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First Discovery of Late Paleozoic Radiolarians in the Eastern Yakutiya

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Abstract—Some assemblages of Late Paleozoic radiolarians are first established in Yakutiya. The radiolarians occur in hemipelagic deposits reduced in thickness. They are extracted from siliceous tuffites by using the hydrofluoric acid and studied under a scanning electron microscope. In total, five radiolarian assemblages are detected: two Early Carboniferous assemblages with *Albaillella* cf. *paradoxa* and *Albaillella indensis*, two Early Permian assemblages with *Latentifistula astricta* and *Spinodeflandrella* cf. *sinuata*, and one Late Permian assemblage with *Follicucullus* cf. *scholasticus*. The most representative assemblage is that with *Albaillella indensis* of the Tournaisian-Visean. Three species of this assemblage (*Albaillella paradoxa* Deflandre, *A. indensis* Won, and *A. uncus* Won) are described.

Key words: *the Carboniferous, the Permian, radiolarians, Yakutiya.*

Late Paleozoic radiolarians are widespread in different regions of the world: in Europe, North America, Japan, China, Russia, and Kazakhstan, where they are adequately studied. The radiolarians occur in deposits of different (carbonate, siliceous, and terrigenous) lithological types. The most representative and diverse Late Paleozoic radiolarians were recovered from carbonate concretions of the South Uralian flysch deposits, which yielded well-preserved and abundant forms of the Late Carboniferous and Early Permian age (Nazarov and Rudenko, 1981; Kozur, 1980, 1981; Isakova and Nazarov, 1986; Nazarov, 1988; Amon, 1985; Amon *et al.*, 1990). In addition, the radiolarian assemblage with *Polyentactinia nyatvica* referred to the Middle Carboniferous (the Moscovian Stage) was identified by Nazarov in carbonate concretions from the left bank of the Kolyma River, the Kolyma Uplift (Nazarov and Ormiston, 1987, 1993; Nazarov, 1988).

The Late Paleozoic radiolarians are widespread in siliceous deposits of Russia. Nazarov reported on the Early Carboniferous poorly preserved radiolarians *Albaillella* sp., *Pylentonema* sp., *Popofskyellum* sp., and *Palaeoscenidium* (?) sp. from the siliceous deposits of Middle Asia and eastern Kazakhstan, and on the assemblage with *Albaillella paradoxa* from jaspers and phtanites of the Penzhina Ridge, all studied only in thin sections. Regretfully, it is unknown whether Nazarov later distinguished any Carboniferous radiolarians from siliceous deposits by means of chemical treatment. He briefly mentioned just their occurrence in one of his last publications (Nazarov, 1988, p. 144). The Early Carboniferous radiolarians (*Archocyrium* sp., *Entactinia* aff. *vulgaris*, and *Pylentonema* sp.), along with some Devonian and Ordovician forms, were discovered in chert samples from the melange and olistostrome of the Chara belt in eastern Kazakhstan (Ivata *et al.*, 1994). The Late Carboniferous radiolarians, including *Tormentum sequilateralis* Nazarov, *T.* cf. *pervagatum* Nazarov, and *Latentifistula* sp., also were identified in the siliceous deposits of the Koryak Upland (Krimsalova, 1994). In Russia, Permian radiolarians are known from siliceous deposits of the Sikhote-Alin' (Rudenko and Panasenko, 1990b; Rudenko, 1991; Nikitina *et al.*, 1992; Rudenko, 1994), the Koryak Upland (Rudenko, 1991; Vishnevskaya, 1994), and Sakhalin (Bragin, pers. commun.).

Single Late Permian radiolarians were found in the terrigenous siltstones and tuffaceous siltstones of the Vladivostok, Ugodinzin and Yastrebovka formations of Primor'e (Belyanskii *et al.*, 1984; Kiseleva and Rudenko, 1984; Rudenko and Panasenko, 1990a; Rudenko, 1991).

The new occurrences of radiolarians of the Late Paleozoic are very important, because this time interval comprises the stages of thriving and the global extinction of one of the largest group of bilaterally symmetrical radiolarians of the Albaillellaria Order. The radiolarian localities of Yakutiya mark the northernmost geographic position of Albaillellaria distribution.

† Deceased.

A comparative analysis of the studied assemblages with those known from other regions can improve our understanding of the evolution and paleogeographic distribution of Late Paleozoic radiolarians. The new data are also valuable in a stratigraphic aspect, especially for dating and the subdivision of siliceous deposits.

This article is based on the analysis of the Late Paleozoic radiolarians that we detected in siliceous tuffs and tuffites sampled at the left bank of the Indigirka River in the Selennyakh block of northeastern Yakutiya (Fig. 1). The Selennyakh block extends meridionally for 120 km in the interfluve between the middle course of the Uyandina River and the upper reaches of the Selennyakh River. The block is predominantly composed of Ordovician, Silurian and Devonian carbonates and the Lower Carboniferous clayey-siliceous deposits, which are deformed into large folds and monoclines disturbed by the reversed and strike-slip faults of northeastern and meridional orientation. Tectonic structures of the Selennyakh block are constituents of the Kolyma–Omolon microcontinent (Parfenov, 1991). The Selennyakh block is separated by the submeridional Tirekhtyakh fault from the Triassic and Jurassic deposits of the southern Polousnyi synclinorium in the west.

Early Permian (Early Asselian) radiolarians have been first identified by S.V. Zyabrev (Institute of Tectonics and Geophysics, Far East Division of Russian Academy of Sciences) in 1991 from a single sample collected by A.V. Nesterenko in the southern limb of the Polousnyi synclinorium adjacent to the Selennyakh Block, in the distribution area of the Triassic and Jurassic deposits (Fig. 2). The assemblage with *Latentifistula astricta* that is detected here will be considered in detail below together with other assemblages. The radiolarian-bearing sequence is composed of virtually unaltered pelitomorphic gray and greenish gray, frequently banded siliceous tuffite and rare interbeds of fine-grained sandstone. The deluvial talus of the sequence is exposed at the left watershed of the Nagondzha River. The sequence is estimated to be not more than 100 m thick. Stratigraphic relationships between the sequence and underlying and overlying deposits cannot be observed, but, according to the geological survey data, the sequence rests on fossiliferous limestones and conglomerates of the Lower Devonian (Emsian Stage) and underlies the terrigenous-carbonate deposits containing bivalves of the Upper Triassic (Norian Stage). In the general structure, it is located in the core part of the anticline (Fig. 2). In 1993–1994, we collected some samples of the siliceous tuffites from the sequence. The samples yielded a rich radiolarian assemblage with *Albaillella indensis* of the Early Carboniferous age (Rudenko *et al.*, 1994). Thus, in the area under consideration, the Early Carboniferous and Early Permian radiolarians were first distinguished from the siliceous tuffite sequence of inconsiderable thickness. In 1994, V.A. Aristov identified some Early Carboniferous conodonts from the same sequence.

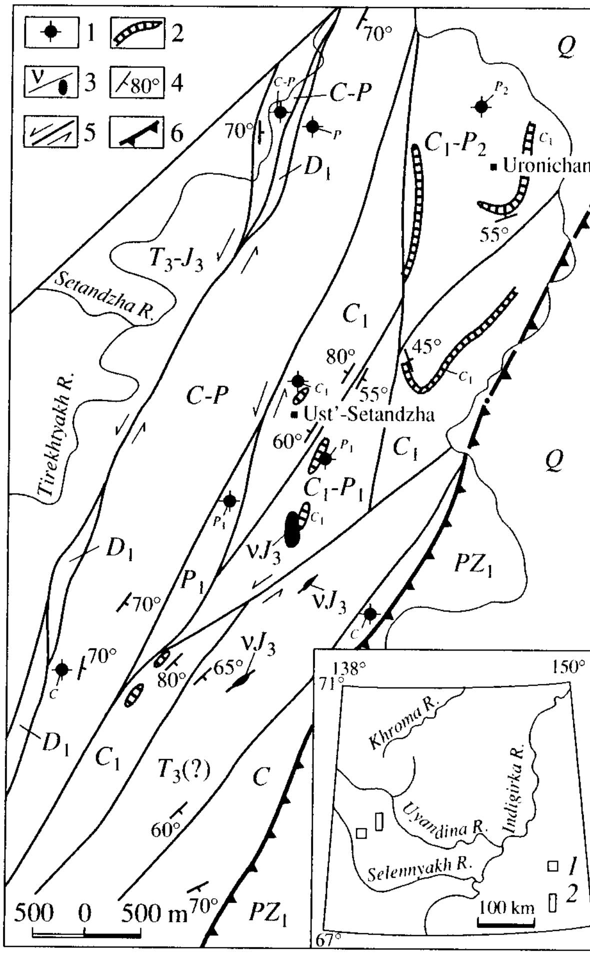


Fig. 1. Geological structure of the area in the right bank of the Tirekhtyakh River: (1) radiolarian localities; (2) marker limestone beds; (3) dikes and bodies of the Upper Jurassic gabbro-diabase; (4) attitude and dip of beds; (5) normal and reverse strike-slip faults; (6) tectonic boundary separating Lower Paleozoic carbonate deposits from younger formations. The inset map shows the Late Paleozoic radiolarian localities: (*1*) in the Nagondzha River basin; (*2*) in the Tirekhtyakh River basin.

An area of the Lower Carboniferous–Permian deposits up to 2 km wide and up to 12 km long stretches northeastward along the right bank of the Tirekhtyakh River (the right tributary of the Uyandina River) as a constituent of the northern Selennyakh block and is located 50 km to the north of the described region. These deposits are faulted by minor shears and contact along the reversed strike-slip faults with clayey-siliceous deposits of Late Triassic–Early Jurassic age in the west and with sandstones and siltstones of presumably Late Triassic age and carbonate Lower Paleozoic deposits in the east (Fig. 1). It is impossible to observe stratigraphic relationships of these deposits with underlying and overlying rocks.

Some fragments of this sequence were studied in scarce bedrock exposures and in alluvial-deluvial deposits. The sequence is represented by alternating

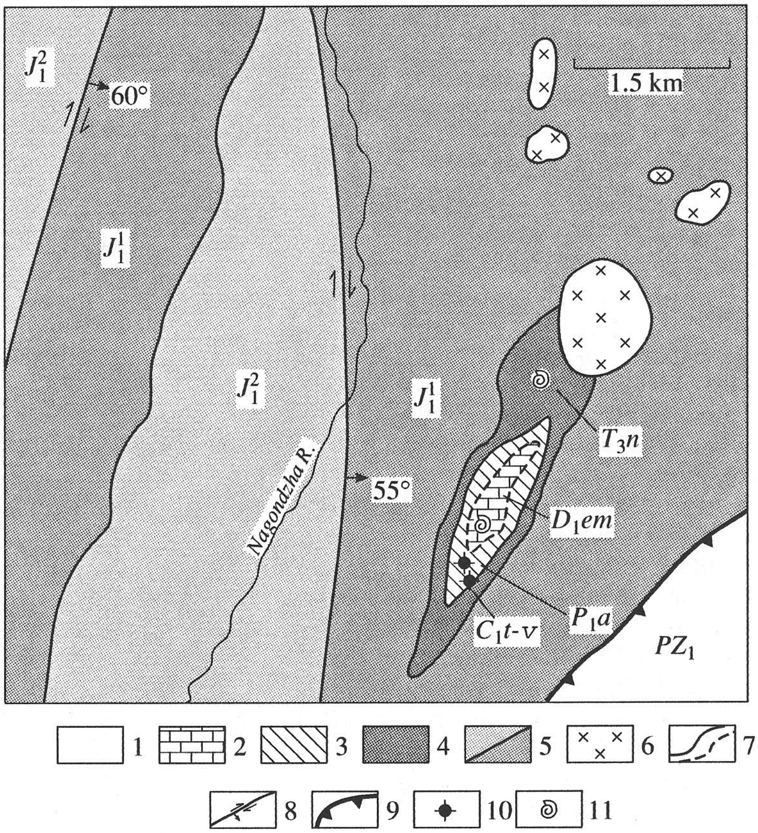


Fig. 2. Geological structure of the area in the left bank of the Nagondzha River: (1) Middle Paleozoic carbonate deposits; (2) Devonian carbonate deposits; (3) Carboniferous-Permian siliceous tuffites; (4) Triassic carbonate-terrigenous deposits; (5) Jurassic terrigenous deposits; (6) diorite; (7) established and presumable stratigraphic boundaries; (8) strike-slip fault separation plane dip; (9) overthrust; (10) localities of radiolarians; (11) localities of macrofauna. The geographic position of the area is shown in the inset map of Fig. 1.

fine-grained to pelitomorphic siliceous tuffites and tuffaceous shales of dark-gray, black, and greenish gray color. The deposits include beds and lenses of dark- and light-gray fine-grained massive limestones and calcareous siltstones. The siliceous tuffites have a pelitic texture and shaly to massive structure. The fine-grained pelitic clayey mass contains from 5 to 30% of micrograined siliceous matter. It also bears abundant radiolarian tests filled with secondary material. The limestones are composed of newly formed carbonate grains isometric in form and variable in size (0.3–0.8 mm). Prospect trenches revealed stratigraphic contacts of tuffites and pelitic tuffs with limestones. The thickness of limestone beds varies from 0.5–1 to 15–20 m; the thickest beds traceable for 300–1300 m in the watershed area and easily recognizable in aerial photographs are used as the marker horizons. By geological mapping on a scale of 1 : 200 000, A.V. Dorofeev (unpublished data of 1969) discovered limestone beds with foraminifers of the Early Carboniferous (Tournaisian-Visean). Afterwards, special investigations conducted by A.V. Nesterenko (1992) detected some silicified columnals of crinoids in a limestone bed near the town of Uronichan, and G.A. Stukalina (All-Russia Geological Institute) assigned them to the Visean and Namurian stages of the Lower Carboniferous. In 1990, V.P. Tarabukin distinguished some Early Carboniferous (Tournaisian) conodonts from a limestone bed exposed further to the south. Carboniferous and Permian radiolarians were found in limestones, siliceous tuffites, and pelitic tuffs (Fig. 1). In 1993, N.Yu. Bragin established three assemblages of radiolarians from these deposits: the Early Carboniferous assemblage with *Albaillella* cf. *paradoxa* Deflandre, the Early Permian assemblage with *Spinodeflandrella* cf. *sinuata*, and the Late Permian assemblage with *Follicucullus* cf. *scholasticus* Ormiston et Babcock.

Thus, the hemipelagic deposits of northeastern Yakutia contain the following radiolarian faunas: the Early Carboniferous assemblages with (1) *Albaillella* cf. *paradoxa* and (2) *Albaillella indensis*; the Early Permian age assemblages with (3) *Latentifistula astricta* and (4) *Spinodeflandrella* cf. *sinuata*; and the Late Permian assemblage (5) with *Follicucullus* cf. *scholasticus*. Easily detectable bilaterally symmetrical and stauraxonic radiolarians of these assemblages enable the accurate dating of the enclosing deposits and interregional correlation, whereas the spherical Spumellaria from siliceous deposits are seldom diagnostic and have wider stratigraphic ranges.

(1) The assemblage with *Albaillella* cf. *paradoxa* is extracted from the siliceous tuffs of the Tirekhtyakh River basin. It consists of *Albaillella* cf. *paradoxa* Deflandre, *A.* cf. *uncus* Won, *Archocyrtium* sp., *Cyrtisphaeroctenium* (?) sp., Entactinia cf. *vulgaris* Won, and *Spongoentactinia* cf. *variabilis* (Ormiston et Babcock). The species *Albaillella paradoxa* is widespread in the following localities of the Lower Carboniferous deposits: the Tournaisian phosphate concretions of the Baltalimani Formation, the Bosporus, Turkey (Holdsworth, 1973); the Tournaisian phosphate concretions of the Montagne Noire (Deflandre, 1952) and Central Pyrenees, France (Gourmelon, 1986, 1987); the Tournaisian calcite concretions in the phosphate beds of the Woodman Formation, Utah, United States (Gourmelon, 1987; Sandberg and Gutschick, 1984); and the middle Tournaisian of siliceous shales and mudstones of "Kulm-facies", Germany (Braun and Schmidt-Effing, 1993). The assemblage with *Albaillella* cf. *paradoxa* is certainly the Early Carboniferous (most probably Tournaisian) in age.

(2) The assemblage with *Albaillella indensis* is most significant and diverse. These radiolarians were found in siliceous tuffites of the Nagondzha River basin. The assemblage is mainly represented by spherical forms of a poor preservation complicating identification of genera and species. Among them, there are *Entactinia vulgaris* Won, *Entactinia* cf. *vulgaris* Won, *E.* cf. *parva* Won, *E.* (?) *inaequoporosa* Won, *Entactinia* sp., *Meschedea hirsuta* Won, *M.* cf. *pyramispinosa* Won, *Belowea tenuestesta* Won, *Belowea* cf. *variabilis* (Ormiston et Lane), *Belowea* sp., and *Triaenosphaera* cf. *bareillensis* Gourmelon. Another abundant group includes representatives of the *Albaillella* genus: predominant *Albaillella indensis* Won (hundreds of specimens) and rare *A. uncus* Won, *A.* cf. *paradoxa* Deflandre, and *Albaillella* sp. Both groups coexist with infrequent *Popofskyellum* cf. *campanella* Won, *Popofskyellum* sp., *Archocyrtium* cf. *coronaesimile* Won, *A.* cf. *riedeli* Deflandre, *A.* cf. *lagabirielli* Deflandre, *Archocyrtium* sp., *Pylentonema* sp., *Ceratoikiscum* sp., *Cubaxonium* (?) *octaedrospongiosum* Won, and *Palaeoxyphostylus* (?) sp.

The assemblage with *Albaillella indensis* is widespread in the Lower Carboniferous of Europe, North America, and Asia. It is most similar with the assemblage from the "Gedauer-Konglomerat" of Germany (Won, 1983). The *Albaillella indensis* Zone was also recognized in the phosphate concretions of the Montagne Noire in France (Gourmelon, 1987), where its stratigraphic range corresponds to the upper Tournaisian–lower Visean. The index species is also known in the "faunal Group IA" of the northern Brooks Range (Holdsworth and Murchey, 1988). A similar assemblage was distinguished as well in siliceous deposits of China, in the Shixia Reservoir of southeastern Guangxi (Wang and Kuang, 1993). In addition, the *Albaillella indensis* Zone was recognized in Germany (Braun and Schmidt-Effing, 1993). It is referred here to the upper Tournaisian–lower Visean. Thus, we consider the *Albaillella indensis* assemblage from the siliceous tuffs of the Yakutiya to be of the Tournaisian–Visean age

(3) The *Latentifistula astricta* assemblage (according to data of Zyabrev) from the siliceous tuffites of the Nagondzha River basin is mainly represented by stauraxonic radiolarians *Latentifistula astricta* Nazarov, *L. astricta astricta* Nazarov, *L. torulosa* Nazarov, *Latentifistula* aff. *crux* Nazarov et Ormiston, *Tormentum* aff. *circumfluum* Nazarov, *Tormentum* spp., *Copicyntra* spp., and *Spongentactinia* (?) spp. Similar radiolarian assemblages are known from the Lower Permian of the southern Urals and North America (Nazarov and Ormiston, 1985).

(4) The *Spinodeflandrella* cf. *sinuata* assemblage was distinguished in limestones of the Tirekhtyakh River basin. The sparse radiolarians are represented here by *Spinodeflandrella* cf. *sinuata* (Ishiga et Watase), *Spinodeflandrella* sp., and *Latentifistula* (?) sp. The index species is widespread in the Lower Permian siliceous deposits throughout the world, being known in Japan (Ishiga, 1986, 1990), Sikhote Alin' (Rudenko and Panasenko, 1990b; Rudenko, 1991), the Koryak Upland (Rudenko, 1991; Vishnevskaya, 1994), and North America (Holdsworth and Murchey, 1988). The assemblage is similar in composition to radiolarians from the *Spinodeflandrella acutata* Zone of Sikhote-Alin' (Yakhtashian–Bolorian of the Tethian scale), and *Albaillella sinuata* Zone of Japan (Leonardian of the North American scale). Until recent times, assemblages of this type were known only from siliceous deposits. The occurrence of their radiolarians in the carbonate deposits of the Yakutia suggests a considerably wider spectrum of habitats of the Early Permian Albaillellaria.

(5) The *Follicucullus* cf. *scholasticus* assemblage was distinguished from siliceous tuffites of the Tirekhtyakh River basin. Rare radiolarians are represented here by *Follicucullus* cf. *scholasticus* Ormiston et Babcock and *Tormentum* cf. *inflatum* Nazarov et Ormiston. *Follicucullus scholasticus* is widespread in carbonate, terrigenous and siliceous deposits of the Upper Permian in Japan (Ishiga, 1986, 1990; Caridroit, 1986; and others), the Sikhote–Alin' (Belyanskii *et al.*, 1984; Rudenko and Panasenko, 1990a), and North America (Ormiston and Lane, 1979). The *Follicucullus scholasticus* assemblage from Sikhote–Alin' can be assigned to the Murgabian Stage of the Tethyan scale, or to the upper Guadelupian Stage of the North American scale.

Thus, the Late Paleozoic radiolarians were first found in Yakutiya, and the Early to Late Permian radiolarians enabled us to date the enclosing deposits of the region, whereas the Early Carboniferous radiolarians from siliceous deposits are distinguished and described in Russia for the first time.

The Late Paleozoic radiolarians occur in hemipelagic deposits reduced in thickness. Analogous siliceous and siliceous-clayey sequences with thin limestone interbeds are known from the western framing structures of the Selennyakh block and from the Tas-Khayakhtakh block of the Kolyma–Omolon microcontinent located to the south. In many cases, these sequences are considered free of fossils, and their age is conventionally dated as the Early Carboniferous or Early Jurassic. Similar sequences in other orogenic belts do not exceed several dozens or few hundreds of meters in thickness. Their accurate dating requires a thorough study of microfauna, primarily, radiolarians.

The data obtained may help to reconstruct the Late Paleozoic geological history of the region. The northeastern Yakutiya experienced rifting in the second half of the Paleozoic Era. At that time, the Selennyakh block was a component of the Omulevskii microcontinent separated by oceanic basins from the Verkhoyansk passive margin in the west and from the Kolyma–Omolon microcontinent in the east (Parfenov, 1991). The Late Paleozoic deposits of the Verkhoyansk passive margin were accumulated in different facies environments as compared to the described sequences deposited in an open sea, far from the Kolyma–Omolon microcontinent and this passive margin. Undoubtedly, the oceanic basin was much greater than the distribution area of the exposed sequences. The current structural position of these sequences seems to be a result of the Late Mesozoic collision between the North Asian craton and the Kolyma–Omolon microcontinent that was responsible for subsequent horizontal displacements and resultant spatial proximity of different sedimentary facies of the Late Paleozoic age.

Because the Carboniferous radiolarians are found sporadically in the Russian territory and their new locality is confined to siliceous deposits located far from the type area, it seems necessary to describe once more the most significant species of Early Carboniferous *Albaillella* genus from Yakutiya.

Albaillella indensis Won, 1983,
Plate, Figs. 1–4

1983. *Albaillella indensis* Won, p. 127; Pl. 1, Figs. 19 and 20; Text-Fig. 3g.

1987. *Albaillella indensis* Won: Gourmelon, pp. 87–88, Pl. 12, Figs. 6–10.

1988. *Albaillella indensis* Won group: Holdsworth and Murchey, p. 789, Pl. 34.1, Figs. 16–20.

1993. *Albaillella indensis* Won: Braun and Schmidt-Effing, Pl. II, Fig. 4.

1993. *Albaillella indensis* Won: Wang Yu-jing and Kuang Guo-dun, Pl. I, Figs. 1–8.

Description. Bilaterally symmetrical cone-shaped cross-segmented (5–7 segments) test has a spinelike process in the lower part of the apical cone.

Size (based on 32 specimens): the test without H-frame is 200–250 μm in height and 120–150 μm in diameter.

Comparison. The species differs from *Albaillella paradoxa* Deflandre (Deflandre, 1952, pp. 872–874, Figs. 1–3, 5) in having the segmented test, spinelike process, and larger diameter of the lower part of the test. The studied specimens also differ by smaller tests from the earlier described representatives of this taxon.

Locality: siliceous tuffites at the left bank of the Indigirka River (the Nagondzha River basin), northeastern Yakutiya.

Distribution: the Tournaisian of France, phosphate concretions of the Central Pyrenees (Gourmelon, 1986, 1987); the Namurian (?) of Germany, "Gedauer-Konglomerat" (Won, 1983); the Tournaisian (?)–Visean (Middle–Upper Osagen, Lower Mississippian) of North America, siliceous deposits of the northern Brooks Range (Holdsworth and Murchey, 1988); the Tournaisian–Visean of Germany, siliceous shales and mudstones of "Kulm-facies" (Braun and Schmidt-Effing, 1993); the Tournaisian–Visean of China, siliceous deposits of southeastern Guangxi (Wang and Kuang, 1993).

Albaillella paradoxa Deflandre, 1952

Plate, Fig. 5

1952. *Albaillella paradoxa* Deflandre, pp. 872–874, Figs. 1–3, 5.

1966. *Albaillella paradoxa* Deflandre: Holdsworth, pp. 321–323.

1969. *Albaillella paradoxa* Deflandre: Holdsworth, pp. 230–236, Pl. I, Figs. 10a and 12a.

1973. *Albaillella paradoxa* Deflandre: Holdsworth, p. 127, Pl. I, Figs. 12 and 15.

1985. *Albaillella paradoxa* Deflandre: Gourmelon, Pl. 2, Fig. 20.

1986b. *Albaillella paradoxa* Deflandre: Gourmelon, pp. 191–192, Pl. 3, Fig. 5; Pl. 4, Fig. 4.

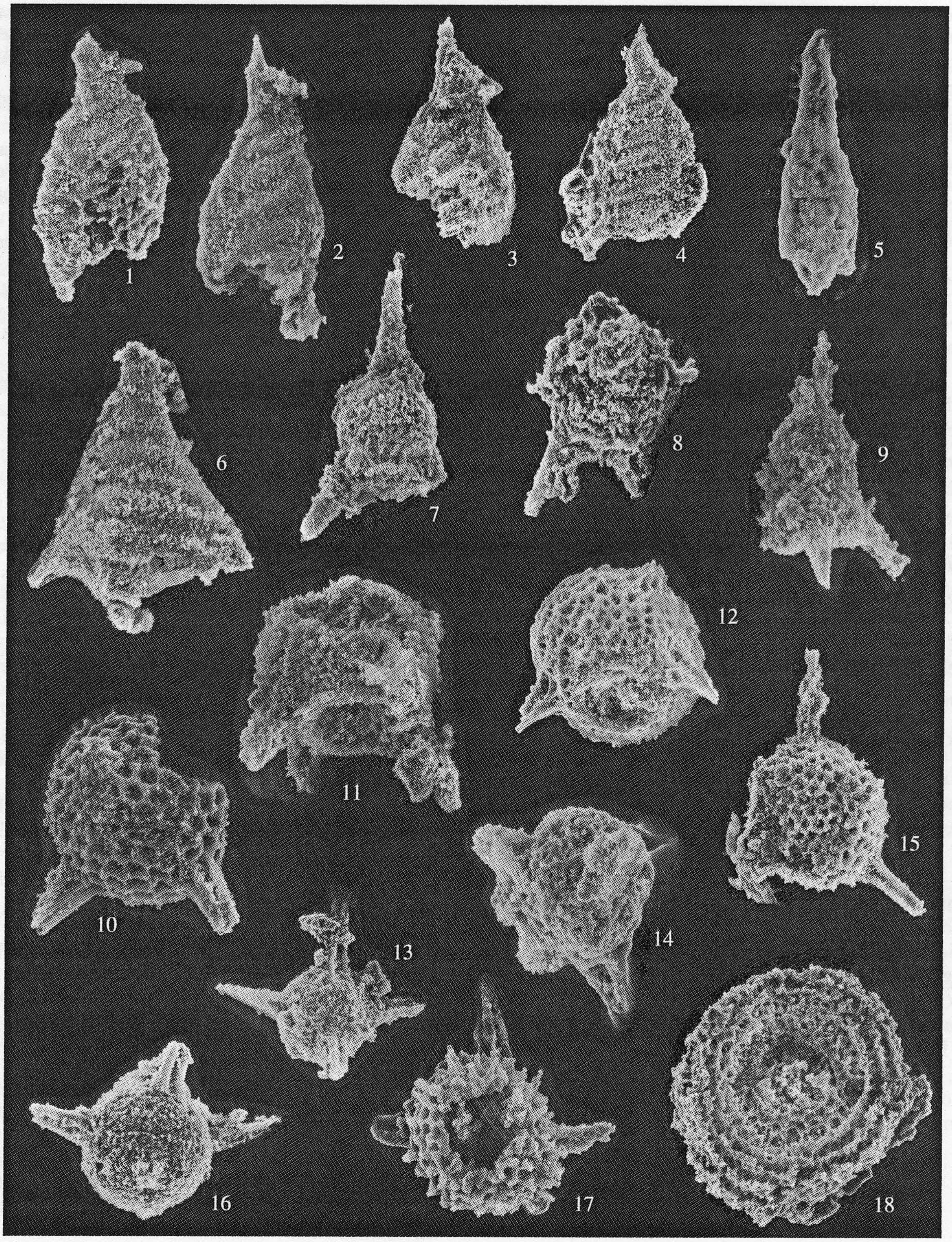
1987. *Albaillella paradoxa* Deflandre: Gourmelon, pp. 84–85, Pl. 11, Figs. 1–5.

1993. *Albaillella paradoxa* Deflandre: Braun and Schmidt-Effing, Pl. 1, Fig. 6.

Description. The test is bilaterally symmetrical, conical, straight and smooth.

Size (based on 3 specimens): the test without H-frame is 240 μm in height and 80 μm in diameter.

Comparison. This species differs from *Albaillella cornuta* Deflandre (Deflandre, 1952, p. 873, Figs. 6 and 7) in the absence of a spinelike process, and, in contrast to other species of the genus, it has the straight conical test.



Early Carboniferous (Tournaisian–Visean) radiolarians from siliceous tuffites of the left bank of the Indigirka River, northeastern Yakutiya

Assemblage with *Albaillella indensis:* (1–4) *Albaillella indensis* Won, ×160; (5) *Albaillella paradoxa* Deflandre, ×160; (6) *Albaillella uncus* Won, ×250; (7) *Archocyrtium* cf. *lagabriellei* Deflandre, ×160; (8) *Archocyrtium* sp., ×250; (9) *Archocyrtium* cf. *riedeli* Deflandre, ×250; (10) Sphaeroidea, gen. et sp. indet., ×160; (11) *Pylentonema* sp., ×250; (12) *Pylentonema* sp., ×160; (13) *Belowea* (?) sp., ×160; (14) *Triaenosphaera* (?) sp., ×250; (15) *Triaenosphaera* cf. *bareillensis* Gourmelon, ×160; (16) *Pylentonema* sp., ×160; (17) *Entactinia* cf. *inaequoporosa* Won, ×160; (18) *Belowea variabilis* (Ormiston et Lane), ×160.

Locality: siliceous tuffs and tuffites at the left bank of the Indigirka River (basins of the Nagondzha and Tirekhtyakh rivers), northeastern Yakutiya.

Distribution: the Tournaisian of Turkey, phosphate concretions of the Baltalimani Formation, the Bosphorus (Holdsworth, 1973); the Tournaisian of France, phosphate concretions of the Montagne Noire (Deflandre, 1952) and Central Pyrenees (Gourmelon, 1986, 1987); the Tournaisian of North America, calcitic concretions in phosphate beds of the Woodman Formation, Utah, United States (Sandberg and Gutschich, 1984 after Gourmelon, 1987).

Albaillella uncus Won, 1983,
Plate, Fig. 6

1983. *Albaillella uncus* Won, p. 127, Pl. 1, Figs. 16–18, Text-Figs. 3d and 3e.

Description. The test is conelike, segmented (7 segments), and has two wings in the lower part.

Size (based on 2 specimens): the test without H-frame is 190 μm in height and 150 μm in diameter at the wing base.

Comparison. The species differs from morphologically similar *Albaillella furcata* Won (Won, 1983, pp. 126–127, Pl. 12, Figs. 3–5, 7) in smaller test size and less developed wings.

Locality: siliceous tuffs and tuffites at the left bank of the Indigirka River (the basins of the Nagondzha and Tirekhtyakh rivers), northeastern Yakutiya.

Distribution: the Namurian (?) of Germany, "Gedauer–Konglomerat" (Won, 1983).

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