

Lower Bajocian ammonites from the stratotype section of the Etropole Formation kept in the Historical Museum in Etropole (Bulgaria)

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Abstract. The area of the town of Etropole is famous for the well-preserved Lower Bajocian ammonites, which can be still often found in the nearby located exposures. These ammonites were the source of a number of species that enabled the recognition of the Bajocian in Bulgaria. The ammonite faunas and their host rocks were allocated to a series of stratigraphic horizons that composed the stratotype section designated as the reference standard for the definition and characterization of the Etropole Formation. The latter includes an ammonite spectrum which is composed of both Lower Bajocian species of Northwest European distribution and proper Bulgarian dispersal. It contains rare examples of the ammonite families Graphoceratidae and Sphaeroceratidae, frequent ammonites of the family Sonniniidae, and much more common members of the families Oppeliidae, Otoitidae and Stephanoceratidae that define a biostratigraphic interval from the *Hyperlioceras discites* to the *Stephanoceras humphriesianum* zones. This paper deals with the Lower Bajocian ammonite specimens hosted in the collection of the Historical Museum in Etropole (Bulgaria). The best preserved and the most valuable examples of this collection are described and figured. Although not purposefully collected, these ammonites give an excellent impression of the relative abundances of what is common and typical for stratotype section of the Etropole Formation. The study of this collection has triggered the rocks of the Etropole Formation (including the type-section) to be biostratigraphically reassessed, but this will be done elsewhere. Considering that both exposures and the fossil-bearing levels previously known from the Etropole area have now nearly disappeared, the ammonite collection of the Historical Museum in Etropole provides authentic specimens to be viewed. Besides, the collection forms an integral part of the overall heritage of the Etropole region and therefore offers both scientific and educational values.

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Key words: Lower Bajocian, ammonites, Etropole Formation, stratotype section, Etropole Museum, Bulgaria.

INTRODUCTION

The Historical Museum in the town of Etropole opened doors on 7 December 1958. It was hosted in the former monastery school at the church "St. Georgi". Ten years later, the museum launched a new exhibition in the restored Turkish Konak, and it is still housed there. The building of the museum was constructed between 1853 and 1870 from Etropole master painters Deno and Tsvetko, and it is a national cultural monument. The house of the museum and the Clock Tower (from 1710)

are the unique authentic old buildings in Etropole that have remained to the present. The present museum exposition was set up in 1992. It represents the rich historical heritage of the Etropole region, and it is displayed in 10 exhibition rooms. The Museum contains more than 15 000 cultural treasures, including many photos and authentic documents. In addition, it also holds small but valuable collection of Jurassic fossils (mainly ammonites), which have been gathered in the area of the town of Etropole and donated by locals. The Museum preserves nearly 70 Lower Bajocian

ammonites, referred to 18 genera and at least 25 species of the ammonite families Sonniniidae, Oppeliidae, Stephanoceratidae and Otoitidae, and corresponding to the biostratigraphic interval from the *Hyperlioceras discites* to the *Stephanoceras humphriesianum* zones (an approximate time-slice from 171.5 to 169.5 Ma). Although not purposefully collected, these ammonites give an excellent impression of the relative abundances of what is common and typical for the Lower Bajocian strata of the Etropole area. Considering that only a handful of Bulgarian museums have ammonites from Etropole, and also that the exposures and fossiliferous levels, previously known from this area, have now nearly disappeared, the ammonite collection hosted by the Historical Museum in Etropole provides reliable specimens to be viewed. Besides, the collection includes taxa and specimens that have been poorly known in Bulgaria before. The aim of this paper is to describe and illustrate the best preserved and the most valuable examples of this collection. In addition, we believe that the collection forms an integral part of the overall heritage of the Etropole region and therefore offers both high scientific and educational values.

STRATIGRAPHIC BACKGROUND OF THE COLLECTION

The area of the town of Etropole has long been famous for the well-preserved Lower Bajocian ammonites that have been obtained from nearby exposures. Best known and the most common are the examples from the ammonite fields St. Iliya (42°50'0.771"N; 23°59'12.623"E) and near the cemetery (42°50'10.95"N; 23°59'23.03"E) (see Fig. 1), first listed by Zlatarski (1908), and then described by Kamenov (1936). These specimens were the source of a number of ammonite species that enabled the recognition of the Bajocian in Bulgaria and later allowed the studies of the Lower Bajocian ammonites for the purposes of ammonite taxonomy and biostratigraphy (e.g. Sapunov, 1961, 1963, 1971; Sapunov, Stephanov, 1964). The rocks and the associated ammonite faunas were allocated to a series of stratigraphic horizons that composed the stratotype section designated as the reference standard for the definition and characterization of the Etropole Formation (Sapunov et al., 1967; Sapunov, 1969). After that, little has been added (e.g. Sapunov,

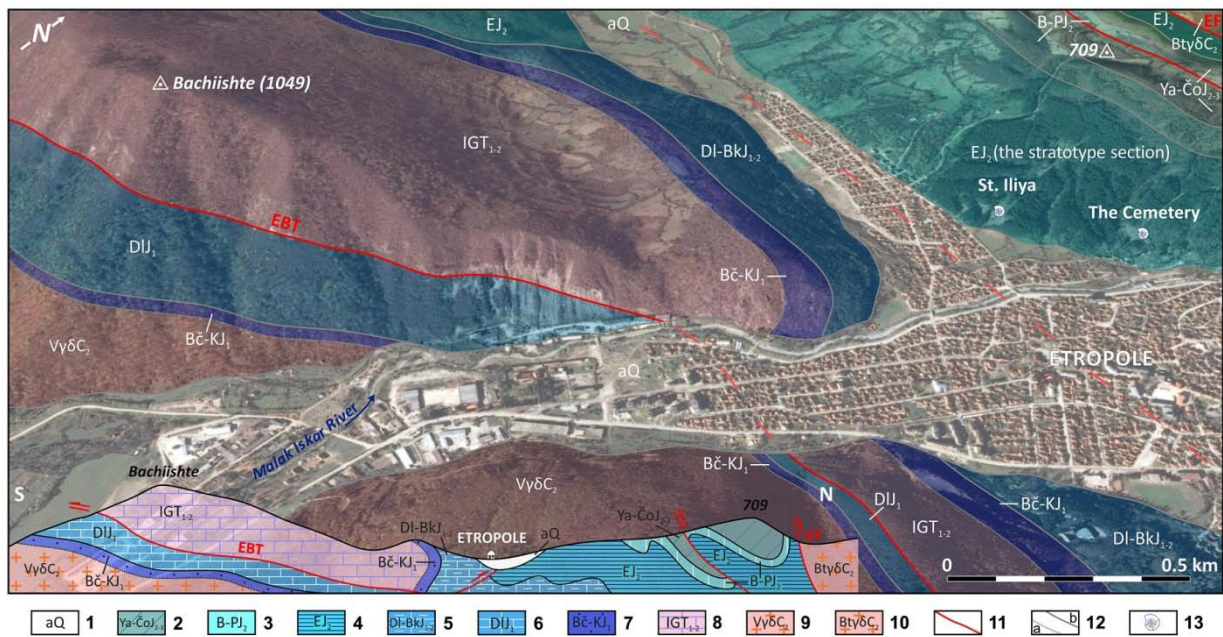


Fig. 1. Schematic geological map and cross section of the Etropole area (the background is a satellite image provided by Google Earth, structural plan is after Vangelov et al., 2013 and our field-data).

1. Quaternary (alluvial); 2. Cherni Osam–Yavorets Formations (turbidity, hemipelagic and pelagic sediments), Tithonian–Middle Callovian; 3. Bov and Polaten Formations (hemipelagic deposits overlaid by coarse-grained sediments), Bathonian–Upper Bajocian; 4. Etropole Formation (offshore argillaceous sediments), Lower Bajocian–Aalenian; 5. Bukorovtsi and Dolni Lukovit Members of the Ozirvo Formation (shallow-marine argillaceous and terrigenous-carbonate rocks), Aalenian–Upper Sinemurian; 6. Dolni Lukovit Member of the Ozirvo Formation (shallow-marine terrigenous-carbonate rocks), Upper Pliensbachian–Upper Sinemurian; 7. Kostina Formation (shallow-marine clastic rocks) and Bachiishte Formation (continental and paralic clastic deposits), Lower Sinemurian–Upper Hettangian; 8. Iskar Carbonate Group (limestones and dolostones), Middle–Lower Triassic; 9. Vezhen pluton (granodiorites), Upper Carboniferous; 10. Botevgrad pluton (granodiorites), Upper Carboniferous; 11. Fault and back-thrust structures (EBT=Etropole back-thrust, EF=Etropole fault); 12. Lithological boundaries (a - transgressive, b - normal lithological boundary); 13. Main ammonite fields of the Etropole area.

Tchoumatchenco, 1989; Cheshitev et al., 1995) and there are almost no new data from the strata of the type-section in Bulgarian literature.

According to the labels in the ammonite collection of the Museum in Etropole, the localities of the available specimens nearly match the fossil fields recorded from the previous authors. Both older records and our material certainly revealed that the locality St. Iliya refers to the upper part of the *Witchellia laeviuscula* Zone, and is a diagnosing field of the *Otoites sauzei* and *Stephanoceras humphriesianum* zones, whereas the locality near the cemetery mainly yields ammonites that identify the *Hyperlioceras discites* and *Witchellia laeviuscula* zones (see Table 1 for the zonal scheme used in this paper and the zonal equivalents of Bulgarian Lower Bajocian ammonite zones in Northwest Europe). When the examination of the collection has started, a few reasonable questions have appeared: are these localities still exposed and still productive, and can the exposures be revised? It was known that the bulk of the fossils, previously obtained from the type-section of the Etropole Formation, were collected from shale-hosted rows of phosphoritic and sideritic nodule clusters, where abundant and often mixed faunal elements, such as ammonites, belemnites, bivalves, gastropods, and even sponges, solitary corals and echinoids occur. At present, most of the type-section area is forested or falls into the urban area of the town of Etropole and therefore the fossil-bearing levels are traceless. Yet despite this deficiency, the localities St. Iliya and near the cemetery still provide good outcrops and even rare, nice ammonites appear. Additionally, the rocks of nearly the base of the Etropole Formation that crop out around the local dam in the western suburbs of Etropole (42°50'2.040"N; 23°56'252"E) have recently yielded some good ammonites of *H. discites* and *W. laeviuscula* zones (Fig. 2), but the finds are also rare and the succession is badly cropping out.

Even not being as accessible as in the former times, we have easily found that the currently recognizable stratotype succession of the Etropole Formation hardly corresponds equally to the given standard sequence description, as well as to the earlier accounts. It emerged that the beds of the type-section were subjected to considerable shearing and bending by a series of local WSW-ENE-trending faults, roughly parallel to the regional fault structures that control the distribution of the Jurassic outcrops in the Etropole area, which displace the outcrops into many smaller slice-blocks and thus subtract the succession of the Etropole Formation from normal, a conspicuous feature of the exposures that was not taken into account from the previous workers. The bedding of the main fossil-bearing fields and the other surrounding rocks displayed that they piled on top of, and do not correspond directly with each other and even less with the stratification of the older and the younger Jurassic strata. The latter fact reveals that both the internal lithological boundaries and

the two limits of the Etropole Formation in the type-section have undergone more or less strengthened tectonic treatment, and probably there are losses of sequence. A further sequence-leakage is suggested by the Etropole Formation itself, as it has a fossil content of quite irregular dispersal. Perhaps, the fossil-bearing beds compose faunal levels, which are too narrow within the total extent of the succession and separated by broad intervals of almost no fossils. These and the above stated features clearly identify the fossiliferous intervals of the stratotype as condensed sections, and certainly imply omission discontinuities. The latter, however, cannot be evaluated as fresh material is needed, but it does not seem possible now. Both structural complexity and the nature of the fossil distribution of the stratotype have serious consequences for the Lower Bajocian ammonite faunas as they become no longer biostratigraphically subdivisible of what has been achieved in the earlier times. Therefore we retain the basic framework that has remained from the forerunners, and in this account no attempt is made at a biostratigraphic revision of the ammonite fields from which our material has been obtained. Significant refinement of the scheme for the biostratigraphic classification of the Lower Bajocian strata in Bulgaria, including those from the stratotype of the Etropole Formation, is necessary because the ammonite zones that our specimens were assigned to, do not have adequate defining criteria yet. In addition, the ammonites were not found to lie at constant horizons. Nevertheless, we believe that the faunal elements of the type-section, including the museum collection treated in this work, have the same diagnostic properties as, and correspond very well to the typifying zonal components that define the currently used coeval ammonite zones in Northwest Europe (Table 1).

Despite the above stated imperfections of type-section of the Etropole Formation, it yielded characteristic Lower Bajocian ammonites, which have earned special attention and usually are rarely found in this facies elsewhere in Bulgaria. The ammonite spectrum of the stratotype includes the most valuable assemblage of the oppeliid genus *Bradfordia* in Bulgaria. The same applies for the oppeliid ammonites of the genus *Protoecotraustes* that possibly give rise to varied later forms, which play more important role in the ammonite associations of the Upper Bajocian and the Bathonian. The outcrops of type-section of the Etropole Formation also yielded common examples of the ammonite family Sonniniidae referred to the genera *Fissiloboceras*, *Euhoplloceras*, *Witchellia*, *Pelekodites*, *Dorsetensia*, *Nannina* and *Sonninia*, the latter genus probably being represented by the best specimens in this country. The members of the family Otoitidae are another significant faunal element of the beds exposed near Etropole, comprising fairly common and nice specimens of the genera *Emileia* and *Otoites*. The Stephanoceratidae are also relevant component, enclosing fragmentary preserved but characteristic

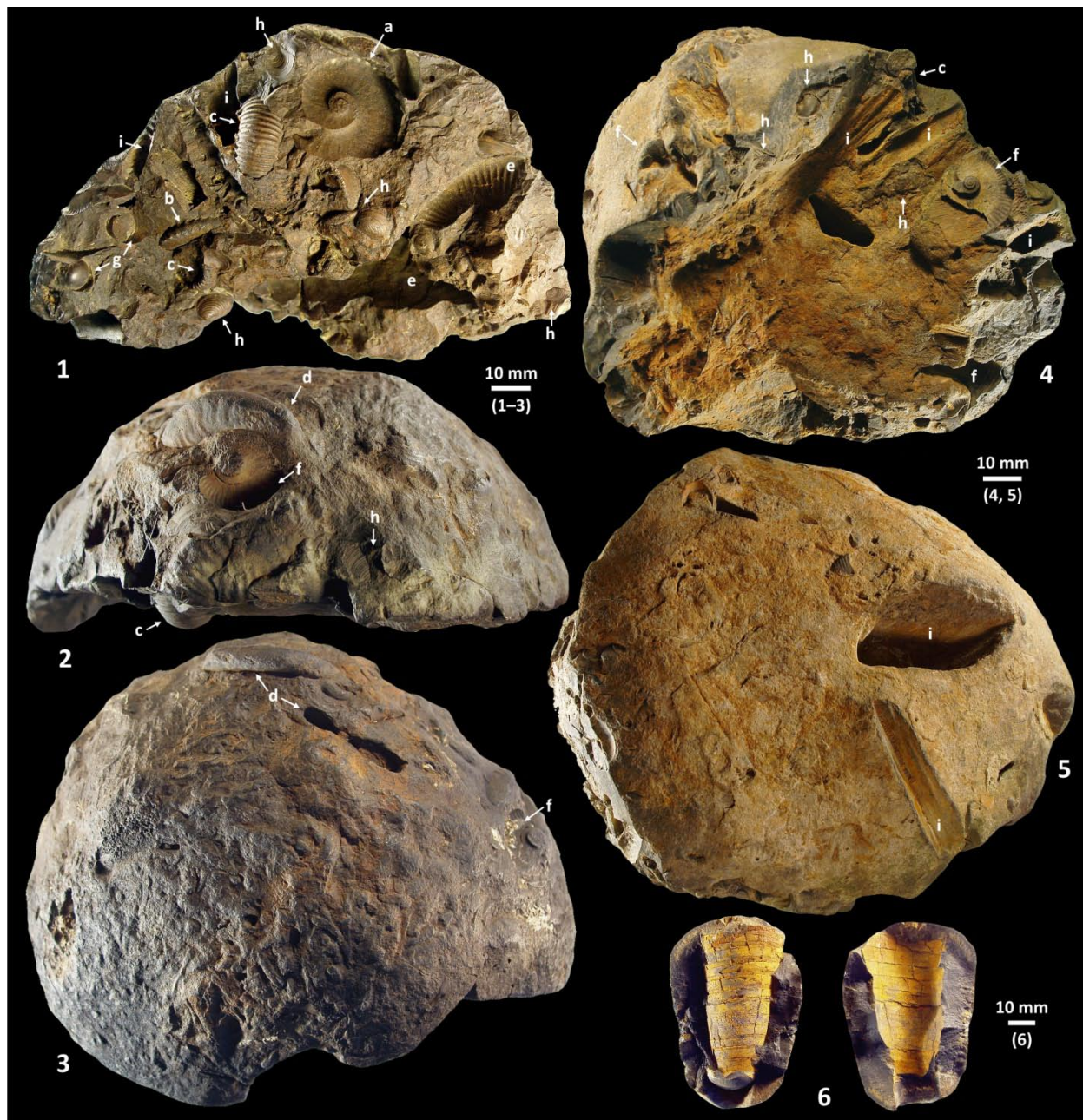


Fig. 2. Examples for preservation of the Lower Bajocian fossils from the base of the Etropole Formation, corresponding to the *W. laeviuscula* Zone (locality near the local dam west of the town of Etropole).

1–3. Internal and external views of a fragment from large ovoid fossiliferous phosphoritic nodule (Inv.-Nr. FSR. 013175) containing abundant whole and crushed ammonites and bivalves, less common reworked remnants of belemnites and a few wood slivers. 4, 5. Internal and external views of an oblate-spheroidal sideritic nodule (Inv.-Nr. FSR. 013176) comprising scattered whole and crushed ammonites and nuclei, a few bivalves and wood fragments. 6. An example of taphonomic reelaboration of disassembled and reburied belemnite alveolar chamber, showing structural discontinuity with the sedimentary matrix in an argillaceous-phosphoritic nodule (Inv.-Nr. FSR. 013177). Constituent faunal elements (a–i): a - nearly complete specimen of *Protoecotraustes laevigatus* Sapunov, b - sticking venter of *Protoecotraustes dundriensis* Spath, c - small stephanoceratid cadicones, d - complete and altered specimens of *Protoecotraustes kamenovi* Sapunov, e - external moulds of *Bradfordia (Praeoppelia)* spp., f - normal specimens and nuclei of *Bradfordia (Iokastelia) praeradiata* (Douvillé), g - resedimented alveolar chambers of big belemnite rostra (internal mould showing structural discontinuity with the sedimentary matrix), h - bivalves of notably small sizes, i - imprints of fossil wood fragments.

Table 1

Correlation between the Lower Bajocian ammonite (sub)zones in Bulgaria and the standard (sub)zones in Northwest Europe (according to Rioult et al., 1997; see also Chandler et al., 2006, 2013, and Dietze et al., 2005, 2007)

Bulgaria		Northwest Europe	
Zone	Subzone	Subzone	Zone
<i>Stephanoceras humphriesianum</i>	<i>Teloceras blagdeni</i>	<i>Teloceras blagdeni</i>	<i>Stephanoceras humphriesianum</i>
	<i>Stephanoceras humphriesianum</i>	<i>Stephanoceras humphriesianum</i>	
	<i>Dorsetensia romani</i>	<i>Dorsetensia romani</i>	
<i>Otoites sauzei</i>	no subzones divided	<i>Dorsetensia hebridica</i>	<i>Sonninia propinquans</i>
		<i>Sonninia patella</i>	
<i>Witchellia laeviuscula</i>	no subzones divided	<i>Witchellia laeviuscula</i>	<i>Witchellia laeviuscula</i>
		<i>Shirbuirnia trigonalis</i>	
		<i>Fissilobicerias ovalis</i>	
<i>Hyperlioceras discites</i>	<i>Hyperlioceras rudidiscites</i>	<i>Hyperlioceras subsectum</i>	<i>Hyperlioceras discites</i>
	<i>Toxolioceras walkeri</i>	<i>Toxolioceras walkeri</i>	

The combined extend from the *H. discites* to *O. sauzei* Zone corresponds to the former "Sowerbyi Zone" in older Bulgarian literature. Ammonite faunal horizons from NW Europe are not shown. The *F. ovalis* Subzone has a rank of zone in Chandler et al. and in Dietze et al. Dashed lines in subzones of the Bulgarian *S. humphriesianum* Zone denote subzonal boundaries remaining to be better defined.

ammonites of the genera *Kumatostephanus*, *Skirroceras*, *Stephanoceras*, *Teloceras* and *Itinsaites*. The faunal list of the stratotype of the Etropole Formation consists of a number of other ammonite taxa, but we draw attention upon the above listed genera as they compose the bulk of the collection for which the Museum in Etropole takes care.

SYSTEMATIC PART

Overall, we studied about 70 specimens hosted at the Historical Museum in Etropole. The ammonites appear as external moulds or phosphatized and ferruginized internal moulds in phosphoritic and sideritic nodules, having usually well-preserved ornament, and commonly preserved body-chamber and aperture, but without sedimentary infill in the inner whorls (as "hollow ammonoids", in: Fernández-López, 2011; Fernández-López et al., 2014). There are also fragmentary preserved but characteristic specimens, which are good enough for taxonomic identification. This work concerns the material kept in the Museum, but also includes comparisons with other Bulgarian specimens that confirm our conclusions. Where needed, the ammonite specimens were supported by plaster casts, which are stored in the Geological Institute of Bulgarian Academy of Sciences. This part of the paper does not include synonymy, but contains only short notes of nomenclature on the type-specimens that define the species recognized. Fossil plates have been prepared showing the ammonites without additional treatment, at nearly $\times 1$ magnification for the smaller individuals and $\times 0.8$ for larger specimens. An asterisk indicates the position of the last septal suture. The ammonite

measurements and proportions are given at fossil plate captions as follows: *D* (shell diameter in mm), *Wh* (whorl height in mm), *Wb* (whorl breadth in mm), *U* (umbilical width in mm), as well as whorl height, whorl breadth and umbilical width as ratios of shell diameter in brackets. Inventory numbers of studied material have been abbreviated to letter-number codes, according to their repository: Historical Museum in Etropole (HME) and Geological Institute of Bulgarian Academy of Sciences (GI-BAS).

Family Sonniniidae Buckman, 1892

Genus *Sonninia* Douvillé, 1879

***Sonninia propinquans* (Bayle, 1878)**

(Figs. 3.1–5)

Lectotype: *Waagenia propinquans* (Bayle, 1878, pl. 84, fig. 1; lectotype designation by Gillet, 1937, pp. 30, 32), from the Sauzei Zone of Les Moutiers near Caen (Normandy) (see Dietze et al., 2009, p. 30; see also Howarth, 2013, p. 115, fig. 79.1a, b – refigured lectotype). For the emended use of the genus *Sonninia*, see the extensive discussion in Dietze et al. (2005). See also Rulleau (2011).

Material and record: three specimens [HME Inv.-Nrs. IMET I-47/IMET I-44 (152), IMET I-47 (19) and IMET I-47 (187)], 5 plaster casts of the specimen displayed in Fig. 3.1–4 [GI-BAS Inv.-Nrs. F.013142.c.1-4, F.013143], 1 cast of specimen in Fig. 3.5 [GI-BAS Inv.-Nr. F. 013144.c], and 1 cast of the last noted HME example, which is not figured [GI-BAS Inv.-Nr. F. 013145.c]. Locality St. Iliya (Etropole), Etropole

Formation (probably the lower, but not basal part of the *O. sauzei* Zone).

Description. Small to medium-sized ammonites (diameters varying from 50 to 90 cm), moderately involute and compressed, having flat whorl sides (slightly varying whorl proportions: $Wh/D=0.46-0.48$, $Wb/D=0.27-0.28$, $U/D=0.34-0.36$), sloping to bevelled umbilical walls, strong, hollow and floored keel, bordered by rounded smooth areas, but no sulci. Whorl section is initially rounded, becoming compressed and highly elliptical on the outer whorls. Whorl height and whorl breadth both gradually increase as a proportion of the diameter as growth proceeds, whereas the umbilical width increases steadily as a proportion of the diameter with growth. The phragmocone includes more than three whorls, and the body-chamber comprises at least a half of the last whorl. The mouth-border is unknown. The ornament consists of well-spaced falcoid ribs, usually prominent and sharp, strongly sculptured on the inner whorls and weakening on the body-chamber. The dorsal half of each rib is straight or slightly curved convex, and above the mid-flanks ribs bend in broad sweeps forwards. Ribbing is irregular, including single and bifurcate ribs. The latter are divided into two at the umbilical edge in small tubercles that fade nearly at the end of the phragmocone. On the body-chamber, ribs become single or vaguely bunched at the peri-umbilical area.

Notes. The HME examples are very similar in ornament and whorl proportions both to the lectotype and to a few characteristic and better stratigraphically recorded specimens of this species from Germany and France that we have found in the literature (e.g. Dietze et al., 2009; Rulleau, 2011). However, we cannot evaluate the

biostratigraphic significance of *S. propinquans*, since no other ammonites have been found elsewhere in Bulgaria than those from the Etropole area. Except our examples, a few other good and probably coeval specimens of this species are kept in the collection of the University of Sofia, but these are just labelled "Etropole" and any supporting stratigraphic data do not exist. It is clear, however, that *Sonninia propinquans* do not exceed the middle of total extent of the *O. sauzei* Zone. In this sequence-slice, the ammonite association of the *O. sauzei* Zone is characterized by the combined occurrence of *Otoites* and *Emileia*. *Pelekodites* are also present though accessorially. Upwards, *Emileia* and particularly *Otoites* tend to become gradually less common, attended by scattered sphaeroceratids of the genera *Labyrinthoceras* and *Frogdenites* and occasional *Sonninia* nuclei. The upper levels of the *O. sauzei* Zone include randomly dispersed and extremely serpenticonic *Skirroceras*, some large examples of the genus *Kumatostephanus* and a few other smaller-sized and hardly discernible stephanoceratids.

Genus *Witchellia* Buckman, 1889

Witchellia jugifera (Waagen, 1867)

(Figs. 3.6–7)

Lectotype: *Ammonites jugiferus* Waagen (*Sonninia jugifera* (Waagen, 1867), in: Schlegelmilch, 1985, pl. 16, fig. 2 – photographic figuration of the lectotype; Dietze et al., 2005, pp. 59–60 is the valid designation of the lectotype) from the Sowerbyi-Bank (Ovale Zone, *oechslei* Horizon) at Gingen an der Fils (Southern Germany).

Fig. 3. Lower Bajocian *Sonniniidae* and *Oppeliidae* (collection of the Historical Museum in Etropole).

1–4. *Sonninia propinquans* (Bayle), Inv.-Nr. IMET I-47/IMET I-44 (152), nearly complete specimen in sideritic nodule with leached inner whorls and body-chamber preserved as an internal mould: 1, 2 - side and sectional view of the entire specimen, 3 - side view of the body-chamber, 4 - negative in the nodule. Dimensions: $D=90.0$; $Wh=42.2$ (0.47); $Wb=24.0$ (0.27); $U=31.0$ (0.34).

5. *Sonninia propinquans* (Bayle), Inv.-Nr. IMET I-47 (187). Compressed inner whorls with a portion of body-chamber as concretionary internal mould in phosphoritic nodule.

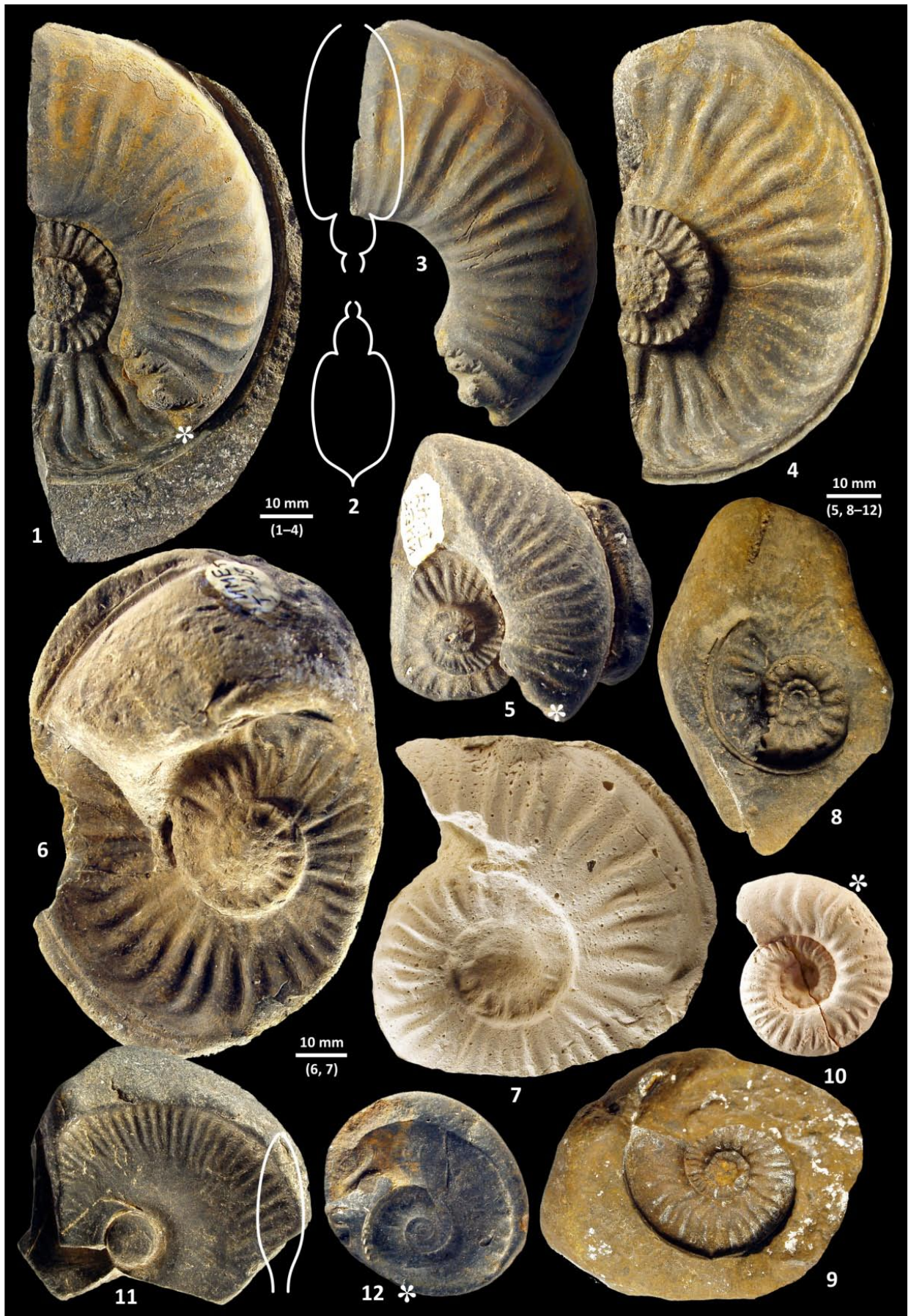
6, 7. *Witchellia jugifera* (Waagen), nearly complete adult in sideritic nodule with compressed and leached inner whorls and beginning of the body-chamber attached: 6 - side view of the specimen Inv.-Nr. IMET I-48 (148), 7 - plaster cast of the inner whorls (Inv.-Nr. F. 013146.c.₁). Dimensions: $D=95.0$; $Wh=38.0$ (0.40); $U=37.0$ (0.39).

8. *Euhoplaceras* gr. *marginatum* Buckman, Inv.-Nr. IMET I-47 (193). Leached inner whorls in sideritic nodule. Dimensions: $D=27.0$; $Wh=11.0$ (0.41); $U=11.0$ (0.41).

9, 10. *Pelekodites moisyi* (Brasil), Inv.-Nr. IMET I-47 (199). Leached phragmocone with the beginning of the body-chamber in sideritic nodule: 9 - side view of the specimen, 10 - plaster cast (F.013147.c.₁). Dimensions: $D=32.0$; $Wh=11.4$ (0.36); $Wb=9.3$ (0.29); $U=12.8$ (0.40).

11. *Bradfordia* (*Iokastelia*) *helenae* (Renz), Inv.-Nr. IMET I-47 (113). Negative in phosphoritic nodule. Side and sectional views of specimen described and figured by Sapunov (1971, p. 78, pl. 1, fig. 3).

12. *Protoecotraustes laevigatus* Sapunov, Inv.-Nr. E-30. Negative in phosphoritic nodule of complete specimen with long spatulate lappet at the peristome. Dimensions: $D=34.5$; $Wh=10.5$ (0.30); $U=13.0$ (0.38).



Material and record: one specimen [HME Inv.-Nr. IMET I-48 (148)] and three plaster casts [GI-BAS Inv.-Nr. F. 013146.c.1-3]. Probably from the locality near the cemetery (Etropole), Etropole Formation (*W. laeviuscula* Zone).

Description. Medium-sized, moderately evolute and compressed ammonite (probably wholly septate), with high and rounded sub-rectangular whorl section, and sub-tabular venter bearing a thin but distinct keel. The ornament is relatively far apart and pointed out, consisting of falcoid ribs, which are single or occasionally joined near the umbilical edge. It seems that the whorls are periodically and weakly constricted. The relief of the ornament does appear to decrease with growth.

Notes. This HME example displays whorl-shape and growth, and ribbing style that are typical to the species to which it is referred. This makes it significant discovery as the ammonites of the genus *Witchellia* are too poorly known from the type-section of the Etropole Formation. The presence of *Witchellia* in Bulgaria remains problematic, and the bulk of the existing Bulgarian citations of species of this genus are most likely misidentifications. Our study has revealed that true *Witchellia* can be found in a few ammonites collected from the stratotype of the Etropole Formation so far. We believe that the available material, which has previously been published or labelled as "*Witchellia*" (cf. Kamenov, 1936; Sapunov, 1961), includes both *Witchellia* examples and species of other different genera. For instance, Kamenov (1936, p. 94, pl. 3, fig. 2, pl. 7, fig. 4) recognized two ammonites as "*Witchellia pinguis* Roem." and "*Witchellia deltafalcata* Qu." that we place in the genus *Nannina*. In fact, these ammonites are very similar to the example of *Nannina deltafalcata* that we describe below, and all comparable specimens probably came from a source level at the top of the *O. sauzei* Zone or the base of the *S. humphriesianum* Zone, which is too high for *Witchellia*. The ammonite from the locality St. Iliya identified as "*Witchellia corrugata* Sowerby" (Kamenov, 1936, p.95, pl. 3, fig. 4) is an almost exact match of *Witchellia* aff. *laeviuscula*, from the Green-grained Marl of Osborne (mid-*W. laeviuscula* Zone at Dundry, Avon, SW England), illustrated by Chandler et al. (2006, fig. 5/4). We agree with the records of "*Witchellia deltafalcata* Quenstedt" (Kamenov, 1936; Sapunov, 1961), but we place them into the genus *Nannina* and describe another example of Quenstedt's species. No real specimen that meets the identification "*Witchellia (Zugella)* aff. *connata* Buckman" (Sapunov, 1961) has been found. There are many other examples from the type-section of the Etropole Formation that have been collected but not found a place in older publications, but they are beyond the scope of this study and will be therefore discussed elsewhere.

Genus *Euhoploceras* Buckman, 1913

Euhoploceras gr. *marginatum* (Buckman, 1892) (Fig. 3.8)

Material and record: one specimen [HME Inv.-Nr. IMET I-47 (193)]. Probably from the locality near the cemetery (Etropole), Etropole Formation (*H. discites* Zone).

Description. Incompletely preserved *Euhoploceras* (27 mm in diameter) that is fairly evolute (the *U/D* ratio is 0.41) and represents compressed, sub-rectangular and tuberculate inner whorls with sub-tabular venter and low hollow keel. The umbilicus is surrounded by sub-vertical umbilical walls and appears to be relatively deep. The ornament consists of thick, radial to slightly concave, mainly simple ribs, some of which are paired near the umbilical edge, while others have mid-lateral tubercles.

Notes. Due to the state of preservation, our specimen cannot be confidently assigned to the species to which we feel it refers. However, it is similar in coiling, whorl-section and ornament to the spinose stage of the inner whorls that was documented by Sandoval, Chandler (2000) in the superb examples of *Euhoploceras marginatum* from the Inferior Oolite (Southern England) and Betic Cordillera (Southern Spain). This similarity gives us reason to believe that even incomplete, this ammonite is an example of *E. marginatum* from the stratotype of the Etropole Formation. We cannot also confidently give its stratigraphic position, but taking into account that it takes part of an association of *Docidoceras-Riccardiceras* faunas, we consider it as an indication of the *H. discites* Zone.

Genus *Pelekodites* Buckman, 1923

Pelekodites moisyi (Brasil, 1895) (Figs. 3.9–10)

Type: *Pæcilomorphus moisyi* (Brasil, 1895, pp. 36–37, pl. 3, figs. 6, 7), from "Bajocien moyen (Couches à *Witchellia*) de Feuguerolles-sur-Orne" south of Caen (Calvados), Northwest France. The only described and figured specimen by Brasil (1895) is the holotype of this species. According to the recently revised scheme of the Bajocian near Caen (Pavia et al., 2013), the holotype comes from an interval labelled as RL-1/1–RL-2/2, which corresponds to the condensed *laeviuscula* and *propinquans* zones of the "*Oolithe ferrugineuse de Bayeux*" Formation. Surprisingly, Pavia et al. (2013) have not found any new *Pelekodites* specimens in the Bajocian outcrops where this species had been defined.

Material and record: one specimen [HME Inv.-Nr. IMET I-47 (199)] and two plaster casts [GI-BAS Inv.-Nr. F.013147.c.1, 2]. Locality St. Iliya (Etropole), Etropole Formation (*O. sauzei* Zone).

Description. Small ammonite (probably including the phragmocone and the initial portion of the body-chamber), with relatively evolute whorls (*U/D* ratio is

0.40), a sub-rectangular section (Wh/D and Wb/D ratios are 0.36 and 0.29, respectively), rounded umbilical edge, and a tricarinate-bisulcate venter. The ribs are strong and sinuous, the dorsal half being strongly prorsiradiate, especially on the inner whorls. Most of the ribs bifurcate near the umbilical edge, but simple ribs also occur. Both rib pairs and single ribs have thickened periumbilical stem and ventrolateral end, and fade close to the narrow ventral grooves. The strength of the ornament decreases with coiling and ribs become weak near the end of the last preserved whorl.

Notes. The HME specimen appears to be good match of the holotype, even being slightly more evolute, and with somewhat lesser whorl height. Perhaps, it has higher stratigraphic position than that of the holotype as almost certainly it comes from the same level from which are the above described examples of *S. propinquans*. The latter fact is not disturbing because nearly the same coeval examples of *Pelekodites moisyi* were recorded in SW Germany (Dietze et al., 2009). Apparently, *Pelekodites* are much more common in the ammonite faunas than assumed in earlier times, and lie in a range that roughly corresponds to the combined extend of *W. laeviuscula* and *O. sauzei* zones in Bulgaria.

Genus *Nannina* Buckman, 1927

Nannina deltafalcata (Quenstedt, 1856)

(Figs. 4/1–2)

Lectotype: *Ammonites deltafalcatus* (Quenstedt, 1856, p. 394; pl. 53, figs. 7, 8), from the *deltafalcata* or *romani* horizons (*humphriesianum* Zone) of “Ostreenkalke” at Öschingen (S Germany) (see Dietze et al., 2011, p. 224; pl. 7, figs. 13, 14 – figured plaster cast of the lectotype).

Material and record: two specimens [HME Inv.-Nr. IMET I-43 (178), IMET I-47 (95)] and 4 plaster casts of the specimen figured in Figs. 4.1–2 [GI-BAS Inv.-Nr. F.013148.c.1–4]. Locality St. Iliya (Etropole), Etropole Formation (near the *O. sauzei* Zone/*S. humphriesianum* zones boundary).

Description. Small and moderately evolute ammonites with high-oval whorl section, pronounced but rounded falcooid ribbing on the flanks, and slightly separated ventral keel. Steep umbilical walls and rounded umbilical edge surround a moderately deep umbilicus. Ventral area is rather flat and no furrows around the keel have been observed. The ornament appears to be present as far back as earliest growth stages and seems to become progressively more distant and weaken. It is composed mainly of bifurcate ribs that are branched on the umbilical edge. The ribs are slightly prorsiradiate and projected on the ventrolateral area. Occasional intercalary ribs occur also, but only in inner whorls. The ribs tend to become simple at the end of the last preserved whorl. Figured specimen probably includes a body-chamber, which extends for three-quarters of the last whorl. No aperture is preserved.

Notes. This species has already been recorded from the same locality near Etropole by Kamenov (1936, pl. 7, fig. 4) and Sapunov (1961, p. 121), but referred to the genus *Witchellia* (see above). A few smaller ammonites from the Etropole Formation near Gaganitsa Village (Montana District), with falcooid ribbing and preserved long spatulate lappets, were previously determined as *Witchellia deltafalcata* by Nachev et al. (1963). However, we believe they match two other different species: *Pelekodites aurifer* (Buckman) and *Nannoceras nannomorphum* Buckman. These specimens were recorded clearly in lower stratigraphic position than that of *Nannina deltafalcata*, and they are attributable to the *W. laeviuscula* Zone. Several good examples of *N. deltafalcata* have recently been found in the area of the Zimevitsa Plateau (Sofia District). They come from the topmost beds of the Etropole Formation and the very base of the Bov Formation that were assigned to the *D. romani* Subzone of the *S. humphriesianum* Zone (Metodiev et al., 2014).

Family Oppeliidae Douvillé, 1890

Genus *Bradfordia* Buckman, 1910

Notes. It was Sapunov (1971) who previously examined taxonomically the species of this genus from Bulgaria and who attempted to link them phylogenetically. Following Arkell et al. (1957, p. L275), that author has adopted a broader concept of the genus *Bradfordia* and interpreted it to be composed of four subgenera (Sapunov, 1971, p. 87): *B. (Bradfordia)*, *B. (Iokastelia)*, *B. (Praeoppelia)*, and *B. (Etropolia)*. The latter subgenus was based on ammonites from the stratotype of the Etropole Formation and named after the Etropole area. There is no agreement in the literature what would be the more logical way to classify these earliest members of the family Oppeliidae as they are very similar and closely related but yet tending to be different. It is clear that the subgeneric names, which are currently in use, match no more than derivatives of a single main morphology as every bigger collection shows many intermediates between different end-forms. On the other hand, they display stable differences that are running in parallel throughout the total range of *Bradfordia* faunas both in Bulgaria and elsewhere. Complete specimens sufficiently differ from each other and placing them all under one generic name would unite forms that are always different. Taxonomical splitting, however, does not appear to have stratigraphical significance for the full range of morphologies that occur throughout the range of *Bradfordia* in Bulgaria. The bulk of the Bulgarian *Bradfordia* faunas come from mixed assemblages, and they remain indistinguishable in terms of its proper occurrence. Even so, we argue that the advent and the acme of *Bradfordia* in Bulgaria fell into the *W. laeviuscula* Zone, after which the genus continued ranging with decreasing numbers to at least the base of the *S. humphriesianum* Zone where it gave rise to the

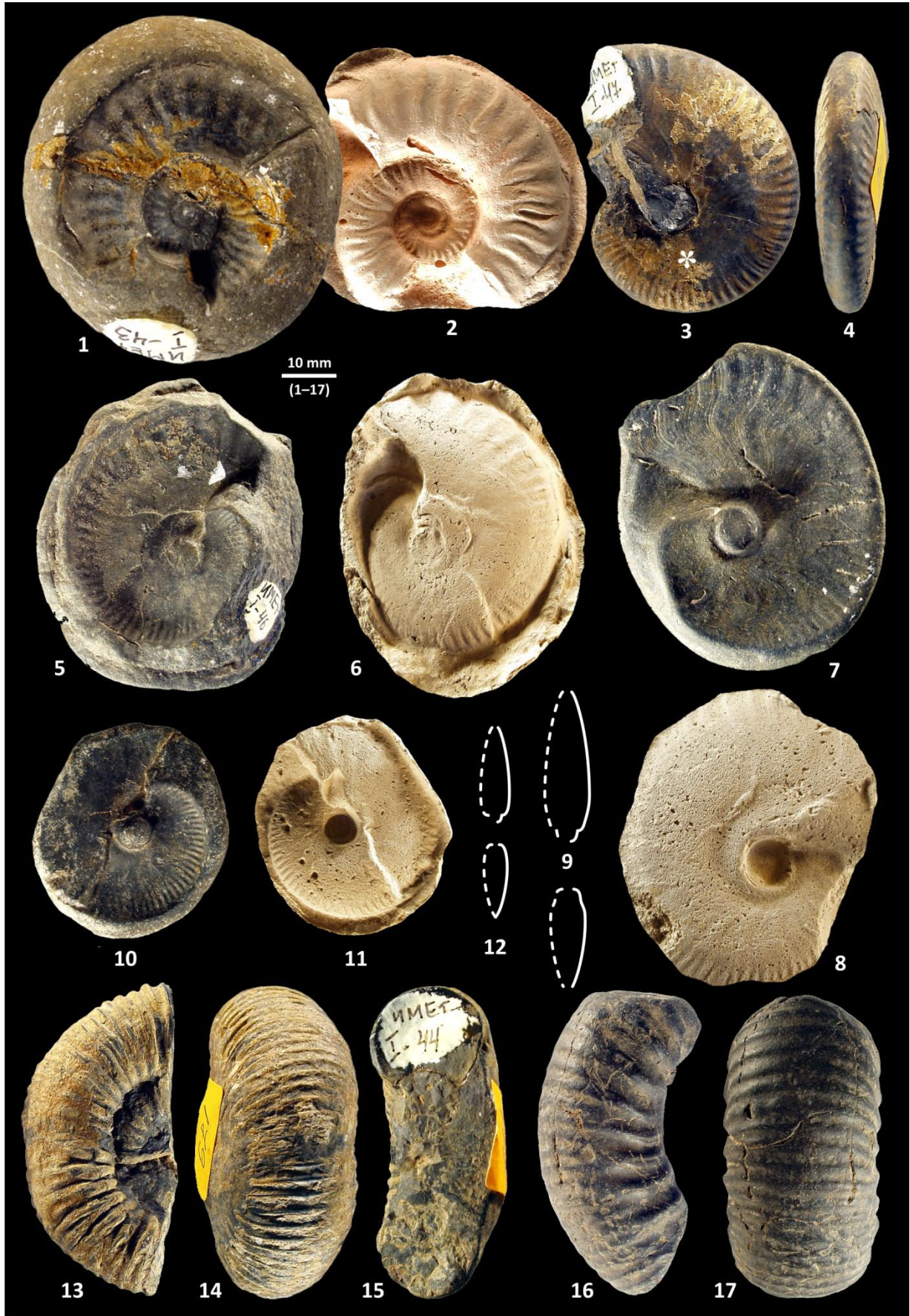




Fig. 4. Lower Bajocian Opeleliidae and Stephanoceratidae (collection of the Historical Museum in Etropole).

1, 2. *Nannina deltafalcata* (Quenstedt), Inv.-Nr. IMET I-43 (178). Negative of phragmocone and portion of the body-chamber in phosphoritic concretion: 1 - side view of the specimen, 2 - plaster cast (Inv.-Nr. F.013148.c.₁). Dimensions: $D=44.0$; $Wh=15.0$ (0.34); $U=17.5$ (0.40).

3, 4. *Bradfordia* (*Iokastelia*) *praeradiata* (Douville), Inv.-Nr. IMET I-47 (182). Side and ventral views of specimen described and figured by Sapunov (1971, p. 79, pl. 1, figs. 4a, b). Dimensions: $D=50.5$; $Wh=28.0$ (0.55); $Wb=13.7$ (0.27); $U=7.4$ (0.15).

5, 6. *Bradfordia* (*Praeoppelia*) *subplicatella* (Vacek), Inv.-Nr. IMET I-46 (165). Negative in phosphoritic concretion: 5 - side view of the specimen, 6 - plaster cast (Inv.-Nr. F.013151.c.₁). Dimensions: $D=53.0$; $Wh=30.0$ (0.57); $U=7.0$ (0.13).

7–9. *Bradfordia* (*Praeoppelia*) *gracililobata* (Vacek), Inv.-Nr. E-34. Negative of nearly complete specimen in phosphoritic concretion: 7 - side view of the specimen, 8 - plaster cast figured by Sapunov (1971, p. 80, pl. 1, fig. 5) (Inv.-Nr. F.013152.c.₁), 9 - sectional view of the specimen.

10–12. *Bradfordia* (*Bradfordia*) *inclusa* Buckman, Inv.-Nr. IMET I-48 (188). Negative of a phragmocone and portion of body-chamber in phosphoritic nodule: 10, 12 - side and section views of the specimen, 11 - plaster cast (Inv.-Nr. F.013153.c.₁). Dimensions: $D=36.4$; $Wh=18.0$ (0.49); $U=4.7$ (0.13).

13–15. *Germanites latus* Westermann. Phosphatized internal mould of an incomplete specimen, Inv.-Nr. IMET I-44 (179): 13 - side view, 14 - ventral view, 15 - sectional view. Dimensions: $D=49.4$; $Wh=16.0$ (0.32); $Wb=19.8$ (0.38); $U=20.6$ (0.42).

16, 17. *Itinsaites rhomboidalis* Westermann. Phosphatized portion of an adult body-chamber, Inv.-Nr. IMET I-44: 16 - side view, 17 - ventral view. Dimensions: $Wh=25.0$; $Wb=30.0$.

first *Opelelia* (*O. subcostata*). *Bradfordia* does appear to follow a general trend of reducing sizes and finesse of the ribbing through time. The HME collection includes single ammonites of *B. (Bradfordia)*, *B. (Iokastelia)*, and *B. (Praeoppelia)* that are worthy to be given in this account as they were not noted before.

***Bradfordia (Iokastelia) helenae* (Renz, 1925)**
(Fig. 3.11)

Lectotype: *Opelelia (Iokastelia) helenae* (Renz, 1925, p. 28, pl. 2, figs. 3, 3a), from the condensed Jurassic deposits at Monte San Giuliano (Monte Erice), Western Sicily (lectotype designation by Sapunov, 1971, p. 79). The original figure of the lectotype was recently reproduced by Rulleau (2011, pl. 28, figs. 6a, b).

Material and record: one specimen [HME Inv.-Nr. IMET I-47 (113)] and one plaster cast [GI-BAS Inv.-Nr. F.013149.c]. Unknown locality and level of the Etropole Formation near Etropole.

Notes. This specimen was described and figured by Sapunov (1971, p. 78, pl. 1, fig. 3). It remains without clear stratigraphic position, and is the only record of *B. (I.) helenae* in Bulgaria. The same applies to the lectotype that came from an unrecorded locality in Sicily (see the comments given by Sapunov, 1971, p. 79). It seems, however, that *B. (I.) helenae* represents a rather specific morphology, which includes stouter whorls, characteristic umbilical edge rising into a slight rim that is bordered by prominent funnel-like spiral depression, and forwardly acutely angled ribs at the mid-flanks, which are weak on the inner half of the whorls and become stronger towards the ventrolateral area. Very similar to that species, but having finer and denser ornament, is *B. (I.) costidensa* Imlay, which

surprisingly was recorded in an example located immediately below the first appearance of the genus *Dorsetensia* in the area of the Zimevitsa Plateau (Metodiev et al., 2014). This position corresponds to the top of the *O. sauzei* Zone or the very base of *S. humphriesianum* Zone and it is the youngest record of the genus *Bradfordia* in Bulgaria. We do not exclude *B. (I.) helenae* and *B. (I.) costidensa* to be coeval and thus supposing that they take the endmost part of *Bradfordia* lineage, which is reaching the *S. humphriesianum* Zone.

***Bradfordia (Iokastelia) praeradiata* (Douville, 1884)**
(Figs. 4.3–4)

Lectotype: *Opelelia praeradiata* (Douville 1884, pl. 3, fig. 7, non figs. 6, 6a, see Dietze et al., 2007) from a locality of unknown age near Toulon (Normandy, NW France). Prior to Dietze et al. (2007), Sapunov (1971, p. 79) designated Douville's specimen (Douville 1884, pl. 3, figs. 6, 6a) as lectotype, but this ammonite corresponds to *B. (B.) inclusa* Buckman, and hence the designation in Dietze et al. (2007) is the valid lectotype designation.

Material and record: one specimen [HME Inv.-Nr. IMET I-47 (182)] and one plaster cast [GI-BAS Inv.-Nr. F.013150.c]. Locality St. Iliya (Etropole), Etropole Formation (*O. sauzei* Zone).

Notes. The HME specimen is a good match of the lectotype. A few other nice conspecific examples were described in detail by Sapunov and one of them was figured (Sapunov, 1971, p. 79, pl. 1, figs. 4a, b). Several other ammonites from the same locality and level, collected by Kamenov (1936), also possibly refer to this species. We discovered *B. (I.) praeradiata* in common occurrence in the basal beds of the Etropole Formation

near the dam to the west of Etropole, but these findings are in lower stratigraphic position than the illustrated ammonite, which falls into the *W. laeviuscula* Zone. The latter record confirms the previously given opinion of Sapunov (1971) that *B. (I.) prae radiata* is a conservative species, which ranges relatively unchanged throughout *W. laeviuscula* and *O. sauzei* zones in Bulgaria.

***Bradfordia (Praeoppelia) subplicatella* (Vacek, 1886)**
(Figs. 4.5–6)

Lectotype: *Praeoppelia subplicatella* (Vacek, 1886, p. [26] 82, pl. 11, figs. 1, 4, 5), from the condensed Aalenian–Bajocian "Oolite di San Vigilio" near Lake Garda, North Italy (see Callomon et al., 1994). The original figure of the lectotype was reprinted by Rulleau (2011, pl. 28, figs. 4a, b).

Material and record: two ammonites [HME Inv.-Nrs. IMET I-55 (141) and IMET I-46 (165)], and two plaster casts of the second specimen [GI-BAS Inv.-Nr. F.013151.c.1, 2]. Probably from the locality near the cemetery (Etropole), unknown level of the Etropole Formation.

Description. The figured HME specimen represents small and very involute ammonite with high and compressed whorls (at $D=53$ mm, Wh/D ratio is 0.57, and U/D ratio is 0.13), and almost flat whorl sides with greatest whorl-breadth at the umbilical edge. Narrow, rounded to fastigate, smooth and feebly keeled venter. Ribs are relatively fine and dense, sinuous, single and bifurcate, with low relief, almost weak but distinctly prorsiradiate below the mid-flanks, thickening and bending backwards on the outer half of whorl sides. Ribs are slightly projected forwards at the ventrolateral area.

Notes. The HME specimen is a leached negative, but it shows similar ornament and whorl proportions (measured on the plaster cast) with the lectotype. We suppose that it was found in altered materials and therefore its original stratigraphic position cannot be defined, but there is no doubt that it has higher occurrence than that adopted for this species by Callomon et al. (1994), and thus is probably the *W. laeviuscula* Zone. *B. (P.) subplicatella* is similar to *B. (P.) gracililobata* from which we have also an example. The latter species differs in having more compressed whorls and coarser ornament. Perhaps, *B. (P.) gracililobata* has a higher stratigraphic distribution than *B. (P.) subplicatella*.

***Bradfordia (Praeoppelia) gracililobata* (Vacek, 1886)**
(Figs. 4.7–9)

Lectotype: *Oppelia gracililobata* (Vacek, 1886, p. [27] 83, pl. 10, figs. 1, 1a, 1b) (lectotype designation by Sapunov, 1971, p. 80), from the same locality and level as *Bradfordia (Praeoppelia) subplicatella* (see Callomon et al., 1994). The original figure of the

lectotype was reprinted by Rulleau (2011, pl. 28, figs. 7a, b).

Material and record: one specimen [HME Inv.-Nr. E-34] with three plaster casts [GI-BAS Inv.-Nr. F.013152.c.1–3]. Unknown level and locality of the Etropole Formation near Etropole.

Notes. We refigure here both the plaster cast figured by Sapunov (1971, pl. 1, fig. 5) and the original negative from which this cast was prepared. Its precise origin remains unknown, but it seems that this species might be expected both in beds referred to *W. laeviuscula* and *O. sauzei* zones in Bulgaria. Nothing can be added after description of this species given by Sapunov (1971, p. 80) since no significant material have appeared after that. Judging by their morphology, however, we can assume that *Bradfordia (Praeoppelia)* are the most likely ancestors of true *Oppelia* and we have indications for that from the lower parts of the *S. humphriesianum* Zone.

***Bradfordia (Bradfordia) inclusa* Buckman, 1910**
(Figs. 4.10–12)

Holotype: *Bradfordia inclusa* (Buckman, 1910, pl. 9, figs. 2, 3), from the "Building-Stone, presumably the top layer, post-*discitae* hemera", which probably corresponds to the top of the *ovale* Zone, at Stoke Knap (Dorset, SW England).

Material and record: two specimens [HME Inv.-Nrs. IMET I-47 (114) and IMET I-48 (188)], and two plaster casts of the example figured in Fig. 4.10 [GI-BAS Inv.-Nr. F.013153.c.1, 2]. Locality St. Iliya (Etropole), Etropole Formation (*O. sauzei* Zone).

Notes. Even being only a negative, this example is a valuable addition to the museum's collection as being hitherto an unknown specimen. It demonstrates that the range of *B. inclusa* remains problematic, since Bulgarian ammonites of this species reveal an *O. sauzei* Zone occurrence (Sapunov, 1971 and our data), whereas in the better-dated successions from elsewhere (e.g. in SW England, as documented by Chandler et al., 2006; Dietze et al., 2007; Dietze, Chandler, 2008) the species displays a mid-*W. laeviuscula* Zone abundance. We believe that this discrepancy is due to a later appearance and dispersal of *B. inclusa* in the Lower Bajocian strata in Bulgaria.

Genus *Protoecotraustes* Spath, 1928

***Protoecotraustes laevigatus* Sapunov, 1963**
(Fig. 3.12)

Holotype: *Protoecotraustes laevigatus* (Sapunov, 1963, pl. 1, figs. 1a, b), from the "Sowerbyi Zone" of the locality St. Iliya near Etropole (Bulgaria).

Material and record: two specimens [HME Inv.-Nrs. IMET I-47 (186) and E-30] and two plaster casts of the figured example [GI-BAS Inv.-Nr. F.013155.c.1, 2]. Unknown locality in the Etropole Formation near

Etropole.

Description. We assigned to this species defined by Sapunov (1963, p. 155) a negative of small, moderately evolute and compressed ammonite that displays both *Protoecotraustes* and *Lissoceras* morphology. Shallow umbilicus is bordered by nearly vertical umbilical walls and slightly rounded umbilical edge. Whorl sides are slightly convex and convergent to rounded ventrolateral shoulders. Inner whorls are smooth. The last whorl is one third occupied by the end of the phragmocone and two thirds by the body-chamber. Septate part of this whorl is gently ornamented by fine and weak sigmoid ribs that end with delicate ventrolateral clavi. The body-chamber is almost smooth and covered with hardly visible growth-lines with the same sigmoid outline as the ribs from before. The venter on the last whorl is tabulate. The illustrated negative presents a relatively long spatulate lappet attached to the aperture.

Notes. The HME specimen exhibits morphology, which is very similar to the most complete specimen from the type-series of this species figured by Sapunov (1963, pl. 1, fig. 2). However, it comes from an ammonite, which is more evolute and displays less raised ornament. Similar examples seem to be common in the fossil clusters from the beds of the Etropole Formation near the dam to the west of the town of Etropole that we referred to the *W. laeviuscula* Zone.

Family Stephanoceratidae Neumayr, 1875

Genus *Kumatostephanus* Buckman, 1922

***Kumatostephanus perjucundus* Buckman, 1927**

(Figs. 5.1–2)

Holotype: *Kumatostephanus perjucundus* nov. sp. (Buckman, 1927, Y.T.A. 6, pl. 712 a, b) from the *sauzei* Zone, Milborne Wick, Somerset (SW England). Chandler et al. (2013) treated the evolution of the genus *Kumatostephanus* and its relationships to the other stephanoceratids.

Material and record: seven specimens [HME Inv.-Nrs. IMET I-47 (32), IMET I-47 (126), IMET I-47 (135), IMET I-47 (143), IMET I-47 (160), IMET I-47 (167), IMET I-47 (181)] and 2 plaster casts of figured examples [GI-BAS Inv.-Nrs. F.013156.c, and F.013157.c]. Locality St. Iliya (Etropole), Etropole Formation (unspecified horizon of nodules referred to the *O. sauzei* Zone).

Description. The material underlying this account entirely consists of inner whorls preserved and complete coiling is unobservable. Large ammonites (more than 130 mm in diameter), whorls are evolute and whorl section is nearly sub-circular with approximately equal height and breadth. The outermost whorls are visible to the mid-whorl height and the ventral area is missing. Whorls do appear to become more compressed with less overlap with growth. The umbilicus is fairly deep and bordered by moderately steep umbilical walls, without separate umbilical edge. No traces of septate or suture-

lines are to be seen on any of the samples, but some of them are likely to include at least the initial segments of the body-chamber. The ornament is coarse throughout. The ribs are high, sharp and fairly widely spaced (about 14 per half whorl), straight to slightly prorsiradiate, most trifurcate at small mid-flank tubercles. Up to 55 mm in diameter, the umbilical seam just touches tubercles and the secondary ribs are not visible. Ribs flatten, attenuate and become farther apart at more than 100 mm in diameter.

Notes. This species is relatively common in the beds of stratotype of the Etropole Formation assigned to the *O. sauzei* Zone. It seems also that another *Kumatostephanus* species co-occur at this level and specimens available probably represent *K. kumaterus* Buckman, but this occurrence is random, and the ammonites are too fragmentary to be recognized. The latter species was certainly recorded in the rocks of the shallower facies of the Ponor-Kremikovtsi Jurassic (W Bulgaria), where it does occur in association with ammonites indicating an undivided interval including *W. laeviuscula* and *O. sauzei* zones. The type-section of the Etropole Formation have not provided such evidence, but yielded ammonites of higher occurrence from the lower part of the *S. humphriesianum* Zone that display a *Kumatostephanus* morphological features, but might be also referred to the genus *Stemmatoceras* (see Kamenov, 1936; Sapunov, 1961). These are also broadly-whorled ammonites, with the same coarse ornament as *Kumatostephanus*, but never attaining bigger sizes, and associate with rare *Stephanoceras* spp. ex. gr. *mutabile*, single *Germanites* and common *Itinsaites* faunas. The clustered *W. laeviuscula* Zone faunas from the beds near the dam to the west of the town of Etropole have been found to contain very small stephanoceratids that bear some resemblance with *Kumatostephanus* morphology. These ammonites are tuberculate, broadly whorled and coarsely-ribbed enough, but less than 25 mm in diameter, so they are not easily attributable to *Kumatostephanus*.

Genus *Skirroceras* Maseke, 1907

***Skirroceras leptogyrale* Buckman, 1924**

(Fig. 5.3)

Holotype: *Skirroceras leptogyrale* nov. sp. (Buckman, 1924, Y.T.A. 5, pl. 516), from "*sauzei* Zone, Standford Lane, Sherborne", Dorset (SW England).

Material and record: one specimen [HME Inv.-Nr. IMET I-43 (166)] and 4 plaster casts of the same example [GI-BAS Inv.-Nr. F.013158.c.1–4]. Locality St. Iliya (Etropole), Etropole Formation (*O. sauzei* Zone).

Description. The HME specimen consists of a negative of one-third of whorls, approximately 95 mm in diameter. It is extremely serpenticonic, with a very small overlap of the slender whorls and compressed whorl shape. The whorl height does appear to increase through growth, but whorl breadth is always less than

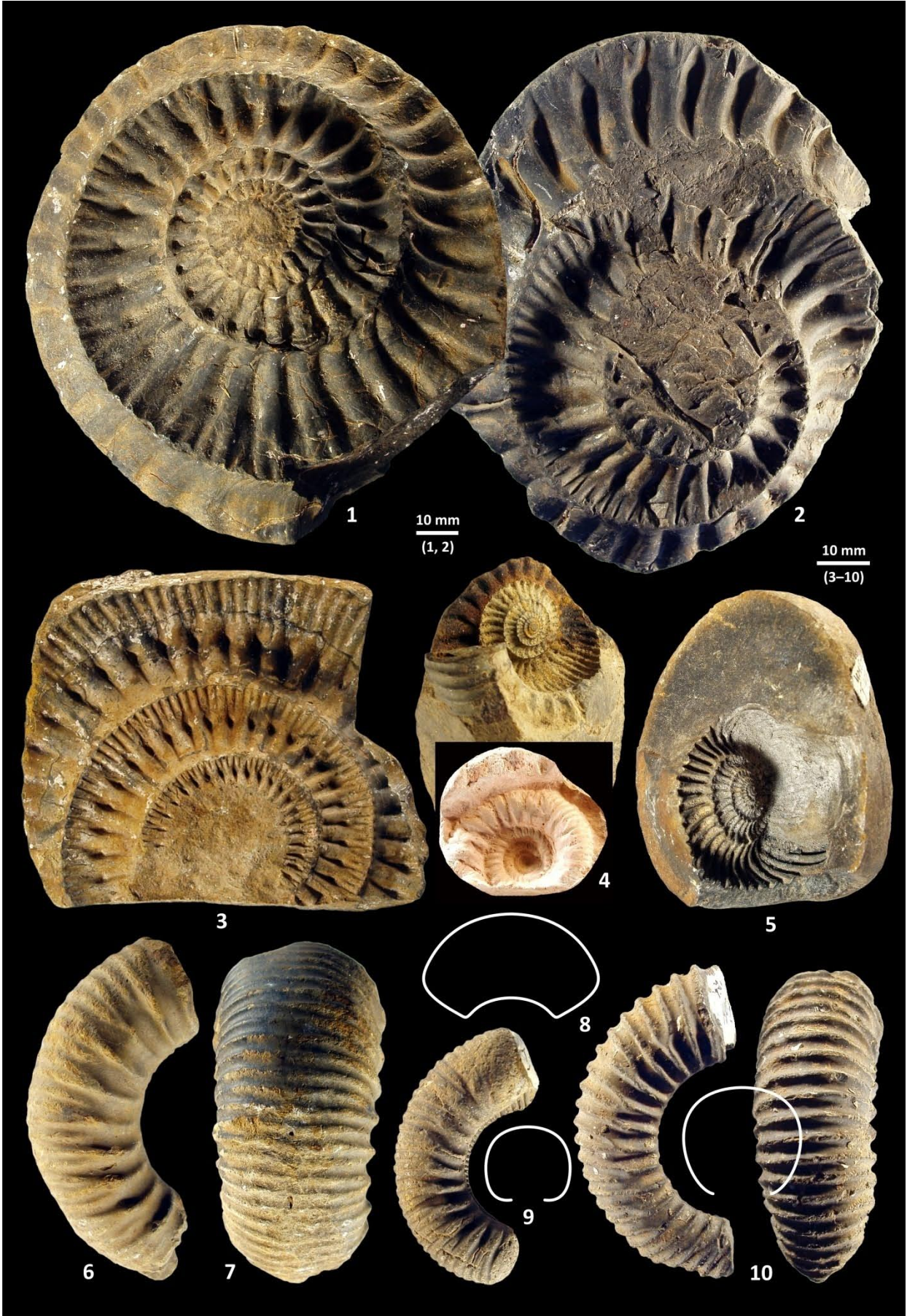




Fig. 5. Lower Bajocian Stephanoceratidae (collection of the Historical Museum in Etropole).

1. *Kumatostephanus perjucundus* Buckman, Inv.-Nr. IMET I-47 (160). Negative of compressed inner whorls and peri-umbilical area of unknown part of the body-chamber in phosphoritic concretion.
2. *Kumatostephanus* cf. *perjucundus* Buckman, Inv.-Nr. IMET I-47 (135) (ibid. 1).
3. *Skirroceras leptogyrale* Buckman, Inv.-Nr. IMET I-43 (166). Negative of compressed inner whorls and peri-umbilical area of unknown part of the body-chamber in sideritic concretion.
- 4, 5. *Teloceras?* cf. *subcoronatum* (Oppel). Negatives of phragmocones in sideritic concretions: 4 - view of specimen Inv.-Nr. IMET I-47 (171) and plaster cast (F.013159.c.₁), 5 - view of specimen Inv.-Nr. IMET I-47.
- 6–8. *Itinsaites rhomboidalis* Westermann, Inv.-Nr. IMET I-44 (2). A portion of an adult body-chamber: 6, 7 - side and ventral views, 8 - sectional view. Dimensions: *Wh*=23.0; *Wb*=33.0.
9. *Itinsaites latumbilicatus* (Westermann), Inv.-Nr. IMET I-44 (4). Side and sectional views of a whorl representing the end of the phragmocone. Dimensions: *Wh*=15.0; *Wb*=20.5.
10. *Itinsaites braikenridgii* (J. Sowerby), Inv.-Nr. IMET I-44 (3). Side view, ventral view and sectional view of an incomplete adult body-chamber. Dimensions: *Wh*=15.5; *Wb*=21.5.

the whorl height. The ornament is characterized by fine rib-density, including an average of about 24 rectiradiate primary ribs per half whorl that usually give rise to three straight secondaries, by small and fine lateral tubercles. Occasional intercalatory ribs also occur.

Notes. Previous records of *Skirroceras* species from the same level of stratotype of the Etropole Formation as *S. leptogyrale* were not supported by figured specimens, except that of Kamenov (1936, pl. 4, fig. 6), which was defined as "*Stephanoceras humphriesi*, Sow. sp. em. K. Weisert". The latter, however, we believe refers to the species that we describe. A few specimens listed as "*Stephanoceras* cf. *macrum*, Qu. sp. em. K. Weisert" and "*Stephanoceras* cf. *plicatissimum*, Quenstedt sp. em. Weisert" (Kamenov, 1936, p. 97) would be also possibly *Skirroceras* examples, but the ammonites on which they were identified are not available and thus unverifiable.

Genus *Teloceras* Mascke, 1907

Teloceras? cf. *subcoronatum* (Oppel, 1856)

(Figs. 5/4–5)

Holotype: *Ammonites coronatus oolithicus* (Quenstedt, 1886, pl. 67, fig. 8) from unspecified level of "Braunjura delta" at Himmelberg near Talheim (South Germany) (see Schlegelmilch, 1985, p. 77, pl. 27, fig. 3 – refigured holotype).

Material and record: two specimens [HME Inv.-Nrs. IMET I-47 and IMET I-47 (171)], and 2 plaster casts of the example given in Fig. 5.4 [GI-BAS Inv.-Nr. F.013159.c._{1, 2}]. Locality St. Iliya (Etropole), Etropole Formation (probably from the top of the *S. humphriesianum* Zone).

Description. Two incomplete negatives have been conditionally assigned to this species. Both represent small cadicones (approximately 50 mm in diameter), inflated whorls, small whorl height and whorl breadth

that is greatest near the umbilical edge, moderately wide and deep umbilicus, wide and arched venter. Whorls are ornamented throughout. Inner whorls (up to 13 mm diameter) are sculptured by thick but closely spaced prorsiradiate ribs (nearly 15 ribs per half whorl). The outer whorls, which are probably still being parts of the phragmocone, are covered by the same thick ribs that are, however, more distant and give rise to three or more secondaries. Every primary rib bears a thick tubercle located on the umbilical edge.

Notes. Kamenov (1936) and Sapunov (1961) recorded a few similar and coeval examples to the HME specimens as "*Stemmatoceras coronatum* Quenstedt", but it seems that these ammonites rather refer to and represent an earliest record of *Cadomites*, which is much more common in the Upper Bajocian and particularly in the Bathonian strata in Bulgaria. *Teloceras coronatum* (Schlotheim) does really occur at the top of the *S. humphriesianum* Zone in the stratotype of the Etropole Formation, but it differs from *T. subcoronatum* in reaching usually quite large size (more than 150 mm).

Genus *Itinsaites* McLearn, 1927

Notes. When proposed *Itinsaites* as a new generic name McLearn (1927, p. 73) was too concise, and in fact the generic diagnosis is nothing more than a comparison with another genus also defined by the same author (*Kanastephanus* n. gen., type-species *Kanastephanus crickmayri* n. sp., McLearn, 1927, p. 73, pl. 1, figs. 5, 6). Besides, the figure of *Itinsaites* type-species (*Itinsaites itinsae* n. sp., McLearn, 1927, pl. 1, fig. 7) is a ventral view that does not give a clear idea of the genus. Later on, Westermann (1954, p. 246) proposed an adequate generic diagnosis and figured the holotype of *I. itinsae* (ibid. pl. 26, figs. 5a, b). Westermann also spread *Itinsaites* over several older specific names that have laid down previously in the literature and argued that this is a widespread and distinctive genus ranging in the *S. humphriesianum* Zone. The same work treated

several other closely similar, possibly related and nearly coeval faunas to *Itinsaites*, including a number of new names proposed by Westermann himself, as being different genera or subgenera of the genus *Normannites*. It was the latter genus around which these ammonite faunas were merged into a new subfamily Normannitinae of the family Otoitidae (Westermann, 1954, p. 124). Shortly thereafter, *The Treatise* (Arkell et al., 1957, p. L289) placed all of these names in synonymy of the genus *Normannites* and considered them as evolute developments of the genus *Otoites*. Recently, Rulleau (2011) realigned this group into the family of Stephanoceratidae, clearly indicating, however, that the use of both the subfamily Normannitinae and its constituent genera might be relevant but remain questionable. In Bulgaria, these round-whorled, evolute and more or less depressed ammonites with characteristic wiry bifurcate ribs and stronger or weaker lateral tuberculation that occur in the *S. humphriesianum* Zone were traditionally referred to genus *Normannites* in which two species were recognized: *N. orbigny* Buckman and *N. braikenridgii* (Sowerby) (Kamenov, 1936; Sapunov, 1961; Sapunov, Stephanov, 1964). The stratotype section of the Etropole Formation was the main sequence that yielded common examples of these faunas and the museum collection in Etropole also includes several specimens. However, the latter display ribbing style and coiling that do appear to be dissimilar to those in *Normannites* s.s. The bulk of the material conforms in morphology to the emended diagnosis of the genus *Itinsaites* (Westermann, 1954) and single specimen was assigned to the genus *Germanites*. We consider that *Itinsaites* arise as more involute and depressed variants with less marked (rudimentary) mid-flank tuberculation prior to *Normannites* s.s., near the base of the *S. humphriesianum* Zone. *Germanites* seems to be approximately coeval with *Itinsaites* and similar, but differs in having more rounded (almost circular) whorls and less raised ornament, and probably represents another pre-*Normannites* development. A number of other specimens from the Etropole area apart from the Etropole Museum collection need to be noted in this context. These are kept in the materials associated with the works of Sapunov (1961), Kamenov (1936) and probably of Zlatarski (1908), which are stored at the University of Sofia but which have lost labels and would hardly be connected with certain taxa listed by these authors. We note among them a few specimens from the *O. sauzei* Zone that display both *Otoites*- and *Normannites*-like morphology. These ammonites are more evolute and depressed than *Normannites* s.s., having relocated spinose tubercles towards the ventrolateral area and triple secondaries or frequent intercalatory ribs, characteristically developed on the venter. These ammonites are good *Epalxites* matches. A few other similar specimens tending, however, cadicone with sharpen and more distant prorsiradiate ribbing we believe to be examples of *Gerzenites* and *Platystomites*.

Clearly, such suggestions require a new fossil hunting in the framework of better stratigraphic assessment than that attained so far. The same applies to the record of *N. orbigny* Buckman in Bulgaria, but it remains to be evaluated elsewhere.

***Itinsaites rhomboidalis* Westermann, 1954**

(Figs. 4.16–17; Figs. 5.6–8)

Holotype: *Itinsaites rhomboidalis* n. sp. (Westermann, 1954, p. 288, pl. 27, figs. 2a, b) from "Coronaten-Schichten" (=Mitt.-Bajocien) at Goslar, Braunschweig, Lower Saxony (N Germany).

Material and record: two specimens [HME Inv.-Nrs. IMET I-44, IMET I-44 (2)] and one plaster cast of specimen displayed in Figs. 5.6–8 [GI-BAS Inv.-Nr. F.013161.c]. Locality St. Iliya (Etropole), Etropole Formation (*S. humphriesianum* Zone).

Description. The HME material consists of fragmentary adult body-chambers of medium-sized and evolute ammonites (probably reaching a diameter of around 80 mm), having rounded and depressed whorls with whorl height/breadth ratio of 0.7 to 0.8 and a broad venter. The ornament exhibits a moderate sharpness and rib-density. It is based on mainly trifurcate ribs, which include relatively long and slightly prorsiradiate primaries that give rise in blunt nodes to secondaries of the same trajectory. An interesting feature seen in specimens available is the nature of the secondary ribbing as it crosses the venter where a shallow central band disrupts and slightly flexes backwards the ribs.

Notes. Even not complete, the HME examples conform in whorl ratio and ribbing style to the holotype, which is, however, wholly-septate and does not contain preserved body-chamber. More complete but smaller specimen of the same age, from the Iberian Cordillera, was described and figured by Fernández-López (1985, p. 313, pl. 34, fig. 7). *I. rhomboidalis* is the least compressed and evolute *Itinsaites* species from the collection kept in the Museum of Etropole.

***Itinsaites latumbilicatus* (Westermann, 1954)**

(Fig. 5.9)

Holotype: *Normannites (Normannites) latumbilicatus* n. sp. (Westermann, 1954, p. 192, pl. 13, figs. 3a, b) from an unrecorded level of locality near Hannover (Lower Saxony), Northern Germany.

Material and record: one specimen [HME Inv.-Nr. IMET I-44 (4)] and one plaster cast [GI-BAS Inv.-Nr. F.013162.c]. Locality St. Iliya (Etropole), Etropole Formation (*S. humphriesianum* Zone).

Description. Small fragment of an evolute ammonite, probably representing the last third portion of the phragmocone at whorl height of about 15 mm, which must have been at about 50 mm diameter. Whorl shape is slightly depressed (*Wh/Wb* ratio is 0.86), rounded, with a maximum width around the middle of the sides and having a broad venter. Although not being too

lengthened, the whorl can be seen to become rapidly more compressed towards the aperture. Rib-density and relief are moderate. Three secondaries issue from mid-flank nodes, each developed on short and relatively thick prorsiradiate primary ribs. Rib projection changes on the ventral half of the sides where secondary ribs gently bend backwards.

Notes. We identified the only existing fragment of the museum collection based on the bundled and flexuous ribbing, which is very characteristic of this species. Besides, our example exhibits the same sub-circular whorl shape in which the whorl breadth is slightly bigger than the height. This species seems to comprise small individuals that generally do not exceed 55 mm in diameter. Westermann (1954) defined two subspecies in *Normannites (N.) latumbilicatus*. The HME specimen does appear to be an exact match of the same part of the phragmocone of both the holotype of *N. (N.) latumbilicatus latumbilicatus* and the holotype of *N. (N.) latumbilicatus bentzi* (Westermann, 1954, pl. 13, figs. 5a–c). Westermann argued in detail distinction of these subspecies, but we believe they do not show significant variations in whorl proportions and large variation in the rib-density. Hence, the subspecies distinction perhaps does not go beyond the local relevance. The problem remaining is stratigraphic occurrence and dispersal of this species, as both the original specimens studied by Westermann and the HME example are not accurately dated and no data exist from elsewhere. The Bulgarian specimen possibly has a stratigraphic position not exceeding the middle part of the *S. humphriesianum* Zone. We attributed the species name "*latumbilicatus*" from *Normannites* to *Itinsaites* as we believe that it is an earlier form preceding and differing from *Normannites s.s.* as noted above.

***Itinsaites braikenridgii* (Sowerby, 1818)**

(Figs. 5.10, 6.1–2)

Holotype: *Ammonites braikenridgii* Sowerby, 1818 (Buckman, 1914, Y.T.A. 2, pl. 71, figs. 1, 2, pl. 71*, figs. 1–3 – cleaned specimen; Westermann, 1954, pl. 9, figs. 1a–c – refigured holotype) from "*sauzei* Zone, near Dundry, Somerset" (SW England).

Material and record: four specimens [HME Inv.-Nrs. IMET I-44 (3), IMET I-56 (158), IMET I-43 (168), and IMET I-43 (173)] and 3 plaster casts corresponding to the first three of these samples [GI-BAS Inv.-Nrs. F.013163.c, F.013164.c and F.013165.c]. Locality St. Iliya (Etropole), Etropole Formation (*S. humphriesianum* Zone).

Description. Small and evolute ammonites in which the U/D ratio is ranging from 0.45 to 0.48. The rounded whorl section varies between square and moderately depressed (*Wh/D* ratio is between 0.32 and 0.35, and the *Wb/D* varies from 0.35 to 0.41), but always having a *Wh/Wb* ratio more than 0.84. The shallow umbilicus is bordered by slope umbilical walls without umbilical edge. Ventrolateral shoulder merges smoothly into a

broad and low-rounded venter. The ornament is sharp and moderately dense, and comprises straight to prorsiradiate primary ribs that bifurcate at small nodes, and form slightly forwardly projected secondary ribs on the venter. Single annular ribs with forwards inclination also occur.

Notes. There are no significant differences in whorl proportions and ribbing style between the HME examples and the specimen exemplified by the holotype of *Normannites (N.) braikenridgii ventriplanus* (Westermann, 1954, p. 168, pl. 9, figs. 4a–c) that was proposed as more coarsely ribbed and ventrally flattened subspecies of *N. (N.) braikenridgii* (Sowerby). *Normannites (N.) braikenridgii ventriplanus* is less compressed, more evolute and displays higher relief of the ornament and lower rib-density than *N. (N.) braikenridgii*, but these morphological differences vary in a too narrow range. Therefore, there is no doubt that the subspecies names reflect no more than minor variations within the same species. It seems that this species is relatively common in Bulgaria (e.g. Kamenov, 1936; Sapunov, 1961) but we cannot date it more accurately than *S. humphriesianum* Zone. When figured Sowerby's cleaned original, Buckman assigned it to the *O. sauzei* Zone. Bulgarian examples clearly revealed a much higher stratigraphic position than the topmost occurrence of *Otoites* in the type-section of the Etropole Formation. Perhaps they have similar dispersal as that recorded by Dietze et al. (2013) in Southwest Germany, which is higher than the range of the genus *Dorsetensia* in the Etropole Formation (i.e. approximately in the mid-*S. humphriesianum* Zone). The latter, however, does not seem enough this species to be assigned to *Normannites*. We assume *Itinsaites braikenridgii* to be foregoing forms that gave rise to *Normannites* two-thirds of the way up the *S. humphriesianum* Zone, with discernible change in morphology involving the development of distinct mid-flank tuberculation, more compressed and more evolute whorls and a size increase. Although not being firm, the evidence from Bulgaria indicate a coinciding range of *Normannites* (that of *N. orbignyi*) with the commonest occurrence of *Teloceras*, which is the top of the *S. humphriesianum* Zone. This distinction claims to be recognized though.

Genus *Germanites* Westermann, 1954

***Germanites latus* Westermann, 1954**

(Figs. 4.13–15)

Holotype: *Germanites latus* n. sp. (Westermann, 1954, p. 327, pl. 30, figs. 6a, b) from "*romani-(complanata)-* Schichten" at Gerzen, near Alfeld, Hannover (Lower Saxony), Northern Germany. Rulleau (2011, pl. 51, figs. 1a, b) refigured the holotype.

Material and record: one specimen [HME Inv.-Nr. IMET I-44 (179)] and one plaster cast [GI-BAS Inv.-Nr. F.013166.c]. Locality St. Iliya (Etropole), Etropole

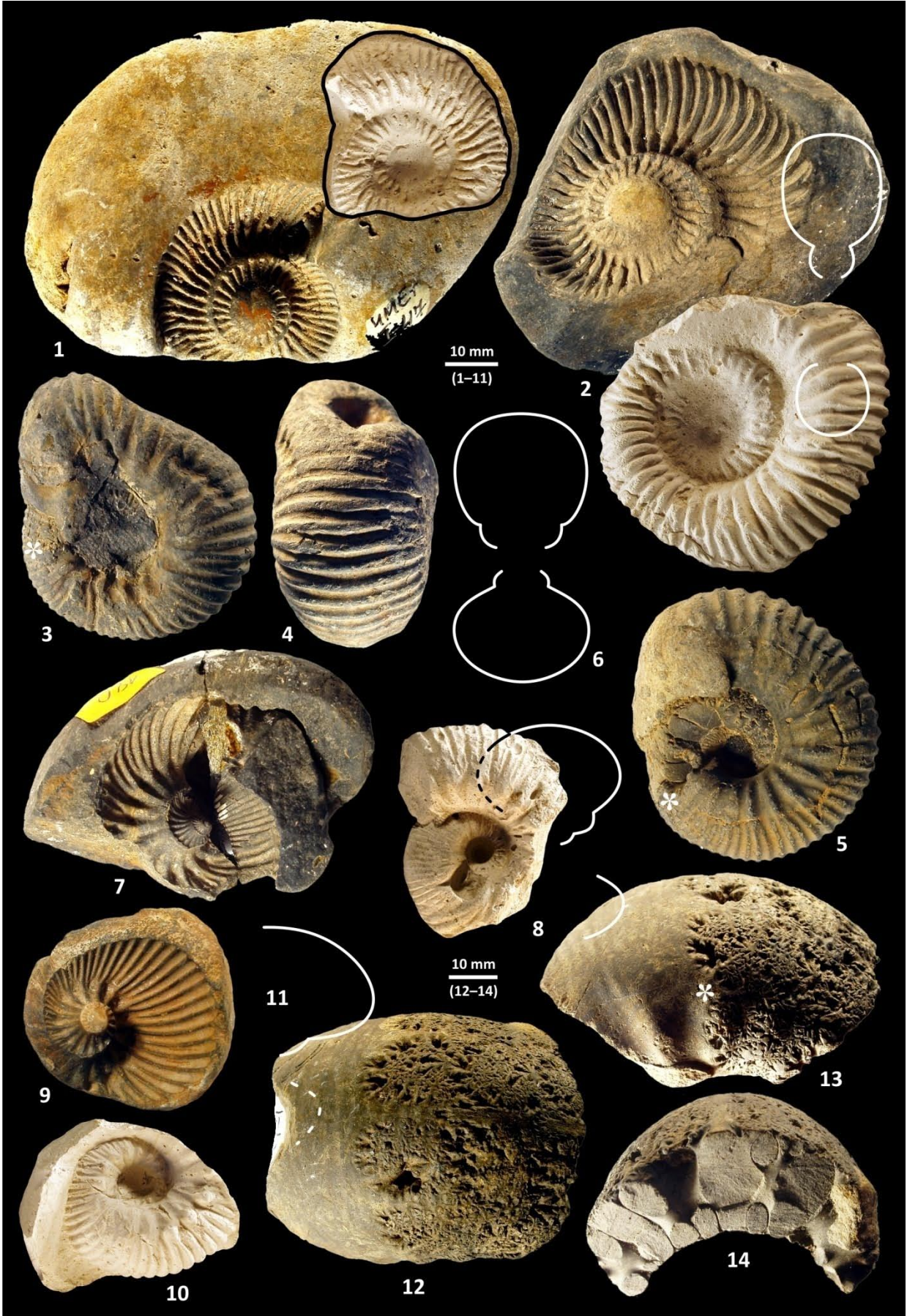




Fig. 6. Lower Bajocian Stephanoceratidae and Otoitidae (collection of the Historical Museum in Etropole).

1. *Itinsaites braikenridgii* (J. Sowerby), Inv.-Nrs. IMET I-56 (158) and F.013164.c. Negative of a wholly-septate in sideritic nodule with attached photo of plaster cast. Dimensions: $D=34.5$; $Wh=11.0$ (0.32); $Wb=12.0$ (0.35); $U=16.4$ (0.48).
2. *Itinsaites braikenridgii* (J. Sowerby), Inv.-Nrs. IMET I-43 (168) and F.013165.c. Negative of specimen with unknown part of the body-chamber in sideritic concretion, arranged with plaster cast and sectional view as seen on the cast. Dimensions: $D=55.0$; $Wh=19.0$ (0.35); $Wb=22.5$ (0.41); $U=25.0$ (0.45).
- 3, 4. *Otoites contractus* (Sowerby), Inv.-Nr. IMET I-49. Side and ventral views of phosphatized internal mould with altered aperture. Dimensions: $D=51.0$; $Wh=21.0$ (0.41); $Wb=23.8$ (0.47); $U=17.0$ (0.33).
- 5, 6. *Otoites douvillei* Parsons, Inv.-Nr. IMET I-49 (184). Side and sectional views of phosphatized internal mould of an adult specimen without aperture preserved. Dimensions: $D=54.0$; $Wh=22.0$ (0.41); $Wb=29.0$ (0.54); $U=17.0$ (0.31).
- 7, 8. *Otoites tumulosus* Westermann, Inv.-Nr. IMET I-46 (183): 7 - negative of phragmocone in phosphoritic nodule, 8 - plaster cast (Inv.-Nr. F.013169.c.) and sectional view on the cast of the same negative. Dimensions: $D=39.0$; $Wh=14.0$ (0.36); $Wb=23.0$ (0.59); $U=11.6$ (0.30).
- 9–11. *Otoites tumulosus* Westermann, Inv.-Nr. IMET I-47 (180): 9 - negative of phragmocone in sideritic nodule, 10, 11 - plaster cast (F.013170.c) and sectional view on the cast of the same negative. Dimensions: $D=39.0$; $Wh=15.5$ (0.40); $Wb=28.0$ (0.72); $U=10.8$ (0.28).
- 12–14. *Emileia brocchii* (J. Sowerby), Inv.-Nr. IMET I-47 (164). Side view, ventral view and sectional view of an internal mould of the last portion of phragmocone and beginning of body-chamber. Dimensions: $Wh=29.5$; $Wb=59.0$.

Formation (*S. humphriesianum* Zone).

Description. Evolute planulate ($U/D=0.42$), whorl section is rounded, nearly circular, but slightly wider than high (the Wh/D ratio is 0.32, whereas Wb/D ratio is 0.38). The specimen available consists of half preserved four whorls, probably referring to the phragmocone, in which an increasing compression of the whorl section is clearly visible. The ribs are sharp and relatively dense, radial to slightly convex, mainly bifurcate at the umbilical portion of the whorl sides, but occasional single and intercalary ribs also occur.

Notes. The HME specimen agrees in whorl proportions, whorl shape and style of ribbing with the holotype but it is incomplete and displays slightly less rib-density. This is the unique record of this genus in Bulgaria and no other determinable specimens were obtained.

Family Otoitidae Mascke, 1907

Genus *Otoites* Mascke, 1907

***Otoites contractus* (Sowerby, 1825)**

(Figs. 6.3–4)

Neotype: *Otoites contractus*, J. de C. Sowerby (Buckman, 1920, Y.T.A. 3, pl. 158) (neotype designation by Westermann, 1954, p. 89, pl. 1, figs. 4a–c – refigured neotype) from "sauzei Zone, near Sherborne, Dorset" (SW England).

Material and record: one specimen [HME Inv.-Nr. IMET I-49] and one plaster cast [GI-BAS Inv.-Nr. F.013167.c]. Locality St. Iliya (Etropole), Etropole

Formation (*O. sauzei* Zone).

Description. Small and tightly coiled ammonite with moderately closed and occluded umbilicus (the U/D ratio is 0.33). Whorl section is sub-oval with whorl breadth slightly exceeding the whorl height (the Wb/D and Wh/D ratios are 0.41 and 0.47, respectively) and wide venter. The inner whorls are not visible. The last preserved whorl corresponds almost entirely to the body-chamber, but the aperture is not preserved. Ribs are coarse with short and slightly curved, initially rursiradial but gradually forwardly inclining primaries (16 per whorl), and long (usually three) prorsiradial secondaries that spring from low lateral tubercles.

Notes. The HME specimen appears to be broken in the whorl contraction at the end of the body-chamber so that the long characteristic *O. contractus* lappets are not preserved. However, we believe it represents a good example of this species, and those characters that can be seen agree with the neotype (Westermann, 1954, pl. 1, figs. 4a–c). We guess it was found with *S. propinquans*, already described in this study, which means that *O. contractus* is located stratigraphically in the lower part of the *O. sauzei* Zone. We cannot judge whether it is coeval with *O. douvillei*, however, according to the position of *O. tumulosus* from our collection that clearly came from the lowest possible levels of the *O. sauzei* Zone, both *O. contractus* and *O. douvillei* must have a higher occurrence than *O. tumulosus*.

***Otoites douvillei* Parsons, 1977**

(Figs. 6.5–6)

Holotype: *Emileia (Otoites) douvillei* (Parsons, 1977, p. 103, pl. 17, figs. 6a, b) from the "ovalis Subzone of the *laeviuscula* Zone", Dundry Hill (Avon, SW England).

Material and record: one specimen [HME Inv.-Nr. IMET I-49 (184)] and one plaster cast [GI-BAS Inv.-Nr. F.013168.c]. Locality St. Iliya (Etropole), Etropole Formation (base of the *O. sauzei* Zone).

Description. Small ammonite, cadicone at first, then with a rapid uncoiling of the umbilical seam and expanding whorl section. Body-chamber extends for more than three-quarters of the last whorl, without preserved mouth-border. The specimen displays at maximum diameter of 54 mm, a whorl height/width ratio amounting to 0.76, whereas at the end of the phragmocone ($D=49$ mm), this ratio is 0.5. Inner whorls are leached, with poorly preserved ornament. The body-chamber bears fourteen short and sharp prorsiradiate primary ribs, each carrying blunt nodes, which give rise to three or four long secondaries that feebly bend forwards on the wide venter. Primary ribs tend to become weaker at the last third of the body-chamber where the secondary ribs are reduced to two per primary.

Notes. The HME specimen is assigned here to *Otoites* because of the rib-style and the presence of highly ornamented body-chamber that becomes rapidly growing towards the aperture. Its morphology is so close to that of the holotype, that there is no doubt, these specimens refer to as a single species, even though the age difference between them is considerable (i.e. basal *W. laeviuscula* Zone and basal *O. sauzei* Zone). In fact, Bulgarian example has only bigger size than the holotype. Hence, we believe these two specimens are conspecific, and therefore we consider that this species might have a longer range than that originally given by Parsons (1977).

***Otoites tumulosus* Westermann, 1954**

(Figs. 6.7–11)

Holotype: *Otoites tumulosus* n. sp. (Westermann, 1954, p. 119, pl. 5, figs. 1a, b) from "*sauzei* Zone, near Dundry, Somerset" (SW England). Another paratype from the same locality and age was also described and figured by Westermann (1954, p. 119, pl. 5, fig. 2).

Material and record: three specimens [HME Inv.-Nrs. IMET I-46 (183), IMET I-47 (150) and IMET I-47 (180)] and two plaster casts of figured specimens [GI-BAS Inv.-Nrs. F.013169.c and F.013170.c]. Locality St. Iliya (Etropole), Etropole Formation (from the very base of the *O. sauzei* Zone).

Description. This species is based on negatives of involute whorls with a deep and narrow, but open umbilicus (the U/D ratio varies between 0.28 and 0.30). The innermost whorls are depressed, whilst the last half whorls exhibit a more rounded whorl section, with a whorl height/width ratio from 0.55 to 0.61. The ribbing is sharp, bundled and well marked, and tends to become more distant with growth. The primary ribs are thick

and enclosing almost radially the umbilicus, and divide just below the whorl shoulder by well pronounced and acute tubercles into three secondaries. Ribbing below 25 mm includes intercalary ribs that evenly occur between the bundles.

Notes. Like the holotype, the HME ammonites are coarse-ribbed small cadicones to sphaerocones retaining its long secondary ribs to the end of the coiling. Interestingly, the specimen displayed in Figs. 6.7–8 agrees very well by its denser ornament and slightly less depressed whorls with the paratype given by Westermann (1954, pl. 5, fig. 2), whereas the specimen in Figs. 6.9–11 matches the holotype (Westermann, 1954, pl. 5, fig. 1). Similar form with similar age from the Swabian Alb was illustrated by Dietze et al. (2008, pl. 2, fig. 1). Also similar but older in age is the example of *O. tumulosus* from Wutach area (SW Germany) (Dietze et al., 2010, p. 77, pl. 3, figs. 3, 4). *O. tumulosus* is more involute with stouter whorls and coarser ornament than *O. contractus*. The HME specimens are from the same level with *Otoites* aff. *compressus* (see Westermann, 1954, pl. 3, figs. 7a, b; pl. 4, fig. 6) and *Otoites dilatatus* (ibid. pl. 4, figs. 1a–c). The former species has quite recently been found in an interesting ammonite from the locality St. Iliya. From the latter species, we have only a plaster cast and the original specimen is now lost. That have led *O. compressus* and *O. dilatatus* not be described and figured herein, but we should note these very distinctive forms. *O. compressus* has nearly similar inflated whorls, whorl proportions and ornament to *O. tumulosus*, but it differs in more opened umbilicus, finer, denser and flexuous ribbing (especially in early growth stages), as well as in having sharpen primary ribs and less marked tuberculation. *O. dilatatus* has much bigger size, much coarser ornament and broader whorls than *O. tumulosus*. We take into account these two species as they appear to be the oldest record of the genus *Otoites* both in the Etropole area and in Bulgaria. Besides, the specimen conventionally attributed to *O. compressus* bears some resemblance in morphology with *Frogdenites extensus* (Buckman) (holotype and a few good examples were described in detail and figured very recently by Sandoval, Chandler, 2015) as being much more depressed than is usual for *Otoites*. The latter fact may reflect a simple case of *Frogdenites-Otoites* homoeomorphy but might also suggests a possible deeper link between these two genera.

Genus *Emileia* Buckman, 1898

***Emileia brocchii* (J. Sowerby, 1818)**

(Figs. 6.12–14)

Lectotype: *Ammonites brocchii* J. Sowerby, 1818 (Buckman, 1908, pl. 4, figs. 1a–c – figuration of the lectotype; Buckman, 1927, Y.T.A. 6, pl. 710A, B – refiguration of the lectotype; Rulleau, 2011, pl. 31, figs. 1a–c – a reproduction of Buckman's plate from 1908) from "near the boundary of the *Laeviuscula* and *Sauzei*

zones, Sherborne, Dorset" (Dietze, Chandler, 2008, p. 175, pl. 1, figs. 1a–c – photographic figuration of the lectotype).

Material and record: one specimen [HME Inv.-Nr. IMET I-47 (164)] and one plaster cast [GI-BAS Inv.-Nr. F.013172.c]. Locality St. Iliya (Etropole), Etropole Formation (*O. sauzei* Zone).

Description. The single HME specimen consists of nearly a quarter of large inflated whorl ($Wh=29.5$, $Wb=59.0$, $Wh/Wb=0.5$), corresponding to approximately 90 mm diameter and including the end of the phragmocone as well as the very beginning of the body-chamber. This is a cadicone fragment, having moderately strong ornament of several swollen peri-umbilical primaries, which divide into four or more, finer and obscure secondaries. The last three suture-lines are observable. These are too complex and so crowded, and become so close together that they deeply interfere each other. Although the suture-lines are difficult to delineate, it seems that they are composed of a deep ventral lobe bordering a long and narrow ventral saddle, broad and high 1st and 2nd lateral saddles that are highly incised and ornate by many accessory lobes, as well as a big suspensive lobe, which has at least 6 auxiliary saddles.

Notes. Despite being a fragment, the illustrated example completely conforms to the lectotype when compare these specimens at similar whorl heights/whorl breadths. This specimen was found in beds lying below the level with *Sonninia propinquans*. This is exactly the same level from which *Otoites douvillei* was found (i.e. at least the base of the *O. sauzei* Zone). *Emileia brocchii* has already been reported from the Etropole area as "*Sphaeroceras* cf. *brocchii*, Sow." (Kamenov, 1936), and "*Emileia brochi* (Sowerby)" (Sapunov, 1961); both records might have meant this species. However, the ammonites available from those authors correspond to small specimens, enclosing inner whorls that do not exceed 50 mm diameter, so it is difficult to say whether they indeed refer to this species. In fact, apart from a few examples, the bulk of the known Bulgarian faunas assigned to the genus *Emileia* until now consist of incomplete phragmocones without attached body-chambers. Hence, when meaning *Emileia* has appeared in previous accounts, this applied to such specimens. Among the few exceptions is the nice example of *Emileia polyschides* recorded from the Etropole area (Kamenov, 1936, p. 111, pl. 4, fig. 1), which differs from our *E. brocchii* by higher and more compressed whorls, a narrower venter, sharpen and more distant primary ribs. We should note also that the older Bulgarian Bajocian literature often contains citations of *Emileia*'s species referred to the genus *Sphaeroceras* and vice versa. The same applies to the genera *Emileia* and *Otoites*. Indeed, in many respects *Emileia* and *Sphaeroceras* strongly resemble each other, but as stated by Parsons (2004), *Sphaeroceras* include notably small ammonites with occluded umbilicus that occur stratigraphically much higher than *Emileia*. In most of

the Bulgarian *Otoites* and *Emileia* record, due to lack of enough material, it is not possible to separate dimorphic counterparts and to assess what is the stratigraphic development of these morphologies as done elsewhere (e.g. Parsons, 1977; Rioult et al., 1997; Rulleau, 2011). Therefore, separate generic names have been retained for these faunas.

CONCLUSIONS

The Historical Museum in Etropole lodges a small but valuable collection of Lower Bajocian ammonites, which have been found in nearby exposures. The aim of this paper is to describe and illustrate the best preserved and the most interesting specimens. Accordingly, this account includes taxonomic descriptions and biostratigraphic comments on twenty five ammonite species from eighteen Lower Bajocian genera, referred to the ammonite families Sonniniidae, Oppeliidae, Stephanoceratidae and Otoitidae. Most of them were not described or figured before. In this way, we would like to remind that the older available collections have fallen into oblivion and require a major overhaul. The accent now is on the recapitulative revision rather than on full taxonomic analysis of the characteristic faunal elements, since the latter is a large task that will take a lot of time. Even not being purposefully collected, the ammonites kept in the Historical Museum in Etropole are good enough to constitute guide fossils for the Lower Bajocian ammonite spectrum not only in the Etropole area, but also in Bulgaria. Hence, we provide new taxonomic and biostratigraphic evidence of an interval from the *Hyperlioceras discites* to the *Stephanoceras humphriesianum* zones. However, it became evident that the ammonite zones that our specimens were assigned to, do not have adequate defining criteria yet. Significant refinement of the scheme for the biostratigraphic classification of the type-section of the Etropole Formation but also for the Lower Bajocian strata in Bulgaria has become necessary. Nevertheless, the ammonites from the stratotype of the Etropole Formation, including those from the Museum in Etropole, appear to be good examples of widespread species, which are well-known from many coeval deposits in Northwest Europe, and can therefore be used for the purposes of comparison and correlation.

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