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Representatives of the Genus *Ammosiphonia* He, 1977 (Foraminifera) from the Jurassic and Carboniferous of Western Siberia

V. A. Marinov

Institute of the Geology of Oil and Gas, Siberian Division, Russian Academy of Sciences, Novosibirsk, Russia
e-mail: marinovVA@uiggm.nsc.ru

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Abstract—The wide distribution of the genus *Ammosiphonia* in the Upper Jurassic and Carboniferous of Western Siberia is established for the first time. Six haplophragmoidid species of Western Siberia are assigned to this genus. The diagnosis of the genus is emended; the taxonomic positions and scopes of the species *Ammosiphonia nonioninoides* (Reuss), *A. beresoviensis* (Bulatova), and *A. sibirica* (Zaspelova) are revised; two new species, *A. suprajurassica* sp. nov. and *A. valanginica* sp. nov., are described.

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Key words: Foraminifera, *Ammosiphonia*, Jurassic, Carboniferous, Western Siberia.

INTRODUCTION

The study of foraminifers of the family Haplophragmoididae Maync, 1952 from the Jurassic and Cretaceous of Western Siberia has shown that representatives of the genus *Ammosiphonia*, which were first described from the Upper Triassic of China, are present in Western Siberia. Monographic study of the morphological characters and internal structure of the shell has established the range of variability of the main diagnostic characters of the genus: the form of the shell and the structure of the apertural apparatus. Based on the emended diagnosis of the genus, the taxonomic positions of three haplophragmoidid species from Western Siberia are revised.

The acme zones of the Siberian *Ammosiphonia* species coincide with the intervals in which all faunal groups show maximum uniformity in composition (Basov, 1991). It is suggested that these levels mark the time intervals when the permanent marine seaways connecting the West Siberian Paleobasin with the World Ocean broadened as a result of transgressions or short-term warming trends in the waters of arctic basins.

SYSTEMATIC PALEONTOLOGY

Family Haplophragmoididae Maync, 1952

Genus *Ammosiphonia* He, 1977

Ammosiphonia: He and Hu, 1977, p. 9; Loeblich and Tappan, 1988, p. 65.

T y p e s p e c i e s. *Ammosiphonia vulgaris* He, 1977; Upper Triassic of China.

D i a g n o s i s. Shell involute or partly evolute, flattened (shell thickness/diameter ratio T/D = 0.4–0.6); shell contour smooth, peripheral edge angular or bluntly angled, apertural surface arrow-shaped, flattened or slightly concave; 1.2–1.5 times as wide as equatorial height (Figs. 1e, 1f). Umbilicus in adult forms small, narrow or widened. Wall shell siliceous, cryptocrystalline. Aperture slit- or arc-shaped, basal, oval, slightly raised over base of apertural surface or rounded areal later in ontogeny.

S p e c i e s c o m p o s i t i o n. In addition to the type species, the following species: *A. suprajurassica* sp. nov., Upper Jurassic, Kimmeridgian of Western Siberia; *A. valanginica* sp. nov., Lower Cretaceous, Lower Valanginian (beds with *Buchia keiserlingi*) Western Siberia; *A. nonioninoides* (Reuss), Lower Cretaceous, Aptian–Albian of Germany, Kazakhstan, Turkmenistan, Western Siberia, and Canadian Arctic Archipelago; *A. beresoviensis* (Bulatova), Lower Cretaceous, Albian of Kazakhstan, Western Siberia, and the Canadian Arctic Archipelago; *A. jamalica* Marinov, Lower Cretaceous, Albian of Western Siberia and Canadian Arctic Archipelago; and *A. sibirica* (Zaspelova), Upper Cretaceous, Turonian of Western Siberia.

C o m p a r i s o n. The *Ammosiphonia* species most closely resemble the genus *Apostrophoides* McNeil, 1997, widely distributed in the Maastrichtian of Arctic Canada (McNeil, 1997). They are similar in the areal position of the rounded aperture, attenuated peripheral edge, and considerable flattening of the shell. However, the genus *Apostrophoides* differs from all the other haplophragmoidids in the presence of the excavation at the base of the apertural surface (basal notch). In addition, the genus *Apostrophoides* has an evolute shell. The *Ammosiphonia* species resemble the genus *Evolutinella* Mjatliuk, 1971 in the smooth shell contour and the positions of the aperture and foramen, which is usually considerably raised over the base of the septal surface. However, *Evolutinella differs* from *Ammosiphonia* in the more evolute shell, semielliptical apertural surface, rounded peripheral edge of the shell, and the aperture and foramen that, as a rule, are located immediately over the base of the septal surface. The *Ammosiphonia* species resemble the genus *Labrospira* Hoeglund, 1947 in the areal position of the aperture and foramen. However, the genus *Ammosiphonia* differs in the character of the peripheral edge, shell contour, and the shape of the apertural surface (in the genus *Labrospira*, the contour is lobate, the apertural surface is semielliptical and convex, and the peripheral edge is rounded). The *Ammosiphonia* species resemble the genus *Haplophragmoides* Cushman, 1910 *Ammosiphonia* in the slightly flattened and, usually, completely involute shell. The distinguishing characters are the pattern of the peripheral edge, shell contour, shape of the apertural surface, position of the aperture, and the structure of the foramen (Figs. 1g, 1h). The genus *Haplophragmoides* has a shell with a lobate contour, rounded peripheral edge, convex apertural surface of a semielliptical or semilunar shape, basal slit-shaped aperture, and a slit-shaped foramen located at the base of the septal surface.

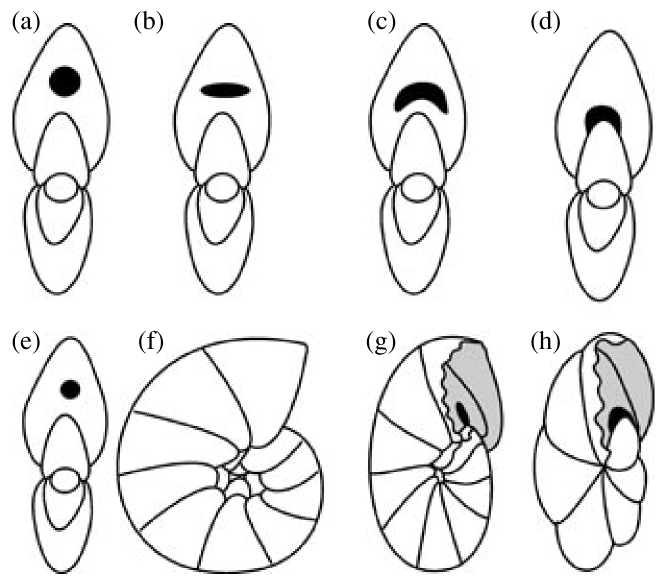


Fig. 1. Shell structure of representatives of the genus *Ammosiphonia*: (a–d) shape and position of the aperture: (a) rounded areal, (b) oval areal, (c) semilunar, raised over the base of the apertural surface, (d) slit-shaped basal; (e, f) shell form: (e) side view, (f) apertural view; (g–h) shape and position of the foramen in representatives of the genera *Ammosiphonia* and *Haplophragmoides*: (g) *Ammosiphonia sibirica* (Zaspelova) and (h) *Haplophragmoides crickmayi* Stelck et Wall.

R e m a r k s. Members of the genus *Ammosiphonia* He, 1977, which have previously been described from the Upper Triassic of China (Loeblich and Tappan, 1988), are described here from the Jurassic and Cretaceous foraminifer assemblages of Siberia for the first time. Among planispiral agglutinated shells of the subfamily Haplophragmoidinae, Z.I. Bulatova encountered shells with a rounded areal aperture fringed with lips in the Lower and Middle Albian of western Siberia. The other shells of the subfamily that were recorded in the same place have either basal or nearly basal slit-shaped apertures. These forms were described by Bulatova as new species: *P. selenae* Bulatova (Bulatova, 1971), placed in the genus *Phenacophragma* Applin, Loeblich, et Tappan, 1950 and *A. beresoviensis* Bulatova (Bulatova, 1976), tentatively placed in the genus *Ammobaculites* Cushman, 1910. However, the species *P. selenae* possesses none of the distinguishing characters of the genus *Phenacophragma*—a terminal aperture and characteristic alternation of normally developed septa and hemisepta that project only slightly in the cavities of the chambers. The species *A. beresoviensis* also cannot be assigned to the genus *Ammobaculites* since this species lacks a flattened portion and terminal aperture characteristic of the *Ammobaculites* species. The aperture that is shaped like a rounded opening fringed with lips at the center of the apertural surface is considered to be the most characteristic feature of the genus *Ammosiphonia*. However, it is necessary to take into account that the Haplophragmoididae exhibit wide variation in the structure of the apertural apparatus. Podobina (1966) and Bulynnikova (1967) have shown that representatives of the subfamily exhibit considerable diversity in the shape and position of the aperture. In order to establish the range of variability I examined the collection of shells of the species described by Bulatova (1976) as *Ammobaculites (?) beresoviensis* (more than 200 specimens in a good state of preservation) from the type locality, the Berezovo-Vartovskii structural-facial region of Western Siberia. Study of the structure of the aperture and foramen under an optical microscope in thin sections immersed in liquid and under an electron scanning microscope shows wide variability of the apertural apparatus. The aperture may be basal (slit- or arc-shaped), oval, slightly raised over the base of the apertural surface or rounded areal in late ontogeny (Figs. 1a, 1b, 1c, 1d, Pl. 5, figs. 1–4). The foramen rounded or oval, located at the base of the septal surface or raised up to its mid-height. Bulatova (1976, pl. VII, fig. 14b, pl. VIII, figs. 1b, 4b) observed a similar range of variability in the shape of the apertural apparatus in the species *Haplophragmoides non-*

ioninoides Reuss [= *Ammosiphonia nonioninoides*]. These variations in the shape and position of the aperture in *Ammosiphonia* species makes it impossible to consider the structure of the apertural apparatus to be a key diagnostic character of the genus.

Ammosiphonia suprajurassica **Marinov, sp. nov.**

Plate 5, figs. 26–28

E t y m o l o g y. From the Latin *super* (upper) and the Jurassic System.

H o l o t y p e. TsSGM, no. 1072/659: northern Western Siberia, Borehole Tukolando-Vadinskaya-320, depth interval of 4065–4091 m, 1.0 m from the core sample base, sample 320-24, Yanov Stan Formation: Upper Jurassic, Upper Kimmeridgian, beds with *Pseudolamarckina lopsiensis* (Pl. 5, fig. 27).

D e s c r i p t i o n. The shell is medium sized, with a maximum diameter up to 0.70 mm, involute at early stages of ontogeny and partly evolute at late stages, and convex (T/D = 0.39–0.67). The contour is smooth, the peripheral edge is angular or bluntly angled. The shell consists of up to 25 chambers comprising 2.5 whorls; the first whorl (d_1 = 0.24–0.27 mm) contains 7 chambers; the second (d_2 = 0.45–0.50 mm), 10 or 11 chambers; and the outer whorl, up to 12 narrowly triangular chambers. The sutures are surficial, straight, and narrow (0.010–0.015 mm wide). The umbilical region is extended, shallow or deepened, with a width of up to one-quarter of the shell diameter. The apertural surface is subtriangular, flat or concave. The aperture is areal, shaped like a rounded opening at the center of the apertural surface. The foramen is located at the center of the

E x p l a n a t i o n o f P l a t e 5

The collection is housed in the Central Siberian Geological Museum (TsGSM) at the Joint Institute of Geology, Geophysics, and Mineralogy, Siberian Division of the Russian Academy of Sciences, Novosibirsk. The photographs of all specimens have been made with a magnification of ×70. Figs. 1, 6, 7, 10, and 14 are made using an electron scanning microscope; figs. 2, 3, 4, 18, 19, 23, 24a, 25a, 27b, and 28 are made using reflected-light microscopy; figs. 5, 8, 9, 11, 12, 13, 15, 16, 17, 20, 21, 22, 24b, 25b, 26, and 27a are made using transmitted-light microscopy.

Figs. 1–8. *Ammosiphonia beresoviensis* (Bulatova, 1976); (1–4) view from the apertural surface showing the position of the aperture: (1) specimen TsGSM, no. 1072/650; areal suboval aperture; Western Siberia, Shaim Region, Borehole Ust'-Iusskaya-8000, depth 894–904 m, Khanty-Mansiisk Formation, Lower Albian, beds with *Ammosiphonia beresoviensis–Ammobaculites fragmentarius*; (2) specimen TsGSM, no. 1072/651; areal rounded aperture; the same place; (3) specimen TsGSM, no. 1072/652; the same place; (4) specimen TsGSM, no. 1072/653; basal arc-shaped aperture; the same place; (5) specimen TsGSM, no. 1072/562; thin section, Western Siberia, Shaim Region, Borehole Sogomskaya-1, depth 1486–1500 m, Khanty-Mansiisk Formation, Lower Albian, beds with *Ammosiphonia beresoviensis–Ammobaculites fragmentarius;* (6) specimen TsGSM, no. 1072/557, side view, the same place; and (8) specimen TsGSM, no. 1072/554; thin section; the same place.

Figs. 9–11. *Ammosiphonia nonioninoides* (Reuss, 1863); (9) specimen TsGSM, no. 1072/536; thin section, Western Siberia, Shaim Region, Borehole Sogomskaya-1, depth 1507–1513 m, Khanty-Mansiisk Formation, Lower Albian, beds with *Arcthoplites (Subarcthoplites)* sp. "*Cleoniceras* cf. *bicurvatoides*"; (10) specimen TsGSM, no. 1072/533; apertural view; the same place; and (11) specimen TsGSM, no. 1072/547; thin section, Western Siberia, Shaim Region, Borehole Sogomskaya-1, depth 1486–1500 m, Khanty-Mansiisk Formation, Lower Albian, beds with *Ammosiphonia beresoviensis–Ammobaculites fragmentarius.*

Figs. 12–14. *Ammosiphonia jamalica* Marinov in Zakharov et al., 2000; (12) specimen TsGSM, no. 1072/603; thin section, Western Siberia, Yamal Peninsula, Borehole Yuzhno-Tambeiskaya-91, depth 1553–1568 m, Yarongskoe Formation, Middle–Upper Albian, beds with *Inoceramus anglicus*; (13) specimen TsGSM, no. 1072/604, thin section, the same place; (14) holotype TsGSM, no. 1072/605; (14a) side view; (14b) apertural view; the same place.

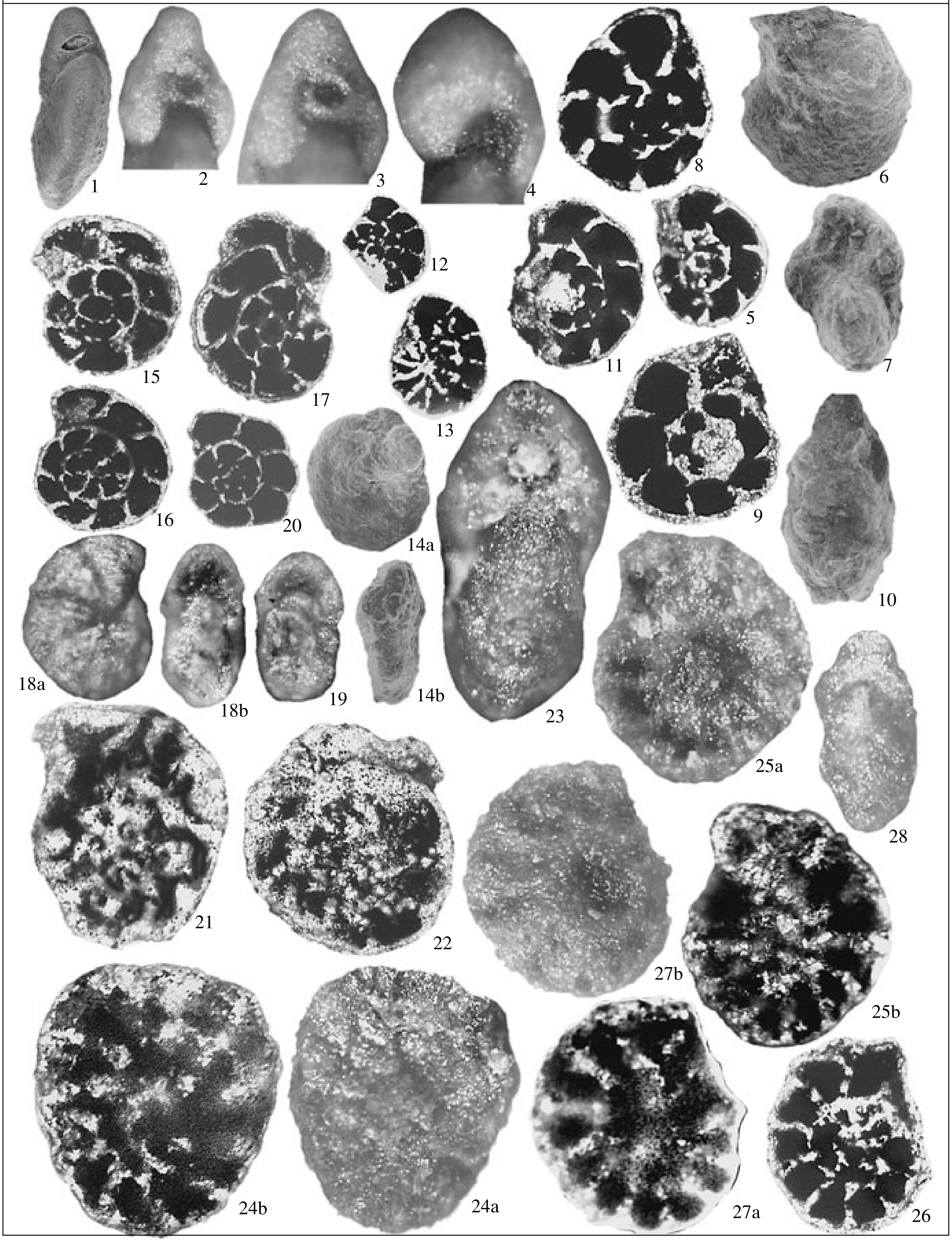
Figs. 15–19. *Ammosiphonia sibirica* (Zaspelova, 1949); (15) specimen TsGSM, no. 1072/631, thin section; Western Siberia, Yamal Peninsula, Borehole Zapadno-Seyakhinskaya-44, depth 1000–1010 m, Kuznetsovo Formation, Lower Turonian, beds with *Inoceramus (Mytiloides) labiatus*; (16) specimen TsGSM, no. 1072/633; thin section; the same place; (17) specimen TsGSM, no. 1072/630; thin section, the same place; (18) specimen TsGSM, no. 1072/638; (18a) side view; (18b) apertural view, the same place; and (19) specimen TsGSM, no. 1072/643, apertural view, the same place.

Fig. 20. *Labrospira collyra* Nauss, 1947, specimen TsGSM, no. 1072/634, thin section, Western Siberia, Yamal Peninsula, Borehole Zapadno-Seyakhinskaya-44, depth 1000–1010 m, Kuznetsovo Formation, Lower Turonian, beds with *Inoceramus (Mytiloides) labiatus.*

Figs. 21–25. *Ammosiphonia valanginica* sp. nov.; (21) specimen TsGSM, no. 1072/697, thin section, Western Siberia, Purpeisko-Urengoiskii Region, Borehole Zapolyarnaya-100, interval 3321–3335 m, Sortym Formation, Lower Valanginian, beds with *Buchia keiserlingi;* (22) specimen TsGSM, no. 1072/699, thin section, the same place; (23) specimen TsGSM, no. 1072/679; apertural view, the same place; (24) holotype, specimen TsGSM, no. 1072/690, side view (24a) in reflected light, (24b) in transmitted light, the same place; (25) specimen TsGSM, no. 1072/688, side view (25a) in reflected light, (25b) in transmitted light, the same place.

Figs. 26–28. *Ammosiphonia suprajurassica* sp. nov.; (26) specimen TsGSM, no. 1072/663, thin section, Western Siberia, Ust'-Eniseiskii Region, Borehole Tukolando-Vadinskaya-320, interval 4065–4091m, Yanov Stan Formation, Upper Kimmeridgian, beds with *Pseudolamarckina lopsiensis*; (27) holotype TsGSM, no. 1072/659; (27a) in reflected light, (27b) in transmitted light, the same place; and (28) specimen TsGSM, no. 1072/661, thin section, the same place.

Plate 5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septal surface (Pl. 5, fig. 26). The proloculus is 0.06–0.07 mm in diameter.

Measurements in mm:

	Specimen no.	D	d	n	T	N	d_1	d_p	n_1
Holotype	1072/659	0.60	0.50	11.5	–	–	–	–	–
	1072/655	0.70	0.59	11	–	–	–	–	–
	1072/656	0.70	0.63	11.5	0.27	–	–	–	–
	1072/657	0.67	–	11	0.30	–	–	–	–
	1072/658	0.62	0.51	11	–	–	–	–	–
	1072/660	0.58	0.49	11	–	–	–	–	–
	1072/661	0.52	–	10	0.26	–	–	–	–
	1072/662	0.51	0.41	10	–	–	–	–	–
	1072/663	0.50	0.43	10	–	–	–	–	–
	1072/664	0.50	–	10	–	–	–	–	–
	1072/665	0.49	0.44	9	–	–	–	–	–
	1072/666	0.48	–	9	–	–	–	–	–
	1072/667	0.47	0.41	9	–	–	–	0.07	–
	1072/668	0.46	0.38	9.5	–	17	0.27	0.07	7
	1072/669	0.44	–	–	0.23	–	–	–	–
	1072/670	0.44	0.33	10	–	–	–	–	–
	1072/671	0.43	–	9	–	–	–	–	–
	1072/672	0.42	0.36	9	–	15	0.24	0.06	7
	1072/673	0.40	0.36	9	–	–	–	–	–
	1072/674	0.36	–	8	–	–	–	–	–
	1072/675	0.36	–	–	0.24	–	–	–	–
	1072/677	0.33	0.28	7	–	–	–	–	–

Designations: (D) larger diameter of the shell; (d) smaller diameter of the shell; (n) number of chambers in the outer whorl; (T) shell thickness; (N) total number of chambers; (d_1) diameter of the first whorl; (d_p) diameter of the proloculus; and (n_1) number of chambers in the first whorl.

Variability. The umbo varies in depth from shallow to deepened. During ontogeny there are regular trends towards an increase in the number of chambers of the last whorl, the degree of evoluteness, and the measurements of the shell (see Description and Measurements).

Comparison. This species differs from *A. beresoviensis, A. nonioninoides*, and *A. jamalica* from the Albian of Western Siberia primarily in the presence of a wide umbilical region. The umbilicus of the species *A. beresoviensis* and *A. nonioninoides* is narrow or poorly defined and that of the species *A. jamalica* is extended but is less than one-sixth of the shell diameter. *A. valanginica* sp. nov. has a larger maximum diameter (D = 1.06 mm), a smaller maximum number of chambers (no more than 10 chambers), a smaller number of chambers (n_2 = 9–10) a greater diameter (d_2 = 0.51–0.64 mm) in the second whorl, and a flatter shell (T/D = 0.40–0.50).

Remarks. The shell of this species somewhat resembles in general appearance that of some malformed specimens of the species *Evolutinella tota* Dain (Dain, 1980) flattened in the direction perpendicular to the coiling axis and found in association with this species. However, although *E. tota* has the same measurements, it differs in the smaller number of chambers in the outer whorl (no more than ten) and in the greater degree of evoluteness.

Occurrence. Upper Jurassic of Western Siberia: Ust'-Eniseiskii Region, Borehole Tukolando-Vadinskaya-320, interval 4065–4091 m, Yanov Stan Formation, Upper Kimmeridgian, beds with *Pseudolamarckina lopsiensis* (36 specimens); Yamal Peninsula, Borehole Yuzhno-Tambeiskaya-5, interval 3435–3450 m, Abalakovo Formation, Lower Kimmeridgian, beds with *"Haplophragmoides" canuiformis–Cancrisiella ambitiosa* (5 specimens); interval 3375–3390 m, Abalakovo Formation, Upper Kimmeridgian–Lower Volgian, beds with *Tolypammina virgula–Planularia pressula* (57 specimens).

Material. Ninety-eight shells in varying states of preservation.

Ammosiphonia valanginica Marinov, sp. nov.

Plate 5, figs. 21–25

Etymology. From the Valanginian Stage.

Holotype. TsSGM, no. 1072/690; northern Western Siberia, Purpeisko-Urengoiskii Region, Borehole Zapolyarnaya-100, interval 3321–3335 m, 1.0 m from the core sample base, sample 100-7, Sortym Formation, Lower Cretaceous, Lower Valanginian, beds with *Buchia keiserlingi* (Pl. 5, fig. 24).

Description. The shell is large (the maximum diameter up to 1.06 mm), partly evolute, and flattened (T/D = 0.40–0.50 mm). The contour is smooth, the peripheral edge is angular or bluntly angled. The shell consists of up to 28 chambers comprising 2.5 whorls; the first whorl (d_1 = 0.22–0.33 mm) contains 7 chambers; the second (d_2 = 0.51–0.64 mm), 9–10 chambers; and the outer whorl, up to 10 narrowly triangular chambers. The sutures are surficial, straight, 0.010–0.015 mm wide. The umbilical region is extended up to one-quarter the shell diameter, shallow. The apertural surface is subtriangular, flat or concave. The aperture and foramen are areal and are shaped like a rounded opening on the apertural and septal surfaces, respectively.

Measurements in mm:

	Specimen no.	D	d	n	T	N	d_1	d_2	d_p	n_1	n_2
Holotype	1072/690	0.70	0.59	10	–	22	0.23	0.51	0.07	7	9
	1072/678	1.06	–	10	0.43	–	–	–	–	–	–
	1072/679	0.87	–	10	0.39	–	–	–	–	–	–
	1072/680	0.89	0.85	10	–	–	–	–	–	–	–
	1072/681	0.81	–	10	0.37	–	–	–	–	–	–
	1072/682	0.80	–	10	–	–	–	–	–	–	–
	1072/683	0.80	–	10	0.34	–	–	–	–	–	–
	1072/684	0.80	–	10	–	–	–	–	–	–	–
	1072/685	0.74	0.61	10	–	–	–	–	–	–	–
	1072/686	0.72	–	10	0.36	–	–	–	–	–	–
	1072/687	0.71	0.57	9.5	–	–	–	–	–	–	–
	1072/688	0.70	0.66	10	–	20	0.33	0.64	0.04	7	10
	1072/689	0.70	0.59	9.5	–	–	–	–	–	–	–
	1072/691	0.70	–	–	0.31	–	–	–	–	–	–
	1072/692	0.70	–	10	0.30	–	–	–	–	–	–
	1072/693	0.67	0.57	10.5	–	21	0.20	0.53	0.04	7	10
	1072/694	0.67	0.52	10	–	–	–	–	–	–	–
	1072/695	0.66	0.46	10	–	–	–	–	–	–	–
	1072/696	0.66	0.57	10	–	18	–	–	–	–	–
	1072/697	0.66	–	9.5	–	–	–	–	–	–	–
	1072/698	0.66	0.47	9.5	–	–	–	–	–	–	–
	1072/699	0.62	–	10	0.26	–	–	–	–	–	–
	1072/700	0.62	0.59	10.5	–	–	–	–	–	–	–
	1072/701	0.61	–	10	–	–	–	–	–	–	–
	1072/702	0.61	–	8.5	0.26	–	–	–	–	–	–
	1072/703	0.60	–	–	0.30	–	–	–	–	–	–
	1072/704	0.57	–	9.5	–	18	0.32	–	0.05	–	–
	1072/706	0.53	–	9.5	–	–	–	–	–	–	–
	1072/707	0.53	–	9	–	–	–	–	0.04	–	–
	1072/708	0.52	–	9.5	0.25	16	–	–	–	–	–
	1072/709	0.52	0.45	9	–	–	–	–	–	–	–
	1072/710	0.50	0.41	9.5	–	18	0.27	–	0.07	7	9
	1072/711	0.44	–	9	–	–	–	–	–	7	–

V a r i a b i l i t y. The umbo varies in depth from shallow to deep. During ontogeny the number of chambers in the outer whorl increases (see Description and Measurements).

C o m p a r i s o n. This species differs from the other Cretaceous *Ammosiphonia* species of Western Siberia in the presence of a wide umbilical region. Comparison with *A. suprajurassica* sp. nov. is provided above.

M a t e r i a l. Forty-five shells in varying states of preservation from Western Siberia, Purpeisko-Urengoiskii Region, Borehole Zapolyarnaya-100, interval 3321–3347 m; Sortym Formation, Lower Cretaceous, Lower Valanginian, beds with *Buchia keiserlingi.*

Ammosiphonia nonioninoides (Reuss), 1863

Plate 5, figs. 9–11

Haplophragmium nonioninoides: Reuss, 1863, p. 30, pl. I, figs. 8a and 8b; Alekseeva, 1963, p. 19, pl. I, figs. 9a and 9b; 1972, pl. 7, fig. 4; Bulatova, 1976, p. 67, pl. VII, figs. 11–14, pl. VIII, figs. 1, 2.

Haplophragmoides excavata var. *umbilicata*: Dain, 1934, p. 34, pl. 1, fig. 2.

Haplophragmoides gigas minor: Nauss, 1947, p. 388–389, pl. 48, fig. 10; Wall, 1983, pl. 6, figs. 5–7.

Phenacophragma selene: Bulatova, 1971 (part.), pl. I, fig. 4.

Haplophragmoides umbilicatulus: Myatlyuk and Vasilenko, 1988 (part.), pl. 7, figs. 4 and 5.

Ammosiphonia nonioninoides: Zakharov et al., 2000, pl. II, figs. 17–19.

H o l o t y p e. The holotype is lost; Albian of Germany (Reuss, 1863, p. 30, pl. I, figs. 8a, 8b).

N e o t y p e. Siberian Research Institute of Geology, Geophysics, and Mineral Resources, no. 201; Western Siberia, Tyumen Region, Malo-Atlymskaya area, Borehole 1-K, depth 1454.7–1461.8 m, Khanty-Mansiisk Formation, Lower Cretaceous, Lower Albian, beds with *Ammobaculites fragmentarius* (designated by Bulatova, 1976, p. 67, pl. VIII, fig. 2).

D e s c r i p t i o n. The shell is medium in size, with the maximum diameter up to 0.60 mm, involute. The contour is smooth or slightly wavy, the peripheral edge is angular or bluntly angled. The shell consists of up to 25 chambers comprising 2.5 whorls; the outer whorl contains up to 11 narrowly triangular chambers. The sutures are surficial, straight, and narrow (width 0.010–0.015 mm). The umbilical region is narrow, occasionally slightly deepened. The apertural surface is subtriangular, flat or slightly concave. The aperture is basal and arc-shaped or septal in the form of a rounded opening.

M e a s u r e m e n t s i n m m:

Specimen no.	D	d	T	n	N	d_p	n_1	n_2
1072/532	0.57	0.54	–	10	–	–	–	–
1072/533	0.54	–	0.26	–	–	–	–	–
1072/546	0.54	0.48	–	7.5	–	–	–	–
1072/534	0.52	0.43	–	9	–	–	–	–
1072/536	0.50	0.41	0.27	7	13	0.06	6	7
1072/537	0.46	–	0.26	–	–	–	–	–
1072/538	0.46	0.32	–	8.5	–	–	–	–
1072/539	0.45	–	0.24	–	–	–	–	–
1072/547	0.45	0.36	0.24	7.5	14	0.048	6	7.5
1072/548	0.44	0.35	–	8	–	–	–	–
1072/540	0.43	–	0.24	8	–	–	–	–
1072/541	0.35	0.28	–	8	–	0.042	6	–
1072/549	0.22	0.18	0.15	–	–	–	–	–

V a r i a b i l i t y. The position of the aperture varies. At the early stages of ontogeny the aperture is arc-shaped and basal, at the later stages the aperture is a rounded opening that is areal, fringed with a small ridge, somewhat raised over the base of the septal surface, and located at the center. During ontogeny the chambers of the outer whorl increase in number. The first whorl (D = 0.30–0.25 mm) contains 6 or 7 chambers; the second (D = 0.50–0.55 mm), 8 to 10 chambers. In individual shells the coiling somewhat deviates from the planispiral pattern.

C o m p a r i s o n. This species differs from the species *A. beresoviensis* from the Albian of Western Siberia in the smaller maximum diameter (*A. beresoviensis* has a diameter of up to 0.90 mm), the larger number of chambers in the outer whorl (in *A. beresoviensis* the first whorl contains six or seven chambers; the second, six to eight); and the thinner septal sutures (in *A. beresoviensis* the sutures are 0.020–0.030 mm thick). The species *Haplophragmoides excavata* var. *umbilicata*, described by L.G. Dain (1934) from the Aptian of the Caspian Sea Region, which was later described as *Haplophragmoides umbilicatulus* (Myatlyuk and Vasilenko, 1988), and forms from the Albian of North America described as *Haplophragmoides gigas minor* (Nauss, 1947) are entirely consistent with the morphological characters of the species *A. nonioninoides* from the Aptian of Germany (Reuss, 1863).

R e m a r k s. The species has been assigned to the genus *Ammosiphonia* based on the characteristic features: an angular or bluntly angled peripheral edge and the areal position of the aperture on the later whorls.

O c c u r r e n c e. Aptian–Albian of Germany, Kazakhstan, Turkmenistan, and Western Siberia; Aptian–Lower Albian of North America.

M a t e r i a l. Two hundred shells in varying states of preservation from two localities in Western Siberia, Shaim Region, Borehole Sogomskaya-1, interval 1486–1520 m, Khanty-Mansiisk Formation, Lower Albian (148 specimens); Borehole Em'-Egovskaya 548, interval 1413–1430 m, Khanty-Mansiisk Formation, Lower Albian, (52 specimens).

***Ammosiphonia beresoviensis* (Bulatova, 1976)**

Plate 5, figs. 1–8

Phenacophragma selenae: Bulatova, 1971 (past.), pl. I, figs. 1 and 2.

Haplophragmoides cushmani: Bulatova, 1976, p. 69, pl. VIII, figs. 3 and 4.

Ammobaculites (?) beresoviensis: Bulatova, 1976, p. 85, pl. XIV, figs. 1–7.

Haplophragmoides reconditus: Bulatova, 1976, pp. 70–71, pl. VIII, figs. 7 and 8.

Recurvoides bekensis: Vasilenko, 1980, pp. 30–31, pl. 6, figs. 5 and 6; Myatlyuk and Vasilenko, 1988, p. 36, pl. 6, figs. 1–3.

Haplophragmoides umbilicatulus: Balakhmatova and Romanova, 1960 (part.), pl. III, fig. 6; Myatlyuk and Vasilenko, 1988 (part.), pl. 7, figs. 6 and 7.

Haplophragmoides gigas: Wall, 1983, pl. 6, figs. 40 and 41.

Ammosiphonia beresoviensis: Zakharov et al., 2000, pl. II, figs. 13–16.

H o l o t y p e. Siberian Research Institute of Geology, Geophysics, and Mineral Resources, no. 262; Western Siberia, Tyumen Region, Tavdinskaya area, Borehole 1-R (depth 1074.5–1070.5 m), Khanty-Mansiisk Formation; Lower Cretaceous, Albian, beds with

Ammobaculites fragmentarius (Bulatova, 1976, p. 85, pl. XIV, fig. 6).

D e s c r i p t i o n. The shell is large, up to 0.90 mm, involute or partly evolute. The contour is smooth, occasionally slightly lobate, the peripheral edge is angular; the chambers are wide, subtriangular; the inner edges of the chambers fall short of the narrow, slightly deepened umbilical region. The 2.5 whorls contain up to 20 chambers, the outer whorl contains 6 to 8 or, rarely, 9 chambers. The sutures are straight, surficial, and wide (0.020–0.030 mm). The apertural surface is subtriangular, wide, and flat or concave. The aperture is either septal, with a rounded opening, or basal, with an arc- or slit-shaped opening.

M e a s u r e m e n t s in mm:

Specimen no.	D	d	T	n	N	d_p	n_1	n_2
1072/550	0.76	0.63	–	7	13	–	6	7
1072/551	0.65	0.55	–	6	11	0.10	–	–
1072/552	0.64	0.52	–	6	–	–	–	–
1072/553	0.55	–	0.30	7	–	–	–	–
1072/554	0.50	0.40	–	7	13	0.09	6	7
1072/555	0.48	–	0.26	6	–	–	–	–
1072/556	0.46	0.40	0.27	5.5	–	–	–	–
1072/557	0.46	0.34	0.31	5	–	–	–	–
1072/558	0.41	–	0.25	6	–	–	–	–
1072/559	0.34	–	0.20	6	–	–	–	–
1072/560	0.30	0.26	0.17	6	–	–	–	–
1072/561	0.30	0.26	0.20	5	–	–	–	–

V a r i a b i l i t y. The position and shape of the aperture vary from basal and arc-shaped (Pl. 5, fig. 4) to the areal and oval (Pl. 5, fig. 1), or to a rounded aperture fringed with a small ridge (Pl. 5, figs. 2, 3); evoluteness of the shell varies in degree from completely involute to semi-involute in large shells. In individual specimens the coiling may somewhat deviate from the planispiral pattern. During ontogeny the number of chambers in the outer whorl changes: the first whorl contains 6 or 7 chambers; the second, 6 to 8.

C o m p a r i s o n. See the Comparison section of the morphologically similar species *Ammosiphonia nonioninoides* for comparison.

R e m a r k s. It seems likely that Bulatova (1971, 1976) assigned to the four different species (*Phenacophragma selenae, Ammobaculites (?) beresoviensis, Haplophragmoides reconditus*, and *Haplophragmoides cushmani*) different developmental stages of *Ammosiphonia beresoviensis*, since at different stages of ontogeny the species has different measurements, different numbers of chambers in the outer whorl, and different degrees of evoluteness. The holotype of the species described by Bulatova as *Phenacophragma selenae* fits all the characters of the species *Ammosiphonia nonioninoides* (Reuss); however, the other specimens should be assigned to *A. beresoviensis. Ammosiphonia beresoviensis* differs from the species described as *Haplophragmoides cushmani* Loeblich et Tappan from the Albian of North America from the Pawpaw Sandstone Formation (Loeblish and Tappan, 1946, p. 244, pl. 35, fig. 4) in the contour pattern of the peripheral edge (*H. cushmani* has a rounded contour, broadly lobate peripheral edge, and convex chamber). The species *Recurvoides bekensis* described by V.P. Vasilenko (1980) from the Aptian–Albian of the Caspian Sea Region fits all the characters of the species described and may be recognized as a junior synonym. The forms from the Khanty-Mansiisk Horizon described and figured as *Haplophragmoides umbilicatulus* (Balakhmatova and Romanova, 1960) have considerably larger measurements and a smaller number of chambers in the outer whorl than the species *A. nonioninoides* [= *H. umbilicatulus*] and fit all the characters of *A. beresoviensis.*

O c c u r r e n c e. Lower Cretaceous, Upper Aptian–Albian of Kazakhstan; Albian of Western Siberia and Canadian Arctic Archipelago.

M a t e r i a l. Four hundred and sixty-two specimens in varying states of preservation from two localities in Western Siberia: Konda Lowland, Borehole Sogomskaya-1, interval 1486–1520 m, Khanty-Mansiisk Formation, Lower Albian (215 specimens) and Borehole Em'-Egovskaya 548, interval 1413–1430 m, Khanty-Mansiisk Formation, Lower Albian (247 specimens).

Ammosiphonia sibirica (Zaspelova, 1949)

Plate 5, figs. 15–19

Haplophragmoides sibiricus: Myatlyuk, 1949, p. 60, pl. I, fig. 8; Balakhmatova and Romanova (part.), 1960, p. 54, pl. III, fig. 8.

Haplophragmoides rota sibiricus: Podobina, 1966, p. 30, pl. IV, fig.7, pl. V, figs. 1–3.

H o l o t y p e. Not designated.

N e o t y p e. Tomsk State University, no. 167; Western Siberia, Omsk Region, Uiskii profile, Borehole 20-K, depth 830 m; Kuznetsovo Formation, Upper Cretaceous, Lower Turonian, beds with *Gaudryinopsis angustus* (Podobina, 1966, p. 30, pl. V, fig. 1).

D e s c r i p t i o n. The shell is medium in size, with the maximum diameter of up to 0.67 mm, involute. The contour is smooth, the peripheral edge is bluntly angled. The outer whorl contains 6–7.5 narrowly triangular chambers; the first whorl (D = 0.28–0.36 mm), 5 or 6 chambers; and the second (D = 0.50–0.58 mm), 7–7.5 chambers. The sutures are surficial, straight, and narrow (0.010–0.015 mm). The umbilical region is narrow and slightly deepened. The apertural surface is subtriangular, flat or slightly concave. The aperture is basal, slit-shaped or arc-shaped.

Measurements in mm:

Specimen no.	D	d	n	T	N	d_1	d_p	n_1
1072/630	0.50	0.38	7	–	13	0.28	0.08	6
1072/631	0.41	0.34	7	–	11	0.36	0.08	5
1072/633	0.39	0.35	8	–	16	0.20	0.06	6
1072/635	0.54	0.44	7	–	12	0.30	0.07	6
1072/636	0.50	0.40	7	–	–	–	0.06	–
1072/637	0.46	0.37	7	–	–	–	–	–
1072/638	0.43	0.36	6	0.20	–	–	–	–
1072/639	0.45	0.37	6.5	–	11	0.30	–	6
1072/640	0.42	0.36	6.5	0.23	–	–	–	–
1072/641	0.42	0.34	6.5	–	–	–	–	–
1072/642	0.42	0.33	6.5	–	10	0.29	0.06	6
1072/643	0.39	–	6.5	0.20	–	–	–	–
1072/644	0.36	0.30	6.5	–	–	–	–	–
1072/645	0.29	0.24	6	–	8	0.28	0.05	6

Comparison. This species differs from *A. nonioninoides*, a species most similar in morphology and shell size, in the number of chambers; both species have, however, the same number of whorls in the shell (see the Description section for *A. nonioninoides*). It differs from *A. beresoviensis* in the smaller maximum measurements. *A. valanginica* has a larger maximum size, a larger maximum number of chambers (which are of the same size), and a flatter shell.

Remarks. In contrast to the other Cretaceous *Ammosiphonia* species in Western Siberia, the species *A. sibirica* has the foramen and aperture located at the base of the septal surface (Pl. 5, figs. 15–17) at all stages of ontogeny. However, as discussed earlier, this character varies within the range of intraspecific variability. The species has all the other characteristic features of the genus: a shell with a smooth contour and angular peripheral edge, a flattened subtriangular apertural surface, and a rounded foramen. Malformed specimens may have considerable similarity to the co-occurring species *Haplophragmoides crickmayi* Stelck et Wall (Fig. 1h) and *Labrospira collyra* Nauss (Pl. 5, fig. 20). *A. sibirica* differs in the shell contour, the flattened apertural surface, and the width of chambers (the forms compared have a lobate contour, a convex apertural surface, and a wide chamber). Previously this species was considered as a subspecies of *Haplophragmoides rota* Nauss, 1947, which was described from the Upper Cretaceous (Campanian, Belly Formation) of Canada (Podobina, 1966, 1989). However, the holotype of *H. rota* (Nauss, 1947, pl. 49, fig. 1) differs from the representatives of the genus *Ammosiphonia* in a number of characteristic features (narrowly rounded peripheral edge and oval apertural surface). The paratype of *H. rota* (Nauss, 1947, pl. 49, fig. 3) closely resembles *Ammosiphonia* species; however, the deformation of the shell makes it impossible to recover the initial form with certainty.

Occurrence. Upper Cretaceous, Turonian of Western Siberia.

Material. One hundred and forty-four specimens in varying states of preservation from two localities in Western Siberia, Yamal Peninsula: Borehole Zapadno-Seyakhinskaya-44, depth 1000–1010 m, samples 1–3; Kuznetsovo Formation, Lower Turonian, beds with *Inoceramus (Mytiloides) labiatus* (86 specimens) and Borehole Zapadno-Seyakhinskaya 48, depth 987–995 m, samples 1 and 2, Kuznetsovo Formation, Lower Turonian, beds with *Inoceramus (Mytiloides) labiatus* (58 specimens).

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