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Late Carboniferous and Early Permian fusulines of the Akiyoshi Limestone Group in the Wakatakeyama area, Akiyoshi (Japan) – Biostratigraphy, biogeography, and biodiversity

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Abstract

The Carboniferous and Permian limestone sequences are most completely preserved in the Akiyoshi Limestone Group of west Japan as a whole among the Panthalassan originated terranes of the Circum-Pacific. This paper focuses on the reviewed fusuline biostratigraphy and description of fusuline species from the Kashirian (lower Moscovian) to Asselian (lowermost Cisuralian) of the Akiyoshi Limestone Group in the Wakatakeyama area of the Akiyoshi Limestone. Those of Artinskian (Cisuralian) exposed in the area are subsidiarily treated. The Sakmarian is not exposed in the area. In this Moscovian-Artinskian interval, the Akiyoshi Limestone Group is subdivided into 12 fusuline zones from the *Fusulinella biconica* Zone to *Paraleeina magna* Zone. One-hundred and nineteen species assignable to 39 genera are distinguished in this small area.

Provincial faunas decipherable through faunal analysis of the group, represented by four species of *Carbonoschwagerina* keeping a record of one-way trend of evolution, are important for ancient plate tectonic movement, phylogeny and paleobiogeography of fusulines, and tectonic evolution of East Asia. Fusuline diversities in this time interval are relatively low in pre-late Kasimovian, gradually increasing from the sixth *Rauserites arcticus-Carbonoschwagerina nipponica* Zone (late Kasimovian), reaching to the maximum in the tenth *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone (early Asselian), and decreasing after the peak in the Asselian. Among the described 108 species, nine are new: *Parastaffelloides kanmerai, Staffella subsphaerica, Quasifusulinoides grandis, Montiparus minensis, Jigulites titanicus, Schwagerina watanabei, Schwagerina wakatakeyamensis, Carbonoschwagerina nipponica,* and *Alpinoschwagerina nagatoensis*.

Keywords

Fusulines, Akiyoshi, Moscovian to Asselian, Biostratigraphy, Biogeography, Biodiversity.

Online supplementary material (Appendix) is available at the website of the Revue de Paléobiologie

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1. INTRODUCTION

Emplacement and correlation of the Carboniferous-Permian boundary, classification and age assignment of inflated schwagerinids, and their related problems had long been controversial in Japan. The "*Pseudoschwagerina*" Zone or "*Pseudoschwagerina morikawai*" Zone had long been assigned to the lowest part of the Permian both in Japan (Kanmera, 1952; Igo, 1957; Toriyama, 1967) and outside Japan (Douglass, 1977; Rauzer-Chernousova & Shchegolev, 1979, pp. 184-186). Species that should be assigned to *Sphaeroschwagerina, Alpinoschwagerina, Robustoschwagerina*, or *Zellia* were included almost all into the genus "*Pseudoschwagerina*" *sensu lato* by 1980's in Japan. T. Ozawa & Kobayashi (1990) and Watanabe (1991) made clear that formerly defined *Pseudoschwagerina* Zone and its equivalents in Japan are included in the uppermost part of the Carboniferous (Gzhelian) and the base of the Permian is defined by the first appearance of *Sphaeroschwagerina* as well as in European Russia and Central Asia. They deduced therefore that the fusuline biostratigraphy of the Late Carboniferous (Kasimovian and Gzhelian) established in European Russia and Central Asia is to be accepted also in Japan, based on the taxonomic reexamination of primitive schwagerinids such as *Protriticites*, *Obsoletes*, *Montiparus* and *Rauserites*, and the correlative stratigraphic distribution of these fusulines in Japan. T. Ozawa *et al.* (1992) proposed the genus *Carbonoschwagerina* with designation of *Pseudoschwagerina morikawa* Igo, 1957 as the type species of this genus and discussed on the phylogenetic lineages of the inflated schwagerinids from the Kasimovian (late Pennsylvanian) to Sakmarian (middle Cisuralian).

The Carboniferous and Permian marine faunas in Japan are most completely furnished in the Akiyoshi Limestone Group. There are many biostratigraphic works of the group mainly by fusulines since Y. Ozawa (1923, 1925b). However, biostratigraphic subdivision scheme of the group, especially in the Upper Carboniferous and Lower Permian, is considerably different among authors (Ueno, 1989; T. Ozawa & Kobayashi, 1990; Watanabe, 1991; M. Ota & Y. Ota, 1993; Sano *et al*., 2004; Nakazawa & Ueno, 2009).

Since 2004, I have been reexamined the foraminiferal, especially fusuline, biostratigraphy of the Akiyoshi Limestone Group. The present paper focuses on the renewed fusuline biostratigraphy and description of fusuline species from the Kashirian (early Moscovian) to Asselian (early Cisuralian) in the Wakatakeyama area of Akiyoshi, west Japan. In relation to these two subjects, provincial faunas of Akiyoshi and taxonomic diversity of fusulines from the Kashirian to Asselian of Akiyoshi are described and discussed. Those of Artinskian (early late Cisuralian) in the area are subsidiarily treated. The Sakmarian is not exposed in the area.

Fusuline biostratigraphy, reexamined by the author, reveals that the Kashirian to Artinskian limestone is subdivided into twelve zones in ascending order: (1) *Fusulinella biconica*, (2) *Kanmeraia itoi*, (3) *Fusulinella bocki-Kanmeraia pulchra*, (4) *Protriticites subschwagerinoides*, (5) *Montiparus matsumotoi-Quasifusulinoides ohtanii*, (6) *Rauserites arcticus-Carbonoschwagerina nipponica*, (7) *Rauserites stuckenbergi-Triticites simplex*, (8) *Carbonoschwagerina morikawai-Jigulites horridus*, (9) *Jigulites titanicus-Carbonoschwagerina minatoi*, (10) *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis*, (11) *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis*, and (12) *Paraleeina magna*. However, the original succession of the Akiyoshi Limestone Group is strongly disturbed resulting structurally repeated or isolated occurrences of the same zone (zones) in several times in the Wakatakeyama area. These secondary tectonic modifications were not almost taken into consideration in the fusuline biostratigraphy of the Wakatakeyama area by T. Ozawa & Kobayashi (1990), Watanabe (1991), and Y. Ota & M. Ota (1993).

One-hundred and nineteen species assignable to 39 genera are distinguished in this small area. Among them, provincial faunas represented by inflated schwagerinids are important for ancient plate tectonic movement, phylogeny and paleobiogeography of fusulines, and tectonic evolution of East Asia. Taxonomic diversities of fusulines, gradually increasing from late Kasimovian (*Rauserites arcticus-Carbonoschwagerina nipponica* Zone) and reaching to the maximum in early Asselian (*Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone), are described and discussed. Among the described 108 species, nine are new: *Parastaffelloides kanmerai, Staffella subsphaerica, Quasifusulinoides grandis, Montiparus minensis, Jigulites titanicus, Schwagerina wakatakeyamensis, Schwagerina watanabei, Carbonoschwagerina nipponica,* and *Alpinoschwagerina nagatoensis*.

2. GEOLOGIC SETTING

The Akiyoshi Limestone is a huge limestone block isolated in the Akiyoshi Terrane, Southwest Japan, as well as Taishaku, Atetsu, and Omi limestones (Fig. 1). The Lower Carboniferous to Middle Permian oceanic rocks and the Middle to lower Upper Permian trench-fill deposits are distributed around these limestone blocks (Kanmera *et al*., 1990). Limestone is mostly gray to light gray, highly fossiliferous, and without any terrigenous siliciclastic intercalations except for volcanic acidic tuff in the uppermost part. Limestone deposition started on the basaltic seamount of the Panthalassan Ocean in the Serpukhovian (Late Mississippian), and ended by the accretion of the oceanic builup to the active continental margin of ancient South China in late Guadalupian (latest Middle Permian) (Kanmera *et al*., 1990; Sano, 2006).

The Akiyoshi Limestone Group is exposed in approximately 7×15 km (Fig. 2), and composed of basaltic rocks at the basal part and overlying massive limestone of atoll facies without showing distinct stratification (M. Ota, 1968). It is in fault contact with the surrounding non-calcarous rock units, and partly thermo-metamorphosed by the late Cretaceous igneous activities. These calcareous and non-calcareous formations (groups) are unconformably overlain by the Upper Triassic Mine Group (Kanmera *et al*., 1990; Kobayashi, 2012). Internally, the Akiyoshi Limestone Group is complicatedly faulted and folded, and thought to be mostly overturned as first recognized by Y. Ozawa (1923) and later ascertained by M. Ota *et al*. (1973) in the Kaerimizu area, 4 km north of the Wakatakeyama area. In the western part of the Akiyoshi Limestone, structurally

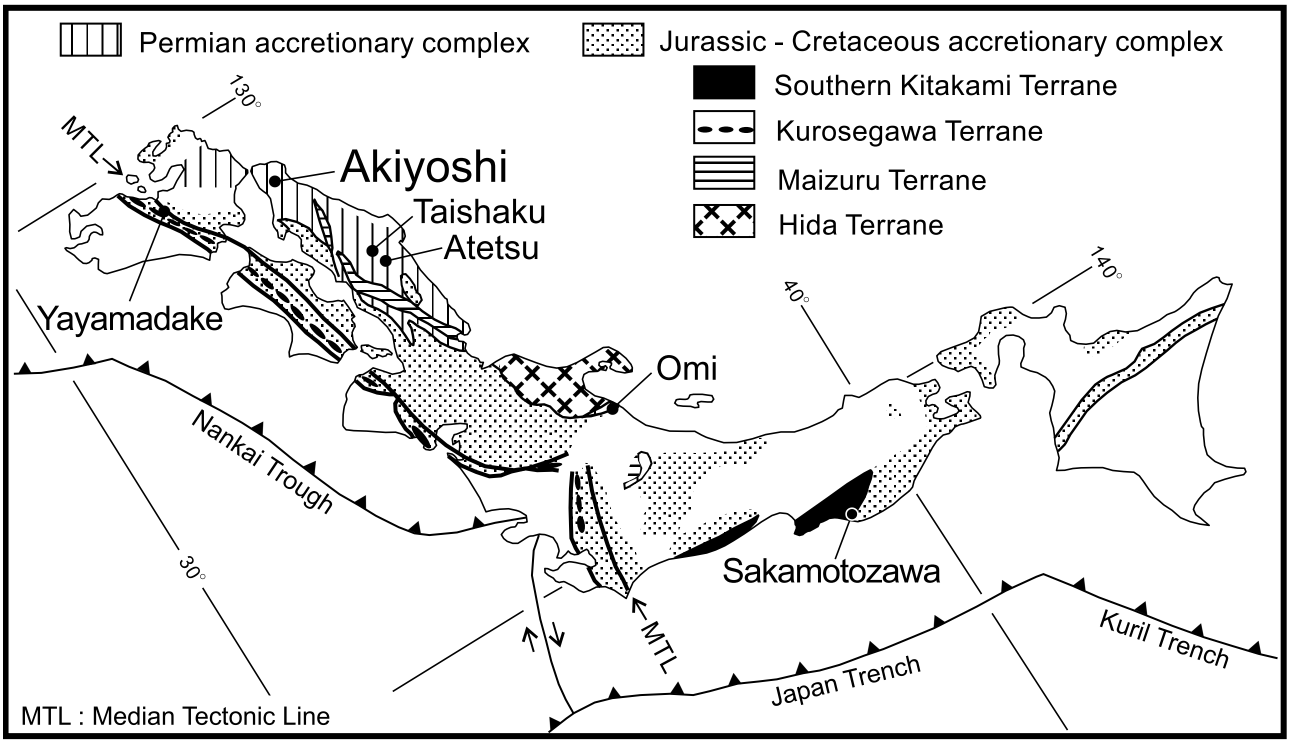


Fig. 1: Distribution of six localities of the Upper Carboniferous and Lower Permian limestone plotted on the pre-Jurassic tectonic map of Japan.

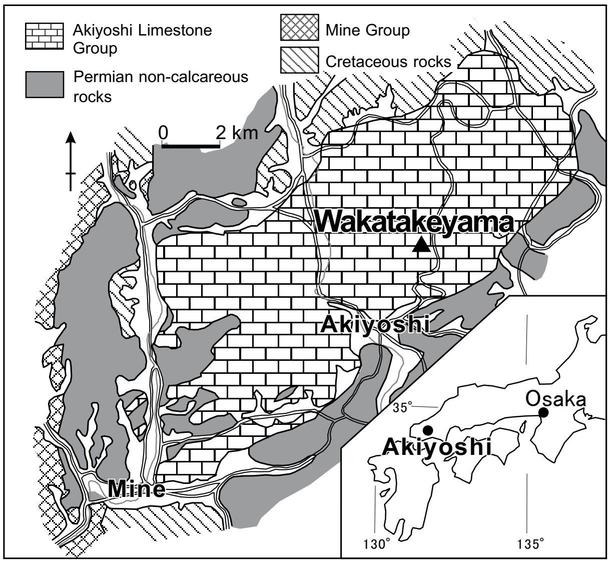


Fig. 2: Distribution of the Akiyoshi Limestone Group and surrounding rocks (simplified from M. Ota, 1977) and the studied Wakatkeyama area.

underlying Permian non-calcareous rocks referable to the Tsunemori Formation are exposed as a tectonic window (M. Ota, 1977; Kobayashi, 2012).

Biostratigraphically, the Carboniferous of the Akiyoshi Limestone Group was subdivided into 13 zones by Ueno (1989) and 30 by T. Ozawa & Kobayashi (1990), and the Permian into 17 by T. Ozawa & Kobayashi (1990) based on the stratigraphic distribution of foraminifers, mostly of fusulines. Biostratigraphic informations of Late Carboniferous to Early Permian fusulines are best provided in the Wakatakeyama area.

3. HISTORICAL REVIEW ON MOSCOVIAN TO ASSELIAN FUSULINE BIOSTRATIGRAPHY OF THE AKIYOSHI LIMESTONE GROUP

Y. Ozawa (1923) was the first who established the fusuline zonation of Japan based mainly on the biostratigraphic data of Akiyoshi, by which the areal overturned structure of the Akiyoshi Limestone was demonstrated. The Upper Carboniferous in the Akiyoshi Limestone Group was divided by Y. Ozawa (1925b) into two units, the lower C2 having *Fusulinella bocki* von Möller, 1877 and *F. biconica* (Hayasaka, 1924) and the upper C3 with *Schellwienia vulgaris* Schellwien, 1909, *S. kraffti* Schellwien, 1909 and *Schwagerina muongthensis* Deprat, 1915. The Carboniferous-Permian boundary was drawn under the unit CPg with *Schellwienia lutugini* Schellwien, 1908 and *S. kaerimizensis* Y. Ozawa, 1925b. Level of *Fusulinella itoi* Y. Ozawa, 1925b, common in the Moscovian of the Akiyoshi Limestone Group, was included in the unit P3 (Upper Permian) on account of its occurrence from a pebble found together with other pebbles with *Yabeina shiwaiwensis* Y. Ozawa, 1925b in the limestone conglomerate of the non-calcareous rock unit (Tsunemori Formation) about 13 km WSW of the Wakatakeyama area.

Toriyama (1954, 1958) improved the Y. Ozawa's (1925b) subdivision. He divided the Moscovian into the lower *Profusulinella beppensis* Subzone correlatable to the upper part of the C1 of Y. Ozawa (1925b) and the upper *Fusulinella biconica* Subzone to the unit C2. The Lower Permian corresponding to the Y. Ozawa's unit C3 was divided into the lower *Triticites simplex* Zone and the upper *Pseudofusulina vulgaris* Zone. He assumed that the upper part of the Upper Carboniferous (Kasimovian and Gzhelian) was entirely missing in the Akiyoshi Limestone Group. *Carbonoschwagerina morikawai* (Igo, 1957), the zonal species of the middle Gzhelian by T. Ozawa & Kobayashi (1990), and *Sphaeroschwagerina fusiformis* (Krotow, 1888), the most reliable indicator of the basal part of the Permian, were erroneously identified with *Pseudoschwagerina muongthensis* (Deprat, 1915) by Toriyama (1958). *Quasifusulina longissima* (von Möller, 1878), restricted from the upper Kasimovian to the lower Gzhelian in the Akiyoshi Limestone Group, and some forms referable to the Gzhelian *Rauserites* are detected from the Toriyama's Lower Permian *Triticites simplex* Zone.

Yanagida *et al*. (1971) showed the detailed map of fusuline zonation of the Shishidedai area about 9 km NE of the Wakatakeyama area. These authors reinforced the Upper Carboniferous biostratigraphy of Toriyama (1954, 1958) by adding the *Akiyoshiella ozawai* Zone below the *Fusulinella biconica* Zone, and the *Beedeina akiyoshiensis* Zone between the *Fusulinella biconica* Zone and the *Triticites simplex* Zone. The *Profusulinella beppensis* Zone was correlated to the Bashikirian instead of the Moscovian. Stratigraphic interval equivalent to the Kasimovian and Gzhelian was assumed to be not developed in the Akiyoshi Limestone Group likely done by Toriyama (1958).

M. Ota (1977) first clarified the development of the Kasimovian in the Akiyoshi Limestone Group based on the *Triticites matsumotoi* Zone that was supposed to be unconformably overlying the *Beedeina akiyoshiensis* Zone and unconformably underlying the *Triticites simplex* Zone. The *Triticites simplex* Zone by Toriyama (1954, 1958) and Yanagida *et al.* (1971) was subdivided the lower *Triticites simplex* Zone and the upper *Pseudoschwagerina* (*Pseudoschwagerina*) *muongthensis* Zone. The former was correlated to the lower Asselian and the latter to the middle Asselian. However, Kasimovian elements of "*Triticites montiparus*" (von Möller, 1878) and "*Triticites arctica*" (Schellwien, 1908), and upper Kasimovian to lower Gzhelian element of *Quasifusulina longissima* were listed in his *Triticites simplex* Zone. Two specimens named *Pseudoschwagerina* (*Pseudoschwagerina*) *muongthensis* (M. Ota, 1977, pl. 2, figs 11,

12) are apparently reassignable to *Sphaeroschwagerina fusiformis* or *Sphaeroschwagerina pavlovi* (Rauzer-Chernousova, 1938).

Ueno (1989) subdivided the Moscovian into four zones, *Akiyoshiella ozawai*, *Fusulinella biconica*, *Fusulinella taishakuensis*, and *Beedeina akiyoshiensis* in ascending order in the Sayama area about 7 km NE of the Wakatakeyama area. These four zones were correlated to the Vereian, Kashirian, Podolskian, and Myachkovian in the Russian Platform, respectively (Fig. 3). The *Fusulinella taishakuensis* Zone, newly settled in the Akiyoshi Limestone Group, was correlated to the upper part of the previously defined *Fusulinella biconica* Zone. Two zonal species, *Fusulinella biconica* and *F. taishakuensis* Sada in Sada & Yokoyama, 1970, range into the Myachkovian *Beedeina akiyoshiensis* Zone according to Ueno (1989). The Kasimovian was divided into two, the lower *Protriticites* sp. Zone and the upper *Quasifusulinoides toriyamai* Zone. Ueno (1989) correlated the *Triticites simplex* Zone to the Gzhelian not to the Asselian as formerly inferred, and redefined the zone by the stratigraphic interval from the first appearance of *Triticites* to the level just below the first appearance of Pseudoschwagerininae. *Pseudoschwagerina*? *nakazawai* Nogami, 1961 was regarded to be restricted to the uppermost part of the *Triticites simplex* Zone. This species, however, is different from the original one by Nogami (1961) from the Atetsu Limestone. *Triticites stuckenbergi* Rauzer-Chernousova, 1938 that was used for his correlation of the *Triticites simplex* Zone is not identical with the types from the lower Gzhelian of European Russia, as shown later in this paper. He showed that the *Triticites simplex* Zone unconformably overlies the underlying *Beedeina akiyoshiensis, Protriticites* sp., and *Quasifusulinoides toriyamai* zones, and conformably underlies the Asselian "*Alpinoschwagerina*? *fusiformis*" Zone. However, the specimen illustrated as *A.*? *fusiformis* by Ueno (1989) is not identified with the original *Schwagerina fusiformis* by Krotow (1888) and that of later authors (e.g., Rauzer-Chernousova & Shcherbovich, 1949). It should be reassigned to *Carbonoschwagerina morikawai* of the middle Gzhelian in age, as discussed below. Ueno assumed that "*Alpinoschwagerina pavlovi*" and "*Alpinoschwagerina moelleri*" (Rauzer-Chernousova, 1936) are confined to the lower part of his *Alpinoschwagerina*? *fusiformis* Zone and *Pseudoschwagerina*? *miharanoensis* Akagi, 1958 first appears in the upper part of his *Alpinoschwageina*? *fusiformis* Zone. Therefore, Ueno's Carboniferous-Permian boundary and his identification of some inflated schwagerinids and other fusulines are needed to be reconsidered.

Subsequently, Ueno (1991) described 12 species belonging to seven genera from the *Protriticites* sp. Zone and *Quasifusulinoides toriyamai* Zone that were modified from Ueno (1989)'s. He indicated that *Protriticites, Obsoletes* and *Quasifusulinoides* occur between his *Beedeina akiyoshiensis* Zone and his *Triticites simplex* Zone. Two species of *Kanmeraia* and one new species of *Protriticites* were added to the uppermost part of his *Protriticites* sp. Zone in Ueno (1991). The former is deduced to be referable to *Kanmeraia pulchra* (Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., 1936) and the latter would be reassigned to *Montiparus* or *Triticites*. Specimens undoubtedly assignable to *Protriticites* are not illustrated in Ueno (1991).

Thus, Ueno (1989, 1991) reorganized the fusuline biostratigraphy from the Moscovian to Asselian. On the other hand, there are considerable disaccordances concerning the stratigraphic distribution of some important species and the stratigraphic order from the Kashirian substage to the Asselian stage between Ueno (1989, 1991) and other works (T. Ozawa & Kobayashi, 1990; Watanabe, 1991) (Fig. 3). The unconformable contact of *Triticites simplex* Zone with some underlying zones insisted by Ueno (1989, 1991) must be reconsidered, along with Carboniferous-Permian boundary.

T. Ozawa & Kobayashi (1990) subdivided the Moscovian into seven fusuline zones, Kasimovian into six, Gzhelian into four, and Asselian into three (Fig. 3). Their subdivision scheme and faunal composition of fusulines are roughly inferable from two range charts and illustrations of characteristic species in these zones shown by them. Although brief description of biostratigraphy was done, there are no descriptions of species in T. Ozawa & Kobayashi (1990). The biostratigraphy of Kasimovian, Gzhelian, and Asselian and their correlation to the coeval reference sections in the Tethyan regions were briefly described and discussed in T. Ozawa *et al*. (1990).

Watanabe (1991) thoroughly and critically reviewed the fusuline faunal composition and biostratigraphic correlation studied by previous workers of Japan through the comparison with those revealed in the stratotypes mainly of European Russia and Central Asia. As a result, he subdivided the Kasimovian to the Artinskian of Japan into 12 fusuline zones. In the Akiyoshi Limestone Group, Watanabe (1991) subdivided the Kasimovian into three fusuline zones, Gzhelian into two, and Asselian into five (Fig. 3) without any stratigraphic disturbances. Among them, the *Montiparus matsumotoi inflatus* and *Schwagerina globulus japonicus* zones were newly proposed. However, there are no descriptions of these two subspecies in Watanabe (1991) and his later works. Biostratigraphic comparison to the schemes by Ueno (1989) and T. Ozawa & Kobayashi (1990) was not mentioned in Watanabe (1991) probably because of a matter of time of Watanabe's manuscript deposited before the issue of the two other publications. He pointed out that the Asselian species elements are found out in the *Pseudofusulina vulgaris* Zone *sensu* Toriyama (1958) and *sensu* M. Ota (1977).

Y. Ota & M. Ota (1993) divided the Upper Carboniferous-Lower Permian distributed in the Wakatakeyama area into eight fusuline zones (Fig. 3). They supposed

This paper	Ueno (1989, 1991)	T. Ozawa & Kobayashi (1990)	Watanabe (1991)	Y. Ota & M. Ota (1993)	Y. Ota (1998)	Nakazawa & Ueno (2009)
Pss. miharanoensis - Paraschw. akiyoshiensis	*Pseudof.* ex. gr. *vulgaris*	*Pseudoschwagerina miharanoensis*	*P. akiyoshi. - Psf. firma*	*Pseudofusulina vulgaris*	*Pseudofusulina vulgaris globosa*	*Pseudofusulina firma*
			S. glob. jap. - P. miharano.			
Sphaeroschw. fusiformis - Pss. muongthensis	*Alpinoschwagerina? fusiformis*	*Pseudoschwagerina muongthensis*	"*Alpinosch.*" cf. *saigusai*			*Pseudoschwagerina muongthensis*
			S. pavlovi - Pss. muongth.	*Pseudoschwagerina muongthensis*	*Pseudoschwagerina muongthensis*	
		"*Sphaero.*" *fusiformis*	*Sphaeroschw. fusiformis*			*Pseudofusulina stabilis*
J. titanicus - Carb. minatoi		*D. robusta - Pss. minatoi*	"*Pseudoschw.*" *minatoi*			
C. morikawai - J. horridus		*T. ozawai - Pss. morikawai*	"*Pseudoschwagerina*" *morikawai*			*Carbonoschwagerina morikawai*
Rauserites stuckenbergi - Triticites simplex	*Triticites* "*simplex*"	*Tr.* (*Rauser.*) *stuckenbergi*		*Triticites simplex*	*Schwagerina?* cf. *satoi*	
		Tr. (*Rauser.*) *paraarcticus*				
Rauserites arcticus - Carbonoschw. nipponica		*Triticites exculptus*	*Schwagerina? satoi*	*Schwagerina* sp. A	*Triticites yamamadakensis*	*Carbonoschwagerina satoi*
		Triticites yayamadakensis				
Montiparus matsumotoi - Quasifusulinoides ohtanii	*Quasifusulinoides toriyamai*	*Montiparus matsumotoi*	*Montiparus matsumotoi inflatus*	*Montiparus* sp. A	*Montiparus* sp. A	*Quasifusulinoides toriyamai*
		M. montip. - Quasi. ohtanii		*Quasifusulinoides* sp. A		
Protriticites subschwagerinoides	*Protriticites* sp.	*Protr. subschwagerinoides*	*Obsoletes obsoletus*	*Protriticites matsumotoi*	*Obsoletes obsoletus*	*Protriticites* sp.
		Obsoletes obsoletus				
Fusulinella bocki - Kanmeraia pulchra		*Pseudofusulinella hidaensis*	(not studied)	*Pseudofusulinella hidaensis*	*Fusulina* cf. *shikokuensis*	
	Beedeina akiyoshiensis	*Fusulinella pseudobocki*				*Beedeina akiyoshiensis*
Kanmeraia itoi	*Fusulinella taishakuensis*	*Beedeina akiyoshiensis*				*Kanmeraia taishakuensis*
		Pseudofusulinella itoi				
Fusulinella biconica	*Fusulinella biconica*	*Fusulinella biconica*		(not studied)	*Fusulinella biconica*	*Fusulinella biconica*
Akiyoshiella ozawai	*Akiyoshiella ozawai*	*Profusulinella* n. sp.			(not studied)	*Akiyoshiella ozawai*
		Akiyoshiella ozawai				

Fig. 3: Comparison of the biostratigraphic zonations (Moscovian to Asselian) of the Akiyoshi Limestone Group.

that the deposits of the *Quasifusulinoides* sp. A Zone are unconformably overlain by the deposits of the *Montiparus* sp. A Zone, and other zones are in conformable relation each other. Zonation scheme, age assignment and international correlation by them are considerably different from those by T. Ozawa & Kobayashi (1990) and Watanabe (1991). For example, the *Pseudoschwagerina muongthensis* Zone by Y. Ota & M. Ota (1993) was totally correlated to the six zones from the *Pseudoschwagerina morikawai* Zone to the *Schwagerina globulus japonicus-Pseudoschwagerina miharanoensis* Zone in Watanabe (1991). They gave three names [*Pseudoschwagerina morikawai, Pseudoschwagerina* sp., and *Sphaeroschwagerina*(?) sp.], all of which should be referable to *Sphaeroschwagerina fusiformis*. They reported *Pseudofusulina vulgaris* var. *globosa* (Schellwien, 1909) from the basal part of their *Pseudofusulina vulgaris* Zone, immediately above their *Pseudoschwagerina muongthensis* Zone. Correlation of the *Pseudofusulina vulgaris* Zone defined by Y. Ota & M. Ota was left uncertain as well as that of the *Pseudofusulina* ex. gr. *vulgaris* Zone done by Ueno (1989).

There are some modifications in the taxonomy and correlation in Y. Ota (1997, 1998), but the biostratigraphy remains almost the same as that of Y. Ota & M. Ota (1993). Y. Ota (1997) showed the inverted geologic structure of the Upper Carboniferous and Lower Permian in the Jigokudai area, about 4 km NNW of the Wakatakeyama area. Newly introduced by Y. Ota (1997) was the *Fusulina* cf. *shikokuensis* Zone in the upper Moscovian of the Jigokudai area (Fig. 3).

After these works, there have been no papers aimed at the biostratigraphy of the Upper Carboniferous to Lower Permian of the Akiyoshi Limestone Group. However, biostratigraphic results accumulated during the last century have worked effectively as a basic data source for related geological sciences, such as the reconstruction of sedimentary process of the Panthalassan-originated Akiyoshi seamount (e.g., Sano *et al.,* 2004; Nakazawa & Ueno, 2009). Biostratigraphic subdivision shown by Sano *et al.* (2004) is the same as that of Ueno (1989). Subdivision and biostratigraphic order of the upper Moscovian-lower Kasimovian are considerably different between these two and the present paper (Fig. 3). The subdivision from the upper Kasimovian to Asselian by Ueno (1989, 1991) was changed by Nakazawa & Ueno (2009). However, detailed comparison of biostratigraphy and correlation between the former and the latter is not possible, since the definition, stratigraphic range and composition of species in the renewed biostratigraphy were not shown in Nakazawa & Ueno (2009).

As summarized and briefly revised above, since Y. Ozawa (1923) many workers tried the biostratigraphic zonation of the Akiyoshi Limestone Group. Correlation and age assignment of fusuline zones by earlier workers were done mainly based on the biostratigraphy and chronostratigraphy established in North America, as exemplified by Toriyama (1954, 1958). Fusuline faunas of the Moscovian to Asselian in the Akiyoshi Limestone Group are close to those of Russian platform, Urals, Timan-Pechra, and Tethyan regions. There are no zonal species common with North America in the Upper Carboniferous and the Lower Permian of the Akiyoshi Limestone Group. Already in those days, there were important fusuline papers of faunas, correlation, and age assignment in the stratotypes of the Upper Carboniferous and Lower Permian (e.g., Rauzer-Chernousova, 1949; Rozovskaya, 1950; Rauzer-Chernousova *et al*., 1951) leading to the establishment of the international geologic time scale in the present day. They were seldom cited by the Japanese workers in those days. In retrospect, several papers printed in “The Carboniferous of the U.S.S.R.” edited by Wagner *et al*. (1979), in which many important original papers by Russian workers were reviewed, might be a turning point for fusuline paleontologists of Japan biostratigraphically as well as chronostratigraphically. After the publication, previous correlation of the “Uralian” fusulines and “*Pseudoschwagerina*” assemblages in Japan have been reexamined and largely revised since 1980’s.

4. MATERIAL AND METHOD

The limestone in the Wakatakeyama area is massive without showing any distinct stratification as well as in other areas of Akiyoshi Limestone. I have realized that the biostratigraphic order is more or less different along every sampling route probably due to many faults. The same biostratigraphic interval is repeated many times or is isolated discontinuously, deducing much more complicated geologic structure of the Akiyoshi Limestone Group than supposed by previous workers. Since encountering with many lines of unexpected evidence of occurrences in the field and laboratory, my sampling plan was forced to be altered into thorough sampling regardless of recognition of foraminifers at a limestone exposure. Based on many samples and thin sections, I would compare the renewed biostratigraphy by myself to the previous ones in the Wakatakeyama area by T. Ozawa & Kobayashi (1990), Watanabe (1991), and Y. Ota & M. Ota (1993).

As a result, the number of collected limestone samples has attained to 312 and thin sections from these samples up to 4,446 in the mapped small area (Figs 4, 5). There is considerable number of samples and thin sections completely free from foraminifers or absent in age-diagnostic fusulines. Litho- and bio-facies of the limestone and foraminiferal faunas of these thin sections were compared under microscope with those of more than 5,000 coeval thin sections prepared outside the mapped area in these twenty years. More than 10,000

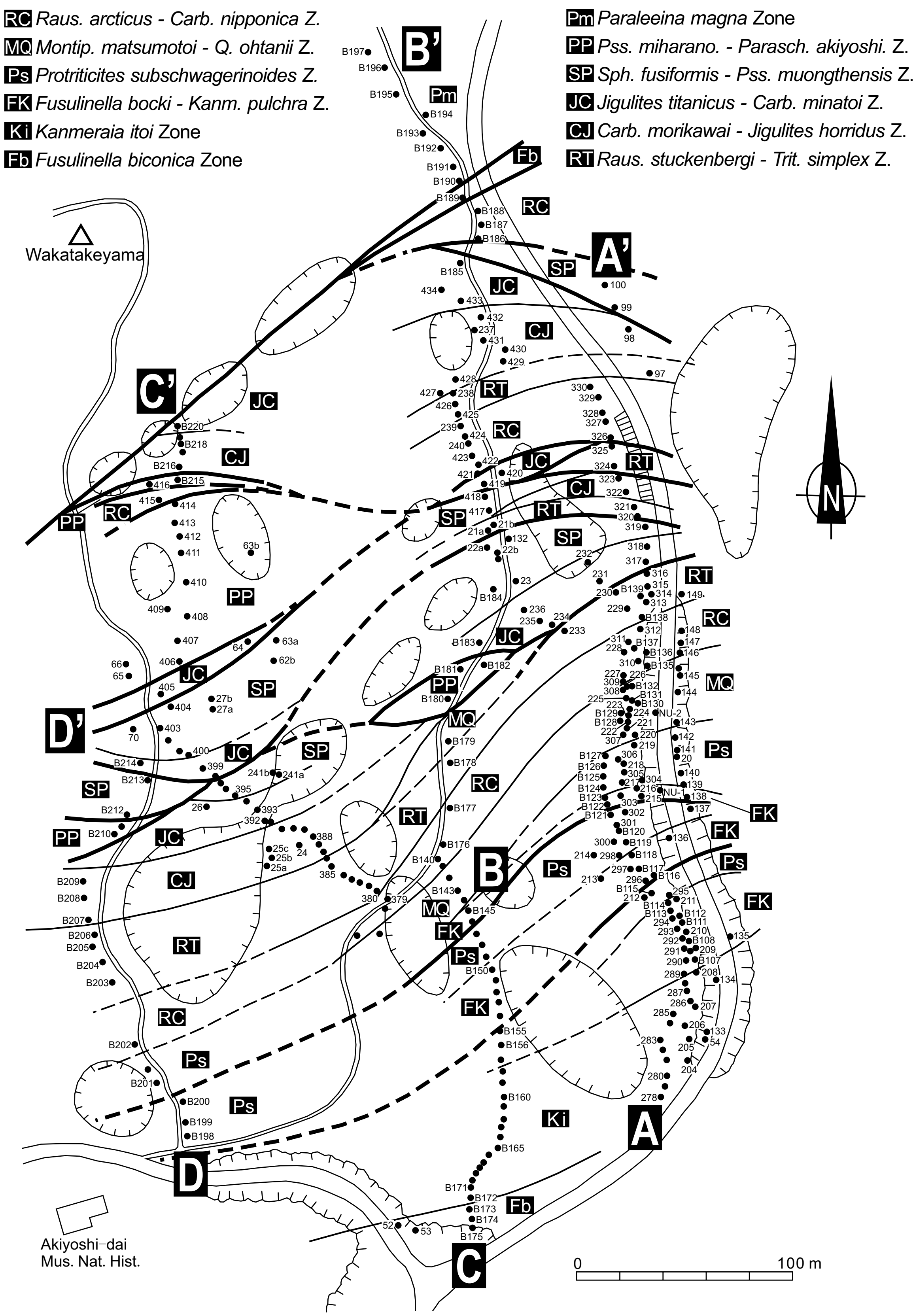


Fig. 4: Geologic map in the Wakatakeyama area showing the biostratigraphic subdivisions from the *Fusulinella biconica* Zone (Kashirian) to the *Paraleeina magna* Zone (Artinskian), sample localities, and the location of four stratigraphic columns (A-A', B-B', C-C', and D-D'). The first letter A, is omitted for the sample number without prefix to two- or three-digit numbers (e.g., A52, A278 vs. B175, NU-2), as well as in Fig. 5.

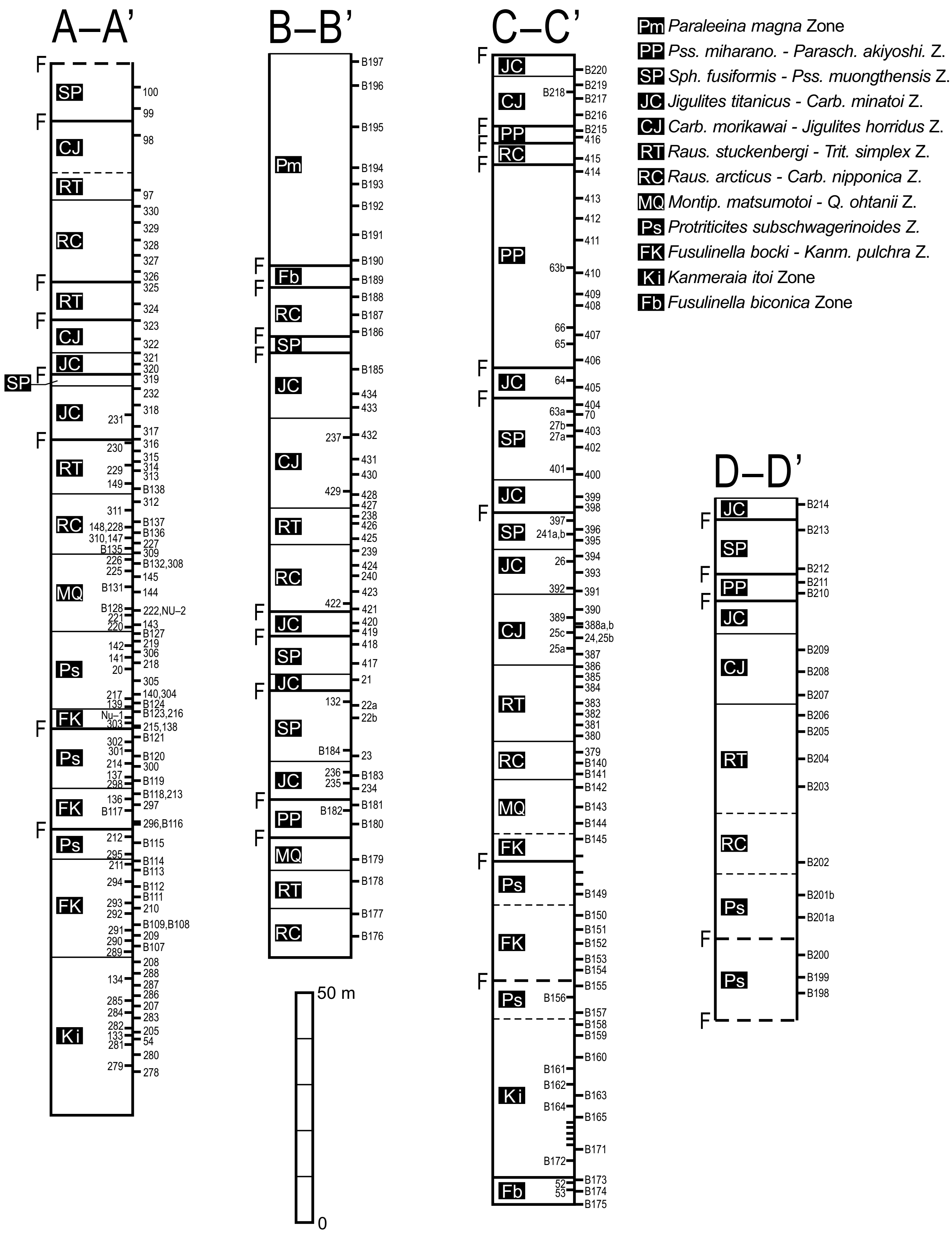


Fig. 5: Four stratigraphic columns in the Wakatakeyama area showing the location of samples and the biostratigraphic assignment of a stratigraphic interval. An abbreviation F, immediately left side of four columns, means a fault.

photographic sheets of film or digital prints were prepared so as that the foraminiferal composition and morphological variation of fusuline species are more accurately and reasonably compared at every sample.
The mapping based on fusuline biostratigraphy results that the massive limestone in the area stikes northeast-southwest to east-west consistently (Fig. 4). The vertical gradation of grain size of laminae, though not easily delineated in the field and restricted to few exposures, suggests that the limestone dips moderately southward. The dark brown limestone of the middle to upper Kasimovian with *Microcodium* structure is areally recognizable in the field. This limestone has been taken a considerable attention because of a secondary product of *Microcodium* by vadose dissolution indexing an unconformity or a hiatus in the Akiyoshi Limestone Group (Sano & Kanmera, 1991a, b; Machiyama, 1994; Sano *et al*., 2004; Sano, 2006). However, any biostratigraphic gaps cannot be detected between the dark brown limestone and its underlying and overlying limestones so far as the Akiyoshi fusuline assemblages and their international correlation with those of stratotypes of the Upper Carboniferous are concerned. The lateral trace of this limestone in the field, recognized in the biostratigraphic interval of "MQ" (*Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone) and "RC" (*Rauserites arcticus-Carbonoschwagerina nipponica* Zone), shows that the limestone strikes northeast and probably dips moderately southeastward (Fig. 4).
Thus, the mapping based on fusuline biostratigraphy, in addition with subordinate criteria as uncommon laminated limestone and the trace of the dark brown limestone in the field, indicates the overturned structure of the Akiyoshi Limestone Group. Four stratigraphic columns were prepared by the assumption that the Akiyoshi Limestone Group dips about 40 degrees southward in the Wakatakeyama area (Fig. 5). Besides the stratigraphic level of the sample, biostratigraphic subdivisions mentioned below are shown in each column by which the stratigraphic relation either continuous or discontinuous and the degree of structural gaps will be comprehensible.

5. BIOSTRATIGRAPHY

Although the original stratigraphic order before the accretion of the Akiyoshi seamount is more or less disturbed, the Akiyoshi Limestone Group in the mapped area can be biostratigraphically subdivided into 12 fusuline zones based on the distribution of age-diagnostic species and its associated ones. These 12 zones are piled up comformably from lower to upper: **(1) *Fusulinella biconica*, (2) *Kanmeraia itoi*, (3) *Fusulinella bocki-Kanmeraia pulchra*, (4) *Protriticites subschwagerinoides*, (5) *Montiparus matsumotoi-Quasifusulinoides ohtanii*, (6) *Rauserites arcticus-Carbonoschwagerina nipponica*, (7) *Rauserites stuckenbergi-Triticites simplex*, (8) *Carbonoschwagerina morikawai-Jigulites horridus*, (9) *Jigulites titanicus-Carbonoschwagerina minatoi*, (10) *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis*, (11) *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis*, and (12) *Paraleeina magna***. Tables 1 and 2 show the faunal association and distribution of fusulines in 82 samples selected from 312. Total number of genus and species of fusulines, and the number of thin sections per a limestone sample in these 82 samples are summarized in Tables 3 and 4. Stratigraphic distribution of 76 species of fusulines among 119 is generalized in Fig. 6. Among non-fusuline foraminifers, three species of *Bradyina* or *Bradyinelloides* commonly occur throughout these 12 zones along with palaeotextulariids and globivalvulinids. However, biostratigraphic division by them is difficult as well as by most of smaller fusulines (schubertellids and staffellids).

Before going into the oldest *Fusulinella biconica* Zone in the mapped area, fusuline faunas of the *Akiyoshiella ozawai* Zone are summarized to make up for the Moscovian fusuline biostratigraphy of the Akiyoshi Limestone Group. The zone exposed just south of the mapped area underlies conformably the limestone referable to the *Fusulinella biconica* Zone and attains about 35 m in its maximum thickness. Its lower boundary is drawn at the level where the zonal species first appears. In addition to the zonal species, *Profusulinella probiconica* Watanabe, 1974 and *Profusulinella hayasakai* (Watanabe, 1974) are characteristic in the *Akiyoshiella ozawai* Zone (Fig. 7).

5.1. *Fusulinella biconica* Zone

The limestone in the southernmost part of the mapped area is equivalent to the upper part of the *Fusulinella biconica* Zone of about 40 m thick that is in the area immediately southward. *Kanmeraia* aff. *itoi* found in the upper part of this zone are absent in its lower part. The upper boundary of the zone is defined by the last occurrence of *Fusulinella biconica*. *Kanmeraia itoi* first appears in the upper part of this zone (B-173 and B-174). *Fusulinella biconica* coexists with *Kanmeraia* aff. *itoi* in B-189 (Fig. 4) where this zone is isolated in fault-bounded with the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and the *Paraleeina magna* Zone. In addition to these three species (*F. biconica, K. itoi* and *K*. aff. *itoi*), smaller fusulines such as *Ozawainella eoangulata* Manukalova, 1950, *Parastaffelloides kanmerai* n. sp., *Pseudoreichelina* sp. A, and *Reitlingerina* sp. A, occur in the upper part of this zone.
Limestone consists of fusuline packstone and bioclastic packstone/grainstone. Chaetetid-bryozoan boundstone dominant in the Bashikirian and also found in the *Akiyoshiella ozawai* Zone even if this zone is not

Table 1: List of fusulines in 42 limestone samples from the *Fusulinella biconica* Zone (Kashirian) to the *Rauserites stuckenbergi-Triticites simplex* Zone (early Gzhelian) in the Wakatakeyama area.

	Flla biconica				*Kanmeraia itoi*						*Flla bochi - Kan. pulchra*						*Protriticites subschwagerinoides*						*Montiparus matsumoti - Q. ohtanii*						*R. arcticus - Carb. nipponica*							*R. stuckenbergi - Trit. simplex*						
	A-52	A-53	B-173	B-174	A-133	A-280	A-281	A-287	B-163	B-170	A-211	A-292	A-294	A-296	B-107	B-123	A-20	A-218	A-295	A-304	A-306	B-124	A-143	A-220	A-225	B-128	B-132	B-179	A-227	A-228	A-240	A-311	A-423	B-176	B-202	A-97	A-149	A-238	A-380	A-384	A-425	A-426
Fusulinella biconica	X	X																																								
Fusulinella bocki												X	*																													
Fusulinella pseudobocki											*	X	X			X																										
Fusulinella rhomboidalis											X			X	*																											
Fusulinella sp. A														X																												
Fusulinella sp. B															X																											
Moellerites paracolaniae					X	X		*						*																												
Beedeina akiyoshiensis					X	*																																				
Quasifusulina longissima																																			X						X	
Quasifusulinoides ohtanii																								*	X	X	X															
Quasifusulinoides grandis																											X															
Kanmeraia itoi			X	X	X		X	X	X	X																																
Kanmeraia aff. *itoi*				X																																						
Kanmeraia pulchra																X																										
Kanmeraia? sp.								*																																		
Obsoletes obsoletus																		*	*	X		X																				
Obsoletes burkemensis																	X					X																				
Obsoletes sp.																			X			X																				
Protriticites variabilis																	X	*	X			X																				

	Flla biconica				Kanmeraia itoi						Flla bochi - Kan. pulchra					
	A-52	A-53	B-173	B-174	A-133	A-280	A-281	A-287	B-163	B-170	A-211	A-292	A-294	A-296	B-107	B-123
Protr. subschwagerinoides																
Montiparus montiparus																
Montiparus umbonoplicatus																
Montiparus matsumotoi																
Montiparus minensis																
Carbonoschw. nipponica																
Carbonoschw. nakazawai																
Rauserites arcticus																
Rauserites exculptus																
Rauserites major																
Rauserites stuckenbergi																
Schwageriniformis parallelos																
Triticites ozawai																
Triticites simplex																
Triticites yayamadakensis																
Triticites parvulus																
Triticites whitei																
Schwagerina satoi																
Eoschubertella obscura					*	*	*						*			*
Schubertella donetzica											*		X		*	
Schubertella magna																

	Protriticites subschwa gerinoides						Montiparus matsumoti - Q. ohtanii					
	A-20	A-218	A-295	A-304	A-306	B-124	A-143	A-220	A-225	B-128	B-132	B-179
Protr. subschwagerinoides	X		X	X	X	X						
Montiparus montiparus												X
Montiparus umbonoplicatus							X					*
Montiparus matsumotoi								X		X	*	
Montiparus minensis												
Carbonoschw. nipponica												
Carbonoschw. nakazawai												
Rauserites arcticus												
Rauserites exculptus												
Rauserites major												
Rauserites stuckenbergi												
Schwageriniformis parallelos												
Triticites ozawai												
Triticites simplex												
Triticites yayamadakensis												
Triticites parvulus												
Triticites whitei												
Schwagerina satoi												
Eoschubertella obscura							X					*
Schubertella donetzica		*		*	*	*		X				*
Schubertella magna								X		*		

	R. arcticus - Carb. nipponica							R. stuckenbergi - Trit. simplex						
	A-227	A-228	A-240	A-311	A-423	B-176	B-202	A-97	A-149	A-238	A-380	A-384	A-425	A-426
Protr. subschwagerinoides														
Montiparus montiparus														
Montiparus umbonoplicatus														
Montiparus matsumotoi														
Montiparus minensis	X	X				*	*							
Carbonoschw. nipponica		*	X			X	*						*	
Carbonoschw. nakazawai	X												X	*
Rauserites arcticus			*	X	X	*	*							
Rauserites exculptus			X		*					*				
Rauserites major														X
Rauserites stuckenbergi									X	X	*			X
Schwageriniformis parallelos			*	*								*	*	X
Triticites ozawai										X			*	*
Triticites simplex										X	*			*
Triticites yayamadakensis								*				X		
Triticites parvulus								X				X		
Triticites whitei												X		
Schwagerina satoi	X	*			X				*			X		
Eoschubertella obscura	X					*			*			*	*	*
Schubertella donetzica	X			*			*						*	*
Schubertella magna		*						X			*	X		

	Flla biconica				*Kanmeraia itoi*						*Flla bochi - Kan. pulchra*						*Protriticites subschwa gerinoides*						*Montiparus matsumoti - Q. ohtanii*						*R. arcticus - Carb. nipponica*							*R. stuckenbergi - Trit. simplex*						
	A-52	A-53	B-173	B-174	A-133	A-280	A-281	A-287	B-163	B-170	A-211	A-292	A-294	A-296	B-107	B-123	A-20	A-218	A-295	A-304	A-306	B-124	A-143	A-220	A-225	B-128	B-132	B-179	A-227	A-228	A-240	A-311	A-423	B-176	B-202	A-97	A-149	A-238	A-380	A-384	A-425	A-426
Schubertella kingi																																			*							
Eostaffella spp.		*							*									*									*															
Ozawainella eoangulata				X				*																																		
Parastaffelloides kanmerai	*	*				*	X					*			X																											
Parastaffelloides spp.	X	*							*			*	*		*																											
Staffella subsphaerica																								X																		
Staffella sp. A																																				X						
Pseudoreichelina sp. A		X																																								
Nankinella nagatoensis			*	*																									*	*	*			*	X					*		X
Nankinella spp.										*																														*		*
Reitlingerina preobrajenskyi																																				X						
Reitlingerina sp. A		X	*	*	X										*		*	*			*								X						*	*		*		*		X
Reittlingelrina sp. B	*	X	*																*																					*		
Reitlingerina spp.	*							*										*																		*		*				

Table 2: List of fusulines in 40 limestone samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone (middle Gzhelian) to the *Paraleeina magna* Zone (Artinskian) in the Wakatakeyama area.

	Carbnoschw. morikawai - Jigulites horridus											*Jigul. titanicus - Carb. minatoi*							*Shaeroschw. fusiformis - Pss. muongthensis*												*Pss. miharano. - P. akiyoshi*							*Paral. magna*		
	A-25a	A-25b	A-25c	A-237	A-388	A-427	A-428	A-430	B-207	B-208	B-218	A-21b	A-391	A-392	A-393	A-394	A-399	A-405	A-22a	A-27a	A-63a	A-100	A-132	A-241b	A-395	A-400	A-403	A-404	B-212	B-213	A-407	A-409	A-412	A-413	B-180	B-181	B-210	B-192	B-193	B-197
Carbonoschwagerina nakazawai		X	X			X	X		X		X																													
Carbonoschwagerina morikawai		X	X			*		X	X	X	X																													
Carbonoschwagerina minatoi															X																									
Rauserites major				X		X		X	*																															
Rauserites hidensis					X	*																																		
Triticites cf. *evectus*																										X														
Triticites? cf. *convexus*																																X								
Triticites? spp.																				X		X		X	X	X														
Sphaeroschwagerina fusiformis																			X	X					X	X		X	X											
Sphaeroschwagerina pavlovi																			X	X	X		X																	
Alpinoschwagerina nagatoensis																										X	X													
Pseudoschwag. muongthensis																			X		X	X		X	X		X	X		X										
Pseudoschwag. miharanoensis																																X			X					
Occidentoschw. cf. *fusulinoides*																				X					X															
Darvasoschwagerina shimodakensis					X								*		X																									
Darvasoschwagerina sp.																	X																							
Likharevites akiyoshiensis																											X				*	X			X	*				
Likharevites cf. *karachatypica*																																				X				

	Carbnoschw. morikawai - Jigulites horridus											*Jigul. titanicus - Carb. minatoi*							*Shaeroschw. fusiformis - Pss. muongthensis*												*Pss. miharano. - P. akiyoshi*							*Paral. magna*		
	A-25a	A-25b	A-25c	A-237	A-388	A-427	A-428	A-430	B-207	B-208	B-218	A-21b	A-391	A-392	A-393	A-394	A-399	A-405	A-22a	A-27a	A-63a	A-100	A-132	A-241b	A-395	A-400	A-403	A-404	B-212	B-213	A-407	A-409	A-412	A-413	B-180	B-181	B-210	B-192	B-193	B-197
Likharevites sp.																																					*			
Schwagerina densa																								X	*	*		*												
Schwagerina princeps																								*						*		X			X	*				
Schwagerina panjiensis																				X																				
Schwagerina stabilis													X	X	*		X	X	*	*					*			*												
Schwagerina watanabei																															X		*	X						
Schwagerina wakatakeyamensis																															X		X							
Eoparafusulina ellipsoidalis																			X	*	*	X	X	*	X	*		X	*											
Mccloudia? truncatus																														X										
Darvasites pseudosimplex																					X																			
Darvasites vandae																																								X
Rugosochusenella shagonensis																						X		X																
Rugosochusenella paragregaria													X		X			*																						
Rugosochusenella sp. A												*			X	*	X																			*				
Rugosochusenella spp.															*	*			*	*	*			*	*		*						*							
Pseudochusenella gregaria																X	X																							
Pseudochusenella explicata																*	*		X	X	X	*				X		X	*	*	*	X			*	*				
Jigulites horridus	X	X	*	X			X		*		*																													
Jigulites titanicus												X	*				X	X					*	X																
Jigulites magnus	*		X	X		X	X		*	*								*																						
Daixina fecunda																								X				*		*		*								

	Carbnoschw. morikawai - Jigulites horridus											*Jigul. titanicus - Carb. minatoi*							*Shaeroschw. fusiformis - Pss. muongthensis*												*Pss. miharano. - P. akiyoshi*							*Paral. magna*		
	A-25a	A-25b	A-25c	A-237	A-388	A-427	A-428	A-430	B-207	B-208	B-218	A-21b	A-391	A-392	A-393	A-394	A-399	A-405	A-22a	A-27a	A-63a	A-100	A-132	A-241b	A-395	A-400	A-403	A-404	B-212	B-213	A-407	A-409	A-412	A-413	B-180	B-181	B-210	B-192	B-193	B-197
Daixina licharevi						X							*	X																		*								
Daixina ossinovkensis																														*										
Daixina sokensis														*			X																							
Daixina parvas																												X												
Daixina cf. *robusta*																				*							X	X		*										
Daixina spp.						*		X						*						*		X				*														
Rugosofusulina serrata												*							*				X		X				*											
Rugosofusulina prisca																				X									*											
Rugosofusulina sp. B													X																											
Pseudofusulina kumasoana			X					X		*	*		X			X																								
Pseudofusulina lutugini																											X							X						
Pseudofusulina parasolida																															X			X						
Chalaroschwagerina sp. A																																X								
Chalaroschwagerina sp. B																																				X				
Chalaroschwagerina sp. C																																					X			
Praeskinnerella cf. *cushmani*																																							X	
Paraleeina magna																																						X		X
Dutkevichites sp.															*																									
Biwaella aff. *omiensis*																													*				*	X				*	X	
Schubertella donetzica						*	*	*							X			*																						
Schubertella kingi	*	*	*	*		*		*	*	*	*	*		*	*		*	*	*	*	*	*	*	*	*	X	*	*	*	*		*		*	*				X	
Schubertella melonica											*																					*			*			X	X	

	Carbnoschw. morikawai - Jigulites horridus											*Jigul. titanicus - Carb. minatoi*							*Shaeroschw. fusiformis - Pss. muongthensis*												*Pss. miharano. - P. akiyoshi*							*Paral. magna*		
	A-25a	A-25b	A-25c	A-237	A-388	A-427	A-428	A-430	B-207	B-208	B-218	A-21b	A-391	A-392	A-393	A-394	A-399	A-405	A-22a	A-27a	A-63a	A-100	A-132	A-241b	A-395	A-400	A-403	A-404	B-212	B-213	A-407	A-409	A-412	A-413	B-180	B-181	B-210	B-192	B-193	B-197
Pseudoreichelina darvasica																																						X	X	X
Pseudoreichelina sp. A																							X																	
Pseudoreichelina sp. B																																						X		
Parastaffelloides spp.			*									X																												
Staffella subsphaerica												X	X			X																								
Staffella? sp.																																						X	X	X
Nankinella nagatoensis			*					*		*			*		*		*									*			*			*			X	*				
Nankinella spp.			*					*	*										*		*					*		*	*			*						*	X	X
Reitlingerina? sp.	*		*				*			*																		*												
Reitlingerina spp.					*			*								X				X	*		*			*														

X : shown in Plate, * : not shown in Plate

Table 3: Total number of genera and species of fusulines in 42 limestone samples (Table 1) and the number of thin sections prepared for each sample from the Kashirian to early Gzhelian in the Wakatakeyama area.

Chronostratigraphy		Kashirian				Podolskian						Myachkovian						early Kasimovian						middle Kasimovian						late Kasimovian							early Gzhelian						
Fusuline Zone		*Flusulinella biconica*				*Kanmeraia itoi*						*Flusulinella bochi - Kanmeraia. pulchra*						*Protriticites subschwa gerinoides*						*Montip. matsumoti - Quasif. ohtanii*						*Rauserites arcticus - Carbonoschw.. nipponica*							*R. stuckenbergi - Trititites simplex*						
Sample		A-52	A-53	B-173	B-174	A-133	A-280	A-281	A-287	B-163	B-170	A-211	A-292	A-294	A-296	B-107	B-123	A-20	A-218	A-295	A-304	A-306	B-124	A-143	A-220	A-225	B-128	B-132	B-179	A-227	A-228	A-240	A-311	A-423	B-176	B-202	A-97	A-149	A-238	A-380	A-384	A-425	A-426
Number of thin section		46	18	13	36	44	11	44	21	10	21	9	18	11	9	12	21	42	32	14	11	20	25	24	39	19	25	18	18	45	47	54	37	34	18	24	58	12	34	17	60	23	42
Number of genus		4	5	3	4	6	5	3	5	3	2	2	2	4	2	4	3	3	6	3	3	3	3	2	4	1	3	3	3	7	5	4	3	2	5	7	5	3	4	3	7	6	8
Number of species		5	7	4	5	5	4	3	5	3	2	3	4	5	3	6	3	4	6	5	3	3	6	2	5	1	3	4	4	7	5	5	3	3	5	8	7	3	6	3	11	7	11
Nos. fusulinids and schwagerinids	genus	2				4						3						2						2						6							6						
	species	3				4						7						5						5						8							13						

Table 4: Total number of genera and species of fusulines in 40 limestone samples (Table 2) and the number of thin sections prepared for each sample from the middle Gzhelian to Artinskian in the Wakatakeyama area.

Chronostratigraphy	middle Gzhelian										
Fusuline Zone	*Carbonoschwagerina morikawai - Jigulites horridus*										
Sample	A-25a	A-25b	A-25c	A-237	A-388	A-427	A-428	A-430	B-207	B-208	B-218
Number of thin section	36	12	24	46	13	48	29	32	30	18	27
Number of genus	3	3	7	3	3	6	4	7	5	6	4
Number of species	4	4	10	4	3	10	5	9	7	6	6
Nos. fusulinids and schwagerinids: genus	6										
Nos. fusulinids and schwagerinids: species	11										

Chronostratigraphy	late Gzhelian						
Fusuline Zone	*Jigulites titanicus - Carbonoschw. minatoi*						
Sample	A-21b	A-391	A-392	A-393	A-394	A-399	A-405
Number of thin section	11	23	13	49	45	39	20
Number of genus	6	9	3	7	5	8	4
Number of species	6	9	5	10	7	9	6
Nos. fusulinids and schwagerinids: genus	10						
Nos. fusulinids and schwagerinids: species	18						

Chronostratigraphy	early Asselian											
Fusuline Zone	*Pseudoschwagerina muonghensis - Sphaeroschwagerina fusiformis*											
Sample	A-22a	A-27a	A-63a	A-100	A-132	A-241b	A-395	A-400	A-403	A-404	B-212	B-213
Number of thin section	68	34	44	27	34	43	24	35	77	32	25	40
Number of genus	10	12	9	8	8	9	10	11	7	10	8	7
Number of species	10	14	9	7	7	10	10	12	7	12	9	8
Nos. fusulinids and schwagerinids: genus	16											
Nos. fusulinids and schwagerinids: species	30											

Chronostratigraphy	late Asselian							Yakhta-shian		
Fusuline Zone	*Pss. miharanoensis - P. akiyoshiensis*							*Paraleeina magna*		
Sample	A-407	A-409	A-412	A-413	B-180	B-181	B-210	B-192	B-193	B-197
Number of thin section	23	42	15	23	34	18	20	17	28	15
Number of genus	4	9	3	4	6	5	2	7	6	5
Number of species	5	12	4	5	7	7	2	7	7	5
Nos. fusulinids and schwagerinids: genus	10							4		
Nos. fusulinids and schwagerinids: species	17							4		

found in the mapped area. Microbial boundstone is fewer than in the outside the mapped area referable to the *Fusulinella biconica* Zone.

5.2. *Kanmeraia itoi* Zone

This zone is defined in the stratigraphic interval from the level above the last occurrence of *Fusulinella biconica* to the first appearance of *Fusulinella bocki* and *Fusulinella rhomboidalis* Niikawa, 1978. Its thickness is estimated about 35 m. The zonal species occurs commonly or rarely at least in five levels throughout the zone. *Parastaffelloides kanmerai* is characteristic in this zone. *Moellerites paracolaniae* (Safonova in Rauzer-Chernousova *et al*., 1951)*, Fusulinella pseudobocki* Lee & Chen in Lee *et al*., 1930 and *Beedeina akiyoshiensis* (Toriyama, 1958) first appear in this zone. The first and second species extend up to the *Fusulinella bocki-Kanmeraia pulchra* Zone and the third species is confined to this zone.

Fusulines are less abundant and limestone is more fine-grained than in the *Fusulinella biconica* Zone. In addition to skeletal packstone/grainstone, skeletal packstone/wackestone and wackestone/lime-mudstone are common in the zone. These limestones are partly filled with heterogeneous lime-mud and lime-silt. A part of skeletal packstone is finely laminated. Also recognized are microbial boundstone, wackestone having many microproblematica, and bioclastic grainstone with micritized oolites, pelloids and wackestone clasts.

5.3. *Fusulinella bocki-Kanmeraia pulchra* Zone

This zone conformably overlying the *Kanmeraia itoi* Zone is defined by the stratigraphic interval of about 20 m thick or more having common to rare *Fusulinella bocki, Fusulinella rhomboidalis*, and *Kanmeraia pulchra*. The third species is associated with *Fusulinella pseudobocki* in B-123 and not associated with *Fusulinella* in NU-1. *Fusulinella* sp. A, *Fusulinella* sp. B, and smaller fusulines (schubertellids and staffellids) occur in association with these three species. Species composition of smaller fusulines is similar between this zone and the underlying *Kanmeria itoi* Zone. A coexistence of *Fusulinella rhomboidalis* and *Kanmeraia pulchra* is recognized in the Omi Limestone of the Permian Akiyoshi Terrane (Fig. 8). This coexistence is supposed to be a reliable biostratigraphic dating of the uppermost Moscovian in Japan. This zone is mainly made up of grainstone rich in calcareous algae, cyanobacteria, crinoids, and foraminifers. Packstone and wackestone are rare. Some of limestones are weakly recrystallized.

Conformable and successive relationship from the *Fusulinella bocki-Kanmeraia pulchra* Zone to the *Rauserites stuckenbergi-Triticites simplex* Zone is distinguished along the middle part of the Section A-A'.

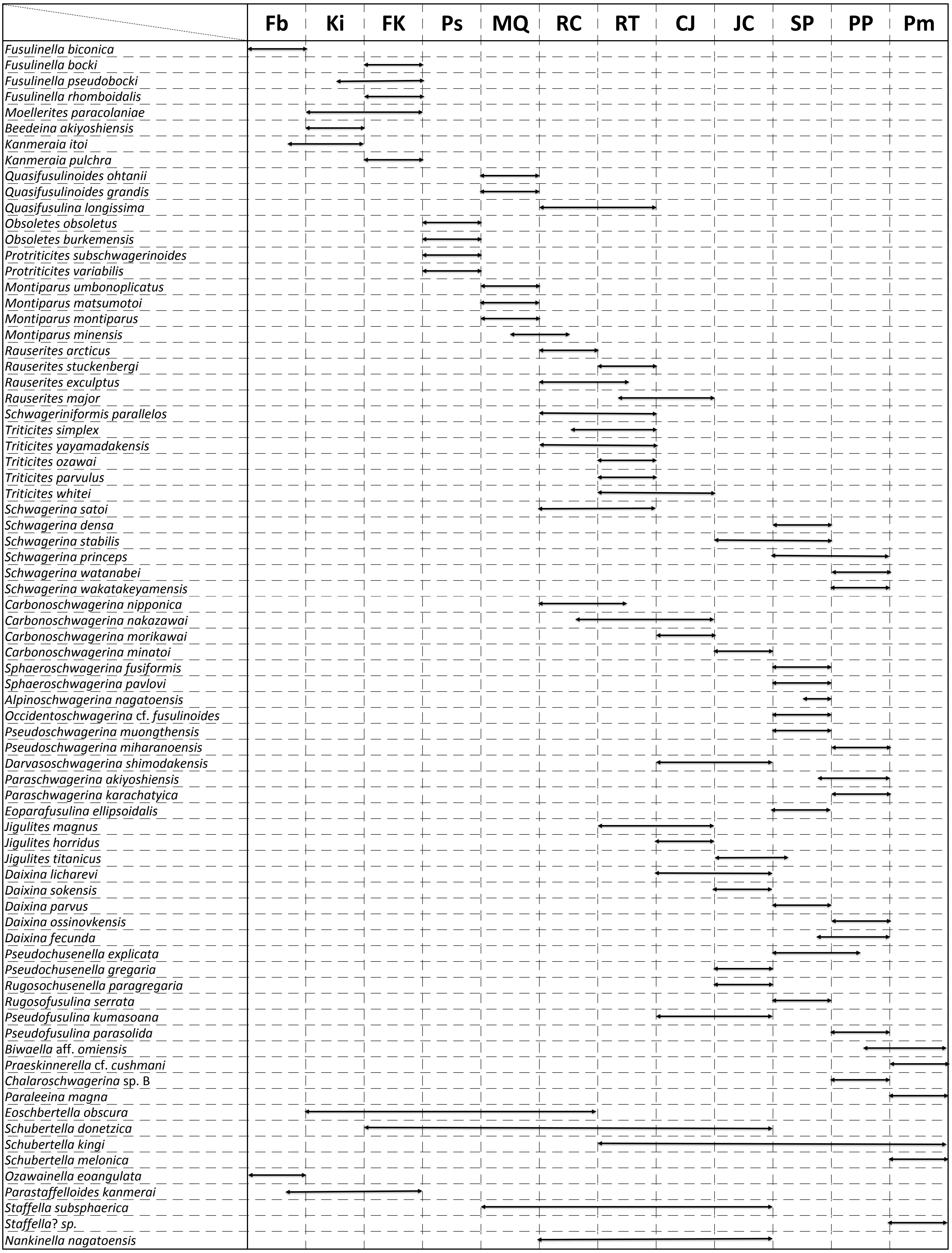


Fig. 6: Generalized biostratigraphic distribution of the selected seventy-six species. An abbreviation of the biostratigraphic unit is the same as in Figs 4 and 5.

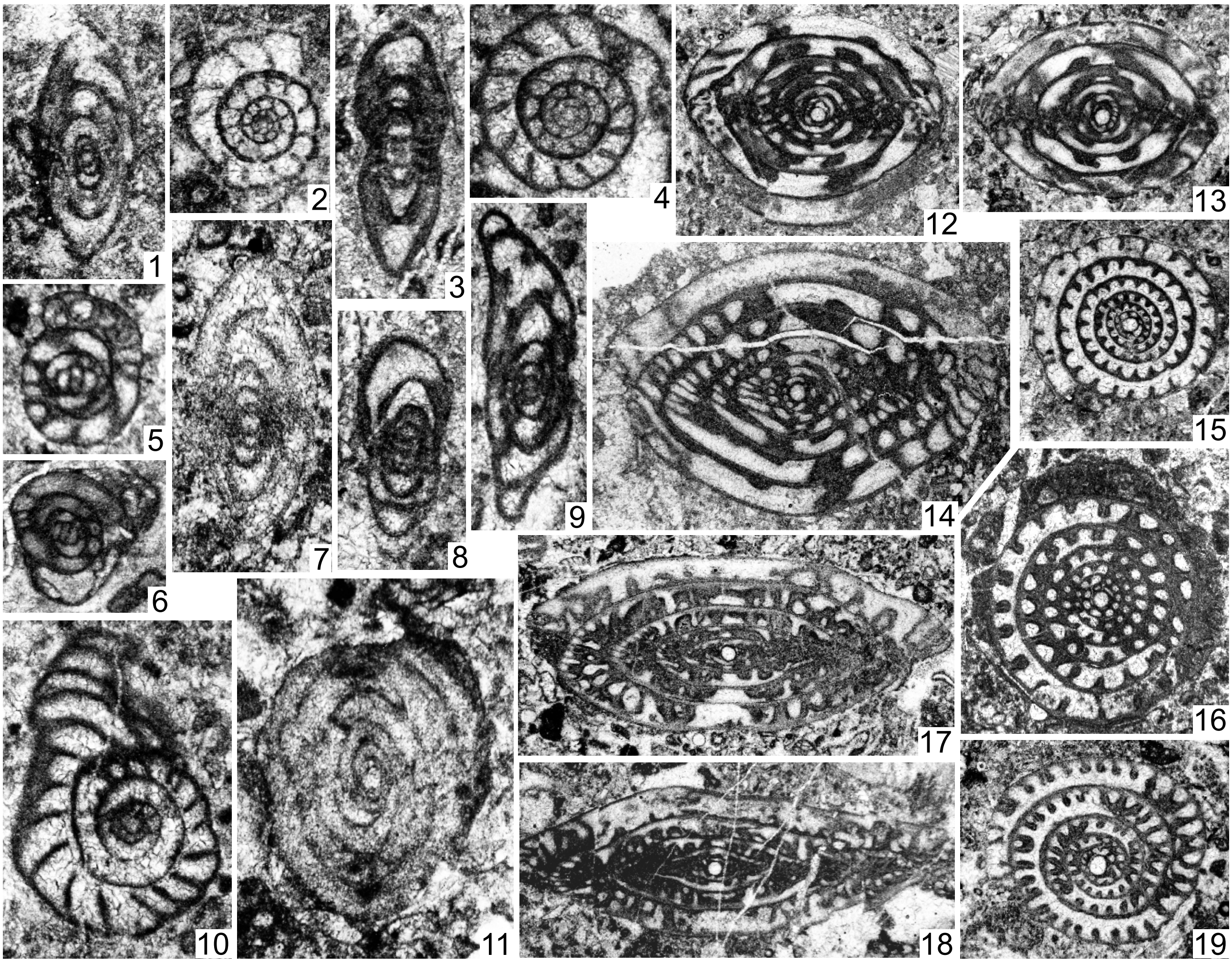


Fig. 7: Fusulines from the *Akiyoshiella ozawai* Zone immediately south of the Wakatakeyama area. 1-2: *Reitlingerina* sp. A, ×50; 3-4: *Reitlingerina* sp. B, ×50; 5-6: *Eoschubertella* sp., 5: ×50, 6: ×40; 7: *Reitlingerina*? sp., ×50; 8: *Eostaffella* sp., ×50; 9-10: *Pseudoreichelina* sp., ×50; 11: *Nankinella akagoensis* (Toriyama, 1958), ×40; 12-13, 15: *Profusulinella probiconica* Watanabe, 1974, ×20; 14, 16: *Profusulinella hayasakai* (Watanabe, 1974), ×20; 17-19: *Akiyoshiella ozawai* Toriyama, 1958, ×15.

That from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone to the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone is confirmed along the middle part of the Section C-C' (Figs 4, 5).

5.4. *Protriticites subschwagerinoides* Zone

This zone is defined in the stratigraphic interval of about 17 m thick containing the zonal species and *Protriticites variabilis* Bensh, 1972. *Obsoletes obsoletus* (Schellwien, 1908), *O. burkemensis* Volozhanina, 1962 and *O.* sp. are fewer than two species of *Protriticites*. The occurrence of these two genera is confined to this zone. Small fusulines are rare or absent in almost all samples as well as non-fusuline foraminifers.
Characteristic limestone to this zone is bioclastic grainstone containing well preserved *Protriticites*. More common in this zone is grainstone/packstone with many bioclasts as crinoids, brachiopods, algae and microproblematica, algal grainstone/packstone, wackestone, and oolitic bioclastic grainstone. Foraminifers are rare or very rare in these limestones. The limestone weakly recrystallized and barren in fusulines, exposed in the southernmost part of the D-D' section (Fig. 4), is tentatively belonged to this zone.

5.5. *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone

This zone is defined in the stratigraphic interval of about 18 m thick yielding *Montiparus matsumotoi* (Kanmera, 1955) and *Quasifusulinoides ohtanii* (Kanmera, 1954). Besides them, *Montiparus montiparus*, *M. umbonoplicatus* (Rauzer-Chernousova & Belyaev in Rauzer-Chernousova & Fursenko, 1937) and *Quasifusulinoides grandis* n. sp. are also confined to this zone. *Montiparus*

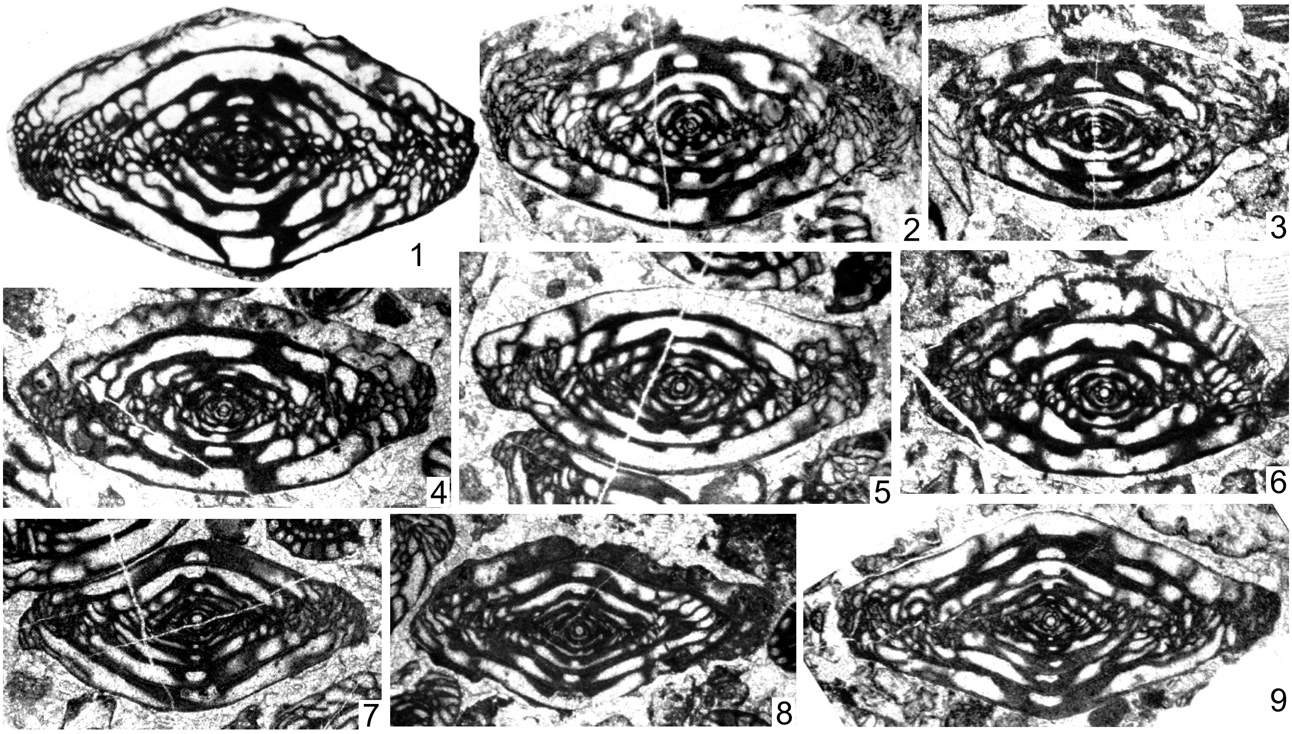


Fig. 8: Myachkovian fusulines outside the Akiyoshi Limestone. 1-6: *Fusulinella rhomboidalis* Niikawa, 1978, 1: holotype after Niikawa (1978, pl. 8, fig. 9) from the Ichinotani Formation, ×15; 2-6: from the Myachkovian of the Omi Limestone, ×15. 7-9: *Kanmeraia pulchra* (Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., 1936) from the Myachkovian of the Omi Limestone, ×15.

minensis n. sp. is more common in the overlying zone than in this zone. Smaller fusulines as well as non-fusulines are very poor in this zone except for rare three species of schubertellids, *Eoschubertella obscura* (Lee & Chen in Lee *et al*., 1930), *Schubertella donetzica* Putrya, 1940 and *Schubertella magna* Lee & Chen in Lee *et al*., 1930, and one staffellid, *Staffella subsphaerica* n. sp.

Lithologically, this zone is characterized by frequent occurrences of various types of limestones with *Microcodium* structure. They are locally oolitic and contain many fossils some of which are micritized and recrystallized. Also marked in this zone are highly algal and crinoidal grainstone/packstone, and bioclastic grainstone with fragmented and abraded fusulines. Matrices of skeletal grains are irregularly filled with heterogeneous lime-mud and lime-silt, some of which exhibit the *Microcodium* structure. Marginal part of phylloid algae in the algal limestones is often covered by pendant cements.

5.6. *Rauserites arcticus-Carbonoschwagerina nipponica* Zone

This zone is defined in the stratigraphic interval of *Rauserites arcticus*. *Carbonoschwagerina nipponica* n. sp. is diagnostic in this zone and ranges up to the overlying zone. *Schwagerina satoi* Y. Ozawa, 1925b, though not restricted to this zone, is also characteristic. *Montiparus minensis* is dominant in this zone even if *Montiparus* disappears in this zone and does not extend upwards as classically established in the Russian work. The number of taxa and individuals of fusulines increases upwards from this zone. Though abundance is fewer than these three species, *Quasifusulina longissima, Triticites yayamadakensis* Kanmera, 1955, *Carbonoschwagerina nakazawai* (Nogami, 1961), *Rauserites exculptus* (Igo, 1957), *Schwagerina satoi, Schwageriniformis parallelos* (Shcherbovich, 1969), and *Schubertella kingi* Dunbar & Skinner, 1937 first appear in this zone and range up to the overlying zone (zones).

This zone is represented by fusuline packstone in which *Rauserites arcticus* is frequently crowded, crinoidal skeletal packstone/grainstone, and pelloidal algal packstone/wackestone. Fragments of rugose corals and sponges, poor or almost absent in the underlying zone, are partly contained in packstone/grainstone of this zone.

5.7. *Rauserites stuckenbergi-Triticites simplex* Zone

This zone is defined in the stratigraphic interval of 22 m thick with *Rauserites stuckenbergi* and corresponds to the acme zone of *Triticites*. *Rauserites* is common in this zone along with *Triticites*. The most dominant species in this zone, *Triticites simplex* (Schellwien, 1908) is almost restricted in this zone but also occurs rarely in the underlying *Rauserites arcticus-Carbonoschwagerina nipponica* Zone.

Jigulites first appears, and *Schwagerina satoi, Rauserites exculptus, Schwageriniformis parallelos,* and *Quasifusulina longissima* disappear in this zone. *Rauserites hidensis* (Igo, 1957) first appears in this zone and ranges up to the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone. *Triticites parvulus* (Schellwien, 1908), confined to this zone, is abundant in fusuline wackestone with vadose-silt (A-97, A-384) and most of them are encrusted by pendant cements (Pl. XXI), as well as other species of *Triticites* such as *T. whitei* Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., 1936 and *T. yayamadakensis.* This wackestone is supposed to have been subsequently influenced by early diageneses under intertidal to supratidal environments. *T. whitei* is also found in skeletal packstone/wackestone of the overlying zone. *T. yayamadakensis* is also contained in packstone/wackestone of the underlying zone. Limestones more or less suffered from vadose dissolution are characteristic in this zone. However, more dominant are fusuline packstone and bioclastic packstone/grainstone containing many fusulines, crinoids, green algae and cyanobacteria in this zone.

5.8. *Carbonoschwagerina morikawai-Jigulites horridus* Zone

This zone is defined in the stratigraphic interval characterized by occurrences of two zonal species. The second zonal species is dominant over the first. Also chararacteristic species, though not confined to this zone, are *Rauserites major* Rozovskaya, 1958, *Jigulites magnus* Rozovskaya, 1950 and *Carbonoschwagerina nakazawai*. This zone ranges in thickness from 16 to 21 m. First appear in this zone are such genera as *Daixina, Darvasoschwagerina* and *Pseudofusulina sensu* Bensh (1972). *Triticites* becomes less abundant and *Jigulites* much more numerous in this zone. *Schubertella* are subordinately contained in most samples.

Thus, the main generic composition between this and underlying zone (zones) is considerably different. Nevertheless, lithological changes are not marked from one zone to another. Predominant limestones in this zone are algal packstone, fusuline packstone, and bioclastic grainstone/packstone. Some of them are interbedded with or graded into packstone/wakestone decreasing their grain size and bioclastic content. Indistinct graded bedding is recognized in the interbedded parts in places. Green algae, crinoid fragments, and fusulines are dominant, and bryozoans, brachiopods, and rugose corals are accessorily contained in them.

5.9. *Jigulites titanicus-Carbonoschwagerina minatoi* Zone

This zone is defined in the stratigraphical interval of *Carbonoschwagerina minatoi* (Kanmera, 1958) and dominant occcurrences of *Jigulites titanicus* n. sp. that ranges up to the lower part of the overlying zone. Thickness of this zone is about 18 m in the C-C' Section. It exceeds more than 20 m, but thickness is exactly uncertain because of its faulted, structural relation with older or younger zone in the B-B' Section.

Jigulites titanicus is the most predominant taxon in this zone. *Daixina sokensis* Rauzer-Chernousova, 1938, though not so common as *Jigulites titanicus*, is confined to this zone. *Carbonoschwagerina minatoi* is important for regional correlation of Gzhelian in East Asia. It is only found from sample A-393 in association with *Darvasoschwagerina shimodakensis* (Kanmera, 1958), *Rugosochusenella paragregaria* (Rauzer-Chernousova, 1940) and *Schwagerina stabilis* (Rauzer-Chernousova, 1937). *Carbonoschwagerina minatoi* is reported from the limestone (locality Wa-11 in T. Ozawa & Kobayashi, 1990) and from several localities of the Wakatakeyama area in Watanabe (1991). *Staffella subsphaerica* n. sp., ranging from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone to this zone, is the most dominant staffellid in this zone. *Pseudofusulina kumasoana* Kanmera, 1958 is characteristic both in this and the underlying zones, and is more common in the underlying zone.

The limestone with *Carbonoschwagerina minatoi* consists of bioclastic fusuline wackestone having more or less abraded fusulines and relatively small bioclasts mostly of crinoids and algae, surrounded by lime-mud and pelloid-bearing lime-mud matrices. On the other hand, *Jigulites titanicus* is densely packed within more coarse-grained skeletal packstone and packstone/grainstone having various kinds of bioclasts represented by algae, crinoids and calcisponges. Additionally, algal crinoidal grainstone/packstone, bioclastic grainstone and wackestone were also found in this zone.

5.10. *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone

This zone is defined in the dominant occurrence of the two zonal species. It conformably overlies the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone. Stratigraphic relation with the upper *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone is not confirmed on account of its uppermost part in fault contact with the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone along the all stratigraphic sections studied (Fig. 4).

In addition to the two zonal species, species characteristic in and confined to this zone are *Sphaeroschwagerina pavlovi, Eoparafusulina ellipsoidalis* (Toriyama, 1958), *Alpinoschwagerina nagatoensis* n. sp., *Occidentoschwagerina* cf. *fusulinoides* (Schellwien, 1898), and others. *Alpinoschwagerina nagatoensis* is confined to the upper part. *Paraschwagerina akiyoshiensis* Toriyama, 1958 first appears in the uppermost part of this zone. Moreover, this zone is marked by common to abundant occurrences of many schwagerinids such as *Daixina fecunda* (Shamov & Shcherbovich, 1958), *Daixina parva* (Belyaev in Belyaev & Rauzer-Chernousova, 1938), *D.* cf. *robusta* Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich, 1958, *Schwagerina densa* (Toriyama, 1958), *Pseudochusenella explicata* (Leven & Shcherbovich, 1978), and *Rugosofusulina serrata* Rauzer-Chernousova, 1937. Most of them are not always confined to this zone except for *Daixina parva* and *Schwagerina densa*. Although generic determination is uneasy, many forms collectively belonged into *Triticites* (*Triticites*? spp.) in this paper (Pl. XXXII, fig. 21-51) are common in this zone. *Biwaella* aff. *omiensis* Morikawa & Isomi, 1960 first appears in this zone. *Schubertella kingi* is contained in almost all samples of this zone along with some indeterminate species of *Nankinella* and *Reitlingerina*.

Lithologically, this zone is marked by algal fusuline packstone, fusuline packstone/wackestone, and bioclastic fusuline packstone/grainstone. Green algae and crinoids are dominant and important constituents of the limestone in this zone along with fusulines, as well as in the underlying two zones.

5.11. *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone

This zone is defined in the stratigraphic interval of *P. miharanoensis* and of the predominant occurrence of *P. akiyoshiensis*. Thickness of this zone attains more than 45 m in the Section C-C’ where this zone in fault contact with underlying zones as well as in the Sections B-B’ and D-D’. *Paraschwagerina* cf. *karachatypica* (Bensh, 1972), *Schwagerina watanabei* n. sp., *Schwagerina wakatakeyamensis* n. sp., and *Pseudofusulina parasolida* Bensh, 1962 are confined to this zone. Other species dominant in this zone are *Schwagerina princeps* (Ehrenberg, 1842), *Pseudofusulina* sp. and *Biwaella* aff. *omiensis. Pseudochusenella explicata* is still common in this zone. Faunal composition of samples B-210 and B-211 is considerably different from those of others in this zone. *Chalaroschwagerina* sp. B is abundantly contained in association with rare *Paraschwagerina* sp. that is somewhat similar to *Paraschwagerina akiyoshiensis.* Other fusulines are not found in B-210.

This zone consists of fusuline crinoidal grainstone, algal crinoidal grainstone, algal fusuline grainstone, fusuline wackestone/packstone, and oolitic bioclastic grainstone. Limestone with sparry calcite cement matrix is more dominant in this zone than in the underlying zones. Oolitic limestone poor in the underlying zones becomes more common. Dominant fossils in this zone consist of green algae, crinoids, and fusulines.

5.12. *Paraleeina magna* Zone

This zone designated to 45 m thick limestone in the northernmost part of Section B-B’ is defined by the entire range of *Paraleeina magna* (Toriyama, 1958). Faunal composition of fusulines in this zone is largely different from those of underlying zones. Consequently, fusulines undoubtedly assigned to the Sakmarian age are lacking in the mapped area. *Praeskinnerella* first appears in this zone. Common schwagerinid genera to those in the underlying zones are confined to *Darvasites* and *Biwaella*. *Staffella*? sp. is restricted in this zone. Dominant species of *Schubertella* changes from *S. kingi* to *S. melonica* Dunbar & Skinner, 1937, and *Nankinella nagatoensis* Toriyama, 1958 becomes dominant in this zone. This zone consists of bioclastic fusuline grainstone, algal crinoidal grainstone, and bioclastic grainstone/packstone.

6. CORRELATION AND AGE

The subdivision of the Pennsylvanian and Cisuralian has been mainly based on the fusuline, ammonoid and conodont biostratigraphy established in the stratotype sections of the Moscow Basin, Donetz Basin and Southern Urals (Aisenverg *et al.*, 1979; Rotai, 1979; Davydov *et al.*, 2012; Henderson *et al.*, 2012). Now, conodont biostratigraphy is thought to be the most reliable for calibration, geochronologic boundary definition and international correlation on account of less faunal provincialism of conodonts. Correlation and geochronologic calibration in the Carboniferous-Permian strata, however, are somewhat different by fusulines and conodonts (Davydov *et al.*, 2012; Henderson *et al.*, 2012). Those of the Akiyoshi Limestone Group are considered based on exclusively fusuline biostratigraphic informations because of no reports of conodonts and ammonoids in the studied stratigraphic interval. The Moscovian to Asselian of the stratotype regions in European Russia is subdivided into 15 fusuline zones (Fig. 9). Similar fusuline zonations are used from Western Europe to Central Asia (Fig. 9a) and from Central Asia to Far East (Fig. 9b). Based on cross-checking the biostratigraphy and correlation of the Upper Carboniferous and Lower Permian inside and outside Japan, correlation and age from the *Fusulinella biconica* Zone to the *Paraleeina magna* Zone are considered.

In the *Akiyoshiella ozawai* Zone, marker of zone is associated with *Profusulinella probiconica*, *Profusulinella hayasakai*, and others (Fig. 7). Association of *A. ozawai*, *P. probiconica*, and *P. hayasakai* is

Stage	Substage	Stratotypes in Russia (Rozovskaya, 1950; Rauser–Chernousova et al.,1979; Davydov et al., 2012)	Cantabrian Mts. (Sánchez de Posada et al., 1993; Ginkel & Villa, 1999; Villa & Ginkel, 2000; Villa et al., 2003)	Carnic Alps Krainer &Davydov, 1998; Forke et al., 2006; Davydov et al., 2013)	Central Taurides (Altiner & Ozgul, 2001: Kobayashi & Altiner, 2008)	Iran (Leven & Gorgij, 2011)	Darvas (Davydov, 1986c; Leven & Davydov, 2001; Leven, 2009)	Fergana & Gissar (Bensh, 1969, 1972; Popov et al., 1989)	Akiyoshi (This papper)
Asselian		Sphaeroschw. sphaerica Schwagerina firma		Sph. sphaerica gigas Sphaero. glomerosa	Dutkevichia complicata	?	Sphaero. sphaerica Schwagerina firma	Sphaeroschwagerina glomerosa	Pss. miharanoensis – Paraschwagerina akiyoshiensis
		Sphaeroschw. moelleri Pseudofusulina fecunda		Pseudoschw. aqualis Occid. fusulinoides	Paraschwagerina sp. Pseudosch. robusta	Pss. robusta Likh. kokectensis	Sphaero. moelleri Pseudof. fecunda	Sphaero. moelleri Pseudof. fecunda	Sphaeroschw. fusiformis – Pss. muongthensis
		Sphaeroschwagerina fusiformis				Sphaeroschwag. fusiformis	Sphaeroschwagerina fusiformis	Sphaeroschwagerina fusiformis	
Gzhelian		Daixina robusta Daixina sokensis		Daix. postgallowayi Daix. postsokensis	Rugosofusulina sp.. A Daixina asiatica	U. bosbytauensis distincta	Daix. bosbytauensis Daixina sokensis	Daixina bosbytauensis	Jigulites titanus – Carbonos. minatoi
		Jigulites jigulensis Jigulites longus		Daixina communis	Jigulites aff. formosus	Jigulites cf. formosus Schwageriniformis acutatus	Shagonella implexa	Daixina asiatica	Carbonos. morikawai – Jigulites horridus
		Rauserites stuckenbergi Pauser. proculomensis	Quasifusulina longissima Jigulites sp.	Shagonella gigantea			Shagonella minor – Shag. proimplexa	Jigulites formosus turanicus	Rauserites stuckenbergi – Triticites simplex
		Rauserites rossicus Rauserites paraarcticus	Rauserites aff. rossicus	Rauserites rossicus Daixina alpina		S. gissaricus T. ex gr. ohioensis	Rauserites rossicus Raus. stuckenbergi	Rauserites rossicus	
Kasimovian		Rauserites irregularis Rauserites acutus	Ferganites ferganensis Tumefactus cf. expressus	Ferganites ferganensis			Rauserites quasiarcticus Rauserites acutus	Ferganites ferganensis	Rauserites arcticus – Carbonoschw. nipponica
		Rauserites arcticus Triticites ohioensis	Montiparus ex gr. umbonoplicatus	Rauserites sp.	Schwageriniformis schwageriniformis			Rauserites arcticus Rauserites acutus	
		Montiparus montiparus	P. pseudomontiparus Quasif. aff. eleganta	Montiparus montiparus	Montiparus umbonoplicatus		Montiparus montiparus	Montiparus montiparus	Mont. matsumotoi Quasifusulinoides ohtanii
		Obsoletes obsoletus Protr. pseudomontiparus		Protriticites pseudomontiparus	Protr. variabilis Q. parafusiformis		Obsoletes obsoletus P. pseudomontiparus	Obsoletes obsoletus P. pseudomontiparus	Protriticites subschwagerinoides
Moscovian	Mya.	Fusulina quasicylindrica Kanmeraia pulchra	Fusulinella ex gr. bocki Fusulina ex gr. kamensis	Protriticites ovatus Q. quasifusulinoides	Fusullinellla bocki Beedeina elegans Kanmeraia eopulchra		Fusulinella kamensis Beedeina consobrina Beedeina timanica Fusulinella bockiformis	Fusulinella bocki, Flla. ex gr. pseudobocki	Fusulinella bocki – Kanmeraia pulchra
	Pod.	Beedeina paradistenta Fusulina kamensis	Fusulina agujasensis Fusulinella ginkeli			Beed. keltmensis Flla. bockiformis			Kanmeraia itoi
	Kash.	Hemif. pseudobocki Eofusulina triangula	Profusul. ex gr. ovata Eofusulina spp.		Neostaff. sphaeroidea Aljutovella aljutovica Eofusulina triangula	Aljutovella iranica Aljutovella goriji	Paraeof. subtilissima Pulchrella eopulchra	Flla. paracolaniae E. triangula gissarica	Fusulinella biconica
	Verei.	Aljutovella aljutovica Profusulinella ovata	Pst. subquardrata Profusulinella sitteri			Aljutovella tumida Neost. rotundata	Prof. timanica Alljutovella znensis	Ps. pseudoquardrata Profusulinella ovata	Akiyoshiella ozawai

Fig. 9: Correlation of the fusuline biozonations, from the Moscovian to Asselian (I).

Stage	Substage	Akiyoshi (This paper)	Primorye (Sosnina & Nikitina, 1976, 1977)	North China	Taizeho (Sheng, 1958a) Shanxi (Rui Lin & Hou, 1987)	Inner Mongolia (Sheng, 1958b: Han, 1975, 1976)	Tien-shan (Chang, 1963a, 1963b; Dzhenchuraeva & Getman, 2007)	South China	Guandong (Lin, 1983) Yunnan (Zhou et al., 1987)	Guizhou (Shi et al., 2012)	Thailand (Pitakpaivan, 1965; Igo, 1972)
Asselian	upper	Pss. miharanoensis – Paraschw. akiyoshiensis	Schwagerina sphaerica gigas	Taiyuan	S. subrotunda – Robust. sp. T. nathorsti – S. nathosti		Paraschw. inflata Pseudof. valida Pss. parasphaerica	Mapingian	Pss. robusta – Zellia cheng., Pss. parabeedei – Sph. sphaerica, P. morsei – Rob.. ixaod.	Sphaeroschwagerina subrotunda	Sphaeroschw. sphaerica
	lower	Sphaeroschw. fusiformis – Pss. muongthensis			Pss. huabeiensis – Pseufosusulina firma						P. muongthensis aff. rossica
Gzhelian	upper	J. titanus – Carb. minatoi	?		?	Pseudoschw.: Pseudoschwa-gerina borealis	D. (B.) bosby.–Pd. kalca. D.(B.) vasil.–Q. kodzha.	Xiaodushanian	Triticites shikhanensis	Triticites panteleevi	?
	middle	C. morikawai – J. horridus				Pseudoschwa-gerina rhodesi	Jigulites corpulentus – Daixina porrecta		Triticites dictyophorus		Triticites ozawai – Paraschwagerina yanagidai
	lower	Rauserites stuckenbergi – Triticites simplex	Triticites (Triticites schwageriniformis, Trit. reticulates)			Triticites laxus	Schwagerinif. arpaensis – Trit. turkestanensis				
Kasimovian	upper	Rauserites arcticus – Carbonoschw. nipponica			Eotriticites paramontiparus – Triticites noinskyi		Trit. komansuensis – Trit. procerulus		Triticites schwageriniformis		
	middle	Montiparus matsumotoi – Quasifusulinoides ohtanii	Obsoletes – Protriticites (Obsoletes, Trit. montiparus)						Triticites montiparus	Triticites hobblensis	
	lower	Protriticites subschwagerinoides			?				Protriticites subschwagerinoides	Protriticites ziyunensis	Protriticites tethydis
Moscovian	Mya.	Fusulinella bocki – Kanmeraia pulchra	Fusulinella pseudobocki – Fusulina quasicylindrica	Penchian	Fusulina cylindrca – F. quasicylindrica	Fusulinella laxa Fusulina pseudokonnoi longa		Huanglungian	Fusulina quasicylindrica	Fusulina – Fusulinella	Fusulina pulchella
	Pod.	Kanmeraia itoi			Fusulina konnoi Fusulina schellwieni				Beedeina pseudonytrica		Beedeina paradisenta
	Kash.	Fusulinella biconica	Profusulinella ovata – Prof. rhomboides (P. parva, P. subovata)		Eostaffella subsolana				Flla. ellipsoidalis		Profusulinella prisca timanica
	Ver.	Akiyoshiella ozawai							Eofusulina – Profusulinella		Profusulinella parva

Fig. 10: Correlation of the fusuline biozonations, from the Moscovian to Asselian (II).

reported from the Omi Limestone (Watanabe, 1974). *A. ozawai* has not been reported from European Russia and west Tethyan regions. Two specimens illustrated as "*Pulchrella hayasakai* (Watanabe, 1974)" from the Kasimovian Krevakinsky Formation in the Yugorskoy Peninsula by Solovieva (1984) are not identical with the types. In my opinion, *Pulchrella* is a junior synonym of *Kanmeraia*. Based on the occurrence of these fusulines, this zone is probably correlated to the lower Moscovian. Further fossil informations are needed for the calibration either Vereian or Kashirian of this zone. In this paper, the *Akiyoshiella ozawai* Zone is provisionally correlated to the lowest Moscovian (Vereian).

6.1. *Fusulinella biconica* Zone

This zone is widely distributed among the Moscovian zones of Akiyoshi and all the previous workers distinguished the *Fusulinella biconica* Zone above the *Akiyoshiella ozawai* Zone (Fig. 3). The zonal species, first described from the Omi Limestone by Hayasaka (1924), has not been known from stratotype regions outside Japan. It is accompanied by *Kanmeraia* aff. *itoi* in the upper part of this zone. One specimen illustrated as *Fusulinella biconica* by Sosnina & Nikitina (1976) from the Upper Moscovian of Primorye (Sosnina & Nikitina, 1977) might be better to be identified with *Fusulinella bocki.* Furthermore, *Parastaffelloides kanmerai* n. sp., reassigned herein for the staffellid named by Kanmera (1954) as *Staffella pseudosphaeroidea* Dutkevich, 1934, is inferred to be surely Moscovian in age, but is uncertain on more detailed calibration. Similarly, correlation is suspicious by other smaller fusulines of *Ozawainella eoangulata*, *Pseudoreichelina* sp. A, and *Reitlingerina* sp. A in this zone. *Eofusulina* and *Hemifusulina* showing the Kashirian, and "*Aljutovella aljutovica* (Rauzer-Chernousova, 1938)" and "*Ovatella ovata* (Rauzer-Chernousova, 1938)" indexing the Vereian have not been reported from Japan. *Beedeina* dominant in the Podolskian and Myachkovian in the Moscow Basin (e.g., Rauzer-Chernousova *et al.*, 1951) and western Tethyan regions (e.g., Leven, 2009) are not found from this zone. Accordingly, the *Fusulinella biconica* Zone is assumed to be the Kashirian in age.

6.2. *Kanmeraia itoi* Zone

Dominant species in this zone are the zonal species and *Parastaffelloides kanmerai*. The former was originally described by Y. Ozawa (1925b) from the limestone pebble of the Middle Permian non-calcareous rock unit distributed in WSW of the mapped area, as mentioned above. The latter is characteristic in the upper Moscovian of the Yayamadake Limestone, Kyushu (Kanmera, 1954). Most of *Fusulinella pseudobocki* described from Japan are possibly of late Moscovian age. *Beedeina akiyoshiensis* occurs only in sample A-133 and A-280, in the middle part of this zone. The *Beedeina akiyoshiensis* Zone by T. Ozawa & Kobayashi (1990) is integrated into this zone.

Subdivision of the upper Moscovian and stratigraphic distribution of characteristic species are considerably different between Ueno (1989) and this paper. For example, *Fusulinella biconica* ranges up to the *Beedeina akiyoshiensis* Zone, and "*Pseudofusulinella* sp. (Ueno, sp. nov.)" or two species of "*Pseudofusulinella* (*Kanmeraia*)", both of which are probably referable to *Kanmeraia pulchra,* occurs in the Kasimovian *Protriticites* sp. Zone according to Ueno (1989, 1991). A part of *Pseudofusulinella hidensis* Zone by Y. Ota & M. Ota (1993) and of *Fusulina* cf. *shikokuensis* Zone by Y. Ota (1997) might be included into this zone. Although close correlation of the *Kanmeraia itoi* Zone is not easy as well as the underlying two zones on account of absence of species useful for faunal correlation, the zone is regarded to be Podolskian in age.

6.3. *Fusulinella bocki-Kanmeraia pulchra* Zone

In addition to two zonal species, *Fusulinella rhomboidalis* is limited to this zone. *Fusulinella pseudobocki* and *Moellerites paracolaniae* range upward to this zone (Table 1, Fig. 6). Characteristic species of the Myachkovian in the Russian Platform and its correlatives in Europe and Central Asia are represented by the occurrence of *Fusulina quasicylindrica* (Lee, 1927)*, Fusulinella bocki, Kanmeraia pulchra* and *Kanmeraia eopulchra* (Rauzer-Chernousova in Rauzer-Chernousova *et al*., 1951) (Fig. 9a; Rauzer-Chernousova *et al*., 1951). Based on *Fusulinella bocki* and *Kanmeraia pulchra* from the level below the first appearance of *Protriticites* in A-A' Section, this zone is certainly Myachkovian. The lower part of *Protriticites* sp. Zone and a part of the *Quasifusulinoides toriyamai* Zone by Ueno (1991) are deduced to be the Myachkovian because of the presence of *Kanmeraia* probably referable to *K. pulchra.*

The top of Huanglungian in South China (Zhou *et al*., 1987) and the top of Penchian in North China (Rui Lin & Hou, 1987) are likely comparable to the Myachkovian (Fig. 9b). Similarly, the *Fusulinella pseudobocki-Fusulina quasicylindrica* Zone of Primorye (Sosnina & Nikitina, 1977) is correlated to the Myachkovian, along with the *Fusulina pulchella* Zone of North Thailand (Igo, 1972).

6.4. *Protriticites subschwagerinoides*, *Montiparus matsumotoi-Quasifusulinoides ohtanii*, and *Rauserites arcticus-Carbonoschwagerina nipponica* zones

Many species of *Protriticites* and *Obsoletes* such as *P. subschwagerinoides* and *O. obsoletes* are reported in the lower Kasimovian of Paleotethyan regions from the Cantabrian Mountains (Sánchez de Posada *et al.*, 1993;Villa & Ginkel, 2000) to South China (e.g., Zhou *et al*., 1987; Shi *et al*., 2012) (Figs 9a, 9b). Many age-diagnostic species of the Kasimovian are also known from Timan (Grozdilova, 1966) and Pechora (Mikhailova, 1974) regions. These three zones in Akiyoshi are calibrated as early, middle, and late Kasimovian ages (Fig. 6, Table 1). The middle Kasimovian *Montiparus matsumotoi* is presumably a species group of *Montiparus montiparus. Triticites fusiformis* Bensh, 1972 from the upper Kasimovian of Southern Fergana, Uzbekistan (Bensh, 1972) is assumed to be a junior synonym of *Triticites yamamadakensis*.

On the other hand, *Obsoletes burkemensis* treated as the zonal species of the uppermost Moscovian by Davydov *et al*. (2012) occurs in association with *Protriticites subschwagerinoides* Rozovskaya, 1950 and other lower Kasimovian species in Akiyoshi. *Quasifusulinoides ohtanii, Q. grandis, Carbonoschwagerina nipponica*, and *C. nakawawai* have not been reported from Europe to Central Asia. *Schwagerina satoi* redefined herein occurs both in the upper Kasimovian and lower Gzhelian (Fig. 6, Table 1). *Schwageriniformis parallelos* described from the upper Kasimovian of the Precaspian Syneclise (Shcherbovich, 1969) ranges from the upper Kasimovian to the lower Gzhelian in Akiyoshi (Table 1). Kasimovian fusuline faunas resemble considerably between Akiyoshi and Primorye and paleobiogeographically important, as well as Moscovian ones.

6.5. *Rauserites stuckenbergi-Triticites simplex* Zone

Rauserites rossicus (Schellwien, 1908), a marker species defining the lowest part of the Gzhelian (e.g., Bensh, 1972) is absent in Japan and possibly also in South East, East and Far East Asia. However, the *Rauserites stuckenbergi-Triticites simplex* Zone of the Akiyoshi is probably correlated to the lower part of the Gzhelian based on the occurrence of *Rauserites stuckenbergi*. This species is shown as the zonal species of the lowest Gzhelian of the international standard (Davydov *et al.*, 2012, fig. 23.5) or the lower part of the Gzhelian of Pan-Euramerica (Schmitz & Davydov, 2012, fig. 5). *Rauserites stuckenbergi* is illustrated from the middle Asselian of Akiyoshi and Atetsu limestones in Watanabe (1991, fig. 4). On the other hand, it is associated with *Schwagerina*? *satoi* and *Daixina sokensis* in the Atetsu Limestone in Watanabe (1991, table 2), resulting the need of reexaminations of his original materials. Almost all limestones with *Triticites simplex* described in Akiyoshi are considered to be assigned to the lower Gzhelian, since the species is commonly associated with *Rauserites stuckenbergi* in the mapped area.

6.6. *Carbonoschwagerina morikawai-Jigulites horridus* and *Jigulites titanicus-Carbonoschwagerina minatoi* zones

Rauserites major and *Jigulites magnus* are commoner in the *Carbonoschwagerina morikawai-Jigulites horridus* Zone than in the *Rauserites stuckenbergi-Triticites simplex* Zone. *Daixina sokensis* is confined to the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone. *Rauserites major* was established by Rozovskaya (1958) from C_3C (lower Gzhelian) and C_3D (middle Gzhelian) of the Samara Bend, and *Jigulites magnus* by Rozovskaya (1950) from $C_3^{1\text{-}d}$ (middle Gzhelian) of the Russian Platform. *Daixina sokensis* is confined to C_3E (*Daixina sokensis-Daixina baituganensis* Zone) of the Samara Bend (Rozovskaya, 1958). It is diagnostic in the uppermost Gzhelian (*Daixina bosbytauensis-D. robusta* Zone) of Pre-Urals, Southern Urals, and Darvas (Davydov, 1986a, b, c). *Daixina licharevi* Davydov, 1986c was described from the upper Gzhelian (*Daixina sokensis* Zone) of Darvas (Davydov, 1986c). Based on these four species associated with the zonal species in Akiyoshi, the *Carbonoschwagerina morikawai-Jigulites horridus* Zone and the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone are considered to be correlated respectively to the middle and upper Gzhelian in the stratotype regions of European Russia and their equivalents in Central Asia.

Four zonal species of the two zones are characteristic in Japan, but not known from Europe and very rare or almost absent in Central Asia. *Jigulites corpulensis* Bensh, 1972 is closely similar to *Jigulites horridus.* This species was originally described by Bensh (1972), as a subspecies of *Jigulites altus* (Rozovskaya, 1952), from the middle Gzhelian of South Fergana (Uzbekistan) and later by Davydov (1986c) from the upper Gzhelian of Darvas (Tajikistan).

In the eastern part of the Tethyan regions, morphologically similar species to *Carbonoschwagerina morikawai* and to *Jigulites horridus*, are *Pseudoschwagerina toriyamai* Igo, 1972 and *Pseudofusulina* (*Daixina*) *petchabunensis* Igo, 1972, both of which were described from North Thailand (Igo, 1972). *Pseudofusulina shetaensis* Han, 1975 from the Upper Carboniferous of Inner Mongolia (Han, 1975) is somewhat similar to *Jigulites titanicus* in its growth pattern of the test and mode of septal foldings. *Pseudoschwagerina paraborealis* Han, 1975 and many other *Pseudoschwagerina* from Inner Mongolia described by Han (1975, 1976) are almost identical with *Carbonoschwagerina minatoi*. *Paraschwagerina indigesta* Igo, 1972 and *P. yanagidai*, Igo 1972 from North Thailand (Igo, 1972) might be reassigned to *Darvasoschwagerina* in the mode of their septal folding and occurrences probably from the Gzhelian limestones. As described later, they are more or less similar to *Darvasoschwagerina shimodakensis* that is characteristic in and restricted to these two zones of Akiyoshi.

The stratigraphic interval in Akiyoshi with *Carbonoschwagerina morikawai* erroneously identified as *Pseudoschwagerina muongthensis* by some workers (e.g., Toriyama, 1958) or as *Alpinoschwagerina*? *fusiformis* by Ueno (1989, pl. 3, fig. 7) should be corrected to the middle Gzhelian not the Lower Permian. That with *Sphaeroschwagerina fusiformis* misidentified as *Pseudoschwagerina morikawai* by Y. Ota & M. Ota (1993) needs no change by chance keeping the lower Asselian. As mentioned in the previous chapters, specimens named as "*Pseudoschwagerina morikawai*" by the end of 1980's in Japan are all middle Gzhelian and not early Asselian in age. Similarly, those done by "*Pseudoschwagerina minatoi*" should be revised to late Gzhelian.

6.7. *Sphaeroschwagerina fusiformis-Pseudoschwagerina moungthensis* Zone

The Carboniferous-Permian boundary is drawn between the *Ultradaixina bosbytauensis-Schwagerina robusta* Zone and the *Sphaeroschwagerina vulgaris aktjubensis-S. fusiformis* Zone in the boundary stratotype of the southern Urals (Davydov *et al*., 1998). Early Asselian age of *Sphaeroschwagerina fusiformis-Pseudoschwagerina moungthensis* Zone is apparent from previous work of the biostratigraphic calibration of the Asselian in Russia and Tethyan regions (Figs 6, 9a; Table 2). *Alpinoschwagerina nagatoensis*, restricted to the upper part of this zone, is comparable to the middle Asselian forms like *Alpinoschwagerina popovi* Bensh, 1972 having smaller test than upper Asselian ones in the *Alpinoschwagerina* lineage in South Fergana (Bensh, 1972). Unidentified species of *Occidentoschwagerina* (Pl. XXXI, figs 14, 16, 19) is comparable to *Schwagerina fusulinoides* proposed by Schellwien (1898) from the Asselian of Carnic Alps. It is also comparable to the specimens described by Lee (1927) from North China and by Chen (1934) from South China.

Pseudoschwagerina muongthensis was formerly thought to occur in the stratigraphic interval upper than the *Sphaeroschwagerina fusiformis* Zone by T. Ozawa & Kobayashi (1990) and Watanabe (1991). However, it occurs from the basal part of this zone in association with *Sphaeroschwagerina fusiformis*. Accordingly, the lower Asselian of Akiyoshi is not separated into two zones. Similarly, the *Alpinoschwagerina* cf. *saigusai* Zone in Watanabe (1991) is also integrated into this zone based on concurrent occurrences of *Alpinoschwagerina* cf. *saigusai* (Nogami, 1961) (=*A. nagatoensis* n. sp.) and *Sphaeroschwagerina fusiformis*.

6.8. *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone

Evolved species of *Sphaeroschwagerina* diagnostic in the middle and upper parts of the Asselian outside Japan such as *S. sphaerica* (Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949), *S. glomerosa* (Schwager, 1883) and *S. subrotunda* (Ciry, 1943) (Figs 9a, 9b) were not found in the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone. Also not found in this zone are large *Paraschwagerina* such as *P. inflata* Chang, 1963b and *P. pseudomira* Miklukho-Maklay, 1949 that might be extended to the Sakmarian in Tian-Shan (Chang, 1963b) and South Fergana (Miklukho-Maklay, 1949; Bensh, 1972).

This zone, however, is thought to be correlated to the upper part of Asselian based on the coexistences of *Paraschwagerina akiyoshiensis* with the following four species reported from Central Asia and European Russia. They are *Paraschwagerina karachatyrica*, originally assigned into *Chusenella*, from the Asselian of South Fergana (Bensh, 1972); *Pseudofusulina parasolida* from the upper Asselian of South Fergana (Bensh, 1972); *Daixina fecunda* diagnostic species of the middle Asselian in Russian Platform, Darvas and Fergana (Fig. 9a); and *Daixina ossinovkensis* Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1958 from the upper part of the *Sphaeroschwagerina sphaerica* Zone in the central part of the Russian Platform (Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1958).

6.9. *Paraleeina magna* Zone

Biostratigraphic data for detailed correlation of this zone to the Lower Permian of Tethyan regions are insufficient in the mapped area. *Pseudofusulina magna,* herein reassigned to *Paraleeina* and treated as an independent species, initially considered as a subspecies of *P. kraffti* by Toriyama (1958), is very common in the upper Lower Permian limestone in the Akiyoshi Terrane (e.g., Toriyama, 1958; Nogami, 1961). Unidentified species of *Praeskinnerella* is comparable to *Pseudofusulina cushmani* Chen, 1934 originally described by Chen (1934) from the Swine Limestone of Jiangsu, South China. The latter is associated with *Darvasites ordinatus* (Chen, 1934), suggesting the limesone correlatable to the Yakhtashian. *Biwaella* aff. *omiensis* occurs both in this zone and the underlying zone. Based on the concurrent ranges of these three species, the *Paraleeina magna* Zone is considered to be correlated to the Yakhtashian (=Artinskian) of the Tethyan standard.

7. FAUNAL ANALYSIS

Correlation and age determination of the Moscovian to Artinskian fusuline zones of Akiyoshi largely depend on the occurrence of age-diagnostic species and the degree of similarities of faunal composition between Akiyoshi and stratotype regions, especially those of European Russia and Central Asia. They are also controlled by the degree of taxonomic diversity in these zones described in the next chapter. In the Akiyoshi Limestone Group, there are many provincial fusulines endemic to Japan, East Asia, and exotic terranes of North America (e.g., Thompson *et al*., 1953; Toriyama, 1958; Han, 1975).

7.1. Provincial fusulines of Akiyoshi

Akiyoshiella is reported from the Cache Creek Terrane of British Columbia, Canada (Thompson *et al.*, 1953; Thompson, 1965) and the *Profusulinella ovata-Profusulinella rhomboidea* Zone of Primorye (Sosnina & Nikitina, 1976) in addition to some limestone blocks contained in the Permian and Jurassic terranes of other localities of Japan. They are *Akiyoshiella toriyamai* Thompson *et al.*, 1953 and *Fusulina*? *occasa* Thompson, 1965 in the former, and, *Akiyoshiella fusulinoides* Sosnina in Sosnina & Nikitina, 1976 and *Akiyoshiella* sp. in the latter. Distribution of *Akiyoshiella* is restricted to these areas. Although *Akiyoshiella* is assigned to Eofusulininae (Rauzer-Chernousova *et al*., 1996), phylogenetic relationships among *Akiyoshiella,* latest Bashikirian *Verella*, and the Kashirian *Eofusulina* cannot be made sure precisely. In Japan, *Verella* is exclusively reported from the Bashkirian Nagaiwa Formation (Kobayashi, 1973) and the Bashkirian cobble from the Maizuru Terrane (Kobayashi, 2003).

Four specimens of *Quasifusulina popensis* described by Thompson (1965, pp. 229-230), not *Schubertella popensis* by Thompson (1965, p. 228), from the Cache Creek Terrane of British Columbia (Thompson, 1965) are probably thought to be conspecific with *Quasifusulinoides ohtanii.* Three new species of *Fusulina* (*Quasifusulinoides*) described by Nikitina (1969) from the *Obsoletes-Protriticites* Zone of Primorye are also allied to *Quasifusulinoides ohtanii*, though having smaller tests. These forms of *Quasifusulinoides* are distinguished from those of western Tethyan regions by having more globose test and more whorls. *Quasifusulinoides grandis* n. sp. with large test and large proloculus is considered to be a specialized form of *Q. ohtanii*.

Gradual morphological changes are recognized in four species of *Carbonoschwagerina, C. nipponica* n. sp., *C. nakazawai, C. morikawai,* and *C. minatoi*, stratigraphically upwards in increasing size, roundness, and number of whorls, and decreasing the length and width of the corresponding whorls at the juvenile stage and development of chomata. *Triticites aculeatus* Sosnina in Sosnina & Nikitina (1976) from Primorye (Sosnina in Sosnina & Nikitina, 1976) is comparable to *C. nipponica. Pseudoschwagerina arta* Thompson, 1965 illustrated from the Cache Creek Terrane of British Columbia (Thompson, 1965) is probably a junior synonym of *C. nakazawai*. *Pseudoschwagerina toriyamai* from North Thailand (Igo, 1972) resembles *C. morikawai*. *Pseudoschwagerina paraborealis* and many other *Pseudoschwagerina* from Inner Mongolia (Han, 1975) are closely allied to and almost identical with *C. minatoi*. They cannot be separated into some species by slight differences of test characters, as mentioned above.

Carbonoschwagerina has not been reported from Europe to Central Asia. It is considered to be phylogenetically unrelated to the genus *Tumefactus*. The latter is characteristic in the middle Kasimovian to the lower Gzhelian of the Cantabrian Mountains, Spain to Fergana and Gissar, Uzbekistan (Leven & Davydov, 2001; Villa *et al*., 2003). *Tumefactus* is absent in Timan-Pechora region, Moscow Basin, Donetz Basin and eastern and southern Asia. It is considered to be a representative provincial genus of inflated schwagerinids in the southern part of western Paleo-Tethys, as well as a coeval schwagerinid species of *Ferganites ferganensis* (Miklukho-Maklay, 1950) restrictedly reported from the southern margin of Eurasia (Villa *et al*., 2002).

In addition to *Akiyoshiella*, *Quasifusulinoides*, and *Carbonoschwagerina*, a lot of species closely resemble or are identical to those of Akiyoshi are described by Thompson (1965) from the Cache Creek Terrane of British Columbia. They are *Fusulina pitrati* Thompson, 1965 closely alike to *Beedeina akiyoshiensis*, *Triticites stuartensis* Thompson, 1965 probably conspecific with *Montiparus matsumotoi*, and *Quasifusulina americana* Thompson, 1965 probably conspecific with *Quasifusulina longissima.*

Schwagerinids as large as *Jigulites titanicus* dominant in the uppermost Gzhelian of Akiyoshi are not reported anywhere from the Upper Carboniferous and Lower Permian. *Pseudoschwagerina miharanoensis* of late Asselian is also endemic to Japan and East Asia. Outside Japan, it is reported from the upper part of the Asselian of China including Tian-Shan (Chang, 1963b), Tarim Basin (Zhao *et al*., 1984), and Inner Mongolia (illustrated as *Pseudoschwagerina aequalis* Kahler & Kahler, 1937 by Han & Guo, 1979). *Nipponitella*, a Sakmarian schwagerinid genus with prominent uncoiled terminal part of the test and known from South Kitakami, Japan, is also reported from Inner Mongolia (Han & Guo, 1979).

Paraschwagerina? sp. (Pl. XXXV, figs 17-18) from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone is supposed to be a significant species that is phylogenetically linked directly to the genus *Acervoschwagerina* very characteristic in the Lower Permian limestone blocks of the Jurassic terranes of Japan. *Acervoschwagerina* is exclusively known from east-central Oregon among the terranes of North America together with many other genera and species having strong Tethyan affinities (Bostwick & Nestell, 1967; Blome & Nestell, 1992; Kobayashi, 2005). *Sphaeroschwagerina*? sp., *Acervoschwagerina endoi*, and *Acervoschwagerina maclayi* Daydov in Davydov *et al*., 1996 are reported from the Koryak Terrane, north of the Kamchaka Peninsula (Davydov *et al*., 1996). *Acervoschwagerina* is also known from Sikhote-Alin (Sosnina, 1965). "*Acervoschwagerina*" *tsharymdarensis* Leven in Leven *et al*., 1992 described from the Sakmarian of the Pamirs (Leven *et al*., 1992) is supposed to be reassigned to "*Likharevites*" *sensu* Leven (2009) from its mode of septal foldings. Although *Robustoschwagerina* is exceptionally reported from Texas by Dunbar (1953), *Sphaeroschwagerina* is completely absent in the cratonic North America. Therefore, such genera are very useful for accurate paleogeographic reconstructions.

7.2. Implications of provincial fusulines of Akiyoshi

Moscovian to Artinskian fusulines of Akiyoshi are more closely related with those of western Tethyan regions during early Kasimovian to early Gzhelian and Asselian than in other ages. The historical change of the degree of faunal similarities should have been strongly influenced by the global sea-level fluctuations due to the advance and retreat of the Gondwana ice sheets (e.g., Crowley & Baum, 1991; Heckel, 1994). Biostratigraphic informations of Akiyoshi are insufficient to closely discuss these problems in relation to major events of the Gondwana glaciation, though considered by Sano *et al.* (2004), Sano (2006), and Nakazawa & Ueno (2009). Sea-level changes shown by these authors in the Akiyoshi Limestone cannot be precisely compared by those in outside Japan (e.g., Eros *et al*., 2012 and Khodjanyazova *et al*., 2014 in the Donets Basin) on account of correlation and calibration of fusuline zones of low-precision and needed to be regionally reconsidered.

On the other hand, the close relation of some faunas between Akiyoshi and some exotic terranes of North America is important viewed from the plate tectonic movements of the Panthalassan-originated seamounts. Davydov *et al.* (1996) inferred that the anomalous occurrences of the Tethyan biota from Koryak and western North America are explained by the ancient plate movements in northern Circum-Pacific regions. Many characteristic fusuline faunas largely different from almost coeval ones of North America are recorded in the Cache Creek and few other terranes (Thompson, 1965; Blome & Nestell, 1992). A part of Early Permian ones were analyzed by Kobayashi (2005) and Middle Permian ones were discussed by Kobayashi (1997) and Kobayashi *et al.* (2010).

As indicated above, fusuline faunas are closely similar between Akiyoshi and some of western Panthalassan and eastern Tethyan regions, especially of Primorye and Inner Mongolia. Moreover, those of the Late Carboniferous reported from the Nadanhada Range, northeast China (Han, 1982) are considerably related to those of Akiyoshi, even if provincial elements are poor in them. An early Middle Permian schwagerinid, *Nagatoella orientis* (Y. Ozawa, 1925b) restricted to the Akiyoshi Terrane is exceptionally reported from the Nadanhada Range (Li *et al*., 1979). Middle Permian neoschwagerinids and verveekinids of the Nadanhada are more closely related with those of Akiyoshi than Late Carboniferous fusulines of Akiyoshi. Nadanhada limestones are exotic as well as Akiyoshi ones and confined within the Mesozoic complexes with ophiolitic rocks (Li *et al*., 1979) and Triassic to Jurassic accretionary complexes (Kojima & Mizutani, 1987). Faunal similarities between Akiyoshi and Nadanhada might be explained by their common origins of Panthalassan seamount.

Faunal similarities between Akiyoshi and peripheral regions of the continental blocks of the Archean North China and the Proterozoic Hanka, such as Inner Mongolia and Primorye, are important for the paleobiogeographic changes and tectonic evolution and amalgamation of East Asia from Late Paleozoic to Middle Mesozoic. During Late Carboniferous, the faunal provinciality with many paleontologic and paleobiogeographic implications is especially noticeable in the *Carbonoschwagerina* fauna characteristic in these regions and the Panthalassan-originated terrane of British Columbia. Four species of *Carbonoschwagerina* keeping a record of one-way trend of evolution are decipherable through their stratigraphic ranges and the morphological analysis of their test characters in the Akiyoshi Limestone Group.

8. TAXONOMIC DIVERSITY

The number of genera and species from the Kashirian *Fusulinella biconica* Zone to the Artinskian *Paraleeina magna* Zone in the Wakatakeyama area is summarized in Table 5. Also shown in this table is the number of samples examined, thin sections, thin section per a sample, and genera and species belonging to the Fusulinidae and Schwagerinidae. The smaller number of thin sections per sample from the Podolskian (*Kanmeraia itoi* Zone) to the middle Kasimovian (*Montiparus matsumotoi*-*Quasifusulinoides ohtanii* Zone) is due to more samples containing few or no fusulines in these zones.

Significant differences of the number of genera and species of fusulines are recognizable from early Kashirian to middle Kasimovian and Artinskian, and from late Kasimovian to late Asselian, though they are not made sure statistically. Richness of genera and species is higher in the latter time interval than in the former ones. It begins to increase gradually from the late Kasimovian, attains to maximum in the early Asselian, and tends to decrease in the late Asselian, though Sakmarian examples are not regionally found. This tendency is more remarkable in the dominance of fusulines belonging to Fusulinidae and Schwagerinidae than the historical change of dominance of smaller fusulines of other families. These larger fusulines are always beyond 50% of the total

Table 5: Historical change of the total number of fusuline genera and species from the *Fusulinella biconica* Zone (Kashirian) to the *Paraleeina magna* Zone (Artinskian) based on 4446 thin sections from 312 limestone samples in the Wakatakeyama area.

Fusuline Zone	Age	sample	thin section	thin section per a sample	genus	species	Fusulinidae & Schwagerinidae	
							genus	species
Fusulinella biconica	Kashirian	6	137	22.8	9	12	2	3
Kanmeraia itoi	Podolskian	34	383	11.3	11	14	4	4
Fusulinella bocki - Kanmeraia pulchra	Myachkovian	39	280	7.2	9	17	3	7
Protriticites subschwagerinoides	Early Kasimovian	39	339	8.7	7	11	2	5
Mont. matsumotoi -Quasifusilinoides. ohtanii	Middle Kasimovian	23	230	10.0	7	12	2	5
Rauserites arcticus - Carbonosch. nipponica	Late Kasimovian	34	522	15.4	12	19	7	10
Rauserites stuckenb.ergi - Triticites simplex	Early Gzhelian	30	436	14.5	14	27	8	17
Carbonosch. morikawai - Jigulites horridus	Middle Gzhelian	25	493	19.7	15	24	10	15
Jigulites titanicus - Carbonosch. minatoi	Late Gzhelian	28	430	15.4	16	28	10	20
Sphaero. fusiformis - Pss. muongthensis	Early Asselian	27	762	28.2	21	37	16	31
Pss. miharanoensis - Likharevites akiyoshiensis	Late Asselian	19	335	17.6	13	29	10	23
Paraleeina magna	Yakhtashian	8	99	12.3	8	11	4	4
	total number	312	4446	14.3	39	119	32	96

number of genera and species of fusulines during the late Kasimovian-late Asselian nearly attaining to 70% to 80% in the Asselian, and are highly contrasting with those in the Kashirian to middle Kasimovian and Artinskian. No marked historical changes are found in small fusulines from the Kashirian to Artinskian.

These historical changes of fusuline diversity revealed in the Wakatakeyama area are similar to those of total foraminifers and fusulines of the coeval periods of North America described by Groves & Wang (2009). They interpreted that: (1) very high diversity in the Moscovian reflects expansion of genus and species number of the family Fusulinidae, (2) declining diversity within the Kasimovian corresponds to the evolutional changeover from fusulinid-dominated to schwagerinid-dominated assemblages, (3) the diversity peak at the Pennsylvanian/Permian boundary represents the main pulse of the schwagerinid radiation, and (4) fusuline diversity then apparently declined throughout the Early Permian. Except for low diversity of the Moscovian in Akiyoshi, mutual relationships between historical changes of the diversity and evolutional pattern of fusulines (Table 5, Fig. 6) are well consistent in North America and Akiyoshi in spite of belonging to the different paleobiogeographic provinces. These general evolutionary trends are also recognizable in China, even if species diversity is much greater than in Akiyoshi. For example, identified in the Asselian *Sphaeroschwagerina subrotundata* Range Zone (Shi *et al*., 2012, pp. 9-12, p. 252) are 140 species of schwagerinids and six species of *Quasifusulina*, including 20 species assigned to *Pseudoschwagerina* and 36 species to *Pseudofusulina*. These values are greater than 31 species of Asselian schwagerinids in the Wakatakeyama area (Table 5). *Robustoschwagerina* was subdivided into six species by Yang & Hao (1991) in the same stratigraphic level of the Mapingian of Guangxi. Taxonomic diversity and its historical change are deduced to be variable by the species concept of author(s) even under the same geological subject studied. Further comments would be restrained herein, leaving as a future problem.

9. DESCRIPTION OF SPECIES

In these 20 years, higher taxonomy of fusulines has been largely renewed and many new genera have been proposed (e.g., Rauzer-Chernousova *et al*., 1996; Leven, 2009); in comparison with e.g., Thompson (1964), Rozovskaya (1975), and Loeblich & Tappan (1988). These renewal and change might be partly resulted from different concepts on the phylogenetic development and supraspecific or suprageneric recognition of Late Paleozoic foraminifers by specialists, in addition to the increase of paleontological informations. Species discriminated in the studied area are described and discussed without their assignment into higher taxon.

Almost all the limestone thin sections used in this paper are stored in the Museum of Natural and Human Activities, Sanda, Hyogo, Japan (Fumio Kobayashi Collection, MNHAH).

Parameters measured that are shown in the appendix table of this paper are the number of whorls, length, width and form ratio of the test, size of proloculus, length, width and number of septa per whorl.

Genus *Ozawainella* Thompson, 1935
Type species: *Fusulinella angulata* Colani, 1924, p. 74.

Remarks: Two different species are represented by the specimens named as *Fusulinella angulata* originally illustrated by Colani (1924). One is the type species of *Ozawainella* (Thompson, 1935, pp. 114-115). The other should be transferred to other genus because of different thickness and composition of the wall, as pointed out by Thompson & Miller (1944, p. 489). Based on these reexaminations, they gave the generic diagnosis of *Ozawainella* and designated the lectotype of *O. angulata*.

***Ozawainella eoangulata* Manukalova, 1950**
Pl. I, figs 44-45

1950. *Ozawainella eoangulata* Manukalova, p. 223, pl. 1, fig. 5.
1969. *Ozawainella eoangulata* Manukalova.– Manukalova in Manukalova *et al*., p. 58, pl. 17, fig. 1.
2011. *Ozawainella eoangulata* Manukalova.– Leven & Gorgij, pl. 4, fig. 20.

Remarks: The Akiyoshi specimens are probably identical with *Ozawainella eoangulata* Manukalova, 1950 described by Manukalova (1950), by Manukalova in Manukalova *et al*. (1969) from the Middle Carboniferous of Dniepr-Donets Basin, and by Leven & Gorgij (2011) illustrated from the Kashirian of Iran, based on degree of sharpness of pointed periphery and relatively weak chomata for the genus. *Ozawainella angulata* has slenderer test with more sharply pointed periphery than this species.
Ozawainella eoangulata differs from the following three species of *Ozawainella* described and/or illustrated from Akiyoshi. *Ozawainella* sp. illustrated from the *Kanmeraia itoi* Zone by T. Ozawa & Kobayashi (1990) has less rapidly expanding test with not so sharply pointed periphery of outer whorls. *Ozawainella japonica* Sada, 1975 from the Bashkirian limestone (Sada, 1975; T. Ozawa & Kobayashi, 1990) has smaller test than this species. Two specimens named *Ozawainella akiyoshiensis* Toriyama, 1958 from the *Neoschwagerina craticulifera* Zone (Toriyama, 1958) are excluded from the genus and reassigned to an other genus because of having weakly recrystallized test with thicker wall.
Occurrence and stratigraphic distribution: Rare in two samples (B-134 and B-135) from the uppermost part of the *Fusulinella biconica* Zone.

Genus *Nankinella* Lee, 1934
Type species: *Staffella discoides* Lee, 1931, p. 286.

***Nankinella nagatoensis* Toriyama, 1958**
Pl. I, figs 51-54

1958. *Nankinella nagatoensis* Toriyama, pp. 65-68, pl. 6, figs 5-13.
2012. *Nankinella nagatoensis* Toriyama.– Kobayashi, figs 6.40-41, 52.

Description: Test medium to small for the genus, thick lenticular and weakly recrystallized. Periphery pointed to bluntly pointed, lateral sides nearly straight and polar regions protruding. Coiling involute throughout growth. Test composed of six to seven whorls, and 0.8 to 1.3 mm in length, 1.5 to 2.1 mm in width, giving a form ratio 0.5 to 0.7. Proloculus minute and spherical, and test expands gradually outwards.
Wall rather thick compared with size of the test and composed of a tectum and inner thicker translucent layer in middle to outer whorls. Septa recrystallized as well as wall and gently curved anteriorly. Chomata inconspicuous, rudimentary and developed at both sides of a low, straight and narrow tunnel.
Remarks: Carboniferous and Permian forms of *Nankinella* having these test characters are not easily distinguished. They are closely similar to *Nankinella nagatoensis* described by Toriyama (1958) from the "Lower Permian" of the Akiyoshi Limestone Group. They are discriminated from *Nankinella*? spp. (Pl. I, figs 47-50) by their larger test with more number of whorls, more pointed periphery and more protruding polar regions without umbilicated depressions, and from three species of *Reitlingerina* in this paper by their larger test, thicker wall and more protruding poles.
Occurrence and stratigraphic distribution: Rare in few samples from the Carboniferous three zones (*Fusulinella biconica, Rauserites articus-Carbonoschwagerina nipponica*, and *Rauserites stuckenbergi-Triticites simplex*), and the Lower Permian two zones in the Wakatakeyama area. This species is also reported from the small limestone block and conglomerate of the Tsunemori Formation (Kobayashi, 2012).

Genus *Reitlingerina* Rauzer-Chernousova, 1985
Type species: *Fusulinella bradyi* von Möller, 1878, p. 111.

***Reitlingerina preobrajenskyi* (Dutkevich, 1934)**
Pl. II, figs 5-7

1934. *Staffella preobrajenskyi* Dutkevich, pp. 73-75, pl. 4, figs 3-8.

Remarks: The genus *Reitlingerina* is distinguished from *Nankinella* by its smaller test and fewer whorls, and from *Pseudoendothra* by its pointed to bluntly pointed periphery. Three forms assignable to *Reitlingerina* are sporadically recognized in the studied area, though well-oriented specimens are few. One of them is similar to and probably identical with *Reitlingerina preobrajenskyi* that was originally assigned to *Staffella* and described by Dutkevich (1934) from the Upper Carboniferous part of a boring core drilled in western slope of the Middle Urals.

More or less differences are recognized in the original specimens such as in form ratio of the test, and shape of periphery and lateral slopes. This species is different from "*Staffella*" *akagoensis* Toriyama, 1958 from the Moscovian of the Akiyoshi Limestone (Toriyama, 1958) in its smaller test and fewer number of whorls.
Occurrence and stratigraphic distribution: Rare in few samples from the *Rauserites stuckenbergi-Triticites simplex* Zone.

***Reitlingerina* sp. A**
Pl. I, figs 33-36; Pl. II, figs 1-2

Remarks: This unnamed species of *Reitlingerina* is different from *R. preobrajenskyi* in its pointed periphery and dissimilar to *Reitlingerina* sp. B (Pl. II, figs 3-4) in having slenderer test with more pointed periphery and more whorls. It is similar to "*Ozawainella*" *akiyoshiensis* that would be transferred to *Reitlingerina*. However, its specific identification to *akiyoshiensis* is postponed because forms referable to *Reitlingerina* sp. A are restricted to the Carboniferous and not extended to the Permian in the Wakatakeyama area.
Occurrence and stratigraphic distribution: Rare in some samples from the *Fusulinella biconica* Zone to *Rauserites stuckenbergi-Triticites simplex* Zone.

Genus *Pseudoreichelina* Leven, 1970
Type species: *Pseudoreichelina darvasica* Leven, 1970, p. 19.

***Pseudoreichelina darvasica* Leven, 1970**
Pl. I, figs 39-40, 42-43

1970. *Pseudoreichelina darvasica* Leven, pp. 19-20, pl. 1, figs 6-13.
1992. *Pseudoreichelina darvasica* Leven.– Ueno, pp. 8, 10, figs 5.1-5.16.

Remarks: The present specimens are assigned to *Pseudoreichelina* from the test construction of early coiled part and later rectilinear part. The number of early coiled whorls is intraspecifically variable as well as some samples from the *Paraleeina magna* Zone. They are similar to the types by Leven (1970) from the Artinskian of southwest Darvas and 16 specimens illustrated and described by Ueno (1992) from the Artinskian of the Akiyoshi Limestone Group in the size and construction of the test. This species is somewhat different from *Pseudoreichelina slovenica* (Kochansky-Devidé, 1966) from the Artinskian of Slovenia (Kochansky-Devidé, 1966) and the Roadian of the Akasaka Limestone (Kobayashi, 2011) in having thicker lenticular inner whorls. One specimen of *Pseudoreichelina* sp. B (Pl. I, fig. 46) from Loc. B-192 (*Paraleeina magna* Zone) is different from *P. darvasica* by its larger test.
Occurrence and stratigraphic distribution: Rare in some samples from the *Paraleeina magna* Zone.

***Pseudoreichelina* sp. A**
Pl. I, figs 37-38

Remarks: *Pseudoreichelina* sp. A is discriminated from *P. darvasica* and *P.* sp. B in having more well-developed rectilinear uncoiled part of the test. Its coiling pattern of the test is similar to that of *Pseudoreichelina endothyroidea* Ueno, 1992 from the Artinskian to Kungurian of the Akiyoshi Limestone Group (Ueno, 1992). This unnamed species, however, has thinner wall and more number of inner coiled part of the test than *P. endothyroidea*.
Occurrence and stratigraphic distribution: Rare in one sample (A-132) from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina moungthensis* Zone.

Genus *Parastaffelloides* Reitlinger, 1963
Type species: *Staffella pseudosphaeroidea* Dutkevich, 1934, p. 17.

***Parastaffelloides kanmerai* n. sp.**
Pl. II, figs 15-28, 30-33; Pl. III, figs 1-2, 4, 6

1954. *Staffella pseudosphaeroidea* Dutkevich.– Kanmera, pp. 123-126, pl. 12, figs 1-13.
1989. *Staffella pseudosphaeroidea* Dutkevich.– Ueno, pl. 4, fig. 11.

Etymology: From late Dr. Kametoshi Kanmera for his excellent work of fusulines of Japan and Thailand.
Type specimens: Holotype D2-051484 (axial section, Pl. II, fig. 23). Paratypes: thirteen axial sections (D2-051485, Pl. II, fig. 15; D2-051473, Pl. II, fig. 18; D2-051516, Pl. II, fig. 19; D2-051482, Pl. II, fig. 20; D2-051509, Pl. II, fig. 21; D2-051458, Pl. II, fig. 22; D2-051484, Pl. II, fig. 23; D2-051454, Pl. II, fig. 24; D2-051491, Pl. II, fig. 25; D2-051469, Pl. II, fig. 26; D2-051486, Pl. III, fig. 1; D2-051476, Pl. III, fig. 2; D2-051478, Pl. III, fig. 6), three tangential sections (D2-051489, Pl. II, fig. 16; D2-051481, Pl. II, fig. 17; D2-051504, Pl. II, fig. 33), five sagittal sections (D2-051487, Pl. II, fig. 27; D2-051480, Pl. II, fig. 28; D2-051452, Pl. II, fig. 30; D2-055119, Pl. II, fig. 31; D2-051461, Pl. II, fig. 32), and one oblique section (D2-055057, Pl. III, fig. 4).
Type locality: About 180 m east of the Akiyoshidai Museum of Natural History, Akiyoshi, Mine City, Yamaguchi Prefecture.
Diagnosis: Subspherical to subquadrate *Parastaffelloides* having thick wall and thickly lenticular inner whorls followed by outer ones gradually expanding, increasing flatness of periphery and umbilical depth of polar regions.
Description: Test rather large for the genus, consisting of six to eight whorls, and subspherical to subquadrate. Periphery broadly arched to nearly straight, lateral sides

highly to broadly convex, polar regions with shallow umbilical depressions. Length 1.2 to 1.6 mm, width 1.5 to 2.2 mm, giving an approximate form ratio from 0.7 to 0.9.

Proloculus small, spherical and 0.07 to 0.12 mm in diameter. First two to three whorls thickly lenticular and tightly coiled. Later ones gradually expanding laterally and vertically, increasing degree of flatness of periphery and of umbilical depression of polar regions.

Wall thick for the test size and composed of thin tectum and its underlying translucent, partly transparent thick layer with lower thin layer comparable to lower tectorium in outer whorls. In middle to outer whorls, septa either perpendicular to the wall or gently inclined anteriorly. Septal counts from the first to the eighth whorl of four specimens illustrated are 5 or 6, 9 or 10, 11 to 13, 14 or 15, 15 to 18, 15 to 18, 17 to 19, and more than 16. Tunnel low and narrow in inner lenticular whorls, and tend to broaden in outer whorls. Its path straight to irregular bordered by low and asymmetrical chomata.

Remarks: Kanmera (1954) described relatively large staffellids from the lower part of *Fusulinella* Zone of the Yayamadake Limestone, Kyushu, Japan. They were identified with *Staffella pseudosphaeroidea* proposed from the Upper Carboniferous in western slope of the Central Urals (Dutkevich, 1934). Among nine specimens illustrated by Dutkevich, three mature ones from the Urals are different from the Yayamadake ones as suggested by Kanmera. As the Akiyoshi specimens are closely similar to the Yayamadake ones, they are proposed herein as a new species of staffellids based on especially of their larger and more spherical test with more whorls than those of the original *pseudosphaeroidea* of Dutkevich.

Parastaffelloides pseudosphaeroidea described by Ketat (1982) from the lower Artinskian of the Volgograd district (Russia) is apparently different from the original ones by Dutkevich in its smaller test and smaller length and width of corresponding whorls. It is supposed to be reassigned to *Staffella* rather than to *Parastaffelloides.*

Occurrence and stratigraphic distribution: Common in some samples from the *Kanmeraia itoi* Zone, rare in few samples from the *Fusulinella biconica* Zone, and also rare in two samples (B-107, B-117) from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

***Parastaffelloides* spp.**
Pl. II, figs 8-13

Remarks: Various forms of *Parastaffelloides* were detected from the Moscovian and Gzhelian in the Watakakeyama area. Although some of the Moscovian specimens coexist with *Parastaffelloides kanmerai*, they differ from *P. kanmerai* in their smaller length and width for corresponding whorls, smaller form ratio of the test, and thinner wall. A part of them might be identical with *Parastaffelloides pseudosphaeroidea* (Dutkevich). Gzhelian specimens in general are different from Moscovian ones in their larger test more rapidly expanding outwards. All of these forms are treated as *Parastaffelloides* spp. without any subdivisions on account of few well-oriented specimens.

Occurrence and stratigraphic distribution: Rare in some samples from the *Fusulinella biconica* Zone to the *Fusulinella bocki-Kanmeraia pulchra* Zone, *Carbonoschwagerina morikawai-Jigulites horridus* Zone, and *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Genus *Staffella* Y. Ozawa, 1925a
Type species: *Fusulina sphaerica* Abich, 1859, p. 168.

***Staffella subsphaerica* n. sp.**
Pl. III, figs 3, 5, 7-23

Etymology: From the subspherical test.

Type specimens: Holotype D2-052760 (axial section, Pl. III, fig. 18). Paratypes: ten axial sections (D2-049974, Pl. III, fig. 3; D2-041507b, Pl. III, fig. 7; D2-041529, Pl. III, fig. 8; D2-052650, Pl. III, fig. 13; D2-052647, Pl. III, fig. 16; D2-052759, Pl. III, fig. 17; D2-052750, Pl. III, fig. 19; D2-052754, Pl. III, fig. 20; D2-052725, Pl. III, fig. 22; D2-052727, Pl. III, fig. 23), two tangential sections (D2-052723a, Pl. III, fig. 11; D2-052723b, Pl. III, fig. 12), one sagittal section (D2-052642, Pl. III, fig. 15), two parallel sections (D2-049974, Pl. III, fig. 5; D2-052634, Pl. III, fig. 21), and three oblique sections (D2-049981, Pl. III, fig. 9; D2-052635, Pl. III, fig. 10; D2-052735, Pl. III, fig. 14).

Type locality: About 240 m south of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture.

Diagnosis: Subspherical to short oval *Staffella* with seven to 10 whorls whose form ratio from 0.8 to 0.9. Inner three to four whorls rhomboidal to thickly lenticular, tightly coiled, and with bluntly pointed to pointed periphery. Later five to six whorls gradually increasing length and width, and roundness of periphery and poles.

Description: Test relatively large for the genus, consisting of seven to 10 whorls, subspherical to short oval, and weakly to moderately recrystallized. Periphery broadly arched, lateral sides convex to nearly straight, polar regions gently protruding sometimes with slight umbilical cavities. Length about 1.5 to 2.6 mm, width about 1.6 to 3.0 mm, giving an approximate form ratio of 0.8 to 0.9.

Proloculus small, spherical and 0.04 to 0.13 mm in diameter. First three to four, rarely five, whorls rhomboidal to thickly lenticular and tightly coiled. Later five to six whorls more strongly recrystallized than inner ones, gradually expanding increasing length and width, and roundness of periphery and poles.

Wall thick for the test size. Its thickness appears to be variable from place to place due to additional secondary deposits and/or mineralization. It is composed of thin tectum and its underlying thicker, translucent or transparent thick layer comparable to diaphanotheca of Fusulinidae, sometimes with discontinuous lower thin layer comparable to lower tectorium in less crystallized part of middle to later whorls. Wall differentiation inconspicuous in inner lenticular whorls.

Septa covered by secondary deposits, more or less recrystallized, and gently inclined anteriorly. Septal counts from the first to the seventh whorl of the specimen illustrated in Pl. III, fig. 15 are 6, 10, 14, 14, 16, 18, and 19?, and uncertain in eighth and ninth whorls due to more remarkable recrystallization. Tunnel low, narrow, and its path straight bordered by low and asymmetrical chomata.

Remarks: *Nankinella hupehensis* Lin, 1977 from the Chihsian (=Artinskian to Kungurian) of Hubei, South China (Lin, 1977) is somewhat similar to this new species in its large test with inner rhomboidal to thickly lenticular whorls and outer thickly lenticular whorls with rounded periphery and poles. However, this new species has larger test, more number of both total whorls and inner whorls. *Staffella haymanaensis* Ciry, 1939 from the Middle Permian in south of Ankara, Turkey (Ciry, 1939) differs from this new species in its smaller test, and more rounded periphery both in inner and outer whorls.

Occurrence and stratigraphic distribution: Rare to common in some samples from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone and *Jigulites titanicus-Carbonoschwagerina minatoi* Zone. Forms probably referable to this new species also occur from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone to the *Carbonoschwagerina morikawai-Jigulites horridus* Zone.

***Staffella* sp. A**

Pl. II, figs 14, 29

Remarks: Subspherical and rather large *Staffella* recognized in the Gzhelian limestones is similar to *Staffella subsphaerica*. It is assumed to be a different species from *S. subsphaerica*, but detailed comparison is difficult on account of its strong recrystallization.

Occurrence and stratigraphic distribution: Rare in few samples from the *Rauserites stuckenbergi-Triticites simplex* Zone. Similar forms occur in the *Carbonoschwagerina morikawaii-Jigulites horridus* Zone.

***Staffella*? sp.**

Pl. III, figs 24-31

Remarks: This unnamed species is similar to *Staffella moelleri* Y. Ozawa, 1925b from the "Moscovian" of the Akiyoshi Limestone Group described by Y. Ozawa (1925b, p. 19) and subsequent ones from the Lower Permian of the group by Toriyama (1958) in many respects. They are common in their thick wall, large proloculus, and few whorls in comparison with test size. But, the present specimens have subspherical to oval tests and thicker walls than *S. moelleri.* These forms including *moelleri* are not recognized in the Carboniferous of the Wakatakeyama and other areas in the Akiyoshi Limestone. *Staffella*? sp. is distinguished from *Parastaffelloides kanmerai* and *Staffella subsphaerica* in its smaller test with fewer whorls and thicker wall. Degree of recrystallization of the test is lower in the former than in the latter two.

Staffella moelleri was designated by Liêm (1966) as the type species of *Palaeostaffella* that was treated as a junior synonym of *Staffella* by Loeblich & Tappan (1988). Despite of that, it was assigned to the Pseudoendothyridae of the Staffellida as a valid genus by Rauzer-Chernousova *et al*. (1996). This unnamed species is provisionally assigned to *Staffella* with question in this paper, since the taxonomic independency of *Palaeostaffella* is supposed to be doubtful. Even if the identification of "*Parastaffelloides pseudosphaeroidea*" by Ketat (1982) is incorrect as indicated above, Ketat's (1982) "*pseudosphaeroidea*" closely resembles *Staffella*? sp.

Occurrence and stratigraphic distribution: Rare to common in some samples from the *Paraleeina magna* Zone.

Genus *Eoschubertella* Thompson, 1937

Type species: *Schubertella obscura* Lee & Chen in Lee *et al*., 1930, p. 112.

Remarks: *Eoschubertella*, proposed as a subgenus of *Schubertella* by Thompson (1937), has long been treated as a junior synonym of *Schubertella* by most of Russian workers (e.g., Rauzer-Chernousova in Rauzer-Chernousova *et al.*, 1951; Rozovskaya, 1975). Its generic independence was confirmed by Rauzer-Chernousova in Rauzer-Chernousova *et al.* (1996). *Eoschubertella* is distinguished from *Schubertella* by its smaller oval test, relatively large proloculus for the test size, and smaller number of whorls.

Schubertina Marshall, 1969 is considered to be a junior synonym of *Eoschubertella*, since *Schubertina circuli* Marshall, 1969, designated by the type species of the genus, is considered to be a junior synonym of *Eoschubertella bluensis* Ross & Sabins, 1965, as done by Groves (1991) and Davydov (2011). *Grovesella* Davydov & Arefifard, 2007 was discriminated from *Eoschubertella* by its short discoidal test with broadly rounded periphery and assumed to be the ancestral taxon to all schubertellids (Davydov, 2011). Although a possibility that *Grovesella* might be an incomplete form lacking the suboval, outer and/or outermost whorl of *Eoschubertella* is remained uncertain, *Grovesella* is treated herein as an independent schubertellid.

Eoschubertella obscura (Lee & Chen in Lee *et al.*, 1930)
Pl. I, figs 6-10

1930. *Schubertella obscura* Lee & Chen in Lee *et al*. 1930, pp. 112-113, pl. 6, figs 12-22.
1958. *Eoschubertella obscura* (Lee & Chen).– Toriyama, pp. 25-27, pl. 1, figs 10-14.
1958. *Eoschubertella* sp. A. Toriyama, pp. 27-28, pl. 1, figs 15-16.
1989. *Eoschubertella obscura* (Lee & Chen).– Ueno, pl. 4, fig. 8.

Remarks: *Schubertella obscura*, originally described from the Moscovian Huanglung Limestone of Southeast China (Lee *et al*., 1930) was designated as the type species of *Eoschubertella* by Thompson (1937).
Five specimens selectively choosen from many specimens show considerably variable characters in size and shape of the test and coiling pattern. These variabilities are also recognized in 11 specimens of *Eoschubertella obscura* illustrated in Lee *et al*. (1930), and thought to represent the intraspecific variation of a single species. This species is distinguished from *Eoschubertella lata* (Lee & Chen in Lee *et al*., 1930) by its fusiform to subspherical test instead of subellipsoidal test of *E. lata*.
Toriyama (1958) pointed out more or less similarities between *Eoschubertella* sp. A and *Eoschubertella texana* Thompson, 1947 from the pre-Desmoinesian of Marble Fall Limestone of Texas (Thompson, 1947). However, it seems to be better that Toriyama's *Eoschubertella* sp. A is transferred to *Eoschubertella obscura* based on wide morphologic variations of *E. obscura*. Generic assignment of *Eoschubertella* sp. B of Toriyama (1958) is questionable. It should be reassigned to either *Profusulinella* or *Schubertella*. Its reassignment to *Profusulinella* is perhaps more possible because of its occurrence from Cmα (Bashkirian *Profusulinella beppensis* Zone) according to Toriyama (1958).
Occurrence and stratigraphic distribution: Rare in some samples from the *Kanmeraia itoi* Zone to the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone.

Genus *Schubertella* Staff & Wedekind, 1910
Type species: *Schubertella transitoria* Staff & Wedekind, 1910, p. 112.

Schubertella donetzica Putrya, 1940
Pl. I, figs 1-5, 11-12, 16-18

1940. *Schubertella donetzica* Putrya, pp. 38-40, pl. 1, figs 7-8.
2008. *Schubertella donetzica* Putrya.– Kobayashi & Altiner, p. 197, pl. 2, figs 27-31.

Remarks: Forms referable to *Schubertella* first appear in the upper part of the Moscovian and extend to the Kubergandian in the Akiyoshi Limestone Group. In general, the earliest forms have more tightly coiled inner endothyroid whorls than later ones as represented by 10 specimens illustrated and identified with *Schubertella donetzica*. These specimens closely resemble illustrated five specimens of *S. donetzica* from the Kasimovian of central Taurides, Turkey by Kobayashi & Altiner (2008). Two specimens illustrated originally by Putrya (1940) from the upper part of Moscovian of the Donetz Basin are characteristic in inner three endothyroid whorls followed by two or three fusiform whorls with distinct chomata, though morphologic variations of the original material are uncertain.
Occurrence and stratigraphic distribution: Rare in some samples from the *Fusulinella bocki-Kanmeraia pulchra* Zone to the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Schubertella kingi Dunbar & Skinner, 1937
Pl. I, figs 22-23, 26-30

1937. *Schubertella kingi* Dunbar & Skinner, pp. 610-611, pl. 45, figs 10-15.
1958. *Schubertella kingi* Dunbar & Skinner.– Toriyama, pp. 73-75, pl. 7, figs 1-8.
1989. *Schubertella kingi* Dunbar & Skinner.– Ueno, pl. 4, fig. 10.

Remarks: Most specimens of elongate forms of *Schubertella* are closely similar to and identified with *Schubertella kingi*. They are different from *Schubertella donetzica* in their more elongate fusiform test with more elongate outer whorls and fewer number of inner endothyroid whorls. By these test characters, this species is distinguished from other two species of *Schubertella* in the Wakatakeyama area.
Occurrence and stratigraphic distribution: Rare to common in some samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone to the *Paraleeina magna* Zone.

Schubertella magna Lee & Chen in Lee *et al.*, 1930
Pl. I, figs 13-15, 19-21

1930. *Schubertella magna* Lee & Chen in Lee *et al*., p. 113, pl. 6, figs 24-25.

Remarks: Some specimens of *Schubertella* rarely found from the Kasimovian to the lower part of Gzhelian are characteristic in their inflated fusiform, rather large test with arched to broadly arched periphery and broadly rounded polar regions. Although morphologic variation is unknown from the original description of this species, they are probably identical with the types of *Schubertella magna* from these features of the external shape of somewhat large test for the Carboniferous *Schubertella*.
Occurrence and stratigraphic distribution: Rare in some samples from the *Montiparus matsumotoi-*

Quasifusulinoides ohtanii Zone to the *Rauserites stuckenbergi-Triticites simplex* Zone.

***Schubertella melonica* Dunbar & Skinner, 1937**
Pl. I, figs 24-25, 31-32, 41

1937. *Schubertella melonica* Dunbar & Skinner, pp. 611-613, pl. 57, figs 10-14.
pars 2012. *Schubertella melonica* Dunbar & Skinner.– Kobayashi, figs 7.7, 7.9-7.11, 7.13-7.15. (non fig. 7.12 = *Schubertella* cf. *magna*)

Description: Test inflated fusiform with broadly arched periphery, nearly straight lateral sides, rounded to bluntly pointed poles, and nearly straight axis of coiling, and composed of four and a half to five and a half whorls. Length 0.6 to 1.1 mm, width 0.6 to 1.0 mm, and a form ratio 1.3 to 2.1. Proloculus is spherical, less than 0.045 mm in diameter. Inner one or two whorls endothyroid and tightly coiled and followed by the succeeding inflated fusiform whorls with a sharp change of axis of coiling.
Wall thin and as thick as 0.02 to 0.035 mm in the last two whorls. Wall is structureless in juvenile whorls, consists of a tectum and underlying thicker translucent layer in later ones. Septa almost plane, but very weakly and irregularly folded in polar regions of the last whorl. Tunnel narrow and its path roughly straight bordered by distinct chomata.
Remarks: This species originally described from the Leonardian of Texas (Dunbar & Skinner, 1937) was distinguished from *Schubertella kingi* by much smaller form ratio of the test, about 1.5 in *melonica* vs. 2.7 to 3.0 in *kingi*. The Wakatakeyama specimens have inflated fusiform test alike the Texas ones, but show more variable shape and size of the test and weaker chomata. Seven specimens illustrated as *Schubertella melonica* by Kobayashi (2012) from the conglomerate of the Tsunemori Formation seem to be related to slenderer fusiform forms of this species.
Occurrence and stratigraphic distribution: Rare to common in some samples from the *Paraleeina magna* Zone.

Genus *Fusulinella* von Möller, 1877
Type species: *Fusulinella bocki* von Möller, 1878, p. 104.

***Fusulinella biconica* (Hayasaka, 1924)**
Pl. IV, figs 1-20

1924. *Neofusulinella biconica* Hayasaka, pp. 13-14, pl. 2, figs 4-7.
1925b. *Fusulinella biconica* (Hayasaka).– Y. Ozawa, pp. 18-19, pl. 3, figs 2-4. [fig. 3 = pl. 1, fig. 6 in Y. Ozawa (1925a)]
1958. *Fusulinella biconica* (Hayasaka).– Toriyama, pp. 45-46, pl. 3, figs 5-10; pl. 4, figs 1-2.
1958. *Fusulinella subspherica* Toriyama, pp. 52-54, pl. 4, figs 7-11.
1977. *Fusulinella biconica* (Hayasaka).– M. Ota, pl. 3, figs 3-4.
1989. *Fusulinella biconica* (Hayasaka).– Ueno, pl. 2, fig. 1.
1990. *Fusulinella biconica* (Hayasaka).– T. Ozawa & Kobayashi, pl. 3, figs 1-2.
1998. *Fusulinella biconica* (Hayasaka).– Y. Ota, pp. 2-4, pl. 1, figs 1-2.

Description: Test inflated to highly inflated fusiform with broadly arched periphery, straight to slightly convex lateral sides and more or less protruding rounded poles, and composed of seven to nine whorls. Axis of coiling straight in most specimens. Length 2.5 to 3.9 mm and width 1.6 to 2.7 mm, giving an approximate form ratio of 1.2 to 1.8.
Proloculus spherical, small, 0.07 to 0.19 mm in diameter. Inner one or two whorls are oval to thick lenticular. They are partly coiled endothyroidly. Subsequent whorls gradually increase their length and width.
Wall thin in inner one or two whorls and undifferentiated. Beyond the third whorl, wall differentiation becomes evident, and consists of tectum, diaphanotheca, and thin discontinuous upper and lower tectoria in middle and outer whorls. Thickness of wall in the median part of the test less than 0.02 mm in inner three to four whorls, and about 0.02 to 0.04 mm in the succeeding whorls, though variable considerably by specimens.
Septa almost plane, but weakly folded only in polar regions of outer whorls, perpendicular to the wall or gently inclined anteriorly, and closely spaced. Septal counts from the first to ninth whorl 7 or 8, 12 or 13, 14 to 17, 16 to 20, 18 to 24, 22 to 25, 24 to 30, 29 to 32, and more than 22, respectively.
Tunnel half to one-third as high as chambers, narrow in inner three to four whorls, gradually widens outward. Its path is not straight in outer whorls. Chomata well developed in middle and outer whorls, obliquely inclined toward tunnel regions, gently sloping down and extending to near poles. Axial fillings not present.
Remarks: Diagnostic characters of this species were clarified by Toriyama (1958). This species is easily distinguishable even in the field on account of its larger and more inflated fusiform test than other most species of *Fusulinella* and its common occurrences in the *Fusulinella biconica* Zone of the Akiyoshi Limestone Group. *Fusulinella "subspherica"* (sic for *F. subsphaerica*) was proposed by Toriyama (1958) for more inflated forms than *F. biconica*. The former is supposed to be synonymous with and to represent the subspherical forms of the latter.
Fusulinella biconica illustrated in Sosnina & Nikitina (1976) from Primorye is not identified with the species. It seems to be rather assignable to *Fusulinella bocki* because of much smaller test with fewer whorls. Moreover, chomata of Primorye specimens are strong but do not extend to near poles as in *F. biconica*.
Occurrence and stratigraphic distribution: Abundant to common in many samples exclusively from the

Fusulinella biconica Zone. This species is very abundant in two samples (A-52 and B-189).

Fusulinella bocki von Möller, 1878
Pl. IV, figs 21-29

1878. *Fusulinella bocki* von Möller, pp. 104-107, pl. 5, figs 3a-g; pl. 14, figs 1-4.
? 1925b. *Fusulinella bocki* Möller.– Y. Ozawa, pp. 17-18, pl. 3, figs 7, 9-10.
1958. *Fusulinella* cf. *bocki* Möller.– Toriyama, pp. 39-43, pl. 2, figs 20-22.
1990. *Fusulinella bocki* Möller.– T. Ozawa & Kobayashi, pl. 3, fig. 6.

Remarks: Lectotype of *Fusulinella bocki* was designated by Thompson (1948) for the tangential section illustrated in pl. 14, fig. 1 by von Möller (1878). Inflated fusiform test with massive high chomata is conspicuous in the lectotype. *F. bocki* and its allies occur in the upper Podolskian and Myachkovian according to Rauzer-Chernousova in Rauzer-Chernousova *et al.* (1951).
In the Akiyoshi Limestone Group, there are three taxa identified or compared to *F. bocki* (Y. Ozawa, 1925b; Toriyama, 1958; T. Ozawa & Kobayashi, 1990). Among the three, Y. Ozawa's identification is questionable because of not inflated fusiform test and not so massive chomata. Differences among *F.* cf. *bocki, Fusulinella simplicata* Toriyama, 1958, and some unnamed species of *Fusulinella* are disputable in the illustrations of Toriyama (1958).
Many thin sections containing *Fusulinella* having inflated fusiform tests with massive chomata were prepared during this study. Although most of them are incomplete and not well oriented, they are presumed to be identical with *Fusulinella bocki* based on their differences from other species of *Fusulinella* from the Wakatakeyama area, in shape and size of the test and development pattern of chomata, as mentioned later.
Occurrence and stratigraphic distribution: Common to rare in some samples from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

Fusulinella pseudobocki (Lee & Chen in Lee *et al.*, 1930)
Pl. V, figs 1-7

1930. *Fusulinella* (*Neofusulinella*) *pseudobocki* Lee & Chen in Lee *et al.*, pp. 122-1123, pl. 9, figs 10-14, pl. 10, figs 1-7.
1990. *Fusulinella pseudobocki* (Lee & Chen).– T. Ozawa & Kobayashi, pl. 3, figs 11-12.

Remarks: This species is distinguished from *Fusulinella bocki* in its larger size and larger form ratio of the test, and more intensely folded septa in polar regions. The present Wakatakeyama specimens are identical with *Fusulinella pseudobocki*, along with those illustrated by T. Ozawa & Kobayashi (1990). Two specimens compared with this species by Toriyama (1958, pp. 43-45, pl. 3, figs 3-4) are reassigned to *Kanmeraia itoi* from their subrhomboidal to fusiform test with straight to slightly concave lateral sides.
Occurrence and stratigraphic distribution: Common to rare in some samples from the middle part of the *Kanmeraia itoi* Zone to the *Fusulinella bocki-Kanmeraia pulchra* Zone.

Fusulinella rhomboidalis Niikawa, 1978
Pl. V, figs 17-23

1978. *Fusulinella rhomboidalis* Niikawa, pp. 549-550, pl. 8, figs 1-9.

Description: Test inflated fusiform with arched to broadly arched periphery, straight to slightly convex lateral sides, and bluntly pointed poles, and composed of seven to eight whorls. Length about 3.5 to 4.4 mm and width about 1.9 to 2.7 mm, giving an approximate form ratio from 1.6? to 1.9?.
Proloculus small, spherical and 0.07 to 0.13 mm in diameter. Inner one and a half to two whorls are ovoid, and subsequent two to three whorls gradually increasing and a few later ones more rapidly increasing their length and width.
Wall thin and not differentiated in inner one or two whorls, thickened gradually outward, and composed of tectum, diaphanotheca, lower tectorium and obscure upper tectorium. In specimens, thickness of wall is variable depending on degree of development of secondary calcareous deposits.
Septa gently inclined anteriorly, and almost plane except for weakly folded in polar regions of outer whorls. Septal counts from the first to the seventh whorl 7?, 12?, 16?, 17, 24, 24, and more than 4, respectively in the specimen shown in Pl. V, fig. 23. Narrow and gradually widening tunnel is bordered by massive, well-developed chomata. Degree of strength of chomata and regularity of tunnel path are variable by development of secondary deposits.
Remarks: Although well-preserved axial sections without abrasion of the test were not obtained, they closely resemble those of specimens proposed by Niikawa (1978) as *Fusulinella rhomboidalis* from the Myachkovian of the Ichinotani Formation in Fukuji, central Japan. The holotype of the species is reprinted herein in Fig. 7.1. Other specimens from the Myachkovian of Omi Limestone are illustrated in Fig. 7.2-7.6.
Niikawa pointed out that this species resembles *F. bocki* and its allies. This species is rather easily distinguishable from *bocki* by its larger, more whorls, and more strongly folded septa in polar regions. It is more silimilar to and might be a junior synonym of *Fusulinella soligalichi* Dalmatskaya, 1961 and its subspecies (*F. slogalichi polasnensis* Rauzer-Chernousova, 1961; *F. soligalichi firma* Reitlinger, 1961) or *Fusulinella valida* Reitlinger, 1961, proposed from the upper Middle Carboniferous of the Volga regions.

Occurrence and stratigraphic distribution: Common in few samples from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

***Fusulinella* sp. A**
Pl. V, figs 8-10

Remarks: This unidentified species is somewhat similar to *Fusulinella pseudobocki*. It is, however, distinguished from this species by its lower tunnel and not so massive chomata.
Occurrence and stratigraphic distribution: Common in only one sample (A-296) from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

***Fusulinella* sp. B**
Pl. V, figs 12-16

Remarks: Five specimens illustrated are somewhat similar to *Fusulinella schwagerinoides* (Deprat, 1913) originally assigned to the subgenus of *Neofusulinella* by Deprat (1913). Both are common in tightly coiled inner few whorls, but the former is different from the latter in thinner wall and shorter fusiform test. *Fusulinella* sp. B named for the former appears to be alike to incomplete specimens of *Fusulinella bocki* lacking outer one or two whorls illustrated in this paper. But, the latter has more massive chomata. *Fusulinella* sp. B co-exists rarely with *F. rhomboidalis* but is not presumed to be incomplete specimens of *F. rhomboidalis* on account of its less massive chomata and smaller chamber height in the corresponding outer whorls.
Occurrence and stratigraphic distribution: Rare in few samples from the *Kanmeraia itoi* Zone and common in few samples from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

Genus *Moellerites* Solovieva, 1986
Type specis: *Moellerites lopasniensis* Solovieva, 1986, p. 15.

***Moellerites paracolaniae* (Safonova in Rauzer-Chernousova *et al.*, 1951)**
Pl. V, figs 11, 24-34

1951. *Fusulinella paracolaniae* Safonova in Rauzer-Chernousova *et al.*, p. 219, pl. 30, figs 7-9.
1989. *Fusulinella paracolaniae* Safonova.– Ueno, pl. 2, fig. 5.
1990. *Fusulinella paracolaniae* Safonova.– T. Ozawa & Kobayashi, pl. 3, figs 9-10.

Description: Test fusiform to elongate fusiform with broadly arched periphery, nearly straight to slightly concex lateral sides, and bluntly pointed poles, and composed of five to six and a half whorls. Axis of coiling straight in most specimens. Length 2.4 to 3.9 mm and width 1.0 to 1.4 mm, giving a form ratio of about 2.0 to 3.2.
Proloculus spherical, small, 0.04 to 0.07 mm in diameter. Inner one and a half to two whorls lenticular to oval and tightly coiled endothyroidly. Subsequent whorls gradually increase their length and width and form ratio, and loosely coiled in the last whorl. Wall thin throughout the test, undifferentiated in inner two to three, partly four whorls and consists of very thin tectum, thin translucent to transparent layer comparable to a diaphanotheca, and a discontinuous inner tectorium. Upper tectorium is obscure. Thickness of wall about 0.02 to 0.05 mm in outer whorls.
Septa almost plane, and only weakly folded in polar regions of outer whorls. Septal counts from the first to seventh whorl 6, 10, 11, 13, 16, 18, and more than 4, respectively in the specimen shown in Pl. V, fig. 31. Tunnel low and its path almost straight or irregular, bordered by massive chomata sloping down toward poles in middle and outer whorls. Axial fillings not present.
Remarks: This species was originally described by Safonova in Rauzer-Chernousova *et al*. (1951) from the uppermost part of Kashirian to the Podolskian in the Samara Bend, Volga region. This species is characterized by relatively smaller test, smaller length and width of corresponding whorls, and thinner wall with transparent layer comparable to diaphanotheca than most species of *Fusulinella*. By these test characters, this species is assumed to be reassigned to the genus *Moellerites* proposed by Solovieva (1986) and *Moellerites* is supposed to be a transitional taxon from *Profusulinella* and *Fusulinella*.
The present specimens and types have many common test characters such as shape and size of the test, and thin wall having not so well-developed diaphanotheca as in the typical *Fusulinella*. The Akiyoshi specimens identified with *Fusulinella paracolaniae* by Ueno (1989) and T. Ozawa & Kobayashi (1990) are also presumably reassigned to *Moellerites* by these test characters.
Occurrence and stratigraphic distribution: Common in some samples from the *Kanmeraia itoi* Zone and rare in few samples from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

Genus *Kanmeraia* T. Ozawa, 1967
Type species: *Pseudofusulinella utahensis* Thompson & Bissel in Thompson, 1954, p. 34.

Remarks: *Kanmeraia*, separated from *Pseudofusulinella* (*s.l.*) by T. Ozawa (1967) in subgeneric level, is characteristic in its fusiform to elongate subrhomboidal test. On the other hand, *Pseudofusulinella* (*s.s.*) is marked by its larger, inflated fusiform to subglobular test. Based on the geographic and stratigraphic distribution in addition to these morphologic differences, *Kanmeraia* and *Pseudofusulinella* are considered to be independent each other in generic level. *Pulchrella* proposed by Solovieva (1983) is closely similar to *Kanmeraia* in many test characters and *Usvaella* by Remizova (1992) has larger proloculus than *Kanmeraia*. These two genera are supposed to be synonymous with *Kanmeraia* because the type species of these two genera are distinguishable from the species group of *Kanmeraia* classified by T. Ozawa (1967), but it is not easy to discriminate them in generic level.

Kanmeraia itoi **(Y. Ozawa, 1925b)**
Pl. VI, figs 4-30

1925b. *Fusulinella itoi* Y. Ozawa, p. 19, pl. 3, figs 6, 8. [fig. 6 = pl. 1, fig. 2 and fig. 8 = pl. 1, fig. 1 in Y. Ozawa (1925a) without description]
1958. *Fusulinella itoi* Y. Ozawa.– Toriyama, pp. 48-50, pl. 4, figs 3-6.
1958. *Fusulinella* cf. *pseudobocki* (Lee & Chen in Lee *et al.*, 1930).– Toriyama, pp. 43-45, pl. 3, figs 3-4.
1989. *Fusulinella taishakuensis* Sada in Sada & Yokoyama, 1970.– Ueno, pl. 2, fig. 3.
1989. *Fusulinella* sp. A (sp. nov.), Ueno, pl. 2, fig. 6.
1989. *Fusulinella* sp. B (sp. nov.), Ueno, pl. 2, fig. 4.
1990. *Pseudofusulinella itoi* (Y. Ozawa).– T. Ozawa & Kobayashi, pl. 3, figs 3-4.

Description: Test inflated fusiform to subrhomboidal with arched periphery, almost straight to more or less concave lateral sides, and bluntly pointed to pointed poles, and composed of six and a half to nine whorls. Length 2.5 to 3.9 mm and width 1.4 to 2.4 mm, giving a form ratio of 1.5 to 2.1.
Proloculus spherical, small, 0.05 to 0.11 mm in diameter. Inner one to two whorls thick lenticular, oval, or subspherical and succeeding whorls becoming almost inflated fusiform and gradually increasing their length and width. Their lateral sides slightly concave in specimens and poles are pointed to bluntly pointed in most specimens. Axis of coiling nearly straight throughout growth, but its abrupt or gentle change against the first whorl is recognized in specimens.
Wall thin, not differentiated in inner two whorls. It is gradually thickening outward and composed of tectum, diaphanotheca, and lower and upper tectoria. Thickness of wall about 0.015 to 0.020 mm in middle and outer whorls and more or less variable by the secondary covers of dark calcareous materials.
Septa almost planar throughout the test, but very weakly folded in polar regions of outer whorls. Septal counts from the first to seventh whorl 6 to 9, 12 or 13, 16 or 17, 22 or 24, 26 or 29?, 28 or 30?, and more than 4, respectively in the illustrated three sections. Tunnel narrow, one-third to half as high as chambers, and its path almost straight to somewhat irregular. Chomata well developed in fusiform whorls, nearly perpendicularly hanging toward tunnel sides and gently extending to polar regions. Axial filling not present.
Remarks: Considerable differences are found in size and shape of the test, length and width of the corresponding whorls, degree of sharpness of polar regions in middle and outer whorls, and development of chomata. Based on the observation of many specimens, these differences are considered to represent wide morphologic variations of this species originally assigned to *Fusulinella* by Y. Ozawa (1925b). This species is reassigned to *Kanmeraia* from these characters of the test.
Based on these intraspecific variations of *Kanmeraia itoi,* two specimens compared to *Fusulinella pseudobocki* by Toriyama (1958) are probably identical with this species. Likewise, three specimens illustrated from Akiyoshi as *Fusulinella taishakuensis* and two unnamed *Fusulinella* by Ueno (1989) are presumed to be included in this species.
Occurrence and stratigraphic distribution: Common in few samples from the upper part of the *Fusulinella biconica* Zone and common to rare in many samples from the *Kanmeraia itoi* Zone.

Kanmeraia pulchra **(Rauzer-Chernousova & Belyaev in Rauzer-Chernousova** ***et al.*****, 1936)**
Pl. VII, figs 6-16

1936. *Fusulinella pulchra* Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al.*, pp. 182-183, pl. 5, figs 1-6.
pars 1990. *Pseudofusulinella hidaensis* (Kanuma, 1953).– T. Ozawa & Kobayashi, pl. 3, fig. 13. (non pl. 3, figs 14-15 = *Kanmeraia*? sp.)

Description: Test fusiform to subrhomboidal with arched periphery, almost straight to more or less concave lateral sides, and bluntly pointed to pointed poles, and composed of six and a half to seven and a half whorls. Length 3.3 to 4.5 mm and width 1.4 to 1.9 mm, giving a form ratio of about 2.2 to 2.5.
Proloculus spherical, small, 0.08 to 0.11 mm in outside diameter. Inner one to two whorls somewhat inflated fusiform, and succeeding ones gradually increasing their length and width and form ratio. In outer whorls, lateral slopes almost straight to slightly concave and poles are pointed to bluntly pointed in most specimens. Axis of coiling nearly straight throughout the growth.
Wall thin in inner one or two whorls where differentiation is obscure, then gradually thickening outward and consists of tectum, diaphanotheca, and lower and upper tectoria. Thickness of wall about 0.03 to 0.04 mm in middle and outer whorls.
Septa almost plane throughout the test, but weakly folded in polar regions of outer whorls. Tunnel narrow and its path almost straight to somewhat irregular. Chomata asymmetrical, not extending to poles, well developed throughout the test, and some are reaching the roof of chambers in fusiform whorls, nearly perpendicularly hanging toward tunnel sides and gently extending to polar regions. Axial filling not present.
Remarks: The Akiyoshi specimens as well as the Omi ones shown in Fig. 7.7-7.9, referable to *Kanmeraia*

pulchra, are discriminated from their larger and more elongate test than almost all of *Kanmeraia itoi*. They are closely similar to original ones by Rauzer-Chernousova & Belyaev in Rauzer *et al*. (1936) described from the well sample drilled at the right bank of the Volga River near Samara Bend. *Kanmeraia eopulchra* (Rauzer-Chernousova in Rauzer-Chernousova *et al*., 1951) might be distinguished from *Kanmeraia pulchra* in having more inflated test and more massive chomata. "*Fusulinella usvae* Dutkevich, 1934" illustrated in Sosnina & Nikitina (1976) from Primorye is different from the types of Dutkevich (1934) from the western slopes of the Middle Urals (Dutkevich, 1934) in its smaller test with gently arched periphery, not so concave periphery, and smaller proloculus. It is better to be reassigned to *Kanmeraia pulchra*.

"*Wedekindellina* (?) *hidaensis*" Kanuma, 1953 from the Moscovian of Mino Terrane, central Japan (Kanuma, 1953), appears to be alike to *Kanmeraia pulchra*, though illustrated three specimens by Kanuma are not well-oriented. It seems to have larger and more inflated test than the latter. One specimen, among three, illustrated as *Pseudofusulinella hidaensis* (Kanuma) by T. Ozawa & Kobayashi (1990) is also better to be reassigned to this species. Two specimens identified with *P. hidaensis* by Y. Ota & M. Ota (1993) are more similar to the Kanuma's original ones than this species.

Many well-oriented specimens were described by Ueno (1991) from the uppermost part of the *Protriticires* sp. Zone and lower part of the *Quasifusulinoides toriyamai* Zone of Ueno (1991) in the northeastern part of the Akiyoshi Limestone. Although they were named as *Pseudofusulinella* (*Kanmeraia*) cf. *delicata* Skinner & Wilde, 1965 and *Pseudofusulinella* (*Kanmeraia*) *praeantiqua* Wilde in Nassichuk & Wilde, 1977, Ueno's specimens are presumed to be reassigned to this species. Morphologically, they are almost the same as *Kanmeraia pulchra* from the Wakatakeyama area (Pl. VII, figs 6-16) and from the Omi Limestone (Fig. 8.7-8.9). *Kanmeraia* is restricted to the Moscovian and not extended into Kasimovian in the Wakatakeyama area.

Occurrence and stratigraphic distribution: Common in few samples (B-123B, NU-1) from the *Fusulinella bocki-Kanmeraia pulchra* Zone.

Kanmeraia aff. *itoi* (Y. Ozawa, 1925b)

Pl. VI, figs 1-3

Related to:

1925b. *Fusulinella itoi* Y. Ozawa, p. 19, pl. 3, figs 6, 8 [fig. 6 = pl. 1, fig. 2 and fig. 8 = pl. 1, fig. 1 in Y. Ozawa (1925a) without description].

Remarks: Inner whorls of three specimens illustrated herein are not so tightly coiled and proloculus of them is smaller than *Kanmeraia itoi*. These specimens have larger test and more massive chomata not extending to poles. They are treated as an alliance with *K. itoi* in this paper, since other test characters of them are closely similar to those of large, inflated forms of *K. itoi*.

Occurrence and stratigraphic distribution: Common in only one sample (B-174) from the upper part of the *Fusulinella biconica* Zone.

Genus *Beedeina* Galloway, 1933

Type species: *Fusulinella girtyi* Dunbar & Condra, 1928, p. 76.

Beedeina akiyoshiensis (Toriyama, 1958)

Pl. VII, figs 1-5

1958. *Fusulina akiyoshiensis* Toriyama, pp. 61-63, pl. 5, figs 13-15.

1977. *Beedeina akiyoshiensis* (Toriyam).– M. Ota, pl. 3, figs 1-2.

1989. *Beedeina akiyoshiensis* (Toriyama).– Ueno, pl. 2, fig. 14.

1990. *Beedeina akiyoshiensis* (Toriyama).– T. Ozawa & Kobayashi, pl. 3, figs 7-8.

Description: Test inflated to highly inflated fusiform with broadly arched periphery, almost straight lateral sides and bluntly pointed to rounded poles, and composed of eight to eight and a half whorls. Length 3.8 to 5.4 mm and width 1.4 to 1.9 mm, giving a form ratio of 2.2 to 2.5 in illustrated four specimens.

Proloculus spherical, small, 0.13 to 0.21mm in diameter. Inner one or one and a half whorls are oval to thickly fusiform and subsequent whorls gradually to rather rapidly expanding. Lateral slopes of middle to outer whorls almost straight but slightly concave in specimens. Wall thin and not differentiated in inner one to two whorls, then gradually thickening outward and consists of tectum, diaphanotheca, and lower and upper tectoria. Thickness of wall about 0.017 to 0.035 mm in middle whorls.

Septa moderately to strongly folded especially in polar regions. Septal folds commonly more than half as high as chambers, and some reach the roof of chambers in the median part of the test. Tunnel narrow and its path straight bordered by distinct chomata in inner whorls, tends to irregular and not straight bordered by septal loops filled with dark calcareous materials.

Remarks: Morphologic variation of test characters, uncertain in the Toriyama's (1958) type specimens, was made clear in this paper. *Beedeina* sp. A (sp. nov.) and *Beedeina* sp. B from Akiyoshi in Ueno (1989) are possibly thought to correspond to a form of *Beedeina akiyoshiensis*, although the former has larger test with more broadly arched periphery, and the latter is an incomplete specimen without outer few whorls. *Beedeina mayiensis* (Sheng, 1958a), ones illustrated from Guangdong by Lin (1983) except for the type material from the Penchian of North China (Sheng, 1958a), might be reassigned to *B. akiyoshiensis* on account of close similarities of shape and size of the test, and mode and strength of septal folding. *Fusulina sinuata* Nikitina in Sosnina & Nikitina, 1976 from the "*Obsoletes-Protriticites* Zone" of Primorye (Sosnina & Nikitina, 1977) is similar to this species except for not so inflated test.

This species is assumed to be a most swelled form of *Beedeina* including the type species of the genus [*B. girtyi* (Dunbar & Condra, 1928)] from the Desmoinesian of Illinois (USA). Size and shape of the test, number whorls, and narrow tunnel are well similar each other. *B. girtyi* is, however, distinguished from this species in having more strongly folded septa. *Beedeina pitrati* (Thompson, 1965) from the Cache Creek Terrane of British Columbia (Thompson, 1965) is closely similar to *B. akiyoshiensis*, but has smaller test. *Beedeina akiyoshiensis* is somewhat similar to *Beedeina schellwieni* (Staff, 1912) and *Beedeina paradistenta* (Safonova in Rauzer-Chernousova *et al.*, 1951), but has larger length and width of the corresponding outer whorls than the latter two.

Occurrence and stratigraphic distribution: Common in few samples from the *Kanmeraia itoi* Zone.

Genus *Quasifusulina* Chen, 1934

Type species: *Fusulina longissima* von Möller, 1878, p. 59.

***Quasifusulina longissima* (von Möller, 1878)**
Pl. XI, figs 25-36

1878. *Fusulina longissima* von Möller, pp. 59-61, pl. 1, fig. 4; pl. 2, fig. 1a-c; pl. 7, fig. 1a-c.
1925b. *Schellwienia* cf. *kattaensis* (Schwager, 1885).– Y. Ozawa, pp. 21-22, pl. 8, fig. 6b.
1934. *Quasifusulina longissima* (von Möller).– Chen, pp. 92-93, pl. 5, figs 6-9.
1965. *Quasifusulina americana* Thompson, pp. 230-231, pl. 35, figs 20-24.
1990. *Quasifusulina longissima* (von Möller).– T. Ozawa & Kobayashi, pl. 4, figs 15-16.
1991. *Quasifusulina longissima* (von Möller).– Watanabe, fig. 31.6-11.
1997. *Quasifusulina longissima longissima* (von Möller).– Watanabe, pp. 101-106, pl. 11, figs 1-16.
1998. *Quasifusulina longissima* (von Möller).– Y. Ota, pp. 21-22, pl. 1, figs 21-22.

Remarks: This species designated as the type species of *Quasifusulina* is widespread in the Upper Carboniferous of the Tethyan regions. In reference to the wide intraspecific variation of *Quasifusulina longissima* of many Akiyoshi specimens (Watanabe, 1997), *Quasifusulina* sp. A illustrated by Y. Ota & M. Ota (1993) belong to this species. *Quasifusulina americana* from the Cache Creek Terrane of British Columbia (Thompson, 1965) also closely resembles this species, and is interpreted herein as a junior synonym.

Occurrence and stratigraphic distribution: Common in some samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and the *Rauserites stuckenbergi-Triticites simplex* Zone.

Genus *Quasifusulinoides* Rauzer-Chernousova & Rozovskaya in Rauzer-Chernousova & Fursenko, 1959

Type species: *Pseudotriticites fusiformis* Rozoskaya, 1952, p. 29.

***Quasifusulinoides ohtanii* (Kanmera, 1954)**
Pl. VII, figs 17-25; Pl. VIII, figs 1-11, 21

1954. *Fusulina ohtanii* Kanmera, pp. 136-138, pl. 13, fig. 30; pl. 14, figs 12-20.
1965. *Quasifusulina popensis* Thompson, pp. 231-232, pl. 35, figs 16-19.
1989. *Quasifusulinoides toriyamai* (sp. nov., MS) Ueno, pl. 2, fig. 8.
1990. *Quasifusulinoidesw ohtanii* (Kanmera).– T. Ozawa & Kobayashi, pl. 4, fig. 3.
1991. *Quasifusulinoides* cf. *ohtanii* (Kanmera).– Watanabe, fig. 20.24-28.
1991. *Quasifusulinoides toriyamai* Ueno, pp. 821, 824, figs 6.1-13.

Description: Test fusiform with broadly arched periphery, gently convex lateral sides, and bluntly pointed to rounded poles. Tests of megalospheric forms consist of six to seven whorls, about 5.1 to 6.7 mm in length and about 2.2 to 2.6 mm in width, giving a form ratio of about 2.2 to 2.3. Microspheric forms have more than nine whorls, though uncertain as well as their length and width because of test abrasion. Axis of coiling straight to slightly curved.

Proloculus spherical to subspherical, 0.18 to 0.38 mm in diameter in megalospheric forms, and 0.03 mm in one microspheric form. The first whorl in megalospheric forms somewhat tightly coiled and succeeding ones gradually increasing their length and width. In microspheric forms, inner two whorls are coiled endothyroid, next two whorls gradually and regularly increasing their length and width, and then rapidly expanding outward. Outer whorls loosely undulated in specimens.

Wall very thin, poorly differentiated in inner whorls, and thin in outer whorls and composed of tectum and translucent layer. Discontinuous upper and lower thin layers are present together in outer whorls of most specimens. Thickness of wall about 0.03 to 0.04 mm in thicker part of outer whorls in most specimens.

Septa closely spaced, intensely and rather regularly folded throughout test of the megalospheric forms, resulting many chamberlets in polar regions. Septal counts from the first to sixth whorl 11 to 14?, 16 to 20, 22 to 29, 27 to 33, 33 or 38, and more than 38 or 49 in three sections illustrated. Tunnel narrow and its path irregular. Chomata poorly developed on proloculus and in inner two or three whorls, and not recognized in outer ones in the megalospheric forms. Axial fillings are well developed in general, but almost absent in specimens.

Remarks: Smaller Wakatakeyama *Quasifusulinoides* are apparently identical with *Quasifusulinoides ohtanii*, originally included in *Fusulina* and described from the Yayamadake Limestone by Kanmera (1954). Ueno (1991) newly introduced *Quasifusulinoides toriyamai* for the Akiyoshi specimens closely similar to *Q. ohtanii* from the slight difference of wall. However, wall structure is essentially the same. The layer apparently referable to diaphanotheca is obscure in most specimens or absent in specimens of Wakatakeyama. Five specimens from Akiyoshi and Omi compared to *Q. ohtanii* by Watanabe (1991) are identical with the species in spite of more developed axial fillings in them than in the types of Yayamadake.

This species is considered to be distinguished from the type species of the genus from the Southern Urals (Rozovskaya, 1952) in its more whorls and not so elongate test. *Quasifusulina popensis* from British Columbia (Thompson, 1965) is presumed to be a junior synonym of this species from the features of shape and size of the test, septal folding, and development of axial fillings. Three new species of *Quasifusulinoides*, treated as a subgenus of *Fusulina,* described by Nikitina (1969) from the *Obsoletes-Protriticites* Zone of the Primorye are closely alike to this species in many respects except for their somewhat smaller test. They might be conspecific with *Quasifusulinoides ohtanii*.

Occurrence and stratigraphic distribution: Common to rare in some samples from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone.

***Quasifusulinoides grandis* n. sp.**

Pl. VIII, figs 12-20, 22

Etymology: From the large test.

Type specimens: Holotype D2-055267 (axial section, Pl. VIII, fig. 14). Paratypes: seven axial sections (D-055256, Pl. VIII, fig. 12; D2-055257, Pl. VIII, fig. 13; D2-055259, Pl. VIII, fig. 15; D2-055276, Pl. VIII, fig. 16; D2-051746, Pl. VIII, fig. 17; D2-051753, Pl. VIII, fig. 19; D2-055269, Pl. VIII, fig. 20) and two sagittal sections (D2-055262, Pl. VIII, fig. 18; D2-049962, Pl. VIII, fig. 22).

Type locality: 330 m southeast of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture, Japan.

Diagnosis: Large, ellipsoidal fusiform *Quasifusulinoides* with six to seven whorls and large one or two proloculi. Subspherical first whorl followed by fusiform to subellipsoidal whorls with rounded to bluntly pointed poles. Axial fillings poorly to moderately developed in inner whorls.

Description: Test ellipsoidal fusiform with broadly arched periphery, gently convex to nearly straight lateral sides and rounded to bluntly pointed poles, and composed of six to seven whorls. Length about 9 mm and width about 2.9 to 3.5 mm, and around 3.0 in a form ratio. Axis of coiling almost straight to slightly curved.

Proloculus spherical to subspherical, 0.27 to 0.42 mm in longer outside diameter. Specimens with double proloculi are not rare. The first whorl subspherical and subsequent ones fusiform to subellipsoidal, loosely undulated in specimens, with almost straight to slightly convex lateral slopes and rounded to bluntly pointed poles.

Wall thin for large test throughout growth, and consists of tectum, translucent layer comparable to protheca rather than to diaphanotheca, and discontinuous thin upper layer on tectum in outer whorls. Translucent layer not clear in inner few whorls. Thickness of wall about 0.03 to 0.04 mm in thicker part of outer whorls.

Septa closely spaced, strongly and rather regularly folded throughout the test, resulting many chamberlets in polar regions. Septal counts from the first to sixth whorl 12 or 14, 20 or 26, 24 or 29, 27 or 37?, 31 or 41?, and more than 28 in two sections illustrated. Tunnel narrow and its path irregular. Chomata poorly developed on proloculus and in inner few whorls. Axial fillings poorly to moderately developed in inner whorls.

Remarks: This new species has larger test and larger proloculus than those described previously. Some specimens with double proloculi are also characteristic in this new species. This new species is distinguishable from *Quasifusulinoides ohtanii* in its larger test, larger proloculus, and larger length and larger height in corresponding whorls. It is thought to be a specialized form of *Q. ohtanii*.

Occurrence and stratigraphic distribution: Common in few samples (A-308, B-131, B-132) from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone.

Genus *Biwaella* Morikawa & Isomi, 1960

Type species: *Biwaella omiensis* Morikawa & Isomi, 1960, p. 301.

***Biwaella* aff. *omiensis* Morikawa & Isomi, 1960**

Pl. XLIX, figs 2-8, 11-13

Related to:

1960. *Biwaella omiensis* Morikawa & Isomi, pp. 302-304, pl. 54, figs 1-5.

pars 1958. *Schubertella* sp. A Toriyama, p. 75, pl. 7, fig. 10 (non pl. 7, figs 9, 11 = *Schubertella* sp.).

Remarks: Kobayashi in Kobayashi & Furutani (2009) reconfirmed the broad intraspecific variation of *Biwaella omiensis* based on the materials obtained from the Mt. Ryozen immediately south of the type locality of this species, along with the previous works of Kobayashi (1993, 2005) based on those from the Kanto Mountains. The Akiyoshi materials containing *Biwaella* are the most dominant in the Artinskian, becoming less dominant stratigraphically lowerward, and range down to the upper Asselian. On the other hand, *Biwaella* has not been reported from the Asselian of Japan. Many common test characters are recognized between materials of Akiyoshi and other localities of Japan, however, the test size and chamber height of outer whorls are significantly smaller in the former. The Akiyoshi materials of *Biwaella* are treated accordingly as an ally of *Biwaella omiensis*.

Toriyama (1958) showed three specimens named as *Schubertella* sp. A at two localities of Akiyoshi. Among them, one illustrated is probably reassigned to *Biwaella* rather than to *Schubertella* from its coiling pattern of the test.

Biwaella zhikalyaki and *Biwaella poletaevi* were newly described by Davydov (2011) from the lower Gzhelian of the Donetz Basin. He supposed that the latter differs from *Biwaella omiensis* in its rather fusiform test with smaller size and much smaller chomata. Both species have endothyroidly coiled juvenarium as well as the type species and other species of *Biwaella.* These two species appear to be closely similar to *B. omiensis*, taking the broad intraspecific variation of the latter into consideration.

Occurrence and stratigraphic distribution: Rare in some samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone and the *Paraleeina magna* Zone. Questionable specimens of *Biwaella* occur rarely in the S*phaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Dutkevichites* Davydov, 1984

Type species: *Dutkevichites darvasica* Davydov, 1984, p. 11.

***Dutkevichites* sp.**

Pl. XLIX, fig. 1

1993. *Biwaella* sp. Kobayashi, pp. 131-132, pl. 1, fig. 29.

Remarks: A few specimens having small elongate test with translucent wall referable to protheca, tightly coiled whorls followed by loosely coiled last whorl are recognized in association with *Carbonoschwagerina minatoi*. Although they are not well oriented, these test characters and associated fusulines are almost the same as those of *Biwaella* sp. described by Kobayashi (1993) from the upper Gzhelian pebble of southern Kanto Mountains. He pointed out but postponed its assignment to the genus *Dutkevichites*. These two forms from Akiyoshi and Kanto are probably assignable to *Dutkevichites*, and differ from *Schubertella* by their thicker wall and from *Biwaella* by their smaller test and fewer whorls.

Occurrence and stratigraphic distribution: Rare in only one sample (A-393) from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Genus *Obsoletes* Kireeva, 1950

Type species: *Fusulina obsoleta* Schellwien, 1908, p. 186.

***Obsoletes obsoletus* (Schellwien, 1908)**

Pl. IX, figs 1-2, 4

1908. *Fusulina obsoleta* Schellwien, pp. 186-188, pl. 19, figs 5-7.
1948. *Protriticites obsoletus* (Schellwien).– Putrya, p. 94, pl. 1, fig. 7.
1989. *Obsoletes* sp. Ueno, pl. 2, fig. 11.
pars 1990. *Obsoletes obsoletus* (Schellwien).– T. Ozawa & Kobayashi, pl. 3, fig. 16. (non pl. 3, figs 17-18 = *Obsoletes burkemensis* Volozhanina, 1962)
1991. *Obsoletes obsoletus* (Schellwien).– Watanabe, figs 20.1-23.
1993. *Obsoletes obsoletus* (Schellwien).– Y. Ota & M. Ota, pl. 1, figs 2-3.
1998. *Obsoletes obsoletus* (Schellwien).– Y. Ota, pp. 7-8, figs 5-6.

Remarks: Significant differences are not easily found out even taking the slight difference of wall composition between *Obsoletes* and *Protriticites* into account. Although protheca with finely alveolar structure is common in their wall of outer whorls, transparent layer comparable to diaphanotheca or porous structure referable to alveolar keriotheca is not clearly developed in both genera. *Obsoletes obsoletus*, designated as the type species of the genus (Kireva, 1950), is assigned to *Protriticites* by Rozovskaya (1950), as well as by Putrya (1948) who proposed the genus *Protriticites*. Although both genera might be congeneric, they are assumed to be independent each other by most workers. In this paper, *Obsoletes* is provisionally separated from *Protriticites* by more elongate test with thinner wall.

Illustrated specimens herein are marked in their elongate fusiform to ellipsoidal test with rounded poles and distinct chomata. They are almost identical with the original one from the Upper Carboniferous of Donetz Basin by Schellwien (1908), along with six examples from Akiyoshi as listed above. However, two specimens in T. Ozawa & Kobayashi (1990) among three are separated from this species by its fusiform test with fusiform whorls, and are herein transferred to *Obsoletes burkemensis*, as described below. Specimens assigned to *Obsoletes* by Ueno (1991), *Obsoletes horridus* Ueno, 1991 and *Obsoletes* cf. *obsoletus*, are different from this species in their thicker wall, folded septa even in inner whorls, and more strongly folded septa in polar regions. They are better to be separated from the genus *Obsoletes* and reassigned to a species of *Protriticites* or *Montiparus.* Some of large, elongate specimens of this species from Akiyoshi (e.g., Pl. IX, fig. 1) seem to be more related to *Obsoletes normalis* and *Obsoletes arsenjevi*, both of which were newly proposed by Nikitina (1969) from the *Obsoletes-Protriticites* Zone of the Primorye regions than the present species. However, morphologic variations of these two species from Primorye are obscure.

Occurrence and stratigraphic distribution: Rare to common in some samples exclusively from the *Protriticites subschwagerinoides* Zone.

***Obsoletes burkemensis* Volozhanina, 1962**
Pl. IX, figs 3, 5-9, 11-12

1962. *Obsoletes burkemensis* Volozhanina, pp. 124-125, pl. 1, fig. 2.
pars 1990. *Obsoletes obsoletus* (Schellwien).– T. Ozawa & Kobayashi, pl. 3, figs 17-18 (non pl. 3, fig. 16 = *Obsoletes obsoletus*).
1993. *Praeobsoletes burkemensis* (Volozhanina).– Remizova, pp. 166-167, fig. 1f.
2000. *Praeobsoletes burkemensis* (Volozhanina).– Davydov *et al*., pl. 8, figs 8-10.

Remarks: Shorter fusiform forms of *Obsoletes* from the Wakatakeyama area are similar to *Obsoletes burkemensis* originally described from the *Protriticites* Zone (lower Kasimovian) of Timan-Pechora region by Volozhanina (1962). This species was later designated as the type species of *Praeobsoletes* proposed by Remizova (1993) who showed that *Praeobsoletes* is the transitional form from *Fusulinella* to *Obsoletes*. It is also reported from north Greenland by Davydov *et al*. (2001). However, detailed comparison is impossible on account of few specimens and brief notes by these authors. This species resembles *Obsoletes fusiformis* Bensh, 1972 from the lower Kasimovian of South Fergana (Bensh, 1972) except for its smaller test and not so elongate test.
Obsoletes? sp. illustrated in this paper (Pl. IX, figs 10, 13-17) is distinguished from this species by its thinner wall. They are slightly deformed and wall differentiation of them is obscure except for outer two whorls consisting of tectum and translucent layer.
Occurrence and stratigraphic distribution: Rare to common in few samples exclusively from the *Protriticites subschwagerinoides* Zone.

Genus *Protriticites* Putrya, 1948
Type species: *Protriticites globulus* Putrya, 1948, p. 91.

***Protriticites subschwagerinoides* Rozovskaya, 1950**
Pl. IX, figs 34-46; Pl. X, figs 1-13, 16-17

1950. *Protriticites subschwagerinoides* Rozovskaya, pp. 9-10, pl. 1, figs 57.
pars 1990. *Protriticites subschwagerinoides* Rozovskaya.– T. Ozawa & Kobayashi, pl. 3, fig. 19, 21 (non pl. 3, fig. 20 = *Protriticites variabilis* Bensh, 1972).

Description: Test fusiform with broadly arched periphery, gently convex lateral sides and bluntly pointed poles, and composed of five and a half to six and a half whorls. Length about 2.4 to 3.4 mm and width about 1.1 to 1.5 mm, giving a form ratio of about 2.0 to 2.5. Axis of coiling straight.
Proloculus almost spherical and 0.06 to 0.19 mm in diameter. The first to second whorls tightly coiled, and succeeding two whorls gradually and further outer ones rapidly expanding.
Wall thin, composed of tectum and thin lower layer comparable to protheca in inner three to four whorls. Finely perforate light-colored layer appears between tectum and lower tectorium in succeeding two or three whorls. This layer corresponding to possibly diaphanotheca becomes indistinct in the last whorl. Thickness of wall about 0.03 to 0.06 mm in outer whorls.
Septa closely spaced, not folded in the median part of the test, but weakly folded in polar regions. Septal counts from the first to sixth whorl 7 or 8, 11 to 13, 13 to 15, 15 to 18, 18 or more, and 20 or more. Tunnel path almost straight. Chomata massive and well developed, but not present in the last whorl by specimens.
Remarks: According to the original description of *Protriticites subschwagerinoides* from the lower Kasimovian of Moscow Basin (Rozovskaya, 1950), the wall is finely to coarsely alveolar and consists of tectum and protheca in the last whorl. However, coarsely alveolar layer is not found in this and other species of *Protriticites* of Akiyoshi. Except for this difference that is presumed to be somewhat variable by the state of preservation of specimens, the present specimens closely resemble and almost identical with the original ones.
The Akiyoshi specimens referable to this species might be distinguished from three local species of *Obsoletes* mainly by their thicker wall and more inflated fusiform test, and are not easily discriminated from those of *Obsoletes* by slight differences of wall composition. They differ from *Protriticites variabilis*, described below, by their more inflated test with more weakly folded septa in polar regions. By this reason, one specimen among three named as this species by T. Ozawa & Kobayashi (1990) is separated.
Occurrence and stratigraphic distribution: Common to rare in many samples exclusively in the *Protriticites subschwagerinoides* Zone.

***Protriticites variabilis* Bensh, 1972**
Pl. IX, figs 18-33

1972. *Protriticites variabilis* Bensh, pp. 22-23, pl. 1, figs 1-4.
pars 1990. *Protriticites subschwagerinoides* Rozovskaya, 1950.– T. Ozawa & Kobayashi, pl. 3, fig. 20. (non pl. 3, figs 19, 21 = *Protriticites subschwagerinoides*)

Description: Test elongate fusiform with broadly arched periphery, gently convex to almost straight lateral sides and bluntly pointed poles, and composed of six to seven whorls. Length about 3.3 to 4.4 mm and width about 1.2 to 1.7 mm, giving a form ratio of about 2.5 to 3.0. Axis of coiling straight.
Proloculus spherical and 0.08 to 0.10 mm in diameter. The first to second whorls tightly coiled and succeeding two to three whorls gradually expanding outwards.
Wall thin, composed of tectum and thin lower layer in inner three to four whorls, tectum, finely perforate light-

colored layer, and lower tectorium in succeeding whorls. Thickness of wall about 0.04 to 0.06 mm in middle and outer whorls.

Septa closely spaced, not folded in the median part of the test, but weakly folded in polar regions. Tunnel path almost straight. Chomata massive and well developed, but not present or rudimental in the last whorl by specimens.

Remarks: Another species referable to *Protriticites* from the Wakatakeyama area is assigned to *P. variabilis*. Original materials were described by Bensh (1972) from the lower Kasimovian (*Protriticites pseudomontiparusi-Obsoletes obsoletus* Zone) of South Fergana. One specimen among three identified with *Protriticites subschwagerinoides* by T. Ozawa & Kobayashi (1990) is separated and reassigned to *P. variabilis* in its more elongate fusiform test. *Protriticites robustus* Ueno, 1991 and *Protriticites* sp. both described from Akyoshi (Ueno, 1991) should be separated from the genus and transferred to a species of *Montiparus* on account of their larger test, larger proloculus, massive chomata throughout whorls, and thicker wall with alveolar keriotheca in outer whorls. Both are probably referable to *M. umbonoplicatus* (Rauzer-Chernousova & Belyaev in Rauzer-Chernousova & Fursenko, 1937), described later.

Occurrence and stratigraphic distribution: Common to rare in some samples exclusively from the *Protriticites subschwagerinoides* Zone.

Genus *Montiparus* Rozovskaya, 1948

Type species: *Fusulina montipara* von Möller, 1878, p. 61.

Montiparus montiparus (von Möller, 1878)
Pl. X, figs 14-15, 18-22

1878. *Fusulina montipara* von Möller, pp. 61-63, pl. 3, figs 2a-f; pl. 8, figs 2a-c.
non 1925b. *Schellwienia montipara* (von Möller).– Y. Ozawa, pp. 40-41, pl. 9, fig. 1 [designated as the lectotype of *Triticites ozawai* by Toriyama (1958)].
1950. *Triticites* (*Montiparus*) *montiparus* (von Möller).– Rozovskaya, pp. 15-16, pl. 2, figs 4-7.
1990. *Montiparus montiparus* (von Möller).– T. Ozawa & Kobayashi, pl. 4, figs 1-2.

Remarks: Identification of this species since the two last centuries seems to be based on the description and illustrations of *Fusulina montipara* by von Möller (1878) that was designated as the type species of *Montiparus* by Rozovskaya (1950). However, this species was not exactly understood in Japan. Y. Ozawa's (1925b) material was referred to a new species of *Triticites* by Toriyama (1958). Specimens by Kanmera (1958) from the Yayamadake Limestone and those by Nogami (1961) from the Atetsu Limestone are not identical with this species. They have larger test, more strongly folded septa in polar regions, and thicker wall with coarser keriotheca in outer whorls, by which they are separated from this species. Illustrated specimens herein are surely identical with this species from their wall structure of finely alveolar keriotheca in outer whorls, massive chomata, and weakly folded septa in polar regions.

Occurrence and stratigraphic distribution: Common in few samples only from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone.

Montiparus matsumotoi (Kanmera, 1955)
Pl. XI, figs 1-24

1955. *Triticites matsumotoi* Kanmera, pp. 184-186, pl. 11, figs 6-25.
1977. *Triticites matsumotoi* Kanmera.– M. Ota, p. 14, pl. 2, figs 13-14.
1990. *Montiparus matsumotoi* (Kanmera).– T. Ozawa & Kobayashi, pl. 4, figs 4-5.
1991. *Montiparus matsumotoi matsumotoi* (Kanmera).– Watanabe, fig. 18.7-12.
1991. *Montiparus matsumotoi inflatus*, n. subsp.– Watanabe, fig. 18.1-6.
1993. *Montiparus matsumotoi* (Kanmera).– Y. Ota & M. Ota, pl. 1, figs 4-5.

Description: Test fusiform to inflated fusiform with broadly arched periphery, gently convex lateral sides and bluntly pointed poles, and composed of five and a half to seven whorls. Length about 2.6 to 4.0 mm and width about 1.1 to 1.8 mm, giving a form ratio of about 1.7 to 3.1. Axis of coiling straight.

Proloculus almost spherical and 0.06 to 0.12 mm in diameter. The first to second whorls subspherical to fusiform and tightly coiled. Subsequent whorls gradually increasing their length and width.

Wall thin and undifferentiated in inner one or two, rarely three whorls, and thickened and composed of tectum and finely alveolar keriotheca in the succeeding whorls. Thin lower and upper tectoria supplementarily accompanied in outer whorls. Thickness of wall about 0.05 to 0.09 mm in outer whorls.

Septa closely spaced, not folded in the median part of the test, but weakly folded in polar regions. Septal counts from the first to sixth whorl 7 to 9, 10 or 11, 11 to 15, 14 to 18, 17 to 20, and 19 to 22. Tunnel narrow, a half as high as chambers. Chomata massive, well developed, and asymmetrical, but not present in the last whorl by specimens.

Remarks: More variabilities of shape and size of the test and development of chomata in *Montiparus matsumotoi* than those shown by previous authors are recognized in the present Akiyoshi material, among which 24 specimens are illustrated. More inflated forms than *Montiparus matsumotoi* (*s.s.*), were informally proposed by Watanabe (1991) from the Omi Limestone without description as *Montiparus matsumotoi inflatus*. They correspond to the inflated forms of this species despite of their larger tests. This species from the Wakatakeyama area is similar to *Montiparus montiparus* and is not easily distinguished from this latter. Although both species from Wakatakeyama might be conspecific, forms with more elongate test are provisionally identified with *M. matsumotoi* in this paper.

Kanmera (1955) suggested that this species was similar to *Montiparus whitei* (Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., 1936). However, both species are distinguished by the smaller tests and massive chomata of the former. *Montiparus stuartensis* (Thompson, 1965) from British Columbia, originally assigned to *Triticites* by Thompson (1965) is supposed to be a junior synonym of this species.

Occurrence and stratigraphic distribution: Common in some samples exclusively from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone.

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

Pl. X, figs 23-37

1937. *Triticites umbonoplicatus* Rauzer-Chernousova & Belyaev in Rauzer-Chernousova & Fursenko, pp. 211-212, pl. 2, figs 1-5; text-fig. 1.
1950. *Triticites* (*Montiparus*) *umbonoplicatus* (Rauzer-Chernousova & Beylaev).– Rozovskaya, pp. 16-17, pl. 2, figs 8-12.
1991. *Montiparus umboplicatus* (Rauzer-Chernousova & Belyaev).– Watanabe, figs 18.13-19 [species name misspelled].
1991. *Protriticites robustus* Ueno, pp. 813-814, figs 3.1–4.
1991. *Protriticites* sp. Ueno, pp. 814-815, figs 3.5-6.

Description: Test fusiform to elongate fusiform with broadly arched periphery, almost straight lateral sides and bluntly pointed poles, and composed of six to seven whorls with straight axis of coiling. Length about 3.3 to 4.1 mm and width about 1.4 to 2.0 mm, giving a form ratio of about 2.2 to 2.8.

Proloculus spherical and 0.09 to 0.14 mm in diameter. The first whorl subspherical, and succeeding ones gradually increasing their length and width, and consequently becoming to fusiform to elongate fusiform.

Wall composed of tectum and thin lower and upper tectoria in inner one to two whorls, and tectum and translucent layer in the next one or two whorls. Tectum and finely alveolar keriotheca are evident in further outer whorls. Thickness of wall about 0.04 to 0.07 mm in the whorls with alveolar keriotheca.

Septa closely spaced, not folded in the median part of the test, but weakly folded in polar regions. Septal counts from the first to sixth whorl 8 or 9, 11 to 14, 14 to 16, 15 to 19, 19 to 21, and 20 to 25 in four sections illustrated. Tunnel narrow, one-third to a half as high as chambers. Chomata massive, well-developed, and asymmetrical in outer whorls.

Remarks: The Wakatakeyama specimens are belonged to an elongate form of *Montiparus*. They well resemble the types of this species by Rauzer-Chernousova & Belyaev in Rauzer-Chernousova & Fursenko (1937) and the subsequent ones from Samara Bend (Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., 1940). This species was reassigned to *Triticites* (*Montiparus*) by Rozovskaya (1950). Her specimens from the Moscow Basin are closely similar to the original and the present ones, but have somewhat stronger septal folding in polar regions. Seven specimens illustrated by Watanabe (1991) from the Omi Limestone are identical with the types. *Protriticites robustus* and *Protriticites* sp., both were described from Akyoshi by Ueno (1991), are transferred to this species, as indicated above.

Occurrence and stratigraphic distribution: Common in few samples only from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone.

Montiparus minensis n. sp.

Pl. XII, figs 1-37

1991. *Triticites sinuosus* Rozovskaya, 1950.– Watanabe, fig. 19.11-18)

Etymology: From the city name, Mine located in western part of Yamaguchi Prefecture, Japan.

Type specimens: Holotype D2-050094 (axial section, Pl. XII, fig. 1). Paratypes: thirty-two axial sections (D2-050090, Pl. XII, fig. 2; D2-050101, Pl. XII, fig. 3; D2-055331, Pl. XII, fig. 4; D2-050111, Pl. XII, fig. 5; D2-055722a, Pl. XII, fig. 6; D2-050096, Pl. XII, fig. 7; D22-055824, Pl. XII, fig. 8; D2-050109, Pl. XII, fig. 9; D2-050078, Pl. XII, fig. 10; D2-050082, Pl. XII, fig. 11; D2-050035, Pl. XII, fig. 12; D2-050093, Pl. XII, fig. 17; D2-050108, Pl. XII, fig. 18; D2-050121, Pl. XII, fig. 19; D2-050123, Pl. XII, fig. 20; D2-050115, Pl. XII, fig. 21; D2-0558222, Pl. XII, fig. 22; D2-050106, Pl. XII, fig. 23; D2-050033, Pl. XII, fig. 24; D2-050107, Pl. XII, fig. 25; D2-050092, Pl. XII, fig. 26; D2-050095, Pl. XII, fig. 27; D2-050068, Pl. XII, fig. 28; D2-050089, Pl. XII, fig. 29; D2-050097, Pl. XII, fig. 30; D2-050116, Pl. XII, fig. 31; D2-050085, Pl. XII, fig. 32; D2-050100, Pl. XII, fig. 33; D2-050091, Pl. XII, fig. 34; D2-050117, Pl. XII, fig. 35; D2-055827, Pl. XII, fig. 36; D2-050105, Pl. XII, fig. 37), three sagittal sections (D2-050133, Pl. XII, fig. 13; D2-051785, Pl. XII, fig. 14; D2-0558223, Pl. XII, fig. 16), and one parallel section (D2-055722b, Pl. XII, fig. 15).

Type locality: 320 m southeast of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture.

Diagnosis: Fusiform to inflated fusiform test, relatively tightly coiled inner whorls followed by gradually to somewhat rapidly expanding outer whorls. Septa almost planar in the median part of the test, and weakly to moderately folded in the polar regions. Chomata massive and asymmetrical.

Description: Test fusiform to inflated fusiform with broadly arched to arched periphery, almost straight to gently convex lateral sides and bluntly pointed poles, and composed of five to six whorls. Length about 3.7 to

5.2 mm and width about 1.6 to 2.3 mm, giving a form ratio of about 1.9 to 2.8. Axis of coiling straight.

Proloculus almost spherical and 0.12 to 0.21 mm in diameter. The first and second whorls are subspherical to fusiform, relatively tightly coiled and succeeding whorls gradually to somewhat rapidly increasing their length and width.

Wall thin, composed of tectum and thin lower and upper tectoria in inner one or two, rarely three whorls. Wall of the succeeding whorls gradually thickened and composed of tectum and finely alveolar keriotheca. Thickness of wall about 0.05 to 0.09 mm in outer two whorls.

Septa almost planar in the median part of the test, and weakly to moderately folded in polar regions. Septal counts from the first to fifth whorl 6 or 9, 12 or 16, 14 or 17, 15 or 19, 14 or 27 in two sections illustrated. Tunnel narrow, less than one-third as high as chambers. Chomata massive, asymmetrical, not extending to the poles but well-developed in general.

Remarks: Although test characters of many specimens illustrated are more or less variable from specimen to specimen, they are considerably different from those of other three species of *Montiparus* (*M. montiparus, M. matsumotoi,* and *M. umbonoplicatus*) described above in their larger size, thicker wall in outer whorls, poorer development of chomata, and more intensely folded septa in polar regions.

Montiparus minensis is considered to be new on the basis of these test characters and morphologic comparison with the known species of *Montiparus*. It is distinguished from *Montiparus subcrassulus* Rozovskaya, 1950 by its weaker septal foldings and weaker development of chomata, and from *Montiparus sinuosus* Rozovskaya, 1950 by its shorter fusiform test and weaker septal foldings. These two species were originally described from the middle Kasimovian of Moscow Basin by Rozovskaya (1950) and assigned to *Triticites* (*Montiparus*).

Eight specimens illustrated as *Triticites sinuosus* by Watanabe (1991) are reassigned to this new species on account of their more inflated fusiform test and less rapidly expanding outer whorls toward poles in comparison with those of the types of *Montiparus sinuosus*. Among four illustrated specimens compared to *Obsoletes obsoletus*, at least one (Ueno, 1991, fig. 4.13) can be probably transferred to this new species because of having broadly arched periphery and thicker wall in outer two whorls than those in other three specimens described by Ueno (1991).

Occurrence and stratigraphic distribution: Rare in few samples from the *Montiparus matsumotoi-Quasifusulinoides ohtanii* Zone and common in some samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone.

Genus *Rauserites* Rozovskaya, 1950

Type species: *Triticites stuckenbergi* Rauzer-Chernousova, 1938, p. 110.

Rauserites arcticus **(Schellwien, 1908)**

Pl. XVII, figs 1-30; Pl. XVIII, figs 1-19

1908. *Fusulina arctica* Schellwien, pp. 173-174, pl. 16, figs 3-9.
1958. *Triticites arctica* (Schellwien).– Toriyama, pp. 110-112, pl. 11, figs 1-25.
1960. *Triticites arcticus* (Schellwien).– Forbes, pp. 216-217, pl. 32, figs 10-17.
1989. *Schwagerina pseudoarcticus* (Rauzer-Chernousova, 1938).– Ueno, pl. 3, fig. 2.
1990. *Triticites (Rauserites) pararcticus* Rauzer-Chernousova, 1938.– T. Ozawa & Kobayashi, pl. 4, figs 10-11 [species name misspelled; not *pararcticus*, but *paraarcticus*].
1991. *Triticites paraarcticus* Rauzer-Chernousova.– Watanabe, fig. 19.1-8.
1993. *Schwagerina* sp. A, Y. Ota & M. Ota, pl. 2, figs 12-15.
1998. *Rugosofusulina arctica* (Schellwien).– Y. Ota, pp. 89-90, pl. 7, figs 11-14.

Description: Test fusiform with broadly arched periphery, almost straight to gently convex lateral sides and bluntly pointed poles, and composed of five to six and a half whorls. Length about 4.9 to 7.0 mm and width about 1.7 to 2.7 mm, giving a form ratio of about 2.3 to 3.0.

Proloculus almost spherical and 0.09 to 0.21 mm in diameter. Inner few whorls tightly coiled against the succeeding whorls gradually increasing their length and width.

Wall thin in tightly coiled inner whorls, then thickend outwards, more or less corrugated, and composed of tectum and finely alveolar keriotheca. Thickness of wall about 0.04 to 0.08 mm in outer two whorls.

Septa closely spaced and some of adjacent septa are combined, and weakly and rather irregularly folded in the median part of the test and moderately folded in polar regions. Septal counts from the first to sixth whorl 7 to 10, 14 to 16, 18 to 22, 23 to 27, 25 to 31, and 34 to 38. Tunnel narrow, less than one-third as high as chambers. Chomata massive, asymmetrical, and distinct in inner whorls, but poorly developed or absent in outer ones.

Remarks: This species and its allies are widespread from the Tethyan to the Arctic regions through Pechora and Timan and important biostratigraphically. On the other hand, generic assignment of this species is variably different among authors. *Triticites paraarcticus* established by Rauzer-Chernousova (1938) based on slight morphologic differences from *T. arcticus* was later reassigned to *Triticites* (*Rauserites*) by Rozovskaya (1950, pp. 35-36; 1958, p. 95). However, taxonomic transfer of the species *arcticus* from *T.* or *T.* (*T.*) to *R.* or *T.* (*R.*) was not done by Rozovskaya (1950, p. 46; 1958, p. 90). *Triticites pseudoarcticus* by Rauzer-Chernousova (1938) is closely allied to these two species. Both species are considered to be intimately related and might be synonymous with *Rauserites arcticus* based on morphologic comparison of these three species previously described and illustrated by many workers. Generic

Plate I

Figs 1-5, 11-12, 16-18: *Schubertella donetzica* Putrya
1, 16-18: sagittal sections; 2-5, 11-12: axial sections.
1: D2-052685, 2: D2-052718, 3: D2-052702, 4: D2-053224, 5: D2-050059, 11: D2-049976, 12: D-050053, 16: D2-050050, 17: D2-051629, 18: D2-049967.
Locality 1-3: A-393 (upper Gzhelian); 4: A-290 (Myachkovian); 5, 12, 16: A-227 (upper Kasimovian); 11, 18: A-220 (middle Kasimovian); 17: A-294 (Myachkovian).
All ×50.

Figs 6-10: *Eoschubertella obscura* (Lee & Chen)
6-7, 9-10: axial sections; 8: sagittal section.
6: D2-047790, 7: D2-050067, 8: D2-047782, 9: D2-056617, 10: D2-051454
Locality 6, 8: A-143 (middle Kasimovian); 7: A-227 (upper Kasimovian); 9: B-169 (Podolskian); 10: A-281 (Podolskian).
9: ×40, others: ×50

Figs 13-15, 19-21: *Schubertella magna* Lee & Chen
13-14, 21: axial sections; 15: tangential section; 19-20: sagittal sections.
13: D2-051766, 14: D2-051943, 15: D2-049965, 19: D-051755, 20: D2-052528, 21: D2-047262.
Locality 13, 19: A-309 (upper Kasimovian); 14: A-324 (lower Gzhelian); 15: A-220 (middle Kasimovian); 20: A-384 (lower Gzhelian); 21: A-97 (lower Gzhelian)
13, 15, 19: ×50; 14, 20-21: ×40.

Figs 22-23, 26-30: *Schubertella kingi* Dunbar & Skinner
22-23, 26: axial sections; 27: tangential section; 28-30: sagittal sections.
22: D-052874, 23: D2-052919, 26: D2-056950, 27: D-057193, 28: D-052862, 29: D2-052865, 30: D2-052883.
Locality 22, 28-30: A-400 (lower Asselian); 23: A-402 (lower Asselian); 26: B-193 (Artinskian).
22, 28-30: ×50; 23, 26-27: ×40.

Figs 24-25, 31-32, 41: *Schubertella melonica* Dunbar & Skinner
24, 31-32: axial sections; 25: oblique axial section; 41: sagittal section.
24: D2-056987, 25: D2-056912, 31: D2-056906, 32: D2-056909, 41: D2-056930.
Locality 24: B-197 (Artinskian); 25, 31-32: B-191 (Artinskian); 41: B-192 (Artinskian).
41: ×50, others: ×40.

Figs 33-36: *Reitlingerina* sp. A
33: parallel section, 34-35: tangential sections, 36: axial section.
33: D2-050069, 34: D2-055888, 35: D2-055896, 36: D2-055891.
Locality 33: A-227 (upper Kasimovian), 34-36: A-426 (lower Gzhelian).
33: ×40; others: ×30.

Figs 37-38: *Pseudoreichelina* sp. A
37: axial section, 38: tangential section.
37: D2-041330, 38: D22-047681.
Locality 37: A-53 (Kashirian), 38: A-132 (lower Asselian).
Both ×40.

Figs 39-40, 42-43: *Pseudoreichelina darvasica* Leven
39, 42: parallel sections; 40, 43: axial sections.
39: D2-056949, 40: D2-056923, 42: D2-056989, 43: D2-056986.
Locality 39: B-193 (Artinskian), 40: B-192 (Artinskian), 42-43: B-197 (Artinskian).
39, 43: ×40; 40, 42: ×30.

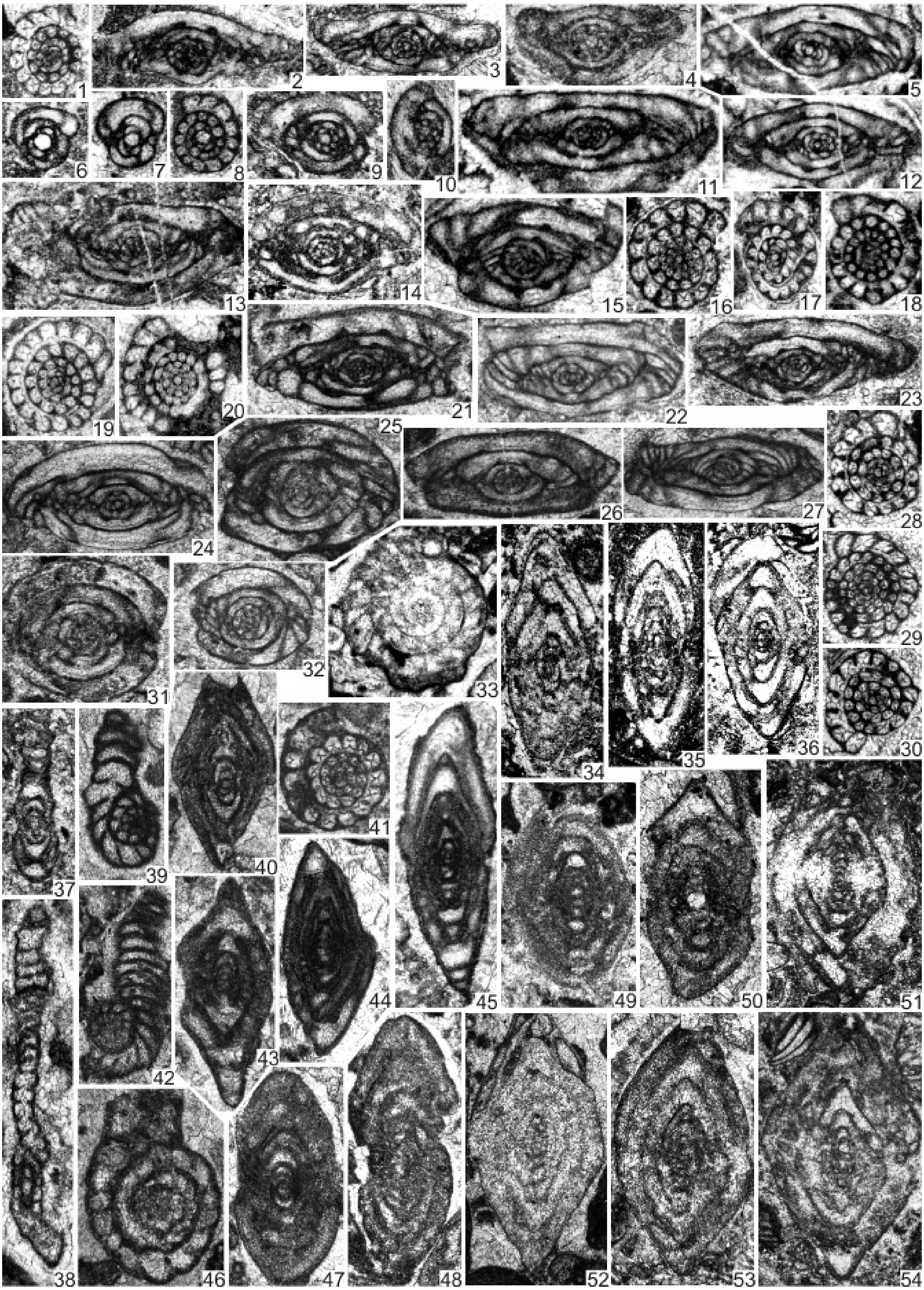
Figs 44-45: *Ozawainella eoangulata* (Manukalova)
44: oblique section, 45: axial section.
44: D2-056687, 45: D2-056672. Locality both B-174 (Kashirian).
Both ×40.

Fig. 46: *Pseudoreichelina* sp. B
Parallel section, D2-056923, Locality B-192 (Artinskian), ×30.

Figs 47-50: *Nankinella*? spp.
47, 49-50: axial sections; 48: tangential section.
47: D2-056981, 14: D2-056987, 49: D2-056951, 50: D2-040956.
Locality 47-48: B-197 (Artinskian), 49: B-193 (Artinskian). 50: A-26 (upper Gzhelian).
All ×30.

Figs 51-54: *Nankinella nagatoensis* Toriyama
51-52: axial sections, 53-54: tangential sections.
51: D2-055882, 52: D2-056775, 53: D2-057028, 54: D2-055880.
Locality 51, 54: A-426 (lower Gzhelian); 52: B-180 (upper Asselian); 53: B-202 (upper Kasimovian).
51-52, 54: ×25; 53: ×30.

Plate I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assignment into *Pseudofusulina* (*Rugosofusulina*) in Ross & Dunbar (1962) from Greenland is based on the more or less corrugated wall of outer whorls.

Fusulina arctica was designated as the type species of the genus *Schellwienia* Staff & Wedekind, 1910 that was emended by Solovieva (1987). Two specimens, originally illustrated by Schellwien (1908, pl. 16, fig. 3) and Forbes (1960, pl. 32, fig. 11) from Spitsbergen, are shown as the typical *Schellwienia* emend. Solovieva in Rauzer-Chernousova *et al*. (1996). Błazejowski *et al*. (2006) assigned specimens from Spitsbergen closely similar to Forbes (1960)'s ones into *Schellwienia arctica* (Schellwien). Thus, the species definition of *Rauserites arcticus* and its generic assignment are different by workers.

The Wakatakeyama specimens are alike to and supposed to be identical with the types by Schellwien (1908) and later ones, especially by Forbes (1960) from size and shape of the test, mode of septal folding and degree of rugosity of wall. On the other hand, these characters are considerably variable from specimen to specimen even in the same sample. Zolotuklina (1982) recognized the undulation of wall of this species as well as that of other species of *Rauserites* and showed no taxonomic significance of the frequency of undulation of wall. In this paper, this species is placed under *Rauserites*. *Schwagerina* sp. A by Y. Ota (1998) and *Schwagerina* sp. B by Y. Ota (1998) from Akiyoshi are not distinguishable from *Rugosofusulina arctica* described by Y. Ota (1998), and these unnamed or named three species are thought to be conspecific and assigned herein to *Rauserites arcticus*.

Occurrence and stratigraphic distribution: Abundant to common in many samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone.

Rauserites exculptus (Igo, 1957)

Pl. XVIII, figs 20-49

1957. *Triticites exculptus* Igo, pp. 225-226, pl. 12, figs 1-17.
1957. *Triticites exculptus* var. *naviformis* Igo, pp. 228-230, pl. 12, figs 18-24.
1990. *Triticites exculptus* Igo.– T. Ozawa & Kobayashi, pl. 4, figs 8-9.

Description: Test fusiform with broadly arched periphery, almost straight lateral sides and bluntly pointed poles, and composed of five and a half to six and a half whorls. Length about 4.4 to 5.7 mm and width about 1.4 to 2.4 mm, giving a form ratio of about 2.1 to 3.3.

Proloculus spherical and 0.13 to 0.22 mm in diameter. Inner two to three whorls tightly coiled against the

Plate II

Figs 1-2: *Reitlingerina* sp. A
1-2: axial sections.
1: D2-047699, 2: D2-041322.
Locality 1: A-133 (Podolskian), 2: A-53 (Kashirian).
1: ×40, 2: ×30.

Figs 3-4: *Reitlingerina* sp. B
3-4: axial sections.
3: D2-051588, 4: D2-041319.
Locality 3: A-290 (Myachkovian), 4: A-53 (Kashirian).
3: ×40, 4: ×30.

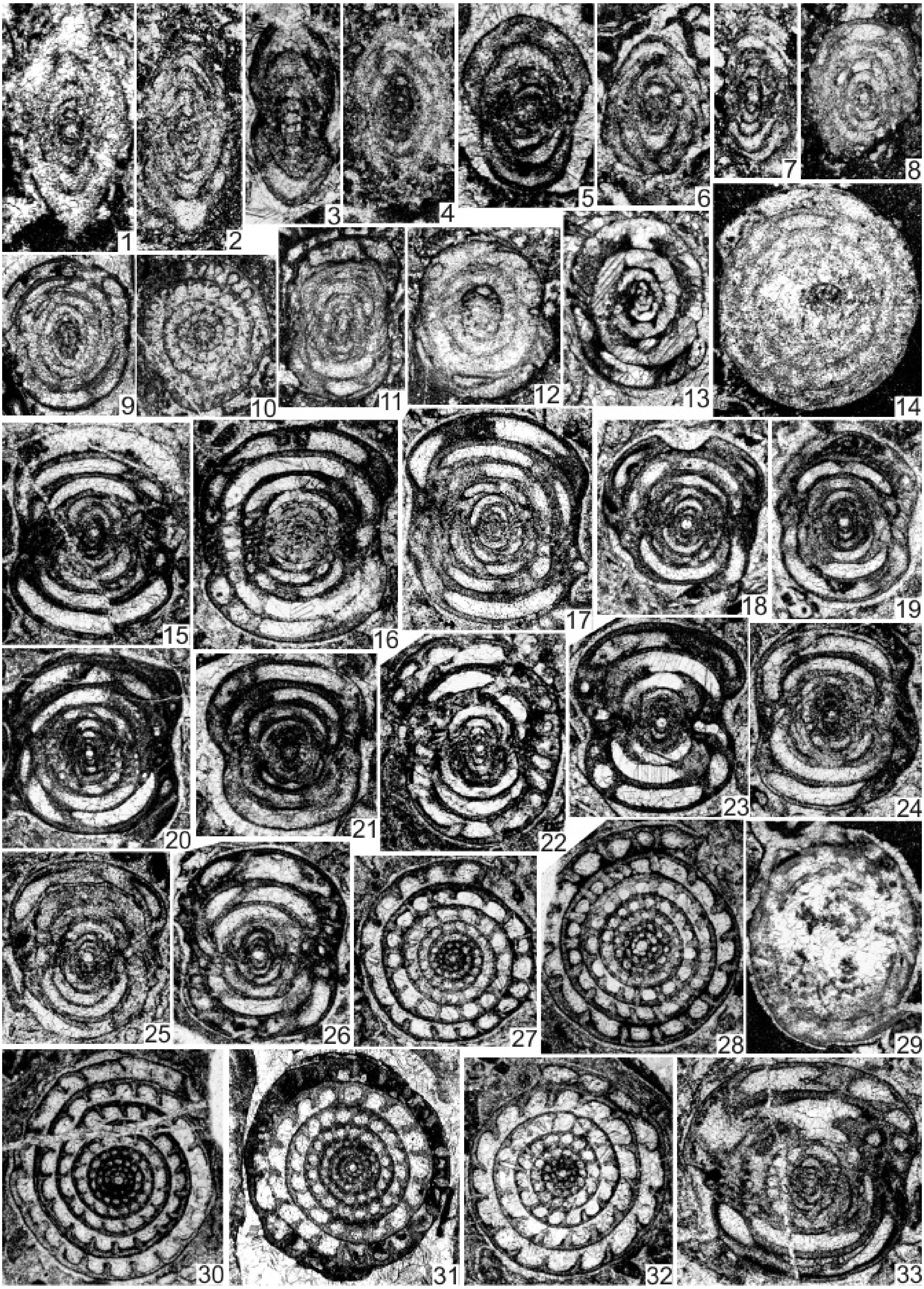
Figs 5-7: *Reitlingerina preobrajenskyi* (Dutkevich)
5-7: axial sections.
5: D2-047251, 6: D2-040992, 7: D2-052742.
Locality 5: A-97 (lower Gzhelian), 6: A-27 (lower Asselian), 7: A-394 (upper Gzhelian).
5-6: ×40, 7: ×30.

Figs 8-13: *Parastaffelloides* spp.
8, 11, 13: axial sections 9, 12: tangential sections; 10: sagittal section.
8: D2-041279, 9: D2-041530, 10: D2-041313, 11: D2-041312, 12: D2-041315, 13: D2-051527.
Locality 8, 10-12: A-52 (Kashirian); 9: A-64 (upper Gzhelian); 13: A-284 (Podolskian).
13: ×30, others: ×20.

Figs 14, 29: *Staffella* sp. A
14: oblique section, 29: tangential section.
14: D2-047290, 29: D22-047274.
Locality both A-97 (lower Gzhelian). Both ×20.

Figs 15-28, 30-33: *Parastaffelloides kanmerai* n. sp.
23: holotype, others: paratypes.
15, 18-26: axial sections; 16-17, 33: tangential sections; 27-28, 30-32: sagittal sections. Register numbers: shown in the description of this new species.
Locality 19, 21, 33: A-283 (Podolskian); 31: B-117 (Myachkovian); others: A-281 (Podolskian).
All ×20.

Plate II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succeeding whorls gradually increasing their length and width.

Wall thin and composed of tectum and translucent layer in tightly coiled inner whorls, then thickend outwards, smooth or gently corrugated in specimens, and composed of tectum and finely alveolar keriotheca. Thickness of wall about 0.05 to 0.08 mm in outer whorls.

Septa weakly folded or planar in the median part of the test and weakly to moderately folded in polar regions. Septal counts from the first to sixth whorl 8 to 10, 14 to 18, 16 to 23, 19 to 26, 22 to 28, and 23 to 27?, respectively. Tunnel narrow, less than one-half as high as chambers. Its path straight in inner whorls, then tends to be irregular in outer ones. Chomata massive and distinct in inner and middle whorls, but asymmetrical and poorly developed in outer ones.

Remarks: Igo (1957) proposed this species from the Upper Carboniferous Ichinotani Formation based on stronger septal folding and slenderer test than those of *Montiparus matsumotoi* (Kanmera). This species is reassigned to *Rauserites* from its mode and strength of septal folding. The Wakatakeyama specimens identical with this species show broader morphologic variations than the Igo's original ones. Forms with stronger septal folding and larger proloculus than those of the original material, and gently corrugated wall are also included in this species. *Triticites excuptus* var. *naviformis* by Igo (1957) from Ichinotani cannot be separated from this species only by slight differences of septal folding and test size.

Occurrence and stratigraphic distribution: Common in many samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and rare in few samples from the lower part of the *Rauserites stuckenbergi-Triticites simplex* Zone.

Rauserites hidensis **(Igo, 1957)**
Pl. XX, figs 16-26

1957. *Triticites hidensis* Igo, pp. 232-234, pl. 13, figs 1-21.

Remarks: This species originally assigned to *Triticites* by Igo (1957) is distinguished from *Rauserites exculptus* by its larger test, larger proloculus, and more strongly folded septa. The Wakatakeyama specimens have somewhat larger test with larger proloculus than the types of the Ichinotani Formation. *Rauserites saurini* (Igo, 1957) from the Ichinotani Formation might be conspecific with this species, though having larger and more elongate test.

Occurrence and stratigraphic distribution: Rare to common in some samples from the *Rauserites stuckenbergi-Triticites simplex* Zone to the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Rauserites major **Rozovskaya, 1958**
Pl. XIX, figs 1-17

1958. *Triticites (Rauserites) major* Rozovskaya, pp. 94-95, pl. 6, figs 5-6.

Description: Test fusiform with broadly arched periphery, almost straight lateral sides, and bluntly pointed to rounded poles, and composed of five and a half to seven whorls. Length about 5.7 to 8.2 mm and width about 2.4 to 3.4 mm, giving a form ratio of about 2.3 to 3.2. Proloculus almost spherical and 0.20 to 0.35 mm in diameter.

Inner one to two whorls somewhat tightly coiled and the succeeding whorls gradually increasing their length and width. Wall thin and composed of tectum and translucent layer in tightly coiled inner whorls, then thickend outwards and composed of tectum and alveolar

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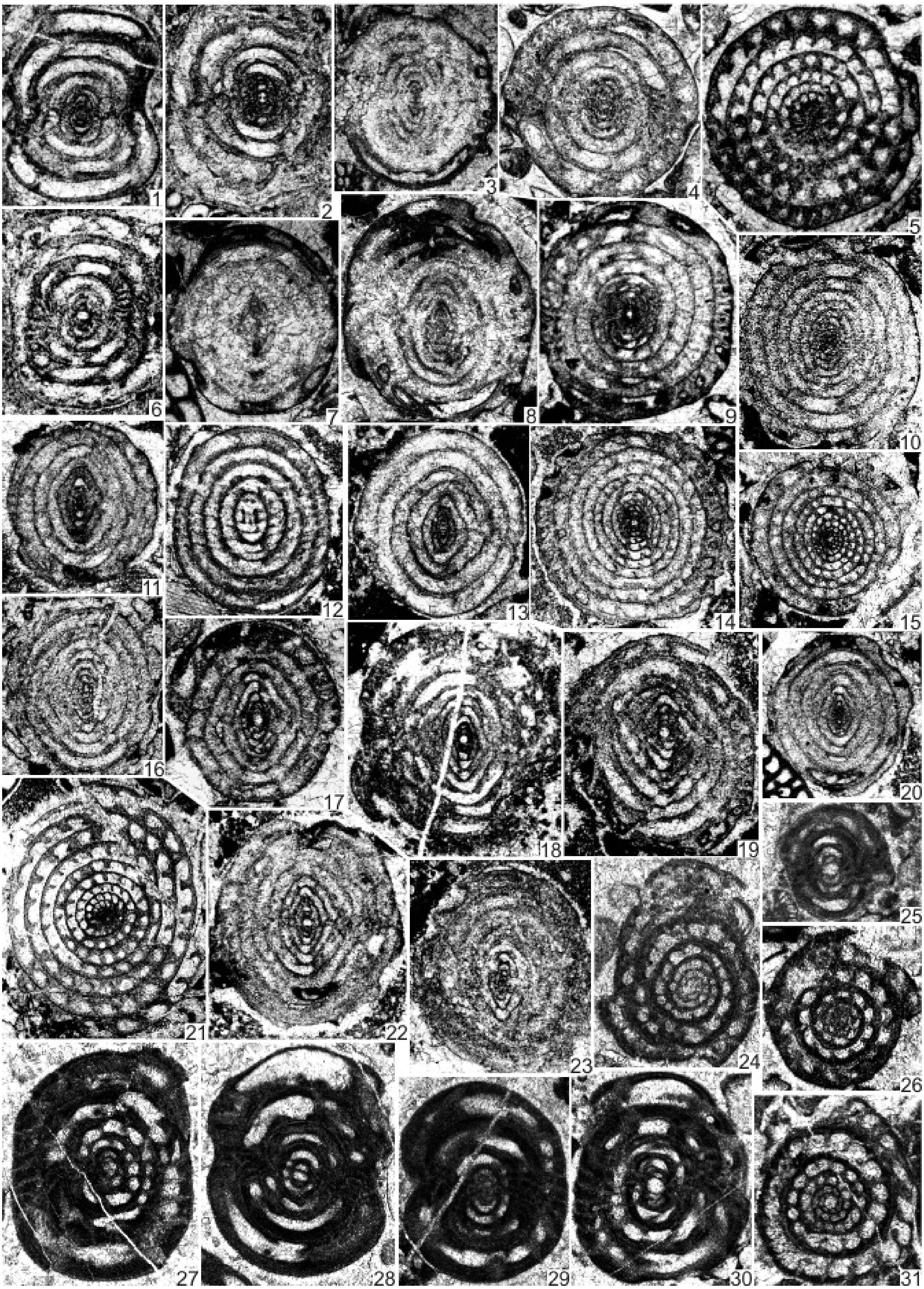
Plate III

Figs 1-2, 4, 6: *Parastaffelloides kanmerai* n. sp.
All paratypes.
1-2, 6: axial sections; 4: oblique section.
Register numbers: shown in the description of this new species.
Locality 4: B-107 (Myachkovian), others: A-281 (Podolskian).
All ×20.

Figs 3, 5, 7-23: *Staffella subsphaerica* n. sp.
18: holotype, others: paratypes.
Register numbers: shown in the description of this new species.
Locality 3, 7-8: A-64 (upper Gzhelian); 5, 9: A-220 (middle Kasimovian), 10, 13, 15-16, 21: A-391 (middle Gzhelian); 11-12, 14, 17-20, 22-23: A-394 (upper Gzhelian).
3, 10-12, 14-16, 18-19, 21: ×15; 5, 7-9, 13, 17, 22-23: ×20; 20: ×10.

Figs 24-31: *Staffella*? sp.
24, 31: sagittal sections; 25: axial section; 26: parallel section; 27, 30: oblique sections; 28-29: tangential sections.
24: D2-056928, 25: D2-056932, 26: D2-056944a, 27: D2-056954, 28: D2-056951, 29: D2-056944b, 30: D2-056950, 31: D2-056985.
Locality 24: B-192 (Artinskian), 31: B-197 (Artinskian), others: B-193 (Artinskian).
All ×30.

Plate III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keriotheca. Alveolae of the keriotheca become gradually coarser outwards. Thickness of wall about 0.06 to 0.09 mm in outer whorls.

Septa closely spaced, weakly folded or almost planar in the median part of the test and moderately folded in polar regions. Septal counts from the first to fifth whorl 11 or 12, 18 to 26, 24 to 31, 27 to 38, 28 or 33 in three illustrated specimens. Tunnel narrow bordered by distinct chomata in inner to middle whorls, and widened irregularly in outer whorls. Chomata rudimentary or absent in outer whorls.

Remarks: The Wakatakeyama specimens are closely similar to the original material of *Rauserites major* from the lower Gzhelian of the Samara Bend (Rozovskaya, 1958) in their large test for the genus, mode of septal folding, and rudimentary or no chomata in outer whorls. By these test characters, they are identical to the types, even if the morphological variation of the original specimens is uncertain. They are not assigned to the genus *Jigulites* on account of their weaker septal folding in the polar regions than that of *Jigulites* and almost planar to weakly folded septa in the median part of the test.

There are some specimens in the lower Gzhelian samples having somewhat similar characters to those of *Rauserites major*. Among them, two axial and sagittal sections and one tangential section (Pl. XIX, figs 18-22) are illustrated as *Rauserites* spp. They are different from *Rauserites major* in having a smaller proloculus and more tightly coiled inner whorls (Pl. XIX, figs 18-20, 21?) and more elongate test and weaker septal folding in the median part of the test (Pl. XIX, fig. 22).

Occurrence and stratigraphic distribution: Common in few samples from the *Rauserites stuckenbergi-Triticites simplex* Zone and common in some samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone.

Rauserites stuckenbergi (Rauzser-Chernousova, 1938)

Pl. XX, figs 1-15

1938. *Triticites stuckenbergi* Rauzer-Chernousova, pp. 110-111, pl. 3, figs 4, 9.
1950. *Triticites (Rauserites) stuckenbergi* Rauzer-Chernousova.– Rozovskaya, pp. 33-34, pl. 6, figs 10-13.
1990. *Triticites (Rauserites) stuckenbergi* Rauzer-Chernousova.– T. Ozawa & Kobayashi, pl. 4, fig. 12.

Description: Test fusiform to inflated fusiform with broadly arched periphery, almost straight lateral sides and rounded poles, and composed of five and a half to eight whorls. Length about 4.8 to 6.5 mm and width about 2.0 to 2.7 mm, giving a form ratio of about 2.0 to 2.5.

Proloculus almost spherical and 0.12 to 0.28 mm in diameter. Inner two whorls relatively tightly coiled against the succeeding whorls gradually increasing their length and width. Roundness of poles increases in the last two whorls.

Wall thin in tightly coiled inner whorls and composed of tectum and translucent layer. Wall thickened outwards and composed of tectum and finely alveolar keriotheca. Thickness of wall about 0.05 to 0.07 mm in outer two whorls.

Septa closely spaced and weakly folded or almost planar in the median part of the test and moderately to somewhat intensely folded in polar regions. Septal counts from the first to fifth whorl 8 to 11, 15 to 19, 15 to 23, 24 or 27, and 23 to 26, in three illustrated specimens. Tunnel narrow and its path becomes irregular outwards. Chomata massive, asymmetrical, and distinct in inner whorls.

Remarks: The present specimens are probably identical to the type-material from the Upper Carboniferous of the Samara Bend described by Rauzer-Chernousova (1938), even if the septa are more intensely folded in polar regions in the former and septal folds are higher in the latter. Rozovskaya's (1950) material also from the Samara Bend resembles the typical and the present

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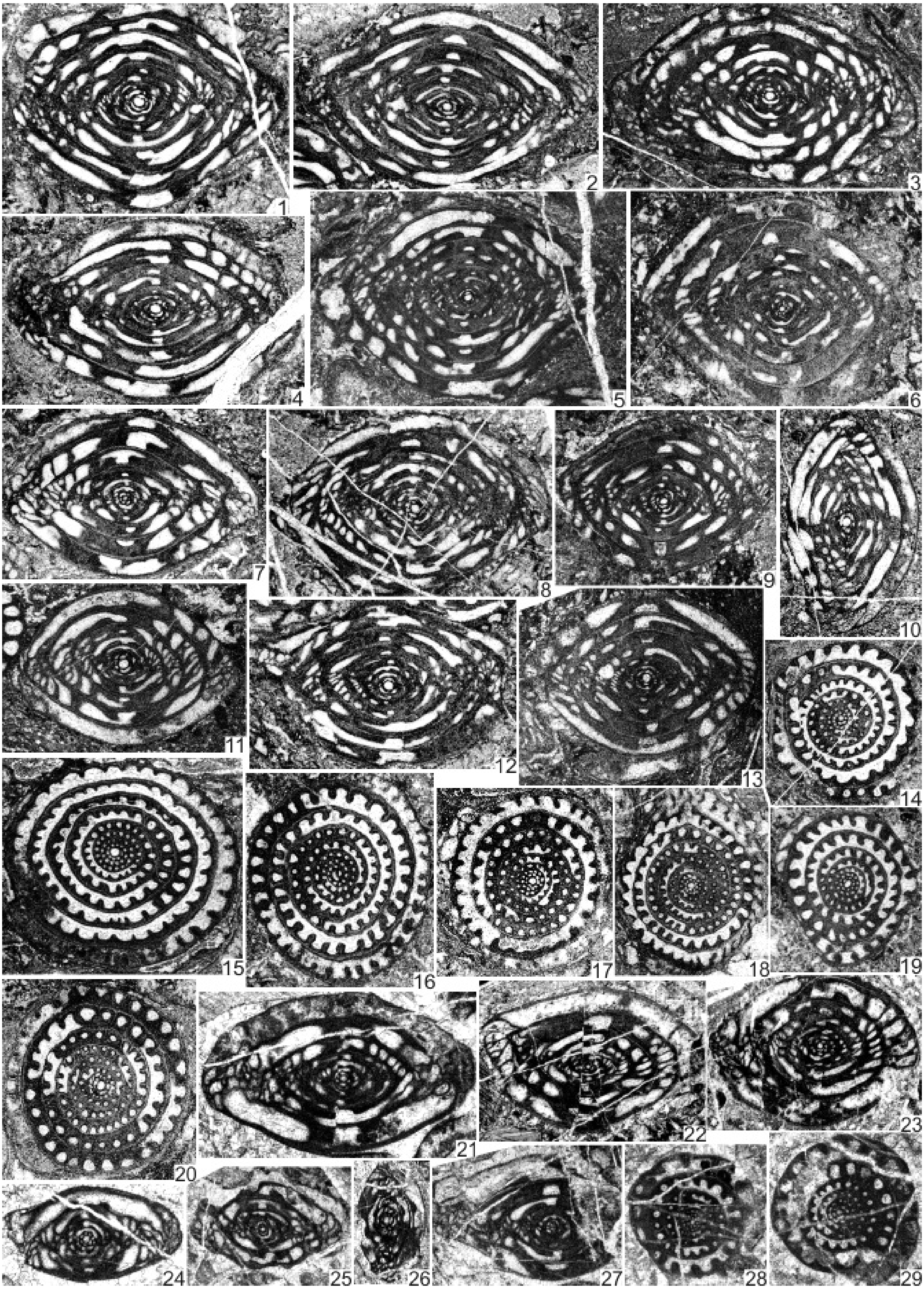
Plate IV

Figs 1-20: *Fusulinella biconica* (Hayasaka)
1-13: axial sections, 14-20: sagittal sections.
1: D2-041292, 2: D2-041282, 3: D2-041293, 4: D2-041310, 5: D2-041297, 6: D2-041303, 7: D2-041309, 8: D2-041284, 9: D2-041311, 10: D2-041327, 11: D2-041307, 12: D2-041283, 13: D2-041316, 14: D2-041306, 15: D2-041285, 16: D2-041298, 17: D2-041275, 18: D2-041302, 19: D2-041319, 20: D2-041278.
Locality 10, 19: A-53 (Kashirian); others: A-52 (Kashirian).
All ×15.

Figs 21-29: *Fusulinella bocki* von Möller
21, 24-26: axial sections; 22-23: oblique sections; 27: tangential section; 28-28: sagittal sections.
21: D2-055111, 22: D2-051634, 23: D22-051626, 24: D2-055109, 25: D2-051607, 26: D2-051603, 27: D2-051615, 28: D2-051617, 29: D2-051614.
Locality 21, 24: B-116 (Myachkovian); others: A-292 (Myachkovian).
21: ×20; others: ×15

Plate IV



specimens except for thicker and more finely alveolar wall.

Rauserites stuckenbergi differs from *R. hidensis* in its more inflated test with more rounded poles and from *R. major* in its smaller test, smaller proloculus, and weaker septal folding. There are three examples identified with this species in the Akiyoshi Limestone Group. One is T. Ozawa & Kobayashi's (1990) material. Ueno's (1989) identification is doubtful because of much smaller test and smaller length and width of corresponding whorls than those of the types. Watanabe's (1991) specimens for the lower Asselian schwagerinids are also doubtful due to inflated test with bluntly pointed poles.

Occurrence and stratigraphic distribution: Common to rare in many samples from the *Rauserites stuckenbergi-Triticites simplex* Zone.

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

Type species: *Triticites schwageriniformis* Rauzer-Chernousova, 1938, p. 107.

***Schwageriniformis parallelos* (Shcherbovich, 1969)**
Pl. XX, figs 27-42

1969. *Triticites schwageriniformis parallelos* Shcherbovich, pp. 9-10, pl. 2, figs 6-10.

1969. *Triticites schwageriniformis parallelos* forma *compacta* Shcherbovich, p. 10, pl. 2, fig. 11.

1969. *Triticites schwageriniformis postparallelos* Shcherbovich, pp. 10-11, pl. 2, fig. 12.

Description: Test fusiform with broadly arched periphery, almost straight lateral sides and bluntly pointed poles, and composed of five and a half to seven whorls. Length about 3.2 to 4.2 mm and width about 1.3 to 1.9 mm, giving a form ratio of about 2.0 to 2.5.

Proloculus almost spherical and 0.05 to 0.13 mm in diameter. Inner two to three whorls tightly coiled and the succeeding whorls gradually increasing their length and width. Wall thin in tightly coiled inner whorls, then thickened outwards and composed of tectum and finely alveolar keriotheca. Thickness of wall about 0.05 to 0.07 mm in outer whorls.

Septa inclined anteriorly and weakly folded in polar regions. Septal counts from the first to fifth whorl 7 or 8, 10 to 14, 13 to 16, 15 to 18, and 18 to 21, respectively in three illustrated specimens. Tunnel narrow bordered by distinct chomata in inner to middle whorls, and more or less widened in the last two whorls.

Remarks: The present specimens appear to a small, primitive form of the triticitids having much a smaller proloculus and more tightly coiled inner whorls than typical *Triticites*. They also appear to an advanced form of *Montiparus* except for their coarser alveolar

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Plate V

Figs 1-7: *Fusulinella pseudobocki* (Lee & Chen)
1, 3, 6-7: axial sections; 2, 4: oblique sections; 5: tangential section.
1: D2-055157, 2: D2-047739, 3: D2-055164, 4: D2-047741, 5: D2-047734, 6: D2-051612, 7: D2-051633.
Locality 1, 3: B-123B (Myachkovian); 2, 4-5: A-136 (Myachkovian); 6: A-292 (Myachkovian); 7: A-294 (Myachkovian).
All ×15.

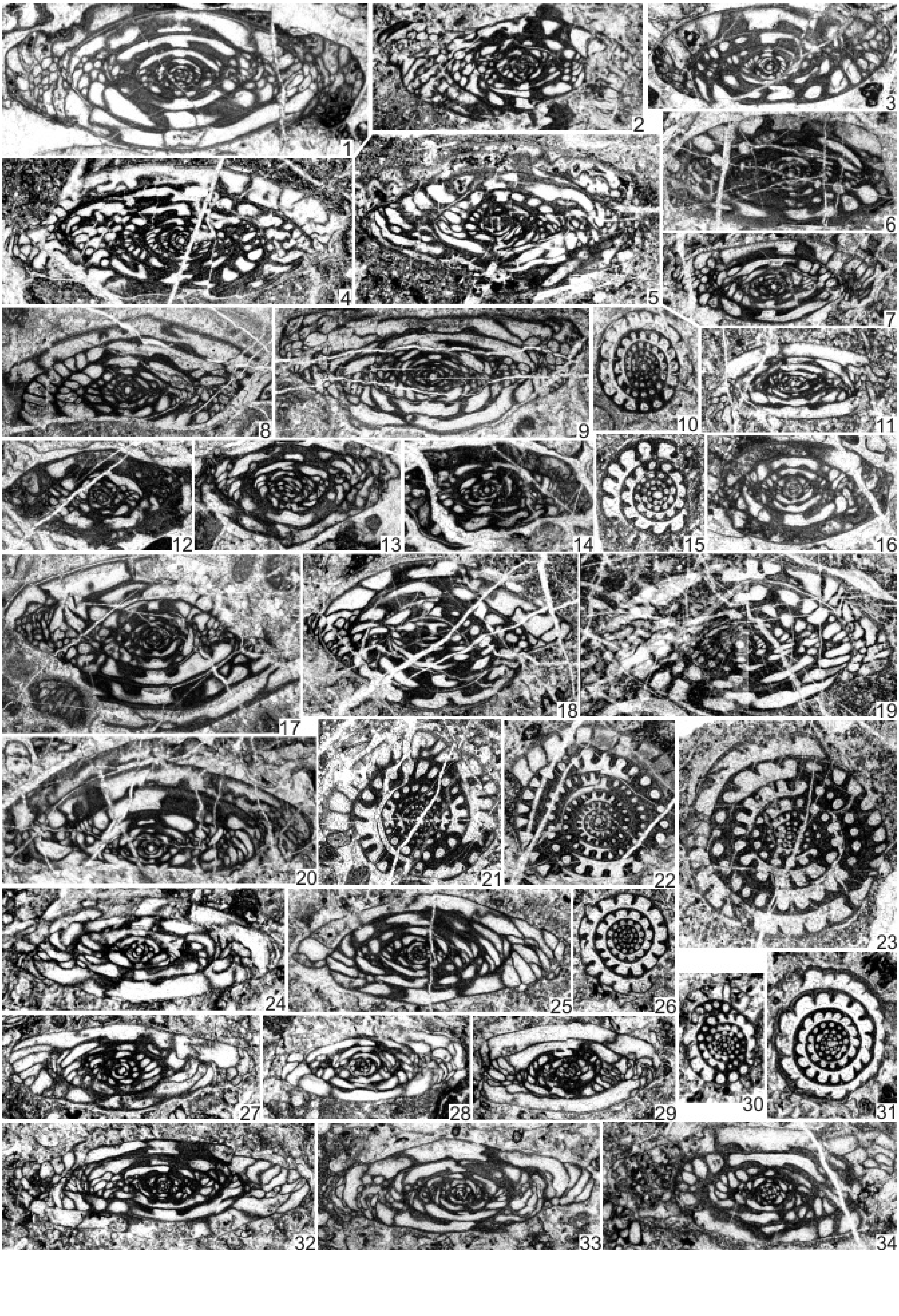
Figs 8-10: *Fusulinella* sp. A
8: oblique section, 9: axial section, 10: sagittal section.
8: D2-051651, 9: D2-051655, 10: D2-51657.
Locality all A-296 (Myachkovian). All ×15.

Figs 11, 24-34: *Moellerites paracolaniae* (Safonova)
11, 24, 28, 32-34: axial sections; 25, 27: oblique sections; 26: parallel section; 29: tangential section; 30-31: sagittal sections.
11: D2-055430, 24: D2-047707, 25: D2-047714a, 26: D-051017, 27: D2-047726, 28: D2-047699, 29: D2-051016, 30: D2-047709, 31: D2-047714b, 32: D2-051009, 33: D-051444, 34: D2-047717.
Locality 11: B-156 (Myachkovian); 24-32, 34: A-133 (Podolskian); 33: A-280 (Podolskian).
11, 26, 29, 32-33: ×15, 24-25, 27-28, 30-31, 34: ×20.

Figs 12-16: *Fusulinella* sp. B
12: axial section; 13, 16: tangential sections; 14: oblique section; 15: sagittal section.
12: D2-049838a, 13: D2-049838b, 14: D2-049833, 15: D2-055064, 16: D2-055049
Locality 12-14: A-208 (Podolskian), 15: B-108 (Myachkovian), 16: B-107 (Myachkovian).
12-14, 16: ×15; 15: ×20.

Figs 17-23: *Fusulinella rhomboidalis* Niikawa
17, 20: axial sections; 18, 21: tangential section; 19: oblique section; 22-23: sagittal sections.
17: D2-051658, 18: D2-049852, 19: D2-05006, 20: D-051589, 21: D2-053224, 22: D2-051001, 23: D2-051003.
Locality 17: A-296 (Myachkovian); 18-19, 22-23: A-211 (Myachkovian); 20-21: A-290 (Myachkovian).
All ×15.

Plate V



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keriotheca and poorer development of chomata in outer whorls. These specimens are presumably best assigned to *Schwageriniformis* among the known genera.

The Wakatakeyama specimens are close to and/or identical with *Schwageriniformis parallelos* subdivided into three subspecies by Shcherbovich (1969). These three ones from the upper Kasimovian *Rauserites arcticus-Rauserites acutus* Zone of the Precaspian Syneclise (Shcherbovich, 1969) are uneasily distinguishable each other by slight differences of the mode of test expansion and of development of chomata. *Schwageriniformis parallelos* is different from *Schwageriniformis schwageriniformis* by its fewer number of whorls, weaker development of chomata, and fusiform test without distinct elongation of outer whorls.

Occurrence and stratigraphic distribution: Common to rare in some samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and *Rauserites stuckenbergi-Triticites simplex* Zone.

Genus *Triticites* Girty, 1904

Type species: *Miliolites secalicus* Say in James, 1823, p. 328.

Triticites ozawai **Toriyama, 1958**
Pl. XXI, figs 48-55

1925b. *Schwagerina montipara* (Ehrenberg) von Möller, 1878.– Y. Ozawa, pp. 40-41, pl. 9, fig. 1.
1958. *Triticites ozawai* Toriyama, pp 92-95, pl. 8, fig. 24; pl. 9, figs 1-7.
1990. *Triticites ozawai* Toriyama.– T. Ozawa & Kobayashi, pl. 4, figs 17-18.
1993. *Triticites ozawai* Toriyama.– Y. Ota & M. Ota, pl. 1, figs 16-17.

Remarks: This species was established by Toriyama (1958) designating the axial section of *Schwagerina montipara* illustrated by Y. Ozawa (1925b) from the Akiyoshi Limestone Group as the lectotype. Compared with the paratypes of this species shown in Toriyama (1958), the present forms have somewhat larger tests with thicker wall gently undulated in outer whorls, as well as those illustrated by T. Ozawa & Kobayashi (1990) and Y. Ota & M. Ota (1993). These differences are assumed to be intraspecific.

Occurrence and stratigraphic distribution: Common to rare in some samples from the *Rauserites stuckenbergi-Triticites simplex* Zone.

Triticites parvulus **(Schellwien, 1908)**
Pl. XXI, figs 1-34

1908. *Fusulina prisca* var. *parvula* Schellwien, p. 184, pl. 19, figs 14-15.
1925b. *Schellwienia subobsoleta* Y. Ozawa, pp. 41-42, pl. 5, fig. 2; pl. 9, figs 2, 4, 5(?), 6-7.
1925b. *Schellwienia* cf. *prisca* var. *parvula* (Schellwien).– Y. Ozawa, p. 39, pl. 5, fig. 3.
1934. *Triticites parvulus* (Schellwien).– Chen, pp. 27-28, pl. 1, fig. 22; pl. 3, figs 2-4, 6-7, 9-12, 15, 17-21; pl. 10, fig. 16.

Description: Test inflated to elongate fusiform with broadly arched periphery, almost straight lateral sides, and bluntly pointed to rounded poles, and composed of five and a half to seven whorls. Length about 3.5 to 5.0 mm and width about 1.3 to 2.4 mm, giving a form ratio of about 2.0 to 2.9 in megalospheric forms. The microspheric form consists of eight whorls with 2.28? mm in length, 1.08 mm in width, and 2.11? in a form ratio.

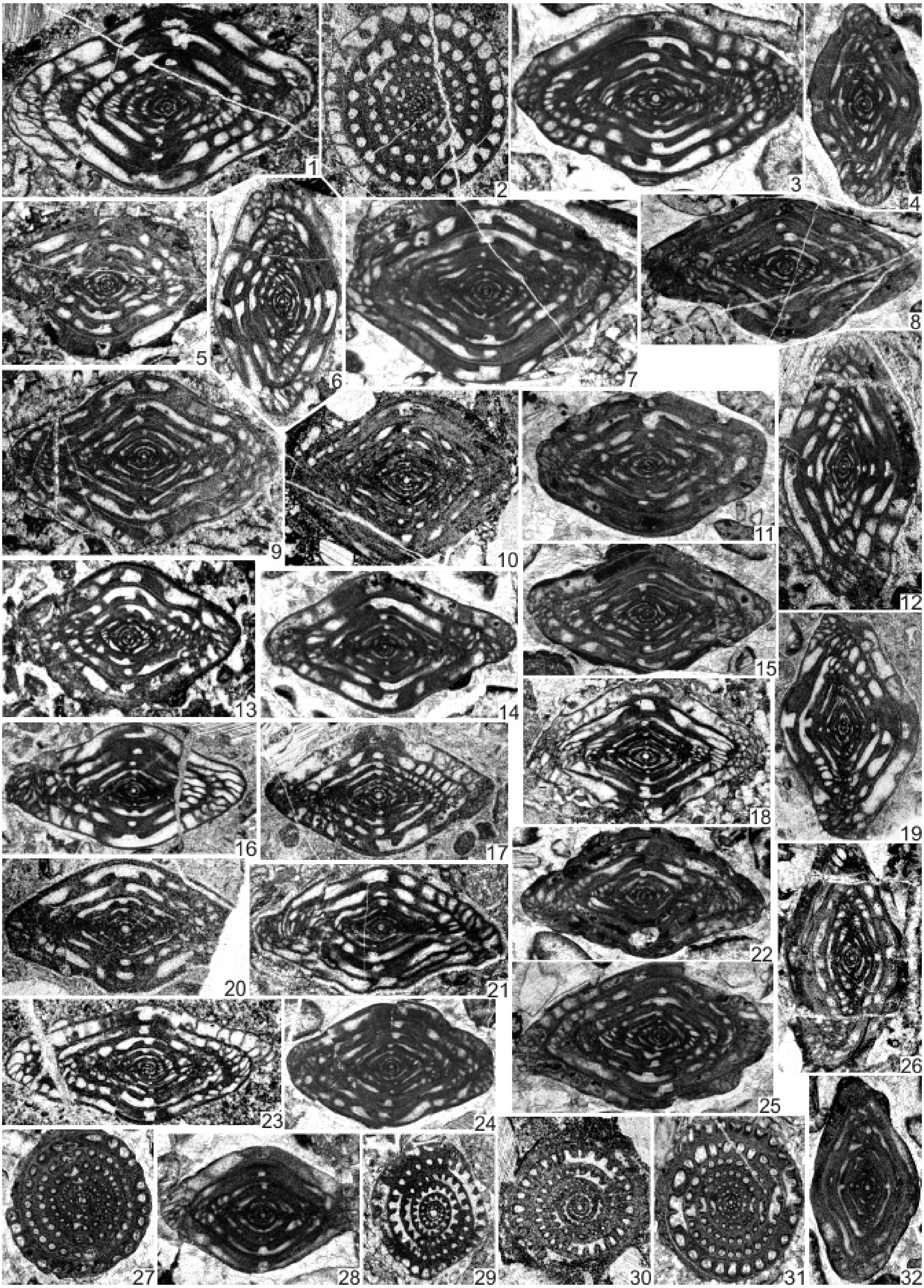
Proloculus spherical and its diameter 0.10 to 0.24 mm in megalospheric forms and 0.02 mm in one microspheric form. Inner two whorls somewhat tightly coiled and outer ones gradually increasing their length and width in megalospheric forms. Inner three whorls are subspherical and very tightly coiled against the succeeding fusiform whorls rather rapidly increasing their length and width in the microspheric forms.

Plate VI

Figs 1-3: *Kanmeraia* aff. *itoi* (Y. Ozawa)
1, 3: axial sections; 2: oblique section.
1: D2-056890, 2: D2-056893, 3: D2-056673.
Locality 1-2: B-189 (Kashirian), 3: B-174 (Kashirian). All ×15.

Figs 4-32: *Kanmeraia itoi* (Y. Ozawa)
4, 6-7, 9-18, 20-22, 24-26, 28, 32: axial sections; 5, 8, 19, 23: tangential sections; 27, 29-31: sagittal sections.
4: D2-056668, 5: D2-056634, 6: D2-055475, 7: D2-056671, 8: D2-056698, 9: D2-056639, 10: D2-051014, 11: D2-056701, 12: D2-056664, 13: D2-056703, 14: D2-056669, 15: D2-056696, 16: D2-051472, 17: D-051477, 18: D2-049817, 19: D2-051462, 20: D2-051489, 21: D2-051556, 22: D2-056694, 23: D2-055489, 24: D2-056683, 25: D2-056688, 26: D2-055480, 27: D2-056697, 28: D2-056692, 29: D2-050992, 30: D2-051019, 31: D2-047722, 32: D2-056693.
Locality 4, 7-8, 11, 14-15, 22, 24-25, 27-28, 32: B-174 (Kashirian); 5, 9: B-170 (Podolskian); 6, 26: B-163 (Podolskian); 10, 30-31: A-133 (Podolskian); 12: B-173 (Kashirian); 13: B-175 (Kashirian); 16-17, 19-20: A-281 (Podolskian); 18, 29: A-207 (Podolskian); 21: A-287A (Podolskian); 23: B-164 (Podolskian).
10: ×10, 28: ×20, others: ×15.

Plate VI



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In megalospheric forms, wall thin in tightly coiled inner whorls, and gradually thickened outwards but still thin in succeeding whorls by specimens. Wall consists of single layer in inner one or two whorls, and tectum and finely alveolar keriotheca in the subsequent ones. Alveolar structure becomes evident in the last one or two whorls.
Septa closely spaced, weakly folded in polar regions, and almost planar in the central part of the test. Septal counts from the first to sixth whorl 6 to 9, 11 to 16, 12 to 18, 14 to 23, 16 to 25, and 22 to 26, respectively in thirteen megalospheric specimens illustrated. Tunnel low and narrow in inner few whorls, gradually widened and its path becoming irregular outwards in general both in megalospheric and microspheric forms. Chomata distinct in inner and middle whorls, and obscure and rudimental in outer ones, whereas, better developed in the microspheric form.
Remarks: Y. Ozawa (1925b) transferred the form comparable to the types of *Fusulina prisca* var. *parvula* by Schellwien (1908) into *Schellwienia* along with newly proposed species, *Schellwienia subobsoleta*. Chen (1934) treated the original specimens as an independent species from *Fusulina prisca* [=*Rugosofusulina prisca* (Ehrenberg, 1842)] and reassigned them into *Triticites*. Specimens illustrated by Chen (1934) appear to resemble elongate forms of *Montiparus* except for coarser alveolar keriotheca and poorer development of chomata in outer whorls. Grozdilova & Lebedeva (1961) proposed a new name of *Triticites cheni* for elongate forms of *Triticites parvulus* described by Chen (1934) based on the Timan material.
Many specimens belonging to *Triticites* are contained in sample A-97. Illustrated specimens of them herein show more or less different appearences in size and shape of both internal and external test. On account of their gradual changes from specimen to specimen in the single sample, they are presumed to be not subdivided but to be treated as a single species, *Triticites parvulus*. *Schellwienia subobsoleta* proposed by Y. Ozawa (1925b) is presumed to be a junior synonym of this species, taking broad morphologic variation of the present material into account.
Occurrence and stratigraphic distribution: Abundant to common in some samples from the *Rauserites stuckenbergi-Triticites simplex* Zone.

***Triticites simplex* (Schellwien, 1908)**
Pl. XXII, figs 1-22, 24-28

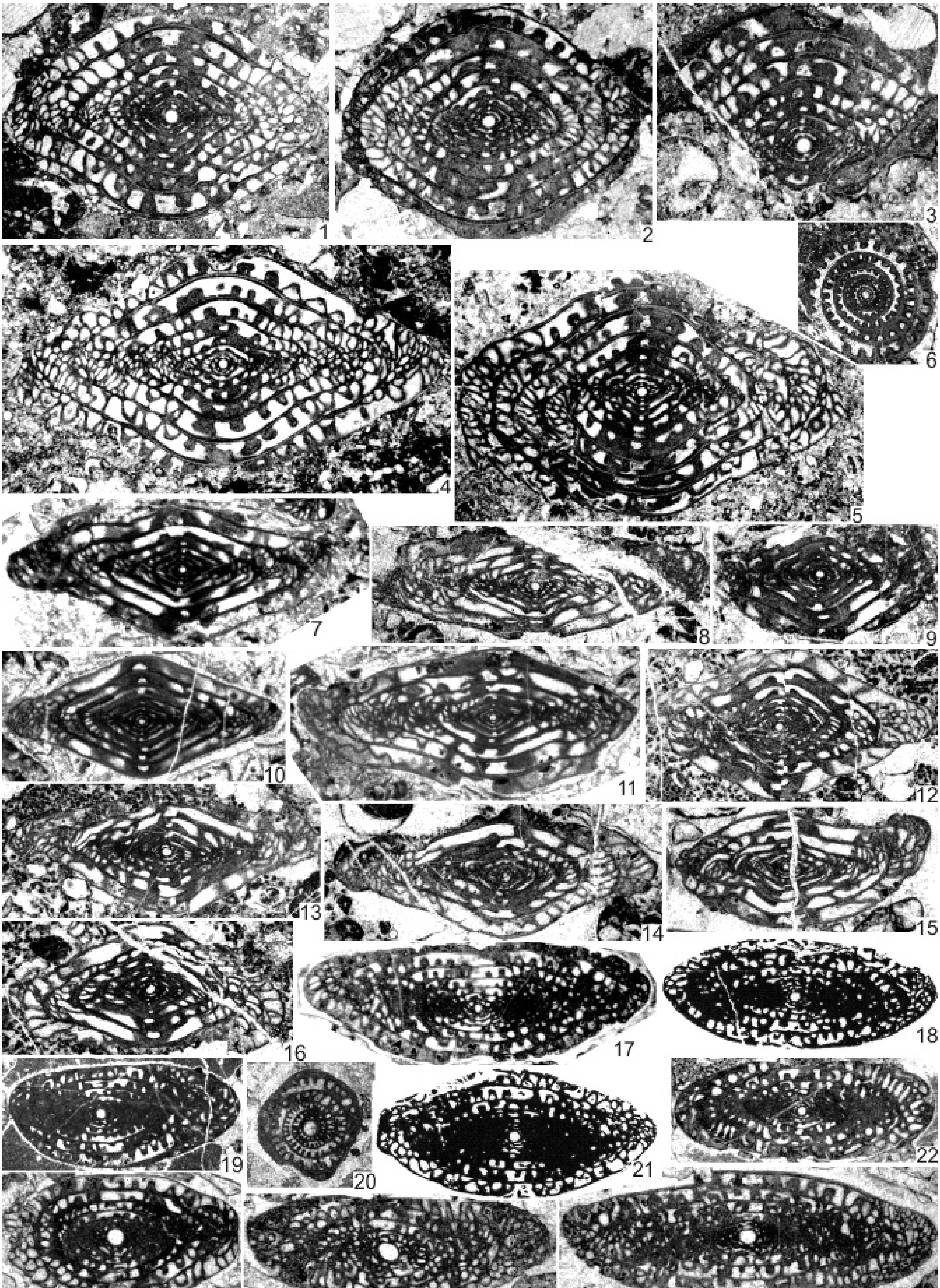
1908. *Fusulina simplex* Schellwien, pp. 179-182, pl. 18, figs 4-6, 12.
? 1934. *Triticites simplex* (Schellwien).– Chen, pp. 24-25, pl. 1, figs 16-18, 21.
1958. *Triticites simplex* (Schellwien).– Toriyama, pp. 95-99, pl. 9, figs 8-25.
1977. *Triticites simplex* (Schellwien).– M. Ota, pl. 2, figs 9-10.
1989. *Triticites "simplex"* (Schellwien).– Ueno, pl. 4, fig. 1.
1998. *Triticites* aff. *simplex* (Schellwien).– Y. Ota, pp. 50-51, pl. 4, fig. 1-4.

Description: Test fusiform to infated fusiform with broadly arched periphery, almost straight lateral sides and bluntly pointed to rounded poles, and composed of six to seven and a half whorls. Length about 4.7 to 6.2 mm and width about 1.9 to 2.9 mm, giving a form ratio of about 2.0 to 2.5.
Proloculus almost spherical and its diameter 0.06 to 0.24 mm. Inner one or two whorls thick fusiform to subspherical, then becoming outwards to fusiform gradually increasing their length and width. Wall thin in

Plate VII

Figs 1-5: *Beedeina akiyoshiensis* (Toriyama)
1-5: axial sections.
1: D22-047700, 2: D2-047720, 3: D2-051013, 4: D2-047715, 5: D2-047725.
Locality all A-133 (Podolskian). All ×15.
Figs 6-16: *Kanmeraia pulchra* (Rauzer-Chernousova & Belyaev)
6: sagittal section, 7-16: axial sections.
6: D2-055156, 8: D2-055158, 9: D2-055155, 12: D2-055169, 13: D2-055168, 14: D2-055166, 15: D2-055165, 16: D2-055159. (7, 10-11: stored in the Nagoya Univ.)
Locality 6, 8-9, 12-13: B-123B (Myachkovian); 7, 10-11: NU-1 (Myachkovian).
All ×15.
Figs 17-25: *Quasifusulinoides ohtanii* (Kanmera)
17-19, 21-25: axial sections; 20: sagittal section.
19: D2-055232, 20: D2-051747, 22: D2-055237, 23: D2-050019, 24: D2-050011, 25: D2-050025. (17-18, 21: stored in the Nagoya Univ.)
Locality 19, 22: B-128 (middle Kasimovian); 20: A-308 (middle Kasimovian); 23-25: A-225 (middle Kasimovian); 17-18, 21: NU-2 (middle Kasimovian).
All ×10.

Plate VII



inner one to three whorls, then rather rapidly thickened as thick as 0.07 to 0.10, rarely 0.15 mm in the thickest part of outer whorls, and consists of tectum and translucent layer in inner whorls and tectum and finely alveolar keriotheca in midde and outer whorls.

Septa plane and not folded in the median part of the test and weakly folded in polar regions. Septal counts from the first to sixth whorl 7 to 10, 11 to 16, 14 to 19, 17 to 19, 18 to 22, and 22 to 24, respectively in four specimens illustrated. Tunnel low and narrow in inner whorls with thinner wall, gradually widened and its path becoming irregular outwards. Chomata massive and distinct in inner and middle whorls, and absent or rudimentary in outer ones of most specimens.

Remarks: So far as one axial section of the original illustration in Schellwien (1908), septa appear to be almost plane in median part of the test. Four specimens illustrated by Chen (1934), who removed this species to *Triticites*, are considerably different from the original ones in having septa more intensely folded in polar regions and weakly folded in the median part of the test. The Putrya's material (1940, pp. 86-89, pl. 8, figs 1-8) from the Upper Carboniferous of the Donetz Basin is closely similar to the present material. Weakly folded septa in median part of the test are also recognized in specimens illustrated by Toriyama (1958) from Akiyoshi. Although the present specimens are more or less different from some of the previously illustrated, they are identified with the original material from general features of the test, especially of mode of septal folding.

Occurrence and stratigraphic distribution: Rare in few samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and common in some samples from the *Rauserites stuckenbergi-Triticites simplex* Zone.

***Triticites whitei* Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., 1936**

Pl. XXI, figs 35-47

1936. *Triticites whitei* Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*., pp. 186, 222, pl. 2, figs 11-13.

Description: Test fusiform to elongate fusiform with broadly arched periphery, almost straight lateral sides and bluntly pointed poles, and composed of five and a half to seven whorls. Length about 3.8 to 4.9 mm and width about 1.5 to 2.0 mm, giving a form ratio of about 2.1 to 2.8.

Proloculus spherical and its diameter 0.07 to 0.17 mm. Inner two to four whorls tightly coiled against the succeeding whorls gradually increasing their length and width.

Wall thin and structureless in tightly coiled inner whorls, and thickened as thick as 0.05 mm in outer whorls consisting of tectum and finely alveolar keriotheca.

Septa loosely spaced, weakly folded in polar regions and almost planar in the median part of the test. Septal counts from the first to fifth whorl 6 or 7, 10 or 13, 12 or 15, 12 or 15, and 14, respectively in two illustrated sections. Tunnel low and narrow in inner few whorls and gradually widened outwards. Chomata distinct in inner and middle whorls, and obscure and rudimentary in outer whorls.

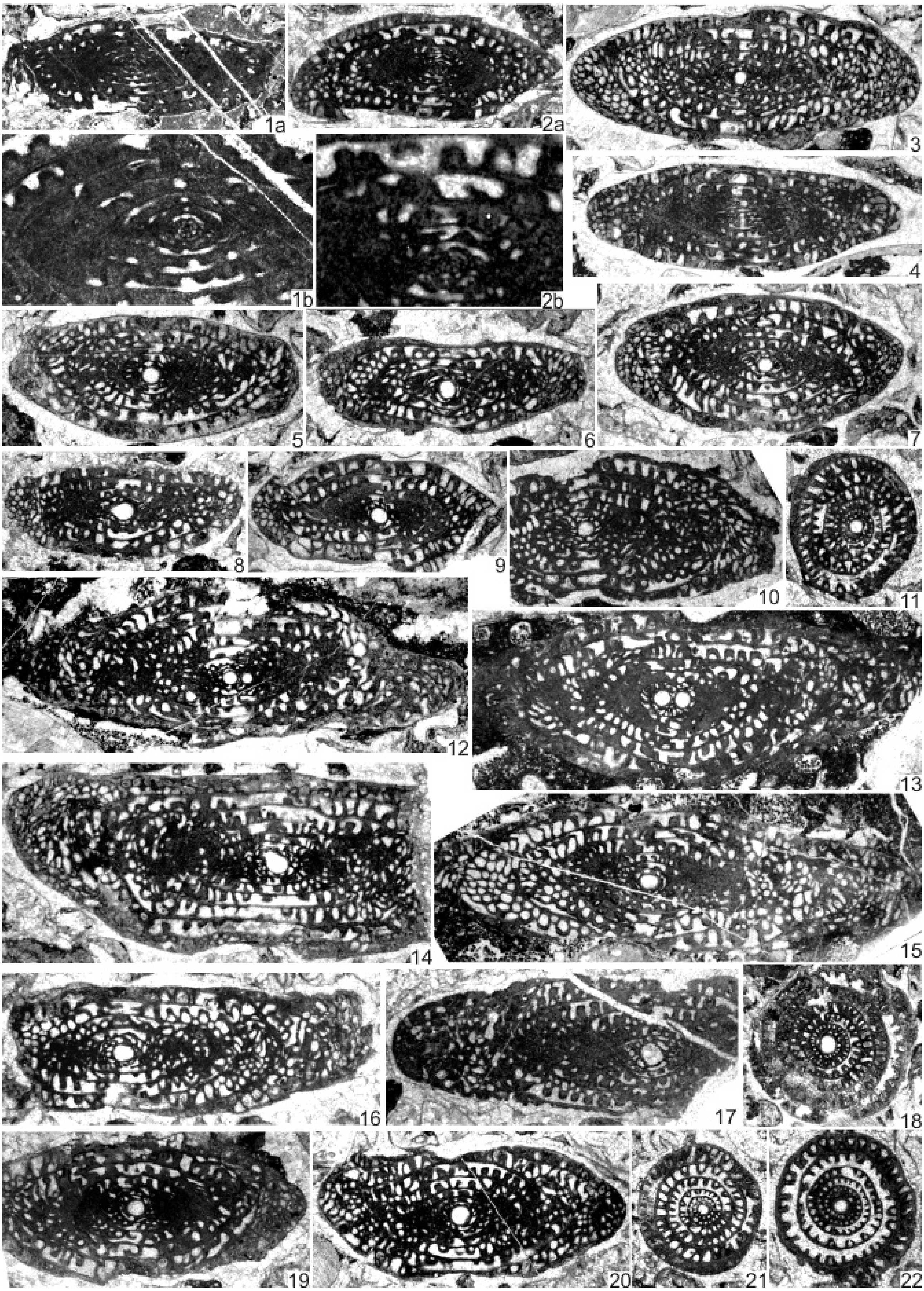
Remarks: Rauzer-Chernousova & Belyaev proposed this species from the Upper Carboniferous of the Pechora region for similar forms to *Triticites moorei* Dunbar & Condra, 1928 from the Pennsylvanian of Nebraska based on its shorter fusiform test with less intensely folded septa and more massive chomata. Illustrated material by Dunbar & Condra (1928) are all free specimens and their thin sections were described by White (1932, pp. 57-59, pl. 5, figs 7-9). Rauzer-Chernousova & Belyaev also pointed out its similarity to *Triticites petschoricus*

Plate VIII

Figs 1-11, 21: *Quasifusulinoides ohtanii* (Kanmera)
1-2: microspheric forms, others: megalospheric forms.
1-3, 5-10: axial sections; 4: tangential section; 11, 21: sagittal section.
1: D2-055222, 2: D2-050001, 3: D2-050013, 4: D2-050014, 5: D2-050009, 6: D2-049999, 7: D2-050020, 8: D2-049992, 9: D2-050021, 10: D2-050015, 11: D2-050017, 21: D2-055265.
Locality 1: B-128 (middle Kasimovian); 2, 6, 8: A-221 (middle Kasimovian); 3-5, 7, 9-11: A-225 (middle Kasimovian). 21: B-132 (middle Kasimovian).
1b, 2b: ×30; others: ×10.

Figs 12-20, 22: *Quasifusulinoides grandis* n. sp.
14: holotype, others: paratypes.
12-17, 19-20: axial sections; 18, 22: sagittal sections.
Register numbers: shown in the description of this new species.
Locality 12-13, 15: B-131 (middle Kasimovian): 14, 16, 18, 20: B-132 (middle Kasimovian); 17, 19: A-308 (middle Kasimovian).
All ×10.

Plate VIII



Rauzer-Chernousova & Belyaev in Rauzer-Chernousova *et al*. (1936). However, the distinction of these three species is not easy because of few specimens illustrated by these authors.

Forms having somewhat elongate test with more number of more tightly coiled inner whorls than those of *Triticites parvulus* and *T. petschoricus* are provisionally identified with *Triticites whitei* herein. More detailed comparison of these three species is difficult so far as the Akiyoshi materials are concerned.

Occurrence and stratigraphic distribution: Common to rare in some samples from the *Rauserites stuckenbergi-Triticites simplex* Zone and the *Carbonoschwagerina morikawai-Jigulites horridus* Zone.

***Triticites yayamadakensis* Kanmera, 1955**
Pl. XXII, figs 23, 29-40; Pl. XXIII, figs 1-3

1955. *Triticites yayamadakensis* Kanmera, pp. 186-188, pl. 12, figs 1-20.
1972. *Triticites fusiformis* Bensh, pp. 48-49, pl. 7, fig. 12; pl. 8, figs 9-10.
1990. *Triticites yayamadakensis* Kanmera.– T. Ozawa & Kobayashi, pl. 4, fig. 6-7.
pars 1991. *Triticites yayamadakensis evectus* Kanmera, 1958.– Watanabe, fig. 18.20-28, 18.30. (non 18-31 = *Triticites yayamadakensis evectus*; 18.29, 18.32-33: other species of *Triticites*).
1998. *Triticites yayamadakensis* Kanmera.– Y. Ota, pp. 54-56, pl. 4, figs 7-14.

Description: Test elongate fusiform with broadly arched periphery, almost straight to slightly convex lateral sides, bluntly pointed poles, and almost straight to slightly curved axis of coiling, and composed of five to seven and a half whorls. Length about 2.6 to 5.6 mm and width about 1.0 to 2.1 mm, giving a form ratio of about 2.3 to 3.1.

Proloculus spherical and its diameter 0.08 to 0.14 mm. Inner two to three whorls tightly coiled and the succeeding whorls gradually to rather rapidly increasing their length and width. Wall thin and structureless in tightly coiled inner whorls, and thickened as thick as 0.05 to 0.07 mm in outer whorls consisting of tectum and finely alveolar keriotheca. Its surface is irregularly undulated in some specimens.

Septa loosely spaced, weakly folded in polar regions and almost planar in the median part of the test. Septal sutures are present in outer one or two whorls, resulting more or less corrugated wall. Septal counts from the first to fifth

Plate IX

Figs 1-2, 4: *Obsoletes obsoletus* (Schellwien)
1: tangential section; 2, 4: axial sections.
1: D2-055173, 2: D2-051706, 4: D2-051707.
Locality 1: B-124 (lower Kasimovian); 2, 4: A-304 (lower Kasimovian). All ×15.

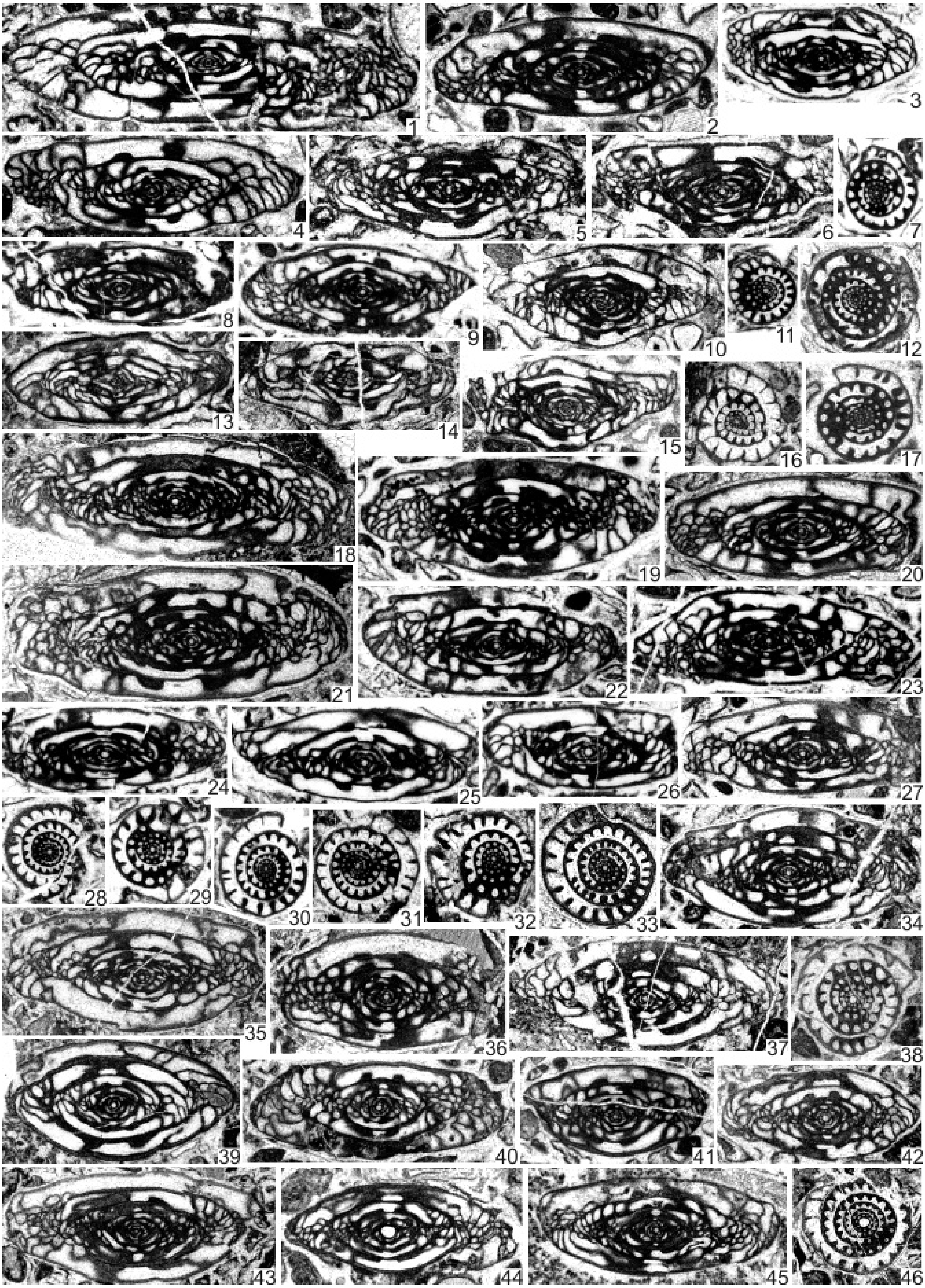
Figs 3, 5-9, 11-12: *Obsoletes burkemensis* Volozanina
3, 5-6, 8-9: axial sections; 7, 11-12: sagittal sections.
3: D2-030206, 5: D2-055188, 6: D2-055178, 7: D2-030196, 8: D2-030175, 9: D2-030198, 11: D2-030182, 12: D2-055175.
Locality 3, 7-9, 11: A-20 (lower Kasimovian); 5-6, 12: B-124 (lower Kasimovian).
All ×15.

Figs 10, 13-17: *Obsoletes*? sp.
10, 13-14: tangential sections; 15: axial section; 16-17: sagittal sections.
10: D2-055185, 13: D2-049946, 14: D2-051646, 15: D-055183, 16: D2-049942, 17: D2-055180.
Locality 10, 15, 17: B-124 (lower Kasimovian); 13, 16: A-219 (lower Kasimovian); 14: A-295 (lower Kasimovian).
All ×15.

Figs 18-33: *Protriticites variabilis* Bensh
18-27: axial sections, 28-33: sagittal sections.
18: D2-047769, 19: D2-030183, 20: D2-051642, 21: D2-051641, 22: D2-030180, 23: D2-030190, 24: D2-030176, 25: D2-030173, 26: D2-030193, 27: D2-055186, 28: D2-030199, 29: D2-030208, 30: D2-030188, 31: D2-030174, 32: D2-030167, 33: D2-055192.
Locality 18: A-142 (lower Kasimovian); 19, 22-26, 28-32: A-20 (lower Kasimovian); 20-21: A-295 (lower Kasimovian); 27, 33: B-124 (lower Kasimovian).
All ×15.

Figs 34-46: *Protriticites subschwagerinoides* Rozovskaya
34-37, 39-45: axial sections; 38, 46: sagittal sections.
34: D2-055210, 35: D2-051720, 36: D2-051649, 37: D2-055212, 38: D2-051723, 39: D2-055216, 40: D2-051643, 41: D2-044952, 42: D2-051722, 43: D2-051732, 44: D2-055176, 45: D2-051702, 46: D2-055214.
Locality 34, 37, 39, 46: B-127 (lower Kasimovian); 35, 38, 42-43: A-306 (lower Kasimoian); 36, 40: A-295 (lower Kasimovian); 41: A-219 (lower Kasimovian); 44: B-124 (lower Kasimovian); 45: A-304 (lower Kasimovian).
All ×15.

Plate IX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whorl 6 or 7, 9 to 11, 12 to 14, 13 or 14, and 15 to 17, respectively in the three illustrated sections. Tunnel low throughout the test and its path irregular in outer whorls. Chomata small but distinct in inner and middle whorls, and absent or rudimentary in outer whorls.

Remarks: The Wakatakeyama specimens are identical with the types from Yayamadake by Kanmera (1955), but they show broader variation of many test characters. Distinct septal sutures, indistinct in the types, are present in outer one or two whorls, resulting more or less corrugated wall in the present ones. *Triticites fusiformis* described by Bensh (1972) from South Fergana is closely similar to this species, in shape and size of the test, mode of septal folding, and weak chomata. From these similarities and its occurrence from the upper Kasimovian, both are assumed to be conspecific. *Triticites nitidus* Getman & Dzhenchuraeva in Dzhenchuraeva & Getman (2007) from middle Tian Shan is also similar to this species, but has smaller test. *T. yayamadakensis* is distinguished from *Triticites whitei* in its more elongate and more weakly folded septa in polar regions. It is easily discriminated from other three species of *Triticites* described above (*T. ozawai, T. parvulus*, and *T. simplex*) by its elongate test, more loosely spaced and more weakly folded septa. Among 14 specimens identified with *Triticites yayamadakensis evectus* Kanmera, 1958 by Watanabe (1991), 10 are transferred to this species. Broad morphologic variations are recognized in these 10 specimens in Watanabe (1991) as well as the present specimens.

Occurrence and stratigraphic distribution: Rare in few samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and common in few samples from the *Rauserites stuckenbergi-Triticites simplex* Zone.

Triticites cf. *evectus* Kanmera, 1958
Pl. XXIII, figs 4-5

Compare:
1958. *Triticites yayamadakensis evectus* Kanmera, pp. 163-165, pl. 25, figs 1-10.
1998. *Triticites yayamadakensis evectus* Kanmera.– Y. Ota, pp. 57-58, pl. 4, figs 15-18.

Remarks: Small number of specimens with larger test than those identified with *Triticites yayamadakensis* are comparable to *Triticites evectus*, originally described as a subspecies of *T. yayamadakensis* by Kanmera (1958). They have more inflated test and thicker wall in comparison with those of the original material. On the other hand, loosely spaced septa and shallow septal sutures in the last whorl are common in the Yayamadake and present specimens. Four specimens illustrated by Y. Ota (1998) and one specimen (Watanabe, 1991, fig. 18.31) among 14 illustrated by Watanabe are closely similar to and identical with the types of Kanmera's (1958).

Occurrence and stratigraphic distribution: Rare in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone and from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Triticites? cf. *convexus* Bensh, 1962
Pl. XLIX, fig. 15

Compare:
1962. *Triticites convexus* Bensh, p. 192, pl. 2, figs 7-8.
1972. *Triticites convexus* Bensh.– Bensh, p. 61, pl. 12, figs 6-8.

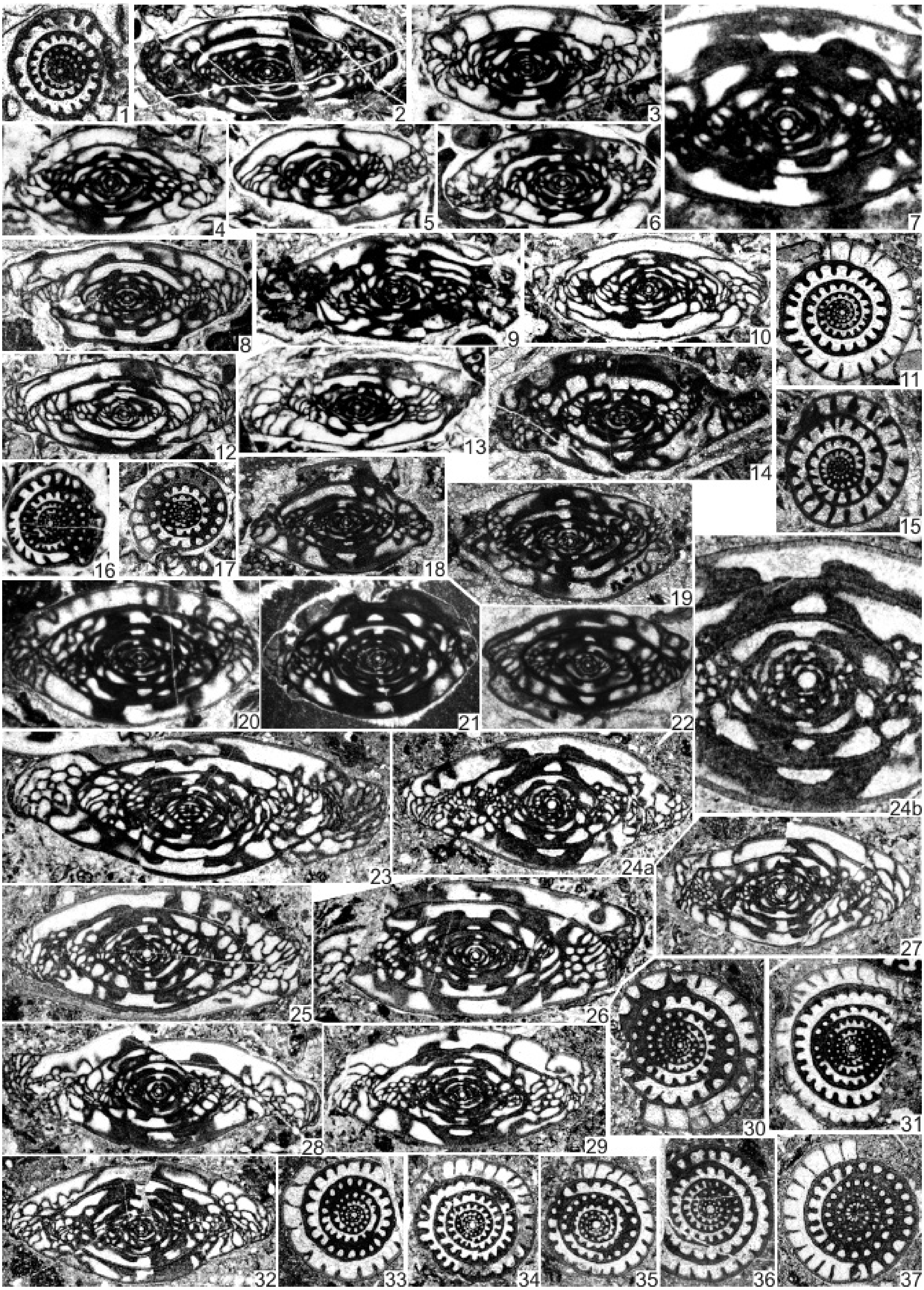
Plate X

Figs 1-13, 16-17: *Protriticites subschwagerinoides* Rozovskaya
1, 11, 16-17: sagittal sections; 2-10, 12-13: axial sections.
1: D2-055190, 2: D2-049941, 3: D2-030192, 4: D2-030199, 5: D2-030201, 6: D2-030181, 7: D2-030183, 8: D2-051726, 9: D2-030197, 10: D2-055218, 11: D2-055179, 12: D2-051727, 13: D2-030203, 16: D2-030194, 17: D2-051730.
Locality 1, 11: B-124 (lower Kasimovian); 2: A-219 (lower Kasimovian); 3-7, 9, 13: A-20 (lower Kasimovian); 8, 12: A-306 (lower Kasimovian); 10: B-127 (lower Kasimovian).
7: ×30, others: ×15.

Figs 14-15, 18-22: *Montiparus montiparus* (von Möller)
14, 18-22: axial sections; 15: parallel section.
14: D2-056758 15: D2-056763, 18: D2-056754, 19: D-056765. (20-22: stored in the Nagoya Univ.)
Locality 14-15, 18-19: B-179 (middle Kasimovian); 20-22: NU-2 (middle Kasimovian).
All ×15.

Figs 23-37: *Montiparus umbonoplicatus* (Rauzer-Chernousova & Belyaev)
23: tangential section; 24-29, 32: axial sections; 30-31, 33-36: sagittal sections; 37: parallel section.
23: D2-047797, 24: D2-047793, 25: D2-047796, 26: D2-047785, 27: D2-047778, 28: D2-047787, 29: D2-047792, 30: D2-047788, 31: D2-047789, 32: D2-047794, 33: D2-047780, 34: D2-047779, 35: D2-047795, 36: D2-047776, 37: D2-047782.
Locality all A-143 (middle Kasimovian).
24b: ×30, others: ×15.

Plate X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Remarks: Although well-oriented specimens are few, the specimen illustrated appears to be assignable to *Mesoschubertella* in its inflated fusiform test with relatively thick wall for the test size, to *Schwageriniformis* in its tightly coiled inner whorls, or to *Triticites* in its mode of septal folding. It is compared to *Triticites convexus* from the middle Asselian of Southern Fergana (Bensh, 1972) based on tightly coiled inner whorls, and tiny but distinct chomata, even if the generic assignment of this species is uncertain.

Occurrence and stratigraphic distribution: Rare in few samples from the *Pseudoschwagerina miharanoensis*-*Paraschwagerina akiyoshiensis* Zone.

***Triticites*? spp.**

Pl. XXXII, figs 21-51

Remarks: Many small forms of schwagerinids not easily identified and assigned into the genus are recognized in the studied area. All of them except for late Gzhelian specimen (Pl. XXXII, fig. 33) illustrated are early Asselian in age because of their associations with age-diagnostic species of schwagerinids. Though detailed comparisons are uneasy, some specimens are more or less similar to a species of *Triticites* or *Rauserites*. Some of other specimens might be questionably assigned into "*Schellwienia*". Nevertheless, an independency of *Schellwienia* emended by Solovieva (1987) is withdrawn herein. Because *Schellwienia sensu* Solovieva is also not easily distinguished taxonomically from both *Triticites* and *Rauserites*, as well as *Schellwienia* originally defined by Staff & Wedekind (1910).

Thirty-one specimens illustrated are classified as *Triticites*? spp. herein without any taxonomic subdivisions. They are roughly classified into three groups. The 19 specimens (Pl. XXXII, figs 21-39) belonged to the first group are more or less similar to *Triticites parvulus* or *T. whitei* and might be included into either *T. parvulus* or *T. whitei*. However, they have more intensely folded septa than these two species described above. Some of their assignment into *Rauserites* or *Rugosofusulina* might be also possible.

Seven specimens (Pl. XXXII, figs 40-44, 48-49) included in the second group are the closest to those named *Triticites obai* Toriyama, 1958 in many respects except for smaller test of this group. However, their assignment to *Triticites* seems doubtful because of low septal folds almost throughout the test. Three specimens compared with *T. obai* by Y. Ota (1998) are included in this second group.

Other five specimens (Pl. XXXII, figs 45-47, 50-51) included in the third group are comparable to "*Schellwienia*" *haydeni* Y. Ozawa, 1925b originally described from Akiyoshi (Y. Ozawa, 1925b). The specimen identified with this species and reassigned to *Triticites* by Ueno (1989) has more inflated test than those by Y. Ozawa (1925b) and Toriyama (1958). Specimens of the third group appear to be alike to *Triticites evectus*, but have more closely spaced septa, thinner wall, and less tightly coiled inner whorls.

Occurrence and stratigraphic distribution: Rare in few samples from the *Jigulites titanicus*-*Carbonoschwagerina minatoi* Zone and common to rare in many samples from the *Sphaeroschwagerina fusiformis*-*Pseudoschwagerina muongthensis* Zone.

Genus *Daixina* Rozovskaya, 1949

Type species: *Daixina ruzhencevi* Rozovskaya, 1949, p. 252.

***Daixina fecunda* (Shamov & Shcherbovich, 1949)**

Pl. XLIV, figs 1-26

1949. *Pseudofusulina fecunda* Shamov & Shcherbovich, p. 165, pl. 1, figs 5-6.

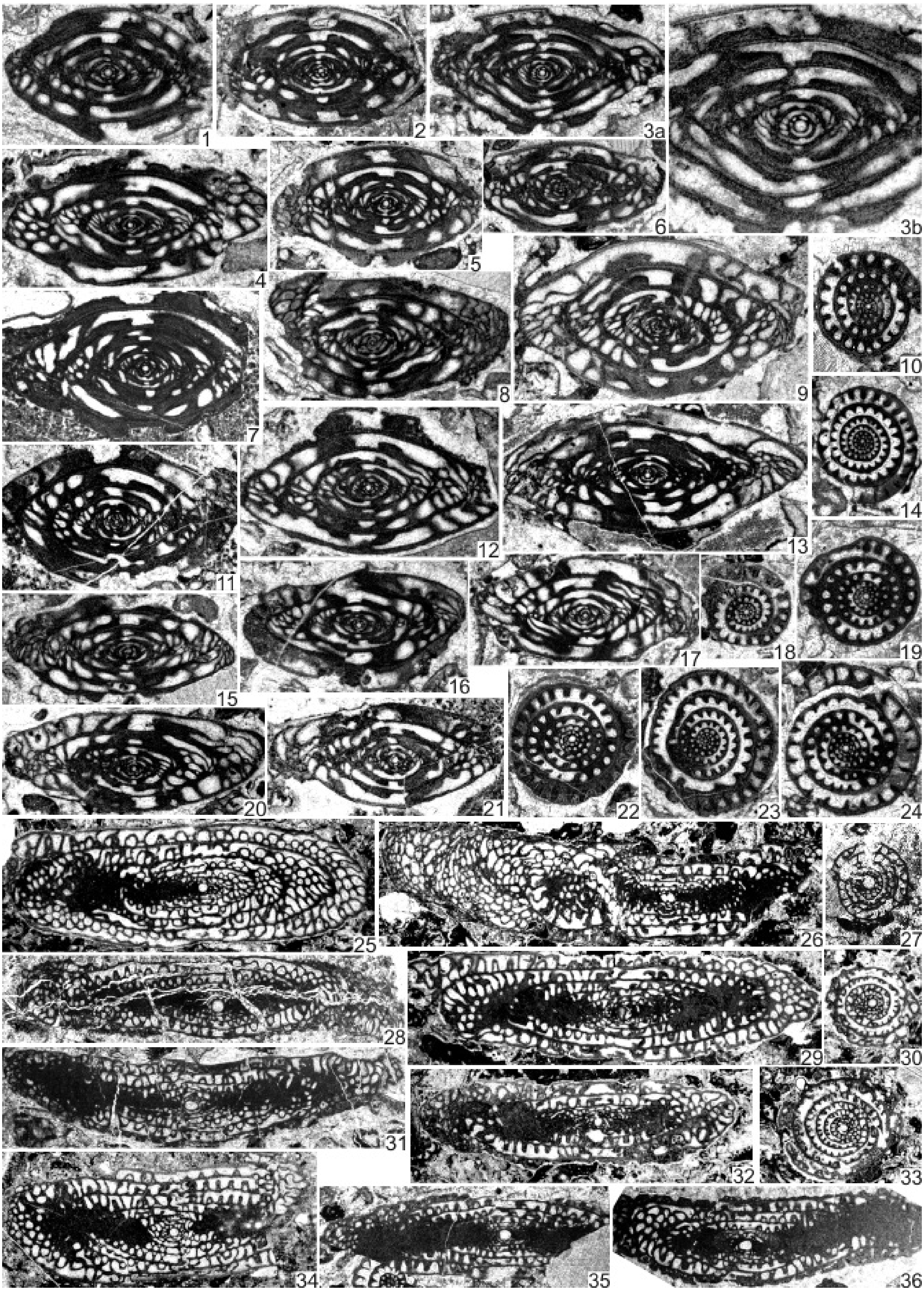
1990. *Daixina* n. sp. B, T. Ozawa & Kobayashi, pl. 6, figs 9-11.

Plate XI

Figs 1-24: *Montiparus matsumotoi* (Kanmera)
1-5, 7-8, 11-13, 15-17, 20-21: axial sections; 6, 9: tangential sections; 10, 14, 18-19, 22-24: sagittal sections.
1: D2-049970, 2: D2-055236, 3: D2-049978, 4: D2-049965, 5: D2-055234, 6: D2-047806, 7: D2-055225, 8: D2-049988, 9: D2-055242, 10: D2-049981, 11: D2-055228, 12: D2-049957, 13: D2-055231, 14: D2-049954, 15: D2-049969, 16: D2-049968, 17: D2-055244, 18: D2-049979, 19: D2-049976, 20: D2-047801, 21: D2-055220, 22: D2-055238, 23: D2-049961, 24: D2-049964
Locality 1, 3-4, 8, 10, 12, 14-16, 18-19, 23-24: A-220 (middle Kasimovian); 2, 5, 7, 9, 11, 13, 17, 21-22: B-128 (middle Kasimovian); 6, 20: A-144 (middle Kasimovian).
3b: ×30, others ×15.

Figs 25-36: *Quasifusulina longissima* (von Möller)
25-26, 28-29, 31-32, 34-36: axial sections; 27, 30, 33: sagittal sections.
25: D2-055859, 26: D2-055837, 27: D2-057035, 28: D2-057018, 29: D2-055842, 30: D2-055854, 31: D2-057020, 32: D2-055848, 33: D2-055840, 34: D2-051868, 35: D2-057021, 36: D2-057034.
Locality 25-26, 29-30, 32-33: A-425 (lower Gzhelian); 27-28, 31, 35-36: B-202 (upper Kasimovian); 34: A-316 (lower Gzhelian).
All ×10.

Plate XI



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Description: Test fusiform to inflated fusiform with broadly arched periphery, almost straight to slightly convex lateral sides, bluntly pointed poles, consisting of five to six and a half whorls with straight axis of coiling. Length about 5.2 to 8.0 mm and width about 2.4 to 3.4 mm, giving a form ratio of about 1.8 to 3.0.

Proloculus spherical to subspherical and its longer diameter 0.19 to 0.42 mm. The first whorl subspherical to inflated fusiform and the succeeding fusiform whorls gradually increasing their length and width.

Wall thick except for inner few whorls, considerably varing 0.05 to 0.11 mm, and consisting of tectum and finely to moderately alveolar keriotheca. Septa intensely and irregularly folded. Shallow septal sutures present in outer whorls. Septal counts from the first to sixth whorl 9 to 13, 14 to 25, 18 to 28, 19 to 29, 22 to 28, and more than 25, respectively in seven sections illustrated.

Tunnel low and narrow in inner few whorls, then becoming higher about one half as high as chambers in middle and outer whorls. Chomata rudimentary or weakly developed on proloculus and inner one to three whorls, but not present in the succeeding whorls.

Remarks: Shape and size of the test and mode of septal folding of the present specimens are similar to those of *Pseudofusulina fecunda* Shamov & Shcherbovich, 1949 from the middle Asselian of Bashkorostan (Shamov & Shchebovich, 1949). They are also alike to *Daixina biconica* Shcherbovich in Rauzer-Chernousova & Shcherbovich (1958) from the upper part of the *Schwagerina* Horizon in the central part of the Russian Platform. Although morphologic variations of these Russian two species are not exactly ascertained, they might be conspecific.

The Wakatakeyama forms are identical with *Pseudofusulina fecunda* in spite of slight differences in somewhat thicker wall and more loosely coiled inner whorls in the latter than in the former. Three specimens named as *Daixina* n. sp. B by T. Ozawa & Kobayashi (1990) from the lower Asselian are presumed to be included in this species, taking broad morphologic variation of the present material into account. Inflated fusiform test with intensely and irregularly folded septa and absence of axial fillings of *Pseudofusulina fecunda* suggest its reassignment to *Daixina*.

Occurrence and stratigraphic distribution: Common in some samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone and rare in few samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Daixina licharevi Davydov, 1986c

Pl. XLV, figs 16-20, 22-24

1986c. *Daixina* (*Daixina*) *licharevi* Davydov, p. 114, pl. 21, figs 5-6.

Description: Test fusiform to elongate fusiform with broadly arched periphery, slightly convex lateral sides, and bluntly pointed poles, and composed of five and a half to seven whorls. Length about 6.3 to 7.6 mm, width about 2.2 to 3.5 mm, and a form ratio of about 2.1 to 2.9. Proloculus spherical to subspherical and its longer diameter 0.12 to 0.20 mm. Inner one to three whorls tightly coiled relatively to the outer whorls gradually increasing their length and width. Wall thin in inner tightly coiled whorls and consists of a single layer or tectum and translucent layer. Wall of outer whorls smooth to more or less corrugated and composed of tectum and finely alveolar keriotheca.

Septa moderately to intensely folded throughout test. Septal counts from the first to sixth whorl 9, 14, 20, 25, 29, and more than 21, respectively in one illustrated section. Tunnel low and narrow in inner tightly coiled whorls, then becoming inconspicuous. Chomata distinct in inner whorls, and indistinguishable in outer ones.

Remarks: *Daixina licharevi* was described from the lower and middle parts of Gzhelian of Darvas (Davydov, 1986c). Its inner whorls are tightly coiled and proloculus is rather small for the genus. These characteristic features

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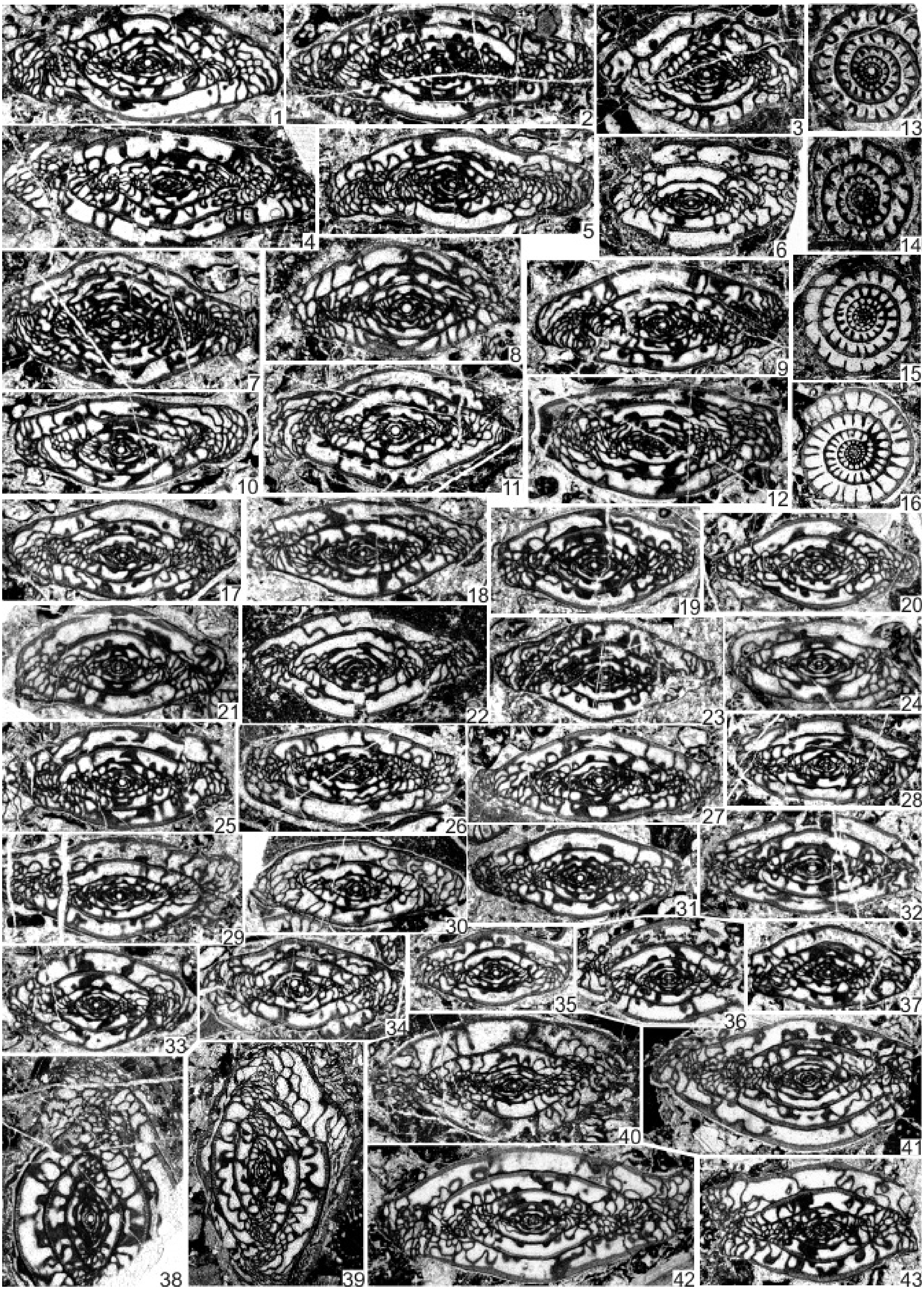
Plate XII

Figs 1-37: *Montiparus minensis* n. sp.
1: holotype, others: paratypes.
1-12, 17-37: axial sections; 13-14, 16: sagittal sections; 15: parallel section.
Register numbers: shown in the description of this new species.
Locality 1-3, 5, 7, 9-11, 13, 17-21, 23, 25-27, 29-35, 37: A-228 (upper Kasimovian); 4: B-140 (upper Kasimovian); 6, 15: A-415 (upper Kasimovian); 8, 16, 22, 36: A-424 (upper Kasimovian); 12, 24, 28: A-227 (upper Kasimovian); 14: A-310 (upper Kasimovian).
All ×10.

Figs 38-43: *Carbonoschwagerina nakazawai* (Nogami)
38-43: axial sections.
38: D2-057302, 39: D2-057310, 40: D2-057320, 41: D2-055849, 42: D2-055844, 43: D2-055850.
Locality 38-39: B-218 (middle Gzhelian), 40: B-219 (middle Gzhelian); 41-43: A-425 (lower Gzhelian).
All ×10.

Plate XII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are also recognized in *Daixina evoluta* Davydov, 1986c from the upper part of Gzhelian of Darvas. However, outer whorls seem to be more loosely coiled in *D. evoluta*. The Wakatakeyama specimens are presumed to be allied to and possibly identical with *D. licharevi*.

Occurrence and stratigraphic distribution: Rare in some samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone and the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone. Few specimens possibly identical with *Daixina licharevi* occur in the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Daixina ossinovkensis **Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1958**

Pl. XLV, figs 21, 25-28; Pl. XLVI, fig. 4

1958. *Daixina ossinovkensis* Shcherbovich in Rauzer-Chernousova & Shcherbovich, p. 30, pl. 1, figs 11-12.

Remarks: Forms similar to *Daixina ossinovkensis*, originally proposed from the *Schwagerina* Horizon of the Russian Platform by Shcherbovich in Rauzer-Chernousova & Shcherbovich (1958) were exclusively obtained from the upper Asselian of the studied area. They are distinguished from *Daixina licharevi* from its smaller test, smaller length and width of the corresponding whorls, and weaker septal folding. Generic assignment to *Daixina* in this paper is followed according to Shcherbovich, though it might be rearranged.

Occurrence and stratigraphic distribution: Common in only one sample (A-406) from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Daixina parva **(Belyaev in Belyaev & Rauzer-Chernousova, 1938)**

Pl. XLIII, figs 8-18

1938. *Pseudofusulina uralica* var. *parva* Belyaev in Belyaev & Rauzer-Chernousova, pp. 184-185, pl. 2, figs 1-4.

1958. *Pseudofusulina uralica* var. *parva* Belyaev.– Rauzer-Chernousova & Shcherbovich, pp. 40-41, pl. 4, figs 1-2.

1961. *Pseudofusulina parva* Belyaev.– Grozdilova & Lebedeva, pp. 202-203, pl. 8, figs 3-4.

Remarks: This species was originally described as a variety of *Pseudofusulina uralica* (Krotow, 1888) by Belyaev in Belyaev & Rauzer-Chernousova (1938) by having smaller test than *uralica* from the “Sakmarian” *Schwagerina* Horizon of the Northern Urals. Later, it was treated as an independent species by Grozdilova & Lebedeva (1961) who showed it occurs in the lower Asselian Nenetskom Horizon and the upper part of the *Schwagerina* Horizon of northern Timan (Russia). The present Wakatakeyama specimens are probably identical with these Russian forms in size and shape of the test and mode of septal folding, though having somewhat larger proloculus. They are somewhat larger than those described by Rauzer-Chernousova & Shcherbovich (1958) from the *Schwagerina* Horizon of the central part of the Russian Platform.

This species, herein reassigned to *Daixina*, might be distinguished from *Daixina sokensis* (Rauzer-Chernousova, 1938) by its more inflated fusiform to subrhomboidal test with less rounded poles. Other test characters are systematically comparable. Some specimens with more loosely coiled inner whorls and more weakly folded septa are recognized in the Wakatakeyama materials. They might be reassigned to *Daixina* (*Bosbytauella*) proposed by Isakova (1982) [=*Ultradaixina* by Davydov (1986c) according to Rauzer-Chernousova *et al.* (1996)]. These incomplete specimens, however, are included in this species because of similar shape and size of the test and mode of septal folding, and co-existence with this species.

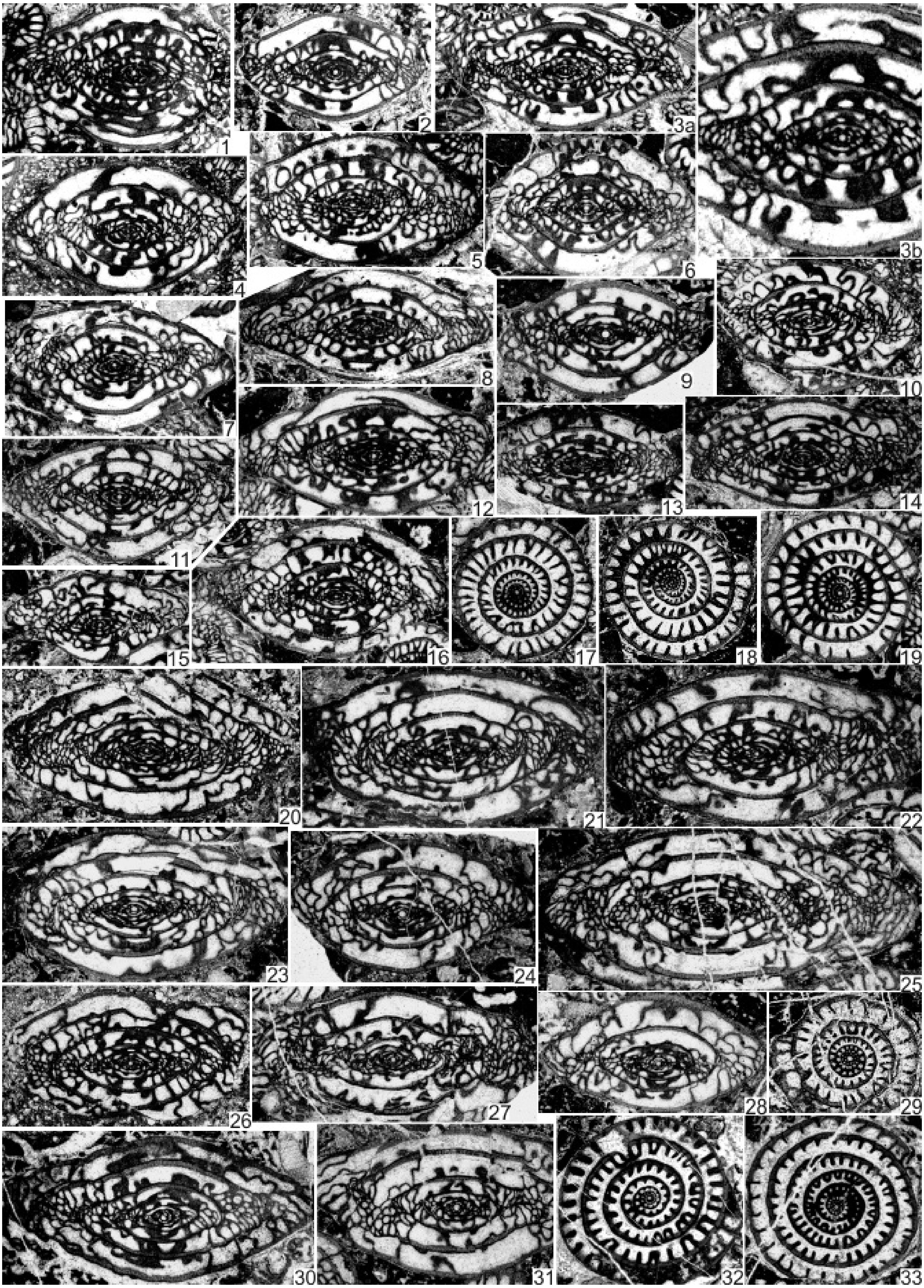
Occurrence and stratigraphic distribution: Common in few samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Plate XIII

Figs 1-19: *Carbonoschwagerina nipponica* n. sp.
3: holotype, others: paratypes.
1-16: axial sections, 17-19: sagittal sections.
Register numbers: shown in the description of this new species.
Locality 1, 3-8, 10-13, 15-19: A-240 (upper Kasimovian); 2: B-141 (upper Kasimovian); 9: A-425 (lower Gzhelian); 14: B-176 (upper Kasimovian)
3b: ×20, others ×10.

Figs 20-33: *Carbonoschwagerina nakazawai* (Nogami)
20-28, 30-31: axial sections; 29, 32-33: sagittal sections.
20: D2-040929, 21: D2-055910, 22: D2-055924, 23: D2-055943, 24: D2-055928, 25: D2-055919, 26: D2-040933 27: D2-055906, 28: D2-055908, 29: D2-053237, 30: D2-055969, 31: D2-055916, 32: D2-050038, 33: D2-050057.
Locality 20, 26: A-25C (middle Gzhelian); 21-25, 27-28, 31: A-427 (middle Gzhelian); 29: A-322 (middle Gzhelian); 30: A-428 (middle Gzhelian); 32-33: A-227 (upper Kasimovian).
All ×10.

Plate XIII



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Daixina sokensis (Rauzer-Chernousova, 1938)
Pl. XLIII, figs 1-7

1938. *Pseudofusulina sokensis* Rauzer-Chernousova, pp. 135-137, 159, pl. 8, figs 1-2.
cf. 1958. *Pseudofusulina sokensis* Rauzer-Chernousova.– Kanmera, pp. 206-208, pl. 35, figs 1-9.
cf. 1958. *Daixina sokensis* (Rauzer-Chernousova).– Rozovskaya, p. 106, pl. 12, figs 3-5.
cf. 1986c. *Daixina* ex gr. *sokensis* (Rauzer-Chernousova).– Davydov, p. 114, pl. 21, fig. 4.

Description: Test inflated fusiform with broadly arched periphery, slightly convex lateral sides, rounded poles, and straight to slightly curved axis of coiling, and composed of five to six whorls. Length about 6.0 to 8.2 mm and width about 2.6 to 3.9 mm, giving a form ratio of about 1.8 to 2.5.
Proloculus spherical to subspherical and its longer diameter 0.22 to 0.40 mm. The first whorl subspherical to inflated fusiform. The succeeding whorls inflated fusiform and rather rapidly increasing their length and width. Poles change from bluntly pointed to rounded toward outer whorls.
Wall as thick as 0.07 to 0.11 mm in outer whorls of most specimens and consists of tectum and alveolar keriotheca. Finely alveolar structure is preserved even in the first whorl in specimens.
Septa intensely and rather irregularly folded throughout the test. Septal folds are high and some are reaching the roof of chambers, but considerably variable by specimens. Septal counts from the first to fifth whorl 10, 20, 21 or 26, 24 or 29, and 25, respectively in two illustrated sections. Tunnel low, narrow and straight in inner one or two whorls, then becoming higher and irregularly widened outwards. Chomata rudimentarily preserved on proloculus and in inner one or two whorls, but not present in the succeeding ones.
Remarks: Two specimens were illustrated in the original description by Rauzer-Chernousova (1938) from the Samara Bend. They are different each other in shape of the test, proloculus size, mode of septal folding, and length and width of corresponding whorls. The Yayamadake specimens described by Kanmera (1958) are similar to the inflated form designated as the holotype (Rauzer-Chernousova, 1938, pl. 8, fig. 2), whereas the Darvas specimen by Davydov (1986c) resembles the elongate form (Rauzer-Chernousova, 1938, pl. 8, fig. 1). Both inflated and elongate forms are recognized in the Samara Bend specimens by Rozovskaya (1958), as well as the present Wakatakeyama specimens in which specimens with inflated test are dominant. Variable appearances of shape and size of the test, mode of septal folding, wall thicknesss, and size of proloculus are considered to a result of important morphologic variations of this species.
Occurrence and stratigraphic distribution: Common to rare in some samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Daixina cf. *robusta* Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich, 1958
Pl. XLV, figs 1-15

Compare:
1958. *Daixina robusta* Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich, pp. 28-29, pl. 1, figs 6-7.
1986a. *Daixina robusta robusta* Rauzer-Chernousova.– Davydov, p. 70, pl. 7, figs 4-5.
1990. *Daixina* sp. cf. *D. robusta* Rauzer-Chernousova.– T. Ozawa & Kobayashi, pl. 5, fig. 4.

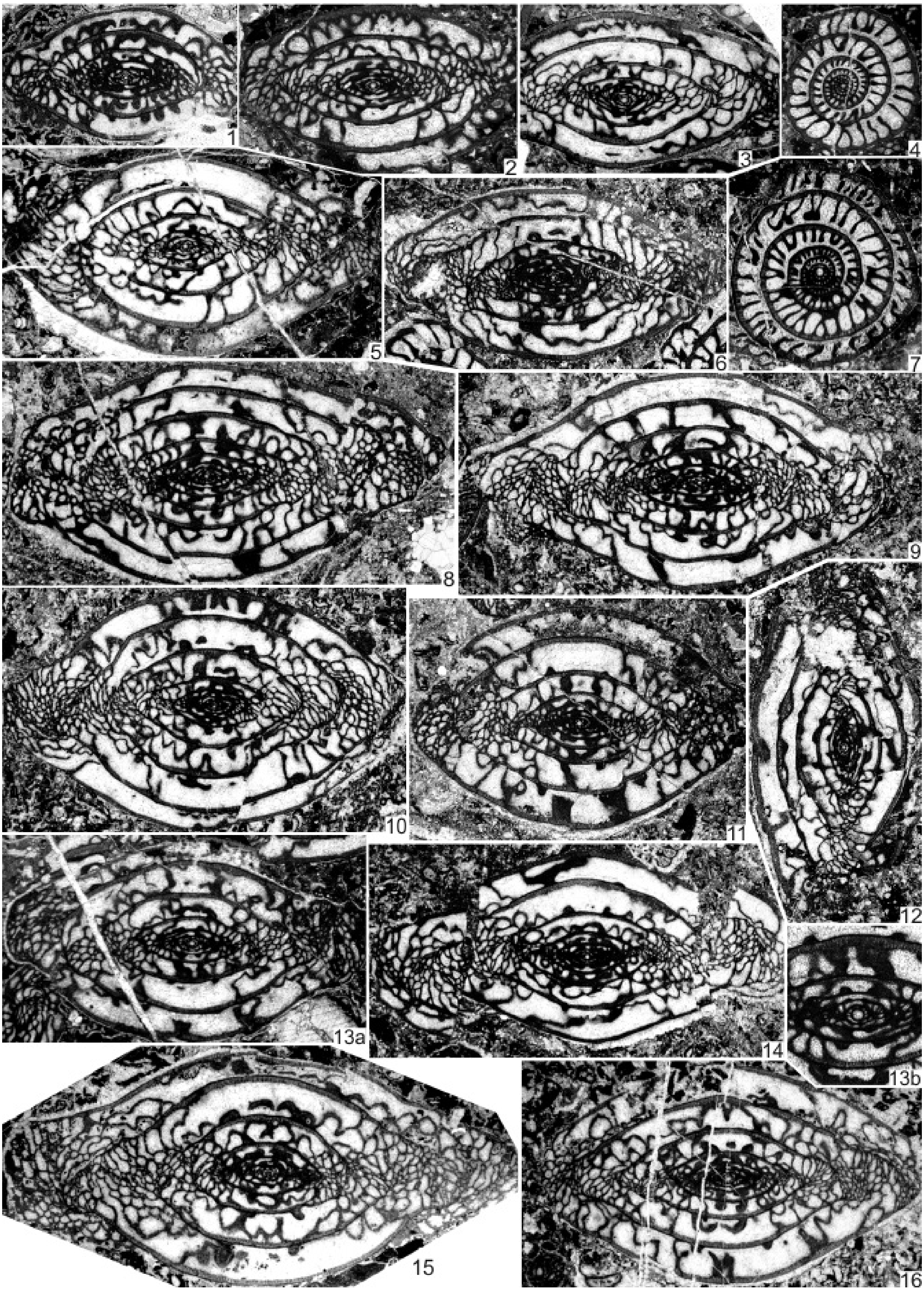
Description: Test inflated fusiform with arched to broadly arched periphery, almost straight lateral sides, and rounded to bluntly pointed poles, and composed of five to six whorls. Length about 4.7 to 6.5 mm and width about 2.4 to 3.4 mm, giving a form ratio of about 1.8 to 2.6.
Proloculus spherical to subspherical and its longer diameter 0.20 to 0.40 mm. Inner one to two whorls subspherical to inflated fusiform, and succeeding whorls inflated fusiform rather rapidly increasing their width. Wall thin and of single layer in inner one to two whorls, and as thick as 0.05 to 0.08 mm consisting of tectum and alveolar keriotheca in outer whorls.

Plate XIV

Figs 1-4: *Carbonoschwagerina nakazawai* (Nogami)
1-3: axial sections, 4: sagittal sections.
1: D2-040910, 2: D2-057094, 3: D2-055927, 4: D2-057105.
Locality 1: A-25b (middle Gzhelian); 2, 4: B-207 (middle Gzhelian); 3: A-427 (middle Gzhelian).
All ×10.

Figs 5-16: *Carbonoschwagerina morikawai* (Igo)
5-6, 8-14, 16: axial sections; 7: sagittal section; 15: tangential section.
5: D2-047302, 6: D2-040924, 7: D-057313, 8: D2-040922, 9: D2-040937, 10: D2-040926, 11: D2-040945, 12: D2-040931, 13: D2-057082, 14: D2-040927, 15: D2-056003, 16: D2-056022.
Locality 5: A-98 (middle Gzhelian); 6, 8-12, 14: A-25C (middle Gzhelian); 7: B-218 (middle Gzhelian); 13: B-207 (middle Gzhelian); 15-16: A-430 (middle Gzhelian).
13b: ×20, others: ×10.

Plate XIV



Septa closely spaced in inner whorls, moderately to intensely and rather irregularly folded throughout the test. Septal folds are high and some are reaching the roof of chambers. Septal counts from the first to fifth whorl 9 to 11, 18 to 20, 21 to 23, 25 to 29, and 26 to 31, respectively in three illustrated sections. Tunnel low, narrow and straight in inner one to two whorls, then becoming somewhat higher outwards. Chomata rudimentary on proloculus and in inner one or two whorls and not developed in the succeeding ones.

Remarks: The present specimens are distinguished from *Daixina fecunda* described above by their more inflated test and more loosely coiled middle and outer whorls. They are allied to *Daixina robusta* originally described by Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich (1958) from the lower part of the *Schwagerina* Horizon (lower Asselian) and the upper part of the *Pseudofusulina* Horizon (upper Gzhelian) in their inflated fusiform test and mode of septal folding. However, detailed comparison is not easy because of few specimens illustrated in the original description. The Wakatakeyama specimens are also comparable to *Daixina robusta robusta* described by Davydov (1986a) from the uppermost Gzhelian of the Pre-Urals. *Daixina robusta raznicini* Volozhanina, 1962 re-described by Davydov (1986a) is different from the original material by Volozhanina (1962) from the upper Gzhelian of the Timan-Pechora region and nearly the same as his *D. robusta robusta* from the Pre-Urals.

The present specimens are also similar to *Daixina firma* (Shamov, 1958) described by Sheng & Wang (1984) from Jiangsu and illustrated by Watanabe (1991) from Akiyoshi. However, septal foldings are more irregular and polar regions of the test are more rounded in the present specimens.

Occurrence and stratigraphic distribution: Common in some samples only from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

***Daixina* spp.**

Pl. XLVI, figs 1-2, 3(?), 5-6

Remarks: Considerable number of specimens probably included in the genus *Daixina* are contained in the middle Gzhelian to upper Asselian samples of the present material. Most of them are not well oriented or fragmental, and their specific identification is impossible. Among them, five axial sections are illustrated for reference to compare with the species described above. The specimen contained in the middle Asselian (e.g., Pl. XLVI, fig. 6) is somewhat alike to *Daixina ossinovkensis*, but has more inflated test. That from the upper Gzhelian (Pl. XLVI, fig. 3) might be belonged to another genus, though uncertain because of absence of a few outer whorls.

Occurrence and stratigraphic distribution: Common to rare in some samples in the *Carbonoshwagerina morikawai-Jigulites horridus* Zone to the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Genus *Jigulites* Rozovskaya, 1948

Type species: *Triticites jigulensis* Rauzer-Chernousova, 1938.

Remarks: *Jigulites* resembles other relatively large schwagerinids known from the Gzhelian and Asselian, such as *Daixina* and *Pseudofusulina*. In general, *Jigulites* and *Pseudofusulina* might be distinguished from *Daixina* by their more elongate fusiform test and not so intensely folded septa in the median part of the test. *Jigulites* is not strictly discriminated from *Pseudofusulina* by its intensity and irregularity of septal folding, whereas axial fillings are more indistinct and almost absent in the former. It seems to be almost difficult to separate these three genera based on slight differences of ontogenetic changes of the test expansion, intensity and regularity of septal folding, degree of undulation of wall, and development of chomata and phrenothecae. Diagnoses of these three genera are more or less different and considerably variable among specialists. Those in this paper and in Bensh (1972) are close in general.

***Jigulites horridus* (Kanmera)**

Pl. XXXVIII, figs 1-20; Pl. XXXIX, figs 1-20

1958. *Pseudofusulina horrida* Kanmera, pp. 196-199, pl. 31, figs 13-20.

1958b. *Schwagerina amushanensis* Sheng, pp. 49-50, pl. 2, figs 6-8.

Plate XV

Figs 1-16: *Carbonoschwagerina morikawai* (Igo)

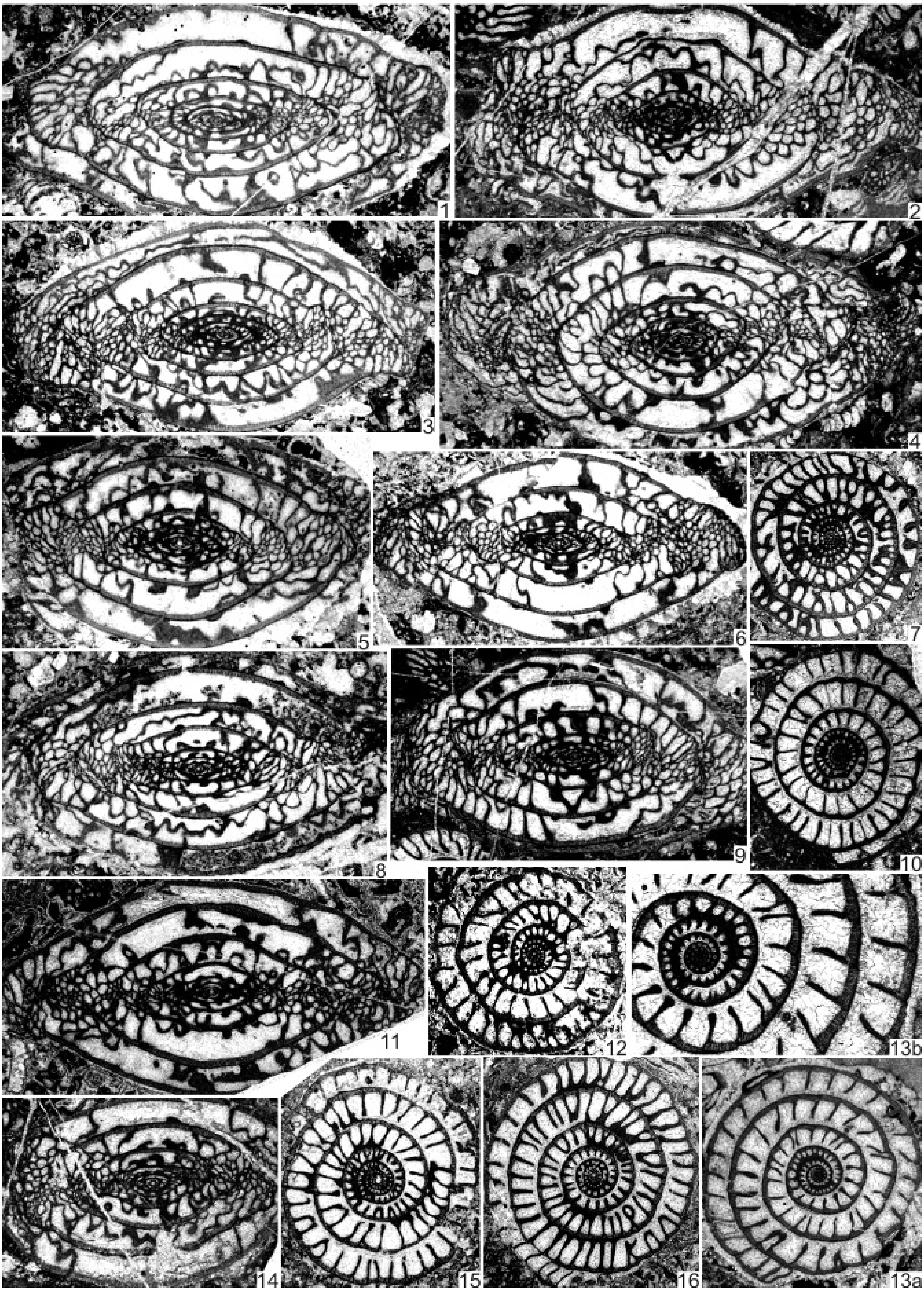
1-3, 5-6, 8-9, 11, 14: axial sections; 4: tangential section; 7, 12-13, 15-16: sagittal sections; 10: parallel section.

1: D2-056018, 2: D2-057292, 3: D-056020, 4: D2-057296, 5: D2-056004, 6: D2-056024, 7: D2-040935, 8: D2-055989, 9: D2-057300, 10: D-040944, 11: D2-040913, 12: D2-056021, 13: D2-057120, 14: D2-057311, 15: D22-040941, 16: D2-040928

Locality 1, 3, 5-6, 12: A-430 (middle Gzhelian); 2, 4, 9, 14: B-218 (middle Gzhelian); 7, 10, 15-16: A-25c (middle Gzhelian); 8: A-429 (middle Gzhelian); 11: A-25b (middle Gzhelian); 13: B-208 (middle Gzhelian).

13b: ×20, others: ×10.

Plate XV



1972. *Jigulites altus corpulensis* Bensh, pp. 63-64, pl. 13, fig. 1.
1975. *Schwagerina amushanensis* Sheng.– Han, p. 153, pl. 6, figs 4-10.
1986c. *Jigulites*? *corpulensis* Bensh.– Davydov, pp. 104-105, pl. 20, fig. 8.
1990. *Daixina horrida* (Kanmera).– T. Ozawa & Kobayashi, pl. 5, fig. 8.

Description: Test fusiform to elongate fusiform with broadly arched to almost straight periphery, straight to slightly convex lateral sides, bluntly pointed poles, and straight axis of coiling, and composed of five to six and a half whorls. Length about 6.3 to 9.4, rarely 10.7 mm and width about 2.1 to 3.5 mm, giving a form ratio about 2.3 to 3.4.

Proloculus spherical to almost spherical and its outside diameter 0.19 to 0.35 mm. Whorls gradually expand increasing their length and width in specimens with larger proloculus. The first one to one and a half whorl rather tightly coiled against the succeeding whorls in specimens with relatively small proloculus.

Wall surface smooth in general, but gently and irregularly undulated in several specimens. Wall consists of tectum and alveolar keriotheca, and is as thick as 0.01 to 0.03 mm in inner whorls with relatively thin wall and mostly 0.05 to 0.09 mm in outer whorls, rarely 0.11 mm.

Septa closely spaced, intensely and rather irregularly folded in polar regions and moderately in the median part of the test. Some septal folds reach the roof of chambers. Septal counts from the first to sixth whorl 8 to 13, 16 to 24, 19 to 28, 22 to 34, 24 to 36, and 25 to 35, respectively in nine sections illustrated.

Tunnel low, narrow, and straight in inner whorls, becoming irregularly widened outwards. Chomata weakly or rudimentarily developed in inner few whorls, and absent in outer whorls. Axial fillings poorly developed in some specimens.

Remarks: This species was originally assigned to *Pseudofusulina* by Kanmera (1958) and transferred to *Daixina* by T. Ozawa & Kobyayashi (1990). It is better to be reassigned to *Jigulites* from the mode of the septal folding. Smaller appearance of some of the types than the present material is due to the smaller number of whorls. *Pseudofusulina*(?) sp. A by Y. Ota (1998, pl. 7, figs 7-10) from Akiyoshi is probably included in this species, though its septa are not so intensely folded as those of the types and the present specimens. *Schwagerina amushanensis* described from the Upper Carboniferous of Inner Mongolia (north China) originally by Sheng (1958b) and later by Han (1975) is supposed to be conspecific.

This species closely resembles *Triticites altus* originally described by Rozovskaya (1952) from the uppermost Gzhelian of the South Urals, and reassigned to *Jigulites* by Bensh (1972). However, the former is distinguished from the latter by its more strongly and more irregularly folded septa and septal folds reaching the roof of chambers. *Jigulites altus corpulensis* described from the middle Gzhelian (*Daixina asiatica* Zone) of South Fergana (Bensh, 1972) is presumed to be a junior synonym of the present species based in its shape and size of the test and mode of septal folding. *Jigulites*? *corpulensis* described by Davydov (1986c) from the lower part of the *Daixina sokensis* Zone of Darvas is more similar to the present species than the Bensh's (1972) from South Fergana.

Igo's (1972) *Pseudofusulina* (*Daixina*) *petchabunensis* from northern Thailand is probably similar to *J. horridus*, though having somewhat more intensely folded septa than those of types from Yayamadake. "?*Schwagerina*" *nathorsti* var. *laxa* (Lee, 1927) described by Sheng (1958b) from Inner Mongolia is also similar to *J. horridus* in shape and size of outer whorls, and mode of septal folding, but differs from this species in its more pointed poles of inner whorls that is chraracteristic in *Fusulina* (*Schellwienia*) *nathorsti* Staff & Wedekind, 1910.

Occurrence and stratigraphic distribution: Abundant to common in many samples exclusively from the *Carbonoschwagerina morikawai*-*Jigulites horridus* Zone.

Jigulites magnus Rozovskaya, 1950
Pl. XLII, figs 1-18

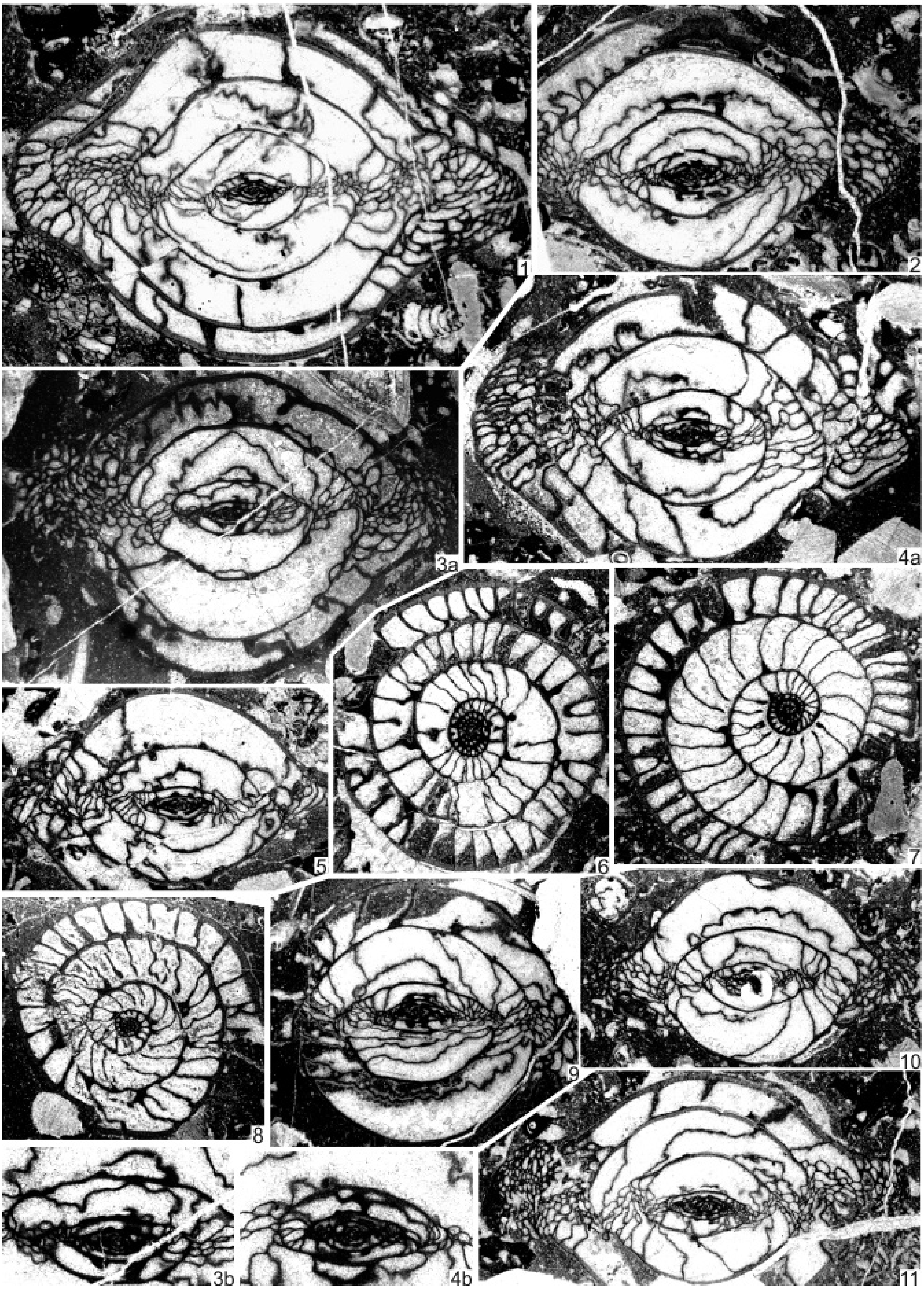
1950. *Triticites* (*Jigulites*) *magnus* Rozovskaya, pp. 40-41, pl. 9, figs 4-7.
1990. *Pseudofusulina* sp., T. Ozawa & Kobayashi, pl. 6, fig. 12.

Description: Test fusiform to inflated fusiform with broadly arched periphery, slightly convex lateral sides, bluntly pointed to rounded poles, and straight axis of coiling, and composed of five to six and a half whorls. Length about 6.0 to 8.3 mm and width about 2.7 to 4.4 mm, giving a form ratio about 2.2 to 2.5.

Plate XVI

Figs 1-11: *Carbonoschwagerina minatoi* (Kanmera)
1-4, 11: axial sections; 5, 9-10: tangential sections; 6, 8: sagittal sections; 7: parallel section.
1: D2-052681, 2: D2-052679, 3: D2-052688, 4: D2-052717, 5: D2-052704, 6: D2-052718, 7: D2-052682, 8: D2-052712, 9: D2-052706, 10: D2-052676, 11: D2-052684.
Locality all A-393 (upper Gzhelian).
3b, 4b: ×20; others: ×10.

Plate XVI



Proloculus almost spherical and its diameter 0.20 to 0.33 mm. Inner one to two whorls relatively tightly coiled for the succeeding whorls gradually increasing their length and width. Wall surface smooth, but gently and irregularly undulated in specimens, 0.09 to 0.12 mm in thicker part of outer whorls, and consists of tectum and alveolar keriotheca. Alveolar keriotheca is not observed in inner whorls with relatively thin wall.

Septa closely spaced, intensely and rather irregularly folded in polar regions and moderately in the median part of the test. Septal counts from the first to sixth whorl 11 or 12, 19 or 21, 24 or 28, 29 or 32, 32 or 35, and 38, respectively, in two sections illustrated. Tunnel low, narrow and straight in inner whorls, becoming irregularly widened outwards, though considerably variable by specimens. Chomata rudimentary in inner one to two whorls, but absent in outer whorls. Axial fillings only present in inner whorls of some specimens.

Remarks: Size and shape, and mode of expansion of the test, mode of septal folding of the present specimens are closely similar to those of the types described by Rozovskaya (1950) from the upper Gzhelian *Daixina sokensis* Zone of Russian Platform. This species is distinguished from *Jigulites horridus* by its more inflated test and more intensely folded septa. Based on irregularly and intensely folded septa and wide morphologic variation of other characters of the present material, *Pseudofusulina* sp. illustrated by T. Ozawa & Kobayashi (1990) is included into this species. Toriyama (1958) showed three specimens of relatively large schwagerinids with undulated wall and folded septa moderately in the median part of the test and intensely in polar regions. He identified them with *Schwagerina alpina* var. *rossicus* (Schellwien, 1908). They cannot be identified with the types of *Rauserites rossicus* (Schellwien) from the lower Gzhelian of Russia, and might be possibly reassigned to *Jigulites magnus*.

Occurrence and stratigraphic distribution: Common to rare in many samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone, and rare in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Jigulites titanicus n. sp.

Pl. XL, figs 1-10; Pl. XLI, figs 1-16

1990. *Daixina* n. sp. A, T. Ozawa & Kobayashi, pl. 5, fig. 11.

Etymology: From the large test.

Type specimens: Holotype D2-052836 (axial section, Pl. XL, fig. 5). Paratypes: seventeen axial sections of megalospheric forms (D2-052829, Pl. XL, fig. 1; D2-055521, Pl. XL, fig. 2; D2-052826, Pl. XL, fig. 3; D2-040706, Pl. XL, fig. 4; D2-055518, Pl. XL, fig. 6; D2-047319, Pl. XL, fig. 10; D2-052835, Pl. XLI, fig. 1; D2-052841, Pl. XLI, fig. 4; D2-052837, Pl. XLI, fig. 6; D2-057234, Pl. XLI, fig. 9; D2-056833, Pl. XLI, fig. 10; D2-052831, Pl. XLI, fig. 11; D2-052824, Pl. XLI, fig. 12; D2-057236, Pl. XLI, fig. 13; D2-050380, Pl. XLI, fig. 14; D2-055519, Pl. XLI, fig. 15; D2-0503094, Pl. XLI, fig. 16), seven sagittal sections of megalospheric forms (D2-052855, Pl. XL, fig. 7; D2-052854, Pl. XL, fig. 8; D2-050365, Pl. XL, fig. 9; D2-050388, Pl. XLI, fig. 2; D2-050376, Pl. XLI, fig. 3; D2-056825, Pl. XLI, fig. 7; D2-050364, Pl. XLI, fig. 8), and one axial section of microspheric form (D2-052843, Pl. XLI, fig. 5).

Type locality: 240 m south of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture, Japan.

Diagnosis: Elongate to elliptical fusiform *Jigulites* with large proloculus, few and loosely coiled whorls for the large test, more or less undulated wall, and intensely and irregularly folded septa especially in polar regions in megalospheric forms. Minute proloculus, very tightly coiled inner three whorls followed by rapidly enlarging outer whorls in microspheric forms.

Description of megalospheric forms: Test elongate to elliptical fusiform with broadly arched to almost straight periphery, rounded poles, and straight to gently curved axis of coiling, and composed of four and a half to six whorls. Length about 9.0 to 14.5 mm and width about 2.4 to 4.8 mm, giving a form ratio about 2.5 to 3.9.

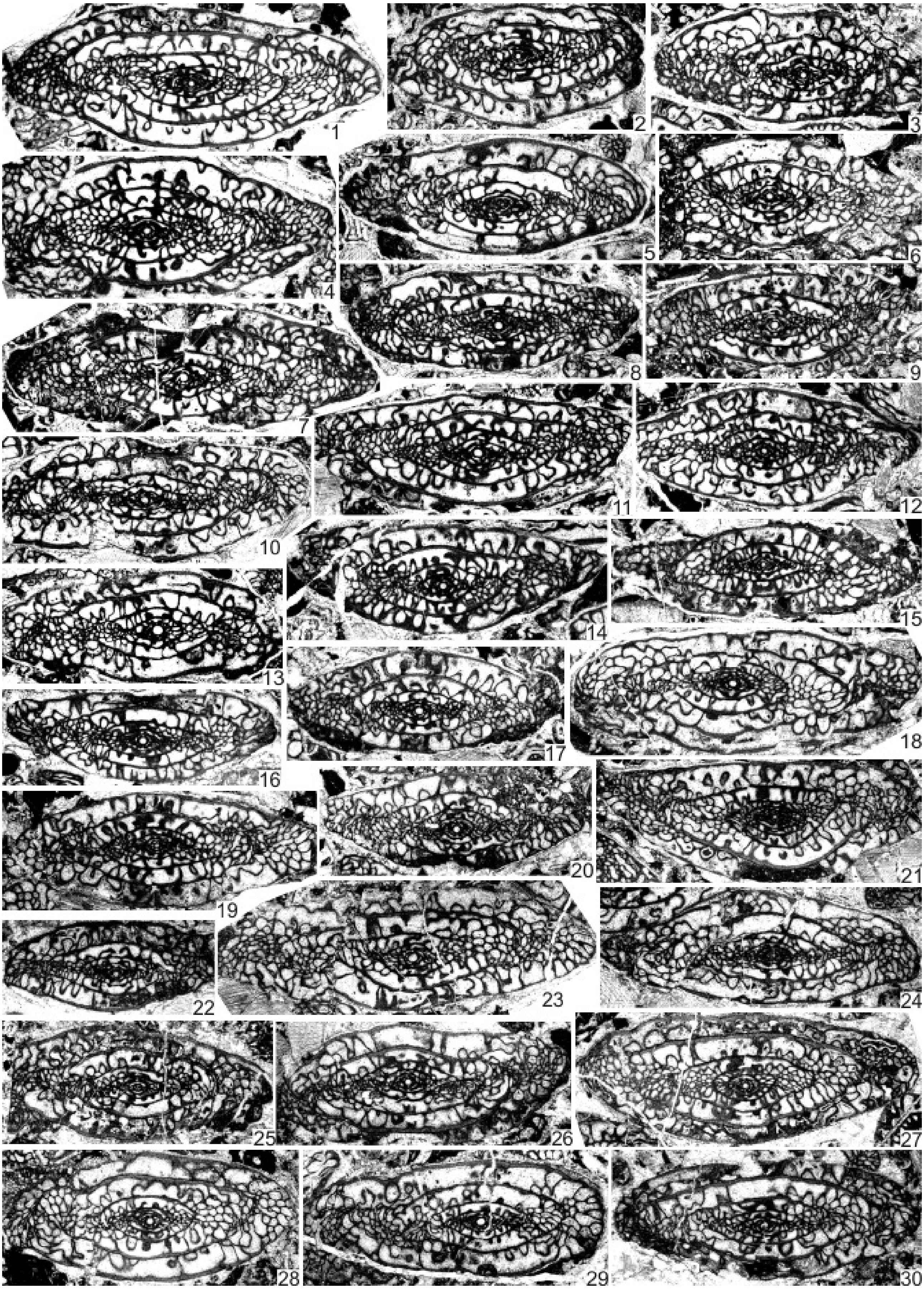
Proloculus spherical to subspherical and its outside diameter 0.27 to 0.65 mm. Width of whorl gradually and length of whorl rapidly increasing outwards, especially in elongate forms.

Wall more or less irregularly undulated in elongate forms and gently undulated in inflated forms. Wall thin in the first whorl in specimens with relatively small proloculus,

Plate XVII

Figs 1-30: *Rauserites arcticus* (Schellwien)
1-24, 26-30: axial sections; 25: tangential section.
1: D2-055805, 2: D2-055792, 3: D2-055794, 4: D2-055811, 5: D2-055813, 6: D2-055810, 7: D2-055809, 8: D2-055798, 9: D2-055797, 10: D2-055817, 11: D2-055814, 12: D2-055816, 13: D2-055818, 14: D2-055787, 15: D2-055790, 16: D2-055802, 17: D2-055815, 18: D2-051803, 19: D2-051827, 20: D2-051807, 21: D2-051811, 22: D2-051818, 23: D2-051817, 24: D2-051806, 25: D2-051976, 26: D2-051825, 27: D2-051975, 28: D2-051829, 29: D2-051819, 30: D2-051822.
Locality 1-17: A-423 (upper Kasimovian); 18-24, 26, 28-30: A-311 (upper Kasimovian); 25, 27: A-327 (upper Kasimovian).
All ×10.

Plate XVII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then gradually thickened outwards and about 0.07 to 0.14 mm in outer few whorls consisting of tectum and coarsely alveolar keriotheca.

Septa closely spaced, intensely and irregularly folded producing many chamberlets in polar regions especially in elongate forms. Narrowly folded septa reaching the roof of chambers. Some of septa are combined by phrenothecae. Septal counts from the first to sixth whorl 9 to 15, 18 to 26, 22 to 31, 24 to 35, 27 to 38, and 32 or more, respectively in seven sections illustrated. Tunnel low and narrow in the first whorl. Its height and path are obscure in the succeeding whorls. Chomata absent except for rudimentary ones on proloculus and in the first whorl. Dark calcareous deposits referable to axial fillings are not developed.

Description of microspheric forms: Test elongate fusiform with more than seven whorls, broadly arched periphery, almost straight lateral sides, and rounded poles. Incomplete axial section illustrated has 6.37 mm in length, 2.50 mm in width, and 2.55 in a form ratio, and 0.05 mm in proloculus. The first whorl nearly spherical and the succeeding two whorls become fusiform and very tightly coiled. From the fourth whorl, length and width rapidly increasing. Length from the first to seventh whorl 0.09, 0.23, 0.60, 1.27, 2.03, 3.71, and 6.37 mm, width from the first to seventh 0.10, 0.19, 0.28, 0.46, 0.81, 1.12, and 2.50 mm, and a form ratio from the first to seventh 0.90, 1.21, 2.14, 2.76, 2.51, 3.31, and 2.55, respectively.

Wall structureless in inner tightly coiled whorls, and somewhat undulated and of tectum and finely alveolar keriotheca in outer whorls. Mode of septal folding in outer whorls is the same as that in megalospheric forms. Chomata absent except for rudimentary ones in inner whorls.

Remarks: This new species is presumed to be a specialized form of *Jigulites*. Some morphologic differences of the test characters are more or less recognized between elongate and inflated forms in the megalospheric forms. They are considered to be intraspecific variation of this new species. One microspheric form illustrated is a counterpart of megalospheric ones of this species, not a species of other genus. It is exclusively found from sample A-399 (upper Gzhelian). In the sample, it coexists with abundant megalospheric ones of this species, and other schwagerinids with tightly coiled inner whorls such as *Darvasoschwagerina* are completely absent.

Jigulites titanicus is easily distinguished from large elongate forms of schwagerinids such as *Rugosofusulina dastarensis* Bensh, 1972 and *Shagonella gigantea* Davydov, 1986c in having much larger proloculus, more irregularly but not so intensely folded septa, and larger length and width of corresponding whorls. *R. dastarensis* was described from the uppermost Gzhelian ("*Pseudofusulina*" *ferganensis* Zone) in South Fergana (Bensh, 1972) and *S. gigantea* from the lower part of *Daixina sokensis* Zone in Darvas (Davydov, 1986c). Concerning the mode of test expansion, small number of whorls for the large test and undulated wall, this new species is similar to *Rugosofusulina alpina* (Schellwien, 1898) described by Leven & Shcherbovich (1978) from the Asselian of Darvas, but the latter has much more intensely and irregularly folded septa throughout the test. *Pseudofusulina shetaensis* Han, 1975 from Inner Mongolia (Han, 1975) is similar to this species, but it has more strongly folded septa than the present material and is presumed to be reassigned to *Jigulites*. *Daixina* n. sp. A illustrated by T. Ozawa & Kobayashi (1990) from the Shishidedai area, 6.5 km NNE of the Wakatakeyama area is characteristic in its large, elongate test with undulated wall and intensely folded septa. It is probably identical with this species.

Occurrence and stratigraphic distribution: Abundant

Plate XVIII

Figs 1-19: *Rauserites arcticus* (Schellwien)

1-9: axial sections, 10-19: sagittal sections.

1: D2-051794, 2: D2-051800, 3: D2-051796, 4: D2-051981, 5: D2-051814, 6: D2-051809, 7: D2-055314, 8: D2-055315, 9: D2-050326, 10: D2-051828, 11: D2-055804, 12: D2-051818, 13: D2-051825, 14: D2-055793, 15: D2-055791, 16: D2-051985, 17: D-055806, 18: D-051982, 19: D2-051988.

Locality 1-3, 5-6, 10, 12-13: A-311 (upper Kasimovian); 4, 16, 18-19: A-328 (upper Kasimovian); 7-8: B-137 (upper Kasimovian); 9: A-240 (upper Kasimovian); 11, 14-15, 17: A-423 (upper Kasimovian).

All ×10.

Figs 20-49: *Rauserites exculptus* (Igo)

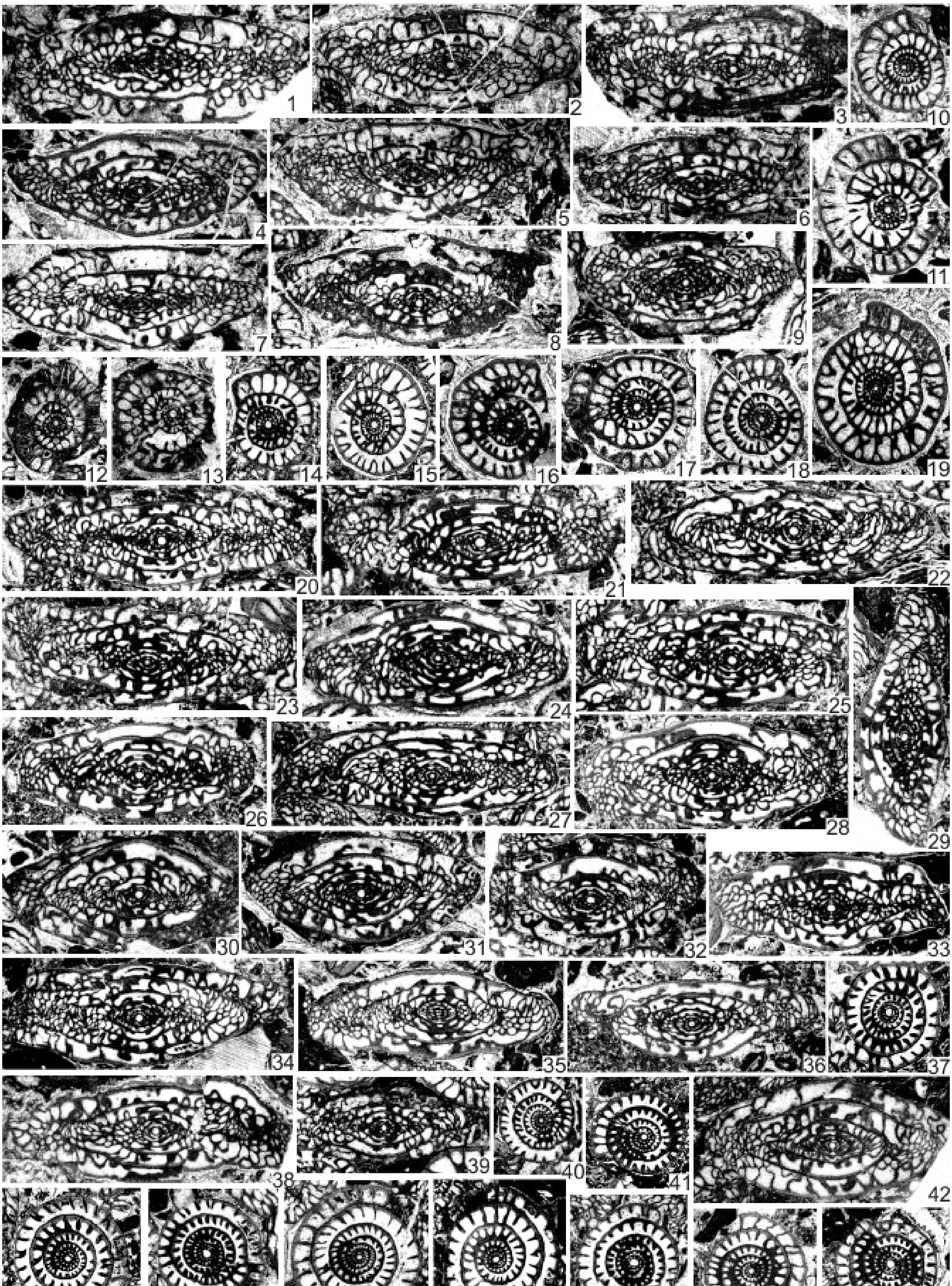
20-34, 36, 38-39, 42: axial sections; 35: tangential section; 37, 40-41, 43-49: sagittal sections.

20: D2-050317, 21: D2-050341, 22: D2-050336, 23: D2-050313, 24: D2-050335, 25: D2-050322, 26: D2-055831, 27: D2-050314, 28: D2-050345, 29: D2-050323, 30: D2-050332, 31: D2-050299, 32: D2-050347, 33: D2-050295, 34: D2-050315, 35: D2-050346, 36: D2-055832, 37: D2-050308, 38: D2-055829, 39: D2-050319, 40: D2-050310, 41: D2-050306, 42: D2-050307, 43: D2-050301a, 44: D2-050342, 45: D2-050294, 46: D2-050316, 47: D2-050301b, 48: D2-055828, 49: D2-050297.

Locality 20-25, 27-35, 37, 39-47, 49: A-240 (upper Kasimovian); 26, 36, 38, 48: A-424 (upper Kasimovian).

All ×10.

Plate XVIII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to common in some samples from the the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone and common in few samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Schwagerina* von Möller, 1877

Type species: *Borelis princeps* Ehrenberg, 1842, p. 274.

Remarks: According to Dunbar & Skinner (1936) who first defined the Ehrenberg's original material through the examination of thin sections, *Schwagerina princeps* (Ehrenberg) is characterized by inflated fusiform or subglobular test with six to six and a half whorls gradually expanding outward, and closely spaced septa intensely and regularly folded. Many genera more or less similar to *Schwagerina sensu* Dunbar & Skinner (1936) not *sensu* Rauzer-Chernousova (1936) have been proposed for inflated fusiform to subglobular schwagerinids. Definition of *Schwagerina* and its differences from related genera, however, appear to be considerably diverse among later authors as well as those in the last century. A promising idea of a junior synonym of *Schwagerina krotowi* (Schellwien, 1908) with *S. princeps* suggests a senior synonym of *Schwagerina* with *Globifusulina,* proposed by Alekseeva *et al*. (1983) designating *S. krotowi* as the type species. This idea is also applicable to *Anderssonites* by Syomina *et al*. (1987) designating "*Fusulina anderssoni*" Schellwien (1908, pp. 192-193) as the type species which is presumably conspecific with *S. krotowi* in spite of having somewhat elongate test.

Seven species described below are included in *Schwagerina sensu* Loeblich & Tappan (1988). They are distinguished from *Paraschwagerina*, *Darvasoschwagerina*, and *Likharevites* by their more regularly folded seta, larger proloculus, and not so tightly coiled inner whorls.

***Schwagerina densa* (Toriyama, 1958)**

Pl. XXXIII, figs 20-26, 27(?), 28-33

1958. *Dunbarinella densa* Toriyama, pp. 123-125, pl. 13, figs 12-20.

Description: Test inflated fusiform to fusiform with broadly arched periphery, slightly convex lateral sides and bluntly pointed poles, and composed of six to eight whorls. Length about 4.5 to 6.2 mm and width about 1.7 to 2.8 mm, giving a form ratio about 2.0 to 2.5.

Proloculus spherical and its diameter 0.10 to 0.20 mm in megalospheric forms and less than 0.03 mm in the microspheric form. Inner two to three whorls tightly coiled and the succeeding whorls gradually increasing their length and width in megalospheric forms. Wall thin and alveolar keriotheca not observed in tightly coiled inner whorls, then gradually thickened in succeeding whorls and consists of tectum and finely alveolar keriotheca both in megalospheric and microspheric forms.

Septa closely spaced, moderately folded in the median part of the test and strongly folded in polar regions. Septal counts from the first to seventh whorl 7, 12, 14, 17, 21, 23, and more than 14 in one specimen illustrated. Tunnel low and narrow throughout the test. Its path almost straight bordered by small chomata and somewhat irregular in outer whorls. Axial fillings weakly developed in some specimens.

Remarks: This species should be separated from *Dunbarinella* due to its weaker axial fillings and fewer number of whorls, and considered to be reassigned to *Schwagerina*. The present specimens are identical with the original ones of Toriyama (1958) in many test characters, but their septal folding is somewhat weaker than the types. One microspheric specimen is referable to this species on account of its association with megalospheric ones of this species in sample A-241b. One axial section (Pl. XXXIII, fig. 27) is questionably included in this species, though having more rapidly expanding outer whorls. This species is distinguished from *Schwagerina princeps*, described below, by its more strongly folded septa and not so inflated test.

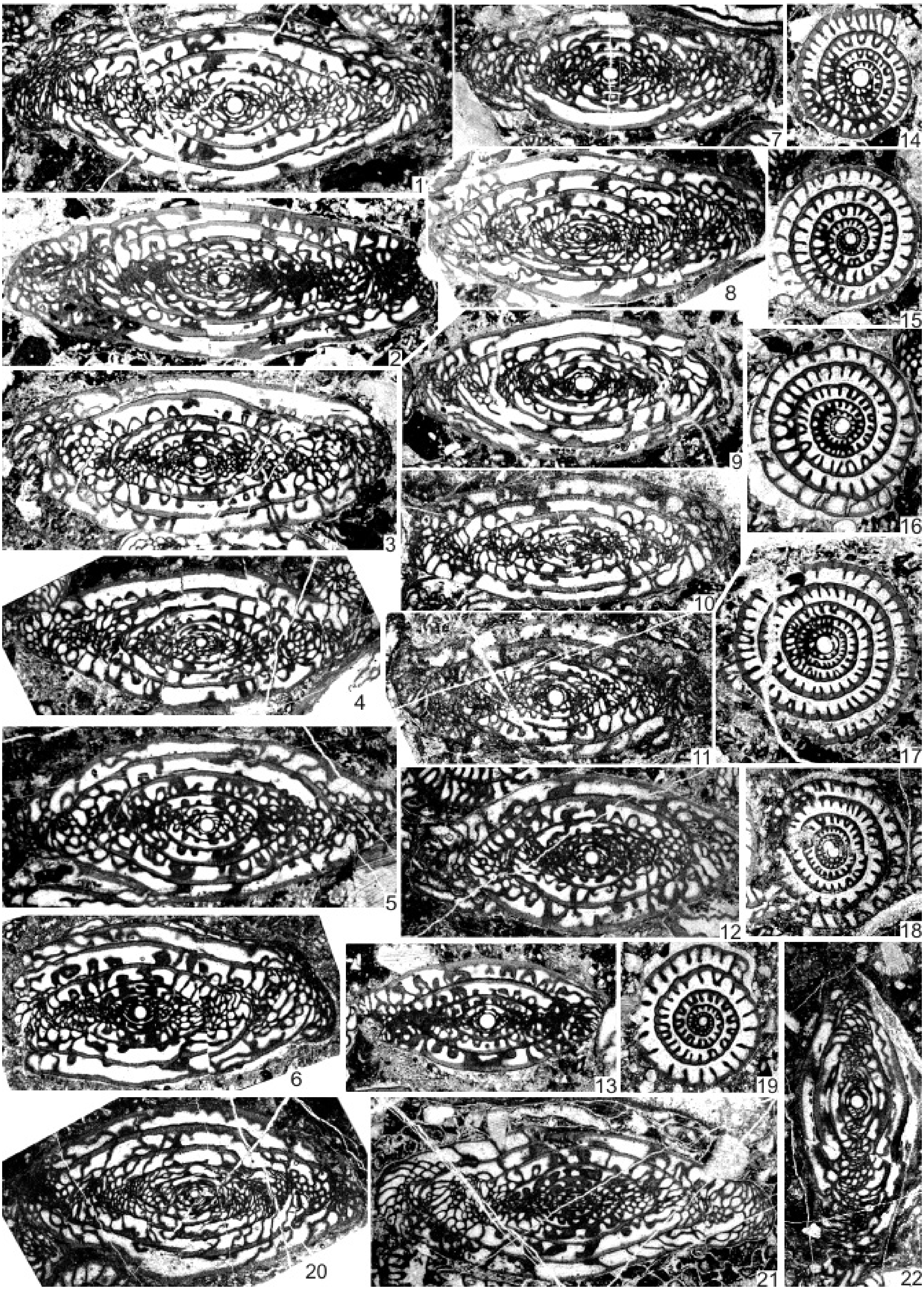
Occurrence and stratigraphic distribution: Common to rare in some samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Plate XIX

Figs 1-17: *Rauserites major* Rozovskaya
1-13: axial sections, 14-17: sagittal sections.
1: D2-055911, 2: D2-056011, 3: D2-055926, 4: D2-055949, 5: D2-055913, 6: D2-055901, 7: D-055940, 8: D2-055938, 9: D2-055915, 10: D2-055917, 11: D2-055929, 12: D2-055928, 13: D2-055933, 14: D2-056010, 15: D2-050226, 16: D2-050222, 17: D2-055997.
Locality 1, 3-5, 7-13: A-427 (middle Gzhelian); 2, 14, 17: A-430 (middle Gzhelian); 6: A-426 (lower Gzhelian), 15-16: A-237 (middle Gzhelian).
All ×10

Figs 18-22: *Rauserites* spp.
18-19: sagittal sections; 20, 22: axial sections; 21: tangential section.
18: D2-052505, 19: D2-052502, 20: D2-052500, 21: D2-052490, 22: D2-052501.
Locality 18-20, 22: A-383 (lower Gzhelian); 21: A-382 (lower Gzhelian). All ×10.

Plate XIX



***Schwagerina princeps* (Ehrenberg, 1842)**
Pl. XXXIII, figs 1-14; Pl. XLVII, figs 2-10

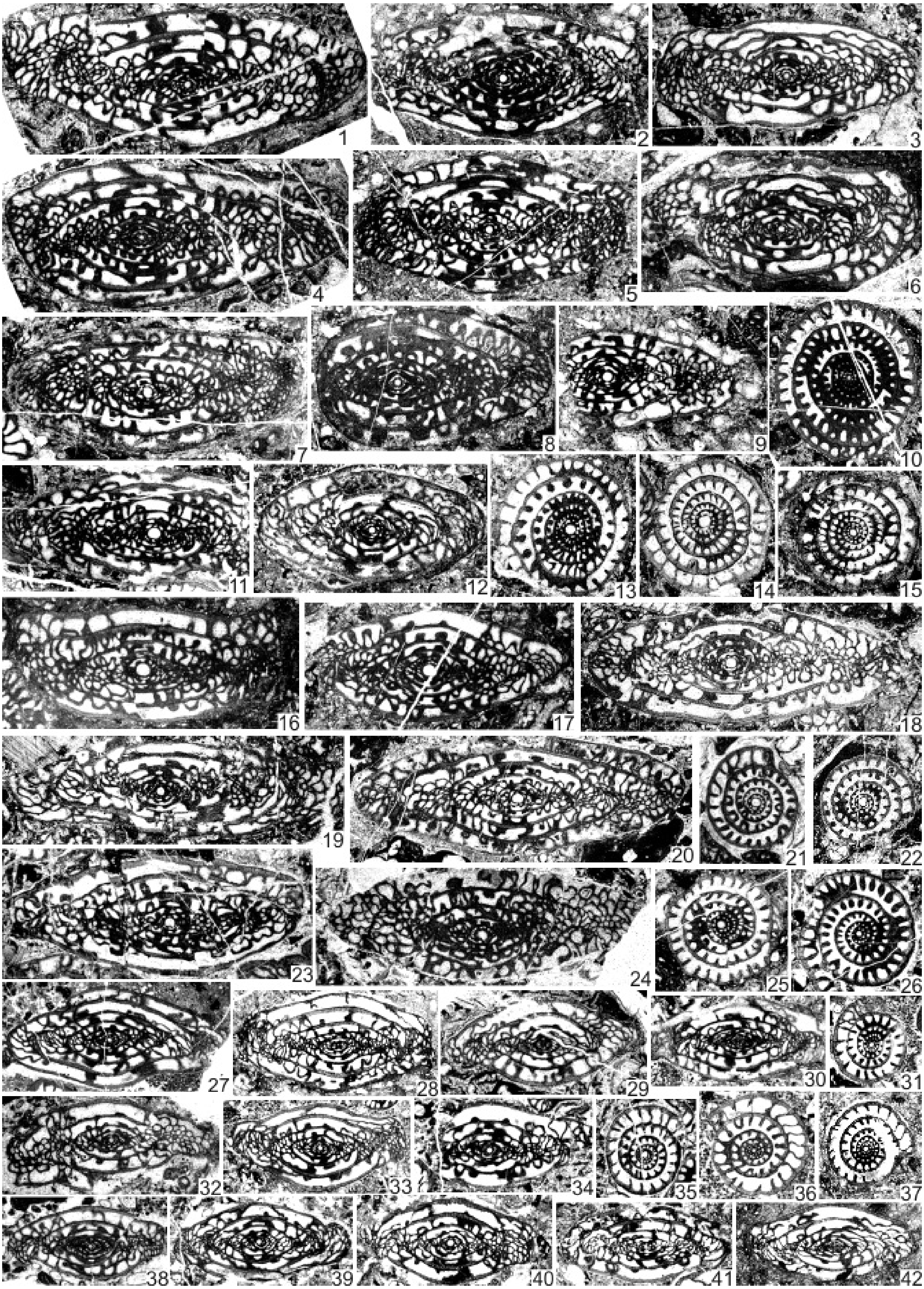
1842. *Borelis princeps* Ehrenberg, p. 273, pl. 37, figs X, C, C1-4.
1908. *Fusulina krotowi* Schellwien, pp. 190-192, pl. 20, figs 1-10.
1925b. *Schellwienia krotowi* (Schellwien).– Y. Ozawa, pp. 27-28, pl. 7, figs 5-6.
1936. *Schwagerina princeps* (Ehrenberg).– Dunbar & Skinner, pp. 86-87, pl. 10, figs 1-11.
pars 1958. *Schwagerina krotowi* (Schellwien).– Toriyama, pp. 134-138, pl. 15, figs 8-10, 12. (non 11: primitive form of *Carbonoschwagerina*?, 13-19: other species of *Schwagerina*)
1960. *Schellwienia princeps* (Ehrenberg).– Forbes, p. 218, pl. 33, figs 8-11.

Description: Test inflated fusiform with broadly arched periphery, almost straight to slightly convex lateral sides, bluntly pointed poles, and straight axis of coiling, and composed of five and a half to seven and a half whorls. Length about 4.1 to 5.7 mm and width about 1.9 to 2.6 mm, giving a form ratio about 1.7 to 2.8.
Proloculus spherical and its diameter 0.09 to 0.23 mm. Inner one to two whorls tightly coiled against the succeeding whorls gradually increasing their length and width. Wall thin and consists of tectum and translucent layer or single layer in inner two whorls, then gradually thickened and consisting of tectum and finely alveolar keriotheca.
Septa closely spaced and rather regularly folded, moderately folded in the median part of the test and more intensely folded in polar regions. Septal counts from the first to seventh whorl 7 to 10, 11 to 16, 14 to 19, 17 or 19, 18 to 22, 22 or 24, and 32, respectively in four illustrated sections. Tunnel low and narrow in inner whorls, still narrow and one half as high as chambers in outer whorls. Chomata small and distinct on proloculus and in inner whorls, and rudimentary or absent in outer one to three whorls.
Remarks: The Wakatakeyama specimens are considered to be identical with *Schwagerina krotowi* in their similar size and shape of the test and mode of septal folding, especially to the type material of Schellwien (1908) that is supposed herein to be a junior synonym of *S. princeps*. Their detailed comparison with the original specimens of Ehrenberg (1842), thin sections of which were illustrated in Dunbar & Skinner (1936), is difficult on account of silicified test of the original material. They are similar to and not easily distinguished from the eleven illustrations subdivided into *Pseudofusulina krotowi* and its four varieties by Rauzer-Chernousova (1940). Two specimens illustrated by Y. Ozawa (1925b) are more closey similar to the Schellwien's *Schwagerina krotowi* than the present Akiyoshi specimens in mode of test expansion and number of septa.
Occurrence and stratigraphic distribution: Rare in few samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone and abundant to rare in some samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Plate XX

Figs 1-15: *Rauserites stuckenbergi* (Rauzer-Chernousova)
1-9, 11-12: axial sections; 10, 13-15: sagittal sections.
1: D2-052474, 2: D2-047835, 3: D2-053472, 4: D2-052475, 5: D2-047833, 6: D2-051507, 7: D-050271, 8: D2-052473, 9: D2-047834, 10: D2-052482, 11: D2-050272, 12: D2-055897, 13: D2-047828, 14: D2-051503, 15: D2-051504.
Locality 1, 3-4, 8, 10: A-380 (lower Gzhelian); 2, 5, 9, 13: A-149 (lower Gzhelian); 6, 14-15: A-383 (lower Gzhelian); 7, 11: A-238 (lower Gzhelian); 12: A-426 (lower Gzhelian).
All ×10.
Figs 16-26: *Rauserites hidensis* (Igo)
16-20, 24-24: axial sections; 21-22, 25-26: sagittal sections.
16: D2-052507, 17: D2-052483, 18: D2-040694, 19: D2-052477, 20: D2-040691, 21: D2-040706, 22: D2-040692, 23: D2-053236, 24: D2-052598, 25: D2-052479, 26: D2-055318.
Locality 16: A-383 (lower Gzhelian); 17, 19, 25: A-380 (lower Gzhelian), 18, 20, 22: A-21A (upper Gzhelian); 21: A-21B (upper Gzhelian); 23: A-322 (middle Gzhelian); 24: A-388 (middle Gzhelian), 26: B-138 (lower Gzhelian)
All ×10.
Figs 27-42: *Schwageriniformis parallelos* (Shcherbovich)
27, 30, 32-34, 38-42: axial sections; 28-29: tangential sections; 31, 35-37: sagittal sections.
27: D2-055868, 28: D2-055867, 29: D2-055321, 30: D2-055875, 31: D2-055876, 32: D-055825, 33: D2-055877, 34: D2-055316, 35: D2-055321, 36: D2-055830, 37: D2-055874, 38: D2-055834, 39: D2055863, 40: D2-055873, 41: D2-055872, 42: D22-055866.
Locality 27-28, 30-31, 33, 37, 39-42: A-426 (lower Gzhelian); 29, 34-35: B-138 (lower Gzhelian); 32, 36, 38: A-424 (upper Kasimovian).
All ×10.

Plate XX



Schwagerina panjiensis
(Leven & Shcherbovich, 1978)
Pl. XXXIII, figs 15-19

1978. *Pseudofusulina panjiensis* Leven & Shcherbovich, pp. 122-123, pl. 19, figs 8-9.
2009. *Anderssonites panjiensis* (Leven & Shcherbovich).– Leven, p. 131, pl. 15, fig. 5.

Remarks: Detailed comparison of the present material is not easy based on two axial sections and some oblique axial sections in my hand. The outermost whorl of the axial sections illustrated is abraded. However, the present material is possibly identical with *Schwagerina panjiensis* originally assigned to *Pseudofusulina* by Leven & Shcherbovich (1978) from the Asselian of Darvas. Later, this species was transferred by Leven (2009) to *Anderssonites* that was proposed by Syomina *et al*. (1987) designating *Schellwienia anderssoni* (Schellwien, 1908) as the types. However, *Anderssonites* is assumed to be a junior synonym of *Schwagerina*, as pointed out above.

The present and eponymous Darvas materials are common in approximate size and shape of the test, rather regularly folded septa, and development of axial fillings. This species resembles some large forms of *Schwagerina stabilis*, described below, but the former has weaker axial fillings and smaller proloculi.

Occurrence and stratigraphic distribution: Rare in only one sample (A-27a) from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

***Schwagerina satoi* (Y. Ozawa, 1925b)**
Pl. XXIII, figs 6-31

1925b. *Schellwienia satoi* Y. Ozawa, pp. 44-45, pl. 8, figs. 4, 6a, 8; pl. 9, fig. 3
1958. *Schwagerina*(?) *satoi* (Y. Ozawa).– Toriyama, pp. 148-151, pl. 17, figs 3-8.
1961. *Triticites montiparus gravitestus* Nogami, pp. 166-168, pl. 1, figs 13-17.
non 1990. *Schwagerina satoi* (Y. Ozawa).– T. Ozawa & Kobayashi, pl. 4, figs 13-14. [13: indeterminable, 14 = *Carbonoschwagerina nakazawai* (Nogami, 1961)]
pars 1991. *Schwagerina*? *satoi* (Y. Ozawa).– Watanabe, fig. 25.17-20. (non figs 25.15-16 = *Carbonoschwagerina nipponica* n. sp.)
non 2001. *Darvasoschwagerina satoi* (Y. Ozawa).– Leven & Davydov, p. 41, pl. 11, figs 8, 10-11 (indeterminate *Schwagerina*).
non 2011. *Darvasoschwagerina satoi* (Y. Ozawa).– Davydov, fig. 5G (indeterminate *Schwagerina*).

Description: Test highly inflated fusiform to subspherical with arched periphery, almost straight to slightly convex lateral sides, bluntly pointed to rounded poles, and straight axis of coiling, and composed of six to seven and a half whorls. Length about 3.4 to 6.0 mm and width about 2.2 to 3.7 mm, giving a form ratio about 1.3 to 2.4. Proloculus spherical and its diameter 0.05 to 0.17 mm. Tightly coiled inner two to three whorls are followed by succeeding ones rapidly increasing their width and gently increasing their length.

Wall thin and consists of single layer or tectum and lower thin translucent layer. Wall of rapidly expanding outer

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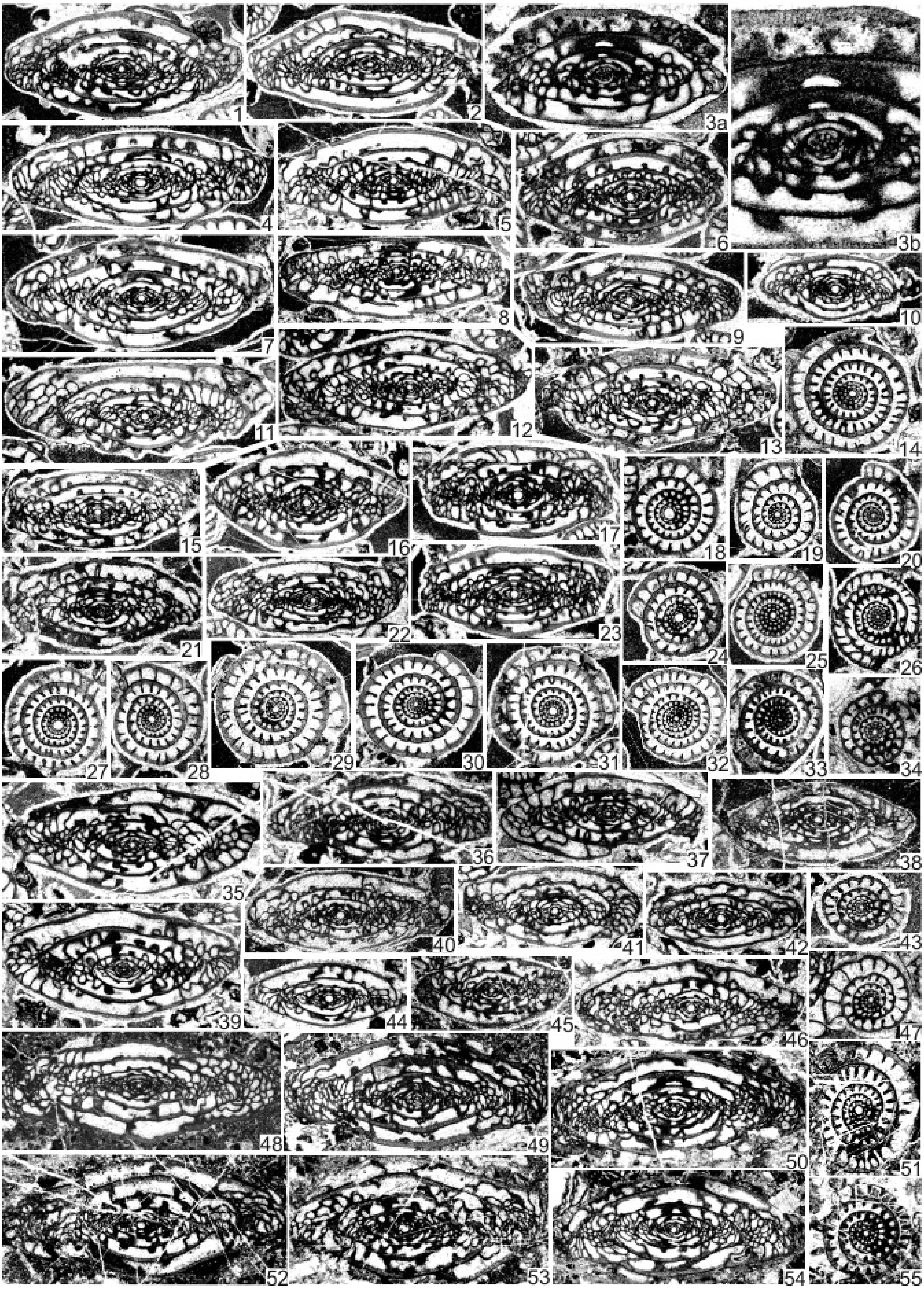
late XXI

Figs 1-34: *Triticites parvulus* (Schellwien)
3: microspheric form, others: megalospheric forms.
1-13, 15-17, 21-23: axial sections; 14, 18-20, 24-34: sagittal sections.
1: D2-047293, 2: D2-047297, 3: D2-047259, 4: D2-047250, 5: D2-047253, 6: D2-047265, 7: D2-047260, 8: D2-047294a, 9: D2-047287, 10: D2-047294b, 11: D2-047266, 12: D2-047270, 13: D2-047282, 14: D2-047279, 15: D2-047288, 16: D2-047248, 17: D2-047286, 18: D2-047242, 19: D2-047272, 20: D2-047261, 21: D2-052520, 22: D2-047255, 23: D2-047251, 24: D2-047267, 25: D2-047280, 26: D2-047269, 27: D2-047262, 28: D2-047254, 29: D2-047241, 30: D2-047264, 31: D2-047291, 32: D2-047295, 33: D2-047263, 34: D2-052566,
Locality 1-20, 22-33: A-97 (lower Gzhelian); 2, 34: A-384 (lower Gzhelian).
33b: ×40, others: ×10.

Figs 35-47: *Triticites whitei* Rauzer-Chernousova & Belyaev
35-42, 44-46: axial sections; 43, 47: sagittal sections.
35: D2-052546, 36: D2-052563, 37: D2-052558, 38: D2-057317, 39: D2-052545, 40: D2-057318, 41: D2-052544, 42: D2-052521, 43: D2-052524, 44: D2-052551, 45: D2-057316, 46: D2-052550, 47: D2-052557.
Locality 35-37, 39, 41-44, 46-47: A-384 (lower Gzhelian); 38, 40, 45: B-219 (middle Gzhelian).
All ×10.

Figs 48-55: *Triticites ozawai* Toriyama
48-50, 52-54: axial sections; 51, 55: sagittal sections.
48: D2-057069, 49: D2-057068, 50: D2-050270, 51: D2-050149, 52: D2-050140, 53: D2-050147, 54: D2-050273, 55: D2-050137.
Locality 48-49: B-205B (lower Gzhelian); 50, 54: A-238 (lower Gzhelian); 51-53, 55: A-230 (lower Gzhelian).
All ×10.

Plate XXI



whorls thickened gradually as thick as 0.05 to 0.09 mm and consists of tectum and alveolar keriotheca. Thickness of wall decreases in the last whorl.

Septa closely spaced throughout the test and moderately to weakly folded in the median part of the test and more intensely folded in polar regions. Septal counts from the first to seventh whorl 8 to 10, 12 to 14, 16 to 19, 23 to 25, 25 to 33, 32 to 36, and more than 32, respectively in four sections illustrated. Tunnel low and narrow in inner whorls, and slightly becoming higher and broader outwards and less than one half as high as chambers in most specimens. Chomata narrow and distinct on proloculus and in inner whorls, and variably changing from narrow and asymmetrical to rudimentary or absent in outer whorls.

Remarks: Toriyama (1958) designated the specimen illustrated by Y. Ozawa (1925b) in pl. 8, fig. 8 as the lectotype of this species and questionably reassigned it to the genus *Schwagerina*. He pointed out its similarity to *Pseudoschwagerina* and assumed its earliest Permian age corresponding to the Plα (*Triticites simplex* subzone) in his biostratigraphic zonation of the Akiyoshi Limestone Group. However, late Kasimovian to early Gzhelian age of this species is evident from many specimens associated with other age-diagnostic species from many localities in the Wakatakeyama area. *Triticites montiparus gravitestus* proposed from the Atetsu Limestone by Nogami (1961) is considered to be conspecific with and referable to large and elongate form of this species.

Two specimens in T. Ozawa & Kobayashi (1990) and two specimens of *Schwagerina*? *satoi* (Watanabe, 1991, fig. 25.15-16) should be reassigned to other genera because of their different modes of septal folding from those of sixteen specimens illustrated herein in addition to that of the lectotype of this species. Namely, septa are folded throughout the test in the lectotype of *Schwagerina satoi* and specimens identified with the lectotype herein. In contrast, they are plane or weakly to very weakly folded in the median part of the test in *Carbonoschwagerina*. *Schwagerina satoi* is easily distinguished from other species of *Schwagerina* recognized in the Akiyoshi Limestone Group by its more inflated test with smaller proloculus and much more tightly coiled inner whorls, more closely spaced septa and more weakly folded septa in the median part of the test.

Leven & Davydov (2001) described inflated schwagerinids from the lower Gzhelian of Darvas and identified them with this species. They transferred this species to *Darvasoschwagerina*, proposed by Leven & Davydov (2001), and assumed that this species *sensu* Watanabe (1991) is most probably ancestral form for both *Carbonoschwagerina* and *Darvasoschwagerina*. Although the present author does not deny the taxonomic independencies of these two genera, he is doubtful for their phylogenetic interpretation of these two genera. Because specimens named as this species from Darvas are different from the Japanese materials in much more intensely and more regularly folded septa, almost all whorls with much more pointed poles, and weaker development of chomata in inner whorls in the former. By the same reasons, *Darvasoschwagerina satoi* illustrated by Davydov (2011) from the lower Gzhelian of Donetz Basin is also separated from this species.

Occurrence and stratigraphic distribution: Common in many samples from the *Rauserites arcticus*-*Carbonoschwagerina nipponica* Zone and common to rare in few samples from the *Rauserites stuckenbergi*-*Triticites simplex* Zone.

Schwagerina stabilis (Rauzer-Chernousova, 1937)

Pl. XXXVI, figs 1-17

1937. *Rugosofusulina stabilis* Rauzer-Chernousova, pl. 1, fig. 7.
1938. *Pseudofusulina stabilis* (Rauzer-Chernousova).– Rauzer-Chernousova, pp. 133-134, 158, pl. 7, figs 8-9; pl. 8, fig. 3.
1958. *Schwagerina stabilis* (Rauzer-Chernousova).– Kanmera, pp. 191-193, pl. 32, figs 1-8.

Plate XXII

Figs 1-22, 24-28: *Triticites simplex* (Schellwien)

1-16, 18-22: axial sections; 17, 21, 24-27: sagittal sections; 28: abnormally grown specimen.

1: D2-050256, 2: D2-055886, 3: D2-050254, 4: D2-050276, 5: D2-050264, 6: D2-050268, 7: D2-050282, 8: D2-050274, 9: D2-050258, 10: D2-050255, 11: D2-050279, 12: D2-050267, 13: D2-055890, 14: D2-050261, 15: D2-055885, 16: D2-050263, 17: D2-050264, 18: D2-050259, 19: D2-050260, 20: D2-055883, 21: D2-050284, 22: D2-055889, 24: D2-050088, 25: D2-055894, 26: D2-050283, 27: D2-050120, 28: D2-050287.

Locality 1, 3-12, 14, 16-19, 21, 26, 28: A-238 (lower Gzhelian); 2, 13, 15, 20, 22, 25: A-426 (lower Gzhelian); 24, 27: A-228 (upper Kasimovian).

All ×10.

Figs 23, 29-40: *Triticites yayamadakensis* Kanmera

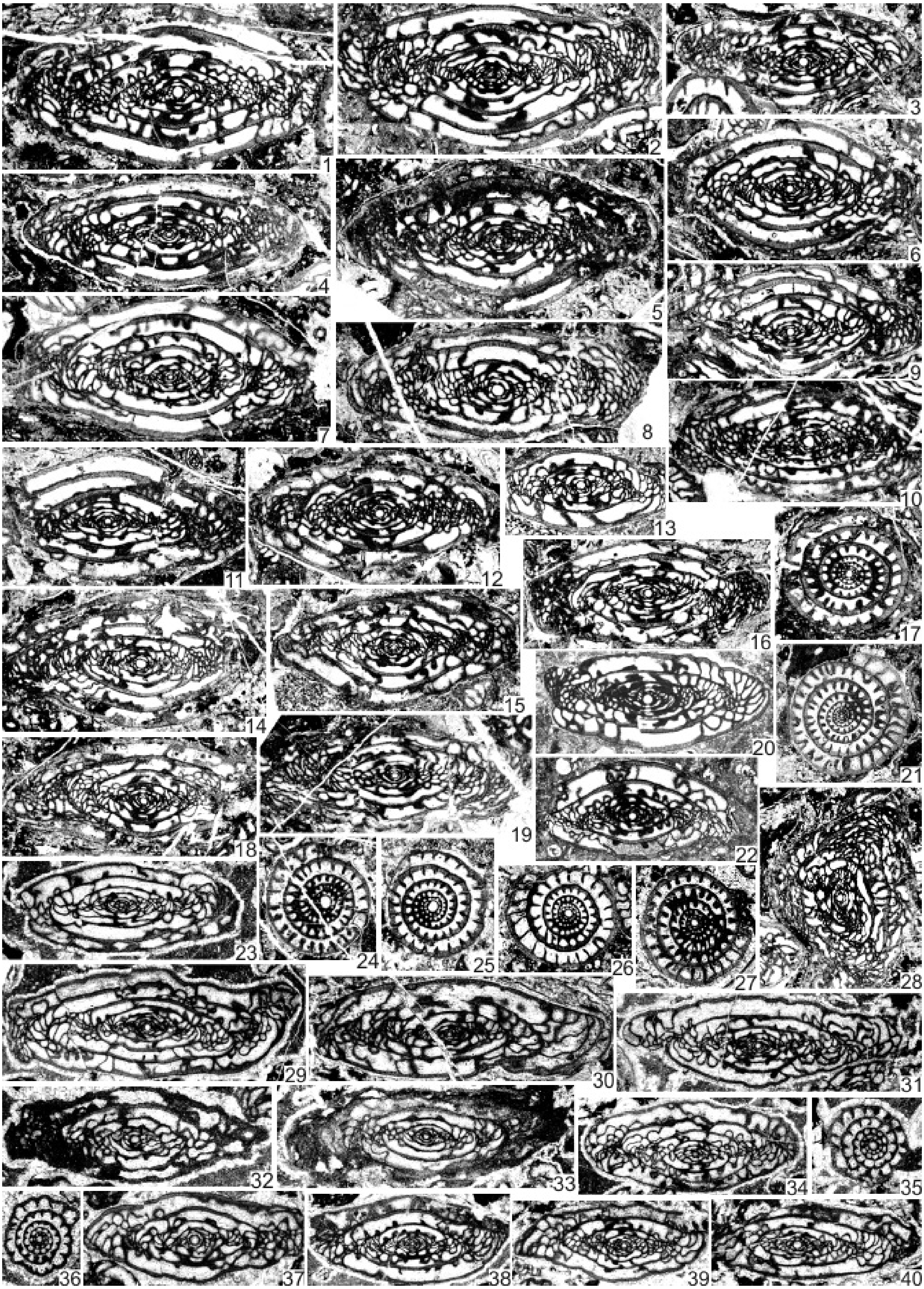
23, 29-33, 37-40: axial sections; 34: tangential section; 35-36: sagittal sections.

23: D2-052531, 29: D2-052537, 30: D2-051775, 31: D2-052513, 32: D2-052533, 33: D2-052536, 34: D2-052527, 35: D2-052570, 36: D2-052531, 37: D2-052562, 38: D2-052547, 39: D2-052540, 40: D2-052517.

Locality 23, 29, 31-40: A-384 (lower Gzhelian); 30: A-310 (upper Kasimovian).

23, 29, 31, 34, 38-40: ×10; 30, 32-33, 35-37: ×15.

Plate XXII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1958. *Rugosofusulina stabilis* (Rauzer-Chernousova).– Rozovskaya, p. 111, pl. 15, fig. 4.
1991. *Pseudofusulina stabilis* (Rauzer-Chernousova).– Watanabe, fig. 5.19-28.
1993. *Pseudofusulina stabilis* (Rauzer-Chernousova).– Y. Ota & M. Ota, pl. 2, figs 8-9.

Description: Test inflated fusiform with broadly arched periphery, convex lateral sides, bluntly pointed to rounded poles, and straight to slightly curved axis of coiling, and probably composed of seven to eight and a half whorls. Length about 4.9 to 7.5 mm and width about 2.4 to 4.1 mm, giving a form ratio about 1.9 to 2.3.
Proloculus spherical and its diameter 0.10 to 0.24 mm. Test gradually and uniformly expands throughout growth. Wall gradually thickened outwards and consists of tectum and alveolar keriotheca except for inner one or two whorls. Wall loosely undulated in outermost whorl in specimens. Thickness of wall in outer one to two whorls varies 0.05 to 0.09 mm.
Septa closely spaced and regularly folded and some septal folds of narrowly and highly folded parts reaching the roof of chambers. Shallow septal sutures present in outer one to two whorls. Septal counts from the first to seventh whorl 8, 13, 14, 19, 25, 26, and more than 31 in the specimen shown in Pl. XXXVI, fig. 14. Tunnel low and narrow in all whorls, and its path becomes irregular in outer whorls. Chomata weakly developed in inner whorls, but absent or rudimentary in outer whorls. Axial fillings well and variably developed in polar to central regions.
Remarks: This species has been assigned to various genera by authors. Four specimens illustrated in Rauzer-Chernousova (1937) and Rauzer-Chernousova (1938) are incomplete without outer or outermost whorls and are characterized by well-developed axial fillings and undulated spiral wall. This species has been designated as the type species of *Benshiella* proposed by Leven in Leven & Gorgij (2009) for an elongate to inflated schwagerinid having well developed axial fillings and corrugated wall. Various generic assignment of this species into *Schwagerina, Pseudofusulina, Rugosofusulina*, or *Benshiella* is assumed to be due to broad morphologic variation of this species and diverse schemes of classification of schwagerinids among specialists. In this paper, *Benshiella* is treated as a junior synonym of *Schwagerina*, along with *Anderssonites* and *Globifusulina* as mentioned above.
The test of considerable number of specimens in the present material is incomplete without a few outer whorls. Accordingly, the size and number of whorls of the test are exactly uncertain in the present material. However, length and width of corresponding whorls, mode of septal folding, and development of axial fillings are similar each other.
Occurrence and stratigraphic distribution: Abundant to common in many samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone, common to rare in some samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone, and rare in few samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone.

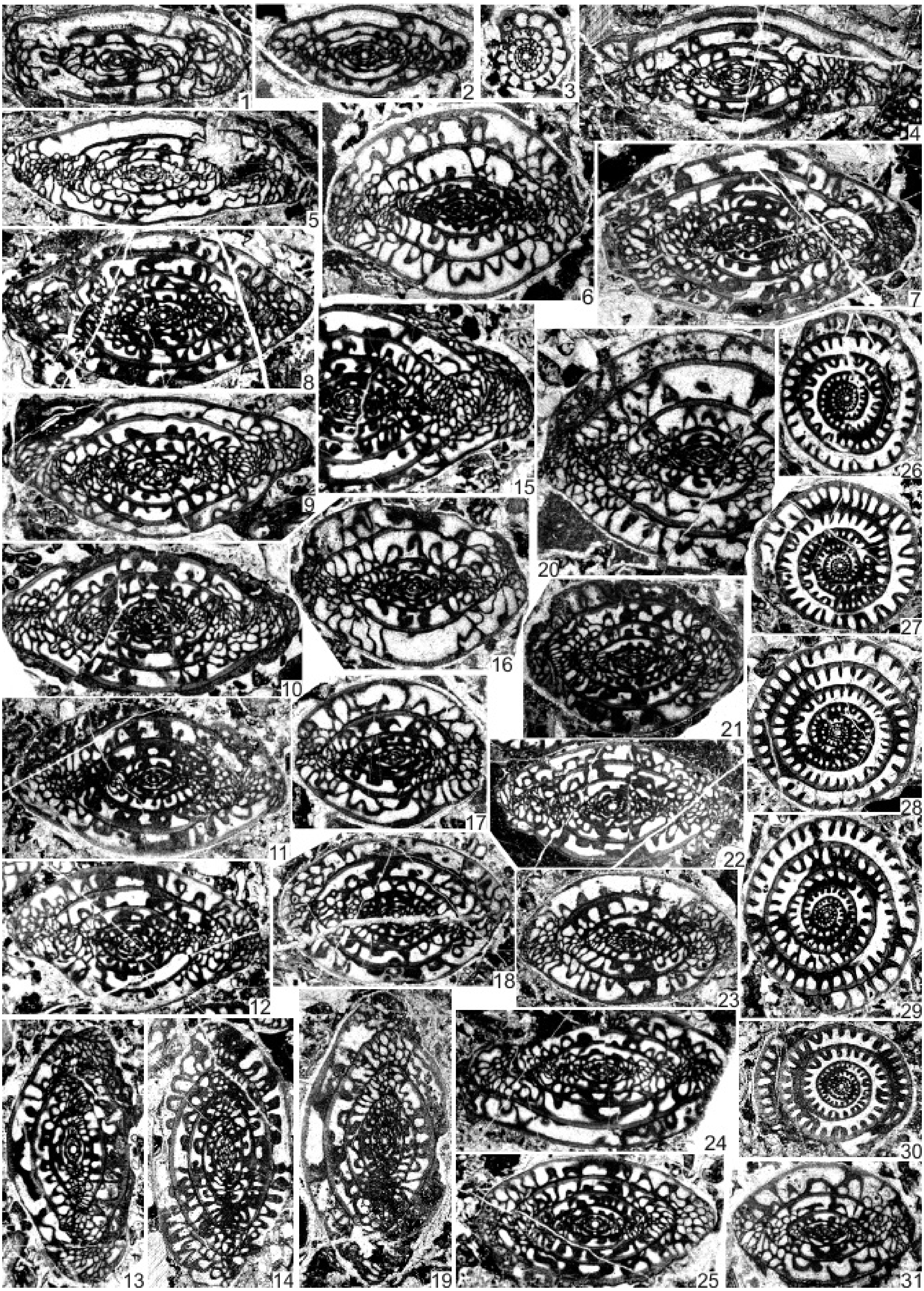
***Schwagerina watanabei* n. sp.**
Pl. XXXIV, figs 1-14

pars 1958. *Schwagerina* sp. C, Toriyama, p. 154, pl. 17, figs 17-18. (non fig. 16: indeterminate schwagerinid)
1991. *Schwagerina globulus japonica* Watanabe, n. subsp., fig. 41.1-15. (name not available because of no description)
1998. *Schwagerina* sp. C, Y. Ota, pp. 69-71, pl. 6, figs 1-2.

Plate XXIII

Figs 1-3: *Triticites yayamadakensis* Kanmera
1-2: axial sections, 3: sagittal section.
1: D2-051779, 2: D2-052561, 3: D2-052555.
Locality 1: A-310 (upper Kasimovian), 2-3: A-384 (lower Gzhelian).
1-2: ×15, 3: ×10.
Figs 4-5: *Triticites* cf. *evectus* Kanmera
4: axial section, 5: tangential section.
4: D2-051872, 5: D2-052857.
Locality 4: A-317 (upper Gzhelian), 5: A-400 (lower Asselian). Both ×10.
Figs 6-31: *Schwagerina satoi* Y. Ozawa
6-22, 24-25, 31: axial sections; 23: tangential section; 26-30: sagittal sections.
6: D2-052515, 7: D2-051772, 8: D2-050073, 9: D2-050071, 10: D2-050036, 11: D2-051768, 12: D2-050069, 13: D2-050047, 14: D2-055795, 15: D2-050048, 16: D2-052526, 17: D2-052519, 18: D2-051755, 19: D2-051759, 20: D2-052530, 21: D2-051773, 22: D2-055294, 23: D2-051765, 24: D2-050054, 25: D2-050055, 26: D2-050051, 27: D2-050063, 28: D2-050056, 29: D2-050050, 30: D2-051774, 31: D2-052570.
Locality 6, 16-17, 20, 31: A-384 (lower Gzhelian); 7, 11, 18-19, 21, 23, 30: A-309 (upper Kasimovian); 8-10, 12-13, 15, 24-29: A-227 (upper Kasimovian); 14: A-423 (upper Kasimovian); 22: B-135 (upper Kasimovian).
All ×10.

Plate XXIII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Etymology: From late Dr. K. Watanabe for his contribution toward fusuline biostratigraphy of the Carboniferous-Permian boundary strata in Japan.

Type specimens: Holotype D2-055699 (axial section, Pl. XXXIV, fig. 7). Paratypes: three axial sections (D2-055705, Pl. XXXIV, fig. 2; D2-055588, Pl. XXXIV, fig. 11; D2-055564, Pl. XXXIV, fig. 14), five tangential sections (D2-055644, Pl. XXXIV, fig. 1; D2-055694, Pl. XXXIV, fig. 3; D2-055742, Pl. XXXIV, fig. 4; D2-055692, Pl. XXXIV, fig. 5; D2-055703, Pl. XXXIV, fig. 8), four parallel sections (D2-055711, Pl. XXXIV, fig. 6; D2-055645, Pl. XXXIV, fig. 10; D2-055640, Pl. XXXIV, fig. 12; D2-055583, Pl. XXXIV, fig. 13), and one sagittal section (D2-055710, Pl. XXXIV, fig. 9).

Type locality: 150 m south of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture, Japan.

Diagnosis: Inflated fusiform to subspherical *Schwagerina* with minute proloculus, tightly coiled two to three, rarely four, initial whorls followed by rapidly expanding outer ones, intensely and regularly folded septa, high and narrow septal folds reaching the roof of chambers, and discontinuous low tunnel.

Description: Test inflated fusiform to subspherical with broadly arched periphery, almost straight to slightly convex lateral sides, bluntly pointed to rounded poles, and straight axis of coiling, and composed of eight and a half to ten whorls. Length about 6.1 to 8.0 mm and width about 3.7 to 5.5 mm, giving a form ratio of about 1.2 to 1.8.

Proloculus spherical and minute, less than 0.08 mm. Tightly to extremely tightly coiled inner two to three whorls are *Schubertella*-like. In specimens, the first whorl coiled endothyroidly like that of the holotype with six septa. The succeeding whorls rapidly increasing their width and gently increasing their length. The terminal whorl tends to somewhat decreases its width.

Wall very thin and not differentiated in initial one or two whorls. Very finely alveolar keriotheca first appears after the third or fourth whorl. The succeeding whorls consist of tectum and finely alveolar keriotheca. Thickness of wall about 0.09 to 0.12 mm in the thicker part of the last three whorls, but attaining 0.16 mm in narrow space of adjacent septa approaching each other.

Septa inclined anteriorly, closely spaced throughout the test and intensely and rather regularly folded. High and narrow septal folds reaching the roof of chambers. Some of adjacent septa are combined each other as a variable style. Septal counts from the second to ninth whorl more than 5, 13, 17, 26, 34, 36, 43, and more than 43, respectively in one section of the paratype, in which its first whorl coiled endothyroidly.

Phrenothecae poorly developed in outer whorls of most specimens. Tunnel low to very low and discontinuous throughout the test and its path possibly narrow and irregular. Rudimentary chomata discernible faintly in inner tightly coiled whorls. Axial fillings only developed in inner tightly coiled whorls in most specimens.

Remarks: This new species is provisionally assigned to *Schwagerina*, though test size and the number of whorls are considerably different from those of the type species of the genus, in addition to very tightly coiled inner whorls and partial presence of phrenothecae in this new species. Watanabe (1991) noticed the unique test characters of the inflated form of *Schwagerina* yielded from the upper Asselian of Akiyoshi, Atetsu and Omi limestones, to which he gave a new name *Schwagerina globulus japonica* without description. It is assumed that he would place it as a subspecies of *globulus* either *Pseudofusulina krotowi* var. *globulus* Rauzer-Chernousova, 1940 originally proposed from the western slopes of the Urals by Rauzer-Chernousova or *P. globula* reassigned by Grozidilova (1966) based on the Timan material.

The sample locality of present material is possibly the same as Watanabe's locality from Wakatakeyama. Few specimens with larger proloculus or with more pointed poles than the present material are illustrated in Watanabe (1991). All the specimens including these few specimens have more whorls, better developed juvenile whorls, and more intensely folded septa than those of *globulus* from

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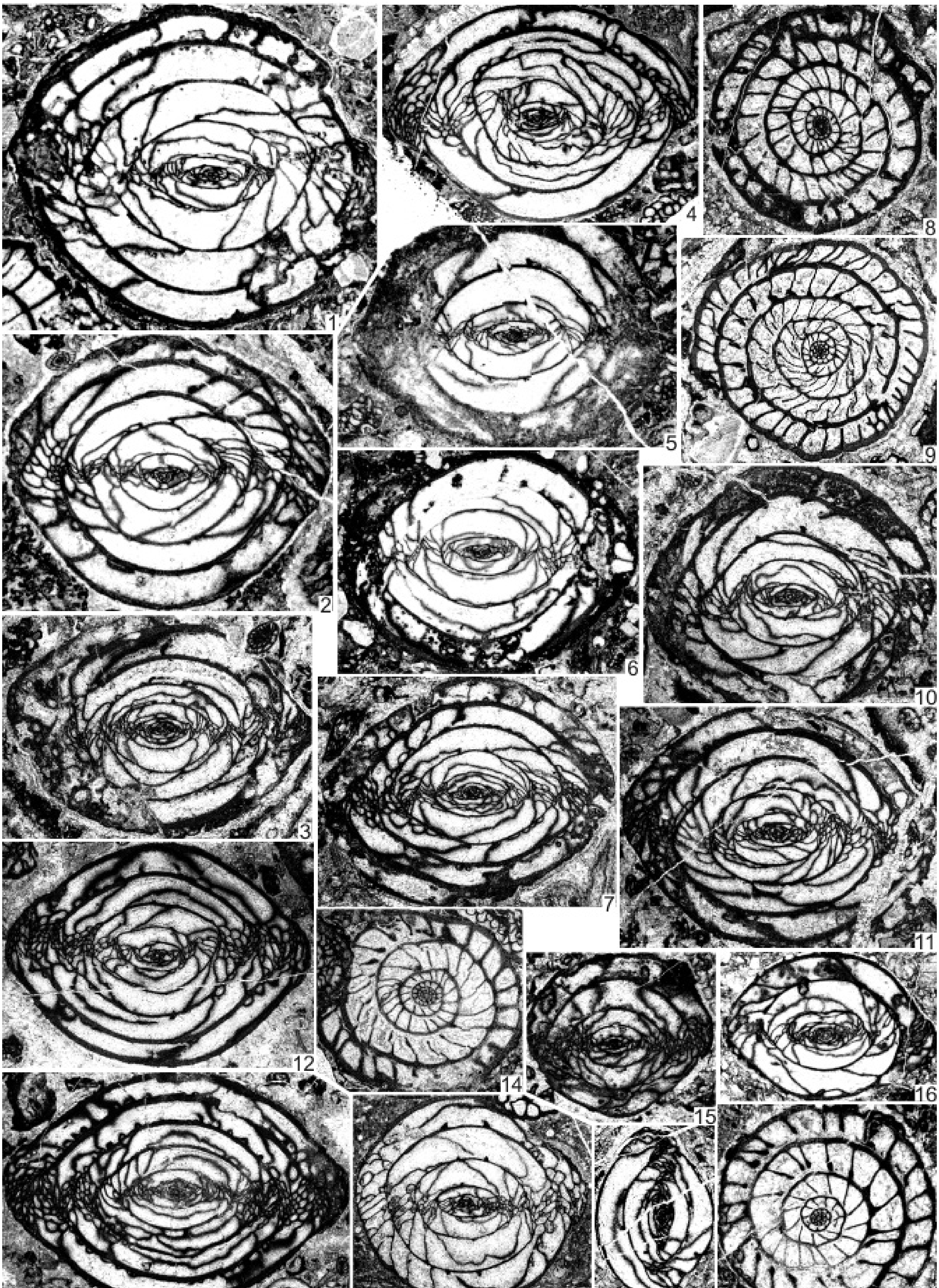
Plate XXIV

Figs 1-11, 14-19: *Sphaeroschwagerina fusiformis* (Krotow)
1: tangential section; 2-7, 10-11, 15-18: axial sections; 8-9, 14, 19: sagittal sections.
1: D2-052776, 2: D2-055488, 3: D2-040710, 4: D2-052877, 5: D2-052906, 6: D2-047314, 7: D2-040738, 8: D2-040784, 9: D2-040756, 10: D2-040790, 11: D2-040818, 14: D2-040967, 15: D2-057173, 16: D2-052921, 17: D2-041015, 18: D2-052885, 19: D2-055511.
Locality 1: A-395a (lower Asselian); 2, 19: A-404 (lower Asselian); 3, 7, 9: A-22a (lower Asselian); 4, 18: A-400 (lower Asselian); 5: A-401 (lower Asselian); 6: A-99 (lower Asselian); 8, 10-11: A-22b (lower Asselian); 14: A-27a (lower Asselian); 15: B-212 (lower Asselian); 16: A-402 (lower Asselian); 17: A-27b (lower Asselian).
All ×10.

Figs 12-13: *Sphaeroschwagerina pavlovi* (Rauzer-Chernousova)
12-13: axial sections.
12: D2-041470, 13: D2-041460.
Locality both A-63a (lower Asselian). Both ×10.

Plate XXIV



Urals and Timan, and are considered to be a new species. Two specimens among three in Toriyama (1958) named as *Schwagerina* sp. C are included in this new species. *Schwagerina* sp. C by Y. Ota (1998) is also probably included in the new species.

General features of growth pattern of the test are relatively similar to those of *Darvasoschwagerina donbasica* Leven & Davydov, 2001 from the lower Gzhelian of Donetz Basin (Leven & Davydov, 2001). However, this new species has larger and more spherical test with more whorls and more regularly folded septa. Both are presumed to be unrelated phylogenetically.

Schwagerina watanabei appears alike to *Iranella orbiculata* Leven in Leven & Mohaddam (2004) from the upper Cisuralian (Bolorian = late Kungurian) of eastern Iran (Leven in Leven & Mohaddam, 2004) in general features of the test. However, the former has more whorls, smaller proloculus, more tightly coiled juvenile whorls, not so intensely and regularly folded septa, and not so tall and slender septal folds. *Iranella* was established by Leven in Leven & Mohaddam (2004) designating *Iranella bella* Leven in Leven & Mohaddam, 2004 as the type species and was supposed to be a descendent of *Chalaroschwagerina vulgarisiformis* (Morikawa, 1952) by Leven. Therefore, *Iranella* is homeomorphous but derivates from another lineage of inflated schwagerinids of the Cisuralian. The present new species is different from *Pseudofusulina globularis* Gübler, 1935 described from the Permian of Battambang, Cambodia (Gübler, 1935). The former has more closely spaced septa and more weakly folded septa in polar regions than the latter, and mode of development of axial fillings is different between the two.

Occurrence and stratigraphic distribution: Common in some samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

***Schwagerina wakatakeyamensis* n. sp.**
Pl. XXXV, figs 1-15

Etymology: From the studied area, Wakatakeyama, Akiyoshi, Shuho-cho, Mine City, Yamaguchi Prefecture, Japan.

Type specimens: Holotype D2-055567 (axial section, Pl. XXXV, fig. 1). Paratypes: nine axial sections (D2-055571, Pl. XXXV, fig. 2; D2-055688, Pl. XXXV, fig. 3; D2-055555, Pl. XXXV, fig. 5; D2-055565, Pl. XXXV, fig. 6; D2-055685, Pl. XXXV, fig. 7; D2-055687, Pl. XXXV, fig. 9; D2-055557, Pl. XXXV, fig. 10; D2-055572, Pl. XXXV, fig. 14; D2-055570, Pl. XXXV, fig. 15), four sagittal sections (D2-055562, Pl. XXXV, fig. 8; D2-055686, Pl. XXXV, fig. 11; D2-055682, Pl. XXXV, fig. 12; D2-055577, Pl. XXXV, fig. 13), and one oblique section (D2-055558, Pl. XXXV, fig. 4).

Type locality: 150 m south of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture.

Diagnosis: Inflated fusiform to subspherical *Schwagerina* with large proloculus, not straight axis of coiling deviated in few times during the growth, intensely folded septa, high and narrow septal folds reaching the roof of chambers, and discontinuous low tunnel.

Description: Test inflated fusiform to subspherical with broadly arched periphery, almost straight to slightly convex lateral sides, and bluntly pointed to rounded poles, and composed of seven to eight whorls. Axis of coiling not straight and deviated in early to middle, rarely in late, stage of the growth. Length 6.90 mm, width 5.28 mm, and form ratio 1.29 in the holotype, but exactly unknown in most specimens on account of abrasion of outer whorls and the orientation of section due to not straight axis of coiling.

Proloculus spherical to subspherical and about 0.20 to 0.51 mm in longer diameter. Length and width of whorls are also not exactly compared among specimens due to not straight axis of coiling deviated in few times during the growth. In the holotype, length from the first to seventh whorl 0.67, 0.1.20, 1.93, 2.65, 3.24, 4.26, and 6.04 mm, width from the first to seventh 0.63, 1.03, 1.65, 2.36, 2.99, 4.04, and 4.87 mm, and a form ratio from the first to seventh 1.06, 1.17, 1.17, 1.12, 1.08, 1.05, and 1.24, respectively.

Wall relatively thin in the first to third whorl in comparison with succeeding whorls gradually thickened outwards, and consists of tectum and finely alveolar keriotheca beyond the first to the third whorl. Thickness of wall about 0.07 to 0.11 mm in the thicker part of outer whorls. Septa closely spaced throughout the test and intensely folded, especially in polar regions resulting many

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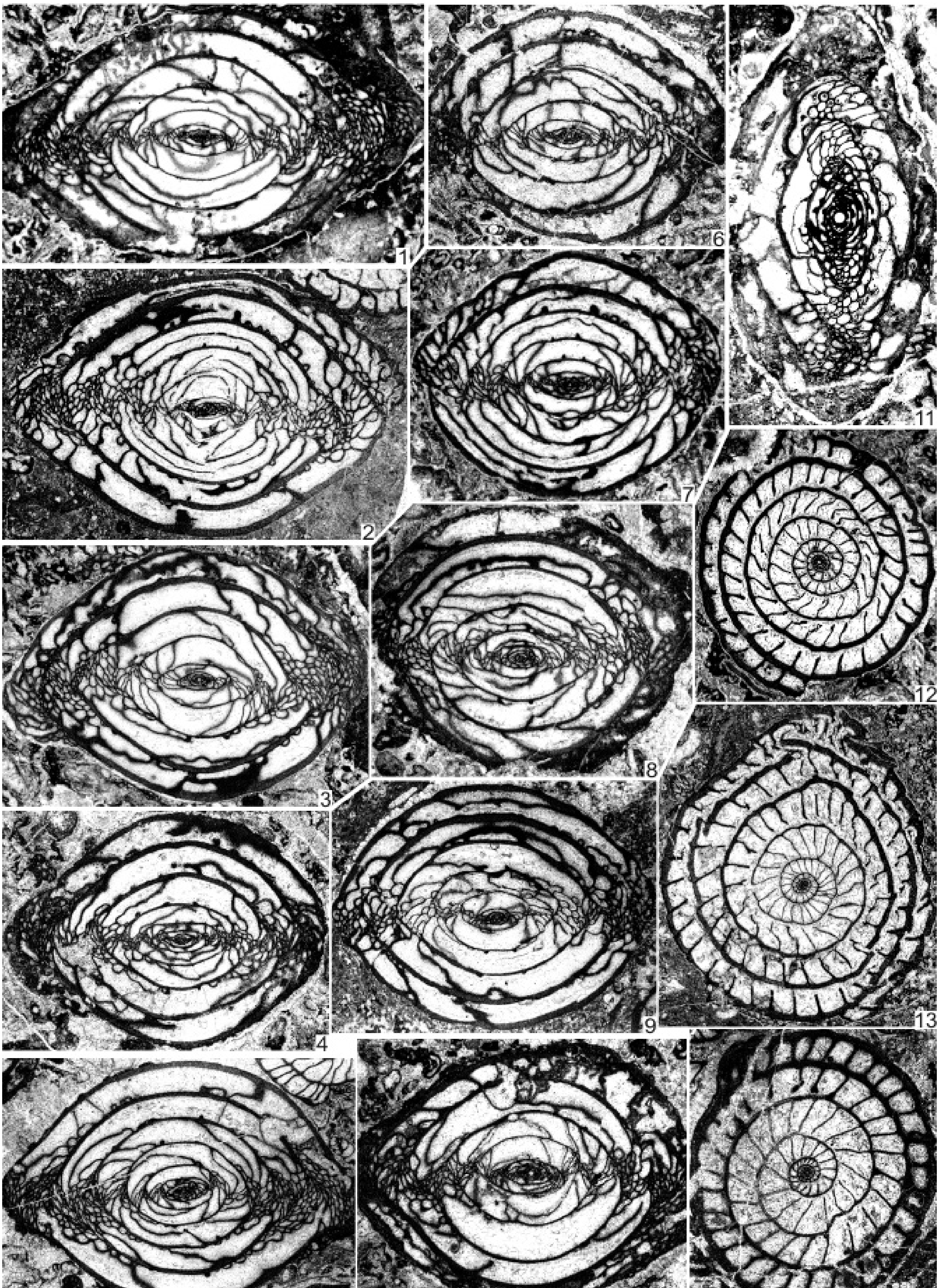
Plate XXV

Figs 1-10, 12-14: *Sphaeroschwagerina pavlovi* (Rauzer-Chernousova)
1-10: axial sections, 12-14: sagittal sections.
1: D2-047690, 2: D2-041005, 3: D2-040977, 4: D2-040751, 5: D2-041480, 6: D2-040799, 7: D2-047675, 8: D2-0476, 9: D2-041017, 10: D2-041473, 12: D2-047695, 13: D2-040998, 14: D2-040821.
Locality 1, 7, 12: A-132 (lower Asselian); 2, 9, 13: A-27b (lower Asselian); 3: A-27a (lower Asselian); 4: A-22a (lower Asselian); 5, 10: A-63a (lower Asselian); 6, 14: A-22b (lower Asselian).
All ×10.

Fig. 11: *Pseudoschwagerina muongthensis* (Deprat)
Axial section, D-055509, Locality A-404 (lower Asselian), ×10.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chamberlets. High and narrow septal folds reaching the roof of chambers. Septal counts from the first to sixth whorl approximately 12 to 14, 19 to 22, 26 to 29, 29 to 41, 36 to 41, 42 to 46, respectively in the illustrated four sections, but more exactly uncertain due to slight changes of axis of coiling.

Phrenothecae poorly developed. Tunnel very low and discontinuous. Rudimentary chomata on proloculus. Axial fillings or secondary dark calcareous materials irregularly developed in inner whorls in most specimens.

Remarks: This new species is also provisionally assigned to *Schwagerina* as well as *Schwagerina watanabei*. Variably deviant axis of coiling during growth is very characteristic in this new species. The mode of septal folding and low and discontinuous tunnel are common between this new species and *Schwagerina watanabei*. On the other hand, size of proloculus and morphologies of inner whorls are largely different between the two, along with not straight axis of coiling in the former, though these two new species co-exist in two samples (A-407 and A-412).

Occurrence and stratigraphic distribution: Common in few samples only from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Genus *Eoparafusulina* Coogan, 1960

Type species: *Fusulina gracilis* Meek, 1864, p. 4.

***Eoparafusulina ellipsoidalis* (Toriyama, 1958)**

Pl. XXXI, figs. 15, 17–18, 20–28; Pl. XXXII, figs. 1-20

1958. *Triticites ellipsoidalis* Toriyama, pp. 115-118, pl. 12, figs 13-34.
1989. *Eoparafusulina ellipsoidalis* (Toriyama).– Ueno, pl. 3, fig. 8.
1990. "*Triticites*" *langsonensis* Saurin, 1950.– T. Ozawa & Kobayashi, pl. 6, figs 7-8.
1991. *Eoparafusulina ellipsoidalis* (Toriyama).– Watanabe, fig. 5.1-14.

Description: Test ellipsoidal to subcylindrical with nearly flat to broadly arched periphery, slightly convex lateral sides, rounded to bluntly pointed poles, and straight to slightly curved axis of coiling, and composed of six and a half to eight whorls. Length about 3.3 to 6.2 mm and width about 1.3 to 2.2 mm, giving a form ratio of about 2.0 to 3.7.

Proloculus spherical and 0.09 to 0.22 mm in diameter. Test gradually and uniformly expands throughout growth. Wall thin for the test size, loosely undulated in specimens, gradually and regularly thickened outwards and consists of tectum and finely to very finely alveolar keriotheca in outer whorls. Alveolar structure of wall is obscure in inner and middle whorls. Thickness of wall less than 0.03 mm in inner three to four whorls, about 0.03 to 0.07 mm in outer ones in most specimens.

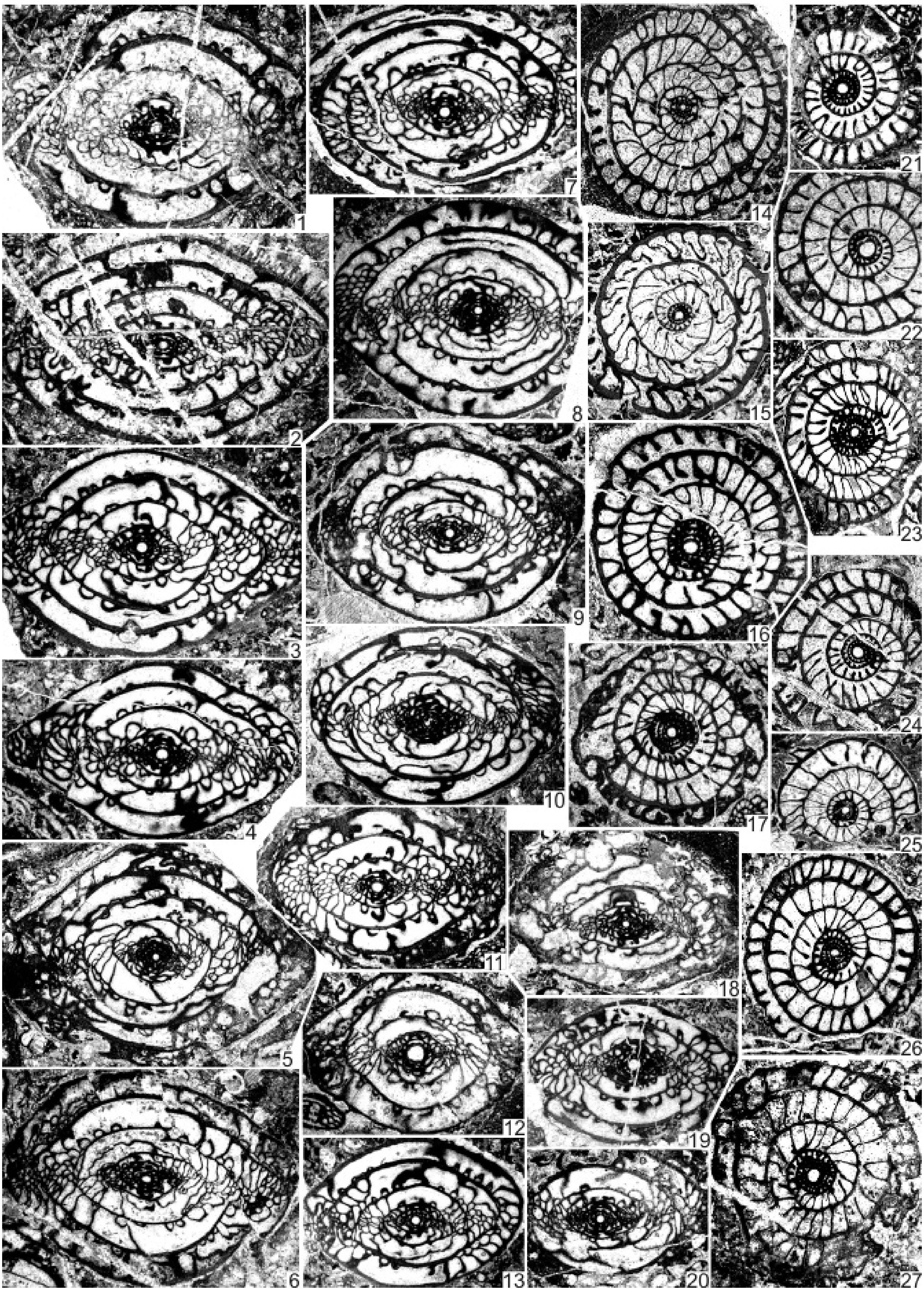
Septa closely spaced and almost plane to weakly folded in the median part of the test and weakly to moderately folded in polar regions. Septal folds are low and somewhat regular. Shallow septal sutures present in outer one to two whorls. Septal counts from the first to eighth 7 to 9, 10 to 15, 11 to 18, 12 to 18, 15 to 22, 17 to 25, 20 to 24, 25 or more, respectively. Indistinct cuniculi detected in few specimens. Tunnel low and narrow and its path rather irregular. Chomata well developed in inner and middle whorls, but absent or rudimentary in outer whorls of some specimens. Weak axial fillings developed in polar regions of inner and middle whorls.

Remarks: This species is reassigned to *Eoparafusulina* as done by Ueno (1989) and Watanabe (1991) based on its elongate test, low and rather regular septal folding, and the presence of cuniculi. Septal folding of this species is weaker in the median part of the test than of other species of *Eoparafusulina*. The size and form ratio, and strength of septal folding are more or less different from specimen to specimen, suggesting broad intraspecific variations of this species. One specimen named *Triticites langsonensis* by T. Ozawa & Kobayashi (1990) corresponds to an elongate form of *E. ellipsoidalis*. In European Russia, relatively small and elongate schwagerinids similar to those of this species were described from northern Timan (Grozdilova & Lebedeva, 1961): *Pseudofusulina*(?) *perplexa* Grozdilova & Lebedeva, 1961 and *Pseudofusulina*(?) *perplexa* forma *pertenia* Grozdilova & Lebedeva, 1961.

Occurrence and stratigraphic distribution: Abun-

Plate XXVI

Figs 1-27: *Pseudoschwagerina muongthensis* (Deprat)
1-13, 18-20: axial sections; 14-17, 21-27: sagittal sections.
1: D2-055737, 2: D2-055740, 3: D2-050430, 4: D2-047329, 5: D2-040721, 6: D2-040749, 7: D2-047347, 8: D2-047341, 9: D2-040771, 10: D2-052780, 11: D2-050400, 12: D2-040787, 13: D2-050407, 14: D2-040814, 15: D2-052949, 16: D2-047346, 17: D2-040823, 18: D2-040803, 19: D2-047339, 20: D2-040740, 21: D2-050399, 22: D2-040798, 23: D2-050404, 24: D2-040713, 25: D2-051904, 26: D2-047322, 27: D2-055507.
Locality 1-2: A-417; 3, 11, 13, 21, 23: A-241b (lower Asselian); 4, 7-8, 16, 19, 26: A-100 (lower Asselian); 5-6, 9, 20, 24: A-22a (lower Asselian); 10: A-395a (lower Asselian); 12, 14, 17-18, 22: A-22b (lower Asselian); 15: A-403 (lower Asselian); 25: A-319 (lower Asselian); 27: A-404 (lower Asselian).
All ×8.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dant to rare in many samples exclusively from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Mccloudia* Ross, 1967
Type species: *Eoparafusulina contracta* Skinner & Wilde, 1965, p. 78.

***Mccloudia*? *truncatus* (Chen, 1934)**
Pl. XLIX, figs 9-10

1934. *Triticites truncatus* Chen, pp. 39-40, pl. 2, figs 8-10.

Remarks: Two forms having similar mode of septal folding but somewhat different form ratios were recognized. Although morphologic variations of these two forms in the present material are uncertain, they are not separated because forms similar to these two forms are described and illustrated by Chen (1934) as *Triticites truncatus* from the Chuanshan Limestone of Zhejiang and Maping Limestone of Guangxi (China). Although the presence of cunniculi is uncertain, they are questionably reassigned to *Mccloudia*, originally proposed as the subgenus of *Eoparafusulina* by Ross (1967), by their stout test with more broadly rounded poles and smaller proloculus in comparison with *Eoparafusulina*. This species is distinguished from *Darvasites pseudosimplex*, described below, in having a smaller form ratio, weaker chomata, and more irregularly folded septa.
Occurrence and stratigraphic distribution: Rare in few samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Darvasites* Miklukho-Maklay, 1959
Type species: *Triticites ordinatus* var. *daroni* Miklukho-Maklay, 1949, p. 70.

***Darvasites pseudosimplex* (Chen, 1934)**
Pl. XLIX, fig. 16

1934. *Triticites pseudosimplex* Chen, pp. 25-26, pl. 1, figs 19-20.
1997. *Darvasites pseudosimplex* (Chen).– Leven, p. 66, pl. 9, fig. 11.

Remarks: In spite of few well-oriented specimens from the studied area, specimens including the illustrated one are identical with *Triticites pseudosimplex* by their similar size and shape of the test and mode of septal foldings. This species was originally described from the Lower Permian Swine Limestone of Jiangsu (China) by Chen (1934) and later transferred to *Darvasites* by Miklukho-Maklay (1959) along with *Triticites truncatus* Chen, 1934. From the relatively weak development of chomata *D. pseudosimplex* might be included in *Darvasites* (*Alpites*) proposed by Davydov in Davydov *et al*. (2013) designating *Fusulina contracta* Schellwien, 1909 as the type species. However, conclusion is reserved from insufficient material from the Wakatakeyama area.
Occurrence and stratigraphic distribution: Rare in only one sample (A-63a) from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

***Darvasites vandae* Leven & Shcherbovich, 1980**
Pl. XLIX, fig. 14

1980. *Darvasites vandae* Leven & Shcherbovich, p. 27, pl. 4, figs 7-9.
1997. *Darvasites vandae* Leven & Shcherbovich.– Leven, p. 66, pl. 9, figs 13-15.

Remarks: Although well-oriented specimens are few, the present material is identical with *Darvasites vandae* in shape and size of the test and mode of the septal folding, originally described from the Sakmarian of Darvas by Leven & Shcherbovich (1980) and later from the Sakmarian to Yakhtashian of Afghanistan by Leven (1997). This species is similar to *Darvasites contractus* (Schellwien, 1909), but has larger test and more strongly folded septa.
Occurrence and stratigraphic distribution: Rare in few samples from the *Paraleeina magna* Zone.

Genus *Carbonoschwagerina* T. Ozawa, Watanabe & Kobayashi, 1992
Type species: *Pseudoschwagerina morikawai* Igo, 1957, p. 238.

Remarks: *Carbonoschwagerina* was erected for inflated fusiform schwagerinids that were reported

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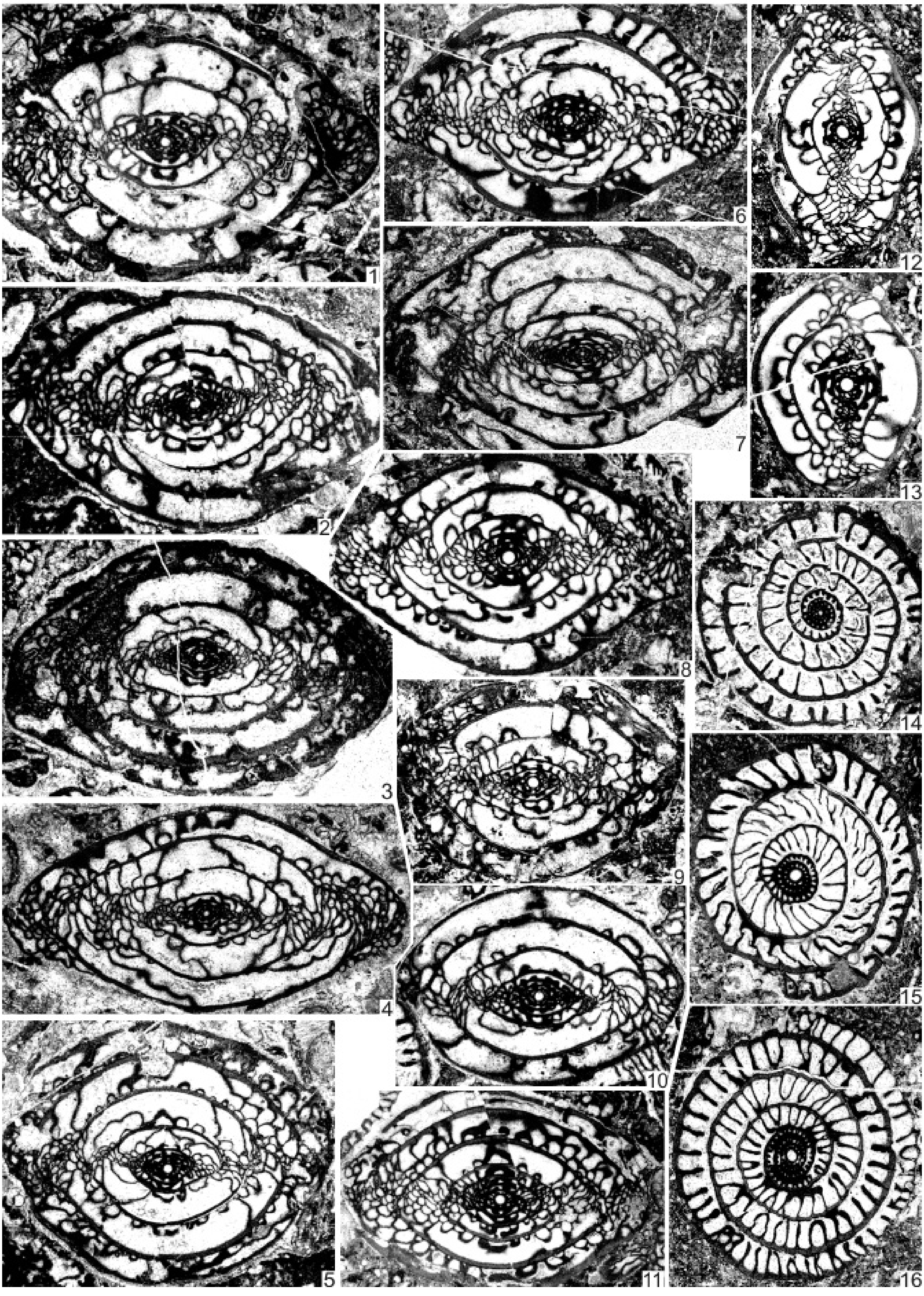
Plate XXVII

Figs 1-16: *Pseudoschwagerina muongthensis* (Deprat)
1-13: axial sections, 14-16: sagittal sections.
1: D2-040815, 2: D2-055513, 3: D2-0407830 4: D2-041446, 5: D2-040770, 6: D2-047343, 7: D2-040748, 8: D2-047342, 9: D2-040795, 10: D2-040731, 11: D2-050403, 12: D2-050415, 13: D2-050423, 14: D2-040767, 15: D2-047333, 16: D2-047348.
Locality 1, 3, 9: A-22b (lower Asselian); 2: A-404 (lower Asselian); 4: A-63a (lower Asselian); 5, 7, 10, 14: A-22a (lower Asselian); 6, 8, 15-16: A-100 (lower Asselian); 11-13: A-241b (lower Asselian).
All ×10.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restrictedly from the Upper Carboniferous of Japan, North China, and British Columbia (T. Ozawa *et al*., 1992). These forms have in common small proloculi and tightly coiled inner whorls, and massive chomata. T. Ozawa *et al.* (1992) already discussed the varidity of *Carbonoschwagerina* and its differences from *Pseudoschwagerina*, *Alpinoschwagerina*, and *Sphaeroschwagerina*, and phylogenies of these and related genera. *Pseudoschwagerina morikawai* was transferred to *Alpinoschwagerina* along with *Pseudoschwagerina minatoi* by Bensh (1972, p. 101). However, *Carbonoschwagerina* should be separated from *Alpinoschwagerina* in having more well-developed chomata and thicker wall, as indicated by T. Ozawa *et al.* (1992). Most remarkable differences between them are more massive chomata throughout the test and confined occurrence from the upper Kasimovian to the upper Gzhelian in the former, strongly suggesting its derivation from *Montiparus*. *Carbonoschwagerina* appears to be somewhat similar to *Schwageriniformis* (*Tumefactus*) proposed by Leven & Davydov (2001) designating *Triticites expressus* Anosova in Bensh (1969) as the type species. However, the latter has remarkable phrenothecae and less developed chomata in outer whorls.

Gradual change of the test morphologies and stratigraphic distribution suggest one-way trend of evolution from *Carbonoschwagerina nipponica* to *C. minatoi* through *C. nakazawai* and *C. morikawai*, all of which are described below. Test becomes larger and more inflated, proloculus smaller, juvenarium more evident, and strength of septal folding less remarkable stratigraphically upwards.

***Carbonoschwagerina minatoi* (Kanmera, 1958)**
Pl. XVI, figs 1-11

1958. *Pseudoschwagerina minatoi* Kanmera, pp. 179-181, pl. 28, figs 1-8.
1990. *"Pseudoschwagerina" minatoi* Kanmera.– T. Ozawa & Kobayashi, pl. 5, fig. 1.
1991. *"Pseudoschwagerina" minatoi* Kanmera.– Watanabe, fig. 29.1-14, fig. 30.1-9, fig. 31.1-5.
1993. *Pseudoschwagerina minatoi* Kanmera.– Zhou, pl. 2, fig. 3.
non 2006. *Carbonoschwagerina* cf. *minatoi* (Kanmera).– Ueno & Fujikawa, pl. 4.2, fig. 11 (= *Alpinoschwagerina nagatoensis* Kobayashi, n. sp.).
non 2012. *Pseudoschwagerina minatoi* Kanmera.– Shi *et al*., p. 223, pl. 23, fig. 5 (= *Pseudoschwagerina* sp.).

Description: Test highly inflated fusiform to subspherical with arched periphery, slightly convex lateral sides, bluntly pointed to rounded poles, and almost straight axis of coiling, and composed of seven to eight and a half whorls. Length about 7.5 to 9.8 mm and width about 5.3 to 6.7 mm, giving a form ratio of about 1.3 to 1.6.

Proloculus spherical and its diameter 0.02 to 0.06 mm. Inner four whorls very tightly coiled. The first and succeeding three whorls fusiform increasing sharpness of pointed poles and form ratio. Beyond the fourth whorl, test expands rapidly. Outer whorls become highly inflated fusiform to subspherical due to higher expansion degree in median portion than in axial portion. Width of the outermost whorl decreases against that of the preceeding whorl.

Wall thin in juvenile whorls, thickened gradually outerwards, and rather suddenly thickened in the last two whorls as thick as 0.10 mm. Wall consists of tectum and finely alveolar keritotheca except for that of juvenile whorls.

Septa closely spaced throughout the test, almost plane in juvenile whorls, and almost plane to irregularly and very weaky folded in the median part of the test. Septal counts in the last whorl about 38 to 44, but their ontogenetic changes exactly unknown.

Tunnel low and narrow in juvenile whorls, then somewhat irregularly broadened but still low and less than one-sixth as high as chambers. Chomata well developed in juvenile whorls. Distinct to rudimentary chomata recognizable further outwards, but possibly absent in outermost one or two whorls.

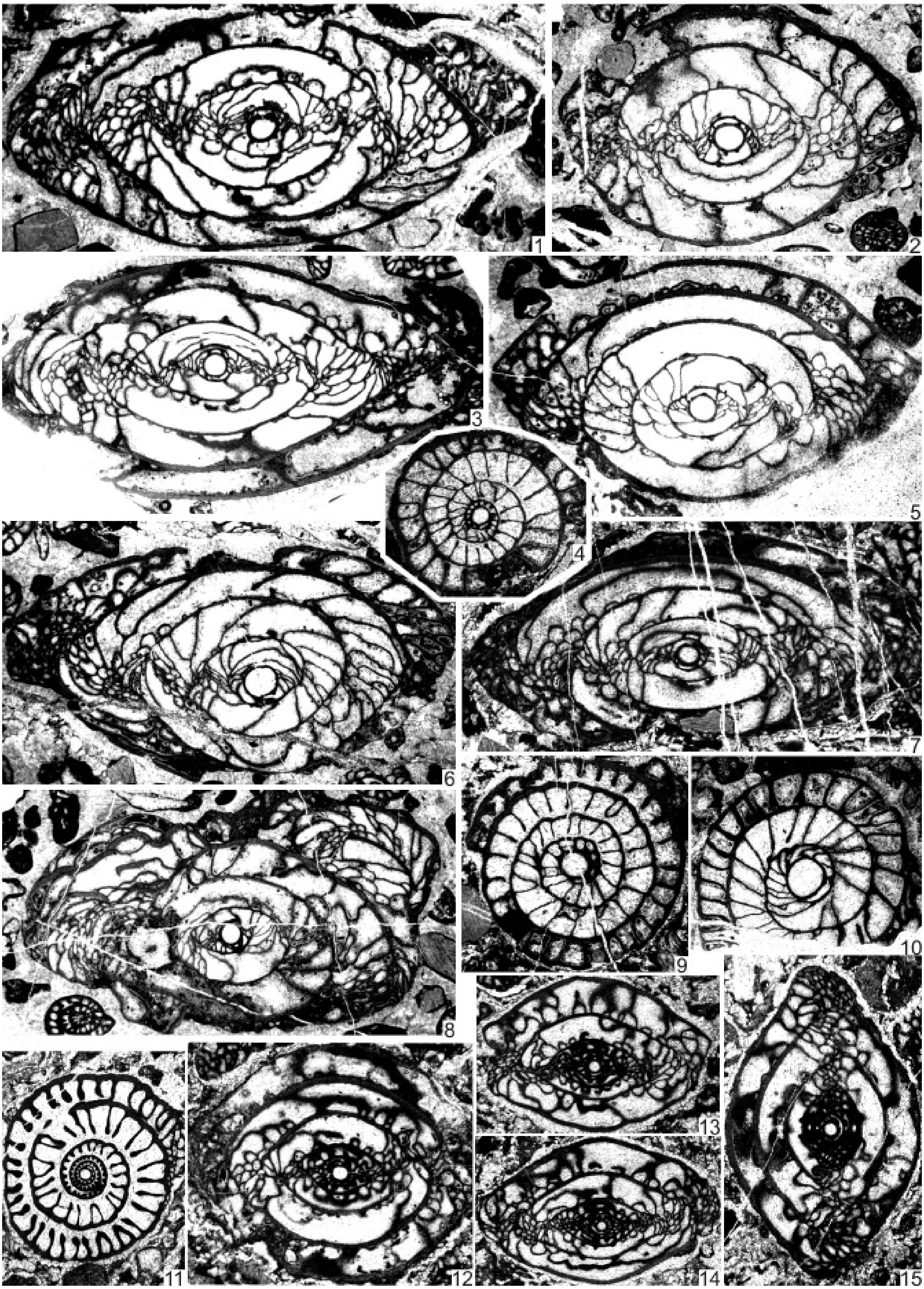
Remarks: This species, considered to be an endemic form of *Carbonoschwagerina*, was established by Kanmera (1958) on the basis of more widely spaced septa and more rapidly expanding whorls in the middle stage of the growth than those of *Pseudoschwagerina morikawai*. Besides them, this species is considered to be

Plate XXVIII

Figs 1-10: *Pseudoschwagerina miharanoensis* Akagi
1-3, 5-8: axial sections; 4, 9-10: sagittal sections.
1: D2-055620, 2: D2-055603, 3: D2-055612, 4: D2-056788, 5: D2-055614, 6: D2-055597, 7: D2-056780, 8: D2-055625, 9: D2-056782, 10: D2-055616.
Locality 1-3, 5-6, 8, 10: A-409 (upper Asselian); 4, 7, 9: B-180 (upper Asselian)
All ×10.

Figs 11-15: *Pseudoschwagerina muongthensis* (Deprat)
11: sagittal section, 12-15: axial sections.
11: D2-057203, 12: D2-057199, 13: D2-057196, 14: D2-057205, 15: D2-057195.
Locality all B-213 (lower Asselian). All ×10.

Plate XXVIII



discriminated from *morikawai* by its more tightly coiled and more number of juvenile whorls.

The present specimens and the Watanabe's (1991) ones both from the Wakatakeyama area have somewhat larger test, more number of whorls, and smaller proloculus than the original ones of Kanmera (1958). These characteristic features are further remarkable in specimens illustrated by Watanabe (1971) from the Mizuyagadani Formation of the Fukuji area. Furthermore, Watanabe (1991) recognized a transitional form from *morikawai* to *minatoi*. These morphologic similarities and its gradual changes strongly suggest the one-way trend evolution from *C. morikawai* to *C. minatoi,* as pointed out by Kanmera (1958).

Outside Japan, this species is described from the Upper Carboniferous of Guangxi (South China) by Zhou (1993). The following species all from Inner Mongolia (North China) are closely allied to and considered to be junior synonyms of *Carbonoschwagerina minatoi* based on their similar test characters diagnostic in this species. However, these Chinese materials are somewhat smaller in comparison with Japanese ones. They are *Pseudoschwagerina borealis* (Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949) described by Sheng (1958b) and Han (1975), *Pseudoschwagerina constans* (Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949) by Han (1975), and *Pseudoschwagerina paraborealis* Han, 1975 by Han (1975). Both *P. borealis* illustrated by Sheng (1958b) and Han (1975), and *P. constans* by Han (1975) cannot be identified with the Shcherbovich's original ones referable to *Sphaeroschwagerina*.

Carbonoschwagerina cf. *minatoi* from Akiyoshi by Ueno & Fujikawa (2006) is not compared with the types. It is assumed to be a deformed form of *Alpinoschwagerina nagatoensis* n. sp. One specimen identified with this species from the Lower Permian of Guizhou (South China) by Shi *et al*. (2012) is excluded from this species. It is presumed to be an unidentified species of *Pseudoschwagerina*.

Occurrence and stratigraphic distribution: Common in only one sample (A-393) from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone in association with *Darvasoschwagerina shimodakensis* (Kanmera, 1958) and others (Table 2).

***Carbonoschwagerina morikawai* (Igo, 1957)**
Pl. XIV, figs 5-16; Pl. XV, figs 1-13

1957. *Pseudoschwagerina morikawai* Igo, pp. 238-239, pl. 15, figs 11-17.
1958. *Pseudoschwagerina morikawai* Igo.– Kanmera, pp. 177-179, pl. 27, figs 1-11.
pars 1958. *Pseudoschwagerina* (*Pseudoschwagerina*) *muongthensis* (Deprat, 1915).– Toriyama, pp. 158-161, pl. 18, figs 15-17 (non pl. 18, fig. 18; pl. 19, figs 1-6: *Sphaeroschwagerina fusiformis*).
1989. *Alpinoschwagerina*? *fusiformis* (Krotow, 1888).– Ueno, pl. 3, fig. 7.
1990. "*Pseudoschwagerina*" *morikawai* Igo.– T. Ozawa & Kobayashi, pl. 4, figs 19-20.
1991. *"Pseudoschwagerina" morikawai* Kanmera.– Watanabe, fig. 26.1-14, fig. 27.1-11, fig. 28.3-5.

Description: Test highly inflated fusiform with arched periphery, slightly convex lateral sides, bluntly pointed to rounded poles, and almost straight axis of coiling, and composed of seven to nine whorls. Length about 7.2 to 8.4 mm and width about 3.3 to 4.4 mm, giving a form ratio about 1.5 to 2.2.

Proloculus spherical and its diameter about 0.04 to 0.18 mm. Inner three to four whorls tightly coiled. These inner fusiform whorls with pointed pols are followed by rapidly expanding outer inflated fusiform whorls increasing the roundness of pointed poles. Width of whorl decreases in the outermost whorl against in the preceeding whorl.

Wall thin in juvenile whorls and thickened gradually outerwards, about 0.08 to 0.12 mm in thickness in outer three whorls. Wall consists of tectum and alveolar keritotheca. Alveolar strucuture obscure or absent in inner two to three whorls, but becomes distinct outerwards.

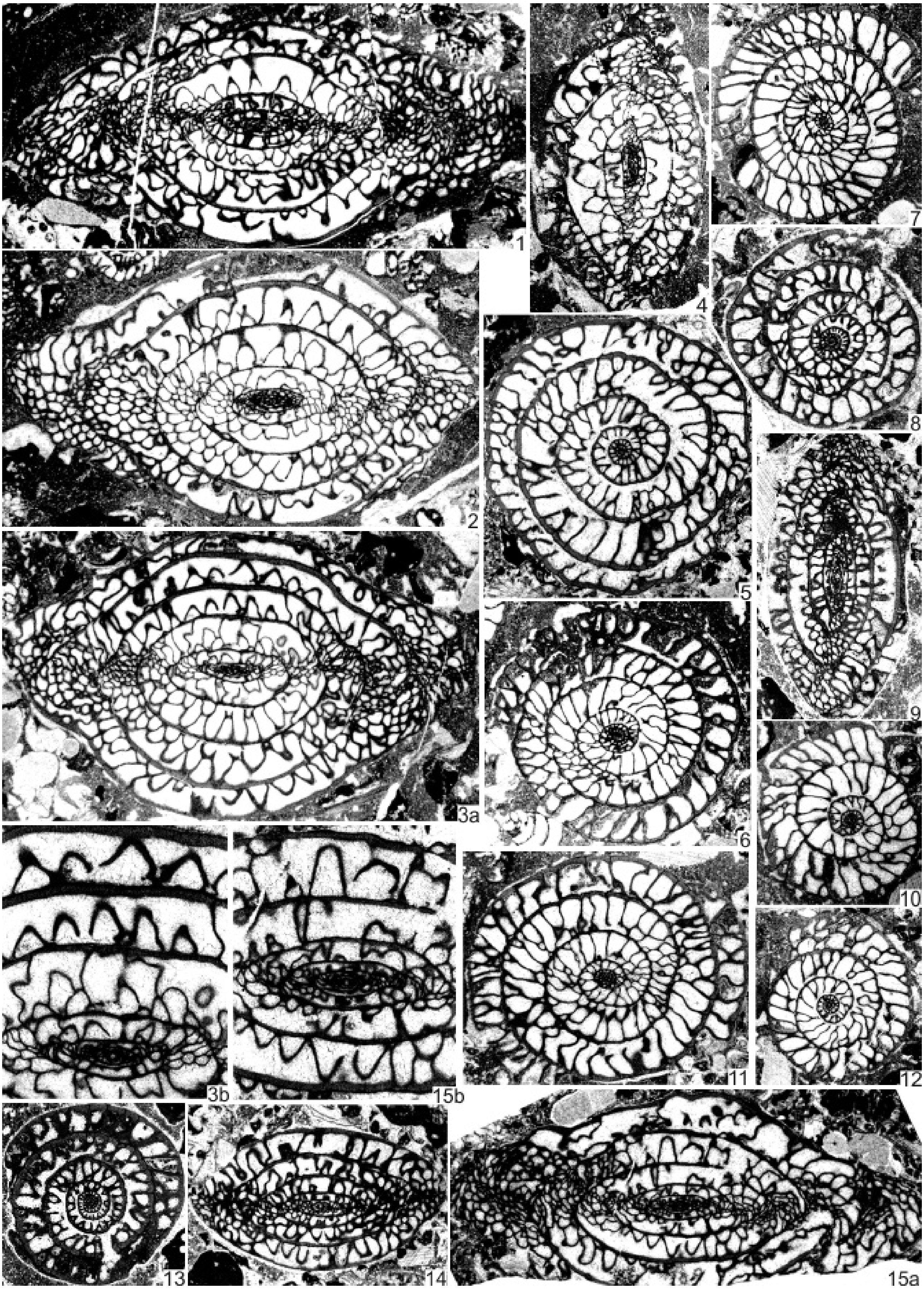
Septa closely spaced throughout the test, almost plane in juvenile whorls. In inflated whorls, septa almost plane to irregularly and weaky folded in the median part of the test and intensely folded in polar regions resulting many loops. Septal counts from the first to eighth whorl about 6 to 8, 9 to 19, 13 to 26, 17 to 29, 20 to 30, 22 to 32, 22 to 37, and 25 to 34, respectively.

Tunnel low and narrow in juvenile whorls, then irregularly broadened, but still low and less than one-fourth as high as chambers. Chomata well developed in inner whorls, distinct but small and low for height of chambers. They are absent in outer one or two whorls.

Plate XXIX

Figs 1-15: *Darvasoschwagerina shimodakensis* (Kanmera)
1, 3, 9, 14-15: axial sections; 2, 4: tangential sections; 5-6, 8, 13: parallel sections; 7, 10-12: sagittal sections.
1: D2-052696, 2: D2-052683, 3: D2-052692, 4: D2-052703, 5: D2-052603, 6: D2-052673, 7: D2-052691, 8: D2-052651, 9: D2-052586, 10: D2-052705, 11: D2-052707, 12: D2-052671, 13: D2-052594, 14: D2-052587, 15: D2-052597.
Locality 1-4, 6-7, 10-12: A-393 (upper Gzhelian); 5, 15: A-388 (middle Gzhelian); 8: A-391 (middle Gzhelian); 9, 13-14: A-387 (middle Gzhelian).
3b, 15b: ×20; others: ×10.

Plate XXIX



Remarks: Specimens described herein and done by Kanmera (1958) from the Yayamadake Limestone, and those illustrated by Watanabe (1991) are larger than the type specimens from Fukuji by Igo (1957). However, they cannot be separated from the types, because many important test characters are essentially the same among these Japanese materials and these differences by localities are presumed to be due to broad intraspecific variations of this species.

Among thirteen specimens illustrated as *Pseudoschwagerina* (*Pseudoschwagerina*) *muongthensis* by Toriyama (1958), three are probably reassigned to this species and seven are done to *Sphaeroschwagerina fusiformis*. One specimen illustrated as *Alpinoschwagerina*? *fusiformis* by Ueno (1989) is also reassigned to this species from its closely similar morphologies of juvenile whorls, expansion of the test, and mode of septal foldings.

Pseudoschwagerina arta by Thompson (1965) from British Columbia is different from the original one by Thompson & Hazzard (1946) from southern California. His description of this species is assumed to be based mainly on three specimens as specified by him (Thompson, 1965, p. 233, pl. 33, figs 6-8). They have smaller test, smaller length and height of corresponding outer whorls than the original three specimens from southern California. They are more similar to the types of *C. morikawai* from Fukuji than of *P. arta* from California. These two species from British Columbia and Fukuji are supposed to be closely allied each other and might be conspecific. Although proloculus is larger in *P. arta* than in *C. morikawai* illustrated herein, it is considerably variable in the Fukuji specimens (unpublished data by the author). On the other hand, two specimens named as *Pseudoschwagerina arta* (Thompson, 1965, pl. 35, figs 1-2) are more similar to *Carbonoschwagerina nakazawai* (Nogami, 1961) from their smaller test with larger form ratio.

Occurrence and stratigraphic distribution: Common to abundant in many samples from the *Carbonoschwagerina morikawai-Jigilites horridus* Zone.

***Carbonoschwagerina nakazawai* (Nogami, 1961)**

Pl. XII, figs 38-43; Pl. XIII, figs 20-33; Pl. XIV, figs 1-4

1961. "*Pseudoschwagerina*" *nakazawai* Nogami, pp. 183-185, pl. 3, figs 5-13.
1965. *Pseudoschwagerina arta* Thompson & Hazzard.– Thompson, pl. 35, figs 1-2 [non *P. arta* Thompson & Hazzard, 1946 by Thompson (1965, p. 233, pl. 33, figs 6-8) = *Carbonoschwagerina morikawai* (Igo, 1957)].
1975. *Pseudoschwagerina rhodesi* Thompson, 1954.– Han, pl. 8, fig. 6.
1989. "*Pseudoschwagerina*"? *nakazawai* Nogami.– Ueno, pl. 3, fig. 5.
pars 1990. *Schwagerina satoi* (Y. Ozawa, 1925b).– T. Ozawa & Kobayashi, pl. 4, fig. 14. (non pl. 4, fig. 13: indeterminable).

Description: Test inflated fusiform with arched periphery, slightly convex to almost straight lateral sides, and bluntly pointed poles, and composed of six to seven and a half whorls. Length about 4.4 to 6.0 mm and width about 2.0 to 3.4 mm, giving a form ratio about 1.8 to 2.5. Proloculus spherical and its diameter about 0.07 to 0.15 mm. Inner two to three whorls tightly coiled against succeeding whorls rather rapidly expanding.

Wall thin in inner whorls and gradually thickened outerwards, about 0.08 to 0.11 mm in thickness in outer two whorls. Wall consists of tectum and alveolar keritotheca. Alveolar structure obscure in inner two whorls becomes gradually coarser outerwards.

Septa closely spaced throughout the test, almost plane in juvenile whorls. In succeeding whorls, septa almost plane to irregularly and weaky folded in the median part of the test and moderately folded in polar regions. Septal counts from the first to seventh whorl 6 or 7, 9 to 12, 11 to 17, 12 to 24, 19 to 33, 25 to 33, and 32 or 33, respectively in three specimens illustrated.

Tunnel low and narrow in inner whorls, then irregularly broadened and gradually hightened outerwards. Chomata massive and well developed in inner and middle whorls, and poorly to rudimentarily present in outer one or two whorls.

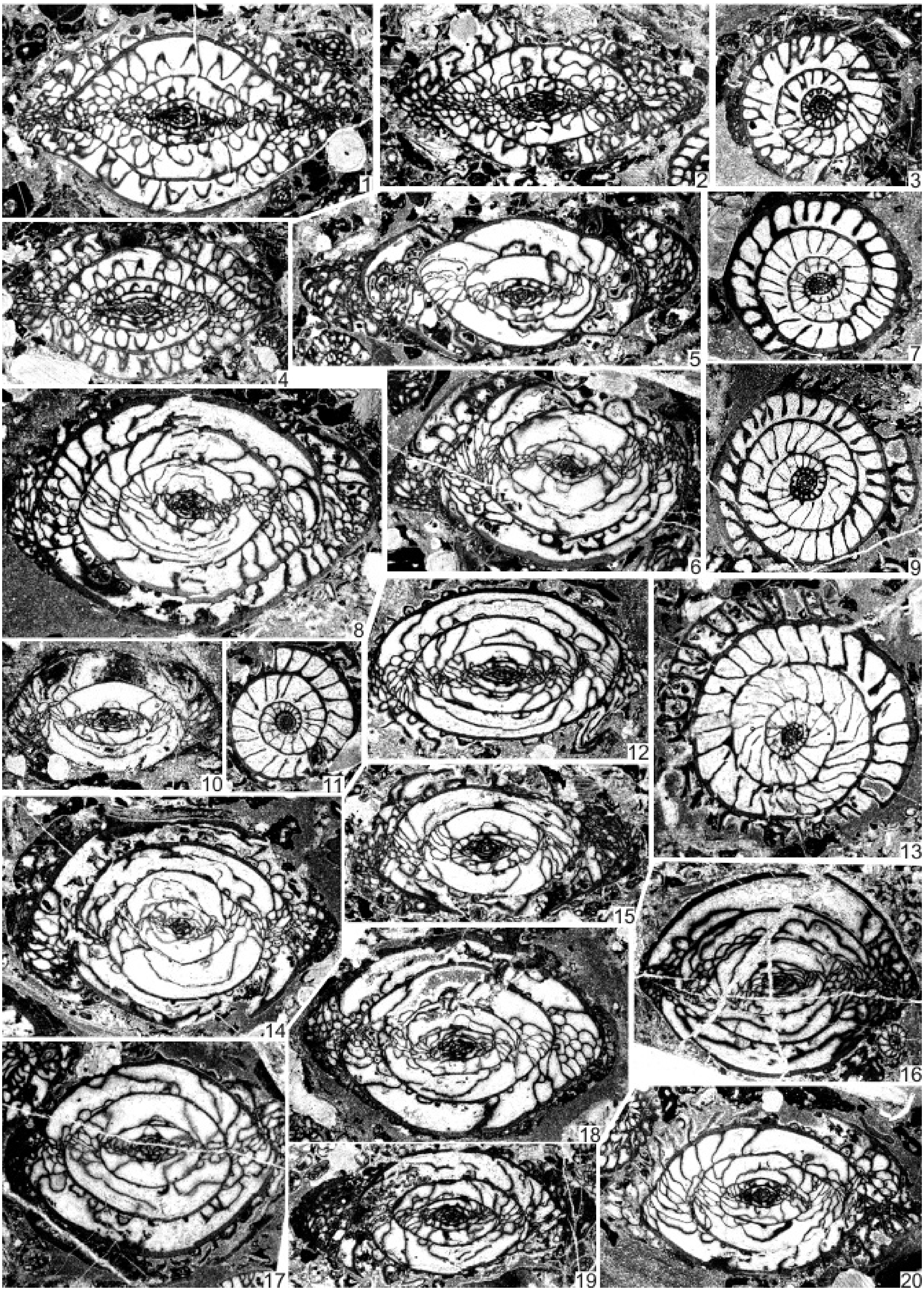
Remarks: The present specimens closely resemble the

Plate XXX

Figs 1-4: *Paraschwagerina akiyoshiensis* Toriyama
1, 4: axial sections; 2: tangential section; 3: parallel section.
1: D2-052983, 2: D2-052953, 3: D2-052946, 4: D2-052934,
Locality all A-403 (lower Asselian). All ×10.

Figs 5-20: *Alpinoschwagerina nagatoensis* n. sp.
8: holotype, others: paratypes.
5-6, 8, 10, 14-20: axial sections; 7, 9, 11, 13: sagittal sections; 12: tangential section.
Register numbers: shown in the description of this new species.
Locality 16: A-400 (lower Asselian), others: A-403 (lower Asselian).
All ×10.

Plate XXX



type material of this species proposed by Nogami (1961) from the "lowest Permian" of the Atetsu Limestone. He pointed out its resemblances to *Pseudoschwagerina beedei* Dunbar & Skinner, 1937, *Pseudoschwagerina rhodesi* Thompson, 1954, and *Schwagerina satoi*. However, many elements suggesting an ancestral form of *Carbonoschwagerina morikawai* are detected in nine specimens illustrated by him such as shape and size of the test and mode of the test enlargement and septal folding. Reassignment of the original material to *Carbonoschwagerina* might be understood by direct comparison between Nogami's nine and the present 24 illustrated specimens.

As earlier pointed out, one specimen (according to T. Ozawa & Kobayashi, 1990, pl. 4, fig. 14) should be separated from *Schwagerina satoi* and replaced to this species. The other one (T. Ozawa & Kobayashi, 1990, pl. 4, fig. 13) is also excluded from *S. satoi* but its assignment is indeterminable. One specimen, named as *Pseudoschwagerina rhodesi* and described by Han (1975) from Inner Mongolia, is better to be reassigned to this species taking its broad intraspecific variation into consideration. Two specimens (Thompson, 1965; pl. 35, figs 1-2) without description are largely different from other three specimens (Thompson, 1965; pl. 33, figs 6-8), though named also as "*Pseudoschwagerina arta*". They are better to be referable to *Carbonoschwagerina nakazawai* based on their similar mode of test expansion and septal folding to those of the original and present ones.

Occurrence and stratigraphic distribution: Common in some samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and the *Rauserites stuckenbergi-Triticites simplex* Zone, and common in many samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone.

***Carbonoschwagerina nipponica* n. sp.**
Pl. XIII, figs 1-19

pars 1991. *Schwagerina*? *satoi* (Y. Ozawa).– Watanabe, figs 25.15-16. (non fig. 25.17-20: *Schwagerina satoi*)
1992. *Carbonoschwagerina satoi* (Y. Ozawa).– T. Ozawa *et al.*, fig. 10.5-7.

Etymology: From Nippon, another name of Japan.
Type specimens: Holotype D2-050346 (axial section, Pl. XIII, fig. 3). Paratypes: fifteen axial sections (D2-050308, Pl. XIII, fig. 1; D2-055339, Pl. XIII, fig. 2; D2-050303, Pl. XIII, fig. 4; D2-050339, Pl. XIII, fig. 5; D2-050337, Pl. XIII, fig. 6; D2-050344, Pl. XIII, fig. 7; D-050331, Pl. XIII, fig. 8; D2-055853, Pl. XIII, fig. 9; D2-050300, Pl. XIII, fig. 10; D2-050327, Pl. XIII, fig. 11; D2-050326, Pl. XIII, fig. 12; D2-050320, Pl. XIII, fig. 13; D2-056723, Pl. XIII, fig. 14; D2-050312, Pl. XIII, fig. 15; D2-050338, Pl. XIII, fig. 16), and three sagittal sections (D2-050321, Pl. XIII, fig. 17; D2-050343, Pl. XIII, fig. 18; D2-050309, Pl. XIII, fig. 19).
Type locality: 180 m southeast of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture.
Diagnosis: Inflated to highly inflated fusiform test, relatively small for the genus, with small proloculus, tightly coiled two to three inner whorls succeeded by rapidly expanding outer whorls. Septa weakly and irregularly folded to almost plane in the median part of test and more intensely folded in polar regions.

Plate XXXI

Figs 1-6: *Paraschwagerina akiyoshiensis* Toriyama
1-3, 5: axial sections; 4, 6: tangential sections.
1: D2-055633, 2: D2-055610, 3: D2-056772, 4: D2-055607, 5: D2-055634, 6: D2-056785.
Locality 1-2, 4-5: A-409 (upper Asselian); 3, 6: B-180 (upper Asselian). All ×10.

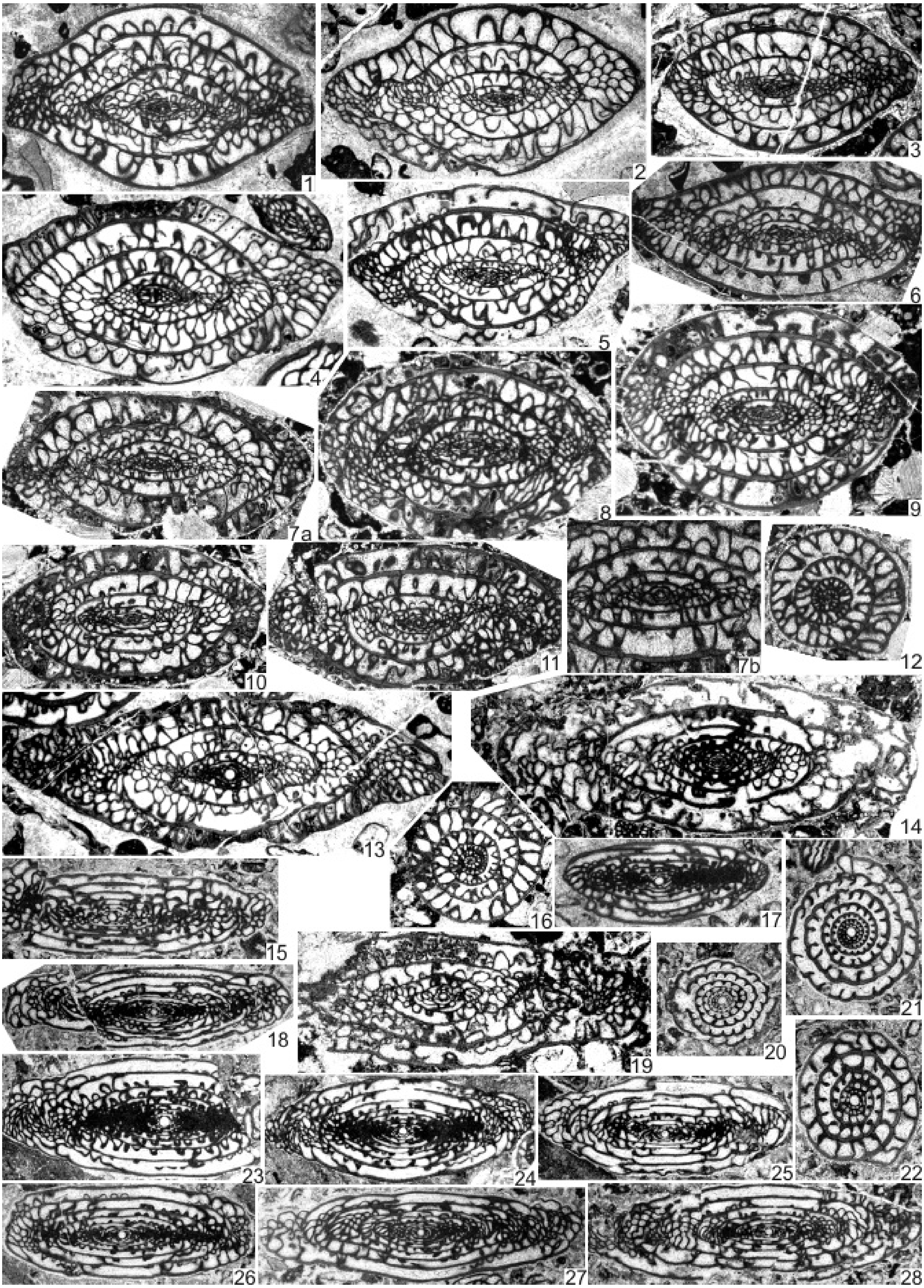
Figs 7-12: *Paraschwagerina* cf. *karachatypica* (Bensh)
7-8, 11: axial sections; 9-10: tangential sections; 12: sagittal section.
7: D2-056803, 8: D2-056816, 9: D2-056800, 10: D2-056801, 11: D2-056813, 12: D2-056815.
Locality all B-181 (upper Asselian). All ×10, except for 7b: ×20.

Fig. 13: *Chalaroschwagerina* sp. A
Axial section, D2-055618, Locality A-409 (upper Asselian), ×10.

Figs 14, 16, 19: *Occidentoschwagerina* cf. *fusulinoides* (Schellwien)
14, 19: axial sections; 16: parallel section.
14: D2-040972, 16: D2-052787, 19: D2-052783.
Locality 14: A-27a (lower Asselian); 16, 19: A-395b (lower Asselian). All ×10.

Figs 15, 17-18, 20-28: *Eoparafusulina ellipsoidalis* (Toriyama)
15, 17-18, 23-28: axial sections; 20-22: sagittal sections.
15: D2-047671, 17: D2-041468, 18: D2-047678, 20: D2-047687, 21: D2-047694, 22: D2-047676, 23: D2-052770, 24: D2-052775, 25: D2-047669, 26: D2-047686, 27: D2-047674, 28: D2-047684.
Locality 15, 18, 20-22, 25-28: A-132 (lower Asselian); 17: A-63a (lower Asselian); 23-24: A-395a (lower Asselian).
All ×10.

Plate XXXI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Description: Test inflated to highly inflated fusiform with arched periphery, almost straight to slightly convex lateral sides, bluntly pointed poles, and straight axis of coiling, and composed of five and a half to seven whorls. Length about 3.3 to 4.8 mm and width about 1.8 to 2.9 mm, and a form ratio about 1.4 to 2.3.

Proloculus spherical, small, and 0.05 to 0.18 mm. Tightly coiled inner two to three whorls are succeeded rapidly and variably by expanding outer whorls with variable sharpness of poles.

Wall thin and structureless or tectum and thin translucent layer in initial one to two whorls. After the third whorl, the wall consists of tectum and finely alveolar keriotheca. Thickness of wall about 0.07 to 0.10 mm in the thicker part of the last two whorls.

Septa closely spaced throughout the test and almost plane in inner tightly coiled whorls. In outer whorls, they are weakly and irregularly folded to almost plane in the median part of test and more intensely folded in polar regions. Septal counts from the first to sixth whorl 7 to 10, 13 to 16, 16 to 19, 21 to 24, 25 to 27, and 27 to 31, respectively in three sections of the paratypes.

Tunnel low and narrow in inner whorls, and heightened outwards. Its path nearly straight bordered by massive and asymmetrical chomata. Chomata rudimentary or absent in outermost whorls in specimens.

Remarks: Concerning the inflated test, tightly coiled inner whorls, and mode of septal folding, the present new species is similar to *Triticites katoi* Niikawa, 1978 and *Triticites ichinotaniensis* Niikawa, 1978, both of which were described from the Ichinotani Formation (Niikawa, 1978). The former, however, is different in its larger test and thinner wall. Among six specimens assigned to *Schwagerina*? *satoi* by Watanabe (1991), two are reassigned to this new species, as mentioned above. On the other hand, specimens having intermediate characters between this new species and *Montiparus minensis* are recognized in the Wakatakeyama area. These intermediate forms suggest their close phylogenetical connection and the derivation of this new species from *Montiparus minensis* in late Kasimovian time. Furthermore, *Montiparus minensis* is different from *Triticites michiae* Toriyama, 1958 from Akiyoshi by its smaller proloculus, and more numerous and more tightly coiled inner whorls. This new species appears to be similar to some specimens of *Triticites biconica* Toriyama, 1958 also from Akiyoshi. However, the latter is discriminated from the former by having the septa more intensely folded thoroughout the test, and septal folds reaching the roof of chambers.

This new species somewhat resembles *Triticites aculeatus* Sosnina in Sosnina & Nikitina, 1976 from the *Triticites* Zone of Primorye (Sosnina & Nikitina, 1976). The latter is provisionally reassigned herein to *Carbonoschwagerina* from tightly coiled inner whorls and mode of septal folding in spite of thicker wall of inner whorls.

Occurrence and stratigraphic distribution: Common to abundant in some samples from the *Rauserites arcticus-Carbonoschwagerina nipponica* Zone and rare in only one sample (A-425) from the *Rauserites stuckenbergi-Triticites simplex* Zone.

Genus *Pseudoschwagerina* Dunbar & Skinner, 1936

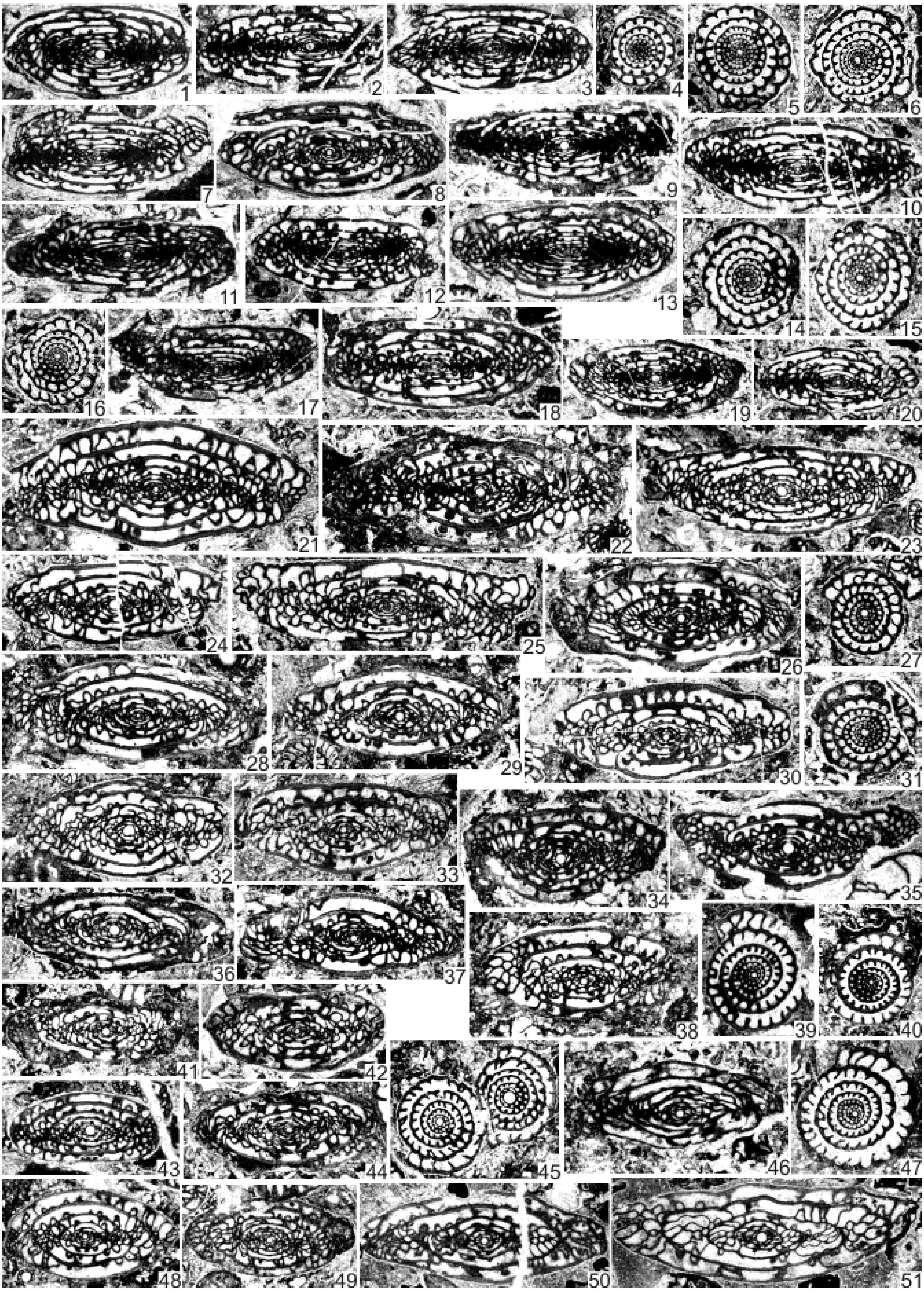
Type species: *Schwagerina uddeni* Beede & Kniker, 1924, p. 27.

Plate XXXII

Figs 1-20: *Eoparafusulina ellipsoidalis* (Toriyama)
1-3, 7-13, 17-20: axial sections; 4-6, 14-16: sagittal sections.
1: D2-040789, 2: D2-040739, 3: D2-057177, 4: D2-040752a, 5: D2-052875, 6: D2-047680, 7: D2-040783, 8: D2-040752b, 9: D2-055497, 10: D2-052861, 11: D2-057185, 12: D2-040750, 13: D2-040727, 14: D2-052882, 15: D2-052871, 16: D2-047688, 17: D2-057188, 18: D2-052887, 19: D2-040849, 20: D2-052884.
Locality 1, 7: A-22b (lower Asselian); 2, 4, 8, 12-13: A-22a (lower Asselian); 3, 11, 17: B-212 (lower Asselian); 5, 10, 14-15, 18, 20: A-400 (lower Asselian); 6, 16: A-132 (lower Asselian); 9: A-404 (lower Asselian); 19: A-23 (lower Asselian).
All ×10.

Figs 21-51: *Triticites*? spp.
21-26, 28-30, 32-38, 41-44, 46, 48-51: axial sections; 27, 31, 39-40, 45, 47: sagittal sections.
21: D2-052778, 22: D2-052771, 23: D2-040990, 24: D2-052860, 25: D2-040986, 26: D2-050409, 27: D2-040982, 28: D2-050405, 29: D2-050431, 30: D2-052867, 31: D2-052904, 32: D2-040994, 33: D2-051906, 34: D2-052879, 35: D2-052888, 36: D2-040980, 37: D2-050429, 38: D2-050408, 39: D2-050406, 40: D2-050401, 41: D2-050414, 42: D2-052791, 43: D2-040993, 44: D2-050413, 45: D2-040989, 46: D2-047345, 47: D2-052777, 48: D2-050411, 49: D2-040969, 50: D2-051900, 51: D2-05096.
Locality 21-22: A-395a (lower Asselian); 23, 25, 27, 32, 36, 43, 45, 49: A-27a (lower Asselian); 24, 30, 34-35: A-400 (lower Asselian); 26, 28-29, 37-41, 44, 48: A-241b (lower Asselian); 31: A-401 (lower Asselian); 33: A-320 (upper Gzhelian); 42: A-396 (lower Asselian); 46: A-100 (lower Asselian); 47: A-395a (lower Asselian); 50-51: A-319 (lower Asselian).
All ×10.

Plate XXXII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***Pseudoschwagerina miharanoensis* Akagi, 1958**
Pl. XXVIII, figs 1-10

1958. *Pseudoschwagerina miharanoensis* Akagi, pp. 153-156, pl. 1, figs 1-15.
pars 1958. *Pseudoschwagerina* (*Pseudoschwagerina*) sp., Toriyama, pp. 161-162, pl. 19, fig. 10 (non pl. 19, fig. 11: indeterminable).
1963b. *Pseudochwagerina miharanoensis* Akagi.– Chang, pp. 213-214, pl. 8, fig. 3.
1979. *Pseudoschwagerina aequalis* Kahler & Kahler, 1937.– Han & Guo, pl. 3, fig. 2.
1984. *Pseudochwagerina miharanoensis* Akagi.– Zhao *et al.*, p. 91, pl. 13, figs 1-4.
1990. *Pseudochwagerina miharanoensis* Akagi.– T. Ozawa & Kobayashi, pl. 7, figs 1-2.
1991. *Pseudochwagerina miharanoensis* Akagi.– Watanabe, fig. 39.1-17.

Description: Test loosely coiled, inflated fusiform to elliptical with broadly arched periphery, slightly convex lateral sides, almost rounded poles, and almost straight axis of coiling, and composed of three and a half to five whorls. Length about 6.5 to 10.3 mm and width about 4.0 to 5.0 mm, giving a form ratio about 1.5 to 2.1.
Proloculus spherical to subspherical and 0.35 to 0.76 mm in longer diameter. The first subspherical whorl is followed by a rapidly expanding second whorl, and then by gradually expanding outer ones. Wall thin in inner whorls and thickened in outer two whorls, approximately 0.02 to 0.05, 0.03 to 0.07, 0.04 to 0.08, 0.07 to 0.12, and 0.09 to 0.13 mm in thickness from the first to fifth whorl, and consists of tectum and alveolar keriotheca.
Septa weakly and irregularly folded throughout the test and more intensely folded in polar regions. Septal counts from the first to fourth whorl 11 or 12, 17 to 19, 21 to 26?, and 28, respectively, in three sections illustrated.
Tunnel low and narrow throughout the test and its path irregular in outer whorls. Chomata massive, well developed in inner tightly coiled whorls, and rudimentary or absent in outer whorls.
Remarks: This species proposed by Akagi (1958) from the Taishaku Limestone is easily distinguished from other species of the genus in its more loosely coiled whorls. It is exclusively reported from Japan and China. The Wakatakeyama specimens have somewhat larger test than the original ones, but other test characters are essentially the same between the two. One specimen without the terminal half whorl, belonged to unnamed species of *Pseudoschwagerina* (*Pseudoschwagerina*) by Toriyama (1958) from Akiyoshi, is probably included in this species. Ten specimens identified with *Zellia nunosei* (Hanzawa, 1939) by Watanabe (1991, fig. 21.1-10) from the Sakmarian Sakamotozawa Formation, South Kitakami show wide morphologic variations in many test characters. Some having inflated fusiform test appear to be similar to this species. However, this species has more loosely coiled whorls throughout the test and larger proloculus.
Among Chinese materials, one specimen illustrated by Chang (1963b) from Xinjiang is probably identical with this species in spite of absence of the terminal whorl. Four specimens from Tarim Basin by Zhao *et al.* (1984) are closely similar to the types, though having somewhat stronger septal folding. One specimen by Han & Guo (1979) from Inner Mongolia illustrated as *Pseudoschwagerina aequalis* Kahler & Kahler, 1937 is probably reassignable to this species from the mode of test expansion and large proloculus. That by Han & Guo (1979) illustrated as *Zellia colaniae* Kahler & Kahler, 1937 might be included in this species, though the conclusion is reserved.

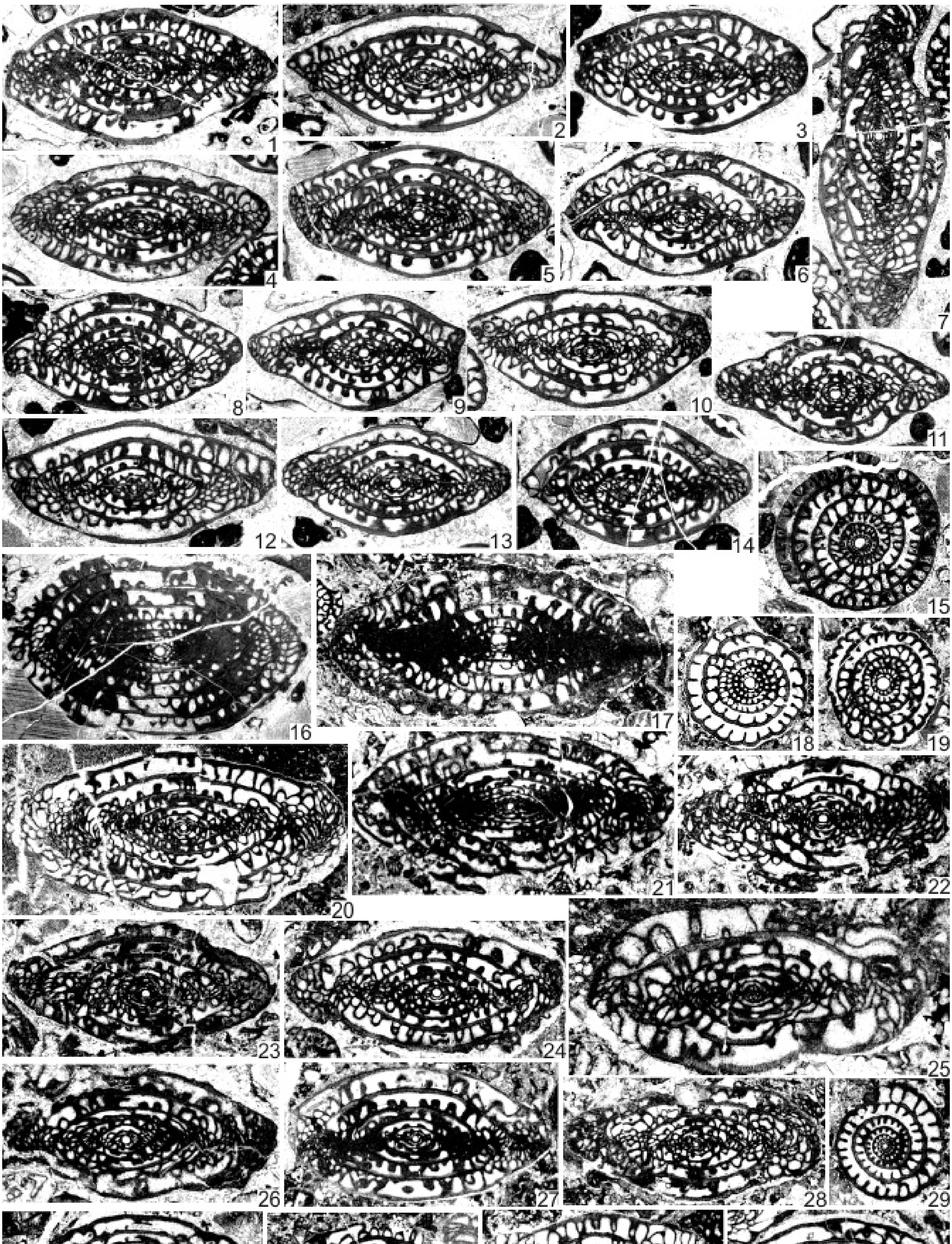
Plate XXXIII

Figs 1-14: *Schwagerina princeps* (Ehrenberg, 1842)
1-14: axial sections.
1: D2-055629, 2: D2-055604, 3: D2-055627, 4: D2-055611, 5: D2-055600, 6: D2-055626, 7: D2-055620, 8: D2-055602, 9: D2-055622a, 10: D2-055635, 11: D2-055636, 12: D2-055622b, 13: D2-055624, 14: D2-055605.
Locality all A-409 (upper Asselian).
All ×10.

Figs 15-19: *Schwagerina panjiensis* (Leven & Shcherbovich)
15, 18-19: sagittal sections; 16-17: axial sections.
15: D2-055580, 16: D2-055587, 17: D2-040978, 18: D22-040961, 19: D2-040979.
Locality 15-16: A-408 (upper Asselian), 17-19: A-27a (lower Asselian). All ×10.

Figs 20-26, 27(?), 28-33: *Schwagerina densa* (Toriyama)
25: microspheric form, others: megalospheric forms.
20-28, 30-33: axial sections; 29: sagittal section.
20: D2-040804, 21: D2-040822, 22: D2-040828, 23: D2-040794, 24: D2-040825, 25: D2-050422, 26: D2-040808, 27: D2-050420, 28: D2-050395, 29: D2-050402, 30: D2-040777, 31: D2-050396, 32: D2-050419, 33: D2-040833.
Locality 20-24, 26, 30, 33: A-22b (lower Asselian); 25, 27-29, 31-32: A-241b (lower Asselian)
25: ×20, others: ×10.

Plate XXXIII



On the other hand, one specimen by Chen & Wang (1983) from Yishan of Guangxi is questionable because of its lower height and thicker wall in inner two whorls than the types. Two specimens by Shi *et al*. (2012) from southern Guizhou should be reassigned to *Pseudoschwagerina muongthensis* (Deprat, 1915).

Occurrence and stratigraphic distribution: Common in two samples (A-409, B-180) from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

***Pseudoschwagerina muongthensis* (Deprat, 1915)**
Pl. XXV, fig. 11; Pl. XXVI, figs 1-27; Pl. XXVII, figs 1-16; Pl. XXVIII, figs 11-15

1915. *Fusulina muongthensis* Deprat, pp. 5-6, pl. 2, figs 1-6.
1925b. *Schwagerina muongthensis* (Deprat).– Y. Ozawa, pp. 47-48, pl. 8, figs 1-2.
pars 1958. *Pseudoschwagerina* (*Pseudoschwagerina*) *muongthensis* (Deprat).– Toriyama, pp. 158-161, pl. 19, figs 7-8 (non pl. 18, figs 15-17 = *Carbonoschwagerina morikawai*; pl. 18, fig. 18, pl. 19, figs 1-6 = *Sphaeroschwagerina fusiformis*).
1990. *Pseudoschwagerina muongthensis* (Deprat).– T. Ozawa & Kobayashi, pl. 2, figs 11-12.
1991. *Pseudoschwagerina muongthensis* (Deprat).– Watanabe, figs 36.1-14, 37.1-20.
1993. *Pseudoschwagerina muongthensis* (Deprat).– Y. Ota & M. Ota, pl. 3, fig. 4.
1998. *Pseudoschwagerina muongthensis* (Deprat).– Y. Ota, pp. 92-94, pl. 8, figs 1-4.

Description: Test inflated fusiform with arched periphery, slightly convex lateral sides, bluntly pointed to rounded poles, and almost straight axis of coiling, and composed of six to eight whorls. Length about 5.5 to 7.7 mm and width about 3.6 to 5.4 mm, giving a form ratio about 1.2 to 1.9.

Proloculus spherical to subspherical and 0.14 to 0.43 mm. The first two to three whorls relatively tightly coiled against rapidly expanding outer whorls with more rounded poles. Wall thickened gradually outwards and consists of tectum and alveolar keriotheca gradually increasing its coarseness outwards. Its thickness in the last one or two whorls as thick as 0.08 to 0.11 mm.

Septa closely spaced, weakly and very weakly folded in the median part of test and more intensely folded in polar regions in general, but considerably variable by specimens. They thickened in the last one or two whorls as well as wall. Septal counts from the first to seventh whorl 9 to 14, 11 to 23, 14 to 27, 16 to 31, 22 to 33, 28 to 36, and 35 to 40, respectively.

Tunnel low and narrow throughout the test and its path straight in inner whorls and straight to irregular in outer whorls. Chomata massive, symmetrical, and well developed in inner whorls. Their development is variable in outer whorls from absent, rudimentary, to distinct.

Remarks: Considerable number of species reported under different names from the Paleo-Tethyan regions are considered to be junior synonyms of this species originally described by Deprat (1915) from Tonkin, northern Vietnam. Although the present specimens are much more variable than the types, they are undoubtedly identical with this species in many respects such as size and shape of the test, test expansion, and mode of septal folding. This species is also very common in the Akiyoshi Limestone Group, and described and/or illustrated by many workers. As already mentioned above, only two specimens among fourteen in Toriyama (1958) are identical with this species, and other twelve are belonged to either *Sphaeroschwagerina* or *Carbonoschwagerina*. Likewise, two specimens illustrated in M. Ota (1977) are referable to *Sphaeroschwagerina fusiformis*.

Some of these misidentifications of inflated schwagerinids are perhaps assumed to be more strongly caused by few citations of important literatures especially by Russian workers and/or low frequencies of an academic circulation among workers rather than a different taxonomic concept of an author. They are also found out in other taxa described above and below in this paper.

Occurrence and stratigraphic distribution: Abundant to common in many samples exclusively from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

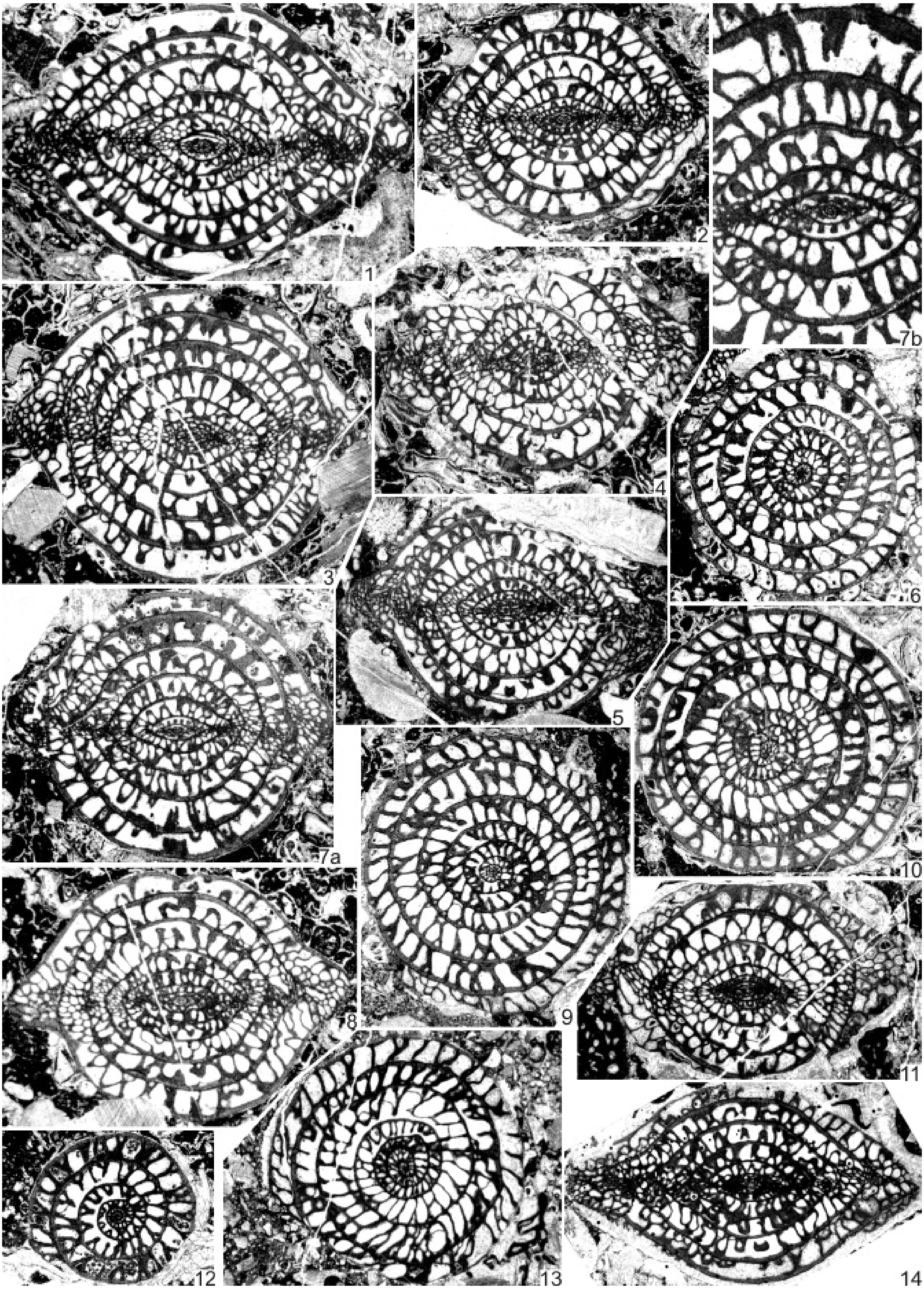
Genus *Alpinoschwagerina* Bensh, 1972

Type species: *Alpinoschwagerina turkestanica* Bensh, 1972, p. 100.

Plate XXXIV

Figs 1-14: *Schwagerina watanabei* n. sp.
7: holotype, others: paratypes.
1, 3-5, 8: tangential sections; 2, 7, 11, 14: axial sections; 6, 10, 12-13: parallel sections, 9: sagittal section.
Register numbers: shown in the description of this new species.
Locality 1, 10, 12: A-410 (upper Asselian); 2-3, 5-9: A-413 (upper Asselian); 4: A-414 (upper Asselian); 11, 13: A-408 (upper Asselian); 14: A-407 (upper Asselian).
7b: ×20, others: ×10.

Plate XXXIV



Alpinoschwagerina nagatoensis n. sp.
Pl. XXX, figs 5-20

1989. *Alpinoschwagerina moelleri* (Rauzer-Chernousova, 1936).– Ueno, pl. 3, fig. 6.
1991. *Alpinoschwagerina* cf. *saigusai* (Nogami, 1961).– Watanabe, fig. 38.9-19.
2006. *Carbonoschwagerina* cf. *minatoi* (Kanmera, 1958).– Ueno & Fujikawa, pl. 4.2, fig. 11.

Etymology: From the ancient geographic name, Nagato, for western part of the present Yamaguchi Prefecture, Japan.
Type specimens: Holotype D2-052942 (axial section, Pl. XXX, fig. 8). Paratypes: ten axial sections (D2-052975, Pl. XXX, fig. 5; D2-053000, Pl. XXX, fig. 6; D2-052947, Pl. XXX, fig. 10; D2-052959, Pl. XXX, fig. 14; D2-052928, Pl. XXX, fig. 15; D2-052862, Pl. XXX, fig. 16; D2-052973, Pl. XXX, fig. 17; D2-052969, Pl. XXX, fig. 18; D2-053002, Pl. XXX, fig. 19; D2-052958, Pl. XXX, fig. 20), four sagittal sections (D2-052980, Pl. XXX, fig. 7; D2-052933, Pl. XXX, fig. 9; D2-052991, Pl. XXX, fig. 11; D2-052965, Pl. XXX, fig. 13), and one tangential section (D2-05293, Pl. XXX, fig. 12).
Type locality: 230 m south of Wakatakeyama, Akiyoshi, Mine City, Yamaguchi Prefecture.
Diagnosis: Highly inflated fusiform to subspherical test, with minute proloculus, tightly coiled three to four inner whorls, succeeded by rapidly expanding outer whorls. Septa weakly and irregularly folded in the median part of the test and moderately folded in polar regions. Chomata well developed in inner tightly coiled whorls, and rudimentary or absent in outer whorls.
Description: Test highly inflated fusiform to subspherical with arched to broadly arched periphery, slightly convex lateral sides, and bluntly pointed to rounded poles, and composed of six and a half to eight and a half whorls. Length about 6.2 to 7.5 mm, width about 3.5 to 5.2 mm, and a form ratio about 1.2 to 1.8.
Proloculus spherical, minute, and 0.06 to 0.10 mm. Inner three to four whorls fusiform to inflated fusiform and very tightly coiled, and succeeding whorls highly inflated fusiform to subspherical and rapidly expanding outwards.
Wall thin and structureless or consists of tectum and translucent layer in inner three to four whorls, still thin and of tectum and very finely alveolar keriotheca in the succeeding whorls. In the last two to two and a half whorls, wall rather abruptly thickened and of tectum and alveolar keriotheca and as thick as 0.09 to 0.13 mm in their thickest part.
Septa closely spaced and gently inclined anteriorly, weakly and irregularly folded in the median part of the test and moderately folded in polar regions. Septal counts from the first to the seventh whorl 6 or 7, 10 to 12, 13 to 15, 13 to 18, 16 to 18, 24 to 29, and 31?, respectively, in four sections of the paratypes.
Tunnel low and narrow throughout the test and its path irregular in outer whorls. Chomata massive, well developed in inner tightly coiled whorls, and rudimentary or absent in outer whorls.
Remarks: *Pseudoschwagerina saigusai* Nogami, 1961 from the Atetsu Limestone is better to be replaced to *Alpinoschwagerina*, as done by Watanabe (1991), from its more tightly coiled inner whorls with thinner wall. It is similar to *Alpinoschwagerina popovi* Bensh, 1972 from the middle and upper Asselian of South Fergana (Bensh, 1972) in many respects, but has more strongly folded septa.
Both Akiyoshi specimens that were compared to the types of *Alpinoschwagerina saigusai* by Watanabe (1991) and the present specimens show broad morphologic variations. They are distinguished from *A. saigusai* by their smaller proloculus and better developed juvenile whorls and considered to be a new species of the genus. One specimen illustrated by Ueno (1989) without description was named as *Alpinoschwagerina moelleri* originally described from the Timan region by Rauzer-Chernousova (1936) for *Schwagerina princeps* (Ehrenberg) *sensu* Rauzer-Chernousova. However, the Ueno's one is not identified with the original and later ones of *Sphaeroschwagerina moelleri* (e.g.,

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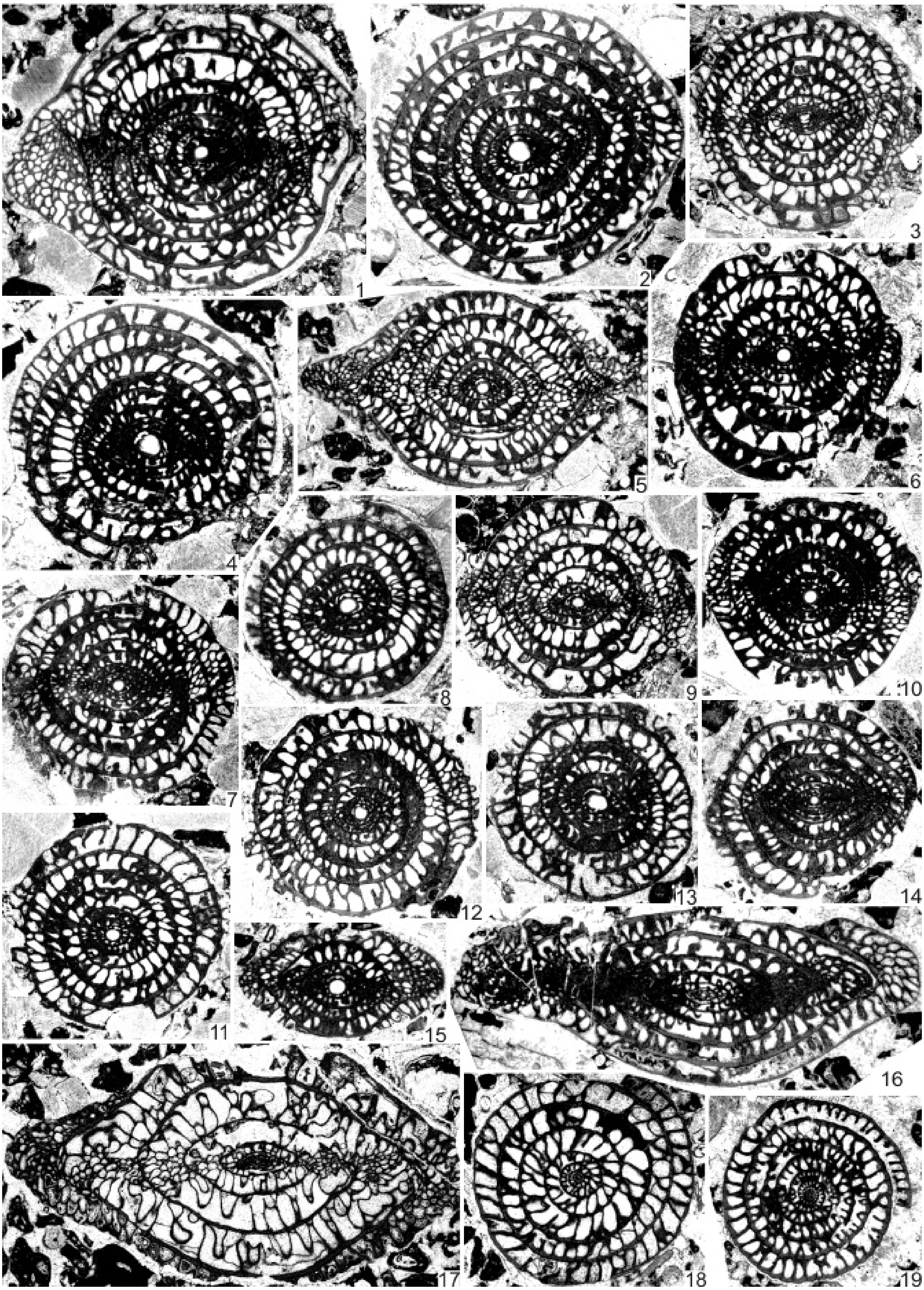
Plate XXXV

Figs 1-15: *Schwagerina wakatakeyamensis* n. sp.
1: holotype, others: paratypes.
Register numbers: shown in the description of this new species.
Locality 1-2, 4-6, 8, 10, 13-15: A-407 (upper Asselian); 3, 7, 9, 11-12: A-412 (upper Asselian).
All ×10.
Fig. 16: *Jigulites*? sp.
Axial section, D2-055791, Locality A-432 (middle Gzhelian), ×10.
Figs 17-18: *Paraschwagerina*? sp.
17: axial section, 18: parallel section.
17: D2-041486, 18: D2-041693. Locality both A-63b (upper Asselian). Both ×10.
Fig. 19: *Darvasoschwagerina*? sp.
Sagittal section, D2-055796, Locality A-432 (middle Gzhelian), ×10.

Plate XXXV



Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949; Rauzer-Chernousova & Shcherbovich, 1958) in its more intensely and more irregularly folded septa in the median part of the test and presumed to be reassigned to this new species. Though somewhat deformed, one specimen from Akiyoshi illustrated by Ueno & Fujikawa (2006) cannot be identified with *Carbonoschwagerina minatoi* and should be also reassigned to this new species based on the comparison with many samples containing deformed *Alpinoschwagerina* from the outside of the Wakatakeyama area (unpublished data by the author).

Occurrence and stratigraphic distribution: Common in some samples exclusively from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Genus *Sphaeroschwagerina* Miklukho-Maklay, 1959

Type species: *Schwagerina sphaerica* var. *karnica* Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949, p. 102.

***Sphaeroschwagerina fusiformis* (Krotow, 1888)**
Pl. XXIV, figs 1-11, 14-19

1888. *Schwagerina fusiformis* Krotow, pp. 438-439, pl. 2, figs 13-15.
1949. *Schwagerina fusiformis* Krotow.– Shcherbovich in Rauzer-Chernousova & Shcherbovich, pp. 85-86, pl. 6, figs 5-8.
pars 1958. *Pseudoschwagerina* (*Pseudoschwagerina*) *muong-thensis* (Deprat, 1915).– Toriyama, pp. 158-161, pl. 18, fig. 18; pl. 19, figs 1-6 (non pl. 18, figs 15-17 = *Carbonoschwagerina morikawai*).
1964. *Pseudoschwagerina kanmerai* Sada, pp. 263-266, pl. 28, figs 1-4.
1977. *Pseudoschwagerina (Pseudoschwagerina) muong-thensis* (Deprat, 1915).– M. Ota, pl. 2, figs 11-12.
1990. “*Sphaeroschwagerina*” *fusiformis* (Krotow).– T. Ozawa & Kobayashi, pl. 6, figs 1-4.
1991. *Sphaeroschwagerina fusiformis* (Krotow).– Watanabe, fig. 32.1-11, figs 34.1-6.
1993. *Pseudoschwagerina morikawai* Igo, 1957.– Y. Ota & M. Ota, pl. 3, fig. 1 (= Y. Ota, 1998, pl. 8, fig. 5), fig. 2 (= Y. Ota, 1998, pl. 8, fig. 7), fig. 3 (= Y. Ota, 1998, pl. 8, fig. 6).
1993. *Pseudoschwagerina* sp. Y. Ota & M. Ota, pl. 3, fig. 5.
1993. *Sphaeroschwagerina*(?) sp. Y. Ota & M. Ota, pl. 3, fig. 6.

Description: Test subspherical to almost spherical with arched periphery, slightly convex lateral sides, bluntly pointed to rounded poles, and composed of seven to eight and a half whorls. Length about 5.3 to 6.8 mm, width about 3.7 to 5.8 mm, and a form ratio 1.1 to 1.5.

Proloculus spherical, minute, and 0.03 to 0.09 mm. Except for rare specimens coiled endothyroidly in the first whorl, inner three to four whorls fusiform with pointed poles and very tightly coiled. Succeeding whorls highly inflated fusiform to subspherical, and rapidly expanding outwards.

Wall very thin and not differentiated in inner two to three whorls. Thin translucent layer or very finely alveolar keriotheca is observable under tectum after the fifth to sixth whorls, though somewhat variable by the state of preservation of the test. In the last two to two and a half whorls, wall rather abruptly thickened and of tectum and alveolar keriotheca as thick as 0.10 mm in most specimens.

Septa closely spaced and inclined anteriorly, almost plane to very weakly folded irregularly throughout the test except for polar regions. Septa involve faint secondary

Plate XXXVI

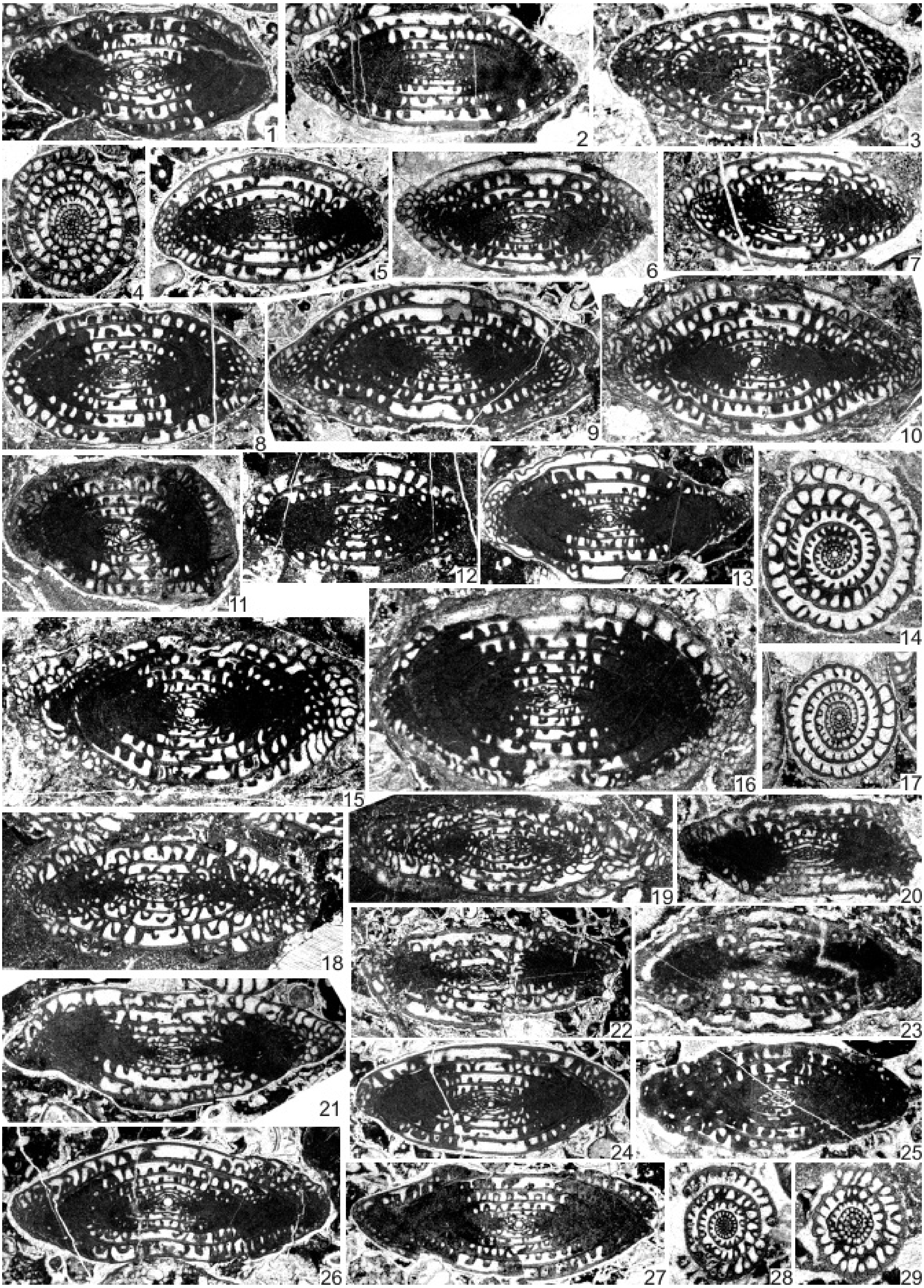
Figs 1-17: *Schwagerina stabilis* (Rauzer-Chernousova)
1-2, 6-13, 15-16, 18: axial sections; 3, 5: tangential sections; 4: parallel section; 14, 17: sagittal sections.
1: D2-052834, 2: D2-052817, 3: D2-052636, 4: D2-052851, 5: D2-052850, 6: D2-040954, 7: D2-040946, 8: D2-052809, 9: D2-0528, 10: D2-052662, 11: D2-052803, 12: D2-052609, 13: D2-055517, 14: D2-052798, 15: D2-052664, 16: D2-052792, 17: D2-052840, 18: D2-052613.
Locality 1, 4-5, 9, 17: A-399 (upper Gzhelian); 2, 8: A-398 (upper Gzhelian); 3: A-391 (upper Gzhelian); 6-7: A-26 (upper Gzhelian); 10, 15: A-392 (upper Gzhelian); 11, 14: A-397 (lower Asselian); 12: A-389 (middle Gzhelian); 13: A-405 (upper Gzhelian); 16: A-396 (lower Asselian).
All ×10.

Figs 18-19: *Rugosochusenella* sp. A
Axial sections. 18: D2-052613, 19: D2-052624; Locality: both A-389 (middle Gzhelian) Both ×10.

Figs 20-23, 29: *Rugosochusenella* sp. B
20-23: axial sections; 29 sagittal section.
20: D2-057200, 21: D2-052853, 22: D2-052837, 23: D2-057198, 29: D2-052697.
Locality 20, 23: B-213 (lower Asselian), 21-22: A-399 (upper Gzhelian), 29: A-393 (upper Gzhelian). All ×10.

Figs 24-28: *Pseudochusenella gregaria* (Lee)
24, 26-27: axial sections; 25: tangential section; 28: parallel section.
24: D2-052846, 25: D2-052746, 26: D2-052852, 27: D2-052819, 28: D2-052733.
Locality 24, 26-27: A-399 (upper Gzhelian); 25, 28: A-394 (upper Gzhelian).
All ×10.

Plate XXXVI



deposits in their tips in most specimens, and some are in contact with the base of chambers in the median part of the test. Septal counts from the first to the eighth whorl 6, 7, 9 or 10, 9 to 13, 12 to 17, 18 to 20, 20 to 23, and 33, respectively, in four sections illustrated.

Tunnel low and narrow throughout the test. Its path irregular in outer whorls. Chomata distinct in inner tightly coiled whorls, and asymmetrical and rudimentary or not present in outer whorls.

Remarks: Although immature specimens of the present material are subspherical to highly inflated fusiform (Pl. XXIV, figs 15-18) and more or less similar to the types of this species, those reaching to the mature stage have spherical to subspherical test. One tangential section shown in Krotow (1888) appears to be closely related to one specimen of *Schwagerina fusiformis* var. *crassa* (Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949, pl. 6, fig. 10) and to *Schwagerina fusiformis* described by Grozdilova (1966). The Krotow's (1888) tangential section might be referable to an immature form of this species *sensu* Shcherbovich or *Schwagerina vulgaris* Shcherbovich in Rauzer-Chernousova & Shcherbovich, 1949 in a broad sense. Shcherbovich in Rauzer-Chernousova & Shcherbovich (1949) and Rauzer-Chernousova & Shcherbovich (1958) showed various forms of *Schwagerina* (= *Sphaeroschwagerina*) from the *Schwagerina* Horizon of European Russia. However, specific identification of them is not easy on account of uncertain morphologic variations.

In this paper, spherical forms with relatively weaker septal foldings among *Sphaeroschwagerina* in the studied area are provisionally assigned to *S. fusiformis* without any subdivisions. Those having more intensely folded septa are tentatively separated from this species and included into *Sphaeroschwagerina pavlovi* (Rauzer-Chernousova, 1938), though clear distinction between them is difficult. *Pseudoschwagerina kanmerai* described from the Atetsu Limestone by Sada (1964) is a junior synonym of this species. It is not easily distinguished from *Pseudoschwagerina pavlovi* described by Sada (1964). Likewise, specimens listed above from Akiyoshi are all referable to this species including those previously assigned to other genera by authors, because of much more tightly coiled inner whorls and others. One specimen illustrated by Ueno (1989) as *Alpinoschwagerina*? *fusiformis* (Krotow) is excluded and reassigned to *Carbonoschwagerina morikawai,* as mentioned above.

Occurrence and stratigraphic distribution: Abundant to common in many samples exclusively from the *Sphaeroschwagerina fusiformis*-*Pseudoschwagerina muongthensis* Zone.

Sphaeroschwagerina pavlovi
(Rauzer-Chernousova, 1938)
Pl. XXIV, figs 12-13; Pl. XXV, figs 1-10, 12-14

1938. *Schwagerina pavlovi* Rauzer-Chernousova, pp. 127-128, pl. 6, figs 6-7.
1991. *Sphaeroschwagerina pavlovi* (Rauzer-Chernousova).– Watanabe, fig. 32.16-20, fig. 34.13-19, fig. 35.1-17.

Remarks: Description of morphologic features of the test of this species is omitted on account of essentially the same ones as those of *Sphaeroschwagerina fusiformis*. Measurable test characters are shown in the Appendix Table.

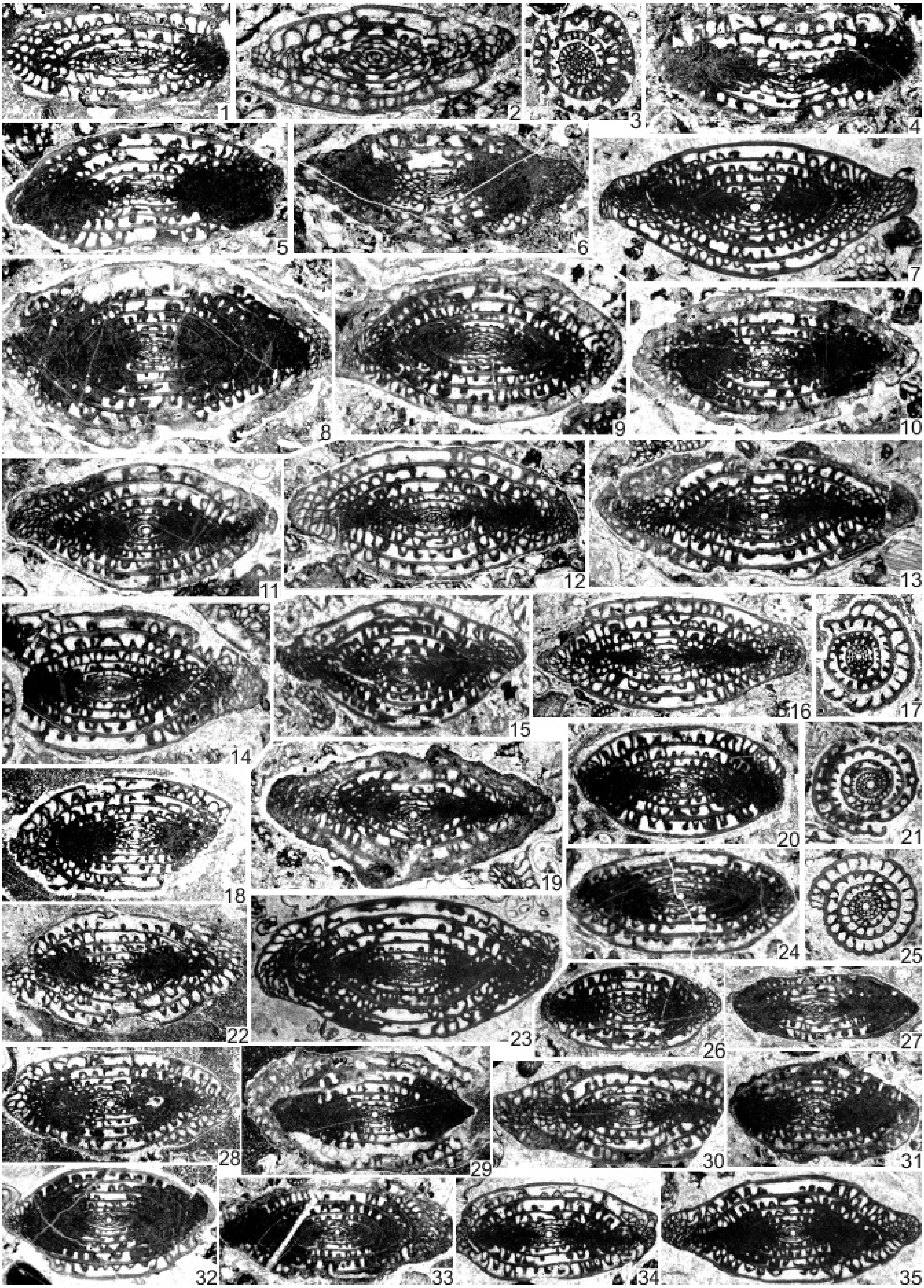
Plate XXXVII

Figs 1-3: *Rugosochusenella paragregaria* (Rauzer-Chernousova)
1-2: tangential sections, 3: parallel section.
1: D-052711, 2: D2-051911, 3: D2-052651.
Locality 1: A-393 (upper Gzhelian), 2: A-320 (upper Gzhelian), 3: A-391 (upper Gzhelian).
All ×10.

Figs 4-6: *Rugosochusenella shagonensis* Davydov
4-6: axial sections.
4: D2-050412, 5: D2-050416, 6: D2-047331.
Locality 4-5: A-241b (lower Asselian), 6: A-100 (lower Asselian).
All ×10.

Figs 7-35: *Pseudochusenella explicata* (Leven & Shcherbovich)
7-16, 18-20, 22-24, 26-35: axial sections; 17, 21, 25: sagittal sections.
7: D2-041449, 8: D2-055506, 9: D2-0554900, 10: D2-055497, 11: D2-055514, 12: D2-040992, 13: D2-040776, 14: D2-040836, 15: D2-040840, 16: D2-052891, 17: D2-052800, 18: D2-052795, 19: D2-052911, 20: D2-040720, 21: D2-052913, 22: D2-053229, 23: D2-041451, 24: D2-055493, 25: D2-040788, 26: D2-040753, 27: D2-053232, 28: D2-040791, 29: D2-040813, 30: D2-055632, 31: D2-041461, 32: D2-055485, 33: D2-040724, 34: D2-055608, 35: D2-041457.
Locality 7, 23, 31, 35: A-63a (lower Asselian); 8-11, 24, 32: A-404 (lower Asselian); 12: A-27a (lower Asselian); 13, 20, 26, 33: A22a (lower Asselian) 14, 25, 28-29: A-22b (lower Asselian); 15: A-23 (lower Asselian); 16: A-400 (lower Asselian); 17-18: A-397 (lower Asselian); 19, 21: A-402 (lower Asselian); 22, 27: A-319 (lower Asselian); 30, 34: A-409 (upper Asselian).
All ×10.

Plate XXXVII



As noticed above, specimens with more intensely folded septa than *Shaeroschwagerina fusiformis* are tentatively named as this species originally described from the Samara Bend and Trans-Volga region by Rauzer-Chernousova (1938). The Wakatakeyama materials are closer to *Schwagerina pavlovi* described by Rauzer-Chernousova & Shcherbovich (1958) than the original one. Although Watanabe (1991) divided *Sphaeroschwagerina* of the Akiyoshi Terrane into *S. fusiformis* and *S. pavlovi*, distinction of the two is not easy as well as the present materials. Moreover, both cannot be separated stratigraphically, as mentioned in the previous chapter.

Occurrence and stratigraphic distribution: Abundant to common in many samples exclusively in the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Occidentoschwagerina* Miklukho-Maklay, 1959

Type species: *Schwagerina fusulinoides* Schellwien, 1898, p. 259.

***Occidentoschwagerina* cf. *fusulinoides* (Schellwien, 1898)**

Pl. XXXI, figs 14, 16, 19

Compare:

1898. *Schwagerina fusulinoides* Schellwien, pp. 259-260, pl. 21, figs 1-4, 8.
1927. *Schwagerina fusulinoides* Schellwien.– Lee, pp. 118-120, pl. 22, figs 6-17.
1934. *Schwagerina fusulinoides* Schellwien.– Chen, pp. 94-94, pl. 14, figs 1-4; pl. 15, fig. 7.

Remarks: Although well-oriented specimens are few, three specimens illustrated are supposed to be included in the genus *Occidentoschwagerina* based on their elongate fusiform test, mode of test expansion, distinct chomata in inner whorls, and their association with *Sphaeroschwagerina fusiformis*. These specimens are considerably variable in proloculus size, the number of tightly coiled whorls, and mode of septal folding. They are presumably comparable to *Schwagerina fusulinoides* originally described by Schellwien (1898) from the Carnic Alps, though having more irregularly folded septa and larger length and width in outer whorls. Forms identified with this species by Lee (1927) are somewhat alike to the types, but have larger proloculus, more inflated fusiform test, and more intensely folded septa than those of types. Compared with those by Chen (1934), the present specimens have smaller proloculus and more irregularly folded septa. More specimens are necessary for further comparison with other species.

Occurrence and stratigraphic distribution: Rare to common in some samples exclusively from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Darvasoschwagerina* Leven & Davydov, 2001

Type species: *Paraschwagerina archaica* Leven & Shcherbovich, 1978, p. 111.

***Darvasoschwagerina shimodakensis* (Kanmera, 1958)**

Pl. XXIX, figs 1-15

1958. *Paraschwagerina shimodakensis* Kanmera, pp. 181-183, pl. 29, figs 1-13.
1990. *Paraschwagerina shimodakensis* Kanmera.– T. Ozawa & Kobayashi, pl. 5, fig. 3.
1991. *Paraschwagerina shimodakensis* Kanmera.– Watanabe, fig. 42.1-7.

non 2006. *Darvasoschwagerina shimodakensis* (Kanmera).– Ueno & Fujikawa, pl. 4.2, figs 3, 4, 4a (= *Paraschwagerina akiyoshiensis* Toriyama, 1958).

Description: Test highly inflated fusiform with broadly arched periphery, almost straight to slightly convex lateral sides, bluntly pointed poles, and straight axis of coiling, and composed of seven to eight and a half whorls. Length about 6.5 to 9.7 mm and width about 4.0 to 5.5 mm, giving a form ratio about 1.6 to 1.9.

Proloculus spherical, minute, and 0.05 to 0.12 mm. Inner three to three and a half whorls fusiform with pointed poles and very tightly coiled. Succeeding whorls inflated to highly inflated fusiform, and rapidly expanding outwards and decreasing chamber height in the last whorl.

Wall very thin and of single layer in inner tightly coiled whorls. Succeeding whorls gradually increasing their thickness and consisting of tectum and finely alveolar

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Plate XXXVIII

Figs 1-20: *Jigulites horridus* (Kanmera)

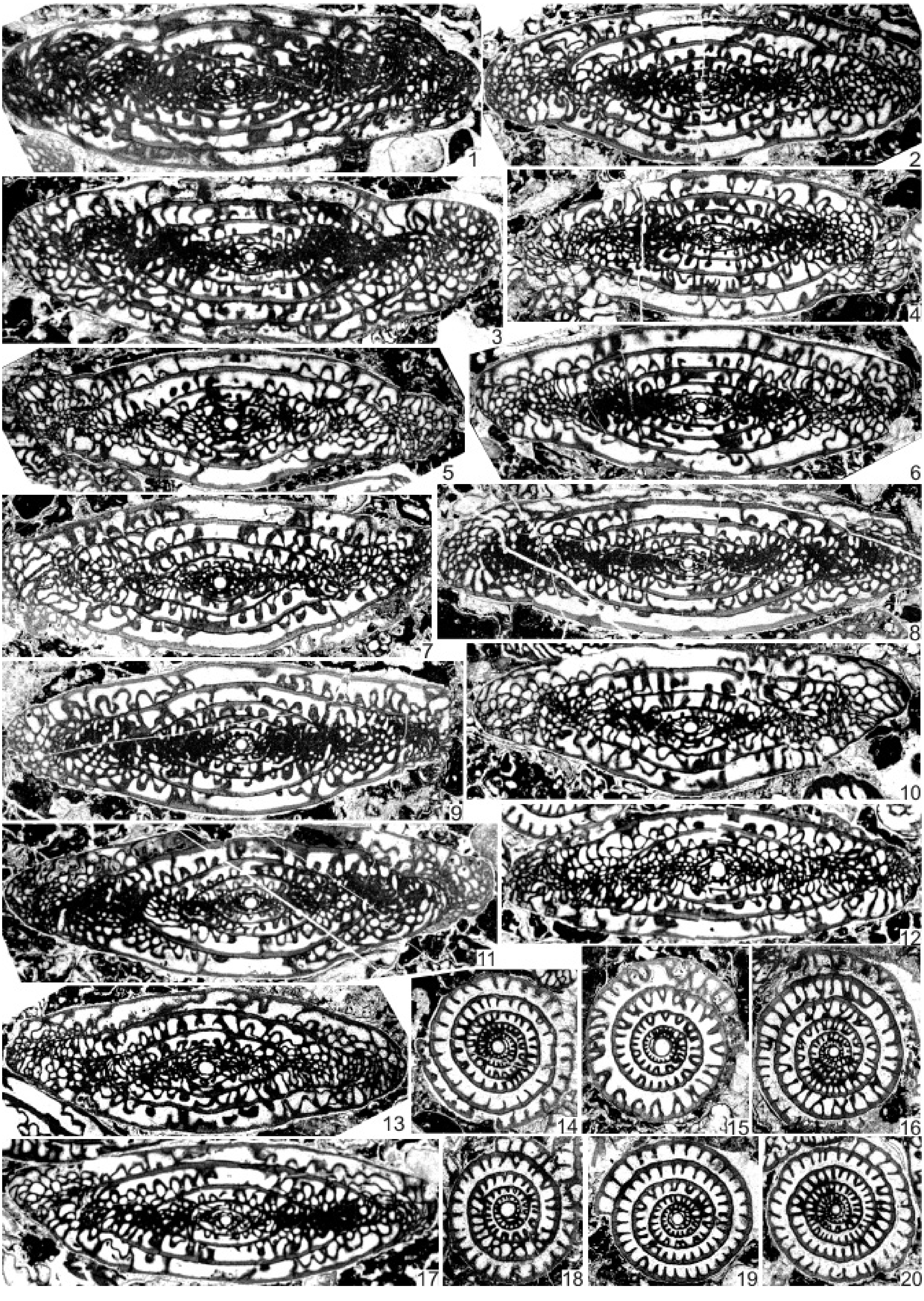
1-13, 17: axial sections; 14-16, 18-20: sagittal sections.

1: D2-055960, 2: D2-050230, 3: D2-050235, 4: D2-050241, 5: D2-050227, 6: D2-050244, 7: D2-040912, 8: D2-040867, 9: D2-040857, 10: D2-040900, 11: D2-040895, 12: D2-040903, 13: D2-040880, 14: D2-050242, 15: D2-050213, 16: D2-050240, 17: D2-040904, 18: D2-050237, 19: D2-050238, 20: D2-050217.

Locality 1: A-428 (middle Gzhelian); 2-6, 14-16, 18-20: A-237 (middle Gzhelian); 7: A-25b (middle Gzhelian); 8-9: A-24 (middle Gzhelian); 10-13, 17: A-25a (middle Gzhelian).

All ×10.

Plate XXXVIII



keriotheca, and as thick as 0.07 to 0.10 mm in the last two whorls.

Septa closely spaced, gently inclined anteriorly, intensely folded throughout the test except for inner one or two whorls, and highly intensely folded in polar regions. Some of adjacent folded septa are combined in outer whorls resulting many chamberlets especially in polar regions. Some are in contact with the base of chambers in the median part of the test resulting obscure appearance of tunnel path. Septal counts from the first to the seventh whorl 7?, 9 or 10, 13 to 15, 16 to 19, 21 to 25, 31 to 34, and 40, respectively, in five specimens illustrated.

Tunnel low and narrow bordered by distinct or rudimentary chomata in inner tightly coiled whorls. Chomata absent in outer whorls.

Remarks: This species was first described from the Yayamadake Limestone by Kanmera (1958) and has long been assigned to *Paraschwagerina*. In this paper, it is reassigned to *Darvasoschwagerina* proposed by Leven & Davydov (2001), because of more intensely and more irregularly folded septa of this species than those of large forms of *Paraschwagerina* known from the Tethyan regions, such as *P. mira* Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich, 1949, *P. pseudomira* Miklukho-Maklay, 1949, and *P. inflata* Chang, 1963b.

Incomplete axial sections of this species (e.g. Pl. XXIX, figs 9, 14; pl. 29, fig. 6 in Kanmera, 1958) appear to be similar to *Paraschwagerina archaica* Leven & Shcherbovich, 1978, designated as the type species of *Darvasoschwagerina*, originally described from the lower part of middle Gzhelian of Darvas (Leven & Shcherbovich, 1978). However, those three are only incomplete forms of *D. shimodakensis* due to abrasion of outer part of the test. Except for some resemblances in the juvenile stage, this species is easily distinguished from the Darvas ones in its much larger test with more whorls and more rapidly expanding after the juvenile stage.

Paraschwagerina yanagidai Igo, 1972 and *P. indigesta* Igo, 1972 from probably the Gzhelian limestones of northern Thailand (Igo, 1972) are inferred to be also reassigned to the genus *Darvasoschwagerina* from the mode of septal foldings. Both are more or less similar to *D. shimodakensis*. However, the former has larger proloculus, less distinct juvenile stage, and less rapidly expanding outer whorls, and the latter has more irregularly folded septa than *D. shimodakensis*.

Two specimens identified with this species by Ueno & Fujikawa (2006) from Akiyoshi are largely different from the types from Yayamadake in their smaller test and more weakly folded septa. They should be replaced to *Paraschwagerina akiyoshiensis.*

Occurrence and stratigraphic distribution: Common to rare in few samples in the *Carbonoschwagerina morikawai*-*Jigulites horridus* Zone and in some samples in the *Jigulites titanicus*-*Carbonoschwagerina minatoi* Zone.

Genus *Paraschwagerina* Dunbar & Skinner, 1936

Type species: *Schwagerina gigantea* White, 1932, p. 82.

Remarks: Both forms similar to and somewhat dissimilar to the types of *Paraschwagerina* have been reported from European Russia and Tethyan regions. The former forms are represented by *P. mira* Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich (1949) and *P. inflata* Chang, 1963b with large test and intensely folded septa. Such species as *Paraschwagerina inglorius* Bensh, 1962, *Occidentoschwagerina*? *primaeva kokpectensis* Shcherbovich, 1969, and *Alpinoschwagerina paranitida* Bensh, 1972 might be included in the latter forms. These three species have smaller test, and weaker and more irregularly folded septa. They were reassigned to the genus *Likharevites* by Davydov in Popov *et al*. (1987) designating *Paraschwagerina*? *sartauensis* Davydov 1986b as the type species. Taxonomic interpretation of *Likharevites* by Rauzer-Chernousova *et al*. (1996) is uncertain because of no description of the genus in the paper. Leven in Leven & Gorgij (2006) and Leven (2009) transferred *Paraschwagerina mira* and *P. inflata* to *Likharevites* v.v. Davydov in Davydov *et al*. (2013) hesitated about this reassignment. Leven in Leven & Gorgij (2006) emphasized a taxonomic independence of *Likarevites* based on its ontogenetical and phylogenetical differences from those of North American genus *Paraschwagerina*. It is supposed that Davydov recognizes *Likharevites* for subspherical to spherical forms like the type species of

Plate XXXIX

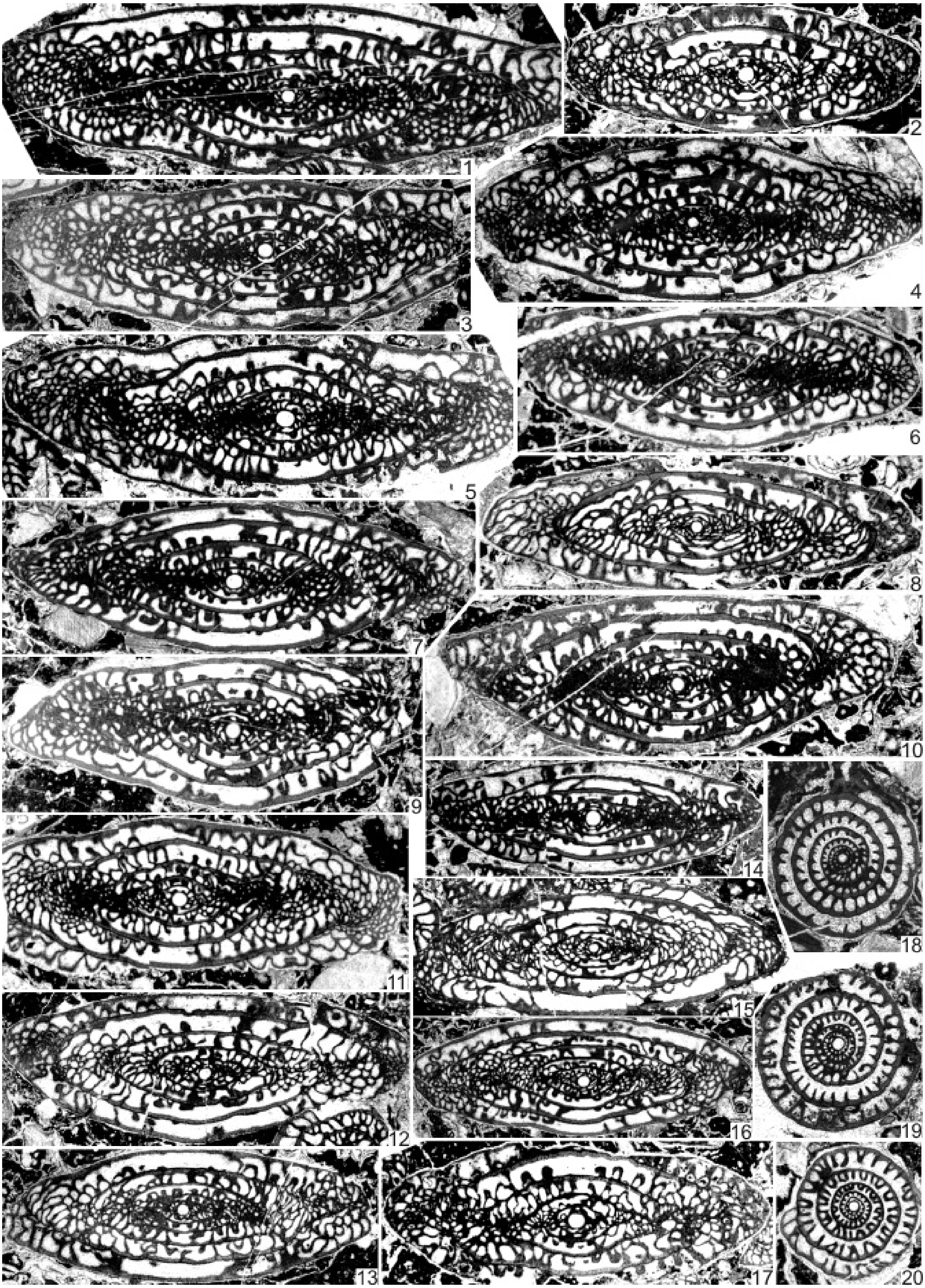
Figs 1-20: *Jigulites horridus* (Kanmera)

1-17: axial sections, 18-20: sagittal sections.

1: D2-040869, 2: D2-040887, 3: D2-040873, 4: D2-050232, 5: D2-040905, 6: D2-040902, 7: D2-040886, 8: D2-040894, 9: D2-040868, 10: D2-040911, 11: D2-040906, 12: D2-050250, 13: D2-050218, 14: D2-040898, 15: D2-057107, 16: D2-040878, 17: D2-040907, 18: D2-057082, 19: D2-057110, 20: D2-055952.

Locality 1, 3, 9: A-24 (middle Gzhelian); 2, 5-8, 11, 14, 16-17: A-25a (middle Gzhelian); 4, 12-13: A-237 (middle Gzhelian); 10: A-25b (middle Gzhelian); 15, 18: B-207 (middle Gzhelian); 19: B-208 (middle Gzhelian); 20: A-428 (middle Gzhelian). All ×10.

Plate XXXIX



the genus, by which *Likharevites* is differentiated from *Paraschwagerina*.

Thus, further analyses are desired for taxonomy and classification of inflated fusiform genera with moderately to intensely folded septa and tightly coiled juvenile whorls including *Likharevites*. In this paper, forms having more irregularly folded septa than those of typical *Paraschwagerina* are reserved to the genus (e.g., *Paraschwagerina akiyoshiensis* described below). *Likharevites* seems to be better to be restrictedly defined for inflated fusiform species like the type species of the genus and its allies as done by Davydov in Davydov *et al*. (2013).

***Paraschwagerina akiyoshiensis* Toriyama, 1958**
Pl. XXX, figs 1-4; Pl. XXXI, figs 1-6

1958. *Paraschwagerina* (*Paraschwagerina*) *akiyoshiensis* Toriyama, pp. 155-158, pl. 18, figs 1-14.
non 1990. *Paraschwagerina akiyoshiensis* Toriyama.– T. Ozawa & Kobayashi, pl. 8, fig. 5 (= *Chalaroschwagerina*? sp.).
1990. *Paraschwagerina* sp. ex. gr. *P. moelleri* (Schellwien, 1908).– T. Ozawa & Kobayashi, pl. 8, fig. 6.
1991. *Paraschwagerina akiyoshiensis* Toriyama.– Watanabe, fig. 43.1-5.
pars 1998. *Paraschwagerina* spp. Y. Ota, pp. 98-99, pl. 8, figs 10-12 (fig. 13: indeterminable).
2006. *Darvasoschwagerina shimodakensis* (Kanmera, 1958).– Ueno & Fujikawa, pl. 4.2, figs 3, 4, 4a.

Description: Test inflated fusiform with arched periphery, almost straight to slightly convex lateral sides, bluntly pointed poles, and straight to slightly curved axis of coiling, and composed of six and a half to seven whorls. Length about 4.7 to 6.9 mm and width about 2.7 to 3.9 mm, giving a form ratio about 1.6 to 1.9.

Proloculus spherical, minute, and 0.05 to 0.13 mm. Inner three whorls fusiform and tightly coiled. Succeeding whorls inflated fusiform with pointed poles, and rapidly expanding outwards. Wall very thin and not differentiated in inner two to three, rarely four whorls. Succeeding whorls gradually thickened and consist of tectum and finely alveolar keriotheca, and about 0.07 to 0.10 mm in the thickest part of last two whorls.

Septa gently inclined anteriorly, intensely folded throughout the test except for inner tightly coiled whorls. Septal folds rather regular and some are in contact with the roof of chambers. Phrenothecae variably and irregularly developed. Tunnel low and narrow bordered by rudimentary chomata in inner tightly coiled whorls, and possibly low, irregular, and discontinuous in outer whorls. Chomata absent in outer ones.

Remarks: Including the present specimens in this paper, all forms to have been identified with *Paraschwagerina akiyoshiensis* have more inflated test with septal folds more irregular than the typical ones of *Paraschwagerina*. This species resembles *Likharevites gracilis* Leven in Leven & Gorgij (2006) from the Asselian of central Iran (Leven in Leven & Gorgij, 2006). But, the former has more intensely folded septa. It is somewhat similar to *Paraschwagerina ishimbajica* and *Paraschwagerina acumina uralensis,* both of which were first described by Rauzer-Chernousova in Rauzer-Chernousova & Shcherbovich (1949) from the *Schwagerina* Horizon of European Russia. However, this species is different from them by its more inflated test and more rapidly expanding outer whorls.

In spite of wide intraspecific variation of this species, one specimen identified with this species by T. Ozawa & Kobayashi (1990) is dissimilar to those of Toriyama (1958), Watanabe (1991), and the present paper. It should be separated from this species because of its not so tightly coiled inner whorls, larger proloculus, and more intensely and irregularly folded septa resulting many chamberlets. *Paraschwagerina* sp. compared to *Fusulina moelleri* Schellwien, 1908 by T. Ozawa & Kobayashi is presumed to be corresponding to an elongate form of *P. akiyoshiensis*.

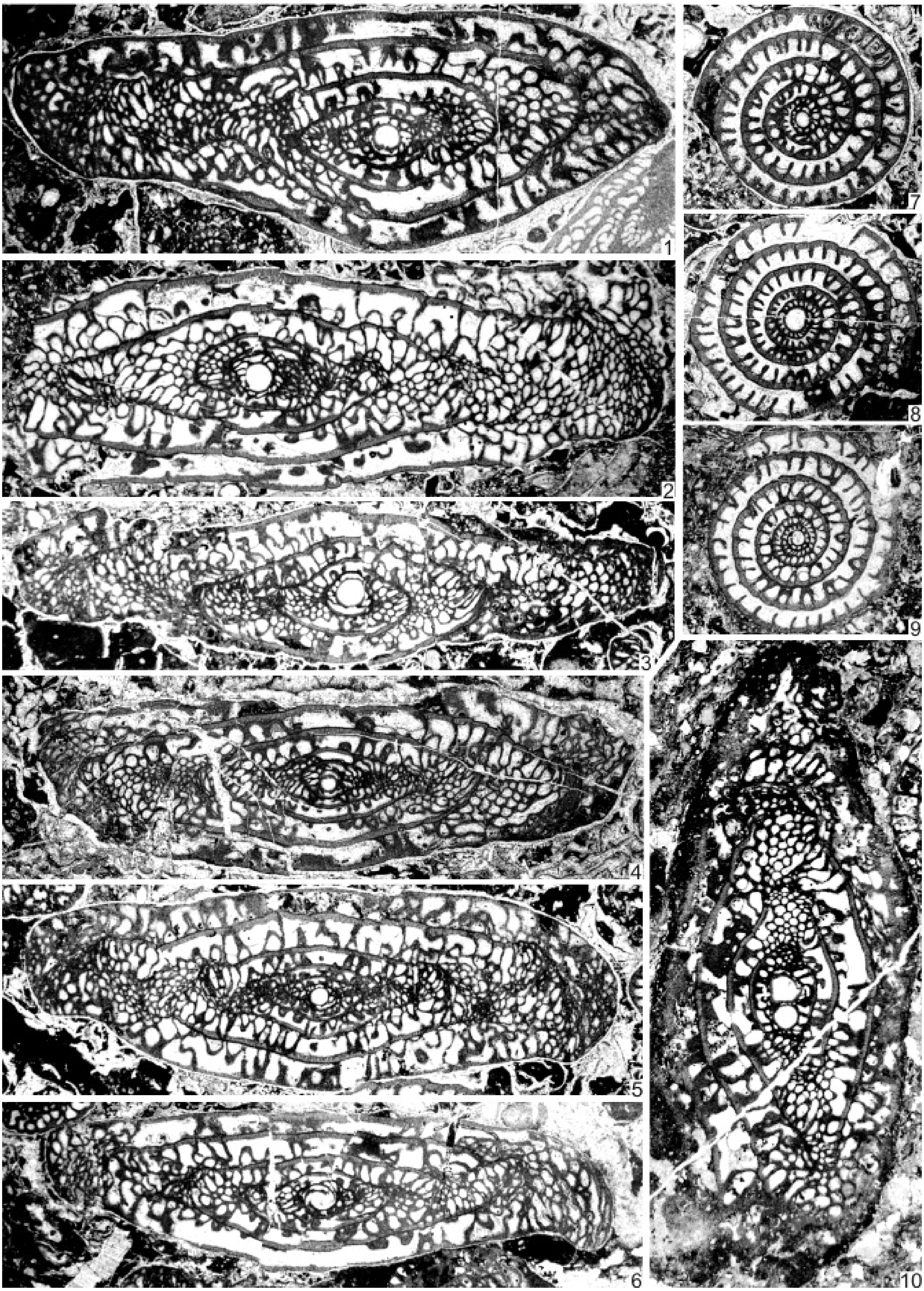
Three specimens among four illustrated by Y. Ota (1998) as *Paraschwagerina* spp. from Akiyoshi are referable to this species, but other one is excluded from *Paraschwagerina*. Two specimens named as *Darvasoschwagerina shimodakensis* by Ueno & Fujikawa (2006) from Akiyoshi are different from the types of *D. shimodakensis* and included in this species, as mentioned above.

Occurrence and stratigraphic distribution: Common in only one sample (A-403) from the upper part of the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone, and common in many samples

Plate XL

Figs 1-10: *Jigulites titanicus* n. sp.
5: holotype, others: paratypes.
1-6, 10: axial sections; 7-9: sagittal sections.
Register numbers: shown in the description of this new species.
Locality 1, 3, 5, 7-8: A-399 (upper Gzhelian); 2, 6: A-405 (upper Gzhelian); 4: A-21b (upper Gzhelian); 9: A-241a (lower Asselian); 10: A-99 (lower Asselian).
All ×10.

Plate XL



from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

***Paraschwagerina* cf. *karachatypica* (Bensh, 1972)**
Pl. XXXI, figs 7-12

Compare:
1972. *Chusenella karachatypica* Bensh, pp. 117-118, pl. 26, figs 5-6.

Remarks: Although complete axial sections of mature stage are few, specimens illustrated are separated from *Paraschwagerina akiyoshiensis* by their outline of the test with almost straight to broadly rounded periphery and more rounded poles, and more intensely folded septa. They are comparable to the original material of the species included in *Chusenella* and described by Bensh (1972) from the upper Asselian of South Fergana. However, outer two to three whorls are more loosely coiled in the present ones.
Occurrence and stratigraphic distribution: Common to rare in few samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

***Paraschwagerina*? sp.**
Pl. XXXV, figs 17-18

Remarks: The mode of the test expansion of this unnamed species is somewhat similar to that of larger form of *Paraschwagerina akiyoshiensis*. However, it has larger test, more whorls, more distinct phrenothecae, and more irregularly folded septa. Septal folds reaching the roof of chambers producing many various-sized and -shaped vesicular loops suggest a phyletic relation between *Paraschwagerina*? sp. and a species of *Acervoschwagerina*. Although its morphologic variation is uncertain due to few well-oriented specimens, this unnamed species is questionably assigned to the genus *Paraschwagerina.*
Occurrence and stratigraphic distribution: Common in only one sample (A-63b) from the *Pseudoschwagerina miharanoensis–Paraschwagerina akiyoshiensis* Zone.

Genus *Rugosofusulina* Rauzer-Chernousova, 1937
Type species: *Rugosofusulina prisca* (Ehrenberg, 1842) *sensu* Möller, 1878 = *Fusulina prisca* Ehrenberg, 1842, emend. Möller, 1878, p. 56.

***Rugosofusulina prisca* (Ehrenberg, 1842)**
Pl. XLVI, figs 21-24, 26-27

1878. *Fusulina prisca* (Ehrenberg).– Möller, pp. 56-59, pl. 3 fig. 1 a-c; pl. 6, fig. 2 a-c.
1908. *Fusulina prisca* (Ehrenberg).– Schellwien, pp. 182-184, pl. 18, figs 7-11, 13-14, 16-17.
1925b. *Schellwienia prisca* (Ehrenberg).– Y. Ozawa, pp. 38-39, pl. 5, fig. 4-5.
1937. *Rugosofusulina prisca* (Ehrenberg).– Rauzer-Chernousova, pp. 11-12, pl. 1, fig. 1.
1990. *Rugosofusulina prisca* (Ehrenberg).– T. Ozawa & Kobayashi, pl. 4, fig. 21.

Remarks: This species was designated as the type species of *Rugosofusulina* by Rauzer-Chernousova (1937). The present specimens are similar to those described by Möller (1878) in shape and size of the test, degree of rugosity of wall, and mode of septal folding. Although detailed comparison is uneasy, septal folds are more irregular in the latter. Later ones such as Schellwien's (1908), Y. Ozawa's (1925b), and T. Ozawa & Kobayashi's (1990) have larger and more elongate test with weaker septal foldings than the types. Rauzer-Chernousova's (1937) specimen has much more strongly undulated wall in outer whorls than the types.
Occurrence and stratigraphic distribution: Common in few samples from the *Sphaeroschwagerina fusiformis-Pseudofusulina muongthensis* Zone.

***Rugosofusulina serrata* Rauzer-Chernousova, 1937**
Pl. XLVI, figs 7-20

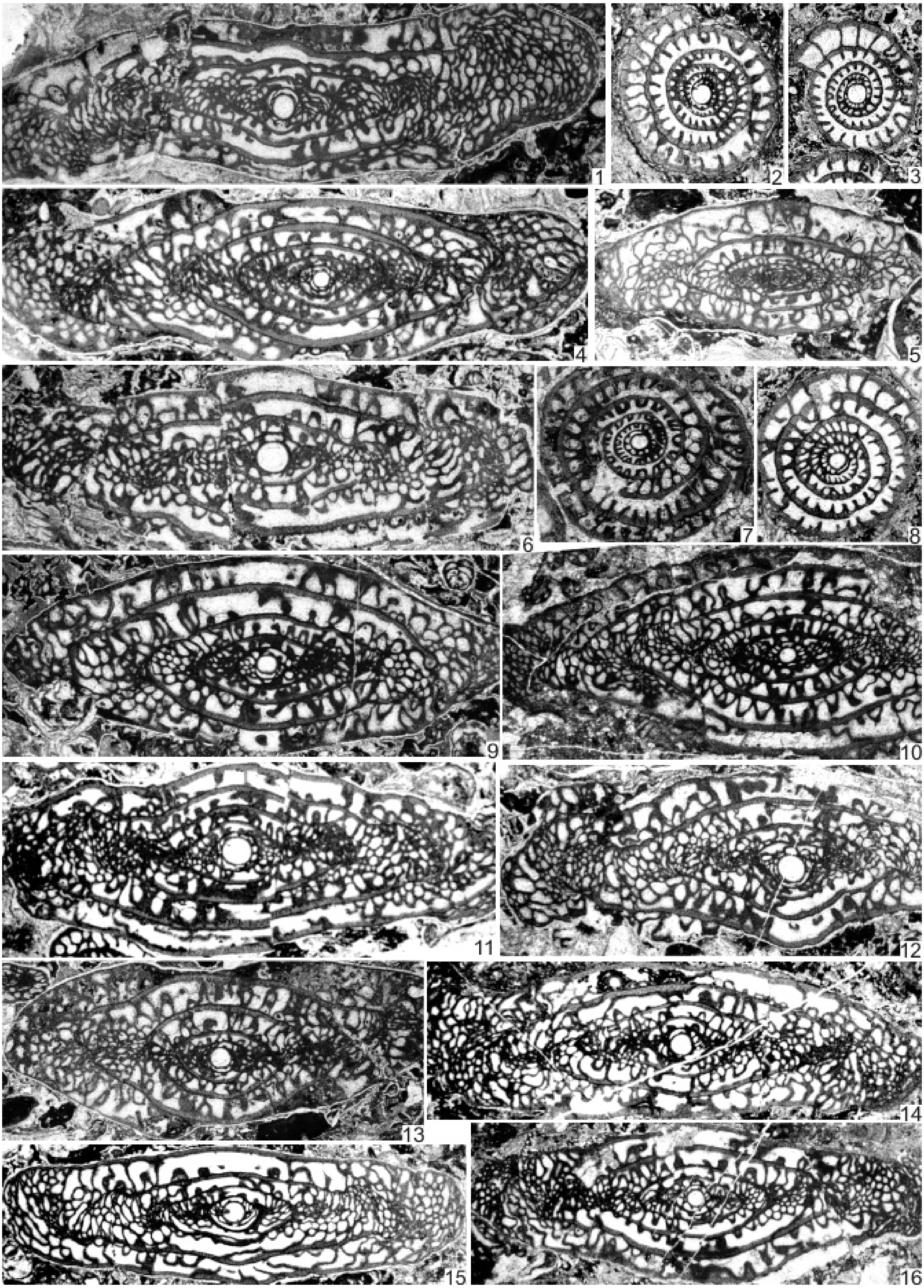
1937. *Rugosofusulina serrata* Rauzer-Chernousova, pp. 13-14, pl. 1 figs 4-6.

Description: Test elongate fusiform to fusiform with broadly arched periphery, slightly convex lateral sides, and bluntly pointed poles. Periphery and lateral sides are more or less undulated. Test consists of five to seven whorls, about 5.6 to 7.6 mm in length and about 1.8 to 2.7 mm in width, giving a form ratio about 2.2 to 3.1. Proloculus almost spherical and its longer diameter 0.13

Plate XLI

Figs 1-16: *Jigulites titanicus* n. sp.
All paratypes.
1, 4, 6, 9-16: axial sections (megalospheric forms); 2-3, 7-8: sagittal sections (megalospheric forms); 5: axial section (microspheric form).
Register numbers: shown in the description of this new species.
Locality 1, 4-6, 11-12: A-399 (upper Gzhelian); 2-3, 8, 14: A-241a (lower Asselian); 15: A-405 (upper Gzhelian); 7, 10: B-183 (upper Gzhelian); 9, 13: B-214 (upper Gzhelian); 16: A-241b (lower Asselian).
All ×10.

Plate XLI



to 0.27 mm. Length, width, and form ratio of whorls increasing gradually outerwards. Wall thin, smooth in inner whorls without clear alveolar structure. Wall more or less corrugated in middle and outer whorls and consists of tectum and alveolar keriotheca. Its thickness is about 0.06 to 0.10 mm in outer whorls.

Septa rather irregularly folded throughout the test and strongly folded in polar regions. Septal counts from the first to sixth whorl 8 or 9, 16 or 17, 18 or 19, 21 or 24, 23 or 25, and 23, respectively in two sections illustrated. Septal sutures clear in outer whorls. Tunnel low and narrow in inner whorls. Its path becomes irregular and wider in outer whorls. Chomata absent except for inner few whorls.

Remarks: Rauzer-Chernousova (1937) proposed this species from the core sample of the *Schwagerina* Zone in Ishimbaevo oil field, Southern Urals. She distinguished this species from *Rugosofusulina prisca* based mainly on its very poorly undulated walls and supplementarily on its larger test and larger width of whorls. Most test characters shown in two axial sections illustrated by her are closely similar to those of the present material. More or less differences in outline of outer whorls, degree of wall undulation, strength and regularity of septal folds, and depth of septal sutures in the present material are presumed to represent the broad morphologic variation of this species.

Occurrence and stratigraphic distribution: Rare in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone and common to rare in many samples from the *Sphaeroschwagerina fusiformis-Pseudofusulina muongthensis* Zone.

Rugosofusulina sp. A
Pl. XLVI, fig. 25

Remarks: Two unidentified groups of *Rugosofusulina* are recognized in the Wakatakeyama material. Though outermost whorl is not preserved, the first one, named *Rugosofusulina* sp. A has slenderer fusiform test with more pointed poles and thinner wall than the two species described above.

Though also incomplete, the second group, *Rugosofusulina* sp. B (Pl. XLVI, fig. 28) has more irregularly folded septa and axial fillings. It seems to be alike to *Rugosofusulina aktjubensis* Rauzer-Chernousova 1937 from the Southern Urals (Rauzer-Chernousova, 1937). However, further comparison of these unidentified species is impossible due to poor specimens in my hand.

Occurrence and stratigraphic distribution: Rare in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone. *Rugosofusulina* sp. B is rare in only one sample (A-391) from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Genus *Rugosochusenella* Skinner & Wilde, 1965

Type species: *Rugosochusenella zelleri* Skinner & Wilde, 1965, p. 102.

Rugosochusenella paragregaria (Rauzer-Chernousova, 1940)
Pl. XXXVII, figs 1-3

1940. *Pseudofusulina paragregaria* Rauzer-Chernousova, pp. 81-82, 93, pl. 2, figs 4-7.

1986c. *Rugosochusenella paragregaria* (Rauzer-Chernousova).– Davydov, p. 123, pl. 25, fig. 12.

Remarks: Rauzer-Chernousova (1940) proposed this species based on the difference from *Schellwienia gregaria* Lee, 1931 in having more pointed poles, deeper septal furrows and uneven surface. In addition, axial fillings are almost absent in *R. paragregaria*. By these similar characters to the original ones, the Wakatakeyama specimens are identical with this species. This species was later reassigned to *Chusenella* by Stewart (1963). Davydov (1986c) transferred it to *Rugosochusenella* and pointed out the stratigraphic range of this species from upper Gzhelian to Asselian in Central Asia.

Occurrence and stratigraphic distribution: Rare in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

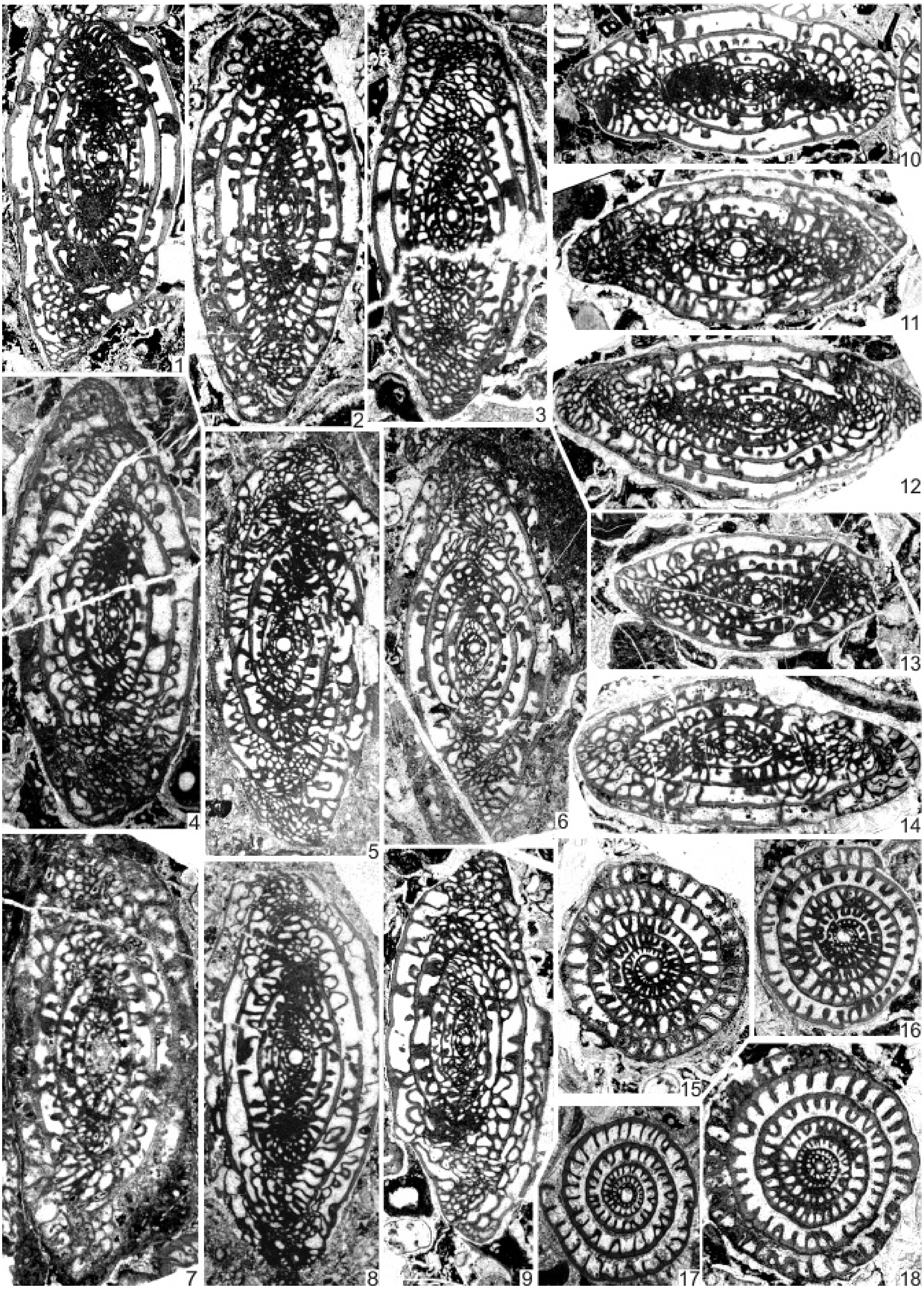
Rugosochusenella shagonensis Davydov, 1986c
Pl. XXXVII, figs 4-6

1986c. *Rugosochusenella shagonensis* Davydov, pp. 123-124, pl. 25, figs 9, 14.

Plate XLII

Figs 1-18: *Jigulites magnus* (Rozovskaya)
1-14: axial sections, 15-18: sagittal sections.
1: D2-050243, 2: D2-055978, 3: D2-055965, 4: D2-055958, 5: D2-040932, 6: D2-055948, 7: D2-055941, 8: D2-040923, 9: D2-055970, 10: D2-050216, 11: D2-055966, 12: D2-055977, 13: D2-051930, 14: D2-055974, 15: D2-055951, 16: D2-055971, 17: D2-056742, 18: D2-055976.
Locality 1, 10: A-237 (middle Gzhelian); 2-4, 9, 11-12, 14-16, 18: A-428 (middle Gzhelian); 5, 8: A-25c (middle Gzhelian); 6-7: A-427 (middle Gzhelian); 13: A-322 (middle Gzhelian); 17: B-178 (lower Gzhelian).
All ×10.

Plate XLII



Remarks: The present specimens are similar to and identified with the original ones named *Rugosochusenella shagonensis* by Davydov (1986c) from the uppermost Gzhelian of Darvas in many respects such as the mode of test expansion and septal folding, axial fillings, and the degree of rugosity of wall. The former has more tightly coiled inner whorls with more pointed poles and thinner wall than the latter.
Occurrence and stratigraphic distribution: Rare to common in some samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

***Rugosochusenella* sp. A**
Pl. XXXVI, figs 18-19

Remarks: Two axial sections illustrated herein have tightly coiled inner whorls, corrugated wall, and weak axial fillings, as well as other sections excentered or not well-oriented. This unidentified species differs from other species assignable to *Rugosochusenella* in the Wakatakeyama area in its more irregularly and more intensely folded septa.
Occurrence and stratigraphic distribution: Rare in only one sample (A-389) from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone.

***Rugosochusenella* sp. B**
Pl. XXXVI, figs 20-23, 29

Remarks: Another unidentified species, *Rugosochusenella* sp. B, appears to be corresponding to an elongate form of *Rugosochusenella shagonensis*. Inflated forms of *Rugosochusenella* such as *R. shagonensis* and *R.* sp. A, however, are not contained in the samples with this unidentified species. Therefore, it is tentatively treated as an independent species of the genus.
Occurrence and stratigraphic distribution: Rare to common in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone and the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone.

Genus *Pseudochusenella* Bensh, 1987
Type species: *Pseudofusulina pseudopointeli* Rauzer-Chernousova in Shcherbovich, 1969, p. 50.

***Pseudochusenella gregaria* (Lee, 1931)**
Pl. XXXVI, figs 24-28

1931. *Schellwienia gregaria* Lee, p. 288, pl. 1, figs 3, 3a, 3b.
1934. *Pseudofusulina gregaria* (Lee).– Chen, pp. 51-52, pl. 3, fig. 14 (?); pl. 8, figs 9-10, 3b.

Remarks: Tightly coiled inner whorls, strong axial fillings, and almost even wall characteristic in the Wakatakeyama specimens are referable to those of *Schellwienia gregaria* by Lee (1931) from the Chuanshan Limestone near Nanjing. Stewart (1963) reassigned this species to *Chusenella*, along with many other species with tightly coiled inner whorls that had been included in *Pseudofusulina* or *Schwagerina.* This species might be better to be transferred to *Pseudochusenella* that is probably distinguished from *Rugosochusenella* by the absence of rugosity of the wall. It is distinguished from *Pseudochusenella explicata* described later by more elongate test and more well-developed axial fillings reaching to poles. This species is different from *Schwagerina stabilis* by its more tightly coiled inner whorls and somewhat smaller proloculus.
Occurrence and stratigraphic distribution: Rare to common in some samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Pseudochusenella explicata
(Leven & Shcherbovich, 1978)
Pl. XXXVII, figs 7-35

1978. *Pseudofusulina explicata* Leven & Shcherbovich, pp. 121-122, pl. 18, figs 7-9.
2009. *Pseudochusenella explicata* (Leven & Shcherbovich).– Leven, p. 141, pl. 13, fig. 16.

Description: Test fusiform to inflated fusiform with broadly arched periphery, slightly convex to almost

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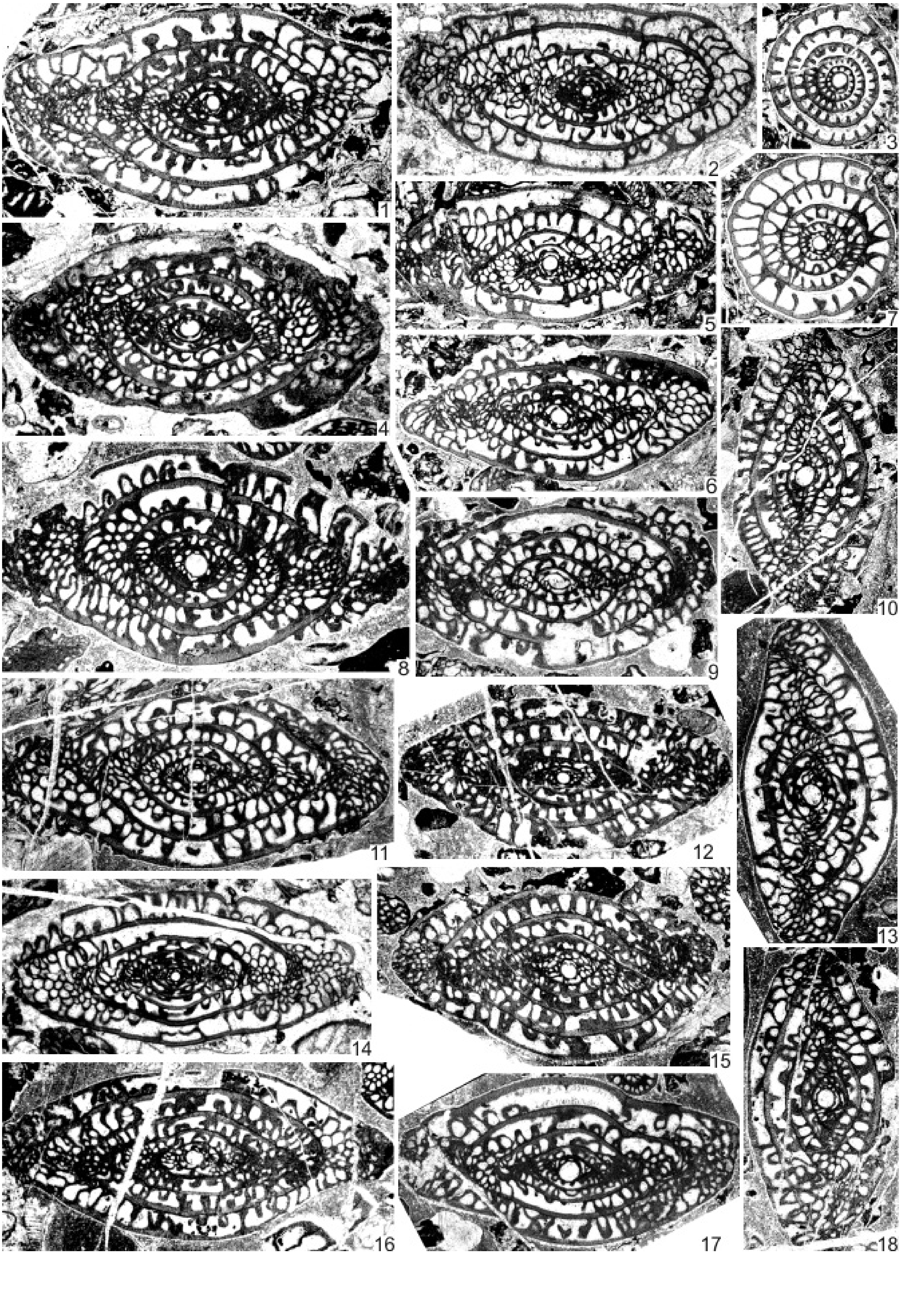
Plate XLIII

Figs 1-7: *Daixina sokensis* Rauzer-Chernousova
1-2, 4-6: axial sections; 3, 7: sagittal sections.
1: D2-052810, 2: D2-050189, 3: D2-052811, 4: D2-040958, 5: D2-040686, 6: D2-052825, 7: D2-052812,
Locality 1, 3, 7: A-398 (upper Gzhelian); 2: A-235 (upper Gzhelian); 4: A-26 (upper Gzhelian); 5: A-21a (upper Gzhelian); 6: A-399 (upper Gzhelian). All ×10.
Figs 8-18: *Daixina parva* (Belyaev)
8-18: axial sections.
8: D2-051902, 9: D2-051903, 10: D2-053235, 11: D2-051894, 12: D2-051901, 13: D2-051905, 14: D2-055492, 15: D2-053230, 16: D2-051893, 17: D2-051895, 18: D2-051899.
Locality: 8-13, 15-18: A-319 (lower Asselian); 14: A-404 (lower Asselian)
All ×10.

Plate XLIII



straight lateral sides, and bluntly pointed poles, and composed of seven to nine whorls. Length about 4.1 to 6.1 mm, width about 1.9 to 2.9 mm, and a form ratio about 1.9 to 2.5.

Proloculus spherical and its diameter 0.10 to 0.21 mm. Inner two to three whorls tightly coiled and later whorls regularly expand gradually increasing their length and width. Wall thin and consists of tectum and translucent layer or of single layer in inner one to three whorls, gradually thickened outwards, and consists of tectum and finely alveolar keriotheca. Its thickness about 0.06 to 0.09 mm in the last two whorls.

Septa regularly spaced, intensely and rather regularly folded throughout the test. Septal counts from the first to sixth whorl 7 to 9, 11 to 14, 13 to 21, 16 to 24, 20 to 24, 23 or more, respectively. Tunnel low and narrow in inner whorls, and low and irregular in outer whorls. Chomata rudimentary in inner few whorls and absent in outer whorls.

Remarks: Leven & Shcherbovich (1978) newly proposed *Pseudofusulina explicata* by its smaller and more inflated test than *Pseudofusulina pseudopointeli* Rauzer-Chernousova in Shcherbovich, 1969 and *Pseudofusulina postcallosa* Bensh, 1962. Morphologic variations of these three species are uncertain. The first species, however, was designated as the type species of *Pseudochusenella* by Bensh (1987).

The illustrated 29 specimens more or less resemble these three species and are not easily distinguished by slight differences of test characters. In this paper, the Wakatakeyama specimens are provisionally identified with *Pseudochusenella explicata* by their closer similarities of the shape and size of the test. Among the illustrated four specimens named as *Pseudofusulina gregaria* by Watanabe (1991), two having more inflated test (Watanabe, 1991, figs 5.17-18) might be better to be transferred to this species.

Occurrence and stratigraphic distribution: Common to rare in some samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone and rare in few samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Genus *Chalaroschwagerina* Skinner & Wilde, 1965

Type species: *Chalaroschwagerina inflata* Skinner & Wilde, 1965, p. 72.

***Chalaroschwagerina* sp. A**

Pl. XXXI, fig. 13

Remarks: The illustrated specimen in association with *Paraschwagerina akiyoshiensis* is belonged to *Chalaroschwagerina* from the mode of septal folding, shape of the test, and proloculus size, though species identification is impossible. It is discriminated from *Chalaroschwagerina* sp. B in its thinner wall and septa, well-developed phrenothecae, and not so loosely coiled inner whorls.

Occurrence and stratigraphic distribution: Common in only one sample (A-409) from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

***Chalaroschwagerina* sp. B**

Pl. XLVII, fig. 1, Pl. XLIX, figs 17-23

Description: Test inflated fusiform with broadly arched periphery, almost straight to slightly convex lateral sides, and bluntly pointed poles, and composed of five or six whorls. Length 6.94 mm and width 3.30 mm, giving a form ratio 2.10 in the specimen shown in Pl. XLIX, fig. 23.

Proloculus almost spherical and its longer diameter 0.24 to 0.37 mm. Later whorls with pointed poles from the second whorl rapidly expanding longitudinally and vertically. Wall more or less corrugated, thin and consists of tectum and finely alveolar keriotheca in inner one to two whorls, rather abruptly thickened and of tectum and coarsely alveolar keriotheca in outer two to three whorls. Its thickness about 0.06 to 0.09 mm in the last two whorls.

Septa intensely and rather irregularly folded throughout the test. Septal folds tall and some are in contact with the roof of chambers. Phrenothecae weakly developed. Tunnel low and narrow in inner whorls, but obscure on account of complicated septal folding in the median part of the test. Chomata absent except for rudimentary ones on proloculus and in the first whorl. Axial fillings absent throughout the test.

Plate XLIV

Figs 1-24, 25(?), 26: *Daixina fecunda* (Shamov & Shcherbovich)

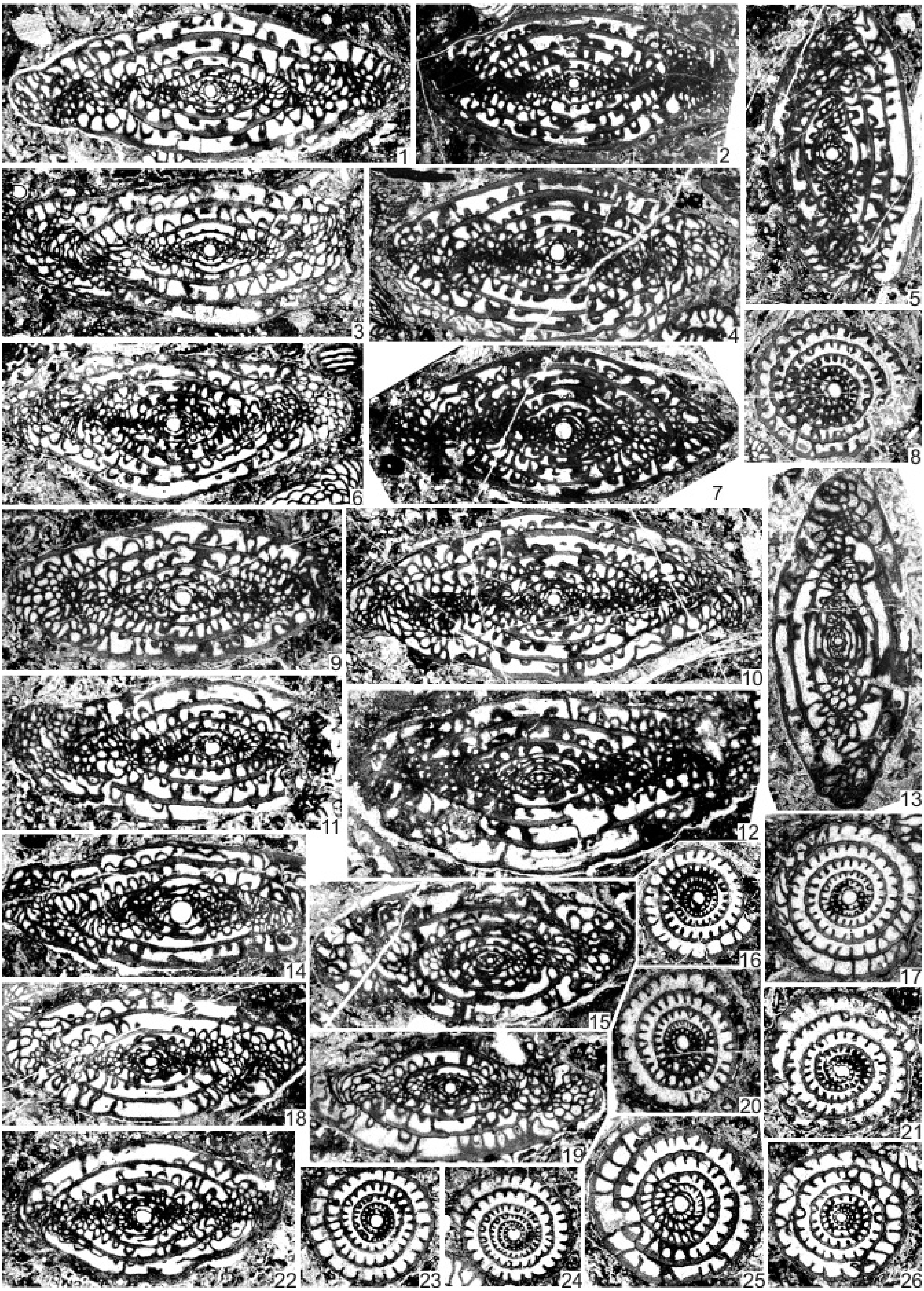
1-7, 9-15, 18-19, 22: axial sections; 8, 16-17, 20-21, 23-26: sagittal sections.

1: D2-050398, 2: D2-055655, 3: D2-050386, 4: D2-055669, 5: D2-055751, 6: D2-050354, 7: D2-055659, 8: D2-055665, 9: D2-050382, 10: D2-055653, 11: D2-050358, 12: D2-050418, 13: D2-052900, 14: D2-050352, 15: D2-050384, 16: D2-050348, 17: D2-050359, 18: D2-050363, 19: D2-050424, 20: D2-050350, 21: D2-050385, 22: D2-050378, 23: D2-050383, 24: D2-050379, 25: D2-050364, 26: D2-050353.

Locality 1, 12, 19: A-241b (lower Asselian); 2, 4, 7-8, 10: A-411 (upper Asselian); 3, 6, 9, 11, 14-18, 20-26: A-241a (lower Asselian); 5: A-418 (lower Asselian); 13: A-401 (lower Asselian).

All ×10.

Plate XLIV



Remarks: *Chalaroschwagerina* sp. B is presumably the oldest form of the genus, as well as *Chalaroschwagerina* sp. A, and is the late Asselian age from its association with *Paraschwagerina akiyoshiensis*. Although most specimens are incomplete, their inflated fusiform tests appear to be alike to *Chalaroschwagerina vulgaris* (Schellwien, 1909) and its allies, and more inflated forms to *Chalaroschawagerina globosa* (Schellwien, 1909) and its allies. However, *Chalaroschwagerina* sp. B is more loosely coiled and has more irregularly folded septa than the types of Schellwien's ones from Darvas.
Chalaroschwagerina vulgaris is age-diagnostic of the Artinskian in the Tethyan regions (e.g., Leven, 1980) and have been reported from many Lower Permian strata. On the other hand, the definition of them and their allies are considerably different among specialists. Toriyama (1958) subdivided those into many forms based on the Akiyoshi materials. Among them, *Chalaroschwagerina* sp. B somewhat resembles *Pseudofusulina globosa* (Deprat, 1912) var. *exilis* Toriyama, 1958 from the "*Pseudofusulina vulgaris*" Zone, but has smaller proloculus and much more pointed poles throughout whorls. *Pseudofusulina vulgaris* var. *globosa* by Y. Ota & M. Ota (1993) from the basal part of the "*Pseudofusulina vulgaris*" Zone immediately above the *Pseudoschwagerina muongthensis* Zone in the Wakatakeyama area according to Y. Ota & M. Ota (1993) is largely different from the types and should be belonged to a species of *Daixina* or other genus.
Occurrence and stratigraphic distribution: Rare in one sample (B-181) and abundant to common in two samples (B-210, B-211) from the *Pseudoschwagerina miharanoensis*-*Paraschwagerina akiyoshiensis* Zone.

Genus *Pseudofusulina* Dunbar & Skinner, 1931
Type species: *Pseudofusulina huecoensis* Dunbar & Skinner, 1931, p. 252.

***Pseudofusulina kumasoana* Kanmera, 1958**
Pl. XLVII, figs 11-26

1958. *Pseudofusulina kumasoana* Kanmera, pp 199-201, pl. 32, figs 9-15; pl. 35, figs 10-12.
1990. *Pseudofusulina kumasoana* Kanmera.– T. Ozawa & Kobayshi, pl. 5, fig. 9.
1991. *Pseudofusulina kumasoana* Kanmera.– Watanabe, fig. 16.1-12.

Description: Test elongate fusiform with broadly arched periphery, slightly convex lateral sides, and bluntly pointed poles, and composed of five to six and a half whorls. Length about 6.5 to 9.6 mm, width about 2.1 to 3.2 mm, and a form ratio about 3.0 to 3.2.
Proloculus spherical to subspherical and its longer diameter 0.25 to 0.40 mm. Subspherical first whorl is succeeded by elongate fusiform later whorls that are gradually increasing their length and width. Wall thin in the first to second whorls, then thickened outwards, as thick as 0.09 to 0.12 mm in the last two whorls, and consists of tectum and keriotheca. Alveolar keriotheca coarsened in the last few whorls. Wall surface more or less corrugated in outer whorls.
Septa closely spaced, intensely and rather irregularly folded throughout the test. Septal counts from the first to fifth whorl 11 or 12, 22 or 24, 28 or 29, 28 or 31, and more than 20, respectively in two specimens illustrated. Tunnel rather broad and its path irregular. Chomata absent except for rudimentary ones on proloculus and in the first whorl. Axial fillings well developed and almost completely filling the polar regions.

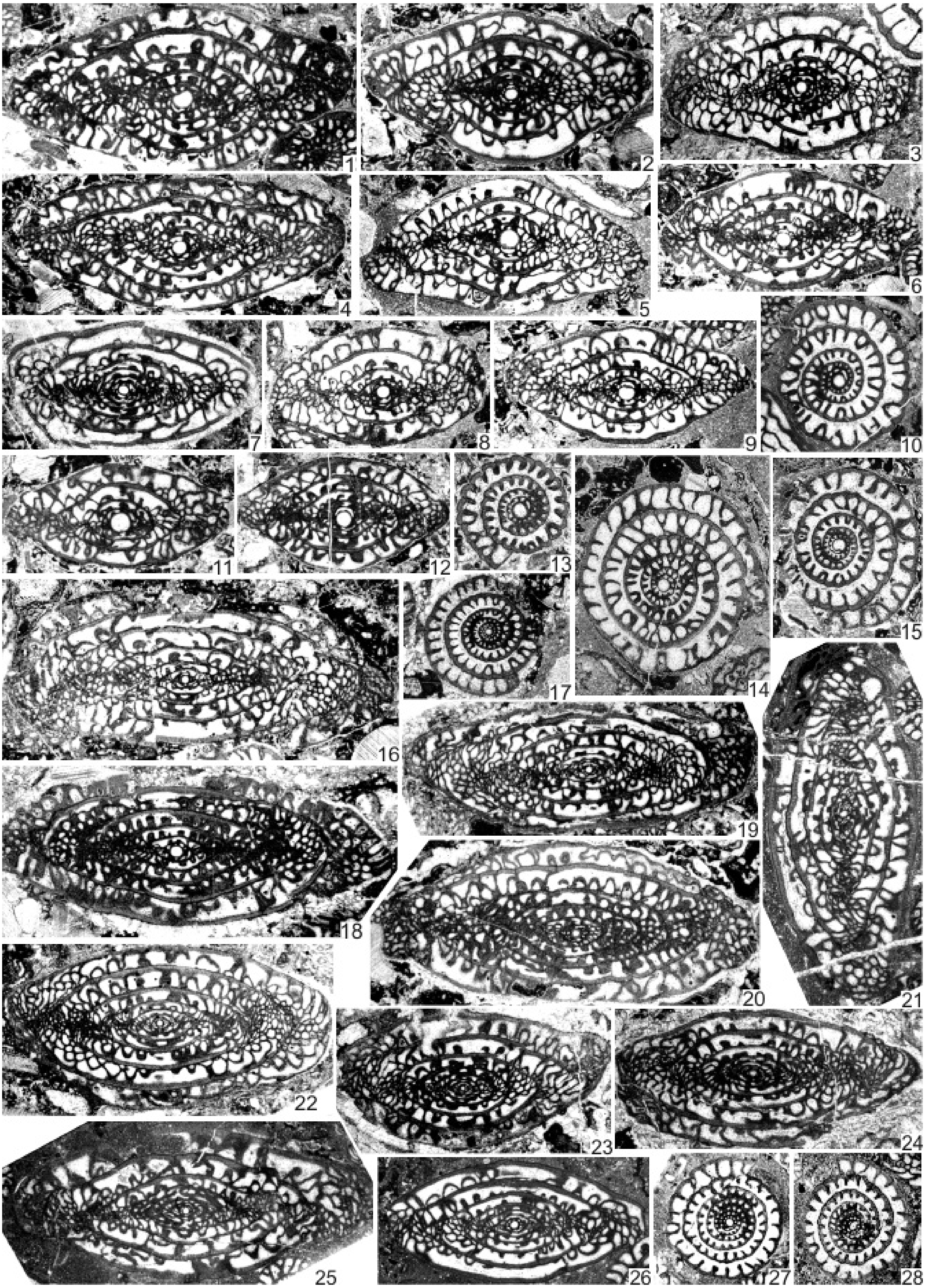
Plate XLV

Figs 1-6, 7(?), 8-15: *Daixina* cf. *robusta* Rauzer-Chernousova
1-9, 11-12: axial sections; 10, 13-15: sagittal sections.
1: D2-052956, 2: D2-052977, 3: D2-041016, 4: D2-052966, 5: D2-052936, 6: D2-052974, 7: D2-055505, 8: D2-052957, 9: D2-052937, 10: D2-052992, 11: D2-052932, 12: D2-052929, 13: D2-053004, 14: D2-052940, 15: D2-052991.
Locality 1-2, 4-6, 8-15; A-403 (lower Asselian); 3: A-27b (lower Asselian); 7; A-404 (lower Asselian).
All ×15.

Figs 16-20, 22-24: *Daixina licharevi* Davydov
16, 18-20, 22-24: axial sections; 17: sagittal section.
16: D2-055920, 17: D2-050194, 18: D2-050187, 19: D2-052659, 20: D2-055956, 22: D2-052663, 23: D2-040950, 24: D2-050178.
Locality 16: A-427 (middle Gzhelian); 17-18: A-235 (upper Gzhelian); 19, 22: A-392 (upper Gzhelian); 20: A-428 (middle Gzhelian); 23: A-26 (upper Gzhelian); 24: A-234 (upper Gzhelian).
All ×10.

Figs 21, 25-28: *Daixina ossinovkensis* Shcherbovich
21, 25-26: axial sections; 27-28: sagittal sections.
21: D2-055551, 25: D2-055537, 26: D2-055542, 27: D2-055549, 28: D2-055546.
Locality all A-406 (upper Asselian). All ×10.

Plate XLV



Remarks: The present specimens are apparently identical with *Pseudofusulina kumasoana* originally described from the Yayamadake Limestone by Kanmera (1958), as well as those illustrated by T. Ozawa & Kobayashi (1990) and Watanabe (1991) from Akiyoshi. Smaller appearence of some of the tests than these materials is due to the abrasion of the outer whorls in the present material. Minor differences of the mode of septal folding and other test characters are due to the intraspecific variation of this species.

This species somewhat resembles the types of *Pseudofusulina fusiformis* (Schellwien, 1909), but has more prominent axial fillings and more irregular septal foldings. The latter species was designated as the type species of *Leeina* by Galloway (1933) that was eliminated as invalid by Thompson (1964) and later revived as a valid genus by Bensh (1987). Many schwagerinid species with fusiform test in the Cisuralian were reassigned to *Leeina* by Davydov *et al.* (2013). However, generic independency of *Leeina* is highly questionable because *Pseudofusulina fusiformis* is designated as its type species of the genus.

Occurrence and stratigraphic distribution: Common in some samples from the *Carbonoschwagerina morikawai-Jigulites horridus* Zone and rare in few samples from the *Jigulites titanicus-Carbonoschwagerina minatoi* Zone.

Pseudofusulina parasolida **Bensh, 1962**
Pl. XLVIII, figs 13-20

1962. *Pseudofusulina* (?) *parasolida* Bensh, pp. 246-247, pl. 23, figs 1-2.

1972. *Pseudofusulina parasolida* Bensh.– Bensh, pp. 129-130, pl. 28, fig. 8; pl. 29, fig. 1.

Description: Test subcylindrical to elongate fusiform and composed of five and a half to seven whorls. Periphery straight and nearly parallel to axis, lateral sides straight to slightly convex, and poles rounded to bluntly pointed. Length about 9.0 to 13? mm and width about 2.4 to 3.4 mm, giving a form ratio about 3.8 to 4.1.

Proloculus almost spherical and its diameter 0.24 to 0.34 mm. The first whorl subspherical to inflated fusiform and followed by later whorls rather abruptly increasing their form ratios. Degree of sharpness of poles increases gradually outwards and then decreases. Wall thin for the test size, weakly corrugated in specimens, and consists of tectum and finely alveolar keriotheca. Its thickness about 0.05 to 0.08 mm in the last two whorls.

Septa regularly spaced, intensely folded throughout the test, especially in polar regions resulting many loops. Some septal folds reaching the roof of chambers even in the median part of the test. Septal counts from the first to sixth whorl 10 or 12, 23 or 24, 26 or 31, 28 or 33, 33 or 36, and more than 31 or 37, respectively in two sections illustrated. Tunnel low and narrow, and its path not straight in outer part of the test. Chomata rudimentary only on proloculus. Axial fillings well developed and completely filling the polar regions of early and middle whorls.

Remarks: This elongate form of *Pseudofusulina* is different from other species of *Pseudofusulina* from the Wakatakeyama area in its larger and more elongate test, more strongly folded septa, and more well-developed

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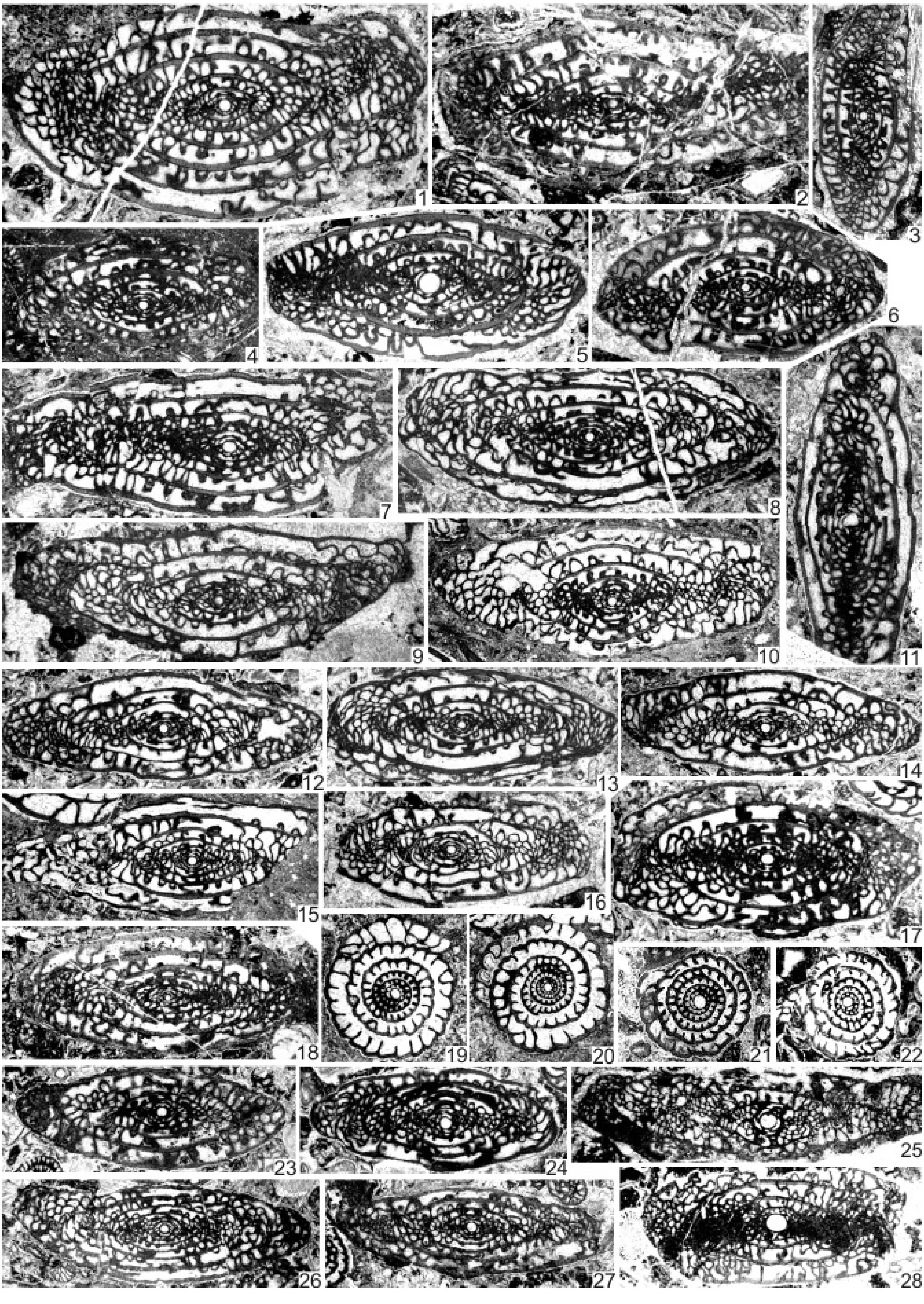
Plate XLVI

Figs 1-2, 3(?), 5-6:	*Daixina* spp. All axial sections. 1: D2-047330, 2: D2-051884, 3: D2-050198, 5: D2-056016, 6: D2-040960. Locality 1: A-100 (lower Asselian), 2: A-317 (upper Gzhelian), 3: A-235 (upper Gzhelian), 5: A-430 (middle Gzhelian), 6: A-26 (upper Gzhelian). All ×10.
Fig. 4:	*Daixina ossinovkensis* Shcherbovich Axial section, D2-055538, A-406 (upper Asselian), ×10.
Figs 7-20:	*Rugosofusulina serrata* Rauzer-Chernousova 7-18: axial sections, 19-20: sagittal sections. 7: D2-052764, 8: D2-047685, 9: D2-052787, 10: D2-041000, 11: D2-047672, 12: D2-047681, 13: D2-047683, 14: D2-047670, 15: D2-041002, 16: D2-040797, 17: D2-047697, 18: D2-050361, 19: D2-041003, 20: D2-041006. Locality 7: A-395a (lower Asselian); 8, 11-14, 17: A-132 (lower Asselian); 9: A-395b (lower Asselian); 10, 15, 19-20: A-27b (lower Asselian); 16: A-22b (lower Asselian); 18: A-241a (lower Asselian). All ×10.
Figs 21-24, 26-27:	*Rugosofusulina prisca* (Ehrenberg) 21-22: sagittal sections; 23-24, 26-27: axial sections. 21: D2-040974, 22: D2-040991, 23: D2-040973, 24: D2-040968, 26: D2-040971, 27: D2-040976. Locality all A-27a (lower Asselian). All ×10.
Fig. 25:	*Rugosofusulina* sp. A Axial section, D2-050190, Locality A-235 (upper Gzhelian), ×10.
Fig. 28:	*Rugosofusulina* sp. B Axial section, D2-052649, Locality A-391 (upper Gzhelian), ×10.

Plate XLVI



loops in polar regions. Based on these characteristic features, the present specimens can be identified with *Pseudofusulina parasolida* by Bensh (1962, 1972) from the Asselian of Fergana. Slight difference between the two is more irregularly folded septa in the former. This species is somewhat similar to *Pseudofusulina hindukushiensis* Leven, 1971 from the Sakmarian of northern Afghanistan (Leven, 1971), but has more regular septal folding and more elongate test. More detailed comparison is difficult on account of few specimens illustrated from Fergana and northern Afghanistan.

Occurrence and stratigraphic distribution: Common in some samples in the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Pseudofusulina sp.
Pl. XLVIII, figs 6-12

1991. *Parafusulina*? *lutugini* (Schellwien).– Watanabe, fig. 8.1-12.

Remarks: This unnamed species resembles *Fusulina lutugini*, described from the *Schwagerina*-Limestone of Arctic Russia by Schellwien (1908) in its elongate test, and the mode of septal folding. However, the former is smaller and not so cylindrical, and has stronger axial fillings than the latter. *Pseudofusulina* sp. is different from *Pseudofusulina parasolida* described above in its regular septal folding, and smaller length of the corresponding outer whorls. Many schwagerinids named as *Schellwienia lutugini* shown in the thin section photograph of Y. Ozawa (1925b, pl. 6, fig. 4) are larger than the types and assumed to be incomplete specimens probably referable to *Parafusulina kaerimizensis* (Y. Ozawa, 1925b) of the Middle Permian age. Twelve specimens of *Parafusulina*? *lutugini* illustrated by Watanabe (1991) have smaller and not so cylindrical test with more pointed poles, and stronger axial filings than the Schellwien's (1908) types. They are closely similar to and not distinguished from this unidentified species of *Pseudofusulina*.

Occurrence and stratigraphic distribution: Common in some samples from the *Sphaeroschwagerina fusiformis-Pseudoschwagerina muongthensis* Zone and rare in few samples from the *Pseudoschwagerina miharanoensis-Paraschwagerina akiyoshiensis* Zone.

Genus *Praeskinnerella* Bensh, 1987

Type species: *Schwagerina guembeli* Dunbar & Skinner, 1937, p. 639.

Praeskinnerella cf. _cushmani_ (Chen, 1934)
Pl. XLVIII, figs 1-4, 5(?)

Compare:
1934. *Pseudofusulina cushmani* Chen, pp. 72-73, pl. 6, figs 4-6.

Remarks: Schwagerinid specimens of surely Artinskian age, whose generic assignment either *Schwagerina* or *Pseudofusulina* is not easy, are provisionally included into *Praeskinnerella* proposed by Bensh (1987). Their specific determination is difficult on account of no axial sections of complete specimens. However, they are comparable to *Pseudofusulina cushmani* from the Lower Permian of Jiangsu, South China (Chen, 1934) from their similar mode of septal folding and axial fillings. Intensity of septal foldings is less remarkable compared with those of the types. This species was transferred to *Praeskinnerella* by Leven (2009, p. 138).

Occurrence and stratigraphic distribution: Common in few samples from the *Paraleeina magna* Zone.

Genus *Paraleeina* Leven in Leven & Mohaddam, 2004

Type species: *Parafusulina postkraffti* Leven, 1967, p. 157.

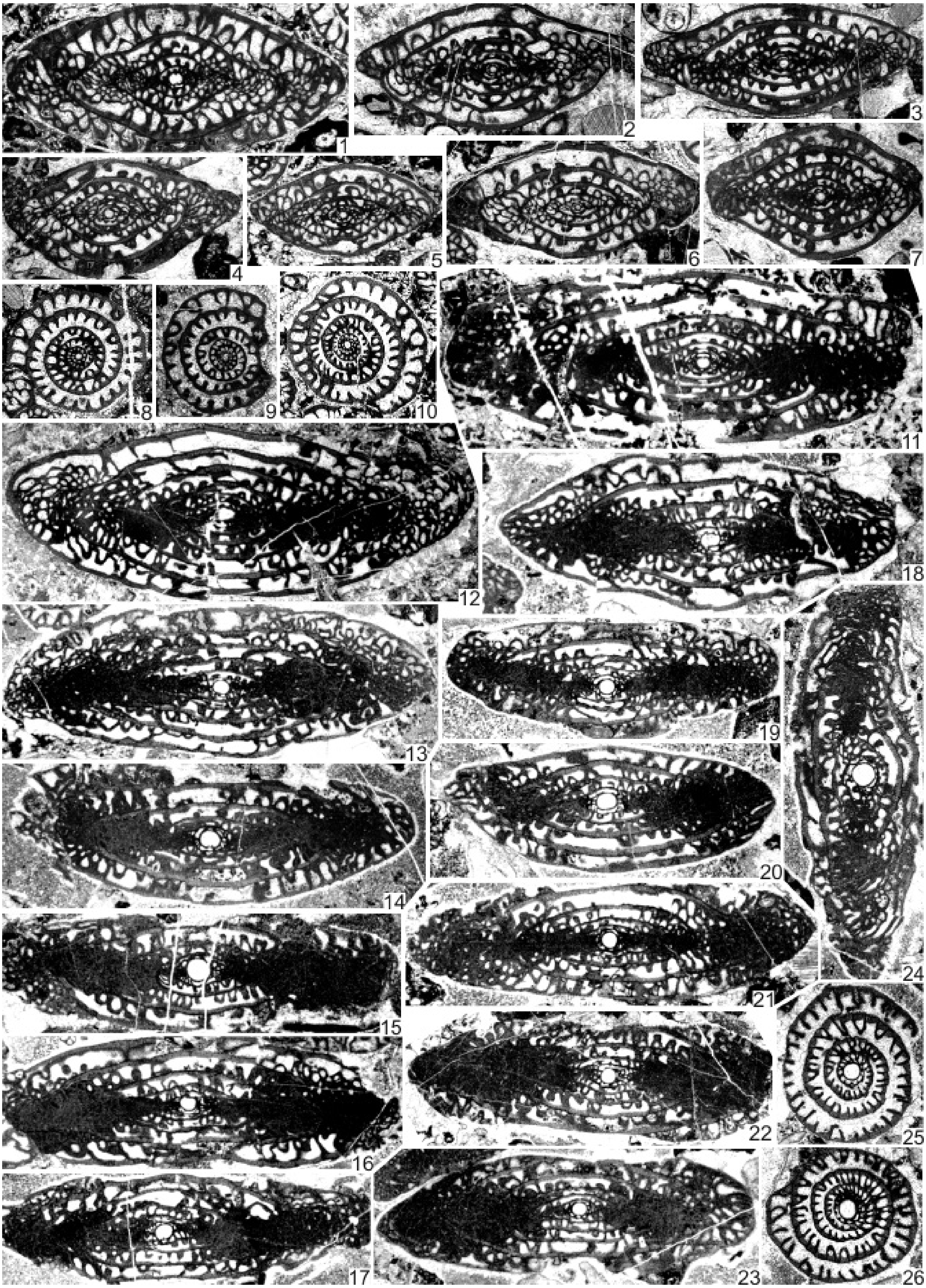
Plate XLVII

Fig. 1: *Chalaroschwagerina* sp. B
Axial section, D2-056815, Locality B-181 (upper Asselian), ×10.

Figs 2-10: *Schwagerina princeps* (Ehrenberg)
2-7: axial sections, 8-10: sagittal sections.
2: D2-056775, 3: D2-056783, 4: D2-056769, 5: D2-056786, 6: D2-056795, 7: D2-056797, 8: D2-056771, 9: D2-056767, 10: D2-056793.
Locality all B-180 (upper Asselian).
All ×10.

Figs 11-26: *Pseudofusulina kumasoana* Kanmera
11-24: axial sections, 25-26: sagittal sections.
11: D-056038, 12: D-040939, 13: D-052721, 14: D-052762, 15: D-052637, 16: D-052719, 17: D-052724, 18: D-052740, 19: D-052734, 20: D-052736, 21: D-052726, 22: D-052641, 23: D-052739, 24: D-052755, 25: D-052733, 26: D-052749.
Locality 11: A-430 (middle Gzhelian); 12: A-25c (middle Gzhelian); 13-14, 16-21, 23-26: A-394 (upper Gzhelian); 15, 22: A-391 (upper Gzhelian).
All ×10.

Plate XLVII



***Paraleeina magna* (Toriyama, 1958)**
Pl. XLIX, figs 24-29

1958. *Pseudofusulina kraffti* var. *magna* Toriyama, pp. 178-181, pl. 25, figs 1-10; pl. 26, figs 1-15.
1961. *Pseudofusulina kraffti magna* Toriyama.– Nogami, pp. 216-217, pl. 10, figs 1-4.
?1967. *Pseudofusulina magna* (Toriyama).– Leven, p. 149, pl. 11, fig. 5 [=*Praeskinnerella magna*, Leven (2009, p. 139, pl. 24, fig. 33)], fig. 6.
1990. *Pseudofusulina kraffti magna* Toriyama.– T. Ozawa & Kobayashi, pl. 8, figs 8-9.

Description: Test rhombohedral to thick fusiform with almost straight to slightly concave periphery, almost straight to slightly convex lateral sides, rounded to broadly rounded poles, and composed of seven to eight whorls. Axis of coiling straight to slightly curved. Length about 5.5 to 8.1 mm and width about 4.0 to 5.3 mm, giving a form ratio about 1.3 to 1.8.

Proloculus spherical to ellipsoidal and its longer diameter 0.31 to 0.54 mm. Inner two to three whorls subspherical to short fusiform with broadly arched periphery and almost rounded poles. Outer whorls tend to be rhombohedral with slightly concave periphery and rounded poles. Wall consists of tectum and keriotheca. Alveolar keriotheca fine in inner whorls then becoming coarser outwards. Thickness of wall in outer one to two whorls about 0.09 to 0.13 mm.

Septa closely spaced and intensely and rather regularly folded throughout the test. Regularity of septal folds is considerably variable from specimen to specimen and some folds reaching the roof of chambers. Cuniculi poorly developed exclusively in outer part of the test in specimens. Septal counts cannot be estimated because of dark calcareous, secondary material in outer whorls in most specimens. Those from the first to fourth whorl 11, 28, 29, and 38? in one section illustrated. Weak phrenothecae partly developed in outer whorls in specimens.

Tunnel low and narrow possibly in all whorls, but its path uncertain due to strongly folded septa and secondary deposits in outer whorls. Chomata not developed except for rudimenrary ones on proloculus. Axial fillings well developed and completely filling the chambers in polar regions of inner and middle whorls.

Remarks: This species is very common in the upper Lower Permian (Artinskian) limestone of the Akiyoshi Terrane (e.g., Toriyama, 1958; Nogami, 1961). The illustrated specimens are certainly identified with the types treated as a variety of *Pseudofusulina kraffti* (Schellwien, 1909) by Toriyama (1958). They show broad morphologic variation in many test characters as easily understood from the specimens illustrated by Toriyama (1958) and Nogami (1961). However, it is questionable that two specimens illustrated by Leven (1967) from the Southeast Pamir are identified with the types, since they have smaller test, smaller length and width of the corresponding whorls.

This species had long been assigned to *Pseudofusulina* until its reassignment to *Praeskinnerella* by Leven (2009). However, it is almost impossible to be reassigned to *Praeskinnerella*, since *Schwagerina guembeli* Dunbar & Skinner, 1937, largely different from *magna*, is designated as the type species of *Praeskinnerella*. In addition, *S. guembeli* is quite different from other five species of *Praeskinnerella* shown by Leven (2009).

This species is supposed to be treated as a species of the genus *Paraleeina* that was proposed by Leven in Leven & Mohaddam (2004) designating *Parafusulina postkraffti* Leven, 1967 as the type species. Because, large test, large proloculus, strong axial fillings, and rather regularly folded septa of this species are more intimate with those of *Paraleeina* than of *Praeskinnerella*. On the other hand, cuniculi, a diagnostic character for the definition of

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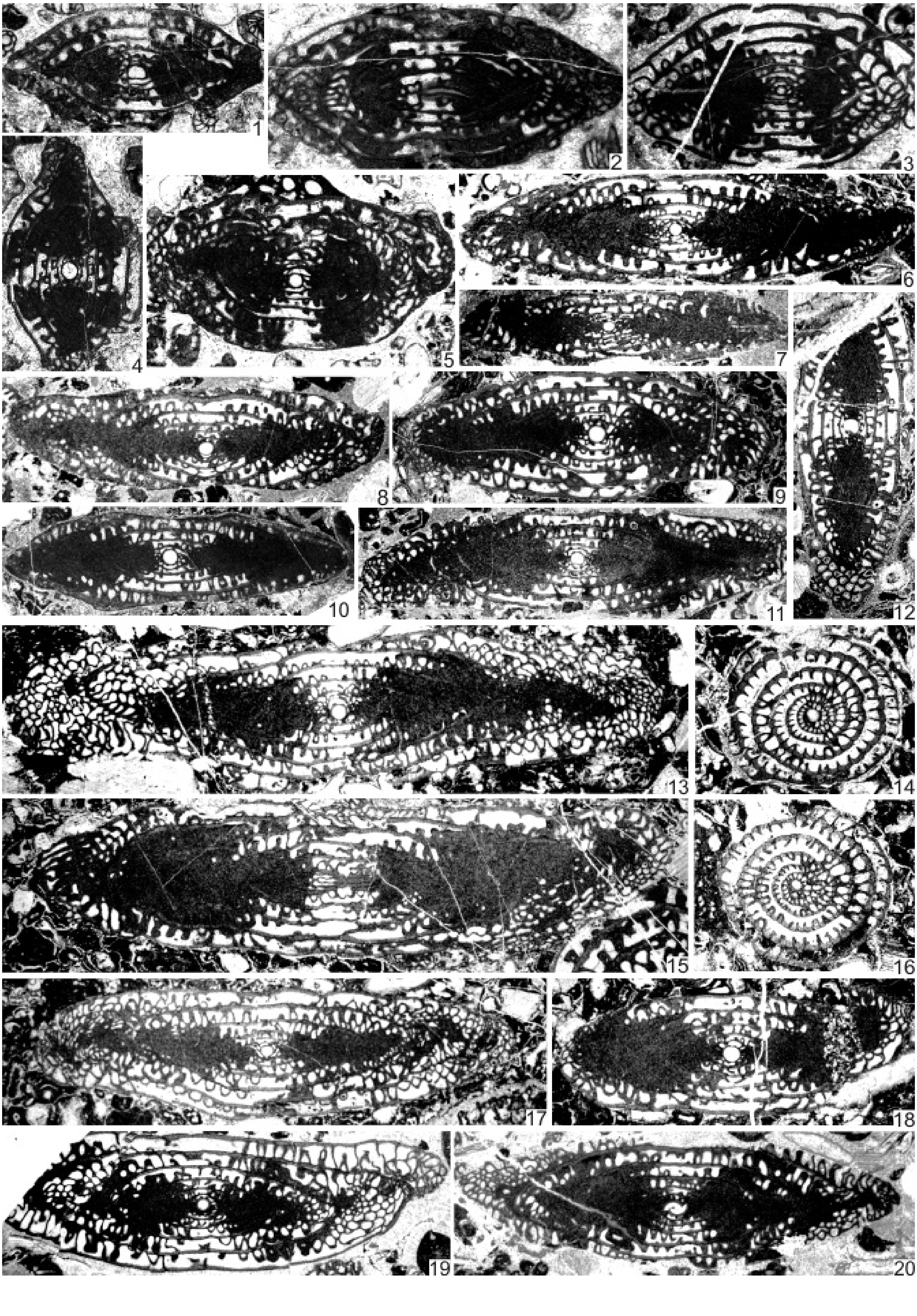
Plate XLVIII

Figs 1-4, 5(?): *Praeskinnerella cushmani* (Chen)
1, 3-5: axial sections; 2: tangential section.
1: D2-056938, 2: D2-056939, 3: D2-056942, 4: D2-056941, 5: D2-056953.
Locality all B-193 (Artinskian).
All ×15.

Figs 6-12: *Pseudofusulina* sp.
6-12: axial sections.
6: D2-052990, 7: D2-052989, 8: D2-052950, 9: D2-055691, 10: D2-052968, 11: D2-052982, 12: D2-053001.
Locality 6-8, 10-12: A-403 (lower Asselian); 9: A-413 (upper Asselian).
All ×10.

Figs 13-20: *Pseudofusulina parasolida* Bensh
13, 17-20: axial sections; 14, 16: sagittal sections; 15: tangential section.
13: D2-055708, 14: D2-055712, 15: D2-055690, 16: D2-055697, 17: D2-055698, 18: D2-055703, 19: D2-055573, 20: D2-055568.
Locality 13, 15-18; A-413 (upper Asselian); 14: A-414 (upper Asselian); 19-20: A-407 (upper Asselian).
All ×10.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Paraleeina, occur poorly in some tangential sections of the topotypes of *P. magna* from Akiyoshi.

Occurrence and stratigraphic distribution: Common to rare in many samples from the *Paraleeina magna* Zone.

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Plate XLIX

Fig. 1: *Dutkevichites* sp.
Tangential section, D2-057247, Locality B-214 (upper Gzhelian), ×20.

Figs 2-8, 11-13: *Biwaella* aff. *omiensis* Morikawa & Isomi
2, 6: tangential sections; 3-5, 8, 13: axial sections; 7, 12: sagittal sections; 11: parallel section.
2: D2-056955a, 3: D2-055587a, 4: D2-056948, 5: D2-056955b, 6: D2-056944, 7: D2-056937, 8: D2-056945, 11: D2-055691, 12: D2-055587b, 13: D2-056912.
Locality 2, 4-8: B-193 (Artinskian); 3, 12: A-408 (upper Asselian); 11: A-413 (upper Asselian); 13: B-191 (Artinskian).
4: ×25, others: ×30.

Figs 9-10: *Mccloudia*? *truncatus* (Chen)
9: axial section, 10: tangential section.
9: D2-057225, 10: D2-057214.
Locality both B-213 (lower Asselian).
Both ×10.

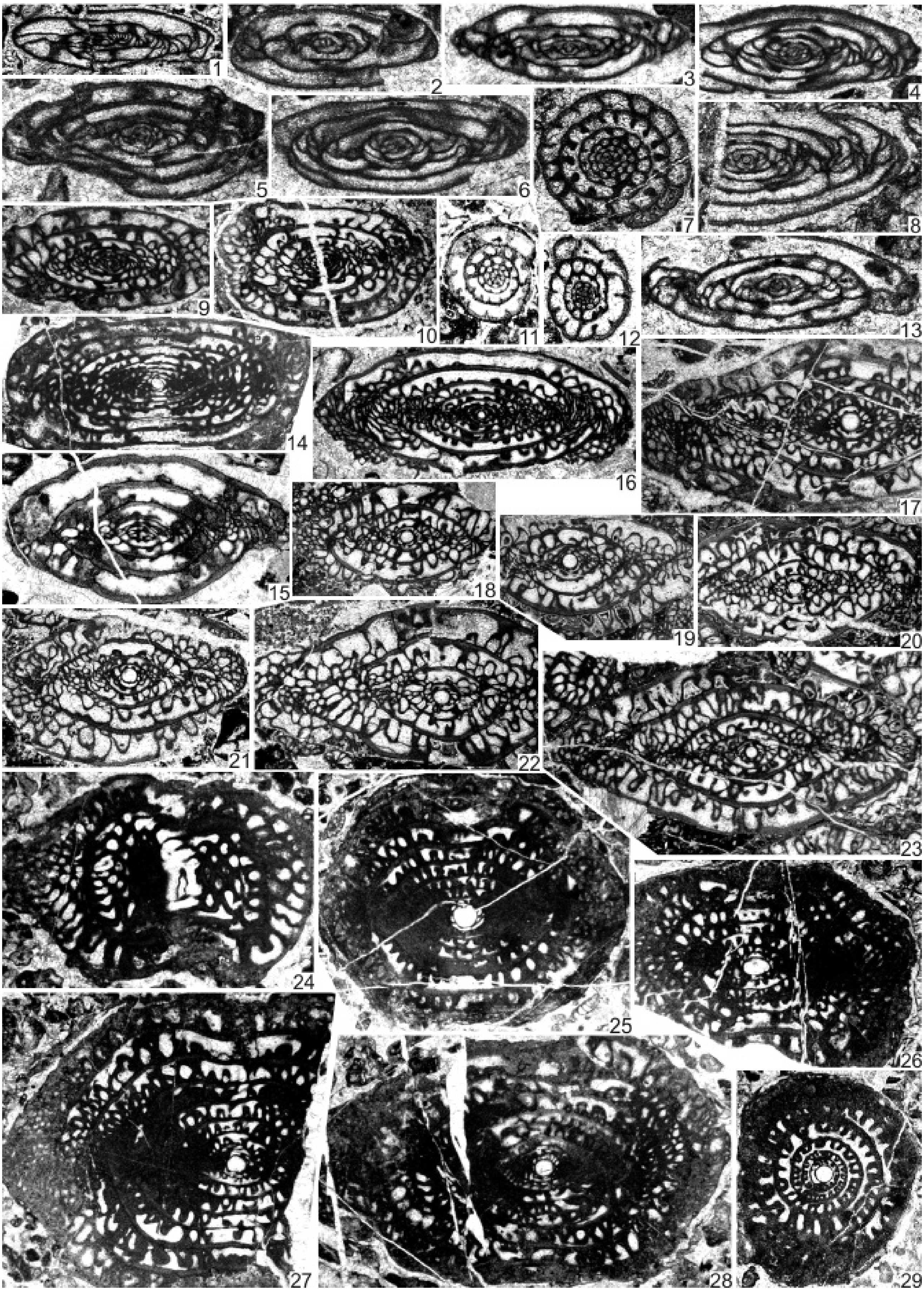
Fig. 14: *Darvasites* aff. *contractus* (Schellwien)
Axial section, D2-056981, Locality B-197 (Artinskian), ×10.

Fig. 15: *Triticites*? cf. *convexus* Bensh
Tangential section, D2-055600, Locality A-409 (upper Asselian), ×15.

Fig. 16: *Darvasites pseudosimplex* (Chen)
Axial section, D2-041471, Locality A-63a (lower Asselian), ×10.

Figs 17-23: *Chalaroschwagerina* sp. B
17-23: axial sections.
17: D2-057162, 18: D2-057142, 19: D2-057157, 20: D2-057160, 21: D2-057147, 22: D2-057154, 23: D2-057148.
Locality 17: B-211 (upper Asselian); 18-23: B-210 (upper Asselian). All ×10.

Figs 24-29: *Paraleeina magna* (Toriyama)
24: tangential section, 25-28: axial sections, 29: sagittal section.
24: D2-056922, 25: D2-056994, 26: D2-056991, 27: D2-056920, 28: D2-056925, 29: D2-056988.
Locality 24, 27-28: B-192 (Artinskian); 25: B-197. All ×10.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fusulinids of the *Schwagerina* Horizon (the group of *Pseudofusulina uralica* Krotow). *Trudy Instituta Geologicheskikh Nauk, Akademiya Nauk SSSR*, 52: 169-191. (in Russian with English summary)

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Supplementary Online Material

Late Carboniferous and Early Permian fusulines of the Akiyoshi Limestone Group in the Wakatakeyama area, Akiyoshi (Japan) – Biostratigraphy, biogeography, and biodiversity

Fumio KOBAYASHI

Appendix Tables

Characters measured that are shown in the appendix table of this paper are the number of whorls, length, width and form ratio of the test, size of proloculus, length, width and number of septa per whorl. An asterisk mark shows the characters that cannot be measured due to abrasion, recrystallization, and/or destruction of the test and/or whorls. Measurement value with a question mark shows the approximate value. Measurement value within a dotted frame shows either the length of the whorl (in the case with decimals) or number of septa (without decimal).

Ozawainella eoangulata **Manukalova**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. I, fig. 45	5.5	0.453	1.331	0.34	0.033	0.045	0.088	0.169	0.273	0.386	0.103	0.210	0.402	0.705	1.121

Eoschuberetella obscura **(Lee & Chen)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	L. whorl/No. septa			Width of whorl		
						1	2	3	1	2	3
Pl. I, fig. 6	2.5	0.254	0.236	1.08	0.087	0.095	1.120		0.014	0.197	
Pl. I, fig. 7	3	0.185	0.267	0.69	0.064	0.067	0.114	0.185	0.085	0.58	0.267
Pl. I, fig. 8	2.8	*	0.291	*	0.071	6	11	10>	0.120	0.206	
Pl. I, fig. 9	3.5	0.494	0.379	1.30	0.053	6	0.223	0.426	0.123	0.191	0.308

***Schubertella donetzica* Putry**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. I, fig. 5	5	0.078	0.326	2.40	0.039	0.040	0.056	0.174	0.420	0.783		0.068	0.117	0.124	0.195	0.181	
Pl. I, fig. 11	5.5	0.970	0.376	2.58	0.028	0.035	0.072	0.208	0.505	0.937		0.058	0.107	0.115	0.196	0.290	
Pl. I, fig. 12	4.5	0.693	0.287	2.41	0.032	0.043	7	0.272	0.476			0.066	0.125	0.154	0.237		
Pl. I, fig. 16	5.1	*	0.421	*	0.036	0.045	7	10	12	13	2>	0.063	0.114	0.172	0.257	0.419	
Pl. I, fig. 17	4.4	*	0.495	*	0.043	0.044	6	10	15	7>		0.084	0.129	0.181	0.345		

***Schubertella kingi* Dunbar & Skinner**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. I, fig. 23	4.5	1.038	0.391	2.65	0.025	0.044?	0.180	0.513	0.848			0.075	0.104	0.194	0.309		
Pl. I, fig. 26	4.5	0.994	0.394	2.52	0.045	0.055	0.170	0.356	0.8122			0.060	0.116	0.190	0.296		
Pl. I, fig. 28	5.6	*	0.395	*	0.032	0.036	8	9	12	13	10>	0.058	0.107	0.170	0.238	0..365	
Pl. I, fig. 29	5.6	*	0.405	*	0.019	0.050	9	12	15	17	10>	0.067	0.098	0.186	0.267	0.400	
Pl. I, fig. 30	4.1	*	0.34?	*	0.042	6	9	13	15	1>		0.091	0.123	0.245	0.34?		

***Schubertella melonica* Dunbar & Skinner**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. I, fig. 24	4.5	0.994	0.491	202	0.044	0.055	0.163	0.469	0.838		0.085	0.120	0.221	0.377	
Pl. I, fig. 32	5	0.61?	0.453	1.3?	0.041	0.051	0.125	0.231	0.415	0.61?	0.074	0.133	0.184	0.284	0.453
Pl. I, fig. 41	4.6	*	0.452	*	0.028	0.047	10	11	14	9>	0.071	0.116	0.182	0.331	

***Reitlingerina preobrajienskyi* (Dutkevich)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. II, fig. 5	6	0.61	0.82	0.74	0.04?	0.06?	0.12	0.19	0.29	0.43	0.61	0.10	0.16?	0.26	0.41?	0.60	0.82

***Reitlingerina* sp. A**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. I, fig. 36	5.5	0.63?	1.30?	0.48?	0.06	0.07	0.13	0.22	0.38	0.56	0.13	0.25	0.46	0.74	1.11
Pl. II, fig. 1	5	0.53	1.08	0.49	0.09	0.11	0.13	0.23	0.36	0.53	0.12	0.21	0.42	0.66	1.08

***Nankinella nagatoensis* Toriyama**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. I, fig. 53	6.5	0.87	1.59?	0.55?	0.06	0.08?	0.14	0.23	0.40	0.60	0.81	0.12	0.24	0.42	0.69	1.06	1.41
Pl. I, fig. 54	6.5	1.22	2.00	0.61	0.06	0.10	0.17	0.30	0.46	0.68	0.98	0.14	0.27	0.51	0.78	1.15	1.72

***Parataffelloides kanmerai* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus.	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. II, fig. 18	6.5	1.29	1.58?	0.82?	0.11	0.16	0.28	0.47	0.59	0.83	1.19			0.20	0.37	0.55	0.78	1.05	1.40?		
Pl. II, fig. 19	6	1.22	1.59	0.77	0.12	0.14	0.27	0.45	0.68	0.93	1.22			0.23	0.37	0.60	0.87	1.15	1.59		
Pl. II, fig. 20	7	1.45	1.65	0.88	0.07	0.11	0.22	0.39	0.60	0.90	1.16	1.45		0.15	0.28	0.45	0.64	0.92	1.20	1.65	
Pl. II, fig. 21	6.5	1.26	1.57	0.80	0.09	0.18	0.30	0.48	0.71	0.94	1.20			0.21	0.33	0.50	0.73	1.02	1.39		
Pl. II, fig. 23	6.5	1.23	1.75	0.70	0.11	0.14	0.28	0.45	0.65	0.93	1.21			0.20	0.33	0.53	0.75	1.11	1.53		
Pl. II, fig. 24	6.5	1.39	1.68	0.83	0.10	0.14?	?	?	0.66?	0.91	1.23			0.21	0.36	0.54	0.79	1.09	1.46		
Pl. II, fig. 25	7	1.32	1.63	0.81	0.12	0.15?	0.22?	0.37	0.55	0.76	1.03	1.32		0.20	0.32	0.47	0.71	0.97	1.31	1.63	
Pl. II, fig. 26	6.5	1.43?	1.77	0.81?	0.12	0.15	0.28	0.43	0.73	1.00	1.29			0.23	0.37	0.56	0.77	1.08	1.50		
Pl. II, fg. 27	6.8	*	1.70	*	0.08	6	10	13?	14?	16?	17	15>		0.19	0.34	0.51	0.77	1.07	1.45		
Pl. II, fig. 28	7.2	*	2.07	*	0.11	5	10	12	14?	16	17	17	5>	0.21	0.39	0.56	0.82	1.14	1.50	1.91	
Pl. II, fig. 31	7.7	*	2.10	*	0.09	6	9	11	15	18	18	19	16>>	0.17	0.31	0.48	0.68	0.98	1.37	1.74	
Pl. II, fig. 32	6.8	*	1.96	*	0.08	6	10	13	14	15	15	13>		0.19	0.34	0.52	0.80	1.17	1.59		

***Staffella subsphaerica* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. III, fig. 13	7.5	1.56	1.73	0.90	0.06	0.08	0.14	0.22	0.42	0.70	0.97	1.30			0.15	0.26	0.42	0.65	0.92	1.21	1.55		
Pl. III, fig. 17	8	1.54	1.67	0.92	0.09	0.11	0.16	0.27	0.45	0.64	0.86	1.18	1.54		0.16	0.28	0.44	0.62	0.80	1.05	1.42	1.67	
Pl. III, fig. 18	9.5	2.6?	2.97?	0.9?	0.10	0.12	0.22	0.36?	0.58?	0.83?	*	*	*	*	0..28	0.47	0.68	0.92	1.21	1.52	1.85?	2.32	*
Pl. III, fig. 22	9	1.73	1.98?	0.87?	0..12	0.12	0.16	0.24	0.40	0.55	0.81	1.11	1.39	1.73	0.20	0.30	0.44	0.63	0.82	1.05	1.33	1.61	1.98?
Pl. III, fig. 23	9	1.68?	2.0?	0.8?	0.07	0.08	0.13	0.23?	0.36?	0.51?	*	*	*	1..68?	0.14	0.27	0.45	0.62?	0.86?	*	*	*	2.0?
Pl. III, fig. 15	9.0	*	2.12?	*	0.07	6	10	14	14	16	18	19?	*	*	0.20	0.32	0.49	0.66	0.89	1.15	1.42	1.79	2.12?

***Staffella*? sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. III, fig. 25	3.5	*	*	*	0.09	0.13	0.28	0.46				0.20	0.34	0.55			
Pl. III, fig. 28	5	1.08	1.42	0.76	0.10	0.11	0.28	0.52	0.80	1.08		0.19	0.37	0.62	0.96	1.42	
Pl. III, fig. 29	5	1.02	1.24	0.82	0.08	0.12	0.18	0.42	0.73	1.02		0.18	0.32	0.53	0.84	1..24	
Pl. III, fig. 30	5	1.06	1.28	0.83	0..11	0.15	0.27	0.53	0.76	1.06		0..20	0.35	0.60	0.91	1.28	
Pl. III, fig. 31	5.2	*	1.16	*	0.08	7	9	14	15	18	4>	0..16	0.30	0.48	1.03		

***Fusulinella biconica* (Hayasaka)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. IV, fig. 1	8.5	3.7?	2.59?	1.4?	0.19	0.34	0.61	0.93	1.43	1.98	2.52	3.12	3.47?		0.30	0.44	0.64	0.90	1.19	1.49	1.96	2.37	
Pl. IV, fig. 2	8	3.68	2.22	1.66	0.13	0.33	0.64	0.99	1.39	1.87	2.48	3.06	3.68		0.23	0.35	0.56	0.80	1.12	1.46	1.81	2.22	
Pl. IV, fig. 3	7.5	3.88	2.18	1.78	0.12	0.27	0.53	0.93	1.43	2.04	2.66	3.24			0.25	0.40	0.61	0.89	1.06	1.63	2.01		
Pl. IV, fig. 4	8	3.7?	2.20	1.7?	0.16	0.32	0.58	0.95	1.43	1.94	2.59	3.15	3.7?		0.23	0.36	0.55	0.76	1.07	1.41	1.80	2.20	
Pl. IV, fig. 6	8	3.43?	2.65?	1.29?	0.07	8	0.39	0.73	1.08	1.52	2.09	2.74	3.43?		0.17	0.32	0.49	0.76	1.12	1..48	2.09	2.65?	
Pl.. IV, fig. 7	7	3.23	2.02	1.60	0.08	6	0.39	0.66	1.30	1.96	2.57	3.23			0.19	0.30	0.50	0.77	1..17	1.65	2.02		
Pl. IV, fig. 9	7	2.68	1.91	1.40	0.13	0.19	0.33	0.65	1.07	1.60	2.18	2.68			0.19	0.33	0.48	0.72	1.09	1.54	1.91		
Pl. IV, fig. 10	7	2.9?	1.62	1.8?	0.13	0.30	0.56	0.89	1.39	1.87	2.37	2.9?			0.19	0.30	0.47	0.69	0.99	1.29	1.62		
Pl. IV, fig. 11	7	2.86	1.96	1.46	0.14	0.25	0.45	0.76	1.11	1.53	2.15	2.86			0.23	0.34	0.52	0.77	1.10	1.53	1.96		
Pl. IV, fig. 13	7.5	3.0?	2.27?	1.3?	0.13	0.27	0.50	0.82	1.27	1.85	2.33	2.90			0.22	0.35	0.53	0.80	1.16	1.55	2.04		
Pl. IV, fig. 14	7.4	*	2.01	*	0.09	7	12	15	17	24	25	24	10>		0.20	0.32	0.57	0.81	1.09	1.43	1.87		
Pl. IV, fig. 15	8.6	*	2.75	*	0.13	8	13	17	20	19	23	30	32	22>	0.22	0.39	0.59	0.85	1.22	1.57	2.01	2.54	
Pl. IV, fig. 17	8.4	*	2.35	*	0.11	7	12	15	18	21	22	24	29	13>	0.22	0.34	0.48	0.73	0.99	1.32	1.72	2.14	
Pl. IV, fig. 19	7.2	*	1.90	*	0.12	8	12	14	16	18	22	24	4>		0.19	0.35	0.53	0.74	1.03	1.46	1.82		
Pl. IV, fig. 20	7.3	*	2.37	*	0.14	7	13	16	20	24	23	27	9>		0.26	0.48	0.74	1.02	1.33	1.82	2.32		

Fusulinellla bocki **von Möller**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. IV, fig. 21	6.5	2.5?	1.34	1.9?	0.08	0.08	0.15	?	?	?	?	0.14	0.22	0.37	0.54	0.82	1.23
Pl. IV, fig. 24	5	*	*	*	0.07	8	0.29	0.55	0.98	1.48		0.13	0.22	0.36	0.59	0.85	
Pl. IV, fig. 25	5.5	*	*	*	0.08	0.11	0.28	0.61	1.03	1.52		0.14	0.24	0.32	0.56	0.89	

Fusulinella pseudobocki **Lee & Chen**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. V, fig. 1	7	4.44	2.01?	2.21?	0.10?	0.19?	0.35	0.66	1.18	2.00	3.22	4.44	0.14?	0.26	0.40	0.65	0.99	1.53	2.01?

Moellerites paracolaniae **(Safonova)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. V, fig. 24	6	3.20	1.01	3.17	0.06	0.08	0.17	0.49	1.11	1.63	3.20		0.12	0.19	0.27	0.42	0.64	1.01	
Pl. V, fig. 32	6.5	3.9?	1.28	3.0?	0.05	8	0.23	0.62	1.25	2.08	?		0.12	0.21	0.32	0.49	0.72	1.06	
Pl. V, fig. 33	5..5	3.49	1.15	3.03	0.06	0.13	0.32	0.77	1.42	2.43			0.15	0.25	0.39	0.60	0.91		
Pl. V, fig. 31	6.2	*	1.32	*	0.07	6	10	11	13	16	16	4>	0.15	0.26	0.37	0.56	0.89	1.24	

Kanmeraia **aff. *itoi* (Y. Ozawa)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. VI, fig. 3	7	3.62	2.04	1.77	0.11	0.29	0.65	1.05	1.71	2.35	2.99	3.62	0.21	0.35	0.56	0.81	1.15	1.54	2.04

***Kanmeraia itoi* (Y. Ozawa)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. VI, fig. 4	7	2.50	1.40	1.79	0.06	0.11	0.25	0.58	0.97	1.55	2.03	2.50			0.13	0.21	0.33	0.54	0.80	1.06	1.40		
Pl. VI, fig. 6	7.5	3.17?	1.70?	1.86?	0.08	0.23	0.43	0.72	1.11	1.57	2.28	2.92			0.15	0.24	0.39	0.57	0.82	1.11	1.55		
Pl. VI, fig. 7	9	3.83?	2.35	1.63?	0.07	0.12	0.27	0.49	1.03	1.39	2.00	2.50	3.27	3.83?	0.12	0.20	0.32	0.53	0.77	1.08	1.52	1.95	2.35
Pl. VI, fig. 9	8	3.39	2.13	1.59	0.07	0.10	0.27	0.58	0.96	1.49	2.07	2.35	3.39		0.13	0.21	0.34	0.55	0.82	1.19	1.61	2.13	
Pl. VI, fig. 12	7.5	3.45	1.68	2.05	0.08	0.17	0.32	0.64	1.08	1.59	2.30	3.01			0.12	0.20	0.31	0.45	0.69	1.07	1.45		
Pl. VI, fig. 14	7.5	3.12	1.73	1.80	0.07	0.11	0.35	0.55	0.93	1.38	2.07	2.70			0.13	0.18	0.25	0.46	0.74	1.03	1.43		
Pl. VI, fig. 15	7	2.96	1.49	2.00	0.06	0.13	0.33	0.60	1.01	1.45	2.34	2.96			0.15	0.22	0.36	0.55	0.77	1.08	1.49		
Pl. VI, fig. 17	6.5	2.86	1.59	1.80	0.11	0.30	0.59	0.90	1.37	1.91	2.36				0.19	0.30	0.53	0.71	0.99	1.33			
Pl. VI, fig. 18	7	?	1.82?	*	0.11	0.33	0.60	0.94	1.15	1.64	2.29	?			0.16	0.29	0.46	0.72	1.06	1.40	1.82?		
Pl. VI, fig. 24	7.5	2.7?	1.53	1.8?	0.06	0.10	0.32	0.60	0.88	1.37	1.98	2.46			0.13	0.19	0.30	0.51	0.69	0.98	1.38		
Pl. VI, fig. 25	8.5	3.4?	1.83?	1.9?	0.05	0.09	0.26	0.54	0.82	1.31	1.82	2.30	3.00		0.11	0.15	0.28	0.42	0.65	0.93	1.32	1.65	
Pl. VI, fig. 32	6.5	*	*	*	0.07	0.16	0.32	0.68	1.18	1.67	2.28				0.13	0.23	0.36	0.55	0.83	1.24			
Pl. VI, fig. 27	7.1	*	1.85	*	0.08	6	12	16	22	26	28	4>			0.17	0.31	0.57	0.83	1.14	1.50	1.84		
Pl. VI, fig. 29	6.2	*	1.66	*	0.10	9	13	16	24	29?	7>				0.19	0.27	0.54	0.86	1.15	1.47			
Pl. VI, fig. 30	6.7	*	1.82	*	0.08	7	12	17	22	26	30?	?			0.18	0.33	0.54	0.86	1.20	1.57			

***Kanmeraia pulchra* (Rauzer-Chernousova & Belyaev)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. VII, fig. 7	7.5	4.44	1.87?	2.37?	0.10	0.22	0.42	0.80	1.29	1.97	2.90	3.81	0.15	0.27	0.41	0.64	0.90	1.19	1.68
Pl. VII, fig. 10	7	3.35	1.47	2.28	0.10	0.23	0.45	0.82	1.28	1.87	2.55	3.35	0.14	0.25	0.39	0.61	0.86	1.14	1.47
Pl. VII, fig. 11	7.5	4.47?	1.80	2.48?	0.09	0.23	0.46	0.96	1.45	2.23	3.17	3.90?	0.15	0.24	0.37	0.56	0.80	1.15	1.57
Pl. VII, fig. 6	6.6	*	1.60	*	0.10	9	15	19	23	25	26	16>	0.20	0.32	0.52	0.77	1.05	1.42	

***Beedeina akiyoshiensis* (Toriyama)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. VII, fig. 1	8	4.33?	2.70?	1..60?	0.19	0.37	0.64	1.06	1.36	2.16	2.92	3.75	4.33?	0.30	0.49	0.72	1.01	1.36	1.78	2.31	2.70?
Pl. VII, fig. 2	8	3.83?	2.87?	1.33?	0.20	0.45	0.76	1.09	1.58	2.11	2.77	3.40	3.83?	0.29	0.45	0.67	0.97	1.35	1.90	2.38	2.87?
Pl. VII, fig. 4	8.5	5.40	2.82?	1.91?	0.13	0.26	0.55	0.90	1.40	1.94	2.76	3.68	4.73	0.21	0.30	0.46	0.70	1.07	1.50	2.61	
Pl. VII, fig. 5	8.5	*	2.83	*	0.15	0.35	0.54	0.84	1.22	1.61	*	*	*	0.22	0.33	0.51	0.73	1.11	1.58	2.09	2.58

Quasifusulina longissima **(von Möller)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. XI, fig. 29	5.5	7.96?	1.98	4.02?	0.29	0.84	1.85	3.20	5.08	7.30	0.44	0.63	0.92	1.28	1.74
Pl. XI, fig. 36	5>	*	*	*	0.25	0.76	1.67	2.56	4.55	5.85?	0.36	0.54	0.78	1.09	1.47
Pl. XI, fig. 30	5.5	*	1.75	*	0.19	9	18	22	25	29?	0.33	0.49	0.76	1.08	1.55

Quasifusulinoides ohtanii (**Kanmera)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. VII, fig. 17	7	6.8>	2.30?	*	0.18	0.51	1.04	1.85	2.86	3.88	5.33	6.5>			0.31	0.49	0.69	0.97	1.36	1.91	2.30		
Pl. VII, fig. 18	6.5	*	*	*	0.18	0.48	0.85	1.59	2.41	3.50	4.23?				0.30	0.42	0.60	0.85	1.28	1.74			
Pl. VII, fig. 21	7	5.17?	2.32	2.23?	0.21	0.45	0.83	1.53	2.26	3.14	4.06	5.17?			0.33	0.44	0.68	0.93	1.30	1.81	2.32		
Pl. VII, fig. 25	6	6.8?	2..6?	2.6?	0.35	0.63	1.35?	*	*	*	*				0.39	0.61	0.98	1.42	2.01	2.6?			
Pl. VIII, fig. 2	9	5.1?	2.2?	2.3?	0.03	0.05	0.16	0.39	0.58	?	2.7?	3.42	4.28	5.1?	0.09	0.10	0.18	0.29	0.57	0.93	1.29	1.76	2.2?
Pl. VIII, fig. 3	6.5	6..6?	2.58?	2.6?	0.29	0.71	1.17	2.01	3.09	4.27	5.65				0.40	0.59	0.86	1.27	1.98	2.37			
Pl. VIII, fig. 5	5.5	5.6>	2.31	*	0.37	0.74	1.26	2.22	3.36	4.67					0.48	0.82	1.08	1.49	2.01				
Pl. VIII, fig. 7	6	5..36	2.60?	2.06?	0.31	0.76	1.37	2.04	3.09	4.22	5.36				0.38	0.61	1.03	1.50	2.04	2.60?			
Pl. VII, fig. 20	4.8	*	*	*	0.35	14?	20	29	32	?					0.48	0.72	1.09	1.56					
Pl. VIII, fig.11	6.2	*	2.6?	*	0.28	12	19	28	33	38	49	?			0.44	0.65	0.99	1.40	1.37	2.31			
Pl. VIII, fig. 21	5.9	*	2.28	*	0.21	11	16	22	27	33	38>				0.37	0.61	0.94	1.44	1.95				

Quasifusulinoides grandis **n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. VIII, fig. 14	7	9.0>	3.45?	*	0.41	0.85	1.79	3.09	4.39	*	*	*	0.51	0.79	1.14	1.63	2.17	2.84	3.45?
Pl. VIII, fig. 15	7	9.2?	3.25?	2.8?	0.42	0.74	1.49	2.52	3.62	4.81	7.29	9.2?	0.49	0.86	1.11	1.55	2.07	2.68?	3.25?
Pl. VIII, fig. 16	5>	*	*	*	0.40	1.07	1.91	3..23	4.41	*			0.58	0.88	1.26	1.75	2.28		
Pl. VIII, fig. 20	6>	*	*	*	0.38	0.68	1.29	2.10	3.15	4.19	5.44		0.52	0.74	1.06	1.52	2.04	2.6?	
Pl. VIII, fig. 18	6.6	*	*	*	0.36	14	26	29	37?	41?	?	?	0.58	0.85	1.26	1.76	2.34	2.88	
Pl. VIII, fig. 22	5.7	*	2.91	*	0.29	12	20	24	27	31	28>		0.50	0.87	1.18	1.08	2.30		

***Obsoletes obsoletus* (Schellwien)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. IX, fig. 2	5.5	3.46	1.19	2.91	0.09	0.23	0.42	0.90	1.76	2.93		0.15	0.23	0.36	0.59	0.94	
Pl. IX, fig. 4	6	3.72	1.19	3.13	0.08	0.11	0.27	0.52	1.17	2.23	3.72	0.13	0.16	0.27	0.44	0.75	1.19

***Obsoletes burkemensis* Volozanina**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. IX, fig. 3	5.5	*	1.08	*	0.07	0.20	0.42	0.87	1.61	2.05			0.11	0.24	0.37	0.58	0.88		
Pl. IX, fig. 5	5.5	3.34?	1.20	2.78?	0.09	0.17	0.50	0.97	1.77	3.05			0.12	0.24	0.41	0.67	1.02		
Pl. IX, fig. 8	5	2.80	0.92	3.04	0.08	0.10	0.49	1.06	1.92	2.80			0.14	0.22	0.36	0.59	0.92		
Pl. IX, fig. 9	6	2.9?	1..15	2.5?	0.09	0.20	0.41	0.83	1.47	2.09	2.9?		0.16	0.23	0.36	0.56	0.80	1.15	
Pl. IX, fig. 7	5.1	*	0.99	*	0.07	8	12	13	12	17	3>		0.19	0.29	0.44	0.67	0.99		
Pl. IX, fig. 12	6.4	*	1.41	*	0.05	8	12	14	14	18	18	9>	0.13	0.21	0.33	0.57	0.89	1.24	

***Protriticites variabilis* Bensh**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. IX, fig. 18	6.5	4.34	1.49	2.91	0.10	0.23	0.50	0.96	1.53	2.44	3.43		0.15	0.25	0.37	0.59	0.83	1.27	
Pl. IX, fig. 19	6	3.72	1.42	2.62	0.10	0.21	0.44	0.86	1.43	2..38	3.72		0.15	0.23	0.36	0.57	0.95	1.42	
Pl. IX, fig. 20	6	3.30?	1.23	2.68?	0.09	0.16	0.30	0.78	1.40	2.35	3.30?		0.11	0.19	0.31	0.50	0.81	1.23	
Pl. IX, fig. 21	7	4.25?	1.62	2.62?	0.09	0.14	0.29	0.65	1.09	1.91	3.15	4.25?	0.13	0.18	0.28	0.49	0.76	1.09	1.62
Pl. IX, fig. 22	6	3.37?	1.32	2.55?	0.10	0..20	0.32	0.81	1.49	2.30	3.37?		0.14	0.20	0.33	0.52	0.83	1.32	
Pl. IX, fig. 30	5.6	*	1.28	*	0.08	10	12	15	16	19	10>		0.12	0.25	0.42	0.63	0.93		
Pl. IX, fig. 33	6.7	*	1.50	*	0.08	9	12	14	16	18	21	16>	0.16	0.27	0.42	0.64	0.95	1.42	

Protriticites subschwagerinoides **Rozovskaya**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. IX, fig. 34	6.5	3.23	1.46	2.21	0.07	0.16	0.32	0.62	1.20	1.88	2.95		0.11	0.20	0.32	0.53	0.80	1.23	
Pl. IX, fig. 35	6	3.37?	1.49	2.26?	0.08	7	0.36	0.68	1.43	2.53	3.37?		0.16	0.23	0.39	0.62	0.99	1.49	
Pl. IX, fig. 36	6.5	2.97?	1.45	2.05?	0.07	0.14	0.33	0.63	1.09	1.92	2.75?		0.14	0.21	0.33	0.54	0.80	1.17	
Pl. IX, fig. 39	6	2.90	1.48	1.96	0.09	0.18	0.37	0.74	1.37	2.14	2.90		0.16	0.26	0.42	0.69	1.06	1.48	
Pl. IX, fig. 42	5.5	2.45	1.10	2.23	0.09	0.18	0.38	0.75	1.29	2..12			0.15	0.23	0.30	0.57	0.91		
Pl. IX, fig. 43	6.5	3.31	1.34	2.47	0.06	0.16	0.37	0.66	1.10	1.75	2.93		0.16	0.23	0.35	0.52	0.78	1.15	
Pl. IX, fig. 44	4>	*	*	*	0.19	0.50	0.85	1.53	2.57				0.28	0.45	0.70	1.07			
Pl. IX, fig. 45	6	2.99	1.19	2.51	0.06	0.16	0.34	0.65	1.65	2.04	2.99		0.12	0.20	0.31	0.51	0.78	1.19	
Pl. X, fig. 3	6	2.95	1.36	2.17	0.07	0.20	0.38	0.71	1.23	1.87	2.95		0.14	0.22	0.36	0.56	0.88	1.36	
Pl. X, fig. 4	6	2.62	1.31	2.00	0.07	0.19	0.30	0.60	1.09	1.69	2.62		0.13	0.22	0.34	0.53	0.89	1.31	
Pl. X, fig. 6	5.5	2.64	1.19	2.22	0.08	0.20	0.37	0.67	1.24	1.85			0.15	0.22	0.36	0.61	0.92		
Pl. X, fig. 8	6	3.02	1.27	2.38	0.07	0.19	0.33	0.73	1.25	2.08	3.02		0.14	0.22	0.36	0.57	0.85	1.27	
Pl. X, fig. 10	6	2.87	1.25	2.30	0.09	0.19	0.37	0.41	1.20	2.06	2.87		0.15	0.22	0.36	0.55	0.86	1.25	
Pl. X, fig. 12	5.5	2.87	1.17	2.45	0.07	0.15	0.37	0.79	1.48	2.23			0.14	0.23	0.37	0.59	0.94		
Pl. X, fig. 1	5.8	*	1.39	*	0.09	8	13	15	18	18	15>		0.18	0.25	0.40	0.97	1.02		
Pl. X, fig. 11	6.1	*	1.75	*	0.08	8	12	13	17	18	22	2>	0.17	0.27	0.43	0.70	1.13	1.74	
Pl. X, fig. 17	5.9	*	1.28	*	0.06	7	11	13	15	17>			0.13	0.20	0.32	0.52	0.80		

Montiparus montiparus **(von Möller)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. X, fig. 18	6.5	*	1.37	*	0.05	0.09	0.24	0.63	0.92	1.38	2.07		0.08	0.13	0.24	0.41	0.69	1.12	
Pl. X, fig. 19	6	2.76	1.37	2.01	0.08	0.15	0.35	0.78	1.32	2.01	2.76		0.12	0.24	0.30	0.56	0.90	1.37	
Pl. X, fig. 20	7	3.14	1.74	1.80	0.06	0.16	0.34	0.65	1.10	1.47	2.43	3.14	0.11	0.18	0.29	0.50	0.79	1.21	1.74
Pl. X, fig. 21	7	2.68	1.60	1.68	0.07	0.15	0.33	0.58	0.99	1.53	2.25	2.68	0.12	0.19	0.30	0.51	0.80	1.18	1.60
Pl. X, fig. 22	6.5	2.80?	1.43?	1.96?	0.06	0.14	0.26	0.62	1.18	1.90	2.58		0.10	0.17	0.28	0.49	0.81	1.23	

Montiparus umbonoplicatus **(Rauzer-Chernousova & Belyaev)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. X, fig. 24	6	3.90	1.64	2.38	0.14	0.24	0.48	0.80	1.27	2.20	3.90		0.21	0.32	0.50	0.75	1.16	1.64	
Pl. X, fig. 25	6>	3.37	*	*	0.12	0.23	0.46	0.72	1.20	2.03	3.01		0.19	0.30	0.47	0.71	1.04	1.51	
Pl. X, fig. 26	6.5	4.33?	1.67	2.59?	0.10	0.22	0.42	0.95	1.57	2.35	3.60		0.17	0.27	0.43	0.68	1.00	1.43	
Pl. X, fig. 29	6.5	3.43	1.52	2.26	0.09	0.23	0.43	0.65	1.22	1.93	3.11		0.13	0.22	0.30	0.54	0.79	1.25	
Pl. X, fig. 30	6.8	*	2.01	*	0.10	8	14	16	19	19	20	17>	0.22	0.34	0.54	0.77	1.16	1.95	
Pl. X, fig. 33	6.4	*	1.61	*	0.09	8	11	14	15	20	22	9>	0.23	0.29	0.41	0.70	1.00	1.45	
Pl. X, fig. 34	6.4	*	1.63?	*	0.09	8	11	16	18	21	25	13>	0.16	0.27	0.44	0.69	1.03	1.45	
Pl. X, fig. 35	6.0	*	1.47	*	0.12	9	11	15	18	20	23								

Montiparus matsumotoi **(Kanmera)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XI, fig. 1	6	*	1.67	*	0.12	0.22	0.57	1.02	1.72	2.38			0.19	0.31	0.48	0.78	1.16	1.67	
Pl. XI, fig. 2	6	2.6?	1.44	1.8?	0.09	6	0.40	0.74	1.33	2.11	2.6?		0.18	0.26	0.43	0.67	0.97	1.44	
Pl. XI, fig. 5	6.5	*	1.50	*	0.09	0.18	0.42	0.75	1.23	1.91	2..50?		0.14	0.23	0.36	0.60	0.92	1.31	
Pl. XI, fig. 7	7	*	1.80?	*	0.11	0.15	0.30	0.66	1.22	1.93	2.93?		0.13	0.20	0.35	0.60	0.93	1.45	1.80?
Pl. XI, fig. 11	7	3.07?	1..75?	1.75?	0.05	9	0.24	0.59	1.07	1.54	2.41	3.07?	0.12	0.19	0.32	0.55	0.84	1.31	1.75?
Pl. XI, fig. 12	7	*	1.78	*	0.09	7	0..38	0.77	1.21	1.92	2.92		0.13	0.22	0.36	0.57	0.89	1.28	1.78
Pl. XI, fig. 13	7	4.0>	1.78?	*	0.09	0.20	0.54	0.94	1.50	2.28	3.40	4.0>	0.14	0.23	0.38	0.59	0.90	1.32	1.78?
Pl. XI, fig. 17	6	2.80	1.29	2.17	0.08	0.14	0.41	0.82	1.32	1.90	2.80		0.14	0.22	0.37	0.59	0.86	1.29	
Pl. XI, fig. 20	6	3.29	1.06	3.10	0.07	0.16	0.35	0.73	1.39	2.24	3.29		0.13	0.18	0.29	0.50	0.78	1.06	
Pl. XI, fig. 21	5.5	2.95	1.27	2.32	0.09	0.22	0.30	0.89	1.63	2.41			0.16	0.28	0.44	0.70	1.06		
Pl. XI, fig. 10	5.9	*	1.29	*	0.08	8	10	11	14	17	19>		0.13	0.21	0.36	0.60	0.97		
Pl. XI, fig. 14	6.3	*	1.43	*	0.07	7	11	15	18	20	22	8>	0.15	0.24	0.39	0.61	0.90	1.24	
Pl. XI, fig. 19	5.5	*	1.50	*	0.09	9	11	14	16	19	10>		0.20	0.32	0.60	0.93	1.29		
Pl. XI, fig. 22	5.7	*	1.49	*	0.12	7	11	13	15	19	18>		0.20	0.32	0.56	0.89	1.32		
Pl. XI, fig. 23	6.7	*	1.81	*	0.06	8	10	12	15	19	22	18>	0.12	0.19	0.40	0.52	0.90	1.40	

***Montiparus minensis* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XII, fig. 1	6	5.19	2.23	2.32	0.15	0.40	0.74	1.27	2.15	3.65	5.19	0.22	0.35	0.58	0.98	1.59	2.23
Pl. XII, fig. 5	5.5	4.97	1.82	2.73	0.13	0.29	0.60	1.22	2.38	3.79		0.21	0.34	0.59	0.93	1.20	
Pl. XII, fig. 8	5.5	4.30	2.08	2.07	0.21	0.34	0.95	1.49	2.63	3.92		0.27	0.42	0.62	1.02	1.73	
Pl. XII, fig. 9	5.5	4.71	1.98	2.38	0.17	0.27	0.76	1.58	2.59	3.91		0.23	0.35	0.58	0.96	1.54	
Pl. XII, fig. 17	5	4.36	1.81	2.41	0.12	0.46	0.90	1.60	2.82	4.36		0.22	0.33	0.67	1.15	1.81	
Pl. XII, fig. 18	5	4.34	1.77	2.45	0.12	0.39	0.61	1.45	2.59	4.34		0.19	0.32	0.57	1.05	1.77	
Pl. XII, fig. 20	4.5	3.72	1.65	2.25	0.18	0.37	0.78	1.61	2.36			0.24	0.44	0.80	1.36		
Pl. XII, fig. 21	5.5	4.08?	2.05	1.99?	0.13	0.27	0.58	1.02	2.24	3.65		0.19	0.29	0.51	0.92	1.60	
Pl. XII, fig. 26	5	4.09	1.80	2.27	0.12	0.31	0.77	1.58	2.99	4.09		0.18	0.32	0.61	1.09	1.80	
Pl. XII, fig. 27	5>	*	*	*	0.17	0.37	0.85	1.75	2.82	4.29		0.25	0.39	0.63	1.07	1.67	
Pl. XII, fig. 31	5	3.97	1.67	2.38	0.15	0.34	0.74	1.35	2.43	3.97		0.23	0.37	0.62	0.99	1.67	
Pl. XII, fig. 32	5.5	4.15?	1.83	2.27?	0.18	0.39	0.76	1.31	2.36	3.90		0.23	0.34	0.55	1.48	1.56	
Pl. XII, fig. 13	5	*	2.24	*	0.18	9	16	17	19	27		0.31	0.52	0.85	1.48	2.24	
Pl. XII, fig. 14	5.3	*	2.08	*	0.15	6	12	14	15	14	7>	0.26	0.40	0.60	1.01	1.70	

***Carbonoschwagerina nakazawai* (Nogami)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XII, fig. 39	6.5	*	*	*	0.11	0.19	0.35	1.21	2.12	3.29	4.6?			0.16	0.25	0.46	0.94	1.64	2.47		
Pl. XII, fig. 40	6>	*	*	*	0.09	0.20	0.47	0.92	1.98	3.38	4.59			0.15	0.23	0.39	0.70	1.37	2.28		
Pl. XII, fig. 41	7	5.4?	2.42	2.2?	0.08	0.15	0.46	0.71	1.45	2.33	3.93	5.4?		0.16	0.18	0.38	0.64	1.03	1.73	2.42	
Pl. XII, fig. 42	6.5	5.84	2.46	2.37	0.09	0.21	0.44	0.91	1.91	3.10	5.18			0.18	0.24	0.44	0.77	1.27	2.03		
Pl. XII, fig. 43	6	*	2.16	*	0.07	0.18	0.41	0.88	1.60	3.09	*			0.15	0.21	0.40	0.74	1.35	2.16		
Pl. XIII, fig. 21	6.5	5.8?	2.58	2.2?	0.14	0.28	0.67	1.40	2.44	3.59	5.21			0.17	0.30	0.53	0.98	1.63	2..47		
Pl. XIII, fig. 22	6.5	*	2.87	*	0.11	0.24	0.54	1.10	1.88	3.12	5.40			0.23	0.31	0.49	0.83	1.47	2.38		
Pl. XIII, fig. 23	7	5.43?	2.97	1..83?	0.15	0.30	0.64	1.22	1.89	3.00	4.49	5.43?		0.17	0.28	0.45	0.71	1..19	1.91	2.72	
Pl. XIII, fig. 26	7	*	2.48	*	0.09	0.28	0.55	0.98	1.75	2.82	3.93	*		0.18	0.24	0.38	0.65	1.18	1.85	2.48	
Pl. XIII, fig. 27	6	5.09	2.77	2.24	0.10	0.25	0.58	0.97	1.88	3.45	5.09			0.17	0.25	0.40	0.67	1.32	2.77		
Pl. XIII, fig. 30	6.5	5.90	2.66	2.22	0.14	0.35	0.61	1.16	1.46	3.47	5.30			0.19	0.29	0.45	0.81	1.35	2.22		
Pl. XIV, fig. 1	6.5	4.47?	2.41	1.85?	0.08	0.21	0.46	0.90	1.52	2.41	4.07			0.16	0.25	0.40	0.73	1.29	2.03		
Pl. XIV, fig. 2	6.5	*	2.04	*	0.15	0.30	0.75	1.42	2.27	3.71	5.09			0.21	0.36	0.59	1.67	2.64			
Pl. XIII, fig. 32	7.4	*	3.38	*	0.10	6	9	11	12	19	32	33	13>	0.17	0.31	0.51	0.91	1.57	22.38	3.22	
Pl. XIII, fig. 33	7.4	*	3.31	*	0.09	7	10	15	24	33	33	32	12>	0.18	0.31	0.63	1.11	1.74	2.45	3.21	
Pl. XIV, fig. 4	6.2	*	2.66	*	0.11	6	12	17	21	22	25	7>		0.22	0.35	0.57	0.95	1.70	2.64		

***Carbonoschwagerina nipponica* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XIII, fig. 2	6	3.45	1.97	1.75	0.10	0.17	0.38	0.84	1.57	2.50	3.45		0.16	0.33	0.41	0.70	1.27	1.97	
Pl. XIII, fig. 3	6	4.66	2.31	2.02	0.08	0.27	0.59	1.01	1.70	3.19	4.66		0.14	0.25	0.48	0.88	1.53	2.31	
Pl. XIII, fig. 4	6.5	4.32	2.43	1.78	0.05	0.16	0.39	0.68	1.21	2.23	3.49		0.12	0.22	0.32	0.55	1.18	2.01	
Pl. XIII, fig. 5	6.5	4.35?	2.39	1.82?	0.12	0.22	0.42	0.77	1.24	2.05	3.45		0.17	0.28	0.40	0.71	1.25	1.99	
Pl. XIII, fig. 6	6	3.85	2.64	1.46	0.12	0.22	0.51	1.05	1.80	2.82	3.85		0.19	0.33	0.63	1.10	1.83	2.64	
Pl. XIII, fig. 8	6	4.64	2.05	2.26	0.13	0.28	0.57	1.16	1.85	2.98	4.64		0.15	0.25	0.47	0.84	1.40	2.05	
Pl. XIII, fig. 9	5.5	4.0?	2.12	1.9?	0.17	0.41	0.83	1.29	2.15	3.42			0.22	0.35	0.60	1.03	1.74		
Pl. XIII, fig. 10	6.5	*	2.48	*	0..10	0.18	0.44	0.95	1.64	2.49	3.60		0.14	0.22	0.36	0.66	1.25	1.99	
Pl. XIII, fig. 11	6	4.19	2.20	1.90	0.14	0.37	0.67	1.09	1.80	2.83	4.19		0.20	0.33	0.57	0.94	1.50	2.20	
Pl. XIII, fig. 12	6.5	4.70	2.32	2.03	0.12	0.26	0.54	1.10	1.75	2.80	4.44		0.16	0.28	0.45	0.73	1.28	2.04	
Pl. XIII, fig. 13	6.5	*	1.85	*	0.08	0.19	0.46	0.73	1.17	2.08	3.20		0.14	0.19	0.30	0.55	0.92	1.50	
Pl. XIII, fig. 14	7	4.4?	2.01	2.2?	0.09	0.14	0.38	0.72	1.20	2.06	3.31	4.4?	0.13	0.19	0.29	0.54	0.30	1.44	2.01
Pl. XIII, fig. 16	7	4.45	2.49	1.79	0.09	0.12	0.34	0.75	1.18	2.07	3.15	4..45	0.19	0.18	0.30	0.55	1.03	1.83	2.49
Pl. XIII, fig. 17	6.3	*	2.60	*	0.11	7	13	17	23	27	31	13>	0.24	0.30	0.63	1.03	1.70	2.54	
Pl. XIII, fig. 18	6.6	*	2.76	*	0.08	7	13	16	21	25	27	20>	0.22	0.36	0.61	1.05	1.63	2.43	
Pl. XIII, fig. 19	6.4	*	2.88	*	0.12	10	16	19	24	26	28	14>	0.25	0.44	0.79	1.26	2.08	2.75	

***Carbonoschwagerina morikawai* (Igo)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XIV, fig. 5	8	*	*	*	0.10	0.13	0.34	0.73	1.30	2.35	3.67	6.07	*		0.15	0.20	0.32	0.54	1.04	1.97	3.18	*	
Pl. XIV, fig. 8	8.5	8.4?	3.98	2.1?	0.10	0.22	0.60	0.86	1.63	2.57	3.90	6.33	7.9?		0.14	0.22	0.35	0.60	1.04	1.66	2.65	3.57	
Pl. XIV, fig. 9	8	8.2?	3.96	2.1?	0.10	0.20	0.46	1.01	1.64	2.75	3.83	5.85	8.2?		0.13	0.19	0.33	0.59	1.13	1.98	2.95	3.96	
Pl. XIV, fig. 10	8.5	8.0>	4.39	*	0.06	0.14	0.36	0.75	1.34	2.14	3.41	4.92	7.32		0.11	0.17	0.28	0.54	1.27	2.37	2.99	4.09	
Pl. XIV, fig. 11	8	6.30	4.06	1.55	0.11	0.21	0.44	0.86	1.45	2.13	3.22	4.94	6.30		0.16	0.24	0.40	0.66	1.04	1.70	2.86	4.06	
Pl. XV, fig. 1	8.5	8.7>	4,4>	*	0.05	0.11	0.29	0.63	1.34	2.20	3.73	5.59	7.80		0.08	0.17	0.27	0.46	0.80	1.38	2.47	3.87	
Pl. XV, fg. 3	8	7.92	3.85	2.06	0.11	0.23	0.43	1.07	1.70	2.46	3.81	5.77	7.92		0.18	0.27	0.40	0.69	1.04	1.79	2.94	3.85	
Pl. XV, fig. 5	7.5	7.2>	3.96	*	0.12	0.20	0.47	0.94	1.71	2.79	4.35	6.44			0.18	0.24	0.41	0.73	1.40	2.49	3.51		
Pl. XV, fig. 6	7	6.87	3.35	2.05	0.10	0.24	0.49	1.00	1.63	2.92	4.80	6.87			0.15	0.22	0.39	0.72	1..33	2.35	3.35		
Pl. XV, fig. 8	7.5	*	4.18	*	0.09	0.21	0.62	1.28	2.30	3.76	5.75	*			0.14	0.24	0.42	0.88	1.70	2.70	3.81		
Pl. XV, fig. 9	7>	*	*	*	0.08	0.25	0.54	1.15	1.92	3.01	4.71	6.6?			0.17	0.25	0.43	1.25	1.40	2.51	3.62		
Pl. XV, fig. 11	7	8.05	3.93	2.05	0.10	0.31	0.55	1.18	2.13	3.65	5.73	8.05			0.16	0.27	0.47	0.92	1.76	3.04	3.93		
Pl. XIV, fig. 7	5.8	*	3.69	*	0.18	8	19	26	29	30	30>				0.34	0.59	0.98	1.79	2.86				
Pl. XV, fig. 7	8.2	*	3.49	*	0.07	0.08	9	13	15	23	28	33	32	8>	0.10	0.21	0.39	0.65	0.99	1.68	2.67	3.46	
Pl. XV, fig. 13	8.8	*	4.15	*	0.04	?	8?	11?	17	20	22	22	25	24>	0.06	0.15	0.25	0.47	0.75	1.40	2.28	3.46	
Pl. XV, fig. 15	7.3	*	4.10	*	0.13	?	12?	19	22	27	25	34	13>		0.18	0.35	0.54	0.95	1.60	2.71	3.81		
Pl. XV, fig. 16	7.7	*	4.36	*	0.08	8	10	15	17	21	30	37	25>		0.18	0.30	0.48	0.81	1.38	2.47	3.60		

***Carbonoschwagerina minatoi* (Kanmera)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XVI, fig. 1	8.5	9.8?	6.7?	1.5?	?	?	0.28?	0.49	1.44	1.88	3.91	6.98	9.62	?	0.13?	0.24	0.40	1.04	2.79	4.71	6.15
Pl. XVI, fig. 3	7.5	8.06	5.54	1.45	0.03	0.15	0.28	0.68	1.13	2.24	4.24	6.70		0.09	0.14	0.23	0.44	1.01	2.88	2.91	
Pl. XVI, fig. 4	8	8.3?	5.9?	1.4?	0.02	0.09	0.31	0.75	1.30	2.75	4.65	6.52	8.4?	0.14	0.16	0.29	0.50	1.33	3.16	2.97	5.9?
Pl. XVI, fig. 11	8	7.85	*	*	0.02	0.07	0.34	0.89	1.49	2.54	4.20	6.12	7.85	0.15	0.17	0.30	0.51	1.52	3.27	*	*
Pl. XVI, fig. 7	7.6	*	5.63	*	?	?	?	?	18	21	20	29	24>	?	?	0.33?	0.54	1.11	3.00	4.83	

***Rauserites arcticus* (Schellwien)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XVII, fig. 1	6	6.92	2.55	2.71	0.14	0.33	0.98	1.63	3.27	5.34	6.92		0.22	0.33	0.56	1.01	1.70	2.55	
Pl. XVII, fig. 3	5.5	5.1?	1.97	2.6?	0.12	0.28	0.79	1.22	2.23	3.59			0.19	0.31	0.51	0.85	1.54		
Pl. XVII, fig. 4	5.5	*	2.7?	*	0.17	0.40	0.86	1.85	4.02	6.20			0.20	0.42	0.74	1.39	2.31		
Pl. XVII, fig. 5	6	5.61	2.13	2.63	0.09	0.25	0.49	1.25	2.18	3.52	5.61		0.17	0.26	0.42	0.74	1.30	2.13	
Pl. XVII, fig. 6	5.5	*	2..4?	*	0.15	0.41	0.86	1.44	3.35	*			0.22	0.35	0.65	1.19	2.03		
Pl. XVII, fig. 8	5	5.43	1.86	2.92	0.20	0.39	0.90	1.98	3.71	5.43			0.26	0.37	0.63	1.15	1.86		
Pl. XVII, fig. 10	5.5	*	2.25	*	0.18	0.38	0.87	1.68	3.39	5.55			0.22	0.33	0.60	1.14	1.91		
Pl. XVII, fig. 11	5.5	*	2.31	*	0.21	0.45	1.08	2.01	3..96	5.61			0.28	0.46	0.78	1.35	2.00		
Pl. XVII, fig. 12	5	5.5?	2.13	2.6?	0.15	0.40	1.04	1.80	3.24	5.5?			0.23	0.43	0.73	1.34	2.13		
Pl. XVII, fig. 14	5.5	*	*	*	0.15	0.39	0.92	1.95	3.45	5.49			0.21	0.36	0.69	1.28	1.96		
Pl. XVII, fig. 15	5.5	*	*	*	0.12	0.34	0.83	1.71	2.97	5.38			0.18	0.30	0.52	0.98	1.65		
Pl. XVII, fig. 16	5	4.92	1.71	2.88	0.19	0.38	0.91	1.85	3.54	4.92			0.23	0.37	0.64	1.13	1.71		
Pl. XVII, fig. 17	5.5	*	2.1?	*	0.15	0.32	0.78	1.55	2.68	4.81			0.21	0.35	0.63	1.10	1.85		
Pl. XVII, fig. 19	6	6.1?	2.06	3.0?	0.10	0.21	0.49	1.31	2.28	3.57	6.1?		0.16	0.26	0.44	0.76	1.31	2.06	
Pl. XVII, fig. 20	5	4.85	1.80	2.69	0.13	0.27	0.70	1.39	3.18	4.85			0.20	0.35	0.62	1.14	1.80		
Pl. XVII, fig. 26	6.5	*	2.29	*	0.13	0.24	0.52	0.93	1.81	3.39	5.25		0.18	0.24	0.41	0.74	1.28	2.00	
Pl. XVII, fig. 27	6	6.30	2.39	2.64	0.15	0.30	0.59	1.15	2.60	4.54	6.30		0.24	0.36	0.59	1.03	1.74	2.39	
Pl. XVII, fig. 28	5	5.35	2.32	2.31	0.16	0.39	0.84	1.78	4.03	5.35			0.27	0.44	0.88	1.50	2.32		
Pl. XVIII, fig. 1	6	5.52	2.01	2.75	0.09	0.24	0.50	0.95	1.77	3.56	5.52		0.15	0.23	0.38	0..61	1.19	2.01	
Pl. XVIII, fig. 10	4.9	*	1.81	*	0.12	7	14	21	23	22>			0.24	0.40	0.91	1.16			
Pl. XVIII, fig. 11	5.3	*	2.22	*	0.16	7	16	18	27	7>			0.25	0.42	0.68	1.35	2.19		
Pl. XVIII, fig. 14	4.5	*	1.73	*	0.16	9	15	22	23	13>			0.29	0.51	0.85	1..40			
Pl. XVIII, fig. 15	4.7	*	2.04	*	0.17	9	16	20	24	23>			0.24	0.40	0.73	1.31			
Pl. XVIII, fig. 17	5.2	*	2.30	*	0.18	9	16	20	27	30	6>		0.28	0.55	0.84	1.07	2.29		
Pl. XVIII, fig. 18	5.3	*	2.06	*	0.15	10	14	20	23	25			0.27	0.41	0.73	1.13	1.74		
Pl. XVIII, fig. 19	6.1	*	2.87	*	0.10	8	14	20	24	27	34	3>	0.25	0.37	0.61	1.03	1.33	2.64	

***Rauserites exculptus* (Igo)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XVIII, fig. 20	5.5	5.63	1.77	3.18	0.20	0.36	0.76	1.50	2.91	4.95			0.25	0.38	0.63	0.99	1.46		
Pl. XVIII, fig. 21	6	5.5?	1.92	2.9?	0.22	0.47	0.91	1.38	2.57	4.18	5.5?		0.29	0.43	0.64	0.95	1.40	1.92	
Pl. XVIII, fig. 25	5.5	*	1.76	*	0.20	0.39	0.69	1.40	2.52	4.35			0.24	0.40	0.62	1.00	1.51		
Pl. XVIII, fig. 27	6	5.4?	1.65	3.3?	0.15	0.30	0.66	1.23	2.15	3.67	5.4?		0.21	0.35	0.57	0.83	1.24	1.65	
Pl. XVIII, fig. 28	6	4.96?	1.89	2.62?	0.16	0.35	0.62	1.04	1.71	3.40?	4.96?		0.22	0.34	0.56	0.87	1.35	1.89	
Pl. XVIII, fig. 29	6	4.70	1.9?	2.5?	0.17	0.29	0.60	1.23	1.78	2.87	4.70		0.22	0.34	0.58	0.92	1.40	1.9?	
Pl. XVIII, fig. 31	6	4.5?	2.16	2.1?	0.16	0.42	0.85	1.54	2.18	3.27	4.5?		0.23	0.36	0.60	0.99	1.60	2.16	
Pl. XVIII, fig. 33	5.5	*	1.79	*	0.18	0.37	0.73	1.17	2.20	4.01			0.22	0.35	0.55	0.89	1.45		
Pl. XVIII, fig. 34	6	5.3?	1.86	2.8?	0.16	0.30	0.62	1.16	2.39	4.08	5.3?		0.23	0.34	0.55	0.91	1.38	1.86	
Pl. XVIII, fig. 36	5.5	4.38	1.47	2.98	0.14	0.34	0.65	1.20	1.93	3.06			0.21	0.25	0.54	0.82	1.24		
Pl. XVIII, fig. 42	5.5	4.65?	2.16	2.15?	0.16	0.28	0.74	1.31	2.25	3.86			0.20	0.35	0.57	1.07	1.80		
Pl. XVIII, fig. 37	5.4	*	1.99	*	0.17	10	16	18	24	23	13>		0.29	0.42	0.75	1.23	1.85		
Pl. XVIII, fig. 40	4.8	*	1.53	*	0.13	10	17	20	26	22>			0.26	0.41	0.71	1.15			
Pl. XVIII, fig. 41	5.2	*	1.74	*	0.14	8	15	20	20	25	8>		0.23	0.37	0.60	1.01	1.51		
Pl. XVIII, fig. 43	5.5	*	2.28	*	0.18	8	18	22	19	26	14>		0.30	0.49	0.87	1.35	1.96		
Pl. XVIII, fig. 44	5.7	*	2.11	*	0.19	10	17	21	25	28	19>		0.30	0.50	0.83	1.25	1.81		
Pl. XVIII, fig. 45	6.3	*	2.44	*	0.14	9	16	23	21	27	23	7>	0.25	0.43	0.64	0.98	1.58	2.29	
Pl. XVIII, fig. 46	5.6	*	2.42	*	0.17	8	16	20	22	22	15>		0.29	0.45	0.79	1.40	2.14		
Pl. XVIII, fig. 47	5.7	*	1.97	*	0.17	9	15	17	24	24	18>		0.28	0.45	0.70	1.06	1.56		
Pl. XVIII, fig. 48	5.4	*	1.92	*	0.13	9	14	16	24	24	10>		0.21	0.38	6.90	1.10	1.69		
Pl. XVIII, fig. 49	5.6	*	1.81	*	0.17	9	16	20	24	24	18>		0.29	0.46	0.76	1.13	1.58		

***Rauserites major* Rozovskaya**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XIX, fig. 1	6	8.17	3.36	2.43	0.32	0.68	1.27	2.26	3.70	5.76	8.17		0.48	0.73	1.18	1.83	2.64	3.36	
Pl. XIX, fig. 2	7	8.03	2.53	3.17	0.25	0.55	1.04	1.60	2.47	3.86	6.18	8.03	0.35	0.53	0.79	1.13	1.63	2.22	2.53
Pl. XIX, fig. 3	6	7.10	2.96	2.40	0.26	0.69	1.28	2.15	3.57	5.69	7.10		0.40	0.64	1.02	1.55	2.30	2.96	
Pl. XIX, fig. 4	6	6.58	2.48	2.65	0.23	0.70	0.97	1.81	3.04	4.53	6.58		0.29	0.48	0.78	1.19	1.84	2.48	
Pl. XIX, fig. 5	6	7.07	3.07	2.30	0.27	0.56	1.16	2.09	3.56	5.05	7.07		0.36	0.64	1.09	1.73	2.42	3.07	
Pl. XIX, fig. 7	6	5.88	2.50	2.35	0.30	0.68	1.08	1.75	2.36	4.39	5.88		0.39	0.60	0.90	1.38	1.94	2.50	
Pl. XIX, fig. 8	6.5	*	2.79	*	0.20	0.44	0.87	1.45	2.43	3.70	5.96		0.27	0.42	0.64	1.08	2.01	2.46	
Pl. XIX, fig. 9	6	6.15?	2.72	2.26?	0.35	0.57	1.26	2.36	3.37	4.81	6.15?		0.41	0.63	1.00	1.47	2.09	2.72	
Pl. XIX, fig. 10	6.5	*	2.43	*	0.20	0.44	0.86	1.44	2.31	3.80	5.86		0.27	0.39	0.61	0.95	1.48	2.02	
Pl. XIX, fig. 11	6	*	*	*	0.28	0.64	1.45	2.56	3.87	5.22	*		0.43	0.71	1.05	1.61	2.25	*	
Pl. XIX, fig. 12	5>	*	*	*	0.30	0.74	1.36	2.57	4.13	5.09?			0.47	0.79	1.32	2.10	2.94		
Pl. XIX, fig. 13	4.5	*	*	*	0.31	0.63	1.26	2.46	3.77				0.41	0.67	1.09	1.73			
Pl. XIX, fig. 14	4>	*	*	*	0.35	11	26	31	38				0.64	1.03	1.70	2.45			
Pl. XIX, fig. 15	5.2	*	2.91	*	0.27	11	22	25	27	33	7>		0.40	0.74	1.24	1.91	2.59		
Pl. XIX, fig. 16	5.6	*	3.23	*	0.33	12	18	24	29	28	21>		0.47	1.05	1.32	2.12	2.88		

***Rauserites stuckenbergi* (Rauzer-Chernousova)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XX, fig. 2	6.5	5.4?	2.34	2.3?	0.20	0.42	0.80	1.35	2.21	3.24	4.58			0.27	0.40	0.71	1.03	1.44	2.05		
Pl. XX, fig. 3	5.5	4.83	1.98	2.44	0.16	0.46	0.72	1.68	2.45	4.13				0.24	0.41	0.68	1.13	1.70			
Pl. XX, fig. 4	8	6.4?	2.68	2.4?	0.12	0.22	0.48	0.91	1.52	2.25	3.58	*	*	0.18	0.27	0.45	0.72	1.07	1.49	2.07	2.68
Pl. XX, fig. 5	7	5.4?	2.57	2.1?	0.17	0.35	0.60	1.07	1.98	3.05	4.51	5.4?		0.23	0.35	0.58	0.97	1.47	2.02	2.57	
Pl. XX, fig. 6	7	5.2?	2.47	2.1?	0.15	0.26	0.55	1.08	1.85	2.97	4.02	5.2?		0.21	0.30	0.48	0.85	1.30	1.89	2.47	
Pl. XX, fig. 11	6	*	2.20	*	0.25	0.53	1.08	1.69	2.76	3.85	*			0.35	0.50	0.78	1.19	1.69	2.20		
Pl. XX, fig. 13	6.0	*	2.67	*	0.23	10	19	23	24	23	29			0.43	0.65	0.99	1.48	2.07	2.67		
Pl. XX, fig. 14	5.1	*	2.50	*	0.28	11	17	22	27	26	2>			0.45	0.73	1.12	1.79	2.49			
Pl. XX, fig. 15	6.4	*	2.49	*	0.16	8	15	15	24	24	13>			0.28	0.47	0.57	1.06	1.54	2.49		

Rauserites hidensis **(Igo)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XX, fig. 16	5	5.28	2.16	2.44	0.29	0.52	1.30	2.59	4.30	5.28		0.38	0.61	0.94	1.50	2.16	
Pl. XX, fig. 17	5.5	4.99	2.10	2.38	0.24	0.50	0.99	1.42	2.82	4.05		0.37	0.57	0.85	1.23	1.76	
Pl. XX, fig. 18	6	5.86	2.17	2.70	0.20	0.41	0.75	1.26	2.27	4.15	5.86	0.28	0.42	0.68	1.06	1.61	2.17
Pl. XX, fig. 20	6	6.21	2.17	2.86	0.22	0.49	0.85	1.65	2.76	4.74	6.21	0.30	0.48	0.80	1.18	1.75	2.17
Pl. XX, fig. 21	4.6	*	1.86	*	0.19	9	15	18	22	14>		0.37	0.60	0.95	1.51		
Pl. XX, fig. 25	5.4	*	2.18	*	0.19	10	18	22	19	25	13>	0.35	0.59	0.99	1.41	2.07	
Pl. XX, fig. 26	5.2	*	2.32	*	0.13	7	14	18	22	27	6>>						

Schwageriniformis parallelos **(Shcherbovich)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XX, fig. 27	7	4.15?	1.89	2.20?	0.10	0.19	0.34	0.85	1.37	2.11	3.27	4.15?	0.15	0.24	0.38	0.63	0.98	1.44	1.89
Pl. XX, fig. 30	7	3.45?	1.53	2.25?	?	0.10	0.31	0.63	1.19	1.92	2.80	3.45?	0.11	0.18	0.28	0.43	0.70	1.16	1.53
Pl. XX, fig. 32	5.5	*	1.70	*	0.11	0.24	0.73	1.18	1.94	3.68			0.17	0.27	0.45	0.84	1.10		
Pl. XX, fig. 33	6	3.26	1.62	2.01	0.12	0.30	0.54	0.83	1.46	1.74	3.26		0.16	0.25	0.42	0.70	1.15	1.62	
Pl. XX, fig. 34	5	*	1.55	*	0.12	0.39	0.76	1.22	2.2?	*			0.19	0.31	0.55	0.96	1.55		
Pl. XX, fig. 39	5.5	3.27	1.48	2.21	0.12	0.21	0.51	1.10	1.82	2..66			0.20	0.31	0.54	0.86	1.27		
Pl. XX, fig. 40	5>	*	*	*	0.15	0.39	0.68	1.25	2.11	3.13			0.23	0.39	0.65	1.04	1.54		
Pl. XX, fig. 41	6	3.4?	1.36	2.5?	0.05	0.17	0.47	0.87	1.69	2.68	3.4?		0.07	0.14	0.27	0.53	0.90	1.36	
Pl. XX, fig. 42	6	3.17	1.40	2.26	?	0.21	0.43	0.84	1.30	2.07	3.17		0.14	0.20	0.34	0.58	0.95	1.40	
Pl. XX, fig. 31	5.2	*	1.56	*	0.11	8	12	15	16	18	4>		0.18	0.28	0.49	0.87	1.36		
Pl. XX, fig. 35	5.1	*	1.67	*	0.13	7	14	16	18	21	2>		0.23	0.37	0.64	1.08	1.67		
Pl. XX, fig. 36	5..7	*	1.94	*	0.08	7	10	13	15	18	14>		0.15	0.27	0.48	0.85	1.49		

***Triticittes parvulus* (Schellwien)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXI, fig. 1	6.5	4.41	1.95	2.26	0.12	0.29	0.60	1.04	1.75	2.67	3.66			0.21	0.27	0.40	0.66	1.08	1.60		
Pl. XXI, fig. 2	7	4.24	1.80	2.36	0.14	0.22	0.50	0.96	1.65	2.17	3.33	4.24		0.19	0.30	0.38	0.59	0.89	1.28	1.80	
Pl. XXI, fig. 3 (microspheric form)	8	2.28?	1.08	2.11?	0.02	0.06	0.09	0.19	0.40	0.63	1.02	1.65	2.28?	0.07	0.08	0.13	0.19	0.28	0.46	0.71	1.08
Pl. XXI, fig. 4	5.5	4.76	1.72	2.77	0.23	0.45	0.92	1.60	2.57	4.04				0.25	0.40	0.62	0.99	1.44			
Pl. XXI, fig. 5	6	4.5?	1.78	2.5?	0.15	0.24	0.47	1.18	1.93	2.91	4.5?			0.19	0.30	0.45	0.74	1.17	1.78		
Pl. XXI, fig. 6	6	4.0?	1.98	2.0?	0.19	0.35	0.62	1..17	1.98	3.13	4.0?			0.26	0.40	0.61	0.94	1.46	1.98		
Pl. XXI, fig. 7	6.5	4.93	1.96	2.52	0.14	0..29	0.54	0.96	1.71	2.75	4.28			0.17	0.28	0.44	0.71	1.15	1.69		
Pl. XXI, fig. 10	5	2.50	1.13	2.21	0.20	0.36	0.50	0.92	1.61	2.50				0.23	0.35	0.53	0.77	1.13			
Pl. XXI, fig. 11	6	4.96	1.80	2.76	0.17	0.32	0.71	1.14	2.13	3.41	4.96			0.22	0.34	0.52	0.82	1.29	1.80		
Pl. XXI, fig. 12	6.5	*	*	*	0.14	0..24	0.50	1.07	1.91	2.95	4.35			0.19	0.28	0.45	0.73	1.17	1.74		
Pl. XXI, fig. 15	6	3.9?	1.38	2.8?	0.14	0.34	0.57	1.06	1.74	2.71	3.9?			0.20	0.28	0.39	0.64	0.98	1.38		
Pl. XXI, fig. 16	6	3.98	1.83	2.17	0.17	0.35	0.73	1.01	1.56	2.40	3,98			0.22	0.33	0.52	0.83	1.26	1.83		
Pl. XXI, fig. 17	5.5	*	1.66	*	0.19	0.35	0.77	1.35	2.26	3.27				0.25	0.37	0.58	0.95	1.36			
Pl. XXI, fig. 22	6	3.55	1.33	2.67	0.13	0.23	0.49	1.15	1.59	2.31	3.55			0.18	0.28	0.40	0.61	0.93	1.33		
Pl. XXI, fig. 23	6	3.8?	1.62	2.3?	0.16	0.38	0.71	1.09	1.69	2.75	3.8?			0.22	0.29	0.47	0.70	1.10	1.62		
Pl. XXI, fig. 14	6.7	*	2.27	*	0.14	9	11	14	17	21	28	19>		0.23	0.34	0.51	0.85	1.34	0.96		
Pl. XXI, fig. 18	4.3>	*	*	*	0.23	9	15	18	19	6>				0.39	0.64	0.97	1.55				
Pl. XXI, fig. 19	5.1	*	1.66	*	0.13	9	12	13	14	19	2>			0.21	0.35	0.60	1.05	1.61			
Pl. XXI, fig. 20	5.7	*	1.75	*	0.10	8	11	16	16	19	19>			0.18	0.31	0.47	0.84	1.36			
Pl. XXI, fig. 24	5.3	*	1.72	*	0.20	9	14	17	16	16	7>			0.33	0.48	0.73	1.10	1.66			
Pl. XXI, fig. 25	5.8	*	1.70	*	0.16	6	13	18	23	25	23>			0.29	0.45	0.65	0.92	1.31			
Pl. XXI, fig. 26	6.7	*	1.85	*	0.12	8	13	14	16	20	24	21>		0.18	0.28	0.42	0.63	0.98	1.42		
Pl. XXI, fig. 27	5.7	*	1.93	*	0.20	9	16	18	22	23	19>			0.32	0.49	0.74	1.15	1.60			
Pl. XXI, fig. 28	5.8	*	1.90	*	0.15	8	14	16	17	18	19>			0.24	0.34	0.53	0.82	1.32			
Pl. XXI, fig. 29	6.6	*	2.43	*	0.16	9	11	12	16	19	24	17		0.23	0.33	0.51	0.81	1.32	2.08		
Pl. XXI, fig. 30	6.6	*	2.24	*	0.11	7	13	14	15	20	22	14>		0.21	0.31	0.48	0.77	1.25	1.89		
Pl. XXI, fig. 31	6.8	*	2.31	*	0.18	9	14	16	18	25	26	19>		0.28	0.40	0.57	0.91	1.36	2.03		
Pl. XXI, fig. 32	6.4	*	1.82	*	0.12	7	13	17	19	22	22			0.23	0.37	0.54	0.80	1.13	1.55		

***Triticits whitei* Rauzer-Chernousova & Belyaev**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXI, fig. 35	6	4.9?	1.93	2.5?	0.12	0.24	0.54	1.11	2.10	3.42	4.9?		0.17	0.29	0.48	0.83	1.34	1.93	
Pl. XXI, fig. 37	5.5	3.9?	1.57	2.5?	0.12	0.26	0.58	1.13	2.05	3.36			0.18	0.28	0.46	0.79	1.30		
Pl. XXI, fig. 38	5.5	3.53	1.50	2.35	0.16	0.24	0.59	1.19	2.07	3.05			0.23	0.30	0.51	0.80	1.23		
Pl. XXI, fig. 39	7	4.20	2.00	2.10	0.07	0.16	0.28	0.55	0.99	1.83	3.06	4.20	0.13	0.21	0.31	0.49	0.83	1.38	2.00
Pl. XXI, fig. 40	5	3.77	1.50	2.51	0.15	0.27	0.56	1.40	2.44	3.77			0.23	0.35	0.56	0.96	1.50		
Pl. XXI, fig. 41	4.5	*	*	*	0.16	0.46	0.86	1.62	2.17				0.25	0.40	0.74	1.16			
Pl. XXI, fig. 42	4.5	*	*	*	0.17	0.45	0.88	1.63	2.38				0.23	0.37	0.86	1.00			
Pl. XXI, fig. 44	4.5	*	*	*	0.15	0.30	0.77	1.39	2.27				0.22	0.38	0.57	0.66			
Pl. XXI, fig. 45	5.5	*	*	*	0.10	0.19	0.40	0.74	1.53	2.55			0.18	0.27	0.43	0.66	1.03		
Pl. XXI, fig. 46	5	4.18	1.51	2.77	0.17	0.29	0.65	1.70	2.34	4.18			0.21	0.35	0.58	1.00	1.51		
Pl. XXI, fig. 43	5.8	*	1.52	*	0.08	6	10	12	12	14	18>		0.11	0.24	0.37	0.65	1.02		
Pl. XXI, fig. 47	4.6	*	1.66	*	0.14	7	13	15	15	10>			0.26	0.45	0.75	1.24			

***Triticites ozawai* Toriyama**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXI, fig. 48	6.5	5.33	1.91	2.79	0.10	0.18	0.41	0.92	1.56	2.84	4.53		0.12	0.23	0.34	0.57	0.98	1.51	
Pl. XXI, fig. 49	6	5.1?	2.06	2.5?	0.11	0.21	0.62	1.24	2.15	3.45	5.1?		0.18	0.30	0.51	0.70	1.44	2.06	
Pl. XXI, fig. 50	7	5.2?	2.2?	2.4?	0.11	0.21	0.40	0.85	1.54	2.43	3.82	5.2?	0.19	0.24	0.37	0.61	0.99	1.54	2.2?
Pl. XXI, fig. 54	7	*	*	*	0.12	0.20	0.47	0.90	1.50	2.57	4.18	*	0.18	0.25	0.39	0.58	1.06	1.63	
Pl. XXI, fig. 55	5.1	*	1.79	*	0.14	7	13	17	17	21	2>		0.29	0.50	0.78	1.26	1.77		

***Triticites simplex* (Schellwien)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXII, fig. 2	6.5	6.2?	2.66	2.3?	0.15	0.37	0.74	1.36	2.40	*	*			0.21	0.41	0.70	1.07	1..69	2.37		
Pl. XXII, fig. 5	7	5.96	2.89	2.06	0.14	0.29	0.56	1.05	1.76	3.20	4.74	5.96		0.20	0.30	0.54	0.91	1.48	2.20	2.89	
Pl. XXII, fig. 6	7	4.7?	2.40	2.0?	0.16	0.30	0.59	1.00	1.57	2.33	3.31	4.7?		0.19	0.29	0.44	0.70	1.08	1.67	2.40	
Pl. XXII, fig. 8	5>	*	*	*	0.24	0.55	1.01	2.13	3.90	5.56				0.37	0.59	0.96	1.54	2.06			
Pl. XXII, fig. 11	6.5	*	2.36	*	0.15	0.41	0.77	1.35	*	*	*			0.21	0.34	0.53	0.87	1.37	2.00		
Pl. XXII, fig. 12	7	4.98?	2.49	2.00?	0..16	0.31	0.62	1.05	1.63	2.43	3.98	4.98?		0.24	0.35	0.55	0.84	1.27	2.09	2.49	
Pl. XXII, fig. 14	6.5	5.7>	2.41	*	0.20	0.37	0.80	1.47	2.32	3.72	4.9?			0.27	0.39	0.66	1.09	1..59	2.15		
Pl. XXII, fig. 15	6.5	4.9>	2.3?	*	0.13	0.20	0.48	1.16	2.13	3.25	4.41			0.20	0.33	0.54	0.90	1.42	2.04		
Pl. XXII, fig. 22	5.5	3.9?	1.83	2.1?	0.15	0.27	0.64	1.10	1.91	3.22				0.21	0.32	0.54	0.90	1.41			
Pl. XXII, fig. 17	6.5	*	2.68	*	0.19	9	12	16	17	18	22	12>		0.25	0.38	0.64	1.04	1.61	2.37		
Pl. XXII, fig. 21	7.2	*	2.35	*	0.06	7	11	14	17	19	24	32	6>	0.19	0.28	0.44	0.69	1.03	1.60	2.28	
Pl. XXII, fig. 25	5.1	*	2.02	*	0.21	10	16	18	19	22	2>			0.35	0.58	0.94	1.43	2..01			
Pl. XXII, fig. 26	5.4	*	2.07	*	0.17	8	16	19	19	20	11>			0.29	0.48	0.74	1.19	1.85			

***Triticites yayamadakensis* Kanmera**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXII, fig. 23	6	4.20	1.63	2.58	0.12	0.26	0.59	1.15	1.84	3.20	4.20		0.19	0.27	0.45	0.75	1.21	1.63	
Pl. XXII, fig. 29	7.5	5.56	2.04	2.73	0.13	0.24	0.50	0.72	1.24	1.96	3.48	4.35	0.18	0.23	0.36	0.52	0.84	1.20	1.77
Pl. XXII, fig. 31	5.5	5.19	1.71	3.04	0.13	0.30	0.65	1.22	2.20	3.57			0.19	0.31	0.52	0.85	1.09		
Pl. XXII, fig. 32	5>	*	*	*	0.14	0.30	0.59	1.25	2.20	2.91			0.16	0.27	0.49	0.80	1.19		
Pl. XXII, fig. 33	7	*	*	*	0.09	0.15	0.40	0.70	1.31	2.03	2.96	*	0.13	0.19	0.32	0.53	0.80	1.18	*
Pl. XXII, fig. 37	5	2.73	1.09	2.50	0.13	0.26	0.50	0.84	1.61	2.73			0.18	0.29	0.45	0.72	1.09		
Pl. XXII, fig. 38	6.5	3.9?	1.61	2.4?	0.07	0.13	0.27	0.56	1.20	2.18	3.32		0.13	0.25	0.36	0.49	0.85	1.35	
Pl. XXII, fig. 39	6	3.54	1.33	2.66	0.13	0.23	0.40	0.74	1.37	2.25	3.54		0.15	0.26	0.39	0.60	0.91	1.33	
Pl. XXII, fig. 40	5.5	4.0?	1.35	3.0?	0.17	0.30	0.56	1.35	2.11	3.39			0.19	0.30	0.43	0.71	1.17		
Pl. XXIII, fig. 1	5	2.94	1.17	2.51	0.09	0.20	0.46	1.05	1.67	2.94			0.13	0.22	0.40	0.67	1.17		
Pl. XXIII, fig. 2	5.5	2.59	1.10	2.35	0.12	0.23	0.40	0.75	1.22	2.07			0.15	0.24	0.37	0.57	0.88		
Pl. XXII, fig. 35	4.3	*	1.03	*	0.13	7	10	14	14	6>			0.22	0.38	0.64	0.93			
Pl. XXII, fig. 36	5.1	*	1.00	*	0.08	7	9	12	14	17	2>		0.16	0.27	0.41	0.69	0.97		
Pl. XXIII, fig. 3	5.7	*	1.47	*	0.14	6	11	14	13	15	12>		0.19	0.32	0.44	0.70	1.15		

***Triticites*? spp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXXII, fig. 21	7	5.64	2.27	2.48	0.10	0.32	0.52	1.00	1.93	2.51	4.14	5.64		0.20	0.30	0.46	0.76	1.11	1.64	0.27	
Pl. XXXII, fig. 23	5.5	4.81	1.65	2.92	0.21	0.47	0.89	1.70	2.86	4.05				0.28	0.44	0.68	1.02	1.42			
Pl. XXXII, fig. 26	6	4.52	1.86	2.43	0.20	0.60	0.69	1.33	2.22	3.19	4.52			0.23	0.33	0.55	0.84	1.24	1.86		
Pl. XXXII, fig. 28	7	4.85	1.87	2.59	0.10	0.23	0.44	0.85	1.36	2.32	3.61	4.85		0.15	0.24	0.38	0.60	0.91	1.38	1.87	
Pl. XXXII, fig. 29	5	4.21	1.66	2.54	0.26	0.50	0.82	1.46	2.74	4.21				0.31	0.50	0.75	1.13	1.66			
Pl. XXXII, fig. 30	5.5	4.7?	1.70	2.8?	0.15	0.35	0.61	1.24	2..26	3.85				0.22	0.34	0.58	0.90	1.39			
Pl. XXXII, fig. 33	5	3.91	1.65	2.37	0.15	0.31	0.63	1.25	2.77	3.91				0.26	0.44	0.70	1.11	1.65			
Pl. XXXII, fig. 34	5.5	3.9?	1.72	2.3?	0.20	0.44	0.95	1.47	2.18	3.40				0.33	0.49	0.80	1.05	1.50			
Pl. XXXII, fig. 36	6	*	*	*	0.19	0.43	0.93	1.55	2.35	3.57	*			0.29	0.43	0.65	1.04	1.39	*		
Pl. XXXII, fig. 37	6	4.12	1.8?	2.3?	0.13	0.24	0.57	0.99	1.61	3.06	4.12			0.17	0.27	0.45	0.74	1.21	1.8?		
Pl. XXXII, fig. 38	6	4.5?	2.03?	2.2?	0.15	0.35	0.79	1.27	2.15	3.38	4.5?			0.20	0.35	0.60	0.99	1.46	2.03?		
Pl. XXXII, fig. 42	6	3.25	1.58?	2.06?	0.13	0.25	0.58	0.96	1.57	2.36	3.25			0.18	0.25	0.41	0.70	1.14	1.58?		
Pl. XXXII, fig. 44	6	3.59?	1.54?	2.33?	0.13	0.37	0.60	1.06	1.85	2.71	3.59?			0.19	0.30	0.49	0.81	1..19	1.54?		
Pl. XXXII, fig. 48	6	3.23	1.65	1.96	0.11	0.22	0.41	0.90	1.47	2.25	3.23			0.18	0.28	0.46	0.78	1.19	1.65		
Pl. XXXII, fig. 49	6.5	3.11	1.43	2.17	0.11	0.22	0.50	0.91	1.27	1.99	2.77			0.20	0.33	0.49	0.67	0.94	1.24		
Pl. XXXII, fig. 51	5.5	5.69	1.79	3.18	0.24	0.42	0.87	1.78	3.41	5.13				0.28	0.42	0.70	1.10	1.56			
Pl. XXXII, fig. 27	4.8	*	1.60	*	0..16	8	13	17	21	17>				0.30	0.54	0.80	1.24				
Pl. XXXII, fig. 31	6.3	*	1.85	*	0.18	8	15	17	20	19	21	6>		0.21	0.38	0.57	0.87	1.26	1.76		
Pl. XXXII, fig. 39	6.2	*	2.26	*	0.18	7	12	16	20	23	27?	6>		0.27	0.42	0.69	1.07	1.60	2.15		
Pl. XXXII, fig. 40	6.1	*	1.93	*	0.12	9	10	14	18	23	24	3>		0.22	0.35	0.55	0.85	1.29	1.82		
Pl. XXXII, fig. 45	5.4	*	1.81	*	0.15	7	15	15	18	23	9>			0.26	0.44	0.75	1.12	1.58			
Pl. XXXII, fig. 47	7.2	*	2.30	*	0.13	8	12	4	21	20	22	25	4>	0.22	0.35	0.42	0.68	1.02	1.55	2.26	

***Schwagerina satoi* Y. Ozawa**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXIII, fig. 6	7	5.1?	3.50	1.5?	0.08	0.25	0.46	0.87	1.58	2..45	3.82	5.1?	0.14	0.21	0.40	1.19	1.61	2.18	3.50
Pl. XXIII, fig. 8	7	*	*	*	0.14	0.39	0.66	1.31	2.05	3.17	4.59	*	0.20	0.33	0.62	1.12	1.75	2.51	*
Pl. XXIII, fig. 9	6	5.69	2.59	2.20	0.15	0.33	0.90	1.48	2.51	3.94	5.69		0.25	0.40	0.74	1.34	2.01	2..59	
Pl. XXIII, fig. 11	6.5	5.3?	2.9?	1.8?	0.12	0.39	0.61	1.14	2.02	3.10	4.82		0.23	0.34	0.57	1.03	1.74	2.65	
Pl. XXIII, fig. 12	6.5	4.68	2.72	1.72	0.13	0.31	0.45	1.03	1.62	2.56	3.75		0.22	0.35	0.57	0.98	1.56	2.33	
Pl. XXIII, fig. 13	6	4.9?	2.6?	1.9?	0.16	0.45	1.01	1.57	2.30	3..52	4.9?		0.21	0.35	0.60	1.04	1.80	2.6?	
Pl. XXIII, fig. 14	6.5	4.90	2.63	1.86	0.10	0.39	0.60	1.11	2.12	3.04	3.95		0.20	0.32	0.56	0.97	1.54	2.30	
Pl. XXIII, fig. 15	7.5	*	3.55?	*	0.12	0.21	0.45	0.84	1.51	*	*	*	0.19	0.32	0.53	0.96	1.60	2.43	3.27
Pl. XXIII, fig. 16	6	4.5?	3.05	1.5?	0.09	0.26	0.58	1.25	2.12	3.44	45?		0.17	0.28	0.54	0.94	1.94	3.05	
Pl. XXIII, fig. 17	6.5>	*	*	*	0.10	0.24	0.61	1.17	1.70	2.59	3.63?		0.19	0.26	0.43	0.87	1.60	2.71	
Pl. XXIII, fig. 19	6.5	5.42	2.81	1.93	0.16	0.36	0.70	1.21	1.97	3.05	4.39		0.21	0.35	0.64	1.05	1.92	2.42	
Pl. XXIII, fig. 21	6.5	4.1?	2.87	1.4?	0.12	0.24	0.55	1.15	2.02	2.66	3.61		0.19	0.29	0.54	1.01	1.58	2.45	
Pl. XXIII, fig. 25	5.5	4.51	2.33	1.94	0.17	0.50	0.92	1.59	2.58	3.87			0.31	0.42	0.80	1.30	1.99		
Pl. XXIII, fig. 31	6	3.40	2.26	1.50	0.05	0.17	0.44	0.86	1.45	2.38	3.40		0.12	0.19	0.34	0.64	1.24	2.26	
Pl. XXIII, fig. 27	6.4	*	3.01	*	0.11	10	14	19	24	32	35	16>	0.22	0.41	0.69	1.21	1.81	2.70	
Pl. XXIII, fig. 28	6.8	*	3.28	*	0.17	8	13	17	23	33	33	30>	0.24	0.44	0.80	1.25	2.04	2.73	
Pl. XXIII, fig. 29	6.9	*	3.61	*	0.13	8	14	19	24	26	36	32>	0.21	0.54	0.82	1.33	2.05	2.82	
Pl. XXIII, fig. 30	6.7	*	2.9	*	0.13	9	12	16	25	25	32	27>	0.21	0.35	0.60	1.49	1.76	2.47	

Schwagerina princeps **(Ehrenberg)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXIII, fig. 1	7	4.86	2.40	2.02	0.09	0.19	0.40	0.86	1..50	2.37	3.45	4.86	0.13	0.19	0.34	0.63	1.04	1.61	2.40
Pl. XXXIII, fig. 2	6.5	4.96	2.11	2.35	0.14	0.25	0.53	1.00	1.56	2.44	3.90		0.19	0.27	0.44	0.73	1.20	1.85	
Pl. XXXIII, fig. 3	5.5	4.3?	2.20	2.0?	0.16	0.33	0.75	1.36	2.38	3.77			0.24	0.41	0.73	1.22	1.86		
Pl. XXXIII, fig. 4	6.5	4.67	2.14	2.18	0.13	0.26	0.60	1.24	2.09	3.03	4.28		0.19	0.29	0.45	0.79	1.30	1.88	
Pl. XXXIII, fig. 5	5.5	4.9?	2.36	2.1?	0.23	0.47	0.92	1.82	3.05	4.33			0.32	0.49	0.86	1.35	2.05		
Pl. XXXIII, fig. 6	6	4.30	2.24	1.92	0.15	0.28	0.59	1.07	1.56	2.98	4.30		0.20	0.34	0.55	0.94	1.56	2.24	
Pl. XXXIII, fig. 8	6	4.36?	2.11	2.07?	0.21	0.36	0.73	1.25	2.03	3.17	4.36?		0.26	0.43	0.65	1.01	1.55	2.11	
Pl. XXXIII, fig. 9	5	3.96	2.09	1.89	0.20	0.45	0.86	1.49	2.67	3.96			0.29	0.53	0.88	1.39	2.09		
Pl. XXXIII, fig. 10	6	4.46?	2.05	2.17?	0.14	0.30	0.58	1.20	2.08	3.20	4.46?		0.21	0.34	0.52	0.94	1.46	2.05	
Pl. XXXIII, fig. 11	5.5	4.18	1.96	2.13	0.21	0.46	0.73	1.30	2.06	3.08			0.28	0.44	0.70	1.21	1.72		
Pl. XXXIII, fig. 12	6.5	4.90	2.17	2.26	0.11	0.20	0.39	0.83	1.50	2.56	4.35		0.21	0.28	0.45	0.78	1.17	1.88	
Pl. XXXIII, fig. 13	5	4.10	2.01	2.04	0.21	0.49	1.07	1.76	2.38	4.10			0.33	0.53	0.87	1.38	2.01		
Pl. XXXIII, fig. 14	6	4.14	2.28	1.82	0.15	0.32	0.70	1.35	2.15	3.09	4.14		0.20	0.34	0.60	1.04	1.60	2.28	
Pl. XLVII, fig. 2	6	5.02	2.34	2.15	0.16	0.53	0.69	1.30	2.11	3.46	5.02		0.24	0.38	0.64	1.05	1.67	2.34	
Pl. XLVII, fig. 3	5.5	5.66	2.05	2.76	0.20	0.40	0.91	1.70	2.88	4.23			0.25	0.44	0.75	1.22	1.74		
Pl. XLVII, fig. 4	5.5	4.38	2.18	2.01	0.20	0.44	0.85	1.34	2.10	3.62			0.30	0.49	0.79	1.25	1.92		
Pl. XLVII, fig. 5	4.5	3.44	1.69	2.04	0.17	0.37	0.93	1.92	2.93				0.25	0.44	0.79	1.36			
Pl. XLVII, fig. 6	5.5	4.78	2.04	2.34	0.12	0.25	0.73	1.26	2.21	3.53			0.18	0.32	0.59	1.06	1.67		
Pl. XLVII, fig. 7	5.5	4.22?	2.49	1.69?	0.20	0.40	0.82	1.50	2.39	3.87			0.27	0.46	0.87	1.42	2.16		
Pl. XLVII, fig. 8	5.3	*	2.60	*	0.15	7	16	19	26	25	11>		0.31	0.60	0.95	1.54	2.25		
Pl. XLVII, fig. 9	5.5	*	2.30	*	0.16	9	11	18	20	23?	14>		0.28	0.47	0.79	1.33	2.01		
Pl. XLVII, fig. 10	6.4	*	2.52	*	0.15	8	12	17	22	29	28	11>	0.23	0.38	0.63	1.04	1.63	2.36	

Schwagerina panjiensis **(Leven & Shcherbovich)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXIII, fig. 16	7.5	5.8?	3.3?	1.8?	0.21	0.47	0.95	1.52	2.46	3.37	4.30	5.27	0.29	0.46	0.75	1.14	1.62	2.27	2.97
Pl. XXXIII, fig. 17	6.5	6.2?	3.0?	2.1?	0.31	0.41	0.93	1.81	2.98	4.02	5.2?		0.28	0.44	0.79	1.34	1.98	2.66?	
Pl. XXXIII, fig. 15	6.8	*	2.97	*	0.23	9	16	26	27	29	38	35>	0.27	0.49	0.77	1.19	1.81	2.36	
Pl. XXXIII, fig. 18	5.8	*	2.22	*	0.21	8	15	21	24	18	20>		0.39	0.65	0.88	1.20	1.75		

***Schwagerina denssa* (Toriyama)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXIII, fig. 20	7.5	6.20	2.81	2.21	0.15	0.23	0.42	0.99	1.65	2.48	3.89	5.43	0.18	0.36	0.44	0.70	1.13	1.76	2.45
Pl. XXXIII, fig. 24	6..5	*	2.43?	*	0.20	0.46	0.88	1.63	2.24	3.40	4.83		0.24	0.40	0.69	1.02	1.59	2.18	
Pl. XXXIII, fig. 26	6.5	*	1.70?	*	0.14	0.34	0.74	1.19	1.65	2.40	3.26		0.25	0.35	0.53	0.76	1.13	1.54	
Pl. XXXIII, fig. 27	6.5	4.8?	2.37	2.0?	0.11	0.26	0.62	1.15	1.78	2.91	4.10		0.20	0.29	0.48	0.81	1.30	1.99	
Pl. XXXIII, fig. 30	7	4.56	1.85	2.46	0.15	0.32	0.57	1.00	1.57	2.23	3.20	4.56	0.21	0.31	0.45	0.65	0.96	1.34	1.85
Pl. XXXIII, fig. 31	4.5	*	*	*	0.14	0.29	0.78	1.30	2.09				0.22	0.36	0.60	0.96			
Pl. XXXIII, fig. 32	5	*	*	*	0.13	0.23	0.47	0.87	1.86	2.77			0.19	0.28	0.47	0.83	1.30		
Pl. XXXIII, fig. 33	5	*	*	*	0.14	0.27	0.63	1.05	1.54	2.54			0.18	0.30	0.51	0.75	1.17		
Pl. XXXIII, fig. 29	6.6	*	2.03	*	0.10	7	12	14	17	21	23	14>	0.19	0.28	0.45	0.73	1.19	1.72	

***Schwagerina watanabei* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XXXIV, fig. 1	9.5	7.8?	5.4?	1.4?	?	?	?	0.8?	1.3?	2.13	3.34	*	*	*	?	?	0.3?	0.5?	1.15	1.86	3.04	4.05	4.98
Pl. XXXIV, fig. 2	9	5.31	4.32?	1.23?	0.06?	0.14	0.34	0.77	1.15	1.60	2.17	3.08	4.13	5.31	0.09	0.18	0.29	0.52	0.91	1.60	2.59	3.56	4.32?
Pl. XXXIV, fig. 3	9	6.66	5.42	1.23	?	?	0.48?	0.86	1.47	2.20	3.14	3.91	5.02	6.66	?	0.25?	0.44	0.66	1.32	2.38	3.35	4.40	5.42
Pl. XXXIV, fig. 7	8.5	6.06	4.9	1.24	0.04	6	0.18	0.80	1.66	2.36	3.21	4.17	5.25		0.12	0.17	0.46	0.70	1.44	2.31	3.52	4.53	
Pl. XXXIV, fig. 8	9	6.37	4.59	1.39	?	0.17?	0.38?	0.78	1.25	1.84	2.60	3.48	4.46	6.37	?	0.15?	0.26	0.51	1.03	1.70	2.69	3.62	4.59
Pl. XXXIV, fig. 11	8.5	*	3.8?	*	0.06	0.16	0.40	0.78	1.22	1.77	2.61	*	*		0.12	0.20	0.34	0.62	1.15	2.19	3.13	3.8?	
Pl. XXXIV, fg. 14	8.5	7.3?	4.1?	1.8?	0.08?	0.29	0.61	1.00	1.63	2.34	3.47	4.98	6.3?		0.14	0.22	0.34	0.74	1.41	2.15	3.04	3.71?	
Pl. XXXIV, fig. 6	8.5?	*	4.6?	*	?	?	?	?	?	28	33	37	40	24>	?	?	?	0.9>	1.60	2.36	2.89	4.18	
Pl. XXXIV, fig. 9	8.8	*	5.17	*	0.04	0.17	5>	13	17	26	34	36	43	43>	0.13	0.19	0.41	0.87	1.65	2.41	3.52	4.41	

***Schwagerina wakatakeyamensis* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXXV, fig. 1	7.5	6.80	5.28	1.29	0.28	0.67	1.20	1.93	2.65	3.24	4.26	6.04		0.63	1.03	1.65	2.36	2.99	4.04	4.87	
Pl. XXXV, fig. 3	8	4.4?	4.4?	1.0?	0.23	0.40	0.81	1.35	1.99	2.30	3.13	3.78	4.4?	0.29	0.42	0.74	1.38	2.06	2.78	3.62	4.4?
Pl. XXXV, fig. 4	8?	*	4.9?	*	0.46	0.76	1..11	1..27	1.73	27?	38?	44?	?	0.55	0.92	1.33	1.82	2.4?	3.6?	4.3?	4.9?
Pl. XXXV, fig. 5	7	6.5?	*	*	0.29	0.68	0.96	1.85	2.53	3.97	5.27	6.5?		0.41	0.75	1.25	1.83	2.81	3.60	*	
Pl. XXXV, fig. 6	6.5	4.3?	4.28	1.0?	0.32	0.60	1.02	1.70	2.31	3.13	3.9?			0.39	0.70	1.20	2.07	2.91	3.94		
Pl. XXXV, fig. 7	8	4.33	3.92?	1.10?	0.23	0.51	0.84	1.35	1.78	2.40	2.81	3.55	4.33	0.30	0.54	0.85	1.32	1.83	2.56	3.40	3.92?
Pl. XXXV, fig. 9	7	*	*	*	0.29	0.53	0.95	1.64	2.20	3.04	4.08	*		0.31	0.64	1.15	1.98	2.66	3.64	*	
Pl. XXXV, fig. 10	6.5	*	*	*	0.30	0.63	0.95	1.60	2.27	2.85	3.76			0.50	0.89	1.43	1.98	2.80	3.7?		
Pl. XXXV, fig. 14	7.5	*	3.63?	*	0.20	0.48	0.77	1.28	1.80	2.31	42	41>		0.26	0.46	0.75	1.24	1.79	2.54	3.27?	
Pl. XXXV, fig. 8	6.2	*	41?	*	0.35	0.74	22	27	35	39	46?			0.43	1.25	1.71	2.37	3.14	3.8?		
Pl. XXXV, fig. 11	7.1	*	*	*	0.33	13	19	27	29	38	42	?		0.55	0.96	1.48	2.22	2.84	3.69	*	
Pl. XXXV, fig. 12	7>	*	*	*	0.25	12	21?	26	31	36?	44	?		0.54	0.89	1.34	1.91	2.66	3.48		
Pl. XXXV, fig. 13	5.7	*	*	*	0.45	14	22?	29	41	41	?			0.70	1.15	1.79	2.40	3.43			

***Schwagerina stabilis* (Rauzer-Chernousova)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXXVI, fig. 1	6.5	5.2?	2.5?	2.1?	0.20	0.64	1.12	1.95	2.86	3.86	4.83			0.27	0.42	0.73	1.09	1.70	2.31		
Pl. XXXVI, fig. 2	7	5.5?	2.42?	2.3?	0.15	0.38	0.98	1.83	2.61	3.61	4.60	5.5?		0.21	0.32	0.51	0.84	1.25	1.86	2.42?	
Pl. XXXVI, fig. 6	8	4.9?	2.43?	2.0?	0.15	0.35	0.79	1.17	1.90	2.46	3.28	4.12	4.9?	0.20	0.28	0.45	0.69	1.00	1.44	1.95	2.43?
Pl. XXXVI, fig. 7	6.5	4.8?	2.22?	2.2?	0.19	0.53	1.07	1.84	2.63	3.66	4.57			0.29	0.44	0.66	0.98	1.41	2.02		
Pl. XXXVI, fig. 8	7.5	4.85	2.51	1.93	0.15	0.32	0.70	1..05	2.04	2.85	3.64	4.42		0.19	0.30	0.43	0.74	1.13	1.72	2.25	
Pl. XXXVI, fig. 9	7.5	6.20	2.84	2.18	0.18	0.48	0.94	1.70	2.47	3.49	4.50	5.58		0.25	0.35	0.56	0.89	1.34	1.80	2.47	
Pl. XXXVI, fig. 10	7.5	6.04	3.03	1.99	0.24	0.40	0.81	1.46	2.13	2.90	4.08	5.38		0.29	0.44	0.63	0.96	1.44	2.01	2.60	
Pl. XXXVI, fig. 12	6.5	4.33	2.25	1.92	0.14	0.29	0.83	1.47	2.35	3.08	3.89			0.19	0.28	0.49	0.87	1.35	1.89		
Pl. XXXVI, fig. 13	7	5.2?	2.45	2.1?	0.16	0.34	0.85	1.62	2.48	3.53	4.39	5.2?		0.22	0.31	0.50	0.80	1.26	1.87	2.45	
Pl. XXXVI, fig. 15	8	6.54	3.47	1.88	0.24	0.54	0.97	1.71	2.54	3.33	4.30	5.43	6.54	0.31	0.47	0.70	1.03	1.56	2.12	2.83	3.47
Pl. XXXVI, fig. 16	8.5	7.4>	4.1>	*	0.22	0.85	1.48	2.42	3.25	4.15	4.90	5.79	6.78	0.30	0.44	0.78	1.25	1.74	2.35	3.02	3.76?
Pl. XXXVI, fig. 14	6..9	*	3.25	*	0.13	8	13	14	19	25	26	31>		0.25	0.36	0.61	1.02	1.65	2.37		

***Sphaeroschwagerina fusiformis* (Krotow)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XXIV, fig. 1	8	6.7?	5.8	1.2?	?	?	0.28?	0.71	1.53	2.62	4.13	5.59	6.7?		?	0.17?	0.27	0.62	1.65	3.11	4.64	5.80	
Pl. XXIV, fig. 2	8	5.95	4.96	1.20?	0.06	6	0.25	0.48	1.20	2.14	3.43	4.72	5.95		0.13	0.15	0.26	0.63	1.60	2.80	3.89	4.96	
Pl. XXIV, fig. 3	8.5	5.7?	4.1?	1.4?	0.05	0.10	0.22	0.51	0.79	1.55	2.30	3.41	4.73		0.12	0.21	0.29	0.46	0.84	1.62	2.60	3.68	
Pl. XXIV, fig. 4	8	5.63	3.95	1.43	0.05	0.11	0.23	0.46	1.04	1.57	2.91	4.30	5.63		0.13	0.20	0.38	0.61	1.13	2.08	3.01	3.95	
Pl. XXIV, fig. 6	8	5.4?	4.25?	1.3?	0.03	0.10	0.18	0.55	1.16	2.13	3.29	4.37	5.4?		0.08	0.09	0.23	0.43	1.16	2.22	2.37	4.25?	
Pl. XXIV, fig. 7	8.5	5.6?	4.30	1.3?	0.05	0.11	0.27	0.65	1.28	2.09	3.05	4.18	5.07		0.10	0.20	0.33	0.68	1.17	2.16	2.98	3.86	
Pl. XXIV, fg. 10	7	5.22	4.49	1.16	0.09	0.17	0.47	1.15	1.85	2.70	4.21	5.22			0.15	0.24	0.40	1.03	2.08	3.29	4.49		
Pl. XXIV, fig. 11	8.5	5.75	4.37	1.32	0.07	0.13	0.21	0.52	1.01	1.61	2.46	3.80	5.23		0.10	0.17	0.27	0.43	0.98	1.75	2.92	3.97	
Pl. XXIV, fig. 16	5.5	*	*	*	0.09	0.18	0.29	1.03	2.05	3.12					0.18	0.28	1.17	1.30	2.18				
Pl. XXIV, fig. 17	7	4.24	3.79	1.12	0.04	0.13	0.23	0.59	1.12	2.02	3.10	4.24			0.10	0.17	0.28	0.56	1.43	2.65	3.79		
Pl. XXIV, fig. 8	8.0	*	4.16	*	0.06	*	*	10	13	15	20	22	33		0.13?	0.18	0.28	0.57	1.24	2.16	3.27	4.16	
Pl. XXIV, fig. 9	8.3	*	4.31	*	0.03	0.07	7	9	11	17	18	20	33	13>	0.09	0.19	0.30	0.56	1.03	1.83	2.99	3.91	
Pl. XXIV, fig. 14	7.5	*	3.74	*	0.04	6?	7	10	13	15	19	20	13>		0.12	0.21	0.34	0.55	1.13	2.15	3.15		
Pl. XXIV, fig. 19	7.1	*	3.93	*	0.06	6	7	10	9	12	18	23	2>		0.13	0.22	0.35	0.78	1.64	2.83	3.91		

***Sphaeroschwagerina pavlovi* (Rauzer-Chernousova)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XXIV, fig. 12	8.5	5.6?	4.1?	1.4?	0.06	0.10	0.20	0.51	0.97	1.55	2.30	3.29	4.38		0.12	0.16	0.29	0.46	0.83	1.60	2.60	3.74	
Pl. XXIV, fig. 13	8	6.35	4.22	1.50	0.09	0.17	0.41	0.83	1.61	2.70	3.73	5..18	6.35		0.15	0.25	0.51	0.88	1.55	2.46	3.40	4.22	
Pl. XXV, fig. 1	9.5	7.9?	*	*	0.03	0.12	0.18	0.44	1.04	1.75	2.63	4.13	5.57	6.93	0.06	0.13	0.21	0.36	0.84	1.71	2.78	3.77	4.58
Pl. XXV, fig. 2	9	7.31	4.75	1.54	0.06	0.10	0.24	0.55	1.02	1.89	2.74	4.20	5.95	7.31	0.16	0.14	0.23	0.36	1.27	2.07	3.00	4.01	4.75
Pl. XXV, fig. 3	7.5	6.67	4.47	1.49	0.08	0.16	0.34	0.86	1.60	2.88	4.37	5.81			0.13	0.19	0.31	0.78	1.82	2.97	4.01		
Pl. XXV, fig. 4	9	5.96?	4.65?	1.28?	0.05	0.10	0.23	0.55	1.06	1.70	2.65	3.78	5.30	5.96?	0.12	0.15	0.22	0.37	0.77	1.54	2.65	3.76	4.65?
Pl. XXV, fg. 5	9	6.48	4.44	1.46	0.06	0.11	0.29	0.55	0.89	1.33	2.20	3.33	4.74	6.48	0.09	0.16	0.29	0.44	0.56	1.50	2.36	3.31	4.44
Pl. XXV, fig. 6	8	5.56	4.11	1.35	0.08	0.16	0.35	0.73	1.40	2.22	3.36	4.56	5.56		0.13	0.20	0.28	0.49	1.10	2.12	3.19	4.11	
Pl. XXV, fig. 7	9	5.62	4.46	1.26	0.07	0.17	0.24	0.45	0.98	1.61	2.43	3.57	4.77	5.62	0.12	0.15	0.23	0.38	0.70	1.48	2.44	3.39	4.46
Pl. XXV, fg. 8	9	6.2?	5.1?	1.2?	0.08	0.11	0.20	0.51	0.96	1.75	2.81	3.92	5.20	6.2?	0.11	0.17	0.26	0.38	0.87	1.75	2.98	4.17	5.1?
Pl. XXV, fig. 9	8	5.91	4.44	1.33	0.07	0.14	0.29	0.59	1.21	2.30	3.64	4.85	5.91		0.13	0.18	0.28	0.69	1.46	2.43	3.46	4.44	
Pl. XXV, fig. 10	8	6.5?	4.7?	1.4?	0.11	0.18	0.36	0.90	1..37	2.45	3.44	5.26	6.5?		0.15	0.22	0.34	0.60	1.60	2.75	3.84	4.7?	
Pl. XXV, fig. 12	8.1	*	4.63	*	0.10	6	13	13	14	17	21	27	30	3>	0.17	0.25	0.47	0.93	1.74	2.56	3.57	4.43	
Pl. XXV, fig. 13	9..2	*	5.35?	*	?	?	?	11?	13	18	22	21	27	32	?	0.16?	0.25	0.46	1.01	2.05	3.10	4.07	4.97
Pl. XXV, fig. 14	8.1	*	5.02	*	0.06	6?	10	12	14	15	*	*	*		0.10	0.14	0.25	0.43	1.18	2.53	3.81	5.01	

Pseudoschwagerina muongthensis **(Deprat)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXV, fig. 11	6.5	7.7?	4.1?	1.9?	0.25	0.61	1.01	2.02	3.15	4.98	7.00			0.40	0.60	0.91	1.34	2.99	3.57		
Pl. XXVI, fig. 3	6	7.38?	4.75	1.55?	0.29	0.54	1.16	2.24	3.93	6.02	7.38?			0.46	0.73	1.28	2.53	3.70	4.75		
Pl. XXVI, fig. 4	6	6.75	4.02	1.68	0.32	0.49	0.98	1.64	3.36	5.20	6.75			0.43	0.64	1.07	1.93	3.06	4.02		
Pl. XXVI, fig. 5	8	7.38	5.21	1.42	0.16	0.33	0.48	1.00	1.55	2.91	4.76	5.98	7.38	0.31	0.41	0.60	1.06	1.99	3.05	4.16	5.21
Pl. XXVI, fig. 7	6.5	6.56?	4.56?	1.44?	0.27	0.56	1.21	2.00	3.54	4.80	6.09			0.45	0.70	1.24	1.69	3.29	4.14		
Pl. XXVI, fig. 8	7	*	5.03	*	0.23	0.44	0.70	1.29	2.19	3.85	5.23			0.35	0.49	0.77	1.35	2.61	3.79	5.03	
Pl. XXVI, fig. 9	6.5	6.50	4.61	1.21	0.24	0.48	0.93	1.75	2.98	4.12	5.78			0.32	0.52	0.81	1.66	2.74	4.10		
Pl. XXVI, fig. 11	5.5	5.81?	3.81	1.52?	0.31	0.48	0.84	1.86	3.36	5.19				0.41	0.65	1.14	2.19	3.38			
Pl. XXVI, fig. 12	5	5.25	3.79	1.39	0.42	0.74	1.31	1.98	3.39	5.25				0.58	0.91	1.55	2.82	3.79			
Pl. XXVI, fig. 13	5.5	5.04	3.46	1.46	0.24	0.45	0.90	1.59	3.10	4.75				0.36	0.55	1.00	1.89	2.94			
Pl. XXVI, fig. 18	6.5	5.5?	3.69	1.5?	0.18	0.36	0.69	1.31	2.03	3.18	4.97			0.23	0.39	0.62	0.99	1.96	3.25		
Pl. XXVII, fig. 1	7.5	7.6?	5.4?	1.4?	0.23	0.36	0.75	1.21	1.96	3.30	4.94	6.6?		0.30	0.44	0.63	1.02	2.05	3.58	4.91	
Pl. XXVII, fig. 3	7	7.4?	4.66	1.6?	0.19	0.38	0.79	1.50	2.52	4.20	6.05	7.4?		0.29	0.49	0.73	1.24	2.37	3.65	4.66	
Pl. XXVII, fig. 4	7	7.54	4.2?	1.8?	0.15	0.31	0.73	1.38	2.14	3.90	5.87	7.54		0.20	0.34	0.55	0.95	2.09	3.19	4.2?	
Pl. XXVII, fig. 5	6.5	6.3?	4.83	1.3?	0.20	0.44	0.92	1.65	2.87	4.31	5.84			0.31	0.53	0.80	1.83	3.18	4.24		
Pl. XXVII, fig. 6	6	6.62	4.00	1.66	0.25	0.43	0.85	1.48	2.77	4.70	6.62			0.34	0.54	0.87	1.71	2.85	4.00		
Pl. XXVII, fig. 7	8	*	4.8?	*	0.14	0.36	0.65	1.03	1.68	2.73	4.47	6.3?	*	0.21	0.34	0.50	0.78	1.30	2.54	3.79	4.8?
Pl. XXVII, fig. 8	6	6.66	4.05	1.64	0.30	0.45	0.83	1.35	2.83	4.66	6.66			0.36	0.58	0.94	1.74	2.91	4.05		
Pl. XXVII, fig. 9	6	5.7?	3.77	1.5?	0.24	0.46	0.90	1.51	2.60	4.27	5.7?			0.29	0.48	0.76	1.47	2.75	3.77		
Pl. XXVII, fig. 10	6.5	5.34	3.66	1.46	0.20	0.41	0.79	1.30	2.04	3.55	4.83			0.28	0.44	0.69	1.05	2.06	3.08		
Pl. XXVII, fig. 12	5	4.80	3.06	1.57	0.31	0.53	0.97	1.60	3.27	4.80				0.34	0.55	0.96	2.05	3.06			
Pl. XXVII, fig. 13	4	*	*	*	0.30	0.65	1.45	2.57	4.02					0.50	0.88	1.71	3.10				
Pl. XXVIII, fig. 12	6	5.5?	4.33	1.3?	0.30	0.37	0.73	1.47	2.73	4.09	5.5?			0.37	0.56	0.91	1.83	3.18	4.33		
Pl. XXVIII, fig. 13	5	4.40	2.85	1.54	0.23	0.46	0.90	1.59	2.84	4.40				0..37	0.56	0.88	1.62	2.85			
Pl. XXVIII, fig. 14	5.5	4.47	2.69	1.66	0.23	0.43	0.82	1.32	2.45	3.71				0.28	0.45	0.70	1.10	2.06			
Pl. XXVIII, fig. 15	5.5	5.78	3.60	1.61	0.29	0.64	0.97	1.55	2.85	4.77				0.45	0.73	1.08	1.93	3.10			
Pl. XXVI, fig. 14	6.9	*	5.14	*	0.17	9	11	14	16	22	28	35>		0.30	0.48	0.88	1.88	3.09	4.31		
Pl. XXVI, fig. 15	5	*	4..63?	*	0.25	12	18	17	20	29				0.44	0.90	1.96	3.31	4.63?			
Pl. XXVI, fig. 16	5.6	*	5.16	*	0.40	12	23	26	24	32	18>			0.71	1.06	1.76	3.15	4.58			
Pl. XXVI, fig. 17	6.6	*	3.98	*	0.27	11	19	24	26	27	29	24>		0.51	0.75	1.08	1.86	2.87	3.94		
Pl. XXVI, fig. 22	4..2	*	4.11	*	0.43	14	20	16	25	7>				0.75	1.42	2.66	3.94?				
Pl. XXVI, fig. 24	5.2	*	3.96	*	0.31	12	19	21	20	28	6>			0.49	0.71	1.34	2.60	3.71			
Pl. XXVI, fig. 26	6.2	*	4..49	*	0.24	11	19	21	22	23	34	6>		0.46	0.69	1.14	2.13	3.44	4.48		
Pl. XXVII, fig. 15	5.3	*	4.77	*	0.28	12	22	24	25	32	10>			0.52	0.79	1.56	2.78	4.15			
Pl. XXVII, fig. 16	6.7	*	4.98	*	0.26	10	20	27	31	33	36	37>		0.37	0.60	0.95	1.79	2.86	4.06		
Pl. XXVIII, fig. 11	5.2	*	3.63	*	0.24	11	19	21	22	31	9>			0.40	0.62	1.00	2.26	3.41			

Pseudoschwagerina miharanoensis **Akagi**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloculus	Length of whorl/Number of septa					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. XXVIII, fig. 1	4.5	10.25	4.8?	2.1?	0.59	1.54	3.15	5.92	8.62		0.91	1.93	3.24	4.35	
Pl. XXVIII, fig. 2	3.5	6.59	4.34	1..52	0.57	1,16	2.90	5.44			0.89	2.17	3.76		
Pl. XXVIII, fig. 3	5	8.84	4.45	1.99	0.41	0.71	2.07	3.82	6.59	8.84	0.58	1.03	2.10	3.41	4.45
Pl. XXVIII, fig. 5	4.5	8.0?	4.96?	1.6?	0.53	1.34	2.87	5.19	7.15		0.93	2.11	3.36	4.4?	
Pl. XXVIII, fig. 6	4.5	8.4?	4.8?	1.8?	0.61	1.27	2.91	5.17	7.43		0.84	1.84	3.25	4.32?	
Pl. XXVIII, fig. 7	5	8.7?	4.36?	2.0?	0.45	0.88	2.45	4.15	6.92	8.7?	0.59	1.17	2.30	3.48	4.36?
Pl. XXVIII, fig. 4	4	*	3.70	*	0.35	11	17	21	28		0.89	1.44	2.65	3.70	
Pl. XXVIII, fig. 9	3.8	*	3.99	*	0.58	11	19	22	23>		0.73	2.28	3.41		
Pl. XXVIII, fig. 10	2.9?	*	4.38	*	0.76	12	18	24>			1.63	3.05?			

Alpinoschwagerina nagatoensis **n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXX, fig. 5	7>	*	*	*	0.08?	0.15?	0.30	0.63	1.05	2.47	4.28	6.29	*	0.12?	0.19	0.30	0.50	1.25	2.46	3.4?	*
Pl. XXX, fig. 6	6.5	*	*	*	?	0.15?	0.26	0.60	1.27	2.64	4.30			0.14?	0.20	0.36	0.79	1.86	3.02		
Pl. XXX, fig. 8	8	7.0?	4.8?	1..5?	0.10	0.22	0.40	0.71	1.22	2.28	3.71	5.44	7.0?	0.16	0.25	0.41	0.62	1.27	2.48	3.76	4.8?
Pl. XXX, fig. 14	8.5	6.5?	4.9?	1.3?	0.08	0.10	0.17	0.48	0.87	1.71	2.94	4.46	5.89?	0.11	0.21	0.38	0.60	1..20	2.42	3.47	4.4?
Pl. XXX, fig. 15	7	5.6?	*	*	0.10	0.23	0.47	0.97	1.53	2.80	4.49	5.6?		0.16	0.24	0.41	0.73	1.64	2.48?	*	
Pl. XXX, fig. 18	7>	*	*	*	0.10	0.17	0.35	0.69	1.41	2.25	3.64	5.55		0.14	0.20	0.34	0.60	1.36	2.60	3.82	
Pl. XXX, fig. 20	7.5	6.4?	3.7?	1.7?	0.09	0.16	0.27	0.58	1.20	2.40	4.15	5.65		0.13	0.19	0.30	0.53	1.30	2.36	3.25	
Pl. XXX, fig. 7	6.3	*	3.34	*	0.07	6	11	15	18	18	24	9>		0.14	0.23	0.38	0.87	1.84	3.02		
Pl. XXX, fig. 9	6.7	*	4.2?	*	0.09	7	12	13	17	17	29	?		0.19	0.31	0.54	1.29	2.40	3.37		
Pl. XXX, fig. 11	5.6	*	2.49	*	0.08	0.12	10	14	16	17				0.15	0.23	0.35	0.84	1.92			
Pl. XXX, fig. 13	7.2	*	4.95?	*	0.09	?	?	11?	13	16	24	31?		0.13?	0.20	0.32	0.80	1.95	3.41	4.73	

***Darvasoschwagerina shimodakensis* (Kanmera)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXIX, fig. 1	8	9.7?	4.8?	2.0?	0.06?	0.24	0.51	1.25	1.89	2.86	5.03	7.58	9.7?	0.15	0.17	0.32	0.72	1.46	2.91	4.13	4.8?
Pl. XXIX, fig. 2	8	8.9?	5.5?	1.6?	0.05?	0.20	0.45	0.87	1.60	2.92	4.47	6.74	8.9?	0.16?	0.17	0.32	0.64	1..59	3.13	4.47	55?
Pl. XXIX, fig. 3	8	8.90	5.24	1.70	0.05	0.18	0.42	0.86	1.73	3.02	5.04	6.97	8.90	0.10	0.17	0.25	0.57	1.65	2.93	4.34	5.24
Pl. XXIX, fig. 9	7	5.6?	2.95?	1.9?	0.09	0.24	0.53	1.13	1.88	2.91	4.52	5.6?		0.13	0.21	0.34	0.59	1.21	2.10	2.95?	
Pl. XXIX, fig. 14	6.5	4.86	2.59	1.88	0.07	0.16	0.35	0.88	1.71	2.79	4.03			0.09	0.18	0.31	0.64	1.30	2.11		
Pl. XXIX, fig. 15	8.5	*	*	*	0.06	0.17	0.28	0.71	1.42	2.65	4.33	6.17	8.3?	0.08	0.15	0.24	0.43	0.96	1.80	2.97?	*
Pl. XXIX, fig. 7	7.1	*	4.07	*	0.04	?	10?	13	16	25	31	40	2>	0.10	0.16	0.29	0.80	1.54	2.79	4.05	
Pl. XXIX, fig. 10	6.1	*	3.13	*	0.04	?	9?	14	19	21	3>			0.12	0.19	0.29	0.68	1.76	3.12		
Pl. XXIX, fig. 11	7.5	*	4.7?	*	0.04	?	9	15	18	22	34	20>		0.11	0.19	0.29	0.54	1.37	2.80	4.16	
Pl. XXIX, fig. 12	6.2	*	2.95	*	0.05	7?	10	13	17	22	32	7>		0.11	0.18	0.30	0.76	1.73	2.89		

***Darvasoschwagerina*? sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XXXV, fig. 19	8.4	*	3.48	*	0.04	6	11	15	21	29	32	45	41	24>	0.18	0.30	0.50	0.85	1.21	1.73	2.36	3.15	

***Paraschwagerina akiyoshiensis* Toriyama**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXX, fig. 1	6.5	6.81	3.80	1.79	0.11	0.32	0.76	1.09	1.95	3.44	5.63		0.15	0.29	0.50	0.84	1.91	3.36	
Pl. XXX, fig. 2	7	6.2?	3.5?	1.8?	0.07	0.23	0.51	0.89	1.46	2.90	4.73	6.2?	0.13	0.21	0.35	0.55	1.27	2.35	3.5?
Pl. XXX, fig. 4	7	5.2?	3.1?	1.7?	0.05	0.14	0.36?	0.99	1.40	2.13	3.60	5.2?	0.13	0.19?	0.35	0.58	0.99	2.01	3.1?
Pl. XXXI, fig. 2	7	*	*	*	0.06	0.15	0.35	0.81	1.48	2.80	4.87	*	0.13	0.22	0.28	0.53	1.24	2.45	*
Pl. XXXI, fig. 3	6.5	4.83?	2.74	1.76?	0.06	0.23	0.41	0.84	1.66	2.97	4.38		0.12	0.21	0.32	0.59	1.35	2.30	
Pl. XXXI, fig. 5	7	*	3.00	*	0.08	0.19	0.39	0.95	1.78	3.13	4.66	*	0.11	0.18	0.33	0.48	1.18	2.24	3.00
Pl. XXX, fig. 3	6.8	*	3.6?	*	?	?	?	16	22	24	28	?	0.13?	0.24?	0.42	0.75	1.65	2..83	

***Paraschwagerina* cf. *karachatypica* (Bensh)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXI, fig. 7	7	5.94?	*	*	0.07	0.17	0.47	1.06	2.05	3.24	4.82	5.94?	0.14	0.20	0.35	0.75	1.37	2.43	*
Pl. XXXI, fig. 8	7	5.7?	3.50	1.6?	0.11	0.24	0.54	1.36	2.09	3.40	4.68	5.7?	0.15	0.25	0.46	0.93	1.72	2.81	3.50
Pl. XXXI, fig. 9	7	5.60	3.79	1.48	0.09	0.31	0.63	1.20	2.06	3.17	4.59	5.60	0.17	0.24	0.45	0.86	1.65	2.76	3.79
Pl. XXXI, fig. 11	7	*	*	*	0.09	0.20	0.37	0.87	1.53	2.72	4.84	*	0.15	0.23	0.34	0.65	1.25	2.10	*

***Paraschwagerina*? sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXV, fig. 17	7.5	8.8>	4.8?	*	0.04	0.20	0.47	0.77	1.43	2.85	4.96	7.8>	0.07	0.17	0.30	0.60	1.38	2..90	4.4?

***Eoparafusulina ellipsoidalis* (Toriyama)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XXXI, fig. 18	7.5	5.3>	1.43	*	0.15	0.43	0.80	1.29	1.86	0.37	*	*		0.19	0.28	0.39	0.54	0.76	0.95	1.27	
Pl. XXXI, fig. 23	7	*	2.12	*	0.20	0.64	1.13	1.70	2.45	*	*	*		0.28	0.40	0.57	0.81	1.14	1.63	2.12	
Pl. XXXI, fig. 24	8	4.93	1.90	2.59	0.15	0.31	0.74	1.20	1.62	2.21	2.94	3.75	4.93	0.20	0.29	0.43	0.61	0.84	1.08	1.46	1.90
Pl. XXXI, fig. 26	7	4.9?	1.70	2.9?	0.16	0.41	0.84	1.52	2.20	3.12	4.05	4.9?		0.20	0.28	0.42	0.62	0.90	1.23	1.70	
Pl. XXXI, fig. 27	8	5.95	1.79?	3.32?	0.16	0.39	0.99	1.27	1.86	2.40	3.59	4.80	5.95	0.21	0.29	0.41	0.56	0.78	1.03	1.41	1.79?
Pl. XXXI, fig. 28	7	6.13	1.73?	3.54?	0.16	0.37	0.72	1.47	2.22	3.71	4.99	6.13		0.19	0.29	0.43	0.63	0.92	1.29	1.73?	
Pl. XXXII, fig. 1	7	3.46	1.62	2.14	0.19	0.45	0.98	1.37	1.83	2.23	2.84	3.46		0.25	0.36	0.52	0.73	0.98	1.25	1.62	
Pl. XXXII, fig. 9	7.5	*	1.8?	*	0.17	0.47	0.76	1.30	1.91	2.80	3.29	4.14		0.23	0.34	0.47	0.65	0.91	1.22	1.58?	
Pl. XXXII, fig. 13	8	4.15	1.68	2.47	0.11	0.33	0.77	1.12	1.66	2.09	2.75	3.53	4.15	0.18	0.27	0.39	0.53	0.68	0.96	1.24	1.68
Pl. XXXII, fig. 18	7	4.31	1.65	2.61	0.10	0.30	0.65	1.04	1..67	2.30	3.37	4.31		0.16	0.25	0.36	0.56	0.80	1.24	1.65	
Pl. XXXI, fig. 20	6.7	*	1.86	*	0.20	7	13	15	13	15	19	16>		0.22	0.34	0.46	0.68	0.99	1.40		
Pl. XXXI, fig. 21	6.7	*	1.70	*	0.13	9	15	18	17	22	19>			0.21	0.30	0.45	0.67	1.02	1..41		
Pl. XXXII, fig. 5	8.0	*	1.96	*	0.13	7	12	14	18	21	25	20	25	0.18	0.29	0.41	0.56	0.75	1.06	1.46	1.96
Pl. XXXII, fig. 6	7.9	*	1.99	*	0.17	8	14	16	18	18	20	22	18>	0.24	0.33	0.43	0.60	0.83	1.11	1.55	
Pl. XXXII, fig. 14	7.4	*	2.03	*	0.12	8	10	11	12	15	17	20	20>	0.18	0.27	0.47	0.54	0.92	1.35	1.83	
Pl. XXXII, fig. 15	6.7	*	2.01	*	0.17	8	15	15	15	17	20	19>		0.27	0.42	0.64	0.87	1.25	1.67		
Pl. XXXII, fig. 16	6.5	*	1.64	*	0.15	8	11	13	16	19	20	12>		0.24	0.34	0.54	0.79	1.03	1.45		

Pseudochusenella gregaria **(Lee)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXVI, fig. 24	7.5	4.99	2.02	2.47	0.13	0.23	0.56	1.08	1.62	2.55	3.46	4.29	0.18	0.25	0.36	0.54	0.85	1.29	1.76
Pl. XXXVI, fig. 26	6.5	5.91	2.09	2.83	0.18	0.54	1.00	1.87	2.85	3.80	5.04		0.24	0.37	0.55	0.84	1.24	1.80	
Pl. XXXVI, fig. 27	7	5.7?	2.14?	2.7?	0.17	0.24	0.83	1.50	*	*	*		0.23	0.34	0.50	0.82	1.17	1.71	2.14?
Pl. XXXVI, fig. 17	6.6	*	2.1	*	0.15	8	16	20	22	24	26	15>	0.2	0.33	0.50	0.82	1.25	1.78	

Pseudochusenella explicata **(Leven & Shcherbovich)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XXXVII, fig. 7	7.5	5.85	2.54	2.30	0.21	0.43	0.98	1.45	2.24	3.12	4.23	5.41			0.24	0.37	0.56	0.82	1.18	1.64	2.24		
Pl. XXXVII, fig. 9	9	5.6?	2.90?	1.9?	0.14	0.33	0.73	1.10	1.75	2.38	3.15	3.92	4.84	5.6?	0.21	0.27	0.38	0.56	0.83	1.16	1.65	2.27	2.90?
Pl. XXXVII, fig. 11	7	5.02	2.36	2.13	0.18	0.35	0.77	1.40	2.03	2.75	3.90	5.02			0.21	0.34	0.55	0.84	1.23	1.75	2.36		
Pl. XXXVII, fig. 12	7.5	5.55	2.40	2.31	0..10	0.24	0.70	1.32	2.01	2.59	3.71	4.98			0.17	0.25	0.42	0.69	1.04	1.59	2.18		
Pl. XXXVII, fig. 13	8	6.02	2.55?	2.36?	0.17	0.48	0.89	1.55	2.23	2.85	3.67	5.06	6.02		0.24	0.33	0.50	0.75	1.04	1.51	2.08	2.55?	
Pl. XXXVII, fig. 16	7	5.2?	2.06	2.5?	0.16	0.46	0.93	1.58	2.41	3.20	4.36	5.2?			0.20	0.28	0.45	0.68	1.09	1.55	2.06		
Pl. XXXVII, fig. 20	6.5	4.0?	2.04	2.0?	0.15	0.40	0.82	1.36	2.05	2.77	3.57				0.21	0.29	0.46	0.76	1.18	1.74			
Pl. XXXVII, fig. 22	7	4.44	2.17	2.05	0.13	0.21	0.65	1.22	1.80	2.47	3.45	4.44			0.18	0.27	0.43	0.72	1.09	1.59	2.17		
Pl. XXXVII, fig. 23	8	5.67	2.80	2.03	0.12	0.34	0.69	1.25	1.96	2.70	3.48	4.57	5.67		0.18	0.25	0.41	0.64	1.02	1.47	2.02	2.80	
Pl. XXXVII, fig. 26	6	3.33	1.55	2.15	0.12	0.30	0.72	1.37	2.00	2.58	3.33				0.21	0.34	0.53	0.79	1.14	1.55			
Pl. XXXVII, fig. 28	7	4.7?	2.04?	2.3?	0.15	0.45	0.92	1.56	2.28	2.94	3.80	4.7?			0.20	0.35	0.53	0.81	1.14	1.60	2.04?		
Pl. XXXVII, fig. 31	7.5	*	*	*	0.14	0.32	0.66	1.04	1.57	2.18	2.81	3.46			0.18	0.26	0.40	0.61	0.89	1.27	1.70		
Pl. XXXVII, fig. 32	8	4.03?	2.02	2.00?	0.11	0.24	0.60	1.05	1.67	2.22	2.70	3.37	4.03?		0.16	0.24	0.33	0.53	0.79	1.10	1.53	2.02	
Pl. XXXVII, fig. 34	6	3.9?	1.75	2.2?	0.16	0.46	0.96	1.55	2.28	3.06	3.9?				0.22	0.32	0.51	0.80	1.24	1.75			
Pl. XXXVII, fig. 35	7	4.84	1.90	2.55	0.14	0.30	0.60	1.13	2.02	2.74	3.57	4.84			0.16	0.24	0.39	0.64	0.97	1.35	1.90		
Pl. XXXVII, fig. 17	6.2	*	2.05	*	0.12	7	11	13	16	20	?	4>			0.24	0.36	0.54	0.84	1.36	1.95			
Pl. XXXVII, fig. 21	6.5	*	1..85	*	0.18	9	14	21	24	20	23	15>			0.24	0.37	0.55	0.84	1.19	1.57			
Pl. XXXVII, fig. 25	5.9	*	1.99	*	0.15	9	12	16	18	22>					0.27	0.43	0.65	1.01	1.51				

Rugosochusenella shagonensis **Davydov**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. 37 fig. 4	6.5	5..5>	1.95	*	0.15	0.44	0.97	1.74	2.68	3.60	4.67			0.22	0.33	0.48	0.70	1.12	1.62		
Pl. XXXVII, fig. 5	7	5.4?	2.13	2.5?	0.07	0.35	0.74	1.52	2.43	3.46	4.44	5.4?		0.13	0.23	0.37	0.60	0.97	1.48	2.13	
Pl. XXXVII, fig. 6	8	5.5>	2.16	*	0.08	0.25	0.55	1.03	1.8?	2.7?	*	*	*	0.13	0.18	0.29	0.41	0.69	1.10	1.55	2.16

Rugosochusenella **sp. A**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXVI, fig. 18	7	5.92	2.65?	2.23?	0.10	0.24	0.70	1.39	2.30	3.37	4.66	5.92	0.16	0.24	0.39	0.73	1.24	2.00	2.65?
Pl. XXXVI, fig. 19	7	5.8>	2.1?	*	0.18	0.34	0.76	1.60	2.47	3.49	4.54	5.8>	0.21	0.28	0.52	0.83	1.17	1.68	2.1?

Rugosochusenella **sp. B**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXVI, fig. 21	7.5	6.35	2.12	3.00	0.09	0.23	0.66	1.02	1.88	2.83	3.95	5.16	0.13	0.20	0.29	0.45	0.78	1.22	1.84
Pl. XXXVI, fig. 22	7.5	*	2.14?	*	0.05	0.27	0.55	.1.11	*	*	*	*	0.12	0.21	0.31	0.47	0.83	1.30	1.87
Pl. XXXVI, fig. 23	7	5.8>	2.31	*	0.13	0.33	0.60	1.1?	*	*	*	*	0.20	0.32	0.44	0.69	1.05	1.64	2..31
Pl. XXXVI, fig. 29	5.8	*	2.03	*	0.13	7	10	14	21	21	21>		0.20	0.32	0.53	0.86	1.36		

***Jigulites horridus* (Kanmera)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XXXVIII, fig. 1	6	9.03	3.03	2.98	0.25	0.66	1.33	3.00	5.05	7.72	9.03		0.39	0.71	1.15	1.74	2.37	3.03	
Pl. XXXVIII, fig. 2	6	8.35	2.82	2.96	0.25	0.68	1.27	2.15	3.62	5.84	8.35		0.31	0.55	0.96	1.54	2.16	2.82	
Pl. XXXVIII, fig. 3	6.5	9.37	2.93	3.20	0.24	0.47	0.98	2.04	3.53	5.45	7.49		0.28	0.58	0.76	1.20	1.89	2.60	
Pl. XXXVIII, fig. 4	5.5	7.41	2.75	2.69	0.19	0.64	1.27	2.49	3.90	6.33			0.34	0.49	0.92	1.52	2.31		
Pl. XXXVIII, fig. 5	4.5	8.05	2.54	3.17	0.32	0.85	2.01	3.78	6.75				0.54	0.91	1.49	2.23			
Pl. XXXVIII, fig. 6	5.5	8.19	2.72	3.01	0.24	0.64	1.51	2.83	4.56	7.31			0.43	0.57	1.03	1.59	2.30		
Pl. XXXVIII, fig. 7	6	8.5?	3.3?	2.6?	0.27	0.70	1.30	2.80	4.77	6.65	8.5?		0.36	0.62	1.06	1.72	2.48	3.3?	
Pl. XXXVIII, fig. 8	6.5	9.2?	2.79	3..3?	0.23	0.41	0.96	1.88	3.45	5.56	8.13		0.29	0.59	0.75	1.20	1.78	2.49	
Pl. XXXVIII, fig. 9	5.5	8.6?	2.77	3.1?	0.25	0.65	1..40	2.79	4.26	7.09			0.37	0.64	1..13	1.74	2.42		
Pl. XXXVIII, fig. 10	4..5	8.12	2.76	2.94	0.28	0.87	2.22	4.10	7.22				0.48	0.87	1.51	2.33			
Pl. XXXVIII, fig. 11	5.5	9.03	2.87	3.15	0.27	0.53	1.92	2.56	4.60	7.42			0.35	0.64	1.10	1.84	2.50		
Pl. XXXVIII, fig. 13	5	7.36	2.65	2.78	0.31	0.70	1.76	3.19	5.56	7.36			0.44	0.75	1.23	1.94	2.65		
Pl. XXXVIII, fig. 17	5.5	7.98	2.49	3.20	0.22	0.45	1.13	2.41	4.48	6.97			0.29	0.46	0.86	1.46	2.22		
Pl. XXXIX, fig. 1	5.5	10.7?	3.11	3.4?	0.26	0.78	1.65	3.07	5.23	9.50			0.39	0.69	1.20	1.86	2.71		
Pl. XXXIX, fig. 2	5	6.60	2.33	2.83	0.30	0.69	1.21	2.65	4.88	6.60			0.41	0.65	1.04	1.64	2.33		
Pl. XXXIX, fig. 5	5	9.8?	3.27	3.0?	0.35	0.94	2.00	3.56	7.32	9.8?			0.60	1.01	1.76	2.55	3.27		
Pl. XXXIX, fig. 6	6	7.55	2.73?	2.77?	0.22	0.43	1.19	2.05	3.63	5.77	7.55		0.31	0.53	0.89	1.44	2.13	2.73?	
Pl. XXXIX, fig. 7	5>	*	*	*	0.33	1.07	1.89	3.68	6.30	8.3?			0.47	0.77	1.31	2.09	2.70		
Pl. XXXIX, fig. 8	6	8.1?	2.48?	3.3?	0.25	0.51	1.01	1.75	3.52	5.72	8.1?		0.31	0.49	0.88	1.25	1.88	2.48?	
Pl. XXXIX, fig. 9	5	7.6?	2.76	2.8?	0.31	0.80	1.52	2.74	4.82	7.6?			0.51	0.80	1.29	1.95	2.76		
Pl. XXXIX, fig. 10	6	8.35	3.04	2.75	0.29	0.82	1.70	2.73	4.10	5.97	8.35		0.45	0.73	1.11	1.68	2.35	3.04	
Pl. XXXIX, fig. 11	5	*	3.19?	*	0.30	0.85	2.05	3.63	6.34				0.51	0.93	1.59	2.37	3.19?		
Pl. XXXIX, fig. 12	5.5	7.55	2.78	2.72	0.26	0.77	1.59	2.91	4.90	6.83			0.35	0.58	1.07	1.71	2.47		
Pl. XXXIX, fig. 13	5.5	6.88	2.43	2.83	0.24	0.67	1.40	2.42	3.91	6.24			0.34	0.53	0.90	1.41	2.06		
Pl. XXXIX, fig. 14	5	6.25	2.07	3.02	0.27	0.79	1.78	3.30	4.92	6.25			0.41	0.89	1.04	1.54	2.07		
Pl. XXXIX, fig. 15	6	7.3?	2.6?	2.9?	0.23	0.60	1.36	2.34	3.59	5.30	7.3?		0.32	0.51	0.80	1.28	1.87	2.6?	
Pl. XXXIX, fig.16	5.5	6.30	2.16	2.92	0.25	0.60	1.35	2.60	4.08	5.60			0.31	0.58	0.95	1.44	1.90		
Pl. XXXIX, fig. 17	5	7.11	3.2?	2.2?	0.34	0.89	1.68	3.46	5.35	7.11			0.42	0.67	1.49	2.28	3.2?		
Pl. XXXVIII, fig. 14	5.7	*	2.94	*	0.28	13	23	28	26	25	22>		0.47	0.83	1.24	1.82	2.58		
Pl. XXXVIII, fig. 15	4.6	*	3.03	*	0.34	13	24	27	34	23>			0.58	0.97	1.57	2.58			
Pl. XXXVIII, fig. 16	6.2	*	3.56?	*	0.22	11	22	24	33	29	35?	7>	0.37	0.61	1.12	1.75	3.40		
Pl. XXXVIII, fig. 18	4.6	*	2.65	*	0.33	14	21	26	29	17>			0.60	1.01	1.60	2.35			
Pl. XXXVIII, fig. 19	5.5	*	2.88	*	0.22	8	20	25	28	31	15>								
Pl. XXXVIII, fig. 20	5.8	*	2.65	*	0.19	10	18	25	31	31	24>		0.34	0.65	1.08	1.59	2.30		
Pl. XXXIX, fig. 18	6.2	*	2.80	*	0.19	10	18	19	22	24	25	7>	0.37	0.59	0.88	1.39	2.06	2.69	
Pl. XXXIX, fig. 19	5.7	*	3.08	*	0.25	12	21	24	28	33	24>		0.44	0.73	1.12	1.75	2.49		
Pl. XXXIX, fig. 20	5.4	*	2.56	*	0.21	8	16	25	29	36	15>		0.28	0.56	0.97	1.56	2.20		

***Jigulites titanicus* n. sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XL, fig. 1	5	12.22	4.38	2.79	0.50	1.52	2.87	5.30	8.89	12.22			0.80	1.30	2.19	3.38	4.38		
Pl. XL, fig. 2	4.5	14.5>	4.03	*	0.55	*	*	*	*				0.86	1.38	2.35	3.53			
Pl. XL, fig. 3	4.5	12.0>	3.7>	*	0.56	1.04	*	*	*				0.80	1.41	2.27	3.3?	3.7>		
Pl. XL, fig. 4	5.5	11.2?	3.48	3.2?	0.31	0.96	2.28	4.07	6.24	9.48			0.53	0.89	1.35	2.20	3.04		
Pl. XL, fig. 5	5.5	11.5?	3.72	3.1?	0.39	0.78	1.77	3.41	6.62	10.06			0.50	0.84	1.36	2.16	3.28		
Pl. XL, fig. 6	4.5	11.0>	2.89	*	0.44	0.91	2.60?	5.95?	9.60?				0.62	1.03	1.73	2.55			
Pl. XL, fig. 10	5	11.9?	4.75?	2.5?	0.51	1.30	2.22	4.44	7.83				0.72	1.24	2.05	3.31	4.75?		
Pl. XLI, fig. 1	5	11.32	3.0?	3.8?	0.46	0.77	2.15	4.60	7.94	11.32			0.71	1.05	1.59	2.34	3.0?		
Pl. XLI, fig. 4	6	10.85	3.6?	3.0?	0.29	0.76	1.59	2.78	4.70	6.89	10.85		0.46	0.77	1.18	1.63	2.72	3.6?	
Pl. XLI, fig. 5	7	6.37	2.50	2.55	0.05	0.09	0.23	0.60	1.27	2.03	3.71	6.37	0.10	0.19	0.28	0.46	0.81	1.12	2.50
Pl. XLI, fig. 6	4	10.0>	3.46	*	0.65	1.70	*	*	*				0.96	1.70	2.63	3.46			
Pl. XLI, fig. 9	5	9.5?	3.60	2.6?	0.40	1.02	2.51	4.31	6.80	9.5?			0.57	1.00	1.65	2.67	3.60		
Pl. XLI, fig. 10	5.5	*	3.83	*	0.34	0.84	2.01	3.46	*	*			0.49	0.93	1.60	2.54	3.47		
Pl. XLI, fig. 11	5	9.5?	3.46	2.7?	0.52	0.89	*	*	*	*			0.71	1.25	1.82	2.63	3.46		
Pl. XLI, fig. 12	5	*	3.95?	*	0.56	1.34	2.98	5.90	*	*			0.80	1.36	2.19	3.16	3.95?		
Pl. XLI, fig. 13	5	8.3>	3.6?	*	0.43	0.96	1.95	3.07	5.80	8.3>			0.55	0.96	1.72	2.75	3.6?		
Pl. XLI, fig. 14	5	*	*	*	0.45	1.00	2.33	4.99	8.63	*			0.61	1.10	1.74	2.48	*		
Pl. XLI, fig. 15	4.5	8.9?	2.49?	3.6?	0.44	0.98	2.80	6.20	8.9?				0.64	1.08	1.70	2.49			
Pl. XL, fig. 7	5.4	*	3.96	*	0.34	10	19	25	27	34	19>		0.55	1.07	1.80	2.71	3.67		
Pl. XL, fig. 8	5.2	*	4.25	*	0.49	15	26	30	35	38	7>		0.82	1.29	2.08	3.05	4.03		
Pl. XL, fig. 9	6.0	*	3.76	*	0.27	10	21	22	24	31	32		0.49	0.75	1.26	2.01	2.87	3.76	
Pl. XLI, fig. 2	5.2	*	3.14	*	0.36	15	25	26	31	31	5>		0.38	0.98	1.40	2.10	3.05		
Pl. XLI, fig. 3	4.2	*	2.57	*	0.37	14	18	22	25	5>			0.63	0.99	1.40	2.26			
Pl. XLI, fig. 7	5.7	*	3.74?	*	0.35	9	24	31	29?	35	28>		0.65	1.00	1.56	2.39?	3.24		
Pl. XLI, fig. 8	5.0	*	3.20	*	0.37	11	23	27	24	27			0.66	1.05	1.70	2.47	3.20		

Jigulites magnus **(Rozovskaya)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLII, fig. 1	6.5	*	3.24	*	0.22	0.39	1.20	2.25	3.48	4.72	6.2?		0.34	0.60	0.98	1.50	2.11	2.78	
Pl. XLII, fig. 2	6	7.73	3.10	2.49	0.24	0.75	1.54	2.53	4.23	6.15	7.73		0.35	0.59	0.93	1.50	2.35	3.10	
Pl. XLII, fig. 3	5.5	*	3.18	*	0.26	0.89	1.71	2.99	5.40	7.44			0.56	0.89	1.46	2.11	2.86		
Pl. XLII, fig. 4	6	8.26?	3.46	2.39?	0.20	0.56	1.23	2.50	3.87	6.00?	8.26?		0.28	0.53	0.93	1.61	2.54	3.46	
Pl. XLII, fig. 6	6.5	*	3.55	*	0.31	0.57	1.17	2.15	3.33	5.42	7.44		0.38	0.64	1.07	1.73	2.49	3.23	
Pl. XLII, fig. 8	6.5	8.1?	3.32	2.4?	0.32	0.58	1.25	2.39	3.74	5.85	7.40		0.44	0.66	1.01	1.54	2.30	2.97	
Pl. XLII, fig. 9	6	7.16	3.07	2.33	0.21	0.60	1.23	2.13	3.46	5.40	7.16		0.27	0.54	0.88	1.34	2.13	3.07	
Pl. XLII, fig. 10	5.5	6.13	2.69	2.28	0.20	0.61	1.17	1.95	3.41	5.60			0.35	0.57	0.96	1.56	2.30		
Pl. XLII, fig. 11	5	6.28	2.75	2.28	0.33	0.74	1.44	3.14	4.73	6.28			0.45	0.85	1.20	1.96	2..75		
Pl. XLII, fig. 12	6	7.10	2.92	2.43	0.31	0.53	1.26	2.37	3.87	5.48	7.10		0.34	0.59	0.97	1.55	2.23	2.92	
Pl. XLII, fig. 14	5.5	*	2.70	*	0.22	0.77	1.45	2.33	4.19	5.86			0.34	0.58	0.95	1.61	2.38		
Pl. XLII, fig. 17	5.1	*	2.89	*	0.26	11	19	24	29	32	2>		0.43	0.73	1.27	2.02	2.80		
Pl. XLII, fig. 18	6.3	*	4.35	*	0.25	12	21	28	32	35	38	11>	0.53	0.85	1.41	2.14	3.04	4.00	

***Jigulites*? sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa									Width of whorl								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Pl. XXXV, fig. 16	8	8.3?	3.4?	2.4?	0.10	0.23	0.51	1.14	2.03	3.37	4.83	6.40?	8.3?		0.17	0.23	0.37	0.71	1.26	2.06	2.78	3.4?	

Daixina sokensis **Rauzer-Chernousova**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XLIII, fig. 1	5.5	8.0>	3.79	*	0.29	0.70	1.63	2.71	4.54	7.10		0.50	0.89	1.43	2.22	3.36	
Pl. XLIII, fig. 2	6	6.75	3.24	2.08	0.22	0.51	0.82	1.47	3.28	4.95	6.75	0.36	0.55	0.87	1.45	2.38	3.24
Pl. XLIII, fig. 4	6	6.95	3.85?	1.81?	0.40	0.67	1.56	2.43	3.46	5.19	6.95	0.48	0.79	1.42	2.21	3.05	3.85?
Pl. XLIII, fig. 5	4.5	*	*	*	0.27	0.47	1.45	3.12	*			0.45	0.77	1.40	2.21		
Pl. XLIII, fig. 6	5	6.17	2.55	2.42	0.35	0.61	1.49	2.43	4.32	6.17		0.44	0.72	1.14	1.81	2.55	
Pl. XLIII, fig. 3	4.8	*	2.63	*	0.32	10	20	26	24	22>		0.54	0.91	1.40	2.04		
Pl. XLIII, fig. 7	5	*	3..20	*	0.29	10	20	21	29	25		0.43	0.76	1.39	2.19	3.20	

***Daixina parva* (Belyaev)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XLIII, fig. 8	5	7.43	4.05	1.83	0.40	0.90	1.76	2.87	5.11	7.43		0.41	1..14	1.86	2..99	4.05	
Pl. XLIII, fig. 11	6	7.4?	3.48	2.1?	0.26	0.70	1.15	2.13	3.35	3.58	7.4?	0.44	0.71	1.10	1.75	2.72	3.48
Pl. XLIII, fig. 13	5	6.4?	2.96	2.2?	0.44	0.69	1.16	2.40	4.69	6.4?		0.54	0.84	1.28	2.01	2.96	
Pl. XLIII, fig. 14	6.5	7.3>	2.95	*	0.19	0.41	0.87	1.66	2.46	4.00	6.44	0.33	0.49	0.76	1.10	1.70	2.44
Pl. XLIII, fig. 15	6	6.3?	3.62	1.7?	0.32	0.43	1.23	2.20	3..58	4.87	6.3?	0.41	0.67	1.18	1.94	2.79	3.62
Pl. XLIII, fig. 18	5	5.9?	2.84	2.1?	0.37	0.83	1.67	2.85	4.62	5.9?		0.53	0.88	1.41	2.20	2.84	

***Daixina fecunda* (Shamov & Shcherbovich)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLIV, fig. 1	5.5	7.28	2.70	2.70	0.25	0.43	1.21	2.60	3.26	6.09			0.35	0.61	0.98	1.59	2.34		
Pl. XLIV, fig. 2	6.5	6.2?	2.85	2.2?	0.20	0.44	1.07	1.95	3.11	4.44	5.72		0.31	0.50	0.84	1.44	2.08	2.59	
Pl. XLIV, fig. 3	5.5	6.9>	2.75	*	0.24	0.55	1.36	2.51	*	*			0.37	0.64	1.00	1.57	2.35		
Pl. XLIV, fig. 4	6.5	7.1>	3..21?	*	0.33	0.78	1.64	*	*	*	*		0.45	0.76	1.16	1.68	2.30	2.93	
Pl. XLIV, fig. 5	5.5	5.9?	2.66	2.2?	0.28	0.54	1.16	2.43	3.90	5.25			0.42	0.67	1.11	1.63	2.27		
Pl. XLIV, fig. 6	6.5	6.7>	2.94?	*	0.24	0.43	*	*	*	*	*		0.39	0.60	0.90	1.36	2.46	2.63	
Pl. XLIV, fig. 7	5	6.45	2.77	2.33	0.34	0.80	1.68	2.73	4.39	6.45			0.63	1.07	1.55	2.22	2.77		
Pl. XLIV, fig. 9	4.5	6.3?	2.67	2.4?	0.31	0.98	1.94	3.62	5.36				0.52	0.89	1.45	2.21			
Pl. XLIV, fig. 10	6	7.8?	3.12	2.5?	0.26	0.60	1.29	2.24	*	*			0.44	0.76	1.15	1.72	0.04	3.12	
Pl. XLIV, fig. 12	6.5	8.0?	3.36	2.4?	0.20	0.51	1.05	1.93	3.12	5.29	7.17		0.29	0.49	0.80	1.26	2.06	2.87	
Pl. XLIV, fig. 14	4.5	*	*	*	0.42	0.98	2.38	3.98	*				0.62	0.95	1.15	2.04			
Pl. XLIV, fig. 18	5	*	2.45	*	0.23	0.63	1.34	2.19	*	*			0.40	0.68	1.07	1.71	2.45		
Pl. XLIV, fig. 19	5.5	7.2?	2.40	3.0?	0.21	0.57	0.99	1.76	3.03	4.71			0.28	0.49	0.85	1.34	1.94		
Pl. XLIV, fig. 22	6	5.2?	2.82?	1.8?	0.29	0.59	1.18	2	3.31	4.23	5.2?		0.33	0.63	0.98	1.55	2.18	2.82?	
Pl. XLIV, fig. 16	4.5	*	2.22	*	0.26	12	22	24	26	14>			0.52	0.85	1.32	1.90			
Pl. XLIV, fig. 17	5.8	*	2.66	*	0.30	9	21	24	24	28	24>		0.55	0.86	1.29	1.84	2.60		
Pl. XLIV, fig. 20	5.0	*	2.53	*	0.28	10	23	25	28	27			0.51	0.79	1.20	1.89	2.53		
Pl. XLIV, fig. 23	5.2	*	2.41	*	0.27	11	24	23	26	26	5>		0.48	0.76	1.13	1.62	2.31		
Pl. XLIV, fig. 24	5.3	*	2.30	*	0.24	13	22	28	29	26	9>		0.31	0.49	0.93	1.44	2.04		
Pl. XLIV, fig. 25	5.0	*	3.16	*	0.35	11	23	26	24	27			0.67	1.05	1.71	2.45	3.16		
Pl. XLIV, fig. 26	6.2	*	2.74	*	0.19	9	14	18	19	22	25	6>	0.28	0.45	0.77	1.18	1.70	2.39	

***Daixina* cf. *robusta* Rauzer-Chernousova**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XLV, fig. 1	5	6.46	3.03	2.13	0.40	0.90	1.61	2.85	4.44	6.46		0.55	0.98	1.52	2.25	3.03	
Pl. XLV, fig. 2	5.5	5.43	2.82	1.93	0.24	0.44	0.99	1.70	2.74	4.67		0.34	0.59	0.98	1.56	2.40	
Pl. XLV, fig. 4	5	6.35	2.43	2.61	0.26	0.67	1.31	2.66	4.44	6.35		0.39	0.70	1.19	1.80	2.43	
Pl. XLV, fig. 5	4.5	5.33	2.57	2.07	0.40	0.86	1.79	2.88	4.64			0.54	0.91	1.44	2..28		
Pl. XLV, fig. 6	5	4.75	2.51?	1.89?	0.29	0.53	1.17	1.91	3.10	4.75		0.38	0.64	1.11	1.75	2.51?	
Pl. XLV, fig. 7	6	4.7?	2.27	2.1?	0.20	0.49	0.88	1.60	2.47	3.51	4.7?	0.30	0.49	0.78	1.12	1.63	2.27
Pl. XLV, fig. 8	4	*	*	*	0.25	0.61	1.39	2.75	4.1>			0.43	0.75	1.12	2.17		
Pl. XLV, fig. 9	4.5	4.62	2.14	2.16	0.32	0.72	1.41	2.55	4.07			0.32	0.63	1.03	1.75		
Pl. XLV, fig. 10	4.3	*	2.76	*	0.25	11	20	23	26	12>		0.49	0.83	1.51	2.43		
Pl. XLV, fig. 14	5.6	*	3.40	*	0.22	9	19	23	29	31	19>	0.42	0.77	1.33	2.15	3.06	
Pl. XLV, fig. 15	5.1	*	2.91	*	0.23	11	18	21	25	26	4>	0.41	0.70	1.24	2.07	2.90	

***Daixina licharevi* Davydov**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLV, fig. 16	6.5	*	3.25?	*	0.17	0.44	1.02	*	*	*	*		0.27	0.47	0.76	1.34	2.09	2.87	
Pl. XLV, fig. 18	5.5	7.4?	2.9?	2.6?	0.25	0.64	1.48	2.93	4.77	6.09			0.35	0.64	1.10	1.71			
Pl. XLV, fig. 19	6.5	6.8?	2.39?	2.8?	0.13	0.61	1.10	1.76	2.95	4.28	5.97		0.29	0.40	0.63	1.04	1.60	2.18?	
Pl. XLV, fig. 20	6	7.3?	2.91	2.5?	0.20	0.58	1.24	2.44	3.87	5.92	7.3?		0.29	0.54	0.95	1.44	2.20	2.91	
Pl. XLV, fig. 22	7	6.4?	3.01	2.1?	0.15	0.32	0.75	1.38	2.38	3.36	4.83	6.4?	0.21	0.34	0.56	0.95	1.53	2.30	3.01
Pl. XLV, fig. 17	5.7	*	2.23	*	0.13	9	14	20	25	29	21>		0.26	0.43	0.57	1.19	1.87		

***Daixina ossinovkensis* Shchebovich**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLV, fig. 25	7.5	6.8?	2.76	2.5?	0.12	0.24	0.56	1.10	1.83	2.75	4.07	5.75	0.19	0.29	0.43	0.67	1.10	1.58	2.31
Pl. XLV, fig. 26	6.5	5.05	2.22	2.27	0.16	0.36	0.77	1.25	1.94	3.13	4.44		0.25	0.38	0.60	0.91	1.39	1.86	
Pl. XLV, fig. 27	6.6	*	2.22	*	0.15	8	13	17	18	21	22	15>	0.24	0.40	0.62	0.89	1.26	1.85	

***Daixina* spp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLVI, fig. 1	7	8.0>	4.12?	*	0.21	0.64	1.23	2.32	3.97	5.83	*		0.35	0.62	1.06	1.75	2.57	3.36	4.12?
Pl. XLVI, fig. 5	5	6.0>	2.69	*	0.41	0.67	1.45	*	*				0.48	0.83	1.25	1.86	2.69		
Pl. XLVI, fig. 6	6	5.3>	2.48	*	0.19	0.38	0.55	1.18	*	*			0.23	0.31	0.70	1.16	1.85	2.48	

***Rugosofusulina serrata* Rauzer-Chernousova**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLVI, fig. 7	6	7.5>	2.65	*	0.26	0.56	1.19	2.10	3.56	*			0.35	0.54	0.83	1.24	1.88	2.65	
Pl. XLVI, fig. 8	7	7.3?	2.52	2.9?	0.19	0.32	0.87	1.53	2.42	4.40	5.96	7.3?	0.26	0.39	0.54	0.90	1.39	2.00	2.52
Pl. XLVI, fig. 9	5	7.22	2.36	3.06	0.20	0.65	1.38	2.62	5.09	7.22			0.33	0.54	1.00	1.60	2.36		
Pl. XLVI, fig. 10	6.5	6.53	2.44	2.68	0.17	0.34	0.72	1.12	2.06	3.45	5.04		0.26	0.40	0.65	0.98	1.46	2.10	
Pl. XLVI, fig. 12	5.5	5.90	2.00	2.95	0.17	0.43	0.88	1.63	3.50	5.57			0.26	0.34	0.68	1.09	1.65		
Pl. XLVI, fig. 13	6	5.8?	2.15	2.7?	0.18	0.34	0.77	1.48	2.77	4.18	5.8?		0.25	0.37	0.60	1.01	1.59	2.15	
Pl. XLVI, fig. 14	5.5	5.64	1.87	3.02	0.18	0.33	0.75	1.46	2.67	4.50			0.26	0.41	0.62	0.98	1.55		
Pl. XLVI, fig. 15	6.5	*	2.21	*	0.18	0.34	0.75	1.22	2.02	3.15			0.26	0.37	0.55	0.86	1.30	1.86	
Pl. XLVI, fig. 16	6	*	2.02	*	0.20	0.32	0.55	*	*	*	*		0.25	0.40	0.64	0.98	1.46	2.02	
Pl. XLVI, fig. 17	6	6.00?	2.67	2.25?	0.27	0.45	0.88	1.90	3.03	4.32	6.00?		0.33	0.52	0.85	1.35	1.95	2.67	
Pl. XLVI, fig. 18	6.5	6.10?	2.24	2.72?	0.13	0.33	0.65	1.41	2.21	3.78	5.27		0.19	0.31	0.52	0.85	1.31	1.90	
Pl. XLVI, fig. 19	5.6	*	2.65	*	0.20	8	16	19	21	25	18>		0.36	0.59	0.95	1.42	2.14		
Pl. XLVI, fig. 20	6.6	*	2.51	*	0.17	9	17	18	24	23	23	15>	0.28	0.43	0.64	0.90	1.44	2.19	

***Rugosofusulina prisca* (Ehrenberg)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XLVI, fig. 23	5	4.96	1.84	2.70	0.20	0.45	1.09	2.52	3.30	4.96		0.36	0.55	0.85	1.24	1.84	
Pl. XLVI, fig. 24	5.5	4.76	1.85	2.57	0.23	0.48	0.95	1.98	3.03	4.22		0.35	0.55	0.84	1.24	1.66	
Pl. XLVI, fig. 26	6.5	5.5>	1.78	*	0.19	0.41	0.76	1.39	*	*	*	0.26	0.41	0.59	0.85	1.15	1.53
Pl. XLVI, fig. 27	5.5	5.15?	1.62	3.18?	0.20	0.41	0.88	1.56	2.82	4.48		0.28	0.40	0.64	0.97	1.35	
Pl. XLVI, fig. 21	5.3	*	2.10	*	0.24	10	15	19	20	23	7>	0.42	0.68	1.02	1.44	1.96	

***Pseudofusulina kumasoana* Kanmera**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XLVII, fig. 11	6.5	9.5?	3.16	3.0?	0.25	0.57	1.18	2.2?	4.3?	6.2?	8.2?	0.39	0.56	0.81	1.26	1.89	2.78
Pl. XLVII, fig. 12	6	8.8>	3.05	*	0.35?	*	*	*	*	*		0.47	0.74	1.15	1.73	2.39	3.05
Pl. XLVII, fig. 13	6	8.22	2.66	3.09	0.28	0.49	1.34	3.02	4.41	6.30	8.22	0.36	0.57	0.93	1.43	2.02	2.66
Pl. XLVII, fig. 14	5	*	2.52?	*	0.40	0.75	1.91	*	*	*		0.44	0.74	1.19	1.90	2.52?	
Pl. XLVII, fig. 16	5	7.5?	2.37	3.1?	0.29	0.73	1.95	3.7?	5.6?	7.5?		0.40	0.64	1.11	1.69	2.37	
Pl. XLVII, fig. 18	5	*	2.73	*	0.36	0.74	2.00	*	*	*		0.39	0.66	1.18	1.95	2.73	
Pl. XLVII, fig. 19	5	6.5>	2.12	*	0.28	0.60	1.72	3.13	4.77			0.41	0.64	1.00	1.60	2.12	
Pl. XLVII, fig. 20	4.5	*	*	*	0.37	1.07	2.23	4.11	6.4?			0.46	0.86	1.40	1.98		
Pl. XLVII, fig. 21	6	7.8>	2.7?	*	0.29	0.67	1.55	2.91	4.68	6.62	7.8>	0.39	0.61	0.91	1.38	2.06	2.7?
Pl. XLVII, fig. 23	6	7.0>	2.4?	*	0.29	0.61	1.53	2.73	4.20	6.1?	7.0>	0.28	0.49	0.79	1.24	1.80	2.4?
Pl. XLVII, fig. 25	4.3	*	2.86	*	0.29	11	22	29	31	10>		0.55	1.01	1.80	2.67		
Pl. XLVII, fig. 26	4.6	*	2.74	*	0.34	12	24	28	28	20>		0.56	0.94	1.46	2.25		

***Pseudofusulina* sp.**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl						Width of whorl					
						1	2	3	4	5	6	1	2	3	4	5	6
Pl. XLVIII, fig. 6	6.5	8.5>	*	*	0.24	0.57	1.75	2.97	4.33	6.00	7.85	0.34	0.55	0.90	1.36	1.89	2.4?
Pl. XLVIII, fig. 8	6.5	7.3>	*	*	0.28	0.61	1.49	2.35	3.38	4.90	6.48	0.35	0.53	0.83	1.20	1.66	2.16?
Pl. XLVIII, fig. 9	5	7.18	2.33	3.08	0.33	1.01	2.32	3.71	5.15	7.18		0.56	0.91	1.30	1.87	2.33	
Pl. XLVIII, fig. 10	5	6.45	1.85	3.49	0.30	0.92	1.97	3.30	4.96	6.45		0.43	0.80	1.02	1.44	1.85	
Pl. XLVIII, fig. 11	6.5	8.3?	2.3?	3.6?	0.26	0.60	1.29	2.45	3.77	5.6?	7.6?	0.35	0.50	0.79	1.12	1.56	2.03
Pl. XLVIII, fig. 12	5.5	*	*	*	0.34	0.96	2.10	3.43	*	*		0.49	0.79	1.21	1.68	2.23?	

***Pseudofusulina parasolida* Bensh**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLVIII, fig. 13	6.5	12.5?	3.1?	4.0?	0.34	0.57	1.73	3.70	5.5?	*	*		0.50	0.79	1.26	1.80	*	*	
Pl. XLVIII, fig. 17	5.5	9.69	2.47	3.92	0.25	0.63	2.01	3.84	6.35	8.80			0.38	0.66	1.03	1.59	2.10		
Pl. XLVIII, fig. 19	5.5	9.0>	2.48	*	0.25	0.25	2.14	3.70	5.82	8.1?			0.44	0.73	1.10	1.58	2.19		
Pl. XLVIII, fig. 14	6.2	*	3.35	*	0.29	12	23	26	28	33	37	10>	0.55	0.84	1.37	1.93	2.70	3.31	
Pl. XLVIII, fig. 16	5.8	*	3.22	*	0.24	10	24	31	33	36	31>		0.56	0.93	1.50	2.17	2.95		

***Praeskinnerella cushmani* (Chen)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLVIII, fig. 1	5.5	3.33?	1.45	2.30?	0.23	0.47	0.97	1.50	2.32	3.03			0.27	0.40	0.63	0.91	1.24		
Pl. XLVIII, fig. 3	7.5	3.8>	2.01	*	0.14	0.36	0.58	1.02	*	*	*	*	0.27	0.34	0.50	0.72	1.01	1.38	1.77

***Darvasites pseudosimplex* (Chen)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLIX, fig. 16	7	6.0?	2.44?	2.5?	0.18	0.37	0.84	1.30	2.12	3.25	4.57	6.0?	0.23	0.38	0.61	0.93	1.35	1.95	2.44?

***Chalaroschwagerina exilis* (Toriyama)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloculus	Length of whorl					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. XLIX, fig. 17	5	*	3.5?	*	0.37	1.03	1.96	*	*	*	0.65	1.19	1.90	2.74	3.5?
Pl. XLIX, fig. 20	3.5	*	*	*	0.24	0.96	1.95	3.63			0.53	1.11	1.92		
Pl. XLIX, fig. 22	5	*	*	*	0.32	0.68	1.51	3.33?	*	*	0.49	0.95	1.87	2.85	*
Pl. XLIX, fig. 23	5	6.94	3.30	2.10	0.24	0.58	1.28	2.87	4.85	6.94	0.40	0.73	1.29	2.26	3.3

***Chalaroschwagerina* sp. A**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloculus	Length of whorl					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. XXXI, fig. 13	5.5	*	3.4?	*	0.23	0.49	1.31	2.84	4.95	8.03	0.33	0.50	1.02	2.04	2.98

***Chalaroschwagerina* sp. B**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloculus	Length of whorl					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
Pl. XLVII, fig. 1	5	6.6?	3.2?	2.1?	0.26	0.55	1.53	3.08	5.04	6.6?	0.40	0.79	1.49	2.48	3.2?

***Biwaella* aff. *omiensis* Morikawa & Isomi**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa							Width of whorl						
						1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pl. XLIX, fig. 3	4.5	1.47	0.45	3.27	0.04	0.13	0.37	0.75	1.05				0.06	0.11	0.18	0.34			
Pl. XLIX, fig. 4	5.5	1.86?	0.64	2.91?	0.05	7	0.26	0.70	0.98	1.56?			0.09	0.14	0.23	0.37	0.54		
Pl. XLIX, fig. 5	5.5	1.73?	0.71	2.44?	0.05	0.12	0.29	0.64	1.04	1.57			0.08	0.15	0.25	0.42	0.61		
Pl. XLIX, fig. 8	6.5	*	0.70	*	0.05	0.12	0.25	*	*	*	*		0.07	0.12	0.19	0.30	0.43	0.57	
Pl. XLIX, fig. 13	5.5	1.75	0.58	3.02	?	0.10?	0.23	0.54	1.00	1.37			0.06?	0.11	0.19	0.33	0.46		
Pl. XLIX, fig. 7	6.7	*	0.94	*	0.04?	?	8?	10	12	12	16	11>	0.09	0.15	0.25	0.37	0.59	0.8	
Pl. XLIX, fig. 12	5.4	*	0.67	*	0.03	5?	10	9	11	11	5>		0.08	0.11	0.17	0.27	0.50		

***Paraleeina magna* (Toriyama)**

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Prolo-culus	Length of whorl/Number of septa								Width of whorl							
						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Pl. XLIX, fig. 25	8	6.1?	4.30?	1.4?	0.41	0.85	1.45	2.11	2.93	3.80	4.53	5.33	6.1?	0.63	0.96	1.44	1.90	2.47	3.18	4.02	4.30?
Pl. XLIX, fig. 26	7	*	*	*	0.52	0.89	*	*	*	*	*	*		0.50	0.82	1.21	1.68	2.38	*	*	
Pl. XLIX, fig. 27	8	*	5.05?	*	0.36	0.81	1.42	2.20	*	*	*	*	*	0.51	1.00	1.48	2.09	2.70	3.46	4.35	5.05?
Pl. XLIX, fig. 28	8	*	4.33	*	0.34	0.83	1.50	2.34	*	*	*	*	*	0.50	0.81	1.24	1.70	2.21	2.92	3.59	4.33
Pl. XLIX, fig. 29	7>	*	*	*	0.32	11	28	29	38?	*	*	*		0.60	0.97	1.54	2.30	*	*	*	