

Genus *Delphinella* (Ammonoidea) from the Berriasian of the Crimean Mountains

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Abstract—Seven species of the genus *Delphinella*, i.e., *D. subchaperi* (Retowski), *D. crimensis* (Burckhardt), *D. obtusenodosa* (Retowski), *D. tresanensis* Le Hégarat, *D. delphinensis* (Kilian), *D. janus* (Retowski), and *D. pectinata* sp. nov., and the species *Berriasella berthei* (Toucas) from the upper *grandis* Subzone of the *jacobi* Zone of the Berriasian of the Crimean Mountains are described. Their stratigraphic distribution is different from that in the stratotype area.

Key words: new species, *Delphinella*, Ammonoidea, Berriasian, Crimean Mountains.

INTRODUCTION

Species of the genus *Delphinella* frequently occur in the Berriasian of the Crimea and are very important for stratigraphy. Along with other Berriasian genera (*Pseudosubplanites*, *Berriasella*, *Fauriella*, *Tirnovella*, etc.) they form stable zonal assemblages easily traceable in the sections. *Delphinella* have been known from the Berriasian of the Crimea for a long time, although they received little monographic study except for the works of Retowski (1893) and Druschits (1960). *D. delphinensis*, *D. ex gr. obtusenodosa*, *D. subchaperi*, *D. crimensis*, and *D. berthei* were recorded but not described from the vicinity of Feodosiya (Bogdanova *et al.*, 1984).

The authors of this paper have a large collection (several tens of specimens) of *Delphinella* shells, collected over years in the Crimea by V.V. Druschits, B.T. Yanin, T.N. Bogdanova, S.V. Lobatscheva, V.A. Prozorovskii, T.A. Favorskaya, V.V. Arkadiev, and Yu.N. Savelieva. These shells were found predominantly in the eastern Crimean Mountains (vicinity of Feodosiya) and, to a lesser extent, in the central Crimean Mountains (basin of the Tonas River), where the clayey carbonate beds of the *jacobi* Zone are widespread (Fig. 1).

In the section on Cape St. Ilya (Fig. 2), the assemblage of *Delphinella* (*D. subchaperi*, *D. crimensis*, *D. obtusenodosa*, *D. tresanensis*, *D. delphinensis*, *D. janus*, and a new species, *D. pectinata*) was found together with *Pseudosubplanites ponticus* (Ret.), *P. grandis* (Maz.), *P. lorioli* (Zitt.), and *P. combesi* Le Hégarat in the 13-m-thick "Feodosiya Marl" Member, which is presently dated the *grandis* Subzone of the *jacobi* Zone (Arkadiev and Savelieva, 2002; Arkadiev, 2003). *Delphinella* that were found in the vicinity of the

villages of Nanikovo and Sultanovka also belong to the *jacobi* Zone (Fig. 2) (Bogdanova *et al.*, 1984).

In the Tonas River basin, infrequent *Delphinella* sp. were found together with *Pseudosubplanites ponticus* and *P. lorioli* (Bogdanova *et al.*, 1981).

The collection contains molds completely replaced by rock matrix, so detailed study of the shell ontogeny is impossible. The collection is housed in TsNIGR Museum (St. Petersburg) (coll. no. 13055). We also studied the collection of Retowski from the Feodosiya Section (TsNIGR Museum, coll. no. 10916).

HISTORY OF STUDIES OF DELPHINELLA SPECIES

Retowski (1893) described an usual group of ammonoids characterized by ornamentation that

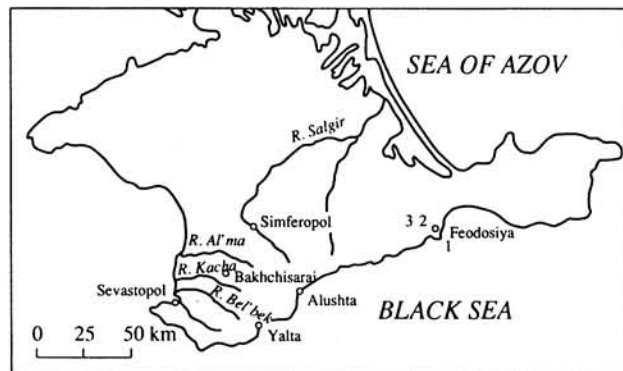


Fig. 1. Location of the sections studied: (1) Cape St. Ilya, (2) village of Sultanovka, and (3) village of Nanikovo, Barakol Valley.

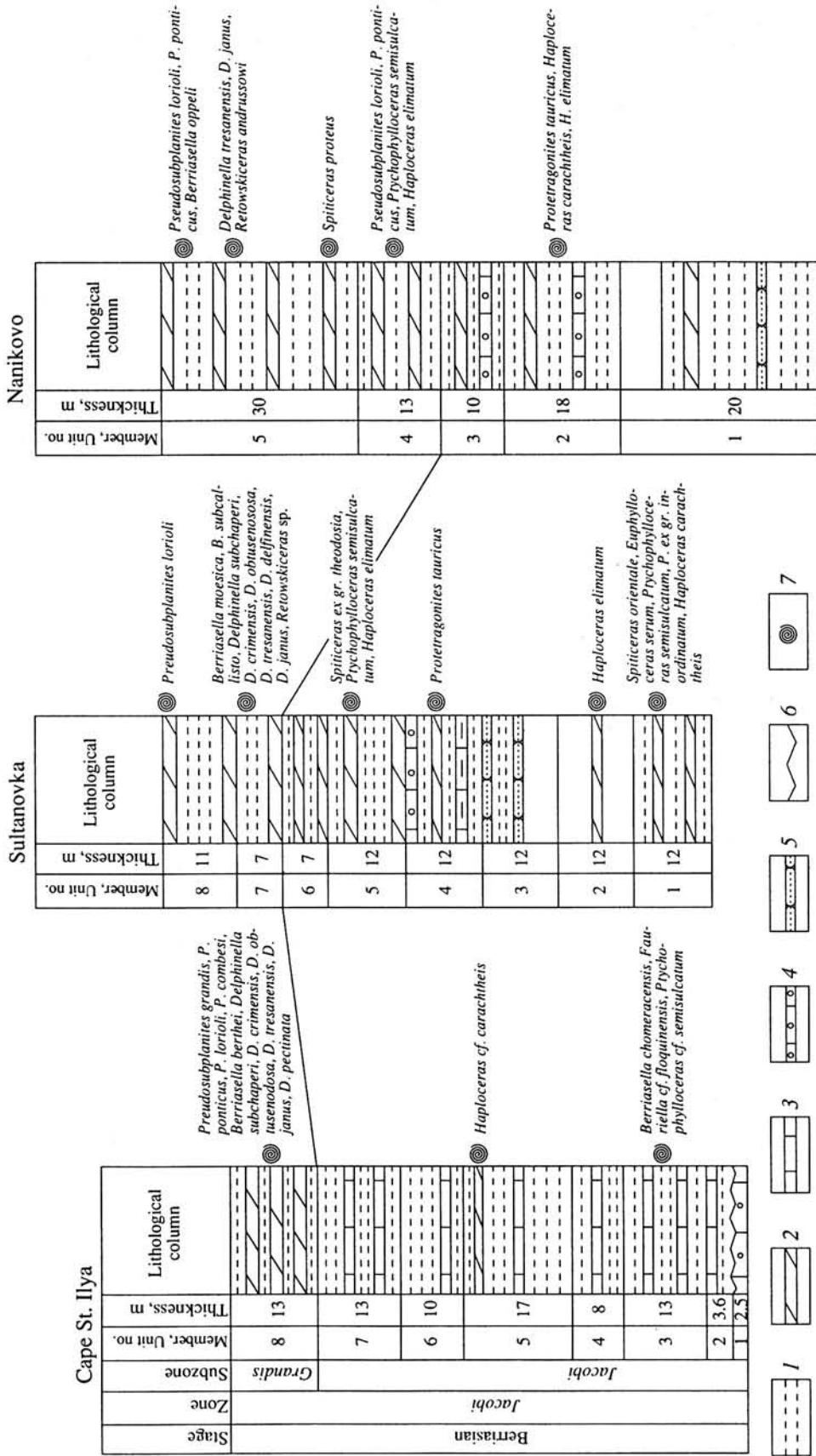


Fig. 2. Correlation of the Bertiasian sequences of the Eastern Crimea. Explanation: (1) clay, (2) marl, (3) limestone, (4) conglomerate limestone, (5) calcareous sandstone, (6) stratigraphic unconformity, and (7) levels of ammonoid occurrences.

becomes smooth on the living chamber and by the presence of umbilical and lateral nodes from the Berriasian section near Feodosiya (*Hoplites calisto* var. *kaffae*, *H. calisto* var. *berthei*, *H. calisto* var. *delphinensis*, *H. janus*, *H. obtusenodosus*, *H. consanguineus*, and *H. subchaperi*). Later Mazenot (1939) described and assigned to the group *Berriasella delphinensis* the following ammonites from the Berriasian of France: *B. delphinensis*, *B. garnieri*, *B. aff. janus*, *B. sp. ind.*, *B. moravica*, *B. obtusenodosa*, *B. aff. obtusenodosa*, and *B. alpillensis*. Mazenot (1939, p. 67) indicated that "this group includes *Berriasella* of small and medium size and flat shape in which the ribbed ornamentation ... smoothens on the body chamber beginning from the external third of the flanks, spreading more or less completely to the more external and internal portions of the shell."

Based on the group of species *B. delphinensis* described by Mazenot, Le Hégarat (1971) described the genus *Delphinella* and gave it the following diagnosis (p. 852): "Ammonites with rather evolute coiling. The ornamentation consists of simple and bifurcating rings, discontinued on the venter, with thickened terminations. The cross section is trapezoid in the first whorls to become elliptical later. The siphonal band is stable. The ornamentation shows a trend to smoothing in the body chamber." Le Hégarat assigned 11 species to *Delphinella* (*D. auzonensis*, *D. boisseti*, *D. berthei*, *D. delphinensis*, *D. garnieri*, *D. obtusenodosa*, *D. subchaperi*, *D. tresanensis*, *D. ellenica*, *D. sevenieri*, and *D. crimensis*). Later Le Hégarat (1971) indicated that four of the 11 species have bundles at the beginning of the ribs (*D. auzonensis*, *D. crimensis*, *D. subchaperi*, and *D. tresanensis*), while these species should probably be recognized as a separate subgenus.

Later changes were made regarding the rank of members of *Delphinella*. Hoedemaeker (1982) placed them as a subgenus in the genus *Berriasella*. Tavera (1985) did not accept the genus *Delphinella* and assigned the species *berthei*, *delphinensis*, *garnieri*, and *obtusenosoda* to *Berriasella* (*Berriasella*), and the species *subchaperi* to the genus *Jabronella*. Partly, without indicating exactly which species he meant, he included the genus *Delphinella* into the synonymy of the genera *Elenaella*, *Fauriella*, and *Tirnovella*.

In the new edition of the American list of Cretaceous Ammonites, *Delphinella* is considered as a junior synonym of the subgenus *Elenaella* Nikolov, 1966 of the genus *Berriasella* (Wright *et al.*, 1996). At the same time Nikolov (1982) regarded *Elenaella* as a subgenus of the genus *Dalmasiceras*. This opinion was supported by Howarth (1992), when he described *Dalmasiceras* from the Chia Gara Formation of Iraq for the volume of *Treatise*.

In our opinion, the genus *Delphinella* sensu Le Hégarat (1971) includes species with different sets of morphological characters. On the one hand, the list

includes microconches (species *berthei* and *delphinensis*) with simple ornamentation (paired and single ribs), and, on the other hand, the list includes macroconches (species *crimensis*, *janus*, and *subchaperi*) with complex ornamentation (triple and bidichotomous ribs) and umbilical and, occasionally, lateral nodes. Nevertheless, we follow Le Hégarat and accept this genus. We consider the smoothing of the ornament on the body chamber and clear discontinuity of ribbing on the venter to be the main diagnostic characters of this taxon. Because of this, we assign the species *berthei*, in which the ribs are not smoothed, to the genus *Berriasella*.

SYSTEMATIC PALEONTOLOGY

Family Berriasellidae Spath, 1922

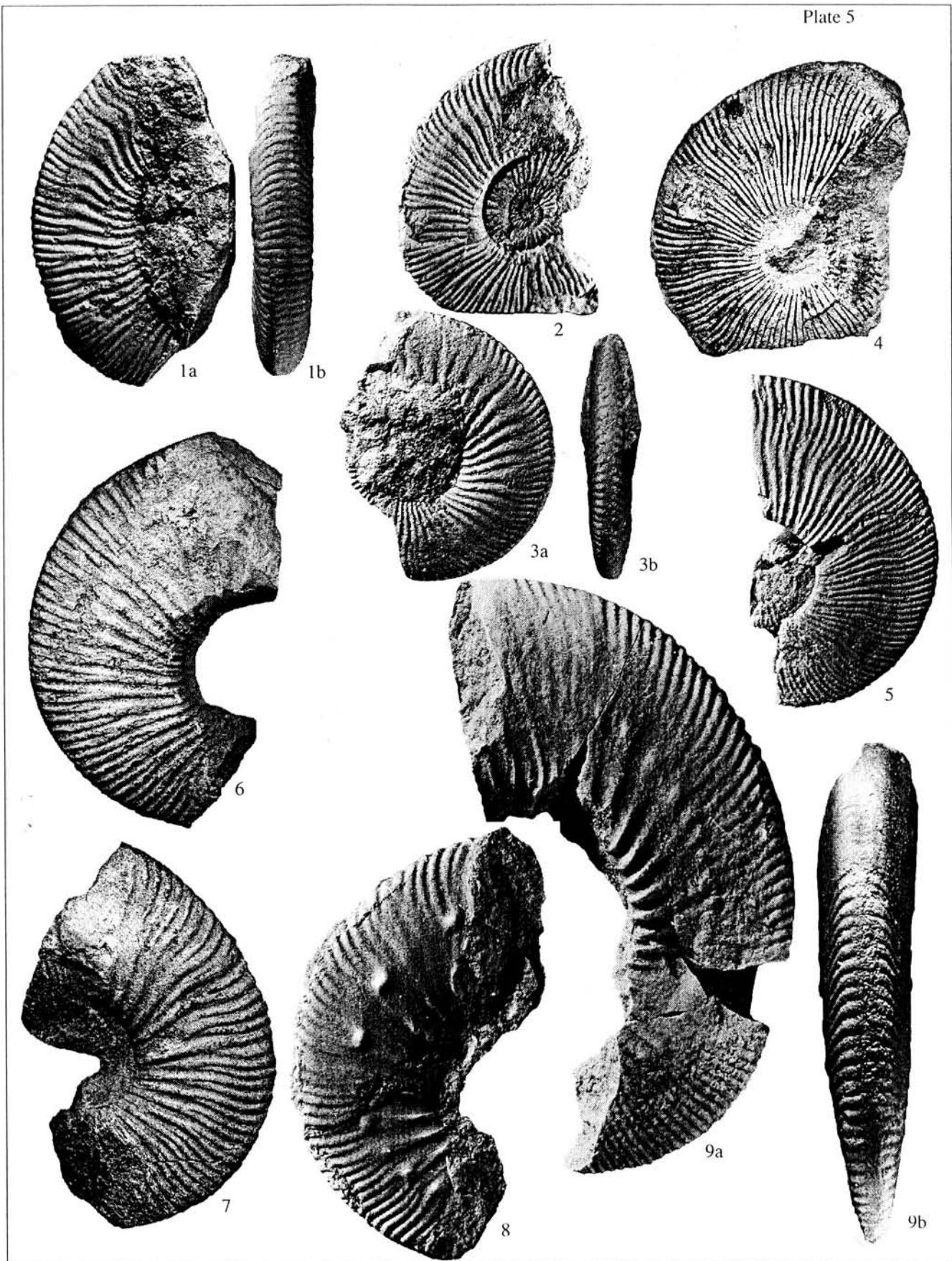
Genus *Delphinella* Le Hégarat, 1971

Type species. *Hoplites delphinensis* Kilian, 1889; Berriasian of southeastern France.

Diagnosis. Shells discoidal, evolute, micro- and macroconches. Umbilicus wide and stepped. Ornamentation consisting of either paired or single ribs, or has triply bundled, or bidichotomous ribs. In the bifurcation point, ribs thickened, sometimes forming umbilical and lateral nodes. On body beginning from mid-height, ornamentation smoothed, although sharply increasing near venter. Ribs discontinuing on venter. Suture ammonitic.

Species composition. Fifteen species: *D. delphinensis* (Kilian), *D. garnieri* (Mazenot), *D. obtusenodosa* (Retowski), *D. subchaperi* (Retowski), *D. ellenica* (Nikolov), *D. crimensis* (Burckhardt), *D. janus* (Retowski), *D. auzonensis* Le Hégarat, *D. boisseti* Le Hégarat, *D. tresanensis* Le Hégarat, *D. sevenieri* Le Hégarat, *D. mollovi* Nikolov, *D. veselinensis* Nikolov, *D. consanguinea* (Retowski), *D. pectinata* sp. nov. from the Berriasian of western Europe, Crimea, Caucasus, and Tunisia.

Comparison. The genus *Delphinella* closely connected with the genus *Berriasella*, and in many cases the separation of the two genera is difficult. Large shells of *Delphinella* differ sharply from *Berriasella* in two ways. Smoothing of the ribbing and the presence of lateral nodes. Some paleontologists consider members of the genus *Delphinella* as macroconches and those of *Berriasella* as microconches. By the smoothing of the ribbing, which is also observed in *Dalmasiceras*, *Delphinella* differ from this genus in the absence of umbilical nodes and by the presence of pronounced lateral nodes. *Delphinella* is very similar to tubercular berriasianellins, for example, *Malbosiceras* s.l. (Wright *et al.*, 1996, p. 50), from which it is distinguished by the presence of a sharp discontinuity of the ribs on the venter with the rib terminations thickened on the ventrolateral shoulder, by the absence of umbilical nodes, and by the thinner (less robust) ribs.



Delphinella subchaperi (Retowski, 1893)

Plate 5, figs. 8 and 9

Hoplites subchaperi: Retowski, 1893, p. 64, pl. 4, figs. 3 and 4; Simionescu, 1899, p. 5, pl. 1, fig. 2.

Dalmasiceras ? subchaperi: Grigorieva, 1938, p. 118, pl. 7, figs. 2a and 2b.

Berriassella subchaperi: Luppov *et al.*, 1949, p. 220, pl. 63, fig. 1; non *Berriassella subchaperi*: Druschits, 1960, p. 276, pl. 21, fig. 1 (= *Retowskiceras andrussowi* (Ret.)).

Delphinella subchaperi: Le Hégarat, 1971, p. 112, pl. 13, fig. 12, pl. 42, fig. 10; Bogdanova *et al.*, 1984, pl. 4, figs. 4 and 5; Khimshiashvili, 1989, p. 17, pl. 4, fig. 1.

Delphinella obtusenodosa: Nikolov, 1982, p. 86, pl. 20, fig. 5.

Jabronella subchaperi: Tavera, 1985, p. 304, pl. 46, fig. 1, text-fig. 23/A.

Shell shape. Shells are large, discoidal, with slowly expanding whorls. Flanks are wide, almost flat. The venter is flattened. The umbilicus is shallow, moderately wide, with a narrow, sloping umbilical wall. The umbilical shoulder is gently sloping. The whorl cross section is rectangular to oval, compressed.

Ornamentation. The whorls less than 50–60 mm in diameter have very thin and dense ribbing. Paired ribs dichotomizing at mid-flank or slightly above predominate. Very rarely the bifurcation occurs near the umbilical shoulder with further deviating of both ribs. Single intercalating ribs are present. In the adult whorl two pairs of thickenings appear on the ribs: umbilical and lateral (at the point of rib bifurcation). Umbilical swellings virtually do not develop into nodes but remain as elongated sharp ridges. These ridges give rise to indistinct dichotomously branching ribs. Approximately in the middle of the whorl, these branches are connected by nodes, which in some specimens are elongated and pointed, and are oriented perpendicular to the ribs. After the lateral node in the upper part of the whorl within the pair of ribs, a third rib appears. Two or three single intercalating ribs are present between the bundles. These ribs begin from the mid-whorl or slightly lower. Near the lateral nodes the ribs are smoothed and indistinct. Near the venter the ribs are distinct, wide, and ribbon-like. They are interrupted on the venter by a smooth band. The rib terminations on the ventrolateral shoulder are directed slightly forward.

Comparison. This species is distinguished from the similar species *D. obtusenodosa* by the less robust

ornamentation in early whorls, more pronounced umbilical ridges, and by the lateral nodes in adults.

Remarks. Following Grigorieva (1938) we include the specimen figured by Simionescu, 1899, pl. 1, fig. 2 in the synonymy list of this species, although it differs somewhat from the typical *subchaperi* in the longer (reaching the umbilicus) intercalating ribs, we think that this is just variability. The specimen figured and described by Nikolov (1982, p. 86, pl. 20, fig. 5) as *D. obtusenodosa* has strongly pronounced umbilical nodes. We assign this specimen to *D. subchaperi*. The specimen figured by Druschits (1960, pl. 21, fig. 1) has coarse ribs (without smoothing) and sharply pronounced lateral nodes and most likely should be assigned to *Retowskiceras andrussowi*.

Occurrence. Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone), Caucasus, Bulgaria, south-eastern France, Spain; Berriasian of Switzerland.

Material. Three specimens (nos. 1/13055–3/13055) from Cape St. Ilya and the village of Sultanovka; coll. by T.N. Bogdanova.

Delphinella crimensis (Burckhardt, 1912)

Plate 6, figs. 7–9

Hoplites calisto d'Orbigny var. *delphinensis*: Retowski, 1893, p. 57, pl. 3, fig. 4.

Hoplites occitanicus: Retowski, 1893, p. 60, pl. 3, figs. 7 and 8, non fig. 9.

Steuroceras crimensis: Burckhardt, 1912, p. 165.

Delphinella crimensis: Le Hégarat, 1971, p. 103, pl. 42, figs. 6 and 8; Bogdanova *et al.*, 1984, pl. 2, fig. 6; pl. 3, fig. 6.

Shell shape. Shells are medium-sized, with discoidal, moderately low and weakly expanding whorls. The flanks are strongly flattened. The venter is narrow, very weakly convex. The whorl cross section is high and rectangular to oval. The umbilicus is moderately wide and shallow. The umbilical shoulder is smooth. The umbilical wall is narrow and gently sloping.

Ornamentation. On the inner whorls (up to $Dm = 30\text{--}35$ mm), the ornamentation consists of very thin, densely spaced, weakly curved ribs. Triply bundled ribs with low bifurcation points at the umbilical shoulder and high bifurcation points of one of the branches in the mid-flank dominate. In addition, doubly bundled ribs with bifurcation at the umbilical shoulder and paired ribs dichotomizing at the mid-whorl are

Explanation of Plate 5

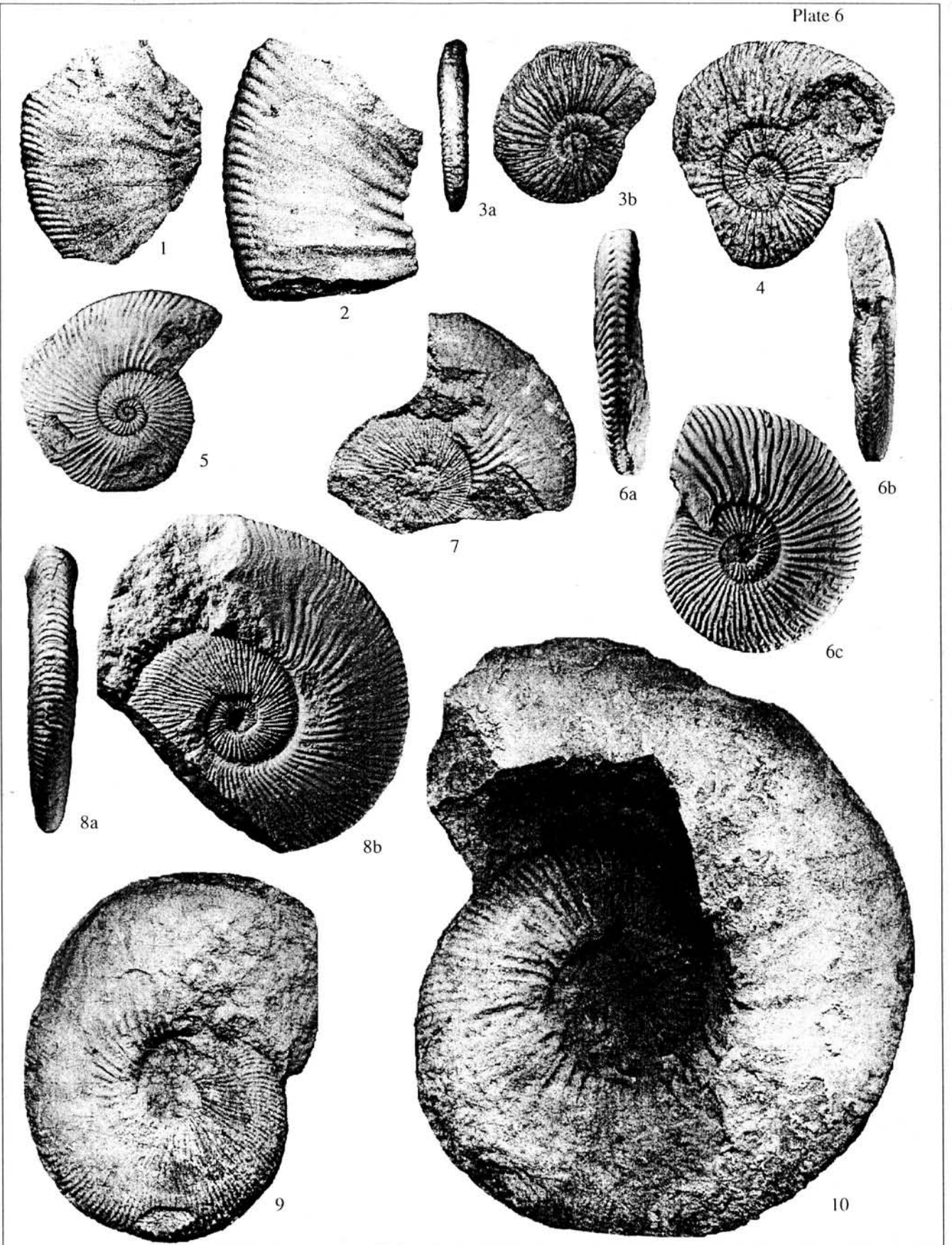
In all cases the size is natural.

Figs. 1–3. *Delphinella janus* (Retowski); (1) specimen no. 35/1305: (1a) lateral view, (1b) ventral view; village of Sultanovka; *grandis* Subzone; (2) specimen no. 33/13055, lateral view; village of Nanikovo; *grandis* Subzone; (3) specimen no. 32/13055: (3a) lateral view, (3b) ventral view; Cape St. Ilya; *grandis* Subzone.

Figs. 4 and 5. *Delphinella tresanensis* Le Hégarat; (4) specimen no. 20/13055, lateral view; village of Nanikovo; *grandis* Subzone; (5) specimen no. 19/13055, lateral view; Barakol Valley; *grandis* Subzone.

Figs. 6 and 7. *Delphinella obtusenodosa* (Retowski); (6) specimen no. 16/13055, lateral view; Cape St. Ilya; *grandis* Subzone; (7) specimen no. 15/13055, lateral view; the same age and locality.

Figs. 8 and 9. *Delphinella subchaperi* (Retowski); (8) specimen no. 1/13055, lateral view; village of Sultanovka; *grandis* Subzone; (9) specimen no. 3/13055: (9a) lateral view, (9b) ventral view; the same age and locality.



present. Rarely, bidichotomous ribs and, very rarely, single ribs are present. No pattern in alternation of the rib types is present. In the body chamber at WH = 23–25 mm, the whorls increase more slowly in height, while the ribbing smoothen in the mid-flank. At this stage, thin single crestlike ribs are seen running from the umbilical shoulder to one-third of the whorl height. Further, the ribs smoothen to the extent that the places of their bifurcation become very indistinct. After branching, the ornamentation consists of bundles of two or three ribs, which are sharply pronounced near the ventrolateral shoulder. In the inner whorls, the ribs are separated on the venter by a smooth band that disappears in the body chamber because ribs continue onto the venter.

Dimensions in mm, ratios, and number of whorls per half whorl:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per half whorl	
								inner	outer
4/13055	68	24	10	23	0.35	0.15	0.34	34	64
	30							25	–
5/13055	50	23	–	14	0.46	–	0.28	–	–
	28							20	45
6/13055	71	32	–	18	0.45	–	0.25	–	–
7/13055	46.5	19	–	12.5	0.41	–	0.27	24	49

Comparison. This species differs from other species in the diversity of ribs and their considerable smoothening in the body chamber.

Remarks. Burckhardt (1912) only named the species *crimensis*, without describing or figuring it. Le Hégarat (1971) was the first to describe the species. This author placed this species in the synonymy list of *Hoplites calisto* d'Orbigny var. *delphinensis*, described by Retowski (1893). We studied Retowski's collection and concluded that the variety *delphinensis*, similar to specimens described by Le Hégarat, is characterized by the development of various ribs: triple (bundled), bidichotomous, paired, and single.

Occurrence. Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone), southeastern France, Spain.

Material. Nine specimens (nos. 4/13055–12/13055) from Cape St. Ilya, Barakol Valley, and the village of Sultanovka; coll. by V.V. Druschits, B.T. Yanin, T.N. Bogdanova, and V.V. Arkadiev.

Delphinella obtusenodosa (Retowski, 1893)

Plate 5, figs. 6 and 7; Plate 6, fig. 6

Hoplites obtusenodosa: Retowski, 1893, p. 62, pl. 3, figs. 10 and 11.

Berriasella obtusenodosa: Mazenot, 1939, p. 73, pl. 8, figs. 3 and 4; Druschits, 1960, p. 275, pl. 22, fig. 1.

Berriasella n. sp. ind. (gr. *B. delphinensis*): Mazenot, 1939, p. 71, pl. 6, fig. 19.

non *Berriasella* aff. *obtusenedosa*: Mazenot, 1939, p. 72, pl. 7, figs. 6 and 7 (= *Delphinella ellenica* (Nikolov)).

non *Berriasella obtusenodosa*: Arnould-Saget, 1953, p. 46, pl. 5, fig. 1 (= ? *Berriasella*).

? *Berriasella* aff. *obtusenedosa*: Le Hégarat and Remane, 1968, pl. 4, fig. 2.

non *Delphinella obtusenodosa*: Khimshiashvili, 1976, p. 100, pl. 16, fig. 6.

non *Berriasella* (*Delphinella*) *obtusenedosa*: Sapunov, 1979, p. 178, pl. 56, fig. 8 (= *Delphinella janus* (Retowski)).

Delphinella obtusenodosa: Le Hégarat, 1971, p. 109, pl. 13, figs. 10, 11, 13, and 14; pl. 41, figs. 6 and 7 (non fig. 1); Nikolov, 1982, p. 86, pl. 21, fig. 1 (non pl. 20, fig. 5); Bogdanova *et al.*, 1984, pl. 4, fig. 2.

Shell shape. Shells are medium-sized to large, with discoidal, low, moderately expanding whorls. The whorl cross section is high and rectangular. The umbilicus is shallow and moderately wide. The umbilical wall is narrow, poorly delineated, and gently sloping.

Ornamentation. Flanks on the inner whorls up to Dm = 25–30 mm are covered by thin bifurcating straight ribs. They begin on the umbilical wall, lean weakly backwards on the umbilical shoulder, and after that slightly slanting orad run across the flank. Somewhat above the mid-flank, the ribs branch into two similarly pronounced ribs, with the posterior leaning slightly backwards. On the venter, the ribs are interrupted by a smooth narrow band. The ornamentation of adult whorls at Dm = 50 mm consists of paired and, more rarely, single ribs. Weak crests develop on the umbilical shoulders of the body chamber. Swellings develop in the bifurcation points. These swellings sometimes become indistinct elongated nodes. Immediately after the swellings, ribs smoothen. This effect disappears near the venter. The ribs on the venter of the

Explanation of Plate 6

In all cases the size is natural.

Figs. 1 and 2. *Delphinella pectinata* sp. nov.; (1) holotype no. 39/13055, lateral view; Cape St. Ilya; *grandis* Subzone; (2) specimen no. 40/13055, lateral view; the same age and locality.

Figs. 3 and 4. *Berriasella berthei* (Toucas); (3) specimen no. 42/13055: (3a) ventral view, (3b) lateral view; village of Sultanovka; *grandis* Subzone; (4) specimen no. 41/13055, lateral view; Barakol Valley; *grandis* Subzone.

Fig. 5. *Delphinella delphinensis* (Kilian); specimen no. 28/13055, lateral view; village of Nanikovo; *grandis* Subzone.

Fig. 6. *Delphinella obtusenodosa* (Retowski); specimen no. 13/13055: (6a) ventral view, (6b) apertural view, (6c) lateral view; Cape St. Ilya; *grandis* Subzone.

Figs. 7–9. *Delphinella crimensis* (Burckhardt); (7) specimen no. 5/13055, lateral view; Cape St. Ilya; *grandis* Subzone; (8) specimen no. 4/13055: (8a) ventral view, (8b) lateral view; Barakol Valley; *grandis* Subzone; (9) specimen no. 6/13055, lateral view; village of Sultanovka; *grandis* Subzone.

Fig. 10. *Delphinella janus* (Retowski); specimen no. 34/13055, lateral view; Cape St. Ilya; *grandis* Subzone.

body chamber are separated by a smooth band. Rib terminations are curved anteriorly.

Dimensions in mm, ratios, and number of whorls per half whorl:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per half whorl	
								inner	outer
13/13055	51	20.5	9.5	16.5	0.40	0.19	0.32	22	42
14/13055	26.5	11	-	7	0.42	-	0.26	25	48

Comparison. This species differs from *D. subchaperi* in the less strongly pronounced umbilical ridges and weakly developed lateral nodes.

Remarks. Khimshiashvili (1976) described *D. obtusenodosa* from the Northern Caucasus. The attentive study of his paper shows that the only specimen from the Caucasus possesses tripled ribs and has no smoothening of the ornamentation, features that are not characteristic of *D. obtusenodosa*. Because of this, the authors of this paper do not place the specimen from the Northern Caucasus in the synonymy list.

Occurrence. Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone); Bulgaria, southeastern France, and Spain.

Material. Six specimens (nos. 13/13055–18/13055) from the Cape St. Ilya and from the village of Sultanovka; coll. by T.N. Bogdanova.

Delphinella tresanensis Le Hégarat, 1971

Plate 5, figs. 4 and 5

Hoplites occitanicus: Retowski, 1893, p. 60, pl. 3, fig. 9, nos. figs. 7 and 8.

Delphinella tresanensis: Le Hégarat, 1971, p. 113, pl. 13, fig. 15; pl. 42, figs. 1 and 2.

Berriasella (Delphinella) tresanensis: Hoedemaeker, 1982, pl. 1, fig. 4.

Shell shape. Shells are medium-sized, flattened, with high moderately expanding whorls. The flanks are weakly convex, slightly diverging toward the umbilicus. The venter is narrow, flat, and smooth. The umbilicus is shallow, moderately narrow, with low sloping walls. The umbilical shoulder is very rounded.

Ornamentation. The ribbing is thin and dense. The ribs are weakly curved, paired, tripled (bundled), and occasionally single. In the tripled rib, the bottom branching occurs somewhat above the umbilical shoulder. One of the branches again fork into two branches slightly below the middle of the flank. Paired ribs, branching on the umbilical shoulder or subdividing approximately in the mid-flank are present. Sparse single ribs, appearing near the umbilical shoulder, are present. Whorls about 60 mm in diameter show weakening of the ribbing in the mid-flank, which is clearly visible in the specimen figured by Retowski (1893, pl. 3, fig. 9). All ribs are flattened toward the periphery and are interrupted on the ventrolateral shoulder, leaving the venter smooth.

Dimensions in mm, ratios, and number of whorls per half whorl:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per half whorl	
								inner	outer
19/13055	63	28	-	18.5	0.44	-	0.29	27	60
20/13055	62	32	13	10.5	0.52	0.21	0.17	24	55
21/13055	39	18	-	11	0.46	-	0.28	24	48
22/13055	27	14	-	8	0.52	-	0.30	23	47

Comparison. This species differs from the similar, densely ribbed spaces *D. crimensis* in the sparser and straighter ribs in the inner whorls (up to Dm = 25–30 mm) and also, to a lesser extent, in the smoothening of the ribbing on the body chamber.

Occurrence. Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone), southeastern France, and Spain.

Material. Nine specimens (nos. 19/13055–27/13055) from Cape St. Ilya, Barakol Valley, and the villages of Nanikovo and Sultanovka; coll. by V.V. Druschits, T.N. Bogdanova, and V.V. Arkadiev.

Delphinella delphinensis (Kilian, 1889)

Plate 6, fig. 5

Hoplites delphinensis: Kilian, 1889, p. 662, fig. 1.

Hoplites calisto: Retowski, 1893, p. 55, pl. 3, fig. 1, non *Hoplites calisto* var. *delphinensis*: Retowski, 1893, p. 57, pl. 3, fig. 4 (= *D. crimensis*).

Berriasella delphinensis: Mazonot, 1939, p. 67, pl. 6, figs. 14 and 15; Arnould-Saget, 1953, p. 45, pl. 4, figs. 10 and 11, text-fig. 14.

Delphinella delphinensis: Le Hégarat, 1971, p. 104, pl. 13, figs. 7 and 8; pl. 42, figs. 3 and 9; Nikolov, 1982, p. 86, pl. 20, figs. 2–4, non *Berriasella (Delphinella)* cf. *delphinensis*: Sapunov, 1977, pl. 6, fig. 5; 1979, p. 177, pl. 56, fig. 7 (= *Delphinella mollovi* Nikolov).

Shell shape. Shells are small (microconches), with slowly expanding whorls. The flanks are flattened. The venter is flat. The umbilicus is shallow and wide. The umbilical wall is narrow, indistinct, and gently sloping. The whorl cross section is high, rectangular to oval.

Ornamentation. The flanks are covered by straight or weakly curved bifurcating or, less commonly, single ribs. The whorls 20–30 mm in diameter possess weak swelling and flattening of ribs. A general smoothening of the ribbing is developed above the mid-flank. The ribs do not cross the venter, on which a wide smooth band is developed.

Dimensions in mm, ratios, and number of whorls per half whorl:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per half whorl	
								inner	outer
28/13055	41	15.5	-	12.5	0.38	-	0.30	25	48

Comparison. This species differs from most species in the smaller size (microconches) and early smoothening of the ribbing. The latter character is very weakly developed.

Remarks. The study of Retowski's collection showed that the specimen of *Hoplites calisto* figured by him (Retowski, 1893, pl. 3, fig. 1) has the ribbing smoothened on the body chamber and, hence, should be assigned to *D. delphinensis*. Previously Arkadiev and Bogdanova (2004) identified this specimen as *Berriassella calisto*. The variety *delphinensis*, described by Retowski, 1893, shows various types of ribs (triple, bidichotomous, etc.), which does not agree with the diagnosis of the species *delphinensis* given by Kilian (1889). Triple ribs are present in *B. (D.) cf. delphinensis*, described by Sapunov (1977, 1979), which apparently instigated Nikolov (1982) to recognize it as a new species, *D. mollovi*.

Occurrence. Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone), Bulgaria, southeastern France, Spain, and Tunisia.

Material. Three specimens (nos. 28/13055–30/13055) from the Cape St. Ilya, Barakol Valley, and the village of Sultanovka; coll. by V.V. Druschits and T.N. Bogdanova.

Delphinella janus (Retowski, 1893)

Plate 5, figs. 1–3; Plate 6, fig. 10

Hoplites janus: Retowski, 1893, p. 59, pl. 3, figs. 5 and 6.

Berriassella aff. janus: Mazonot, 1939, p. 70, pl. 6, figs. 20 and 21.

Delphinella janus: Nikolov, 1982, p. 88, pl. 21, fig. 5.

Delphinella delphinensis: Bogdanova et al., 1984, pl. 2, fig. 3.

Shell shape. The shells are discoidal and medium-sized. The whorls are high, weakly overlapping, and slowly expanding. The flanks are very weakly convex. The venter is narrow and weakly convex. The umbilicus is wide and shallow. The umbilical shoulder is rounded. The umbilical wall is narrow and steep.

Ornamentation. In juvenile whorls (up to Dm = 40 mm), the flanks possess various ribs, mainly paired and tripled (bundled) and, less commonly, bidichotomous and single. The ribs begin in the middle of the umbilical wall. Their terminations are directed sharply forward. On the umbilical shoulder, they form an arc directed backward, whereas on the flanks again slant forward. The ribs run straight across the flanks. The first branching occurs on the umbilical shoulder; the upper branching is in mid-flank. In the upper part of the whorl, all ribs become flattened, and soon after crossing the ventrolateral shoulder discontinue to leave a smooth band on the venter. The shape of the ribbing on the body chamber at Dm = 50–60 mm changes. Paired ribs prevail, and single ribs are less common. In the middle part, the ribs smoothen; hence, the upper branching is indistinct. The frequency of ribbings compared to younger stages is reduced. The ribs become thicker and sparser.

Dimensions in mm, ratios, and number of whorls per half whorl:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per half whorl	
								inner	outer
31/13055	66	25.5	11	21.5	0.39	0.17	0.33	28	60
32/13055	52	18.5	9	–	0.36	0.17	–	25	52
33/13055	53	19	9.2	18	0.36	0.17	0.34	25	53

Comparison. This species differs from *D. delphinensis* in the larger size and more intense ribbing, which become smoother later in ontogeny. It is distinguished from the closely related *D. crimensis* by the less dense and more crestlike ribs on the body chamber.

Occurrence. Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone), Bulgaria, and southeastern France.

Material. Eight specimens (nos. 31/13055–38/13055) from Cape St. Ilya, Barakol Valley, and the villages of Sultanovka and Nanikovo; coll. by T.N. Bogdanova, V.V. Druschits, and V.V. Arkadiev.

Delphinella pectinata Arkadiev et Bogdanova, sp. nov.

Plate 6, figs. 1 and 2

Etymology. From the Latin *pectinatus* (pectinate).

Holotype. TsNIGR Museum, no. 39/13055; Feodosiya, Cape St. Ilya, Berriasian, *jacobi* Zone, *grandis* Subzone.

Shell shape. Judging from two fragments of adult whorls, the shells are discoidal, with wide flattened flanks and narrow venter.

Ornamentation. Two fragments of a quarter of a whorl possess a distinctive ornamentation. Six inner ribs are present. They begin on the umbilical shoulder with small spiky nodes and slant orad. Somewhat above one-third of the height of the whorl a crestlike swelling on the flanks is present. Ribs near nodes are narrow and sharp and, after entering the swelling, become flattened, wide, and indistinctly bifurcate. The swelling subdivides the flank into two unequal parts. Before the swelling, the thickness of the shell increases to become slightly reduced later. After the swelling, a wide depression is present on the shell. Hardly noticeable ribs run across the depression, slanting backwards. Near the ventrolateral shoulder, the ends of the ribs become sharp, distinct, and thin. They are then turned forward again. An additional two or three ribs appear between the bundles of ribs. The number of external ribs on a quarter of the whorl reaches 25. On the venter, the ribs are interrupted by a narrow smooth band.

Comparison. This species differs from *Delphinella* in the very distinctive ornamentation.

Occurrence. Berriasian, *jacobi* Zone, *grandis* Subzone of the Crimea.

Material. Two specimens (nos. 39/13055 and 40/13055) from Cape St. Ilya; coll. by V.V. Arkadiev.

Genus *Berriasella* Uhlig, 1905

Berriasella berthei (Toucas, 1890)

Plate 6, figs. 3 and 4

Hoplites callisto var. *berthei*: Toucas, 1890, p. 601, pl. 17, figs. 6 and 7; Retowski, 1893, p. 55, pl. 3, fig. 3.

Berriasella berthei: Mazenot, 1939, p. 48, pl. 2, figs. 9 and 10, non figs. 11 and 12 (= *D. sevenieri*); Arnould-Saget, 1953, p. 26, pl. 2, figs. 12 and 13; pl. 3, fig. 3; Le Hégarat and Remane, 1968, pl. 5, fig. 5.

Delphinella berthei: Le Hégarat, 1971, p. 99, pl. 13, figs. 3–5; pl. 42, figs. 11 and 12; Nikolov, 1982, p. 87, pl. 21, figs. 2–4.

Berriasella (Berriasella) berthei: Tavera, 1985, p. 248, pl. 34, figs. 1 and 2, text-fig. 19/H.

Shell shape. The shells are small (microconches), flattened, with high, moderately expanding whorls. Flanks are weakly convex. The venter is flattened. The umbilicus is wide, with low, gently or steeply sloping wall.

Ornamentation. The flanks possess relatively coarse, straight, mainly bifurcating ribs. Branching occurs in the middle part of the flanks. Sparse single ribs beginning from the umbilicus are present. On the body chamber, at the place where ribs are branching, crestlike swellings are developed. The ribs become coarser, flatter, and sparser. The rib terminations on the ventrolateral shoulder are weakly curved forward. On the venter the ribs are interrupted by a narrow smooth band.

Dimensions in mm, ratios, and number of whorls per half whorl:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm	Number of ribs per half whorl	
								inner	outer
41/13055	45	17.5	–	16	0.39	–	0.36	–	–
42/13055	31	12	6.5	9	0.39	0.21	0.29	20	39

Comparison. This species is distinguished from other species by the type of ribbing near the venter and slight swellings at the points of rib bifurcation.

Remarks. This species has a conflicting set of characters. On the one hand, it shows a weak thickening and flattening of the ribs on the body chamber, which is characteristic of the genus *Delphinella*; on the other hand, the ribbing (paired and single ribs) and the absence of smoothening of the ribbing suggest its affinity to the genus *Berriasella*. Such a combination of characters certainly indicates a close connection between these genera. We decided to leave the species *berthei* in the genus *Berriasella*. However, its precise diagnostics will be possible only when new data on the morphogenesis of the shells and the sutural outline become available.

Occurrence. Berriasian, *jacobi*–*occitanica* Zones (*subalpina* Subzone) southeastern France, Bulgaria;

Berriasian, *jacobi* Zone of the Crimea (*grandis* Subzone), Spain, and Tunisia.

Material. Two specimens (nos. 41/13055–42/13055) from Cape St. Ilya and from the Barakol Valley; coll. by T.N. Bogdanova.

CONCLUSIONS

As a result of this study, a rich assemblage of *Delphinella* species (seven species, including *D. subchaperi*, *D. crimensis*, *D. obtusenodosa*, *D. tresanensis*, *D. delphinensis*, *D. janus*, and *D. pectinata*) has been described for the first time from the Berriasian of the Crimean Mountains. This assemblage allows the recognition of the standard *jacobi* Zone in the section and correlation with southwestern France (Le Hégarat, 1971), Spain (Tavera, 1985), Bulgaria (Nikolov, 1982), Caucasus (Khimshiashvili, 1976, 1989), and other areas of the Mediterranean region.

The *chomeracensis* Subzone, recognized by Arkadiev in the Feodosiya section in the lower part of the *jacobi* (Arkadiev and Savelieva, 2002; Arkadiev, 2003), is presently characterized only by members of the genera *Berriasella* and *Fauriella*. *Delphinella* have not been found in this subzone. In the Crimea all records of this genus are restricted to the *grandis* Subzone, where they have been found together with *Pseudosubplanites*, *Berriasella*, and *Retowskiceras*. The study by Arkadiev of the section of the *jacobi* Zone in the basin of the Tonas River in 2003 showed that very few *Delphinella* occur with *Pseudosubplanites grandis* and other *Pseudoplanulites*, i.e., they are also characteristic only of the *grandis* Subzone. Furthermore, in the lower part of the Tonas section, below the levels with *Pseudosubplanites grandis*, the species *Berriasella jacobi* was found. This allowed the subdivision of the *jacobi* Zone into two subzones, *jacobi* and *grandis*, rather than *chomeracensis* and *grandis*, as was suggested previously (Arkadiev, 2003).

For southeastern France Le Hégarat (1971) noted that *D. crimensis*, *D. delphinensis*, *D. obtusenodosa*, *D. subchaperi*, and *D. tresanensis* are characteristic only of the *jacobi* Zone in Le Hégarat's terminology, i.e., for the lower part of the *jacobi* Zone in its modern understanding (Hoedemaeker and Bulot, 1990). No separation of the finds of *Delphinella* and *Pseudosubplanites* have been so far found in the Crimea, perhaps, because all the sections studied (Cape St. Ilya, Sultanovka, and Nanikovo) are incomplete. They do not expose deposits covering the *jacobi* Zone in a complete section. Hence, we can correlate the Crimean *grandis* Subzone only with the entire *jacobi* Zone. However, the analysis of ammonites from Retowski's collection allows the recognition of the overlying *occitanica* Zone in the Feodosiya Section (Bogdanova et al., 1999). Most likely, deposits of this zone are presently in the built up part of the town and are not exposed.

We emended the diagnosis of the genus *Delphinella*, according to which the species *berthei* is assigned to the genus *Berriasella*.

A close connection of the Berriasian marine basin of the Crimean Mountains existed with the western European basins. Of 15 species of the genus *Delphinella* known now, seven are recorded from the Crimea, of which five are shared with France.

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