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The Genus *Dalmasiceras* (Ammonoidea) from the Berriasian of the Mountainous Crimea

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Abstract—The genus *Dalmasiceras* from the Berriasian of the Mountainous Crimea is revised. Three new species of this genus, *D. tauricum*, *D. belbekense*, and *D. subtoucasi* are described. The distribution of ammonites in the Kabanii Log Section (basin of the Belbek River) supports a correlation of the beds yielding *Dalmasiceras* in the Mountainous Crimea to the *D. dalmasi* Subzone of the Berriasian stratotype.

INTRODUCTION

Ammonoids of the genus *Dalmasiceras* play an important role in Berriasian biostratigraphy in all the regions where they occur, in Southeastern France (Le Hegarat, 1973), Northern Caucasus (Khimshiashvili, 1976; Sakharov *et al.*, 1987; Sei and Kalacheva, 1997), and in Crimea (Gorbatchik *et al.*, 1970; Druschits, 1975; Kvantaliani and Lysenko, 1979; Bogdanova *et al.*, 1981; *Atlas*..., 1997).

Druschits (1960) was first to determine this genus from Crimea. He described the following species: *D. dalmasi*, *D. punctatum*, and *D. crassicostatum*. Kvantaliani (1989) described the beds yielding *Dalmasiceras* in Central Crimea and listed the following species: *D. dalmasi*, *D. punctatum*, *D. crassicostatum*, *D. botellae*, *D. abkhasicum*, *D. mazenoti*, and *D. elegans*. He studied the siphuncle and septal necks in *D. punctatum*, and shell and sutural ontogeny in *D.* ex gr. *housai*.

The beds with Dalmasiceras in Crimea were previously recognized as the *Euthmiceras euthymi* and *Dalmasiceras dalmasi* Zone (Gorbatchik *et al.*, 1970) or the *D. dalmasi* Zone (Kvantaliani and Lysenko, 1979), and later in the *D. crassicostatum* Zone (Bogdanova *et al.*, 1981). These beds in the view of all the above workers correspond with the *D. dalmasi* Zone of the Berriasian in its type region. At present, they should apparently be regarded as beds containing a faunal assemblage rather than a zone since the paleontologically based boundaries of these beds are known only in the section of Central Crimea (basin of the Sary-sy River, Balki Section) and since the underlying and overlying strata are the local stratigraphic units that are not put in correspondence with the zonal scale in the Berriasian type region. In contrast, the stratigraphic position of the underlying and overlying strata is determined by the Dalmasiceras-bearing beds (Bogdanova and Kvantaliani, 1983).

MATERIAL

The collections are housed in the Museum of the State Mining Institute (Technical University), St. Petersburg (SPGGI), nos. 330 and 333.

Abbreviations: D–shell diameter, UW–umbilical width, WH–whorl height, WW–whorl width., W–whorl expansion rate

RESULTS

In 1983 V.V. Arkadiev described a sequence of the Berriasian rocks in the Kabanii Log Section (valley of the Belbek River, Southwestern Crimea) (Fig. 1). The systematic composition of the ammonite fauna and the stratigraphic range of the species show that the upper part of Member 2 (about 3 m) should be assigned to the beds with *Dalmasiceras*. Below these beds, immediately above the series of polymict conglomerates, tentatively assigned to the Berriasian, *Ptychophylloceras* cf. *ptychoicum* (Quenst.) and *P.* cf. *inordinatum* (Toucas) were found. These species do not determine the stratigraphic position of these beds in the biostratigraphic scheme of the Berriasian. Hence, the lower boundary of the Beds with *Dalmasiceras* in this section was not drawn. Above these beds in Members 4 and 5 *Lytoceras honnorati* d'Orb., *Ptychophylloceras ptychoicum* (Quenst.), *Malbosiceras* ex gr. *paramimounum* (Maz.), *M.* ex gr. *malbosi* (Pict.) and *Himalayites* sp. were found. The *Dalmasiceras* species were not found in this part of the section. Hence, the upper boundary of the Beds with *Dalmasiceras* should be placed in the sandstone bed (Member 3). The above ammonoids of the genus *Malbosiceras*, although poorly preserved and determined (in open nomenclature), belong to the species widespread in Southeastern France in the Lower Subzone of the *Ferule* bossier-*Malbosiceras paramimounum* Zone. Hence, the new material supports the correlation of the beds with *Dalmasiceras* in Crimea with the *D. dalmasi* Subzone, ter-

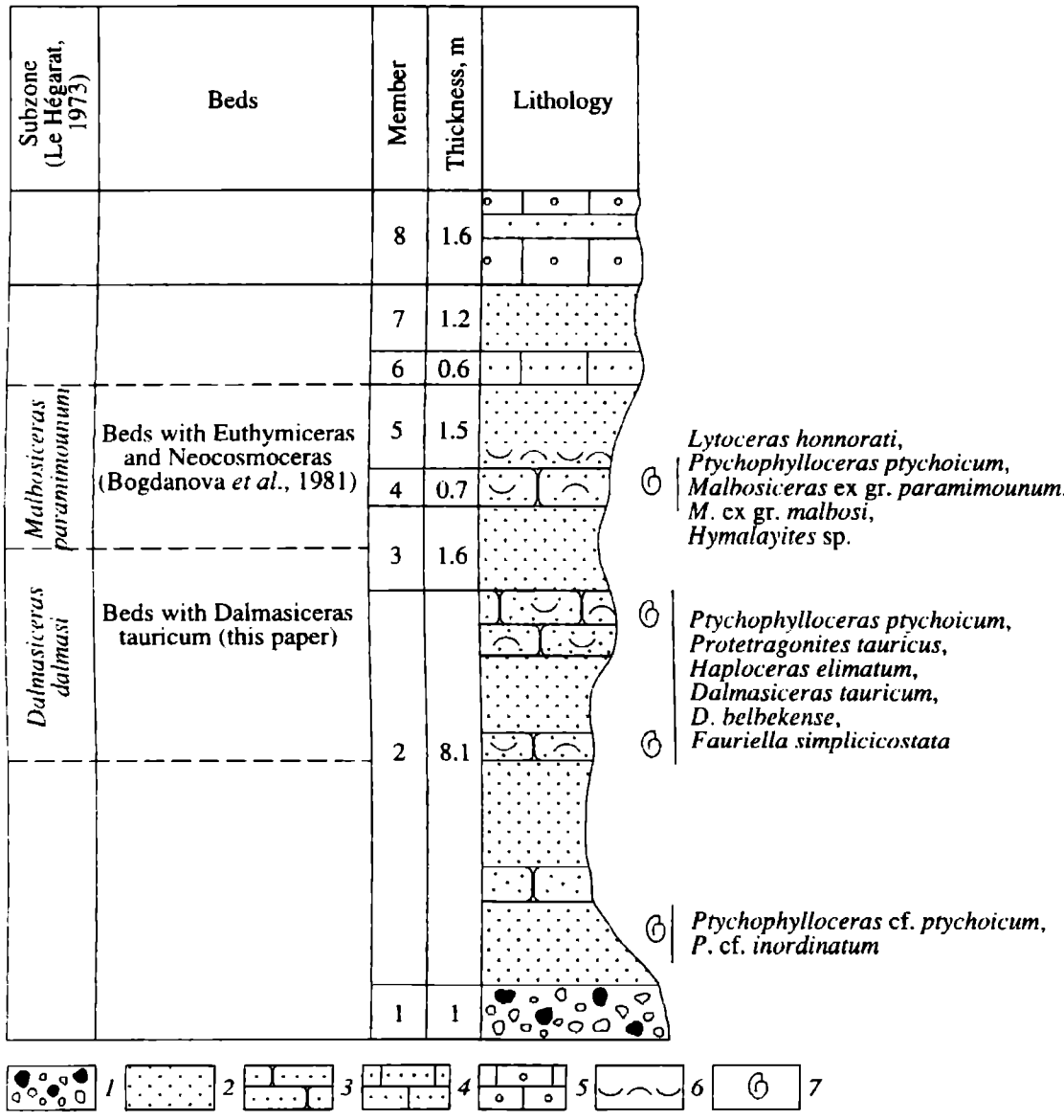


Fig. 1. The Berriasian sequence (*Dalmasiceras dalmasi-Malbosiceras paramimounum* Subzone in the Kabanii Log Section (Southwestern Crimea, Belbek River, village of Kuibyshevo). Explanations: 1—conglomerates, 2—sandstone, 3—calcareous sandstone, 4—sandy limestone, 5—oncolite limestone, 6—coquina, 7—beds with ammonoids.

minal in the *Tirnovella occitanica* that lies below the *F. boissieri* Zone in the Berriasian zonal scheme in the type region.

There are different views on the name of the stratigraphic unit under discussion. Kvantaliani (1989, p. 148) suggested retaining the name *Dalmasiceras dalmasi* since it widely used in the literature and also because this species frequently occurs in Crimea. As mentioned above, the Crimean specimens of this species was never figured, and we did not determine this species in our collection. Therefore, we propose that these strata with *Dalmasiceras tauricum* be named as Beds since they contain the most numerous and widespread Crimean species. The presence of *D. punctatum* in the same beds supports their correlation with the *D. dalmasi* Subzone of the stratotype section in Southeastern France.

We studied the shell ontogeny of *D. tauricum* and *D. belbekense* and also the sutural ontogeny of *D. tauricum*. All stages of the whorl ontogeny were previously described by Djanelidze (1922), Mazenot (1939), and Kvantaliani (1989). The sutural ontogeny of the genus *Dalmasiceras* is typical of the Berriasellidae in that is has a five-lobed primary suture, subdivided inner lateral lobe I and an undivided dorsal lobe (Fig. 2). Lobe I gives rise to I_v and I_d lobes of which the former is subsequently repeatedly subdivided to eventually form a concave sutural lobe. The stages of the sutural

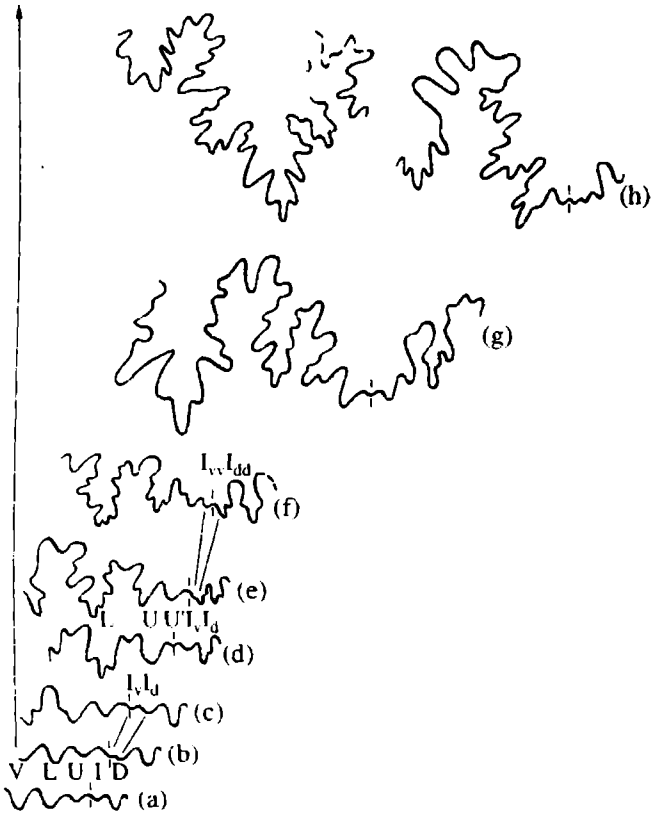


Fig. 2. Sutural ontogeny of *Dalmasiceras tauricum* sp. nov.; (a–c) specimen no. 6/333, (d–h) specimen no. 4/333: (a) 1.1 whorls, ×22; (b) 1.5 whorls, ×22; (c) 2.0 whorls, ×22; (d) 2.5 whorls, ×11; (e) 3.0 whorls, ×11; (f) 3.3 whorls, ×11, (g) 4.0 whorls, ×11, (h) 4.6-4.8 whorls, ×5.5; Southwestern Crimea, Belbek River, village of Kuibyshevo; Berriasian, Beds with *D. tauricum*.

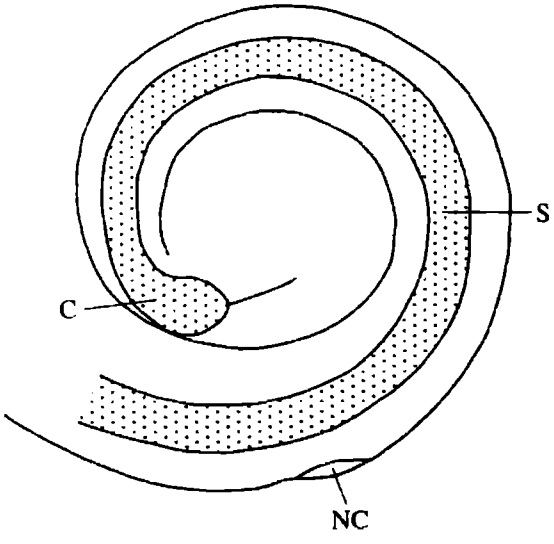


Fig. 3. Protoconch and the first whorl of the phragmocone of *Dalmasiceras tauricum* sp. nov., specimen no. 3/333, ×75; Southwestern Crimea, Belbek River, village of Kuibyshevo; Berriasian, Beds with *D. tauricum*. Explanations: C—caecum, S—siphuncle, NC—nepionic constriction.

ontogeny are as follows: VLU:ID (whorls 1.1)—$(V_1 V_1)$LU : $I_v I_d$D (whorls 1.5)—$(V_1 V_1)$LUU^1 : $I_{vv} I_{vd} I_d$D (whorls 3.3–3.6). Lobe I_d is well separated and occupies the place of I_v lobe (in terminology of Besnossov and Mikhailova, 1981). The latter is well developed in many Perisphinctina. Based on the absence of this lobe in some genera in the suborder Perisphinctina, Kvantaliani and Lominadze (1984) established a superfamily Olcostephanaceae, which apparently included the berriasellid genus *Dalmasiceras*.

The median sections of the two specimens of *D. tauricum* show the inner structure (Fig. 3). The siphuncle in the first whorl is central, in the second it become subventral, and in whorls 2.5–2.7 is becomes ventral. The protoconch is spherical and small ($D_1 = D_2$ =0.4 mm). The caecum is drop-shaped and rounded ($C_1 = C_2$ = 0.09 mm, specimen no. 3/333) or slightly elongated (C_1 = 0.15, C_2 = 0.1 mm, specimen no. 2/333). The angle of the primary constriction is α =310°, the diameter of the ammonitella is 0.70–0.75 mm. The septal necks in the middle of the third whorl are short and prochoanitic.

SYSTEMATIC PALEONTOLOGY

Superfamily Olcostephanaceae Pavlov, 1892

Family Berriasellidae Spath, 1922

Genus *Dalmasiceras* Djanelidze, 1922

***Dalmasiceras tauricum* Bogdanova et Arkadiev, sp. nov.**

Plate 3, figs. 2–6, Plate 4, figs. 4 and 5

Dalmasiceras crassicostatum: Druschits, 1960, p. 281, pl. 25, figs. 2 and 3; Bogdanova *et al.*, 1981, p. 6.

Dalmasiceras punctatum: Druschits, 1960, p. 281, pl. 25, fig. 4.

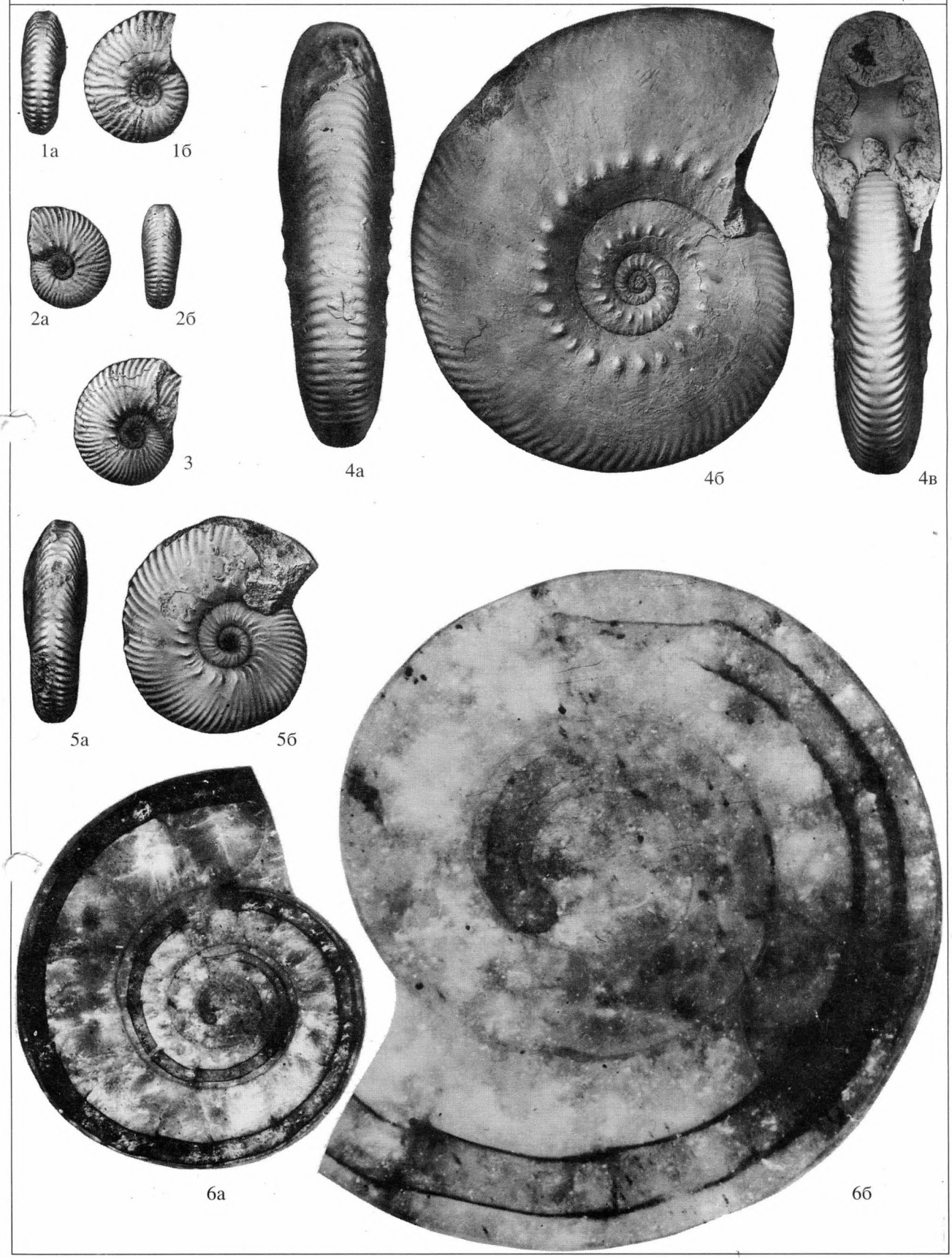
Dalmasiceras aff. *crassicostatum*: Atlas, 1997, p. 114, pl. 31, figs. 2 and 3.

Dalmasiceras sp.: Atlas, 1997, p. 114, pl. 31, fig. 4.

Etymology. From Tauria.

Holotype. SPGGI, no. 6/330; southwestern Crimea, Belbek River; Berriasian, Beds with *D. tauricum*.

Shell shape. (Fig. 4). Until the end of the second whorl the cross section is widely oval. The flanks are convex, gradually transit into the rounded venter. At the end of the third whorl, the width equals the height, the flanks are flattened, and the venter is rounded. At the end of the fourth whorl the cross section becomes elongate and the umbilical shoulder is formed. In the fifth whorl the cross section is rounded-rectangle, compressed, the flanks are weakly convex, and the venter is flattened. The sixth and all the subsequent whorls gradually expand, they are moderately wide, and the venter and flanks are strongly flattened. The cross section is compressed. The umbilicus is moderately wide and wide, stepped, with a gently sloping umbilical wall. The body chamber occupies 1/3 of the whorl.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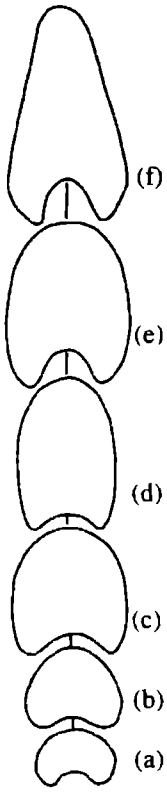


Fig. 4. Ontogeny of *D. tauricum* sp. nov.; specimen no. 4/333: (a) 1.5 whorls, ×11.2; (b) 1.8 whorls, ×12; (c) 2.8 whorls, ×5.9; (d) 3.8 whorls, ×3; (e) 4.8 whorls, ×1.7; (f) 5.8 whorls, (×1); Southwestern Crimea, Belbek River, village of Kuibyshevo; Berriasian, Beds with *D. tauricum*.

Ornamentation. The first two and a half whorls have a smooth shell surface. At the end of the second and at the beginning of the third whorl, the flanks possess first simple, then bifurcating rounded ribs running from the umbilical seam and strongly developed at the ventral shoulder. The ribbing is not weakened in the venter. There are 35 ribs per whorl. In the middle of the third whorl and approximately until its end the places of the rib bifurcation possess lateral nodes (stage of the distal bifurcation or medium-noded stage according to A. Djanelidze). At the end of the third whorl and in the fourth whorl the umbilical shoulder is formed, and the bifurcation point lies on the umbilical shoulder that bears umbilical nodes or ribs. In the second half of the fourth whorl the umbilical ribs transform into umbilical nodes giving rise to coarse sharp branching ribs and shorter ribs intercalate. These intercalating ribs may be simple or branching slightly inward of the mid-height of the whorl. At the stage of 4.5 whorls there are 21 nodes near the umbilicus and 43 ribs near the venter. On the venter the ribbing weakens. Sometimes one or both branches of bifurcating ribs dichotomize again on the flanks. The intercalating ribs are the same as those in the previous stage. Near the nodes the ribs are weak, and approximately from the mid-flank they become more prominent. The nodes become smaller, sharper and elongated. At the end of the fifth whorl the umbilical nodes increase two-fold, the ornament remains similar although there are 65 ribs near the venter. In the sixth whorl and further the umbilical nodes are pointed (25 per whorl). The nodes give rise to the fascicles of weakly developed ribs that almost disappear in the mid-flank and increase at the venter. There are 95 ribs in the last whorl. Near the venter the ribs are strongly bent forward and weakening slightly across the venter at a right angle to the plane of symmetry.

Suture. The suture is shown in Fig. 2.

Dimensions in mm and ratios (%):

Specimen no.	D	UW	W	HW	UW/D	H/D	HW/D	w	wW
9/333	29.0	7.8	12.8	9.0	27	44	31	–	–
8/333	32.8	8.8	14.0	9.4	27	43	29	–	–
5/333	36.0	11.2	14.8	9.1	31	41	25	–	–
7/333	46.2	13.0	18.8	11.8	28	40	25	–	–
4/333	61.8	16.5	27.5	17.7	26	44	28	19.3	1.42
14/333	67.8	19.3	27.6	19.0	29	40	28	20.7	1.34
15/333	80.0	27.4	33.1	20.5	34	41	26	21.6	1.53
4/333	84.2	25.2	34.7	23.4	30	41	28	35.8	1.37
5/330	87.2	29.5	33.2	23.0	33	39	26	23.7	1.40
10/330	92.7	25.0	39.6	23.8	27	42	23	27.4	1.45
Holotype									
6/330	93.1	33.2	33.7	33.2	35	36	36	27.1	1.24

Variability. Some characters may strongly vary. The umbilical width usually increases as the shell grows, but there are some specimens with a narrower umbilicus. Apart from umbilical nodes, the shell possesses umbilical ribs that remain in adults. The whorl width and whorl expansion rate *W*, the strength of rib-

Explanation of Plate 3

All sizes except for fig. 6 are natural. Southwestern Crimea, Belbek River, the village of Kuibyshevo; Berriasian, Beds with *D. tauricum*.

Fig. 1. *Dalmasiceras subtoucasi* sp. nov.; holotype, no. 1/333; (1a) ventral view, (1b) lateral view.

Figs. 2–6. *Dalmasiceras tauricum* sp. nov.; (2a) no. 2/333, lateral view, (2b) ventral view; (3) specimen, no. 3/333, lateral view; (4) specimen no. 4/333: (4a) ventral view, (4b) lateral view, (4c) lateral view, (5) specimen no. 5/333: (5a) ventral view, (5b) lateral view; (6) specimen no. 2/333; medial section: (6a) protoconch and 3.5 whorls of the phragmocone, ×20; (6b) protoconch and two volutions of the phragmocone, ×50.

bing and its density may vary. The ribbing on the flanks may be weakened (almost completely disappearing).

Comparison. Most similar to this species are *D. djanelidzei* Mazenot, 1939, *D. gigas* LeHegarat, 1971 and *D. punctatum* Djanelidze, 1922. The ribbing on the flanks in all these species as in the new one is weak. The new species differs from *D. djanelidzei* in the larger sizes (this is a typical macroconch) and in the developed ontogenetic recapitulations. For instance, the ribbing on the flanks weakens in the new species at Dm = 40–50 mm. The nodes in the new species may vary in shape. The crescentic ribs are very similar to those in *D. djanelidzei*, while the mammilate nodes are very similar to those in *D. punctatum*. The new species differs from *D. punctatum* in the later appearance of the stage with smoothened flanks in ontogeny. The species *D. crassicostatum* is frequently mentioned in the studies of Crimean material. The inner whorls of this species (especially well shown by Djanelidze, 1922, pl. 13, fig. 4a) possess weakened ribs at the same growth stage as in *D. tauricum*. However, in contrast to *D. tauricum*, the shells of *D. crassicostatum* possess the nodes at Dm = 80 mm.

Occurrence. Berriasian, Beds with *D. tauricum*; Northern Caucasus, Crimea.

Material. 30 well preserved specimens from Southwestern Crimea (Belbek River, Kabanii Log, Korlu Gully, near the village of Peredovoe) and Central Caucasus, Tonas River, village of Alekseevka, vicinity of the Balanovskoe Reservoir; basin of the Sary-su River, Enisarai Gully.

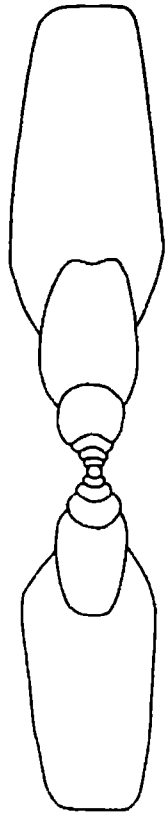


Fig. 5. Cross section of the shell of *Dalmasiceras belbekense* sp. nov.; specimen no 8/330 (×2); Southwestern Crimea, Belbek River, village of Kuibyshevo; Berriasian, Beds with *D. tauricum*.

Dalmasiceras belbekense **Bogdanova et Arkadiev, sp. nov.**

Plate 4, figs. 1–3

?*Dalmasiceras subloevis*: Khimshiashvili, 1976, p. 130, pl. 6, fig. 2; pl. 19, fig. 3.

Dalmasiceras crassicostatum: *Atlas*, 1997, p. 114, pl. 32, fig. 1.

Etymology. From the Belbek River.

Holotype. SPGGI, no. 7/330; southwestern Crimea, Belbek River; Berriasian, Beds with *D. tauricum*.

Shell shape (Fig. 5). In the first three whorls the shell is inflated, evolute, with a broadly rounded venter and narrow flanks. In the fourth whorl the whorl section first becomes oval (WH=WW), later becomes compressed, rectangular, with flattened and almost parallel flanks and a flattened venter. The shells with Dm over 55 mm (the beginning of the body chamber) are discoidal, moderately involute, with slowly expanding whorls and a wide umbilicus.

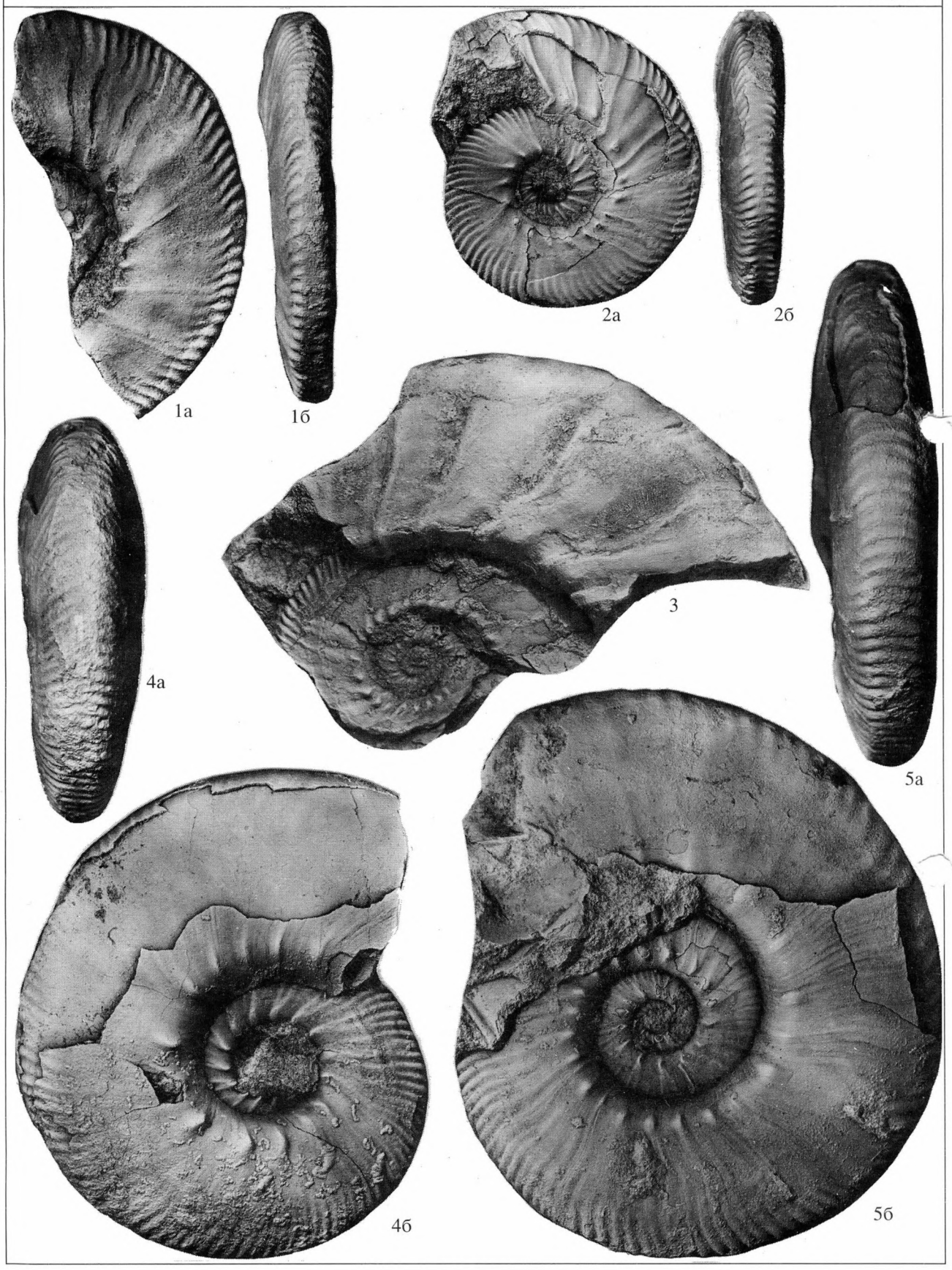
Ornamentation. In the first whorl up to Dm = 45–55 mm the ribbing is dense. Usually a pair of ribs branching at the end of the umbilical nodes are intercalated by 2–3 simple ribs that start inward of the mid-flank at different distances from the umbilical shoulder. Sometimes the intercalating ribs fuse with some of the branches of the main ribs. The umbilical nodes are subacute and elongate. At the ventral shoulder, the ends of the ribs become raised without forming nodes and are interrupted leaving a smooth zone on the venter. In later whorls the character of the ribbing changes. The intercalating ribs at the mid-flank become weaker, one of the paired branching ribs become considerably larger, and between them the furrows resembling constrictions appear. The intercalating ribs are maintained for some time along the ventral shoulder. They then gradually

Explanation of Plate 4

All sizes are natural. Southwestern Crimea, Belbek River, village of Kuibyshevo; Berriasian, Beds with *D. tauricum*.

Figs. 1–3. *Dalmasiceras belbekense* sp. nov., (1) specimen no. 2/330: (1a) lateral view, (1b) ventral view; (2) holotype, no. 7/330: (2a) lateral view, (2b) ventral view; (3) specimen no. 3/330, lateral view.

Figs. 4 and 5. *Dalmasiceras tauricum* sp. nov.; (4) specimen no. 10/330: (4a) ventral view, (4b) lateral view; (5) holotype no. 6/330; (5a) ventral view, (5b) lateral view.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disappear and the terminal part of the body chambers of the largest specimens possess only widely spaced and bent simple ribs that sometimes may be accompanied by furrows parallel to the ribs. One of the specimens shows a terminal part of the body chamber with an apertural projection in the mid-flank.

Dimensions in mm and ratios (%):

Specimen no.	D	UW	W	HW	UW/D	WH/D	WW/D	w	wW
Holotype									
7/330	51.4	17.3	19.1	11.6	33	37	20	14.7	1.30
16/333	57.4	20.1	20.3	–	35	35	–	16.6	1.22
17/333	58.7	17.5	22.0	12.2	30	39	20	18.6	1.18
18/333	62.0	21.3	23.4	–	34	38	–	17.9	1.30

Comparison. The new species differs from all other *Dalmasiceras* species in the ornament on the body chamber. *D. belbekense* differs from *D. tauricum* in the wider umbilicus and in the lower whorl expansion rate. While the ribbing at early stages in both species is somewhat similar, the whorls at Dm greater than 50–60 mm are very much different.

Remarks. Preservation of the specimens from the Caucasus figured by Khimshiashvili (1976) is so poor that the majority of them cannot be positively identified. However, the specimen that we identified as *D. belbekense* (see synonyms) shows prominent furrows and occasionally coarser ribs.

Occurrence. Berriasian, Beds with *D. tauricum*; Northern Caucasus, Crimea.

Material. 5 well preserved specimens and about two dozens mold fragments from the Belbek River and from the vicinity of the Balanovskoe Reservoir.

***Dalmasiceras subtoucasi* Bogdanova et Arkadiev, sp. nov.**

Plate 3, fig. 1

Etymology. From *Dalmasiceras toucasi* Mazenot and Latin *sub* (close).

Holotype. SPGGI, no. 1/333; Southwestern Crimea, river bed of the Belbek River near the entrance of the Ul'anovskii Gully; Berriasian, Beds with *D. tauricum*.

Shell shape (Fig. 6). At early stages (up to 2.8 whorls) the shell is inflated, smooth, semievolute, with a widely rounded venter. The whorl cross section is crescentic with a width considerably exceeding the height. In the fourth whorl the shell is involute, with a pentagonal cross section. The ventral shoulder is not developed and the widely rounded venter transits into flanks and then into a gently sloping umbilical wall. At the beginning of the fifth whorl the height equals the width. At the beginning of the sixth whorl the cross section becomes compressed. The adult shell (microconch) at D = 22.8 mm has almost six complete whorls of which 3/4 is occupied by the body chamber. The

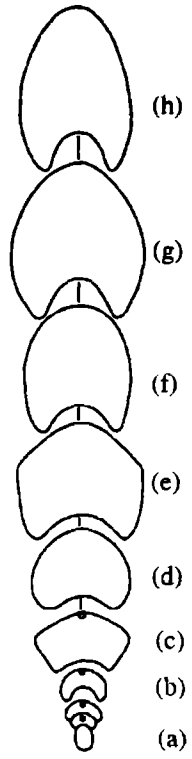

Fig. 6. Ontogeny of *Dalmasiceras subtoucasi* sp. nov., holotype no. 1/333: (a) end of the second whorl, ×4.7, (b) end of the third whorl, ×4.7; (c) second half of the fourth whorl, ×4.7; (d) beginning of the fifth whorl, ×4.7, (e) 3/5 of the fifth whorl, ×3.7; (f) beginning of the sixth whorl, ×3.1; (g) middle of the sixth whorl, ×3.1; (h) end of the sixth whorl, ×1.9; Southwestern Crimea, Belbek River, village of Kuibyshevo; Berriasian, Beds with *D. tauricum*.

shell is moderately wide, and with moderately slowly expanding whorls. The flanks are weakly convex and the venter is flattened. The umbilicus is moderately narrow, funnel-shaped, with gently sloping walls.

Ornamentation. In whorls 2.8–3.0 the nodes appear on the flanks. The nodes give rise to simple and bifurcating ribs that disappear neat the venter. In the fourth whorl the ornamentation remains the same. In the middle of the fifth whorl the flanks possess radial ribs that start on the umbilical wall and bifurcate at the mid-flank forming small nodes. Ribs are radial near the venter, and form there small nodes. Ribbing does not go across the venter. At the end of the fifth whorl the shell bears simple or bifurcating ribs, 35–36 near the venter. Bifurcation occurs either near the umbilical wall (without forming a node) or at the mid-flank where a pointed node is formed. At the beginning of the sixth whorl the ornamentation changes. The nodes on the flanks disappear. The umbilical nodes (10 in the sixth whorl) appear. The nodes are elongated along the ribs giving rise to dichotomizing or trichotomizing crescentic ribs. Simple ribs were also observed. There is no pattern in arrangement of simple ribs and fascicles. All ribs are interrupted at the mid-venter by a shallow furrow, bor-

dered by two rows of small nodes. In the sixth whorls there are 42 ribs at the venter.

Dimensions in mm and ratios (%):

Specimen no.	D	UW	W	HW	UW/D	WH/D	WW/D
Holotype 1/333	22.2	5.8	10.5	7.5	26	47	34

Comparison. This species differs from *D. toucasi* Mazenot 1939 in the narrower umbilicus and in the higher whorls.

Occurrence. Berriasian, Beds with *D. tauricum*; Crimea.

Material. Holotype (collected by A.N. Usov in 1996).

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