

# A New Genus *Leiophylloceras* (Phylloceratida, Ammonoidea) from the Berriasian of the Mountainous Crimea

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**Abstract**—A new genus, *Leiophylloceras* (Phylloceratida, Ammonoidea), is described from the Berriasian of the mountainous Crimea. Shell and sutural ontogeny are discussed.

## INTRODUCTION

Phylloceratid ammonoids assigned by different workers to the genera *Ptychophylloceras*, *Holcophylloceras*, and *Calliphylloceras* frequently occur in the Tithonian–Berriasian of the Mountainous Crimea and other regions of the Mediterranean Realm. The similar morphology and relatively large stratigraphic range of phylloceratids make the species in this group difficult to identify and complicate their taxonomic assignments at the generic level (Spath, 1927; Slavin, 1953; Nikolov, 1960; Joly, 1976, 1993).

The *jacobi-grandis* Zone (Bogdanova *et al.*, 1999) and beds with *Dalmasicerias tauricum* (Bogdanova and Arkadiev, 1999) of the Mountainous Crimea contain, along with numerous *Ptychophylloceras* and rarer *Holcophylloceras*, ammonites differing from other phylloceratids in their morphology. These are smooth shells lacking ribbing, with ventral ridges and deep constrictions on the internal mold. The specimens in the collection studied come from the Berriasian of the basin of the Bel'bek River (collected by the author) and from other regions of the Mountainous Crimea (collected by V.V. Drushchits, B.T. Yanin, and T.N. Bogdanova). Numerous specimens from Bel'bek are found, along with *Dalmasicerias tauricum* Bogdanova et Arkadiev, *D. belbekense* Bogdanova et Arkadiev, *Ptychophylloceras semisulcatum* (d'Orb.), *Protetragonites tauricus* (Kulj.-Vor.), *Haploceras elimatum* (Oppel), and *Fauriella simplicicostata* (Maz.) (beds with *Dalmasicerias tauricum*, corresponding to the Upper *Dalmasicerias dalmasi* Subzone of the *Tirnovella occitanica* Zone of the French stratotype) (Bogdanova and Arkadiev, 1999). In the *jacobi-grandis* Zone, these ammonoids occur rarely, together with *Pseudosubplanites ponticus* (Retowski), *P. lorioli* (Zittel), etc.

Ammonoids with such morphology were first described by d'Orbigny (1840–1842) as *Ammonites calypso* and later were assigned by different researchers to different genera, *Calliphylloceras* (*Holcophyllo-*

*ceras*) (Slavin, 1953), *Ptychophylloceras* (Nikolov, 1960), and *Holcophylloceras* (Khimshiashvili, 1961, 1967, 1976). The author's study of the shell morphology of these ammonites and an analysis of the literature sources showed that these ammonites can be assigned neither to *Ptychophylloceras* nor to *Holcophylloceras*, and should be assigned to a separate genus, *Leiophylloceras*.

## MATERIAL

The material from the basin of the Bel'bek River is well preserved (complete shells with shell matrix). This allowed the study of the shell and sutural ontogeny. The collections used in this study are housed at the TsNIGR Museum (St. Petersburg), collection no. 13078, and at the Museum of the Plekhanov St. Petersburg State Mining Institute (Technical University), collection nos. 330 and 334.

## SYSTEMATIC PALEONTOLOGY

### Family Phylloceratidae Zittel, 1884

#### Genus *Leiophylloceras* Arkadiev, gen. nov.

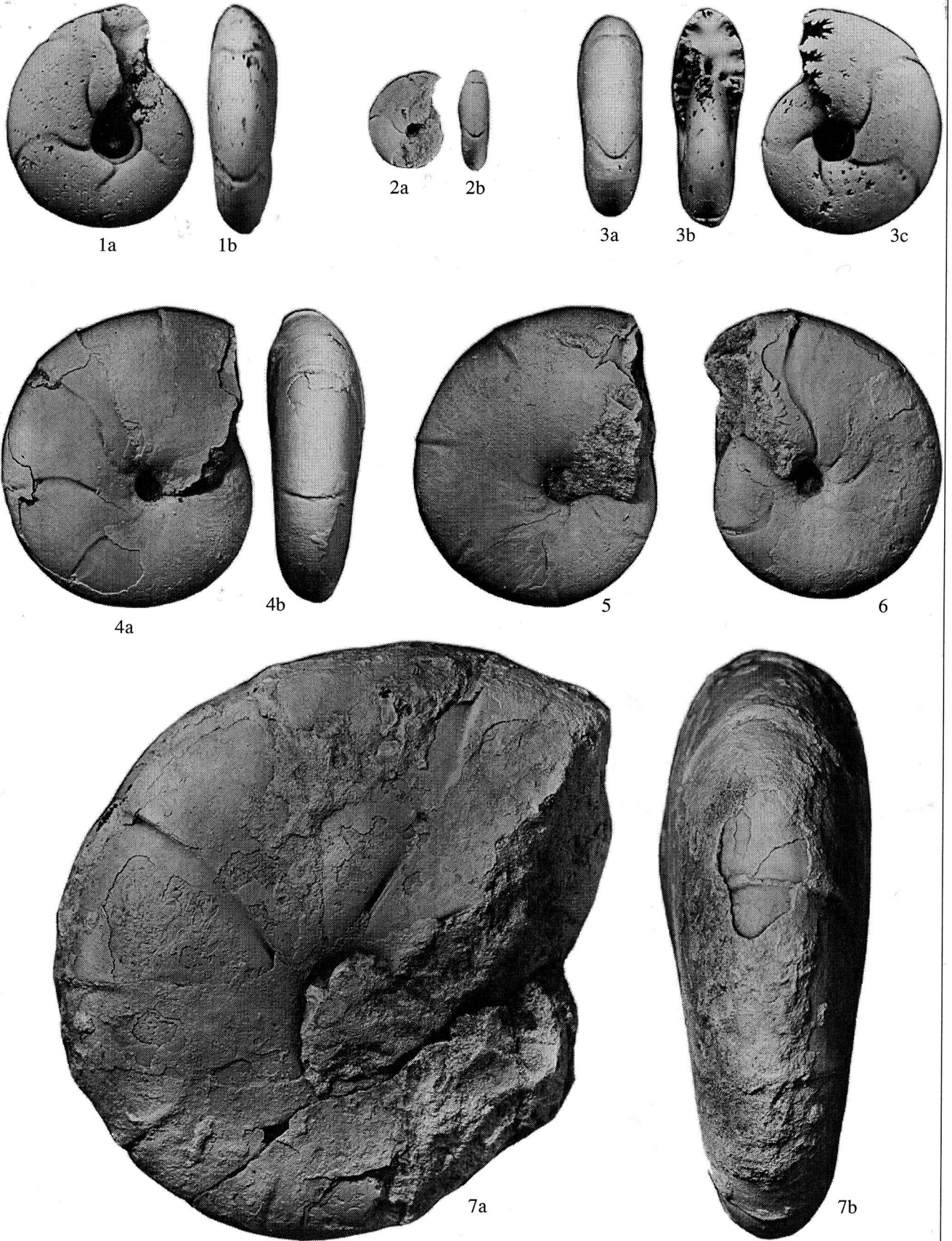
**Etymology.** From the Greek *leios* (smooth), *phyllon* (leaf, plate), and *keras* (horn).

**Type species.** *Ammonites calypso* d'Orbigny, 1840; Berriasian; Alps.

**Diagnosis.** Shell discoidal, involute, smooth, with 6 or 7 ventral ridges and corresponding constrictions. Deep and curved constrictions on flanks well developed on mold and virtually indiscernible on shell surface. Suture ammonitic, with very deep tripartite lateral lobe and lituid dorsal lobe. Ventral lobe half as large as lateral lobe.

**Species composition.** Type species.

**Comparison.** This genus differs from the closely related genus *Holcophylloceras* in the absence



## Explanation of Plate 3

*Leiophylloceras calypso* (d'Orbigny)

**Fig. 1.** Specimen no. 4/13 078: (a) lateral view,  $\times 3$ ; (b) ventral view,  $\times 3$ ; Central Crimea, Sary-Su River.

**Fig. 2.** Specimen no. 6/13 078: (a) lateral view,  $\times 1$ ; (b) ventral view,  $\times 1$ . The locality is the same as in Fig. 1.

**Fig. 3.** Specimen no. 5/13 078: (a) ventral view,  $\times 2$ ; (b) apertural view,  $\times 2$ ; (c) lateral view,  $\times 2$ ; central Crimea, village of Kozlovka.

**Fig. 4.** Specimen no. 2/13 078: (a) lateral view; (b) ventral view; southwestern Crimea, bed of the Bel'bek River near the mouth of the Ul'yanovskii Gully.

**Fig. 5.** Specimen no. 1/13 078: lateral view,  $\times 1$ ; southwestern Crimea, Bel'bek River, Kabanii Gully.

**Fig. 6.** Specimen no. 3/13 078: lateral view,  $\times 1$ ; southwestern Crimea, bed of the Bel'bek River, near the mouth of the Ul'yanovskii Gully.

**Fig. 7.** Specimen no. 16/330: (a) lateral view,  $\times 1$ ; (b) ventral view,  $\times 1$ ; southwestern Crimea, Bel'bek River, Kabanii Gully.

All specimens are from the Berriasian, beds with *Dalmsiceras tauricum*.

of ribbing on the venter, from the genus *Ptychophylloceras* in the shape of constrictions and in a different sutural outline, and from the genus *Sowerbyceras* in the shape of the shell and constrictions.

*Leiophylloceras calypso* (d'Orbigny, 1840)

Plate 3, figs. 1–7

*Ammonites calypso*: d'Orbigny, 1840, p. 167, pl. 52, figs. 7–9; Pictet, 1868, p. 225, pl. 38, figs. 1 and 2.

*Ammonites berriasensis*: Pictet, 1867, p. 70, pl. 12, fig. 1; 1868, p. 227, pl. 37 bis, fig. 2.

*Phylloceras silesiacum*: Zittel, 1868, p. 62, pl. 5, figs. 1–7; Toucas, 1890, p. 592.

*Phylloceras calypso*: Sayn, 1901, pl. 2, figs. 2–4.

*Calliphylloceras* (*Holcophylloceras*) *calypso* var. *zacarpahiensis*: Slavin, 1953, p. 45, pl. 1, figs. 6–8.

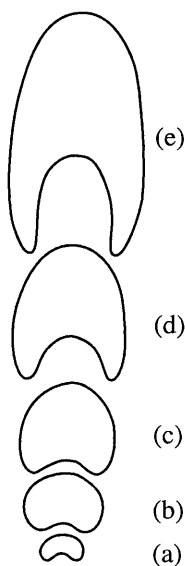
*Ptychophylloceras calypso*: Nikolov, 1960, p. 155, pl. 1, figs. 3 and 4.

*Holcophylloceras silesiacum*: Khimshiashvili, 1961, p. 153, pl. 1, fig. 7; 1967, p. 36, pl. 3, figs. 1 and 2.

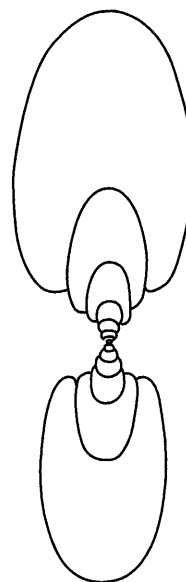
*Holcophylloceras calypso*: Khimshiashvili, 1976, p. 62, pl. 1, fig. 3.

*Ptychophylloceras ptychoicum*: Atlas..., 1997, p. 108 (pars), pl. 34, fig. 2.

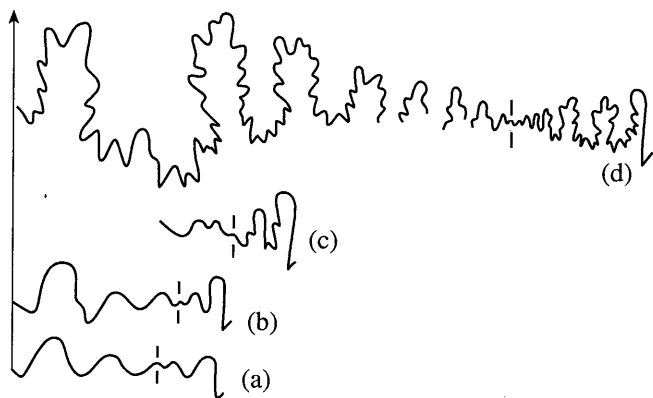
**Shell shape.** Three first whorls are evolute. The whorl cross section is depressed (Fig. 1a). At the beginning of the fourth whorl, the cross section becomes oval, with its height and width approximately equal (Fig. 1b), and, by end of the fourth whorl, its height exceeds the width (Fig. 1c). At the beginning of the fifth whorl, the shell becomes semi-involute and the flanks become flattened (Fig. 1d). The umbilicus at this stage is stepped, with a narrow steep wall. The venter is rounded, gradually transiting into the flanks. At the beginning of the sixth whorl (Fig. 1e), the cross section is compressed. The adult shell of seven whorls at Dm =



**Fig. 1.** Changes in the shape of the cross section in the ontogeny of *Leiophylloceras calypso*, specimen no. 1/13078: (a) 1.7 whorls,  $\times 9$ ; (b) 3.2 whorls,  $\times 7$ ; (c) 3.7 whorls,  $\times 7$ ; (d) 4.2 whorls,  $\times 5.6$ , and (e) 5.2 whorls,  $\times 4$ ; southwestern Crimea, Bel'bek River, Kabanii Gully; Berriasian, beds with *Dalmsiceras tauricum*.



**Fig. 2.** Cross section of the shell of *Leiophylloceras calypso*, specimen no. 8/13078,  $\times 1.5$ ; southwestern Crimea, bed of the Bel'bek River, near the mouth of the Ul'yanovskii Gully; Berriasian, beds with *Dalmsiceras tauricum*.



**Fig. 3.** Sutural ontogeny of *Leiophylloceras calypso*, specimen no. 1/13078: (a) 1.7 whorls,  $\times 21$ ; (b) 2.2 whorls,  $\times 21$ , (c) 3.2 whorls,  $\times 13$ ; and (d) 5.2 whorls,  $\times 6$ ; southwestern Crimea, Bel'bek River, Kabanii Gully; Berriasian, beds with *Dalmasiceras tauricum*.

45–50 mm (including the beginning of the body chamber) is involute and discoidal. The cross section is an extended oval. The venter is narrowly rounded (Fig. 2). The flanks are wide and very slightly convex. The umbilical wall is narrow and steep. The only large specimen of this species ( $Dm = 113$  mm) shows a slightly inflated last whorl with an oval cross section and a rounded venter.

**Ornamentation.** The first four whorls are smooth, showing growth lines only. At the stage of 4.2 whorls, the first slight constriction and a ridge in front of it appear on the venter. Near the umbilicus, there is a corresponding, hardly discernible, slightly curved constriction, which disappears on the flanks. The fifth whorl has four constrictions. They obliquely cross the venter, forming a weak sinus in the backward direction. The ventral constrictions are developed throughout the shell wall and cause the curvature of the siphuncle, which is especially well observed in the later growth stages. In the sixth whorl, the shell has six low ridges and accompanying constrictions on the venter, crossing the venter almost at a right angle. The constrictions are located behind the ridges. A weakly developed cluster of constrictions on the shell surface around the umbilicus corresponds to the ventral constrictions. On the flanks, constrictions are absent; however, once the shell is removed, they are seen on the mold running continuously from the venter to the umbilicus. The constrictions are prominent, deep, and weakly curved forward approximately near the midflank (they are less strongly curved compared to the inner whorls). The venter between the constrictions is smooth. In the seventh whorl, the shell has 6 or 7 ridges and constrictions. In the large specimen (no. 16/330), at  $Dm = 113$  mm, the constrictions on the mold are almost straight.

#### Dimensions in mm and ratios in %:

| Specimen no. | Dm    | WH   | UW   | WW    | WH/Dm | U <sub>w</sub> /Dm | WW/Dm |
|--------------|-------|------|------|-------|-------|--------------------|-------|
| 4/13078      | 12.0  | 5.5  | 2.5  | 4.3   | 49    | 21                 | 36    |
| 5/13078      | 17.2  | 8.7  | 2.9  | 6.0   | 51    | 17                 | 35    |
| 6/13078      | 18.0  | 8.8  | 2.7  | 6.3   | 49    | 15                 | 35    |
| 7/13078      | 40.3  | 20.8 | 3.4? | 13.0  | 52    | 8?                 | 32    |
| 9/13078      | 47.3  | 25.0 | 5.5  | 15.5? | 53    | 11                 | 33?   |
| 8/13078      | 48.0  | 26.5 | 4.7  | 16.6  | 55    | 9                  | 35    |
| 3/13078      | 48.8  | 26.8 | 5.0  | 16.8  | 54    | 10                 | 34    |
| 1/13078      |       |      |      |       |       |                    |       |
| 4.2 whorls   | 9.2   | 4.3  | 3.2  | 3.6   | 47    | 35                 | 39    |
| 5.0 whorls   | 18.3  | 9.4  | 3.3  | 6.6   | 51    | 18                 | 36    |
| 7.0 whorls   | 49.2  | 27.3 | 5.6  | 16.5  | 55    | 11                 | 34    |
| 2/13078      | 50.6  | 30.8 | 4.3  | 16.5  | 61    | 8                  | 33    |
| 10/13078     | 67.0  | 36.0 | 7.0  | 23.5  | 54    | 10                 | 35    |
| 16/330       | 113.0 | 64.8 | 9.5? | 44.8  | 57    | 8                  | 40    |

**Suture.** The suture is studied on the basis of specimen no. 1/13 078 (Fig. 3). At the stage of 1.7 whorls (Fig. 3a), it is composed of six lobes. Lobe  $U^1$  is formed near the umbilical seam on the inner side of the whorl on the saddle  $U/I$ . The ventral lobe is bipartite. The dorsal lobe is narrow and deep. The sutural formula is  $(V_1V_1)LU: U^1ID$ . At the stage of 2.2 whorls (Fig. 3b), lobe  $U^1$ , which is shifted on the seam, is subdivided into two,  $U_v^1$  and  $U_d^1$ . The lateral lobe is the deepest and possesses denticles. Later in ontogeny, new sutural elements appear near the seam because of the subdivision of lobe  $U_d^1$ . At the stage of 3.2 whorls (Fig. 3c), lobe  $U_v^1$  is shifted onto the outer part of the whorl, while lobe  $U_d^1$  located on the seam is subdivided into two. The dorsal lobe is narrow, deep, bipartite, and lituid. The adult suture at the beginning of the sixth whorl (Fig. 3d) has a very deep and wide tripartite lateral lobe and a lituid dorsal lobe. The secondary elements of the suture gradually decrease toward the seam. The ventral lobe is half the depth of the lateral lobe. Altogether the suture comprises 17 lobes. The adult sutures of large specimens show strong serration of lobes and saddles (Fig. 4).

The shell ontogeny is studied on the basis of one polished cross section of specimen no. 1/13 078. The protoconch is small and globose ( $Dm_1 = Dm_2 = 0.40$  mm). The caecum is not preserved. The siphuncle in the first two whorls is not seen; at the beginning of the third whorl, it is subventral, later becoming ventral. Near the constrictions, the siphuncle is curved inward. The ventral ridges are formed by the thickening of the lamellar layer of the shell (Fig. 5).

**Remarks.** The new genus is morphologically similar to *Ptychophylloceras* and *Holcophylloceras*, and when the specimens are represented by molds only,

identification is difficult. The species described is morphologically similar to *Ptychophylloceras semisulcatum* (d'Orb.), differing in the deep constrictions on the mold and the different outline of the ventral lobe. It is distinguished from *Holcophylloceras tauricum* (Retowski) by the absence of ribbing on the venter.

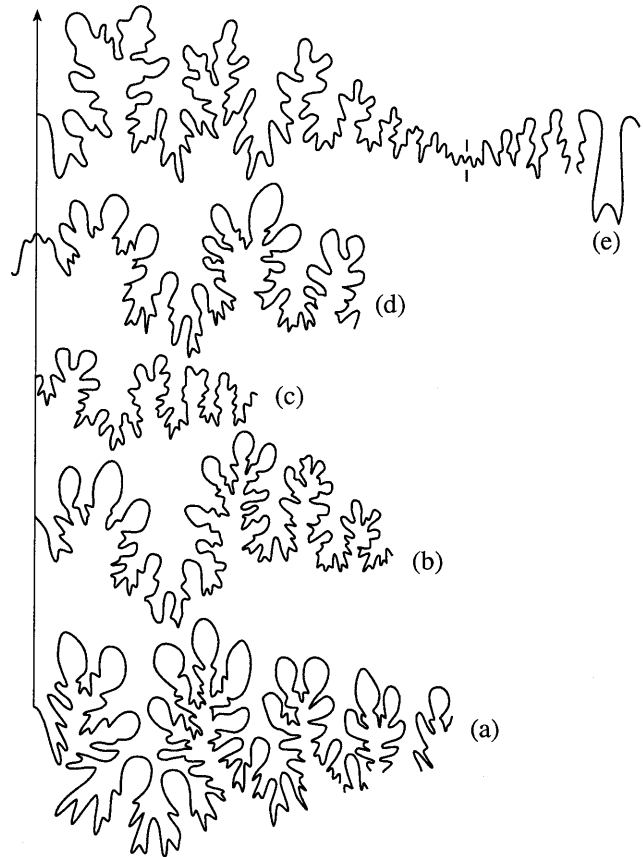
D'Orbigny first described similar smooth ammonites from the Neocomian of the Alps (d'Orbigny, 1840–1842). Later, Pictet (1863–1868) described *Ammonites calypso* from the Tithonian of Stramberg, and Sayn (1901) described *Phylloceras calypso* from the Berriasian of France. The new species *Ammonites berriasensis* established by Pictet is almost identical to *calypso*, judging from the original figures.

Zittel (1868) described *Phylloceras silesiacum* from the Tithonian of Stramberg. Discussing the preservation and morphology of the new species, Zittel (1868, p. 63) wrote: "The specimens with a preserved shell have lateral furrows completely covered, and only on the venter are 5 or 6 short plications seen, accompanied by depressions, which correspond to these elements on the mold. The shell itself is usually completely smooth, rarely possessing fine growth lines." Figures in Zittel's monograph show shells with a preserved outer layer and molds. Complete shells are smooth, possess ridges and constrictions only on the venter, and on the molds distinctly show constrictions crossing the entire surface of the shell from the umbilicus to the venter. The specimens shown by Zittel are apparently identical to those from Bel'bek.

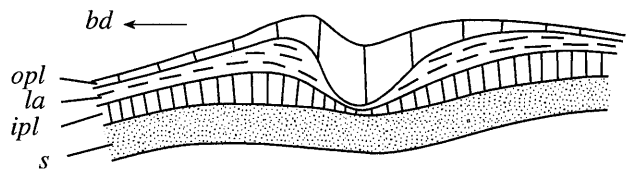
Later, Slavin (1953) described the variety *zacarpathiensis* of the species *calypso* from the Upper Tithonian–Berriasian of the Carpathians and assigned it to the subgenus *Holcophylloceras* of the genus *Calliphylloceras*. Nikolov (1960) described the species *calypso* from the Berriasian of Bulgaria and assigned it to the genus *Ptychophylloceras*. He synonymized the species *silesiacum* and *berriasensis* with *calypso*.

Khimshiashvili (1961, 1967) described *Holcophylloceras silesiacum* from the Tithonian (?) of the northern Caucasus and the Crimea, and later he (Khimshiashvili, 1976) described *H. calypso* from the Tithonian of the Caucasus and included specimens previously assigned by him to *H. silesiacum* in the synonymy of *H. calypso*. A detailed morphological description of this species is published only in the earliest paper by Khimshiashvili (smooth molds lacking ribbing and having six constrictions per whorl). Nevertheless, Khimshiashvili did not explain why he assigned smooth specimens to *Holcophylloceras*, which typically shows ornamentation between the constrictions on the venter. The descriptions and figures of the above authors are similar to those from the Crimea that were used as a basis for this study.

In the subsequent studies of ammonites and the biostratigraphy of the Berriasian of the Tethyan Realm, there is very little mention of the above species. Concerning the Crimean material, this perhaps resulted from the



**Fig. 4.** Sutures of *Leioptychoceras calypso*: (a) specimen no. 16/330 at WH = 53 mm,  $\times 1.6$ ; southwestern Crimea, Bel'bek River, Kabanii Gully; (b) specimen no. 2/13078 at WH = 24.2 mm,  $\times 2.3$ ; southwestern Crimea, bed of the Bel'bek River, near the mouth of the Ul'yanovskii Gully; (c) specimen no. 6/13078 at WH = 6.7 mm,  $\times 5$ ; central Crimea, Sary-Su River; and (d) specimen no. 3/13078 at WH = 25.5 mm,  $\times 2.3$ ; (e) *Ptychophylloceras semisulcatum* (d'Orb.), specimen no. 3/334, 4.3 whorls,  $\times 10$ ; central Crimea, Sary-Su River; southwestern Crimea, bed of the Bel'bek River, near the mouth of the Ul'yanovskii Gully. All specimens are from the Berriasian, beds with *Dalmanites tauricum*.



**Fig. 5.** Structure of the ventral wall of the shell of *Leioptychoceras calypso* (d'Orbigny) at the end of the sixth whorl near the constriction, specimen no. 1/13078,  $\times 40$ ; Designations: (bd) body chamber, (ipl) inner prismatic layer, (la) lamellar layer, (opl) outer prismatic layer, and (s) siphuncle.

erroneous identifications of ammonites (or at least some of them) as *Holcophylloceras tauricum* or *Ptychophylloceras* (Atlas..., 1997). Study of O. Retowski's collection in the TsNIGR Museum and, particularly, specimen no. 10/10 916, which he identified as *Phylloceras mediterraneum* Neum. var. *tauricum* (Retowski, 1893) and

which was later re-described by Drushchits (1969) as *Holcophylloceras tauricum* (Retowski), showed that it is represented by a mold with seven constrictions per whorl extending across the flank. Fine ribbing is observed near one of the constrictions on the venter. This ribbing is virtually indiscernible in the photographs either in Retowski's or Drushchits's papers. Evidently, poorly preserved ammonites of the genera *Holcophylloceras* and *Leiophylloceras* are difficult to differentiate.

**Occurrence.** Upper Tithonian–Berriasian of the Czech Republic and the Carpathians. Berriasian (*jacobi–grandis* and *occitanica* zones) of the Crimea, Bulgaria, southeastern France, and the Alps.

**Material.** 24 specimens from the basin of the Tonas River (village of Krasnoselovka), eastern Crimea (vicinity of Feodosiya, village of Sultanovka), central Crimea (Sary-Su River, villages of Mezghor'e, Kozlovka, and Balki), and southwestern Crimea (Bel'bek River).

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