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New Locality of the Campanian Radiolarians in Southwestern Sakhalin

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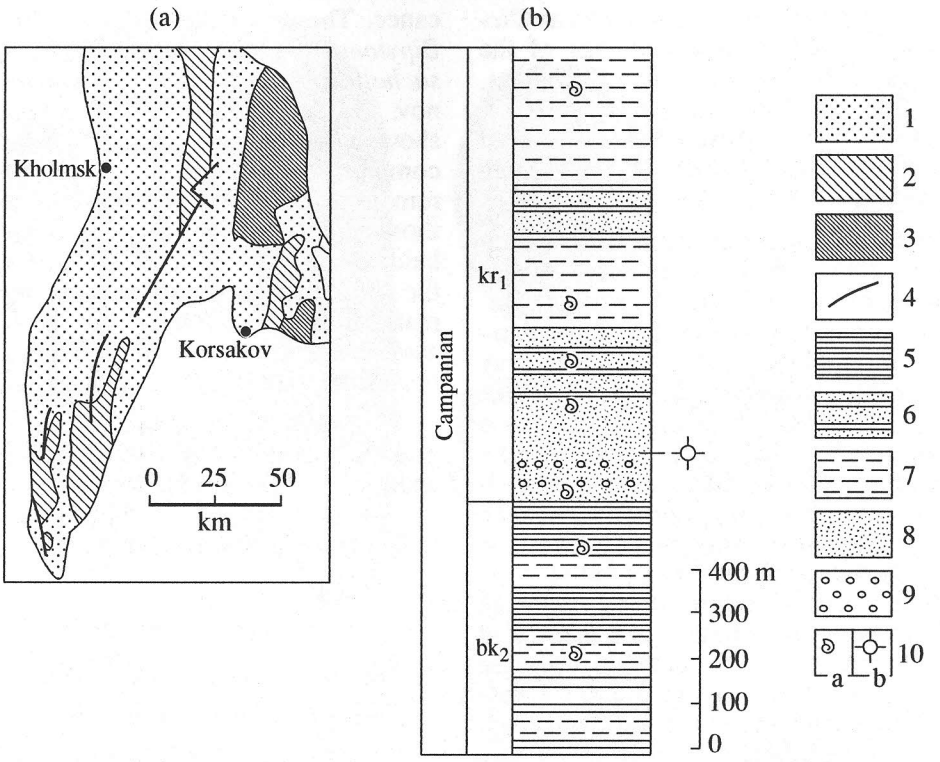
Abstract—The representative radiolarian assemblage different in taxonomy from all known coeval assemblages of Sakhalin was discovered in the basal beds of the Lower Krasnoyarka Subformation of the upper Campanian in the Susuya River basin of southwestern Sakhalin. It appeared to be hardly correlative with coeval assemblages from adjacent and remote areas. The article presents descriptions of the new genus *Bipylomella* gen. nov. and new species *Bipylomella sachalinica* sp. nov., *Hexaloche (?) horridus* sp. nov., and *Spongostaurus (?) sachalinensis* sp. nov.

Key words: *stratigraphy, Sakhalin, Campanian, radiolarians, correlation, endemism.*

In the West Sakhalin mountains, Campanian radiolarians were known from the Krasnoyarka Formation (*Opornyi ...*, 1987) exposed along the Kholmsk highway to the west of the town of Yuzhno-Sakhalinsk. During the field investigation of 1992, a new radiolarian locality was discovered in the Susuya River valley near the Sinegorsk Settlement. The Krasnoyarka Formation section is similar here to the stratotypical one in the Krasnoyarka River basin. It is represented by medium- to fine-grained gray calcareous sandstones intercalated with gray siltstone interbeds, where frequent and big (up to 30–40 cm in diameter) carbonate concretions contain *Schmidticeramus schmidti* (Mich.), *Inoceramus sachalinensis* Sok., and *I. orientalis* Sok. The sandstone beds are overlain by dark-gray siltstones with fine-grained gray sandstone interbeds enclosing carbonate concretions, which bear *Conadoceras* sp., and *Pachydiscus* cf. *neubergicus* Hauer (the figure).

One concretion from the lower part of the sandstone member of the Krasnoyarka Formation (80 m above the base) yielded radiolarians *Crucella espartoensis* Pessagno, *C. zonovae* Kasinzova, *Cuboctostylus kasinzovae* Bragina (Bragina, in press), *Hexalonche (?) horridus* sp. nov., *Patelluta verteroensis* Pessagno, *Patulibracchium* cf. *petroleumensis* Pessagno, *P. vereshagini* Kasinzova, *Phacodiscus* (?) sp., *Phaseliforma carinata* Pessagno, *Bipylomella sachalinica* sp. nov., *Pseudoaulophacus floresensis* Pessagno, *Spongostaurus (?) hokkaidoensis* Taketani, *S. (?) sachalinensis* sp. nov., *Amphipyndax stocki* (Campbell et Clark), *A.* aff. *ellipticus* Nakaseko et Nishimura, *Archaeodictyomitra striata* (Lipman), *A. squinaboli* Pessagno, *Clathrocyclas* sp., *Eucyrtidium* sp. A, *Lithostrobus* cf. *zhamoidai* Kasinzova, *Stichomitra livermorensis* (Campbell et Clark), *Theocampe guttaeformis* Bragina, and *Vistylaria magna* Gorka, and *Stylodruppa bifascicula* Kasinzova.

The assemblage consists of well-preserved diverse radiolarians and shows the close taxonomical similarity to the coeval *Pseudoaulophacus floresensis–Stichomitra livermorensis* assemblage described by Kazintsova (1979; *Atlas ...*, 1993). However, there is a number of species, which were not recorded in the coeval assemblages of the region. Radiolarians are abundant and diverse in morphology; all species are in equal proportions except for some prevailing representatives of the Actinomidae Family. The radiolarians are mostly thin-walled (Plate I, nos. 1, 5, 8; Plate III, nos. 1, 2, 9) (*Stichomitra livermorensis* and *Amphipyndax stocki*). Cellular forms (Actinommidae, Plate II, nos. 1, 2, 4–6) are numerous. Discoidal and prunoidal morphotypes of the assemblage have, as a rule, the spongy shells. Shells have either smooth (*Amphipyndax ellipticus*) or, more frequently, spinous (*Amphipyndax stocki*) surfaces. Some species demonstrate regularly spaced round pores (*Vistylaria magna*) or polygonal pore frames (*Lithostrobus zhamoidai*), while other species are characterized by irregularly spaced pores of variable form and size (*Spongostaurus (?) sachalinensis* sp. nov.). There are some forms with pseudoaulophacoidal wall structure (*Pseudoaulophacus floresensis*). An interesting feature is the heavy patagium cover distinct in representatives of *Patulibraccium petroleumensis*. This feature is characteristic of the same species found at the Kholmsk highway (*Opornyi ...*, 1987, Plate XXXV, Fig. 9). Some Actinommidae forms show very complex structure consisting of several envelopes. In most cases, it is impossible to distinguish the complicatedly branching medular shell. Kazintsova (*Atlas ...*, 1993) reported on a number of species, which have not been described in publications. Most of them are very big Sphaerellaria forms characterized by a complex shell structure and some representatives of genera *Eucyrtid-*



The Upper Cretaceous sequence of the Susuya River area (the West Sakhalin Mountains), schematic geological map (a) and lithological column (b): (1) Cenozoic deposits; (2) Upper Cretaceous deposits; (3) pre-Cretaceous deposits; (4) fault; (5) siltstone; (6) sandstone with siltstone interbeds; (7) clay; (8) sandstone; (9) carbonate concretions; (10) fauna of (a) inocerams and (b) radiolarians; (kr) Krasnoyarka Formation; (bk) Bykov Formation.

ium, Clathrocyclas, and *Phacodiscus*. The analysis revealed some unusual discoids having two pylomas, which had not been earlier detected in the Cretaceous deposits. Another characteristic feature of the assemblage is the presence of spicule-bearing Sphaerellaria forms, namely, of representatives of genus *Cuboctostylus* (*Cubostostylus kasinzovae* Bragina) (Bragina, in press). This find is significant because no spicule-bearing Sphaerellaria have been so far known from the Upper Mesozoic deposits. Only recently, Dumitrica (1994) described some Early and Middle Cretaceous spicule-bearing forms, that he attributed to the new genus *Pyloctostylus*. The occurrence of such forms far from the Mediterranean region and California (the more so, belonging to a different genus found in Sakhalin for the first time; Bragina, 1997) improves our knowledge of the distribution pattern of spicule-bearing forms and allows the inference that these taxa were not relict in the Late Cretaceous. Their scarcity in radiolarian assemblages can also be explained in other way. Being very brittle, these big cellular radiolarians are unsuitable for preservation, and the possibility of finding them depends on lithological features of enclosing rocks. In our case, the carbonate concretions appear to be an ideal material for the brittle cellular forms to be preserved.

In southwestern Sakhalin, Kazintsova (*Atlas ...*, 1993) distinguished two radiolarian assemblages of the Campanian age: (1) the early Campanian *Spongostaurus (?) hokkaidoensis–Hexacontium* sp. assemblage and (2) the late Campanian *Pseudoaulophacus floresensis–Stichomitra livermorensis* assemblage. The assemblage under consideration is of a late Campanian age but it includes *Spongostaurus (?) hokkaidoensis*, which was described from the Campanian deposits of Hokkaido (Taketani, 1982) and taken for the Campanian zonal species of Japan. Therefore, the occurrence of this species in the late Campanian assemblage does not mean that it is the characteristic form of this substage in Sakhalin (*Atlas ...*, 1993). The inference that it ranges throughout the Campanian would be more correct.

The taxonomic analysis shows that the species known in California (Campbell and Clark, 1944; Pessagno, 1976) represent 30% of the assemblage. At the same time, only few species in common (*Amphipyndax stocki, Archaeodictyomitra squinaboli*, and *Pseudoaulophacus floresensis*) are present in the coeval cold-water assemblages of the Middle Volga region (Bragina *et al.*, in press), two other species (*Patulibrachiium petroleumensis* and *Amphipyndax stocki*) are known from the Santonian–early Campanian (?) assemblage of the Moscow region (Bragina, 1994), one species

Amphipyndax stocki is described by Gorbovets as *Dictyomitra uralica* from the coeval assemblage of the West Siberian Lowland (Kozlova and Gorbovets, 1966), and three species (*Crucella espartoensis, A. stocki*, and *Vistularia magna* discovered in the Far East for the first time) are characteristic of Campanian assemblages of Poland (Gorka, 1989).

The regions mentioned above are quite distant from the West Sakhalin Mountains. How similar are these assemblages to those of the Far East? The closest taxonomic similarity is demonstrated by the late Santonian–early Campanian assemblage of the Penzhina Bay (Bragina, 1991b), which contains, in addition to *Theocampe guttaeformis* and *Amphipyndax stocki*, some fragments of *Cubostostylus kasinzovae* and five new undescribed species of the Actinommidae family. It should not be excluded that this similarity between assemblages can be a result of exceptionally favorable burial conditions. The good preservation of radiolarians was controlled by lithological features of the enclosing deposits as in both cases radiolarians are macerated from carbonate concretions. The comparison with another Far East radiolarian assemblage of late Campanian–Maastrichtian age from the Shikotan Island (Bragina, 1991a) revealed their almost absolute difference, because the latter is younger in age.

The assemblage under consideration has only one species in common with the Campanian–Maastrichtian assemblage of the Valaginskii Ridge (Vishnevskaya and Bernard, 1986).

The Campanian radiolarian assemblages of the Shimanto Group (southwestern Japan) consisting of taxa typical of tropical areas (Nakaseko and Nishimura, 1982; Hashimoto and Ishida, 1997) have one species (*Amphipyndax stocki*) in common with the assemblage under discussion. The radiolarian assemblages of Hokkaido (Taketani, 1982) contain three species of this kind: *Amphipyndax stocki, Spongostaurus (?) hokkaidoensis*, and *Crucella espartoensis.* Foraminiferal assemblages of Sakhalin and Hokkaido are also quite different (Taketani, 1982; Maiya and Takayanagi, 1977), whereas there are many features in common (over 50% of taxa) between coeval inoceram assemblages of these regions (*Atlas* ..., 1993; Matsumoto, 1977) The low degree of similarity between radiolarian and foraminiferal assemblages from coeval deposits of the Hokkaido–Sakhalin paleobasin can be explained by inadequate knowledge of microfauna from different localities of the region. Another explanation is that Sakhalin faunal assemblages developed in another paleoclimatic zone should not be excluded as well.

CONCLUSION

This investigation resulted in distinguishing the radiolarian assemblage including some taxa, which have not been recorded earlier in the region. The occurrence of spicule-bearing forms is of particular significance. The new genus *Bipylomella* and new species *Bipylomella sachalinica* sp. nov., *Spongostaurus (?) sachalinensis* sp. nov., and *Hexalonche (?) horridus* sp. nov. are described below. The comparative analysis showed that the distinguished assemblage has little in common with coeval radiolarian assemblages from remote and adjacent regions. Few species identical to those from the Campanian assemblages of the Hokkaido and Shikoku islands may give evidence either for the inadequate study of microfaunas or for paleoclimatic differences. The close similarity between the assemblage in question and remote subtropical assemblages may indicate thorough studies of the latter.

The radiolarian fauna of the Pacific paleogeographic region is considered to be highly endemic. The analyzed composition of new assemblage confirms this opinion. The assemblage includes a number of species to be carefully studied and described.

SYSTEMATIC DESCRIPTIONS

Family Spongodiscidae Haeckel, 1882

Genus *Bipylomella* gen. nov.

Type species: *Bipylomella sachalinica* sp. nov.

Name: *Bipylomella* (Latin.), having two-pylomes.

Description. Large biconvex discoidal shell of a subtriangular form, which has two pylomes oriented toward the apices. The shell is filled up with fine spongy tissue.

Comparison. Representatives of *Bipylomella* gen. nov. differ from those of genus *Spongopyle.* They have two pylomes and show the absence of distinct concentric layers in the internal meshwork.

Remarks. Few discoidal and prunoidal taxa having pylomes were found in Late Cretaceous radiolarian assemblages. This skeletal element is characteristic of Cenozoic and recent forms (Dreyer, 1889; Petrushevskaya, 1967). For instance, the generic identification of the Cretaceous species *Spongopyle insolita* Koslova is based on the presence of one pylome and internal concentric layers. This genus was described by Dreyer (1889) from the recent radiolarian assemblages of the Indian Ocean. In spite of a long period of studies of pylome-bearing taxa, the interpretation of the term "pylome" is still ambiguous. Dreyer (1889), who was the first to use this term, meant the cone-like deepening, which represents a tube connected, according to Petrushevskaya (1967), with radial spines. However, a cone-like hole may also occur in forms with the spongy inner tissue. Being differently interpreted, the term "pylome" cannot be used with confidence for paleontological description. The problem requires thorough investigations of the inner structure of the Cenozoic and recent taxa of this kind.

Bipylomella sachalinica sp. nov.

Plate I, 1–3

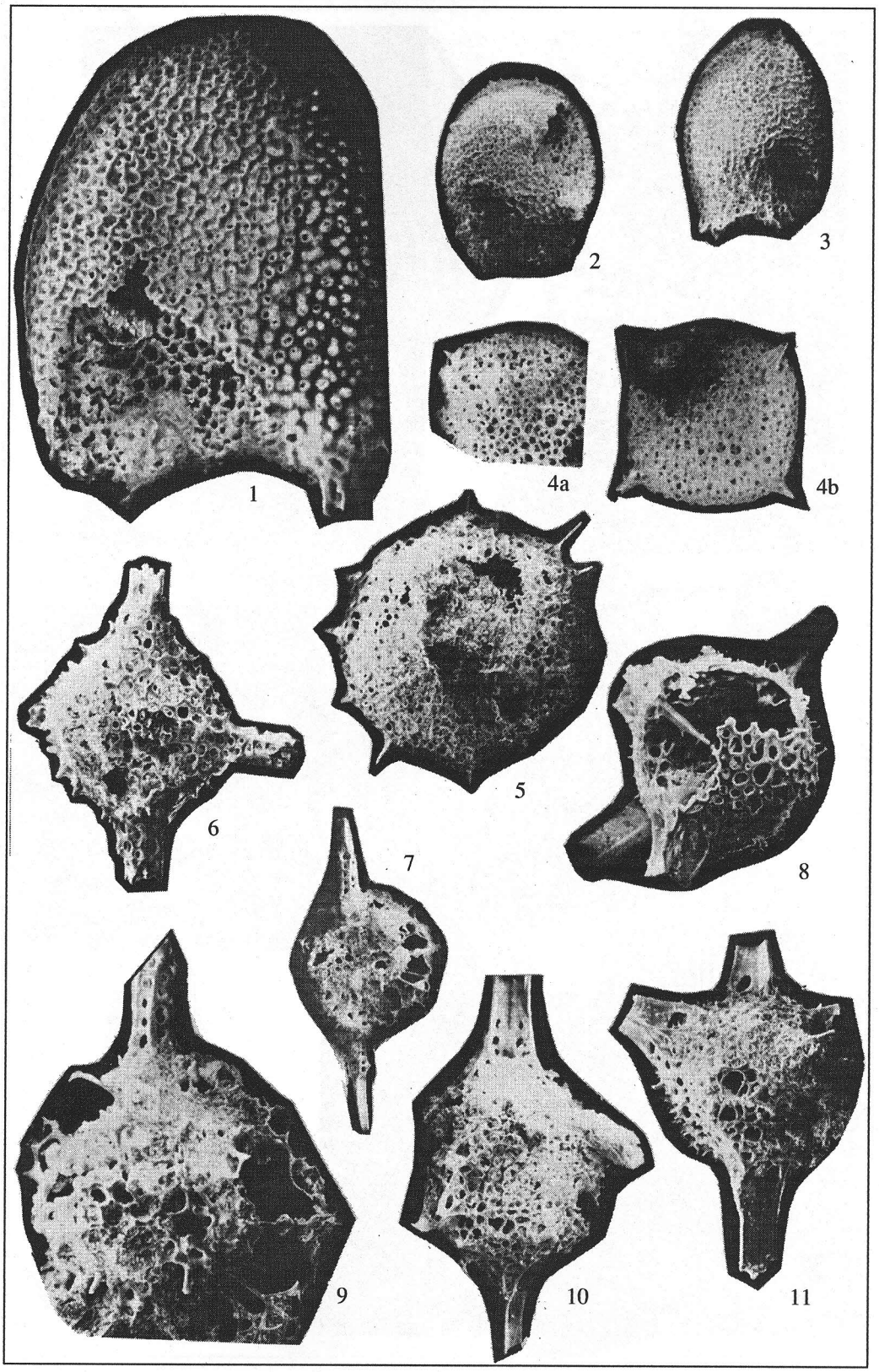


Plate I. Late Campanian radiolarians of southwestern Sakhalin (Plates I–III).
(1–3) *Bipylomella sachalinica* sp. nov., (1) × 500; 2, 3 – × 200. (4a, 4b) *Spongostaurus* (?) *sachalinensis* sp. nov., ×200. (5) *Phacodiscus* sp., ×200. (6, 7) Gen. et sp. indet. A, (6) ×200; (7) ×100. (8) Gen. et sp. indet., ×200. (9) Gen. et sp. indet. A, ×500. (10, 11) Gen. et sp. indet., ×200.

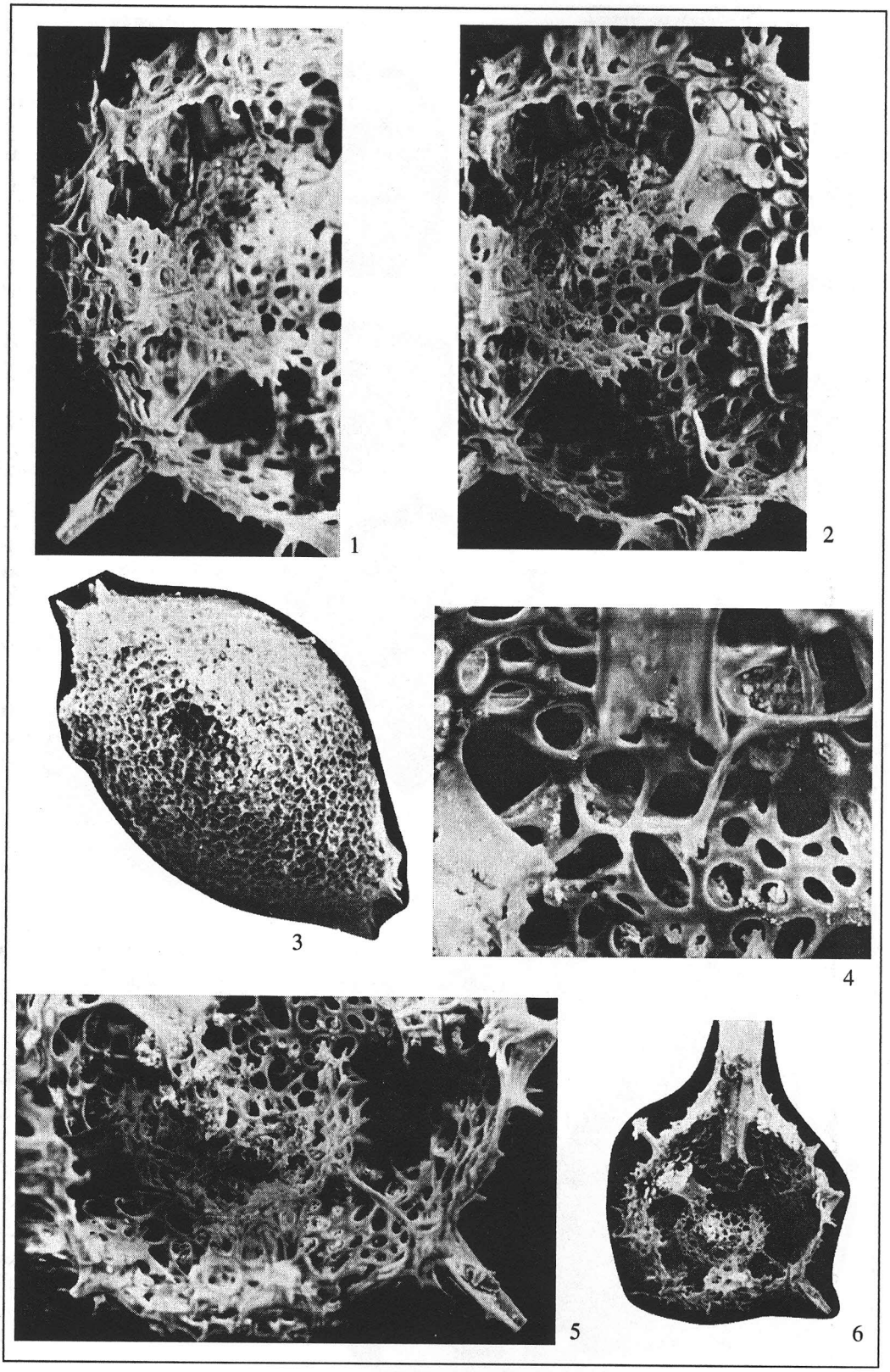


Plate II. (1, 2) *Hexalonche* (?) *horridus* sp. nov., ×500. (3) *Stylodruppa bifascicula* Kasinzova, ×500. (4) *Hexalonche* (?) *horridus* sp. nov., ×1000. (5) *Hexalonche* (?) *horridus* sp. nov., ×500. (6) *Hexalonche* (?) *horridus* sp. nov., ×200.

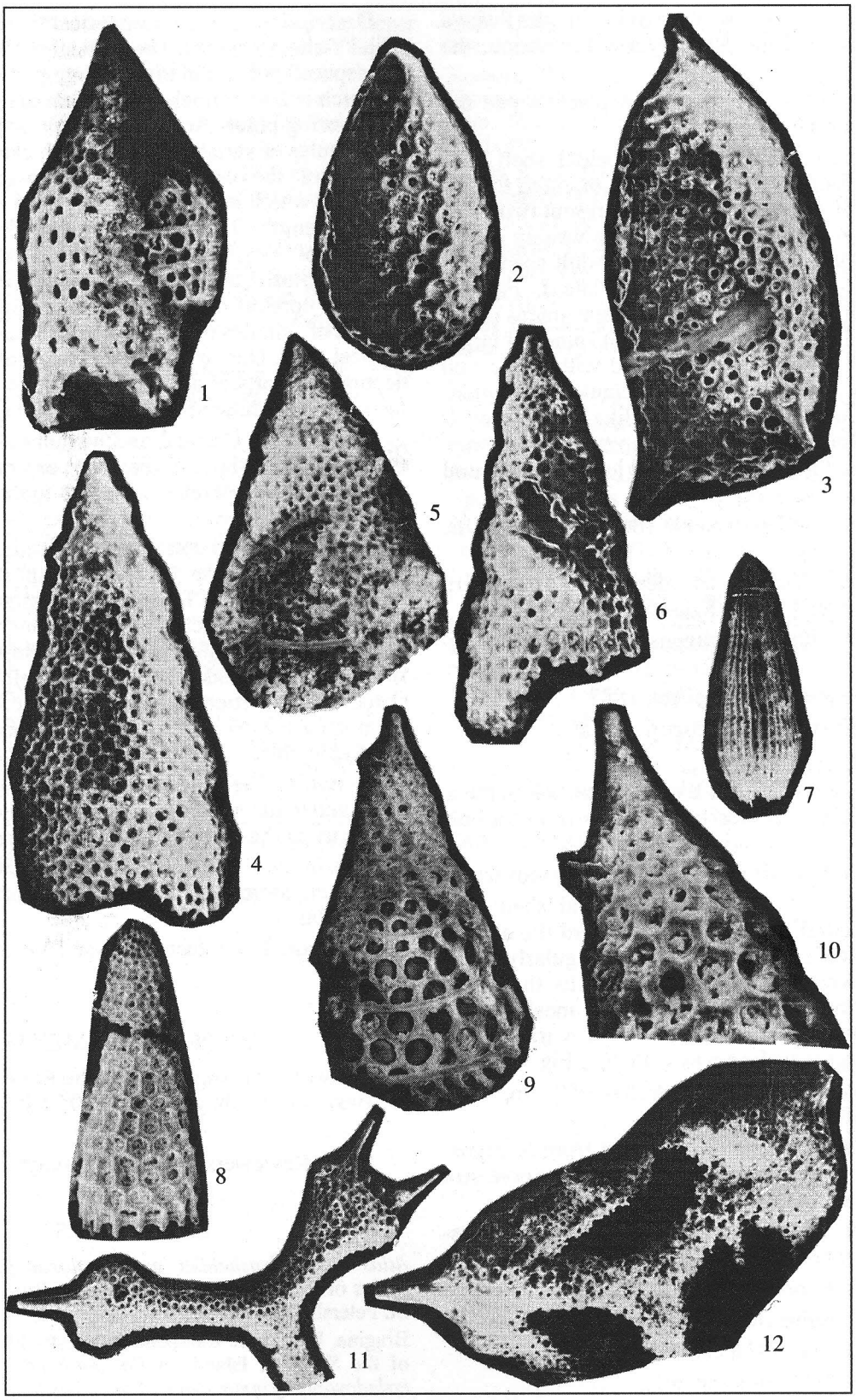


Plate III. (1) *Clathrocyclas* sp., ×200. (2) *Amphipyndax* aff. *ellipticus* Nakaseko et Nishimura, ×200. (3) *Stylodruppa* aff. *bifascicula* Kasinzova, ×500. (4, 5) *Eucyrtidium* sp. A, ×400. (6) *Vistylaria magna* Gorka, ×400. (7) *Archaeodictyomitra squinaboli* Pessagno, ×100. (8) *Cornutella*? sp., ×200. (9) *Clathrocyclas* sp. A, ×200. (10) *Clathrocyclas* sp. A, ×500. (11) *Patulibracchium vereshagini* Kasinzova, ×200. (12) *Patulibracchium* cf. *petroleumensis* Pessagno, ×500.

Holotype: no. 4850/1, western Sakhalin, the Susuya River, Member 1 of the Krasnoyarka Formation, the Campanian.

Name: *sachalinica* points to the place where the species was found first.

Description. Large biconvex discoidal shell of a subtriangular form. Two pylomes are oriented toward the most closely spaced apices and represent two elongate tubes with peripheral spines. The weakly developed keel has spinules at the apices. Adult specimens have the well-developed pylomes (Plate I, Fig. 1), which are poorly developed in young specimens (Plate I, Figs. 2 and 3), and few external joint spines of larger size. The shell surface is ornamented with fine round pores equal in size and with small spinules of irregular form. Several united spinules look like weakly developed ridges. The shell is filled with very loose spongy tissue condensed into a subdiscoidal joint in the central part of the shell.

Dimensions. Shell diameter is 180–230 μm; pylome diameter is 40–80 μm.

Distribution: Campanian deposits of western Sakhalin, Member 1 of the Krasnoyarka Formation.

Material: Six intact specimens and numerous fragments.

Genus *Spongostaurus* Haeckel, 1882

Spongostaurus (?) sachalinensis sp. nov.

Plate I, Figs. 4a and 4b

Holotype: no. 4850/2, the West Sakhalin Mountains, the Susuya River, Member 1 of the Krasnoyarka Formation.

Name: *sachalinensis* after the place of discovery.

Description. Cuboid, almost spherical shell with four short trihedral spines oriented toward the angles. The shell surface is pierced with oval to regularly round large pores, whose diameter is equal to the space between neighboring pores. The spongy meshwork of the inner cavity is so fine that the shell is translucent through the largest surface pores (Plate I, Fig. 4a).

Dimensions. Shell diameter is 200–250 μm, spine length is 40–60 μm.

Comparison. The species is distinct from *Spongostaurus (?) hokkaidoensis* Taketani by a larger pore size and the character of meshwork.

Distribution: the West Sakhalin Mountains, the Susuya River, Member 1 of the Krasnoyarka Formation.

Material: five specimens.

Family Cubosphaeridae Haeckel, 1882

Genus *Hexalonche* Haeckel, 1882

Hexalonch (?) horridus sp. nov.

Plate II, Figs. 1, 2, and 4–6.

Holotype: no. 4850/3, the West Sakhalin Mountains, the Susuya River, Member 1 of the Krasnoyarka Formation.

Name: *horridus* (Latin.) means horrible.

Description. Spinous spherical form with robust radial Y-shaped spines. The cortical shell shows irregularly spaced polygonal to oval large pores, the diameter of which is 2 to 3 times greater than the space between neighboring pores. At the pore conjunction sites, there are spinules of variable length and thickness. The inner surface of the cortical shell is covered with thin spinules, which are similarly disposed but more variable in length. This surface is not ideally spherical because of varying thickness. The medular spherical shell is almost 2 times less in diameter being connected with the cortical one by 6–8 main spines and by the longest of spinules ornamenting the inner surface of the cortical shell. Due to the furcate shape of spinules connecting the cortical and medular shells, the outer surface of the medular shell has an irregular form.

Dimensions. Cortical and medular shells are 400–600 and 150–200 μm in diameter; external parts of the main spines approximate in length to the cortical shell diameter.

Comparison. As compared to *Hexalonche (?) senta* Koslova, *Hexalonche (?) horridus* sp. nov. shows the following distinctive features: (a) greater variability of pore size in the cortical shell; (b) thinner medular shell with different porosity; (c) more developed and furcate spinules, which make the medular shell as irregular in shape as the cortical shell; and (d) greater number of main spines, as *H. (?) senta* has not more than five of these elements.

Remarks. The species described is conventionally attributed to the genus *Hexalonche* because of the close similarity in the outer and inner structure.

Distribution: the West Sakhalin Mountains, the Susuya River, Member 1 of the Krasnoyarka Formation; Campanian.

Material: Two intact and over 10 incomplete specimens.

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REFERENCES

Atlas rukovodyashchikh grup melovoi fauny Sakhalina (Atlas of the Cretaceous Guide Fauna Groups of Sakhalin), St. Petersburg: Nedra, 1993.

Bragina, L.G., Late Campanian–Maastrichtian Radiolarians of the Shikotan Island, in *Paleontologo-stratigraficheskie issledovaniya fanerozoya Dal'nego Vostoka* (Paleontological and Stratigraphical Investigations of the Phanerozoic in the Far East), Vladivostok: Dal'nevost. Otd. Akad. Nauk SSSR, 1991a, pp. 100–103.

Bragina, L.G., Radiolarians of the Santonain–Campanian Bystraya Formation of Northwestern Kamchatka, *Izv. Akad. Nauk SSSR, Ser. Geol.*, 1991b, no. 7, pp. 129–136.

Bragina, L.G., Radiolarians and Stratigraphy of the Upper Cretaceous Khot'kovo Formation of the Moscow Region, *Byull. Mosk. O-va Ispyt. Prir.*, 1994, vol. 69, no. 2, pp. 91–100.

Bragina, L.G., The Spicule-Bearing Spumellaria from the Upper Cretaceous of Sakhalin, in *Interrad VIII*, Paris, 1997, p. 32.

Bragina, L.G., Late Cretaceous Spicule-Bearing Radiolaria from Southern Sakhalin (Russia), *Geodiversitas*, 1999, in press.

Bragina, L.G., Benjamovskii, V.N., and Zastrozhnov, A.S., Upper Cretaceous Radiolarians, Foraminifers, and Stratigraphy of the Southeastern Russian Plate (Right Bank of the Volga River near Volgograd), *Stratigr. Geol. Korrelyatsiya* (in press).

Campbell, A.S. and Clark, B.L., Radiolaria from the Upper Cretaceous of Middle California, *Spec. Pap. Geol. Soc. Am.*, 1944, no. 57, pp. 1–61.

Dreyer, F. Die Pylombildungen in vergleichend–anatomischer und entwicklung–geschitlicher Beziehung bei Radiolarien und bei Protisten uberhaupt, nebst System und Beschreibung neuer und der bis jetzt bekannten pylomatischen Spumellarien, *J. Zeitschr.*, 1889, vol. 23, pp. 1–133.

Dumitrica, P., *Pyloctostylus* n. gen., a Cretaceous Spumellarian Radiolarian Genus with Initial Spicule, *Rev. Micropaleontol.*, 1994, vol. 37, no. 4, pp. 235–244.

Gorka, H., Les Radiolaires du Campaniean inferieur de Cracovie (Pologne), *Acta Palaeontol. Polon.*, 1989, vol. 34, no. 4, pp. 327–354.

Hashimoto, H. and Ishida, K., Correlation of Selected Radiolarian Assemblages of the Upper Cretaceous Izumi and Sotoizumi Groups and Shimanto Supergroup in Shikoku, *News Osaka Micropaleontol.*, 1997, no. 10, pp. 245–257.

Kazintsova, L.I., Campanian Radiolarians from the West Sakhalin Mountains, in *Iskopaemye i sovremennye radiolyarii* (Fossil and Recent Radiolarians), Leningrad: Zool. Inst. Akad. Nauk SSSR, 1979, pp. 93–100.

Kozlova, G.E. and Gorbovets, A.N., Late Cretaceous–Late Eocene Radiolarians from the West Siberian Lowland, *Tr. Vses. Nauch.–Issled. Geol. Razved. Inst.*, 1966, no. 248, pp. 1–159.

Maiya, S. and Takayanagi, Y., Cretaceous Foraminiferal Biostratigraphy of Hokkaido, *Spec. Pap. Paleontol. Soc. Jpn.*, 1977, no. 21, pp. 41–62.

Matsumoto, T., Zonal Correlation of the Upper Cretaceous in Japan, *Spec. Pap. Paleontol. Soc. Jpn.*, 1977, no. 21, pp. 63–74.

Nakaseko, K. and Nishimura, A., Upper Jurassic and Cretaceous Radiolaria from the Shimanto Group in Southwest Japan, *Sci. Rep. Coll. Gen. Educ. Osaka Univ.*, 1982, no. 30, pp. 133–203.

Opornyi razrez melovykh otlozhenii Sakhalina (Naibinskii razrez) (The Cretaceous Reference Section of Sakhalin: the Naiba Section), Leningrad: Nauka, 1987.

Pessagno, E.A., Jr., Radiolarian Zonation and Stratigraphy of Upper Cretaceous Portion of the Great Valley Sequence, *Micropaleontol.*, 1976, no. 2, pp. 1–96.

Petrushevskaya, M.G., Radiolarians of the Spumellaria and Nassellaria Orders of the Antarctic Region, in *Rezul'taty biologicheskikh issledovanii Sovetskoi Antarkticheskoi Ekspeditsii (1955–1958)* (Results of Biological Investigations of the Soviet Antarctic Expedition, 1955–1958), Leningrad: Nauka, 1967, no. 3, pp. 5–186.

Taketani, Y., Cretaceous Radiolarian Biostratigraphy of the Urakawa and Obira Areas, Hokkaido, *Sci. Rep. Tohoku Univ., Ser. 2: Geol.*, 1982, vol. 52, nos. 1–2, pp. 1–76.

Vishnevskaya, V.S. and Bernard, V.V., Age and Depositional Environment of Mesozoic Siliceous Rocks in Kamchatka, in *Ocherki po geologii Vostoka SSSR* (Review of Geology of the Eastern SSSR), Moscow: Nauka, 1986, pp. 35–41.