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Representatives of the Family Bochianitidae (Ammonoidea) from the Lower Cretaceous of the Crimean Mountains

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Abstract—The heteromorph ammonites of the family Bochianitidae from the Lower Cretaceous of the Crimean Mountains are revised. The validity of the genus *Janenschites*, separated from the genus *Bochianites* is confirmed. The species *Bochianites neocomiensis* (d'Orbigny), *B. goubechensis* Mandov, *B. levis* sp. nov. and *B. crymensis* sp. nov. are described from the Berriasian and the species *Janenschites oosteri* (Sarasin et Schöndelmayer) and *J. incisus* sp. nov. are described from the Lower Barremian. The family Bochianitidae first appeared at the beginning of the Berriasian in the southern regions (Africa and the Crimea), and spread to the northern regions of western Europe in the Valanginian–Hauterivian.

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Key words: Bochianitidae, Ammonoidea, Lower Cretaceous, Crimean Mountains.

INTRODUCTION

The heteromorph ammonite genus *Bochianites* is rarely found in the Lower Cretaceous of the Crimean Mountains. Until recently only two species, *Bochianites oosteri* and *B. neocomiensis* were known from this region (Karakash, 1907). However, species of this genus are important components of the Lower Cretaceous (including Valanginian) ammonite assemblages of the western Tethyan Realm (Cecca, 1998; Lukeneder, 2005). The genus *Bochianites* is extremely widespread geographically. This genus was first established based on material from the Valanginian of France (Lory, 1898). Later, it was recorded from many regions of western Europe (see the synonymy list of *Bochianites neocomiensis*), from South Africa (Kitchin, 1908), Tunisia (Arnould-Saget, 1953), Madagascar (Collignon, 1962), and from the Sulu Islands in Indonesia (Boehm, 1904). Two species mainly included in lists by western European workers are *B. neocomiensis* and *B. oosteri*, the former mainly from the Upper Valanginian, the latter from the Upper Valanginian–Lower Hauterivian (Mandov, 1971; Immel, 1987; Lukeneder, 2004a, 2004b, 2005). Several species of *Bochianites* are identified and described from Mexico (Imlay, 1937; Cantú-Chapa, 1976) and California (Anderson, 1938, 1945). In the Boreal Region, *Bochianites* is recorded from the Valanginian of Begichev Island in northern Siberia (Bodylevsky, 1960). Shulgina (1985) recorded *Bochianites* from the same stratigraphic level. Zakharov and Rogov (2006) recorded *Bochianites* cf. *glennensis* Anderson from the *kochi* (Ryazanian Stage) on the Nordvik Peninsula (Laptev Sea).

Unfortunately, in some places the genus *Bochianites* is recorded without species name or species descriptions, which makes it difficult to verify these records; e.g., in Antarctica (Kelly, 1995; Lomas, 1999) and New Guinea (Benson, 1923).

Recently, the species *B*. cf. *neocomiensis* was found in the Valanginian–Hauterivian boundary beds of the Greater Caucasus (Zakharov et al., 2006). After Karakash (1907) no studies of *Bochianites* from the Crimea have been published. Karakah (1907) identified and described the species *B. neocomiensis* and *B. oosteri* from the red limestone beds on the Kacha River in the Crimean Mountains. Baraboshkin (1997) referred this stratigraphic unit to the Lower Barremian *Spitidiscus hugii* Zone, which was later renamed the *Taveraidiscus hugii* Zone (Reboulet et al., 2006). The revision of Karakash's collection housed in the Stratigraphic-Paleontological Museum at the Department of Dynamic and Historical Geology of St. Petersburg State University (SPbGU) has shown that the species *Bochianites* described by Karakash have a very complexly dissected suture, and can be assigned to the genus *Janenschites*, separated from the genus *Bochianites* (Durand-Delga, 1954).

Arkadiev et al. (2005) recorded *Bochianites* sp. from the Berriasian *jacobi* Zone in the basin of the Tonas River. The author has 14 specimens representing this species collected by V.V. Drushchits, T.N. Gorbachik, V.M. Nerodenko, and T.N. Bogdanova from the Crimean Mountains, kindly donated by Bogdanova. The material is poorly preserved, mostly fragments of molds, often compressed and replaced with rock matrix, with no early parts preserved. Nevertheless, in some cases it was possible to observe details of the suture. All Crimean *Bochianites* come from the clayey Berriasian series in the central and eastern Crimea and

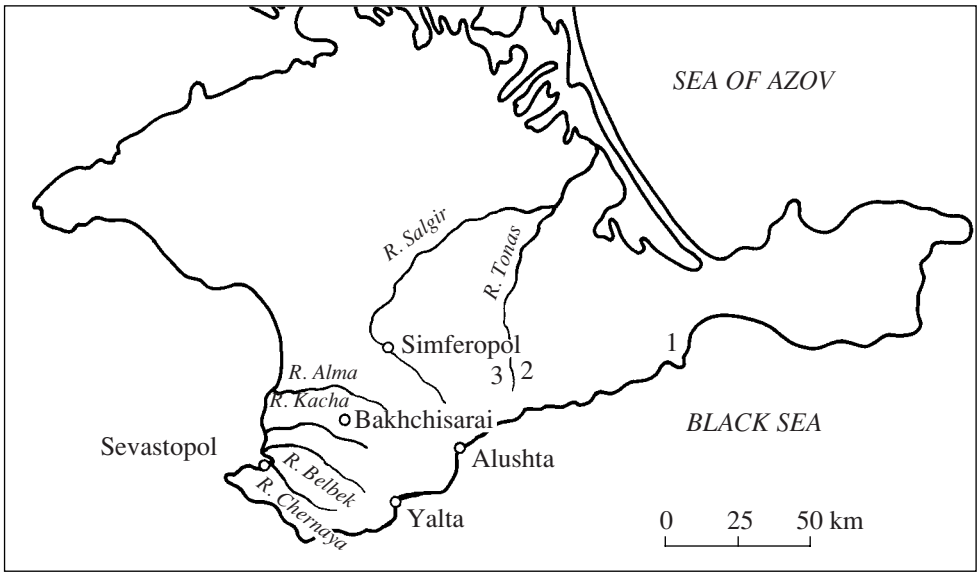


Fig. 1. Schematic map of the examined Berriasian sections containing Bochianitidae: (1)—Feodosiya, St. Iliya Cape, villages of Sultanovka and Nanikovo, Barakol' Valley; (2)—Tonas River, village of Krasnoselovka; (3)—basin of the Sary-Su River.

the Tonas River basin (Fig. 1). Most specimens studied come from the *grandis* Subzone of the *jacobi* Zone (Berriasian) in association with the genera *Pseudosubplanites, Berriasella*, and *Delphinella*. Only some specimens from the basin of the Sary-Su River of the central Crimea were collected from the higher levels within the Berriasian (in the beds with *Euthymiceras* and *Neocosmoceras*) referred to the *boissieri* Zone (Arkadiev et al., 2006a).

MATERIAL

Material described in this paper is housed at the TsNIGR Museum (coll. no. 13169) and Paleontological-Stratigraphic Museum of SPbGU (coll. no. 103, N.I. Karakash Collection).

SYSTEMATIC PALEONTOLOGY

Family Bochianitidae Spath, 1922

Subfamily Bochianitinae Spath, 1922

Genus *Bochianites* Lory, 1898

Type species. *Baculites neocomiensis* d'Orbigny, 1840; Valanginian of France.

Diagnosis. Shell straight, smooth, or ribbed. Cross-section rounded-oval, somewhat elongated dorsoventrally. Ribs simple, on flanks slanted orally, on venter arched orally, on dorsum weakening and disappearing. Suture with three main weakly dissected lobes: V, L, D and auxiliary lobes on tops of saddles.

Species composition. *B. neocomiensis* (d'Orbigny) from the Berriasian of Crimea; Valanginian of the Czech Republic; Upper Valanginian of Poland, Bulgaria, Germany, England, Spain, France, Austria, northern Siberia (?); Upper Valanginian–Lower Hauterivian of Switzerland, Caucasus (?); *B. ambikyensis* Collignon from the Valanginian of Madagascar; *B. baculitoides* Arnould-Saget from the Tithonian and Berriasian of Tunisia; *B. glaber* Kitchin from the Valanginian, Hauterivian (?) of South Africa; *B. weteringi* Boehm and *B. versteeghi* Boehm from the Berriasian (?) of Sulu Islands (Indonesia); *B. nodosocostatus* Mandov from the Upper Valanginian of Bulgaria; *B. goubechensis* Mandov from the Berriasian (*jacobi* Zone) of the Crimea; Upper Valanginian of Bulgaria, England, France; *B. thieuloides* Cantú-Chapa from the Upper Valanginian of Mexico; *B. paskentaensis* Anderson from the Berriasian (?), Valanginian of California; *B. glennensis* Anderson from the Tithonian (?) of California; Berriasian (*kochi* Zone) of northern Siberia; *B. renevieri* Ooster from the Lower Barremian of Switzerland; *B. levis* sp. nov. from the Berriasian (*boissieri* Zone, beds with *Euthymiceras* and *Neocosmoceras*) of the Crimea; Berriasian of Tunisia; Valanginian of the Czech Republic; Upper Valanginian–Lower Hauterivian of Bulgaria, Austria, Switzerland, Majorca; *B. crymensis* sp. nov. from the Berriasian (*jacobi* Zone) of the Crimea.

Comparison. This genus is distinguished from the genera *Kabylites, Janenschites*, and *Baculina* by the sutural outline. It differs from the genus *Baculites* in the tripartite first lateral lobe.

Remarks. Based on the differences in the sutural outline, Durand-Delga (1954) separated the new genera *Kabylites* and *Janenschites* from *Bochianites* (Fig. 2). Wiedmann (1962) did not consider the separation of these genera well substantiated. In the last edition of

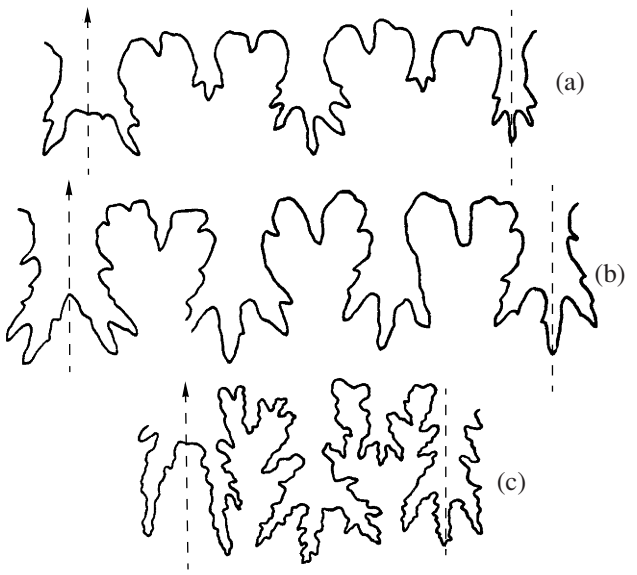


Fig. 2. Sutures of the genera *Bochianites, Kabylites*, and *Janenschites* (from Durand-Delga, 1954): (a) *Bochianites neocomiensis* (d'Orbigny) at Dm = 4.0 mm; (b) *Kabylites superstes* (Pervinquiere) at Dm = 4.5 mm; (c) *Janenschites janenschi* (Zwierzycki) at Dm = 6.0 mm.

Treatise (Wright et al., 1996) both *Kabylites* and *Janenschites* are recognized as separate genera, a view shared by the present author. Evidently, without complete knowledge of shell morphogenesis in all three genera, their validity will remain uncertain (data on the early shell ontogeny and sutural ontogeny are absent).

Ammonite sutures can only be objectively compared at the same growth stage (i.e., the same whorl). Because complete shells of these genera are unknown, the sutures should be compared at least at the same shell diameter. Because the preservation is incomplete even this is difficult. The sutures of the Berriasian *Bochianites* from the Crimean Mountains, drawn mainly at Dm = 4.6–6.8 mm (Fig. 3), are similar to those of the western European species of *Bochianites* at similar diameter (Fig. 4) (d'Orbigny, 1840–1842; Durand-Delga, 1954; Mandov, 1971; Vašiček, 1999). These sutures are weakly serrated, with broad saddles and small auxiliary lobes on the top of the saddles. The suture of *B. oosteri* described by Karakash at Dm = 7.7 mm from the Lower Barremian of the Crimean Mountains is very similar to the suture of *Janenschites janenschi* (Zwierzycki) at Dm = 6.0 mm (Durand-Delga, 1954), whereas the suture *B. neocomiensis* at Dm = 11.0 mm in Karakash's paper is almost identical to that of *B. oosteri* at Dm = 8.0 mm (Sarasin and Schöndelmayer, 1902). The sutures of all these species are very strongly dissected. Taking into account their higher stratigraphic position in the section (Lower Barremian), the recognition of the genus *Janenschites* seems reasonable.

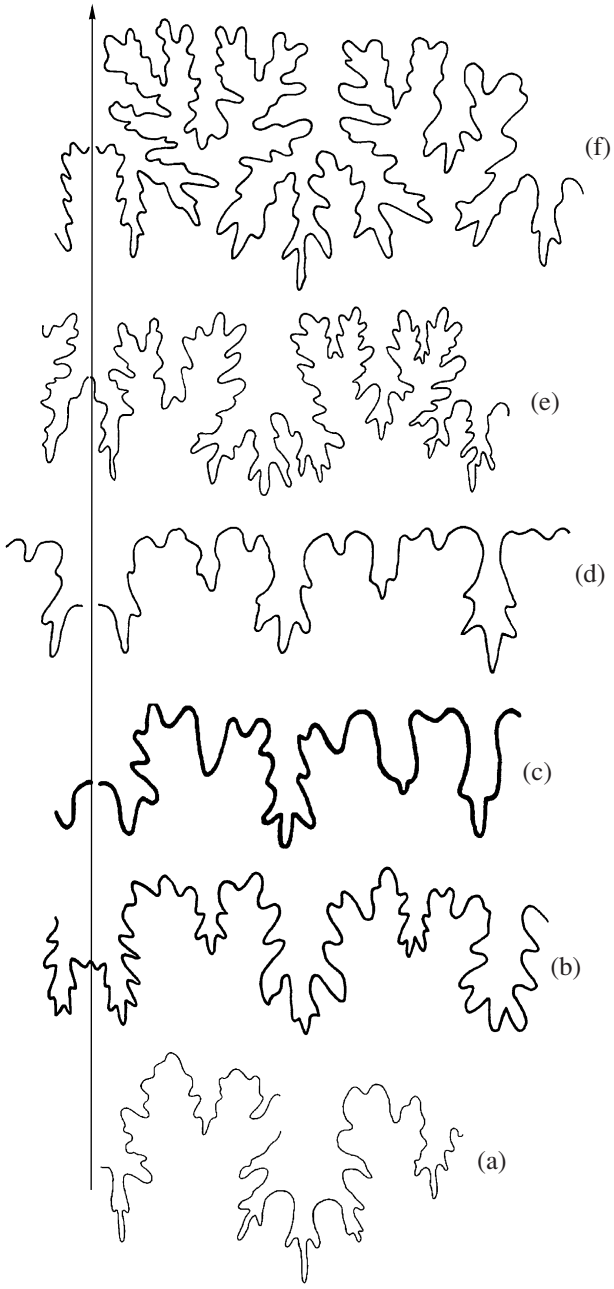


Fig. 3. Sutures of the species of the genera *Bochianites* and *Janenschites*: (a) *Bochianites* sp., specimen no. 14/13169 at Dm = 15.0 mm; eastern Crimea, Feodosiya, St. Iliya Cape; Berriasian, *jacobi* Zone, *grandis* Subzone; (b) *B. neocomiensis* (d'Orbigny), specimen no. 4/13169 at Dm_1 = 6.8 mm, Dm_2 = 6.0 mm; central Crimea, Sary-Su River; Berriasian, *boissieri* Zone; (c, d) *B. levis* sp. nov.; (b) holotype no. 9/13169 at Dm_1 = 5.2 mm, Dm_2 = 4.6 mm; the same age and locality; (c) specimen no. 10/13169 at Dm_1 = 4.6 mm, Dm_2 = 4.0 mm; the same age and locality; (e) *Janenschites oosteri* (Sarasin et Schöndelmayer), specimen no. 800/103 at Dm_1 = 11.0 mm, Dm_2 = 9.5 mm; southwestern Crimea, Kacha River, village of Verkhorech'e; Lower Barremian; (f) *J. incisus* sp. nov., holotype no. 802/103 at Dm_1 = 7.7 mm, Dm_2 = 6.3 mm; the same age and locality.

The poor preservation and impossibility of observing the sutural ontogeny makes it difficult to index the sutural elements at the adult stages. Vašiček (1999, text-fig. 1) identified the lobe on the top of the saddle L/D in the species *B. neocomiensis* as lobe U (although a similar lobe is present on the top of the saddle L/V, it is not designated). Duran-Delga did not index this lobe (apparently not recognizing it as a major lobe). In the specimens of the Berriasian *Bochianites* studied by the present author, the interpretation of the lobes is also not certain. In specimens nos. 4/13169 and 10/13169 the lobes on the tops of the saddles V/L and L/D are identical in size and shape, whereas in specimens nos. 9/13169 and 14/13169 the lobe on the top of the saddle L/D is deeper than the lobe on the top of the saddle V/L. Only three main lobes can be indexed with certainty (V, L, and D). In my opinion, the lobes on the top of the saddles are auxiliary.

The specimen from the Himalayas that was identified by Uhlig (1910) as *Bochianites gerardi* Stoliczka is most likely not *Bochianites*, because, judging from the illustration, it has a curved shell with ribs that do not become weaker on the dorsum. Similarly, the species *B. undulatus* Koenen from the Lower Aptian of northern Germany (Koenen, 1902) is not a *Bochianites*, as its suture is not of the *Bochianites*-type.

Because the shell of *Bochianites* is straight and slightly laterally compressed, it is proposed to measure, whenever possible, two diameters: Dm_1—dorsoventral and Dm_2—lateral.

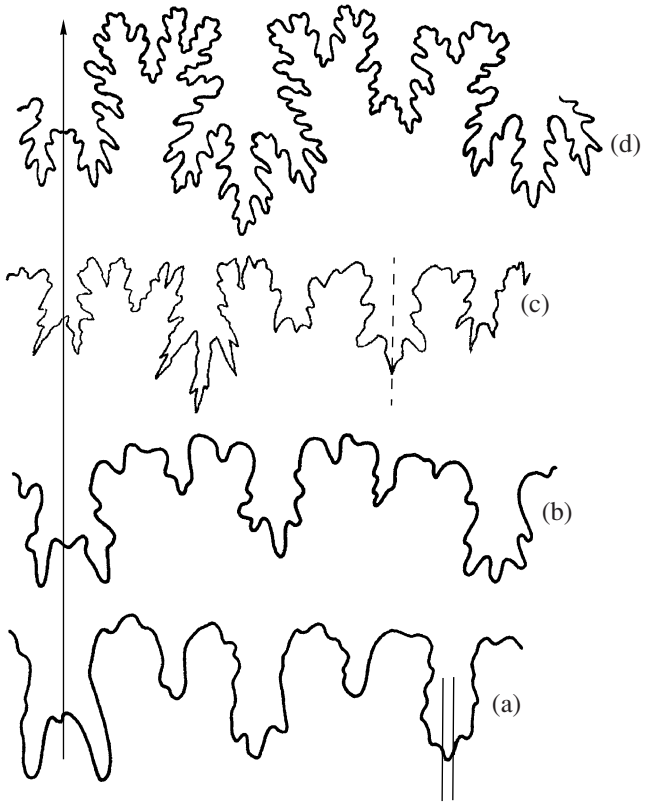


Fig. 4. Sutures of Bochianitidae illustrated by other workers (names of the taxa remained unchanged): (a) *Bochianites oosteri* Sarasin et Schöndelmayer at Dm = 4.0 mm; Valanginian; Czech Republic (after Vašiček, 1999); (b) *B. neocomiensis* (d'Orbigny) at Dm = 3.5 mm; Valanginian, Czech Republic (from Vašiček, 1999); (c) *B. oosteri* Sarasin et Schöndelmayer at Dm = 17.0 mm; Lower Hauterivian; Bulgaria (after Mandov, 1971); (d) *B. oosteri* Sarasin et Schöndelmayer at Dm = 8.0 mm; Lower Barremian; Switzerland (after Sarasin and Schöndelmayer, 1902).

***Bochianites neocomiensis* (d'Orbigny, 1840)**

Plate 3, figs. 1–5

Baculites neocomiensis: d'Orbigny, 1840, p. 560, pl. 138, figs. 1–5; Ooster, 1860, p. 88, pl. 61, figs. 1–8.

Bochianites neocomiensis: Quenstedt, 1846–1849, p. 294, pl. 21, figs. 16a–16d; non Karakash, 1907, p. 156, pl. 25, fig. 17 [=Janeschites]; non Arnould-Saget, 1953, p. 111, pl. 10, fig. 14 [= *Bochianites levis* sp. nov.]; Wiedmann, 1962, p. 87, pl. 6, fig. 6; Mutiu, 1966, p. 450, pl. 2, fig. 3; 1969, p. 14, pl. 1, figs. 4, 5; Kemper, 1976, pl. 31, figs. 21–24; Kemper et al., 1981, p. 265, pl. 34, fig. 20, 21; Company, 1987, p. 84, pl. 1, figs. 12–17; Immel, 1987, p. 114, pl. 11, fig. 3; Reboulet, 1995, p. 179, pl. 26, figs. 6–11 (non figs. 1–4 = *B. levis* sp. nov.; non fig. 5 = *B. nodosocostatus* Mandov; non figs. 12–19 = *B. goubechensis* Mandov); Vašiček, 1999, pl. 1, fig. 1; Busnardo et al., 2003, p. 41, pl. 6, fig. 11.

Bochianites neocomiensis neocomiensis: Mandov, 1971, p. 93, pl. 1, figs. 1–11.

Shell shape. The shell is straight. The collection includes several fragments of various parts of the shell. Specimen no. 5/13169 is a fragment of the part of the shell close to the initial part. It represents a conical, weakly expanding tube, with a rounded cross-section, slightly compressed laterally. The remaining specimens represent fragments of more adult parts of the shell with an oval cross-section, laterally compressed (some specimens are more compressed because of later deformation).

Ornamentation. The shell possesses evenly spaced thin ribs orientated at an angle of 70° to the longer axis of the shell. The ribbing varies from very weak to coarse. The shell fragment of 35 mm long possesses 20 ribs. Near the dorsum the ribs become weaker and disappear. The ribs run across the venter with a weak curvature orally.

Dimensions in mm:

Specimen no.	L fragment	Dm_1	Dm_2
1/13169	53.5	16.0	–
4/13169	32.5	6.8	6.0
5/13169	15.5	2.9	2.3
		3.9	3.3

Suture (Fig. 3b) at $Dm_1 = 6.8$ mm, $Dm_2 = 6.0$ mm is composed of three equally deep lobes V, L, and D. The ventral lobe is subdivided by a low saddle into two parts. The lateral and dorsal lobes are tripartite. The tops of the saddles V/L and L/D possess two identical

auxiliary serrated lobes half as deep as the saddle height.

Comparison. The species described differs from *B. levis* sp. nov. in the presence of ribbing, and from *B. goubechensis* in the absence of constrictions. *B. neocomiensis* described by Karakash (1907) from the Lower Barremian of the Crimean Mountains, has a more strongly dissected suture and is assigned by the present author to *Janenschites.*

Remarks. Reboulet (1995) included a wide variety of forms in the species *B. neocomiensis* (smooth, ribbed, with constrictions and nodelike tubercular inflations). I only assigned specimens with a simple uniform ribbing to the species *neocomiensis*.

Occurrence. Berriasian of the Crimean Mountains; Valanginian of the Czech Republic; Upper Valanginian of Poland, Bulgaria, Germany, England, Spain, France, Austria, northern Siberia (?); Upper Valanginian–Lower Hauterivian of Switzerland, Caucasus (?).

Material. Eight specimens (no. 1–8/13169) from the eastern Crimea (near Feodosiya), central Crimea (basin of the Sary-Su River) and basin of the Tonas River; coll. by V.V. Drushchits, T.N. Gorbachik, and T.N. Bogdanova.

***Bochianites levis* Arkadiev, sp. nov.**

Plate 3, figs. 8 and 9

Bochianites oosteri: Wiedmann, 1962, p. 87, pl. 6, fig. 5; Mandov, 1971, p. 98, pl. 3, fig. 10, pl. 4, figs. 1–5; Immel, 1987, p. 115, pl. 11, fig. 11; Vašiček, 1999, pl. 1, fig. 2.

Bochianites neocomiensis: Arnould-Saget, 1953, p. 111, pl. 10, fig. 14.

Etymology. From the Latin *levis* (simple).

Holotype. TsNIGR Museum, 9/13169; central Crimea, Sary-Su River; Berriasian, *boissieri* Zone, beds with *Euthymiceras* and *Neocosmoceras*.

Shape. The shell is straight, slightly expanding aperturad. The cross-section is rounded, slightly elongated dorsoventrally. The venter is weakly acute, the dorsum is flattened.

Ornamentation. The shell is smooth.

Dimensions in mm:

Specimen no.	L fragment	Dm_1	Dm_2
9/13169	36.5	5.2	4.6
10/13169	12.5	4.6	4.0

Specimen no. 9/13169 shows strongly crowded septa at the end of the shell, facing the aperture. This suggests that this specimen was an adult. Hence, its reconstructed length is about 10 cm.

Suture (Figs. 3c, 3d) at Dm = 4–5 mm is similar to that of *B. neocomiensis*, but is less strongly dissected and the lobe on the top of the saddle L/D is deeper than the lobe on the top of the saddle V/L.

Comparison. This species is distinguished from *B. neocomiensis* by the absence of ribbing. Specimens described by various workers as *B. oosteri* (Arnould-Saget, 1953; Mandov, 1971; Immel, 1987; Vašiček, 1999), have a relatively weakly dissected suture, which is different from Swiss specimens of this species (Sarasin and Schöndelmayer, 1902) and can be the basis for the separation of a new species.

Remarks. The opinions on the taxonomy of the ribbed and smooth *Bochianites* vary. Company (1987) argues for their assignment to the same species, whereas, conversely, (Vašiček, 1999) assigned them to different species based on the differences in the sutural outline. The species *B. levis* and *B. neocomiensis* are certainly very close. The author's collection includes apparently transitional specimens with very fine ribbing, hardly distinguishable on the molds.

Explanation to Plate 3

Figs. 1–5. *Bochianites neocomiensis* (d'Orbigny); (1) specimen no. 1/13169 lateral view, ×1; basin of the Tonas River, village of Krasnoselovka; Berriasian, *jacobi* Zone; coll. by V.M. Nerodenko; (2) specimen no. 2/13169, lateral view, ×1; eastern Crimea, Barakol' Valley; Berriasian, *jacobi* Zone; coll. by T.N. Gorbachik; (3) specimen no. 3/13169, lateral view, ×1; basin of the Tonas River, village of Krasnoselovka; Berriasian, *jacobi* Zone; coll. by V.M. Nerodenko; (4) specimen no. 4/13169: (4a) dorsal view, ×1; (4b, 4c) lateral view (4b, ×1, 4c, ×2); central Crimea, Sary-Su River; Berriasian, *boissieri* Zone, beds with *Euthymiceras* and *Neocosmoceras*; coll. by V.V. Drushchits; (5) specimen no. 5/13169: (5a, 5b) ventral view (5a, ×1; 5b, ×3), (5c) lateral view, ×3; eastern Crimea, vicinity of the town of Feodosiya; Berriasian, *jacobi* Zone, *grandis* Subzone; coll. by V.V. Drushchits.

Fig. 6. *Bochianites goubechensis* Mandov, specimen no. 12/13169; lateral view (6a, ×1, 6b, ×2); eastern Crimea, village of Nanikovo; Berriasian, *jacobi* Zone, *grandis* Subzone; coll. by T.N. Bogdanova.

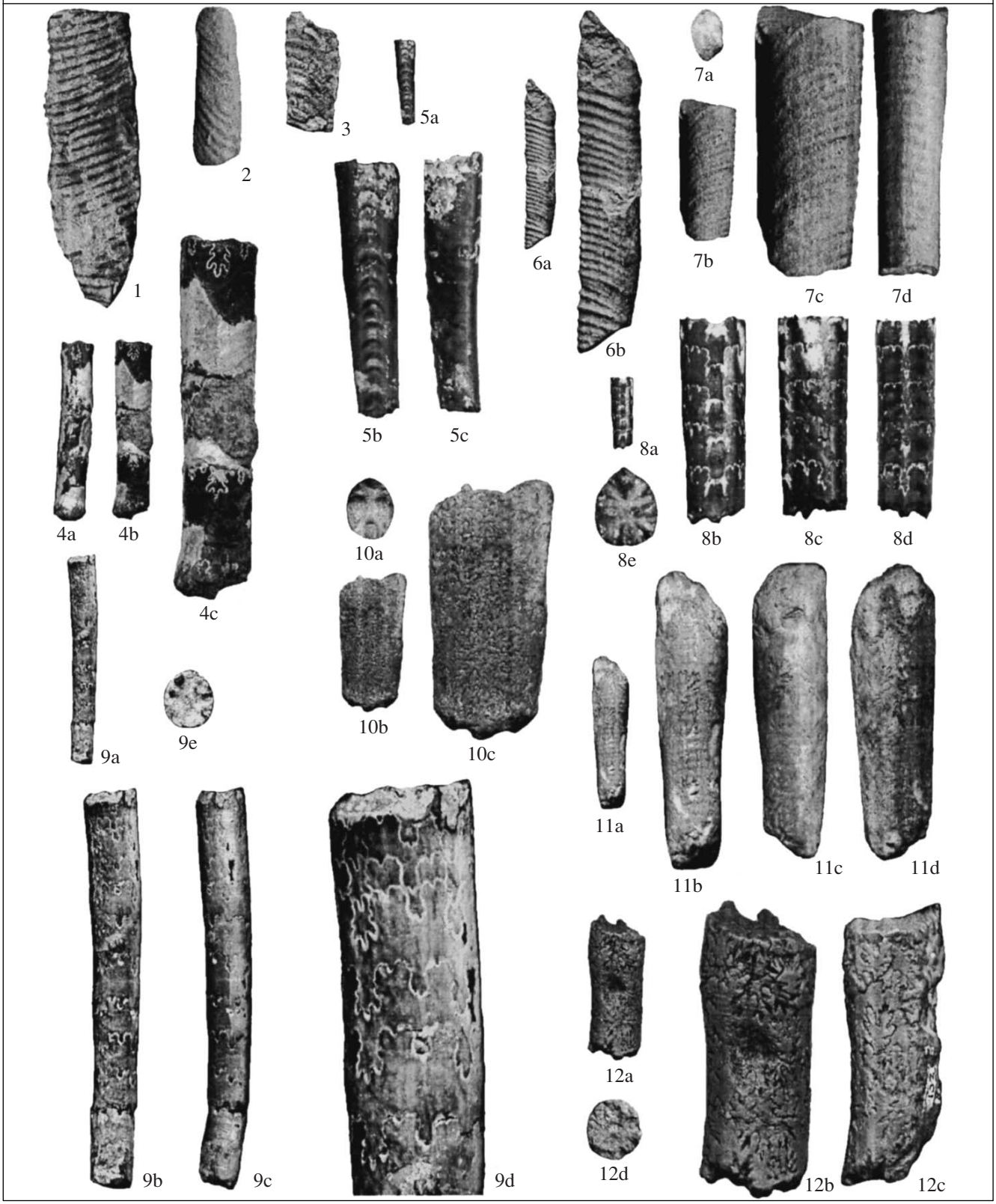
Fig. 7. *Bochianites crymensis* sp. nov., holotype no. 11/13169: (7a) transverse section, ×1; (7b, 7c) lateral view (76, ×1, 7c, ×2), (7d) ventral view, ×2; eastern Crimea, village of Nanikovo; Berriasian, *jacobi* Zone; coll. by T.N. Bogdanova.

Figs. 8 and 9. *Bochianites levis* sp. nov.; (8) specimen no. 10/13169: (8a, 8b) ventral view, (8a, ×1, 8b, ×3), (8c) lateral view, ×3, (8d) dorsal view, ×3, (8e) cross-section, ×3; (9) holotype no. 9/13169: (9a, 9b, 9d) lateral view (9a, ×1, 9b, ×2, 9d, ×5), (9c) dorsal view, ×2, (9e) cross-section, ×2; central Crimea, Sary-Su River; Berriasian, *boissieri* Zone, beds with *Euthymiceras* and *Neocosmoceras*; coll. by V.M. Nerodenko.

Figs. 10 and 11. *Janenschites incisus* sp. nov.: (10) specimen no. 801/103: (10a) cross-section, ×1, (10b, 10c) lateral view, (10b, ×1, 10c, ×2); (11) holotype no. 802/103: (11a, 11b) ventral view (11a, ×1, 11b, ×2), (11c) dorsal view, ×2, (11) lateral view, ×2; southwestern Crimea, Kacha River, village of Verkhorech'e; Lower Barremian; coll. by N.I. Karakash.

Fig. 12. *Janenschites oosteri* (Sarasin et Schöndelmayer), specimen no. 800/103: (12a, 12b) lateral view (12a, ×1, 12b, ×2), (12c) dorsal view, ×2, (12d) cross-section, ×1; locality and age the same; coll. by N.I. Karakash.

Plate 3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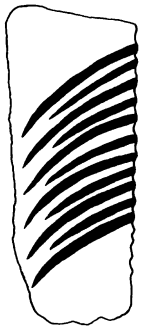

Fig. 5. Ornamentation of *Bochianites crymensis* sp. nov., holotype no. 11/13169, lateral view, ×1.

Occurrence. Berriasian (*boissieri* Zone, beds with *Euthymiceras* and *Neocosmoceras*) of the Crimean Mountains; Berriasian of Tunisia; Valanginian of the Czech Republic; Upper Valanginian–Lower Hauterivian of Bulgaria, Austria, Switzerland, and Majorca.

Material. Two specimens (no. 9/13169 and 10/13169) from the central Crimea (basin of the Sary-Su River); coll. by V.M. Nerodenko.

***Bochianites crymensis* Arkadiev, sp. nov.**

Plate 3, fig. 7

Etymology. From the Crimean Peninsula.

Holotype. TsNIGR Museum, no. 11/13169; eastern Crimea, village of Nanikovo; Berriasian, *jacobi* Zone, *grandis* Subzone.

Shell shape. The shell is straight, laterally compressed, very weakly expanding toward the aperture. The cross-section is elliptical, but this is likely to result from deformation.

Ornamentation. The shell is covered by thin ribs of unequal length (Fig. 5). Longer ribs begin near the dorsum, shorter ribs begin somewhat higher on the flank. The alternation of ribs is regular. All ribs are inclined orally. Long ribs are slightly inclined near the dorsum, and are more steeply inclined on the venter. The ribs arch forward on the venter, while not crossing the dorsum.

Dimensions in mm:

Specimen no.	L fragment	Dm_1	Dm_2
11/13169	25.5	8.8	–
		10.0	–

Suture. The suture was not observed.

Comparison. This species is distinguished from *B. neocomiensis* (Orb.) by the unequally long ribs. It differs from the similar species *B. nodosocostatus* Mandov in the absence of nodes.

Material. Holotype. Collected by T.N. Bogdanova.

***Bochianites goubechensis* Mandov, 1971**

Plate 3, fig. 6

Bochianites goubechensis: Mandov, 1971, p. 97, pl. 3, figs. 1–9.

Bochianites cf. *goubechensis*: Kemper et al., 1981, p. 266, pl. 34, figs. 22, 23.

Bochianites neocomiensis: Reboulet, 1995, p. 179, pl. 26, figs. 12–19.

Shell shape. The shell is straight, strongly compressed laterally as a result of the secondary deformation, which was also the reason for the elliptical shape of the cross-section.

Ornamentation. The shell is covered by thin, closely spaced ribs and constrictions. The ribs are simple, inclined toward the long axis of the shell at an angle of about 80°. The ribs are weakly developed on the dorsum and more strongly on the venter. They run straight across the dorsum and form a weak arch directed orally on the venter. The constrictions follow the ribs, and are spaced evenly (at 1 cm).

Dimensions in mm:

Specimen no.	L fragment	Dm_1	Dm_2
12/13169	31.0	6.0	–

Suture. The suture was not observed.

Comparison. This species is distinguished from other *Bochianites* species by the clearly outlined, evenly spaced constrictions. Reboulet (1995) assigned the specimens with constrictions to the species *B. neocomiensis*, an opinion I do not support.

Occurrence. Berriasian (*jacobi* Zone) of the Crimean Mountains; Upper Valanginian of Bulgaria, England, and France.

Material. Two specimens (nos. 12/13169 and 13/13169) from the eastern Crimea (village of Nanikovo, Barakol' Valley); coll. by T.N. Bogdanova

Genus *Janenschites* Durand-Delga, 1954

Type species. *Bochianites janenschi* Zwierzycki, 1914; Barremian of the region of Lake Tanganyika, Africa.

Diagnosis. Shell straight, with oval cross-section, somewhat compressed laterally. Ornamentation similar to that of *Bochianites*. Suture strongly dissected, composed of three major elements (V, L, and D). Major saddles divided by secondary lobes.

Species composition. *J. janenschi* (Zwierzycki), Barremian of the region of Lake Tanganyika, Africa; *J. oosteri* (Sarasin et Schöndelmayer), Lower Barremian of the Crimean Mountains and Switzerland; *J. incisus* sp. nov., Lower Barremian of the Crimean Mountains.

Comparison. This genus is distinguished from the genus *Bochianites* by the strongly dissected suture.

***Janenschites oosteri* (Sarasin et Schöndelmayer, 1902)**

Plate 3, fig. 12

Bochianites oosteri: Sarasin and Schöndelmayer, 1902, p. 179, pl. 24, figs. 3–4; Busnardo et al., 2003, p. 42, pl. 10, figs. 7 and 8.

Bochianites neocomiensis: Karakash, 1907, p. 156, pl. 25, fig. 17.

non *Bochianites oosteri*: Karakash, 1907, p. 157, pl. 25, fig. 10 [= *Janenschites incisus* sp. nov.]

Shell shape. A single specimen (no. 800/103) from Karakash's collection is a fragment of a mold of a straight shell, somewhat curved as a result of deformation. The cross-section is rounded-oval, slightly elongated ventrodorsally.

Ornamentation. On the flank of the mold there are weakly discernible fine oblique ribs (note that Karakash when describing this specimen indicated on p. 157 that the mold surface was completely smooth).

Dimensions in mm:

Specimen no.	L fragment	Dm_1	Dm_2
800/103	26.0	11.0	9.5

Suture. The suture (Fig. 3e) is identical to that in the specimen from Switzerland (see Sarasin and Schöndelmayer, 1902). The lobes and saddles are strongly dissected, although the saddles have broad bases. The lobe on the top of the saddle L/D is deep, dissecting the saddle into two almost independent elements (it is deeper that on the top of the saddle V/L). The lateral and dorsal lobes are tripartite. The branches are deep, with serrated walls.

Comparison. This species is distinguished from the species *J. incisus* sp. nov. by the less strongly incised suture.

Remarks. Sarasin and Schöndelmayer (1902), who studied ammonites from Veveyse in Switzerland, identified and described three species of *Bochianites* (*B. neocomiensis* (d'Orbigny), *B. renevieri* Ooster and a new species *B. oosteri* Sarasin et Schöndelmayer. Talking about the stratigraphic distribution of these species, the authors noted that *B. renevieri* is found in association with *Holcodiscus hugii*, zonal species from the Lower Barremian. The stratigraphic range of the remaining two species of *Bochianites* is somewhat unclear. Later, French workers (Busnardo et al., 2003) reexamined the section and ammonites from Veveyse, *B. neocomiensis* and *B. oosteri.* However, the species *neocomiensis* is shown in their figure in the Valanginian–Hauterivian part of the section, where the species *oosteri* is absent. The species *oosteri* is illustrated by the photographs of the specimens and a drawing of the sutural outline from Sarasin and Schöndelmayer' paper. Thus, it can be suggested that the species *oosteri* may also come from the Lower Barremian (*hugii* Zone). Taking into account that the suture of this species figured by Sarasin and Schöndelmayer is strongly dissected and is very different from the sutures of the Berriasian taxa, this species should be assigned to the genus *Janenschites*. The suture of *B. neocomiensis*, described by Karakash (1907) also from the Lower Barremian, is almost identical to the suture of *oosteri* as figured by Sarasin and Schöndelmayer. Specimens described by Karakash (1907) as *B. oosteri*, have an even more strongly dissected suture and are assigned by the present author to a new species *Janenschites incisus* sp. nov. Smooth forms, with a more simple suture, which were previously assigned to the species *oosteri* by many western European workers, I assign to a new species of the genus *Bochianites* (*B. levis* sp. nov.).

Occurrence. Lower Barremian, the Crimean Mountains, Switzerland.

Material. Specimen no. 800/103 from the southwestern Crimea (village of Verkhorech'e, Kacha River); coll. by N.I. Karakash.

Janenschites incisus
Arkadiev, sp. nov.

Plate 3, figs. 10 and 11

Bochianites oosteri: Karakash, 1907, p. 157, pl. 25, fig. 10.

Etymology. From the Latin *incisus* (incised).

Holotype. Stratigraphic-paleontological Museum of SPbGU, no. 802/103; southwestern Crimea, Kacha River, village of Verkhorech'e; Lower Barremian.

Shell shape. Two specimens from N.I. Karakash's collection represent fragments of straight shells (weakly expanding conical tubes). The cross-section is rounded-oval, slightly compressed laterally.

Ornamentation. Both specimens show thin oblique ribs on the flanks.

Dimensions in mm:

Specimen no.	L fragment	Dm_1	Dm_2
801/103	23.0	9.9	7.1
		11.2	8.8
802/103	26.5	6.6	5.3
		7.7	6.3

Suture (Fig. 3f). The suture is strongly incised. The sutural outline in specimen no. 802/103 is similar to that in *J. janenschi* Zwierzycki (Durand-Delga, 1954), differing in details. The lobes and saddles are strongly incised. The bases of the saddles are very narrow.

Comparison. This species is distinguished from other species of *Janenschites* by the more strongly incised suture.

Material. Two specimens (no. 801/103, 802/103) from the type locality. Coll. by N.I. Karakash.

CONCLUSIONS

Bochianites neocomiensis, B. goubechensis, B. levis sp. nov. and *B. crymensis* sp. nov. are reported for the

first time by the present author from the Berriasian of the Crimean Mountains. The new species *B. levis* includes specimens with a smooth shell and weakly dissected suture, which were previously assigned to the species *B. oosteri.* The discovery of the Crimean *Bochianites* in the *boissieri* Zone supports its correlation with *Hectoroceras kochi* Zone from the Boreal Realm (Baraboshkin, 2004), where *Bochianites* cf. *glennensis* Anderson was recorded by Zakharov and Rogov (2006).

The majority of the *Bochianites* studied come from the clayey deposits of the Dvuyakornaya Formation of the eastern Crimea and the basin of the Tonas River, interpreted as deep-water deposits, i.e., formed at a depth of more than 200 m on the continental slope (Arkadiev et al.,, 2006b). Similar depths are determined by Lukeneder (2005) for the Upper Valanginian beds with *Bochianites* in Austria. In the shallow-water Berriasian beds of the southwestern Crimea *Bochianites* has not been recorded.

The genus *Bochianites* is interpreted either as nektobenthic (Company, 1987) or deep-water nektonic (Reboulet and Atrops, 1997; Reboulet et al., 2003, 2005), and species of this genus are considered to have been epipelagic, similar to the Albian *Lechites* and Cenomanian *Baculites*. Evidently, this lifestyle facilitated the cosmopolitan distribution of the genus in almost all paleobiogeographic regions. The presence of *Bochianites* in the Berriasian of the Crimean Mountains supports the hypothesis of their initial appearance in the southern regions (Africa, Crimea) and subsequent migration in the Valanginian–Hauterivian in the more northerly regions of western Europe (Zakharov and Rogov, 2003).

Species described by Karakash (1907) as *Bochianites neocomiensis* and *B. oosteri*, and by Sarasin and Schöndelmayer (1902) as *B. oosteri*, based on the sutural outline are assigned by the present author to the genus *Janenschites*, separated from the genus *Bochianites*. In the Crimean Mountains, species of the genus *Janenschites* come from the Lower Barremian red limestones of the Kacha River. In Switzerland the species *oosteri*, most likely, also characterizes the Barremian. Baraboshkin and Enson (2003) interpret the Barremian limestones of the southwestern Crimea as of relatively deep-water origin (500–600 m). Solovjev (2006), who studied echinoids from these limestones, shared this opinion. Hence, the occurrence of members of the family Bochianitidae (in addition to other factors) may be used as indicators of deep-water sedimentary settings.

The evolution of the members of the Bochianitidae during the Tithonian–Barremian was, most likely, directed towards the change of the suture from simple in the genus *Bochianites* to strongly dissected in the genus *Janenschites*. Data on shell morphogenesis and on evolution are absent.

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REFERENCES

1. F. M. Anderson, “Lower Cretaceous Deposits in California and Oregon,” Geol. Soc. Am., Spec. Pap., No. 16, 1–328 (1938).
2. F. M. Anderson, “Knoxville Series in the California Mesozoic,” Bull. Geol. Soc. Am. **56** (10), 909–1014 (1945).
3. V. V. Arkadiev, T. N. Bogdanova, and S. V. Lobacheva, “New Data on the Biostratigraphy of the Berriasian Deposits of the Tonas River Basin (Crimean Mountains),” in *The Cretaceous System of Russia: Problems of Stratigraphy and Paleogeography*, Ed. by V. V. Arkadiev and V. A. Prozorovskii (NIIZK S.-Peterb. Gos. Univ., St. Petersburg, 2005), pp. 111–135 [in Russian].
4. V. V. Arkadiev, T. N. Bogdanova, S. V. Lobacheva, et al., “The Berriasian of the Crimean Mountains: Problems of Zonal Subdivision and Correlation,” in *The Cretaceous System of Russia and Adjacent Countries: Problems of Stratigraphy and Paleogeography*, Ed. by V. A. Musatov (Izd. SO EAGO, Saratov, 2006a), pp. 18–20 [in Russian].
5. V. V. Arkadiev, A. A. Fedorova, Yu. N. Savel’eva, and E. M. Tesakova, “Biostratigraphy of Jurassic–Cretaceous Boundary Sediments in the Eastern Crimea,” Stratigr. Geol. Korrelyatsiya **14** (3), 84–112 (2006b) [Stratigr. Geol. Korrelyatsiya **14** (3), 302–330 (2006b)].
6. S. Arnould-Saget, “Les ammonites pyriteuses du Tithonique superiéur et du Berriasien de Tunisie centrale,” Ann. Min. Géol. Publ. Serv. Géol. Tunisie, No. 10, 1–132 (1953).
7. E. Yu. Baraboshkin, “A New Stratigraphic Scheme of the Lower Cretaceous Deposits of the Kacha–Bodrak Interfluve (Southwestern Crimea),” Vestn. Mosk. Univ., Ser. 4, Geol., No. 3, 22–29 (1997).
8. E. Yu. Baraboshkin, “The Boreal–Tethyan Correlation of the Lower Cretaceous Ammonoid Scales,” Vestn. Mosk. Univ., Ser. 4, Geol., No. 6, 1–19 (2004).
9. E. Yu. Baraboshkin and K. V. Enson, “Paleobathymetry of the Valanginian–Aptian Basin in the Crimean Mountains Based on Strength Indices of Ammonoid Shells,” Vestn. Mosk. Univ., Ser. 4., Geol., No. 4, 8–17 (2003).
10. W. N. Benson, “Palaeozoic and Mesozoic Seas in Australasia,” Trans. New Zealand Inst. **54**, 1–62 (1923).
11. V. I. Bodylevsky, “New Late Valanginian Ammonoids of Northern Siberia,” in *New Species of Ancient Plants and Invertebrates of the USSR, Part 2* (Gosgeoltekhizdat, Moscow, 1960), pp. 172–176 [in Russian].
12. G. Boehm, “Beiträge zur Geologie von Niederländisch-Indien. Abt. 1. Die Südküsten der Sula-Inseln Taliabu und Mongoli, Abschn. I. Grenzschichten zwischen Jura und Kreide,” Palaeontographica **1** (Suppl. 4), 1–46 (1904).
13. R. Busnardo, J. Charollais, M. Weidmann, and B. Clavel, “Le Crétacé inférieur de la Veveyse de Châtel (ultrahelvétique des préalpes externs; canton de Fribourg, Suisse),” Rev. Paléobiol. **22** (1), 1–174 (2003).

14. A. Cantú-Chapa, "El contacto Jurásico-Cretácico, la estratigrafía del Neocomiano, el hiato Hauteriviano Superior-Eoceno Inferior o las amonitas del pozo Bejuco 6 (Centro-Este de México)," Bol. Soc. Geol. Mexicana **37**, 60–83 (1976).
15. F. Cecca, "Early Cretaceous (pre-Aptian) Ammonites of the Mediterranean Tethys: Palaeoecology and Palaeobiogeography," Palaeogeogr. Palaeoclimatol. Palaeoecol. **138**, 305–323 (1998).
16. M. Collignon, *Atlas des fossils caracteristiques de Madagascar. Fasc. 8. Berriasien, Valanginien, Hauterivien, Barrémien* (Serv. Géol. Madagascar, Tananarive, 1962).
17. M. Company, *Los ammonites del Valanginiense del sector oriental de las Cordilleras Béticas (SE de España). Tesis Doctoral* (Univ. Granada, Granada, 1987).
18. M. Durand-Delga, "A propos de "*Bochianites*" *superstes* Perv.: remarques sur les ammonites droites du Crétacé inférieur, C.R. Somm. Soc. Géol. France, No. 7, 134–137 (1954).
19. R. W. Imlay, "Lower Neocomian Fossils from the Miquihuana Region, Mexico," J. Paleontol. **11** (7), 552–574 (1937).
20. H. Immel, "Die Kreideammoniten der Nördlichen Kalkalpen," Zitteliana **15**, 3–163 (1987).
21. N. I. Karakash, "The Lower Cretaceous Deposits of the Crimean Peninsula and Their Fauna," Tr. S.-Peterb. Obva Estestvoispyt. Otd. Geol. Mineral. **32** (5), 1–483 (1907).
22. S. Kelly, "New Trigonioid Bivalves from the Early Jurassic to Earliest Cretaceous of the Antarctic Peninsula Region: Systematics and Austral Paleobiogeography," J. Paleontol. **69** (1), 66–84 (1995).
23. E. Kemper, "Geologischer Führer durch die Grafschaft Bentheim und die angrenzenden Gebiete mit einem Abriss der emsländischen Unterkreide," Das Bentheimer Land, No. 64, 1–206 (1976).
24. E. Kemper, P. Rawson, and J.-P. Thieuloy, "Ammonites of Tethyan Ancestry in the Early Lower Cretaceous of North-West Europe," Palaeontology **24** (Part 2), 251–311 (1981).
25. F. L. Kitchin, "The Invertebrate Fauna and Palaeontological Relationships of the Uitenhage Series," Ann. S. Afr. Museum **7**, 21–250 (1908).
26. A. Koenen, "Die Ammonitiden des Norddeutschen Neocom (Valanginien, Hauterivien, Barrêmien und Aptien)," Abhandl. K. Preuss. Geol. Landes. Bergakad. Neue Folge, No. 24, 1–451 (1902).
27. S. A. Lomas, "A Lower Cretaceous Clastic Slope Succession, Livingston Island, Antarctica: Sand-Body Characteristics, Depositional Processes and Implications for Slope Apron Depositional Models," Sedimentology **46**, 477–504 (1999).
28. P. Lory, "Sur le Crétacé inférieur du Dévoluy et des régions voisines," Bull. Soc. Géol. Fr., Sér. 3, **26** 132–138 (1898).
29. A. Lukeneder, "Stratigrafische Erkenntnisse aus einem neuen Vorkommen von Unterkreide-Ammonoideen in der Losensteiner Mulde (Ternberger Decke, Nördliche Kalkalpen)," Jb. Geol. Bund. **144** (2), 173–189 (2004a).
30. Lukeneder A., "The *Olcostephanus* Level: An Upper Valanginian Ammonoid Mass-Occurrence (Lower Cretaceous, Northern Calcareous Alps, Austria)," Acta Geol. Pol. **54** (1), 23–33 (2004b).
31. A. Lukeneder, "Taphonomy and Stratigraphy of Early Cretaceous Ammonoid Mass Occurrences (Late Valanginian; Northern Calcareous Alps; Upper Austria)," Austrian J. Earth Sci. **98**, 34–51 (2005).
32. G. Mandov, "Representatives of the Genus *Bochianites* Lory, 1898 (Ammonoidea) in the Lower Cretaceous Deposits in Bulgaria," Izv. Geol. Inst., Ser. Paleontol. **20**, 91–113 (1971).
33. R. Mutiu, "Contribuţii la studiul Neocomianului ammonitic din platforma Moesică (Partea Centrală)," Petrol şi gaze **17** (9), 447–454 (1966).
34. R. Mutiu, "Noi contribuţii la studiul amonitic al Cretaciculuiinferior din platforma Moesică," Petrol şi gaze **20** (1), 14–18 (1969).
35. W. A. Ooster, *Catalogue des céphalopodes fossiles des Alpes Suisses* (Zürich, 1857–1860).
36. A. d'Orbigny, Paléontologie Française. Terrains crétacés, Vol. 1: *Céphalopodes* (Masson, Paris, 1840–1842).
37. F. A. Quenstedt, *Petrefactenkunde Deutschlands. Die Cephalopoden* (Tübingen, 1846–1849).
38. F. A. Quenstedt, *Atlas zu den Cephalopoden* (Tübingen, 1849).
39. S. Reboulet, "L'évolution des Ammonites du Valanginien-Hauterivien inférieur du basin vocontien et de la plate-forme provençale (Sud-Est de la France)," Doc. Lab. Géol. Lyon, No. 137, 1–371 (1995).
40. S. Reboulet and F. Atrops, "Quantitative Variations in the Valanginian Ammonite Fauna of the Vocontian Basin (Southeastern France) within Limestone–Marl Cycles and within Parasequence Sets," Palaeogeogr. Palaeoclimatol. Palaeoecol **135**, 145–155 (1997).
41. S. Reboulet, K. Mattioli, B. Pittet, et al., "Ammonoid and Nannoplankton Abundance in Valanginian (Early Cretaceous) Limestone–Marl Successions from the Southeast France Basin: Carbonate Dilution or Productivity?," Palaeogeogr. Palaeoclimatol. Palaeoecol. **201**, 113–139 (2003).
42. S. Reboulet, F. Giraud, and O. Proux, "Ammonoid Abundance Variations Related to Changes in Trophic Conditions across the Oceanic Anoxic Event 1d (Latest Albian, SE France)," Palaios **20** (2), 121–141 (2005).
43. S. Reboulet, P. J. Hoedemaeker, M. B. Aguirre-Urreta, et al., "Report on the 2nd International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Neuchâtel, Switzerland, 8 September, 2005)," Cretaceous Res. **27**, 712–715 (2006).
44. C. Sarasin and C. Schöndelmayer, "Étude monographique des ammonites du Crétacique inférieur de Châtel-Saint-Denis," Mém. Soc. Paléontol. Suisse **29**, 1–195 (1902).
45. N. I. Shul'gina, *Boreal Basins at the Jurassic–Cretaceous Boundary* (Nedra, Leningrad, 1985) [in Russian].
46. A. N. Solovjev, "On Early Cretaceous Disasterid Sea Urchins," in *The Cretaceous System of Russia and Adjacent Countries: Problems of Stratigraphy and Paleogeography,* Ed. by V. A. Musatov (Izd. SO EAGO, Saratov, 2006) [in Russian].

47. V. Uhlig, "The Fauna of the Spiti Shales," Palaeontol. Ind., Ser. 15, **4** (1–3), 1–511 (1903–1910).

48. Z. Vašiček, "Comments on Some New Occurrences of Heteromorphy Ammonites in the Lower Cretaceous (Late Valanginian–Early Barremian) of the Eastern Alpine and Western Carpathian Systems," Scripta Geol. Spec. Issue, No. 3, 215–227 (1999).

49. J. Wiedmann, "Unterkreide-Ammoniten von Mallorca. 1. Lieferung Lytoceratina, Aptychi," Akad. Wiss. Liter. Abh. Math.-Natur. Kl., No. 1, 1–148 (1962).

50. C. W. Wright, J. H. Calloman, and M. K. Howarth, *Treatise on Invertabrate Paleontology. Part L, Mollusca 4. Revised*, Vol. 4: *Cretaceous Ammonoidea* (Geol. Soc. Am. and Univ. Kansas Press, Boulder (Colo.) and Lawrence (Kans.), 1996).

51. V. A. Zakharov and M. A. Rogov, "Boreal–Tethyan Mollusk Migrations at the Jurassic–Cretaceous Boundary: Time and Biogeographic Ecotone Position in the Northern Hemisphere," Stratigr. Geol. Korrelyatsiya **11** (2), 54–74 (2003) [Stratigr. Geol. Correlation **11** (2), 152–171 (2003)].

52. V. A. Zakharov and M. A. Rogov, "New Data on the Jurassic–Cretaceous Boundary Beds in the Arctic (Nordvik Peninsula, Northern Siberia)," in *The Cretaceous System of Russia and Adjacent Countries: Problems of Stratigraphy and Paleogeography*, Ed. by V. A. Musatov (Izd. SO EAGO, Saratov, 2006) [in Russian].

53. V. A. Zakharov, M. A. Rogov, A. A. Kasumzade, et al., "New Data on the Structure of the Lower Cretaceous Section in the Mt. Kelevudag Region (Azerbaijan, Greater Caucasus Mountains)," in *The Cretaceous System of Russia and Adjacent Countries: Problems of Stratigraphy and Paleogeography*, Ed. by V. A. Musatov (Izd. SO EAGO, Saratov, 2006) [in Russian].

54. J. Zwierzycki, "Die Cephalopodenfauna der Tendagura-Schichten in Deutsch-Ostafrica," Arch. Biontol. Berlin **3** (4), 1–96 (1914).