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New records of ammonites from the Lower Bajocian (Middle Jurassic) of England and Italy

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ABSTRACT

The rare ammonite genus *Bajocia* is reported, as *Bajocia farcyi* Brasil, for the first time from the Middle Jurassic, Lower Bajocian Humphriesianum Zone, Romani Subzone of Dorset, UK. *Bajocia paiardinii* Chandler and Cresta sp. nov. is erected from the Humphriesianum Zone, uppermost Romani or lowest Humphriesianum Subzone of Monte Nerone, Apennines, Italy. The taxonomic and stratigraphical position of the genus is considered and possible evolutionary routes are suggested. The genus is likely to have evolved in the Tethys–Panthalassa Realm or southern Mediterranean–Caucasian Subrealm. Leptosphinctids, the earliest Perisphinctidae probably originated from Western Tethyan Stephanoceratidae.

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1. Introduction

The Inferior Oolite Group (Middle Jurassic, Aalenian, Bajocian and lowest Bathonian stages) of southern Britain consists of a series of limestones deposited in a sediment-starved area of a shallow shelf sea. In early Mid Jurassic times Dorset lays at the western end of the Tethys Ocean and there is evidence for the existence of a 'Hispanic Corridor' linking Europe with the eastern Pacific (e.g., Westermann, 1984; Taylor et al., 1984; Sandoval and Westermann, 1986; Sadki and Mouterde, 1994; Pavia, 2000; Sandoval et al., 2012). The composition of the Dorset fauna in the Aalenian and Lower Bajocian reflects that of the extra-Alpine, North-West European Province (Callomon and Chandler, 1994), but sometimes includes the rare occurrence of ammonite species known far more abundantly in the Mediterranean and Eastern Pacific. The palaeolatitude of Dorset was approximately 30° north, at the southern margin of extra-Tethyan Britain, an area close to the division of bioprovincialism between southern Britain and Tethys. Periodically one or other region had influence resulting in the two-way dispersal of exotic taxa.

The strata of the Toarcian–Bajocian Pelagic Carbonate Platform of the Umbro-Marchean Apennines of the Monte Nerone area, Italy

(Cecca et al., 1990; Santantonio, 1994) constitute part of the western Tethys outcropping limestones of the Bugarone Inferiore Formation (Upper Toarcian–Lower Bajocian). Strata above the Humphriesianum Zone of the Lower Bajocian at all locations in the region are cut out by a hiatus with Kimmeridgian–Tithonian rocks above (Bugarone Superiore Formation), therefore the remainder of the Jurassic sequence apart from the uppermost part is absent.

In the Monte Nerone region (Fig. 1) detailed ammonite biostratigraphical studies have been conducted that have enabled the establishment of a biohorizon scheme with 30 'first occurrence biohorizons' distinguished for the Toarcian–Lower Bajocian (Cresta et al., 1995). In Dorset (Fig. 2) for the Aalenian–Bajocian, detailed biostratigraphical studies have established 64 biohorizons of which 32 are recognised in the Lower Bajocian, with a total of 13 zones and 32 subzones for both stages. Of interest herein is the Humphriesianum Zone of both areas, where nine biohorizons are recognised in Dorset (Chandler, 2024) and two from 13 beds over 1.25 m of strata at Monte Nerone. The zonal scheme (Fig. 3) for the Sauzei and Humphriesianum zones is used for both areas, however the established biohorizons are those of Dorset. The morphospecies identified at Pian del Sasso, Monte Nerone area are shown next to the stratigraphical section (Fig. 4).

A recent (September 2024) examination of the collections of Lower Bajocian ammonites at the Museo Geo-paleontologico at Piobbico from the Monte Nerone region revealed a high degree of

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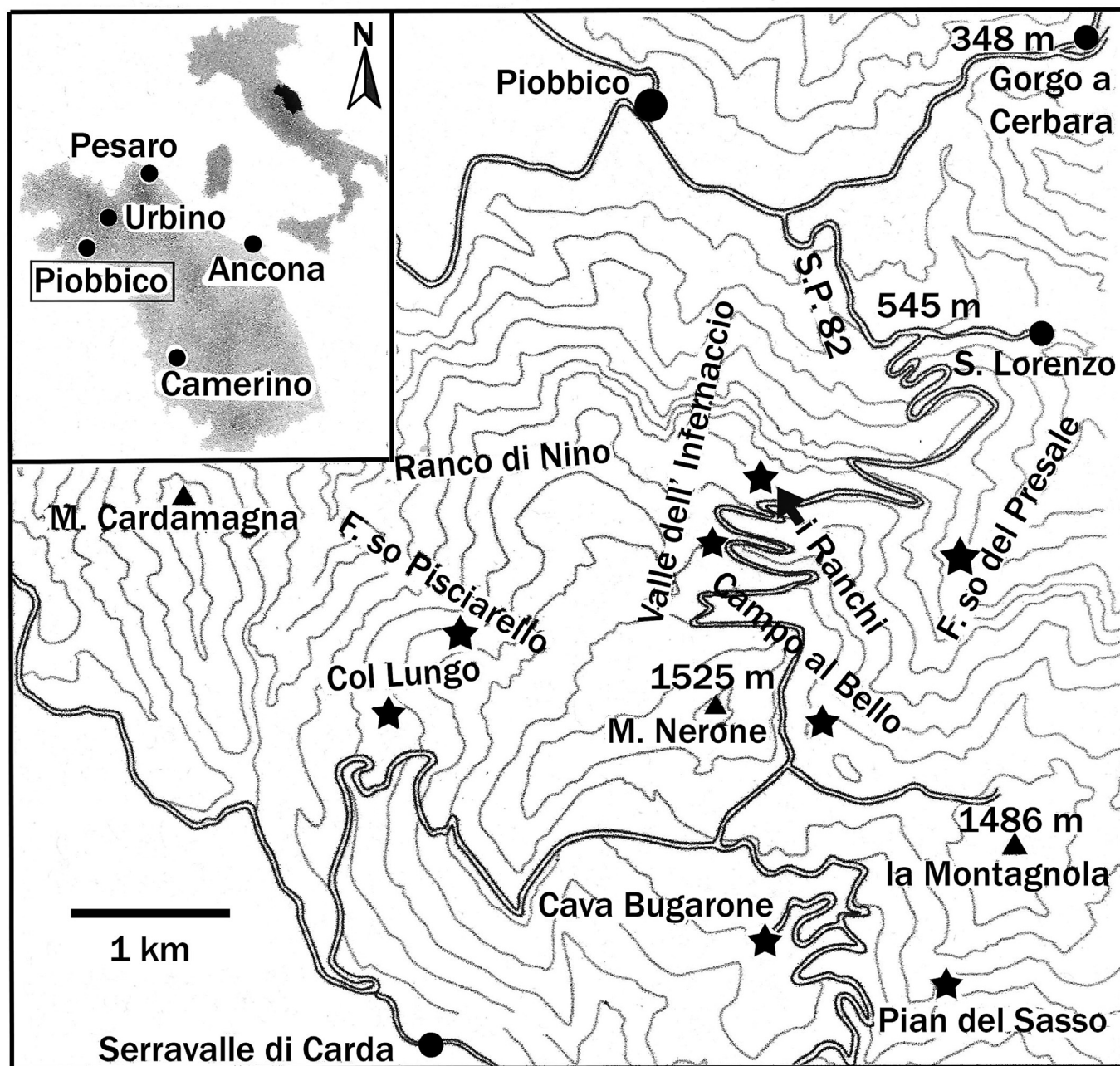


Fig. 1. Location map of Monte Nerone area; black stars indicate the sampled outcrops of Bugarone Inferiore Formation (Cresta et al., 1995). The inset shows that region and its position in respect to Italy.

similarity between the stephanoceratid ammonite assemblages (biohorizons labelled XXIV–XXIX of Cresta et al., 1995) of the lower Humphriesianum Zone of Monte Nerone and those established in Dorset (Chandler, 2024), apart from the high percentages of phylloceratids (around 30–40 %) that are very rare in Britain and the absence of some key taxa of the Romani Subzone from Monte Nerone. Examination of the collection from Pian del Sasso (Cresta et al., 1995, p. 136) has provided a fauna that ranges in age from the Sauzei to Humphriesianum zones. The section is shown in Figure 4 and illustrated in Figure 5. The focus herein is on two specimens recorded from Bed 7 of Pian del Sasso that we attributed to the genus *Bajocia* Brasil, 1895; they appear to be unrecorded in the literature and are described below as a new species. We also report and figure two examples of the genus *Bajocia* from the lower Humphriesianum Subzone of Milborne Wick, Dorset (Fig. 6). To the authors' knowledge the genus has not been hitherto reported from

Britain and in the case of the two specimens in question they have been collected from a single biohorizon, *in situ*, and thus have stratigraphical provenance.

2. Stratigraphical details

In South-west England, the strata of the Inferior Oolite Group of Dorset and Somerset are ferruginous, iron oolitic limestones, very thin, often rich in fossils, frequently totalling less than 20 m in thickness. The age of individual beds and horizons is often dramatically different between adjacent locations. Despite this, evidence suggests that each bed often consists of one or more biohorizons, each deposited over a geologically very brief duration and separated from adjacent biohorizons by episodes of non-deposition and local erosion of considerable duration (Callomon and Chandler, 1990). No claim is made that the biohorizons are instantaneous events of deposition with entirely isochronous

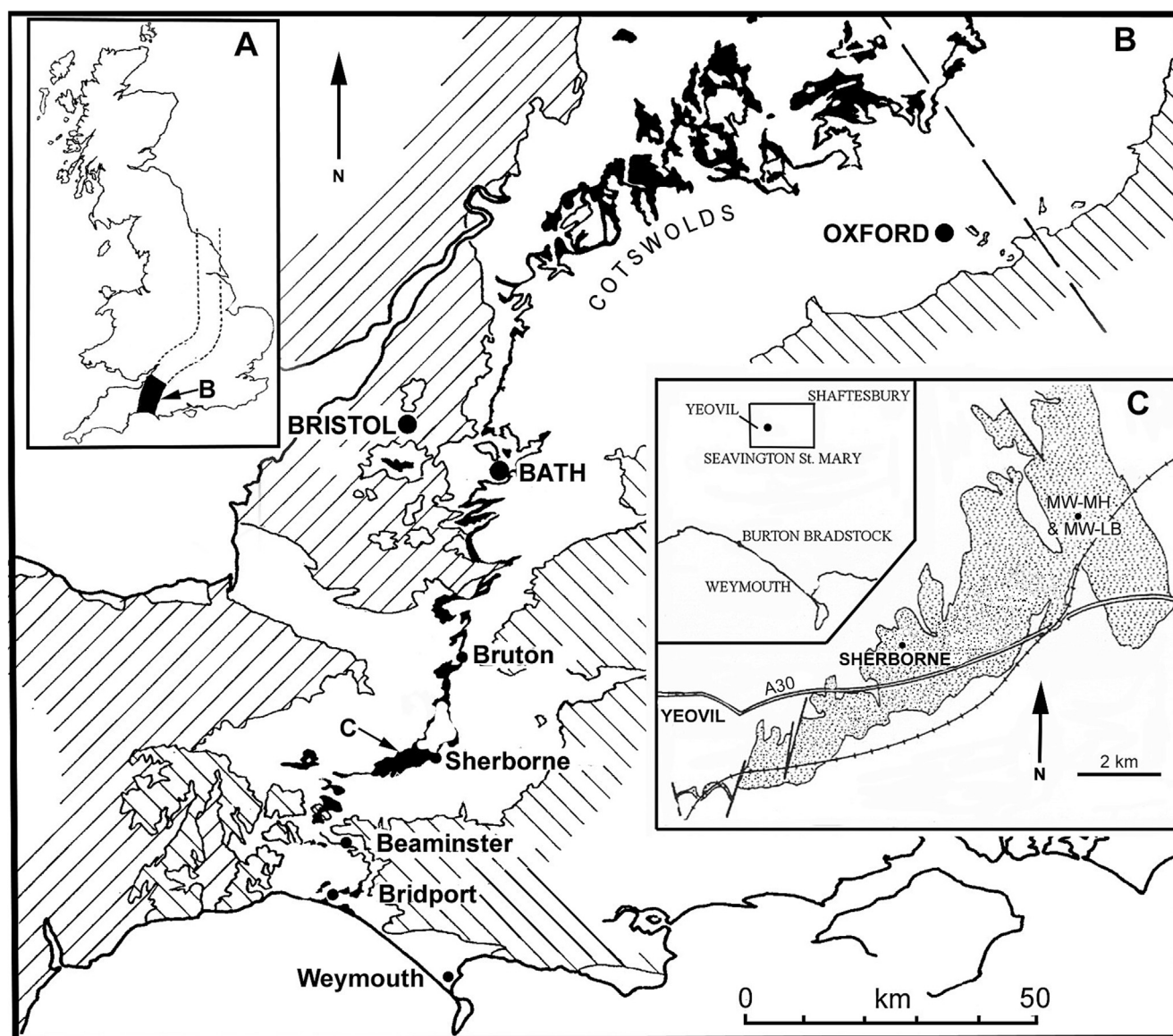


Fig. 2. A. Sketch map of Britain showing the outcrop of the Aalenian–lowest Bathonian of England. The solid black area is that shown in B. B. Outcrop of the Inferior Oolite Group (solid) in southwest England. Diagonal shading to the west: pre-Jurassic rocks; diagonal shading to the east: post-Jurassic rocks. C. Outcrop of the Inferior Oolite Group (dotted) in the Sherborne region. MW-MH Miller's Hill SSSI and MW-LB Little Bradley, Milborne Wick.

content; they do, however, represent geologically very short episodes at the highest resolution possible by ammonite biostratigraphy. The biohorizons often contain a fauna of beautifully preserved fossils of many groups, particularly ammonites. A zonal and biohorizon scheme for the Sauzei and Humphriesianum zones of Dorset is given as [Figure 3](#).

The excellent outcrop of the Jurassic sequence in the Monte Nerone area has over the last fifty years facilitated the biostratigraphical study of its ammonite associations (Sinemurian to Tithonian). The richly diverse Tethyan assemblages enable their correlation at a regional level encompassing an area in which Monte Nerone (including the Bosso and Candigliano river valleys) constitutes one of the key sections for the Tethyan Jurassic. The Jurassic deposits of the Monte Nerone area record the rifting and drowning of part of the vast Mediterranean Late Triassic peritidal carbonate–evaporitic platform. The post-drowning, submarine rift topography comprised basins and fault-bounded swells, *i.e.*, the pelagic carbonate platforms defined as ‘intrabasinal highs’ on the continental crust, bordered by synsedimentary faults and sites of condensed and discontinuous pelagic carbonate sedimentation over drowned fragments of a former “peritidal carbonate platform” ([Santantonio, 1994](#), p. 122).

The strata of the Lower Bajocian of the Umbro-Marchean Apennines of the Monte Nerone area are mostly pale yellow, micro-crystalline fine grained limestones with glauconite grains, and they comprise part of the Bugarone Formation. In the Monte Nerone area ([Fig. 1](#)) [Cresta et al. \(1995\)](#) made records from seven localities: Presale, Ranchi, Campo al Bello, Infernaccio, Pian del Sasso, Fosso Pisciarelllo and Gorgo a Cerbara. Each location exposes various parts of the Upper Toarcian–Lower Bajocian succession. Some horizons are rich in ammonites, mostly as internal moulds. Of specific interest here is the Pian del Sasso locality (section shown in [Fig. 4](#)) where there is a rich fauna of the Sauzei and Humphriesianum zones.

2.1. Acronyms, repositories, terminology and locality codes

WCC – Wessex Cephalopod Club Collection; PB – Specimens from Pian del Sasso, housed in Brancaloni Civic Museum, Piobbico, Italy. Authorship of species is given on first usage only. The alphanumeric biohorizon markers of [Callomon and Chandler \(1990\)](#) have been discontinued but have been included in some examples here for clarity. [M] and [m], macroconch and microconch respectively; HT, holotype; *type

Stage/Substage		Zone	Subzone	biohorizon
Bajocian	Lower Bajocian	Humphriesianum	Blagdeni	<i>Teloceras coronatum</i>
				<i>Teloceras blagdeni</i>
				<i>Lokuticeras rossbrunnense</i>
			Humphriesianum	<i>Stephanoceras blagdeniforme</i>
				<i>Stephanoceras gibbosum</i>
				<i>Stephanoceras humphriesianum</i>
				<i>Pseudoteloceras labrum</i>
			Romani	<i>Chondroceras wrighti</i>
				<i>Chondroceras delphinum</i>
		Sauzei	Hebridica	<i>Nannina evoluta</i>
				<i>Stephanoceras rhytum</i>
				<i>Pseudoteloceras digbyi</i>
			Kumaterus	<i>Stephanoceras kalum</i>
				<i>Kumatostephanus kumaterus</i>

Fig. 3. The Stage, Substage, zones and subzones of the Lower Bajocian Sauzei–Humphriesianum zones used here for Italy and England. Biohorizons are separated from one another by time-gaps of unknown duration and labelled by a characteristic guide fossil; the scheme is that of Dorset based on Callomon and Chandler (1990) for the Inferior Oolite Group (pars).

species. Locality codes and map references: Maps of the area are shown in Figures 1 and 2. Milborne Wick, Little Bradley (ST 663 207) 50° 59' 05" N 2° 28' 52" W and Pian del Sasso 43° 32' 44" N 12° 32' 4".

3. Ammonite biostratigraphy

3.1. Milborne Wick, Little Bradley

Collections made from temporary exposures near Milborne Wick include specimens from the Laeviuscula to Parkinsoni zones. A provisional, part section is shown in Figure 6. Included in the collections from the base of Bed 5 is an extensive fauna from the Humphriesianum Zone, Romani Subzone. The following is provisional and based on morphospecific comparisons with type specimens.

Pale brown or yellow, micritic limestone, mostly soft with many fossils, mostly indifferently preserved and often with rotted pyrite cavities. Morphospecies include:

Bed 5a, Humphriesianum Zone, Romani Subzone, *delphinum* biohorizon (Bed 5 pars. Cox in Cox and Sumbler, 2002, pp. 84–86). *Stephanoceras sturani* Pavia, *Stephanoceras plicatum* (Quenstedt) *Stephanoceras umbilicum* (Quenstedt), *Stephanoceras rochei* Maubeuge, *Stephanoceras* aff. *humphriesianum* (J de C. Sowerby), *Stephanoceras scalare* Weisert, *Stephanoceras tenuicostatum* Hochstetter, *Stephanoceras* (Paviceras) *hoffmanni* (Schmidtill and Krumbeck), *Phaulostephanus paululum* Buckman, *Stephanoceras* microconchs including *Epalkites lepsi* Westermann and spp. aff. *Gerzenites rugosus* Westermann, *Germanites latus* Westermann, *Itinisis varicostatus* Westermann, *Normannites formosus* Buckman, *Masckites densus* Buckman, *Normannites orbigny* Buckman, *Chondroceras wrighti* Buckman, *Chondroceras delphinum* Buckman, *Chondroceras evolvens* (Waagen), *Chondroceras gervillii* (J. Sowerby), *Poecilomorphus regulatus* Buckman, *Poecilomorphus cycloides* (d'Orbigny), *Dorsetensia edouardiana* (d'Orbigny), *Dorsetensia tessoniana* (d'Orbigny),

Dorsetensia deltafacata (Quenstedt), *Dorsetensia liostraca* Buckman, *Dorsetensia romani* (Oppel), *Dorsetensia subsecta* (Buckman), *Lissoceras oolithicum* (d'Orbigny), *Oppelia subradiata* (J de C. Sowerby), *Toxalambites densicostatus* Sturani and spp. cf., *Oecotraustes genicularis* Waagen and spp. cf., *Bajocia farcyi* Brasil, *Teloceras* aff. *labrum* Buckman, *Teloceras blagdeniformis* (Roché), *Pseudoteloceras boursicoti* Fernández-López and Pavia, *Pseudoteloceras geometricum* (Maubeuge) and *Lytoceras eudesianum* (d'Orbigny). 0. 07–0.10 m.

3.2. Pian del Sasso

The Pian del Sasso section was sampled in the early 1980s during stratigraphical survey activities in the Monte Nerone area (Cecca et al., 1990). All geological formations composing the Jurassic succession of the Pelagic Carbonate Platform, as defined by Santantonio (1994), were identified. Specifically, the biostratigraphical study of the Lower Bajocian was conducted on a block made up of 8 layers (total thickness 3.10 m) that had fallen from the face (Fig. 5) (Cresta et al., 1995). The following morphospecies are recorded:

Beds 1–6, Sauzei Zone, ? Hebridica Subzone: *Emileia broccii* (J. Sowerby), *Labyrinthoceras meniscum* (Waagen), *Stephanoceras* (*Skirroceras*) *dolichoecus* (Buckman), *Phylloceras baconicum* Prinz, *Holcophylloceras ultramontanum* (Zittel).

Bed 7, Humphriesianum Zone, Romani or Humphriesianum Subzone: *Calliphylloceras mediojurassicum* Prinz, *H. ultramontanum*, *Oppelia* spp., *Pseudoteloceras* sp., *Stemmatoceras* (? = *Kumatostephanus*), *St.* aff. *humphriesianum*, *St.* (P.) *hoffmanni*, *St. scalare*, *St. tenuicostatum*, *Stephanoceras sturani*, *Stephanoceras* cf. *plicatum*, *Stephanoceras* (*Skirroceras*) ?*kalum* (Buckman), *Stephanoceras* (*Skirroceras*) *macrum* (Quenstedt), *Stephanoceras* (*Skirroceras*) cf. *freycineti* (Bayle), *Bajocia paiardinii* sp. nov. and an indeterminate sonniniid. 0. 40 m.

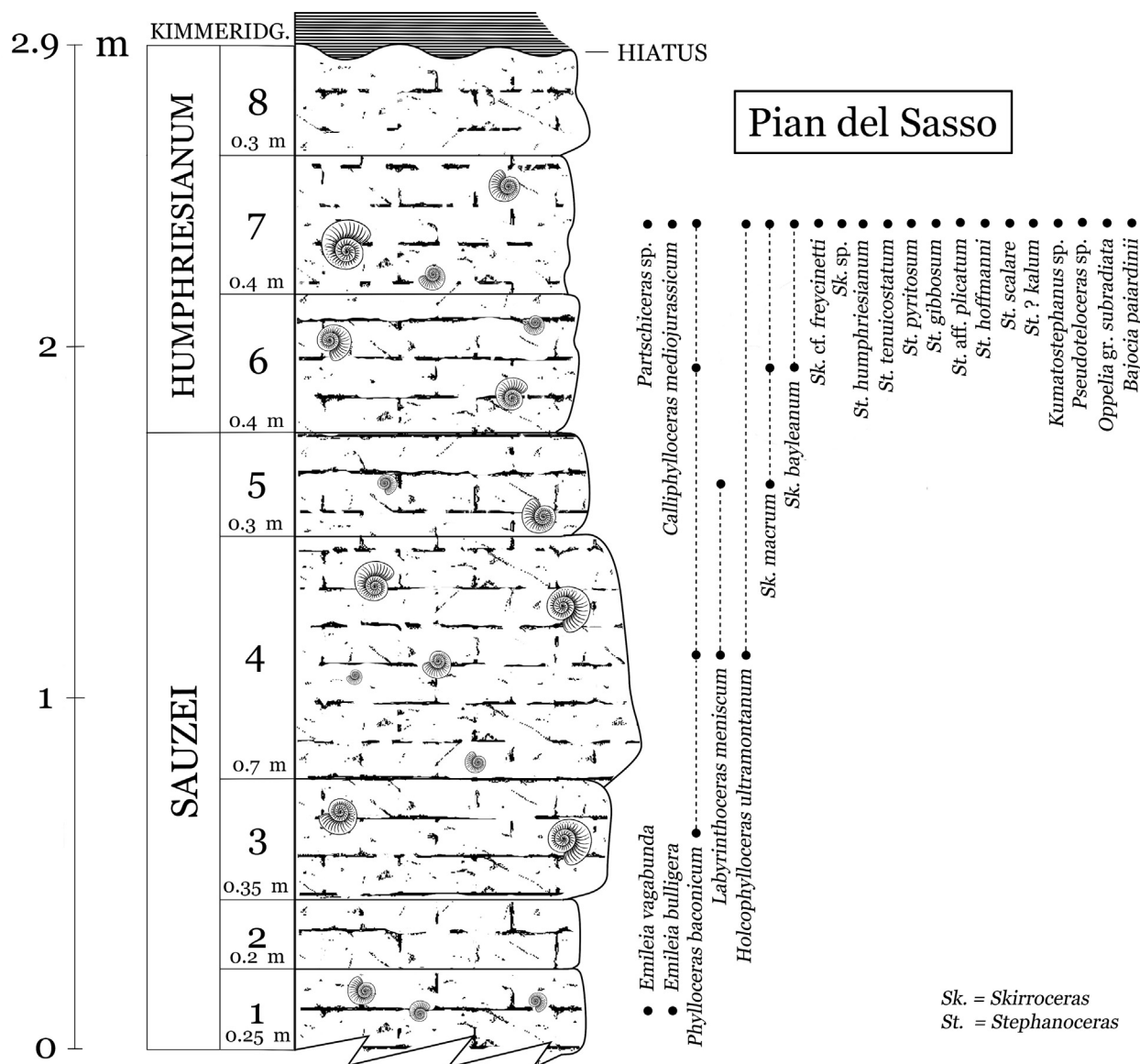


Fig. 4. Diagrammatic section showing bed numbers and species occurrence in the Bugarone Inferiore Formation at Pian del Sasso (Monte Nerone). The wavy line indicates a regional hiatus at the top of Middle Humphriesianum Zone.

Bed 8 is the last unit of strata above Bed 7. It is unfossiliferous thus its age cannot be determined.

4. Systematic palaeontology

4.1. Description of specimens

Class Cephalopoda Cuvier, 1798

Subclass Ammonoidea von Zittel, 1884

Superfamily Stephanoceroidea Neumayr, 1875

Family Stephanoceratidae Neumayr, 1875

Subfamily ?Frebolditinae Fernández-López and Pavia, 2015

Genus *Bajocia* Brasil, 1895

Type species *Bajocia farcyi* Brasil, 1895, p. 11, pl. 2, figures 9–11, by original designation; holotype, is a specimen of 26 mm, refigured by Arkell et al. (1957, fig. 311.2), reproduced here Figure 7f, from the “Oolithe ferrugineuse de Bayeux” Formation, Sully, Calvados, NW France, Humphriesianum Zone.

Two nominal morphospecies of *Bajocia* are published: *B. farcyi* Brasil, 1895 [?M] and *Bajocia rarinoda* Sturani, 1971 [m]. Sturani (1971)

reports that over 25 specimens of *B. farcyi* have been found at fossil location Troch 1 from the basal Humphriesianum Zone, Cycloides Subzone (present Romani Subzone) from the “Posidonia alpina” beds of the Venetian Alps, Italy, along with an additional reworked specimen from Troch 2 in rocks of the Subfurcatum (now Niortense) Zone. Troch 1 and Troch 2 are locations that are not recorded by the Italian Ordinance Survey, and they are at Monte Longara, north of Gallio. Troch 2 is some 50 m west of Troch 1 but displays a different faunal composition. Sturani (1971, pl. 3 figs. 7–9) figured specimens close in morphology to Brasil's (1895) holotype. Fernández-López and Pavia (2015) include *Bajocia* in the Frebolditinae Fernández-López and Pavia, 2015 and re-figure (fig. 9a–d) a resedimented specimen from Sturani (1971, pl. 3, fig. 8) and a section of the body-chamber (fig. 9e–h). Arkell et al. (1957, L271) place *Bajocia* in the Sonniniidae whereas Donovan et al. (1981, p. 118) include it in Stephanoceratidae. The genus *Bajocia* appears to have been overlooked by Howarth (2017).

B. rarinoda Sturani, 1971 [m] is based on more than 20 specimens of which five were figured (p. 127, pl. 3, figs. 10–15). The holotype (fig. 14) is 16 mm in diameter and has pronounced lappets. The type series are from the “Posidonia alpina” beds of the Venetian Alps, Italy, Cycloides (Romani) Subzone, Humphriesianum Zone. We reject the inclusion of



Fig. 5. Field picture of the Bugarone Inferiore Formation in Pian del Sasso. At the bottom right is the stratigraphical contact with the greenish-grey nodular limestones belonging to the Rosso Ammonitico Formation (Upper Toarcian). The lower Bajocian block of nodular limestone from which the described ammonites come has detached from the wall at the top left of the photo.

these specimens in *Bajocia* along with *Bajocia* (?) n. sp. (Sturani, 1971, pl. 3, fig. 16) of which two specimens are reported on the basis that the innermost whorls of *B. farcyi* [M] are serpenticonic and very finely ribbed, without laterally displaced small ventral tubercles. These specimens are morphologically much closer to *Subcollina* [m] but of slightly earlier age.

4.2. Genus *Bajocia* Brasil, 1895

- Bajocia farcyi* Brasil, 1895, Figure 7a–f.
- Synonymy
- 1895 *Bajocia farcyi* Brasil, 1895, pp. 35–36, pl. 2, figures 9–11.
- 1912 *Bajocia farcyi* Brasil, Roman and Gennevaux, p. 270, pl. 3, figure 6a–b.
- 1964 *Bajocia farcyi* Brasil, Sturani, pl. 4, figure 5.
- 1971 *Bajocia farcyi* Brasil, Sturani, pp. 126–127; pl. 3, figures 7–9.
- 2015 *Bajocia farcyi* Brasil, Fernández-López and Pavia, p. 12, figure 9a–h (refigured from Sturani, 1971).

Diagnosis: Discoid small shells (40 mm), extremely serpenticonic and compressed, no keel, numerous whorls that are broader than high, quadrangular whorl section. Prominent, regular straight ribs, persisting throughout ontogeny, ending at the ventral edge of the flank at the junction with the venter where ribs are feeble and slightly prorsiradiate. The innermost two whorls are smooth. The ventral end of the ribs raised into miniscule bumps. The venter is smooth and slightly convex; the umbilicus is extremely wide, slightly concave and shallow. Sutures relatively simple. In the two new examples described here from Dorset (WC6020, Fig. 7a1–4 and WC2380, Fig. 7b1–3), both have a fraction short of one whorl of the body-chamber present. Both specimens display slight flaring preceding what may be an indication of a simple peristome, thus possibly small macroconchs.

Occurrence: This extremely rare genus is represented by the type species *B. farcyi* currently known from the uppermost lower Bajocian of the Northwest European Province (Calvados, NW France; Brasil, 1895) and from the lowermost Humphriesianum Zone (Romani Subzone) of the Mediterranean Province (Venetian Alps, NE Italy; Sturani, 1971). Here we add to the record two precisely recorded specimens from the *delphinum* biohorizon of the Humphriesianum Zone, Romani Subzone of Milborne Wick, Dorset, UK.

Remarks: The two new specimens from Milborne Wick came from temporary excavations for buildings, cable laying and water installations. Further specimens for comparison are refigured after Sturani

(1971, pl. 3, figures 7, 8, 9). They are here Figure 7, e1–2, c1–2 and d1–2 respectively. Image Figure 7f is Brasil's (1895) holotype. During the fieldwork the discovery of both specimens by A. Steadman and P. Lacroix was made in the presence of one of us (RBC). The specimens are interesting for a number of reasons; they are both very well-preserved, one (WC2380) was collected *in situ* in Bed 5a of the *delphinum* biohorizon of the Humphriesianum Zone, Romani Subzone. In the matrix, two further ammonites that characterise this level were found. The second specimen (WC6020) was collected in rock material extracted from the same bed and stored for later examination.

4.3. *Bajocia paiardinii* Chandler and Cresta sp. nov. [M]; specimens: Figure 8a–b HT and b1–4 PT

Biometry:

Specimen	D mm	Dph mm	H mm	H/D	W mm	W/D	U mm	U/D	R1/2
PB3385 HT	71.7	69	13	0.18	9.6	0.13	48.2	0.67	50

The values given above are estimates due to the incomplete nature of the specimen. D preserved diameter, Dph diameter of phragmocone, H whorl height, W whorl breadth, U umbilical diameter, and R ribs for half a whorl. Holotype: Specimen PB3385 figured in Figure 8a1–3, housed in the palaeontological collections of the Brancaloni Civic Museum, Piobbico, Italy.

Paratype: Specimen PB3391 figured in Figure 8b1–4.

Type horizon: Lower Bajocian, Humphriesianum Zone, Romani Subzone.

Derivation of name: This new species is named to honour Mr. Lino Paiardini of Piobbico as recognition and tribute to his forty year curation of the palaeontological collections of the Brancaloni Civic Museum, Piobbico.

Records: Bed 7 of the Pian del Sasso section and Bed 7 of the Bugarone Formation of Monte Nerone, Italy. No specimens of this new species appear to have been reported in the literature.

Diagnosis: Discoid shells preserved to 70 mm. Note that both specimens of the type series are incomplete; extremely serpenticonic and compressed, no keel, numerous whorls that are slightly higher than broad, quadrangular whorl section. Well defined, regular, dense, non-bifurcating, straight, rectiradiate primary ribs that persist to the end of

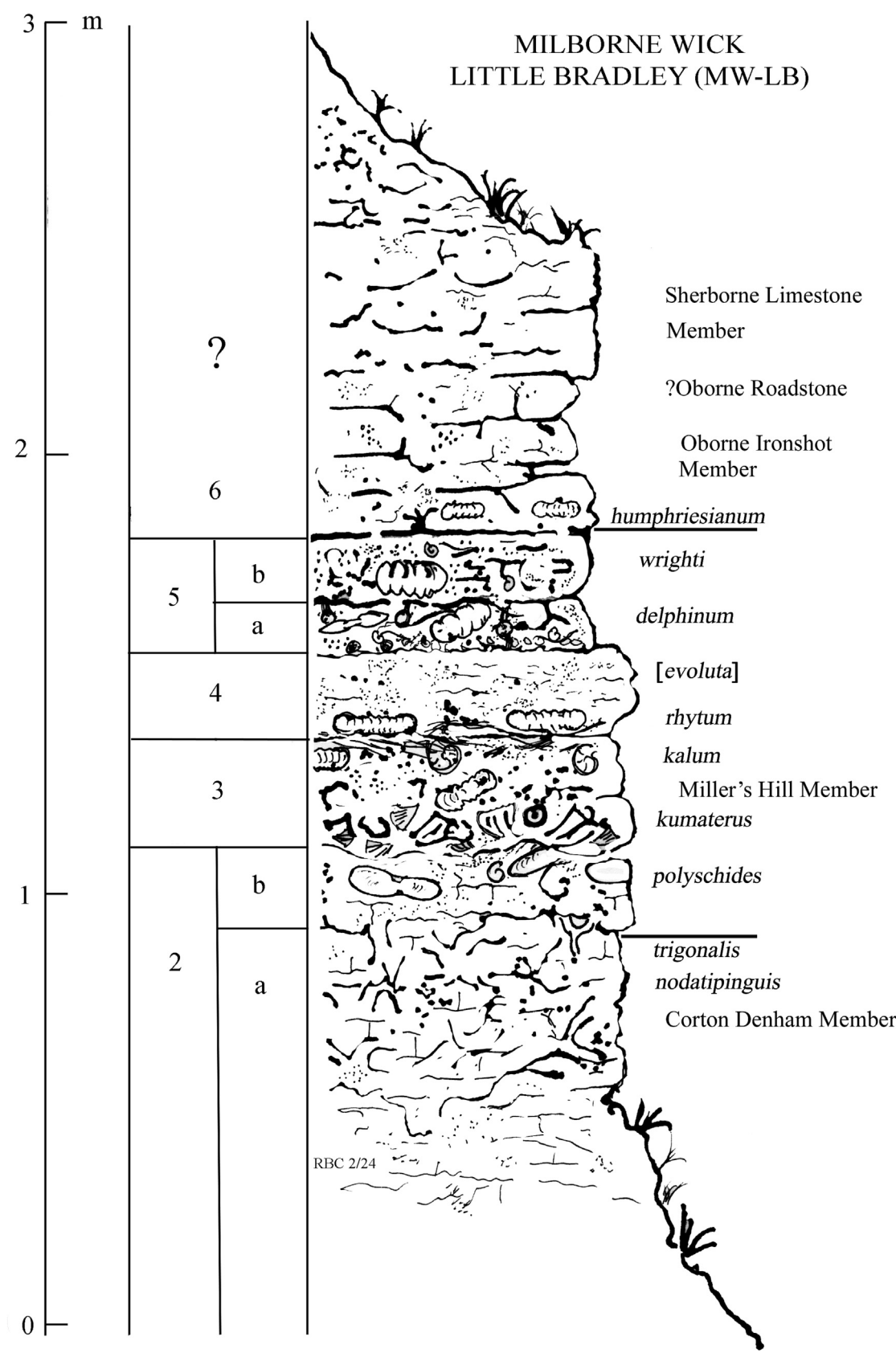


Fig. 6. Diagrammatic representation through the Inferior Oolite Group at Little Bradley, Milborne Wick (MW-LB). The section is similar, but not identical to that at Miller's Hill (MW-MH) of Cox and Sumblar (2002). Biohorizons in italics and given by guide species name.

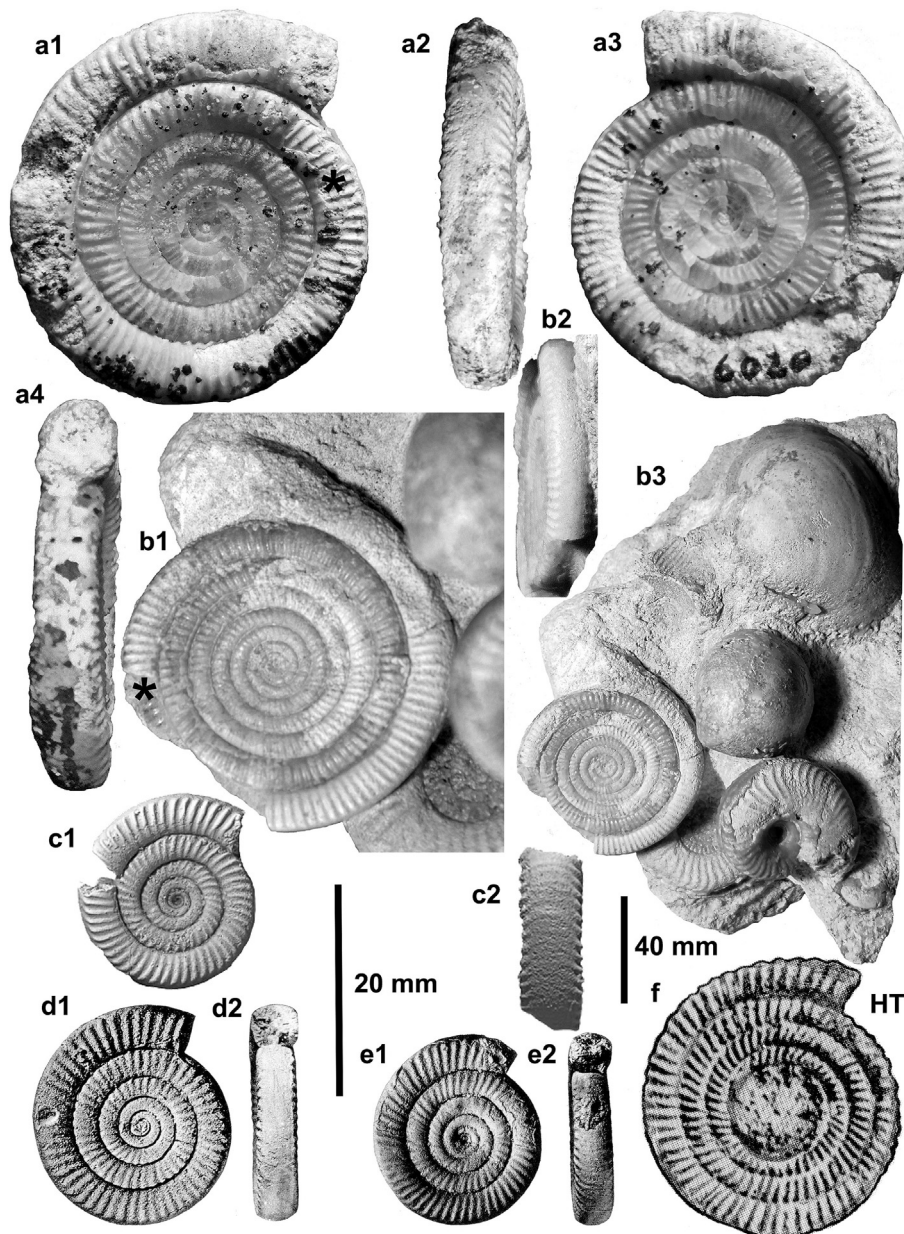


Fig. 7. a1–a4, b1–b2 & c1–f. Scale bar 20 mm. Images are twice natural size. b3 Scale bar 40 mm. Image at natural size. An asterisk marks the last preserved suture where preserved. *Bajocia farcyi* Brasil, 1895 [?M] a1–4 WC6020; b1–3 WC2380, specimen at twice natural size b1 and ventral view b2. Specimen at natural size b3, included in matrix *Poecilomorphus cycloides* (d'Orbigny), *Dorsetensia edouardiana* (d'Orbigny), a terebratulid brachiopod and bivalve cast. The reverse side has the cast of a large stephanoceratid ammonite. Milborne Wick, Bed 5a, Humphriesianum Zone, Romani Subzone, *delphinum* biohorizon. c–e Copies of images of specimens of *B. farcyi* previously figured by Sturani, 1971, pl. 3, from the basal Humphriesianum Zone, Cycloides Subzone (present Romani Subzone) of the 'Posidonia alpina' beds of the Venetian Alps, Italy: c1–2 Sturani, 1971, pl. 3, figure 9 (with ventral detail c2 added by Fernández-López and Pavia, 2015). d1–2 and e1–2 Sturani, 1971, pl. 3, figures 9 and 7 respectively. f. HT of Brasil from Sully, said to be uppermost Lower Bajocian of the Northwest European Province (Calvados, NW France).

preservation, encroaching on the edges of the venter where they are feeble and slightly prorsiradate. The innermost whorls are too badly preserved to comment. The venter is unornamented but poorly preserved; the umbilicus is extremely wide, slightly concave and shallow. Sutures are fairly simple and only preserved in parts of the shell (Fig. 8b3). In the two examples described here, PB3385 (HT Fig. 8a1–3) has half a whorl of the body-chamber preserved and the paratype PB3391 (Fig. 8b1–4 PT) has no indication of the preserved length of the body-chamber. The large size of the specimens suggests that both are macroconchs.

Occurrence: Monte Nerone, Italy, unique to Bed 7.

Remarks: The two specimens of *B. paiardinii* appear to be unique records and from a single locality and bed. In comparison to the other recorded specimens of this genus, they are large, incomplete, but

almost twice the diameter of the presumed complete British specimens at 40 mm. The terminal adult size of the two type specimens suggests an adult size of around 80–90 mm based on comparison with *B. farcyi* having one whorl of the body-chamber. Their placement in *Bajocia* is unquestionable as there is nothing in the fauna at this level that is comparable in either Italy or other locations known to date. In view of the extreme rarity of this genus it is possible that all the previously reported specimens (Brasil, 1895; Sturani, 1971; Fernández-López and Pavia, 2015) may be microconchs. This would be the case if the horizon of *B. paiardinii* first occurs earlier alongside examples of *B. farcyi* and that *B. rarinoda* [m], HT, pl. 3, figure 14 might be excluded from *Bajocia* being better placed in *Subcollina* [m]; however, the assemblage herein that includes *B. paiardinii* is of a slightly higher horizon in the uppermost Romani or lower Humphriesianum Subzone.

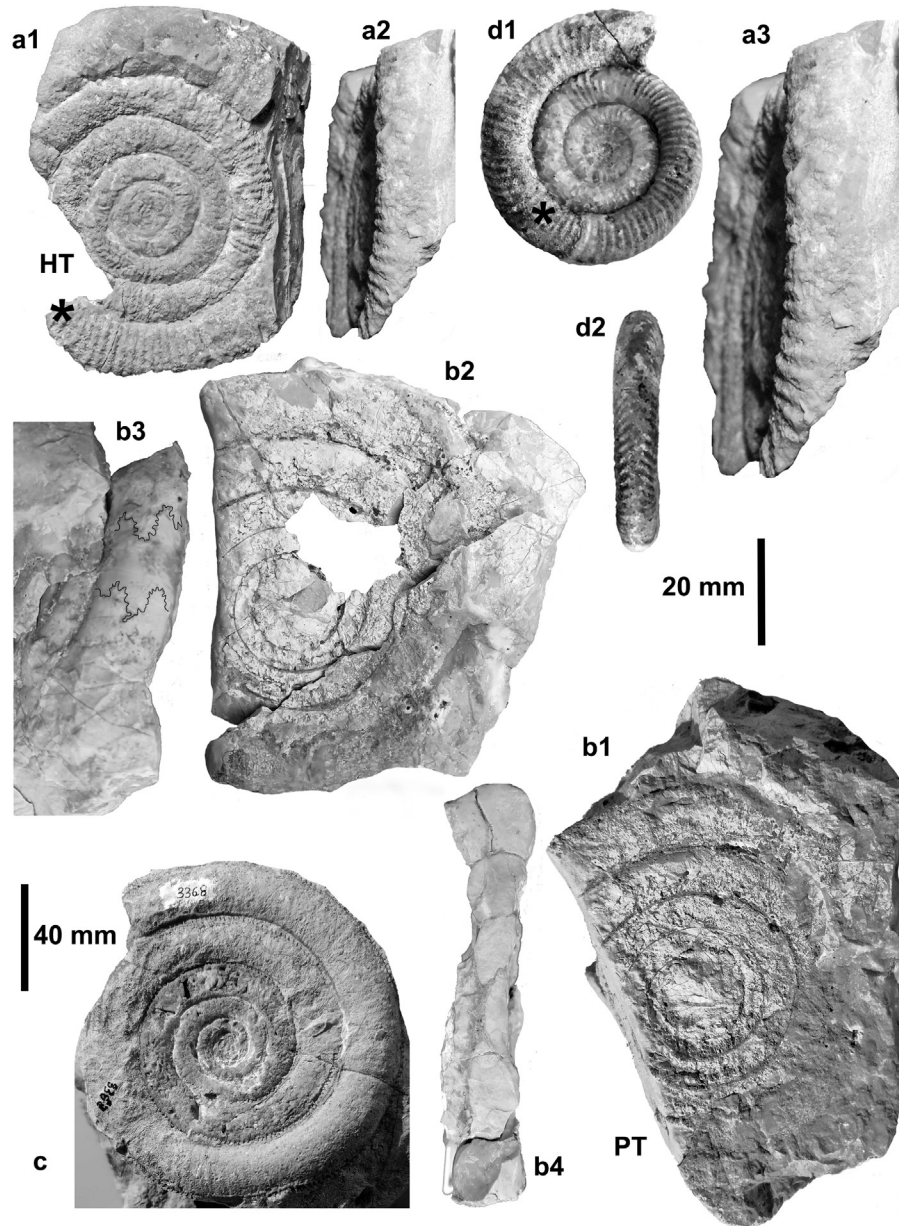


Fig. 8. Scale bar 20 mm for images a1–2, b1–2 and b4, and d1–2. a3 and b3 are enlargements. Scale bar for c only is 40 mm. An asterisk marks the last preserved suture where preserved. *Bajocia paiardinii* Chandler and Cresta sp. nov. [M]; a1–3 PB3385, HT, a3 enlargement of the venter showing rectiradiate ribbing and loss of ribbing on the venter. b1–4 PB3391, PT, b1 original specimen welded in limestone matrix, b2 and b4 specimen deconstructed to show part of whorl section, and b3 enlarged detail of the suture line. Both HT and PT from Bed 7 of the Lower Bajocian, Humphriesianum Zone, Romani Subzone, Pian del Sasso section, Bugarone Inferiore Formation, Monte Nerone, Italy. c. ?*Bajocia*, a small evolute macroconch stephanoceratid with very fine ribbing that weakens on the venter. PB3368 from Bed 7 of the Lower Bajocian, Humphriesianum Zone, Romani Subzone, Pian Del Sasso section, Bugarone Formation, Monte Nerone, Italy. d1–2. *Caumontisphinctes* [m] or *Subcollina* [m] WC6082, Bed 6c, Niortense Zone, Banksii Subzone, Osborne, Frogden Quarry, Dorset.

5. Discussion

B. paiardinii sp. nov. is included in the genus *Bajocia* on account of its close morphological similarity to *B. farcyi*, the dense, rectiradiate ribbing, weakness of the ornament on the venter and extreme serpenticonic coiling. It is however much larger than any of the *Bajocia* specimens figured in the literature. Brasil (1895, pp. 35–6) states “*Bajocia* is very close to *Dorsetensia*, that we can consider this genus as a branch from *Haplopleuroceras*”. Arkell (in Arkell et al., 1957, L271) also considered that it had evolved from *Haplopleuroceras*. Donovan et al. (1981, p. 118) include *Bajocia*, provisionally, in the Stephanoceratidae based on its possible relationship to *Subcollina* (in text as *Collina* err.) and *Parastrenoceras*. *Bajocia* is placed in the Frebolditinae Fernández-López and Pavia, 2015 linking it to origins in *Phaulostephanus*, a miniature

macroconch stephanoceratid. In fact, the origins of *Bajocia* are unknown. Due to its extreme rarity and having no confirmed evolutionary ancestor that pre-exists its occurrence in the Humphriesianum Zone, the closest comparison is a micromorphic stephanoceratid, possibly one that evolved as an intraspecific variant of the population rather than from a separate line of evolution.

The two morphospecies of *Bajocia*: *B. farcyi* and *B. paiardinii* occur at different, but close, stratigraphical levels; the newly introduced *B. paiardinii* being the younger, and second published morphospecies. The presently known range of the genus, considering only Dorset and Monte Nerone, is the Romani Subzone to lower Humphriesianum Subzone. Galácz (2012) regards the origins of the Perisphinctidae s. str., likely to originate from Western Tethyan Stephanoceratidae. *Bajocia* may have its origin in small Stephanoceratidae in the Tethyan lower

Humphriesianum Zone and then be a possible origin of the genus *Caumontisphinctes*, but possibly having as intermediate form such as the genus *Subcollina*, an almost certain ancestor of *Caumontisphinctes*, which has more similarity to *Bajocia* than to *Caumontisphinctes* and appears earlier in the stratigraphical record. The origins of the Leptosphinctinae (Perisphinctidae s. str.) would be in the Stephanoceratidae, with *Stephanosphinctes* Sandoval and Westermann, 1986 being the earliest genus of this subfamily. The type specimens of this genus came from the *Duashnoceras floresi* Zone of the Taberna Formation (Oaxaca, Mexico), which corresponds to the upper part of the Humphriesianum Zone and the base of the Niortense Zone; not only to the basal Niortense Zone as Hillebrandt von et al. (1992, table 12.2) and Galácz (2012, p. 288) have indicated. *Bajocia* bears considerable morphological homoeomorphy with certain younger early perisphinctids. Figured herein (Fig. 8d1–2) is a specimen of *Caumontisphinctes* [m] from the Niortense Zone (WC6082); apart from the slight curvature of the ribbing on the ventral flank and its prosiphonate continuation on the venter, it also has similarity to *Subcollina* (Sandoval, pers. comm.). If proven that *B. farcyi* is a microconch or miniature macroconch, then a search in the Mediterranean–Caucasian Subrealm may provide evidence of larger sized examples.

In Bed 7 of the Pian del Sasso section and other sections in the Monte Nerone area occur a number of small c. 120 mm extremely serpenticonic, evolute, compressed, finely ribbed stephanoceratids previously identified as “*St. tenuicostatum*” (Cresta et al., 1995, p. 136; Faraoni and Paiardini, 2019, p. 62). These small ammonites are contemporary with *B. paiardinii* sp. nov. and occur together. The morphospecies is well-represented in numbers from the assemblages and has been utilised as nominal guide species of the biohorizon at the junction of faunule 29 and 30 of Cresta et al. (1995); an example is shown in Fig. 8c as ?*Bajocia*. This and further specimens from Monte Nerone, Pian del Sasso have not been subjected to revised description and may be members in the intraspecific variability of a palaeobiospecies that includes *B. paiardinii*. We refrain from erecting a new name for these small stephanoceratids pending further investigation and consider that they also are likely to belong to *Bajocia*. These ammonites appear to follow the same evolutionary behaviour as that noted by Chandler (2019, p. 323). If *B. farcyi* is proven to be a microsomic macroconch, this suggests that the origin of *Bajocia* is as a small member of the *Stephanoceras*/*Skirrocera*s population around the lower part of the Humphriesianum Zone, and in common with other taxa they evolve to a larger size over time if suitable conditions prevail. This group originated in Tethys and includes a number of major lines of evolution including Perisphinctidae arising from Leptosphinctinae. *Leptosphinctes chaudonensis* Pavia, 1983 from the Blagdeni Subzone of Chaudon, South-east France, is younger than the stephanoceratids of Bed 7 at Pian Del Sasso, but has similarities to some specimens. In Bajocian times (mainly early/late Bajocian transition) the Hispanic Corridor was open (Taylor et al., 1984; Westermann, 1984; Sandoval and Westermann, 1986) and the communication between the Mixteca terrane (Oaxaca, Mexico, which was positioned in the Pacific entrance of the Hispanic Corridor) and westernmost Tethys, more specifically the Mediterranean Province (Hungary, Italy, Southern Spain, etc.) was relatively close and well connected. This would allow taxa originating within the corridor itself or in each of the domains to easily migrate from one to the other. Therefore, the Perisphinctidae could have originated in the Hispanic Corridor, in the Mediterranean–Caucasian Subrealm or in the Eastern Pacific as proposed by Galácz (2012).

In Dorset the ammonite composition of the *delphinum* biohorizon (Callomon and Chandler, 1990, p. 98 as *P. cycloides* faunal horizon Bj-14), lowest Romani Subzone, is, in some respects, very close to that of the specimens depicted by Sturani (1971, pp. 50–51). The exception is the high frequency of lytoceratids, phylloceratids and the near absence of sonniniids from the “*Posidonia alpina*” beds of the Venetian Alps and the common occurrence of *Dorsetensia* and macroconch stephanoceratids in Dorset. Of similarity is the abundance of microconch stephanoceratid morphospecies in both locations (Sturani, 1971, pl. 12) and *Chondroceras*, *Poecilomorphus*, *Strigoceras* and other haploceratids as common

components. The Dorset specimen depicted in Figure 7b3 (WC6020) is preserved in matrix that also contains *P. cycloides* and *D. edouardiana* [m] typically of the Romani Subzone. So far, *B. farcyi* has only been found in what is probably a single biohorizon. There can be no doubt that the biohorizons with *Bajocia* in Dorset and the Venetian Alps are of the same age.

The fauna of Bed 7 at Pian Del Sasso has a different composition. The presence of a single sonniniid indicates the age of the bed to pre-date the disappearance of the sonniniids around the upper part of the Romani Subzone (assuming no re-elaboration). The assemblage is close to that of the *wrighti* biohorizon in Dorset (Chandler, 2024, fig. 2, p. 179), but preceding the incoming of abundant *Stephanoceras mutabile* (Quenstedt). The dominant ammonites are stephanoceratids of *St. (P.) hoffmanni* morphology, typically those described by Pavia (1983, pl. 21, figs. 1 and 2). The *Chondroceras*, *Poecilomorphus* components of the ‘*Posidonia alpina*’ beds and the Dorset Romani Subzone appear to be entirely absent.

Fernández-López and Pavia (2015) proposed two new subfamilies of the Stephanoceratidae, the Mollistephaninae and Frebolditinae that both arose from *Mollistephanus* at the root of the lineage traceable back to the Discites Zone; they suggest that *Bajocia* could belong to the Frebolditinae. Chandler (2019) proposed that rather than forming a separate lineage, the small, adult macroconch ammonites appear as variants in the intraspecific population. They exist in parallel, through time, within the population of the larger ‘normal sized’ macroconchs. Several ammonite taxa have origins in small morphospecies e.g., *Frogdenites* (Sandoval and Chandler, 2015). Parent et al. (2008) and Schweigert and Kuschel (2017) have discussed this phenomenon and Fernández-López and Pavia (2016) have discussed mechanisms by which such specimens might arise. Such observations are not restricted to stephanoceratids and are identified in a number of ammonite groups (e.g., graphoceratids, otoitids, sonniniids). This behaviour occurs consistently in a number of faunas throughout the Jurassic succession. Presently, it cannot be confirmed if *B. farcyi* is a small macroconch or microconch or if it is segregated from contemporary larger forms in Tethys that might resemble an earlier variant of *B. paiardinii*.

Bajocia has only been reported from the Mediterranean–Caucasian Subrealm. Sandoval (pers. comm.) reports a specimen of *Bajocia* (?*B. farcyi*) from Spain in the Humphriesianum Zone of the Camino de Casa Blanca section, central sector of the Middle Subbetic. That specimen, in the A. Linares collection, is unfortunately lost. Roman and Gennevaux (1912, p. 270, pl. 3, fig. 6a–b) figure a specimen from Pic Saint-Loup, France as *B. farcyi* from the Romani Subzone. This example has features of *Bajocia* and those of *Caumontisphinctes*.

We are not aware of any Eastern Pacific Subrealm specimens. *B. farcyi* is very small compared to contemporary stephanoceratids of the Venetian Alps, Normandy and Dorset, where it may exist on the outer limits of its palaeogeographical range. The genus as *B. paiardinii* occurs slightly later at Pian del Sasso, Bed 7 where examples are larger and exist alongside contemporary, small stephanoceratids that share some morphological similarity to *Bajocia*. These specimens await redescription. Strata of the critical lower Romani Subzone age are absent at Pian del Sasso due to a hiatus and Bed 7 lies directly above rocks of the Sauzei Zone. We presently reserve judgement regarding the inclusion of *Bajocia* in Frebolditinae on the basis that the feint ribbing over the venter is equilateral, a feature observed in larger ‘*Skirrocera*s’ and the serpenticonic coiling is clearly more like that of a small stephanoceratid. Further specimens are required to establish any firm evolutionary pathway.

6. Conclusion

We support the view of Fernández-López and Pavia (2015, 2016) that the taxa described herein are the result of two-way migration via the ‘Hispanic Corridor’. A possible origin of *Bajocia* may lie in the Tethys–Panthalassa Realm or southern Mediterranean–Caucasian

Subrealm. The extremely rare genus *Bajocia* is described from two localities, additional to those previously reported. The new species *Bajocia paiardini* Chandler and Cresta sp. nov. [M] is introduced from Italy and *B. farcyi* is reported from Dorset, UK. The presently known geological range of the genus is within the Humphriesianum Zone, Romani Subzone or lowest Humphriesianum Subzone. Galácz (2012) proposed that leptosphinctids, the earliest Perisphinctidae s. str., probably originated from Western Tethyan Stephanoceratidae. This line of descent is supported by findings herein with stephanoceratids morphologically close to earliest leptosphinctids.

CRedit authorship contribution statement

Robert Chandler: Writing – review & editing, Writing – original draft. **Stefano Cresta:** Writing – review & editing, Writing – original draft.

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