ASPIDOCERATIDAE (*Epaspidoceras, Schaireria, Hybonoticeras*) SPECIES FROM THE UPPER JURASSIC DEPOSITS OF HĂGHIMAŞ MTS. (EAST CARPATHIANS – ROMANIA)

GRIGORE Dan

Abstract. The present study documents several Aspidoceratidae species belonging to the genera *Epaspidoceras*, *Physodoceras*, *Schaireria*, and *Hybonoticeras* from the Upper Jurassic deposits of Ghilcoș. The species *Epaspidoceras rupellensis* (d'Orbigny, 1849), *Physodoceras neumayri* (Checa, 1985), *Schaireria neoburgensis* (Oppel, 1863), *Hybonoticeras beckeri* (Neumayr, 1873), and *H. verestoicum* (Herbich, 1878) are described in detail. Additional material, referable to *Hybonoticeras* cf. *pressulum* (Neumayr, 1871), *H.* cf. *knopi* (Neumayr, 1873), and *H.* cf. *hybonotum* (Oppel, 1863), is represented by juvenile individuals recovered from fine sandstones in the uppermost portion of the Upper Jurassic succession. For the first time, microconchiate representatives of *Hybonoticeras* - *H. attenuatum* Berckhemer & Hoelder, 1959, *H. geminatum* Olóriz & Villaseñor, 1999, and *H.* cf. *mundulum* (Oppel, 1865) - are reported from the upper Ghilcoș deposits, at the Kimmeridgian–Tithonian boundary. In addition, a new species, *Hybonoticeras neumayri* sp. nov., is described herein.

Keywords: Aspidoceratidae, Hybonoticeras, paleontology, taxonomy, Ghilcoș, Carpathians.

Rezumat. Specii de Aspidoceratidae (*Epaspidoceras, Schaireria, Hybonoticeras*) din depozitele Jurasicului superior din Munţii Hăghimaș (Carpații Orientali - România). Prezentul studiu documentează paleontologia mai multor specii de Aspidoceratidae aparținând genurilor *Epaspidoceras, Physodoceras, Schaireria și Hybonoticeras* din depozitele Jurasicului superior de la Ghilcoș. Speciile *Epaspidoceras rupellensis* (d'Orbigny, 1849), *Physodoceras neumayri* (Checa, 1985), *Schaireria neoburgensis* (Oppel, 1863), *Hybonoticeras beckeri* (Neumayr, 1873) și *H. verestoicum* (Herbich, 1878) sunt descrise în detaliu. Material suplimentar, referitor la *Hybonoticeras* cf. *pressulum* (Neumayr, 1871), *H.* cf. *knopi* (Neumayr, 1873) și *H.* cf. *hybonotum* (Oppel, 1863), este reprezentat de indivizi juvenili recoltați din gresii fine din partea superioară a succesiunii Jurasicului superior. Pentru prima dată, reprezentanți de microconchiate ai *Hybonoticeras* - *H. attenuatum* Berckhemer & Hoelder, 1959, *H. geminatum* Olóriz & Villaseñor, 1999, și *H.* cf. *mundulum* (Oppel, 1865) - sunt raportate din depozitele superioare ale Ghilcoșului, de la limita Kimmeridgian–Tithonian. În plus, este descrisă aici o nouă specie, *Hybonoticeras neumayri* sp. nov..

Cuvinte cheie: Aspidoceratidae, Hybonoticeras, paleontologie, taxonomie, Ghilcoș, Carpați.

INTRODUCTION

As I mentioned 15 years ago, this is the famous Neumayr site in Ghilcoș, discovered and analyzed by Herbich since 1860. Professor Neumayr (1871, 1873) describes numerous new species and genera from here, considering the association here the most representative for the "*Acanthicum Shale Zone*" of all those known at that time. In the present work, I managed to confirm one of the described and unnamed forms represented by a fragment, after discovering new specimens, Neumayr intuiting it to be a new species - for which reason the credit belongs to him.

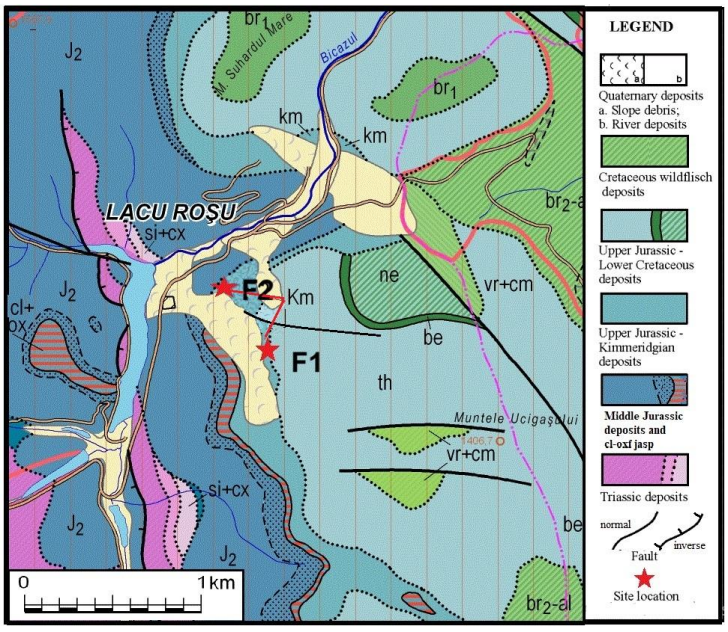


Figure 1. Outcrops location on the geological map scale 1: 50,000 Dămuc Sheet (after Săndulescu & al. 1975, revised).

The aspidoceratid specimens described in this paper are part of the same assemblage of ammonites collected from the Kimmeridgian - Lower Tithonian deposits described by the author past years from the Lacu Roșu area (Hăghimaș Massif, Eastern Carpathians). The outcrops located in the western walls of Ghilcoș Mountains and the northern slope (Fig. 1) oppen various lithologic succesions from nodular limestones to marls and sandstones, the detritic fraction increassing for Tithonian leyers. Detailed descriptions about outcrops status and the lithological successions were previously presented (Grigore 2002, Grigore 2011) same time with the biostratigraphy.

The *Epaspidoceras* specimens originate from the light greenish nodular facies in blocks (E and F) of the F2 outcrop, limestones with *Sutneria platynota*. The *Hybonoticeras* specimens originate mostly from the gray

limestones and glauconitic sandstones found in the upper part of the F1 outcrop; most of the fossils in the sandstones are poorly preserved (external or internal casts) and appear as beaches of small (?juvenile or microconchiates) ammonites on the sandstone surface.

The frequency of representatives of the genera *Epaspidoceras* and *Schaireria* is moderate compared to that of species of the genus *Hybonoticeras*, which dominates the top of the Kimmeridgian. Their biostratigraphic distribution is presented in the table in figure 2.

MATERIAL AND METHOD

The material belongs to the author's collection and is stored in the Paleontology Collection of the National Geological Museum (NGM – GIR) in Bucharest. On this occasion, specimens from other collections originating from the same outcrops were also analyzed and reviewed. These include specimens from the Preda Collection, hosted at the University of Bucharest (LGB), the Museum of Natural Sciences in Piatra Neamț (MPN), and the Herbich Collection, housed at the "Babeș-Bolyai" University Museum in Cluj (UBB).

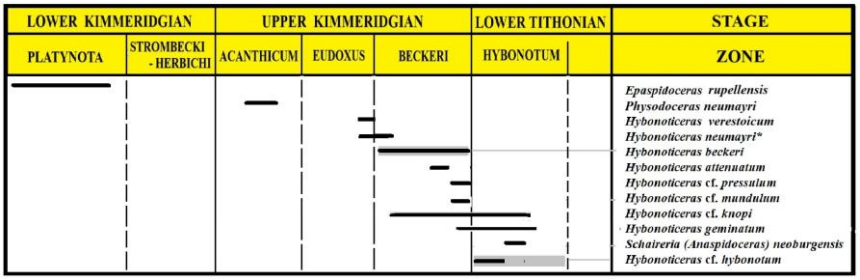


Figure 2. Biostratigraphic distribution of studied taxa in these paper.

Most of the *Hybonoticeras* specimens in my collection originate from the upper levels of sandstones and siltstones, are small in size, and are preserved as internal or external casts. For fossil preparation, standard tools such as chisels and hammers were used, as well as a Micro Jack compressed air tool and a binocular magnifying glass. The casts were made using plasticine and/or plaster. The measurements were made with the caliper directly or on images, then calibrated. The pictures have been taken with a Sony Camera α68, equipped with a Sony Lens DT 3.5-5.6/18-55 SAM II.; only the specimen LRa50F1, which was donated, the images were taken with a first generation webcam in 1998.

Species identification was based on comparison with specimens known from the literature and listed in synonymies. Whenever possible, type specimens (holotypes or others) served as the primary reference for comparison (morphometric parameters and morphology).

SYSTEMATIC PALEONTOLOGY

Used abbreviations for collections, outcrops and morphometric parameters of specimens:

Dmax = maximal diameter
Dph = phragmocone diameter
D = measured diameter
U = diameter of umbilicus
H = whorl height
W = whorl width

UBB = "Babeș Bolyai" University from Cluj Napoca
LGB = Geology Laboratory of Bucharest University
MPN = Museum of Natural Sciences - Piatra Neamț
GIR = Geological Institute of Romania
GBA = Geological Institute of Austria (Bundesanstalt)
GMB = Geological Museum in Budapest (SARA)

F1 = Outcrop from western Ghilcoș walls
F2 = Outcrop from north-western Ghilcoș slope
A, D… K = studied sections (GRIGORE, 2002, 2011)

Family Aspidoceratidae ZITTEL, 1895
Subfamily Euaspidoceratinae SPATH, 1931
Genus *Epaspidoceras* SPATH, 1931
Epaspidoceras rupellensis (D'ORBIGNY, 1849)
Pl. 1, Figs. 1-2.

1849 *Ammonites Rupellensis* D'ORBIGNY - ORBIGNY; p. 538; pl. 205, Figs. 1-5.
1873 *Aspidoceras Rüpellense* D'ORBIGNY – NEUMAYR; p. 193.
1878 *Aspidoceras Rüpellense* D'ORBIGNY – HERBICH; p. 170.
1993 *Epaspidoceras* gr. *rupellensis* (D'ORBIGNY) – SARTI; p. 116.
2009 "*Paraspidoceras" rupellense* (D'ORBIGNY 1849) – HORNUNG; p. 229, Figs. 1a-d, 2a-d, 3a, 4.

Material: LRa49E1, LRa50F1, both were in Grigore Collection in GIR; LRa50F1 was donated to Udubașa G., former Director of GIR.. The species is only cited by HERBICH (1878) and NEUMAYR (1873) from Ghilcoș and

Ciofronca. PREDA's specimen (1973): Collection of LGB – inv. **1aLGB** (unfigured), originates from spotted nodular limestones (green/red) of Ghilcoş F1 outcrop (W_{1-3} levels).

Description**.** Two specimens are available, both representing phragmocones: one large (LRa50F1) and one juvenile (LRa49E1). Both are preserved as internal moulds and exhibit the same morphometric features: an evolute shell, absence of an umbilical wall, and an oval-rectangular whorl section with broadly curved flanks and venter. Ornamentation consists of two rows of tubercles—one in peri-umbilical position and the other marginal-ventral—connected by fold-like ribs. The external tubercles are spine-like, truncated on the last whorl in the present specimens. Preda's specimen (**1aLGB**) is of medium size and displays a wider umbilicus (U/D = 0.48; Table 1), similar to the type specimen; it is, however, more eroded and retains only limited elements of the characteristic ornamentation.

Table 1. Measurements of *Epaspidoceras rupellensis* (D'ORBIGNY, 1849) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	600	-	600	282	168	180	0.47	0.28	0.30	1.07
Preda **1aLGB**	85	-	85	41	27	27	0.48	0.32	0.32	1
LRa49E1	20	20	20	8	7	7	0.40	0.35	0.35	1
LRa50F1	150	150	150	64	46	46	0.43	0.31	0.31	1

Occurrence. Lower Kimmeridgian – Platynota Zone in Ghilcoș outcrops; Lower Kimmeridgian – Silenum Zone in Italy and Rupellensis Zone in France (Aquitaine, Paris Basin) and in Eastern Germany.

Subfamily Physodoceratinae SCHINDEWOLF, 1925 here emendet

Taking into account the fact that Sarti (2020, p. 172) mentions the lineage of representatives of the genus Schaireria (specific on the Kimmeridgian-Tithonian boundary) through a representative of the genus Physodoceras - Physodoceras neumayri Checa - as a branch detached within the Physodoceratines, we consider it appropriate to preserve the two genera with more representatives in the Kimmeridgian-Tithonian interval separately in the Subfamily Physodoceratine SCHINDEWOLF, 1925. The second argument would be the almost parallel appearance of representatives from both subfamilies - Aspidoceratinae and Physodoceratinae. In addition, in the Treatise Enay & Howarth, 2019, there is no clear reference to the changes made and especially to the deletion of several genera, families or subfamilies.

Genus *Physodoceras* HYATT, 1900
Physodoceras neumayri (CHECA, 1985)
Pl. 1, fig. 3.

1985 *Schaireria neumayri* nov.sp. - CHECA; p.186; pl.38, Figs. 2, 3, pl. 39, fig. 2 (NON pl. 38, fig. 1 = *Schaireria* (*Schaireria*) *vetera* SARTI, 2020).
1987 *Schaireria neumayri* CHECA – CHECA; Fig. 2A.
1993 *Schaireria (Schaireria) neumayri* CHECA - SARTI; p. 128; Fig.tx. 64.
2020 *Physodoceras neumayri* (CHECA, 1985) – SARTI; p. 172.
Material: LRa40D2 Grigore Collection in GIR.

Table 2. Measurements of *Physodoceras neumayri* (CHECA, 1985) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	89	-	89	22	40	36	0,25	0,44	0,40	0.90
LRa40D2	81	54	81	24	35	33	0.30	0.43	0.41	0.94

Description. The specimen is an internal mould preserving half a whorl of the body chamber. It is a medium-large conch (D = 81 mm) with involute coiling and a compressed, oval whorl section. The umbilicus has a narrow, straight, vertical wall. The umbilical margin is angular and bears a row of small tubercles (spines) directed towards the umbilical interior; their density decreases towards the body chamber, where they become larger. The morphometric differences (wider umbilicus and whorl section; Table 2) compared with Checa's specimen may be attributed to ontogenetic changes in whorl parameters within the body chamber of the present specimen.

Occurrence. Upper Kimmeridgian – Acanthicum Zone in Ghilcoș outcrop (F2, block D - level with *Aspidoceras acanthicum* and *Taramelliceras compsum*; Upper Kimmeridgian to Lower Tithonian – Compsum to (?)Verruciferum zones in Spain.

Genus *Schaireria* CHECA, 1985 emended SARTI, 1993, 2020
Subgenus *Anaspidoceras* SARTI, 1993
Schaireria (Anaspidoceras) neoburgensis (OPPEL, 1863)

1863 *Ammonites neoburgensis* - OPPEL; p. 223; pl.58, Figs. 5a-b.
1878 *Aspidoceras cyclotum* OPPEL – HERBICH; p. 178; pl. 20, Figs. 2a-b.

1985 *Schaireria neoburgensis* (OPPEL) - CHECA, p. 199; pl. 40, Figs. 3-5.
1993 *Schaireria (Anaspidoceras) neoburgense* (OPPEL) – SARTI; p. 128.
2011 *Physodoceras neoburgense* (OPPEL, 1863) – FŐZY & al.; Figs. 6.8-9.
2020 *Schaireria (Anaspidoceras) neoburgensis* (OPPEL, 1863) – SARTI; p. 172; pl. 32, fig. 1.

Table 3. Measurements of *Schaireria (Anaspidoceras) neoburgensis* (OPPEL, 1863) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	85	-	85	20	40	45	0,23	0,47	0,53	1.12
Herbich's	23	-	23	2	16	18	0.09	0.69	0.78	1.12
Preda **17 MPN**	48	42	48	9	25	32	0.19	0.52	0.67	1.28

Observations. The specimen described and figured by Herbich (1878, p. 178, pl. 20, fig. 2) as *Aspidoceras cyclotum* Oppel can be referred to the present species. It is very small (D = 23 mm) and has a much narrower umbilicus than Oppel's original specimen. It is housed in the UBB collection and originates from the red sandy limestones with *Pygope janitor* of the Ghilcoș outcrop (F1; T5.0–8.0 levels). A second specimen from the same outcrop, belonging to the Preda Collection (MPN Collection, inv. **17 MPN**), is herein identified as conspecific. This is a globular ammonite with a narrow, deep umbilicus and a reniform whorl section. It preserves the initial portion of the body chamber (Table 3) and is entirely devoid of ornamentation. It originates from the grey limestones of the Ghilcoș outcrop.

Occurrence. Lower Tithonian – (?)Hybonotum Zone in Ghilcoș outcrop; Lower Tithonian – Hybonotum /Albertinum zones in Italy, Germany, France and Bulgaria.

Subfamily Hybonoticeratinae CALLOMON, 1981
Genus *Hybonoticeras* BREISTROFFER, 1947
Hybonoticeras beckeri (NEUMAYR, 1873)
Pl. 1, Fig. 4a-b; Pl. 2, Figs. 1-3, 5.

1873 *Aspidoceras beckeri* – NEUMAYR; p. 202; pl. 38, Figs. 3, 4.
1973 *Aspidoceras* (*Hybonoticeras*) *beckeri* NEUMAYR - PREDA; pl. 9, Fig. 1.
1978 *Hybonoticeras* (*Hybonoticeras*) *beckeri beckeri* (NEUMAYR) - OLÓRIZ; p. 346; pl. 31, Fig. 1.
1979 *Hybonoticeras beckeri* (NEUMAYR) – SAPUNOV; p. 62; pl. 51, Figs. 2a-b, 3.
1993 *Hybonoticeras beckeri* (NEUMAYR, 1873) – SARTI; p. 133; pl. 28, Fig. 2.
1996 *Hybonoticeras beckeri* (NEUMAYR). - SCHWEIGERT el al.; p.358, Figs. 4a-b.
1999 *Hybonoticeras beckeri* (NEUMAYR) – CARACUEL & OLÓRIZ; p. 584; Figs. 6/ 1-3.
2020 *Hybonoticeras beckeri* (NEUMAYR, 1873) – SARTI; p. 190; pl. 44, Figs.1A-C.

Material: LRa51K25, LRa61K30, LRa54K30, LRa63K30, LRa55K30, LRa68D30; Grigore Collection in GIR. Neumayr's Paratype (pl. 38, fig. 4; 1873): in Collection of GMB – originates from green sandy limestones with *Pygope janitor* of Ghilcoș outcrop. PREDA's specimen (pl. 9, Fig. 1; 1973): in Collection of MPN – inv. **4 MPN,** originates from green-gray sandy limestones of Ghilcoș outcrop.

Table 4. Measurements of *Hybonoticeras beckeri* (NEUMAYR, 1873) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	80	-	80	34	29	23	0,43	0,36	0,28	0.79
Paralectotype	23.5	-	23.5	9	8.5	7.5	0.40	0.36	0.32	0.88
Preda **4 MPN**	97	94	97	41	29	27	0.42	0.30	0.28	0.93
LRa68D30	~68	-	68	~32	~19	>13	~0.47	~0.28	-	-
LRa51K25	30	-	30	13	10	-	0.43	0.33	-	-

Description. Preda's specimen (Pl.1/fig. 4a, b) is the best preserved and represents a phragmocone (Dph=94 mm) of a large individual that preserves the beginning of the living chamber. The ornamentation is made up of ribs and tubercles. The ribs are strong, straight or flexuous, exhibiting a rursiradiate development on the flanks. The tubercles are arranged in two rows - periumbilical and periventral; they are rare and do not correspond. The tubercles in the periventral row are more robust and spine-shaped. Between the tubercles, pairs of connecting ribs form a crescentic pattern. Compared to Neumayr's specimen, this one displays stronger costation, a larger diameter, and a wider cross-section. My specimen (LRa68D30 - pl. 2/ fig. 1) is an internal mold of a medium-sized individual (H=19.5 mm and D>67mm; Table 4) that better preserves a portion of the last whorl, where the ornamentation is visible. It is compressed in sandstone. Two rows of tubercles (periumbilical and ventro-lateral), small, rare, and irregular, are present. The costation is of moderate thickness and comprises straight or curved, rursiradiate ribs originating from the umbilical suture. These ribs are thin initially, thickening slightly on the flanks between the two tubercle rows; some extend somewhat and curve toward the ventral serrated carina. Two pairs of curved ribs united at the ventro-lateral tubercles are also observed. The tubercles in the external row are finer than those of Neumayr's specimen.

The remainder of my specimens are small, probably juveniles of this species, representing compressed internal or external molds derived from the upper levels of gray-green sandstones in profile K (outcrop F1), on the Ghilcoș wall.

Most measure less than 30 mm, are evolute, and exhibit ornamentation of straight or slightly flexuous, robust ribs, some terminating in extended periventral spines. Their morphology resembles the internal whorls of the type specimen (holotype) or Preda's specimen. The best preserved juvenile is LRa51K25, an external mold whose ornamentation changes near a diameter of approximately 30 mm.

Occurrence. Upper Kimmeridgian –Beckeri Zone in Ghilcoș outcrops (K and D profiles); Upper Kimmeridgian –Beckeri Zone in Italy, Spain, France, Germany and Bulgaria.

Hybonoticeras verestoicum (HERBICH, 1878)
Texte Fig. 3

Material: Herbich's Holotype (1878): in Collection of UBB inv. **2054UC** – originates from the greenish sandy limestones with *Pygope janitor* of Ghilcoș outcrop.

Table 5. Measurements of *Hybonoticeras verestoicum* (HERBICH, 1878) specimen.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Holotype	100	~63	100	45	31	26	0.45	0.31	0.26	0.80

Diagnosis. As derived from Herbich's description, the species exhibits the following characters: a medium-sized aspidoceratid with an evolute shell and a shallow umbilicus. The umbilical wall is straight and vertical, with a rounded margin. The whorl section is oval and compressed, with nearly flat flanks and maximum thickness located at the umbilical margin. The ventral region bears a broad, shallow median groove, bordered by two crenulated keels formed by the terminations of the ribs. On the body chamber, some ribs cross the ventral groove. Lateral ornamentation consists of moderately strong, falcoid ribs, irregularly spaced, and a row of peri-umbilical tubercles. The tubercles are of moderate strength and relatively dense. From each tubercle arise one or two delicate ribs that thicken toward the outer half of the flanks; there are also external intercalatory ribs. The suture line illustrated by Herbich is only vaguely sketched, generally weakly denticulated, with elements of equal breadth and the first lateral lobe deep, tricuspid, and symmetrical.



Figure 3: Holotype of the *Hybonoticeras verestoicum* (Herbich, 1878) – Collection of UBB, Inventory number **2054**. Foto Dr. Liana Săsăran.

Remarks. The holotype preserves almost the entire body chamber (two-thirds of a whorl); Herbich also mentioned the presence of two additional specimens, poorly preserved, with no further details provided.

This species has been placed in the synonymy of *Hybonoticeras monacanthum* (Waagen, 1875) by SARTI (2020, p. 190; fig. tx. 42). In my view, the synonymy of these two species remains uncertain. The taxon described by Waagen is based solely on a fragment of the living chamber, and, as Neumayr remarked in connection with his fragment of *Aspidoceras* nov. sp. cf. *harpephora*, "the erection of a new species under such circumstances is a precarious undertaking". Spath (1931, p. 644), who revised Waagen's species and discussed Herbich's taxon, did not consider them synonymous. The fragment in question differs both in morphometric proportions (W/H = 0.64; Table 5), showing a much more compressed whorl, and in ornamentation – ribs more strongly developed in the lower half of the flanks, single and connected to the tubercles, with both ribbing and tubercles being sparse; the ventral keels are not crenulated or serrated. Spath also noted a rapid morphological change in the ventral sculpture: in the earlier whorl, the keels and the median sulcus are narrower and more prominent.

Occurrence. Upper Kimmeridgian – Beckeri Zone from Ghilcoș outcrop; Upper Kimmeridgian – Beckeri (Pressulum) Zone in Italy, Spain, Germany (Bavaria).

Hybonoticeras neumayri nov.sp.
Pl. 2, Figs. 16-18 and text figure 4.

1873 *Aspidoceras* nov. sp. cf. *harpephorum* NEUMAYR – NEUMAYR; p. 203; pl. 39, Figs. 6a-b.

Type series
Holotypus: specimen LRa64K23 figured in Pl. 2, fig. 16 and text Fig. 4.
Paratype 1: LRa65D16 figured in Pl. 2, Fig. 17.
Paratype 2: LRa66K23 figured in Pl. 2, Fig. 18.
Paralectotype 3: specimen of NEUMAYR (1873, Pl. 39, Figs. 6a-b).
Derivatio nominis: "*neumayri*" = dedicated to Prof. Dr. Melchior von Neumayr, who first drew attention to this form.
Locus tipicus: Hăghimaș Masiff – Acanthicum beds – Lacu Roșu, Ghilcoș outcrops (F1 and F2).
Stratum tipicum: K23 level – in the lower part of the Beckeri Zone.
Material: LRa64K23, LRa65D16, LRa69K23; Grigore Collection in GIR. NEUMAYR's specimen (pl. 39, Fig. 6; 1873) in the Collection from GIA; originates from green sandy limestones of Ghilcoș outcrop.

Table 6. Measurements of *Hybonoticeras neumayri* type series.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Paralectotype = Neumayr specimen	-	-	-	-	~30	~20	-	-	-	~0.67
Holotype = LRa64K23	~50	-	25.4	10	10.2	~7	0,39	0,40	0,27	0.69
*Paratype*1 = LRa65D16	-	-	-	-	10	8	-	-	-	0.80
*Paratype*2 = LRa66K23	-	-	-	-	20	15	-	-	-	0.75

Diagnosis. Medium-sized aspidoceratid, evolute with a shallow umbilicus. The umbilical wall is narrow, flared, and slightly rounded. The whorl section is compressed, subtrapezoidal, with slightly curved flanks. The ventral side features a wide groove bordered by two smooth, slightly prominent carinae. Ornamentation differs between the internal whorls (phragmocone) and the last whorl (living chamber). The internal whorls bear medium-thick, radial or curved ribs, with paired ribs united into large spines along the ventral margin. On the last whorl, costation occurs only on the external half of the flanks; the ribs are falciform and thinner, while the external tubercles disappear, replaced by a row of robust tubercles (spines) on the umbilical margin, spaced more widely than the ribs (one tubercle correspondig per two to four ribs).

Type series description.

The *holotype* – is a fragmentary specimen with an estimated maximum diameter of 50 mm (Table 6), partially preserving the phragmocone and a portion of the living chamber. It includes an internal mold of half a whorl of the phragmocone and a fragment of the living chamber, and an external mold of the innermost whorls (the nucleus). It was selected as the holotype because it preserves ornamentation relatively well, illustrating the ontogenetic development of the diagnostic characters.

Paratype 1 – is a fragmentary internal mold of a specimen smaller than the holotype, better preserving the ornamentation of the internal whorls, including periventral spines, as well as a portion of the living chamber exhibiting the same ornamentation characteristics as the holotype.

Paratype 2 and the *Paralectotype* (Neumayr) – are two internal mold fragments from the living chamber of medium-sized ammonites (H = 20 and 30 mm), larger than the other type specimens. They preserve well the characteristic ornamentation, featuring more developed spines on the umbilical margin.

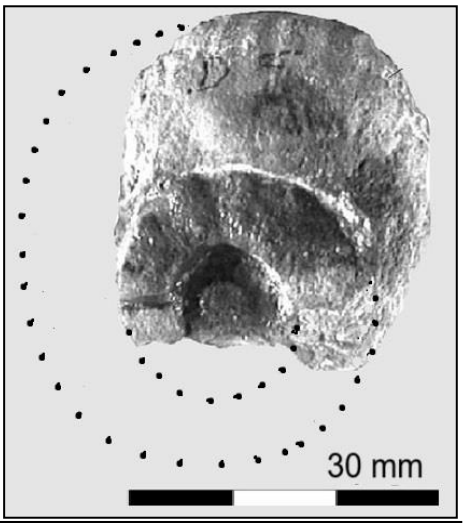


Figure 4. Holotype of *Hybonoticeras neumayri*

Comparations. Compared to *H. beckeri* (Neumayr) – the ornamentation in the internal (innermost) whorls is comparable, it differs in the ornamentation on the living chamber, the shallow groove and the smooth ventral carinas, and it is subtrapezoidal in section. Compared to *H. harpephorum* (Neumayr) – it does not have two rows of tubercles in any stage and no obvious costation along the entire height of the flanks in the external whorls, where it is provided with strong periumbilical spines. Compared to *H. verestoicum* (Herbich) – it is the closest species but differs from it in the change of ornamentation from the internal whorls to the external one, and the row of periumbilical tubercles are rarer and stronger; the ventral carinas are smooth.

Occurrence. Upper Kimmeridgian - Beckeri zone in Ghilcoș outcrops.

Hybonoticeras attenuatum BERCKHEMER & HÖLDER, 1959
Pl. 2, Fig. 15.

1879 *Waagenia pressula* NEUMAYR – FONTANNES; p. 86; pl. 12, Figs. 3a-b.
1959 *Hybonoticeras mundulum attenuatum* n. subsp. - BERCKHEMER & HÖLDER; p. 35, pl. 3, Figs. 10-11; text Figs. 19-20.
1959 *Hybonoticeras mundulum attenuatum* BERCKHEMER & HÖLDER – HÖLDER & ZIEGLER; p. 198.
1978 *Hybonoticeras* (*Hybonotella*) sp. aff. *H.* (*Hybonotella*) *mundulum attenuatum* BERCKHEMER & HÖLDER –

OLÓRIZ; p. 367; pl. 33, Fig. 6.
Material: LRa75D26; Grigore Collection in GIR.

Table 7. Measurements of *Hybonoticeras attenuatum* BERCKHEMER & HÖELDER specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
FONTANNES specimen	27	-	27	11.9	8.1	4.9	0.44	0.30	0.18	0.60
BERCKHEMER & HÖELDER Lectotype	23	-	23	9	8	4.4	0.39	0.35	0.19	0.55
LRa75D26	27.3	20	19	7	7.4	4.5	0.37	0.39	0.23	0.61

Description. The specimen closely resembles the one described by Fontannes (1879). It represents the internal cast of a small-sized, evolute ammonite (D = 27.3), preserving both the phragmocone and part of the body chamber. The whorl section is oval and compressed (Table 7), with a shallow umbilicus, incised umbilical wall, and rounded umbilical margin. Ornamentation, visible only on the outer whorl, initially consists of strong, flexuous (rursiradiate) ribs and bunches of costulae converging ventrally into spine-like tubercles with variably elongated bases. The remainder of the whorl is nearly smooth, marked only by broad lateral folds. The venter bears a narrow groove bordered by thin, smooth keels. The suture line, visible up to the fold-bearing portion (approximately one-third from the end of the whorl), is highly denticulated, a feature indicative of a mature growth stage (microconch) of the ammonite.

Occurrence: Upper Kimmeridgian – Beckeri Zone from Ghilcoș outcrop (D26 level of grey limestones in D profile – F2); Upper Kimmeridgian – Beckeri Zone in France (Crussol), Germany (Subeumela Subzone) and Spain.

Hybonoticeras geminatum OLÓRIZ & VILLASEÑOR, 1999
Pl. 2, Figs. 8a-b, 13.

1993 *Hybonoticeras* (*Hybonotella*) sp. – OLÓRIZ et al. p. 280, pl. 2, fig. 6.
1999 *Hybonoticeras pressulum* (NEUMAYR) – OLÓRIZ & VILLASEÑOR; p. 567; Figs. 4b-c; 5a-d; 8.2-5.
Material: LRa53K30, LRa76T25 Grigore Collection in GIR.

Table 8. Measurements of *Hybonoticeras geminatum* OLÓRIZ & VILLASEÑOR, 1999 specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	30.5	-	30.5	12.4	10.8	-	0.41	0.35	-	-
LRa53K30	~28	-	27	12	8	-	0.44	0.31	-	-
LRa76T25	~21	-	20	8.5	5.5		0.42	0.27	-	-

Description. Two specimens, both of small size. The better-preserved specimen (LRa76T25) retains part of the peristome, which is furnished with apophyses; it is partly an internal mould, while the remainder is preserved as an external mould in sandstone. The umbilicus is shallow and relatively wide (0.44; Table 8). Ornamentation consists of simple, prominent, radial ribs which, on the last whorl (the living chamber), tend to become rursiradiate and geniculated. The ribs originate thin at the umbilical suture and thicken along the flanks toward the ventral margin; some ribs appear to merge in the umbilical region. The specimen LRa53K30 represents an external mould in sandstone, with poorly preserved ornamentation, but showing the same morphological features as the first specimen.

Occurrence. Upper Kimmeridgian-Lower Tithonian – Beckeri - Hybonotum zones, from Ghilcoș F1 outcrop; Uppermost Kimmeridgian – top of Beckeri Zone in Mexico.

Hybonoticeras cf. *pressulum* (NEUMAYR, 1871)
Pl. 2, Figs. 6-7.

1871 *Aspidoceras pressulus* – NEUMAYR; p. 23.
1873 *Aspidoceras pressulus* NEUMAYR – NEUMAYR; p. 201; pl. 37 a, b, c, 3 a, b.
1978 *Hybonoticeras pressulum* (NEUMAYR)–BARTHEL & SCHAIRER; p. 18; pl. 2, Fig. 4 *non* Figs. 6-7 = *H. monacanthum*).
1978 *Hybonoticeras* (*Hybonoticeras*) *pressulum pressulum* (NEUMAYR) – OLÓRIZ; p. 355; pl. 32, Fig. 5.
1984 *Hybonoticeras pressulum* (NEUMAYR) – VERMA & WESTERMANN; p. 75; pl. 19, Fig. 1.
1985 *Hybonoticeras pressulum* (NEUMAYR) – SARTI; p. 327; pl. 2, Figs. 4a-b.
1993 *Hybonoticeras pressulum* (NEUMAYR) – SARTI; p. 132; pl. 28, Figs. 1a-b.
2020 *Hybonoticeras pressulum* (NEUMAYR) – SARTI; p. 191; pl. 44, Figs. 2A-C.
2021 *Hybonoticeras pressulum* (NEUMAYR) – BUJTOR et al.; p. 298, Figs. 11 / A1, A2.
2022 *Hybonoticeras pressulum* (NEUMAYR) – FŐZY & al.; p. 279; pl. 54, Fig. 4; pl. 55, Fig. 4.
Material: LRa57K30, LRa59K30, LRa60K30; Grigore Collection in GIR. Neumayr's Holotype (1873): in Collection of GIA – originates from the green sandy limestones of Ghilcoș outcrop.

Description**.** The specimens are small in size (Table 9), preserved as positive–negative moulds in sandstones. Two of them (LRa57K30, LRa59K30) are relatively complete and retain, as external moulds, the inner whorls

ornamented with rigid, radial ribs, as well as part of the last whorl, where the ornamentation consists of peri-umbilical tubercles and faint folds. It cannot be determined whether their outer whorl represents the living chamber. The suture line is not discernible, and the apertural region is not preserved, preventing any assessment of whether the specimens are microconchs or juveniles. The third specimen consists of a portion of a whorl of similar size to the others, preserving ornamentation with fine peri-umbilical tubercles. With some reservations, we assign the specimens to *H. pressulum*, as juveniles, taking into account the remarks of Olóriz et al. (2000, p. 163) regarding the absence of peri-umbilical tuberculation on the living chamber of microconchiate species.

Table 9. Measurements of *Hybonoticeras pressulum* (NEUMAYR, 1873) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	43	-	43	17	15	12	0.40	0.35	0.28	0.80
LRa57K30	~29	-	20	9	7.5	-	0.45	0.37	-	-
LRa59K30	26	-	22	8	9	-	0.36	0.41	-	-

Occurence: Upper Kimmeridgian – Beckeri Zone from Ghilcoș outcrop (K profile); Upper Kimmeridgian – Beckeri (Pressulum) Zone in Italy, Spain, Bulgaria and Germany (Bavaria).

Hybonoticeras cf. *knopi* (NEUMAYR, 1873)
Pl. 2, Figs. 4, 9-11.

1873 *Aspidoceras knopi* – NEUMAYR; p. 203; pl. 43, Figs.1-3.
1978 *Hybonoticeras knopi* (NEUMAYR) – BARTHEL & SCHAIRER; p. 19; pl. 2, Figs. 8-9.
1978 *Hybonoticeras* (*Hybonoticeras*) *knopi* (NEUMAYR) – OLÓRIZ; p. 358; pl. 27, Figs. 3a-b.
1993 *Hybonotyceras knopi* (NEUMAYR) – SARTI; p. 134; pl. 29, Fig. 1.
1996 *Hybonotyceras knopi* (NEUMAYR) - SCHWEIGERT et al.; p. 350, Figs. 2a-c.
1999 *Hybonoticeras knopi* (NEUMAYR) – CARACUEL & OLÓRIZ; p. 586; Fig. 6 /7.
2020 *Hybonoticeras knopi* (NEUMAYR, 1873) – SARTI; p. 188; pl. 43, Figs.1A-B, 2, 3A-C.
2022 *Hybonoticeras* cf. *knopi* (NEUMAYR, 1873) – FŐZY et al.; p. 279; pl. 50, Fig. 5.

Material: LRa67D26, LRa58K30, LRa62K30,?LRa70K36; Grigore Collection in GIR.

Description. Specimen LRa67D26 (pl. 2/ fig. 4) represents a fragment of the outer-ventral half of a whorl from a medium-sized individual (H > 14 mm, W > 12 mm), with well-preserved ornamentation. The flanks exhibit strong ribbing that extends onto the venter, where the ribs bifurcate from sparse periventral tubercles. The ribbing terminates in well-developed, serrated keels that border a moderately wide and deep sulcus, closely resembling the morphology of the specimen illustrated by Neumayr.

Specimens LRa58K30, LRa62K30, and LRa70K36(?) are small-sized (D ~ 30 mm or less; H = 7–8 mm), fragmentary, and preserved as internal molds, variably compressed within sandstones. The best-preserved of these is LRa58K30, which shows moderate-strength ribs projected ventrally, some bifurcating from periventral nodes. Two prominent, finely serrated keels (the distal terminations of the outer ribs) are visible on the venter, delimiting a narrow, deep sulcus. This morphology is comparable to Neumayr's specimen, albeit at a smaller scale. The morphology of LRa62K30 is similar (moderate ribbing and ventral keels), though less well preserved, while LRa70K36 preserves the ornament only partially. These specimens may represent juvenile stages of *H. knopi*, or alternatively, microconchs of a distinct species. However, due to the lack of clear ontogenetic markers (such as lappets, changes in ribbing pattern, or the maturity of the suture line), a definitive interpretation cannot be made.

Occurrence. Upper Kimmeridgian – Beckeri Zone (to ?Lower Tithonian – Hybonotum Zone) from Ghilcoș outcrop; Upper Kimmeridgian/Lower Tithonian – Beckeri/Hybonotum zones in Italy, Spain and Germany (Bavaria).

Hybonoticeras cf. *mundulum* (OPPEL, 1865) in Zittel, 1870
Pl. 2, Fig. 14.

1865 *Ammonites mundulus* – OPPEL; p. 547.
1870 *Oppelia mundula* OPPEL sp. – ZITTEL; p. 63; pl. 4, fig. 12.
1959 *Hybonoticeras mundulum mundulum* (OPPEL) – HÖLDER & ZIEGLER; p. 197; pl. 20, figs. 1 - 5.
1978 *Hybonoticeras* (*Hybonotella*) sp. gr. *H. mundulum* (OPPEL) – *striatulum* BERCKHEMER & HÖLDER – OLÓRIZ; p. 365; pl. 33, figs. 4, 5, 7.
1999 *Hybonoticeras mundulum mundulum* (OPPEL) – CARACUEL & OLÓRIZ; p. 584; Fig. 6/ 4, 5.
2000 *Hybonoticeras mundulum* (OPPEL, 1865)(m) s.s. – OLÓRIZ & al.; p. 162; fig. 3 A-M.
2005 *Hybonoticeras* (*Hybonotella*) cf. *mundulum* (OPPEL) – ENAY; fig. 3 / 1 a, b.

Material: LRa56K30; Grigore Collection in GIR.

Description. A very small specimen (D = 18 mm; Table 10), probably a microconch, preserved as an internal mould in sandstones. The umbilicus is shallow, with a rounded margin, and the whorls display an oval cross-section. Ornamentation consists of rigid, radial ribs that do not change in thickness along their course across the flanks. The suture line is not

discernible, nor can it be determined whether the last whorl represents the living chamber.

Table 10. Measurements of *Hybonoticeras mundulum* (OPPEL, 1870) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Hölder specimen	21	-	21	10	7	5.5	0.48	0.33	0.26	0.78
LRa56K30	18	-	18	9	6.5	-	0.50	0.36	-	-

Occurrence: Upper Kimmeridgian – Beckeri Zone from Ghilcoș, F1 outcrop; Upper Kimmeridgian – Beckeri Zone in France (Crussol), Germany, Spain and Mexic.

Hybonoticeras cf. *hybonotum* (OPPEL, 1863)
Pl. 2, Figs. 12a-b.

1863 *Ammonites hybonotus* – OPPEL; p. 254; pl. 71, Figs. 1-3.
*1863 *Ammonites autharis* – OPPEL; p. 255; pl. 71, Figs. 4 (Holotype), 5, 6.
1959 *Hybonoticeras hybonotum* (OPPEL) – BARTHEL; p. 63; Fig. 7.
1959 *Hybonoticeras hybonotum* (OPPEL) – BERCKHEMER & HÖLDER; p. 30; pl. 3, Fig. 2
1978 *Hybonoticeras* (*Hybonoticeras*) *hybonotum* subsp. *hybonotum* (OPPEL) – OLÓRIZ; p. 336; pl. 33, Fig. 2.
2005 *Hybonoticeras* (*Hybonoticeras*) cf. *hybonotum* (OPPEL) – ENAY; Fig. 3 / 3, Fig. 4 / 2a-b.
2015 *Hybonoticeras hybonotum* (OPPEL) – FŐZY; pl. 27, fig. 1 a, b; pl. 34, Figs. 8a-b.
2020 *Hybonoticeras hybonotum* (OPPEL) – SARTI; p. 184; pl. 39, Figs. 1A-C; 2A-B; pl. 40, Figs. 1A-B; Fig. tx. 35.
Material: LRa52K31; Grigore Collection in GIR.

Table 11. Measurements of *Hybonoticeras hybonotum* (OPPEL, 1863) specimens.

Specimen	Dmax	Dph	D	U	H	W	U/D	H/D	W/D	W/H
Lectotype	85	-	85	37	29	-	0.43	0.34	-	-
LRa52K31	~33	-	26	11	9.5	-	0.42	0.36	-	-

Description. A juvenile specimen (LRa52K31), preserved as an external mould in sandstones. The shell is evolute, with a relatively deep umbilicus and a narrow, angular umbilical margin. The whorl section is oval, with flattened flanks, probably due to compression within the sandstone. Ornamentation on the inner whorls consists of thin, simple, radial ribs, whereas on the last whorl the ribs become irregular and more widely spaced. On the last whorl, the ribs bear strong, elongated ventrolateral tubercles; one rib is observed to bifurcate in the outer third of the flank, ending in fine ventrolateral tubercles. No peri-umbilical tubercles are present. The suture line is not preserved; however, the last half-whorl, marked by the change in ornamentation, appears to represent the living chamber.

Occurrence: Lower Tithonian – Hybonotum Zone from Ghilcoș, F1 outcrop; Lower Tithonian – Hybonotum Zone from Europe and Mexic.

CONCLUSIONS

In this study, the presence of microconchs of the group *Hybonoticeras* is documented for the first time in Romania, at the boundary between the Kimmeridgian and Tithonian: *Hybonoticeras attenuatum* BERCKHEMER & HÖLDER, 1959 and *Hybonoticeras geminatum* OLÓRIZ & VILLASEÑOR, 1999. It is worth noting that the Kimmeridgian deposits of this area preserve Aspidoceratidae microconchs throughout the entire interval, as indicated by the abundant occurrence of species of the genus *Sutneria*. Also for the first time, the occurrence of the index species *H. hybonotum* is documented here, thereby marking the base of the Tithonian and the Hybonotum Zone. In addition, several species (*H. verestoicum*) and specimens (*S. neoburgensis*) described by earlier authors (Neumayr, Herbich, Preda) are here revised and discussed.

This *Hybonoticeras* assemblage from Ghilcoș represents a diverse and rich ammonite fauna from the limit between Kimmeridgian and Tithonian which worth more attention in the future.

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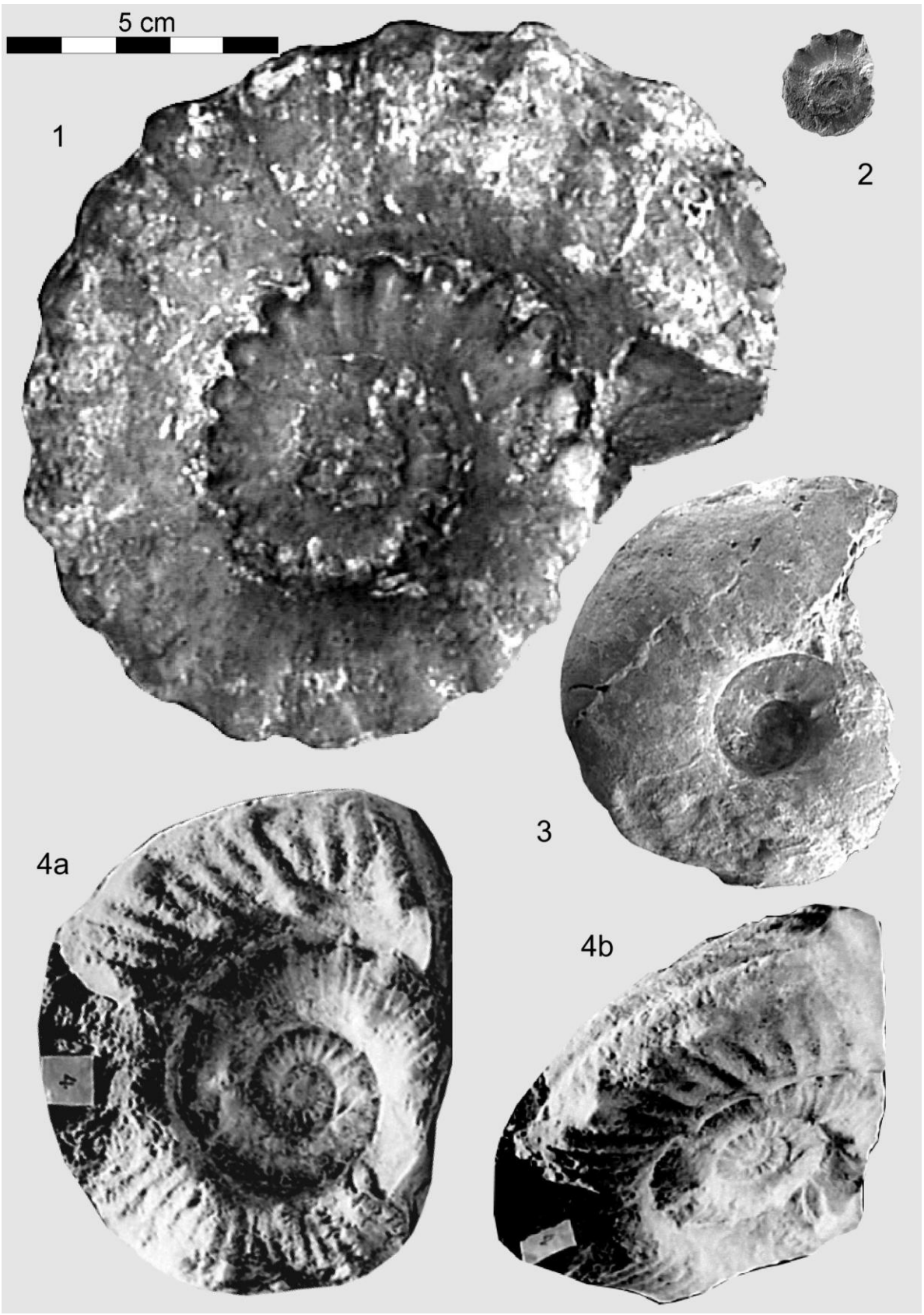


Plate 1 (Figures): ***Epaspidoceras rupellense*** (D'ORBIGNY) **1**. specimen LRa50F1, gerontic, phragmocone - green-grey facies in block F, level 1; **2**. specimen LRa49E1, juvenile; green-grey facies in block E, level 1; both from outcrop F2 - Platynota Zone; **3.** ***Schaireria* (*Schaireria*) *neumayri*** CHECA (LRa40D2); green-grey facies in block D, level 2, F2 outcrop - Acanthicum Zone; **4**. ***Hybonoticeras beckeri*** (NEUMAYR), Preda's specimen (4 MPN); green-grey facies, Upper Kimmeridgian – Beckeri Zone; a) lateral and b) ventral view.

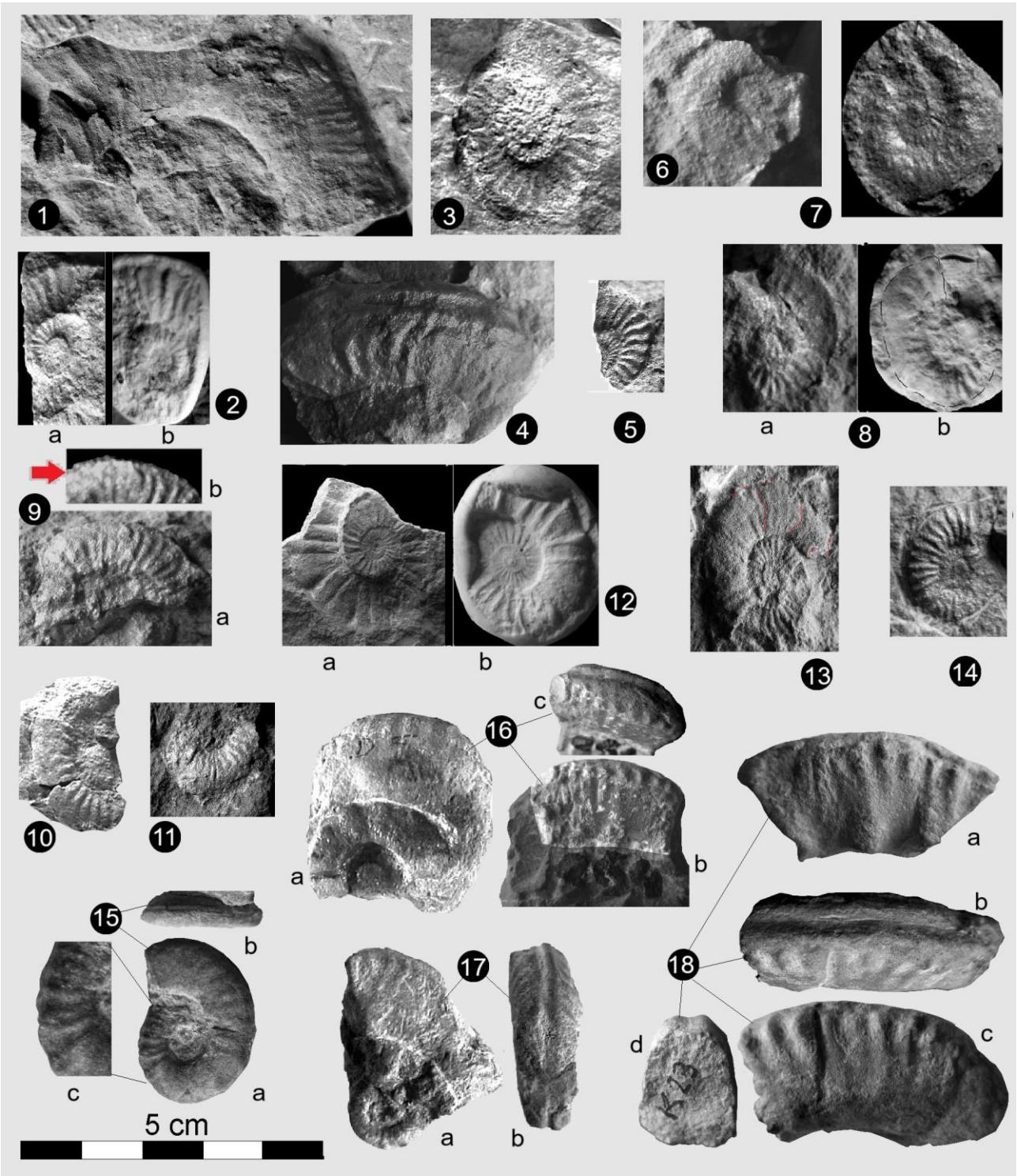


Plate 2 (Figures): **1-3 and 5**. ***Hybonoticeras beckeri***: **1.** (LRa68D30) internal mould, F2 outcrop; **2, 3, 5**. (LRa61K30), (LRa51K25),(LRa54K30), juvenile external casts, F1 outcrop; all from the gray-greenish sandy facies - Beckeri Zone; **4, 9, 10, 11**. ***Hybonoticeras* cf. *knopi***: **4**. (LRa67D26) ventral fragment from a whorl of a large individual, F1 outcrop; **9, 11**. (LRa58K30), (LRa62K30) juvenile internal moulds, F1 outcrop, gray-greenish sandy facies - Beckeri Zone; **10**. (LRa70K36) juvenile internal mould, F1 outcrop, yellow sandstones – Hybonotum Zone; **6, 7**. ***Hybonoticeras* cf. *pressulum***: (LRa59K30), (LRa57K30) juvenile external moulds, F1 outcrop, gray-greenish sandy facies - Beckeri Zone; **8, 13**. ***Hybonoticeras geminatum***: **8**. (LRa53K30) external cast of a microconch, F1 outcrop, gray-greenish sandy facies – Beckeri Zone; **13**. (LRa76T25) internal mould of a microconch with lappets, yellow sandstones – Hybonotum Zone; **12**. ***Hybonoticeras* cf. *hybonotum*** (LRa52K31) juvenile external cast, F1 outcrop, yellow sandstones – Hybonotum Zone; **14**. ***Hybonoticeras* cf. *mundulum*** (LRa56K30) internal mould of a microconch, F1 outcrop, gray-greenish sandy facies - Beckeri Zone; **15**. ***Hybonoticeras attenuatum*** (LRa75D26) microconch internal mould, F2 outcrop, grey lime – Beckeri Zone; **16-18**. ***Hybonoticeras neumayri* nov.sp.: 16.**(LRa64K23) Holotype, F1 outcrop, gray-greenish sandy facies - Beckeri Zone; **17**. (LRa65D16) Paratype 1, F2 outcrop. grey-greenish facies – ?Eudoxus Zone; **18**. (LRa69K23) Paratype 2, whorl fragment, F1 outcrop, gray-greenish sandy facies - Beckeri Zone.