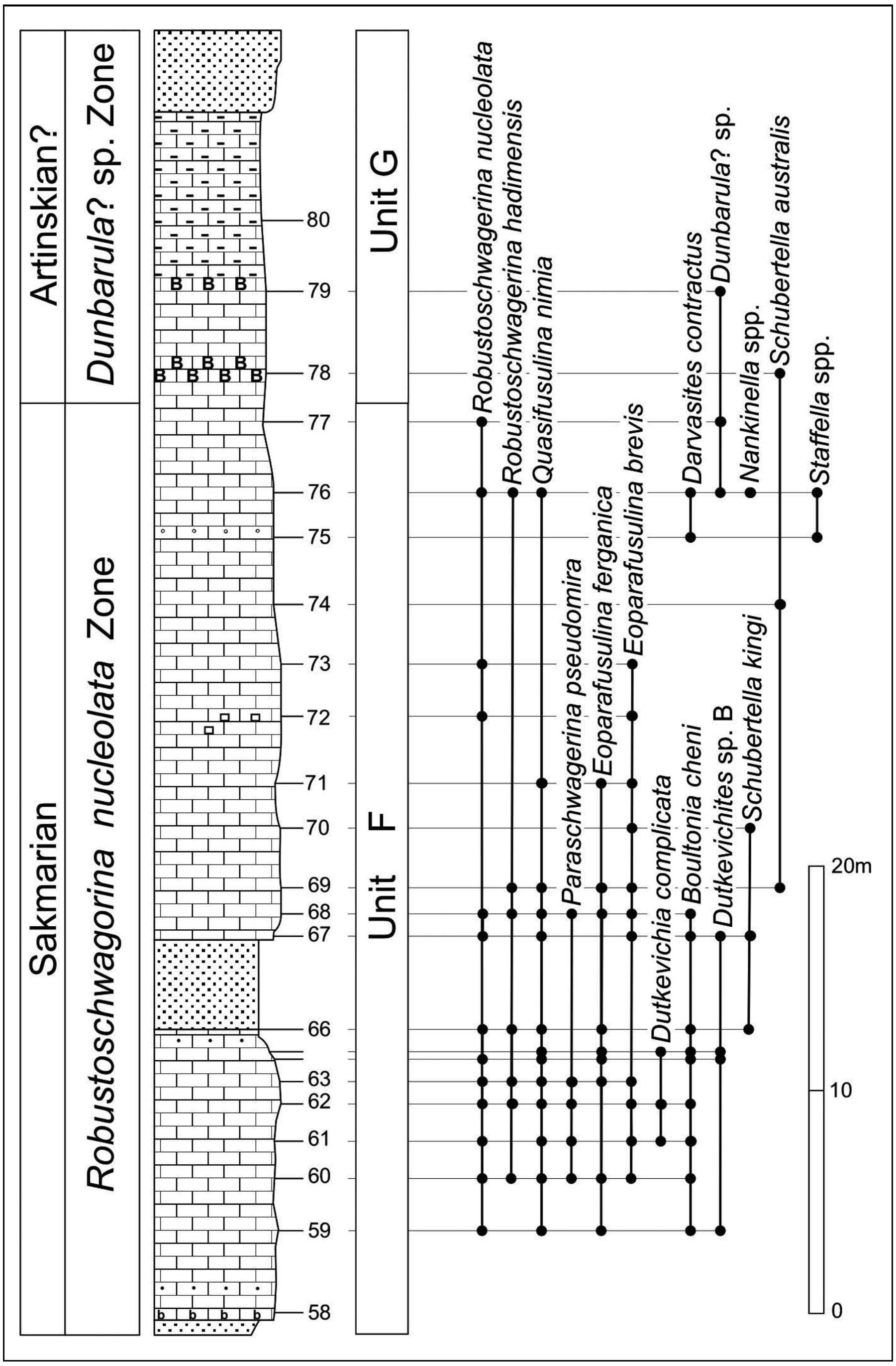


Fig. 4 - Stratigraphic division, and biostratigraphic zonation based on stratigraphic distribution of fusulinoideans in the B-B' section. Legend is the same as that of Fig. 3 (after Kobayashi & Altiner 2008).

Systematic paleontology

Superfamily Fusulinoidea von Möller, 1878

Family Ozawainellidae Thompson and Foster, 1937

Genus *Eostaffella* Rauser-Chernousova, 1948

Eostaffella sp.

Pl. 1, figs 3 -5

Material. The three illustrated axial sections and others.

Discussion. Forms named *Eostaffella* sp. are discriminated from those of *Millerella* sp. (Pl. 1, figs. 1, 2) by having involute inner and evolute outer whorls in the former, without which the two are not easily differentiated.

Stratigraphic distribution. Rare in five levels from FD-22 to FD-52 in the A-A' section (upper Gzhelian to Sakmarian, *Rugosofusulina* sp. A Zone to *Paraschwagerina pseudomira* Zone).

Genus *Ozawainella* Thompson, 1935

Ozawainella rhomboidalis Putrya, 1940

Pl. 2, figs 35-39

1940 *Orobias (Ozawainella) rhomboidalis* Putrya, p. 44, 45, pl. 1, figs 11, 12.

Material. The five illustrated axial sections and others.

Discussion. Almost all specimens from the Hadim area assignable to *Ozawainella* are identical with *O. rhomboidalia* described by Putrya (1940) from the Kasimovian of the eastern part of the Donetz Basin in association with *Protriticites ovoides* (Putrya, 1940). Variable appearances in size and number of whorls in the Hadim specimens are due to the abrasion of outer whorls. This species is probably distinguished from other species of *Ozawainella* prolific in the Bashikirian and Moscovian throughout Tethyan regions by its less elongate rhombic test form and narrower tunnel.

This species is different from *Ozawainella* sp. (Pl. 3, figs 34, 35), which occurs only in FD-27 (middle Asselian) in having fewer septa, broader tunnel, and a more inflated test along the axis of coiling.

Stratigraphic distribution. Rare to common in FD-1 and FD-3, and rare in FD-2, -4, -5, and -11 in the A-A' section (Kasimovian, *Protriticites variabilis* Zone to *Schwageriniformis schwageriniformis* Zone).

Family Schubertellidae Skinner, 1931

Subfamily Schubertellinae Skinner, 1931

Genus *Fusiella* Lee and Chen in Lee et al., 1930

Fusiella lancetiformis Putrya, 1939

Pl. 2, figs 12, 22

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

1949 *Fusiella lancetiformis* Putrya var. *karlensis* Suleimanov, p. 36, 37, pl. 1, fig. 15.

Material. One tangential and one parallel section are illustrated.

Discussion. This species was proposed by Putrya (1939) from the Upper Carboniferous of the Donetz Basin. The Hadim specimens attain more than 2.3 mm in the longest length of the test and seem to be larger than typical *lancetiformis*. Wide intraspecific variation of this species is suggested from many well-oriented specimens compared with Putrya's original one and *Fusiella lancetiformis karlensis* Suleimanov, 1949 from the Lower and Middle Kasimovian of the Cantabrian Mountains, respectively (Villa & Ginkel 2000). Villa & Ginkel (2000) suggested *karlensis* as being a junior synonym of *lancetiformis*. *Fusiella lancetiformis* is distinguished from *Fusiella typica* (Lee & Chen in Lee et al., 1930) and its allies mostly known from the Moscovian of the Tethyan regions by its better developed axial filling, more whorls, and larger test.

Stratigraphic distribution. Rare in FD-1 and FD-3 in the A-A' section (Kasimovian, *Protriticites variabilis* Zone and *Montiparus umbonoplicatus* Zone).

Genus *Schubertella* Staff & Wedekind, 1910

Schubertella australis Thompson & Miller, 1949

Pl. 1, figs 31-34; Pl. 3, figs 32, 33

1949 *Schubertella australis* Thompson & Miller, p. 9, 10, pl. 1, figs 6-8.

Material. Five axial and one sagittal section are illustrated, and others.

Discussion. Small schuberetellid fusulinoideans are observed in many stratigraphic levels characterized by limestones of different facies types. Among them, nearly spherical forms are less than 0.4 mm in diameter, and have primitive but highly variable test morphologies. Based on their occurrences in different facies of limestone and their comparison of inner whorls with those of the associated larger fusulinoideans, these simple test characters are diagnostic in this species.

Fusulinoideans with small spherical test similar to this species are known from the Middle Carboniferous to Middle Permian throughout the world. Various species names were given to them by authors. Some of them were further classified as subspecies or varieties based on slight morphologic differences by specimens. They are exemplified by *Eoschubertella obscura* (Lee & Chen in Lee et al.,1930) from the Middle Carboniferous of North China; *Schubertella pauciseptata* Rauser-Chernousova, 1938 from the Moscovian of Samara Bend; *Eoschubertella mexicana* Thompson, 1948 from the Pennsylvanian of New Mexico; *Schubertella australis* Thompson and Miller, 1949 from the Wolfcampian of the Maracaibo Basin; *Schubertella sphaerica* Suleimanov, 1949 from the Asselian and Sakmarian of the Pre-Urals; and *Schubertella pseudoglobulosa* Safonova in Rauser-Chernousova et al., 1951 from the Moscovian of the Russian Platform.

All of these fusulinoideans are probably undoubtedly assignable to Schubertellidae, but their classification seems to have been still confused. The Hadim specimens were tentatively assigned to *Schubertella* and classified as *Schubertella australis* because of its stratigraphic distribution ranging up to the Lower Permian and morphologic similarity to the type specimens.

Stratigraphic distribution. Rare in 15 levels from FD-11 to FD-54 in the A-A' section (Upper Kasimovian to Sakmarian, *Schwageriniformis schwageriniformis* Zone to *Paraschwagerina pseudomira* Zone), two levels of FD-69 and -74 (Sakmarian, *Robustoschwagerina nucleolata* Zone) and one level of FD-78 (Artinskian?, *Dunbarula*? sp. Zone) in the B-B' section.

Schubertella donetzica Putrya, 1940

Pl. 2, figs 27-31

1940 *Schubertella donetzica* Putrya, p. 38-40, pl. 1, figs 7, 8.

Material. Four axial and one sagittal sections are illustrated, and others.

Discussion. The present specimens are assigned to *Schubertella donezica* originally described by Putrya (1940) from the upper part of the Moscovian of the Donetz Basin. This taxon differs from many specimens of schuberetllids identified as *Schubertella kingi* Dunbar and Skinner, 1937 from the Hadim area (Pl. 1, figs 26-30) and many other localities by having more tightly coiled inner endothyroid whorls and smaller proloculus, and by its stratigraphic position lower than that of *S. kingi*. However, it is not easy to distinguish these two species because of their highly variable test characters.

Stratigraphic distribution. Rare in six levels from FD-2 to FD-8 in the A-A' section (Kasimovian, *Protriticites variabilis* Zone to *Schwageriniformis schwageriniformis* Zone).

Schubertella? sp.

Pl. 1, figs 35, 39

Material. One axial and one sagittal section are illustrated, and others.

Discussion. Characteristic features of this unidentified species are large and irregular-shaped proloculus followed by a few whorls and thick wall in the outermost whorl in comparison with its small test and simple test construction. In addition to the illustrated two specimens, we have found many specimens having these test characters. They are thought to be mature specimens questionably assigned to *Schubertella* and not to represent the juvenaria of a species of other genus.

Stratigraphic distribution. Rare in FD-40 in the A-A' section (upper Asselian, *Dutkevichia complicata* Zone).

Genus *Mesoschubertella* Kanuma and Sakagami, 1957

Mesoschubertella sp.

Pl. 1, figs 36-38

Material. Two tangential and one parallel sections are illustrated.

Discussion. The Hadim specimens are assignable to *Mesoschuberetella* by having thick wall consisting of tectum and inner dark layer, an endothroid juvenarium, unfolded septa, and distinct chomata. Small dimensions of test suggest that the taxon represents a primitive form of the genus.

Stratigraphic distribution. Rare in FD-24 (upper Gzhelian, *Rugosofusulina* sp. A Zone) and FD-41 (upper Asselian, *Dutkevichia complicata* Zone) in the A-A' section.

Genus *Dutkevichites* Davydov, 1984

Dutkevichites sp. A

Pl. 2, figs 32-34

Material. Two axial and one tangential sections are illustrated, and others.

Discussion. Diagnostic characters of this unnamed species are a minute proloculus about 0.07 mm, a few *Schubertella*-type tightly coiled whorls and undulate outer one or one and a half whorls, and thin wall consisting of a tectum and finely perforate protheca in outer elongate fusiform whorls. It is assigned to *Dutkevichites* proposed by Davydov (1984) from the Gzhelian of southwest Darvas. *Dutkevichites darvasica*, type species of the genus, has larger test and thicker wall in the outermost whorl than this unidentified species. Septa are weakly folded in the axial region of the former, but they are nearly plane throughout the test in the latter.

Stratigraphic distribution. Rare in FD-12 and FD-14 (lower Gzhelian, *Jugulites* aff. *formosus* Zone) and FD-32 (upper Asselian, *Dutkevichia complicata* Zone) in the A-A' section.

Dutkevichites sp. B

Pl. 1, figs 22-25

Material. Illustrated three axial and one sagittal sections, and others.

Discussion. In spite of the absence of fully-grown axial sections, the present unnamed species is assumed to be a transitional form from the genus *Dutkevichites* to *Biwaella,* because of its *Schubertella*-type juvenarium, thickness and composition of wall, and test size. The wall of the outer whorls consists of tectum and finely perforate alveolar keriotheca. Its thickness is thinner than that of typical *Biwaella*, and thicker than that of *Dukevichites* sp. A and of *D. darvasica*. However, exact test size and other diagnostic characters in the mature stage are not easily reconstructed because of abrasion of outermost whorls in most specimens. More specimens are necessary to compare this unnamed species with some schubertellids that were assigned to *Triticites*, *Fusiella*, or *Biwaella* and described from the Lower Permian of Slovenian Karavanken (Kochansky-Devidé 1970) and northwest Croatia (Kochansky-Devidé 1959).

Stratigraphic distribution. Rare in four levels from FD-59 to FD-67 in B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Subfamily Boultoniinae Skinner and Wilde, 1954
Genus *Boultonia* Lee, 1927

Boultonia cheni Ho, 1956

Pl. 1, figs 6-21; Pl. 3, figs 9, 10

1956 *Boultonia cheni* Ho, p. 61, 62, 64, 65, pl. 1, figs 1-7.

PLATE 1

Figs. 1, 2 - *Millerella* sp. Axial sections, 1: D2-031000; 2: D2-031002, both FD-16, ×60.

Figs. 3-5 - *Eostaffella* sp. Axial sections, 3: D2-031674, FD-52; 4: D2-031243, FD-30; 5: D2-031092, FD-22, all ×60.

Figs. 6-21 - *Boultonia cheni* Ho, 1956. 6-9, 13, 14, 18-21: axial sections; ×40, 10-12, 15-17: sagittal sections; ×60, 6: D2-031548, FD-48; 7: D2-031960, FD-56; 8: D2-031986, FD-57; 9: D2-022013, FD-56; 10: D2-031602, FD-49; 11: D2-031961, FD-56; 12: D2-031970, FD-56; 13: D2-031642, FD-51; 14: D2-032013, FD-57; 15: D2-031945, FD-55; 16: D2-031617, FD-49; 17: D2-031577, FD-49; 18: D2-031980, FD-56; 19: D2-031650, FD-51; 20: D2-031617, FD-50; 21: D2-031561, FD-48.

Figs. 22-25 - *Dutkevichites* sp. B. 22-24: axial sections; 25: sagittal section, 22: D2-032283; 23: D2-032371; 24: D2-032313; 25: D2-032320, 22, 24, 25: FD-65; 23: FD-67, all ×40.

Figs. 26-30 - *Schubertella kingi* Dunbar & Skinner, 1937. 26-28, 30: axial sections; 29: sagittal section, 26: D2-030930, FD-12; 27: D2-031229, FD-30; 28: D2-030952, FD-12; 29: D2-031373, FD-39; 30: D2-031533, FD-48; 26: ×50; 27, 28: ×40; 29, 30: ×60.

Figs. 31-34 - *Schubertella australis* Thompson and Miller, 1949. 31, 32, 34: axial sections; 33: sagittal section, 31: D2-031022, FD-18; 32: D2-030923, FD-11; 33:D2-031400, FD-40; 34: D2-031392, FD-40; all ×60.

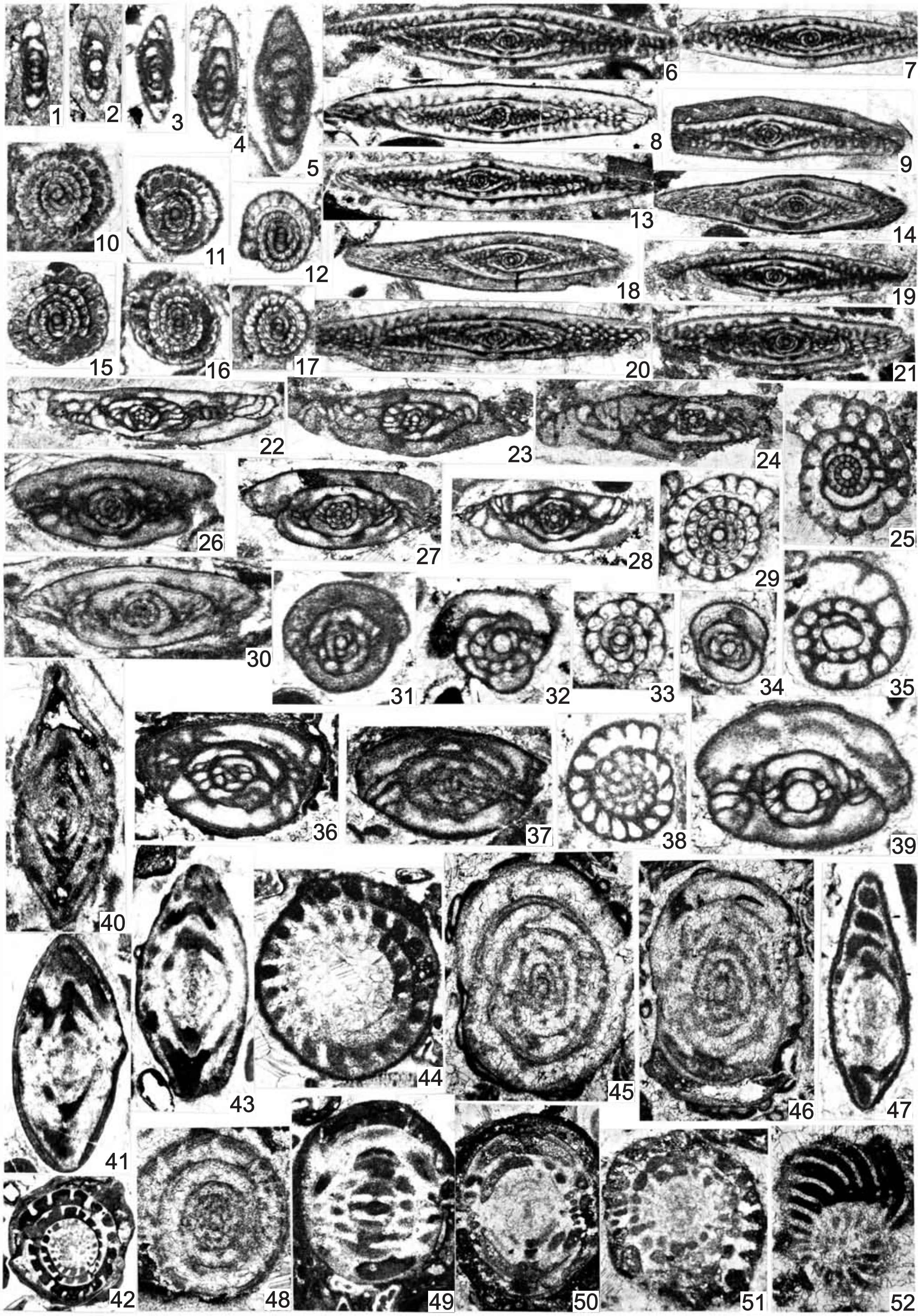
Figs. 35, 39 - *Schubertella*? sp. 35: sagittal section, D2-031393; 39: axial section, D2-031401; both FD-40, ×60.

Figs. 36-38 - *Mesoschubertella* sp. 36, 37: tangential sections; 38: parallel section, 36: D2-031410, FD-41, ×40; 37: D2-031105, FD-23, ×50; 38: D2-031098, FD-23, ×60.

Figs. 40-44 - *Nankinella* spp. 40, 41, 43: axial sections; 42, 44: sagittal sections, 40: D2-030827, FD-5, ×40; 41: D2-031010, FD-17, ×40; 42: D2-031009, FD-17, ×20; 43: D2-030867, FD-8, ×30; 44: D2-031595, FD-49, ×40.

Figs. 45, 46, 48-51- *Staffella* spp. 45, 50: axial section; 46, 49: tangential section; 48: sagittal section; 51: oblique section, 45: D2-031389, FD-39, ×30; 46: D2-031345, FD-38, ×25; 48: D2-031362, FD-38, ×30; 49: D2-030965, FD-13, ×30; 50: axial section, D2-032657, FD-76, ×20; 51: oblique section, D2-032682, FD-76, ×30.

Figs. 47, 52 - *Pseudoreichelina* sp. 47: axial section, D2-032016, FD-57, ×60; 52: parallel section, D2-031230, FD-30, ×40.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Material. Eleven axial and seven sagittal sections are illustrated, and many others.

Discussion. Numerous specimens of *Boultonia* obtained from a wide stratigraphic interval are identical with *B. cheni* proposed from the Asselian of Jiangsu, eastern part of China by Ho (1956). Ho discriminated this species from *Boultonia willsi* Lee, 1927 by more elongate test, more sharply pointed poles, and more strongly and regularly folded septa. In the material studied, there are many specimens with smaller test similar to *Boultonia willsi*. They are thought to represent immature or incomplete individuals of *Boultonia cheni*.

Stratigraphic distribution. Common to rare in 21 levels from FD-25 to FD-57 in the A-A' section (middle Asselian to Sakmarian, *Paraschwagerina* sp. Zone to *Paraschwagerina pseudomira* Zone) and nine levels from FD-59 to FD-68 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Boultonia sp.

Pl. 9, figs 6-8

Material. Three axial sections are illustrated.

Discussion. Fusiform to short cylindrical test in the middle and outer whorls of this unnamed species is different from elongate test of the known species of the genus *Boultonia*. It may be a new species of the genus. Proposal of a new species, however, is refrained on account of unknown morphologic variation and the small number of this unnamed species.

Stratigraphic distribution. Rare in FD-51 and FD-52 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Genus *Dunbarula* Ciry, 1948

Dunbarula? sp.

Pl. 10, figs 1-3

Material. Three axial sections are illustrated.

Discussion. The general appearance of three illustrated specimens suggests their assignment to *Schubertella* rather than to *Dunbarula*. However, they are not assignable to *Schubertella* because of larger proloculus, wall with septal pores in the outermost whorl and weakly folded septa in polar regions. These characters indicate the possible assignment of the present form to the genus *Dunbarula*.

Stratigraphic distribution. Rare in FD-76 (Sakmarian, *Robustoschwagerina nucleolata* Zone), and FD-77 and FD-79 (Artinskian?, *Dunbarula*? sp. Zone) in the B-B' section.

Family Fusulinidae von Möller, 1878

Genus *Protriticites* Putrya, 1948

Protriticites variabilis Bensh, 1972

Pl. 2, figs 1-6

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

Material. Five axial and one sagittal sections are illustrated, one axial section (Pl. 2, fig. 1) in Kobayashi and Altiner (2008), and others.

Discussion. The present material is assignable to *Protriticites* in having wall structure with diaphanotheca in inner whorls and with perforate rather than thick translucent layer in outer ones. Apparent diaphanotheca is not observable in outer whorls. *Protriticites* is closely similar to *Obsoletes* and they are hardly discriminated by the difference of wall structure. Specimens shown in Pl. 2, figs 1-3 have more elongate test with more pointed poles than those in Pl. 2, figs 4, 5. However, these and other test characters change gradually from specimen to specimen. These differences are thought to represent the morphologic variation in the Hadim population. They are safely identified with *Protriticites variabilis*, originally described from the lower Kasimovian of southern Fergana by Bensh (1972) in having rather elongate fusiform test, large proloculs, and indistinct juvenile whorls. However, close comparison of this species with other species is not easy.

Stratigraphic distribution. Common in FD-1 and FD-2 in the A-A' section (lower Kasimovian, *Protriticites variabilis* Zone).

Genus *Quasifusulinoides* Rauser-Chernousova and Rozovskaya in Rauser-Chernousova and Fursenko, 1959

Quasifusulinoides parafusiformis Bensh, 1969

Pl. 2, figs 7-11

1969 *Quasifusulinoides parafusiformis* Bensh, p. 143, 144, pl. 12, fig. 6; pl. 13, figs 1-4.

PLATE 2

Figs. 1-6 - *Protriticites variabilis* Bensh, 1972. 1-5: axial sections; 6: sagittal section, 1: D2-030732; 2: D2-030754; 3: D2-030725; 4: D2-030744; 5: D2-030747; 6: D2-030728, all FD-1, 1, 2: ×15; 3-6: ×20.

Figs. 7-11 - *Quasifusulinoides parafusiformis* Bensh, 1969. 7: sagittal section; 8-11: axial sections, 7: D2-030739; 8: D2-030731; 9: D2-030746; 10: D2-030740; 11: D2-030737, all FD-1, 7, 9, 10: ×15; 8, 11: ×10.

Figs. 12, 22 - *Fusiella lancetiformis* Putrya, 1939. 12: tangential section, D2-030785, FD-3, ×25; 22: sagittal section, D2-030764, FD-3, ×30.

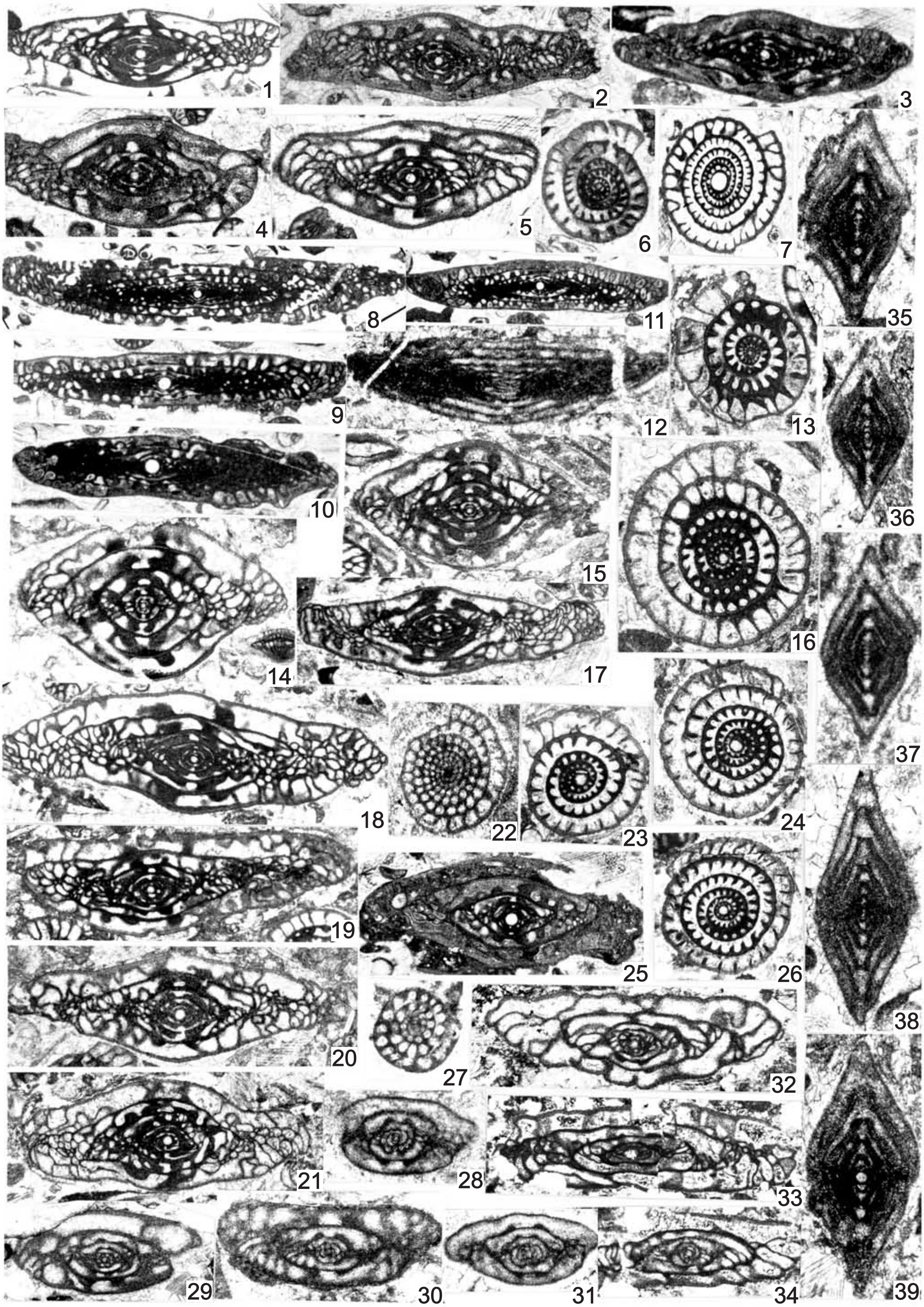
Figs. 13-16 - *Montiparus montiparus* (Ehrenberg, 1854). 13, 16: sagittal sections; 14, 15: axial sections, 13: D2-030779; 14: D2-030794; 15: D2-030782; 16: D2-030789, all FD-3, ×20.

Figs. 17-21, 23-26- *Montiparus umbonoplicatus* (Rauser-Chernousova, 1937). 17-21, 25: axial sections; 23, 24, 26: sagittal sections, 17: D2-030774; 18: D2-030788; 19: D2-030769; 20: D2-030787; 21: D2-030784; 23: D2-030791; 24: D2-030792; 25: D2-030798; 26: D2-030775, 17-21, 23, 24, 26: FD-3; 25: FD-4; 17-19, 21, 25: ×15; 20, 23, 24, 26: ×20.

Figs. 27-31 - *Schubertella donetzica* Putrya, 1940. 27: sagittal section; 28-31: axial sections, 27: D2-030825, FD-5; 28: D2-030797, FD-4; 29: D2-030870, FD-8; 30: D2-030803, FD-5; 31: D2-030901, FD-4; 27, 28, 30, 31: ×40, 29: ×30.

Figs. 32-34 - *Dutkevichites* sp. A. 32, 34: axial sections; 33: tangential section, 32: D2-030938; 33: D2-030940; 34: D2-030936, all FD-12; 32, 34: ×30; 33: ×20.

Figs. 35-39 - *Ozawainella rhomboidalis* Putrya, 1940. Axial sections, 35: D2-030785, FD-3; 36: D2-030777, FD-3; 37: D2-030756, FD-2; 38: D2-030745, FD-1; 39: D2-030776, FD-3, all ×40.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Material. Four axial and one sagittal sections are illustrated, one axial section (Pl. 2, fig. 7) in Kobayashi & Altiner (2008), and others.

Discussion. Based on the difference of wall structure of tectum and translucent layer pierced by minute pores instead of tectum and diaphanotheca, *Quasifusulinoides* was established by Rauser-Chernousova and Rozovskaya in Rauser-Chernousova & Fursenko (1959), designating *Pseudotriticites fusiformis* as the type species originally described by Rozovskaya (1952) from the Upper Moscovian *Fusulina cylindrica* Zone of the Southern Urals. The present specimens are similar to *Quasifusulinoides parafusiformis* described by Bensh (1969) from the Lower Kasimovian of the Gissar Mountains, southern Fergana. They differ from the type species of the genus and other species common in the Moscow and Donetz Basins such as *Quasifusulinoides quasifusulinoides* (Rauser-Chernousova in Rauser-Chernousova et al. 1951) in having more well-developed axial filling.

Stratigraphic distribution. Common in FD-1 and FD-3 in the A-A' section (Kasimovian, *Protriticites variabilis* Zone and *Montiparus umbonoplicatus* Zone).

Genus *Quasifusulina* Chen, 1934

Quasifusulina longissima (von Möller, 1878)

Pl. 8, figs 2-5; Pl. 9, fig. 9

1878 *Fusulina longissima* von Möller, p. 59-61, pl. 1, fig. 4; pl. 2, fig. 1a-c; pl. 7, fig. 1a-c.

1934 *Quasifusulina longissima* (von Möller), Chen, p. 92, 93, pl. 5, fig. 6-9.

Material. Five axial sections are illustrated, one axial section (Pl. 2, fig. 18) in Kobayashi and Altiner (2008), and others.

Discussion. Wide morphologic variations particularly in the size of proloculus are recognized in our material as well as previously described by many authors. The present material is undoubtedly identical with *Quasifusulina longissima* widely known from the Kasimovian and Gzhelian throughout the Tethyan regions. It is different from *Q. nimia* Kochansky-Devidé, described below, by having smaller proloculus and test, and smaller length and width in the corresponding whorls.

Stratigraphic distribution. Rare in FD-5 and FD-8, and common in FD-12 in the A-A' section (middle Kasimovian to lower Gzhelian, *Montiparus umbonoplicatus* Zone and *Jigulites* aff. *formosus* Zone).

Quasifusulina nimia Kochansky-Devidé, 1959

Pl. 8, figs 1, 6-14; Pl. 9, figs 1-5

1959 *Quasifusulina nimia* Kochansky-Devidé, p. 19-21, 48, pl. 2, figs 1-4.

Material. Ten axial (nine megalospheric and one microsheric forms) and one tangential sections are illustrated, as well as incomplete four axial sections (inner whorls of microspheric forms, Pl. 9, figs 2-5), one axial section (pl. 2, fig. 8) in Kobayashi & Altiner (2008), and others.

Description of megalospheric forms. Test large, cylindrical to subcylindrical, slightly curved, with broadly rounded to bluntly pointed poles and straight to slightly curved axis of coiling, resulting variable appearances of test size, periphery, lateral slopes, and others in axial sections.

Mature specimens with six to seven whorls, 9 to 14 mm or more in length, 2.2 to 3.1 mm in width, giving approximate form ratio 3.3 to 6.2. Proloculus subspherical, short ellipsoidal, or rounded rectangular, and 0.25 to 0.80 mm, mostly 0.35 to 0.50 mm in its longer diameter, and becoming gradually larger stratigraphically upwards in general trend. Outline and size of whorls especially of inner whorls highly variable depending upon the size of proloculus and the orientation of axial sections. Test slowly expanding outerwards beyond inner one or two whorls.

Septa strongly folded throughout the test, especially in polar regions, resulting numerous chamberlets on and above the chamber floor. Septal folds are rather regular and generally low in tunnel regions, but some reaching the top of chambers. Septal counts in the last whorl ranging from 30 to 38, averaging 34 in 18 specimens. Cuniculi low, narrow, and well-developed even in the inner whorls.

Wall thin, less than 15 microns and of an undifferentiated single layer in inner one to two, rarely three whorls. Wall still thin, commonly 20 to 35 microns in outer whorls in comparison with large test, consisting of a very finely perforate tectum and a thicker translucent layer comparable with diaphanotheca.

Axial filling well-developed in inner three to four whorls, but not developed beyond the forth whorl in most specimens. In the more or less micritized specimens, axial filling is present almost throughout test. Distribution and density of axial filling are highly variable in specimens.

Chomata not recognized throughout whorls, sometimes present on proloculus rudimentarily. Chomata-like massive appendices sporadically present near tunnel in inner whorls are referable to secondary deposits.

Tunnel low, probably less than one-thirds as high as chambers, and its path narrow and irregular. In axial and deeply tangential sections, tunnel is uneasily distinguishable due to well-developed septal folds in the median part of the test.

Description of microspheric forms. Eleven axial sections of the microspheric form were obtained from FD-48 (two specimens), FD-49 (two specimens), FD-51 (one specimen), FD-55 (two specimens), FD-63 (one specimen), FD-66 (one specimen), FD-67 (one specimen), and FD-71 (one specimen). Among them, five are illustrated in pls. 8 and 9. Largely different characters of the test between dimorphic forms are proloculus size and number of whorls.

The test consists of 8 or more whorls. Exact size of the test is uncertain due to the abrasion or destruction of outer whorls. The largest length more than 40 mm in the specimen (tangential section) from the sample FD-62 (pl. 9, fig. 1) having much more chamberlets than individuals of megalospheric forms and meandering low and long cuniculi. Width and form ratio not exactly determined as well as length. They are possibly 3 mm or more, and 6 to 8 or more, respectively.

Proloculus spherical and less than 0.025 mm. Minute proloculus and the following very tightly coiled three whorls show *Fusiella*-like appearance. The subsequent two to three whorls rapidly expand their heights and width. Beyond these tightly coiled whorls, the test expands gradually, then rapidly increasing its length in the outer two or three whorls. Length of the last whorl attains two or more times as large as those of the preceding two or three whorls. These remarkable changes in length is not found in width, resulting form ratio of outer whorls more than two times as large as that of inner ones.

In the *Fusiella*-type initial whorls, wall is exceedingly thin, septa are unfluted and plane, chomata are well-developed, and the tunnel is clearly recognized. Axial filling is not developed in these whorls. Except for the presence of the *Fusiella*-type whorls completely absent in the megalospheric forms, other characters such as septal folding, wall structure, axial filling, chomata, and tunnel in the middle and later whorls are essentially the same between microspheric and megalospheric forms.

More number, more variable size, and more irregularly-spaced chamberlets than those in smaller individuals of the microspheric form are recognized in a specimen with extraordinary large test, in which cuniculi are low, long, and not running transverse to but meandering oblique to the axis of coiling. Chomata are completely lacking in the outer whorls rapidly increasing their length.

Discussion. Among the described species of *Quasifusulina*, our material is the closest to *Quasifusulina nimia* originally described from the Lower Permian of Croatia by Kochansky-Devidé (1959). The Croatian material differs from *Q. longissima* described from various localities of the Tethyan regions in addition to the Hadim area by much larger test and proloculus. Gradual increase of test size and proloculus size stratigraphically upwards is recognizable in the present species in the A-A' section. Some test characters of specimens yielded from the lower levels seem to be more similar to those of other species of the genus than *Q. nimia*. They are, however, considered to be intraspecific variation of this species highly variable in many test characters among specimens.

Quasifusulina spatiosa proposed by Sheng (1956) from the Lower Permian of Inner Mongolia resembles this species, but differs by its smaller proloculus and less-developed axial filling. *Quasifusulina nimia* has larger test and proloculus than other species known from the Lower Permian such as *Q. tenuissima* (Schellwien, 1898) and *Q. cayeuxi* (Deprat, 1913).

Stratigraphic distribution. Abundant to rare in 21 levels from FD-24 to FD-57 in the A-A' section (upper Gzhelian to Sakmarian, *Rugosofusulina* sp. A Zone to *Paraschwagerina pseudomira* Zone) and 13 levels from FD-59 to FD-76 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Family Schwagerinidae Dunbar and Henbest, 1930

Genus *Montiparus* Rozovskaya, 1948

Montiparus montiparus (von Möller, 1878)

Pl. 2, figs 13-16

1878 *Fusulina montipara* von Möller, p. 94-99, pl. 3, fig. 2a-f; pl. 8, fig. 2a-c.

Material. Two axial and two sagittal sections are illustrated, one axial section (pl. 2, fig. 3) in Kobayashi & Altiner (2008), and others.

Discussion. The genus *Montiparus* was separated from *Triticites* as an independent phylogenetic lineage that continued to *Jugulites* through *Rauserites* in Late Carboniferous (Rozovskaya 1948). Although the phylogeny of early groups of *Triticites* and generic independency of *Obsoletes* are variable among authors (e.g. Davydov 1990; Ginkel & Villa 1999), *Montiparus* is thought to be taxonomically valid by many authors.

The present material is discriminated from *Protriticites* by clear, though not always present, alveolar wall structure referable to keriotheca in outer whorls. *Montiparus montiparus* is characterized by having more inflated test in comparison with other species of the genus.

Stratigraphic distribution. Common in HD-3 in the A-A' section (middle Kasimovian, *Montiparus umbonoplicatus* Zone).

Montiparus paramontiparus Rozovskaya, 1950

Pl. 3, figs 1, 2

1950 *Triticites* (*Montiparus*) *paramontiparus* Rozovskaya, p. 13, 14, pl. 1, figs 8-10.

Material. Two axial sections are illustrated, one axial section (pl. 2, fig. 5) in Kobayashi & Altiner (2008), and others.

Discussion. This species resembles *Montiparus montiparus* in many respects such as size of the test, massive chomata, and narrow and high tunnel. *Montiparus paramontiparus*, however, is probably distinguished from *M. montiparus* by having thicker wall and well-developed alveolar structure in outer inflated whorls. We cannot determine, however, that the Hadim specimens are closer to whether *M. paramontiparus paramontiparus* or *M. paramontiparus mesopachus* Rozovskaya, 1950. These two forms are treated as to be synonymous in this paper.

Stratigraphic distribution. Common in the arenaceous limestone of FD-5 in the A-A' section (Middle Kasimovian, *Montiparus umbonoplicatus* Zone).

Montiparus umbonoplicatus (Rauser-Chernousova & Belyaev in Rauser-Chernousova & Fursenko, 1937)

Pl. 2, figs 17-21, 23-26

1937 *Triticites umbonoplicatus* Rauser-Chernousova & Belyaev in Rauser-Chernousova & Fursenko, p. 211, 212, fig. 154.

1950 *Triticites* (*Montiparus*) *umbonoplicatus* (Rauser-Chernousova & Beljaev), Rozovskaya, p. 16, 17, pl. 2, figs 8-12.

Material. Six axial and three sagittal sections are illustrated, one axial section (pl. 2, fig. 2) in Kobayashi & Altiner (2008), and others.

Discussion. This species obtained from a core sample in Samara Bend was distinguished from *Montiparus montiparus* by its larger form ratio in outer one and a half to two whorls by Rauser-Chernousova and Belyaev in Rauser-Chernousova & Fursenko (1937). Diagnostic characters of this species in the original and Rozovskaya's (1950) materials, such as elongate test, massive chomata and mode of septal folding in polar regions, well agree with those of later ones (e.g. Bensh 1972, Ginkel & Villa 1999) as well as the present ones. Leven & Davydov (2001) subdivided this species into three subspecies. Ginkel & Villa (1999) pointed out difficulties to distinguish precisely this species from other similar species of *Montiparus*, and treated this and allied forms as a species group of *Montiparus umbonoplicatus* based on highly variable test characters in specimens from the Cantabrian Mountains. On the other hand, they did not assign exactly any forms of their materials to *M. umbonoplicatus*.

Stratigraphic distribution. Abundant in FD-3 and rare in FD-4 and FD-5 in the A-A' section (Middle Kasimovian, *Montiparus umbonoplicatus* Zone).

Genus *Rauserites* Rozovskaya, 1948

Rauserites sinuosus (Rozovskaya, 1950)

Pl. 3, figs 21-23

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

Material. Two axial and one sagittal sections are illustrated, one axial section (Pl. 2, fig. 10) in Kobayashi and Altiner (2008), and others.

Discussion. The Hadim material is closely similar to the types described by Rozovskaya (1950). Smaller test size of some of the Hadim material than of the types is apparently due to the abrasion of the outer part of their test. This species has more intensely folded septa and more distinct alveolar wall in outer whorls than the species referable to *Montiparus*, by which it is transferred herein to the genus *Rauserites*.

Stratigraphic distribution. Rare in the arenaceous limestone and calcareous sandstone of FD-11 in the A-A' section (Upper Kasimovian, *Schwageriniformis schwageriniformis* Zone).

Rauserites stuckenbergi (Rauser-Chernousova, 1938)

Pl. 3, figs 27, 28, 30, 31

1938 *Triticites stuckenbergi* Rauser-Chernousova, p. 110-112, pl. 3, figs 4, 9.

Material. Four axial sections are illustrated, one axial section (pl. 2, figs. 15) in Kobayashi & Altiner (2008), and others.

Discussion. Septa of this species are folded throughout outer whorls in the well-preserved specimens, as shown in the specimen in Kobayashi & Altiner (2008). Appearance of lack of folded septa in the tunnel region of some specimens of the present materials is due to the resorption of septa and/or destruction of a part of outer test. From many similar test characters including septal folding, they are probably identical with the types by Rauser-Chernousova (1938) from the lower horizon of the "*Triticites*" Zone in Samara Bend. On the other hand, they have more rhomboidal outer whorls with more pointed poles than the types. This species was later transferred to *Rauserites* by Rozovskaya (1950). Schellwien's (1908) original "*Fusulina*" *prisca* var. *parvula* and the subsequent Chinese ones by Lee (1927) and Chen (1934) are similar to this species. They are uneasily distinguishable except for more intensely and more irregularly folded septa of the present species.

Stratigraphic distribution. Common in the arenaceous limestone of FD-12 in the A-A' section (Lower Gzhelian, *Jigulites* aff. *formosus* Zone).

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

Schwageriniformis asiaticus (Bensh, 1962)

Pl. 3, figs 12-20

1962 *Triticites asiaticus* Bensh, p. 186, 187, pl. 1, figs 1, 2.

1969 *Triticites gissaricus* Bensh, p. 154-156, pl. 16, figs 5-8; pl. 17, figs 1-5.

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

1972 *Triticites perlongus* Bensh, p. 44, 45, pl. 8, figs 7, 8.

Material. Six axial, two tangential and one parellel sections are illustrated, one axial section (Pl. 2, fig. 12) in Kobayashi & Altiner (2008), and others.

Discussion. The Hadim material is marked by elongate fusiform test with minute proloculus, and tightly coiled inner and succeeding rapidly expanding outer whorls. However, septal fluting, development of chomata, and tunnel angle are variable by specimens. These differences are thought to be intraspecific variation of this species. Closely similar tendency of the morphologic variation can be recognized in the above-listed species proposed by Bensh from the Upper Kasimovian and Lower Gzhelian of Fergana. By the same reasons as indicated above each of them are not valid as an independent species. Accordingly, the Hadim materials are named *Schwageriniformis asiaticus* (Bensh, 1962) based on the representative form among the Fergana forms and the priority of nomenclature. They are reassigned into the genus *Schwageriniformis* on the basis of generic diagnosis of *Triticites* and *Schwageriniformis*. More inflated forms of *Triticites gisanicus* in Bensh (1972), *T. parafusiformis* Bensh, 1972 and smaller and slenderer form classified as *Triticites* sp. No. 1 Bensh, 1972 might be also synonymous with *Schwageriniformis asiaticus*, though their conclusion is reserved.

Stratigraphic distribution. Abundant in the arenaceous limestone and calcareous sandstone of FD-11 in the A-A' section (upper Kasimovian, *Schwageriniformis schwageriniformis* Zone).

Schwageriniformis schwageriniformis (Rauser-Chernousova, 1938)

Pl. 3, figs 3-8, 11

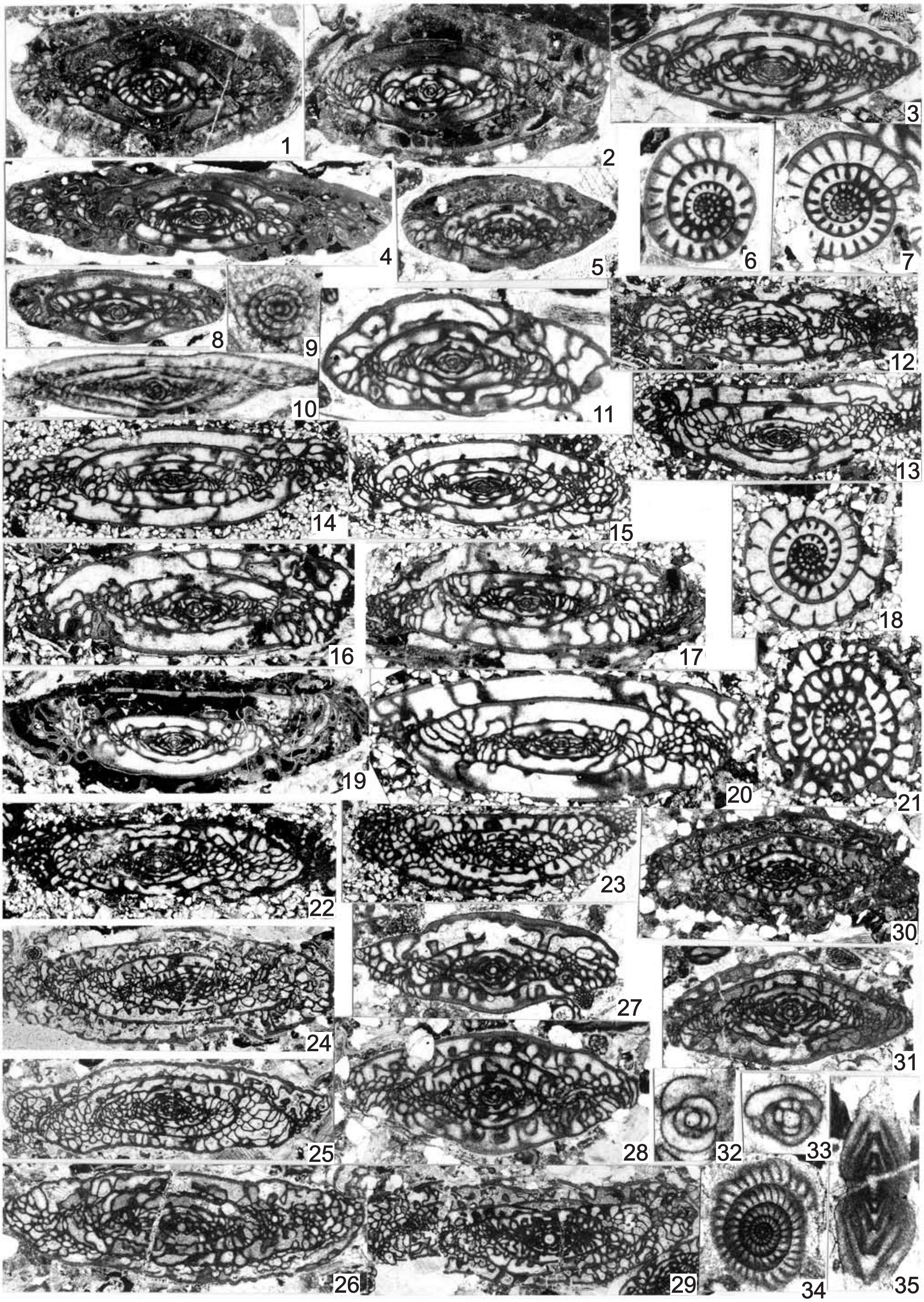
1938 *Triticites schwageriniformis* Rauser-Chernousova, p. 107, 108, pl. 3, figs 1-3.

Material. Five axial, one sagittal, and one parellel sections are illustrated, one axial section (pl. 2, fig. 4) in Kobayashi & Altiner (2008), and others.

Discussion. Since Rauser-Chernousova (1938) proposed *Triticites schwageriniformis* from the Upper Carboniferous of Samara Bend, many subspecies of this species were proposed by Russian paleontologists. The present material is thought to be identical with the original ones by Rauser-Chernousova (1938). All these forms are common in having small proloculus and tightly coiled inner whorls, and all had been assigned to *Triticites* until the proposal of *Schwageriniformis* by Bensh in Rauser-Chernousova et al. (1996). Subsequently, Leven & Davydov (2001) erected a new subgenus *Schwageriniformis* (*Tumefac-*

PLATE 3

Figs. 1, 2	- *Montiparus paramontiparus* Rozovskaya, 1950. Axial sections, 1: D2-030830; 2: D2-030816, both FD-5, ×20.
Figs. 3-8, 11	- *Schwageriniformis schwageriniformis* (Rauser-Chernousova, 1938). 3-5, 8, 11: axial sections; 6, 7: sagittal sections, 3: D2-030880; 4: D2-030875; 5: D2-030851; 6: D2-030871; 7: D2-030855; 8: D2-030851; 11: D2-030858, all FD-8, all ×20 except for 5: ×15.
Figs. 9, 10	- *Boultonia cheni* Ho, 1956. 9: sagittal section, D2-031648, FD-51, ×60; 10: axial section, D2-031899; FD-55, ×40.
Figs. 12-20	- *Schwageriniformis asiaticus* (Bensh, 1962). 12, 13, 15-17, 19: axial sections; 14, 20: tangential section; 18: parallel section, 12: D2-030903, 13: D2-030924, 14: D2-030898; 15: D2-030912; 16: D2-030901; 17: D2-030923; 18: D2-030921; 19: D2-030902; 20: D2-030911; all FD-11, 12-15: ×10; 16-20: ×15.
Figs. 21-23	- *Rauserites sinuosus* (Rozovskaya, 1950). 21: sagittal section, 22, 23: axial sections; 21: D2-030915; 22: D2-030909; 23: D2-030904, all FD-11, 21: ×15; 22, 23: ×10.
Figs. 24-26, 29	- *Jigulites* aff. *formosus* Rozovskaya, 1950. Axial sections, 24: D2-030935; 25: D2-030950, 26: D2-030951, 29: D2030968; all FD-12; 24, 25, 29: ×10; 26: ×15.
Figs. 27, 28, 30, 31	- *Rauserites stuckenbergi* (Rauser-Chernousova, 1938). Axial sections, 27: D2-030957; 28: D2-030960; 30: D2-030930; 31: D2-030945, all FD-12; 27, 28, 31: ×15; 30: ×10.
Figs. 32, 33	- *Schubertella australis* Thompson and Miller, 1949. Axial sections, FD-40, ×60, 32: D2-031399; 33: D2-031394.
Figs. 34, 35	- *Ozawainella* sp. 34: sagittal section, D2-031169, ×30; 35: tangential section, ×40, both FD-27.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tus) designating *Triticites expressus* Anosova in Bensh, 1969 as the type species, that was originally described from the Kasimovian of the Gissar Mountains, southern Fergana. The strict discrimination between *S.* (*Schwageriniformis*) and *S.* (*Tumefactus*) seems to be uneasy by the difference of inner test characters and test expansion as insisted by Leven & Davydov (2001). Villa & Ueno (2002) thought *Tumefactus* as an independent genus based on its characteristic development of phrenotheca.

Stratigraphic distribution. Abundant in FD-8 and rare in FD-10 in the A-A' section (Upper Kasimovian, *Schwageriniformis schwageriniformis* Zone).

Schwageriniformis spp.

Pl. 4, figs 26, 29

Material. Two axial sections are illustrated and others.

Discussion. Small schwagerinids are contained in bioclastic limestones from more than five stratigraphic levels. Almost all of them are incomplete and their diagnostic characters are not easily understood due to the abrasion of the outer part of the test. Two examples illustrated are assigned to the genus *Schwageriniformis* because of tightly coiled and small inner whorls.

Stratigraphic distribution. Rare in FD-13, -17, -20, and -21 in the A-A' section (Gzhelian, *Jigulites* aff. *formosus* Zone and *Daixina asiatica* Zone).

Genus *Jigulites* Rozovskaya, 1948

Jigulites aff. **formosus** Rozovskaya, 1950

Pl. 3, figs 24-26, 29

Akin to: 1950 *Triticites* (*Jigulites*) *longus formosus* Rozovskaya, p. 42, pl. 10, figs 2, 3, 5-7.

Material. Four axial sections are illustrated, one axial section (Pl. 2, fig. 6) in Kobayashi & Altiner (2008), and others.

Discussion. The genus *Jugulites* was proposed by Rozovskaya (1948) as a subgenus of *Triticites*, designating "*Triticites*" *jigulensis* as the type species that was described by Rauser-Chernousova (1938) from the upper horizon of the "*Triticites* Zone" in Samara Bend. It was thought to have evolved from *Rauserites* in the late Kasimovian based on having thicker wall, more strongly folded septa and weaker development of chomata (Rozovskaya 1950). But these test characters are considerably variable by species according to Rozovskaya (1950).

Among the described species, the present material is thought to be the closest to and akin to *Jigulites formosus* that was proposed by Rozovskaya (1950) as a subspecies of *longus*, in having elongate fusiform, rather irregularly and strongly folded septa and narrow tunnel. Specific identification with the species is, however, reserved on account of smaller and more elongate test, and more distinct chomata of the present material. The studied population is different from *Rauserites sinuosus* that occurs in a few meters lower level in the Hadim area, in having larger test, more strongly folded septa, coarser alveolar keriotheca and weaker development of chomata.

Stratigraphic distribution. Abundant in FD-12, rare in FD-13 and FD-14 in the A-A' section (lower Gzhelian, *Jigulites* aff. *formosus* Zone).

Genus *Daixina* Rozovskaya, 1949

Daixina asiatica Bensh, 1972

Pl. 4, figs 1-10

1972 *Daixina asiatica* Bensh, p. 64, 65, pl. 13, figs 3, 4.
1972 *Daixina minima* Bensh, p. 65, 66, pl. 13, figs 5, 6.

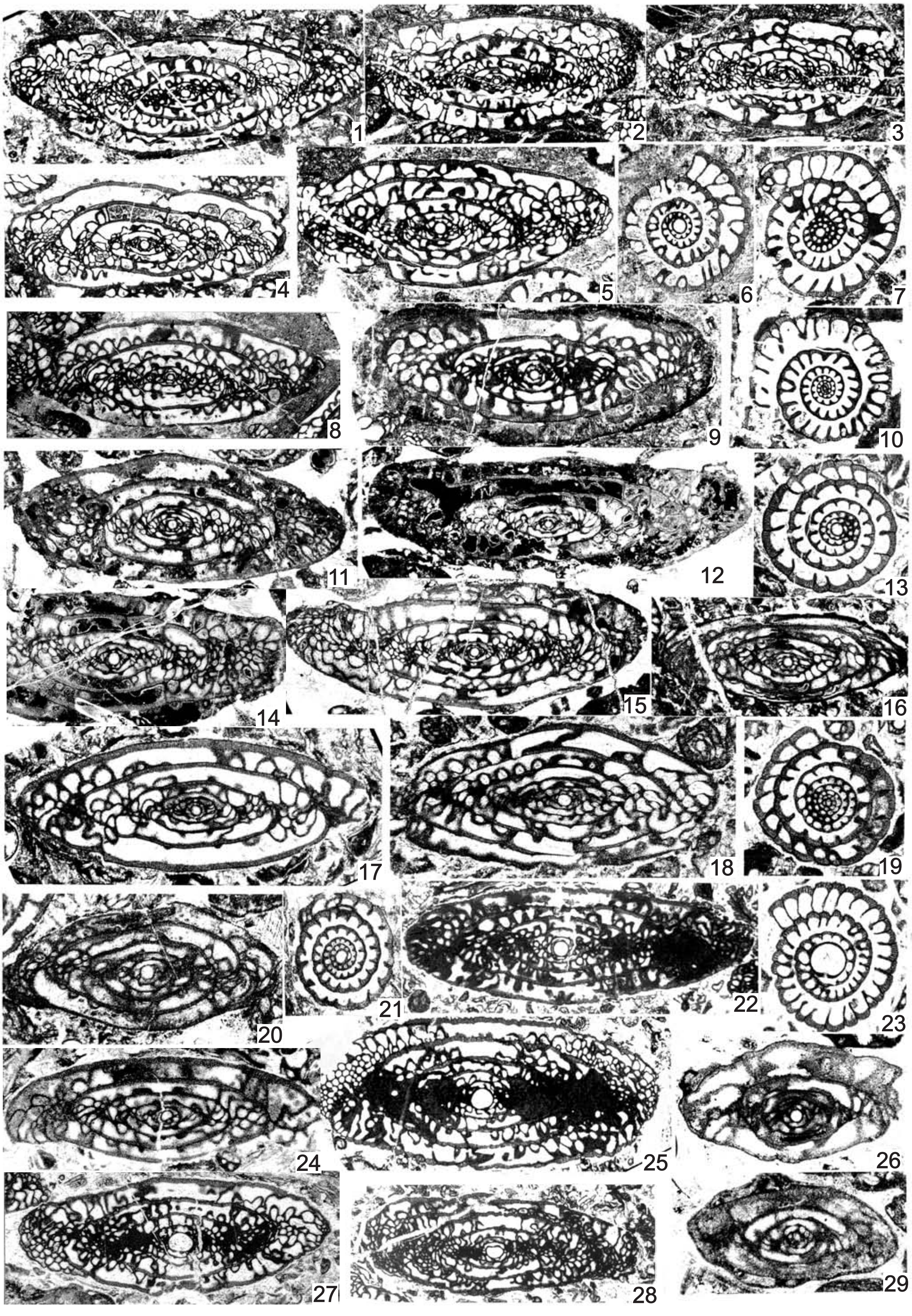
Material. Seven axial and three sagittal sections are illustrated, one axial section (pl. 2, fig. 9) in Kobayashi & Altiner (2008), and others.

Discussion. The genus *Daixina*, proposed from the upper part of the Zianchurian Horizon of the lower Gzhelian in the Southern Urals (Rozovskaya 1949), is differentiated from the genus *Triticites* in having chomata only on the first to the second whorls (Rozovskaya 1950). Although various forms of *Daixina* are known from the Kasimovian to Asselian of former Soviet Russia (e.g. Rozovskaya 1958; Rauser-Chernousova & Scherbovich 1958; Davydov 1986), large-sized *Daixina*, some of which were referable to *Ultradaixina* Davydov, 1982, were not found from the Hadim area. The present material is thought to be identical with *Daixina asiatica* and its synonymous *D. minima* described from the middle Gzhelian of southern Fergana by Bensh (1972), taking variable morphologic characters, especially the proloculus size, expansion of the test, and mode of septal fluting into account.

Stratigraphic distribution. Abundant in FD-16, common in FD-15 and FD-19, and rare in FD-17 in the A-A' section (middle Gzhelian, *Daixina asiatica* Zone).

PLATE 4

Figs. 1-10	- *Daixina asiatica* Bensh, 1972. 1-5, 8, 9: axial sections; 6, 7, 10: sagittal sections, 1: D2-030986; 2: D2-030996; 3: D2-030983; 4: D2-031047; 5: D2-030993; 6: D2-031046; 7: D2-030986; 8: D2-031005; 9: D2-031034; 10: D2-031028, 1, 3, 7,: FD-15; 2, 5, 8: FD-16; 4, 6, 9, 10: FD-19, 1-4, 8: ×10; 5-7, 9: ×15; 10: ×20.
Figs. 11-15	- *Rugosofusulina prisca* (Ehrenberg, 1854). 11, 12, 14, 15: axial sections, FD-20, ×15; 13: sagittal section, FD-21, ×20, 11: D2-031061; 12: D2-031052; 13: D2-031066; 14: D2-031055; 15: D2-031056.
Figs. 16-21, 24	- *Triticites simplex* (Schellwien, 1908). 16-18, 20, 24: axial sections; 19, 21: sagittal sections, 16: D2-031121; 17: D2-031069; 18: D2-031118; 19: D2-031076; 20: D2-031126; 21: D2-031115; 24: D2-031067, 16, 18, 20, 21: FD-25; 17, 19, 24: FD-21; 16: ×15; others: ×20.,
Figs. 22, 23, 25, 27, 28	- *Rugosofusulina* sp. A. 22, 25, 27, 28: axial sections; 23: sagittal section, 22: D2-031091; 23: D2-031088; 25: D2-031097; 27: D2-031085; 28: D2-031093, all FD-22; 22, 25, 27, 28: ×10; 23: ×20.
Figs. 26, 29	- *Schwageriniformis* spp. Axial sections, 26: D2-031013, ×30, 29: D2-031013, ×40, both FD-17.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Genus *Triticites* Girty, 1904

Triticites simplex (Schellwien, 1908)

Pl. 4, figs 16-21, 24

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

Material. Five axial and two sagittal sections are illustrated, and others.

Discussion. The Hadim material is probably identical with the types described by Schellwien (1908) from the "Upper Carboniferous" of the south of Moscow and the Donetz Basin in having distinct chomata and weakly folded septa. By these characters, this species is assigned to the genus *Triticites*.

Stratigraphic distribution. Common in FD-25, and rare in FD-21, -22, and -30 in the A-A' section (middle Gzhelian to middle Asselian, *Daixina asiatica* Zone to *Paraschwagerina* sp. Zone).

Triticites pseudosimplex Chen, 1934

Pl. 7, fig. 4

1934 *Triticites pseudosimplex* Chen, p. 25, 26, pl. 1, figs 19, 20.

Material. one tangential section is illustrated, and others.

Discussion. Our material is identical with the original description of *Triticites pseudosimplex* by Chen (1934) from Jiangsu, South China in spite of slight differences in larger test and more strongly fluted septa in the latter.

Stratigraphic distribution. Common in FD-32, in the A-A' section (upper Asselian, *Dutkevichia complicata* Zone).

Genus *Rugosofusulina* Rauser-Chernousova, 1937

Rugosofusulina prisca (Ehrenberg) von Möller, 1878

Pl. 4, figs 11-15

1842 *Alveolina prisca* Ehrenberg, p. 274.

1878 *Fusulina prisca* (Ehrenberg), emend. von Möller, p. 38, pl. 3, fig. 1a-1e; pl. 6, fig. 2a-2c.

1908 *Fusulina prisca* (Ehrenberg), Schellwien, p. 182-184, pl. 18, figs 7-11, 13, 14, 16, 17.

1908 *Fusulina prisca* var. *artiensis* Schellwien, p. 184, pl. 19, figs 1-4.

Material. Four axial and one sagittal sections are illustrated, and others.

Discussion. The axial section shown in pl. 6, fig. 2a in von Möller (1878) was designated as the lectotype specimen of this species by Thompson (1948). It is approximately of 6 mm in length, 2 mm in width, and 0.23 mm in proloculus diameter, and has five whorls gradually expanding outwards, rather irregularly fluted septa, and chomata on proloculus and inner two whorls.

Fusulina prisca (Ehrenberg) and *F. prisca* var. *artiensis*, described by Schellwien (1908) from the Upper Carboniferous of Russia, well agree with the lectotype specimen, but have larger test. Most of our specimens are closer to Schellwien's specimens than von Möller's ones. As marked differences seem to be not recognized between them, *artiensis* is thought to be a junior synonym of *prisca*, and the Hadim material is identified with *Rugosofusulina prisca* with reference to many descriptions and illustrations of this species in the last century.

Stratigraphic distribution. Common in FD-20 and FD-23 in the A-A' section (Gzhelian, *Daixina asistica* Zone and *Rugosofusulina* sp. A Zone).

Rugosofusulina cf. **latispiralis** Forke, 2002

Pl. 6, figs 1-7

Rugosofusulina sp. C Kobayashi & Altiner, 2008, pl. 2, fig. 16.

Compare: 2002 *Rugosofusulina latispiralis* Forke, p. 239, pl. 36, figs. 22, 23; pl. 43, fig. 5.

Material. Five axial and two sagittal sections are illustrated, one axial section (pl. 2, fig. 16) in Kobayashi & Altiner (2008), and others.

Discussion. The present specimens are similar to "*Rugosofusulina alpina*" Schellwien, 1898 that were described by Rauser-Chernousova (1937) and later many Russian workers. Recently, Forke (2002) concluded that these Russian materials are never conspecific with the topotype one from the Carnic Alps, by which Forke proposed the new designation as *Rugosofusulina latispiralis*.

The Hadim specimens are comparable to this renamed species from silimarities of shape of the test, mode of septal folding and others. The former, however, has more tightly coiled inner whorls, and smaller test and proloculus than the latter.

Stratigraphic distribution. Abundant in FD-38, and common to rare in FD-30 and FD-39 to FD-41 in the A-A' section (middle and upper Asselian, *Paraschwagerina* sp. Zone and *Dutkevichia complicata* Zone).

Rugosofusulina sp. A

Pl. 4, figs 22, 23, 25, 27, 28

Material. Four axial and one sagittal sections are illustrated, one axial section (pl. 2, fig. 11) in Kobayashi & Altiner (2008), and others.

Discussion. Degree of wall rugosity and development of axial filling, and form ratio are variable from one specimen to the other specimen in our material. Axial filling, for example, is well developed in the specimen shown in Pl. 4, fig. 25 and nearly absent in that in Pl. 4, fig. 28. Nevertheless, the mode of its development is gradually changeable among many specimens examined. These conspicuous morphologic differences recognized in the Hadim material are therefore thought to be intraspecific variation.

Rugosofusulina sp. A is different from *Rugosofusulina* cf. *latispiralis* and *R. prisca* in the Hadim area by its more inflated fusiform test with larger proloculus, and well-developed chomata; *Pseudofusulina stabilis* (Rauser-Chernousova, 1937) by its more distinct wall rugosity and less developed axial filling; and from *Rugosofusulina* sp. B (Pl. 6, fig. 14) by its not tightly coiled inner whorls and larger proloculus. Similar forms to the Hadim material are *Rugosofusulina intermedia* Suleimanov, 1949 from the Asselian of the Preurals (Suleimanov 1949) and *Rugosofusulina arianica* Leven & Scherbovich, 1978 from the upper Gzhelian of the South Urals (Davydov 1986).

Stratigraphic distribution. Common in FD-22 and FD-24 in the A-A' section (upper Gzhelian, *Rugosofusulina* sp. A Zone).

Genus *Schwagerina* von Möller, 1877

Schwagerina cushmani (Chen, 1934)

Pl. 6, figs 8-11

1934 *Pseudofusulina cushmani* Chen, p. 72, 73, pl. 6, figs 4-6.

Material. Three axial and one sagittal sections are illustrated, one axial section (pl. 2, fig. 14) in Kobayashi & Altiner (2008), and others.

Discussion. Wide morphologic variations are discernible among the Hadim specimens, especially in the development of axial filling and form ratio of both the external test and each whorl. The ovoid test with bluntly pointed poles, tightly coiled inner whorls with pointed poles, intensely and rather regularly folded septa and tall septal folds in outer whorls, and dense and broad axial filling are common in the present material, and this population is similar to those of *Pseudofusulina cushmani* proposed by Chen (1934) from the Sakmarian of southern Jiangsu. This species is referred to *Schwagerina* instead of *Pseudofusulina* because the mentioned characters are commoner in *Schwagerina* than in *Pseudofusulina*.

Stratigraphic distribution. Common to rare in seven levels, FD-32 to FD-47 in the A-A' section (upper Asselian and Sakmarian, *Dutkevichia complicata* Zone and *Paraschwagerina pseudomira* Zone).

Genus *Pseudofusulina* Dunbar & Skinner, 1931

Pseudofusulina stabilis (Rauser-Chernousov 1937)

Pl. 5, figs 6, 7

1937 *Rugosofusulina stabilis* Rauser-Chernousova, pl. 1, fig. 7.

1938 *Pseudofusulina stabilis* (Rauser-Chernousova) p. 158, pl. 7, figs 8, 9; pl. 8, fig. 3.

Material. Two axial sections are illustrated and others.

Discussion. The Hadim material is nearly identified with the Russian types which were originally referred to *Rugosofusulina* and later to *Pseudofusulina*, from the Gzhelian of Samara Bend (Rauser-Chernousova 1937, 1938). They are common in ovoid test with bluntly pointed poles, expansion of the test, strongly fluted septa, weakly corrugated wall, and massive and broad axial filling.

Stratigraphic distribution. Common to rare in six levels from FD-35 to FD-47 in the A-A' section (upper Asselian and Sakmarian, *Dutkevichia complicata* Zone and *Paraschwagerina pseudomira* Zone).

Pseudofusulina sp. A

Pl. 5, figs 1-4

Material. Four axial (three megalospheric and one microspheric) sections are illustrated, and others.

Discussion. Small test appearance of the present specimens is due to abrasion of outer whorls. Intensity and regularity of septal folding and bluntly pointed poles in outer whorls of the Hadim specimens are similar to those of *Pseudofusulina tschernyschewi* (Schellwien, 1908), but the latter has more elongate test. The microspheric form consists of a minute proloculus about 0.025 mm, *Schubertella*- or *Fusiella*-type inner three whorls, and the fourth whorl with thicker perforate wall. Test characters in the outer whorls are not different in megalosperic and microspheric forms.

This unidentified species is tentatively assigned to *Pseudofusulina*. Intensity and regularity of septal fluting and other characters, however, are similar to those of primitive forms of *Eoparafusulina* like *E. brevis* Kobayashi and Altiner n. sp., proposed in this paper, and suggest their phylogenetic relationships. However, the tunnel is broader and more irregular, and the test expands more slowly in *Pseudofusulina* sp. A.

Stratigraphic distribution. Common in FD-32 and rare in five levels from FD-25 to FD-41 (Asselian, *Paraschwagerina* sp. Zone and *Dutkevichia complicata* Zone).

Pseudofusulina sp. B

Pl. 6, figs 15-17

Material. Two axial (one megalospheric (Pl. 6, fig. 15) and one microspheric (Pl. 6, fig. 16) and one sagittal (microspheric) (Pl. 6, fig. 17) sections are illustrated, and others.

Discussion. The two illustrated specimens with minute proloculus are thought to represent the microspheric forms of the illustrated axial section of the megalospheric form based on co-existing many specimens from three levels. These two microspheric specimens consist of minute proloculus less than 0.035 mm in outside diameter and succeeding tightly coiled whorls. In the sagittal section, the tightly coiled initial stage continues to the seventh whorl gradually increasing their heights, and distinct alveolar wall structure is found in rapidly expanding later whorls. In the axial section, on the other hand, the initial stage is not so evident. In spite of somewhat different test expansion in microspheric specimens, both morphotypes are thought to be conspecific.

The present material is assignable to a group of elongate forms of *Pseudofusulina* in having irregularly and moderately folded septa throughout the test. Among the described species, this unnamed species is thought to be morphologically silimar to *Pseudofusulina verneuili* (von Möller, 1878) and *Pseudofusulina verneuili solida* (Schellwien, 1908).

Stratigraphic distribution. Rare in FD-44, -45, and -48 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Genus *Dutkevichia* Leven and Scherbovich, 1978

Dutkevichia complicata (Schellwien, 1898)

Pl. 5, figs 9-16; Pl. 7, figs 10, 11

1898 *Fusulina complicata* Schellwien, 1898, p. 249, 250, pl. 20, figs 1-7.

Material. Nine axial (seven megalospheric and two microspheric) and one sagittal sections are illustrated, and one axial section (pl. 2, fig. 19) in Kobayashi & Altiner (2008), and others.

Discussion. The Hadim material is highly variable in proloculus size, form and expansion of the test, septal folding in outer whorls, axial filling, and development of phrenotheca. Some specimens have relatively weaker septal folding in polar regions and more inflated fusiform test (Pl. 7, fig. 11) than others, and appear to be assignable to *Chalaroschwagerina* Skinner and Wilde, 1965b rather than to *Dutkevichia.* These differences, however, are thought to only represent the wide morphologic variation of this species. All the specimens assignable to the genus *Dutkevichia* in the Hadim material are nearly identical with the types described by Schellwien (1898) from the Upper Asselian of the Carnic Alps. Wide morphologic variation of this species is also recognized in microspheric forms. Although outer whorls are not preserved, the number and expansion of whorls, and axial filling in the juvenile whorls are somewhat different between the illustrated two microspheric specimens.

Wide morphologic variations of this species are also found in other examples reported from many localities of the Tethyan regions. Length of the test, for example, is 11 mm in the original specimen, varies approximately from 7 to 11 mm in our ones, and attains to 14 mm in the specimen from the lower Asselian of the Southern Urals (Rozovskaya 1952). Much more intensely folded septa than those of ours are exemplified by the specimens in Bensh (1972) from the upper Asselian of southern Fergana. Many species of this genus have been proposed from the Asselian and Sakmarian of Central Asia (e.g. Leven & Scherbovich 1978), but some of them are thought to be synonymous.

Stratigraphic distribution. Abundant to common in ten levels from FD-32 to FD-52 in the A-A' section (upper Asselian and Sakmarian, *Dutkevichia complicata* Zone and *Paraschwagerina pseudomira* Zone), and common to rare in three levels from FD-61 to FD-65 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Genus *Rugosochusenella* Skinner & Wilde, 1965a

Rugosochusenella karatchatyrica (Bensh, 1972)

Pl. 6, figs 18, 19

1972 *Chusenella karatchatyrica* Bensh, p. 117, 118, pl. 26, figs 5, 6

Material. Two oblique axial sections are illustrated and others.

Discussion. Our material is thought to be identical with *Chusenella karatchatyrica* from southern Fergana by Bensh (1972), which is better to be assigned to *Rugosochusenella*. Specimens of *R. karatchatyrica* should not be taken as microspheric individuals of a dimorphic species, since minute proloculus is considered to be typical for this species. In addition to these characters, our material resembles the Bensh's ones in test size and number of whorls. Our specimens have thicker and clearer rugosity of wall in outer whorls.

This species is different from *Rugosochusenella shagoniensis* in having thicker wall with clearer alveolar structure and rugosity in outer whorls in addition to more tightly coiled inner whorls. Furthermore, this species was distinguished in three stratigraphic levels. *Rugosochusenella shagoniensis* is easily distinguished from *Schwagerina cushmani* (Chen, 1934) in having thicker rugose wall and more sharply pointed poles. *Rugosochusenella* sp. (Pl. 6, fig. 20), a form occurring in the *Paraschwagerina pseudomira* Zone of the A-A' section must not be interpreted as immature specimens of *Rugosochusenella karatchatyrica*, because they never occur together in the same sample.

Stratigraphic distribution. Common to rare in FD- 37, -38, and 43 in the A-A' section (upper Asselian, *Dutkevichia complicata* Zone).

Rugosochusenella pseudogregaria (Bensh, 1962)

Pl. 5, figs 5, 8

1962 *Pseudofusulina pseudogregaria* Bensh, p. 231-232, pl. 17, figs 1-4.

Material. One axial and one sagittal sections are illustrated, one axial section (pl. 2, fig. 13) in Kobayashi & Altiner (2008), and others.

Discussion. Elongate fusiform schwagerinids with sharply pointed poles, small proloculus, tightly coiled inner whorls, and well-developed axial filling represented by *Rugosochusenella gregaria* (Lee, 1931) have been described by many workers from the Gzhelian to Sakmarian. Different names such as *paragregaria*, *gregariaeformis*, and *pseudogregaria* were given to these forms, and some were further subdivided into subspecies or variety (e.g. Rauser-Chernousova & Scherbovich 1958). They and their allies were assigned to *Pseudofusulina, Chusenella*, or *Rugosochusenella* by various authors.

Although the taxonomic problems of this species group remain unresolved, our present material is tentatively identified as *Rugosochusenella pseudogregaria* proposed by Bensh (1962) from the Asselian of northern Fergana on account of many similarities in the mentioned characters. *Rugosochusenella* sp. (Pl. 6, fig. 20), found in two samples from the *Paraschwagerina pseudomira* Zone, differs from *Rugosochusenella pseudogregaria* in having larger form ratio for corresponding whorls.

Stratigraphic distribution. Rather rare in FD-38 (upper Asselian, *Dutkevichia complicata* Zone) and FD-50 (Sakmarian, *Paraschwagerina pseudomira* Zone) in the A-A' section.

Rugosochusenella shagoniensis Davydov, 1986

1986 *Rugosochusenella shagoniensis* Davydov, p. 123, 124, pl. 25, figs 9, 14.

Material. One axial section (pl. 2, fig. 17) figured in Kobayashi & Altiner (2008), and others.

Discussion. Small number of individuals, one of which was illustrated in Kobayashi & Altiner (2008), seem to attain to the mature stage. From the decrease of height of the whorl in the last whorl, they are thought to be independent from other species of the genus distinguished in the Hadim area. The Hadim material is closely similar to *Rugosochusenella shagoniensis* described by Davydov (1986) from the uppermost Gzhelian of Darvaz in many test characters.

Stratigraphic distribution. Rare in FD-22 in the A-A' section (upper Gzhelian, *Rugosofusulina* sp. A Zone).

Genus *Darvasites* Miklukho-Maklay, 1959a

Darvasites contractus (Schellwien, 1909)

Pl. 7, figs 15-19

1909 *Fusulina contractus* Schellwien, p. 159-163, pl. 13, figs 9-12.

Material. Four axial and one sagittal sections are illustrated, one axial section (pl. 3, fig. 4) in Kobayashi & Altiner (2008), and others.

Discussion. More or less different appearances in test size and varying numbers of whorl among specimens are apparently due to the abrasion of outer whorls. Among more than 50 axial and sagittal sections, well-preserved five specimens are illustrated. Differences of

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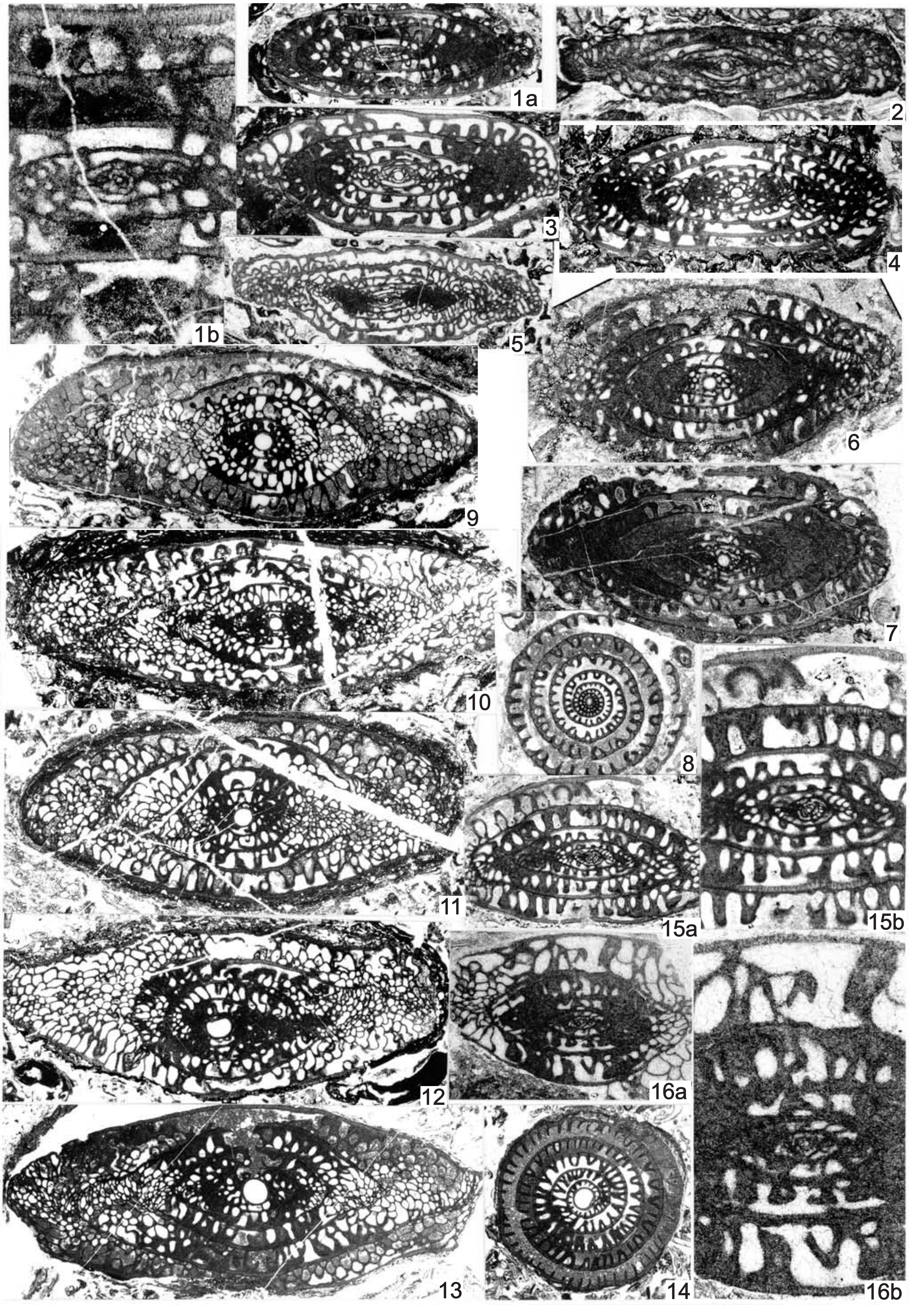
PLATE 5

Figs. 1-4 - *Pseudofusulina* sp. A. Axial sections (1: microspheric form), 1: D2-031264, FD-32; 2: D2-031141, FD-25; 3: D2-031404, FD-41; 4: D2-031293, FD-32; 1a, 2, 4: ×10; 1b: ×40; 3: ×15.

Figs. 5, 8 - *Rugosochusenella pseudogregaria* (Bensh, 1962). 5: axial section, D2-031369, FD-38, ×10; 8: sagittal section, D2-031643, FD-51, ×15.

Figs. 6, 7 - *Pseudofusulina stabilis* (Rauser-Chernousova, 1937). Axial sections, 6: D2-031505, FD-46; 7: D2-031343, FD-37; both ×15.

Figs. 9-16 - *Dutkevichia complicata* (Schellwien, 1898). 9-13, 15, 16: axial sections (15, 16: microspheric forms); 14: sagittal section, 9: D2-031615, FD-49; 10: D2-031301, FD-32; 11: D2-031473, FD-46; 12: D2-031271, FD-32; 13: D2-031612, FD-49; 14: D2-031568, FD-49; 15: D2-031675, FD-52; 16: D2-031471, FD-46; 9-14: ×10; 15a, 16a: ×15; 15b: ×30; 16b: ×35.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proloculus size, form ratio, development of chomata, and tunnel angle are thought to the result of a wide morphologic variation of the Hadim material. They are undoubtedly identical with *Darvasites contractus* by their common characters such as test expansion, mode of septal fluting, and narrow and high tunnel bordered by massive chomata.

Stratigraphic distribution. Abundant to common in three levels, FD-55 to -57 in the uppermost A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone) and two levels, FD-75 and FD-76 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Darvasites? sp.

Pl. 6, figs 12, 13

Material. Two axial are illustrated and other sections.

Discussion. A few well-oriented and other specimens of this unnamed species questionably referable to *Darvasites* all measure less than 2.5 mm in length and have less than five whorls. Tunnel is well recognized, but chomata are lacking in outer whorls. They are probably different from *Darvasites contractus* in having different test characters and occurrence in different stratigraphic levels.

Stratigraphic distribution. Rare in FD-46 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Genus *Eoparafusulina* Coogan, 1960

Eoparafusulina ferganica (Miklukho-Maklay, 1949)

Pl. 7, figs 5-8, 12-14

1949 *Parafusulina ferganica* Miklukho-Maklay, p. 100, 101, pl. 14, figs 1-4.

1949 *Parafusulina* (?) *ferganica* var. *leda* Miklukho-Maklay, p. 101-103, pl. 14, figs 1-4.

Material. Five axial and two sagittal sections are illustrated, one axial section (pl. 3, figs. 12) in Kobayashi & Altiner (2008), and others.

Discussion. Miklukho-Maklay (1949) proposed *Parafusulina ferganica* and *Parafusulina* (?) *ferganica* var. *leda* having larger and more elongate test and more intensely folded septa from the Lower Permian of southern Fergana. He insisted on their close similarities to *Monodiexodina kattaensis* (Schwager, 1887). However, morphologic characters of the variety *leda* claimed to be different from those of *ferganica* by Miklukho-Maklay (1949) should be considered as an intraspecific variation.

The Hadim material is identical with the types illustrated by Miklukho-Maklay (1949) in many respects. They are more or less variable by specimens in the number of tightly coiled inner whorls, height and length of whorls throughout growth, shape of periphery, development of cuniculi, and others. This species apparently assignable to *Eoparafusulina* is thought to be an ancestral form of *Monodiexodina* from test characters suggesting their intimate phylogenetic relationships. Gradual morphologic changes between them are recorded as the increase of test size and form ratio, intensity and regularity of folded septa with well development of cuniculi. The upper part of septa tends to be unfolded and chomata are absent in outer whorls.

Stratigraphic distribution. Abundant to common in nine levels from FD-59 to FD-71 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Eoparafusulina brevis n. sp.

Pl. 9, figs 10-17

Origin of the name. After the short length of the test in comparison with width for the genus *Eoparafusulina*.

Type specimens. Holotype D2-032550 (Pl. 9, fig. 10); Paratypes D2-032120 (Pl. 9, fig. 11), D2-032547 (Pl. 9, fig. 12), D2-032478 (Pl. 9, fig. 13), D2-032083 (Pl. 9, fig. 14), D2-032109 (Pl. 9, fig. 15), D2-032542 (Pl. 9, fig. 16), D2-032445 (Pl. 9, fig. 17), D2-032088 (Pl. 3, fig. 3 in Kobayashi and Altiner, 2008).

Material. Six axial (five megalospheric and one microspheric) and two sagittal sections are illustrated, one axial section (pl. 3, fig. 3) in Kobayashi & Altiner (2008), and others.

Diagnosis. Ellipsoidal to subcylindrical *Eoparafusulina* having smaller form ratio, less well-developed cuniculi, higher and more irregular septal folds, and thicker wall in outer whorls than those of the known species of the genus.

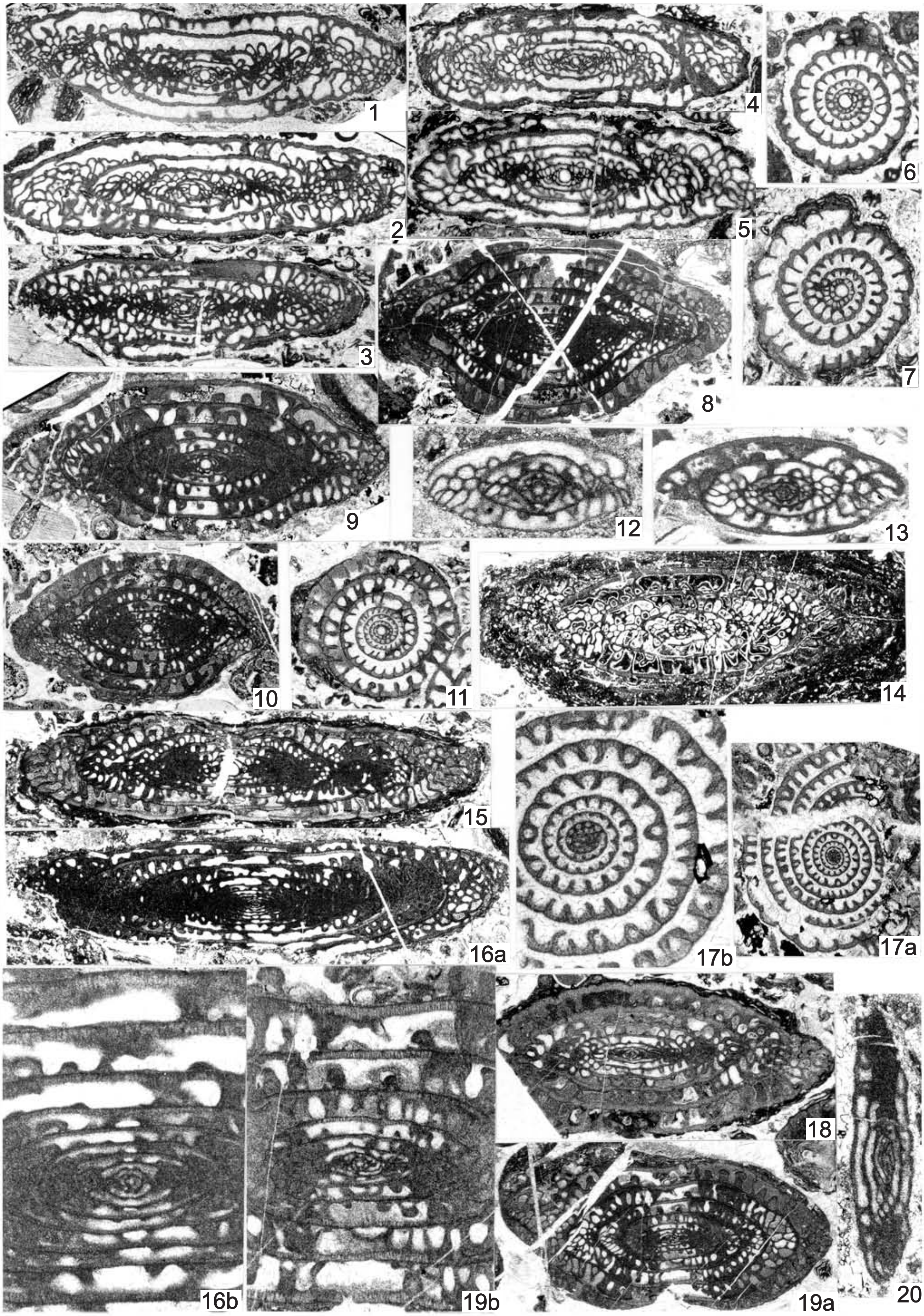
Description. Test ellipsoidal to subcylindrical with straight to broadly arched periphery, slightly convex lateral slopes, rounded to bluntly pointed poles, and straight axis of coiling. Mature test with eight whorls, about 5 to 7 mm in length, about 2.5 to 3.1 mm in width, and about 2.0 to 2.6 in form ratio in the megalospheric form. The microspheric form consists of more than ten whorls, but its test size is not exactly known due to the abrasion of outer whorls.

Proloculus nearly spherical, and 0.12 to 0.16 mm in the megalospheric, and 0.016 mm in the microspheric form. Test gradually increasing its length and width. Tightly coiled juvenile stage consists of four whorls in the microspheric form.

Length, width, and approximate form ratio form from the first to the eighth whorl: 0.38, 0.85, 1.20, 2.25, 3.10, 4.15, 5.28, and 6.8 (?) mm; 0.25, 0.41, 0.68, 0.96, 1.30, 1.71, 2.15, and 2.78 mm; 1.5, 2.1, 1.8, 2.3, 2.4, 2.4, 2.5, and 2.4 (?), respectively, in the holotype specimen.

PLATE 6

- Figs. 1-7 - *Rugosofusulina* cf. *latispiralis* Forke, 2002. 1-5: axial sections, ×10; 6, 7: sagittal sections, ×15, 1: D2-031364; 2: D2-031350; 3: D2-031362; 4: D2-031347; 5: D2-031355; 6: D2-031346; 7: D2031387, 1-4, 6: FD-38; 5, 7: FD-39.
- Figs. 8-11 - *Schwagerina cushmani* (Chen, 1934). 8-10: axial sections; 11: sagittal section, 8: D2-031516, FD-47; 9: D2-031434, FD-44; 10: D2-031515, FD-47; 11: D2-031365, FD-38, 8, 10: ×10; 9, 11: ×15..
- Figs. 12, 13 - *Darvasites*? sp. Axial sections, 12: D2-031491, ×30; 13: D2-031478, ×20, both FD-46.
- Fig. 14 - *Rugosofusulina* sp. B. Axial section, D2-031245, FD-30, ×15.
- Figs. 15-17 - *Pseudofusulina* sp. B. 15, 16: axial sections (16: microspheric form); 17: sagittal section (microspheric form), 15: D2-031545, FD-48; 16: D2-031438, FD-44; 17: D2-031455, FD-45; 15, 16a: ×10; 16b, 17b: ×40; 17a: ×15.
- Figs. 18, 19 - *Rugosochusenella karachatyrica* (Bensh, 1972). Axial sections, 18: D2-031338, FD-37; 19: D2-031420, FD-43; 18: ×15; 19a: ×10; 19b: ×30.
- Fig. 20 - *Rugosochusenella* sp. Axial section, D2-031506, FD-46, ×30.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Septa rather thick, partially coated by calcareous dark materials, strongly folded in polar regions and moderately in the median parts. Septal folds commonly about half or more as high as chambers, and some reaching the top of chambers. Cuniculi well developed where adjacent septa regularly and intensely fluted. Septal counts from the first to the sixth whorl: 8, 15, 17, 26, 23, and 30 (?) in the paratype shown in Pl. 9, fig. 16; and 6, 16, 16, 21, 23, and 27 in Pl. 9, fig. 17.

Wall thin in inner four to five whorls, rather abruptly thickened in outer ones consisting of tectum and coarse alveolar keriotheca, and up to 0.1 mm in the thickest part. Chomata present on proloculus and inner two, rarely four whorls. Chomata-like projection near tunnel in outer whorls are due to septal thickenings or interstitial fillings within septal folds, resulting low and narrow tunnel in inner whorls, but irregular and indistinct tunnel path in outer whorls.

Discussion. This new species is easily distinguished from *Eoparafusulina ferganica* by having much shorter test, but mode of septal folding is similar between them. It is different from typical species of *Eoparafusulina* in its shorter and smaller test and thicker wall in outer whorls and less regularly folded septa. These characters diagnostic to the new species suggest its possible assignment to *Mccloudia* separated by Ross (1967) from *Eoparafusulina* as a new subgenus, designating *Eoparafusulina contracta* Skinner and Wilde, 1965b as the type species. *E.* (*M.*) *contracta* and many other forms from the Wolfcampian McCloudia Limestone (Skinner & Wilde 1965b) are easily distinguished from the present new species by their much thicker wall and smaller test. Based on these respects in particular septal folding and wall thickness, this new species is more reasonably assigned to *Eoparafusulina* than other genera.

Some similar forms to the new species are such ones as "*Hemifusulina*" *ovata* Chang, 1963 and "*Hemifusulina*" *shengi* Chang, 1963 from the Sakmarian of Xinjiang Tienshan by Chang (1963a), and *Pseudofusulina* ex. gr. *ovata* (Chang) and *Pseudofusulina mikhailovi* Leven, 1971 from north Afghanistan by Leven (1971). These Asian forms may be assigned to *Mccloudia*. The present new species is different from them by having larger test, more intensely and regularly folded septa, less tightly coiled inner whorls, and axial filling. From these characters, *Eoparafusulina brevis* is thought to be phylogenetically related to the *Monodiexodina* lineage along with *E. ferganica*.

Stratigraphic distribution. Common in FD-60 and FD-71, and rare in nine levels from FD-61 to FD-73 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Genus *Pseudoschwagerina* Dunbar and Skinner, 1936

Pseudoschwagerina globosa n. sp.

Pl. 11, figs 1-4

Origin of the name. After the globose test.

Type specimens. Holotype D2-031967 (Pl. 11, fig. 1); Paratypes D2-031964 (Pl. 11, fig. 2), D2-031976 (Pl. 11, fig. 3), D2-035127 (Pl. 11, fig. 4), D2-031979 (Pl. 3, fig. 8 in Kobayashi and Altiner, 2008).

Material. Two axial and two sagittal sections are illustrated, one axial section (pl. 3, fig. 8) in Kobayashi & Altiner (2008), and others.

Diagnosis. Nearly spherical test consisting of minute proloculus, extremely tightly coiled *Triticites*-type inner whorls, subsequent loosely coiled middle and outer whorls, weakly folded to plane septa in middle and outer whorls, and showing *Sphaeroschwagerina* appearance but should be assignable to *Pseudoschwagerina* based on its ontogenetic development.

Description. Test nearly spherical with 6.5 to 7 whorls. Approximate length, width, and form ratio varying from 4.8 to 5.8 mm, 5.0 to 6.2 mm, and 0.94 to 1.07, respectively. Proloculus spherical and 0.08 to 0.11 mm in its outside diameter. Beyond extremely tightly coiled, inner two and a half to four, fusiform whorls (initial stage), the test expanding rapidly and changing into an oval to globose form with shallow umbilical depressions (middle stage), and finally becoming nearly spherical decreasing the height of chambers (final stage). Length, width, and form ratio from the first to sixth whorl in the holotype specimen: 0.29, 0.86, 1.60, 3.25, 4.30, and 5.39 mm; 0.19, 0.32, 0.68, 1.94, 3.70, and 4.98 mm; 1.53, 2.69, 2.35, 1.68, 1.16, and 1.08, respectively.

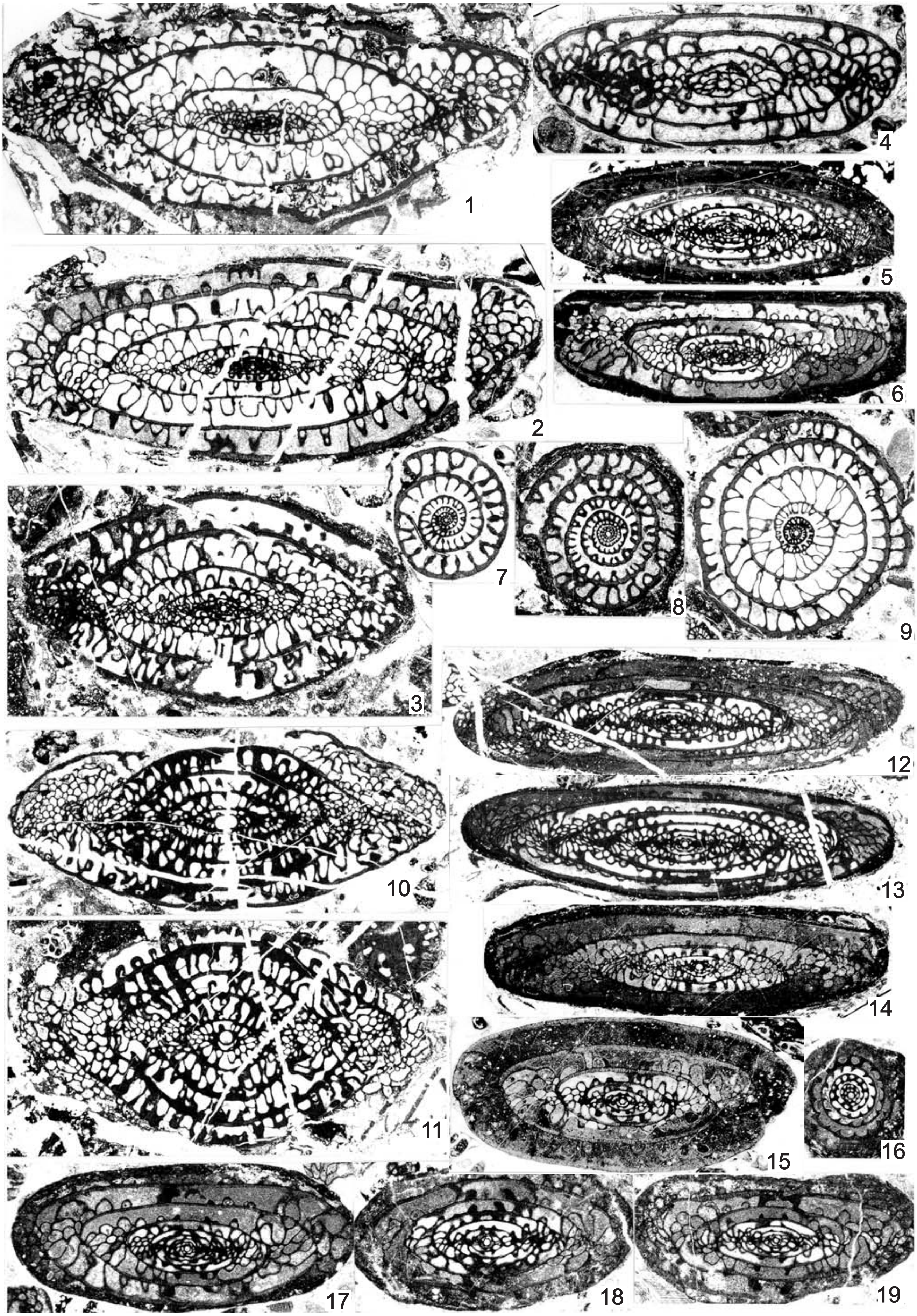
Septa thin, perpendicular to the wall, and weakly fluted in the initial stage; very thin, long, nearly plane, and inclined anteriorly in the middle stage; and rather thick, closely spaced, nearly unfluted to weakly fluted with folds confined to lower one-thirds of their height in the middle part of the test and weakly fluted in polar regions in the final stage. Septal counts from the first to sixth whorl 11, 18, 19, 16, 16, 16, and 25, and those of the last half whorl more than 25 in the paratype specimen shown in pl. 11, fig. 3.

Wall structureless in the first whorl, consisting of tectum and perforate protheca in the second to third, tectum and finely alveolar keriotheca in the third to fourth in the initial stage. Wall in the middle stage thinner than in the initial stage, and composed of very thin tectum partly with very finely alveolar layer. Wall thicker and consisting of tectum and distinct alveolar keriotheca in the final stage. Its thickness is up to 0.115 mm in the terminal whorl. Tunnel high, straight, and bordered by massive chomata coated by secondary dark calcareous materials in the initial stage. It is very low and its path indistinct in the middle stage, and becoming higher in the final stage. Chomata are absent in outer whorls.

Discussion. Test morphologies are different in three ontogenetic stages in this new species. Those in the middle and final stages, and minute proloculus, and length and width of the initial stage are much more similar to those of *Sphaeroschwagerina* than of *Pseudoschwagerina*. Based on the widely accepted generic diagnosis of inflated schwagerinids, however, this new species is assignable to *Pseudoschwagerina* because of the *Triticites*-type test construction in the initial stage,

PLATE 7

Figs. 1-3, 9	- *Paraschwagerina pseudomira* Miklukho-Makalay, 1949. 1-3: axial sections; 9: sagittal section, 1: D2-032143, FD-61; 2: D2-032395, FD-68; 3: D2-031451, FD-44; 9: D2-032206, FD-63, all × 10.
Fig. 4	- *Triticites pseudosimplex* Chen, 1934. Tangential section, D2-031270, FD-32, × 15.
Figs. 5-8, 12-14	- *Eoparafusulina ferganica* (Miklukho-Maclay, 1949). 5, 6, 12-14: axial sections; 7, 8: sagittal sections, 5: D2-032042; 6: D2-032539; 7: D2-032492; 8: D2-032522; 12: D2-032443; 13: D2-032545; 14: D2-032556, 5: FD-59; 6, 8, 13, 17: FD-71; 7, 12: FD-69, 5-7, 12-14: × 10; 8: × 15.
Figs. 10, 11	- *Dutkevichia complicata* (Schellwien, 1898). Axial sections, 10: D2-032187, FD-63; 11: D2-032325, FD-65, both × 10.
Figs. 15-19	- *Darvasites contractus* (Schellwien, 1908). 15, 17-19: axial sections; 16: sagittal section, 15: D2-032687; 16: D2-032655; 17: D2-032654; 18: D2-032668; 19: D2-032700, all FD-76, × 20.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and not similar to those of *Sphaeroschwagerina,* that was derived from *Schubertella*.

Pseudoschwagerina globosa is quite characteristic in its many characters, especially those of its initial stage by which it is apparently distinguished from the known species of both *Pseudoschwagerina* and *Sphaeroschwagerina*. Diagnostic characters represented by spherical test with distinct *Triticites*-type juvenarium and rapidly expanding succeeding whorls suggest that this new species was a specialized descendant derived from an Asselian *Pseudoschwagerina*.

Stratigraphic distribution. Rare to common in FD-56 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Pseudoschwagerina ozguli n. sp.

Pl. 10, figs 18-25; Pl. 11, fig. 5

Origin of the name. After Dr. Necdet Özgül who mapped and distinguished the major tectonic units of the Tauride Belt and made great contribution to the understanding of the Phanerozoic stratigraphy of Turkey.

Type specimens. Holotype D2-031926 (Pl. 10, fig. 20); Paratypes D2-031927 (Pl. 10, fig. 18), D2-031919 (Pl. 10, fig. 19), D2-035120 (Pl. 10, fig. 21), D2-035116 (Pl. 10, fig. 22), D2-031912 (Pl. 10, fig. 23), D2-031938 (Pl. 10, fig. 24), D2-035119 (Pl. 10, fig. 25), D2-031879 (Pl. 11, fig. 5; pl. 3, fig. 5 in Kobayashi & Altiner 2008).

Material. Seven axial and two sagittal sections are illustrated, one axial section (pl. 3, fig. 5) in Kobayashi & Altiner (2008), and others.

Diagnosis. Test ellipsoidal, consisting of small proloculus, tightly coiled *Triticites*-type inner whorls, rapidly enlarging later ones, and decreasing its width and form ratio in the last one. Septa weakly fluted with folds confined to lower half to one-thirds of their height in the middle part of the test and more intensely fluted in polar regions.

Description. Test ellipsoidal, about 4.5 mm in length and about 3 mm in width, with rounded poles and six to seven whorls. Proloculus spherical, 0.06 to 0.14 mm in its outside diameter. Inner 3 to 4.5 whorls tightly coiled, succeeding whorls rapidly enlarging, and the last whorl decreasing its width and form ratio. Length, width, and form ratio from the first to fifth whorl in the holotype specimen: 0.38, 0.87, 1.65, 2.48, and 3.46 mm; 0.23, 0.37, 0.65, 1.07, and 1.94 mm; and 1.65, 2.35, 2.54, 2.32, and 1.78, respectively.

Septa closely spaced in inner tightly coiled whorls, perpendicular to the wall or inclined anteriorly and weakly fluted with folds confined to lower half to one-thirds of their height in the middle part of the test and more intensely fluted in polar regions. Septal counts from the first to sixth whorl 8, 12, 16, 20, 16, and 21 in the paratype specimen shown in Pl. 10, fig. 18. Wall structureless in the first whorl, consisting of tectum and finely alveolar keriotheca in the subsequent tightly coiled whorls, and thin tectum and coarsely alveolar keriotheca in outer loosely coiled whorls. Its thickness is up to 0.12 mm in the last and about 0.067 mm in the preceeding two whorls in the holotype specimen. Tunnel straight, and bordered by massive chomata in inner whorls. Chomata are absent in outer whorls.

Discussion. Although the exact size of the test of the present new species is unknown due to abrasion of outer whorls in most specimens, it resembles *Pseudoschwagerina velebitica* Kochansky-Devidé, 1959 from the Asselian Rattendorf beds of Croatia in mode of septal fluting and *Triticites*-type inner whorls. The former has more inflated test and more rapidly expanding outer whorls than the latter. This new species is also similar to *Pseudoschwagerina rhomboides* described by Miklukho-Maklay (1949) from the Asselian of southern Fergana. However, *P. ozguli* has slenderer test, more number of juvenile whorls.

Relatively small test and simple test construction of this new species appear to be its alliance with *Pseudoschwagerina beedei* Dunbar and Skinner, 1937. These two species are thought to be phylogenetically unrelated in spite of their morphologic resemblance. Because the former occurs exclusively in the upper part of the Sakmarian in the Hadim area, whereas, the latter was originally described from the base of the lowest Permian Hueco Limestone of Texas by Dunbar & Skinner (1937). The present new species is thought to be distinguished from most of other species of *Pseudoschwagerina* by its smaller test and its occurrence in the Sakmarian.

Stratigraphic distribution. Abundant in FD-55 and rare in FD-54 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Pseudoschwagerina robusta (Meek, 1864)

Pl. 10, figs 11-17; Pl. 11, fig. 7

1864 *Fusulina robusta* Meek, p. 3, 4, pl. 2, figs 3, 3a-c.

1946 *Pseudoschwagerina robusta* (Meek); Thompson & Wheeler, p. 28, pl. 3, figs 1-3; pl. 6, figs 6, 7.

Material. Five axial and two sagittal sections are illustrated, one axial section (pl. 3, fig. 7) in Kobayashi & Altiner (2008), and others. Axial section shown in Pl. 11, fig. 7 is enlarged from that in Pl. 10, fig. 15.

Discussion. Wide morphologic variations are recognized in the Hadim material in test and proloculus sizes, the number of tightly coiled inner whorls, expansion of the test, septal fluting, and others. Some of these dissimilar appearances among specimens are apparently related to the abrasion of the outer part of the test. Our material should be treated as a single species without any subdivions.

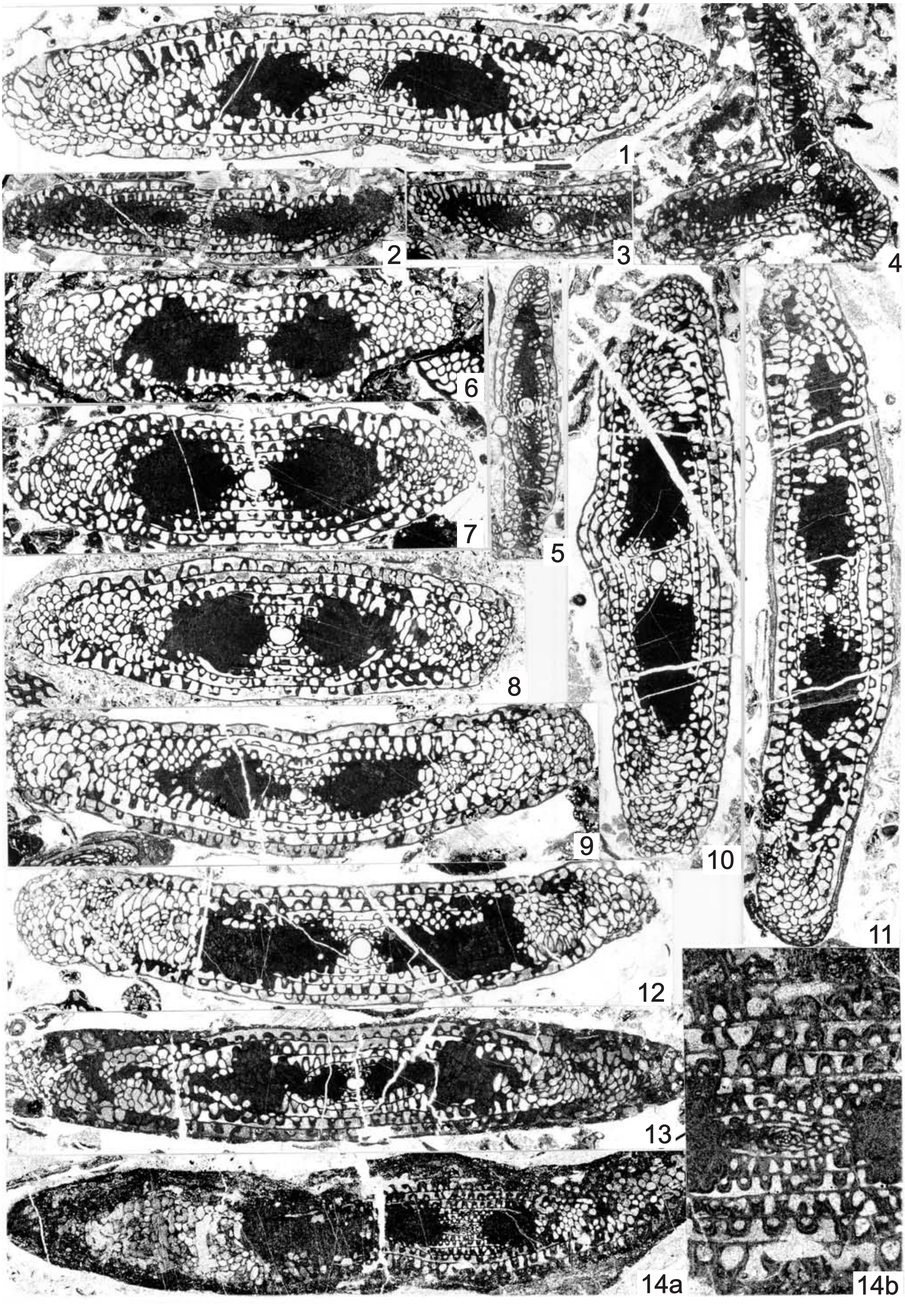
They are closer to the four specimens identified by Scherbovich (1969) with *Pseudoschwagerina robusta* than to the original ones reexamined by Thompson & Wheeler (1946) in having similar test size, septal folding, and spherical middle whorls with shallow umbilical cavities. Scherbovich's materials were based on those from the Asselian of the eastern part of Kazakhstan.

Original specimens by Meek (1864) were described from the upper Wolfcampian of the McCloud Limestone of California. Diagnostic characters of this species were made clear by the restudy of the topotype specimens by Thompson & Wheeler (1946) who considered this species the oldest valid specific name of any representative *Pseudoschwagerina*. The Hadim material appears to be smaller and more inflated than the topotype material. These differences, however, are due to abrasion of outer whorls of the Hadim materials. Smaller height of

PLATE 8

Figs. 1, 6-14 - *Quasifusulina nimia* Kochansky-Devidé, 1959. Axial sections (14: microspheric form), 1: D2-032162, FD-62; 6: D2-031282, FD-32; 7: D2-031558, FD-48; 8: D2-031795, FD-53; 9: D2-032155, FD-61; 10: D2-032086, FD-60; 11: D2-032384, FD-68; 12: D2-032108, FD-60; 13: D2-032091, 60; 14: D2-032562, FD-71, 1, 6-13, 14a: ×10; 14b: ×30.

Figs. 2-5 - *Quasifusulina longissima* (von Möller, 1878). Axial sections (4: abnormally grown specimen), 2: D2-030929; 3: D2-030932; 4: D2-030944; 5: D2-030952, all FD-12, ×10.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whorls and fewer inner tightly coiled whorls in the most complete specimen illustrated in Pl. 10, fig. 14 are similar to those of the original ones. *Pseudoschwagerina roeseri* proposed by Thompson & Hazzard (1946) from the Bird Spring Formation of southern California is probably synonymous with this species.

Two tangential sections compared with *Pseudoschwagerina turbida* from Slovenia by Kochansky-Devidé (1970) are more closely related to the Hadim material than the original one from the Carnic Alps by Kahler & Kahler (1937). *Pseudoschwagerina ishimbajica* Rauser-Chernousova and Scherbovich, 1949 and *P. intermedia* Rauser-Chernousova and Scherbovich, 1949 from the middle part of the "*Schwagerina*" horizon of the Moscow Basin (Rauser-Chernousova & Scherbovich 1949) are different from the present materials in having thicker wall and more elongate test. Septal folding and expansion of the test of *Pseudoschwagerina uddeni* (Beede & Kniker, 1924) from the "*Schwagerina*" horizon of the Moscow Basin (Rauser-Chernousova & Scherbovich 1949) are similar to those of the present material, but the latter has more inflated test with rounded poles and thinner wall.

Also morphologically related to this species are the specimens identified by Bensh (1972) with *Pseudoschwagerina pseudoaequalis* Anosova in Anosova et al., 1964 and *Pseudoschwagerina uddeni* (Beede & Kniker, 1924), both of which were described from the Middle Asselian of southern Fergana. *Pseudoschwagerina pseudoaequalis* was proposed on the basis of three specimens named as *Pseudoschwagerina aequalis* Kahler & Kahler, 1937 by Kochansky-Devidé (1959) from Croatia.

Stratigraphic distribution. Common in FD-27 and FD-30, and rare in FD-28, 29, and 32 in the A-A' section (middle Asselian, *Paraschwagerina* sp. Zone).

Pseudoschwagerina sp.

Pl. 11, fig. 6

Material. One axial section is illustrated and others.

Discussion. This unidentified species is distinguished from *Pseudoschwagerina globosa* in its smaller test and slower expansion of the test, from *P. ozguli* in its fewer number of inner tightly coiled whorls and more rapidly expanding outer ones, and from *P. robusta* in its smaller proloculus and more tightly coiled and more number of inner whorls. Among the described species, this unnamed species appears to be the closest to *Pseudoschwagerina rhomboides* (Miklukho-Maklay, 1949). Further comparison of this unidentified species needs more specimens.

Stratigraphic distribution. Rare in FD-52 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Genus *Robustoschwagerina* Miklukho-Maklay, 1959b

Robustoschwagerina nucleolata (Ciry, 1943)

Pl. 11, fig. 8; Pl. 13, figs 1-10

1943 *Pseudoschwagerina nucleolata* Ciry, p. 36-39, Fig. 15; pl. 3, figs 2-6.

1959 *Pseudoschwagerina tumida* (Likharev, 1939); Kochansky-Devidé, p. 37, 38, pl. 8, figs 9, 10.

non 1991 *Robustoschwagerina nucleolata* (Ciry, 1934), Yang and Hao, pl. 3, fig. 4, not described.

Material. Nine axial and one sagittal sections are illustrated, one axial section (pl. 3, fig. 10) in Kobayashi & Altiner (2008), and others.

Description. Test nearly spherical with 4.5 to 6 whorls in mature specimens, which are distinguishable by decreasing their width compared with the preceeding one. Length, width, and form ratio varying from 5.8 (?) to 7.12 mm, 6.53 to 7.42 mm, 0.89 to 1.07, respectively. Proloculus spherical, 0.16 to 0.47 mm, averaging 0.34 mm, in its outside diameter (Tab. 1). Obvious or rudimentary chomata always present on the proloculus.

Inner 0.5 to 1.5 whorls are fusiform to subspherical with relatively thick wall consisting of tectum and finely alveolar keriotheca. Low tunnel is bordered by rudimentary chomata. Septa are nearly straight, but gently folded near poles in specimens.

Subsequent 2 to 2.5 whorls rapidly expanding, with nearly straight axis of coiling, gradually decreasing their form ratio and close to spherical form increasing their width about three times or more as large as the initial whorl. Wall and septa commonly exceedingly thin relative to large height of whorl. Septa are plane and not folded. Chomata are lacking and tunnel cannot be recognized in thin sections.

The last 1.5 to 2 whorls decreasing their expansion ratio, and finally decrease their height. Wall and septa, especially wall, thickened. Septa not folded and chomata lacking in these whorls.

Discussion. The present specimens are quite identical with *Robustoschwagerina nucleolata* originally described from the "Artinskian" in south of Yahyali, north of Adana, eastern Taurides by Ciry (1943). Wider morphologic variation in the number of tightly coiled initial whorl, test expansion, thickness of wall and septa during growth, and others have been observed in our many specimens examined. Some of them are shown in Tab. 1, though well-oriented mature specimens are few due to their unfavourable preservation.

Two specimens assigned to this species from Kelpin, Tienshan (Kahler 1974) have smaller test and slower expansion of the test than the original and present ones. Two specimens identified as *Robustoschwagerina tumida* (Likharev, 1939) from the Rattendorf beds of Croatia by Kochansky-Devidé (1959) are assigned to this species, though they have thicker wall in outer whorls than the original ones. *R. nucleolata* is different from *R. tumida*, *R. schellwieni* (Hanzawa, 1939), *R. pamirica* Leven & Scherbovich, 1978, and their allies in lesser number of juvenile whorls. Yang & Hao (1991) have probably erroneously identified this species. The form illustrated has distinct chomata and tunnel in outer whorls, not so rapidly expanding test, and many others quite different from those of the types by Ciry (1943). This Chinese specimen should be assigned to *Pseudoschwagerina*.

The present species was designated as the type species of a new subgenus *Robustoschwagerina* (*Robustoschwagerinoides*) proposed by Sheng et al. (1984), who distinguished this new subgenus from *Robustoschwagerina* (*Robustoschwagerina*) by the absence of *Triticites*-type juvenarium in *R. nucleolata*. They regarded it similar to *Zellia* Kahler & Kahler, 1937 in having thick wall in the last whorl. Yang & Hao (1991) raised the subgenus to an independent genus rank by pointing out its spherical juvenarium being different from that of *Robustoschwagerina*, and its thinner wall and less septal pores than those of *Zellia.* We do not agree with this taxonomic treatment, because these Chinese authors took the morphologic variation of the species of *Robustoschwagerina* into little consideration, as further discussed below.

Stratigraphic distribution. Common in FD-46, -50, -51, and -52 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone), and abundant to common in 13 levels from FD-59 to FD-77 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Robustoschwagerina regularis (Ciry, 1943)

Pl. 11, figs 10-13; Pl. 12, figs 1-14

1943 *Pseudoschwagerina regularis* Ciry, p. 39, pl. 4, fig. 2.

non 1984 *Robustoschwagerina regularis* (Ciry, 1943), Sheng et al., p. 525, pl. 1, figs 7, 8.

Material. Eleven axial and three sagittal sections are illustrated, one axial section (pl. 3, fig. 11) in Kobayashi & Altiner (2008), and others.

Description. Test nearly spherical with 5 to 7, rarely 8 whorls in mature specimens. Length, width, and form ratio varying from 6.08 to 7.6(?) mm, 6.41 to 7.23 mm, 0.92 to 1.05, respectively in 10 specimens with more than five whorls illustrated in this paper and Kobayashi and Altiner (2008). Outside diameter of proloculus ranging from 0.01 to 0.39 mm, averaging 0.23 mm in the 15 specimens (Tab. 2). Chomata always present on spherical proloculus.

Inner one to three whorls fusiform to subspherical, and tightly coiled. Wall consists of tectum and very fine alveolar keriotheca in specimens with relatively thick wall, and tectum and perforate protheca in those with relatively thin wall. Chomata and tunnel distinct, and septa weakly folded in polar regions in specimens with more than 1.5 whorls. Chomata absent and septa not folded in those with less than 1.5 whorls.

Subsequent 2 to 2.5 whorls rapidly expanding, with nearly straight axis of coiling, by gradually decreasing their form ratio and being close to a spherical form. Their width becoming five to ten times or more as large as the initial whorl. Wall and septa exceedingly thin relative to height of whorl. Septa commonly plane, inclined anteriorly, and gently curved. They are weakly folded in their lower end in specimens. Chomata are absent and tunnel cannot be recognized in thin sections.

The last 2 to 2.5 whorls decrease their length and width. Decrease of height in the last 0.5 to 1 whorls is more conspicuous than that in preceeding ones, and terminal whorl becoming nearly spherical. Wall and septa, especially wall, thickened. Septa commonly plane, but weakly folded in their lower end. Chomata are absent in these whorls.

Discussion. *Robustoschwagerina regularis* was proposed from the "Artinskian" in south of Yahyali, north of Adana, eastern Taurides by Ciry (1943) based on a single specimen. The specimen is a tangential section close to the center of the nearly spherical test consisting of probably six whorls. Inner one and a half whorls following possibly large proloculus are fusiform and tightly coiled. In outer inflated whorls, septa are plane or weakly folded in their lower end, and chomata are absent. These characters suggest its alliance to *Robustoschwagerina nucleolata* and its apparent independency from *Pseudoschwagerina galatea*, *Sphaeroschwagerina subrotunda*, and *Pseudoschwagerina ? fragilis*, all of which were proposed as a new species from Turkey by Ciry (1943).

The Hadim material consists of highly variable individuals in many test characters especially in inner tightly coiled whorls, which are considered to represent the intraspecific variation. They are probably identical with the monotypic specimen of this species, and distinguished from *Robustoschwagerina nucleolata* by their smaller proloculus, more whorls of inner tightly coiled whorls, and more conspicuous changes from initial to the later stages.

Robustoschwagerinoides Sheng, Wang & Zhong, 1984, and *Longlinia* Yang & Hao, 1991 were proposed mainly by the difference of the number of tightly coiled inner whorls. However, taxonomic validities of them are doubtful, because wide intraspecific variations not only in the morphology of inner whorls but also in other test characters were not considered in many species of *Robustoschwagerina* from South China. Two illustrated specimens by Sheng et al. (1984) from Yunnan, which were identified as *Robustoschwagerina regularis*, are quite different from both the original and the present specimens in many respects.

Stratigraphic distribution. Abundant in FD-53 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone).

Reg. no. specimen	No. whorl	Length	Width	Form ratio	Proloc.	Length of whorl					Width of whorl					Thickness of wall					Fig. in Pl.
						1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
D2-032209	5	6.65	7.37	0.90	0.41	0.98	2.36	3.95	5.56	6.65	0.78	2.08	4.15	6.11	7.37	0.02	0.02	0.05	0.12	0.16	Pl.3, fig.10
D2-032135	6	6.4?	7.7?	0.83	0.31	0.96	2,28	4.03	5.10	5.8?	0.49	1.56	3.26	4.99	6.9?	0.01	0.01	0.01	0.05	0.11	Pl.13, fig.1
D2-032275	4.5	6.15	6.53	0.94	0.34	0.88	2.43	4.42	5.21	-	0.61	1.80	4.14	5.72	-	0.02	0.01	0.04	0.08	-	Pl.13, fig.2
D2-032383	4.5	7.12	6.70	1.06	0.47	1.19	3.02	4.65	6.49	-	0.77	2.33	4.37	5.88	-	0.03	0.01	0.05	0.09	-	Pl.13, fig.3
D2-032028	5	6.2?	?		0.16	0.62	1.72	3.8?	?	?	0.37	1.06	2.90	?	?	0.03	0.01	0.02	0.05	0.14	Pl.13, fig.4
D2-032032	5	6.6?	6.85	0.96	0.39	0.97	2.46	3.83	5.40	6.6?	0.66	1.61	3.57	5.40	6.85	0.04	0.04	0.04	0.14	0.16	Pl.13, fig.5
D2-032410	4.5	?	?		0.34	1.56	3.39	5.18	6.5?	-	1.07	2.91	?	?	-	0.02	0.01	0.03	0.04	-	Pl.13, fig.6
D2-032318	4.5	5.8?	6.55	0.89	0.36	1.06	2.84	4.35	5.7?	-	0.71	1.70	4.09	5.90	-	0.04	0.03	0.05	0.10	-	Pl.13, fig.8
D2-031653	5	7.1?	6.62	1.07	0.33	1.31	2.67	4.52	5.93	7.1?	0.60	1.64	3.73	5.69	6.72	0.01	0.02	0.04	0.08	?	Pl.13, fig.9
D2-032708	4.5?	?	?		0.35	0.65	1.96	3.3?	?	-	0.57	?	?	?	-	0.03	0.03	0.05	?	-	Pl.13, fig.10
						Number of septa															
						1	2	3	4	5											
D2-031625	5.7	-	7.42	-	0,28	11	19	14	18	?	0.50	0.96	3,08	5.30	6.81	0.02	0.01	0.01	0.05	0.1	Pl.13, fig.7
mean	4.93	6.50	6.97	0.95	0.34	1.02	2.51	4.20	5.74	6.54	0.66	1.85	3.70	5.62	6.93	0.02	0.02	0.04	0.08	0.13	-
s. d.	0.52	0.46	0.46	0.09	0.08	0.28	0.49	0.53	0.54	0.54	0.19	0.53	0.53	0.37	0.25	0.01	0.01	0.01	0.03	0.03	-

Tab. 1 - Measurement of *Robustoschwagerina nucleolata* (Ciry).

Reg. no. specimen	No. whorl	Length	Width	Form ratio	Proloc.	Length of whorl							Width of whorl							Thickness of wall							Fig. in Pl.
						1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
D2-031847	6.5	6.92	6.9?	1.00	0.16	0.56	1.11	2.82	4.73	5.72	6.85	-	0.29	0.48	1.26	3.05	5.17	6.48	-	0.02	0.02	0.02	0.03	0.05	0.09	-	Pl.3, fig.11
D2-031769	6.5	6.43	6.41	1.00	0.11	0.41	1.03	1.75	3.36	5.17	6.42	-	0.23	0.40	0.71	2.28	4.42	5.90	-	0.01	0.02	0.02	0.01	0.04	0.10	-	Pl.12, fig.1
D2-031723	6.5	6.77	6.46	1.05	0.18	0.45	1.05	2.86	4.34	5.63	6.59	-	0.29	0.47	1.38	3.40	4.94	6.01	-	0.03	0.02	0.01	0.02	0.06	0.09	-	Pl.12, fig.2
D2-031827	7	7.6?	7.23	1.05	0.09	0.34	0.66	1.43	3.72	5.40	6.93	7.6?	0.14	0.28	0.51	1.83	4.51	6.32	7.23	0.02	0.02	0.02	0.01	0.01	0.05	0.10	Pl.12, fig.3
D2-031781	5.5	6.69	6.74	0.99	0.19	0.62	1.52	2.87	4.83	6.05	-	-	0.34	0.65	2.07	4.52	6.30	-	-	0.01	0.02	0.02	0.03	0.10	-	-	Pl.12, fig.4
D2-031762	6	6.58	6.71	0.98	0.18	0.61	1.11	2.53	4.42	5.57	6.58	-	0.29	0.53	1.46	3.69	5.52	6.71	-	0.02	0.01	0.01	0.02	0.04	0.05	-	Pl.12, fig.5
D2-031856	8	6.75	6.9?	0.98	0.10	0.28	0.64	2.18	2.58	3.92	4.67	6.14	0.24	0.41	0.71	1.63	3.43	5.01	6.47	0.01	0.01	0.02	0.02	0.04	0.07	0.09	Pl.12, fig.6
D2-031797a	5	6.56	6.57	1.00	0.27	0.99	3.06	4.45	5.78	6.56	-	-	0.50	1.92	3.85	5.53	6.57	-	-	0.02	0.02	0.04	0.06	0.10	-	-	Pl.12, fig.7
D2-031777	5.5	6.08	6.6?	0.92	0.39	0.66	2.52	4.29	5.43	6.08	-	-	0.61	1.40	2.95	4.92	6.2?	-	-	0.03	0.01	0.02	0.05	0.07	-	-	Pl.12, fig.8
D2-031713	5.5	6.71	6.86	0.98	0.32	1.07	2.75	4.30	5.42	6.64	-	-	0.54	1.51	3.43	5.29	6.35	-	-	0.02	0.02	0.03	0.04	0.06	-	-	Pl.12, fig.9
D2-031826	4.5	5.98	5.66	1.06	0.23	1.02	2.83	4.75	5.46	-	-	-	0.42	1.21	3.08	4.94	-	-	-	0.02	0.01	0.02	0.06	-	-	-	Pl.12, fig.10
D2-031815	4.5	5.86	5.70	1.03	0.30	0.98	3.02	4.80	5.74	-	-	-	1.53	1.79	3.73	5.11	-	-	-	0.03	0.02	0.05	0.11	-	-	-	Pl.12, fig.11
						Number of septa																					
						1	2	3	4	5	6	7															
D2-031800	4	-	5.61	-	0.36	11	17	17	24	-	-	-	0.61	2.17	4.30	5.61	-	-	-	0.02	0.02	0.04	0.06	-	-	-	Pl.12, fig.12
D2-031758	4.4	-	6.07	-	0.37	9	16	15	21	-	-	-	0.67	2.36	4.63	6.06	-	-	-	0.02	0.01	0.03	0.05	-	-	-	Pl.12, fig.13
D2-031797b	5.5	-	6.84	-	0.24	10	17	17	17	21	-	-	0.48	0.76	2.46	4.57	6.39	-	-	0.03	0.04	0.02	0.05	0.07	-	-	Pl.12, fig.14
mean	5.66	6.58	6.48	1.00	0.23	0.67	1.78	3.25	4.65	5.67	6.34	6.87	0.48	1.09	2.44	4.16	5.36	6.07	6.85	0.02	0.02	0.02	0.04	0.06	0.08	0.10	-
s. d.	1.10	0.47	0.50	0.04	0.10	0.28	0.97	1.21	1.01	0.78	0.84	1.03	0.33	0.72	1.39	1.43	1.05	0.60	0.54	0.01	0.01	0.01	0.03	0.03	0.02	0.01	-

Tab. 2 - Measurement of *Robustoschwagerina regularis* (Ciry).

Robustoschwagerina hadimensis n. sp.

Pl. 11, fig. 9; Pl. 13, figs 11-17

Origin of the name. After the local geographic name, Hadim, near which this new species was collected.

Type specimens. Holotype D2-032648 (Pl. 13, fig. 16). Paratypes D2-032586 (Pl. 11, fig. 9; Pl. 13, fig. 11), D2-032388 (Pl. 13, fig. 12), D2-032657b (Pl. 13, fig. 13), D2-032380 (Pl. 13, fig. 14), D2-032170 (Pl. 13, fig. 15), D2-032648 (Pl. 13, fig. 16), D2-032157 (Pl. 13, fig. 17), D2-032657a (pl. 3, fig. 9 in Kobayashi & Altiner 2008).

Material. Six axial and one sagittal sections are illustrated, one axial section (pl. 3, fig. 9) in Kobayashi & Altiner (2008), and others.

Diagnosis. Small-sized *Robustoschwagerina* with nearly spherical test consisting of large proloculus, few inner tightly coiled whorls, and rapidly expanding outer whorls close to spherical form outerwards.

Description. Test nearly spherical with 4.5 to 5.5 whorls. Approximate length, width, and form ratio varying from 4.6 to 5.4 mm, 4 to 5 mm, 1.0 to 1.2, respectively. Proloculus spherical, 0.24 to 0.50 mm in its outside diameter, averaging 0.37 mm (Tab. 3). Chomata commonly present on proloculus.

Inner 0.5 to 2 whorls fusiform to subspherical, and with rudimentary chomata and low tunnel. Wall consists of tectum and finely alveolar keriotheca which is obscure in specimens with very thin wall. Septa are nearly plane, but gently folded near poles.

Subsequent 1.5 to 2.5 whorls rapidly expanding with nearly straight axis of coiling, gradually decreasing their form ratio. Wall and septa commonly very thin relative to large height of whorl. The last 1 to 1.5 whorls decrease their expansion ratio. Wall and septa, especially wall, thickened.

In inflated whorls, septa commonly plane and inclined anteriorly, but show low and gentle septal folding in polar regions, even in the middle portion of the test. Chomata commonly lacking and tunnel path obscure in thin sections. Septa and wall are stuck to secondary calcareous dark materials in parts showing appearances of pseudochomata of uneven thickness.

Discussion. The present new species cannot be easily distinguished from *Robustoschwagerina nucleolata* because both forms have similar tightly inner coiled whorls, septal folds and thickness of wall in the corresponding whorls, and proloculus size. However, these two species are different in test expansion in middle and late stages, by which they are separated.

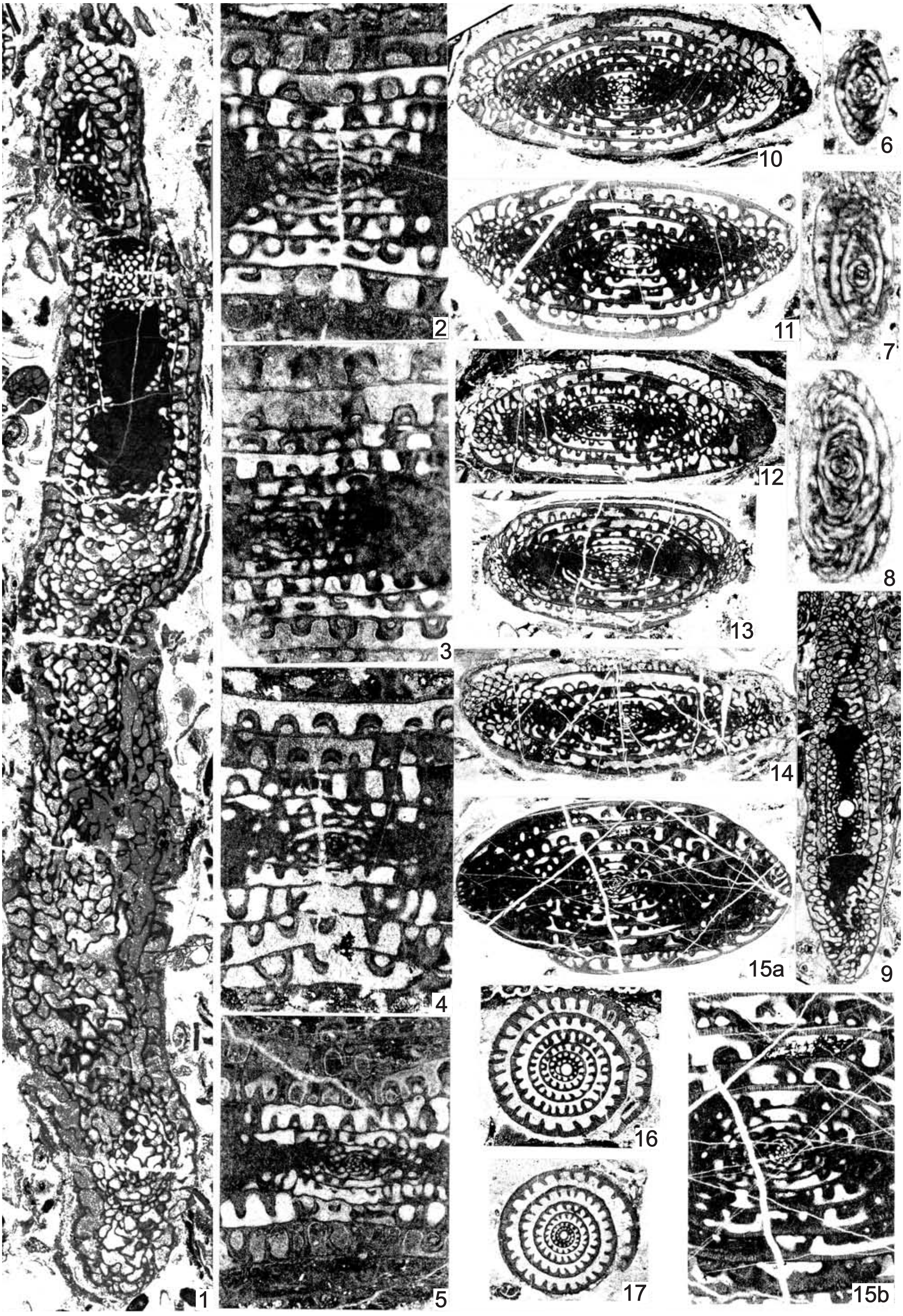
PLATE 9

Figs. 1-5 - *Quasifusulina nimia* Kochansky-Devidé, 1959. 1: tangential section; 2-5: axial sections of microspheric forms, 1: D2-032167, FD-62; 2: D2-031544, FD-48; 3: D2-031893, FD-55; 4: D2-032203, FD-63; 5: D2-032359, FD-67, 1: ×10; 2-4: ×40; 5: ×30.

Figs. 6-8 - *Boultonia* sp. Axial section, 6: D2-031675, FD-52; 7: D2-031675, FD-52; 8: D2-031651, FD-51, all ×60.

Fig. 9 - *Quasifusulina longissima* (von Möller, 1878). Axial section, D2-030926, FD-12, ×10.

Figs. 10-17 - *Eoparafusulina brevis*, n. sp. 10-15: Axial sections (15: microspheric form); 16, 17: sagittal sections, 10: holotype; 11-17: paratypes, 10: D2-032550; 11: D2-032120; 12: D2-032547; 13: D2-032478; 14: D2-032083; 15: D2-032109; 16: D2-032542; 17: D2-032445, 10, 12, 16: FD-71; 11, 14, 15: FD-60; 13, 17: FD-69, 10, 12-14: ×10; 11, 15a, 16, 17: ×15; 15b: ×30.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Some specimens of *Robustoschwagerina hadimensis* appear to be alike to subspherical forms of *Pseudoschwagerina* in their slower test expansion for *Robustoschwagerina*. They are, however, different from *Pseudoschwagerina* and should be assigned to the genus by their rapid expansion of the test with thin wall and septa and nearly plane septa, and without chomata beyond the initial stage.

Pseudoschwagerina prisca Kochansky-Devidé, 1959, which was proposed from the lower Rattendorf beds (Asselian) of Croatia as a subspecies of *Robustoschwagerina nucleolata*, resembles this new species. However, the Croatian species has slower expansion of the test than this new species, and seems to be transitional from *Pseudoschwagerina* to *Robustoschwagerina*.

Robustoschwagerina hadimensis is different from *R. fluxa* (Li in Lin, 1977) in its larger spherical test with more whorls; from *R. xiaodushanica* Sheng, Wang, & Zhong, 1984 in its fewer number and indistinct *Triticites*-type inner tightly coiled whorls; and from *R. minutalis* (Yang & Hao, 1991) and *R. simplex* (Yang & Hao, 1991) in having larger form ratio of the test and whorls.

Stratigraphic distribution. Common to rare in seven levels from FD-60 to FD-76 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Genus *Paraschwagerina* Dunbar & Skinner, 1936

Paraschwagerina kokpectensis Scherbovich, 1969

Pl. 10, figs 7-10

1969 *Occidentoschwagerina*(?) *primaeva kokpectensis* Scherbovich, p. 40, 41, pl. 14, figs 1-3.

1969 *Occidentoschwagerina*(?) *primaeva kokpectensis* forma *regularis* Scherbovich, p. 41, pl. 14, fig. 5.

1969 *Occidentoschwagerina* (?) *primaeva kokpectensis* forma *elongata* Scherbovich, p. 41, pl. 14, fig. 4.

Material. Three axial and one sagittal sections are illustrated, one axial section (pl. 3, fig. 1) in Kobayashi & Altiner (2008), and others.

Discussion. This species was originally proposed as a subspecies of *Paraschwagerina primaeva* Rauser-Chernousova & Scherbovich, 1949 which came from the "*Schwagerina* horizon" of the Southern Urals. Scherbovich (1969) doubted its generic assignment and further subdivided it into two forms, all of which were erected on the basis of boring core samples of middle Asselian age from Kokpekty, eastern part of Kazakhstan. Differences in test form, septal fluting, and others among these three forms are thought to represent the intraspecific variation of *kokpectensis*.

The Hadim material agrees well with this species in having common characters, such as elongate fusiform test, small proloculus, very tightly coiled inner whorls, thick wall in outer whorls, and strongly and rather irregularly folded septa, though their outer whorls are mostly abraded. These diagnostic characters are also common in specimens identified with *Paraschwagerina kokpectensis* by Bensh (1972) from the middle Asselian of southern Fergana.

Stratigraphic distribution. Common to rare in FD-30 and FD-31 in the A-A' section (Asselian, *Paraschwagerina* sp. Zone).

Paraschwagerina pseudomira Miklukho-Maklay, 1949

Pl. 7, figs 1-3, 9

1949 *Paraschwagerina pseudomira* Miklukho-Maklay, p. 81-83, pl. 7, figs 1-3.

1949 *Paraschwagerina pseudomira* var. *margelanica* Miklukho-Maklay, p. 83, 84, pl. 7, fig. 4.

Material. Three axial and one sagittal sections are illustrated, one axial section (pl. 3, fig. 2) in Kobayashi & Altiner (2008), and others.

Discussion. *Paraschwagerina pseudomira* and its variety *margelanica* described from the upper part of the "*Schwagerina* horizon" of southern Fergana by Miklukho-Maklay (1949) are almost impossible to separate by slight differences of test characters. Recognition of *Paraschwagerina veberi* by Miklukho-Maklay (1949) is alike. It is separated herein, however, on account of its occurrence from different locality and strata. *Paraschwagerina inflata* Chang, 1963 and *Paraschwagerina gigantea* (White, 1932) by Chang (1963b) from Xinjiang Tienshan seem to be uneasily distinguished each other. We regard that these two forms by Chang (1963b) are synonymous with *P. pseudomira*. These Middle Asian forms are possibly different from *Paraschwagerina mira* Rauser-Chernousova & Scherbovich, 1949 from the Tastubsky and "*Schwagerina*" horizons in the Pre-Urals with respects to smaller proloculus and clearer shift from the intial to later stages during growth in the former.

The Hadim material is assigned to *P. pseudomira* by its tightly coiled inner whorls and succeeding rapidly expanding outer whorls, and other test characters such as large, elongate, fusiform test, and intensely folded septa throughout growth.

Stratigraphic distribution. Common in four levels from FD-44 to FD-50 in the A-A' section (Sakmarian, *Paraschwagerina pseudomira* Zone), and common to rare in five levels from FD-59 to FD-68 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Paraschwagerina sp.

Pl. 10, figs 4-6

Material. Two axial and one oblique sections are illustrated, one axial section (Pl. 3, fig. 6) in Kobayashi and Altiner (2008), and others.

Discussion. Well-oriented axial sections are not enough to understand the morphologic variation of the present material. Although

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PLATE 10

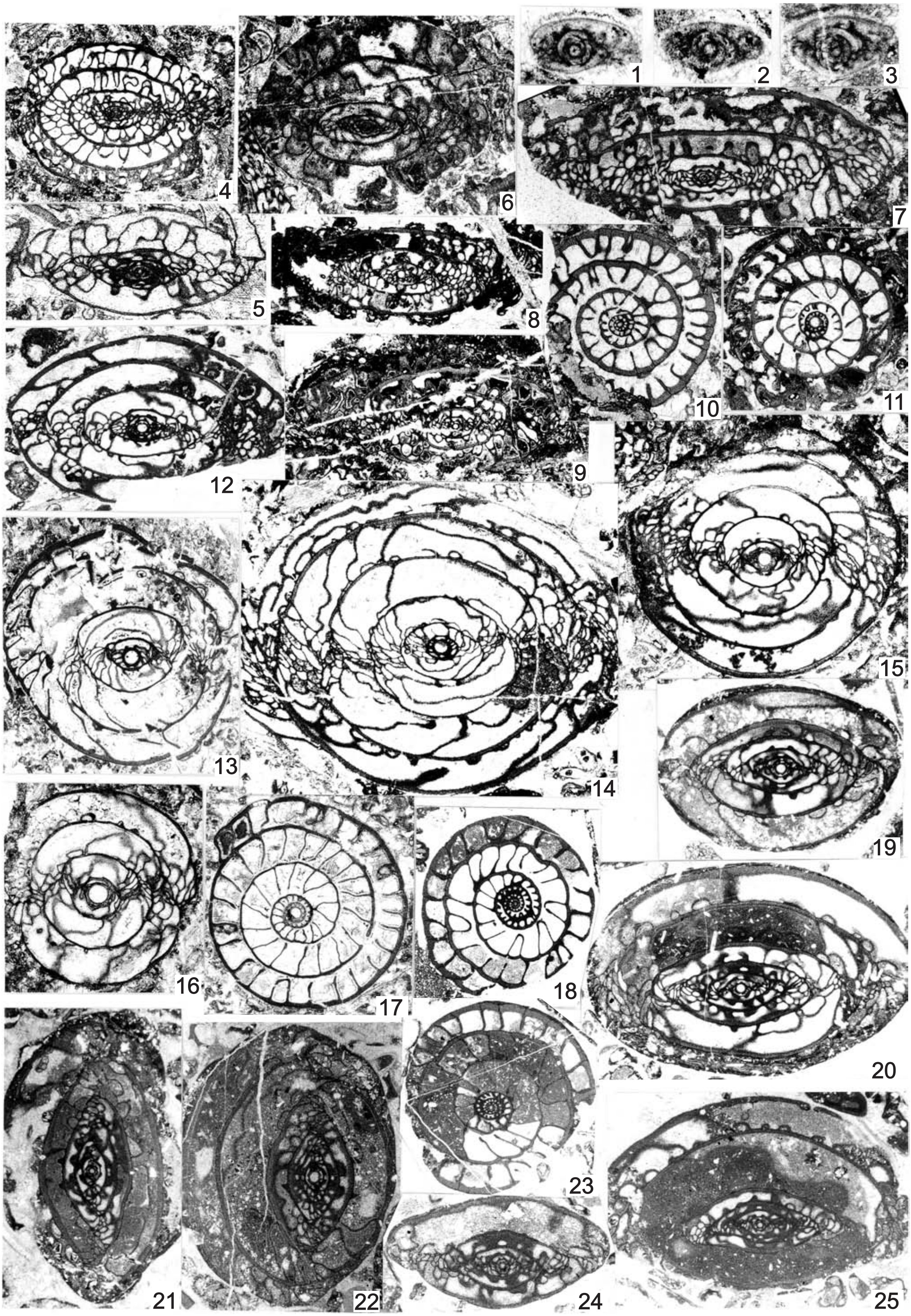
Figs. 1-3 - *Dunbarula*? sp. Axial sections, 1: D2-032717, FD-77; 2: D2-032747, FD-79; 3: D2-032661, FD-76, all ×60.

Figs. 4-6 - *Paraschwagerina* sp., 4: oblique section, D2-031204, FD-27, ×10; 5: axial section, D2-031174, FD-27, ×20; 6: axial section, D2-031134, FD-25, ×15.

Figs. 7-10 - *Paraschwagerina kokpectensis* Scherbovich, 1969. 7-9: axial sections, FD-30; 10: sagittal section, FD-31, 7: D2-031251; 8: D2-031241; 9: D2-031221; 10: D2-031254, 7, 10: ×15; 8, 9: ×10.

Figs. 11-17 - *Pseudoschwagerina robusta* (Meek, 1864). 11, 17: sagittal sections; 12-16: axial sections, 11: D2-031228; 12: D2-031231; 13: D2-031196; 14: D2-031174; 15: D2-031194; 16: D2-031195; 17: D2-031189, 11, 12: FD-30; 13-17: FD-27, all ×10.

Figs. 18-25 - *Pseudoschwagerina ozguli*, n. sp., 18, 23: sagittal sections; 19-22, 24, 25: axial sections, 20: holotype; 18, 19, 21-25: paratypes, 18: D2-031927; 19: D2-031919; 20: D2-031926; 21: D2-035120; 22: D2-035116; 23: D2-031912; 24: D2-031938; 25: D2-035119, all FD-55, 18, 23: ×10; 19-22, 25: ×15; 24: ×20.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they may be classified into two or more taxa based on differences of intensity of septal folding and height of chambers in each whorl, they are not subdivided herein. The present unnamed species is marked by tiny proloculus, tightly coiled inner whorls and abruptly increasing heights of chambers in later whorls, and folded septa throughout test in various degrees. From these characters, they are assigned to *Paraschwagerina*. *Paraschwagerina* sp. is different from *Paraschwagerina kokpectensis* in having smaller and more inflated test.

The Hadim specimens may be identical with "*Alpinoschwagerina*" *paranitida* described from the lower Asselian of southern Fergana by Bensh (1972) in many respects, but the former has smaller test and more intensely folded septa. *Pseudoschwagerina nitida* originally described by Kahler & Kahler (1937) from the upper part of the "*Schwagerina*-limestone" in the Carnic Alps has less intensely folded septa though they are marked by small test and tightly coiled inner whorls. *Paraschwagerina* sp. also resembles *P. tinvenkiangi* (Lee, 1927) originally described from the Lower Permian of Henan (Lee, 1927) and later from Xinjiang Tienshan (Chang 1963b). But, the Hadim specimens are smaller than the latter two.

Stratigraphic distribution. Common in FD-25 and rare in FD-27 in the A-A' section (middle Asselian, *Paraschwagerina* sp. Zone).

Family Staffellidae Miklukho-Maklay, 1949

Genus *Pseudoreichelina* Leven, 1970

Pseudoreichelina sp.

Pl. 1, figs 47, 52

Material. One tangential and one parallel sections are illustrated.

Discussion. The present material is assignable to *Pseudoreichelina* in having small lenticular test becoming uncoiled and rectilinear in the final whorl, with recrystallized wall and septa, and curved and anteriorly inclined septa. By these characters, *Pseudoreichelina* sp. is distinguished from some representatives of *Nankinella* having very similar test morphologies except for those of the uncoiled final stage.

Stratigraphic distribution. Rare in FD-30 (middle Asselian, *Paraschwagerina* sp. Zone) and FD-57 (Sakmarian, *Paraschwagerina pseudomira* Zone) in the A-A' section.

Genus *Nankinella* Lee, 1934

Nankinella spp.

Pl. 1, figs 40-44

Material. Three axial, one sagittal, and one parallel sections are illustrated, and others.

Discussion. Many specimens of *Nankinella*, some of which are illustrated herein, have variable test characters including test size up to 2 mm in width, form ratio, the number of whorl, shape of periphery and lateral sides, thickness of wall and septa, degree of recrystalization of the test, and others. Three or more subdivisions might be possible based on these morphological differences. However, they are better treated together than to be subdivided, avoiding an ambiguous classification in the present material.

Stratigraphic distribution. Rare in 20 stratigraphic levels from FD-2 to FD-49 in the A-A' section (lower Kasimovian to Sakmarian, *Protriticites variabilis* Zone to *Paraschwagerina pseudomira* Zone), and FD-76 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

Reg. no. specimen	No. whorl	Length	Width	Form ratio	Proloc.	Length of whorl					Width of whorl					Thickness of wall					Fig. in Pl.
						1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
D2-032657a	4.5	4.7?	3.96	1.19	0.30	0.72	1.56	3.28	4.35	-	0.45	0.96	2.30	3.58	-	0.03	0.02	0.03	0.09	-	Pl.3, fig.9
D2-032586	4.5?	?	?		0.45	1.11	2.33	3.75	5.2?	-	0.78	2.07	3.71	4.8?	-	0.03	0.03	0.06	?	-	Pl.13, fig.11
D2-032388	4?	?	?		0.44	1.49	3.24	4.73	?	-	1.03	2.69	4.9?	?	-	0.01	0.02	0.06	?	-	Pl.13, fig.12
D2-032380	5.5	?	?		0.24	0.62	1.41	2.62	3.9?	?	0.34	0.83	1.95	3.1?	?	0.02	0.03	0.02	0.04	0.10	Pl.13, fig.14
D2-032170	4.5	?	?		0.36	0.79	1.70	3.53	5.44	-	0.54	0.86	2.17	3.92	-	0.02	0.04	0.04	0.05	-	Pl.13, fig.15
D2-032648	5	5.4?	4.9?	1.10	0.28	0.98	2.22	3.41	4.4?	5.4?	0.49	1.40	2.92	3.97	4.9?	0.01	0.01	0.04	0.06	0.09	Pl.13, fig.16
D2-032157	4?	?	?		0.33	0.73	1.67	2.96	?	-	0.50	0.97	2.04	?	-	0.04	0.01	0.04	?	-	Pl.13, fig.17
						Number of septa															
						1	2	3	4	5											
D2-032657b	3.6?	-	?	-	0.50	9	14	17	-	-	0.97	2.38	3.77	-	-	0.03	0.03	0.08	-	-	Pl.13, fig.13
mean	4.51	5.05	4.43	1.14	0.36	0.92	2.02	3.47	4.66	5.40	0.59	1.40	2.97	3.87	4.90	0.02	0.02	0.04	0.06	0.09	-
s. d.	0.62	0.49	0.66	0.06	0.09	0.30	0.64	0.67	0.64		0.24	0.72	1.06	0.62		0.01	0.01	0.01	0.02		-

Tab. 3 - Measurement of *Robustoschwagerina hadimensis*, n. sp.

Genus *Staffella* Ozawa, 1925

Staffella spp.

Pl. 1, figs 45, 46, 48-51

Material. Two axial, two tangential, one sagittal, and one parallel sections are illustrated, and others.

Discussion. As well as specimens assigned to *Nankinella*, many individuals of *Staffella* from many stratigraphic levels are not subdivided in this paper. They are common in broadly rounded periphery, by which these two staffellid genera are distinguished.

Stratigraphic distribution. Rare in six stratigraphic levels from FD-5 to FD-39 in the A-A' section (middle Kasimovian to upper Asselian, *Montiparus umbonoplicatus* Zone to *Dutkevichia complicata* Zone), and FD-75 and FD-76 in the B-B' section (Sakmarian, *Robustoschwagerina nucleolata* Zone).

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PLATE 11

Figs. 1-4 - *Pseudoschwagerina globosa* n. sp. 1, 4: Axial sections; 2, 3: sagittal sections, 1: holotype; 2-4: paratypes, 1: D2-031967; 2: D2-031964; 3: D2-031976; 4: D2-035127, all FD-56, 1a, 2-4: ×10; 1b: ×20.

Fig. 5 - *Pseudoschwagerina özgüli* n. sp. Axial section, D2-031879, FD-54, ×20. (= Pl. 3, fig. 5 in Kobayashi & Altiner 2008).

Fig. 6 - *Pseudoschwagerina* sp. Axial section, D2-031664, FD-52, 6a: ×10; 6b: ×20.

Fig. 7 - *Pseudoschwagerina robusta* (Meek, 1864). Axial section, D2-031194, FD-27, ×20. (= Pl. 10, fig. 15).

Fig. 8 - *Robustoschwagerina nucleolata* (Ciry, 1943). Axial section, D2-032209, FD-63, ×20. (= Pl. 3, fig. 10 in Kobayashi & Altiner 2008).

Fig. 9 - *Robustoschwagerina hadimensis*, n. sp. Axial section, paratype, D2-032586, FD-73; ×20. (= Pl. 13, fig. 11)

Figs. 10-13 - *Robustoschwagerina regularis* (Ciry, 1943). Axial sections, 10: D2-031827 (= Pl. 12, fig. 3); 11: D2-031762 (= Pl. 12, fig. 5); 12: D2-031713; 13: D2-031800, all FD-53, ×20.

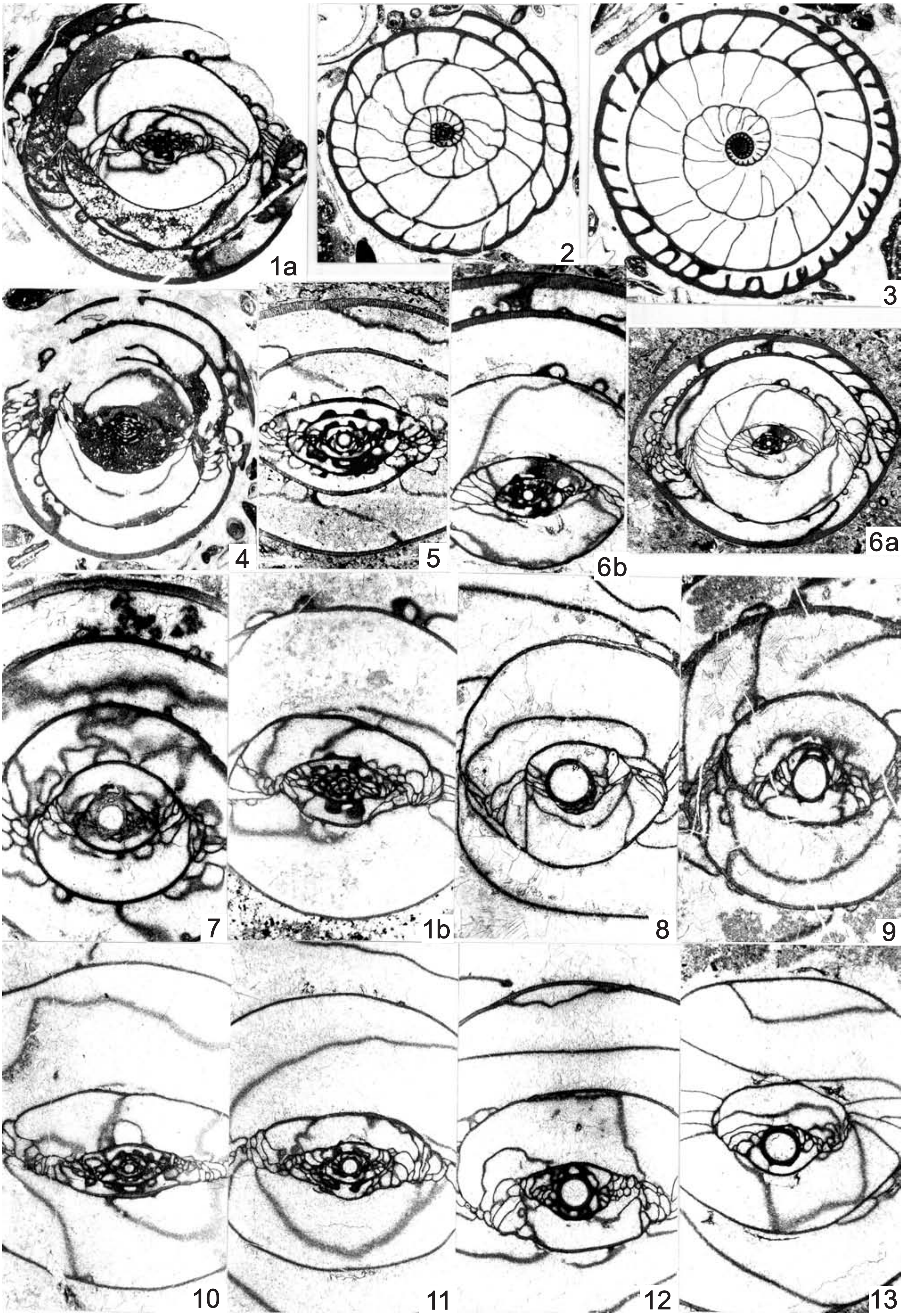
PLATE 12

Figs. 1-14 - *Robustoschwagerina regularis* (Ciry, 1943). 1-11: axial sections; 12-14: sagittal sections, 1: D2-031769; 2: D2-031723; 3: D2-031827; 4: D2-031781; 5: D2-031762; 6: D2-031856; 7: D2-031797; 8: D2-031777; 9: D2-031713; 10: D2-031826; 11: D2-031815; 12: D2-031800; 13: D2-031758, 14: D2-031797, all FD-53, ×8.

PLATE 13

Figs. 1-10 - *Robustoschwagerina nucleolata* (Ciry, 1943). 1-6, 8-10: axial sections; 9: sagittal section, 1: D2-032135, FD-61; 2: D2-032275, FD-64; 3: D2-032383, FD-68; 4: D2-032028, FD-59; 5: D2-032032, FD-59; 6: D-032410, FD-68; 7: D2-031625, FD-50; 8: D2-032356, FD-65; 9: D2-031653, FD-51; 10: D2-032708, FD-77; all ×8.

Figs. 11-17 - *Robustoschwagerina hadimensis* n. sp. 11, 12, 14-17: axial sections; 13: sagittal section, 16: holotype; 11-15, 17: paratypes, 11: D2-032586, FD-73; 12: D2-032388, FD-68; 13: D2-032657, FD-76; 14: D2-032380, FD-68; 15: D2-032170, FD-62; 16: D2-032648, FD-76; 17: D2-032157, FD-62, all ×8.



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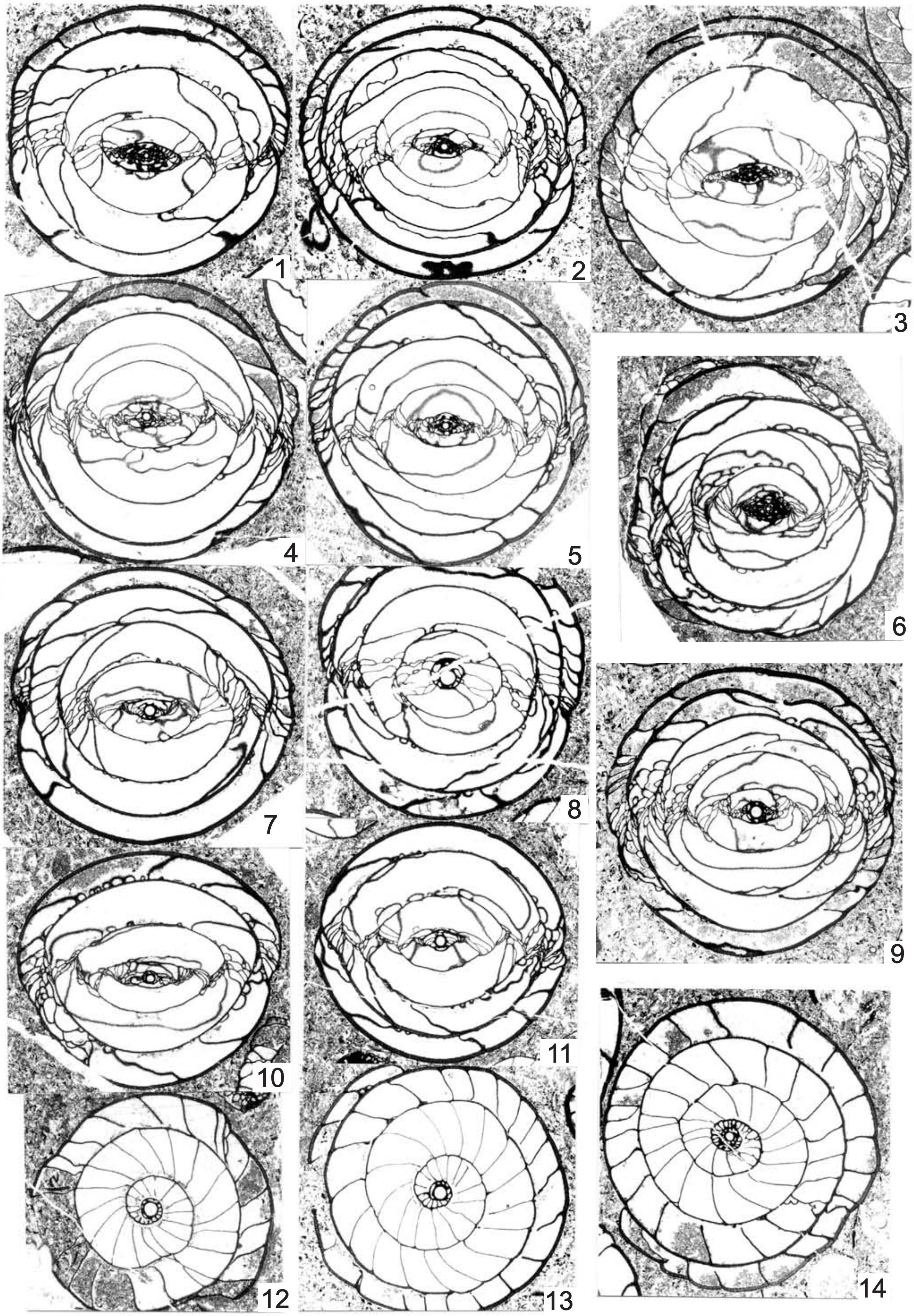

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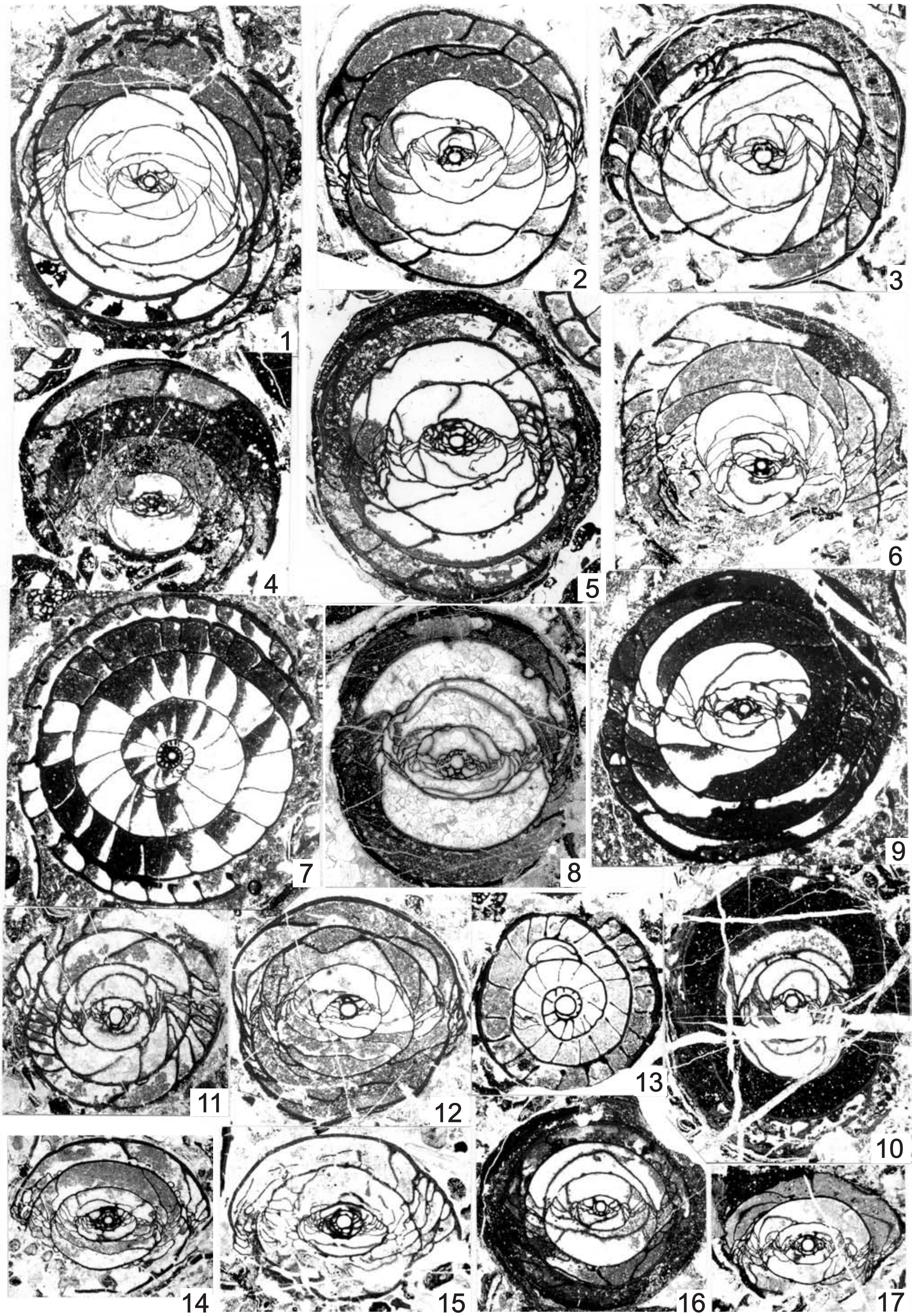

PLATE 13

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