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Ammonites from the *Deshayesites* Genus from Aptian (Lower Cretaceous) Sediments in the Mountainous Crimea

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Abstract—Stratigraphically important ammonites *Deshayesites* ex gr. *deshayesi* (d'Orbigny, 1840), *Deshayesites* sp. juv., and *Paradeshayesites* aff. *callidiscus* [Casey, 1961] from lower Aptian pelagic sediments at the Verkhorech'e Village have been described and depicted. The new finds and revision of previously found ammonites allow the recognition of ammonite zones *Deshayesites volgensis* and *Deshayesites deshayesi* in the Southwestern Crimea.

Key words: ammonites, Aptian, Lower Cretaceous, stratigraphy, Southwestern Crimea.

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INTRODUCTION

Ammonite finds from the *Deshayesites* Kasansky Genus are extremely rare in Southwest Crimea. Only three finds had been known until now and references to them were included in all subsequent publications on Crimean Lower Cretaceous sediments: (1) *Deshayesites* aff. *deshayesi* (Leymerie) found in a section in the Kacha River valley 15 m above the base of the succession [Drushchits, 1960]; (2) *Deshayesites* aff. *deshayesi* (d'Orbigny) from the same section but found 40 m above the base [Drushchits et al., 1981]; and (3) *Deshayesites* ex gr. *dechyi* (Papp) in the Zelenogorsk area redeposited along with blocks of Barremian limestone enclosing the middle Aptian ammonites *Epicheloniceras* cf. *martini orientalis* (Jacob), and *Colombiceras* sp. at the base of the Albian [Drushchits, 1960].

Hoplites cf. *weissi* Neumayr et Uhlig,[1] which is found in "red Barremian limestone" at Biasaly Village (the current name is Verkhorech'e Village) and depicted in a publication by N.I. Karakash (1907, p. 92, Table XI, Fig. 2, Monographic Division, Geological Faculty, St.PbGU, Sp. 103/506) does not belong, in the opinion of Drushchits et al., [1981], to this genus. In our opinion, this specimen may be referred to the *Paradeshayesites* Genus but it was derived, not from the "cephalopoda limestone," but most probably from sections in the North Caucasus or from the Transcaspian region, since it consists of gray sandstone, i.e., a rock absent in Aptian sections of the North Crimea. This find will not be discussed any further.

[1] The "cf." is missing in the description of the ammonite, although it is presented in the explanations to the table.

MATERIALS AND THEIR DISCUSSION

The extreme rarity of *Deshayesites* finds in the Mountainous Crimea is not surprising, since these ammonites are typical of shallow-water and coastal sediments, while during the early Aptian the territory of the Mountainous Crimea presented a rather deep-water pelagic basin [Baraboshkin and Enson, 2003]. At the same time, ammonites from the Deshayesitidae Family are extremely important for the zonal biostratigraphy of lower Aptian sediments in Europe and West Asia [Bogdanova and Mikhailova, 2004] and are presented in all ammonite biostratigraphic charts of the Mountainous Crimea [Drushchits, 1960; Drushchits et al., 1981; Baraboshkin, 1997, 2001].

We have now obtained another four specimens of deshayesits, which will be discussed further in this paper. In addition, we have revised specimen no. 79/5, kept currently at the Museum of Physical Geography of MSU (MPG, MSU) that was found in a section at the Verkhorech'e Village (Fig. 1) 40–50 m above the base

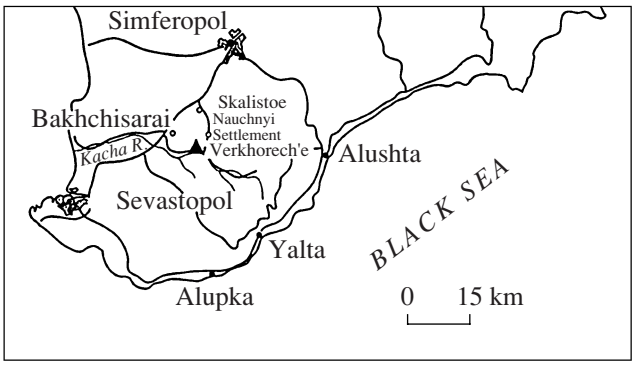
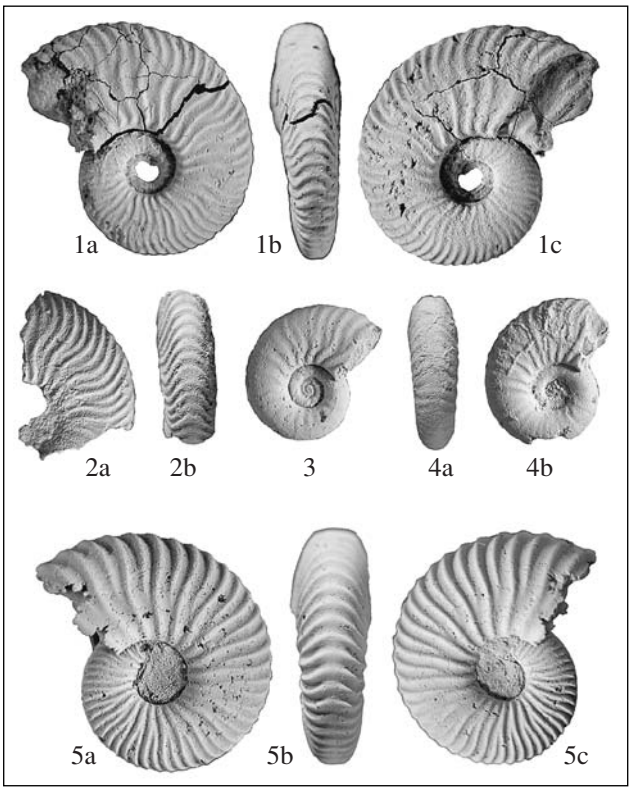


Fig. 1. Layout scheme of section at the Verkhorech'e Village.



Photographic table: Fig. 1. *Paradeshayesites* aff. *callidiscus* [Casey, 1961], Sp. MPG, MSU 79/15; Fig. 2. *Paredeshayesites* aff. *callidiscus* [Casey, 1961], Sp. MPG, MSU 79/10; Fig. 3. *Paradeshayesites* aff. *callidiscus* [Casey, 1961], Sp. MPG, MSU 79/11; Fig. 4. *Deshayesites* sp. juv., Sp. MPG, MSU 79/13; Figs. 5a and 5b. *Deshayesites* ex gr. *deshayesi* [d'Orbigny, 1840], Sp. MPG, MSU 79/12; collection by G.F. Veber. All ammonites are from the lower Aptian sediments, in talus at the Verkhorech'e Village in the Southwest Crimea.

of the clay stratum and determined in a paper by V.V. Drushchits and his colleagues [1981] as *Deshayesites* aff. *deshayesi* Leym. We remolded this ammonite and determined it along with the juvenile specimen (MPG, MSU 79/12) and a fragment of a small phragmocone (MPG, MSU 79/10) as belonging to the species *Paradeshayesites* aff. *callidiscus* [Casey, 1961]. This species is typical of the lower portion of the Uptian Stage in Great Britain (the *forbesi* Zone), the Middle Volga Region (the *volgensis* Zone, and the Transcaspian Region (the *weissi* and *deshayesi* zones) [Bogdanova and Mikhailiova, 2004]. Keeping in mind the extreme similarity and, possibly, synonymy of the *volgensis* and *forbesi* species [Bogdanova and Mikhailova, 2004] and the priority of the first name, we suggest recognizing the interval of this species distribution as the *Deshayesites volgensis* Zone.

Although all the ammonites were found in the talus, it is remarkable that the largest of them was found 40 m above the base of the Barremian–Aptian clay of the Biasala Formation. The boundary between the Barremian and Aptian was traced at approximately the same level (44.5 m) at the base of magnetic anomaly M0 from the distribution of nannoplankton [Baraboshkin et al., 2004] and planktonic foraminifers [Gorbachik, 1986].

We defined another large ammonite from G.F. Veber's collection (MPG, MSU 79/11), which was found in gray clay talus at Verkhorech'e Village as *Deshayesites* ex gr. *deshayesi* (d'Orbigny). It is an index species of the zone of the same name; it characterizes a higher biostratirgraphic level and occurs in the *deshayesi* Zone in France, Britain, Northwest Germany, Bulgaria, in the *weissi* and *deshayesi* zones in Turkmenistan, and in the Uptian Stage of Dagestan and Mangyshlak [Bogdanova and Mikhailova, 1999].

The most recent specimen (MPG, MSU 79/13) that we have is a limonite cast of a juvenile *Deshayesites* that is indeterminable as to its species and characterizes the lower half of the lower Uptian sediments.

Thus, we remolded the known specimens and examined new unique deshayesite finds; we think that the presence of two deshayesite levels in the lower Aptian of the Mountainous Crimea is possible. The boundaries between the zones are tentative and a more precise determination of their stratigraphic volume is left to future work.

The described specimens are kept at the Museum of Physical Geography of MSU, collection no. 79.

Order Ammonitida

Suborder Ancyloceratina Wiedmann, 1966

Suprafamily Deshayesitaceae Stoyanow, 1949

Family Deshayesitidae Stoyanow, 1949

Genus ***Deshayesites*** Kasansky, 1914

Hoplites: Neumayr, 1875, p. 29; Neumayr and Uhlig, 1881, p. 162; Semenov, 1899, p. 109.

Hoplites (Deshayesites): Kasansky, 1914, p. 99.

Parahoplitoides: Spath, 1922, p. 111.

Deshayesites: Rengarten, 1926, p. 30.

Deshayesites: Casey, 1964, p. 291.

Deshayesites: Bogdanova and Mikhailova, 1999, p. 51; 2004, p. 202.

Typical species. *Ammonites deshayesi* Leymerie in d'Orbigny, 1840; lower Aptian; Southern France.

Diagnosis. The shells are of medium and, more rarely, small or large sizes. The whorls are rectangular–oval and are moderately or fast increasing. The ribbing is rare or close and from fine to rough. The ribs are main and intermediate alternating regularly or irregularly. One or two intermediate ribs are located between the main ones. Roughly ribbed species have near-umbilical ridges. Ribs at early whorls are interrupted on the external side. The lobe line formula is $(V_1V_1)UII^2 : I^1D$. The internal side lobe I is located next to the umbilical lobe (U) on the external side of a whorl.

Species composition. Apart from the typical, 40 more species are known [Bogdanova and Mikhailova, 2004].

Comparison. This species differs from the *Paradeshayesites* genus by low, slowly growing whorls, by the absence of thick fasciculate ribbing with distinct near-umbilical ridges, and by the presence of two or three internal side lobes.

Distribution. Lower Uptian in Europe, Greenland, and West Asia.

Deshayesites ex gr. ***deshayesi*** (d'Orbigny, 1840)
(Photographic table, Fig. 5)

Description. The test is semi-evolute and its cross-section is rounded-rectangular and slightly widened at its lower third (Fig. 2a). The sculpture is presented by sharp two-part or intercalating ribs branching in the middle (L < 15 mm) or in the lower third (L > 15 mm) of the lateral sides. The main rib is usually the rear one. Singular ribs are extremely rare (one per whorl). The ribs show slightly sigmoid curves and are the most raised in the ventral side crossing it without any lowering at L > 15mm. At a smaller diameter, they almost do not rise above the venter. There are 12 main and 11 auxiliary ribs at the middle of the last whorl.

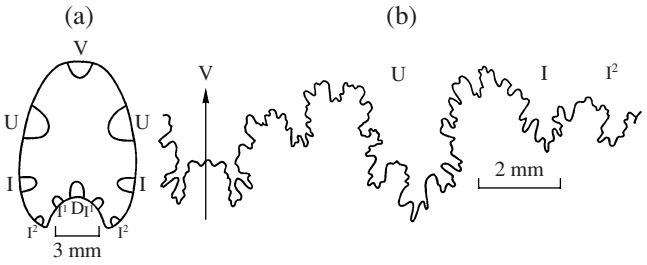


Fig. 2. *Deshayesites* ex gr. *deshayesi* (d'Orbigny, 1840), MPG, MSU 79/12: (a) cross section at L = 24.7 mm; (b) lobe line at L = 24 mm.

The dimensions in mm and ratios:

Specimen no.	L	H	W	L_s	H/L	W/L	L_s/L
MPG, MSU 79/12	24.5	11.5	8.1	6.6	0.47	0.33	0.27

The lobe line (Fig. 2b). The ventral lobe (V) is wide and less deep than the slightly asymmetrical umbilical lobe. The internal side lobe (I) is twice shorter and narrower. The second internal side lobe (U^2) is located next to the suture. The external saddle (V/U) and the next saddle (U/I) are approximately of the same height. Different heights of secondary saddles is a distinctive feature of the external saddle.

Note. This specimen was determined in a publication [Baraboshkin et al., 2004] as *Deshayesites deshayesi* (d'Orbigny) but no picture was presented.

Distribution. Lower Aptian in Europe and West Asia.

Material. MPG, MSU 79/12, a cast replaced with limonite from a section at the Verkhorech'e Village, talus, collection by G.F. Veber.

Deshayesites sp. juv.
(Photographic table, Fig. 4)

Description. The test is semi-evolute and its cross-section is rounded-rectangular (Fig. 3a). The sculpture is presented by still slightly expressed two-part ribs. They branch in the lower third of a whorl; the rear auxiliary rib has a lower relief than the main (frontal). The ribs show sigmoid curves and cross the ventral side without lowering.

The dimensions in mm and ratios:

Specimen no.	L	H	W	L_s	H/L	W/L	L_s/L
MPG, MSU 79/13	10	4.3	3.3	4.2	0.43	0.33	0.42

The lobe line (Fig. 3b) remains very simple at a diameter of 9 mm (~3.3 whorls). The umbilical lobe is deeper than the ventral one, although it is already symmetrical. The internal lobe approaches the umbilical one, and the U^2 lobe is next to it and is on the external side of the whorl as well. The saddles are bifid, and no symmetry is pronounced thus far.

Notes. Due to the small dimensions of the specimen, it is determinable only to genus.

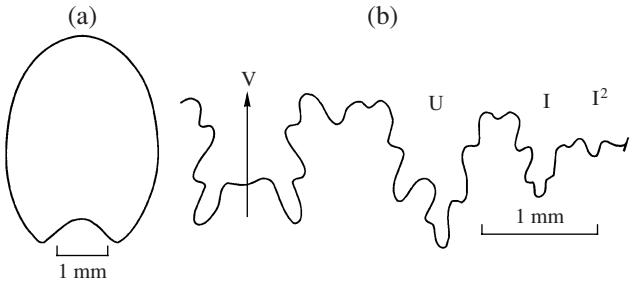


Fig. 3. *Deshayesites* sp. juv, MPG, MSU 79/13: (a) cross section at L = 7.0 mm; (b) lobe line at L = 6.8 mm.

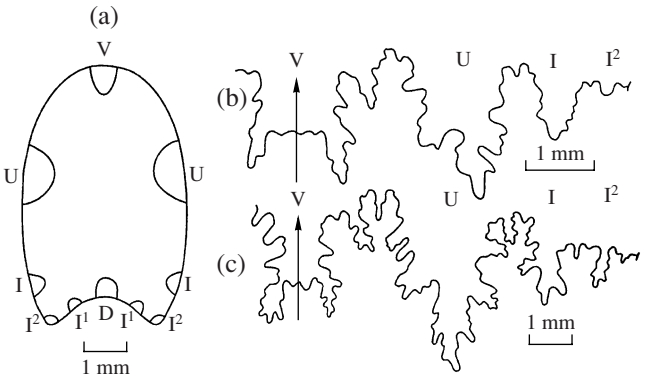


Fig. 4. *Paradeshayesites* aff. *callidiscus* [Casey, 1961], MPG, MSU 79/10: (a) cross section at H = 6.4 mm; (b) MPG, MSU 79/11, lobe line at L = 10.0 mm; (c) MPG, MSU 79/5, lobe line at L = 16.3 mm.

Distribution. Lower Aptian in Europe and West Asia.

Material. MPG, MSU 79/13, a cast replaced with limonite.

Genus ***Paradeshayesites*** Kemper, 1967

Paradeshayesites: Kemper, 1967, p. 124.

Deshayesites: Bogdanova, 1979, p. 155 (pars).

Paradeshayesites: Bogdanova and Mikhailova, 1999, p. 53; 2004, p. 210.

Typical species is *Hoplites laeviusculus* Koenen, 1902; lower Aptian, *tenuicostatus* Zone; Northern Germany.

Diagnosis. The casts are semi-involute of small, medium, and large dimensions. The whorls are high with rounded ventral and flattened lateral sides, fast increasing, rectangular–oval in cross-section. The ribbing is close, fasciculate, fine, and locally grading into striation. Rib branching is low, and umbilical ribs are distinctly pronounced. The number of intermediate ribs reaches 7–9. The ribs do not interrupt on the ventral side at early whorls of ancient species, but such interruptions become longer and more distinct as the genus evolves in time. The lobe line formula is $(V_1V_1)UII^2I^3 : I^1D$; since the involute character in this genus increases compared to the *Deshayesites* genus, this causes the occurrence of lobe U^3.

Species composition. There are 21 species in addition to the typical one.

Distribution. Lower Aptian in Europe and West Asia.

Paradeshayesites aff. ***callidiscus*** (Casey, 1961) (Photographic table, Figs. 1–3)

Deshayesites aff. *deshayesi* (d'Orbigny, 1840); Drushchits et al., 1981, p. 99, Table 1, Fig. 2.

Paradeshayesites sp.: Baraboshkin, 2001, Table 1; Baraboshkin et al., 2004, p. 19.

Description. The cast is semi-involute with high narrow whorls (Fig. 4a); the cross-section is a narrow rounded trapeze, whose maximal width falls into the lower third of a whorl. Ribbing occurs at L > 4 mm. The sculpture is presented by two-part, three-part and intercalating ribs. Either branching occurs in the lower third of a whorl or in the middle of a whorl at L < 20 mm, or subsequently the branching point shifts into the upper third of the lateral side. The main rib becomes separated from the secondary one at the intercalation. Three-part ribs occur in rare cases on young whorls; the third branch either branches off at the umbilical bend or intercalates from the back in the middle of the lateral side. The ribs show sigmoid curves, are smoothed out on the last whorl, and cross the ventral side without lowering. Thirty ribs were found in the middle of the last whorl.

The dimensions in mm and ratios:

Specimen no.	L	H	W	L_s	H/L	W/L	L_s/L
MPG, MSU 79/5	25	11.5	6.7	6.5	0.46	0.27	0.26
MPG, MSU 79/10	10.2	5.7	4.0				
MPG, MSU 79/11	10.2	4.4	3.4	4.0	0.43	0.33	0.39

The lobe line (Figs. 4b and 4c) is more dissected at a diameter of 10 mm than that of *Deshayesites* sp. juv. (Fig. 3b), although the ratios between lobes (V, U, I, and I^2) remain the same. The only difference is that the V/U saddle shows different heights of secondary saddle tops. The lobe line of larger specimens is more dissected at a diameter of 16.3 mm, has a deeper umbilical lobe, and differs in that a shallow fossa occurred at the suture, the source of the U^3 lobe. The ventral lobe is shorter than the narrower and elongated umbilical lobe.

Distribution. The *forbesi* Zone in the south of Great Britain, *vogensis* Zone in the Middle Volga Region, and *weissi* and *deshayesi* zones in the Transcaspian Region.

Material. MPG, MSU 79/5, a small limonite specimen; MPG, MSU 79/11, a small specimen; and MPG, MSU 79/10, a fragment from the middle part of clay section at the Verkhorech'e Village.

A scheme of subdividing the lower Aptian sediments of the Mediterranean Standard and the evolution of opinions on zoning the lower Aptian in the Crimea

Substage	Zonal Mediterranean Standard [Reboulet et al., 2006]		Mountainous Crimea [Gorbachik, 1986]	Mountainous Crimea [Drushchits et al., 1981]	Divide between Kacha and Bodrak rivers [Baraboshkin, 1997]	Mountainous Crimea [Baraboshkin et al., 2001]		Mountainous Crimea (present paper)	
	Zone, subzone		Zone, beds containing fauna	Zone	Zone	Zone		Zone	
Upper Aptian	*Hypacanthoplites jacobi*		Absent	Absent	Absent	Absent		Absent	
	Acanthohoplites nolani	*Diadacnoceras nodosocostatum*	*Ticinella roberti* and *Planomalina cheniourensis*	*Acanthohoplites nolani*	Absent	?*Nolaniceras nolani*		?*Nolaniceras nolani*	
Middle Aptian	*Parahoplites melchioris*		*Planomalina cheniourensis*	*Parahoplites melchioris*	*Aconeceras nisus*		*Acanthohoplites aschiltaensis*		*Acanthohoplites aschiltaensis*
			Hedbergella trocoidea						
			Globogerinelloides ferreolensis and *Globogerinelloides algerianus*				*Parahoplites multicostatus*		*Parahoplites multicostatus*
	Epicheloniceras martini	*E. buxtorfi*	*Leupoldina protuberans*	*Colombiceras crassicostatum*		*Aconeceras nisus*	*Colombiceras crassicostatum*	*Aconeceras nisus*	*Colombiceras crassicostatum*
		E. gracile							
		E. debile							
Lower Aptian	*Dufrenoya furcata*		*Blowiella blowi* and *Clavihedbergella bollii*	*Deshayesites deshayesi*	*Deshayesites deshayesi*	*Aconeceras nisoides*	?	*Aconeceras nisoides*	?
	Deshayesites deshayesi	*Deshayesites grandis*					*Deshayesites deshayesi*		*Deshayesites deshayesi*
									Deshayesites volgensis
	Deshayesites weissi								
	Deshayesites oglanlensis						? *Paradeshayesites*		?
Upper Barremian	*Martellites sarasini*	*Pseudocrioceras waagenoides*	Beds with *Hedbergella aptica*	*Barremites strettostoma*	?			?	
			Globuligerina tardita; and *Clavihedbergella primare*		Beds with *Patruliusiceras*	*Patruliusiceras uhligi*		*Patruliusiceras uhligi*	

CONCLUSIONS

The extreme rarity of Deshayesitidae finds in the Mountainous Crimea is natural since these ammonites are typical of shallow-water and coastal sediments, whereas the territory of the Mountainous Crimea was a rather deep-water pelagic basin during the early Aptian [Baraboshkin and Enson, 2003]. The small dimensions of the found ammonites, caused by stressful dwelling conditions [Wiedmann, 1972; Westermann, 1996] also support this conclusion. In all probability, both these facts were related to rapid deepening of the Mountainous Crimean basin and this caused slight bottom anoxia, which was expressed by absent or subdued character of benthic fauna and by accumulation of authigenic hematite [Yampol'skaya et al., 2006].

The new finds of Deshayesitidae and the revision of available specimens allows the possibility of segregating two ammonite zones (*Deshayesites volgensis* and *Deshayesites deshayesi*) in the pelagic clay of the Biasala Formation; the boundaries between them have been traced tentatively thus far (table).

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