Original article

Middle Permian fusulines from the Funabuseyama area, Mino Terrane, central Japan

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Abstract

The Funabuseyama Limestone, an exotic limestone block in the western part of the Jurassic Mino Terrane, yields various kinds of Permian foraminifers especially fusulines ranging from the Artinskian to Capitanian. Many microphotographs of fusuline and non-fusuline foraminifers are illustrated to reconsider the foraminiferal information of the Funabuseyama faunas and to compare with the coeval faunas in and outside of Japan. Thirty-one species of Middle Permian fusulines are systematically described. Fusuline faunas in the Mino Terrane, characterized by the component of *Acervoschwagerina*, *Parafusulina japonica*, and *Yabeina*, are similar to most of those in other Jurassic terranes of Japan, but different from those of the Permian terranes of Japan where these three taxa are almost absent.

Key words: Funabuseyama, Fusulines, Middle Permian, Mino Terrane

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Introduction

Pre-Cretaceous rocks in the Mino Terrane, central Japan are divided largely into greenstone-limestone facies and more widely distributed sandstone-chert facies (Hy. Igo, 1961; Fig. 1), as well those in other pre-Cretaceous accretionary terranes of Japan (Mizutani, 1990). Since late 1970's, they have been greatly reformed tectonostratigraphically, as exemplified by the Mino Sedimentary Complex in the Mino Terrane established by Wakita (1988), who divided the complex into six units: Sakamototoge, Samondake, Funabuseyama, Nabi, Kanayama, and Kamiasou based on the differences of lithologic composition and of accretionary age.

The Funabuseyama Limestone, reorganized as an exotic block of the Funabuseyama Unit by Wakita (1988), was initially deposited on a Permian Panthalassan seamount, similarly as in other huge limestone blocks distributed in the Hachiman, Uokaneyama, Ibukiyama, and Ryozensan areas in the western part of the Mino Terrane (Fig. 1; F. Kobayashi, 2011). These limestone blocks are several hundred meters thick and yield various kinds of fossils, especially of fusulines (Wakita, 1988; F. Kobayashi, 2011). On the other hand, overall biostratigraphic and paleontological works, accompanied by the illustrations of fusulines available for their references, are few in these huge limestone blocks except for areas of Hachiman (Hh. Igo, 1996), Uokaneyama (Sashida, 1980), Ibukiyama (M. Kobayashi, 1957; Miyamura, 1967), and Ryozensan (F. Kobayashi and Furutani, 2009, 2019).

Based on many age-diagnostic genera and species of fusulines, the depositional period from late Cisuralian (Artinskian) to late Guadalupian (Capitanian) has been estimated by many workers in the Funabuseyama Limestone (e.g. Matsumaru, 1966; Sano, 1988a, b; Wakita, 1991). All aspects of the fusuline faunal composition, biostratigraphic zonation, and age assignments in the limestone were introduced by Matsumaru (1966) and Sano (1988b).

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However, it is difficult to inspect the reliabilities of their results, because detailed descriptions/illustrations of fusulines are not shown in these papers. Described fusulines from the Funabuseyama area are restricted to late Cisuralian to early Guadalupian schwagerinids. They are *Parafusulina iisakai* Hy. Igo and Ogawa, 1958, *P. truncata* (Ozawa, 1927), *P. nakamigawai* Morikawa and Horiguchi, 1956, and *P*. sp. in Hy. Igo and Ogawa (1958); *Acervoschgarerina fujimotoi* Kanuma, 1959 and *Pseudofusulina* cf. *gujoensis* Kanuma, 1959 in A. Ishii (1964); and *Parafusulina funafusensis* Matsumaru, 1966 in Matsumaru (1966). Therefore, it is not easy to closely compare the all aspects of Funabuseyama faunas to the coeval ones in and outside of Japan based on these previous works.

Fifteen limestone samples were collected in the Funabuseyama area, accompanied by the author and the late Dr. A. Ishii in 1968, and 288 limestone thin sections were made which contained many foraminifers. Among them, Middle Permian fusulines, such as *Verbeekina verbeeki* (Geinitz, 1876), *Armenina crassispira* (Chen, 1956), and a few species of *Yabeina* and *Neoschwagerina* prepared in those days have been practically used for my later works, but have been left undescribed systematically. Non-fusuline foraminifer species, *Abadehella coniformis* Okimura and K. Ishii in Okimura et al. (1975), was described in F. Kobayashi (1996). Additional sampling of the Funabuseyama Limestone was done in 1973 and 2015, and 386 thin sections were added to the previous ones. Many available fusulines, which have not been described and illustrated by previous workers from the Funabuseyama area, occur in these 674 thin sections kept in the Museum of Nature and Human Activities, Hyogo, Sanda, Hyogo, Japan (Fumio Kobayashi Collection, MNHAH). They are described systematically herein and discussed their biostratigraphic and paleobiogeographic implications, and are compared to those formerly described and illustrated.

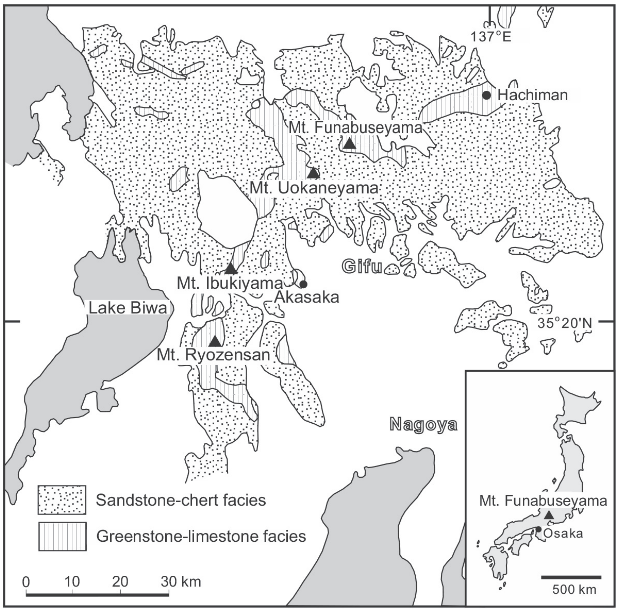

Figure 1. Distribution of greenstone-limestone facies and sandstone-chert facies in the western half of the Mino Terrane, central Japan (modified from F. Kobayashi, 2011).

Geologic setting and samples

The Funabuseyama Limestone located about 28 km NNW of Gifu, is about 12 km in E-W and about 8 km in N-S, and is composed mainly of the Permian limestone block surrounded by the Jurassic siliciclastic rocks with pre-Jurassic exotic blocks (Sano, 1988a, b; Wakita, 1988, 1991). The mapped area is largely divided lithologically into the northern calcareous rock facies and southern siliciclastic rock dominant facies, both of which are in fault-bounded as shown by the broken line in Fig. 2. The area of the former facies consists of the Okumino Group introduced and subdivided by Sano (1988a, b) into nearly coeval three units, the Hashikadani, Funabuseyama, and Amanokawara formations. According to Sano (1988b), the Hashikatani Formation is composed mainly of greenstone of basaltic rocks, chert, and dolostone; and the Funabuseyama Formation consists mostly of limestone and further is subdivided into lower, middle, and upper members. The Amanokawara Formation is characterized by limestone-breccia with greenstone, limestone, and dolostone. The Funabuseyama and Hashikadani formations extend to the mapped area east of Kanzakigawa River (Fig. 2), where the Amanokawara Formation is not exposed. The southern part of the mapped area is occupied by the Neo Formation, proposed by Kawai (1964), mainly consisting of siliciclastic rocks. The formation was reassigned to the Jurassic based on radiolarian biostratigraphy (Sano, 1988a, b). It corresponds to the Neo Mélange assignable to the Kanayama Unit by Wakita (1991).

The localities of limestone samples including 23 float samples collected at Obora and Mahiradani Valley are shown in Fig. 2. All of them belong to the Sano's (1988b) Funabuseyama Formation. Sample

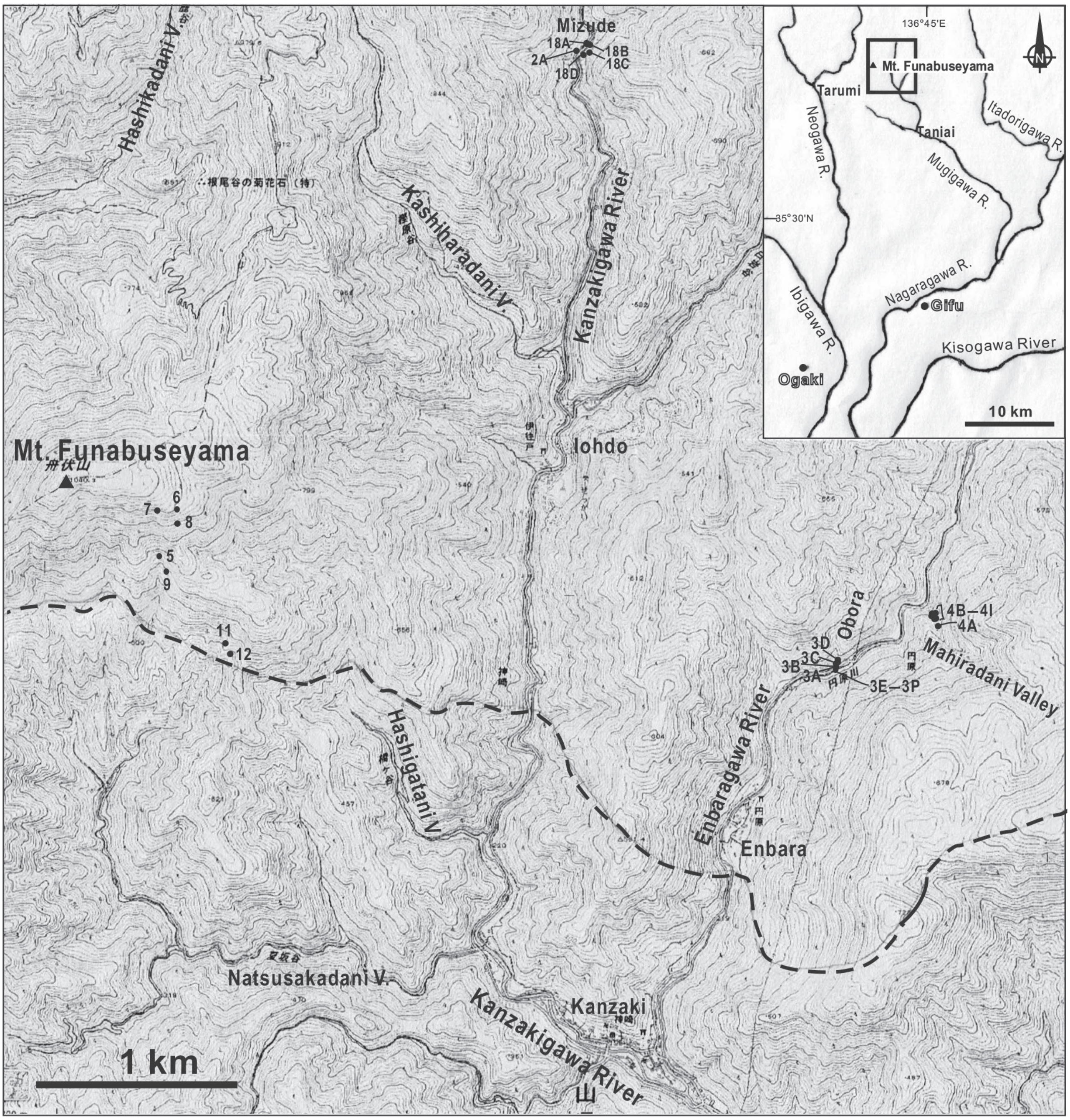

Figure 2. Map showing the Funabuseyama area (the area enclosed by a bold line in the upper right index map) and locality numbers of limestone samples. The prefix Fu of the sample numbers is omitted in this figure. The south area of the broken line running EW is occupied by sandstone-chert facies (Jurassic Neo Formation) and the north of the line by greenstone-limestone facies (Permian Okumino Group). Topographical map is from 1:25,000 map “Taniai” and “Shimo-osu” published by the Geospatial Authority of Japan.

Fu-12 of carbonaceous, black, algal limestone with small amount of *Misellina claudiae* (Deprat, 1912) is assigned to the lower member of the formation from its age and lithologic features. Samples Fu-3A–Fu-3D, Fu-4A, Fu-6–Fu-9, and Fu-11 are composed of grey to dark grey bioclastic grainstone and bioclastic packstone, and compared to those of the middle member based on their fusulines contained. Samples Fu-2A, Fu-5 and Fu-18A–Fu-18D are dark gray to black fossiliferous packstone/wackestone and referable to those of the upper member based on their lithologies and fusuline faunas. Further geologic and stratigraphic information is needed to show the vertical and lateral relationships of these samples. Twenty-three float samples, Fu-3E–Fu-3P from Obora and Fu-4B–Fu-4L from Mahiradani Valley (Fig. 2),

(International)		(Tethyan)	Tethyan Realm (Leven & Bogoslovskaya, 2006; Leven, 2009)	W Tethyan Prov. SE Pamir (Leven, 1967; 1980; 1993; 2009)	E Tethyan Province S China (Sheng, 1963; Sheng & Jin, 1994; Jin et al., 1994)	E Tethyan Province Akiyoshi (F. Kobayashi, 2012a, 2012b, 2019)	Panthalassan Province Funabuse-yama (A. Ishii, 1964; Sano, 1988b; this paper)	Panthalassan Province Ibukiyama (modified from M. Kobayashi, 1957)	Panthalassan Province Akasaka (F. Kobayashi, 2011)	Panthalassan Province Kuzu (F. Kobayashi, 1979; 2006a)
Guadalupian	Capitanian	Midian	*Yabeina* *Sumatrina*	*Yabeina archaica*	*Lepidolina multiseptata*	*Lepidolina shiraiwensis* *Sumatrina longissima*	*Y. higoensis* / *V. verbeeki*	*Yabeina higoensis*	*Yabeina globosa*	*Yabeina globosa*
Guadalupian	Wordian	Midian	*Neoschw. haydeni* *Afghanella schencki*	*Neoschwagerina margaritae*	*Neoschw. margaritae*	*Colania douvillei*	*Neoschw. margaritae*	*Neoschw. margaritae*	*Neoschw. colaniae*	*Neoschw. margaritae*
Guadalupian	Wordian	Murgabian	*Neoschw. deprati* *Afghanella tereshkovae*	*Neoschwagerina craticulifera* / *Neoschw. schuberti*	*Neoschw. craticulifera*	*Afghanella schencki* *N. craticulifera*	*Paraf. japonica* / *Armenina crassispira*	*Paraf. japonica* / *Neoschw. craticulifera*	*Neoschw. craticulifera*	*Parafusulina tochigiensis*
Guadalupian	Roadian	Murgabian	*Neoschwag. simplex* *Presumatrina neoschw.*	*Neoschw. simplex*	*Neoschw. simplex*	*Parafusulina kaerimizensis*	*Neoschw. simplex*	?	*Neoschw. simplex*	*Parafusulina yabei*
Guadalupian	Roadian	Kubergandian	*Cancellina cutalensis*	*Cancellina cutalensis*	*Cancellina elliptica*	*Cancellina pamirica*	*Cancellina nipponica*	*Cancellina* cf. *nipponica*	*Cancellina nipponica*	
Cisuralian	Kungurian	Kubergandian	*Armenina* *Misellina ovalis*	*Armenina salgirica* *Misellina ovalis*	*Misellina claudiae*	*Misellina claudiae*	*Misellina claudiae*	*Misellina ibukiensis*	*Parafusulina nakamigawai*	*Parafusulina nakamigawai*
Cisuralian	Kungurian	Bolorian	*Misellina parvicostata* *Misellina termieri* *Misellina dyhrenfurthi*	*Misellina dyhrenfurthi*	*Misellina dyhrenfurthi*	*Misellina dyhrenfurthi*	?			
Cisuralian	Artinskian	Yakhtashian	*Pamirina darvasica* *Darvasites ordinatus* *Chalaroschwagerina vulgaris*	*Pamirina darvasica* *Cuniculinella vulgarisiformis*	*Pamirina* *Cuniculinella vulgarisiformis*	*Pamirina leveni* *Paraleeina magna*	*Pamirina leveni* *Acervoschwagerina fujimotoi*	"*Pseudofusulina ambigua*" *Acervoschwagerina* sp.		

Figure 3. Correlation chart of the upper part of the Lower and Middle Permian in the Tethyan and Panthalassan regions.

are supposed to have been derived from the middle member based on their grey to dark grey packstone/grainstone lithology, and fusuline and other faunas similar to those of samples Fu-3A–Fu-3D and Fu-4A.

The limestones with four species of *Parafusulina* described by Hy. Igo and Ogawa (1958) and with *P. funafusensis* by Matsumaru (1966), shown above, are probably assigned by the author to the middle member of the formation. An erratic dolomitic limestone containing *Acervoschwagerina fujimotoi* was assumed to be originated from the "Takaradani dolomite member", the lowest unit of the Funabuseyama Formation by A. Ishii (1964), correlatable to the Sano's (1988b) Hashikadani Formation.

Composition and comparison of the fusuline fauna

Matsumaru (1966) showed the biostratigraphic range of 43 species of fusulines assigned to 12 genera from the *Pseudoschwagerina* Zone to the *Yabeina* Zone of the Funabuseyama Limestone. Among them, 21 species were assigned to *Parafusulina* ranging from the *Parafusulina* Zone to the "*Neoschwagerina margaritae-N. craticulifera*" subzone. Sano (1988b) listed 34 species of 17 genera available for age determination of the Funabuseyama Formation, biostratigraphically divided into the lower *Pseudofusulina ambigua*, middle *Parafusulina kaerimizensis*, and upper *Neoschwagerina margaritae-Yabeina globosa* zones. Fusulines illustrated by Sano (1988b) are confined to *Staffella* sp., *Parafusulina kaerimizensis* (Ozawa, 1925), *Codonofusiella* sp., *Verbeekina verbeeki*, and *Yabeina* sp. These species are contained in photomicrographs of three samples prepared by Sano (1988b) for the explanation of limestone lithologic characteristics.

In the present study, 45 species of fusulines are identified from the selected 28 samples of the Funabuseyama Formation (Table 1). However, detailed comparison of these species to the taxa listed by Matsumaru (1966) and by Sano (1988b) is difficult because of few illustrations of fusulines in these papers. Moreover, the basic data are not sufficient in the present study to organize the fusuline biostratigraphy of the formation. Nevertheless, biostratigraphic assignment and correlation of the present fauna are possible based on many common age-diagnostic species between Funabuseyama and Akasaka limestones. The detailed biostratigraphic

Table 1. Fusulines contained in 28 samples of the Funabuseyama Formation. Sample localities are shown in Fig. 2 without prefix Fu.

Species \ Sample	Fu-3B	Fu-3C	Fu-3D	Fu-3E	Fu-3F	Fu-3G	Fu-3H	Fu-3J	Fu-3O	Fu-3P	Fu-4A	Fu-4B	Fu-4C	Fu-4D	Fu-4E	Fu-4F	Fu-4G	Fu-4H	Fu-4I	Fu-2A	Fu-5	Fu-7	Fu-8	Fu-11	Fu-12	Fu-18A	Fu-18B	Fu-18D
Kahlerina sp.																				X							X	
Rauserella sphaeroides																						X						
Rauserella staffi				X	X						X											X						
Pseudoreichelina darvasica																	X											
Chenella sp.												X																
Nankinella? sp.															X													
Schubertella? *karasawensis*	X				X																							
Neofusulinella giraudi			X			X		X			X																	
Neofusulinella phairayensis		X									X																	
Yangchienia compressa																X												
Yangchienia haydeni	X																											
Dunbarula nana	X																			X								
Dunbarula spp.	X																											
Codonofusiella cf. *ashioensis*				X							X																	
Codonofusiella sp.				X																								
Chusenella sinensis																			X									
Chusenella conicocylindrica																X			X									
Chusenella sp.																				X								
Parafusulina gigantojaponica																							X					
Parafusulina japonica	X		X	X			X				X		X	X									X	?				
Parafusulina kinosakii		X							X																			
Parafusulina shimotsukensis											X																	
Parafusulina sp. A									X										X									
Parafusulina sp. B				X																								
Misellina claudiae																									X			
Pseudodoliolina ozawai				X	X			X			X											X						
Armenina crassispira			X								X																	
Armenina aff. *sphaera*											X																	
Armenina sp.			X																									
Armenina? sp.											X																	
Verbeekina akasakensis			X								X						X											
Verbeekina verbeeki			X								X									X								
Verbeekina aff. *grabaui*											X																	
Cancellina nipponica																	X		X					X				
Cancellina sp.																		X										
Neoschwagerina colaniae																				X								
Neoschwagerina craticulifera	X					X																						
Neoschwagerina fujimotoi																										X		
Neoschwagerina fusiformis																				X							X	
Neoschwagerina margaritae																					X							
Neoschwagerina simplex										X		X			X													
Yabeina higoensis																											X	
Yabeina igoi																				X								
Yabeina omurensis																				X								
Yabeina spp.																				X								X
Number of thin sections	17	7	16	24	10	9	14	44	9	9	96	15	20	7	17	13	33	5	19	100	3	10	15	5	2	22	23	8

distribution of fusuline species, and fusuline zonation and its international correlation are made clear in the Akasaka Limestone (F. Kobayashi, 2011; Fig. 3).

The oldest fusuline reported from the Okumino Group is *Acervoschwagerina fujimotoi* described by A. Ishii (1964). This species occurs in the basal part of the limestone of the Hachiman area (Kanuma, 1959; Hh. Igo, 1996). It is coeval with the Artinskian

A. endoi Hanzawa, 1949 and *A. gongendaniensis* F. Kobayashi in F. Kobayashi and Furutani (2019), and is very characteristic in the Jurassic terranes and absent in the Permian terranes of Japan (F. Kobayashi, 2005, 2008; F. Kobayashi and Furutani, 2009, 2019). The occurrence of these three and comparable species of *Acervoschwagerina* from the basal part of the Ibukiyama Limestone (M. Kobayashi, 1957), Funabuseyama (A. Ishii, 1964), Uokaneyama (F. Kobayashi, 2008), and Ryozensan (F. Kobayashi and Furutani, 2009, 2019) strongly suggest that the deposition of these limestones started in the Artinskian, apparently older than the limestone with *Pamirina leveni* F. Kobayashi, 1977 (Fig. 3). Though not found in this study, three species of *Pamirina* from three samples are listed in Sano (1988b).

The presence of the upper Kungurian deposits was made sure by the occurrence of *Misellina claudiae* from sample Fu-12. *Parafusulina nakamigawai* Morikawa and Horiguchi, 1956 coeval with *M. claudiae* is confined to the basal part of limestones of Akasaka and Kuzu (Fig. 3) and coeval limestone blocks in the Jurassic terranes of Japan. *P. nakamigawai* is completely absent in the Permian terranes of Japan (F. Kobayashi, 2011, 2019). The presence or absence of the lower Kungurian (= lower Bolorian in the Tethyan regions) deposits in the Funabuseyama Limestone is, however, not ascertained because there are no findings of *Misellina dyhrenfurthi* (Dutkevich in Likharev, 1939), a marker species of the early Kungurian in the Akiyoshi Terrane (e.g. F. Kobayashi, 2019).

The occurrence of the following species is important biostratigraphically and chronologically. They are *Cancellina nipponica* Ozawa, 1927, *Neoschwagerina simplex* Ozawa, 1927, *N. craticulifera* (Schwager, 1883), *N. colaniae* Ozawa, 1927, *N. margaritae* Deprat, 1913, *Pseudodoliolina ozawai* Yabe and Hanzawa, 1932, *Parafusulina japonica* (Gümbel, 1874), and others found in the studied samples (Table 1). These species suggest the biostratigraphic reconstruction of continuous Roadian and Wordian sequences in the Funabuseyama area based on the stratigraphic range of these fusulines established in the Akasaka Limestone (F. Kobayashi, 2011).

On the other hand, the faunal composition of the Capitanian is somewhat different between Funabuseyama and Akasaka in spite of similar lithologies characterized by carbonaceous black limestone. Species of *Yabeina* undoubtedly identified as *Y. globosa* (Yabe, 1906) and *Y. katoi* (Ozawa, 1927) highly dominant in Akasaka as well as other Jurassic terranes of Japan were not noted in this study. In contrast, *Verbeekina verbeeki*, not found in the *Yabeina globosa* Zone of Akasaka (F. Kobayashi, 2011), is dominant in sample Fu-2A in association with *Y. igoi* Morikawa and Suzuki, 1961, and other smaller *Yabeina* and *Neoschwagerina* (Table 1). Both lithologically and faunistically Sano's (1988b) sample 488 is closely similar to the sample Fu-2A. A relatively large form of *Yabeina* with a thin wall, septa, and septula treated as *Y*. sp. by Sano (1988b) might be identical to *Y. igoi*, and neoschwagerinids with large, inflated fusiform test with bluntly pointed poles, also identified as *Y*. sp., might be reassigned to *Neoschwagerina fusiformis* Skinner and Wilde, 1967 originally described from the Capitanian of Tunisia. *Neoschwagerina margaritae* described by M. Kobayashi (1957) from Ibukiyama is reassigned to *Yabeina higoensis* proposed by F. Kobayashi (2001) from the Kuma Formation and Kaize area of the Saku Basin. *Y. higoensis* distinguished from sample Fu-18B is associated with *N. fusiformis* and *Kahlerina* sp. The complete absence of the late Guadalupian *Afghanella* and *Sumatrina* in the Funabuseyama area as well as in other Jurassic terranes of Japan is important paleobiogeographically (e.g. F. Kobayashi, 1997a, b).

The remarkable faunal elements of the late Cisuralian and Guadalupian fusulines of the Funabuseyama area as well as those of other areas in the Jurassic terranes of Japan are represented by the presence of *Acervoschwagerina, Parafusulina japonica*, and dominant *Yabeina*. On the other hand, *Parafusulina kaerimizensis* and *Lepidolina* are absent or poor in them in addition to complete absence of *Afghanella* and *Sumatrina* (Fig. 3). The spatiotemporal distribution of the Middle Permian fusuline faunas represented by these genera and species in the Jurassic Mino Terrane well agrees with that of those in the Circum-Pacific regions (F. Kobayashi, 1997a, 1997b, 2011). While, the Middle Permian fusuline faunas in the Akiyoshi and Maizuru terranes are closer to those in South China, eastern Jilin, and Primorye rather than in the Jurassic accretionary terranes of Japan (F. Kobayashi, 2003, 2019).

Thirty-six specimens of non-fusuline foraminifers are illustrated in Pl. 1 so as to understand an outline of their faunal composition in the studied samples. Although they are classified provisionally into 18 taxa, detail on the number of taxa, taxonomic composition at every sample, and their stratigraphic distribution cannot be realized in the present materials, except for *Abadehella coniformis* described and discussed in F. Kobayashi (1996) based on sample Fu-2A and others. Nevertheless, noteworthy herein is the occurrence of *Neohemigordius japonica* (Ozawa, 1925) from samples Fu-3E and Fu-3J (Pl. 1, figs. 30, 33). This species, proposed in Akiyoshi and originally assigned to *Hemigordius* by Ozawa (1925), is characteristic in the Japanese Middle Permian, and have been reported from the Murgabian of Akasaka (F. Kobayashi, 2012) and of Akiyoshi (F. Kobayashi, 2019). Among 14 specimens named *Neodiscus padangensis* (Lange, 1925) in Kuzu, five of the Murgabian (F. Kobayashi, 2006b, figs. 6–9, 13) should be reassigned to *Neohemigordius japonica*. Thus, this species is assumed to be important biostratigraphically.

Systematic description

Thirty-one species of fusulines are described systematically. Localities and register numbers of them are shown in the explanation of Plate 1–12.

Order Foraminiferida Eichward, 1830
Suborder Fusulinina Wedekind, 1937
Superfamily Fusulinoidea von Möller, 1878
Family Ozawainellidae Thompson and Foster, 1937
Genus *Kahlerina* Kochansky-Devidé and Ramovš, 1955
Type species: *Kahlerina pachytheca* Kochansky-Devidé and Ramovš, 1955

Kahlerina sp.
Plate 1, Figures 37–40

Remarks.—Funabuseyama specimens assignable to *Kahlerina* are more or less similar to *K. pachytheca* Kochansky-Devidé and Ramovš, 1955 in their size and shape of the test and the degree of depression of polar regions of the test. However, the former is distinguished from the latter by its thinner wall in inner whorls and more rapidly expanding final whorl. The presence of parachomata was regarded as one of important characters of this genus and species by Kochansky-Devidé and Ramovš (1955). However, “parachomata” in the original description are different from the true parachomata developed in verbeekinids and neoschwagerinids, and presumed to be tiny, circular, discontinuous secondary deposits, since they are not extending across the chambers throughout most whorls of the test.

Genus *Rauserella* Dunbar, 1944
Type species: *Rauserella erratica* Dunbar, 1944

Rauserella staffi Skinner and Wilde, 1966
Plate 1, Figures 42, 43, 46–48

Rauserella sp., M. Kobayashi, 1956, p. 226, 227, pl. 32, figs. 8, 9. (8= pl. 1, fig. 16 in M. Kobayashi, 1957; 9= pl. 1, fig. 15 in M. Kobayashi, 1957)
Rauserella? sp., M. Kobayashi, 1956, p. 227, pl. 32, figs. 10–12.
Rauserella staffi Skinner and Wilde, 1966, p. 5, 6, pl. 2, figs. 2–7; F. Kobayashi, 2016, figs. 3.2, 3.5–3.7, 3.9–3.11.

Remarks.—M. Kobayashi (1956) described and illustrated 12 specimens of *Rauserella* and *Rauserella*? from Ibukiyama, and divided them into three species: *Rauserella fujimotoi* M. Kobayashi, 1956, *Rauserella* sp., and *Rauserella*? sp. Among them, *R. fujimotoi* is distinguished from the known species of the genus by its larger chamber height of inner three whorls askew to outer two whorls. The illustrated five specimens herein, along with *R*. sp. and *R*.? sp. by M. Kobayashi (1956), are closely similar to *Rauserella staffi* originally described by Skinner and Wilde (1966) from Sicily and a form by F. Kobayashi (2016) from the Itsukaichi-Ome area.

Family Schubertellidae Skinner, 1931
Subfamily Boultoniinae Skinner and Wilde, 1954
Genus *Codonofusiella* Dunbar and Skinner, 1937
Type species: *Codonofusiella paradoxica* Dunbar and Skinner, 1937

Codonofusiella cf. *ashioensis* F. Kobayashi, 2006
Plate 1, Figures. 49, 52

Compare to:
Codonofusiella ashioensis F. Kobayashi, 2006b, p. 73, 74, figs. 7.40–7.48; F. Kobayashi, 2011, p. 461, 462, pl. 3, figs. 29, 30, 32–39, 42.
? *Codonofusiella* sp. B, F. Kobayashi, 2018, p. 1, fig. 50.

Remarks.—This species was distinguished from the known species of the genus by its uncoiled, rectilinear, terminal whorl with larger chamber heights than the total height of inner coiled whorls. Obscure or absence of the uncoiled terminal portion by specimens is due to either the orientation of thin sections or abrasion of the terminal whorl of the test, as pointed out by showing the original many specimens from the Kuzu area (F. Kobayashi, 2006b) and later reconfirmed based on those from the Akasaka Limestone (F. Kobayashi, 2011). When the terminal portion is not preserved, *Codonofusiella ashioensis* might be erroneously classified as another species of the genus or assigned to an elongate form of *Dunbarula*, as suggested by F. Kobayashi (2011). Although a well-oriented typical form of this species is not found in the Funabuseyama materials, the illustrated two axial sections from samples Fu-3E (Pl. 1, fig. 49) and Fu-4A (Pl. 1, fig. 52) are compared to this species, as they are close to the coiled part of the test in this species.

Genus *Dunbarula* Ciry, 1948
Type species: *Dunbarula mathieui* Ciry, 1948

Dunbarula nana Kochansky-Devidé and Ramovš, 1955
Plate 1, Figures. 53, 54

Dunbarula nana Kochansky-Devidé and Ramovš, 1955, p. 377–379, 409, 410, pl. 1, figs. 3–5, pl. 8, fig. 1; Skinner and Wilde, 1967, p. 13, 14, pl. 15, figs. 1–10.

Remarks.—This species was originally described by Kochansky-Devidé and Ramovš (1955) as a small-sized *Dunbarula* with discoidal juvenile whorls and weakly folded septa only in the polar regions from the *Parafusulina-Neoschwagerina* zone of the Julian Alps of Slovenia. More details on test characters and morphologic variations of this species are comparable to those of ten specimens illustrated by Skinner and Wilde (1967) based on the Tunisia materials in spite of slight differences from the types. This species is distinguishable from other small-sized *Dunbarula* such as *D. schubertellaeformis* Sheng, 1958 and *D. oviformis* F. Kobayashi, 2006 in F. Kobayashi, (2006b) by its larger number of discoidal juvenile whorls largely askew to the ovoid outer whorls and relatively weaker septal folding. By these similar test characters, especially of juvenile whorls, two illustrated specimens herein are identified with this species.

Subfamily Schubertellinae Skinner, 1931
Genus *Neofusulinella* Deprat, 1912
Type species: *Neofusulinella lantenoisi* Deprat, 1913

Neofusulinella giraudi Deprat, 1915
Plate 2, Figures 4–7, 9, 25–27; Plate 10, Figures 1–4, 6

Neofusulinella giraudi Deprat, 1915, p. 11, 12, pl. 1, figs. 6–11; F. Kobayashi, 2011, p. 464, 465, pl. 5, figs. 1–34; F. Kobayashi in F. Kobayashi and Furutani, 2009, p. 32, pl. 1, figs. 23–52; F. Kobayashi, 2018, pl. 1, figs. 38, 39; F. Kobayashi in F. Kobayashi and Furutani, 2019, figs. 2.19–2.35; F. Kobayashi, 2019, p. 60, 61, pl. 5, figs. 15–19, 21, 22.

Schubertella giraudi (Deprat), Sheng, 1963, p. 158, 159, pl. 4, figs. 1–9; M. Kobayashi, 1957, p. 263, 264, pl. 1, figs. 1–5.

Remarks.—The Funabuseyama specimens closely resemble the original ones described by Deprat (1915) in many test features such as size and shape of the test, almost plane septa, relatively thick wall for the test size, and well developed septal pores. Some authors (e.g. Sheng, 1963, M. Kobayashi, 1957) reassigned this species to *Schubertella*. However, this species is better assigned to *Neofusulinella* based on its thicker and more clearly perforated wall.

Neofusulinella phairayensis Colani, 1924
Plate 2, Figures. 12–14

Neofusulinella phairayensis Colani, 1924, p. 104, 105, pl. 16, figs. 1–5, 7–10, 12–16, 20–22; Ozawa, 1927, p. 151, 152 (part), pl. 37, figs. 3b, 5, 6c; pl. 38, (non. figs. 2a and 12= *Yangchienia compressa* Ozawa, 1927), 7, 8, 11 (central part and both sides of 11= *Yangchienia compressa*); pl. 39, figs. 1, 2; pl. 44, fig. 6c, pl. 45, fig. 9; F. Kobayashi, 2011, p. 465, pl. 5, figs. 35–54; F. Kobayashi, 2018, p. 36, 37, pl. 1, figs. 40–43; F. Kobayashi, 2019, p. 61, pl. 5, fig. 37.

Remarks.—Some specimens, especially of the smaller ones, of the present material appear to be *Neofusulinella giraudi* in their test construction. Length and width of corresponding whorls in them are, however, greater than those of *N. giraudi*. They are identical with *N. phairayensis* originally described by Colani (1924) from northern Viet-Nam, and recently by F. Kobayashi (2011) from the Akasaka Limestone, by F. Kobayashi (2018) from Shirasaki Limestone, and by F. Kobayashi (2019) from Akiyoshi Limestone.

Genus *Yangchiena* Lee, 1934
Type species: *Yangchienia iniqua* Lee, 1934

Yangchienia compressa (Ozawa, 1927)
Plate 1, Fig. 51

Fusulina (*Fusulinella*) *compressa* Ozawa, 1927, p. 142, 143, pl. 37, fig. 6f; pl. 38, figs.2b, 10, 13b, 16b; pl. 39, figs. 3, 7.
non. *Fusulinella compressa* Ozawa, Huzimoto, 1936, p. 40, 41, pl. 2, fig. 9. (= probably *Biwaella omiensis* Morikawa and Isomi, 1961)
Schubertella phairayensis (Colani), M. Kobayashi, 1957, p. 260, 261, pl. 1, figs. 9, 10.
Yangchienia cf. *compressa* (Ozawa), M. Kobayashi, 1957, p. 265, 266, pl. 1, fig. 17.
par. *Yangchienia compressa* (Ozawa), F. Kobayashi, 2006b, figs. 8.32–8.36. (non. 8.30, 8.31= *Yangchienia haydeni* Thompson, 1946)
Yangchienia compressa (Ozawa), F. Kobayashi, 2011, p. 467, 468, pl. 4, figs. 1–13.

Remarks.—Though rare and well oriented specimens could not be prepared, schubertellids with tall, broad, and massive chomata extending to poles were obtained. In addition to a fusiform test with more than six whorls and pointed poles, these features indicate their undoubted assignment to *Yangchienia* and probably identified as *Y. compressa*, a species most common in the *Cancellina nipponica* Zone of the Akasaka Limestone (F. Kobayashi, 2011). They are different from *Yangchienia haydeni*, illustrated in Pl. 1, fig. 50, and first described from the Bamian Limestone, Afghanistan (Thompson, 1946) by their much more elongate fusiform test and not so high chomata in the tunnel region.

Family Schwagerinidae Dunbar and Henbest, 1930
Genus Chusenella Hsu, 1942
Type species: *Chusenella ishanensis* Hsu, 1942

Chusenella conicocylindrica Chen, 1956
Plate 2, Figures 19, 20

Chusenella conicocylindrica Chen, 1956, p. 42, 43, pl. 4, figs. 7, 8; F. Kobayashi, 2019, p. 64, 65, pl. 7, figs. 3, 5–16, 18, 20–25, 34, 35.
par. *Chusenella conicocylindrica* Chen, F. Kobayashi, 2012b, fig. 10.6–10.8. (non fig. 10.2, 10.3= *Chusenella deprati* Ozawa, 1925)

Remarks.—This species proposed by Chen (1956) from the Middle Permian of Hunan was separated from *Chusenella deprati* (Ozawa, 1925) by having larger test, more whorls, and more intensely folded septa. However, the two illustrated specimens in Chen (1956) are not easily differentiated, as Chen (1956) supposed a conspecific possibility of them. Based on great number of specimens of the Akiyoshi Limestone, F. Kobayashi (2019) suggested that the former is distinguished from the latter by having more-developed axial fillings. Although exact test size of the two illustrated specimens from Funabuseyama is uncertain, the specimens resemble those referable to *Chusenella conicocylindrica* from Akiyoshi in their well-developed axial fillings and juvenile whorls with very thin wall.

Chusenella sinensis Sheng, 1963
Plate 2, Figures 21–24

Chusenella sinensis Sheng, 1963, p. 80, 209, pl. 23, figs 7–18.

Remarks.—The detailed morphologic features of four illustrated specimens are uncertain, due to abrasion of the test. Although a possibility merely representing an incomplete form of *Chusenella deprati* is remained, these specimens have a more elongate test than *C. deprati*, by which they are provisionally identified as *C. sinensis* proposed by Sheng (1963).

Genus *Parafusulina* Dunbar and Skinner, 1931
Type species: *Parafusulina wordensis* Dunbar and Skinner, 1931

Parafusulina gigantojaponica (M. Kobayashi, 1957)
Plate 3, Figure 10; Plate 4, Figure 27

Schwagerina gigantojaponica M. Kobayashi, 1957, p. 287, 288, pl. 6, fig. 8, pl. 7, figs. 6, 7.
Parafusulina kaerimizensis (Ozawa, 1925), M. Kobayashi, 1957, p. 290, pl. 7, fig. 1.
? *Schwagerina gigantojaponica* M. Kobayashi, Morikawa, 1958, p. 111, 112, pl. 18, figs. 1–7.

Remarks.—Characteristic features of the illustrated axial section and incomplete axial section without one or two outer whorls contained in sample Fu-8 are a large fusiform test more than 13 mm in length, and tall, rectangular to rounded septal folds more than half as high as chambers, many of which reach the top of the chamber. By these common features, the present specimens are identified as "*Schwagerina*" *gigantojaponica* proposed by M. Kobayashi (1957) from the Ibukiyama Limestone. They are distinguished from *Parafusulina japonica* by having a larger test, more regularly folded septa, and weaker development of axial fillings. From much more loosely coiled inner whorls and similar mode of septal folds, one specimen identified with *Parafusulina kaerimizensis* by M. Kobayashi from the Ibukiyama Limestone apparently differs from the types of *P. kaerimizensis* (see F. Kobayashi, 2019), and probably corresponds to an elongate form of *P. gigantojaponica*. Identification of seven specimens named as "*Schwagerina*" *gigantojaponica* from the Akasaka Limestone by Morikawa (1958) is doubtful in their smaller length and width of corresponding whorls, and might be related to *Parafuslina japonica*.

Parafusulina japonica (Gümbel, 1874)
Plate 2, Figures 15–18; Plate 3, Figures 7–9, 11–17; Plate 4, Figures 26, 28; Plate 10, Figures 17, 18, 20–22

Fusulina japonica Gümbel, 1874, p. 479; Schwager, 1883, p. 121–124, pl. 15, figs. 1–10; Deprat, 1914, p. 7–9, pl. 1, figs. 1–9.
Fusulina (*Schellwienia*) *japonica* (Gümbel), Ozawa, 1927, p. 147–149, pl. 36, figs. 1–7, pl. 37, fig. 7a.
non. *Schellwienia japonica* (Gümbel), Lee, 1927, p. 82, pl. 13, figs. 1–3. [= *Praeparafusulina pseudojaponica* (Dutkevich in Likharev, 1939)]
Schwagerina japonica (Gümbel), M. Kobayashi, 1957, p. 285–287, pl. 6, figs. 3–5
Parafusulina japonica (Gümbel), Morikawa, 1958, p. 112–114, pl. 19, figs. 1–7; F. Kobayashi, 2006a, p. 47, figs. 12.1–12.25; F. Kobayashi, 2011, p. 470, 471, pl. 15, figs. 9–15; pl. 16, figs. 1–27; F. Kobayashi, 2013, figs. 11, 23, 30; F. Kobayashi, 2016, p. 403–405, figs. 4.1–4.49, 7.1–7.8, 8.1, 8.2; F. Kobayashi, 2018, p. 37, 38, pl. 3, figs. 1–5, 7, 9, 11–13.
non. *Parafusulina japonica* (Gümbel), Kalmykova, 1967, p. 206, 208, pl. 25, figs. 1–4. [= *Praeparafusulina pseudojaponica* (Dutkevich in Likharev, 1939)]

Remarks.—Identification and generic assignment of this species have been considerably different among authors. For example, *Schellwienia japonica* described by Lee (1927) from North China was renamed as *Parafusulina pseudojaponica* by Dutkevich in Likharev (1939), and was later designated as the type species of *Praeparafusulina* established by Tumanskaya (1962). This species was separated from *Parafusulina* (*Parafusulina*) and reassigned to *Parafusulina* (*Skinnerella*) based on the mode of septal folding by Coogan (1960). F. Kobayashi (2016) revealed that the microspheric specimens of this species are much more typical of those of *P*. (*P*.) and *P. japonica* should be placed in the genus *Parafusulina* without generic and subgeneric subdivisions. Further morphologic and phylogenetic studies based especially on microspheric forms are needed in the "*Parafusulina*" and its allies of the Tethyan and Panthalassan regions.

Morphologic studies based on numerous specimens of *Parafusulina japonica* have been done in Kuzu (F. Kobayashi, 2006a, 2013), Akasaka (F. Kobayashi, 2011), and Tamonouchi (F. Kobayashi, 2016) materials. Twenty-one specimens illustrated herein closely resemble specimens from Kuzu, Akasaka, and Tamanouchi materials by important test characters such as size and form of the test and proloculus, and the mode of septal folding in the megalospheric forms of *Parafusulina japonica*. Microspheric forms of the species hitherto illustrated are very few and confined to two specimens of Tamanouchi (F. Kobayashi, 2016) and one abraded specimen from Kuzu (F. Kobayashi, 2006a).

Parafusulina kinosakii (Morikawa, 1958)
Plate 3, Figures 2–4

Schwagerina kinosakii Morikawa, 1958, p. 109, 110, pl. 16, fig. 10; pl. 17, figs. 1–10.
Parafusulina kinosakii (Morikawa), F. Kobayashi, 2011, p. 471, pl. 13, figs. 18–28; F. Kobayashi, 2018, p. 38, pl. 2, figs. 7, 10, 11.

Remarks.—Morikawa (1958) proposed this species from the Akasaka Limestone and distinguished it from *Parafusulina yabei* Hanzawa, 1942. Both species are similar to each other and might be conspecific as assumed by Hy. Igo (1964) and F. Kobayashi (2006a). Besides indistinct development of cunuculi, this species is reassigned to *Parafusulina* because of its more strongly folded septa throughout growth than those of *Schwagerina* (F. Kobayashi, 2011). The present specimens resemble the topotypes of *P. kinosakii* in many respects. The smaller appearance of the former than of the latter and three illustrated specimens from the Shirasaki Limestone (F. Kobayashi, 2018) is apparently due to abrasion of outer test. *Parafusulina* sp. A, illustrated in Pl. 3, fig. 1, is tentatively distinguished from *P. kinosakii* by its elongate test with a somewhat thicker wall, though a detailed comparison is not easy.

Parafusulina shimotsukensis F. Kobayashi, 2006
Plate 3, Figures 5, 6

Parafusulina shimotsukensis F. Kobayashi, 2006a, p. 49, 51, figs. 9.1–9.8, 10.1–10.13; F. Kobayashi, 2011, p. 473, pl. 15, figs. 1–3; F. Kobayashi, 2013, figs. 12, 13.1–13.23, 14, 16–20, 24, 26–28; F. Kobayashi, 2018, p. 38, pl. 2, figs. 6, 9.

Remarks.—This species proposed by F. Kobayashi (2006a) from the Nabeyama Formation of the Kuzu area shows extremely broad intraspecific variations in many test characters as illustrated by numerous individuals in F. Kobayashi (2013) from six stratigraphic levels of the formation. Total 281 individuals of the species from the area are illustrated in F. Kobayashi (2013), among which 100 axial and 41 sagittal sections are prepared from the one sample (Ka-70). Highly variable morphologic characters gradually changing from specimen to specimen are found in the Kuzu materials.

The Funabuseyama specimens, though rarely contained and mostly incomplete due to abrasion of the outer test, are allied to and identified as *Parafusulina shimotsukensis*. The smaller appearance of the test is undoubtedly due to the incompleteness of the test, as well as parafusulines identified with this species by F. Kobayashi (2018) from the Shirasaki Limestone.

Parafusulina sp. B
Plate 10, Figure 23

Remarks.—*Parafusulina* sp. B is distinguished from *Parafusulina japonica* by its higher number of whorls attaining to nine, and smaller length and width of corresponding whorls.

Family Verbeekinidae Staff and Wedekind, 1910
Subfamily Misellinae A. D. Miklukho-Maklay, 1958
Genus *Pseudodoliolina* Yabe and Hanzawa, 1932
Type species: *Pseudodoliolina ozawai* Yabe and Hanzawa, 1932

Pseudodoliolina ozawai Yabe and Hanzawa, 1932
Plate 4, Figures 3–25

Pseudodoliolina ozawai Yabe and Hanzawa, 1932, p. 40–42; Thompson and Foster, 1937, p. 138–140, pl. 24, figs. 9, 10; F. Kobayashi, 2011, p. 478, 480, 482, pl. 17, figs. 1–20, 22–24, 26, 27, 31; F. Kobayashi, 2018, p. 39, pl. 2, figs. 12–14.
? *Peudodoliolina ozawai* Yabe and Hanzawa, M. Kobayashi, 1957, p. 298–300, pl. 8, figs. 1, 2; pl. 9, figs. 1, 2. [non. pl. 9, figs. 3, 4= ? *Pseudodoliolina pseudolepida* (Deprat, 1912)]

Remarks.—Thompson and Foster (1937) made clear the generic diagnosis of *Pseudodoliolina* and taxonomic independency of *Pseudodoliolina ozawai* which were uncertain in the original description of Yabe and Hanzawa (1932). On the other hand, strict distinction of *Pseudodoliolina ozawai* from its similar species, such as *P. oliviformis* Thompson, Wheeler, and Danner, 1950 and *P. chinghaiensis* Sheng, 1958, is not easy because of their many similarities of test characters (F. Kobayashi, 2011, 2018). Two specimens assigned to *P. ozawai* by M. Kobayashi (1957) might be doubtfully reassigned to *Pseudodoliolina pseudolepida* by their association with *Neoschwagerina colaniae* Ozawa, 1927.

The illustrated 23 specimens from Funabuseyama, including abnormally grown ones (Pl. 4, figs. 17, 18), are closely similar to the topotypes of *Pseudodoliolina ozawai* from the Akasaka Limestone (F. Kobayashi, 2011). Larger and shorter ellipsoidal forms (e.g. Pl. 4, fig. 9) than much slenderer ones (e.g. Pl. 4, fig. 25) and others cannot be separated each other, since they are thought to merely represent the intraspecific variation of this species.

Subfamily Verbeekininae Staff and Wedekind, 1910
Genus *Armenina* A. D. Miklukho-Maklay, 1955
Type species: *Armenina karinae* A. D. Miklukho-Maklay, 1955

Armenina crassispira (Chen, 1956)
Plate 9, Figures 1, 7–10, 13, 14

Verbeekina crassispira Chen, 1956, p. 49, pl. 9, figs. 7–10, 13; Sheng, 1958, p. 285, 286, pl. 1, figs. 5–7.
Verbeekina (*Armenina*) *crassispira* (Chen), Sheng, 1963, p. 217, 218, pl. 24, fig. 10.
par. *Armenina akasakensis* (Thompson, 1936), F. Kobayashi, 2011, p. 486, 488, pl. 19, figs. 1, 12,

14–18, 19?; pl. 21, figs. 6–8. (non. pl. 19, figs. 2–11, 13; pl. 21, fig. 9= *Verbeekina akasakensis*)

Description.—Test subspherical with 13 to 16 whorls, 6.51 mm in length, 4.77 to 5.77 mm in width, and 1.2 in form ratio in illustrated three axial and two sagittal sections (Table 2). Proloculus spherical, small, and 0.02 to 0.05 mm in diameter. Inner three to four or five whorls tightly coiled and gradually increasing chamber height. Beyond these inner whorls, length and width gradually increase in general, and poles are shallowly depressed. Alveolar keriotheca very fine or indistinct in inner whorls.

Wall less than 0.03 mm in inner tightly coiled whorls, and 0.05 to more than 0.08 mm in the thicker part of outer whorls. Septa unfluted, gently inclined anteriorly, and mostly in contact with parachomata. Parachomata semicircular in cross sections, less than one third as high as chambers in outer whorls, and first appear in the third whorl.

Remarks.—Many individuals of verbeekinids of moderate size having a relatively thick wall and well-developed parachomata are found out in the Funabuseyama materials. They are identified with *Armenina crassispira* and mostly occur in samples biostratigraphically lower than those containing *Verbeekina verbeeki* in the Akasaka Limestone (F. Kobayashi, 2011). *Verbeekina akasakensis*, described below, co-exists with this species both in Funabuseyama and Akasaka.

Because the forms with a thicker wall and more-developed parachomata are more dominant and more remarkable than forms with a thinner wall and less-developed parachomata in Akasaka, and the specific diagnosis of *V. akasakensis* sense Thompson (1936) is equivocal, F. Kobayashi (2011) gave an emended diagnosis for *V. akasakensis* and transferred it to *Armenina*. However, taxonomic reconsideration of verbeekinids from the present Funabuseyama materials suggests an unfavorable taxonomic emendation of "*Armenina akasakensis*" carried out by F. Kobayashi (2011). Further notes on the taxonomic complications concerning "*A. akasakensis*" done by F. Kobayashi (2011) are not mentioned herein, as they duplicate with the discussion on the species summarized below.

Armenina aff. *sphaera* (Ozawa, 1927)
Plate 9, Figures 11, 12

Related to:

par. *Verbeekina verbeeki sphaera* Ozawa, 1927, p. 153, pl. 38, figs. 14, 15, 16a; pl. 44, fig. 6b. (non pl. 40, fig. 11b= possibly *Verbeekina verbeeki*)

Verbeekina sphaera Ozawa, Sugi, 1960, p. 313–319, pl. 36, figs. 1–20.

Armenina sphaera (Ozawa), F. Kobayashi, 2011, p. 490, 492, pl. 18, figs. 1–27; pl. 21, figs. 10–13.

Remarks.—The present Funabuseyama specimens contained in sample Fu-4A are similar in general to the topotypes of *Armenina sphaera* described by Sugi (1960) and F. Kobayashi (2011) from the Akasaka Limestone. That specimen illustrated in Pl. 9, fig. 11 is similar to the topotypes except for a somewhat larger test. The one in Pl. 9, fig. 12 might be comparable to a form of *A. sphaera* having a thinner wall and not so massive parachomata (e.g. Sugi, 1960, pl. 36, figs. 9, 10). However, these two specimens have a larger chamber height in the corresponding whorls than the topotypes and co-exist with verbeekinids including very rare *Verbeekina verbeeki*. They are

Table 2. Measurement of *Armenina crassispira* (Chen). An asterisk mark in Tables 2–5 shows the characters that cannot be measured due to abrasion, and/or destruction of the test and/or whorls. A measurement value with question mark, in Tables 2–5 and in the text, is not accurate but approximate to the truth.

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloc.	Length of whorl															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pl. 9, fig. 8	13.5	*	4.96	*	0.04	0.05	0.10	0.19	0.34	0.65	1.07	1.58	2.13	2.70	3.28	3.88	4.56	5.20	*		
Pl. 9, fig. 9	13	5.61	4.77	1.2	0.03?	0.06?	0.11	0.19	0.27	0.61	1.11	1.62	2.20	2.76	3.50	4.22	4.86	5.61			
Pl. 9, fig. 10	13.5	*	5.29	*	0.05?	0.10	0.17	0.26	0.43	0.70	1.14	1.71	2.28	2.90	3.54	4.17	4.67	5.18	*		
						Width of whorl															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						0.06	0.11	0.21	0.35	0.54	0.89	1.32	1.93	2.47	3.08	3.60	4.15	4.72	*		
						0.08	0.10	0.19	0.25	0.44	0.90	1.37	1.89	2.54	3.13	3.72	4.25	4.77			
						0.09	0.15	0.26	0.46	0.67	1.07	1.63	2.20	2.83	3.40	3.93	4.53	5.02	*		
Fig. in Pl.	No. whorl		Width		Proloc.	Width of whorl															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pl. 9, fig. 1	15.8		5.77		0.02	0.06	0.09	0.21	0.34	0.53	0.84	1.26	1.78	2.29	2.81	3.42	3.99	4.58	5.14	5.60?	
Pl. 9, fig. 7	13>		*		0.02	0.05	0.09	0.20	0.35	*	*	*	*	*	*	*	*	*	*		
						Number of septa															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						5	8	10	11	12	11	11	10	15	16	24	26	29	36	41	34>
						5	7	9	10	9	8	11	11	18	22	26	33	39?	*		

treated as an alliance of *A. sphaera* in this paper. Whereas, *Armenina* sp. (Pl. 4, fig. 2) differs from *A.* aff. *sphaera* in its more number of juvenile whorls and more convex lateral slopes of the test, by which it is differentiated from *A.* aff. *sphaera*, as well as *Armenina*? sp. (Pl. 4, fig. 1) having thinner wall and fewer number of parachomata in the corresponding whorls.

Armenina asiatica proposed by Leven (1967) from the southeast Pamir is thought to be a junior synonym of *Armenina sphaera*. Based on morphologic variations of the topotype specimens of *A. sphaera* (Sugi, 1960; F. Kobayashi, 2011), Leven's (1967) *A. sphaera* from the southeast Pamir should be transferred to *Armenina crassispira*. On the other hand, Leven (1967) considered that *A. crassispira* is a junior synonym of *A. sphaera*.

Genus *Verbeekina* Staff, 1909

Type species: *Fusulina verbeeki* Geinitz, 1876

Verbeekina akasakensis Thompson, 1936

Plate 5, Figures 1–8; Plate 9, Figures 4–6

Schwagerina verbeeki (Geinitz, 1876), Deprat, 1912, p. 40, 41, pl. 1, figs. 7–11.

Schwagerina (*Verbeekina*) *verbeeki* (Geinitz), Deprat, 1914, p. 19, 20, pl. 4, figs. 5–7.

Verbeekina akasakensis Thompson, 1936, p. 195.

Verbeekina verbeeki (Geinitz), M. Kobayashi, 1957, p. 301, 302, pl. 9, figs. 3–5.

par. *Armenina akasakensis* (Thompson), F. Kobayashi, 2011, p. 486, 488, pl. 19, figs. 2–11 13; pl. 21, fig. 9. (non. pl. 19, figs. 1, 12, 14–18, 19?; pl. 21, figs. 6–8= *Armenina crassispira*)

Description.—Test nearly spherical to subspherical with shallow umbilical depressions. Mature test consists of 11 to 14 whorls with longer length than width in middle and outer whorls. Length 4.8? to 5.2? mm and width 4.06? to 5.25 mm, giving form ratio 1.1 to 1.2. Proloculus small and 0.02 to 0.05 mm in diameter. Inner two to four whorls elongate lenticular to subspherical and tightly coiled. The next two to three whorls become subspherical with form ratio more than 1.1 and are gradually increasing in their length and width. Beyond these whorls, length and width increase somewhat rapidly and then gradually expand outwards (Table 3).

Wall less than 0.01 mm and structureless in inner few whorls, and also thin up to 0.03 mm in the next few whorls consisting of a tectum and finely alveolar keriotheca. Wall thickness of whorls with alveolar keriotheca is considerably variable by specimens, and varies 0.025 to 0.05 mm in inner part and 0.04 to 0.06 mm in outer part. Septa planar, gently inclined anteriorly throughout growth, and 6? to 15 in the second to fifth whorls, 9 to 11 in sixth to ninth whorl, and then increasing outwards. Parachomata small and semicircular to triangular in cross sections. They are absent in the initial lenticular whorls, sporadical and less than one fifth to one eighth as high as chambers in the subsequent inner whorls. Parachomata become more distinct but still sporadical in general in the outer whorls. Shape and density of them are considerably variable.

Remarks.—The taxonomic complication of *Verbeekina akasakensis* is reviewed historically by F. Kobayashi (2011). The specimen illustrated in pl. 4, fig. 5 in Deprat (1914) from the Akasaka Limestone was designated as the lectotype of this species by

Table 3. Measurement of *Verbeekina akasakensis* Thompson.

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloc.	Length of whorl												
						1	2	3	4	5	6	7	8	9	10	11	12	13
Pl. 5, fig. 1	11	4.8?	4.06?	1.2	0.04	0.05	0.12	0.34	0.56	0.97	1.20	2.22	2.92	3.55	4.24	4.8?		
Pl. 5, fig. 4	10	3.81	3.44	1.1	0.02	0.08	0.18	0.34	0.55	0.84	1.42	1.99	2.63	3.20	3.81			
Pl. 5, fig. 6	11>	*	*	*	0.03	0.08	0.13	0.33	0.52	0.80	1.22	1.86	2.46	3.40	3.78	4.35?	*	*
Pl. 9, fig. 5	13.5	*	5.25	*	0.05	0.06	0.12	0.18	0.34	0.62	1.10	1.81	2.46	3.17	3.82	*	*	*
Pl. 9, fig. 6	12	5.2?	4.64	1.1	0.04	0.06	0.16	0.31	0.55	1.03	1.56	2.14	2.80	3.41	3.97	4.67	5.2?	
						Width of whorl												
						1	2	3	4	5	6	7	8	9	10	11	12	13
						0.12	0.18	0.31	0.52	0.87	1.31	1.85	2.44	3.08	3.63	4.06?		
						0.13	0.17	0.33	0.56	0.85	1.34	1.81	2.33	2.89	3.44			
						0.10	0.21	0.35	0.48	0.70	1.18	1.67	2.29	2.87	3.42	*	*	
						0.10	0.13	0.23	0.36	0.57	1.04	1.49	2.05	2.67	3.26	3.84	4.44	4.99
						0.15	0.18	0.34	0.55	0.86	1.30	1.86	2.33	2.89	3.40	4.00	4.64	
Fig. in Pl.	No. whorl		Width		Proloc.	Width of whorl												
						1	2	3	4	5	6	7	8	9	10	11	12	13
Pl. 5, fig. 8	11.2>		4.14		?	?	0.16?	0.25	0.46	0.81	1.22	1.79	2.25	2.81	3.36	3.89	*	
						Number of septa												
						1	2	3	4	5	6	7	8	9	10	11	12	13
						?	?	6?	8	9	11	13	20	23	23	23?	*	

Thompson (1936). F. Kobayashi (2011) redefined and reassigned this species to *Armenina*, because forms like the lectotype having a subspherical test with thin wall and poorly developed parachomata are rather rare, and most of them with larger test show a closer resemblance to *Armenina crassispira* based on many variable forms of middle-sized verbeekinids in Akasaka. However, taxonomic reconsideration of verbeekinids based on variable forms of the present Funabuseyama materials suggests an unfavorable taxonomic emendation of this species done by F. Kobayashi (2011). The illustrated specimens referred to "*Armenina akasakensis*" from Akasaka by F. Kobayashi (2011) are partly renamed as *Armenina crassispira*, as mentioned above. In this paper, some illustrated Akasaka specimens having a relatively thinner wall and fewer parachomata than *Armenina crassispira* are left as *Verbeekina akasakensis* sense Thompson (1936).

Many test characters of *Verbeekina akasakensis*, especially of size and shape of the corresponding whorls, thickness of wall, and development of parachomata, are considerably variable from specimen to specimen in the Funabuseyama materials. These differences are assumed to represent the broad intraspecific variation of this species, not concretely described by Thompson (1936).

Verbeekina verbeeki (Geinitz, 1876)
Plate 6, Figures 1–7; Plate 7, figures 1–8; Plate 8, Figures 1–9; Plate 9, Figures 2, 3

Fusulina verbeeki Geinitz, 1876, p. 399, 400.
Verbeekina verbeeki (Geinitz), Ozawa, 1925, p. 48–51, pl. 10, figs. 6, 7; F. Kobayashi, 1988b, p. 443, figs. 5.3, 5.4; F. Kobayashi, 2011, p. 492, pl. 17, figs. 34–36; pl. 20, figs. 1–13; pl. 21, figs. 1–5; Ueno, 1992, p. 1045, 1047–1049, fig. 5.1–5.6; fig. 6.1–6.5; F. Kobayashi, 2019, p. 76, pl. 7, fig. 36; pl. 14, figs. 1–13; pl. 15, figs. 1–12.
non. *Verbeekina verbeeki* (Geinitz), F. Kobayashi, 2018, p. 39, 40, pl. 3, figs. 6, 8, 10, 14. (= *Verbeekina akasakensis*)

Description.— Test spherical to subspherical with longer length than width. Mature specimens with 13 to 16 whorls, 6.7? to 8.65? mm in length, 5.9? to 7.21 mm in width, and 1.05 to 1.2 in form ratio. Proloculus very small and 0.01 to 0.05 mm in diameter. Inner three to four whorls eostaffelloid and tightly coiled. With the slight change of axis of coiling, the next few whorls become spherical with shallow umbilicus and are succeeded by outer whorls gradually increasing length and width. Length and width from the first to sixteenth whorls are shown in Table 4.

Wall very thin, less than 0.01 mm, structureless in inner few whorls, and also very thin up to 0.025 mm in the next few whorls consisting a tectum and translucent layer. Beyond these inner whorls, wall of outer whorls consists of a tectum and very finely to finely alveolar keriotheca. Wall thickness of whorls with alveolar keriotheca is considerably variable by specimens, and varies 0.02 to 0.04 mm in inner part and 0.05 to 0.09 mm in outer part.

Septa planar, slender, inclined anteriorly throughout growth, and thin in inner and middle whorls, and thickened outwards. Septal counts 6? to 15 from the second to fifth whorl, 9 to 11 in sixth to ninth whorl, then increasing outwards. Parachomata small and semicircular to triangular in cross sections. They are absent or sporadical, less than one fifth as high as chambers in inner spherical whorls, and become more distinct in outer whorls where they are still sporadical in general, but the shape and density of them are considerably variable.

Remarks.—Even in specimens among the illustrated 26, the form ratio of the test and of corresponding whorls, the degree of umbilicus along the axis of coiling, chamber height, thickness of wall, and development of parachomata are more or less variable from specimen to specimen. Moreover, the mode of ontogenetic changes of these characters is diverse. Except for three, the other 23 illustrated specimens are come from sample Fu-2A. Therefore, these variabilities are considered as the intrapopulational variation of *Verbeekina verbeeki*. Length and width of the test and those of corresponding whorls are larger in the present material than those in Akasaka (F. Kobayashi, 2011) and Akiyoshi (F. Kobayashi, 2019). Different ranges and mean values of measurable characters are supposed to be partly originated from differences of the stratigraphic levels of samples in Funabuseyama, Akasaka, and Akiyoshi.

Among the Funabuseyama materials, this species is distinguished from *Verbeekina akasakensis* by its larger test, and more whorls of the test and more number of juvenile whorls, and from *Armenina crassispira* by its thinner wall except for in outermost few whorls and lesser developed parachomata. *V. verbeeki* differs from *Verbeekina douvillei* (Deprat, 1912) described from the *Lepidolina shiwaiwensis* Zone of the top of the Akiyoshi Limestone (F.

Table 4. Measurement of *Verbeekina verbeeki* (Geinitz).

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloc.	Length of whorl															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pl. 6, fig. 1	14	7.60	7.03?	1.08	0.05	0.08	0.12	0.24	0.46	0.66	1.24	1.92	2.85	3.95	4.90	5.65	6.34	7.09	*		
Pl. 6, fig. 2	16	8.65?	7.32	1.2	0.02	0.03	0.11	0.28	0.39	0.55	0.96	1.45	2.07	2.85	3.92	4.43	5.21	6.11	6.84	7.88	8.65?
Pl. 6, fig. 3	14.5	7.0>	6.08	1.15?	0.02	0.03	0.05	0.12	0.23	0.41	0.61	1.01	1.79	2.48	3.43	4.22	4.92	5.70	6.48	*	
Pl. 6, fig. 4	14	*	6.35?	*	?	?	0.12	0.23	0.39	0.66	1.06	1.85	2.59	3.47	4.38	5.21	5.97	6.75?	*		
Pl. 6, fig. 5	14	*	7.5>	*	?	?	?	0.16?	0.39	0.60	0.99	1.61	2.33	3.32	4.41	5.39	6.32	7.1?	*		
Pl. 6, fig. 6	14.5	6.7>	5.9?	1.1	0.02	0.03	0.07	0.16	0.27	0.38	0.61	1.10	1.59	2.23	3.00	3.82	4.65	5.56	6.29	*	
Pl. 8, fig. 3	12>	*	*	*	0.02	0.04	0.08	0.13	0.31	0.52	1.04	1.48	*	*	*	*	*	*			
Pl. 7, fig. 1	13.5	7.0?	6.8?	1.03?	0.03	0.05	0.09	0.19	0.34	0.58	0.98	1.57	2.20	3.35	4.14	4.97	5.78	6.50?			
Pl. 7, fig. 2	14	*	*	*	0.02	0.03	0.06	0.16	0.40	0.65	1.03	1.57	2.27	3.15	3.98	4.82	5.6?	*	*		
Pl. 7, fig. 3	15	*	6.9?	*	0.03	0.06	0.13	0.21	0.34	0.45	0.80	1.37	2.02	2.73	3.48	4.17	4.89	5.70	6.35	*	
Pl. 7, fig. 4	14	6.7?	6.2?	1.10	0.02?	0.03	0.05	0.14	0.31	0.48	0.85	1.36	1.99	2.57	3.35	4.20	5.11	5.96	6.7?		
Pl. 7, fig. 5	13	*	*	*	0.03?	0.11	0.15	0.24	0.38	0.66	1.06	1.86	2.70	3.77	4.69	5.69	6.52	*			
Pl. 7, fig. 6	12.5	6.07	5.24	1.16	0.01	0.03	0.07	0.14	0.22	0.43	0.70	1.37	2.13	2.87	3.83	4.60	5.47	*			
Pl. 7, fig. 7	12.5	6.04	5.33	1.13	0.02	0.06	0.11	0.20	0.34	0.51	0.93	1.63	2.32	3.03	3.73	4.62	5.51	*			
Pl. 7, fig. 8	12.5	6.05	5.48	1.10	0.02?	0.07?	0.15	0.18	0.36	0.57	1.05	1.68	2.31	3.21	4.04	4.71	5.50	*			
Pl. 8, fig. 1	13.5	7.13	6.8?	1.05	0.04	0.06	0.13	0.20	0.29	0.47	0.78	1.44	2.18	3.11	4.06	4.94	5.73	6.45			
Pl. 8, fig. 5	13	6.8?	6.3?	1.1	0.03	0.04	0.11	0.24	0.39	0.68	1.29	2.14	2.86	3.73	4.57	5.32	6.11	6.8?			
Pl. 8, fig. 6	13	7.01?	*	*	0.02	0.03	0.08	0.15	0.29	0.46	0.95	1.88	2.76	3.15	4.53	5.29	6.32	7.01?			
						Width of whorl															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						0.09	0.16	0.25	0.40	0.69	1.16	1.98	2.89	3.80	4.62	5.35	6.04	6.70	*		
						0.10	0.14	0.26	0.39	0.52	0.85	1.28	1.80	2.49	3.21	3.95	4.68	5.32	5.97	6.64	7.32
						0.07	0.15	0.25	0.39	0.47	0.56	1.08	1.68	2.30	3.16	3.93	4.67	5.37	6.08	*	
						?	0.19	0.21	0.33	0.61	0.99	1.53	2.18	2.98	3.70	4.42	5.10	5.75	6.35?		
						?	?	0.18	0.34	0.56	0.93	1.49	2.23	3.02	4.02?	4.98?	5.95?	6.88	7.5>		
						0.06	0.13	0.18	0.28	0.40	0.64	0.98	1.51	2.19	2.87	3.53	4.25	4.90	5.54	*	
						0.07	0.16	0.23	0.38	0.57	0.99	1.46	*	*	*	*	*	*			
						0.06	0.13	0.22	0.38	0.60	1.01	1.68	2.55	3.26	4.14	4.95	5.73	6.5?			
						0.13	0.19	0.28	0.44	0.65	1.01	1.80	2.18	2.92	3.85	4.77	5.55	6.2?	*		
						0.08	0.17	0.28	0.44	0.61	0.89	1.42	2.11	2.69	3.33	4.10	4.92	5.63	6.31	6.9?	
						0.04	0.06	0.15	0.36	0.54	0.85	1.28	1.96	2.64	3.31	4.16	4.85	5.68	6.2?		
						0.12	0.15	0.27	0.37	0.69	1.02	1.60	2.29	3.14	3.98	4.75	5.45?	*			
						0.09	0.17	0.22	0.30	0.49	0.82	1.33	2.02	2.72	3.45	4.28	4.94	*			
						0.09	0.16	0.25	0.40	0.58	0.97	1.58	2.24	2.89	3.61	4.30	5.05	*			
						0.10?	0.16	0.24	0.39	0.64	1.03	1.57	2.24	2.93	3.65	4.39	5.13	*			
						0.09	0.11	0.21	0.34	0.49	0.82	1.43	2.16	3.17	4.08	4.91	5.6?	6.2?			
						0.07	0.15	0.25	0.41	0.69	1.24	1.95	2.71	3.67	4.22	4.88	5.62	6.3?			
						0.07	0.11	0.19	0.31	0.48	0.78	1.22	2.17	2.93	3.66	4.44	5.15?	*			
Fig. in Pl.	No. whorl		Width		Proloc.	Width of whorl															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pl. 8, fig. 7	13.1		6.59		0.04?	0.07?	0.16	0.25	0.40	0.58	0.96	1.63	2.41	3.28	4.15	5.04	5.80	6.57	*		
Pl. 8, fig. 8	14.1		6.50		0.03	0.07	0.18	0.26	0.43	0.61	0.94	1.58	2.19	2.92	3.73	4.57	5.19	5.91	6.48	*	
						Number of septa															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						?	6?	9	11	12	10	8	11	11	17	21	31	34	4>		
						?	8	12	14	15	11	9	9	11	15	19	25	27	32?	3>	

Kobayashi, 2012a, 2019) in its thicker wall and more developed parachomata.

Verbeekina aff. *grabaui* Thompson and Foster, 1937
Plate 5, Figures 9–19

Related to:

Verbeekina grabaui Thompson and Foster, 1937, p. 136, 137, pl. 23, figs. 14–16; Sheng, 1963, p. 215, pl. 27, fig. 2.

Description.—Spherical to subspherical mature specimens with 13 to 16 whorls, more than 4.2 mm in length, more than 4.8 mm in width, and about 1.1 in form ratio. Proloculus 0.02 to 0.05 mm in diameter. Inner three to four whorls eostaffelloid to subspherical with more or less umblicated poles in specimens, tightly coiled, and with variable shift of axis of coiling. With the slight change of axis of coiling, outer whorls become spherical to subspherical and gradually increasing their length and width outwards (Table 5).

Wall thin, less than several μm, and several to less than 15 μm in middle and outer whorls. Partial thicker appearance of wall in outermost few whorls of some specimens are due to secondary coating of discontinuous dark calcareous layer. Wall differentiation obscure in inner one or two whorls, beyond which the wall consists of a tectum and very finely alveolar keriotheca.

Septa planar, highly slender for the chamber height, and inclined anteriorly. Septal counts from the first to seventh whorl 5, 9, 10, 12, 9, 10, and 13 in the specimen illustrated on Pl. 5, fig. 18. Parachomata not developed in inner few whorls. Rudimentary parachomata sporadically recognized, though essentially absent, in middle whorls in most specimens, and poorly developed in outer whorls in most specimens.

Remarks.—Small-sized verbekinids, though fully grown specimens are few, differ from *Verbeekina akasakensis* by their smaller test with fewer number of whorls, thinner wall, and poorly developed parachomata. They resemble *Verbeekina grabaui* originally described from the Middle Permian of Szechuan (Thompson and Foster, 1937) and later from the Middle Permian of Kwangsi (Sheng, 1963) by especially in rudimentary to poorly developed parachomata and thickness of wall. On the other hand, the length and width of the corresponding whorls are larger in the present specimens than in the Chinese two, by which the present ones are supposed to be related to *V. grabaui*.

Family Neoschwagerinidae Dunbar and Condra, 1927
Subfamily Lepidolininae A. D. Miklukho-Maklay, 1958
Genus *Cancellina* Hayden, 1909
Type species: *Fusulina* (*Neoschwagrina*) *primigena* Hayden, 1909

Cancellina nipponica Ozawa, 1927
Plate 10, Figures 5, 7–14, 19; Plate 11, Figures 1–5

Neoschwagerina (*Cancellina*) *nipponica* Ozawa, 1927, p. 160, 161, pl. 34, figs. 12–17; pl. 35, fig. 8b, 10a; pl. 44, fig. 1a; pl. 45, figs. 4, 5.
par. *Neoschwagerina* (*Cancellina*) *schellwieni* (Deprat, 1913), Ozawa, 1927, p. 161, pl. 44, fig. 1b; pl. 45, fig. 3. [non. pl. 34, fig. 18 (from Akiyoshi) = *Presumatrina ozawai* (Hanzawa, 1954)]
Cancellina nipponica Ozawa, Kanmera, 1957, pl. 1, figs. 8–11; F. Kobayashi, 2011, p. 508, 510, 512, pl. 22, figs. 1–42; pl. 43, figs. 1–20.
? *Cancellina* cf. *nipponica* Ozawa, M. Kobayashi, 1957, p. 302, 303, pl. 9, fig. 15.
Neoschwagerina (*Minoella*) *eonipponica* Honjo, 1959, p. 127–129, pl. 1, figs. 1–5, 9.
Neoschwagerina delicata Morikawa and Suzuki, 1961, p. 48, 49, pl. 4, figs. 1, 2; pl. 12, figs. 1–3.
non. *Neoschwagerina* (*Cancellina*) *nipponica* Ozawa, Zaw Win, 1999, p. 41, 42, pl. 1, figs. 1, 2. (= *Cancellina postnipponica* F. Kobayashi, 2011)

Remarks.―This species is characterized by a fusiform to ellipsoidal test with rounded poles, ten or more whorls, large proloculus for the test size, rather slender parachomata, thin wall, and poorly developed transverse and axial septula in few axial and sagittal sections of the original specimens described by Ozawa (1927) from the Akasaka Limestone. It was separated from *Neoschwagerina* by Kanmera (1957) based on better oriented sections closely similar to those of the types. F. Kobayashi (2011) revealed broad intraspecific variations of the topotypes, in which 62 specimens are illustrated. Based on close examination of neoschwagerines of Akasaka and Akiyoshi, he considered that *Neoschwagerina* (*Cancellina*) *schellwieni* by Ozawa (1927), *N.* (*Minoella*) *eonipponica* by Honjo (1959), and *N. delicata* by Morikawa and Suzuki (1961), all of which were described from Akasaka, are conspecific with *Cancellina nipponica*. Furthermore, he clarified that *N.* (*C.*) *nipponica* by Zaw Win (1999) is excluded from this species and reassigned to *Cancellina postnipponica* F. Kobayashi, 2011 that is characterized by a larger proloculus, more number of transverse and axial septula, and more massive parachomata.

In spite of the small number of specimens saved from abrasion of the outer test, almost all the Funabuseyama specimens are certainly identified with *Cancellina nipponica*, as represented by those abundantly present in sample Fu-4I. Some are weakly recrystallized or mineralized secondarily. Broad morphologic variations are seen in the test size of the mature stage, degree of sharpness and development of parachomata, and thicknesss of wall, as well as in the topotype specimens of Akasaka. *Cancellina* sp. rarely from sample Fu-4H and illustrated in Pl. 10, fig. 16 differs from *C. nipponica* by its more developed transverse septula, thicker wall, and smaller proloculus.

Subfamily Neoschwagerininae Dunbar and Condra, 1927
Genus *Neoschwagerina* Yabe, 1903
Type species: *Neoschwagerina craticulifera* Schwager, 1883

Neoschwagerina colaniae Ozawa, 1927 emend. F. Kobayashi, 2011
Plate 11, Figures 9, 14

Neoschwagerina (*Neoschwagerina*) *colaniae* Ozawa, 1927, p. 157, 158, pl. 40, figs. 9, 12, 13; pl. 41, figs. 3, 11
Neoschwagerina margaritae Deprat, 1913, Morikawa and Suzuki, 1961, p. 61, 62, pl. 7, fig. 4; pl. 12, figs. 16–18; F. Kobayashi, 2005, figs. 9.1–9.5.
? *Neoschwagerina colaniae* Ozawa, Morikawa and Suzuki, 1961, p. 58, 59, p. 7, figs. 1, 2; pl. 12, figs. 7, 8.

Table 5. Measurement of *Verbeekina* aff. *grabaui* Thompson and Foster.

Fig. in Pl.	No. whorl	Length	Width	Form Ratio	Proloc.	Length of whorl											
						1	2	3	4	5	6	7	8	9	10	11	12
Pl. 5, fig. 9	11>	*	*	*	0.03	0.05	0.10	0.18	0.33	0.60	1.13	1.68	2.24	2.90	3.58	4.4?	*
Pl. 5 fig. 11	12	*	4.3>	*	0.05	0.08	0.14	0.25	0.51	0.82	1.32	1.95	2.61	3.33	*	*	*
Pl. 5, fig. 12	12	4.28?	3.8?	1.13?	0.03	0.07	0.15	0.20	0.38	0.57	0.90	1.38	1.94	2.48	3.02	3.73	4.28?
Pl. 5, fig. 13	11>	4.2>	*	*	0.04	0.05	0.10	0.15	0.34	0.52	0.90	1.41	1.99	2.55	3.19	3.9?	*
Pl. 5, fig. 15	8	2.53	2.24	1.13	0.02	0.03	0.13	0.31	0.57	0.98	1.24	1.88	2.53				
Pl. 5, fig. 17	9>	*	*	*	0.04	0.07	0.09	0.17	0.36	0.64	1.04	1.56	2.05	2.60	*		
Pl. 5, fig. 19	9>	*	*	*	0.03	0.10	0.15	0.24	0.42	0.71	1.14	1.61	2.26?	*	*		
						Width of whorl											
						1	2	3	4	5	6	7	8	9	10	11	12
						0.08	0.13	0.20	0.34	0.57	0.99	1.49	*	*	*	*	*
						0.11	0.19	0.30	0.47	0.76	1.20	1.71	2.32	2.88	3.47	3.97	*
						0.08	0.13	0.17	0.32	0.51	0.81	1.25	1.77	2.32	2.88	3.40	3.8?
						0.07	0.16	0.25	0.38	0.56	0.89	1.29	1.84	2.52	2.98?	*	*
						0.12	0.17	0.25	0.38	0.85	1.10	1.72	2.24				
						0.07	0.13	0.22	0.36	0.58	0.91	1.31	1.80	2.32	*		
						0.13	0.16	0.29	0.41	0.60	0.99	1.48	2.14	2.66	*		
Fig. in Pl.	No. whorl		Width		Proloc.	Width of whorl											
						1	2	3	4	5	6	7	8	9	10	11	12
Pl. 5, fig. 18	10>		*		0.04	0.07	0.14	0.26	0.45	0.72	1.16	1.65	2.24	2.87	*	*	
						Number of septa											
						1	2	3	4	5	6	7	8	9	10	11	12
						5	9	10	12	9	10	13	*	*	*	*	

Neoschwagerina haydeni Dutkevich and Khabakov, 1934, F. Kobayashi, 1988b, p. 443, 445, figs. 7.2–7.11; Zaw Win 1999, p. 53, 54, pl. 5, fig. 5; pl. 6, fig. 1; F. Kobayashi et al., 2007, figs. 14.5, 14.6.

Neoschwagerina colaniae Ozawa, Zaw Win, 1999, p. 54, 55, pl. 5, fig. 5; pl. 6, fig. 1; F. Kobayashi, 2011, p, 516, 518, pl. 33, figs. 19–26; pl. 34, figs. 1–21; pl. 37, figs. 7–9; F. Kobayashi, 2016, figs. 13–15.

Remarks.—This species was proposed by Ozawa (1927) for an earlier member of the neoschwagerinids having intermediate test characters between *Neoschwagerina craticulifera* and *N. margaritae* in the *Neoschwagerina margaritae* lineage. It was redefined by F. Kobayashi (2011) based on many topotype specimens from the Akasaka Limestone, based on which some forms formerly identified with *Neoschwagerina haydeni* from Japan should be referred to *N. colaniae*. Specimens named *N. margaritae* by Morikawa and Suzuki (1961) from Akasaka are closer to *N. colaniae* based on the smaller length and width of corresponding whorls. Similarly, *N. margaritae* illustrated by F. Kobayashi (2005) from the Itsukaichi-Ome area is reassigned to *N. colaniae*, as was done by F. Kobayashi (2016). Two illustrated specimens from Funabuseyama closely resemble the typical form of 29 topotype specimens of this species shown by F. Kobayashi (2011). An appearance of a somewhat smaller test and fewer number of whorls is due to the abrasion of the test. *Neoschwagerina* cf. *colaniae* illustrated by M. Kobayashi (1957) from Ibukiyama is better to be reassigned to *N. margaritae*, described below.

Neoschwagerina craticulifera (Schwager, 1883)
Plate 11, Figures 15, 17, 22, 23

Schwagerina craticulifera Schwager, 1883, p. 140, pl. 18, figs. 15–25.

Neoschwagerina craticulifera (Schwager), Yabe, 1906, p. 2, pl. 1, fig. 3; M. Kobayashi, 1957, p. 303–305, pl. 9, figs. 8–13; F. Kobayashi, 2011, p. 518, 520, pl. 33, figs. 1–18; pl. 37, figs. 4–6; F. Kobayashi, 2018, p. 40, pl. 4, figs. 1–15.

Neoschwagerina (*Neoschwagerina*) *craticulifera* (Schwager), Ozawa, 1927, p. 154–156, pl. 40, figs. 1–7, 10, 11a.

Remarks.—Many species or subspecies identified with *Neoschwagerina craticulifera* or its allies and described by many workers in the Akasaka Limestone were discussed by F. Kobayashi (2011). Four specimens illustrated herein are identified with *N. craticulifera* by having a relatively thin wall and slender transverse septula. These slight differences are thought to fall in the broad morphologic variations of this species. This species is distinguished from *N. colaniae* by its smaller test, fewer number of whorls, and absence or fewer number of secondary transverse septula between adjacent primary transverse septula in outer whorls.

Neoschwagerina fujimotoi Yamagiwa, 1956
Plate 11, Figures 25–28

Neoschwagerina sakaguchii Yamagiwa, 1956, p. 237, 238, pl. 34, figs. 5–10, 17.
Neoschwagerina fujimotoi Yamagiwa, 1956, p. 239, pl. 34, figs. 11–15.

Remarks.—Among the described species, the present Funabuseyama specimens are the closest to *Neoschwagerina fujimotoi* described by Yamagiwa (1956) from the Shima Peninsula by their thick wall and stout primary transverse septula, and the absence of secondary transverse septula even in outer whorls. *N. sakaguchii* described from the same locality of the peninsula is not separated from *N. fujimotoi* by its slightly more elongate test. This species is distinguished from *N. simplex* by its more developed transverse septula and slenderer septa.

Neoschwagerina fusiformis Skinner and Wilde, 1967
Plate 11, Figures 6, 7

Neoschwagerina fusiformis Skinner and Wilde, 1967, p. 16, pl. 19, figs. 1–8.
non. *Neoschwagerina fusiformis* Skinner and Wilde, Ueno, 1992, p. 1053, 1055, figs. 9.1– 9.14. (= *Neoschwagerina haydeni* Dutkevich in Dutkevich and Khabakov, 1934)

Remarks.—The illustrated axial section, though fully-grown and not abraded specimens are few, is characteristic in its inflated fusiform test with more than 18 whorls, almost straight lateral slopes and bluntly pointed poles, and regularly spaced primary transverse septula and parachomata. Axial septula first appear in the fifth whorl. Secondary transverse septula are very few or almost absent even in outer whorls, and rudimentary ones first appear in the 12th whorl. From these test characters, the present specimens are identified with *Neoschwagerina fusiformis* proposed by Skinner and Wide (1967) from a higher stratigraphic level than the highest known specimens of *Yabeina* in Tunisia. Fourteen specimens identified with this species by Ueno (1992) from the Akiyoshi Limestone have a relatively thinner wall for the genus, and slenderer septa, septula and parachomata than this species. They are more similar to and transferred to *Neoschwagerina haydeni* described by Ueno (1992) as done by F. Kobayashi (2019).

Neoschwagerina margaritae Deprat, 1913
Plate, 12, Figures 10, 11

Neoschwagerina margaritae Deprat, 1913, p. 58–60, pl. 8, fig. 10; pl. 9, figs. 1–3; F. Kobayashi, 1988a, p. 10, pl. 7, figs. 1–3; F. Kobayashi, 2007, pl. 1, figs. 1, 2, 6–11; F. Kobayashi, 2011, p. 520, 522, pl. 35, figs. 1–12; pl. 37, figs. 10–12.
Neoschwagerina cf. *colaniae* Ozawa, M. Kobayashi, 1957, p. 305, 306, pl. 10, figs. 1, 2.
Metaschwagerina ovalis Minato and Honjo in Honjo, 1959, p. 151–155, pl. 7, figs. 1, 2; pl. 8.
non. *Neoschwagerina margaritae* Deprat, Zaw Win, 1999, p. 55, 56, pl. 6, figs. 2–6 (= *Yabeina globosa*); F. Kobayashi, 2005, figs. 9.1–9.5. (= *N. colaniae*)

Remarks.—Twelve specimens illustrated by F. Kobayashi (2011) from Akasaka are the closest to the types from the Middle Permian of Lang-Nac, Tonkin in their size and shape of the test, the number of whorls, and poorly developed secondary transverse septula and axial septula in comparison with large test. The illustrated two and other specimens from sample Fu-5 of Funabuseyama are undoubtedly identical with *N. margaritae* from the type area and F. Kobayashi's (2011) materials. As pointed out by F. Kobayashi et al. (2010), Zaw Win's (1999) *N. margaritae* should be referable to *Yabeina globosa*, and F. Kobayashi's (2005) *N. margaritae* is reassigned to *N. colaniae*, as mentioned above. *Metaschwagerina ovalis* proposed by Minato and Honjo from Akasaka as a new genus and a new species was named for destroyed specimens referable to *N. margaritae* (F. Kobayashi, 2011).

Neoschwagerina simplex Ozawa, 1927
Plate 11, Figures 16, 19–21, 24

Neoschwagerina (*Neoschwagerina*) *simplex* Ozawa, 1927, p. 153, 154, pl. 34, figs. 7–11, 22, 23; pl. 37, figs. 3a, 6a.
Neoschwagerina simplex Ozawa, Honjo, 1959, p. 139–142, pl. 3, figs. 1, 4, 5: pl. 4; F. Kobayashi, 1988a, p. 11, pl. 6, figs. 1–17; F. Kobayashi, 2011, p. 524, 526, pl. 32, figs. 1–20; pl. 37, figs. 1–3.

Remarks.—Although Honjo (1959) designated the specimen illustrated in pl. 34, fig. 8 by Ozawa (1927) as the lectotype of *N. simplex*, the diagnosis of this species given by Honjo is not satisfactorily understood. As comprehensible from many topotype specimens from the Akasaka Limestone (F. Kobayashi, 2011), diagnostic features of *Neoschwagerina simplex* are the poor development of transverse and axial septula among species of the genus, and a thick wall and small proloculus in comparison with the test size. By these test characters, the Funabuseyama specimens are certainly identified with the topotypes of this species.

Genus *Yabeina* Deprat, 1914

Type species: *Neoschwagerina* (*Yabeina*) *inouyei* Deprat, 1914 [= *Yabeina globosa* (Yabe, 1906)]

Yabeina higoensis F. Kobayashi, 2001
Plate 12, Figures 5–9

Neoschwagerina margaritae Deprat, M. Kobayashi, 1957, p. 306–308, pl. 10, figs. 3–6.
Yabeina higoensis F. Kobayashi, 2001, p. 72, figs. 6.4, 6.8; pl. 5, figs. 1–9; F. Kobayashi, 2006c, p. 189, figs. 6.1–6.17; F. Kobayashi, 2018, p. 40, pl. 4, figs. 16–21, 23.

Remarks.—The Funabuseyama specimens, though more or less recrystallized, are identified with *Yabeina higoensis*, based on many similarities of size and shape of the test, length and width of corresponding whorls, development of secondary transverse septula and axial septula, and thickness of wall. They well resemble the original ones from the Kuma Formation by F. Kobayashi (2001) and the subsequent ones from Kaize, Saku Basin by F. Kobayashi (2006c), and differ from *Yabeina globosa* exhibiting broad morphologic variations in many test characters (e.g. F. Kobayashi, 2011) in their smaller length and width, and poorer development of secondary transverse septula and axial septula in outer whorls. Four specimens identified with *Neoschwagerina margaritae* by M. Kobayashi (1957) from Ibukiyama, though not well-oriented, are better reassigned to *Y. higoensis* by their degree of development of secondary transverse septula.

Yabeina igoi Morikawa and Suzuki, 1961
Plate 12, Figures 1, 2

Yabeina cf. *katoi* (Ozawa), M. Kobayashi, 1957, p. 308, 309, pl. 10, fig. 7.
Yabeina igoi Morikawa and Suzuki, 1961, p. 64, 65, pl. 9, fig. 3; pl. 20, figs. 1–9.

Remarks.—Relatively large-sized *Yabeina* rarely contained in sample Fu-2A is identified with *Y. igoi* proposed by Morikawa and Suzuki (1961) from the Akasaka Limestone based on size and shape, and growth pattern of the test, thickness of wall, and development of primary and secondary transverse septula, axial septula, and parachomata. This form is distinguished from *Gifuelloides larga* (Morikawa and Suzuki, 1961) by its more developed secondary transverse septula. *Yabeina* cf. *katoi* described by M. Kobayashi (1957) from Ibukiyama is different from and not compared to the types of Akasaka in its smaller test, smaller height of chambers, and fewer number of secondary transverse between adjacent primary transverse septula in outer whorls. By these features, it is probably reassigned to this species.

Yabeina omurensis Yamagiwa and K. Ishii, 1958
Plate 12, Figures 3, 4

Yabeina omurensis Yamagiwa and K. Ishii, 1958, p. 62, 64, pl. 4, figs. 1–8.
Yabeina cf. *omurensis* Yamagiwa and K. Ishii, F. Kobayashi, 2018, p. 41, pl. 4, figs. 22, 24.

Remarks.—Two abraded specimens of *Yabeina* illustrated are associated with *Y. igoi*, *Neoschwagerina fusiformis*, and *Verbeekina verbeeki*. From the similarities of the development of the primary and secondary transverse septula, thickness of wall, and length and width of corresponding whorls, they are provisionally identified with *Yabeina omurensis* first described by Yamagiwa and K. Ishii (1958) from the Shima Peninsula. A possibility of them only representing incomplete specimens of *Y. igoi* without outer whorls cannot be denied in this work.

Yabeina spp.
Plate 11, Figures 8, 10–13, 18

Remarks.—In addition to three species of *Yabeina* described above, three forms assignable to the genus are distinguished, though the exact size and shape, and the number of whorls in the fully-grown test are uncertain. The first group of them (Pl. 11, figs 8, 12) is characterized by well-developed axial septula and a minute proloculus. Beyond the eighth whorl, two to four axial septula are inserted between the adjacent septa. The specimen shown in Pl. 11, fig. 10 might belong to the first group because of its well-developed axial septula attaining to four or five between adjacent septa in outer whorls. It is not assigned to *Yabeina igoi* by its not so slender septa and septula and thicker wall, and is not included into *Neoschwagerina fusiformis* by its higher number of axial septula, and shorter septa and axial septula inclined anteriorly with larger angles. These three specimens illustrated are associated with *Yabeina igoi*, *Neoschwagerina fusiformis*, and *Verbeekina verbeeki*.

The specimen (Pl. 11, fig. 11) tentatively included in the second group has very slender septa and axial septula, and a very thin wall. It is associated with *Yabeina higoensis* in sample Fu-18D. The third group of the indeterminate *Yabeina* (Pl. 11, figs. 13, 18) contained in Fu-18D is different from the first and second groups by its larger proloculus and faint secondary transverse septula first appear in the sixth whorl.

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Plate 1

(Scale bars show 1 mm. Bar A for figs. 1, 39; bar B for figs. 4–6, 8–11, 14, 15, 23, 25, 27–30, 33, 38, 40–43, 46–48, 50, 51; bar C for figs. 2, 3, 7, 12, 13, 17, 19–22, 24, 26, 32, 34, 36, 37, 44, 49, 52–55; bar D for figs. 16, 18, 31, 35, 45)
Fig. 1. *Deckerella* sp. D2-067320, Fu-4E.
Figs. 2, 3. *Globivalvulina cyprica* Reichel, 1946. 2: D2-067187, 3: D2-067194, both Fu-3J.
Figs. 4–6. *Tetrataxis* cf. *conica* Ehrenberg, 1854. 4: D2-004718, 5: D2-004689, 6: D2-004671; 4, 5: Fu-4A; 6: Fu-3D.
Fig. 7. *Abadehella*? sp. D2-004687, Fu-4A.
Figs. 8–11. *Nodosinelloides* spp. 8: D2-067273, Fu-4B; 9: D2-067141, Fu-3G; 10: D2-067319, Fu-4E; 11: D2-067326, Fu-4E.
Fig. 12. *Tauridia*? sp. D2-067200, Fu-3J.
Figs. 13–16. *Pachyphloia* sp. A. 13: D2-004688, 14: D2-004690, 15: D2-004747, all Fu-4A.
Figs. 17–19. *Pachyphloia* sp. B. 16: D2-004588, Fu-2A; 17: D2-067363, Fu-4G; 18: D2-067368, Fu-4G; 19: D2-004629, Fu-2A.
Figs. 20–22. *Neodiscus* spp. 20: D2-067138, 21: D2-067145, 22: D2-067142, all Fu-3G.
Fig. 23. Cornuspiridae gen. and sp. indet. D2-004651, Fu-3B.
Fig. 24. *Pseudolangella*? sp. A. D2-004548, Fu-2A.
Fig. 25. *Baisalina*? sp. D2-067315, Fu-4E.
Figs. 26–29. *Agathammina* sp. 26: D2-067473, 27: D2-067318, 28: D2-067323, 29: D2-067328, 26: Fu-18B, others: Fu-4E.
Figs. 30, 33. *Neohemigordius japonicus* (Ozawa) 30: D2-067113, Fu-3E; 33: D2-067196, Fu-3J.
Fig. 31. *Pseudolangella*? sp. B. D2-004601, Fu-2A.
Fig. 32. *Geinitzina* sp. D2-067144, Fu-3G.
Fig. 34. *Endothyra* sp. D2-004654, Fu-3B.
Figs. 35, 36. *Pachyphloia* sp. C. 35: D2-067462, Fu-18B; 36: D2-067123, Fu-3E.
Figs. 37–40. *Kahlerina* sp. 37: D2-067467, 38: D2-004611, 39: D2-004580, 40: D2-004631, 37: Fu-18B, others: Fu-2A.
Fig. 41. *Pseudoreichelina darvasica* Leven, 1970. D2-067348, Fu-4G.
Figs. 42, 43, 46–48. *Rauserella staffi* Skinner and Wilde. 42: D2-067112, Fu-3E; 43: D2-004698, Fu-4A; 46: D2-004786, Fu-7; 47: D2-067131, Fu-3F; 48: D2-004784, Fu-7.
Fig. 44. *Chenella* sp. D2-067286, Fu-4B.
Fig. 45. *Nankinella*? sp. D2-067315, Fu-4E.
Figs. 49, 52. *Codonofusiella* cf. *ashioensis* F. Kobayashi. 49: D2-067125, Fu-3E; 52: D-004711, Fu-4A.
Fig. 50. *Yangchienia haydeni* Thompson. D2-004647, Fu-3B.
Fig. 51. *Yangchienia compressa* (Ozawa). D2-067343, Fu-4F.
Figs. 53, 54. *Dunbarula nana* Kochansky-Devidé and Ramovš. Both D2-004547, Fu-2A.
Fig. 55. *Dunbarula* spp. D2-004643, Fu-3B.

Plate 2

(Scale bars show 1 mm. Bar A for figs. 1, 2; bar B for figs. 3–7, 9, 10, 12–14, 25–27, bar C for 8, bar D for 11, 15–24)
Figs. 1, 2. *Schubertella*? *karasawensis* F. Kobayashi, 2006 in F. Kobayashi (2006b). 1: D2-004654, Fu-3B; 2: D2-067130, Fu-3F.
Figs. 3, 10. *Dunbarula* spp. 3: D2-004643, 10: D2-004644, both Fu-3B.
Figs. 4–7, 9, 25–27. *Neofusulinella giraudi* Deprat. 4: D2-004742, Fu-4A; 5: D2-067140, Fu-3G, 6: D2-004705, Fu-4A; 7: D2-004669, Fu-3D; 9: D2-004744, Fu-4A; 25: D2-004737, Fu-4A; 26: D2-067138, Fu-3G; 27: D2-067191, Fu-3J.
Fig. 8. *Rauserella sphaeroides* Sosnina, 1968. D2-004787, Fu-7.
Fig. 11. *Chusenella* sp. D2-004549, Fu-2A.
Figs. 12–14. *Neofusulinella phairayensis* Colani. 12: D2-004706, Fu-4A; 13: D2-004703, Fu-4A; 14: D2-004660, Fu-3C.
Figs. 15–18. *Parafusulina japonica* (Gümbel). 15: D2-004670, 16: D2-004643, 17: D2-004646, 18: D2-004656, 15: Fu-3D, others: Fu-3B.
Figs. 19, 20. *Chusenella conicocylindrica* (Chen). 19: D2-067344, 20: D2-067335, both Fu-4F.
Figs. 21–24. *Chusenella sinensis* Sheng. 21: D2-067399, 22: D2-067387, 23: D2-067394, 24: D2-067383, all Fu-4I.

Plate 3

(Scale bar of 2 mm is for all)
Fig. 1. *Parafusulina* sp. A. D2-067259, Fu-3O.
Figs. 2–4. *Parafusulina kinosakii* (Morikawa). 2: D2-067257, Fu-3O; 3: D2-067256, Fu-3O; 4: D2-004663, Fu-3C.
Figs. 5, 6. *Parafusulina shimotsukensis* F. Kobayashi. 5: D2-004733, 6: D2-004724, both Fu-4A.
Figs. 7–9, 11–17. *Parafusulina japonica* (Gümbel). 7: D2-004687, Fu-4A; 8: D2-004685, Fu-4A; 9: D2-067303, Fu-4C; 11: D2-004792, Fu-5; 12: D2-067158, Fu-3H; 13: D2-067294, Fu-4C; 14: D2-067308, Fu-4D; 15: D2-067108, Fu-3E; 16: D2-067298, Fu-4C; 17: D2-067296, Fu-4C.
Fig. 10. *Parafusulina gigantojaponica* M. Kobayashi. D2-004796, Fu-8.

Plate 4

(Scale bar A of 2 mm is for 3–27, B of 2 mm is for 1 and 2)
Fig. 1. *Armenina*? sp. D2-004711, Fu-4A.
Fig. 2. *Armenina* sp. D2-004672, Fu-3D.
Figs. 3–25. *Pseudodoliolina ozawai* Yabe and Hanzawa. 3: D2-067169, 4: D2-004784, 5: D2-067178, 6: D2-067185, 7: D2-067192,

8: D2-067179; 9: D2-067176, 10: D2-067168, 11: D2-067208, 12: D2-067193, 13: D2-067134, 14 D2-067184; 15: D2-004700, 16: D2-067183, 17: D2-067195, 18: D2-067197, 19: D2-067172; 20: D2-004688, 21: D2-004706, 22: D2-067174, 23: D2-067201, 24: D2-004688, 25: D2-004689; 4: Fu-7; 13: Fu-3F; 15, 19, 20, 23, 24: Fu-4A; others: Fu-3J.
Figs. 26, 28. *Parafusulina japonica* (Gümbel). 26: D2-004802, Fu-8; 28: D2-067112, Fu-3E.
Fig. 27. *Parafusulina gigantojaponica* M. Kobayashi. D2-004799, Fu-8.

Plate 5

(Scale bar A of 2 mm is for 1a, 2–8, 9a, 10, 11a, 12a, 13a, 14, 15a, 16, 17a, 18, 19; B of 2 mm is for 1b, 9b, 11b, 12b, 13b, 15b, 17b)
Figs. 1–8. *Verbeekina akasakensis* Thompson. 1: D2-004671, 2: D2-004750, 3: D2-004715, 4: D2-004739, 5: D2-004777, 6: D2-004708, 7: D2-004770, 8: D2-004723, 1: Fu-3D, others: Fu-4A.
Figs. 9–19. *Verbeekina* aff. *grabaui* Thompson and Foster. 9: D2-004716, 10: D2-004741, 11: D2-004729, 12: D2-004701, 13: D2-004730, 14 D2-004722; 15: D2-004756, 16: D2-004731, 17: D2-004733, 18: D2-004734, 19: D2-004731, all Fu-4A.

Plate 6

(Scale bar A of 2 mm is for 1a, 2, 3a, 4, 5, 6a; B of 2 mm is for 1b, 3b, 6b, 7)
Figs. 1–7. *Verbeekina verbeeki* (Geinitz). 1: D2-004597, 2: D2-004574 (=Pl. 8, fig. 2), 3: D2-004563, 4: D2-004569, 5: D2-004570, 6: D2-004593, 7: D2-004561 (=Pl. 8, fig. 3), all Fu-2A.

Plate 7

(Scale bar A of 2 mm is for 1a, 2a, 3a, 4, 5, 6a, 7a, 8; B of 2 mm is for 1b, 2b, 3b, 6b, 7b)
Figs. 1–8. *Verbeekina verbeeki* (Geinitz). 1: D2-004564, 2: D2-004578, 3: D2-004594, 4: D2-004568, 5: D2-004588, 6: D2-004581, 7: D2-004562, 8: D2-004541, all Fu-2A.

Plate 8

(Scale bar A of 2 mm is for 1a, 3, 4, 5a, 6a, 7, 8a, 9; B of 2 mm is for 1b, 2, 5b, 6b, 8b)
Figs. 1–9. *Verbeekina verbeeki* (Geinitz). 1: D2-004567, 2: D2-004574 (=Pl. 6, fig. 2), 3: D2-004561 (=Pl. 6, fig. 7), 4: D2-004597, 5: D2-004566, 6: D2-004565, 7: D2-004586, 8: D2-004628, 9: D2-004734, 9: Fu-4A, others: Fu-2A.

Plate 9

(Scale bar A of 2 mm is for 1a, 2–4, 5a, 6, 7a, 8a, 9–11, 12a, 13, 14; B of 2 mm is for 1b, 5b, 7b, 8b, 12b)
Figs. 1, 7–10, 13, 14. *Armenina crassispira* (Chen). 1: D2-004681, 7: D2-004682, 8: D2-004668, 9: D2-004675, 10: D2-004676, 13: D2-004673, 14: D2-004699; 14: Fu-4A, others: Fu-3D.
Figs. 2, 3. *Verbeekina verbeeki* (Geinitz). 2: D2-004717, Fu-4A, 3: D2-004674, Fu-3D.
Figs. 4–6. *Verbeekina akasakensis* Thompson. 4: D2-004719, 5: D2-004703, 6: D2-004718, all Fu-4A.
Figs. 11, 12. *Armenina* aff. *sphaera* (Ozawa). 11: D2-004684, 12: D2-004704, both Fu-4A.

Plate 10

(Scale bars show 1 mm. Bar A for figs. 17, 18, 20–23; bar B for figs. 5, 7–14, 16, 19, bar C for 1–4, 6, 15)
Figs. 1–4, 6. *Neofusulinella giraudi* Deprat. 1: D2-004737, Fu-4A; 2: D2-004672, Fu-3D; 3: D2-094719, Fu-4A; 4: D2-067145, Fu-3G; 6: D2-004680, Fu-3D.
Figs. 5, 7–14, 19. *Cancellina nipponica* (Ozawa). 5: D2-067398, 7: D2-067389, 8: D2-067383, 9: D2-067396, 10: D2-067401, 11: D2-067392, 12: D2-067384, 13: D2-067370, 14: D2-067384, 19: D2-067386, 13: Fu-4G, others: Fu-4I.
Fig. 15. *Codonofusiella* sp. 5: D2-067106, Fu-3E.
Fig. 16. *Cancellina* sp. D2-067378, Fu-4H.
Figs. 17, 18, 20–22. *Parafusulina japonica* (Gümbel). 17: D2-004653, Fu-3B; 18: D2-004648, Fu-3B; 20: D2-004693, Fu-4A; 21: D2-004645, Fu-3B; 22: D2-067103, Fu-3E.
Fig. 23. *Parafusulina* sp. B. D2-067118, Fu-3E.

Plate 11

(Scale bars show 1 mm. Bar A for figs. 6b, 8b, 9b; bar B for figs. 1–5, bar C for 6a, 7, 8a, 9a, 10–28)
Figs. 1–5. *Cancellina nipponica* (Ozawa). 1: D2-067399, 2: D2-067383, 3: D2-067393, 4, 5: D2-067388, all Fu-4I.
Figs. 6, 7. *Neoschwagerina fusiformis* Skinner and Wilde. 6: D2-004607, Fu-2A; 7: D2-067455, Fu-18B.
Figs. 8, 10–13, 18. *Yabeina* spp. 8: D2-004614, 10: D2-004581, 11: D2-067484, 12: D2-004632, 13: D2-004621, 18: D2-004548, 11: Fu-18D, others: Fu-2A.
Figs. 9, 14. *Neoschwagerina colaniae* Ozawa. 9: D2-004539, 14: D2-004576, both Fu-2A.
Figs. 15, 17, 22, 23. *Neoschwagerina craticulifera* (Schwager). 15: D2-004644, 17: D2-004652, 22: D2-067143, 23: D2-004655, 22: Fu-3G, others: Fu-3B.
Figs. 16, 19–21, 24. *Neoschwagerina simplex* Ozawa. 16: D2-067327, Fu-4E; 19: D2-067267, Fu-3P; 20: D2-067273, Fu-4B; 21: D2-067328, Fu-4E; 24: D2-067269, Fu-3P.
Figs. 25–28. *Neoschwagerina fujimotoi* Yamagiwa. 25: D2-067441, 26: D2-067438, 27: D2-067432, 28: D2-067448, all Fu-18A.

Plate 12

(Scale bar A of 1 mm is for 1a, 2, 3a, 4–11; B of 1 mm is for 1b, 3b)

Figs. 1, 2. *Yabeina igoi* Morikawa and Suzuki. 1: D2-004577, Fu-2A; 2: D2-004620, Fu-2A.

Figs. 3, 4. *Yabeina omurensis* Yamagiwa and K. Ishii. 3: D2-004634, Fu-2A; 4: D2-004575, Fu-2A.

Figs. 5–9. *Yabeina higoensis* F. Kobayashi. 5: D2-067457, 6: D2-067452, 7: D2-067460, 8: D2-067458, 9: D2-067466, all Fu-18B.

Figs. 10, 11. *Neoschwagerina margaritae* Deprat. 10: D2-004779, 11: D2-004781, both Fu-5.


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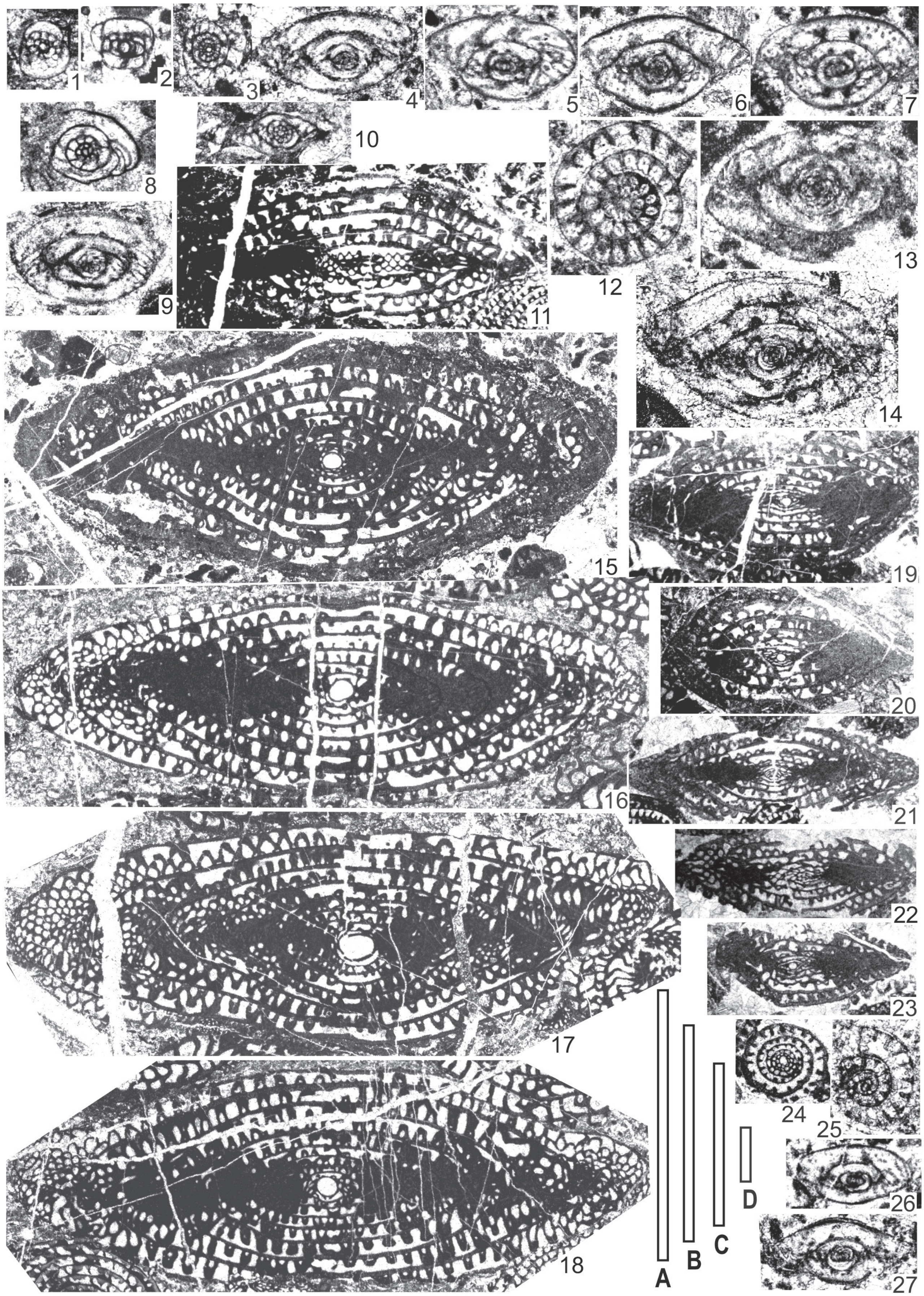
Plate 1.



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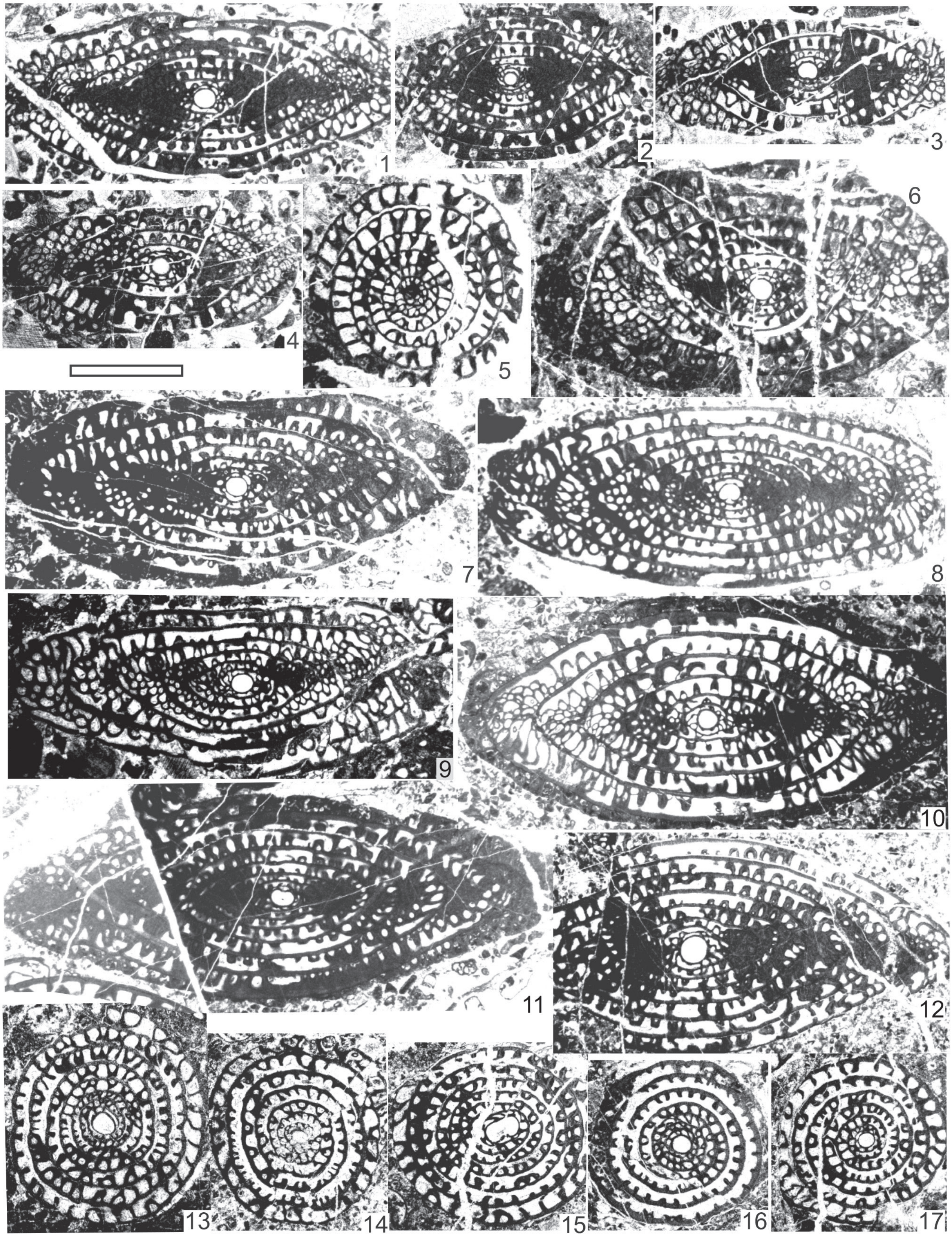

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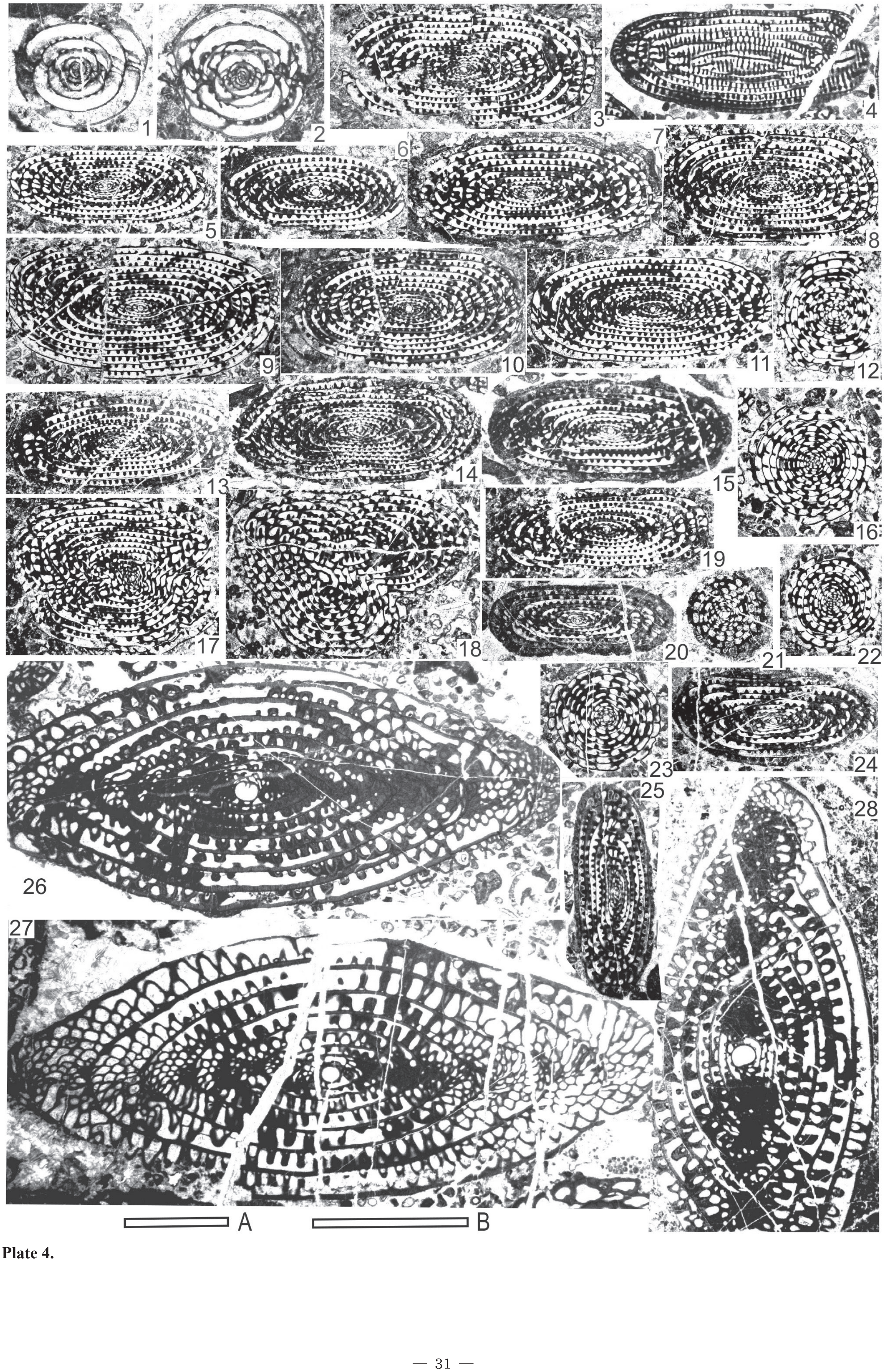

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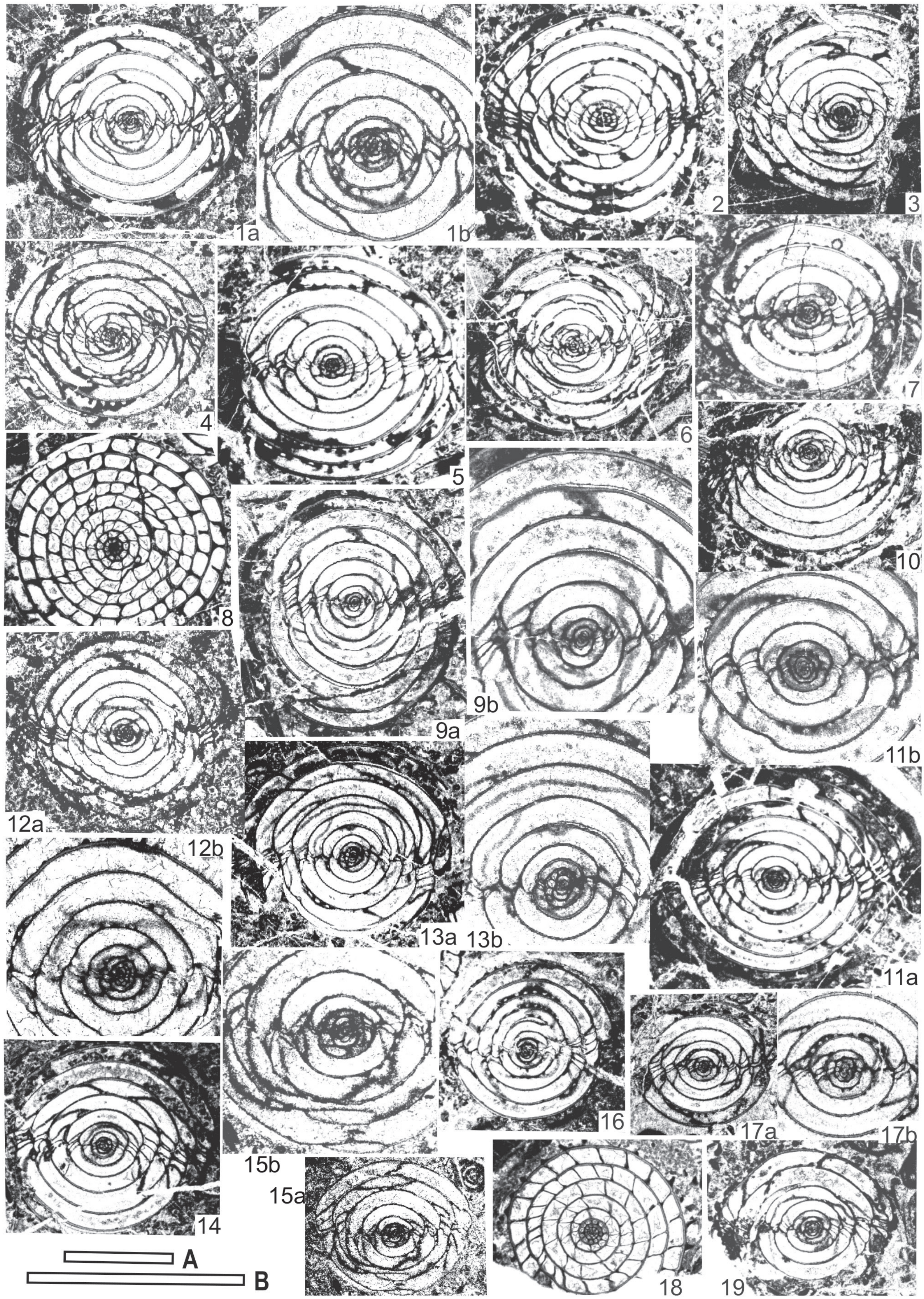
1a
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15a
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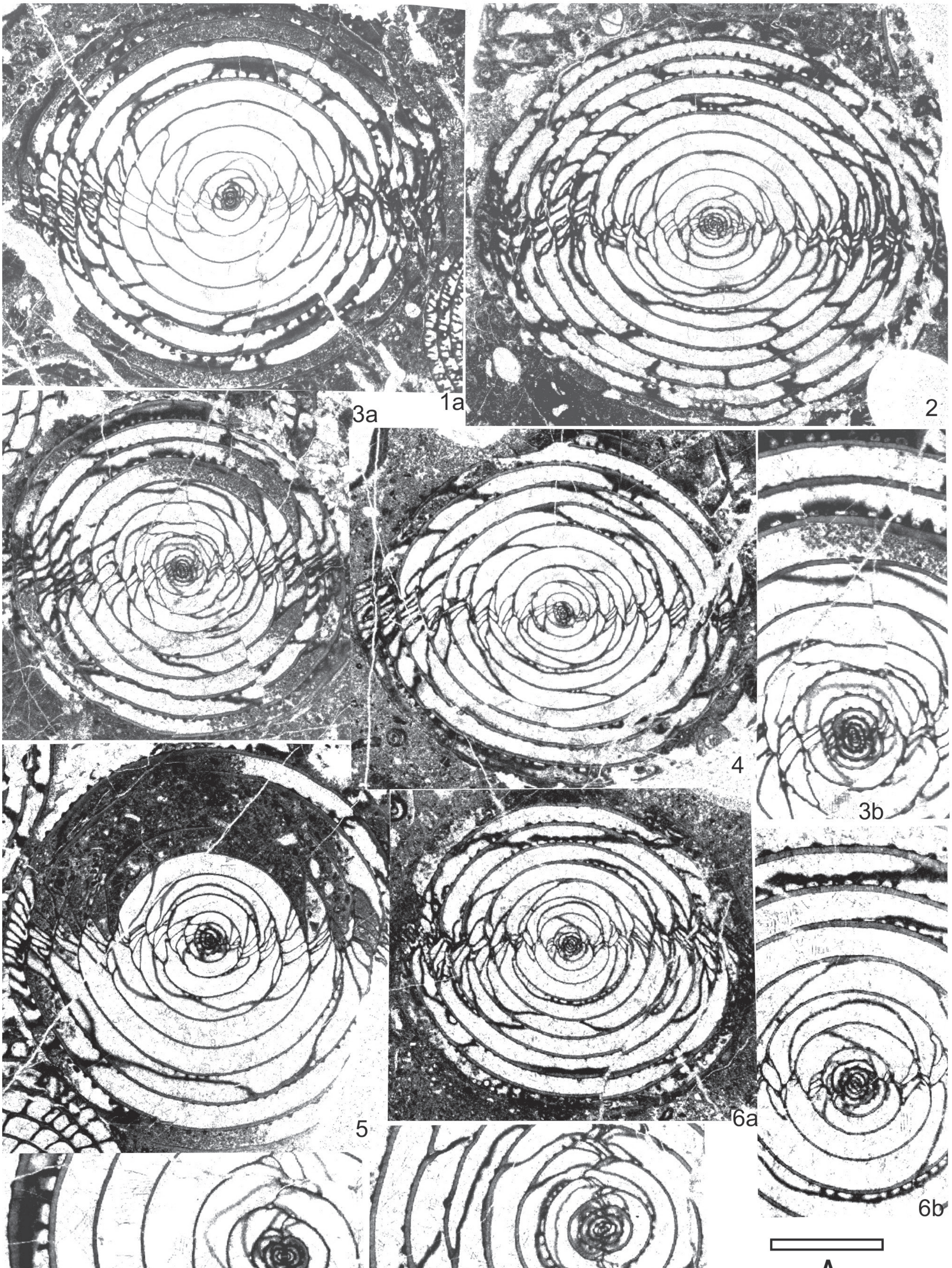
Plate 5.



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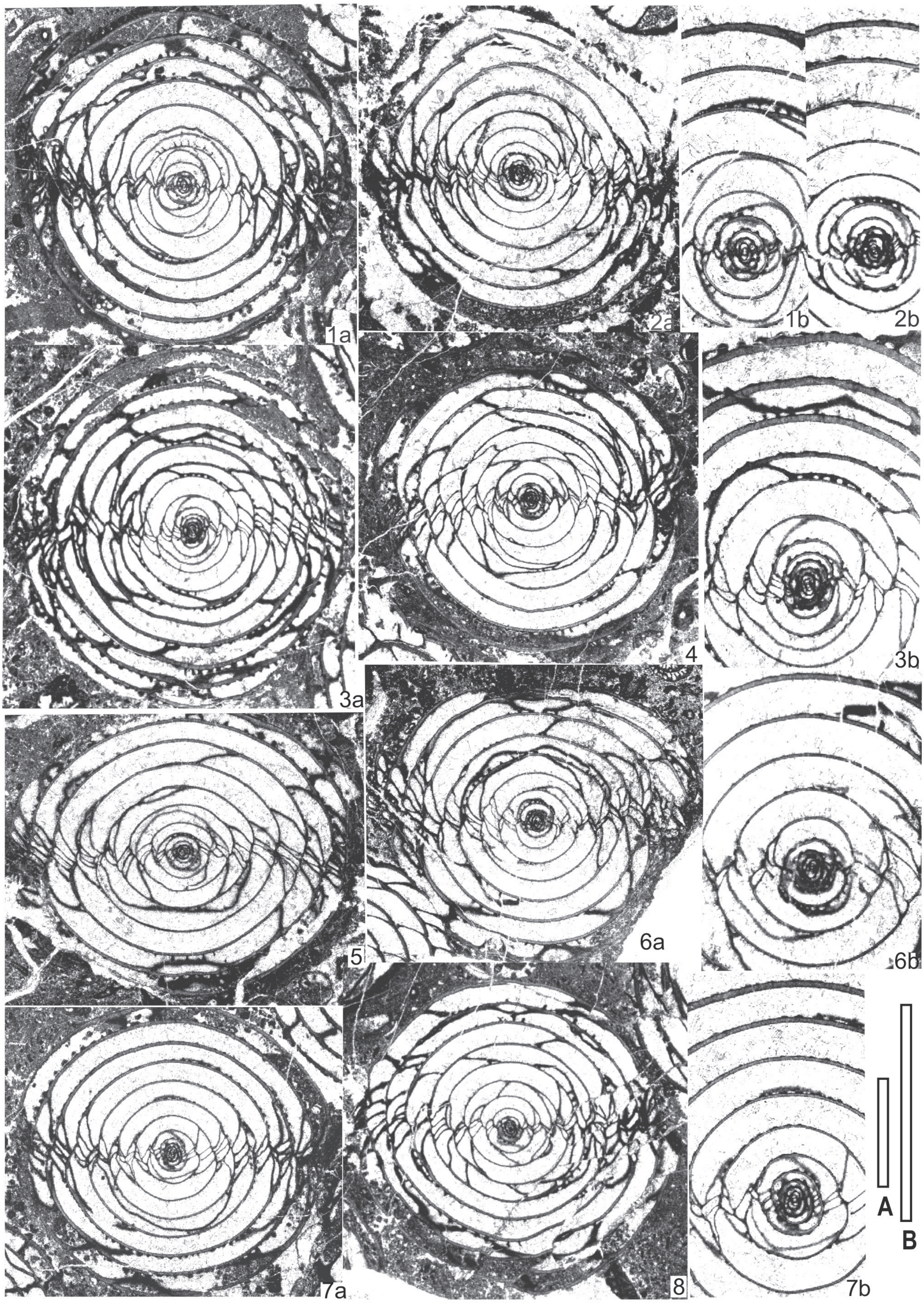

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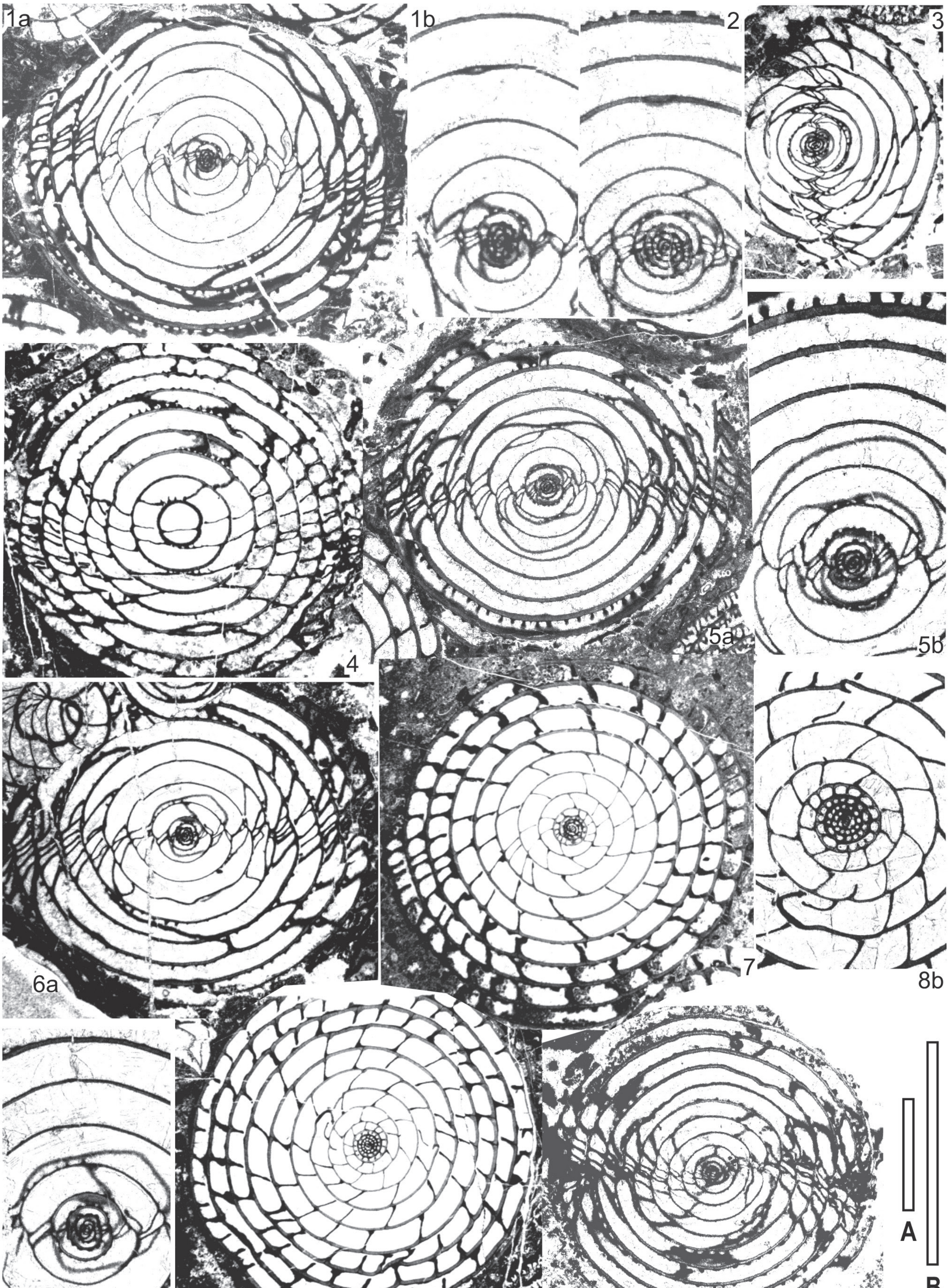

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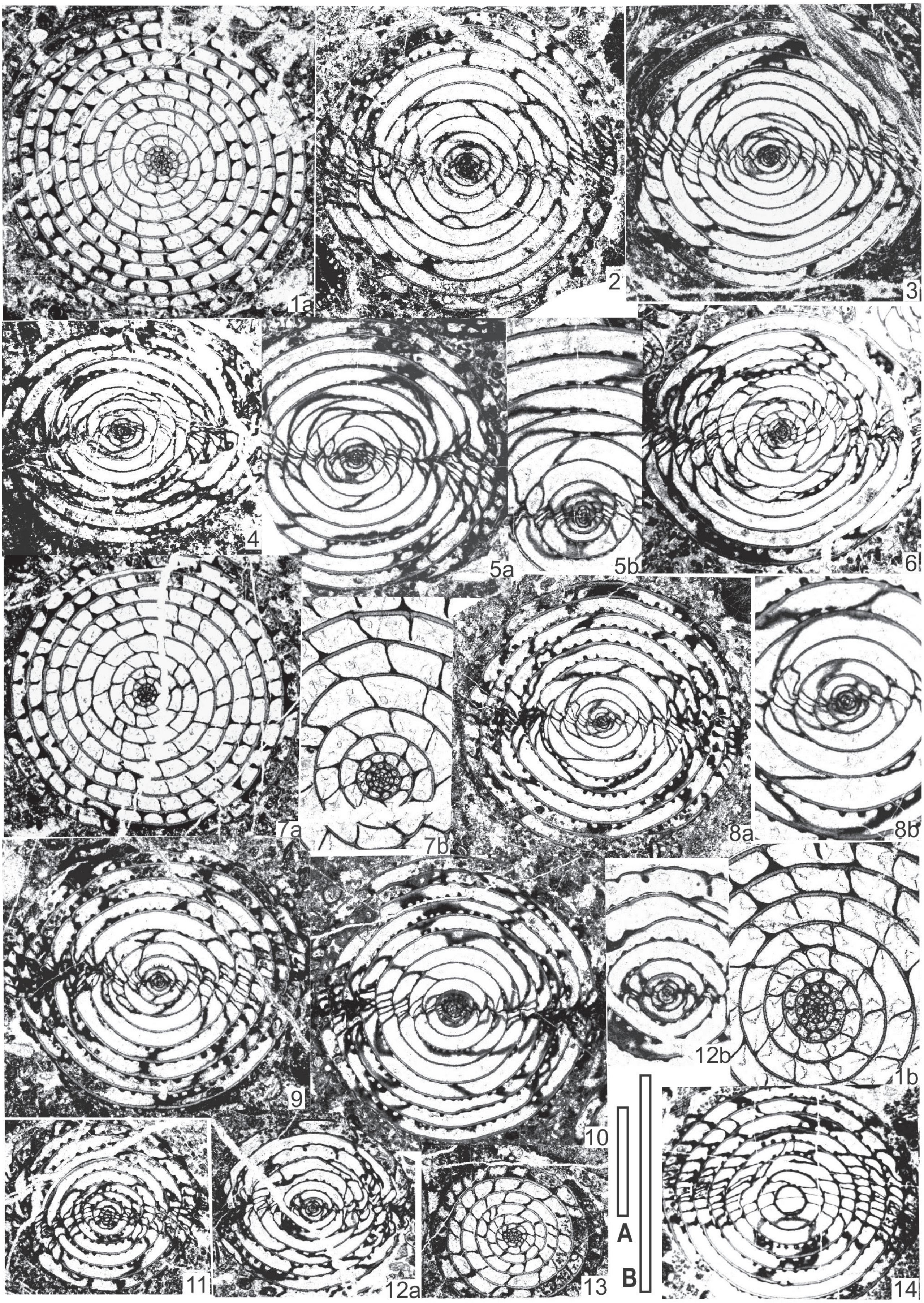

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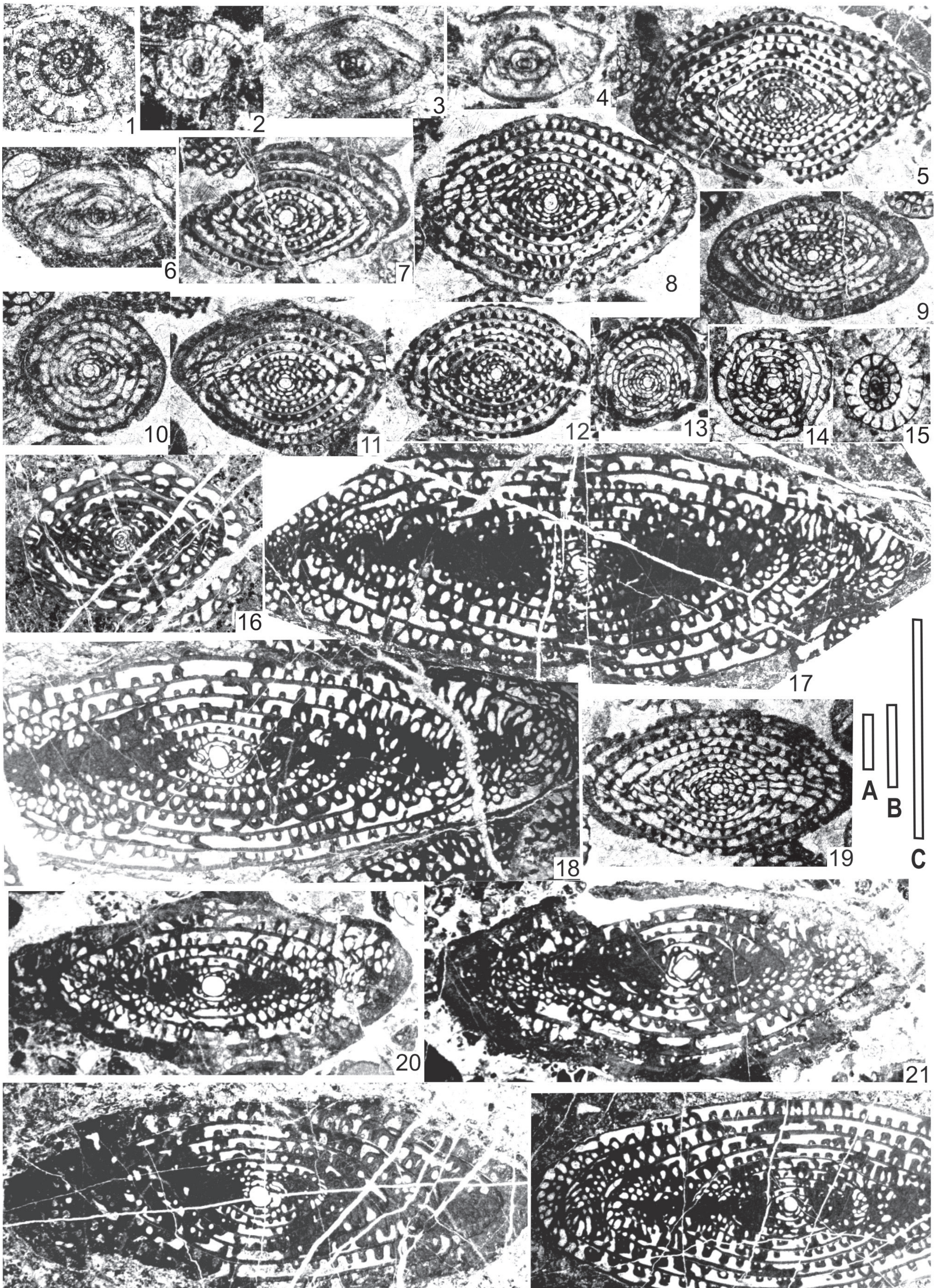

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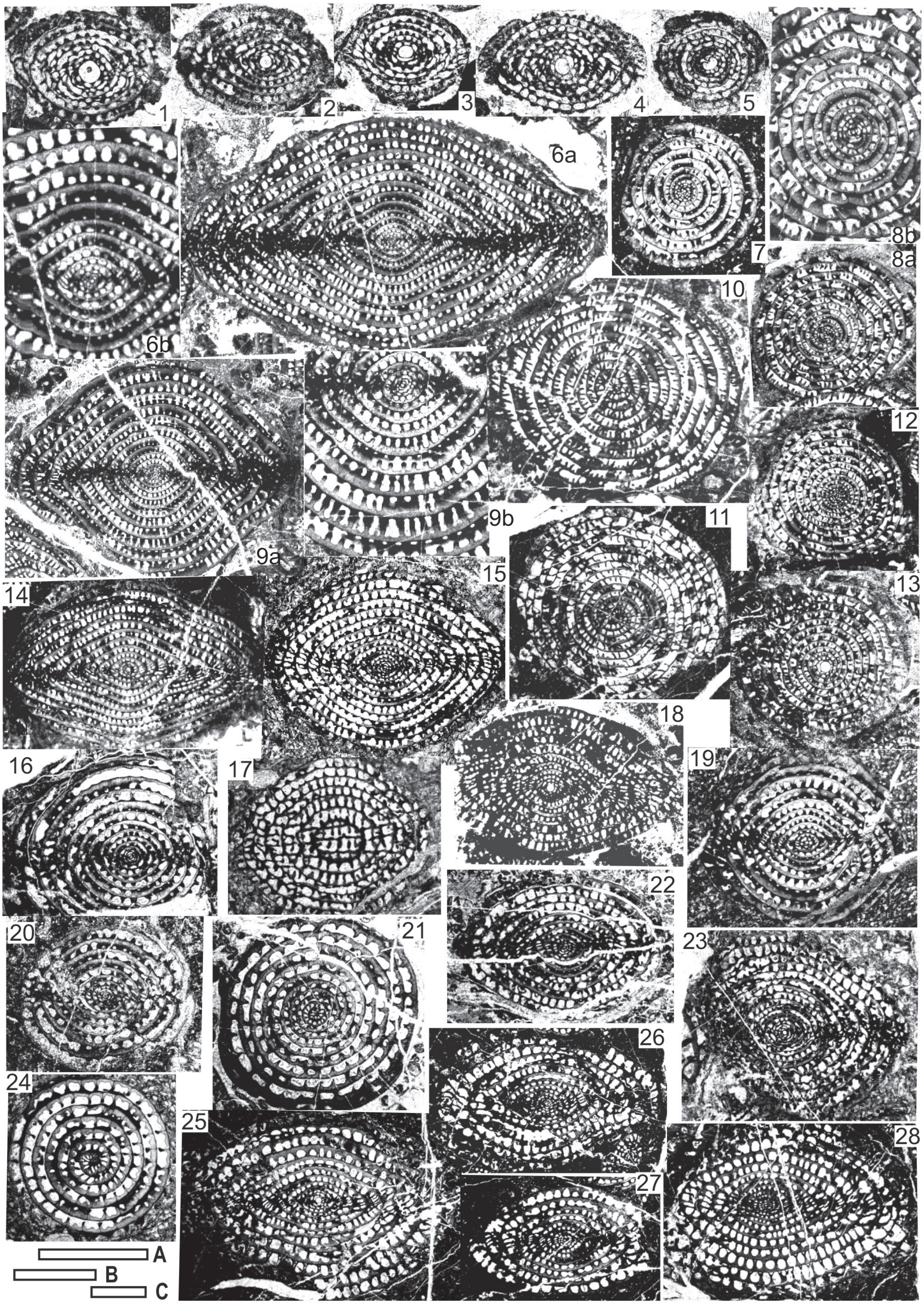
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Plate 11.

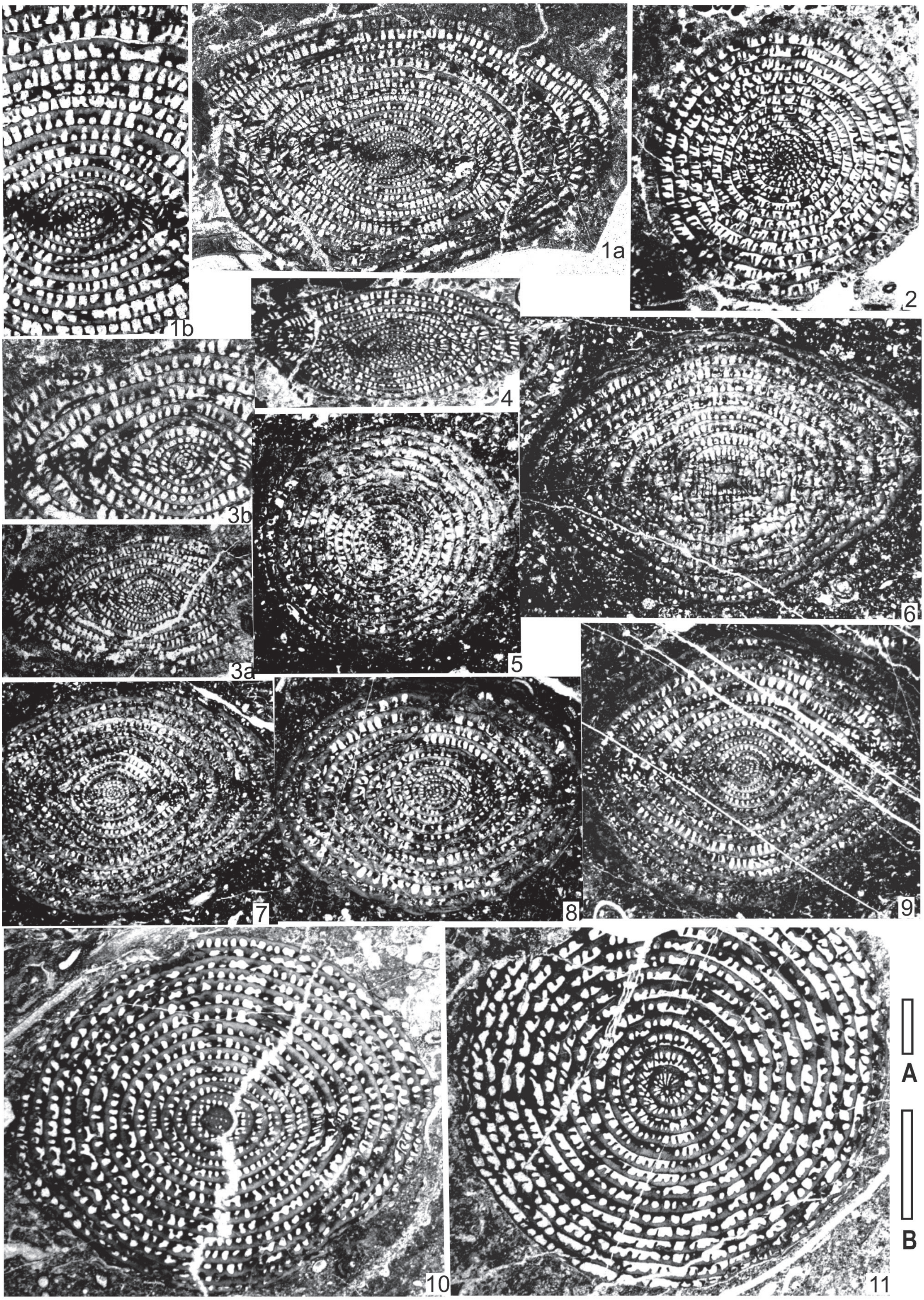

Plate 12.

美濃テレーン，舟伏山地域のペルム紀中期フズリナ類

小 林 文 夫

ジュラ紀付加体美濃テレーンの異地性岩体，舟伏山石灰岩は種々のペルム紀化石，とりわけアーティンスキアン期（前期ペルム紀後葉）からキャピタニアン期（中期ペルム紀後葉）のフズリナ類を多産する．本論文では，舟伏山フォーナの有孔虫化石情報を再検討するとともに国内外の同時期のフォーナとの比較ができるように，多くのフズリナ類やフズリナ類以外の有孔虫化石の顕微鏡写真を示し，舟伏山石灰岩で識別されたフズリナ類 31 種を記載した．*Acervoschwagerina*，*Parafusulina japonica*，*Yabeina* の含有で特徴づけられる美濃テレーンのフズリナフォーナは日本の他のジュラ紀テレーンの多くのものに似ているが，これら 3 属種の大半を欠くペルム紀テレーンのフォーナとは異なる．

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