

## New Species of the Genus *Nucleospira* Hall (Brachiopoda) from the Lower Devonian of Northeastern Russia

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**Abstract**—Three new species of the genus *Nucleospira*—*N. sphaerica*, *N. lata*, and *N. rotunda*—are described from the Lower Devonian of Northeastern Russia.

**Key words:** brachiopods, athyridids, *Nucleospira*, Lower Devonian, Northeastern Russia.

### INTRODUCTION

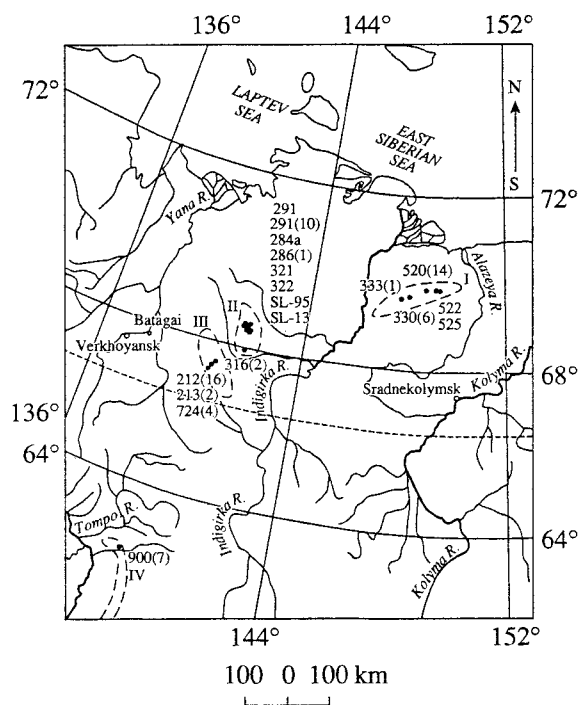
The earliest members of the cosmopolitan genus *Nucleospira*, which flourished in the Early Devonian and became extinct in the Permian, are known from the Late Silurian. Their ancestors are still unknown.

In northeastern Russia, *Nucleospira* species have been reported from the southern Verkhoyansk region (Sette-Dabun Range), Chersky mountain system (Tus-Khaykhtukh Range), Sellennyakh Ridge, and Ulakhan-Sis Range (Fig. 1).

Within the area under study, the *Nucleospira* genus is represented by three new species: *N. sphaerica*, *N. lata*, and *N. rotunda*. All these species are characterized by the presence of thin hollow spines on the shell surface, with bases arranged concentrically, a hinge plate extending into the ventral valve, V-shaped jugum with short branches originating on the saddle and extending backward, jugal stem of varying length, euseptoidum in both valves, and spires in cones that are directed laterally. Jugum branches have not been described in *Nucleospira* (Treatise ..., 1965; Alekseeva and Mendbayar, 1981; Grunt, 1986), probably because of the poor preservation of the inner skeletal structures of the shells.

*N. sphaerica* came from the Darskii Horizon (Early Pragian) (Fig. 2); *N. lata*, from the Galkinskii Horizon (Late Pragian); and *N. rotunda*, from the upper Nikolaevka Horizon and from the Geremgandzhinskii Horizon (Emsian) (Baranov and Alkhovik, 2001, 2002). The first member of *Nucleospira*, *N. sphaerica*, came from basal Pragian strata, and none of its ancestors have been found in the underlying deposits. *N. sphaerica* has an equally biconvex globose shell that is slightly depressed radially in the front part of the ventral valve, V-shaped jugum, short jugal branches, and long jugal stem that almost reaches the ventral valve. In

the Late Pragian, it gave rise to *N. lata*, which has a more convex ventral valve with a conspicuous sulcus and short, rodlike jugal stem. In the Late Emsian *N. rotunda*, the shell form was retained, but the convexity of the ventral valve continued to increase, and the jugal stem was weakly developed.



**Fig. 1.** Scheme of the athyridid localities: (I) Ulakhan-Sis Range, Pravyi Naanchan and Kusagun-Juryakh rivers; (II) Sellennyakh Ridge, the right bank of the Talynja River (Sakynja) and headwaters of the Chibalukh River; (III) Tus-Khaykhtukh Range, Khalim River (right tributary of the Dogdo River); and (IV) Sette-Dabun Range, right bank of the Vostochnaya Khandyga River, Tikhii Creek.

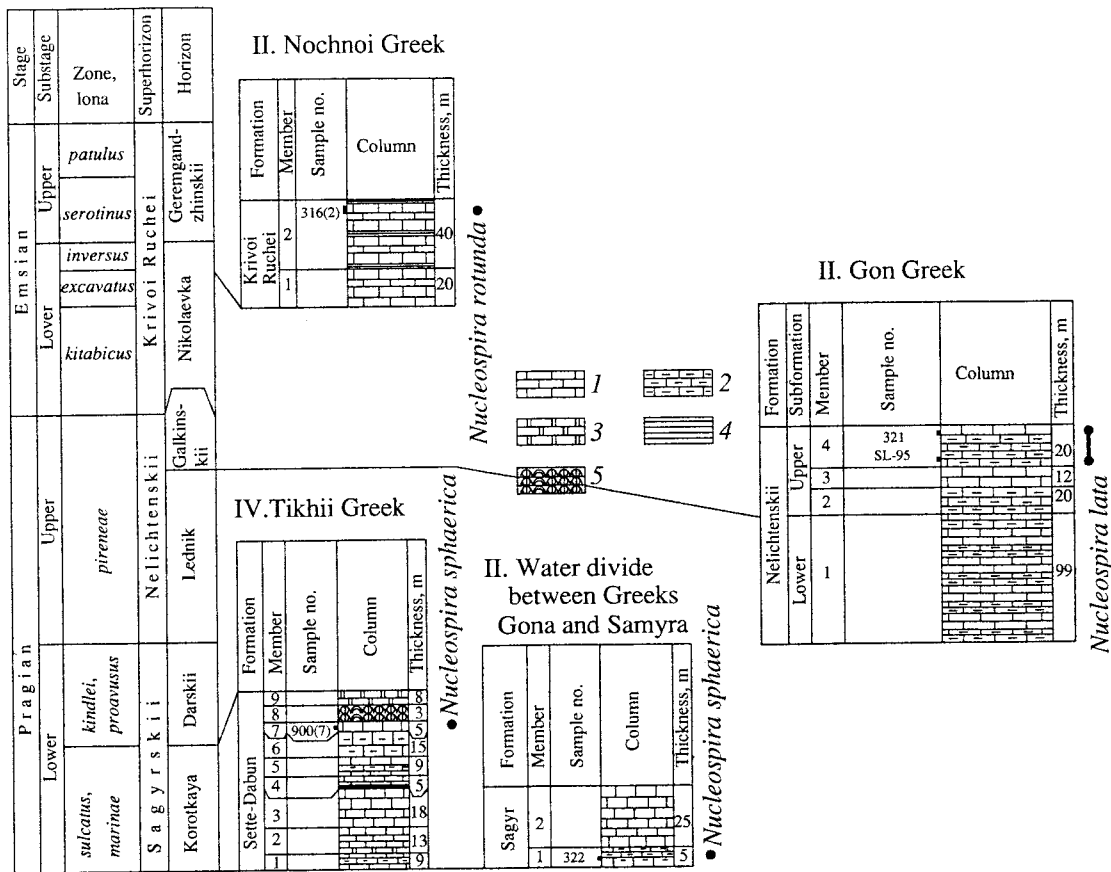


Fig. 2. Fragmentary Lower Devonian sections of northeastern Russia in which fossil remains of *Nucleospira* species under study have been found. Designations: (1) limestone; (2) clayey limestone; (3) dolomite; (4) clayey shale; and (5) biostrome.

MATERIAL

The material under study is housed at the Geological Museum of the Diamond Geology and Precious Metal Geology Institute, Yakutsk Research Center, Siberian Division, Russian Academy of Sciences, Yakutsk (IDGNM), collection no. 182.

SYSTEMATIC PALEONTOLOGY

Family Nucleospiridae Davidson, 1881

Genus *Nucleospira* Hall, 1859

*Nucleospira sphaerica* Baranov et Alkhovik, sp. nov.

Plate 5, figs. 1-5, 13

**Etymology.** From Latin *sphaericus* (globose).

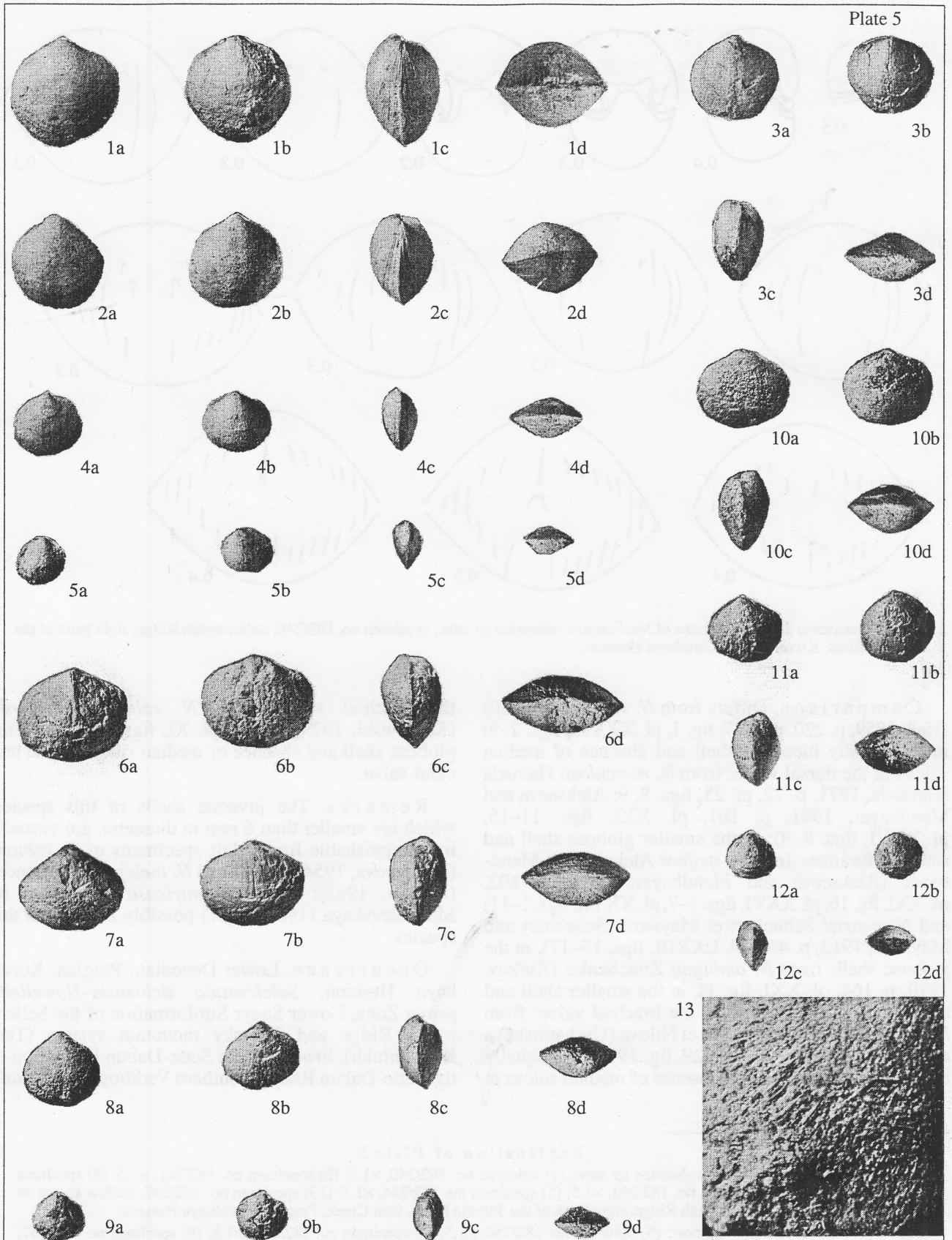
**Holotype.** IDGNM, no. 182/240, whole shell; Sellennyakh Ridge, the right bank of the Talynja River, Gon Creek; Lower Devonian, Pragian, Darskii Horizon, Lower Sagyr Subformation.

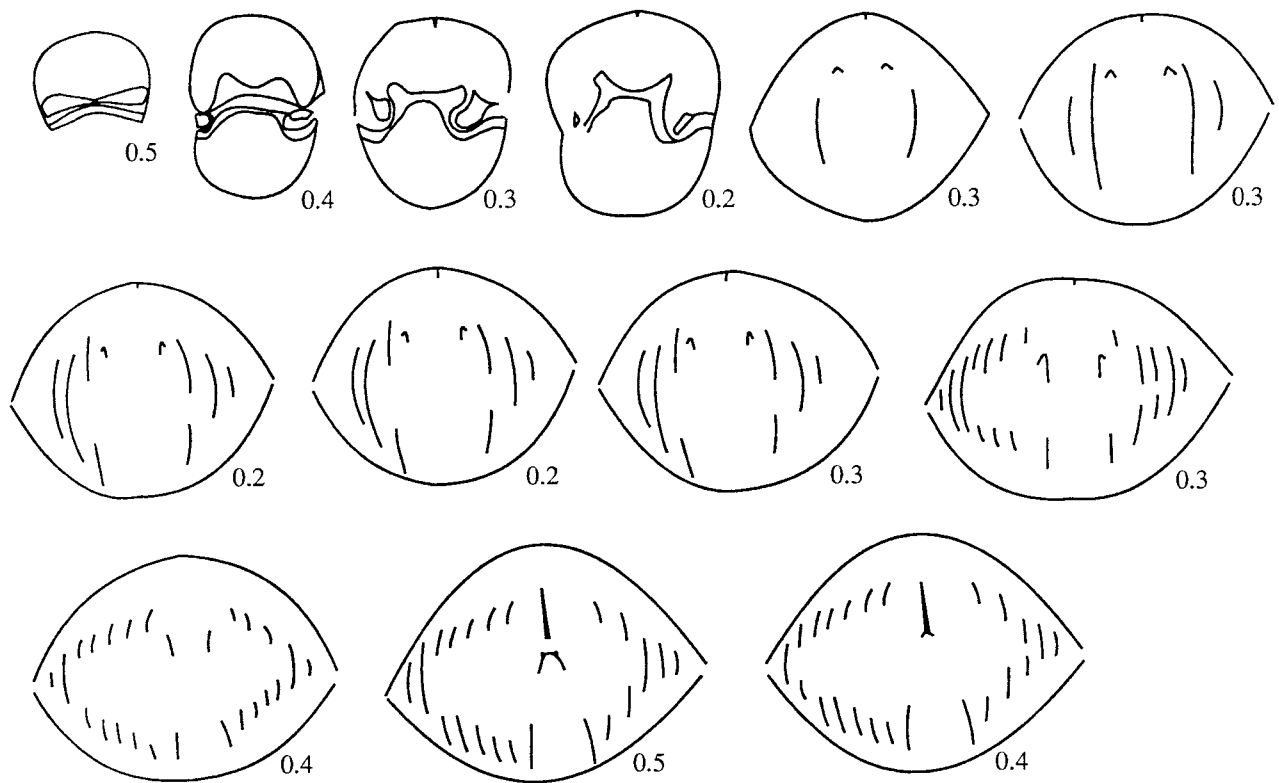
**Description.** The shell is middle-sized and equally biconvex and globose, with the maximum width and thickness in the middle; the anterior commissure is straight and rounded; the surface of the valves is covered with closely spaced hollow spines the bases of which are arranged concentrically; the ventral valve is moderately convex, with the maximum convexity in the middle, and gently depressed anteriorly; the ventral beak is curved and sharpened with an oval foramen nar-

rowing in the middle in the permesothyridid position and thin deltidial plate; the brachial beak is curved; the teeth are tongue-shaped; dental plates are absent from the ventral valve; the ventral and dorsal euseptoidum almost reach the anterior margin; the hinge plate is massive and curved and enters the ventral valve cavity; the jugum is V-shaped and terminates in a thorn that almost reaches the ventral valve; the jugal branches are short and originate at the thorn basis; the ends of the branches are directed ventrally; the spires, with seven whorls, are arranged in cones that are directed laterally (Fig. 3).

**Measurements, mm:**

Specimen no.	Sample no.	L	W	T	L/W	L/T
Holotype, IDGNM no. 182/240	322	13.2	13.3	9.3	0.99	1.42
IDGNM 182/241	322	11.2	11.3	9.0	0.99	1.23
IDGNM 182/242	322	9.7	10.7	6.1	0.9	1.57
IDGNM 182/243	322	9.0	9.8	7.9	0.92	1.14
IDGNM 182/244	322	7.2	8.3	4.2	0.87	1.71
IDGNM 182/245	322	4.9	4.9	3.3	1.0	1.48





**Fig. 3.** Transverse polished sections of *Nucleospira sphaerica* sp. nov., specimen no. 182/246; Sellennyakh Ridge, right bank of the Talynja River, Krivoi Creek; Korotkaya Horizon.

**Comparison.** Differs from *N. ventricosa* (Hall) (Hall, 1859, p. 220, pl. XIV, fig. 1, pl. XXVIII, figs. 2–9) in the equally biconvex shell and absence of median sulcus in the dorsal valve; from *N. musculosa* Hamada (Hamada, 1971, p. 72, pl. 25, figs. 8, 9; Alekseeva and Mendbayar, 1981, p. 101, pl. XXI, figs. 11–15, pl. XXVI, figs. 8, 9); in the smaller globose shell and rounded foramen: from *N. acifera* Alekseeva et Mendbayar (Alekseeva and Mendbayar, 1981, p. 102, pl. XXI, fig. 16, pl. XXVI, figs. 3–7, pl. XXVII, figs. 1–11) and *N. swartzi* Schuchert et Maynard (Schuchert and Maynard, 1913, p. 432, pl. LXXIII, figs. 15–17), in the globose shell; from *N. ambigua* Zintchenko (Kulkov, 1970, p. 164, pl. XXI, fig. 1), in the smaller shell and absence of median sulcus in the brachial valve: from *N. tebesgensis* Uschatinskaya et Nilova (Uschatinskaya and Nilova, 1975, p. 119, pl. 29, fig. 19), in the equally biconvex globose shell and absence of median sulcus in

the brachial valve; from *N. robusta* Kozłowski (Kozłowski, 1929, p. 216, pl. XI, figs. 24–35), in the globose shell and absence of median sulcus in the brachial valve.

**Remarks.** The juvenile shells of this species, which are smaller than 6 mm in diameter, are virtually indistinguishable from adult specimens of *N. robusta* (Nikiforova, 1954, p. 155) and *N. inelegans* (Barrande) (Kulkov, 1963); the "*N. ventricosa*" described by Modzalevskaya (1969, p. 21) possibly belongs to this species.

**Occurrence.** Lower Devonian, Pragian, Korotkaya Horizon, *Sulcicostula tichiensis*–*Howellella prima* Zone, Lower Sagyr Subformation of the Sellennyakh Ridge and Chersky mountain system (Tus-Khaykhtukh), lower Middle Sette-Dabun Formation of the Sette-Dabun Range (southern Verkhoyansk region).

#### Explanation of Plate 5

**Figs. 1–5 and 13.** *Nucleospira sphaerica* sp. nov.: (1) holotype no. 182/240,  $\times 1.5$ ; (2) specimen no. 182/241,  $\times 1.5$ ; (3) specimen no. 182/242,  $\times 1.5$ ; (4) specimen no. 182/243,  $\times 1.5$ ; (5) specimen no. 182/244,  $\times 1.5$ ; (13) specimen no. 182/247, hollow spines on the shell surface,  $\times 20$ ; Sellennyakh Ridge, right bank of the Talynja River, Gon Creek; Pragian, Korotkaya Horizon.

**Figs. 6–9.** *Nucleospira lata* sp. nov.: (6) holotype no. 182/250,  $\times 1.5$ ; (7) specimen no. 182/251,  $\times 1.5$ ; (8) specimen no. 182/252,  $\times 1.5$ ; (9) specimen no. 182/253,  $\times 1.5$ ; Sellennyakh Ridge, right bank of the Talynja River, Gon Creek; Pragian, Galkinskii Horizon.

**Figs. 10–12.** *Nucleospira rotunda* sp. nov.: (10) holotype no. 182/260,  $\times 1.5$ ; (11) specimen no. 182/261,  $\times 1.5$ ; (12) specimen no. 182/262,  $\times 1.5$ ; Sellennyakh Ridge, source of the Chibalukh River, Nochnoi Creek; Geremgandzhinskii Horizon.

Designations: (a) ventral valve, (b) brachial valve, (c) lateral view, and (d) anterior view.

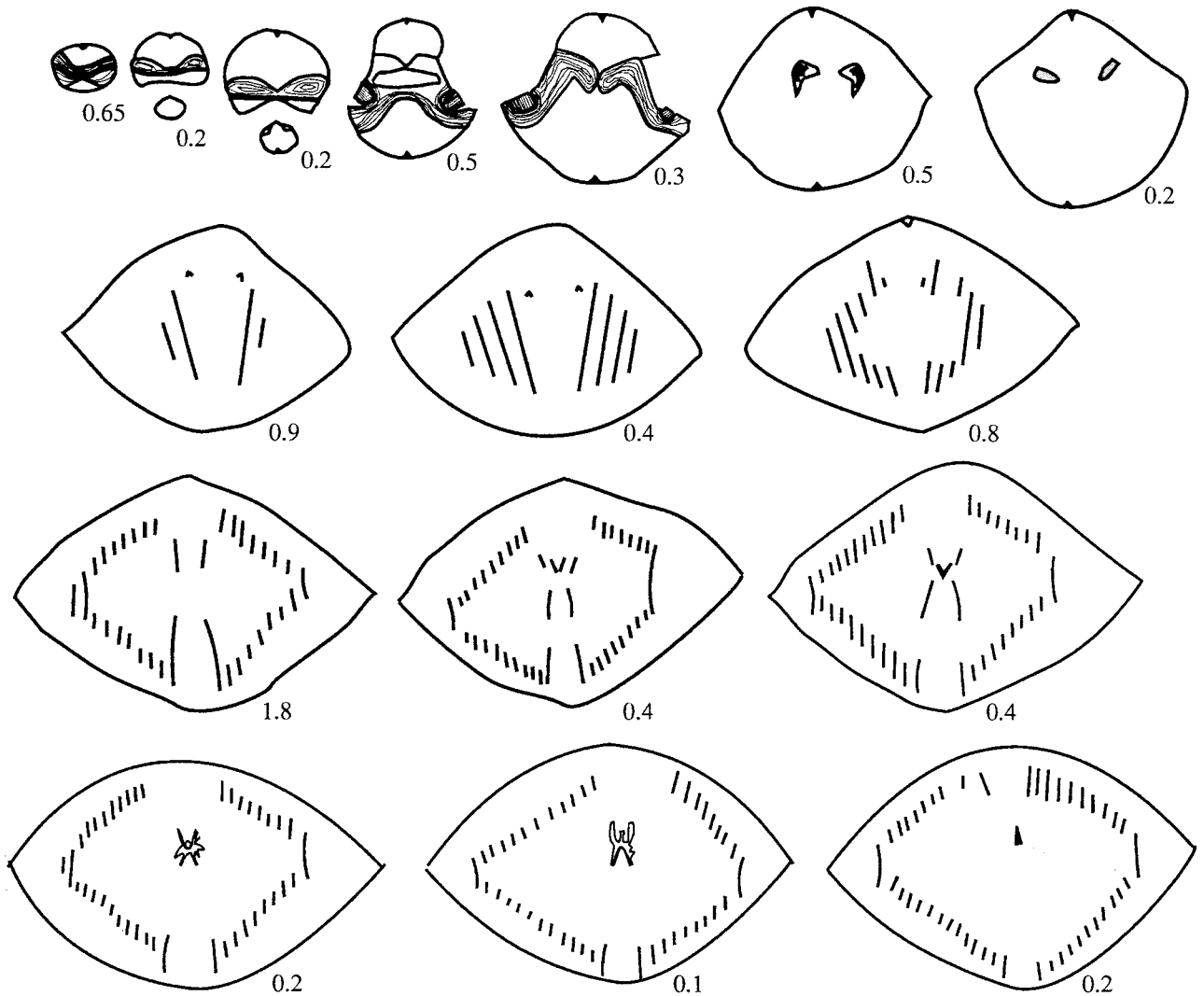


Fig. 4. Transverse polished sections of *Nucleospira lata* sp. nov., specimen no. 182/254; Sellennyakh Ridge, right bank of the Talynja River, Krivoi Creek; Galkinskii Horizon.

**Material.** A total of 112 shells has been found from the following localities: the Sellennyakh Ridge, right bank of the Talynja River (Sakynja), Serp Creek, 12 specimens from sample no. 291 (1) and 26 specimens from sample no. 291; Gon Creek, 21 specimens from sample no. 322 and 6 specimens from sample no. S-13; Krivoj Creek, 33 specimens from sample no. 284a; the Ulakhan-Sis Range, left bank of the Kusagu-Juryakh River, 1 specimen from sample no. 330 (6); the water divide between Krestovka Creek and the Ozernaya River, 10 specimens from sample no. 331 (1); the Tus-Khaykhtukh Range, left bank of the Khalim River, 2 specimens from sample no. 212 (16); and the Sette-Dabun Range, Tikhii Creek, 1 specimen from sample no. 900 (7).

*Nucleospira lata* Baranov et Alkhovik, sp. nov.

Plate 5, figs. 6-9

**Etymology.** From Latin *latus* (wide).

**Holotype.** IDGNM, no. 182/250, whole shell; Sellennyakh Ridge, right bank of the Talynja River, Gon Creek; Lower Devonian, Pragian, Galkinskii Horizon, Upper Nelichtenskii Subformation.

**Description.** The shell is punctate; middle-sized, oval, transversely elongated, moderately biconvex, with the maximum width and thickness located in the middle; the anterior commissure is unisulcate, the surface of the valves is covered with closely spaced hollow spines, the bases of which are arranged concentrically; the ventral valve is moderately convex, with the maximum convexity located in the middle and with a conspicuous sulcus near the anterior margin; the ventral beak is curved and sharpened and has a rounded foramen in the permesothyridid position and a thin deltidial plate; the brachial valve is moderately convex, slightly lower than the ventral valve; the brachial beak is low and curved; dental plates are absent; the teeth are smooth and tongue-shaped; the ventral septum is low

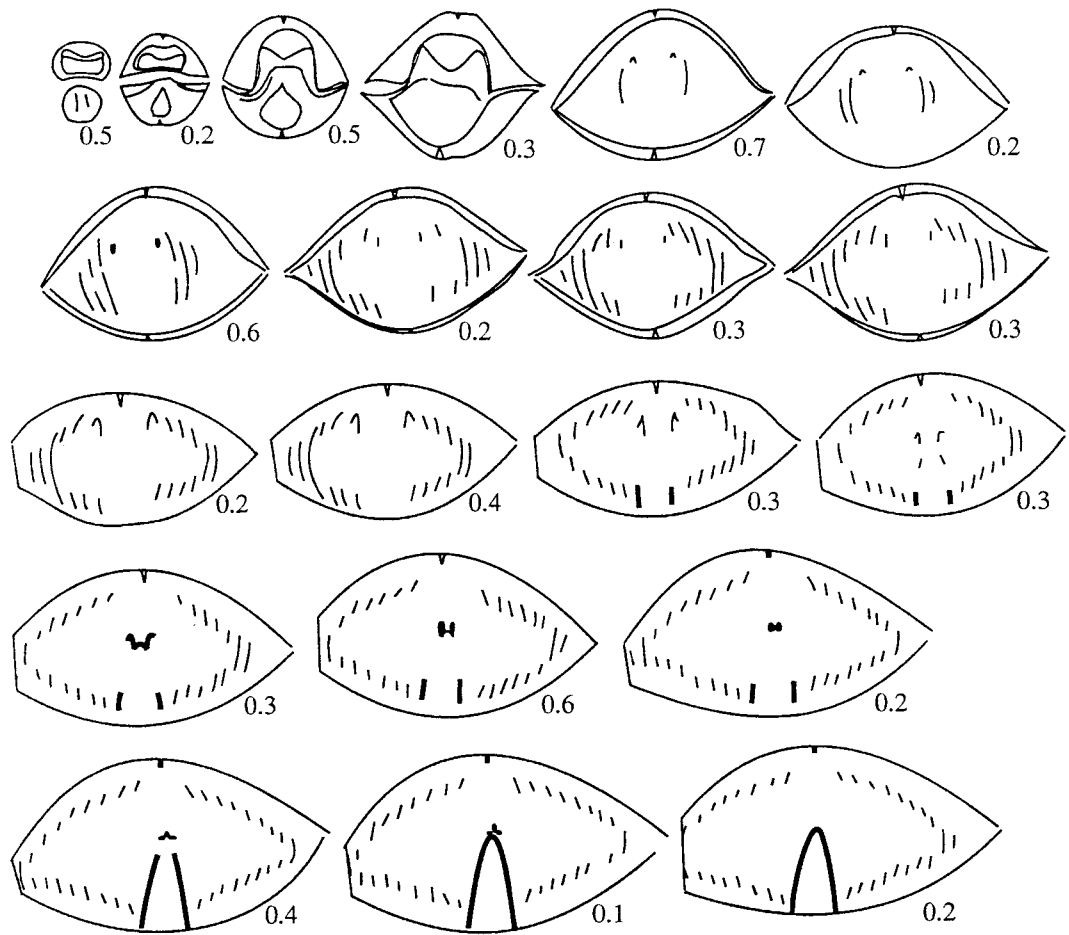


Fig. 5. Transverse polished sections of *Nucleospira rotunda* sp. nov., specimen no. 182/264; the Ulakhan-Sis Range, Dalnii Creek (tributary of the Pravyi Naanchan River); Upper Nikolaevka Subhorizon.

and almost reaches the anterior margin; the dorsal septum almost reaches the anterior margin; the hinge plate is curved dorsally and enters the ventral valve cavity; the primary lamellae are connected in the middle with a V-shaped jugum that terminates in an anteriorly curved thorn; the jugal branches are short and originate at the thorn basis; the ends of the branches are directed posteriorly; the spires, with 11 whorls, are arranged in cones that are directed laterally (Fig. 4).

#### Measurements, mm:

Specimen no.	Sample no.	L	W	T	L/W	L/T
Holotype, IDGNM no. 182/250	321	11.1	14.0	7.2	0.79	1.54
IDGNM 182/251	321	10.5	12.6	6.5	0.83	1.61
IDGNM 182/252	321	8.0	8.9	4.7	0.89	1.7
IDGNM 182/253	321	5.8	6.1	3.5	0.95	1.66

**Comparison.** Differs from *N. ventricosa* (Hall, 1859, p. 220, pl. XIV, fig. 1, pl. XXVIII, figs. 2–9) in the absence of dorsal sulcus; from *N. acifera* (Alekseeva and Mendbayar, 1981, p. 102, pl. XXI, fig. 16, pl. XXVI, figs. 3–7, pl. XXVII, figs. 1–11), in the more convex ventral valve and short jugal stem; from *N. sphaerica* sp. nov., in having a transversely elongated and less swollen shell with a conspicuous sulcus on the anterior margin of the more convex ventral valve and short jugal stem; from *N. robusta* (Kozłowski, 1929, p. 216, pl. XI, figs. 24–35), in the less swollen and transversely elongated shell, absence of the dorsal sulcus, and short jugal stem; from *N. ambigua* (Kulkov, 1970, p. 164, pl. XXI, fig. 1), in the moderately convex shell with a more convex ventral valve and absence of the dorsal sulcus; from *N. bellomata* Talent (Talent, 1963, p. 86, pl. 60, figs. 1, 2), in the large and transversely elongated shell.

**Occurrence.** Lower Devonian, Pragian, Galkinskii Horizon, *Trigonirhynchia ventricosa* Zone, Upper Nelichtenskii Subformation in the Sellennyakh Ridge, and Middle Khobochalo Subformation in the Tuskhaykhtukh Range.

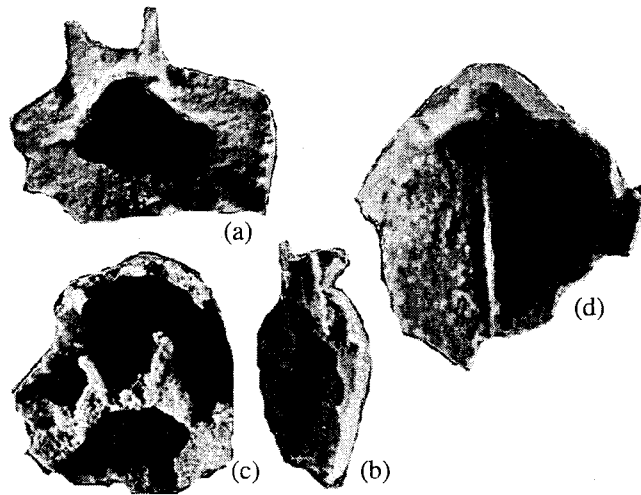


Fig. 6. *Nucleospira rotunda* sp. nov.: (a) and (b) specimen no. 182/265, interior of the brachial valve apex,  $\times 5$ ; (c) specimen no. 182/266, interior of the shell apex,  $\times 5$ ; and (d) specimen no. 182/267, interior of the ventral valve,  $\times 5$ ; Sellennyakh Ridge, Chibalukh River source, Nochnoi Creek; Geremgandzhinskii Horizon.

**Material.** A total of 240 shells has been found from the following localities; the Sellennyakh Ridge, the right bank of the Talynja River (Sakynja), Krivoj Creek, 12 specimens from sample no. 286(1a); Gon Creek, 62 specimens from sample no. 321; locality SL-95, 57 specimens; and the Tus-Khaykhtukh Range, left bank of Krasivyi Creek (right-bank tributary of the Khalim River), 20 specimens from sample no. 213 (2).

*Nucleospira rotunda* Baranov et Alkhovik, sp. nov.

Plate 5, figs. 1-12

**Etymology.** From Latin *rotundus* (round).

**Holotype.** IDGNM, no. 182/260, whole shell; Sellennyakh Ridge, headwaters of the Chibagalukh River, Nochnoi Creek; Lower Devonian, Emsian, Geremgandzhinskii Horizon, Upper Krivoi Ruche Formation.

**Description.** The shell is small, slightly transversely elongated, gently depressed anteriorly, with a more convex ventral valve and the maximum width and thickness located in the middle; the surface of the valves bears no hollow spines; the ventral valve is convex, with the maximum height in the middle; the ventral beak is curved and sharpened, with a rounded foramen in the permesothyridid position and deltidial plate; the pseudointerarea is triangular; the brachial valve is less convex than the ventral valve; the brachial beak is curved; dental plates are absent; the teeth are tongue-shaped; the ventral septum almost reaches the anterior margin; the dorsal septum is low and almost reaches the anterior margin; the inner socket ridges are high and acutely angled; the hinge plate is massive and ventrally curved; the primary lamellae are connected in the middle with a V-shaped jugum; the jugal stem is weakly

expressed; the jugal branches are short and originate at the jugal saddle apex; the ends of the branches are directed posteriorly; the spires with 11 whorls are arranged in cones that are directed laterally; the inner surfaces of the spires have thornlike outgrowths; the shell substance filling the interspaces between the spires is darker (Figs. 5, 6).

**Measurements, mm:**

Specimen no.	Sample no.	L	W	T	L/W	L/T
Holotype, IDGNM no. 182/260	316(2)	9.4	11.0	6.0	0.85	1.57
IDGNM 182/261	316(2)	8.5	11.3	5.8	0.75	1.46
IDGNM 182/262	316(2)	8.8	9.1	5.5	0.97	1.6
IDGNM 182/263	316(2)	5.6	5.6	3.6	1.0	1.55

**Comparison.** Differs from all known Devonian *Nucleospira* in the weakly expressed jugal stem.

**Occurrence.** Lower Devonian; Emsian; Nikolaevka and Geremgandzhinskii horizons; *Sibirirhynchia alata*, *Yanetechia limata*-*Elythyna salairica*, and *Alekseevaella sulcata* zones; Krivoi Ruche Formation in the Sellennyakh Ridge and Ulakhan-Sis Range; and Geremgandzhinskii Formation in the Tus-Khaykhtukh Range.

**Material.** A total of 136 shells has been found from the following localities: the Ulakhan-Sis Range, left bank of the Dalnii Creek (tributary of the Pravyi Naanchan River), 20 specimens from sample no. 522, 20 specimens from sample no. 523, and 9 specimens from sample no. 525; the right-bank divide of Korall-ovyi Creek (right-bank tributary of the Pravyi Naanchan River), 49 specimens from sample no. 520 (14); the Sellennyakh Ridge, headwaters of the Chibagalukh River, Nochnoi Creek, 36 specimens from sample no. 316 (2); and the Tus-Khaykhtukh Range, the water divide between Krasivyi Creek and the Khalim River, 2 specimens from sample no. 724 (4).

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