

## Aalenian and Lowermost Bajocian ammonites (Hammatoceratinae and early Otoitidae) from the Western and Central Balkan Mountains (Bulgaria)

Ljubomir Metodiev, Ivo Sapunov

Geological Institute, Bulgarian Academy of Sciences, 1113 Sofia, e-mail: Lubo@geology.bas.bg; sapunov@geology.bas.bg (Submitted: 21.06.2001; accepted: 21.06.2001)

Л. Методиев, И. Сапунов - Ааленские и нижнебайосские аммониты (Hammatoceratinae и ранние Otoitidae), Западный и Центральный Балкан (Болгария). В этой работе в первый раз в Болгарии, описаны и фигурированы пять таксонов видовой группы. Они принадлежат к подсемейству Hammatoceratinae, а один вид - к семейству Otoitidae. К подсемейству Hammatoceratinae принадлежат *Pseudammatoceras subinsigne* (Oppel, 1856), *Pseudammatoceras cf. ornatum* Elmi, 1963, *Pseudammatoceras broilii* (Renz, 1925), *Planammatoceras planiforme* Buckman, 1922 (ааленский ярус, зона *Ludwigia murchisonae*) и *Parammatoceras boyeri* Elmi, 1963 (ааленский ярус, зона *Graphoceras concavum*), а к семейству Otoitidae - *Docidoceras cf. cylindroides* Buckman, 1919 (нижний байосский подъярус, зона *Hyperlioceras discites*).

**Abstract.** Five taxa of the species group, belonging to the subfamily Hammatoceratinae and one species of the family Otoitidae are described and figured in the present paper, for the first time in this country. From the subfamily Hammatoceratinae they are *Pseudammatoceras subinsigne* (Oppel, 1856), *Pseudammatoceras cf. ornatum* Elmi, 1963, *Pseudammatoceras broilii* (Renz, 1925), *Planammatoceras planiforme* Buckman, 1922 (Aalenian, *Ludwigia murchisonae* Zone) and *Parammatoceras boyeri* Elmi, 1963 (Aalenian, *Graphoceras concavum* Zone), and from the family Otoitidae - *Docidoceras cf. cylindroides* Buckman, 1919 (Lower Bajocian, *Hyperlioceras discites* Zone).

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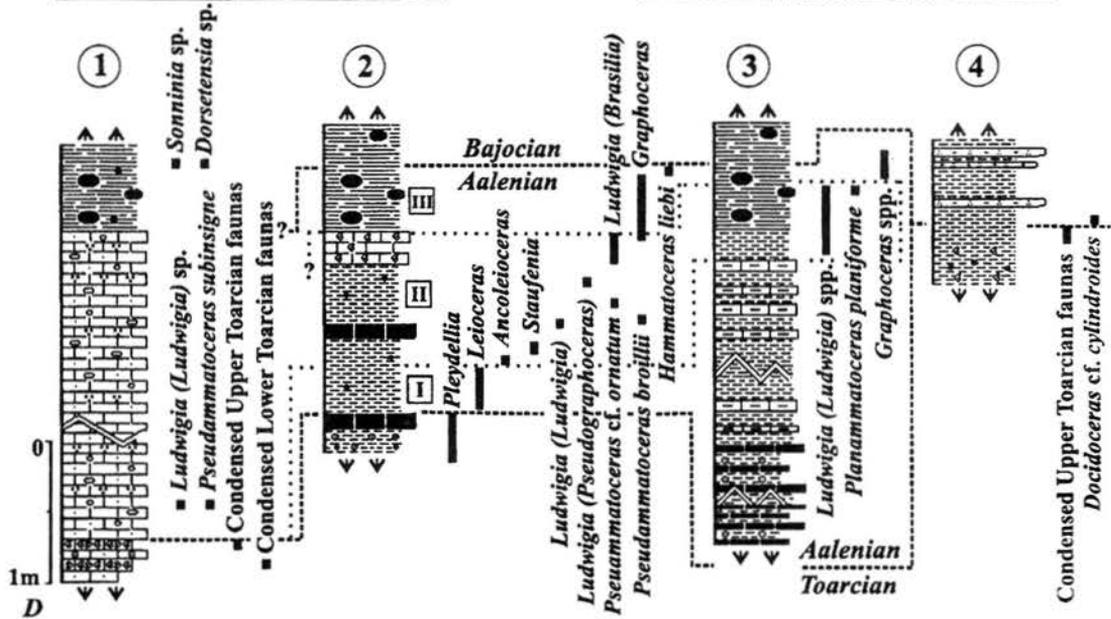
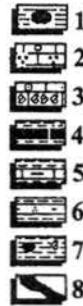
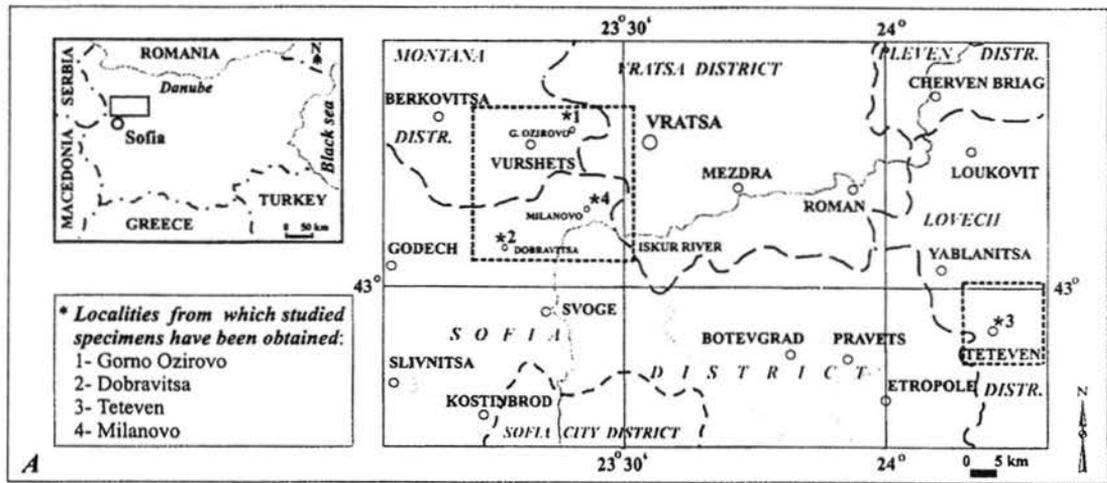
**Key words:** Middle Jurassic (Aalenian, Lowermost Bajocian) ammonites, taxonomy, biostratigraphy, Bulgaria.

### Introduction

The Aalenian and Lowermost Bajocian ammonites in the Western and Central Balkans are represented mainly by different Graphoceratidae (Сапунов, 1964; Sapunov, 1968; Sapunov, Stephanov, 1964; Metodiev, 1997, 2000). Very rare and poorly studied Hammatoceratinae accompanied them. The following species have been described and figured up to now in Bulgaria: *Hammatoceras liebi* (Maubeuge, 1955) from the top Aalenian *Graphoceras concavum* Zone by Metodiev (1997, p. 29, pl. 6, fig. 6); *Eudmeto-*

*ceras amplexens* Buckman, 1920 from the Lowermost Bajocian *Hyperlioceras discites* Zone by Сапунов (1964, p. 261, pl. 1, fig. 2a, b; pl. 3, fig. 1a, b) and *Eudmetoceras klimakomphalum* (Vacek, 1886) also from the Lowermost Bajocian *Hyperlioceras discites* Zone, again by Сапунов (1964, p. 262, pl. 2, fig. 2a-c).

In the present paper are described and figured five species of the subfamily Hammatoceratinae belonging to the genera *Pseudammatoceras*, *Parammatoceras* and *Planammatoceras*. In addition to that here is described and figured one early Otoitidae of the genus *Docidoceras* be-



Established Aalenian ammonite zones: I *Leioceras opalinum* Zone; II *Ludwigia munchisonae* Zone; III *Graphoceras concavum* Zone

Fig. 1. Sketch map for the positions of the localities from which studied Bulgarian Hammatoceratinae and early Otoitidae have been obtained (A). Scheme of the exposures of the Ozirovo and Etropole Formations in a part of the Western Balkan Mts. (B) and Central Fore-Balkan (C). Lithological succession and the distribution of studied ammonite taxa in the Aalenian and Lowermost Bajocian of the localities of Gorno Ozirovo, Dobravitsa, Teteven and Milanovo (D)

1 – black argillites with siderite and clayey-calcareous concretions; 2 – grey-black, grained, sandy limestones; 3 – dark-grey sandy bioclastic limestones with rich fossil assemblages; 4 – grey-black marls with intercalations of micritic limestones; 5 – grey-black marls with intercalations of clayey limestones; 6 – grey clayey marls with interbeds of siltstones; 7 – grey clayey marls with numerous pyritic concretions; 8 – exposures of the Ozirovo and Etropole Formations

cause according to Arkell (1957, p. L287) it derives from late Hammatoceratinae (genera *Erycites* and *Abbasites*).

The examined specimens are kept in the Museum of Palaeontology and Historical Geology at the University of Sofia "St. Kliment Ohridski".

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financial support of the National Fund for Scientific Research (Project No. 1005/00).

### Notes on the distribution of the studied ammonite species

The specimens identified to the taxa of the species group are found in the upper parts of the clayey-calcareous and marly sediments of the Boukorovtzi Member of the Ozirovo Formation and in the base of the above-situated terrigenous-clayey Etropole Formation.

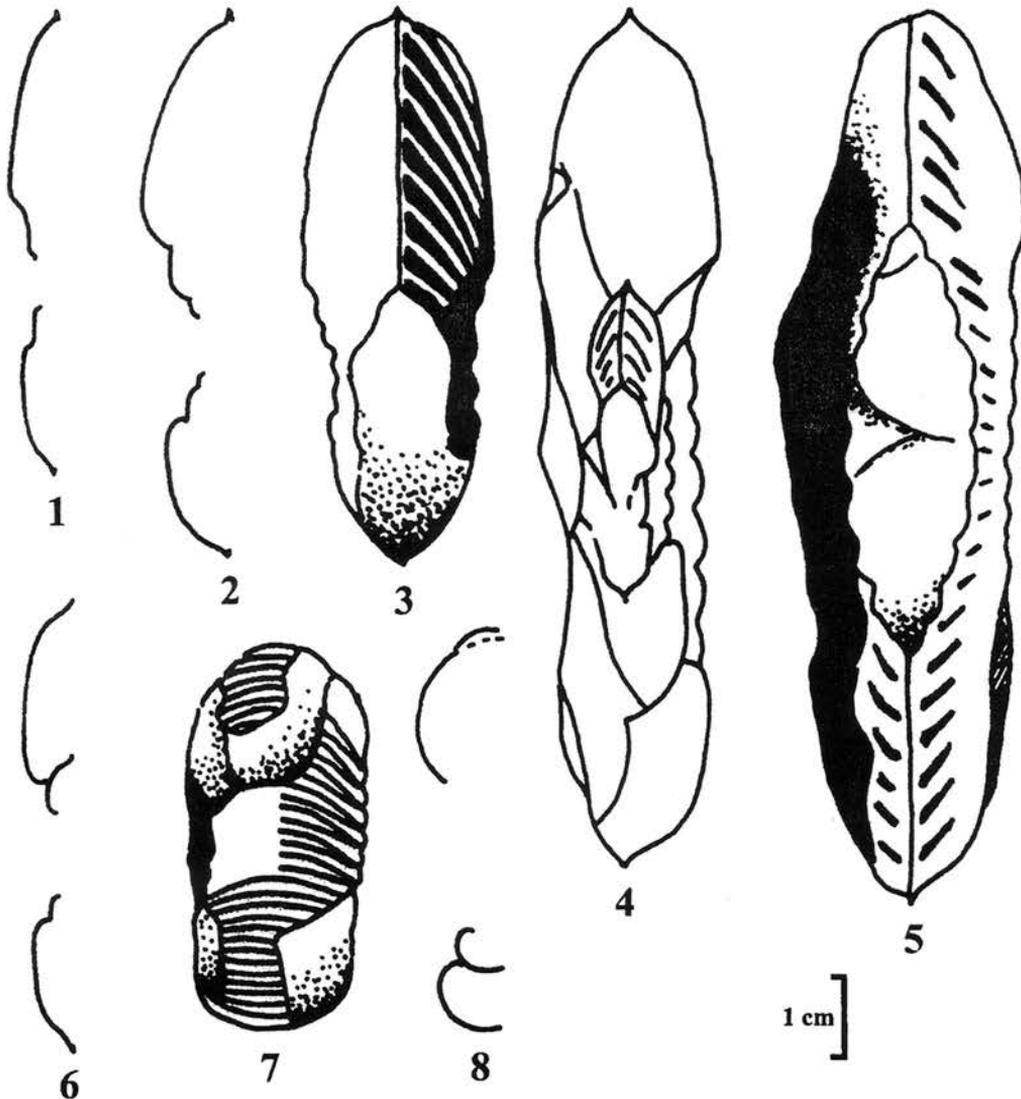


Fig. 2. Ventral views and whorl shapes of the studied Bulgarian Hammatoceratinae and early Otoitidae 1 - whorl section of *Planammatoceras planiforme* Buckman, 1922 (specimen No J<sub>2</sub>1001, figured on pl. I, fig. 3); 2, 3 - whorl section and ventral view of *Pseudammatoveras subinsigne* (Oppel, 1856) (specimen No J<sub>2</sub>1002, figured on pl. I, figs 1, 2); 4, 5 - whorl section and ventral view of *Parammatoceras boyeri* Elmi, 1963 (specimen No J<sub>2</sub>1003, figured on pl. I, fig. 4); 6 - whorl section of *Parammatoceras boyeri* Elmi, 1963 at diameter of 55.0 mm; 7, 8 - ventral view and whorl section of *Docidoceras cf. cylindroides* Buckman, 1919 (specimen No J<sub>2</sub>1004, figured on pl. I, fig. 7)

From the uppermost 10 m of the grey, sandy, bioclastic limestones in the holotype of the Ozirvo Formation, to the north of the village of Gorno Ozirvo (Montana District), Vrachanska Planina Mt. (Western Balkan Mts.) is found *Pseudammatoceras subinsigne* (Oppel, 1856) (see Fig. 1A, B, D). It is distributed probably in the upper part of the Aalenian (*Ludwigia munchisonae* Zone).

*Pseudammatoceras broilii* (Renz, 1925) and *Pseudammatoceras cf. ornatum* Elmi, 1963 come from the upper part of the Boukorovtsi Member of the Ozirvo Formation (represented by grey-black sandy marls with intercalations of micritic limestones), near the village of Dobravitsa (section described by Metodiev, 1997) (former Zaguzhene), Sofia District, Ponor Planina Mt. (Western Balkan Mts.) (see Fig. 1A, B, D). They are also distributed in the Aalenian *Ludwigia munchisonae* Zone.

*Parammatoceras boyeri* Elmi, 1963 is collected also near the village of Dobravitsa (see also Fig. 1A, B, D), but in the lowermost levels of the Etropole Formation (represented by black argillites and siltstones with sideritic and clayey-calcareous concretions). It belongs to the Aalenian *Graphoceras concavum* Zone.

*Planammatoceras planiforme* Buckman, 1922 comes from the base of the black argillites and siltstones with sideritic concretions of the Etropole Formation, from the locality in the northern part of the town of Teteven, Lovech District, Central Fore Balkan (Central Balkan Mts.) (Fig. 1A, C, D). The occurrence of this species is limited probably to the Aalenian *Ludwigia munchisonae* Zone.

From the Boukorovtsi Member of the Ozirvo Formation (probably in its upper part), locally represented only by grey clayey marls, near the village of Milanovo (Sofia District), Vrachanska Planina Mt. (Western Balkan Mts.) (see again Fig. 1A, B, D), is collected one good preserved ammonite fragment identified as *Docidoceras cf. cylindroides* Buckman, 1919. The occurrence of this species is limited in the *Hyperlioceras discites* Zone of the Lowermost Bajocian. This is the first Lower Bajocian biostratigraphic indication in outcrops of the Boukorovtsi Member in Bulgaria. This fact gives us reason to believe that in restricted localities in the Balkan Mountains is possible the highest levels of the Boukorovtsi Member to belong to the Lowermost Bajocian. This new result is in agreement with the stratigraphic data in several deep boreholes in the western and central part of North Bulgaria, where the presence of the Lowermost Bajocian is proved in the highest levels of the Ozirvo Formation (its Souhindol Member).

## Taxonomic descriptions

Family **HAMMATOCERATIDAE** Buckman, 1887  
Subfamily **HAMMATOCERATINAE** Buckman, 1887  
Genus *Pseudammatoceras* Elmi, 1963

*Nomenclature.* Type species, by original designation (Elmi, 1963, p. 13), is *Ammonites subinsigne* Oppel (1856, p. 367). More data about the type specimen are given in the description of the species.

*Diagnosis.* According to the original generic diagnosis (Elmi, 1963, p. 13) *Pseudammatoceras* includes evolute and very coarsely ornamented Hammatoceratinae, with tubercles or tubercle-shaped primaries in inner and middle stages of growth, but the tubercles are located always high on the whorl sides and never on the umbilical edge as in *Hammatoceras*. Characteristic deeply umbilicate. Biplicate or triplicate ribbing trends to be softer in outer whorls and this modification more or less reveals during the ontogenetic development.

*Discussion.* Amongst the Aalenian Hammatoceratinae the representatives of *Parammatoceras* Buckman, 1925 are the most similar to *Pseudammatoceras* but they differ in having more enveloped whorls, less salient and more closely related to the umbilical edge tubercles.

*Occurrence.* Aalenian (closely from the base of the *Leioceras opalinum* Zone to the top of the *Graphoceras concavum* Zone) - Lower Bajocian (*Hyperlioceras discites* Zone). France, Italy, Germany, Hungary, Bulgaria, Caucasus.

### *Pseudammatoceras subinsigne* (Oppel, 1856)

Pl. I, figs 1, 2; Fig. 2/2, 3

1856. *Ammonites subinsigne* Oppel, p. 367.

1925. *Hammatoceras subinsigne* (Oppel); Renz, p. 10, pl. figs 5, 5a (holotype figuration).

V 1963. *Hammatoceras subinsigne* (Oppel); Начев, Сапунов, Стефанов, p. 110.

1963. *Pseudammatoceras subinsigne* (Oppel); Elmy, p. 15, pl. 1, figs 1, 2; Fig. 1.

pars 1966. *Hammatoceras planinsigne* Vacek; Géczy, p. 58, pl. 11, fig. 1 (only).

*Material.* Single specimen has been obtained - J<sub>2</sub> 1002 (coll. I. Sapunov). It comes from the section of the Ozirvo Formation (Aalenian, probably from the *Ludwigia munchisonae* Zone), north of the village of Gorno Ozirvo (Montana District), Vrachanska Planina Mt. (Western Balkan Mts.), Bulgaria (see Fig. 1).

*Nomenclature.* The holotype is Oppel's original specimen, figured by Renz (1925, pl. I, fig. 5, 5a). It refers to a medium-sized and well-preserved, but fragmentary specimen, consisting of a

nearly whole whorl, from "Schichten mit *Lytoceras torulosum*" (probably of the *Leioceras opalinum* Zone), at Gomaringen (Württemberg), Southwest Germany.

**Description.** The holotype and the examined Bulgarian specimen of this species (figured on pl. 1, figs 1, 2) have nearly similar whorl proportions and ornament, though the holotype is probably wholly septate, while Bulgarian example is incomplete. The holotype has a slightly less whorl height and bigger whorl breadth, but both have an equal O/D proportion (see Table 1). Both are medium sized, moderately evolute and moderately compressed, with rounded whorls. Both have a whorl section with the maximal breadth in the umbilical area, abrupt umbilical walls and rounded umbilical edge limiting deep umbilicus. The whorl sides converge towards moderately wide, obtusely angled and keeled venter. It seems that the last suture-line, which limits the beginning of the body chamber of the Bulgarian example, is situated just behind the end of the last preserved whorl.

Coarse and slightly projected ribs, twinned or branched on three at the inner third of the sides, represent the ornament. The ribs are separated by deep and moderately wide interribal spaces. Thick primaries start at the umbilical seam. In inner whorls they are rectiradiate but on the final whorl became slightly concave and prorsiradiate. Rounded umbilical tubercles gave raise to the secondaries. The tubercles fade to become scarcely perceptible on the outer half of the last whorl. At the point of branching ribs curve slightly backwards but rest prorsiradiate. On the ventro-lateral area they are developed obliquely towards the ventral keel. Just below the end of the final whorl the ribs straighten out and incline stronger forwards.

**Discussion.** This Bulgarian representative of the species was reported by Начев, Сапунов, Стефанов (1964, p. 110) as *Hammatoceras subinsigne* (Oppel). We support completely the initial specific determination of these authors and give here description and figuration of their specimen but identify it by new generic name (see the comparative remarks, concerning *Hammatoceras* and *Pseudammatoceras* in the diagnosis of the genus). Two typical well-preserved and wholly septate internal moulds, from the *Leioceras opalinum* Zone, in ferriferous limestones at St-Quentin-Fallavier (Isère), France, were described and figured by Elmi (1963, p. 15, pl. 1, figs 1, 2). In comparison with our specimen they show slightly less opened umbilicus and less compressed whorl section, but have closely similar style of ornament. Géczy (1966, p. 58, pl. 11,

figs 1-3; pl. 39, figs 3, 4; pl. 41, fig. 7; Fig. 47) described and figured as *Hammatoceras planinsigne* (Vacek) three Hungarian specimens, probably from the *Ludwigia murchisonae* Zone, showing considerable morphological differences between themselves, as regard to the main coiling parameters as well as the ornament. We believe that Géczy's example figured on pl. 11, fig. 1 greatly resembles to the holotype and our specimen and put it in the listed synonymy of *P. subinsigne* (Oppel).

Above described Bulgarian *Pseudammatoceras subinsigne* (Oppel) is not exactly stratigraphically determinable on account of material available. It has been found together with the bad-preserved specimens of the genus *Ludwigia*. That fact gave us reason to consider our ammonite as having a more higher stratigraphical position than the holotype and Elmi's specimens – *Ludwigia murchisonae* Zone.

**Occurrence.** Aalenian. *Leioceras opalinum* Zone: France (Isère), Germany (Swabia); *Ludwigia murchisonae* Zone: Hungary (Bacony Mts.), Bulgaria (Western Balkan Mts.).

### ***Pseudammatoceras broillii* (Renz, 1925)**

Pl. I, fig. 5

1925. *Hammatoceras broillii* Renz, p. 14, pl. 2, figs 2, 2a.  
1966. *Hammatoceras* cf. *broillii* Renz; Géczy, p. 38, pl. 3, fig. 3; pl. 37, fig. 17.

**Material.** One specimen has been collected - J<sub>2</sub> 1006 (coll. L. Metodiev). It comes from the *Ludwigia murchisonae* Zone at the upper parts of the Boukorovtsi Member of the Ozirovo Formation, north of the village of Dobravitsa (Sofia District), Ponor Planina Mt. (Western Balkan Mts.), Bulgaria (see Fig. 1).

**Nomenclature.** The holotype is Renz's original specimen (Renz, p. 14, pl. 2, figs 2, 2a) – probably almost complete ammonite, 52 mm diameter. It is most likely to derive from the *Ludwigia murchisonae* Zone, in the locality at Monte Erice (near by Trapani), Western Sicily.

**Description.** Bulgarian example of this species is based on medium sized specimen with relatively well preserved ribbing but extremely flattened, whose whorl section and whorl proportions are undeterminable properly. The whorls are probably subelliptical with parallel whorl sides, sloping umbilical walls and rounded umbilical edge. The umbilicus is wide and shallow and the ventral wall has a thin keel, bordered by narrow flat areas.

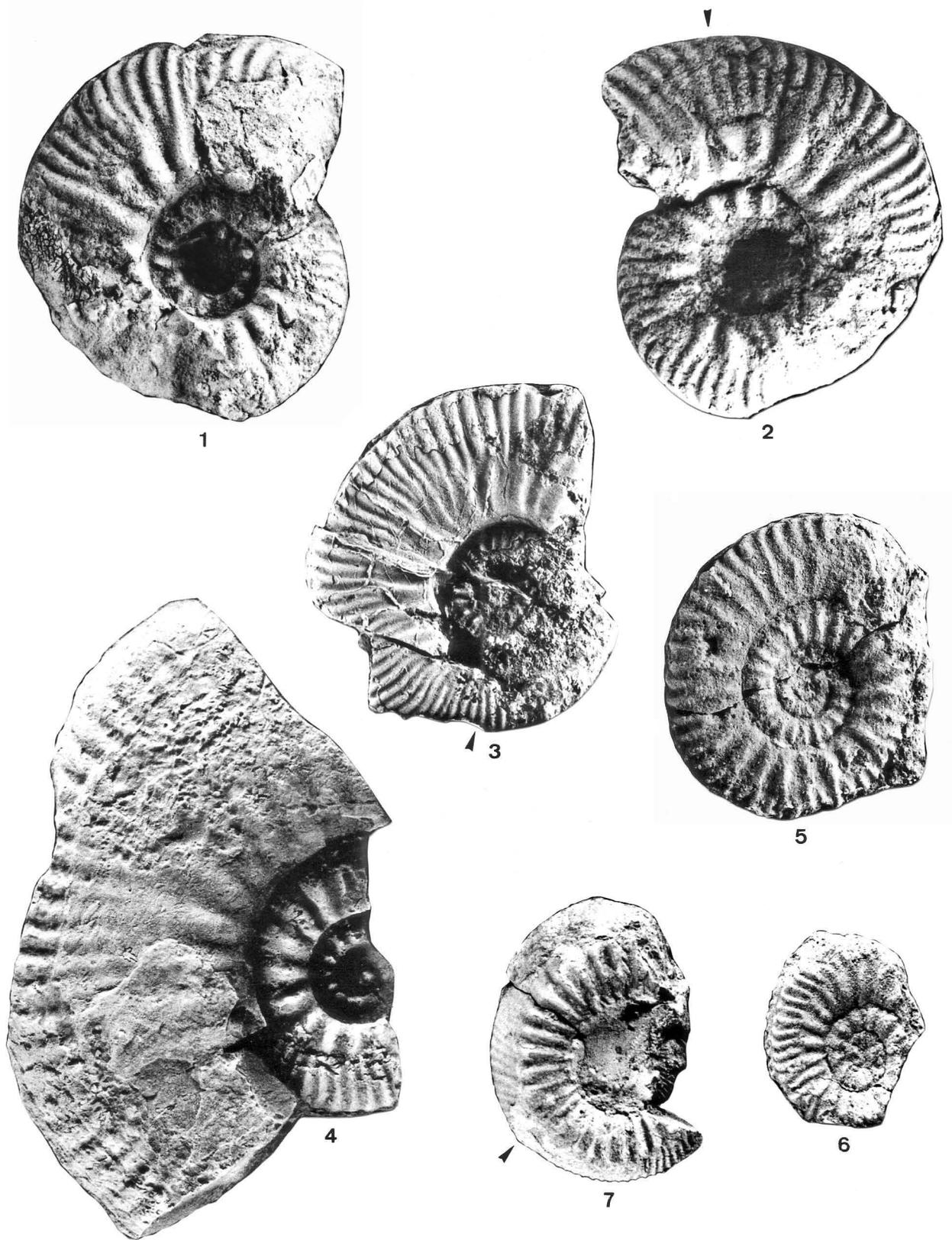
The ornament consists of moderately coarse, widely spaced and mainly biplicate ribs, branching approximately on the middle of the whorl

## PLATE I

- 1, 2. *Pseudammatoceras subinsigne* (Oppel, 1856) (J<sub>2</sub>1002) - a wholly septate specimen, with incomplete body-chamber from the uppermost 10 m in the holostratotype of the Ozirovo Formation, north of the village of Gorno Ozirovo, Montana District (Vrachanska Planina Mt., Western Balkan Mts.); Aalenian, *Ludwigia munchisonae* Zone.
3. *Planammatoceras planiforme* Buckman, 1922 (J<sub>2</sub>1001) - an adult phragmocone with incomplete body-chamber, from the base of the Etropole Formation in the northern vicinity of the town of Teteven, Lovech District (Central Fore-Balkan); Aalenian, *Ludwigia munchisonae* Zone.
4. *Parammatoceras boyeri* Elmi, 1963 (J<sub>2</sub>1003) - probably wholly septate specimen, from the lowermost levels of the Etropole Formation, near the village of Dobravitsa, Sofia District (Ponor Planina Mt., Western Balkan Mts.); Aalenian, *Graphoceras concavum* Zone.
5. *Pseudammatoceras* cf. *ornatum* Elmi, 1963 (J<sub>2</sub>1005) - a highly flattened and probably wholly septate specimen, from the upper parts of the Boukorovtsi Member of the Ozirovo Formation, near the village of Dobravitsa, Sofia District (Ponor Planina Mt., Western Balkan Mts.); Aalenian, *Ludwigia munchisonae* Zone.
6. *Pseudammatoceras broilii* (Renz, 1925) (J<sub>2</sub>1006) - a greatly pressed small specimen, from the upper parts of the Boukorovtsi Member of the Ozirovo Formation, near the village of Dobravitsa, Sofia District (Ponor Planina Mt., Western Balkan Mts.); Aalenian, *Ludwigia munchisonae* Zone.
7. *Docidoceras* cf. *cylindroides* Buckman, 1919 (J<sub>2</sub>1004) - an adult phragmocone with incomplete body-chamber, from the Boukorovtsi Member of the Ozirovo Formation (probably upper part), near the village of Milanovo, Sofia District (Vrachanska Planina Mt., Western Balkan Mts.); Lower Bajocian, *Hyperlioceras discites* Zone.

All figures are in natural size. The arrows mark the position of the last suture-line at the end of the phragmocone. All the studied specimens are kept in the collections of the Museum of Palaeontology and Historical Geology at University of Sofia.

PLATE I



sides. There are also intercalaries. The primaries of the fascicles are in general rectiradiate and bolded at the point of bifurcating. The secondaries are slightly inclined backwards. On the last half of the final whorl the primary ribs acquire straight direction and the bifurcation falls under the middle of the sides. The secondaries are developed on gently concave line and the inners of them are taken up forwards. Ventro-lateral part of ribs is bolded and shortly curved forwards. Rib-density increases and rib-relief trends to decrease with growth.

*Discussion.* Comparing together Renz's original and our specimen, it is obvious that the styles of ornament are the same in both, except for the intercalaries which on the holotype are a little more than on Bulgarian example. As for the whorl proportions and the mode of growth, the holotype has a higher and wider whorl section and 9 % more reduced umbilicus (see Table 1). As regards of the specimen, described and figured by Géczy (1966, p. 38, pl. 3, fig. 3), estimating its morphological features, we believe that despite the doubt to its specific identity, expressed by Hungarian author, there is no doubt that it belongs to studied taxon of species group.

*Occurrence.* Aalenian: *Ludwigia purchisonae* Zone. Sicily (Monte Erice), Hungary (Bacony Mts.), Bulgaria (Western Balkan Mts.).

#### *Pseudammatoceras* cf. *ornatum* Elmi, 1963

Pl. I, fig. 6

1963. *Parammatoceras ornatum* Elmi; p. 35, pl. 1, fig. 5; pl. 2, fig. 2a, b; Fig. 11a-c.

*Material.* One specimen has been obtained - J<sub>2</sub> 1005 (coll. L. Metodiev), from the upper parts of the Boukorovtsi Member of the Ozirovo Formation, Aalenian, *Ludwigia purchisonae* Zone, north of the village of Dobravitsa (Sofia District), Ponor Planina Mt. (Western Balkan Mts.), Bulgaria (see Fig. 1).

*Nomenclature.* The holotype (coll. de Riaz, Fac. Sc. Lyon, No A. 5331), figured by Elmi (1963, pl. 2, fig. 2a, b), is an almost complete adult specimen, 46 mm diameter, from the *Ludwigia purchisonae* Zone at Saint-Quentin-Fallavier (Isère), France. A nucleus from the same locality, designated paratype (coll. Fac. cathol. Lyon, No FC. 3), and one medium sized internal mould topotype (coll. Deshayes, Ec. des Mines, Paris), were figured by the author also (Elmi, 1963, pl. 1, fig. 5; Fig. 11c).

*Description.* The species is determined on small and evolute Bulgarian specimen with moderately high whorls enveloped about 1/3. It comes from the marls of Boukorovtsi Member of the Ozirovo Formation and for this reason it is

extremely flattened. In inner growth stages where the whorls are preserved in its true volume the whorl section is rounded trapezium-shaped with the maximal whorl breadth in the umbilical area. Slope umbilical walls and rounded umbilical edge envelope shallow umbilicus. Whorl sides are moderately rounded and converging to a narrow, flat and thin keeled venter.

The whorls are ornamented by coarse and elbow-shaped bifurcating ribs, developed from the umbilical seam to the base of the ventral keel. There are a rare intercalaries also. In inner whorls thick and slightly prorsiradiate primaries are visible only. On the last whorl the ribs branch out just below the middle of the whorl sides. They have straight inner half, a bend backwards at the point of branching and short curve forwards on the ventro-lateral area.

*Discussion.* Despite its small size and flattened whorls, the morphological resemblance of studied Bulgarian example with the specimens of type series, listed in the nomenclature, is very close. Such described specimen has almost all the characters of the species, including moderately high and one-third enveloped whorls, coarse and elbow-shaped pattern of ribs, but differs by having a more opened and shallower umbilicus. It is most closely similar to the topotype, figured by Elmi (1963, p. 36, Fig. 11a). Compared with him, the specimen representing *P. broilii* (Renz, 1925) has an almost equal H/D O/D proportions (see Table 1), but it has coarser, less curved and more widely spaced ornament.

*Occurrence.* Aalenian: *Ludwigia purchisonae* Zone. France (Isère), Bulgaria (Western Balkan Mts.).

#### Genus *Parammatoceras* Buckman, 1925

*Nomenclature.* Type species, by original designation (Buckman, 1925, pl. 555), is *Parammatoceras obtectum* Buckman, 1925 (holotype). The type specimen comes from "hemera planiforme = *Ludwigia purchisonae* Zone", at Stoke Knap "(Quarry on east slope, towards Beaminster)", Dorset, England.

*Diagnosis.* Coiling moderately evolute. Whorl section compressed but well rounded, with ogival and keeled venter. Ornament is subfalcooid. Thick, rectiradiate to inclined forwards primary ribs give rise to two or three long and slightly projected forwards into ventro-lateral area secondaries, branching out in later growth stages on the middle of the whorl sides. In inner whorls the ribbing usually start from small umbilical tubercles.

*Discussion.* The similar in whorl shape, whorl proportions and ribbing *Planammatoceras* dif-

fers in the complete absence of tubercles in all of stages of coiling. *Pseudammatoceras* Elmi, 1963 have more distant ornament, covered lower, wider and more enveloped whorls with wider and low-rounded venter.

*Occurrence.* Aalenian (*Leioceras opalinum* Zone - *Graphoceras concavum* Zone). France, Germany, Hungary, Bulgaria.

### *Parammatoceras boyeri* Elmi, 1963

Pl. I, fig. 4; Fig. 2/4-6

1963. *Parammatoceras boyeri* Elmi; p. 49, pl. 7, figs 1, 2; Fig. 20.

*Material.* One specimen has been collected - J<sub>2</sub> 1003 (coll. Museum of Paleontology and Historical Geology, University of Sofia). It comes from locality at the base of the Etropole Formation (Aalenian, *Graphoceras concavum* Zone), north of the village of Dobravitsa (Sofia District), Ponor Planina Mt. (Western Balkan Mts.), Bulgaria (see Fig. 1).

*Nomenclature.* The holotype (coll. de Riaz, Fac. Sc. Lyon, No A. 5361), figured by Elmi (1963, pl. 7, fig. 1), is an almost complete specimen, 220 mm diameter, from the *Ludwigia murchisonae* Zone at St-Quentin-Fallavier (Isère), France. One wholly septate paratype (coll. Fac. Sc. Lyon, No A. 887) was figured by the author also (Elmi, 1963, pl. 7, fig. 2).

*Description.* A single Bulgarian specimen has been related to studied species. It consists of a fragment of 4 whorls of small diameter and approximately one-third of the attached next whorl, corresponding probably to a diameter of 150 mm. The whorl height of the last preserved whorl is 50.7 mm and its whorl breadth is respectively 25.0 mm. The maximal whorl breadth to all whorls is situated near by the umbilical edge. At diameter of 55.0 mm the whorl section has rounded umbilical edges, undercut umbilical walls and rounded whorl sides. The sides are convergent to moderately wide venter that has a thin keel, bordered by smooth and narrow flat areas. Smaller whorls limit a moderately opened and deep umbilicus. They are enveloped about 1/3 - 1/4. The umbilical walls at the last whorl are slope and passing through rounded and slightly perceptible umbilical edge into the whorl sides. The venter at the same whorl is sharpened.

The ornament is coarse, sharp and wide spaced, represented by triplicate ribs, developed from the umbilical edge to the base of the ventral keel. The curve of the ribs is gently sinuous. The ribbing is moderately projected forwards in the ventro-lateral area. The rib-relief tends to decrease with growth. At diameter below 25 - 27

mm the whorls are covered by very sharp and thin, slightly inclined forwards ribs, joined by three on the umbilical edge at small and acutely angled round tubercles. Over the diameter 55 mm umbilical tubercles of the earlier whorls convert in strongly protruding, rectiradiate and deep spaced primaries, developed on the first third part of the whorl sides. The primary ribs give rise to three slightly inclined backwards and concave curved secondaries. On the last whorl the branching of the fascicles is fixed at the quarter of the whorl sides height. The primaries are slightly prorsiradiate and bend slightly backwards at the point of furcating.

*Discussion.* Because of its incompleteness, studied Bulgarian specimen could not be compared by the main whorl proportions with the types, presented by Elmi (1963). However, in smaller sizes, where is possible to measure the diameter and all of whorl parameters, it has a similar O/D proportion, an exceeding of 2 to 3 % of H/D proportion and 4 % lower E/D proportion than the holotype and the paratype (see Table 1).

*Occurrence.* Aalenian: *Ludwigia murchisonae* Zone (France, Isère), *Graphoceras concavum* Zone (Bulgaria, Western Balkan Mts.).

### Genus *Planammatoceras* Buckman, 1922

*Nomenclature.* Type species, by original designation (Buckman, 1922, pl. 356), is *Planammatoceras planiforme* Buckman, 1922 (holotype). The type specimen comes from the *Ludwigia murchisonae* Zone at Haselbury, Somerset, England.

*Diagnosis.* Moderately evolute to moderately involute and compressed ammonites, with flat or slightly rounded sides, abrupt or vertical umbilical walls and strong keel. The ornament is biplicate in general, strong and moderately widely spaced, flexuous to sigmoid, becoming striate at adult stages of growth, with distinct lengthened primaries and slightly projected secondaries, but no tubercles.

*Discussion.* Arkell (1957, p. L267) understood genus *Parammatoceras* Buckman, 1925 as a synonym of *Planammatoceras*, but there are very important morphological differences between these genera which gives a good reason to perceiving them as generically distinct. *Parammatoceras* has been proposed by Buckman (1925) to accommodate the forms, tuberculated in earlier growth stages, with lower, wider and less enveloped whorls, deeper umbilicus and considerably coarser and less curved ornament than *Planammatoceras*.

*Occurrence.* Aalenian, *Ludwigia murchisonae* Zone. Worldwide.

***Planammatoceras planiforme* Buckman, 1922**

Pl. I, fig. 3; Fig. 2/1

1889. *Hammatoceras planinsigne* (Vacek); Buckman, p. 661.  
1922. *Planammatoceras planiforme* Buckman, pl. 356.  
1957. *Planammatoceras planiforme* Buckman; Arkell, p. L 267, fig. 308-2a.  
1963. *Planammatoceras planiforme* Buckman; Elmy, p. 82, pl. 11, fig. 1.  
1966. *Hammatoceras planiforme* (Buckman); Géczy, p. 56, pl. 11, fig. 4.

**Material.** One specimen has been examined - J<sub>2</sub> 1001 (coll. I. Sapunov). It was collected from the exposure at the base of the Etropole Formation (Aalenian, *Ludwigia murchisonae* Zone), north of the town of Teteven (Lovech District), Central Fore-Balkan (Central Balkan Mts.), Bulgaria (see Fig. 1).

**Nomenclature.** (see the nomenclature of the genus).

**Description.** Bulgarian example of this species is based on small and almost complete, moderately evolute and compressed specimen. It has preserved part of body chamber, comprising 60% of the last whorl. The end of the phragmocone is localized at about 40 mm diameter. The whorls are narrow, high and have an acute venter. At sizes below 53 mm diameter the whorl breadth-whorl height proportion is 48 %. Beyond 53 mm diameter the whorls are extremely flattened. The maximal whorl breadth is situated at the inner half of the slightly rounded whorl sides. The umbilicus is relatively wide and limited by abrupt to vertical and beveled umbilical walls and slightly rounded umbilical edge. The whorl sides pass through scarcely perceptible ventro-lateral edge into a narrow and reposed ventral wall, having a high and thin keel.

Although Bulgarian example is partly leached in inner whorls, almost all details of the ornament can be seen. Its ornament consists of well salient flexuous and biplicate ribs. On the preserved part of the body chamber there are 15 fascicles and 8 - 10 intercalatory ribs. Umbilical walls are smooth and the ribbing is developed from umbilical edge to the base of the ventral keel. In inner whorls, throughout growth of the phragmocone, sharp and markedly raised distant primaries cover the inner half of the whorl sides. Near the umbilical edge they are rursiradiate, then curve strongly, but not angled, forwards and bifurcate at the middle of the whorl sides, followed by a short and slightly projected curve forwards under the keel. The ornament becomes close together and prorsiradiate throughout the increasing of the whorls. This type of ribbing occurs up to the back half of the body chamber where, however, there

are intercalaries. Ribs are bolder, sparser and less curved on the front half of the body chamber and the number of intercalaries increases considerably. It seems that at the end of the preserved part of the body chamber the ornament disappears and the sides become striate or smooth.

**Discussion.** The holotype represented by Buckman (1922, pl. 356) and the example figured by Elmi (1963, pl. 11, fig. 1), from "sommet du minerai de fer de Saint Quentin-Fallavier", Isère, listed in the synonymy, are large and well preserved specimens, each of them consisting of 4 whorls. The holotype has its last suture-lines at about 85 mm diameter and the French specimen is wholly septate, having considerable diameter. Despite its small size, there are no significant differences in the main morphological features between here described Bulgarian specimen, the holotype and French representative of the studied species. It has a slightly smaller and narrower whorl section and coarser ornament. A Hungarian example figured by Géczy (1966, pl. 11, fig. 4) represents not well-preserved internal mould with similar ribbing and whorl proportions but it has more rounded whorl section, much wider venter and much finer and denser ribbing than Bulgarian specimen. So Table 1 gives the proportions for these three examples of *Planammatoceras*.

**Occurrence.** Aalenian, *Ludwigia murchisonae* Zone. England (Somerset), Southern France (Isère), Hungary (Bacony Mts.), Bulgaria (Central Fore-Balkan).

Family **OTOITIDAE** Mascke, 1907  
Genus ***Docidoceras*** Buckman, 1919

**Nomenclature.** Type species, by original designation (Buckman, 1919, pl. 133 A), is *Docidoceras cylindroides* Buckman (1919 - holotype). More data about the type specimen are available below at the description of the species.

**Diagnosis.** Buckman's new generic name was proposed on figured type specimen without diagnosis and description. We supply here the diagnosis given by Arkell (1957, p. L287): "Coiling at first cadicone, becoming planulate, with reduced and excentric body chamber. Differs from the ancestral *Erycites* and *Abbasites* only by complete loss of keel and all signs of ventral discontinuity in ribbing. Includes a wide range of forms, some of which probably gave rise to Otoitidae, some to Stephanoceratidae, some to Sphaeroceratidae".

**Discussion.** In addition of such cited diagnosis it is necessary to subjoin that the genus accommodate in general medium-sized ammonites with oval section whose ornament is represented by fine ribbing, with rectiradiate to slightly

prorsiradiate primaries and many ventral secondaries springing sometimes from low ventro-lateral tubercles.

**Occurrence.** Lower Bajocian (*Hyperlioceras discites* Zone). Europe (especially in Mediterranean Lower Bajocian successions), North Africa, Middle East.

*Docidoceras* cf. *cylindroides* Buckman, 1919

Pl. I, fig. 7; Fig. 2/7, 8

1919. *Docidoceras cylindroides* Buckman; pls 133A, 133B.

**Material.** One specimen has been obtained - J<sub>2</sub> 1004 (coll. L. Metodiev), from the upper parts of the Boukorovtsi Member of the Ozirovo Forma-

Table 1

Comparison between the main whorl proportions of Bulgarian specimens, some typical examples of studied species and the originals on which described taxa of species group have been defined

Comparable specimens	D (mm)	H (mm)	H/D (%)	E (mm)	E/D (%)	E/H (%)	O (mm)	O/D (%)
<i>Pseudammatoceras subinsigne</i> (Oppel, 1856)								
Holotype (according to Elmi, 1963, p. 16)	50.0	20.0	40	~ 18.0	36	90	17.0	34
n° J <sub>2</sub> 1002 (pl. I, figs 1, 2) - this study	at 64.5	27.5	42	22.4	34	81	22.0	34
Géczy (1966, pl. 11, fig. 1)	53.0	21.0	39.5	16.0	30	76	19.0	35
<i>Pseudammatoceras ornatum</i> Elmi, 1963								
Holotype (Elmy, 1963, pl. 2, fig. 2; Fig. 11a)	46.0 at 37.0	18.0 13.0	39 35	20.0 17.0	43 46	1.11 1.31	18.0 15.0	39 40
Paratype (Elmy, 1963, pl. 1, fig. 5; Fig. 11b)	33.0	12.0	36	17.0	51	1.42	14.0	42
n° J <sub>2</sub> 1005 (pl. I, fig. 6) - this study	~ 32.0	12.0	38	-	-	-	16.0	50
<i>Pseudammatoceras broilii</i> (Renz, 1925)								
Holotype (Renz, 1925, pl. 2, figs 2, 2a)	? 52.0	19.0	37	12.0	23	63	21.0	40
n° J <sub>2</sub> 1006 (pl. I, fig. 5) - this study	50.0	15.0	30	-	-	-	25.5	51
<i>Parammatoceras boyeri</i> Elmi, 1963								
Holotype (Elmy, 1963, pl. 7, fig. 1a, b)	220.0 at 191.0	76.0 73.0	38 38	~ 50.0 ~ 46.0	25 23	66 63	68.0 65.0	34 33
Paratype (Elmy, 1963, pl. 7, fig. 2a, b)	122.0 at 93.0	45.0 36.0	37 38	32.0 27.0	26 29	71 75	42.0 33.0	34 35
n° J <sub>2</sub> 1002 (pl. I, fig. 4) - this study	at 55.0 -	22.0 50.7	40 -	13.8 25.0	25 -	63 49	18.6 ? 33.0	34 -
<i>Planammatoceras planiforme</i> Buckman, 1922								
Holotype (Buckman, 1922, pl. 356)	at 150.0 at 98.0	51.0 37.0	34 38	33.0 24.5	22 25	65 66	57.0 30.4	38 31
n° J <sub>2</sub> 1001 (pl. I, fig. 3) - this study	63.0 at 54.5	23.0 23.3	37 43	- 11.2	- 21	- 48	20.0 17.0	31 31
n° A. 895 (Elmy, 1963)	110.0 at 85.0	41.0 35.0	37 41	21.0 21.0	24 24	51 60	26.0 26.0	30 30
<i>Docidoceras cylindroides</i> Buckman, 1919								
Holotype (Buckman, 1919, pl. 133 A)	137.0 at 82.0	38.0 28.0	28 34	63.0 57.0	46 70	1.66 2.06	64.0 29.0	47 35
Paratype (Buckman, 1919, pl. 133 B)	49.0 at 34.0	17.5 11.5	36 34	37.0 25.5	76 76	2.11 2.22	15.5 8.5	32 25
n° J <sub>2</sub> 1004 (pl. I, fig. 7) - this study	~ 47.0	17.0	34	23.5	50	1.47	18.0	38

tion (Lower Bajocian, *Hyperlioceras discites* Zone), north of the village of Milanovo (Sofia District), Vrachanska Planina Mt. (Western Balkan Mts.), Bulgaria (see Fig. 1).

*Nomenclature.* The holotype is Buckman's original specimen (S. B., ex Darell Coll. 1243) (Buckman, 1919, pl. 133 A). It comes from the *Hyperlioceras discites* Zone at "Bradford Abbas, Fossil Bed, upper part", at Sherborne, Dorset, England. One paratype (S. B. Coll. 3062), from the locality announced as "Bradford Abbas, Inferior Oolite Fossil Bed, middle part, the *Hyperlioceras discites* Zone, Dorset", is figured also by the author (Buckman, 1919, pl. 133 B).

*Description.* It is the only *Docidoceras* that has ever been found in the Middle Jurassic in Bulgaria. It is represented by small and incomplete, crushed specimen, with preserved part of body chamber, whose length takes up about 40 % of the final whorl. It consists of 4 or 5 slightly enveloped whorls with moderate whorl height, moderately deep and funnel-shaped umbilicus. Umbilical walls are abrupt and passing into the whorl sides through a highly rounded umbilical edge. Whorl section varies from oval and highly depressed below the diameter of 30 mm, where breadth/height ratio is 2.20, to moderately depressed sub-circular with breadth/height ratio 1.47 at the end of the phragmocone and preserved part of the body chamber. Venter of depressed whorls is very wide and arched. During the growth it becomes slightly narrower, low-rounded and small marginal tubercles are formed on rounded but discernable ventro-lateral edge. Non carinate.

More depressed inner whorls are covered by dense and sharp ribs, while less depressed outer whorls have a less rib-density and less raised ribs. The ornament is represented by relatively thick and rectiradiate lateral primaries, developed from the umbilical seam to ventro-lateral area, where they gave rise to two, more rarely to three, ventral secondaries. Small marginal tubercles are developed at the points of branching of primaries.

*Discussion.* The holotype of the species, figured by Buckman (1919, pl. 133A, figs 1, 2), is based on large specimen over 135 mm diameter and it could not be compared correctly in respect of its whorl proportions with our ammonite. However, they have very similar style of ornament and the same change in coiling. Bulgarian example is more similar morphologically to the paratype of the species (Buckman, 1919, pl. 133B) which is smaller and has almost equal diameter. The whorl height of those compared specimens is equal but the paratype has a wider whorl section and less opened umbilicus (see Table 1).

*Occurrence.* Lower Bajocian (*Hyperlioceras discites* Zone). England (Dorset), Bulgaria (Western Balkan Mts.).

## Conclusion

The representatives of the subfamily Hammatoceratinae belong to a lineage of the order Ammonitina, loomed for the first time into the ammonite assemblages in the Lower Toarcian (*Hildoceras bifrons* Zone), but distributed mainly in the sediments of Aalenian age. The most abundant populations of them are known so far from the localities in Northwestern and especially in the Southern Europe. Their distribution seems to have been considerably influenced by the marine environments bathymetry i.e. by submarine relief features of Early-Middle Jurassic epicontinental basins in Tethyan palaeogeographic realm. Nevertheless, some assemblages had been more widespread than others, which had been restricted in their spatial distribution. According to Alm eras & Elmi (1982) the Hammatoceratinae are notable for their predominantly Tethyan occurrence, but there was a clear tendency towards considerable enlargement of their distribution to the North, caused by very expressive explosive radiation of some genera. As a result of this radiation the Hammatoceratinae become worldwide at the end of the Aalenian (during the *Ludwigia purchisonae* and *Graphoceras concavum* Zones). However, the rich associations, described from the localities in Southeastern France, Italy and Hungary for example, greatly contrast with the isolated specimens, presented in this study. Although the ammonite successions in the Aalenian in Bulgaria are still feebly known, the general feeling is that in this country the Hammatoceratinae are highly subordinate to the Graphoceratidae. In Bulgarian lowermost Middle Jurassic the involute to moderately evolute and non-tuberculated forms, with compressed conch, falcid and elbow-shaped ornament have a remarkable predominance over the evolute or moderately evolute ammonites with massive whorls, sharp ribbing and well-developed umbilical tuberculation. There is no data about the presence of the Hammatoceratinae in the Toarcian in Bulgaria. According to Westermann (1989) the Hammatoceratinae were nectono-benthic animals, distributed in shallow-water marine environments. Their rarity in Bulgaria could be explained by relatively deep-marine conditions at the end of the Toarcian and in the beginning of Aalenian, imposed in the basin developed on the northern Tethyan margin, at the south outskirts of the Moesian Platform.

As regards of the family Otoitidae, their first appearance in Bulgarian Middle Jurassic had been established as late as in the Lower Bajocian *Otoites sauzei* Zone. It seems that they are more common in the sediments of the Etropole Formation. Here described specimen represents a little piece of a phylum of transitional forms, derived from Hammatoceratinae, which initiates the real otoitids. It is the earliest representative of the family found in Bulgaria until now. The rarity of the Otoitidae in this country is probably predetermined by the same palaeoecologic restrictions as for the Hammatoceratinae.

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