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Ammonites and ammonite stratigraphy of the Bimammatum Zone and lowermost Planula Zone (Submediterranean Upper Oxfordian) at Bobrowniki and Raciszyn in the Wieluń Upland, central Poland

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Abstract. An extensive collection of ammonites made bed by bed from sections in the Submediterranean Upper Oxfordian of the Wieluń Upland, Central Poland, is described and used as a basis for a chronostratigraphical interpretation of the deposits. The ammonites are mostly of Submediterranean character and enable the recognition of the Bimammatum Zone, including the Bimammatum and Hauffianum subzones, as well as the lowermost Planula Zone distinguished here as a new biostratigraphical horizon – the *matyjai* horizon – based on the occurrence of *Subnebrodites matyjai* Wierzbowski et Głowniak sp. nov. The Submediterranean ammonites are mostly oppeliids with *Taramelliceras* (*Taramelliceras*) [M] – *Glochiceras* (*Lingulaticeras*) [m] the most numerous, as well as *Taramelliceras* (*Richeiceras*) and *Taramelliceras* (*Metahaploceras*) [M] – *Glochiceras* (*Coryceras*) [m]. The profusion of ammonites of these two groups in the stratigraphical interval studied provides new information on their evolution, and two new oppeliid species, *Taramelliceras* (*Taramelliceras*) *zelcense* Wierzbowski et Głowniak sp. nov. and *Glochiceras* (*Lingulaticeras*) *bobrownikiense* Wierzbowski et Głowniak sp. nov., are described here. Subboreal and Boreal ammonites are not common in these sections, but are nevertheless important for correlation. Subboreal ammonites of the family Aulacostephanidae are represented by the genus *Vineta* [M], including its newly recognized microconchiate counterpart, *Vineta* [m], and a newly established genus *Vielunia* [M] Wierzbowski et Głowniak gen. nov., with type species *Vielunia dzalosinensis* Wierzbowski et Głowniak sp. nov. The latter genus includes ammonites previously referred in the area of study to *Ringsteadia*, and with a microconchiate counterpart assigned to *Prorasenia* [m]. The Boreal ammonites comprise late cardioceratids assigned to *Amoeboceras* (*Plasmatites*). These ammonites indicate that the deposits in question from the Submediterranean Bimammatum Zone up to the Planula Zone correlate with the Subboreal and Boreal lowermost Kimmeridgian (Baylei Zone, and Bauhini Zone, respectively).

INTRODUCTION

The sections studied are located in the Wieluń Upland, along the Warta River valley, in a neighbourhood of the town of Działoszyn – a local administrative center – west and south of the town, at the villages Bobrowniki and Raciszyn, respectively (Fig. 1). This is a well known and important area for the stratigraphy of the Upper Jurassic of Poland and has yielded abundant and well-preserved ammonites of the Bimammatum Zone and the Planula Zone (Wierzbowski, 1978; Matyja, Wierzbowski, 1997). These zones have been considered for a long time as representing the uppermost Oxfordian of Submediterranean areas, although most of this stratigraphical interval is equivalent to the lowermost Kimmeridgian of the Boreal and Subboreal areas (*e.g.* Matyja *et al.*, 2006).

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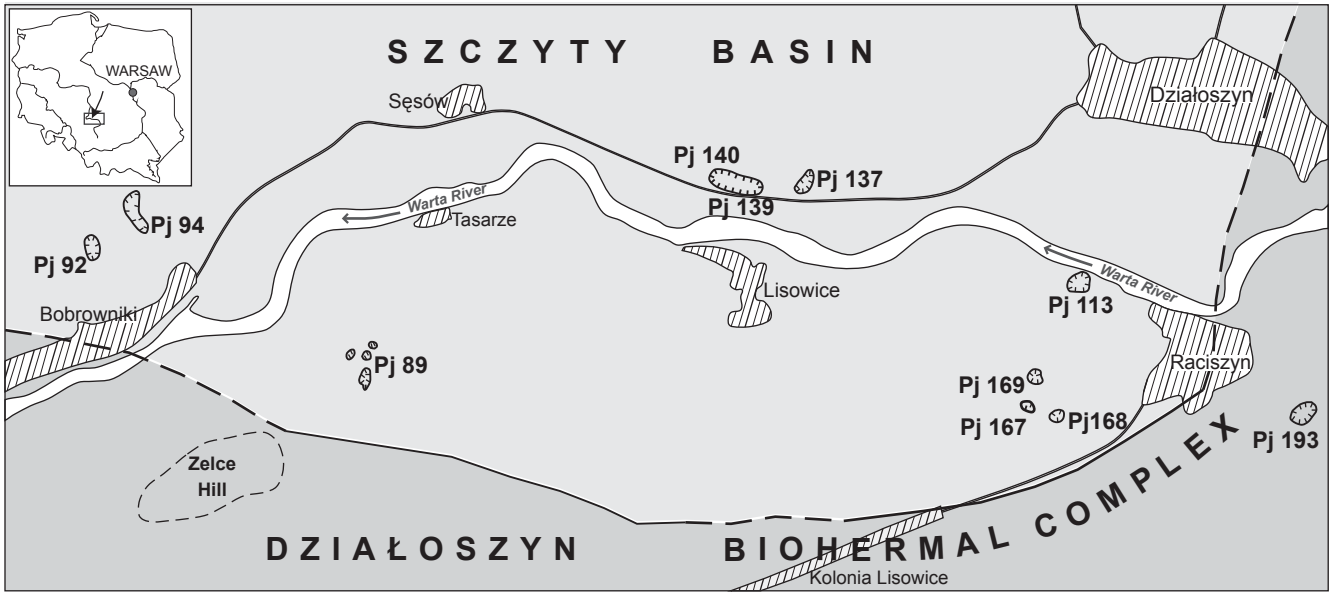

Fig. 1. Location of the sections studied, and palaeogeographical interpretation of the area of study

Dark shaded – Działoszyn Biohermal Complex; light shaded – Szczyty Basin

The ammonites previously described from the area of study (Wierzbowski, 1978; Matyja, Wierzbowski, 1997) are mostly of Submediterranean origin. However, ammonites of Boreal and Subboreal affinity which are important for stratigraphical correlations also occur. Previous studies of the ammonite faunas have concentrated on the upper part of the Bimammatum Zone – the Hauffianum Subzone – and the whole Planula Zone, but knowledge of ammonites from older deposits of the Bimammatum Zone is generally imperfect. In the present work we describe the ammonites and stratigraphy of these older deposits – mostly of the Bimammatum Subzone – with some additional observations on the ammonites of the Hauffianum Subzone, as well as the lowermost part of the Planula Zone. This work, therefore, represents a stratigraphical continuation of the earlier monograph of Matyja, Wierzbowski (1997).

The area of study constitutes the northernmost part of the Wieluń Upland which is the northern part of the Polish Jura Chain. As throughout the Polish Jura Chain, the area studied shows the presence of the sponge megafacies – deep neritic sediments representative of the peri-Tethyan part of the Late Jurassic shelf in Europe (Matyja, Wierzbowski, 1995, 1996). Two main facies types may be recognized here: cyanobacteria-sponge limestones forming large biohermal complexes, and well-bedded limestones and marls of interbiohermal basins. Isolated, smaller bioherms may occur, however, within the dominant bedded deposits of a large interbiohermal basin (*cf.* Wierzbowski, 1992, fig. 13), and bedded limestones may also appear in small basinal depressions within the biohermal complex (*cf.* Matyja, Wierzbowski, 1997, fig. 2). The deposits studied at Bobrowniki and Raciszyn represent the Szczyty Interbiohermal Basin bordered to the south by the Działoszyn Biohermal Complex (Matyja, Wierzbowski, 1997, fig. 2; 2004, fig. 1).

DESCRIPTION OF THE SECTIONS

The locations of the sections studied are given with reference to the index map at a scale 1:25 000 (Pj – sheet Pajęczno), and denoted by a letter abbreviation and number. These localities were previously described by Wierzbowski (1978) and referred to in a similar manner although to the two 1:25 000 map sheets of an older map scheme (Dz – sheet Działoszyn; Mi – sheet Mierzyce). The quarries at Bobrowniki were also numbered in an unpublished MSc thesis (Bardziński, 1975) as Bd 66 and Bd 68. All locality numbers – both the new and the former ones – are given in the descriptions.

The deposits are medium to thick, well-bedded limestones with thin marly intercalations. They were attributed to the Miedzno Chalky Limestone by Wierzbowski (1978). These limestones are often friable and chalky, but sometimes denser limestones (of the wackstone to packstone type) also occur, with cherts and with common fossils (mostly siliceous sponges, brachiopods, serpulids, bryozoans, as well as less commonly occurring bivalves, crabs and echinoderms); more compact limestones (of the wackstone type) are also

encountered, which are more rich in micrite and contain less common benthic fossils, as well as almost pure, often friable, micritic limestones (of the mudstone type) which are very poor in benthic fossils. Ammonites occur in all these limestone types. The deposits studied comprise mostly the succession of the interbiohermal Szczyty Basin, except those of the quarry Pj 193 which represent the bedded deposits of a small depression in the Działoszyn Biohermal Complex (Fig. 1).

Ammonites were collected from here in the late 1960s by one of the authors (A.W.) and partly published and revised (Wierzbowski, 1970, 1978; Matyja, Wierzbowski, 1997), although some specimens are described herein for the first time. Independently, in recent years (2006–2007), ammonites in the quarries at Bobrowniki have been collected by Krzysztof Pietras as part of an MSc study. Ammonites from the quarries at Bobrowniki and one of the quarries at Raciszyn (Pj 193) have been collected in recent years by all the authors (2006–2008). Further specimens from the quarries at Bobrowniki (Pj 92 and Pj 94) have also been collected by Waldemar Bardziński (1975). Additionally, specimens from the quarry at Tasarze near Bobrowniki (Pj 89) were kindly donated by Adrian Kin (Geoscience Friends' Association "Phacops").

Tasarze near Bobrowniki – Pj 89 (former 49 Mi)

Now mostly abandoned, these shallow quarries lie in a wood, on the south (left) side of the Warta River, about 1 km to the east of Bobrowniki Village, at Tasarze Hamlet (coordinates: x – 22618, y – 96350). When active, the quarries revealed a more complete succession which was studied in the 1970s (Wierzbowski, 1978); the succession comprised the following rock units (from the base – see Fig. 2):

Unit 1: thick to medium-bedded chalky limestones with cherts (2.80 m, base not exposed).

Unit 2: chalky limestones with cherts (0.12 m), at the base and the top with well-marked marly intercalations.

Unit 3: thick to medium-bedded chalky limestones with cherts (4.30 m). The detailed succession of the bulk the unit (3.90 m in thickness) was recorded in the quarry in 2001. It consisted of (from the base): bed 1 – chalky limestones with abundant micrite matrix (0.40 m, base not exposed); bed 2 – marly intercalation (0.01 m); bed 3 – chalky limestones with cherts (0.20 m); bed 4 – marly intercalation (0.01 m); bed 5 – chalky limestones with cherts (1.20 m); bed 6 – marly intercalation (0.01 m); bed 7 – chalky limestones with abundant micrite matrix and flaggy weathering (1.10 m) [ammonites include: *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) – abundant, *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov. (Pl. 3: 1a, b, 3a, b), *G.* (*Coryceras*) *modestiforme* (Oppel), *Prorasenia crenata* (Quenstedt)]; bed 8 – marly intercalation (0.01 m); bed 9 – chalky limestones with cherts visible up to about 1 m [ammonites include: *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *costata*, *Orthosphinctes* (*Orthosphinctes*) *colubrinus* (Reinecke)]. Single specimens of *Amoeboceras* ex gr. *bauhini* (Oppel) (Pl. 6: 2) and *Praeataxioceras* spp have come from beds 8, 9; here also have been found: *Trimarginites trimarginatus* (Oppel) and (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *costata*.

Additional ammonites collected from rubble without precise location in the section include: *Taramelliceras* (*Taramelliceras*) *broilii* (Wegele), *T.* (*Richeiceras*) *jaeggii* Quereilhac, *T.* (*R.*) *lochense* (Oppel), *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov.

Bobrowniki – Pj 92 (former 92 Mi, also Bd 66)

A large, shallow, abandoned quarry, about 0.5 km to the north of the main road in Bobrowniki Village, and extending for about 70 meters in a southeast to north-west direction along the local road (coordinates: x – 22478, y – 96409). The section studied is exposed in the northern part of the quarry where the quarry face is still preserved (Figs 2, 3) and shows about 9.5 m of well-bedded limestones with thin marly intercalations. The beds are almost horizontal and show a dip about 3° to the north-west. The following succession is seen from the base:

Bed 1 (0.8 m seen, base not exposed): friable chalky limestones with cherts; interbeds of two more compact micritic limestones – 0.1–0.2 m in thickness – at the top of the bed and in the middle; an ammonite fauna is especially common in the topmost 0.2–0.3 m of bed 1, including: *Taramelliceras* (*Taramelliceras*) cf. *costatum laterinodosum* Karvé-Corvinus, *T.* (*T.*) cf. *costatum* (Quenstedt), *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov., *Taramelliceras* (*Richeiceras*) *lochense* (Oppel), *T.* (*R.*) cf. *pichleri* (Oppel), *T.* (*R.*) *jaeggii* Quereilhac, *Glochiceras* (*Coryceras*) *canale* (Quenstedt) (Pl. 5: 1, 2), *G.* (*C.*) *microdomum* (Oppel), *Aspidoceras binodum* (Oppel) (Pl. 12: 3), *Orthosphinctes* cf. *fontannesi* (Choffat), *Prorasenia* sp., *Amoeboceras* (*Plasmatites*) cf. *lineatum* (Quenstedt) (Pl. 6: 1a, b); *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita* (Pl. 1: 1) present 0.7 m below the top of the bed.

Thin marly intercalation (about 0.5 cm thick) at the boundary between beds 1 and 2.

Bed 2 (1.55 m) rich in sponges, subdivided into (from the base): chalky limestones with common cherts (0.55 m), chalky limestones with rare cherts (0.50 m), chalky limestones without cherts (0.50 m); ammonites

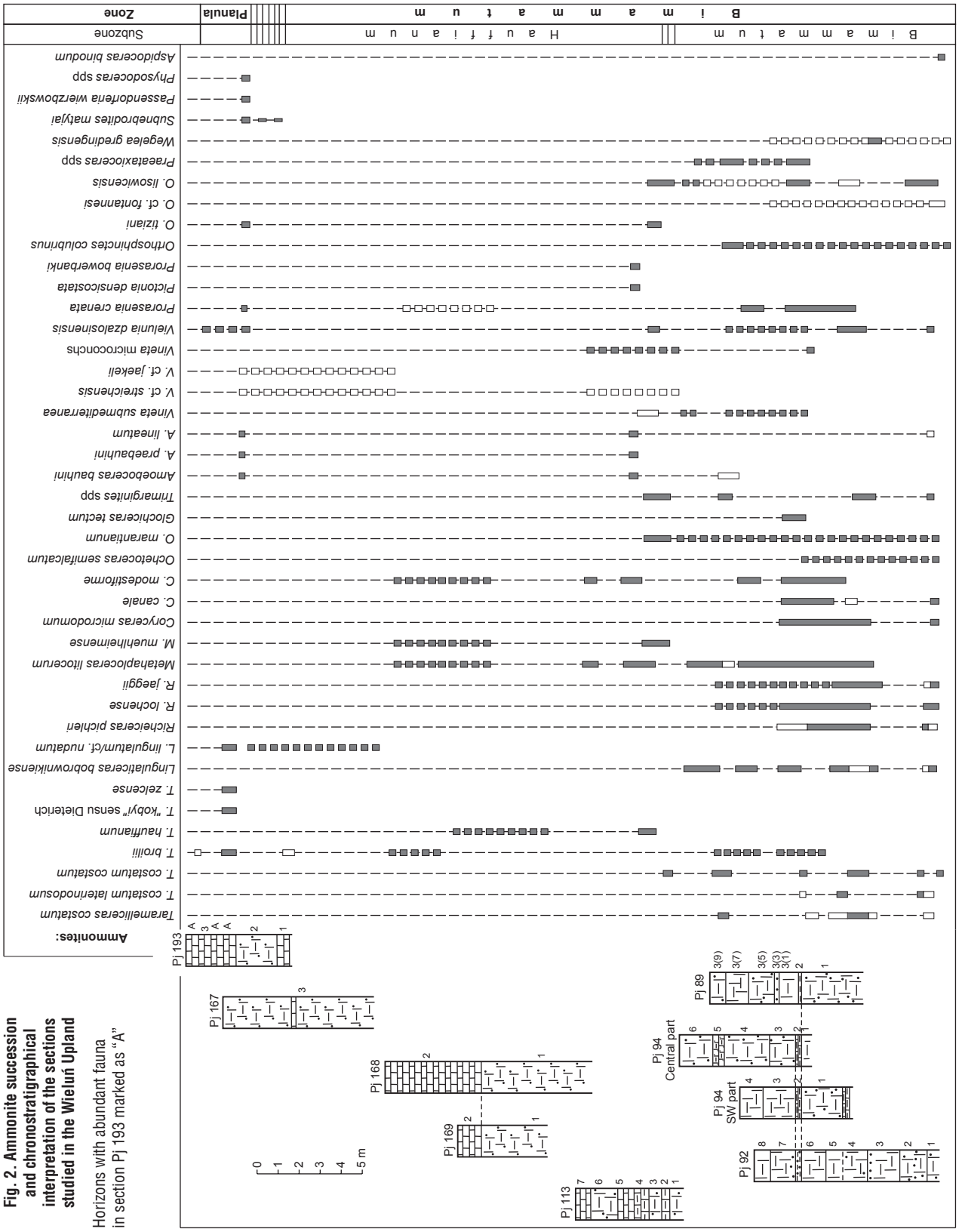

Fig. 2. Ammonite succession and chronostratigraphical interpretation of the sections studied in the Wieluń Upland

Horizons with abundant fauna in section Pj 193 marked as "A"

Fig. 3. Quarry Pj 92 at Bobrowniki – northern face (numbers of beds indicated)

include: *Trimarginites* sp., *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita*, *T.* (*T.*) *costatum laterinodosum* Karvé--Corvinus, *T.* (*T.*) cf. *costatum* (Quenstedt), *Glochiceras* (*Lingulaticeras*) cf. *bobrownikiense* sp. nov., *Taramelliceras* (*Richeiceras*) *lochense* (Oppel), *T.* (*R.*) *pichleri* (Oppel), *T.* (*R.*) cf. *jaeggii* Quereilhac, *Orthosphinctes* cf. *fonatannesi* (Choffat) and *Vielunia dzalosinensis* genus et sp. nov. (Pl. 9: 4) (all specimens from around 0.2 m above the base of the bed); *Orthosphinctes* (*Pseudorthosphinctes*) *lisowicensis* Wierzbowski.

Thin marly intercalation (about 1 cm thick) at the boundary of beds 2 and 3.

Bed 3 (1.20 m): fairly uniform in character and consisting of rather dense, locally also chalky limestones, cherts only in the uppermost part; ammonites rare: *Taramelliceras* (*Taramelliceras*) cf. *costatum* (Quenstedt), *T.* (*Richeiceras*) *jaeggii* Quereilhac (Pl. 4: 2a, b) (upper part of bed), *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov.

Thin marly intercalation (about 1 cm thick) at the boundary of beds 3 and 4.

Bed 4 (1.10 m): chalky limestones with rare cherts; ammonites include: *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita* (Pl. 1: 2), *T.* (*T.*) *costatum* (Quenstedt), *Glochiceras* (*Lingulaticeras*) cf. *bobrownikiense* sp. nov., *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) – abundant, *T.* (*Richeiceras*) *lochense* (Oppel), *T.* (*R.*) *jaeggii* Quereilhac (Pl. 4: 1a, b) (lower part of bed), *Taramelliceras* (*R.*) *pichleri* (Oppel), *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *G.* (*C.*) cf. *canale* (Quenstedt) (upper part of bed), *Trimarginites arolicus* (Oppel) (Pl. 5: 6), *T. trimarginatus* (Oppel), *Wegelea gredingensis* (Wegele) (Pl. 11: 3), *Vielunia dzalosinensis* genus et sp. nov. (upper part of the bed).

Distinctive marly intercalation (3–5 cm thick) with ammonites: *Prorasenia crenata* (Quenstedt).

Beds 5–6 (2.20 m) poorly divisible into a lower bed 5 (0.90 m) and an upper bed 6 (1.30 m) of chalky limestone without cherts; the topmost part of bed 6, about 0.4 m in thickness becomes more marly, weathers flaggy and contains numerous cherts; Bed 5 yielded ammonites including: *Taramelliceras* (*Taramelliceras*) cf. *costatum* (Quenstedt), *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov., *Taramelliceras* (*Richeiceras*) *lochense* (Oppel), *T.* (*R.*) *pichleri* (Oppel) (Pl. 4: 3), *T.* (*R.*) *jaeggii* Quereilhac,

Taramelliceras (*Metahaploceras*) *litocerum* (Oppel) – abundant, *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *Vielunia dzalosinensis* genus et sp. nov. (Pl. 9: 3), *Orthosphinctes* (*Pseudorthosphinctes*) cf. *lisowicensis* Wierzbowski; bed 6 yielded: *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) (Pl. 4: 4) – abundant, *T.* (*Richeiceras*) *lochense* (Oppel), *T.* (*R.*) *pichleri* (Oppel), *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *G.* (*C.*) *canale* (Quenstedt), *G.* (*C.*) *modestiforme* (Oppel) – abundant, *Prorasenia* sp., *Passendorferia* sp.

Bed 7 (1.10 m): chalky limestones with common cherts in the lower part; strongly flaggy weathering; ammonites common: *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov. (Pl. 3: 2a, b), *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) (Pl. 4: 5) – abundant, *T.* (*Richeiceras*) *lochense* (Oppel), *T.* (*R.*) cf. *pichleri* (Oppel), *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *G.* (*C.*) *canale* (Quenstedt), *G.* (*C.*) *modestiforme* (Oppel) (Pl. 5: 3, 4) – abundant, *Glochiceras* (*Glochiceras*) *tectum* Ziegler, *Prorasenia crenata* (Quenstedt) (Pl. 10: 1), *Orthosphinctes* (*Pseudorthosphinctes*) *lisowicensis* Wierzbowski (Pl. 10: 6), *Praeataxioceras* cf. *laufenensis* (Siemiradzki) (Pl. 11: 4); a single specimen of *Taramelliceras* (*Taramelliceras*) *broilii* (Wegele) (Pl. 1: 7) came from either bed 6 or 7.

Thin marly intercalation (about 1 cm thick) at the boundary of beds 7 and 8.

Bed 8 (at the top of the quarry, seen to 0.90 m): chalky limestones with strong flaggy weathering: *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel).

The following ammonites have been found in rubble: *Ochetoceras semifalcatum* (Oppel), *O. marantianum* (d'Orbigny) (see Wierzbowski, 1978, pl. 1: 1), *Orthosphinctes* (*Orthosphinctes*) *colubrinus* (Reinecke), *Orthosphinctes* cf. *fontannesi* (Choffat) (Pl. 11: 2), *Wegelea* cf. *gredingensis* (Wegele).

Bobrowniki Pj 94 (former 85 Mi, also Bd 68)

A large, but shallow and mostly grassed over, abandoned quarry (coordinates: x – 22494, y – 96434), north of the Bobrowniki Village, and about 250 m to the north-east of quarry Pj 92. Two fragmentary sections partly overlapping each other are accessible: in the southwestern part of the quarry (5.2 m thick), and in a central part of the quarry (about 6.2 m thick): these are the only two places where quarry faces are preserved. They provide a composite section which totals about 8.5 m in thickness (Fig. 2).

The southwestern part of the quarry shows the following succession (from the base):

Thin marly intercalation (2 cm thick) at the boundary between the lowest bed of chalky limestones (only its topmost part 0.2 m in thickness is exposed), and bed 1.

Bed 1 (2.0 m): chalky limestones with cherts; the limestones are subdivided into (from the base: chalky limestones without cherts (0.45 m), chalky limestones with rare cherts (0.35 m), chalky limestones with common cherts (1.2 m); ammonites include: *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov., *G.* (*Coryceras*) *modestiforme* (Oppel), *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus (Pl. 1: 4, 5) (from the lower part of the bed), and *T.* (*T.*) cf. *costatum* (Quenstedt) (from the upper part of the bed).

Bed 2 (0.28 m): micritic limestones with marly intercalations; ammonites: *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita* (Pl. 1: 3).

Bed 3 (1.4 m): chalky limestones without cherts; strongly flaggy weathering.

Thin marly intercalation (about 10 cm thick) at the boundary between beds 3 and 4.

Bed 4 (at the top of the quarry seen to 1.2 m): chalky limestones which are strongly flaggy weathered.

The central part of the quarry shows the following succession (from the base; the bed numbers correspond to those of southeastern part of the quarry):

Bed 1 (only the topmost part, 0.2 m in thickness is exposed): chalky limestones; ammonites include *Prorasenia crenata* (Quenstedt) (Pl. 10: 2).

Bed 2 (0.25 m): micritic limestones with marly intercalations; ammonites include: *Taramelliceras* (*Taramelliceras*) cf. *costatum laterinodosum* Karvé-Corvinus, *Vineta* [m] (Pl. 6: 6); in addition *Prorasenia crenata* (Quenstedt) (Pl. 10: 3, 4), *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita*, and *T.* (*T.*) *costatum laterinodosum* Karvé-Corvinus were found in rubble, possibly from beds 1–2.

Bed 3 (1.25 m): chalky limestones with cherts (rare in lower part, more common upwards); ammonites include: *Ochetoceras semifalcatum* (Oppel) (lower 0.5 m), *Glochiceras* (*Coryceras*) *microdomum* (Oppel).

Thin marly intercalation (6 cm thick) at the boundary between beds 3 and 4.

Bed 4 (2.10 m): chalky limestones with rare cherts; the limestones show flaggy weathering.

Bed 5 (0.55 m): chalky limestones with abundant micrite matrix; cherts common; very thin marly intercalations at the base, middle and top of the bed; ammonites include: *Taramelliceras costatum* (Quenstedt), *T.* (*Metahaploceras*) cf. *litocerum* (Oppel). Specimens of *Vineta submediterranea* (Wierzbowski) (Pl. 7: 1a, b, 2) and *Vielunia dzalosinensis* genus et sp. nov.

found in rubble appear to come from the stratigraphical interval corresponding to beds 3–5.

Bed 6 (at the top of the quarry seen to 1.80 m): chalky limestones, strongly flaggy weathered, cherts rare, ammonites not numerous including: *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov. and *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel).

Additional ammonites found in rubble, include: *Ochetoceras marantianum* (d'Orbigny) (Pl. 5: 5), *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus, *T.* (*Richeiceras*) cf. *jaeggii* Quereilhac, *Orthosphinctes* (*Orthosphinctes*) *colubrinus* (Reinecke) (Pl. 11: 1), *Orthosphinctes* (*Pseudorthosphinctes*) cf. *lisowicensis* Wierzbowski and *Praeataxioceras laufenensis* (Siemiradzki).

Raciszyn Pj 113 (former 113 Dz)

The section of the quarry and the ammonite fauna have been described in detail by Matyja, Wierzbowski (1997). The section is now poorly exposed and nothing new can be added to the general description of the succession shown in Figure 3, although new ammonite records, as well as revision of some former determinations are provided here. The ammonites from bed-unit 4, which were originally referred to as *Ringsteadia limosa* (Quenstedt) by Wierzbowski (1978, pl. 2: 10; *cf.* also Matyja, Wierzbowski, 1997), are now assigned to *Vielunia dzalosinensis* genus et sp. nov. (Pl. 8: 2). The ammonites referred to as *Ringsteadia submediterranea* Wierzbowski by Wierzbowski (1978) and Matyja and Wierzbowski (1997, pl. 5: 16), from bed-units 1 and 4–5, are now placed in the genus *Vineta* and referred to as *V. submediterranea* (Wierzbowski). *Vineta* cf. *streichensis* (Oppel) and *Vineta* [m] (Pl. 6: 7) have also been found in upper part of the section, well above the chalky limestones of bed-unit 1. The well known "upper *Amoeboceras* layer", which constitutes the middle part of bed-unit 5 (Matyja, Wierzbowski, 1997), is unfortunately not now exposed in the quarry, but has yielded: *Amoeboceras bauhini* (Oppel), *A. praebauhini* (Salfeld), *A. lineatum* (Quenstedt), *Pictonia densicostata* Buckman and *Prorasenia bowerbanki* Spath.

Additional ammonites records include: *Ochetoceras marantianum* (d'Orbigny) and *Trimarginites* sp. (bed-units 3, 4), as well as *Taramelliceras* (*Taramelliceras*) *hauffianum* (Oppel) (bed-unit 4).

Raciszyn Pj 167 (former 129 Dz): coordinates: x –22972, y – 96334; **Raciszyn Pj 168** (former 128 Dz): coordinates: x – 22987, y – 96340; and **Raciszyn Pj 169** (former 130 Dz): coordinates: x – 22973, y – 96355

These three, now completely grassed over, small quarries were situated at the top of a hill, about 0.5 km to the west of Raciszyn Village. The quarries were active in the 1970s, when the section was measured and ammonites were collected (A.W.). The section, now completely obscured, consisted of three rock units (from the base – see Fig. 2):

Unit 1: represented by medium- to thickly-bedded chalky limestones with cherts [recognized in Pj 168 (seen to 5.40 m) and Pj 169 (seen to 3.1 m), but its base was nowhere exposed].

Unit 2: represented by flaggy micritic limestones with thin marly intercalations; the limestones were generally thin- to medium-bedded (from 0.15 m to about 0.50 m thick) [recognized in Pj 168 (seen to about 4.5 m) and Pj 169 (seen to about 1.1 m) to the top of the quarries]; ammonites include: *Taramelliceras* (*Taramelliceras*) *broilii* (Wegele), *T.* (*Metahaploceras*) *muehlheimense* (Schweigert et Callomon), *T.* (*M.*) *litocerum* (Oppel), *Glochiceras* (*Coryceras*) *modestiforme* (Oppel), *Prorasenia* cf. *crenata* (Quenstedt) from both Pj 168 and Pj 169. In addition, a specimen of *T.* (*T.*) *hauffianum* (Oppel) was found in rubble in quarry Pj 169 (ex unit 1 or 2; see Wierzbowski, 1978, pl. 1: 13);

Unit 3: represented by thick-bedded chalky limestones with cavities after cherts; a thin (0.05 m) marly intercalation occurs in the middle of the rock unit. The unit was recognized in Pj 167 only, where it has been seen to about 7 m. A giant specimen of *Vineta* cf. *jaekeli* Dohm (Pl. 8: 1) and two small specimens referred to as *Vineta* cf. *streichensis* (Oppel) were found here, but unfortunately without precise location in the section. The same rock-unit, possibly its uppermost part, also yielded *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt) and *Subnebrodites matyjai* sp. nov.

A large specimen of *Vielunia dzalosinensis* genus et sp. nov. (Pl. 9: 2), previously referred to as *Ringsteadia limosa* (Quenstedt) by Wierzbowski (1970, pl. 3), has been found in rubble in the general area but not precisely localized as from Pj 167, Pj 168 or Pj 169.

Raciszyn Pj 193 (former 101 Dz)

The quarry (coordinates: x – 23114, y – 96338) is situated south of Raciszyn Village, near the top of the ENE–WSW hill between the village and the main road from Działoszyn to Częstochowa, and about 250 m to the east of the road. This abandoned quarry still has a well exposed face. The section in the eastern part of the quarry comprises a massive and thick bedded biohermal limestone which shows a transition towards the west to well bedded limestones. The latter show the following succession (Fig. 2):

Bed-set 1: (0.6 m only exposed) is represented by dense, flaggy limestones with sponges. A few ammonites are recognized here: *Taramelliceras* (*Taramelliceras*) cf.

broilii (Wegele), *Orthosphinctes* (*Pseudorthosphinctes*) sp., *Passendorferia* sp.

Bed-set 2: hard massive limestones with sponges, about 2 m in thickness, which show indistictly developed bedding towards the south; cherts and cavities after dissolved cherts common.

Bed-set 3: composed of white, fragile, porous, flaggy micritic limestones generally devoid of macrofauna and cherts; these limestones are the youngest partly replacing laterally the massive limestones of bed-set 2. The limestones attributed to bed-set 3 are 2.4 m in thickness to the top of the quarry. Only in three narrow horizons, each about 10 cm in thickness, is there an abundant fauna. This fauna consists mostly of ammonites, but also includes sponges, serpulids, bivalves, gastropods and crabs. The horizons with abundant fauna are recognized in the following intervals (from the base of the bed set): (1) from 0.4 to 0.5 m, (2) from 0.8 to 0.9 m and (3) from 1.9 to 2.0 m. **Horizon 1** yielded: *Taramelliceras* (*Taramelliceras*) *broilli* (Wegele), *T.* (*T.*) *zelcense* sp. nov. (Pl. 2: 1a, b, 2), *T.* (*T.*) "*kobyi* (Choffat)" sensu Dieterich (1940) (Pl. 2: 3a, b), *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt) (Pl. 3: 4–6), *Orthosphinctes* (*Orthosphinctes*) *tiziani* (Oppel), *Subnebrodites matyjai* sp. nov. (Pl. 12: 2), *Passendorferia* (*Enayites*) *wierzbowskii* Melendez, *Prorasenia crenata* (Quenstedt) (Pl. 10: 5), *Vineta* cf. *streichensis* (Oppel) (Pl. 7: 3), *Physodoceras* sp., *Amoeboceras* (*Plasmatites*) *bauhini* (Oppel) (Pl. 6: 5), *A.* (*P.*) cf. *praebauhini* (Salfeld) (Pl. 6: 4), *A.* (*P.*) *lineatum* (Quenstedt) (Pl. 6: 3). **Horizon 2** yielded: *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt), *G.* (*L.*) cf. *nudatum* (Oppel), *Taramelliceras* (*Taramelliceras*) *broilli* (Wegele), *T.* (*T.*) *zelcense* sp. nov., *T.* (*T.*) "*kobyi* (Choffat)"sensu Dieterich (1940). **Horizon 3** yielded *Taramelliceras* (*Taramelliceras*) cf. *broilli* (Wegele). In rubble from bed-set 2, *Vielunia dzalosinensis* gen. et sp. nov. (Pl. 9: 1), has also been found.

SUBMEDITERRANEAN AMMONITE SUCCESSION AND CORRELATION WITH OTHER AREAS OF THE SUBMEDITERRANEAN PROVINCE

The ammonites collected bed by bed in the sections studied at Bobrowniki and Raciszyn in the Wieluń Upland are predominantly Submediterranean in character. They facilitate recognition of the standard ammonite zones and subzones of the Submediterranean Upper Oxfordian including the Bimammatum Zone with the Bimammatum Subzone below, and the Hauffianum Subzone above, as well as the lowermost part of the Planula Zone (Fig. 2).

The large number of specimens collected (about 600 specimens) also makes possible an assessment of the proportions of the occurrence of particular groups of ammonites: *e.g.* in the Bimammatum Subzone where the number of specimens collected is the highest (415 specimens collected in quarries at Bobrowniki), Submediterranean ammonites represent 95.66% of the total number of specimens – with Oppeliidae dominating (88.92%) and less common Ataxioceratidae (5.54%), Perisphinctidae (0.96%) and Aspidoceratidae (0.24%); Subboreal (Aulacostephanidae) and Boreal (Cardioceratidae) ammonites, however, only constitute 3.86 and 0.48% of the total number of specimens, respectively.

The Bimammatum Subzone cannot be recognized in the succession studied by the occurrence of *Epipeltoceras bimammatum* (Quenstedt) because of its extremely rare occurrence in Poland. The only specimen of this species found in the Wieluń Upland (Matyja, Wierzbowski, 1997, pl. 10: 5) – and possibly the only one found so far in the extra-Carpathian Poland – comes from the oldest deposits in the quarry Pj 113 at Raciszyn, which are developed as biohermal limestones. The well-bedded limestones seen in the quarries at Bobrowniki, which attain 13.5 m in thickness and yield the abundant ammonites discussed here, are approximately the lateral equivalent of the deposits in question of Raciszyn Pj 113 quarry. The ammonites recognized in the succession studied at Bobrowniki comprise three main groups of species whose occurrence correlates the Bimammatum Subzone and makes possible its informal subdivision, as follows: (1) species which are known in the Hypselum Zone (or its stratigraphical equivalents *e.g.* the Semiarmatum Subzone of Bonnot *et al.*, 2009) and which range into a lower part of the Bimammatum Subzone only (*cf. e.g.* Cariou *et al.*, 1997; Schweigert, Callomon, 1997; Quereilhac, 2009; Bonnot *et al.*, 2009) – for instance *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *G.* (*C.*) *canale* (Quenstedt), *Taramelliceras* (*Richeiceras*) *pichleri* (Oppel), *T.* (*R.*) *lochense* (Oppel), *T.* (*R.*) *jaeggii* Quereilhac and *Orthosphinctes* cf. *fontannesi* (Choffat); (2) species known in the Hypselum Zone and which range to the top of the Bimammatum Subzone (*cf. e.g.* Zeiss, 1966) including *Taramelliceras* (*Taramelliceras*) *costatum* (Quenstedt) and possibly also *Glochiceras* (*Lingulaticeras*) *bobrownikiense*; (3) species which appear in the Bimammatum Subzone and which range into the Hauffianum Subzone (and sometimes also the Planula Zone) (*cf. e.g.* Cariou *et al.*, 1997; Matyja, Wierzbowski, 1997; Olóriz *et al.*, 1999; Gygi, 2000) including *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel), *Glochiceras* (*Coryceras*) *modestiforme* (Oppel), *Ochetoceras marantianum* (d'Orbigny), *O. semifalcatum* (Oppel), *Orthosphinctes* (*Pseudorthosphinctes*) *lisowicensis* Wierzbowski, *Wegelea gredingensis* (Wegele) and *Aspidoceras binodum* (Oppel). Using these palaeontological data, the interval attributed to the Bimammatum Subzone

can be informally subdivided into two parts: a lower part characterized by the co-occurrence of species of group 1 and some of group 3 (*Ochetoceras semifalcatum*, *O. marantianum*, *Orthosphinctes lisowicensis*, *Wegelea gredingensis* and *Aspidoceras binodum*); and an upper part characterized by the co-occurrence of ammonites of group 2 and some of group 3: *Taramelliceras* (*Metahaploceras*) *litocerum*, *Glochiceras* (*Coryceras*) *modestiforme* (although both these species appear already in the lower part of the subzone) and the virtual absence of ammonites of group 1. An approximate boundary between these two parts of the subzone runs above bed 7 of quarry Pj 92, and bed 3 of quarry Pj 94 at Bobrowniki (see Fig. 2). The base of the Bimammatum Subzone is, however, not exposed at Bobrowniki.

The top of the Bimammatum Subzone corresponds to the top of bed-unit 3 in the quarry Pj 113 at Raciszyn, which marks the highest occurrence of *Taramelliceras costatum* (Quenstedt) (Matyja, Wierzbowski, 1997). In the past, however, there were problems with the correct recognition of the stratigraphical range of *T. costatum*, and Schweigert (1995) noted that *T. costatum* occurred in a *laufenensis* horizon which was originally correlated by him with the lower part of the Hauffianum Subzone. Schweigert and Callomon (1997), however, state that the species *Praeataxioceras laufenensis* (Siemiradzki), as well as the species *T. costatum*, occur in the *bimammatum* horizon of the Bimammatum Zone. The latter is in agreement with data presented herein showing the co-occurrence of *Praeataxioceras laufenensis* and *Taramelliceras costatum* in the Bimammatum Subzone in the sections at Bobrowniki. Wierzbowski (1978), however, previously distinguished an *Idoceras planula–Taramelliceras costatum* horizon correlated with lower part of the Planula Zone. This proposal, however, was based on an incorrect correlation, and the horizon in question in fact corresponded to the wide stratigraphical interval from the top of the Bimammatum Subzone, through the Hauffianum Subzone, up to the lowermost part of the Planula Zone.

The Hauffianum Subzone originally included a stratigraphical interval characterized (Oppel, 1863, p. 175) in southwestern Germany by a wide assemblage of ammonites with *int. al. Taramelliceras hauffianum* (Oppel), *Trimarginites trimarginatus* (Oppel), *Ochetoceras marantianum* (d'Orbigny), *Orthosphinctes tiziani* (Oppell) *Amoeboceras bauhini* (Oppel), and others. This assemblage of ammonites, according to Schweigert and Callomon (1997), corresponds precisely to that of their *bauhini* horizon. The horizon is now best exposed in a quarry at Plettenberg, southwestern Germany, where it is underlain by a poorly defined *tizianiformis* horizon with *Orthosphinctes tizianiformis* (Choffat) and *Taramelliceras* cf. *hauffianum* (Oppel) (Schweigert, Callomon, 1997). Both these horizons are attributed to the Hauffianum Subzone. It should be noted, however, that the detailed ranges of the species indicative of the Hauffianum Subzone have never been demonstrated in the Plettenberg section and that the total thickness of the deposits there reaches about 5 meters of which about 1.5 m corresponds to the *bauhini* horizon (Schweigert, Callomon, 1997). The *bauhini* horizon is overlain in SW Germany by deposits of the Planula Zone, with a distinct regional stratigraphical gap at the zonal boundary (Schweigert, Callomon, 1997, figs 6, 7; Matyja, Wierzbowski, 1997).

In the Wieluń Upland the base of the Hauffianum Subzone has been correlated by the appearance of *T. hauffianum*, and the top by the appearance of the first representatives of *Subnebrodites* indicative of the Planula Zone. The total thickness of deposits of the Hauffianum Subzone is here much larger than in southwestern Germany and attains about 15–18 m (Matyja, Wierzbowski, 1997, fig. 3; text-fig. 2). In the area studied at Raciszyn and Lisowice, ammonites of the subgenus *Taramelliceras* occur abundantly in the lowermost part of the subzone (*T. hauffianum*) and in upper part of the subzone (*T. broilii*, *T.* "*kobyi*" sensu Dieterich, and possibly rare *T. hauffianum* also) (see Matyja, Wierzbowski, 1997, fig. 3; text-fig. 2). Ammonites of the subgenus *Metahaploceras* prevail in the lower part of the Hauffianum Subzone and may even constitute the only oppeliid assemblage occurring in the subzone. They are mainly represented by the dimorphic pair: *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) – *Glochiceras* (*Coryceras*) *modestiforme* (Oppel). The dominance of these ammonites delineates the *litocerum* horizon as distinguished by Matyja and Wierzbowski (1997) in the lower part of the Hauffianum Subzone. This horizon is nearly 5 m in thickness and contains a narrow interval, 0.15–0.40 m in thickness, rich in Boreal ammonites of the genus *Amoeboceras* (the "upper *Amoeboceras* layer" of Matyja, Wierzbowski, 1997).

The base of the Planula Zone in the Wieluń Upland is marked by the appearance of small-sized representatives of the genus *Subnebrodites*. These were originally compared with the species *Subnebrodites minutum* (Dieterich), and the *minutum* horizon was recognized in the succession (Matyja, Wierzbowski, 1997). It has been noted, however, that the horizon in Poland occurs at a lower level than the *minutum* horizon distinguished in the Iberian Chain, southeastern France and Algeria (*cf.* Atrops, Melendez, 1994; see Matyja, Wierzbowski, 1997, and earlier papers cited therein) which corresponds to the highest part of the Planula Subzone directly below the Galar Subzone. Schweigert and Callomon (1997) independently showed that the type level of *S. minutum* (Dieterich) is the *schroederi* horizon in southern Germany, which represents the uppermost part of the Planula Subzone. The small-sized ammonites from the base of the Planula Zone in the Wieluń Upland were, consequently, then referred to as *Subnebrodites* aff. *minutum* (Dieterich)

and the horizon "aff. *minutum*" recognized at the base of the Planula Zone in the study area (Matyja, Wierzbowski, 2006). As the specimens in question differ in morphology and stratigraphical distribution from those of *S. minutum sensu stricto* a new species is established here, *Subnebrodites matyjai* sp. nov. The latter's occurrence is therefore indicative of the lowermost part of the Planula Zone in the area of study – the *matyjai* horizon (see Fig. 2). Although the horizon in question has not yet been unequivocally recognized so far in other Submediterranean successions within Europe, its absence in southern Germany can be easily explained as a result of a stratigraphical gap at the boundary of the Bimammatum Zone and the Planula Zone; it may, however, occur in southern Spain where "*Subnebrodites* n. sp. gr. *minutum* (Dieterich)" has been recorded, but not illustrated, in the lower part of the Planula Zone (Olóriz *et al.*, 1999).

The *matyjai* horizon is recognized in the following quarries in the Wieluń Upland – Pj 139/140 at Lisowice (= "*minutum* horizon" in Matyja, Wierzbowski, 1997), Pj 167 at Lisowice (unit 3 – uppermost part), and Pj 193 at Raciszyn (unit 2), where its total thickness does not exceed a few meters. In addition to the index form, other ammonites also occur, especially numerous oppeliids including *Taramellicereas zelcense* sp. nov. and less commonly ataxioceratids (*Orthosphinctes*), perisphinctids (*Passendorferia*) and aulacostephanids (Fig. 2). This is the level where small sized representatives of the *Amoeboceras* (*Plasmatites*) *bauhini – praebauhini – lineatum* group re-appear in the succession – but not so abundantly as below in the "upper *Amoeboceras* layer" in the lower part of the Hauffianum Subzone.

Some differences in ammonite species abundance (especially in the Oppeliidae) relating to local environmental conditions are observed in the *matyjai* horizon in the area of the Wieluń Upland studied. In quarry Pj 139/140 the horizon yielded representatives of both *T.* (*Taramelliceras*) [M] and *Glochiceras* (*Lingulaticeras*) [m], as well as of *T.* (*Metahaploceras*) [M] and *G.* (*Coryceras*) [m] (*cf.* Matyja, Wierzbowski, 1997). In quarry Pj 193, however, the *matyjai* horizon yielded only representatives of *T.* (*Taramelliceras*) (*T. broilii*, *T.* "*kobyi*" sensu Dieterich and *T. zelcense* sp. nov.) and *G.* (*Lingulaticeras*) (*L. lingulatum – L.* cf. *nudatum*) in abundance (more than 100 ammonites constituting about 83% of the total number of specimens). Whereas the deposits in quarry Pj 139/140 are the "normal" bedded sediments of the interbiohermal area containing a "normal" benthic fauna, those from quarry Pj 193 are micritic limestones mostly devoid of benthic fauna, except rare, thin levels where the fauna occurs. The latter deposits therefore represent a highly stressed local environment, possibly a local depression within the biohermal complex, where the conditions were difficult for benthic organisms (*e.g.* due to oxygen deficiency and/or soupy substrate): and only temporarily conditions enabling the colonization of the sea floor developed. At such levels short-lived faunal assemblages consisting of rare sponges, serpulids, bivalves, gastropods and crabs associated with fairly numerous ammonites flourished temporarily. The ammonites appearing here represent inhabitants of neighbouring bioherms and consist mostly of the coeval oppeliid assemblage – both micro- and macroconchs (see chapter on systematic palaeontology).

SUBBOREAL/BOREAL AMMONITES AND THEIR CORRELATION IMPORTANCE

The Boreal ammonites from the succession studied consist of small-sized Cardioceratidae of the genus *Amoeboceras* and subgenus *Plasmatites*, representing the *A.* (*P.*) *bauhini* group. These occur abundantly in a lower part of the Hauffianum Subzone, in the so called "upper *Amoeboceras* layer" (Matyja, Wierzbowski, 1997, 2006), where they are represented by three closely related forms – *A. bauhini* (Oppel), *A. praebauhini* (Salfeld) and *A. lineatum* (Quenstedt). The same assemblage of forms has also been discovered close to the base of the Planula Zone – in the *matyjai* horizon (Fig. 3; *cf.* also Matyja, Wierzbowski, 1997, 2006). In contrast, ammonites of the genus *Amoeboceras* are always very scarce in the Bimammatum Subzone. However, two small specimens are described here from Bobrowniki: *Amoeboceras* (*Plasmatites*) cf. *lineatum* (Quenstedt) from the lower part of the subzone (Pj 92, bed 1) and *A.* (*P.*) ex gr. *bauhini* (Oppel) from the upper part of the subzone (Pj 89). These Boreal ammonites indicate that the whole succession studied at Bobrowniki should be correlated with the Boreal Bauhini Zone, *i.e.* with the Boreal lowermost Kimmeridgian (see Matyja *et al.*, 2006; Wierzbowski *et al.*, 2006, and older references given therein).

The Subboreal ammonites from the sections of the Wieluń Upland studied comprise mainly an unusual peculiar group of the family Aulacostephanidae, the genus *Vineta* [M and m], and the genera *Vielunia* gen. nov. [M] – *Prorasenia* [m]. The two macroconch genera, *Vineta* and *Vielunia*, have usually been referred in the past to the Subboreal genus *Ringsteadia* (*e.g.* Wierzbowski, 1966, 1970, 1978; Matyja, Wierzbowski, 1997), but were treated as representing the Submediterranean end-members of the *Ringsteadia* lineage which diverged markedly from their Subboreal ancestors. Conversely, however, it was seen that the ornamentation of the inner whorls of the ammonites in question resembles that of the genus *Pictonia*, and that "these ammonites are possibly the involute Submediterranean analogues of true *Pictonia* from the Subboreal and Boreal succession" (Wierzbowski, 1994, p. 19). The similarity of the innermost whorls of the genus *Vineta* to those of

the Subboreal genus *Pictonia* was also noted by Schweigert and Callomon (1997, p. 24).

This similarity of *Vineta* and *Vielunia* to Subboreal *Pictonia* (see also chapter on systematic palaeontology), the similarity of the associated microconchs (*Prorasenia*), which occur both in the Submediterranean and in the Subboreal successions, strongly suggests that the correlation of the stratigraphical interval in the sections of the Wieluń Upland studied (from the Bimammatum Subzone up to the Planula Zone) is with the Subboreal lowermost Kimmeridgian (Baylei Zone). It should be also mentioned that ammonites of the genera *Vineta* and *Prorasenia* occur together with the Boreal ammonites *Amoeboceras* (*Plasmatites*) in a section at Mikhalenino on the Russian Platform, indicating the Boreal Bauhini Zone (= the Subboreal Baylei Zone interval of the Boreal/Subboreal lowermost Kimmeridgian: Głowniak *et al.*, 2010, this issue). The ammonites from the deposits of the *tizianiformis* horizon (lower part of the Hauffianum Subzone) in southwestern Germany referred originally to as *Ringsteadia* cf. *evoluta* Salfeld (Schweigert, Callomon, 1997, p. 45) are in fact also representatives of *Vineta* (G. Schweigert – pers. inf.).

According to Schweigert and Callomon (1997), the deposits of the *bimammatum* horizon in southwestern Germany have yielded a few Boreal ammonites including *Amoeboceras* (*Plasmatites*) *praebauhini* (Salfeld) and *Amoeboceras* cf. *rosenkrantzi* Spath both illustrated by Schweigert (2000, pl. 1: 8; fig. 2a). The co-occurrence of these ammonites is in the lowermost part of the Boreal Bauhini Zone (Matyja *et al.*, 2006; Wierzbowski *et al.*, 2006). It should be also mentioned that the deposits containing *Taramelliceras costatum* (Quenstedt), well above the occurrence of *Epipeltoceras berrense* (Favre) and corresponding to the Bimammatum Subzone in southern Germany, have also yielded rare ammonites referred to *Amoeboceras bauhini* (Oppel); these ammonites, according to Zeiss (1966), are closely comparable with the holotype of the species, which confirms the correlation of at least a part of the Bimammatum Subzone with the lowermost Boreal Kimmeridgian.

Typical Subboreal ammonites of the genus *Pictonia* comparable to forms known from northwestern Europe are very scarce in the succession studied in the Wieluń Upland. Only deposits corresponding to the short-time invasional occurrences of Boreal ammonites of the *Amoeboceras bauhini* group have yielded some ammonites of the northwestern European Subboreal affinity. The "upper *Amoeboceras* layer" in the lower part of the Hauffianum Subzone, as well as a layer with *Amoeboceras* in the lowermost Planula Zone (*matyjai* horizon), have yielded small-sized *Pictonia densicostata* (Buckman) and *Prorasenia bowerbanki* Spath (see Matyja, Wierzbowski, 1997, pl. 5: 5–13; *cf.* also Wright, 2010).

SYSTEMATIC PALAEONTOLOGY

(by Andrzej Wierzbowski and Ewa Głowniak)

The following abbreviations are used in the descriptions of the ammonites: D – diameter of specimen in mm; Wh – whorl height as percentage of D; Ud – umbilical diameter as percentage of D; Wb – whorl breadth as percentage of D; C – coiling index expressed as whorl height/umbilical diameter ratio (coiling is evolute when C <1; coiling is involute when C >1); PR – number of primary ribs per whorl (or half a whorl – when indicated); SR/PR – secondary/primary ribs ratio calculated at 5 primary ribs at given diameter.

Specific names are used in the sense of "morphospecies" having vertical ranges as opposed to isochronous "horizontal" assemblages thought to represent the variable "biospecies" members in the particular lineages. Generic names are used in a similar morphogeneric sense. The dimorphism, when strongly marked in shell morphology as is encountered especially within Oppeliidae and Aulacostephanidae, is traditionally expressed morphotaxonomically at the generic and species level [*e.g.* in Oppeliidae the existing generic level names are retained, but they are grouped together as corresponding groups of macro- and microconchs: *Taramelliceras* (*Taramelliceras*) [M] – *Glochiceras* (*Lingulaticeras*) [m], *Taramelliceras* (*Richeiceras*, *Metahaploceras*) [M] – *Glochiceras* (*Coryceras*) [m], *Ochetoceras* [M] – *Glochiceras* (*Glochiceras*) [m]]. The dimorphism of particular groups of ammonites studied both on generic, and if possible species level, is interpreted and discussed below in the systematic part of the paper. This taxonomical approach results not only from stratigraphical purposes, because the retaining of well-known names of morphospecies having vertical ranges is undoubtedly useful in stratigraphy, but it also results from the still unclear dimorphic relations between particular groups of ammonites as shown by different authors. There is no doubt, however, that the classification should strive towards a natural taxonomy based on a succession of biospecies. So far, however, the arbitrary declaration of natural taxonomy in relation to the ammonites studied seems premature.

Family **Oppeliidae** Bonarelli, 1894

Genus *Taramelliceras* Del Campana, 1905 [M]

Subgenus *Taramelliceras* Del Campana, 1905 [M]

Type species: *Ammonites trachynotus* Oppel 1863.

The bulk of the specimens represents the *Taramelliceras costatum* group sensu Hölder (1955). The following species are recognized here: *T.* (*T.*) *costatum* (Quenstedt),

T. (*T.*) *hauffianum* (Oppel) and *T.* (*T.*) *broilii* (Wegele). These species occur commonly in the sections of the Wieluń Upland and have been illustrated and commented on before (Wierzbowski, 1978; Matyja, Wierzbowski, 1997).

The two species – *T. hauffianum* and *T. broilii* – are generally well known (*e.g.* in Schweigert, Callomon, 1975). The species *T. hauffianum* occurs in the Hauffianum Subzone – mostly in its lower part (*e.g.* quarries Pj 113 and 114 at Raciszyn where it is known below the *Amoeboceras* layer – *cf.* Matyja, Wierzbowski, 1997, pl. 4: 11; Wierzbowski, 1978, pl. 1: 14), but it occurs possibly also higher in the Hauffianum Subzone (quarry Pj 169 at Raciszyn: see specimen illustrated in Wierzbowski, 1978, pl. 1: 13, which was erroneously referred to the Planula Zone); the species *T. broilli* already appears in the upper part of the Bimammatum Subzone (quarry Pj 89 at Tasarze near Bobrowniki; Pj 92 at Bobrowniki – beds 6, 7: see Pl. 1: 7), but it becomes common in the Hauffianum Subzone (see quarries Pj 168 and 169 at Raciszyn), especially in its upper part, and the lowermost part of the overlying Planula Zone (quarry Pj 193 at Raciszyn – bed-set 1 and 3: horizons 1–3; *cf.* also Matyja, Wierzbowski, 1997, pl. 4: 9–12; see also Wierzbowski, 1978: pl. 1: 6, 11, 12).

Newly collected material supplements the palaeontological knowledge on *T. costatum*, and thus the species is briefly described below.

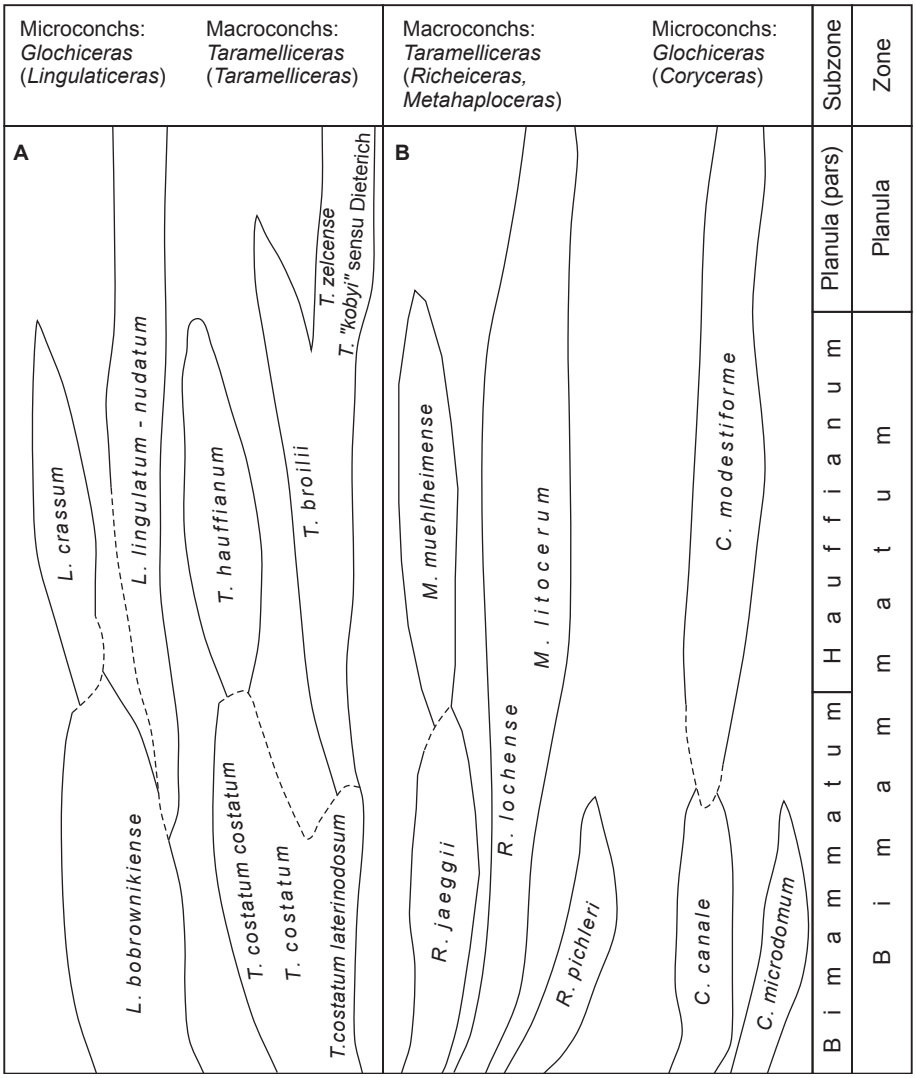

Fig. 4. Phylogeny of oppeliid ammonites during Bimammatum and earliest Planula chrons

The groups of micro- and macroconchs of *Taramelliceras* and *Glochiceras* as interpreted here include: **A.** *Lingulaticeras* [m] and *Taramelliceras* [M]; **B.** *Coryceras* [m] and *Richeiceras* [M] – *Metahaploceras* [M]

A special comment is also given to the form referred here as *Taramelliceras* (*Taramelliceras*) "*kobyi* (Choffat)" sensu Dieterich (1940), as well as the newly established species *T.* (*T.*) *zelcense* sp. nov. These forms show close affinity to some species of the *T. costatum* group including *T. costatum* and *T. broilii* (see Fig. 4A), and they seem not to be related to "true" *Taramelliceras kobyi* (Choffat) (see below).

Taramelliceras (*Taramelliceras*) *costatum* (Quenstedt)

The species *T. costatum* occurs in the Bimammatum Subzone (Quarry Pj 89 at Tasarze near Bobrowniki up to the top of the section; quarry Pj 92 at Bobrowniki beds 1–5; quarry Pj 94 at Bobrowniki beds 1, 2 and 5; quarry Pj 113 at Raciszyn – bed unit 2 – *cf.* Matyja, Wierzbowski, 1997). Two subspecies are represented in the material studied: *T.* (*T.*) *costatum costatum* (Quenstedt) and *T.* (*T.*) *costatum laterinodosum* Karvè-Corvinus (see description below).

Taramelliceras (*Taramelliceras*) *costatum costatum* (Quenstedt)

(Pl. 1: 1–3)

1955 *Taramelliceras* (*Taramelliceras*) *costatum* (Quenstedt); Hölder, pp. 95–99, text-figs 63–68, 74; pl. 17: 9, 11–12 (with given synonymy).
1978 *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt); Wierzbowski, p. 317, pl. 1: 5, non 6 (= *T. broilii*).
1978 *Taramelliceras* (*Taramelliceras*) *costatum auritum* (Quenstedt); Wierzbowski, p. 317, pl. 1: 7, 8.
1997 *Taramelliceras* (*Taramelliceras*) *costatum* (Quenstedt); Matyja, Wierzbowski, pl. 4: 13.

Discussion. — Besides the forms referred to as *T.* cf. *costatum* by Hölder (1955) which are "transitional" in character to other *Taramelliceras* species, the small-sized "*mikrogerontische*" forms of the species, as well as the three formerly distinguished subspecies (*T. costatum rivale* Hölder, *T. costatum pingue* (Quenstedt) and *T. costatum nodoserratum* Hölder), the bulk of the specimens illustrated and placed in the synonymy of the species *T. costatum* by Hölder (1955) correspond to the two main forms of Quenstedt (1887) – *i.e.* to "forma *costata*" (with rounded ventrolateral tubercles) and "forma *aurita*" (with longitudinally elongated tubercles on the body chamber). These two forms are encountered in the material studied: they are closely related and joined together by specimens intermediate in character, and both can be treated as the most typical of the species (Hölder, 1955), and thus they are placed here within the nominative subspecies.

Stratigraphical range and occurrence. — All the specimens studied come from the Bimammatum Subzone (quarries Pj 92, beds 1, 2 and 4; and Pj 94, bed 2, both at Bobrowniki); also quarry Pj 89 (unit 3: bed 9) at Tasarze near Bobrowniki, and quarry Pj 113 at Raciszyn (unit 2 – *cf.* Matyja, Wierzbowski, 1997).

Taramelliceras (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus

(Pl. 1: 4–6)

1966 *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus; Karvé-Corvinus, p. 122, pl. 26: 3.
1978 *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus; Wierzbowski, p. 317, pl. 1: 9.

Description. — This subspecies shows the general features of *T. costatum*, but with strongly developed mid-lateral tubercles. The primary ribs bearing mid-lateral tubercles are generally strong, as are the corresponding secondaries which end with prominent, conical, ventrolateral tubercles. The number of weakly developed secondary ribs placed between secondary ribs with ventrolateral tubercles is usually 5 to 6. The final size of fully grown specimens is about 60–80 mm.

Discussion. — The specimens attributed to this subspecies differ from those of *T. costatum costatum* in its presence of strongly developed mid-lateral tubercles, as well as rather loosely spaced, strongly accentuated secondary ribs with ventrolateral tubercles and fairly numerous subdued secondaries. They resemble in some features representatives of *T. broilii* which occur in younger deposits (Fig. 4A).

Stratigraphical range and occurrence. — The specimens studied come from the lower part of the Bimammatum Subzone. They have been found in following quarries: Pj 92 (Bobrowniki) – beds 1–2; Pj 94 (Bobrowniki) – beds 1–2.

Taramelliceras (*Taramelliceras*) *zelcense* Wierzbowski et Głowniak sp. nov.

(Pl. 2: 1, 2)

1978 *Taramelliceras sarasini* (Loriol); Wierzbowski, p. 217, pl. 2: 1, 2.

Type material: holotype (specimen no. ZI/50/134) figured in Pl. 2: 1a, b, paratype (specimen no. ZI/50/125) figured in Pl. 2: 2.
Type area and locality: Wieluń Upland, Raciszyn Village (quarry Pj 193 – bed-set 3: horizons 1–2) and surroundings of Działoszyn – near Lisowice Village (quarry Dz 133: see Wierzbowski, 1978).
Type horizon: Lower part of the Planula Zone (matyjai horizon), but the species may occur already in the upper part of the Hauffianum Subzone.
Derivation of the name: After Zelce Hill – a nature reserve in the Wieluń Upland.
Diagnosis: Medium-sized species with moderately strong ribs with rounded ventrolateral tubercles on inner whorls up to initial part of body chamber, and thin, densely placed ribs on body chamber with elongated ventrolateral tubercles; ventral side of whorls rounded with median row of small tubercles.

Material. — Eight specimens referred to the species, and five additional specimens referred to as cf. *zelcense*.

Description. — Specimens attain from about 35 to about 70 mm in diameter. The phragmocone/body chamber boundary is at about 20 to 40 mm diameter. The body chamber is a little more than a half whorl long. Coiling is strongly evolute (Wh = 54–58%), and the umbilicus is fairly narrow (Ud = 13–15%). The whorl-section is high-oval; the maximum thickness is at the middle of the whorl height. The ventral side is rounded with a median row of small tubercles. Ornamentation of the inner whorls up to the initial part of the body chamber consists of moderately strongly developed, rather loosely spaced, falcate ribs somewhat accentuated at the mid-height of the whorl, and bearing small rounded tubercles near the ventral side. The ornamentation of the body chamber consists mostly of thin, subdued, densely placed ribs and ventrolateral tubercles which are elongated in the rib direction.

Discussion. — The specimens studied reveal that there is a marked difference in ornamentation between the phragmocone and the body chamber of this species: the phragmocone shows ornamentation somewhat similar to that of the inner whorls of *Taramelliceras broilii*, whereas the ornamentation of the body chamber consists of thin ribs with elongated ventrolateral tubercles and is easily distinguishable from that of *T. broilii*. On the other hand, the body chamber of *T. zelcense* shows a marked similarity to that of *T.* "*kobyi*", but it differs in the presence of median ventral tubercles continuing up to the end of the body chamber.

There is some similarity between *T. zelcense* and the holotype of *Taramelliceras sarasini* (de Loriol) which is represented by the body chamber only (de Loriol, 1902, pl. 3: 19). This is why the specimens of this new species have been compared with the species *T. sarasini* (Wierzbowski, 1978). The species *T. sarasini* shows, however, as proved by a new find, rather weakly ornamented inner whorls, and it occurs in the Middle Oxfordian (Quereilhac, 2009, pp. 14–15, pl. 5: 1–6, and earlier papers cited therein); it thus differs markedly from *T. zelcense*.

Stratigraphical range and occurrence. — The species *T. zelcense* has been encountered in the lowermost part of the Planula Zone (quarry Pj 193 at Raciszyn – bed-set 3: horizons 1–2; but also in similar stratigraphical position in the quarry Pj 133 at Lisowice near Działoszyn – *cf.* Wierzbowski, 1978).

Taramelliceras (*Taramelliceras*) "*kobyi* (Choffat)"sensu Dieterich (1940)

(Pl. 2: 3)

1940 *Oppelia kobyi* Choffat; Dieterich, p. 29.
1955 *Taramelliceras* (?*Metahaploceras*) *kobyi* (Choffat); Hölder, pp. 125–129; text-figs 129–137, 156.
1978 *Taramelliceras* cf. *kobyi* (Choffat); Wierzbowski, p. 217, pl. 2: 4.
1994 *Taramelliceras* (? *Metahaploceras*) *kobyi kobyi* (Choffat); Schlegelmilch, p. 38, pl. 10: 7.
1997 *Taramelliceras kobyi kobyi* (Choffat); Matyja, Wierzbowski, pl. 4: 4.
?1997 *Streblites kobyi* (Choffat) in text = *Taramelliceras kobyi* (Choffat) in plate; Schweigert, Callomon, p. 13, pl. 3: 2.

Material. — Twelve specimens – often complete with final peristome preserved.

Description. — The specimens attain from about 80–120 mm when fully grown; the body chamber being about half a whorl long. The phragmocone ends at about 70 to 100 mm (some incomplete specimens about 60 mm in diameter show the final part of phragmocone at about 40–60 mm diameter). Coiling is strongly involute (Wh = 55–58%; Ud = 8.5–9.5%). The whorl section is high-oval (Wd = 25–29%). The ornamentation of the inner whorls, up to the initial part of the final body chamber, consists of rather weakly developed, loosely spaced primary ribs, somewhat accentuated at the mid-height of whorl; the outer part of the whorl is covered by numerous, concave secondary ribs with weak ventrolateral tubercles, which are elongated in the rib direction. The final ornamentation consists of dense, subdued falcate ribs, and it usually occupies about one-third of a whorl. The ventral side of the whorl is rounded and smooth (at least as observed on the final part of the phragmocone and the body chamber), but it may bear fine small tubercles as sometimes observed on the inner whorls of the phragmocone.

Discussion. — The species *T. kobyi* (Choffat) as illustrated and described by Choffat (1893, pp. 22, 23; pl. 16: 13, 14; pl. 16bis: 2a, b) represented specimens probably related to *Taramelliceras/Streblites externnodosum* (Dorn) (see Hölder, 1958 p. 63; *cf.* Schweigert, Callomon, 1997; *cf.* also Ziegler, 1974, p. 12). On the other hand, there was a group of specimens including such forms as the "Swabian" *Taramelliceras* "*kobyi* (Choffat)" sensu Dieterich (1940; see also Hölder, 1955) which differs from the "true" *T. kobyi* (Choffat) in having a somewhat thicker whorl section, and in weakly developed tubercules on the ventral side. These specimens were illustrated by Hölder (1955, fig. 15: 132–134, 136) and Schlegelmilch (1994, pl. 10: 7). The Polish specimens described here (see also Wierzbowski, 1978, p. 217; Matyja, Wierzbowski, 1997) are also closely comparable with the "Swabian" *T.* "*kobyi*". The latter specimens have their phylogenic continuation in younger forms treated as representing separate subspecies, such as *T.''kobyi*" *quenstedti* Hölder and *T.* "*kobyi*" *wegelei* Schairer, differing in generally stronger and more distant ribbing, and a somewhat wider umbilicus (Schairer, 1972, 1983). It should be remembered that the stratigraphical ranges of all these forms differ markedly: the "true" *T. kobyi* (Choffat) occurs possibly in

the Hypselum Subzone (*cf.* Dorn, 1931; Hölder, 1958; and nothing certain can be said about its occurrence in younger deposits, except that it was not encountered in the studied material of the Bimammatum Subzone in Poland), but the forms grouped around *T.* "*kobyi* (Choffat)" sensu Dieterich (1940), and its direct descendants, are clearly younger, being known from the Hauffianum Subzone, but mostly from the Planula Zone and the Platynota Zone. It seems thus that there exists a stratigraphical gap in between the occurrence of the two main forms in question: *i.e.* "true" *T. kobyi* and *T.* "*kobyi* (Choffat)" sensu Dieterich (1940), and they may represent different species.

The systematic position of "Swabian" *Taramelliceras* "*kobyi* (Choffat)" sensu Dieterich (1940) and allied forms has been a matter of discussion: they were usually attributed to the genus *Taramelliceras*, and (sometimes with reservation) to the subgenus *Metahaploceras* (*e.g.* Schairer, 1972, 1983). On the other hand, some authors (Hölder, 1955, p. 128, text-fig. 24; *cf.* Ziegler, 1974, text-fig. 6) indicated the presence of forms intermediate in character between the Swabian *T.* "*kobyi*" and *Taramelliceras* (*Taramelliceras*) *costatum* (Quenstedt) suggesting thus, a close affinity between the former and representatives of the subgenus *Taramelliceras*. In the material studied there occur some specimens attributed to *Taramelliceras* (*T.*) *broilii* (Wegele), showing features in common with *T.* "*kobyi* (Choffat)" sensu Dieterich (1940), such as rather weakly developed ribbing and somewhat elongated ventrolateral tubercles. Not very distant in morphology, except the development of the ventral tubercles, are also specimens attributed herein to *T. zelcense* sp. nov. These observations suggest additionally the phyletic affinity between *T.* "*kobyi* (Choffat)" sensu Dieterich (1940) and ammonites of the *Taramelliceras* (*Taramelliceras*) *costum* group (Fig. 4A). The same conclusion can be drawn from analysis of the microconchs associated with ammonites of the *T. costatum* group and of *T.* "*kobyi* (Choffat)" which seem in both cases representatives of the *Glochiceras* (*Lingulaticeras*) group (see below).

The specimen referred to as *Streblites kobyi* (Choffat) = *T. kobyi* (Choffat) by Schweigert and Callomon (1997, p. 13, pl. 3: 2) shows "*dichte Knötchen durch kalzitische Relikte ungedeutet*" on the ventral side of whorls, and thus it seems also close to specimens referred herein to *T. zelcense* sp. nov.

Stratigraphical range and occurrence. — The ammonites *T.* "*kobyi* (Choffat)" sensu Dieterich (1940) have been found in the lowermost part of the Planula Zone at Raciszyn (quarry Pj 193, bed-set 3: horizons 1–2); but also in the upper part of the Hauffianum Subzone and in the Planula Zone in the quarries at Raciszyn and Lisowice in the Wieluń Upland – (*cf.* Wierzbowski, 1978; Matyja, Wierzbowski, 1997).

Genus *Glochiceras* Hyatt, 1900

Subgenus Lingulaticeras Ziegler, 1958

Type species: *Ammonites nudatus* Oppel 1863.

The subgenus comprises (*cf.* Ziegler, 1958): *Glochiceras* (*Lingulaticeras*) *crassum* Ziegler, *G.* (*L.*) *lingulatum* (Quenstedt) – *G.* (*L.*) *nudatum* (Oppel) and *Glochiceras* (*Lingulaticeras*) *bobrownikiense* sp. nov. (see description below; see also Fig. 4A).

Glochiceras (*Lingulaticeras*) *bobrownikiense* Wierzbowski et Głowniak sp. nov.

(Pl. 3: 1–3)

Type material: Holotype (specimen no. ZI/50/117) figured in Pl. 3: 1a; paratypes (specimens nos ZI/50/108 and ZI/50/118) figured in Pl. 3: 2a, b–3a, b.

Type area and locality: Wieluń Upland, Bobrowniki Village and surroundings (Tasarze Hamlet): quarries Pj 89, Pj 92 and Pj 94.

Type horizon: Bimammatum Subzone.

Derivation of the name: Bobrowniki Village in the Wieluń Upland.

Diagnosis: Small sized ammonites showing well developed median lateral groove and ornamentation on whorl side; ventral side of phragmocone and initial part of the body with shallow groove.

Material. — 27 specimens, though no specimen has the complete peristome preserved.

Description. — Specimens attain from about 20 mm to 32 mm in diameter: those coming from older deposits are generally smaller (median 20.6 mm), whereas those from younger deposits are often larger (median 26.7 mm). Coiling is moderately involute: Wh is between 40 and 45% (median values in older and younger deposits are 42.5 and 44.1%, respectively) whereas Ud is between 25 and 35% (median values are 28.1 and 27.7%, respectively). The whorl section is high-oval, with flattened whorl sides, to rectangular. The whorl thickness attains a moderate value (Wb is around 27–32%). The ribbing is more or less distinct, and consists of prorsiradiate ribs in the dorsolateral area and concave ribs in the ventrolateral area; the two areas are divided by a median lateral groove usually well developed. The ventral side of the whorl is fairly wide and it bears a shallow groove at the end of phragmocone and on the first part of the body chamber.

The final peristome is nowhere completely preserved in the specimens studied, but it shows the presence of lappets; in the dorsolateral area the peristome margin shows a perpendicular course towards the umbilicus. The body-chamber is about half a whorl long.

Discussion. — The new species shows a marked similarity to *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt),

differing mostly in its grooved ventral side. There is also a marked similarity between the new species and *Glochiceras* (*Lingulaticeras*) *crassum* Ziegler. According to Ziegler (1958) *G. crassum* attains 13–18 mm in diameter only, and it shows a lenticulate whorl section with a fairly high value of whorl-thickness (Wd = 34–38%), and thus it is markedly smaller and thicker than the new species. On the other hand, Schweigert and Callomon (1997) also recognized larger specimens of *G. crassum*, but all of them show a fairly thick whorl-section (Wb = 33–36%).

Stratigraphical range and occurrence. — The species occurs in the Bimammatum Subzone (quarries Pj 92 and Pj 94 at Bobrowniki, from the base, bed 1 in quarry Pj 92 up to the top of the succession exposed there, bed 6 in the quarry Pj 94); additionally it occurs in quarry Pj 89 at Tasarze near Bobrowniki up to the top of the section.

Glochiceras (*Lingulaticeras*) *lingulatum* (Quenstedt)

(Pl. 3: 4–6)

1958 *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt); Ziegler, pp. 131–134; pl. 12: 1–6; text-figs 40–43 (with given synonymy).

1997 *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt); Matyja, Wierzbowski, pl. 4: 1.

Material. — 20 specimens (five with final peristome preserved);

and

Glochiceras (*Lingulaticeras*) cf. *nudatum* (Oppel)

cf. 1958 *Glochiceras* (*Lingulaticeras*) *nudatum* (Oppel); Ziegler, pp. 133, 134, pl. 12: 8–11; text-figs 44–46 (with given synonymy).

cf. 1966 *Glochiceras* (*Lingulaticeras*) cf. *nudatum* (Oppel); Wierzbowski, p. 190, 191, pl. 10: 4.

Material. — Three specimens (one with final peristome preserved).

Discussion. — These two species of the subgenus *Lingulaticeras*: *G.* (*L.*) *lingulatum* and *G.* (*L.*) *nudatum* are closely related and as suggested by Ziegler (1974, p. 24) they could be placed possibly even in a single species with a distinction on the subspecies level only. The main difference (*cf.* Ziegler, 1958) is the presence of the lateral groove in *G.* (*L.*) *lingulatum* which is generally absent in *G.* (*L.*) *nudatum.* However, development of the lateral groove is a rather variable feature, and in the material studied there are a few specimens which show a very weakly developed, almost imperceptible, lateral groove: these are referred to as *Glochiceras* (*Lingulaticeras*) cf. *nudatum* (Oppel).

The newly distinguished species *G.* (*L.*) *bobrownikiense* sp. nov. described above reveals the presence of a shallow groove on the ventral side of whorl at the end of the phragmocone and on the first part of the body chamber. This feature is usually not encountered in the assemblage of specimens of *G.* (*L.*) *lingulatum* – *G.* (*L.*) cf. *nudatum* studied, except for some specimens which do show the presence of such a groove on the ventral side, but on the inner whorls of the phragmocone only. Some smaller differences are related to the final size of the ammonites of the assemblage studied. They are somewhat larger than the specimens of *G.* (*L.*) *bobrownikiense*, and show a somewhat different whorl height and umbilical diameter (in the assemblage of *G.* (*L.*) *lingulatum* – *G.* (*L.*) cf. *nudatum* studied, the median diameter is nearly 30 mm, whereas median Wh is 45.6% and Ud is 26%).

Stratigraphical range and occurrence. — The assemblage of microconchs consisting of *G.* (*L.*) *lingulatum* (Quenstedt) – *G.* (*L.*) cf. *nudatum* has been discovered in the lowermost part of the Planula Zone at Raciszyn: quarry Pj 193, bed-set 3: horizons 1–2 – *G.* (*L.*) *lingulatum*; horizon 2 – *G.* (*L.*) cf. *nudatum*. These ammonites occur also, however, in the Hauffianum Subzone, and the whole Planula Zone (Wierzbowski, 1966; Matyja, Wierzbowski, 1997).

Comments on the dimorphic status of the ammonites *Taramelliceras* (*Taramelliceras*) [M] and *Glochiceras* (*Lingulaticeras* [m] (Fig. 4A):

The fairly thick-whorled *Glochiceras* (*Lingulaticeras*) *crassum* is the microconch of the thick-whorled *Taramelliceras* (*Taramelliceras*) *hauffianum* (Oppel). The consequence is, of course, that their stratigraphic ranges coincide and the innermost whorls are similar (Schweigert, Callomon, 1997). *Taramelliceras* (*T.*) *costatum* (Quenstedt) should be paired with *G.* (*L.*) *bobrownikiense* sp. nov.; *T.* (*T.*) *costatum* shows a stratigraphical range and character of the ventral side of the innermost whorls (with a median "*Conellen-Band*" resulting in the appearance of a ventral groove: Hölder, 1955, pp. 50, 51), similar to those of *G.* (*L.*) *bobrownikiense*.

On the other hand, an assemblage of microconchs consisting of *G.* (*L.*) *lingulatum* (Quenstedt) – *G.* (*L.*) cf. *nudatum* (Oppel) corresponds possibly to the closely related macroconchs *Taramelliceras* (*T.*) *broilii* (Wegele) – *T.* (*T.*) *zelcense* sp. nov. – *T.* (*T.*) "*kobyi* (Choffat)" sensu Dieterich (1940) (see Fig. 4A; see also comments below). The assemblage of ammonites both micro- and macroconchs studied, as the only oppeliids occurring here, was discovered in two narrow horizons in the quarry Pj 193 at Raciszyn (*cf.* description). This phenomenon resulted possibly from ecological reasons (the appearance of ammonites was related to the periodical colonization of the sea bottom of a local infrabiohermal depression – see chapter on stratigraphy). Such a unique situation offers, thus, a possibility for the biological interpretation of the assemblage of oppeliids studied which represents here possibly a homogeneous, "frozen" community. The oppeliids studied are represented by very numerous specimens: 63 specimens of *Taramelliceras* (*Taramelliceras*) and 38 specimens of

Glochiceras (*Lingulaticeras*), which constitute at least 83% of the total ammonite fauna found here (though the 21 specimens of various Perisphinctacae may be an overestimate in relation to the number of oppeliids, as even poorly preserved perisphinctids were collected, not the case with the oppeliids). The data given additionally support the palaeontological interpretation of the assemblage of oppeliids studied as consisting of corresponding macro- and microconchs (Fig. 4A).

Genus *Taramelliceras* Del Campana, 1905 [M]

Subgenus *Richeiceras* Jeannet, 1951 [M]

Type species: *Ammonites pichleri* Oppel, 1863.

The name *Richeiceras* was proposed by Jeannet (1951, p. 95) for the group of ammonites having a narrow umbilicus, a slim whorl section, and a well developed median ventral serration and a lack of ventrolateral tubercles. This group of small-sized *Taramelliceras* of the Bimammatum Zone, includes such forms as *T.* (*R.*) *pichleri* (Oppel), *T.* (*R.*) *tricristatum* (Oppel), but also *T.* (*R.*) *lochense* (Oppel), and the group itself has been treated as possibly related to the first *Metahaploceras* (see Ziegler, 1974, fig. 6; see also Fig. 4B herein).

When discussing the phyletic relations within the *Richeiceras* group a close affinity between *T.* (*R.*) *pichleri* (Oppel) and *T.* (*R.*) *lochense* (Oppel) should be indicated (see Dorn, 1931, pp. 50, 51; Hölder, 1955: p. 87, 124; Bonnot *et al.*, 2009, p. 380): the former shows often stronger developed ribbing at the transition from the lateral to the ventral side, and a serrated ventral side up to the end of the body chamber; the latter shows weak serration (replaced sometimes by a serrated keel or a shallow furrow) on the phragmocone and on the initial part of the body chamber – but never continuing up to the final part of the body chamber. In the material studied both species *T.* (*R.*) *pichleri* (Pl. 4: 3), and *T.* (*R.*) *lochense* occur in the lower part of the Bimammatum Subzone (quarry Pj 92 at Bobrowniki, beds 1–7).

Taramelliceras (*Richeiceras*) *lochense* (Oppel), however, as well as the recently established and closely related species *T.* (*R.*) *jaeggii* Quereilhac (see Quereilhac, 2009) showing an ornamented ventral side, are intermediate in character between the typical representative of the subgenus *Richeiceras* – *T.* (*R.*) *pichleri* and the oldest representatives of the subgenus *Metahaploceras* – *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) and *T.* (*M.*) *muehlheimense* (Schweigert, Callomon), with a smooth ventral side. The gradual transition between the species (see also Fig. 4B) is especially well marked when one compares a succession of ammonites attributed to the species *T.* (*R.*) *lochense* and *T.* (*M.*) *litocerum* (treated as a "morphospecies" according to vertical classification) as recognized in the sections in the Wieluń Upland studied. In a lower part of the Bimammatum Subzone (quarry Pj 92 at Bobrowniki, beds 1–2) all the specimens can be attributed to *T.* (*R.*) *lochense* representing thus isochronous assemblages of a single "biospecies", but somewhat higher in the same subzone the two "morphospecies" co-occur in the same beds (quarry Pj 92, beds 4–7) and represent possibly but variants of a single "biospecies", whereas in younger deposits (the upper Bimammatum Subzone, the Hauffianum Subzone and the Planula Zone) there is a marked overdominance of *T.* (*M.*) *litocerum*, but even as high as in the lower part of the Planula Zone, rare specimens morphologically undistinguishable from typical *T.* (*R.*) *lochense* are still present (Matyja, Wierzbowski, 1997, fig. 6).

Taramelliceras (*Richeiceras*) *jaeggii* Quereilhac

(Pl. 4: 1, 2)

?1931 *Neumayericeras* cf. *cruce* Buckhardt; Dorn, pp. 48, 49; pl. 29: 5a, b, 6.

2009 *Taramelliceras* (*Metahaploceras*) *jaeggii* Quereilhac; Quereilhac, p. 32; pl. 26: 1–7.

Material. — Five specimens attributed to the species, and additionally seven specimens fragmentarily preserved and referred to as cf.

Description. — Because the species is recently established (Quereilhac, 2009), and has not been recorded in Poland, a short description of the collected specimens referred to that species is given.

Small sized ammonites showing well developed loosely spaced falcate ribs; the ventral side of the phragmocone and the initial part of the body chamber are serrated. Specimens attain about 30 mm in final diameter. Coiling is involute (at D = 28 mm, Wh = 53–54%, Ud = 11%, Wb = 27%). The whorl section is high-oval. The body chamber is about half a whorl long. Ornamentation consists of well developed loosely spaced falcate ribs with additional secondary ribs appearing at the middle of the whorl height. Some secondary ribs are more strongly accentuated at the ventral side, but not swollen into ventrolateral nodes. The ribbing at the end of the body chamber becomes densely spaced and weaker. The final part of the body chamber is flattened and it does not show any serration.

Discussion. — This species shows some similarity to *Taramelliceras* (*Metahaploceras*) *muehlheimense* (Schweigert et Callomon), but it differs in its serrated ventral side, lack of ventrolateral tubercles, and generally in its smaller final size. The form referred to as *Neumayericeras* cf. *cruce* Burckhardt by Dorn (1931) is similar, but it differs in its somewhat larger size and occurrence of ventrolateral nodes as in *T. muehlheimense.* The presence of serrated ventral sides indicates a close affinity of *T. jaeggii* with the subgenus *Richeiceras* and not with *Metahaploceras* as stated by Quereilhac (2009). The species

Taramelliceras (*Richeiceras*) *jaeggii* may be treated as a direct forerunner of *T.* (*M.*) *muehlheimense* (see also Fig. 4B).

Stratigraphical range and occurrence. – The species is known from the lower part of the Bimammatum Subzone in the quarries at Bobrowniki (Pj 92, beds 1–5). Some of the specimens referred to as *T.* cf. *jaeggii* have been found in rubble in quarries Pj 89 at Tasarze near Bobrowniki and Pj 94 at Bobrowniki, which also represent the Bimammatum Subzone.

Subgenus *Metahaploceras* Spath, 1925 [M]

Type species: *Ammonites strombecki* Oppel, 1857.

The oldest representatives of the subgenus include *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) (Pl. 4: 4, 5) which commonly occurs in deposits of the Bimammatum Subzone including quarries Pj 92 (from bed 4 upwards) and Pj 94 at Bobrowniki (beds 5–6) and quarry Pj 89 at Tasarze near Bobrowniki (unit 3 – bed 7); and in the Hauffianum Subzone (*e.g.* in quarry Pj 113: units 4, 5, 7 at Raciszyn; in quarries Pj 168 and 169 at Raciszyn: unit 2) and in the Planula Zone (see Wierzbowski, 1966, pl. 10: 3; 1978, pl. 2: 5–7; Matyja, Wierzbowski, 1997, pl. 4: 5). Another representative of the group is *Taramelliceras* (*Metahaploceras*) *muehlheimense* (Schweigert et Callomon) from the Hauffianum Subzone (Schweigert, Callomon, 1997). In the Wieluń Upland this ammonite also occurs in the Hauffianum Subzone (*e.g.* in quarry Pj 113 at Lisowice – units 3–4; in quarries Pj 168 and 169 – unit 2) and had been erroneously referred to as *Taramelliceras* (*Metahaploceras*) *wenzeli* (Oppel) (see Wierzbowski, 1978, pl. 2: 10, 11; Matyja, Wierzbowski, 1997, pl. 4: 7), but later transferred by Matyja and Wierzbowski (2006) to *T.* (*M.*) *muehlheimense*. Both the latter species have their roots in some species of the subgenus *Richeiceras*, for instance *Taramelliceras* (*R.*) *lochense* (Oppel), and *T.* (*R.*) *jaeggii* Quereilhac (see Fig. 4B).

Genus *Glochiceras* Hyatt, 1900

Subgenus *Coryceras* Ziegler, 1958

Type species: *Ammonites microdomus* Oppel 1863.

The subgenus *Coryceras* comprises in the material studied (*cf.* Ziegler, 1958): *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *G.* (*C.*) *canale* (Quenstedt) and *G.* (*C.*) *modestiforme* (Oppel).

The stratigraphical ranges of representatives of the subgenus *Coryceras* in the sections studied are as follows: *Glochiceras* (*Coryceras*) *microdomum* occurs in the lower part of the Bimammatum Subzone (in quarry Pj 92 at Bobrowniki: beds 1, 4–7; in quarry Pj 94, bed 3); *G.* (*C.*) *canale* (Pl. 5: 1, 2) occurs also in the lower part of the Bimammatum Subzone (in quarry Pj 92 at Bobrowniki: beds 1, 4, 6–7); *G.* (*C.*) *modestiforme* (Pl. 5: 3, 4) occurs in the Bimammatum Subzone (in quarry Pj 92 at Bobrowniki beds 6–7; in quarry Pj 94 at Bobrowniki: bed 1; in quarry Pj 89 at Tasarze near Bobrowniki: unit 3 – bed 7) and in the Hauffianum Subzone (in quarry Pj 113 at Raciszyn: units 4–5, 7 see Matyja, Wierzbowski, 1997; in quarries Pj 168 and 169: unit 2), and in the Planula Zone (Wierzbowski, 1978, pl. 1: 2–4).

Comments on the dimorphic status of the ammonites *Taramelliceras* (*Richeiceras*, *Metahaploceras*) [M] and *Glochiceras* (*Coryceras*) [m] (Fig. 4B):

The subgenus *Coryceras* comprises microconchiate counterparts of both *Taramelliceras* (*Richeiceras*) and its descendants – the ammonites of the *Taramelliceras* (*Metahaploceras*) *litocerum* group. The following pairs of corresponding micro- and macroconchs are suggested (Fig. 4B): *Taramelliceras* (*Richeiceras*) *pichleri* (Oppel) – *Glochiceras* (*Coryceras*) *microdomum* (Oppel), *Taramelliceras* (*Richeiceras*) *lochense* (Oppel) – *Glochiceras* (*Coryceras*) *canale* (Quenstedt) and *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel) – *Glochiceras* (*Coryceras*) *modestiforme* (Oppel) (see also Matyja, Wierzbowski, 1997; Schweigert, Callomon, 1997). This interpretation differs somewhat of that of Quereilhac (2009, pp. 29–31) who treated *G. microdomum* ["*T. lochense* morphe *microdomum* [m]"] as a microconchiate counterpart of *T. lochense* [M], whereas the "morphe *courvillei* [m] nov." (Quereilhac, 2009, p. 31, pl. 25: 1–12) was considered to be the microconchiate counterpart of *T. pichleri* [M]. Our interpretation is based on the following premises: (1) the weakly ornamented and phylogenetically related macroconchs *T. lochense* – *T. litocerum* ought to be paired with similar, phylogenetically related microconchs such as *G. canale* – *G. modestiforme* (*cf.* Ziegler, 1974, p. 24, Fig. 14), and this suggests the existence of succeeding dimorphic pairs: *T. lochense* – *G. canale* and *T. litocerum* – *G. modestiforme*; (2) *T. pichleri* – *G. microdomum* showing stronger ornamentation near and at the ventral side should be paired together, (3) the separate status of the "morphe *courvillei* [m] nov." of Quereilhac (2009) is unclear as the form in question seems poorly distinguishable from *Glochiceras* (*Coryceras*) *canale* (Quenstedt) (*cf.* Ziegler, 1958).

As stated previously, *Taramelliceras* (*Richeiceras*, *Metahaploceras*) and *Glochiceras* (*Coryceras*) occur very commonly in bedded limestones, sometimes even in micritic limestones very poor in benthic fauna (generally representing the interbiohermal areas) and are rare in the biohermal areas. This suggests that they preferred a different, possibly more nektonic environment, than the ammonites *Taramelliceras* (*Taramelliceras*) and *Glochiceras* (*Lingulaticeras*), which were possibly more confined to a benthic environment. This suggests that the two groups of oppeliids possibly occupied

different ecological niches, and represent two different ammonite lineages with separate groups of micro- and macroconchs.

Genus *Ochetoceras* Haug, 1885 [M]

Type species: *Ochetoceras canaliculatum* von Buch 1831; and

Genus *Glochiceras* Hyatt, 1900 [m]

Subgenus *Glochiceras* Hyatt, 1900 [m]

Type species: *Ammonites nimbatus* Oppel, 1863.

Rare macroconchs of *Ochetoceras semifalcatum* (Oppel) have been found in quarry Pj 94 (bed 3, Bimammatum Subzone) and a single specimen of *Ochetoceras marantianum* (d'Orbigny) (Pl. 5: 5) has been found in the same quarry in rubble (Bimammatum Subzone) and in quarry Pj 113 at Raciszyn (beds 3–4 – lowermost part of the Hauffianum Subzone). Both species were also found in quarry Pj 92 in rubble. Their microconch counterpart (*cf.* Schweigert, Callomon, 1997; Bonnot *et al.*, 2009) is *Glochiceras* (*Glochiceras*) *tectum* Ziegler represented by rare specimens found in quarry Pj 92 at Bobrowniki (bed 7, Bimammatum Subzone).

Genus *Trimarginites* Rollier, 1909 [M and m]

Type species: *Ammonites trimarginatus* Oppel 1857.

Rare specimens of *Trimarginites trimarginatus* (Oppel) were found in quarry Pj 89 (Tasarze at Bobrowniki, beds 8–9), and quarry Pj 92 (Bobrowniki, bed 4) in the Bimammatum Subzone; a single specimen of *Trimarginites arolicus* (Oppel) (Pl. 5: 6) in quarry Pj 92 (Bobrowniki, bed 4 – Bimammatum Subzone), and other specimens of the same species in quarry Pj 113 unit 3 at Raciszyn (*cf.* Matyja, Wierzbowski, 1997 in the lower part of the Hauffianum Subzone). Ammonites of the genus *Trimarginites* also occur in the Bimammatum Subzone (quarry Pj 92: bed 2) and the lowermost Hauffianum Subzone (in quarry Pj 113: beds 3–4).

Family **Cardioceratidae** Siemiradzki, 1891

Genus *Amoeboceras* Hyatt, 1900 [m and M]

Subgenus *Plasmatites* Buckman, 1925 [m]

Type species: *Plasmatites crenulatus* Buckman 1925.

This subgenus includes three closely allied small-sized forms attributed to the *Amoeboceras* (*Plasmatites*) *bauhini* group: *A. bauhini* (Oppel), *A. praebauhini* (Salfeld) and *A. lineatum* (Quenstedt). These three forms are known abundantly in the "upper *Amoeboceras* layer" in the lower part of the Hauffianum Subzone in the Wieluń Upland at Raciszyn (Matyja, Wierzbowski, 1988, pl. 2; 1997, pl. 5: 1–4). Additional specimens described here come from the lowermost Planula Zone (*matyjai* horizon) in quarry Pj 193 at Raciszyn (horizon 1, 0.4–0.5 m from the base of bed-set 3) where they constitute a small, but distinctive part of the total faunal assemblage (about 5.5%). A similar assemblage has been discovered in the same stratigraphical horizon in the quarry Pj 140 at Lisowice (Matyja, Wierzbowski, 1997). These ammonites (Pl. 6: 3–5) do not differ markedly from those described from the "upper *Amoeboceras* layer", and all three distinctive forms of the lower level forms can be recognized here as well.

More interesting is the occurrence of a single specimen referred to as *Amoeboceras* (*Plasmatites*) cf. *lineatum* (Quenstedt) (Pl. 6: 1) in bed 1 attributed to the lower part of the Bimammatum Subzone in the quarry Pj 92 at Bobrowniki. The ammonite is small, only 21 mm in diameter, but shows characteristic features of the subgenus such as falcoid ribbing with accentuation of the rib divisions and the secondary ribs running up onto the crenulated keel. Another interesting specimen (Pl. 6: 2) comes from the upper part of quarry Pj 89 at Tasarze near Bobrowniki corresponding to the upper part of the Bimammatum Subzone. It is only around 15 mm in diameter but shows strong primary ribs (about 15 per half a whorl), which end with lateral tubercle and are separated from short secondaries by a marked spiral smooth band: this specimen is referred to as *Amoeboceas* (*Plasmatites*) ex gr. *bauhini* (Opel)

Family **Aulacostephanidae** Spath, 1924

The ammonites of this family constitute about 3–4% of the total number of ammonites collected and are represented both by macroconchs of the genera *Vineta* and *Vielunia* gen. nov. as well as newly discovered microconchs correlated with the genus *Vineta* and more heavy ornamented microconchs, traditionally placed in the genus *Prorasenia*, and correlated with the genus *Vielunia.*

Genus *Vineta* Dohm, 1925 [m and M]

Type species: *Vineta jaekeli* Dohm, 1925.

Diagnosis. – Macroconchs involute to strongly involute, covered initially with dense ribbing (Fig. 5) consisting of markedly prorsiradiate primaries and rectiradiate secondaries; then, the secondary ribs become more prorsiradiate and strong, whereas the primary ribs fade. The outer whorls are smooth. Constrictions are better developed on the inner whorls. In contrast to previous opinions (*e.g.* Arkell *et. al.*, 1957; Geyer, 1961), these features make a clear distinction between the genus *Vineta* and the genus *Ringsteadia*, which should be therefore treated separately.

Microconchs are recognized for the first time: involute to weakly evolute on the inner whorls, more evolute at the end

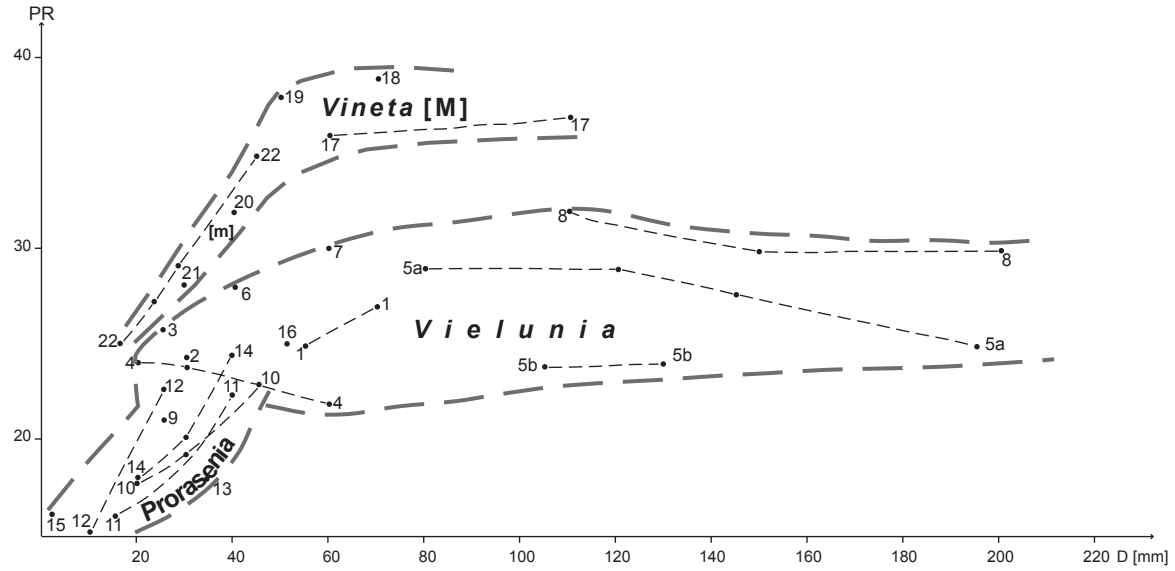

Fig. 5. Rib curves for representatives of: *Vielunia* [M] – *Prorasenia* [m] and *Vineta* [M, m]

Vielunia dzalosinensis sp. nov.: **1** – specimen ZI/50/1, Bobrowniki Pj 92, bed 2; **2** – specimen ZI/50/2, Bobrowniki Pj 92, bed 5; **3** – specimen ZI/50/3, Bobrowniki Pj 92, bed 4; **4** – holotype, specimen ZI/50/4, Raciszyn Pj 193, bed-set 3, rubble; **5a** – specimen IGP UW/A/8/5 (Wierzbowski 1970, pl. 3) – paratype, Raciszyn Pj 167–169; **5b** – specimen IGP UW/A/10/335 (Wierzbowski 1978, pl. 3: 4) – paratype, Raciszyn Pj 113, bed 4; **6** – specimen ZI/50/6, Bobrowniki Pj 94, beds 3–5, rubble; **7** – specimen ZI/50/7, Bobrowniki Pj 94, rubble; **8** – specimen IGP UW/A/10 (Wierzbowski, 1978), Raciszyn Pj 113, bed 4

Prorasenia crenata (Quenstedt): **9** – specimen ZI/50/19, Bobrowniki Pj 92, marly intercalation between beds 4 and 5; **10** – specimen ZI/50/10, Bobrowniki Pj 94, beds 1–2, rubble; **11** – specimen ZI/50/11, Bobrowniki Pj 94, bed 1; **12** – specimen ZI/50/12, Bobrowniki, Pj 92, bed 7; **13** – specimen ZI/50/18, Bobrowniki Pj 94, beds 1–2, rubble; **14** – specimen ZI/50/14, Raciszyn Pj 193, bed-set 3: horizon 1; **15** – specimen ZI/50/15, Raciszyn Pj 193, bed-set 3: horizon 1; **16** – specimen ZI/50/17, Bobrowniki Pj 94, beds 1–2

Vineta submediterranea (Wierzbowski): **17** – specimen IGP UW/A/10/332 (Wierzbowski, 1978, pl. 3: 1) – holotype, Bobrowniki Pj 94, beds 3–5, rubble; **18** – specimen IGP UW/A/10/333 (Wierzbowski, 1978, pl. 3:3) – paratype, Lisowice Pj 137, rubble; **19** – specimen ZI/50/8, Bobrowniki Pj 94, beds 3–5, rubble; *Vineta* cf. *streichensis* (Oppel): **20** – specimen ZI/50/182, Raciszyn Pj 193, bed-set 3: horizon 1; *Vineta* sp. [m]: **21** – specimen ZI/50/13, Bobrowniki Pj 94, bed 2; **22** – specimen ZI/50/16, Raciszyn Pj 113, rubble

of the whorls, covered with dense thin ribbing bi- and triplicate on the inner whorls, and biplicate on the outer whorl; final aperture with lappets (Fig. 5).

Vineta submediterranea (Wierzbowski) [M]
(Pl. 7: 1, 2)

1888 *Ammonites involutus* Quenstedt; Quenstedt, p. 964, pl. 107, fig. 2.
1891 *Olcostephanus involutus* Quenstedt; Siemiradzki, pp. 78, 79.
1978 *Ringsteadia* (*Ringsteadia*) *submediterranea* Wierzbowski; Wierzbowski, pl. 3: 1–3, p. 322.
1997 *Ringsteadia submediterranea* Wierzbowski; Matyja, Wierzbowski, pl. 5: 16.
2007 *Ringsteadia submediterranea* Wierzbowski; Głowniak, Wierzbowski, fig. 75, pp. 121, 122.

Material. — Six specimens, including four described and illustrated previously by Wierzbowski (1978) and Matyja and Wierzbowski (1997) [holotype (IGP UW/A/10/332 – refigured herein in Pl. 7: 1a, b) and paratype (IGP UW/A/10/333)], as well as two specimens newly described here.

Description. — Strongly involute, compressed; coiling strongly involute (at D = 50–60 mm, Wh = 50–52%, Ud = 18–23%; at D = 80–110 mm, Wh = 48–52%, Ud = 14–17%): coiling index C = 2.08–2.16 at D *c.* 55–60 mm, but ranging to much higher values at larger diameters (C = 3.0–3.9 at D = 90–110 mm). The whorl section is oval, tapering towards the venter. The ribbing is dense, PR = 35–40 at D = 55–90 mm. The ribbing of the inner whorls (up to 40–50 mm diameter, but sometimes even later) consists of equally strongly developed, densely placed (Fig. 5) – markedly prorsiradiate primary ribs and more rectiradiate secondary ribs, which gives the rib course a somewhat s-shaped appearance. Then, gradually on the outer whorl, the course of the secondary ribs becomes more prorsiradiate and their development is much stronger than the primary ribs which gradually fade. The ribs split somewhat above the mid-point of the whorl height: bifurcation and less commonly trifurcation occur, but

intercalatory ribs are also common (SR/PR ranges from 2.4 at D = 40 mm to about 2.6–3.6 at D = 60–80 mm). The ribbing completely disappears at larger diameters – possibly already at about 110 mm diameter; in a fragmentary preserved large specimen, a part of its outer whorl at D *c.* 160–170 mm is completely smooth.

Discussion. — The species differs from the very close *Vineta streichensis* (Oppel) – see Oppel (1863, pl. 66: 3) and Schweigert and Callomon (1997, p. 24, pl. 7: 5–9, 11) mostly in its more involute coiling. The full comparison is difficult, however, because *V. streichensis* is known only from its inner whorls up to about 65 mm diameter.

The species *V. submediterranea* was originally attributed to the genus *Ringsteadia* (see Wierzbowski, 1978) as result of a generally poor knowledge of the genus *Vineta*, which had been treated either as a younger synonym of *Ringsteadia* (*e.g.* Arkell *et al.*, 1957) or as a subgenus of *Ringsteadia* characterized by its more involute coiling (Geyer, 1961). The ammonites referred to as *Ringsteadia* cf. *submediterranea* Wierzbowski by Gygi (2003, pp. 38–40, figs 27–29) differ from representatives of the species in their stronger and more distant ribbing.

Stratigraphical range and occurrence. — *Vineta submediterranea* is known from the Bimammatum Subzone in the quarries at Bobrowniki (Pj 94, beds 3–5), and the Bimammatum Subzone and the Hauffianum Subzone in quarries at Raciszyn Pj 113 (lower part, below the *Amoeboceras* layer – see Matyja, Wierzbowski, 1997, fig. 3) and at Lisowice Pj 137 (Wierzbowski, 1978).

Vineta cf. *streichensis* (Oppel) [M]
(Pl. 7: 3)

cf. 1863 *Ammonites streichensis* Oppel; Oppel, p. 236, pl. 66: 3.
cf. 1997 *Vineta streichensis* (Oppel) [M]; Schweigert, Callomon, p. 24, pl. 7: 5–9, 11 (with given synonymy).

Material. — Four specimens.

Description. — The specimens are from about 20 to 40 mm in diameter; coiling is weakly involute (Wh = 43–45%; Ud = 27–33%); coiling index C = 1.35–1.7. The whorl section is high-oval with a fairly wide ventral side (Wb = 34–36%). The ribbing is rather thin, fairly dense (Fig. 5), consisting of about 30 primaries per whorl: the primary ribs are markedly prorsiradiate, wheras the secondaries are rectiradiate, and at larger diameters become prorsiradiate. The primary ribs bifurcate and trifurcate at the mid-point of the whorl height, and the intercalatory ribs appear as well. The SR/PR is about 2.6 at D = 20–35 mm, but it ranges to even 3.4 at D = 40 mm. Constrictions are well developed.

Discussion. — The specimens studied show considerable similarity to the inner whorls of *Vineta streichensis* (Oppel) as illustrated by Schweigert and Callomon (1997, pl. 7: 6–9).

Stratigraphical range and occurrence. — The specimens studied have been found in the rubble in the Raciszyn quarries Pj 113 and Pj 167, in the deposits of the Hauffianum Subzone; also in quarry Pj 193 (bed-set 3, horizon 1: 0.4–0.5 m above the base of the unit) in the lowermost part of the Planula Zone.

Vineta cf. *jaekeli* Dohm, 1925 [M]
(Pl. 8: 1)

cf. 1925 *Vineta jaekeli* Dohm; Dohm, pp. 33, 34, pl. 4: 1, 4, 5; pl. 3: 2; ?pl. 10: 5, 8, 9.
cf. 1988 *Ringsteadia* (*Vineta*) *jaekeli* (Dohm, 1925); Malinowska, p. 343, pl. 151: 4.
cf. 2010 *Vineta jaekeli* Dohm; Głowniak *et al.* (this volume), pp. 23, 24, pl. 5: 13, pl. 8: 2a, b.

Material. — Single giant specimen (no. ZI/50/183) with peristome preserved.

Description. — The specimen attains about 420 mm in final diameter. The final simple peristome is preserved. The body chamber is about half a whorl long. The inner whorls are very badly preserved – but their coiling is strongly involute (C is about 2.0 at D = 200 mm). On the outer whorls the coiling is initially weakly involute (Wh = 38%, Ud = 30% at D = 355 mm), but becomes weakly evolute close to the final aperture (Wh = 32.8%, Ud = 35% at D = 420 mm). The whorl section is high-oval with the largest width below the middle of the whorl height. The ribbing on the inner whorls is not visible due to their preservation; the outer whorl is completely smooth but with two or three poorly marked weak undulations.

Discussion. — This specimen is tentatively compared with the giant specimen of *Vineta jaekeli* recognized as its lectotype (Dohm, 1925, pl. 4: 4; *cf.* Głowniak *et al.*, 2010, this volume) but not as the holotype as erroneously indicated by Malinowska (1988). The similarity is in the coiling and in the development of the outer whorl. Both these specimens do not offer any possibilities, however, of studying the ornamentation of the inner whorls. According to Dohm (1925) the inner whorls of *Vineta jaekeli* were completely smooth; such an opinion resulted, however, most probably from the poor preservation of the specimens. A better preserved specimen from the lowermost Kimmeridgian (*sensu* Boreal) of the Mikhalenino section on the Russian Platform, comparable with the lectotype of *V. jaekeli*, shows weak ornamentation of the inner to middle whorls: the ornament consists initially of dense thin prorsiradiate primary ribs and much stronger rectiradiate to even rursiradiate secondary ribs, and developed thereafter are rather strong secondary ribs contrasting to the nearly complete fading of the primary ribs (Głowniak *et al.*, 2010). It is a partly open question, however, what is the relation of the species *Vineta jaekeli* as

based on specimens from the Boreal/Subboreal sections of Western Pomerania and Russia to the specimen studied, as well as the relation of the latter to other species of the genus *Vineta* known from the Submediterranean sections of Central Poland and southern Germany, such as *V. streichensis* and *V. submediterranea.* The Russian specimen discussed, possibly the nearest to *V. jaekeli*, differs possibly in its more densely ribbed inner whorls when compared with representatives of the two Submediterranean species, the feature which cannot be recognized, however, in the specimen studied.

Occurrence. – The specimen studied comes from rubble from the quarry at Raciszyn (Pj 167: unit 3) where the deposits of the Hauffianum Subzone, and the lowermost part of the Planula Zone, have been recognized.

Vineta sp. [m]
(Pl. 6: 6, 7)

Material. — Two specimens 28 and 45 mm in diameter (nos ZI/50/8, ZI/50/16).

Description. — The final peristome is not preserved in the smaller specimen, but modification of the ribbing shows its proximity; in the larger specimen the final peristome is bordered by a final constriction and shows the presence of lappets. Coiling is from involute to weakly evolute (at D = 26 mm, Wh = 38.5%, Ud = 30.8% in the smaller specimen; and at D = 25 mm, Wh = 34%, Ud = 38% in the larger specimen), but the coiling becomes strongly evolute at the end of the outer whorl in the larger specimen: at D = 45 mm, Wh = 32%, Ud = 45.5%.

The ornamentation of the inner whorls up to about 15–18 mm diameter consists of biplicate and triplicate ribs, but it is replaced later on the body chamber by biplicate ribs. The primary ribs are generally prorsiradiate, whereas the secondary ribs are rectiradiate. The ribs are generally thin and numerous (Fig. 5): from 25–29 primary ribs per whorl at D = 20–30 mm, to even 35 primary ribs at D = 45 mm, markedly different from those of the *Prorasenia* type corresponding to the microconchs of the genus *Vielunia*, which are generally stronger with swollen primary ribs.

Discussion. — The character and density of ribbing of the inner whorls of the specimens studied are similar to those of the inner whorls of specimens attributed to *Vineta streichensis* (Oppel) by Schweigert and Callomon (1997, pl. 7: 6–8). Thus, their close affinity to the macroconch species *V. streichensis* and/or *V. submediterranea* seems substantiated.

Stratigraphical range and occurrence. — The specimens came from the Bimammatum Subzone (Bobrowniki Pj 94, bed 2) and an upper part of the Bimammatum Subzone or the lower part of the Hauffianum Subzone (Raciszyn Pj 113, rubble).

Genus *Vielunia* Wierzbowski et Głowniak gen. nov. [M]

Type species: *Vielunia dzalosinensis* sp. nov., here designated

Derivation of the name: After Wieluń Town (Latin Vielun) at the northwestern edge of the high plateau of the Wieluń Upland, the northwestern part of the Polish Jura Chain.
Diagnosis: Involute macroconchs attaining over 200 mm in diameter. The whorl section is oval, somewhat tapering towards the venter. The ribbing is strong and sparse already at a small diameter (Fig. 5) consisting of strong primary ribs and secondary ribs similarly developed and appearing about the mid-height of whorl, with about 2–3 secondaries per primary. Constrictions are well developed on the inner whorls, marked in front by a flared rib. The primary and secondary ribs are nearly equally strongly developed up to about 200 mm diameter, then they weaken and disappear.
Remarks: The ammonites placed in the new genus were in the past commonly referred to the genus *Ringsteadia* Salfeld, 1913 (see *e.g.* Wierzbowski, 1970, 1978). The main difference is in the stronger development of the secondary ribs, their appearance lower on the whorl side, and their persistence up to larger diameters in the genus *Vielunia.* Additionally, the microconch counterpart of *Vielunia* is *Prorasenia*, whereas that of *Ringsteadia* is *Microbiplices* (*cf.* Matyja *et al.*, 2006).
Stratigraphical range: The ammonites of the genus *Vielunia* appear in the Bimammatum Subzone and continue up into the Hauffianum Subzone of the Bimammatum Zone and the Planula Zone. The genus is a direct forunner of *Eurasenia* Geyer, 1961.

Vielunia dzalosinensis Wierzbowski et Głowniak sp. nov.
(Pl. 8: 2; Pl. 9: 1–4)

1970 *Ringsteadia* (*Ringsteadia*) *limosa* (Quenstedt, 1888); Wierzbowski, pp. 275, 276, pl. 3.
1978 *Ringsteadia* (*Ringsteadia*) *limosa* (Quenstedt); Wierzbowski, pl. 3: 4.

Type material: Holotype (ZI/50/4) figured in Pl. 9: 1, paratypes representing two specimens (IGP UW/A/8/5 and IGP UW/A/10/335) referred previously to as "*Ringsteadia limosa*" (Wierzbowski, 1970, pl. 3; Wierzbowski, 1978, pl. 3: 4) and refigured herein (Pl. 8: 2; Pl. 9: 2).
Type area and locality: Wieluń Upland, Raciszyn Village (Pj 113, Pj 193, Pj 167–169).
Type horizon: Bimammatum and Hauffianum subzones of the Bimammatum Zone, and lowermost part of the Planula Zone.
Derivation of the name: After "Dzalosin" – an old name for Działoszyn Town – a local administrative center of the area, placed in neighbourhood of the villages of Raciszyn and Bobrowniki where the specimens of the new species have been collected.
Diagnosis: Involute macroconchs showing strong ornamentation of primary and secondary ribs continuing up to large diameters with numerous and deeply incised constrictions on inner whorls.

Material. — Nine well preserved specimens from about 25–30 mm in diameter up to large specimens of 200–240 mm

in diameter. The latter attained originally even much larger diameters because the specimens in question show only a fragment of the body-chamber preserved.

Description. — Coiling of the innermost whorls is evolute (see holotype), but soon becomes moderately involute (in two specimens nos ZI/50/2, 3, at D = 25–30 mm, Wh = 42–43%, Ud = 29.5–33.0%), through middle-sized specimens (in holotype at D = 60 mm, Wh = 43%, Ud = 26%), up to large specimens (in paratypes at D = 130–190 mm, Wh = 41–42%, Ud = 26–29%); sometimes, however, the specimens show even more involute coiling (in specimen no. ZI/50/1, at D = 72 mm, Wh = 46%, Ud = 21%). The coiling index C ranges usually from 1.1 to 1.7, but in more involute specimens may attain even 2.0–2.2. The whorl section is oval, tapering towards the venter. The ornamentation consists of strongly developed primary ribs which, especially at smaller diameters, are markedly prorsiradiate, whereas the secondary ribs, both strongly developed, show a more rectiradiate course. On the middle and outer whorls the primary and secondary ribs are similarly strongly developed, and generally rectiradiate, but the secondary ribs at the transition to the ventral side may show a weak prorsiradiate course. The ribs split about the mid-height of whorl: there occur both bifurcation and later on also trifurcation, but intercalated secondaries may appear already at small diameters as well. The rib curve (Fig. 5) shows the number of primary ribs rising gently from about 21–26 per whorl at D = 20–70 mm, up to about 24–32 at D = 80–200 mm. The primary/secondary rib ratio ranges usually from 2.4 to 2.8 at smaller diameters up to about 3.0 at larger diameters. Constrictions are strongly developed only on the inner whorls – deeply incised, bordered in front by a strong rib of the flared type. The ornamentation tends to disappear at large diameters (above 200 mm).

Discussion. — The specimens placed in the synonymy of the new species have been previously attributed to the species "*Ringsteadia*" *limosa* (Quenstedt, 1888). They differ, however, from that species in showing less dense ribbing on the inner whorls, and more involute coiling. In the holotype of "*Ringsteadia*" *limosa*, at D = 110–140 mm, PR = 32, whereas Wh = 40–41% and Ud = 32–34% (Quenstedt, 1888, pl. 124: 3). It seems, however, that both species in question are closely related and should be placed in the same genus *Vielunia*. The species *Vielunia limosa* (Quenstedt) is known, however from younger beds than *V. dzalosinensis* – *i.e.* from the Planula Zone. Quite possibly, small-sized specimens showing fairly dense ribbing on the inner whorls and referred previously to as "*Ringsteadia* (*Ringsteadia*) sp. indet." by Wierzbowski (1970, pp. 277, 278, pl. 4: 1, 2; *cf.* Wierzbowski, 1978, p. 321) could be compared with inner whorls of *Vielunia limosa* (Quenstedt).

Stratigraphical range and occurrence. — *Vielunia dzalosinensis* occurs both in the Bimammatum Subzone and the Hauffianum Subzone of the Bimammatum Zone, and in the lowermost part of the Planula Zone, in the Wieluń Upland at villages Bobrowniki (in quarry Pj 92: bed 2 – 0.2 m above the base; bed 4 – upper part; and bed 5; in quarry Pj 94: beds 3–5) and Raciszyn [in quarry Pj 113: bed unit 4, referred to as *Ringsteadia limosa* (Quenstedt) by Matyja and Wierzbowski (1997); in quarries Pj 167–169 referred to as *Ringsteadia limosa* (Quenstedt) by Wierzbowski (1970); in quarry Pj 193: bed-set 3].

Genus *Prorasenia* Schindewolf, 1925 [m]

Type species: *Prorasenia quenstedti* Schindewolf, 1925.

The genus *Prorasenia* includes the microconchs of several aulacostephanid macroconch genera, such as *e.g.* typical Subboreal *Pictonia* and *Rasenia*, as well as German and Polish raseniids known from Submediterranean areas as *e.g. Eurasenia.* These microconchs constitute a morphologically fairly uniform assemblage and deviate little from the common morphology and ornamentation of the genus consisting of triplicate thick primary ribs on the inner whorls and biplicate ribs on the outer whorl. The assemblage studied here and referred to as *Prorasenia crenata* (Quenstedt), both in morphology and stratigraphical position, seems represent the microconchiate counterpart of *Vielunia dzalosinensis*.

Prorasenia crenata (Quenstedt)

(Pl. 10: 1–5)

1887 *Ammonites crenatus* Quenstedt; Quenstedt, p. 872, pl. 94: 25, 26.
1961 *Rasenia* (*Prorasenia*) *crenata* (Quenstedt); Geyer, p. 110 (with given synonymy).
1973 *Rasenia* (*Prorasenia*) *crenata* (Quenstedt); Ziegler *et al.*, pp. 30, 31.
1978 *Prorasenia crenata* (Reinecke emend. Quenstedt); Wierzbowski, pp. 320, 321, pl. 3: 10, 11.
1978 *Prorasenia* aff. *bathyschista* (Koerner); Wierzbowski, p. 320, pl. 3: 8.
1991 *Microbiplices* sp.; Malinowska, pl. 7: 17.
1997 *Prorasenia crenata* (Quenstedt); Matyja, Wierzbowski, pl. 5: 15.

Material. — Nine specimens.

Description. — Evolute microconchs attaining from about 30 to 52 mm in diameter; final peristome with lappets – preserved in three specimens. The coiling of the inner whorls is usually more evolute than that of the outer whorl, although sometimes the difference in coiling between the inner and outer whorls is not so distinct (see Pl. 10: 3–4: specimen no. ZI/50/10, where at D = 26 mm: Wh = 33%, Ud = 48%, whereas at D = 45 mm: Wh = 38%, Ud = 42%; and specimen no. ZI/50/17, where at D = 30 mm, Wh = 32%, Ud = 53%,

whereas at D = 52 mm, Wh = 36%, Ud = 48%). The whorl section is low-oval, depressed, often with protruding points of rib-division placed markedly above the mid-height of the whorl.

The ribbing of the inner whorls is strong: the primary ribs are thick, markedly swollen and split into 2–3 strongly developed secondary ribs. Whereas the primaries are prorsiradiate, the secondary ribs show a more rectiradiate course. The primary ribs on the inner whorls are sparsely placed: usually there are 15 to 20 primaries per whorl (Fig. 5). The outer whorl shows the presence of biplicate ribs appearing already at 15 to 30 mm diameter and continuing up to the final peristome. The ribs are usually sharp, but they are not so strongly developed as the ribs on the inner whorls. The primary ribs on the outer whorl are somewhat more densely placed than on the inner whorls (from about 20 to 25 per whorl).

Discussion. — The species *Prorasenia crenata* differs from the younger *Prorasenia bathyschista* (Koerner) known mostly from the Planula Zone in its less dense ribbing, generally more evolute coiling and depressed, low oval whorl section (see Wierzbowski, 1978).

Stratigraphical range and occurrence. — From the Bimammatum Subzone in quarries at Bobrowniki (Pj 92 – marly intercalation between beds 4 and 5, bed 7; Pj 94 – bed 1, rubble – possibly of beds 1 or 2), and Bobrowniki – Tasarze (Pj 89, unit 3, bed 7), and the Hauffianum Subzone (in quarries Pj 168 and 169: unit 2) up to lowermost Planula Zone at Raciszyn (in quarry Pj 193: bed-set 3, horizon 1 – 0.4–0.5 m above the base). The illustrated ammonites (Wierzbowski, 1978; *cf.* synonymy above) come from the Bimammatum Zone.

Family **Ataxioceratidae** Buckman, 1921

Genus *Orthosphinctes* Schindewolf, 1925 [m and M]

Subgenera: *Orthosphinctes* Schindewolf, 1925 [m] and *Pseudorthosphinctes* Enay, 1966 [M]

Type species: *Ammonites tiziani* Oppel, 1863 [m] and *Orthosphinctes* (*Pseudorthosphinctes*) *alternans* Enay, 1966 [M].

These two subgenera represent the corresponding microconchs (*Orthosphinctes*) and macroconchs (*Pseudorthosphinctes*).

The first group of specimens is represented by closely related microconch species: *Orthosphinctes* (*Orthosphinctes*) *colubrinus* (Reinecke) and *Orthosphinctes* (*Orthosphinctes*) *tiziani* (Oppel) and corresponding macroconchs referred to as *Orthosphinctes* (*Pseudorthosphinctes*) *lisowicensis* Wierzbowski (*cf.* Głowniak, Wierzbowski, 2007). These ammonites are characterized by their evolute coiling, rounded to oval whorl section and moderately dense ribbing. The microconchiate species *Orthosphinctes colubrinus* (Pl. 11: 1) occurs in older deposits mostly in the Bimammatum Subzone (in quarries Pj 89, Pj 92, Pj 94 at Bobrowniki), whereas *O. tiziani* occurs in the Hauffianum Subzone (in quarries Pj 113 at Raciszyn: *cf.* Matyja, Wierzbowski, 1978, pl. 6: 1) and the lowermost part of the Planula Zone (in quarry Pj 193, bed-set 3 – horizon 1 at Raciszyn). The macroconch species *O. lisowicensis* (Pl. 10: 6) has been reported both from the Bimammatum Subzone and the Hauffianum Subzone of the Bimammatum Zone (in quarries Pj 92 and Pj 94 at Bobrowniki, and quarries at Raciszyn – especially Pj 113 see Wierzbowski, 1970, p. 327, pl. 9: 1, 2; Matyja, Wierzbowski, 1997, p. 87, pl. 6: 3).

The second group of specimens consists of densely ribbed *Orthosphinctes* showing weakly evolute coiling. Although the dimorphic status of the specimens is not clear (the bulk represent probably fragments of macroconchs, and thus of the subgenus *Pseudorthosphinctes*, but some may represent the corresponding microconchs as well), they seem close to representatives of *Orthosphinctes* (*Pseudorthosphinctes*) *fontannesi* (Choffat) (see Choffat, 1893, p. 40, pl. 90: 1, 3; see also Głowniak, Wierzbowski, 2007, p. 109, fig. 67, and the synonymy given therein). The specimens studied attain about 80–120 mm in diameter; the coiling is weakly evolute (Wh = 31–34%, Ud = 38–45%), and the whorl section is high-oval with flattened whorl sides (Wb = 21–24%). The ribbing is dense, there being about 43–52 primary ribs per whorl at D = 35–100 mm diameter; the ribs are mostly biplicate, whereas triplicate ribs may appear at larger diameter. The ammonites studied are, however, fragmentarily preserved, and thus they are referred to as *Orthosphinctes* cf. *fontannesi* (Choffat) (Pl. 11: 2). They have been reported from the oldest deposits studied belonging to the lower part of the Bimammatum Subzone, at Bobrowniki (in quarry Pj 92 only, beds 1 and 2, and rubble).

Genus *Wegelea* Gygi, 2000 [M]

Type species: *Perisphinctes gredingensis* Wegele, 1929.

This new genus was created for a "characteristic perisphinctid with a relatively narrow umbilicus, weak and blunt ribs and attenuation of the ribbing on the whorl sides" (Gygi, 2000, p. 92). The type species is "*Perisphinctes*" *gredingensis* Wegele (Wegele, 1929 p. 49, pl. 1: 7) which has been attributed for a long time to the genus *Orthosphinctes* (*e.g.* Enay, 1966) from which it differs, however, in its narrow umbilicus and different type of ribbing (Gygi, 2000). Several other species like "*Orthosphinctes*"/"*Subdiscosphinctes*" *grandiplex* (Quenstedt) and "*Subdiscosphinctes*" *castroi* (Choffat) (*cf.* Hantzpergue, 1989; Matyja, Wierzbowski, 1997) show similar coiling

and type of ornamentation and also can be attributed to the genus *Wegelea*.

Wegelea gredingensis (Wegele)

(Pl. 11: 3)

1929 *Perisphinctes gredingensis* Wegele; Wegele, p. 49, pl. 1: 7.
1978 *Pomerania helvetica* (Geyer); Wierzbowski p. 322–24 (pars), pl. 4: 3, pl. 5: 2 (only).
2000 *Wegelea gredingensis* (Wegele); Gygi, p. 92, pl. 13: 1.

Material. — Three incomplete specimens.

Description. — The specimens studied are about 80–90 mm in diameter, and represent the phragmocone, sometimes with part of the body chamber preserved. The coiling is weakly evolute (at D = 80 mm, Wh = 32–35%, Ud = 38–39%). The whorl section is high-oval. The ribbing is fairly dense, consisting of weakly prorsiradiate primary ribs (PR = 40–44 at D = 50–90 mm): these are rather thin on the inner whorls, but become much thicker at about 70 mm diameter. The ribs split into two, and sometimes three secondary ribs somewhat above the mid height of whorl, some intercalatory ribs appear as well (the secondary/primary ribs ratio equals 2.4–2.7 at D = 80–90 mm). The secondary ribs are rather thin on the inner whorls but become massive at the end of the last whorl preserved.

Discussion. — In large specimens of *W. gredingensis* the ribbing tends to disappear in the middle of the whorl-side where the smooth spiral band appears (Wegele, 1929; Gygi, 2000). This feature is not observed in the specimens studied because of their smaller diameters. On the other hand, the specimens studied show well the character of ornamentation of the inner whorls of the species in question. Two of these specimens were erroneously referred by Wierzbowski (1978, pl. 4: 3; pl. 5: 2) to as *Pomerania helvetica* (Geyer).

Stratigraphical range and occurrence. — Three specimens come from the quarry Pj 92 at Bobrowniki: two specimens found in rubble including that illustrated by Wierzbowski (1978, pl. 4: 3), and one specimen found in bed 4. Another specimen (Wierzbowski, 1978, pl. 5: 2) comes from the non-existent quarry at Wapiennik, south of the Raciszyn Village, in the Wieluń Upland. All the specimens of *Wegelea* from the Wieluń Upland discussed here come from the Bimammatum Subzone.

Genus *Praeataxioceras* Atrops, 1982 [m and M]

Type species: *Perisphinctes laufenensis* Siemiradzki, 1899.

Originally introduced by Atrops (1982) for the group of *Orthosphinctes laufenenesis* Siemiradzki with the type species "*Perisphinctes*" *laufenensis* of Siemiradzki (1899, p. 188, pl. 26: 46), which is a microconch. The macroconch counterpart according to Atrops (1982, p. 50) was the group of "*Orthosphinctes*" *suevicus* Siemiradzki (Siemiradzki, 1898, p. 238, pl. 24: 35), but the true macroconch representative of *Orthosphintes laufenensis* has been recognized later by Matyja and Wierzbowski (1997, p. 88, pl. 8: 2) and included in *Praeataxioceras*. *Praeataxioceras* differs markedly from typical representatives of *Orthosphinctes* in the common occurrence of bidichotomous rib division, in its different rib density curve, and in the common occurrence of deep constrictions markedly disrupting the ornamentation, and it is treated herein as an independent genus including both micro- and macroconchs.

The specimens studied represent mostly the species *Praeataxioceras laufenensis* (Siemiradzki): it is represented both by microconchs (Wierzbowski, 1978, pl. 10: 2), and macroconchs (Matyja, Wierzbowski, 1997). The specimens (Pl. 11: 4) occur from the upper part of the Bimammatum Subzone (quarry Pj 92, bed 7, and quarry Pj 94 at Bobrowniki, upper part of the section) up to the lowermost part of the Planula Zone (quarry Pj 140 at Lisowice, *cf.* Matyja, Wierzbowski, 1997). The name *P. laufenensis* Siemiradzki, 1899, has been treated sometimes (Schweigert, Callomon, 1997) as a younger synonym of *Ammonites virgulatus* Quenstedt (see Quenstedt, 1887–1888, pl. 100: 5). This interpretation was not accepted, however, by Wierzbowski (*in*: Głowniak, Wierzbowski, 2007, p. 116), because the type specimen of *A. virgulatus* is much more densely ribbed than *Praeataxioceras laufenenesis*.

The specimen of *Praeataxioceras suevicus* illustrated by Siemiradzki (1898, pl. 24: 35), and also the closely allied form referred to as "*Orthosphinctes* (nov. subgen.) aff. *suevicus* (Siemiradzki)" by Atrops (1982, pl. 19: 1), show very densely ribbed inner whorls. When compared with the type of *Ammonites virgulatus* (Quenstedt, 1887, pl. 100: 5), the innermost whorls of the two specimens discussed show much more evolute coiling. A single specimen referred to as *Orthosphinctes* (?) *suevicus* (Siemiradzki) by Wierzbowski (1978, pl. 10: 3) from the Bimammatum Subzone in quarry Pj 113 at Raciszyn unfortunately does not show the ornamentation of the innermost whorls. On the other hand, two small specimens of *Praeataxioceras* from quarry Pj 89 at Tasarze near Lisowice, from an upper part of the Bimammatum Subzone, show very densely ribbed whorls (about 30 primary ribs per half a whorl at D = 23–30 mm): one of these specimens shows very evolute coiling (at D = 28 mm, Wh = 30%, Ud = 44.6%), whereas the second one is markedly less evolute (at D = 23 mm, Wh = 32%, Ud = 37%) – a good example illustrating marked variability of the specimens of a still poorly known group. It should be remembered that the innermost whorls of *Praeataxioceras* show marked similarity to *Subnebrodites matyjai* sp. nov. – the oldest representative of the genus *Subnebrodites*, as described below.

Genus *Subnebrodites* Spath, 1925 [m and M]

Type species: *Ammonites planula* Quenstedt, 1877/1988.

Subnebrodites matyjai Wierzbowski et Głowniak sp. nov.
(Pl. 12: 1, 2)

1997 *Idoceras* (*Subnebrodites*) *minutum* Dieterich; Matyja, Wierzbowski, pl. 9: 4.

Type material: Holotype (ZI/50/28) figured in Pl. 12: 1a–c, paratype (IGP UW/A/33/183) referred previously to as *Idoceras* (*Subnebrodites*) *minutum* Dieterich (Matyja, Wierzbowski, 1997, pl. 9: 4).
Type area and locality: Wieluń Upland, Lisowice Village (Pj 140), Raciszyn (Pj 193, Pj 167).
Type horizon: This is the species which marks the lowermost horizon of the Planula Zone.
Derivation of the name: In honour of Bronisław A. Matyja, the Polish stratigrapher and palaeontologists, and student of the Polish Upper Jurassic ammonite faunas, and the co-author of the ammonite monograph on the Wieluń Upland (Matyja, Wierzbowski, 1997).
Diagnosis: Small, strongly evolute and densely ribbed *Subnebrodites*.

Material. — Five specimens attaining from about 30 to 40 mm in diameter.

Description. — Although none of the specimens studied shows the peristome preserved, it is likely that the specimens represent microconchs. Coiling is strongly evolute from the inner to outer whorls: at about 30 mm diameter, Wh ranges from 27 to 34%, whereas Ud from 48 to 56%. The whorl section is high-oval with flattened whorl sides, and the ventral side is narrow. The specimens are densely ribbed: the number of primary ribs per whorl is about 40 at about 20 mm diameter, and 45–52 at 30–40 mm diameter. The primary ribs are prorsiradiate, mostly biplicate, but some are single. The ribs split very high on the whorl sides close to the venter, into two markedly prorsiradiate secondaries. The ventral side of the whorl bears a spiral band where the ornamentation becomes markedly weaker. Constrictions are narrow and poorly marked.

Discussion. — The specimens of the new species *Subnebrodites matyjai*, have been previously sometimes attributed to another species – *Subnebrodites minutum* (Dieterich). The new species differs, however, in its markedly more evolute coiling and higher point of rib division when compared with specimens of *S. minutum* (see Dieterich, 1940, pp. 33, 34, pl. 2: 3–7; Schairer, 1989, pp. 105–107). Additionally, the two species show a quite different stratigraphical distribution (see below).

Stratigraphical range and occurrence. — The newly distinguished species *S. matyjai* occurs at the base of the Planula Zone, well below the *proteron* horizon, and thus differs markedly in its stratigrapical range from that of *Subnebrodites minutum* which occurs fairly high in the Planula Zone, in the *schroederi* horizon (Schweigert, Callomon, 1997, pp. 37–38). This was the reason that Matyja and Wierzbowski (2006, fig. B1.17) recognized the "aff. *minutum*" horizon at the base of the Planula Zone to distinguish small forms occurring there, currently described as *S. matyjai*, from true *S. minutum.* This ammonite horizon should be distinguished now as the *matyjai* horizon (see stratigraphical part of the paper).

S. matyjai has been found in several quarries at Raciszyn (Pj 167, unit 3, possibly uppermost part; Pj 193, bed-set 3, faunal horizon 1, 0.4–0.5 m from the base) and Lisowice (Pj 140, possibly topmost part of the unit 1, and unit 2; see Matyja, Wierzbowski, 1997, 2006).

Family **Aspidoceratidae** Zittel, 1895

Genus *Aspidoceras* Zittel, 1868 [M]

Type species: *Ammonites rogoznicensis* Zejszner, 1846; and

Genus *Physodoceras* Hyatt, 1900

Type species: *Ammonites circumspinosum* Oppel, 1863.

The family is poorly represented in the material studied by one specimen of *Aspidoceras binodum* (Oppel) (Pl. 12: 3) found in quarry Pj 92 at Bobrowniki (bed 1, lower part of the Bimammatum Subzone), and two specimens of *Physodoceras* sp. in quarry Pj 193 at Raciszyn (bed-set 2, faunal horizon 1, 0.4–0.5 m from the base, representing the lowermost part of the Planula Zone). Previously (Matyja, Wierzbowski, 1997), were reported: *Aspidoceras sesquinodosum* Fontannes from the lowermost part of the Hauffianum Subzone (in quarry Pj 114 at Raciszyn), and *Physodoceras altenense* (d'Orbigny) from lower part of the Planula Zone; a single specimen of *Epipeltoceras bimammatum* (Quenstedt) has been found in quarry Pj 113 at Raciszyn (unit 1).

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PLATES

PLATE 1

Fig. 1. *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita*
ZI/50/82; Bobrowniki Pj 92, bed 1; Bimammatum Subzone; × 0.75

Fig. 2. *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita*
ZI/50/77; Bobrowniki Pj 92, bed 4; Bimammatum Subzone

Fig. 3. *Taramelliceras* (*Taramelliceras*) *costatum costatum* (Quenstedt) forma *aurita*
ZI/50/76; Bobrowniki Pj 94, SW part, bed 2; Bimammatum Subzone; × 0.6

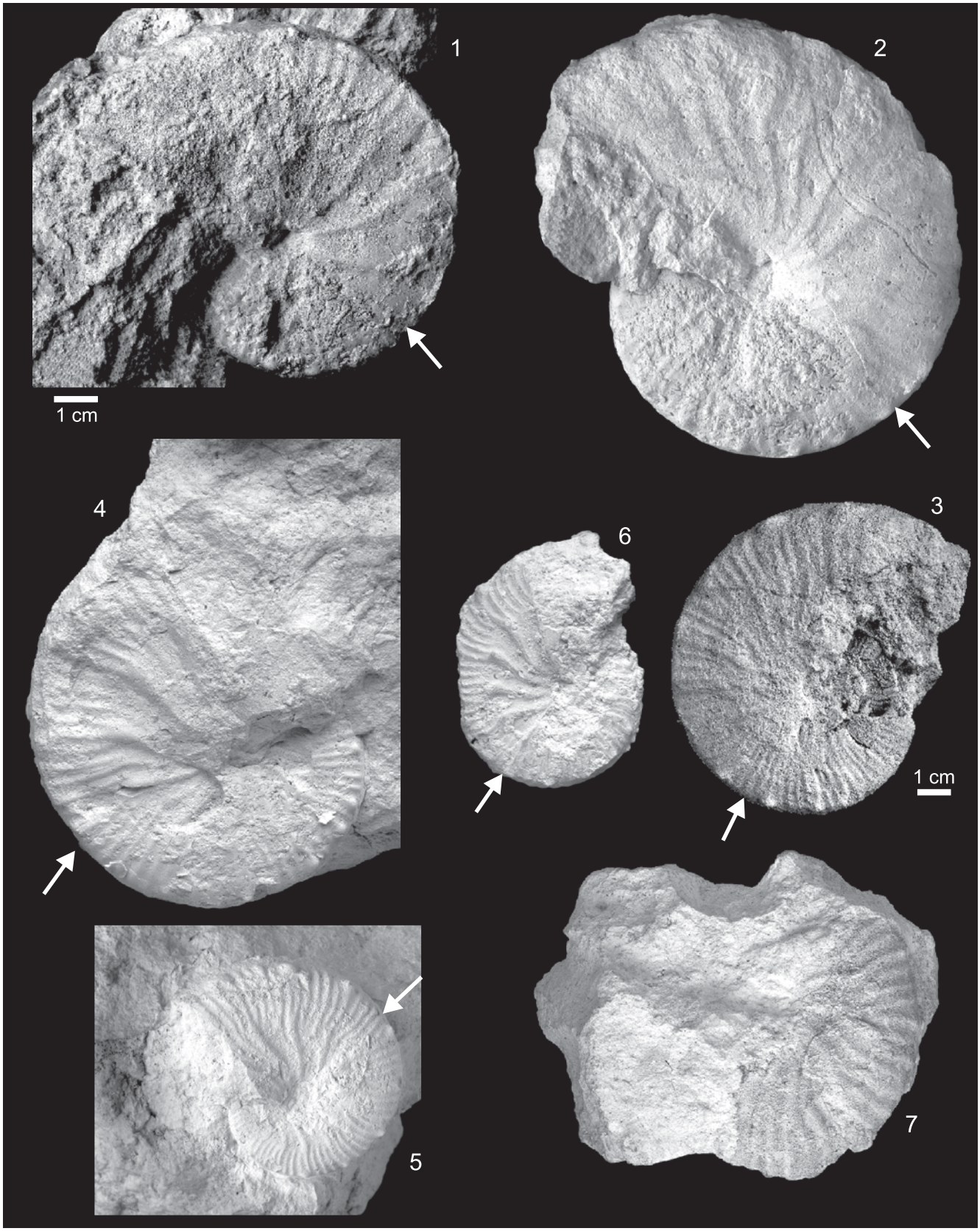
Fig. 4. *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus
ZI/50/84; Bobrowniki Pj 94, SW part, bed 1 (lower part); Bimammatum Subzone

Fig. 5. *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus
ZI/50/85; Bobrowniki Pj 94, SW part, bed 1 (lower part); Bimammatum Subzone

Fig. 6. *Taramelliceras* (*Taramelliceras*) *costatum laterinodosum* Karvé-Corvinus
ZI/50/87; Bobrowniki Pj 92, bed 2 (lower part); Bimammatum Subzone

Fig. 7. *Taramelliceras* (*Taramelliceras*) *broilii* (Wegele)
ZI/50/88; Bobrowniki Pj 92, beds 6, 7; Bimammatum Subzone

All specimens in natural size unless specified otherwise; phragmocone/body chamber boundary arrowed



Andrzej WIERZBOWSKI *et al.* — Ammonites and ammonite stratigraphy of the Bimammatum Zone and lowermost Planula Zone...

PLATE 2

Fig. 1. *Taramelliceras* (*Taramelliceras*) *zelcense* Wierzbowski et Głowniak sp. nov.
a – lateral view, b – ventral view; holotype, ZI/50/134; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

Fig. 2. *Taramelliceras* (*Taramelliceras*) *zelcense* Wierzbowski et Głowniak sp. nov.
paratype, ZI/50/125; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

Fig. 3. *Taramelliceras* (*Taramelliceras*) "*kobyi* (Choffat)" sensu Dieterich 1940
a, b – both sides of the specimen; ZI/50/122; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

Specimens in natural size; phragmocone/body chamber boundary arrowed

Andrzej WIERZBOWSKI *et al.* — Ammonites and ammonite stratigraphy of the Bimammatum Zone and lowermost Planula Zone...

PLATE 3

Fig. 1. *Glochiceras* (*Lingulaticeras*) *bobrownikiense* Wierzbowski et Głowniak sp. nov.
a – lateral view, b – ventral view; holotype, ZI/50/117; Tasarze Pj 89, unit 3, bed 7;
Bimammatum Subzone

Fig. 2. *Glochiceras* (*Lingulaticeras*) *bobrownikiense* Wierzbowski et Głowniak sp. nov.
a – lateral view, b – ventral view; paratype, ZI/50/108; Bobrowniki Pj 92, bed 7;
Bimammatum Subzone

Fig. 3. *Glochiceras* (*Lingulaticeras*) *bobrownikiense* Wierzbowski et Głowniak sp. nov.
a – lateral view, b – ventral view; paratype, ZI/50/118; Tasarze Pj 89, unit 3, bed 7;
Bimammatum Subzone

Figs 4–6. *Glochiceras* (*Lingulaticeras*) *lingulatum* (Quenstedt):
4 – ZI/50/153, 5 – ZI/50/152, 6 – ZI/50/160; Raciszyn Pj 193, bed-set 3, horizon 1;
Planula Zone, *matyjai* horizon

All specimens × 1.5; phragmocone/body chamber boundary arrowed

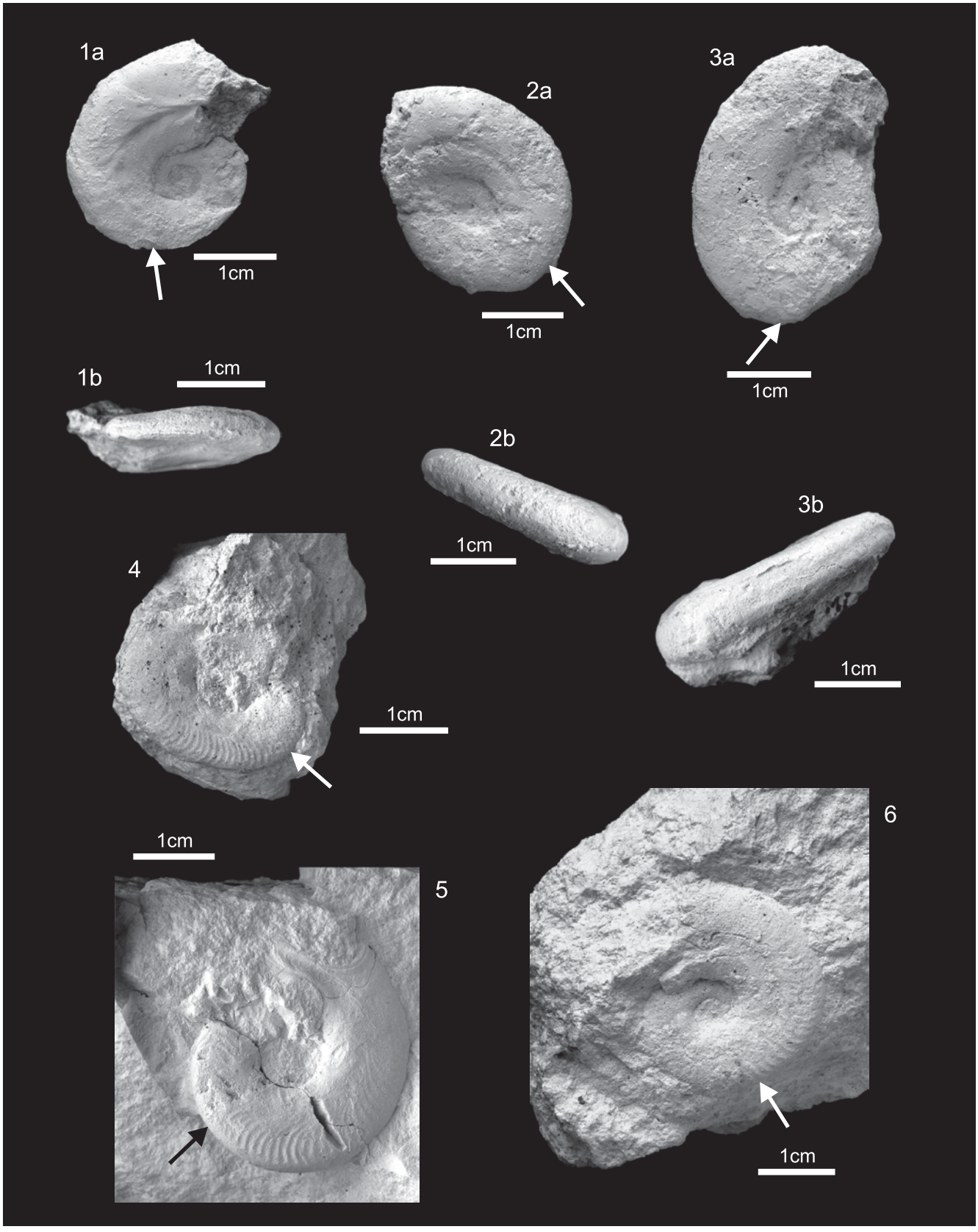


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PLATE 4

Fig. 1. *Taramelliceras* (*Richeiceras*) *jaeggii* Quereilhac
a – lateral view, b – ventral view; ZI/50/49; Bobrowniki Pj 92, bed 4; Bimammatum Subzone

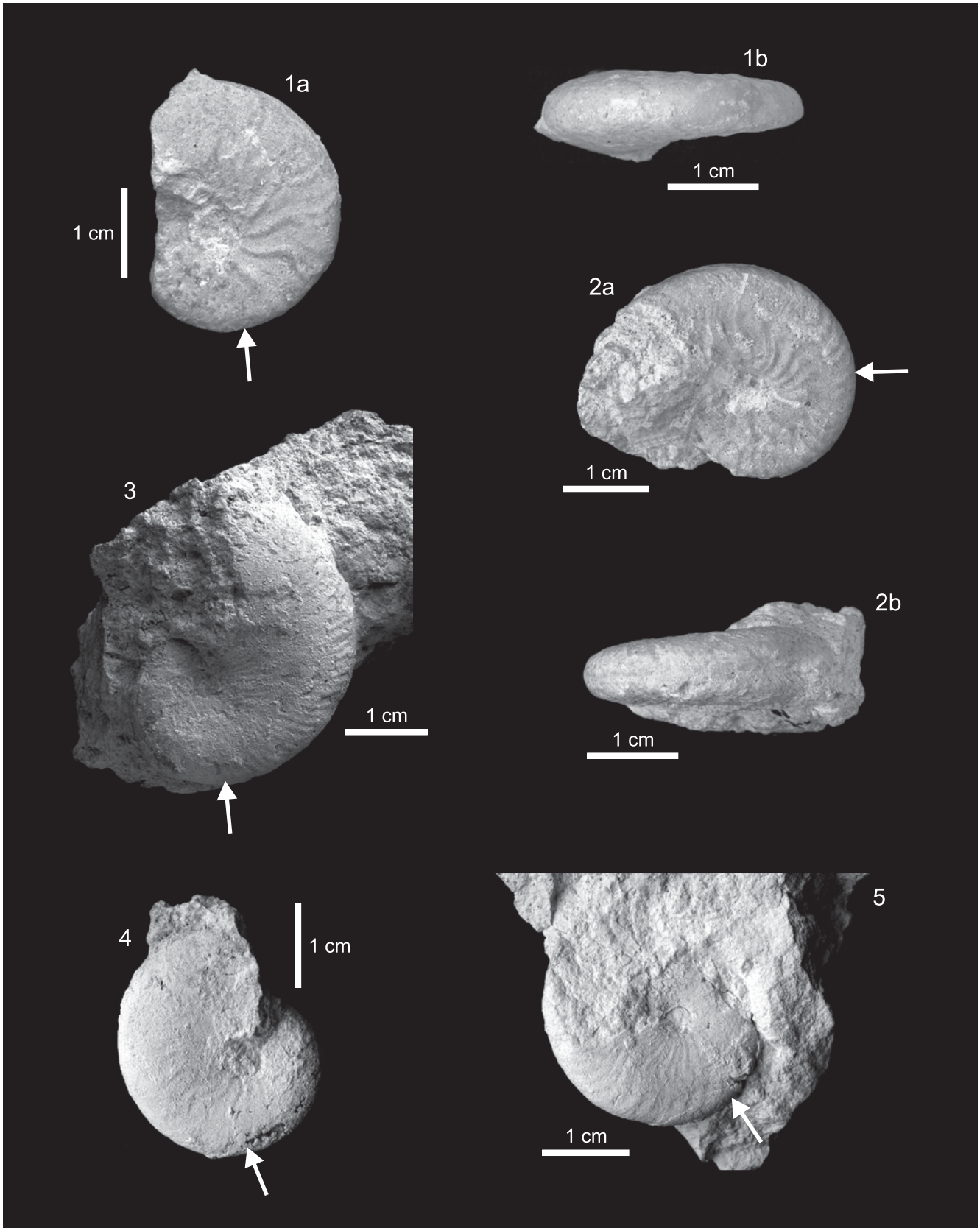
Fig. 2. *Taramelliceras* (*Richeiceras*) *jaeggii* Quereilhac
a – lateral view, b – ventral view; ZI/50/50; Bobrowniki Pj 92, bed 3; Bimammatum Subzone

Fig. 3. *Taramelliceras* (*Richeiceras*) *pichleri* (Oppel)
ZI/50/175; Bobrowniki Pj 92, bed 5; Bimammatum Subzone

Fig. 4. *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel)
ZI/50/176; Bobrowniki Pj 92, bed 6 (uppermost part); Bimammatum Subzone

Fig. 5. *Taramelliceras* (*Metahaploceras*) *litocerum* (Oppel)
ZI/50/177; Bobrowniki Pj 92, bed 7; Bimammatum Subzone

All specimens × 1.5; phragmocone/body chamber boundary arrowed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2a
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3
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2b
1 cm
4
1 cm
5
1 cm

PLATE 5

Fig. 1, 2. *Glochiceras* (*Coryceras*) *canale* (Quenstedt)
ZI/50/65, ZI/50/64; Bobrowniki Pj 92, bed 1; Bimammatum Subzone

Figs 3, 4. *Glochiceras* (*Coryceras*) *modestiforme* (Oppel)
ZI/50/178, ZI/50/179; Bobrowniki Pj 92, bed 7; Bimammatum Subzone

Fig 5. *Ochetoceras marantianum* (d'Orbigny)
ZI/50/180; Bobrowniki Pj 94, rubble; Bimammatum Subzone

Fig 6. *Trimarginites arolicus* (Oppel)
ZI/50/181; Bobrowniki Pj 92, bed 4; Bimammatum Subzone

Specimens in natural size, except those in Figs 1–4 enlarged × 1.5; phragmocone/body chamber boundary arrowed

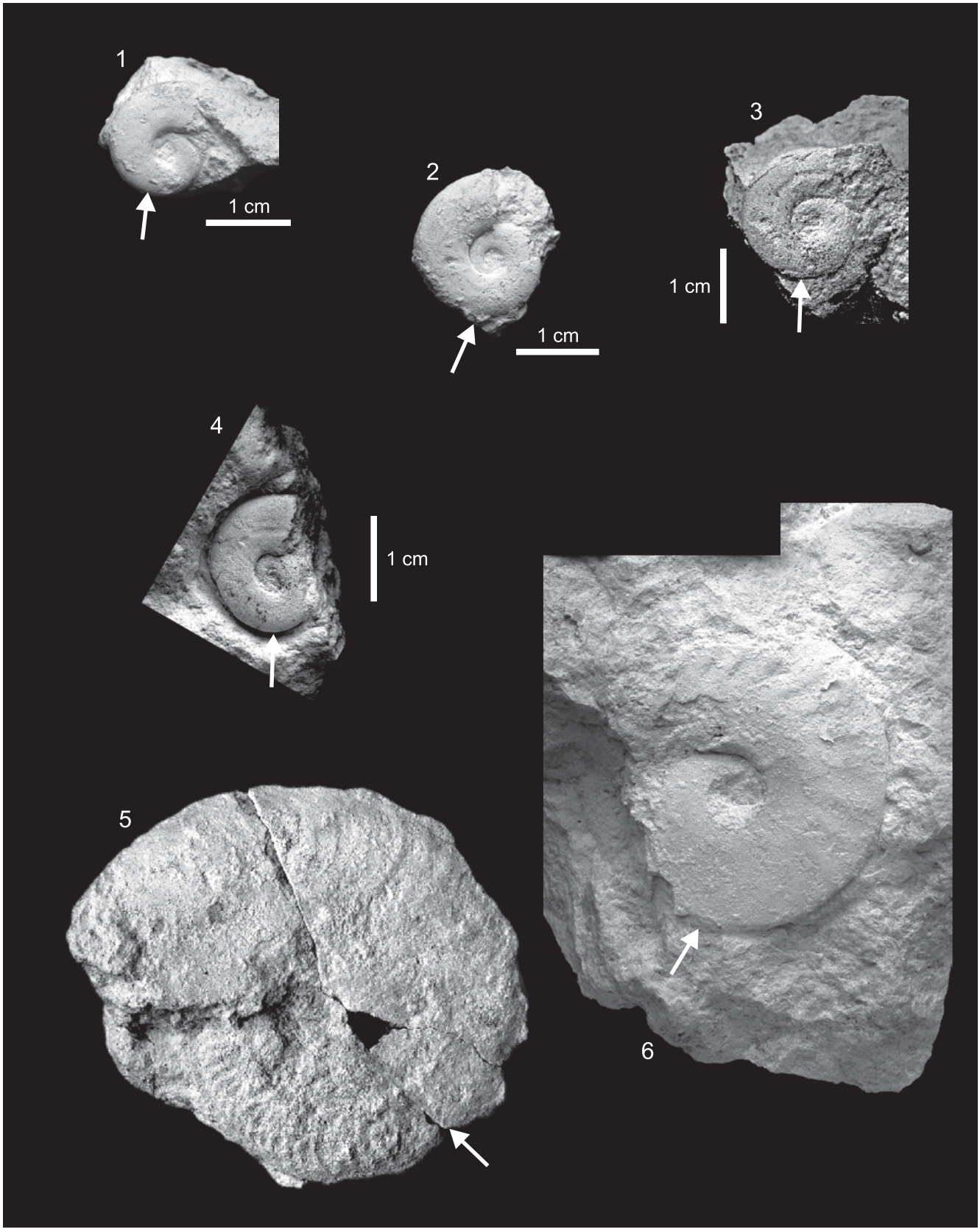
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PLATE 6

Fig. 1. *Amoeboceras* (*Plasmatites*) cf. *lineatum* (Quenstedt);
a – lateral view, b – ventral view; ZI/50/20; Bobrowniki Pj 92, bed 1; Bimammatum Subzone

Fig. 2. *Amoeboceras* (*Plasmatites*) ex gr. *bauhini* (Oppel)
a – lateral view, b – ventral view; ZI/50/45; Tasarze Pj 89, bed-set 3, beds 8–9;
Bimammatum Subzone

Fig. 3. *Amoeboceras* (*Plasmatites*) *lineatum* (Quenstedt)
ZI/50/22; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

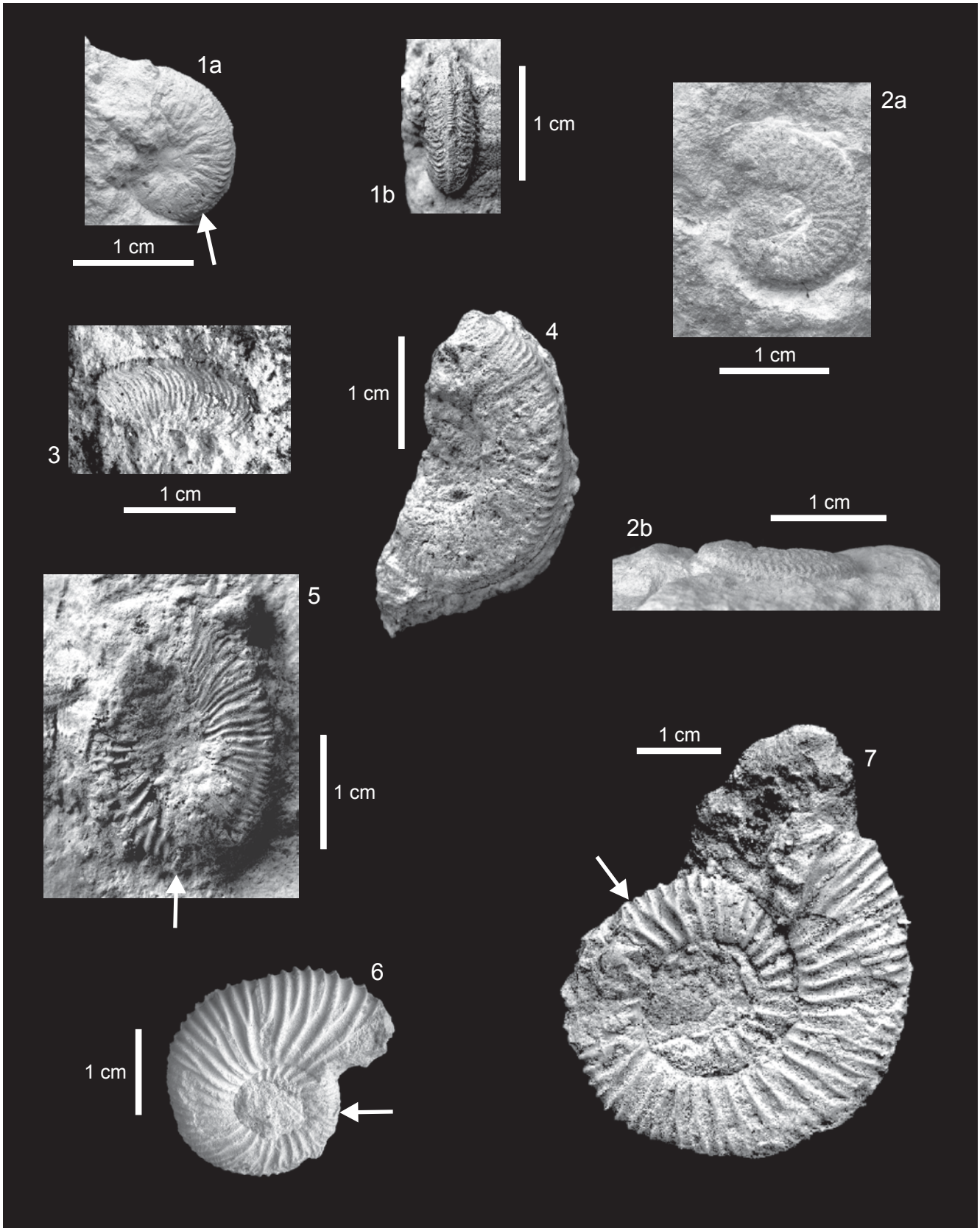
Fig. 4. *Amoeboceras* (*Plasmatites*) cf. *praebauhini* (Salfeld)
ZI/50/24; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

Fig. 5. *Amoeboceras* (*Plasmatites*) *bauhini* (Oppel)
ZI/50/25; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

Fig. 6. *Vineta* sp. [m]
ZI/50/13; Bobrowniki Pj 94, central part, bed 2; Bimammatum Subzone

Fig. 7. *Vineta* sp. [m]
ZI/50/16; Raciszyn Pj 113, upper part of the section, rubble; Hauffianum Subzone

Specimens in Figs 1a, b – 5: × 2; specimens in Figs 6, 7: × 1.5; phragmocone/body chamber boundary arrowed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7
1 cm
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1 cm

PLATE 7

Fig. 1. *Vineta submediterranea* (Wierzbowski)
a, b – both sides of the specimen; IGP UW/A/10/332, holotype refigured (*cf.* Wierzbowski 1978, pl. 3: 1); Bobrowniki Pj 94, central part, beds 3–5; Bimammatum Subzone

Fig. 2. *Vineta submediterranea* (Wierzbowski)
ZI/50/8; inner whorls – phragmocone; fragments of outer whorl – body chamber; Bobrowniki Pj 94, central part, beds 3–5; Bimammatum Subzone

Fig. 3. *Vineta* cf. *streichensis* (Oppel)
ZI/50/182; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, matyjai horizon

Specimens in natural size; phragmocone/body chamber boundary arrowed


1a
2
3
1b

PLATE 8

Fig. 1. *Vineta* cf. *jaekeli* Dohm
ZI/50/183; Raciszyn Pj 167, unit 3, rubble; Hauffianum Subzone or lowermost Planula Zone; × 0.45

Fig. 2. *Vielunia dzalosinensis* sp. nov.
paratype, IGP UW/A/10/335 (= *Ringsteadia limosa* in: Wierzbowski, 1978, pl. 3: 4); Raciszyn Pj 113, upper part of the section; Hauffianum Subzone; × 0.7

Phragmocone/body chamber boundary arrowed

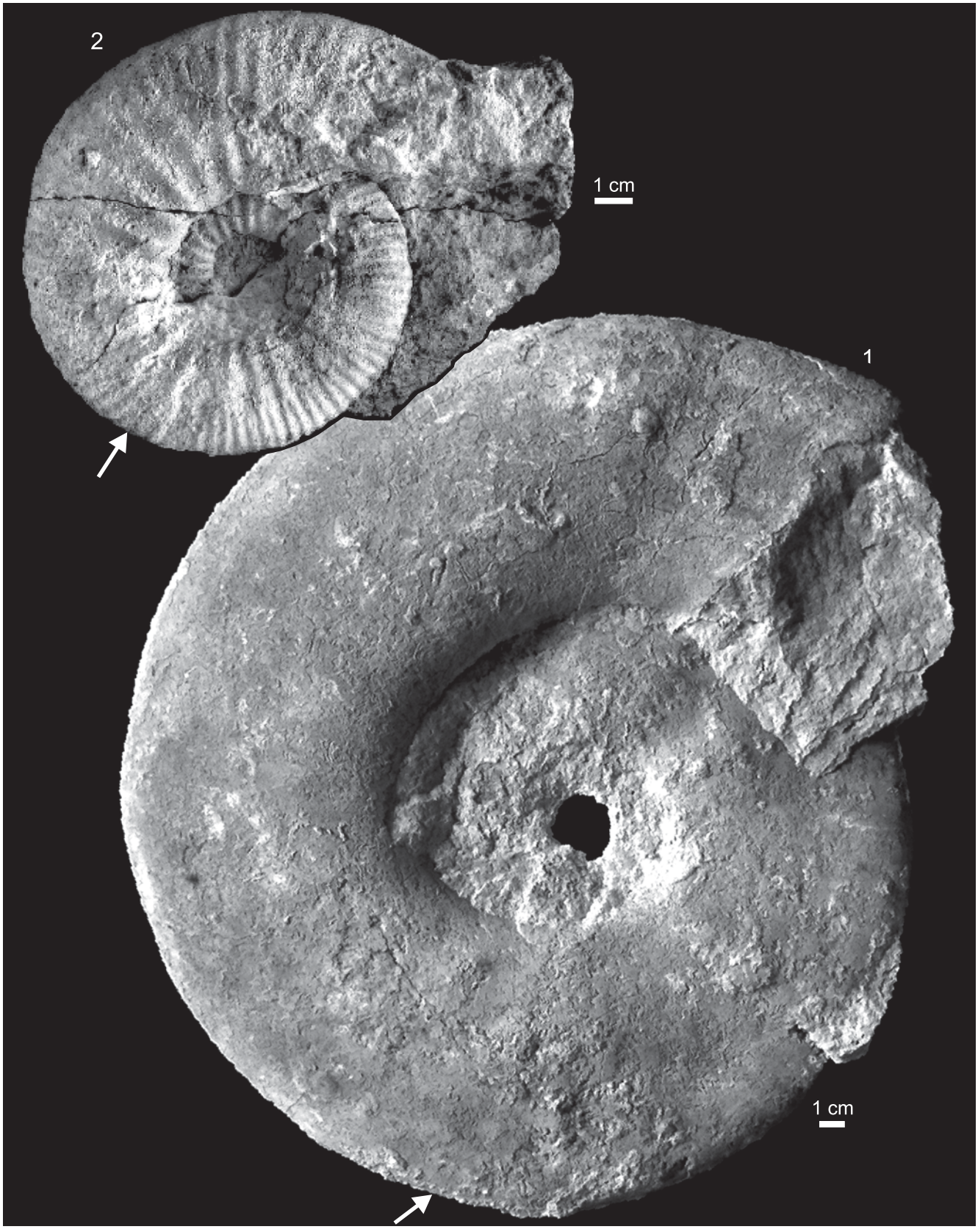
2
1 cm
1
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PLATE 9

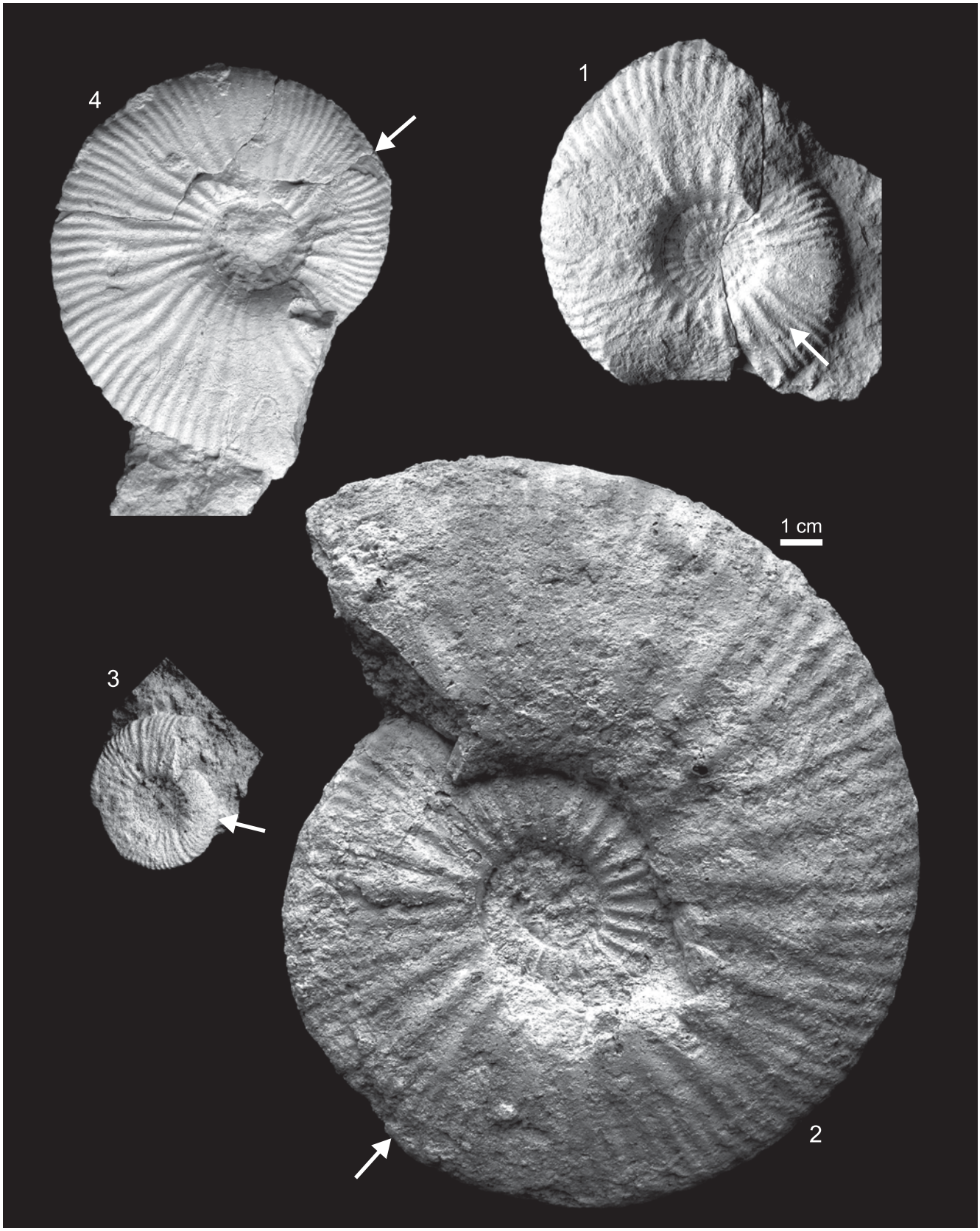
Fig. 1. *Vielunia dzalosinensis* sp. nov.
holotype, ZI/50/4; Raciszyn Pj 193, bed-set 3, rubble; Planula Zone, *matyjai* horizon

Fig. 2. *Vielunia dzalosinensis* sp. nov.
paratype, IGP UW/A/8/5 (= *Ringsteadia limosa* in: Wierzbowski, 1970, pl. 3);
Raciszyn Pj 167–169, rubble; Hauffianum or lowermost Planula Zone; × 0.75

Fig. 3. *Vielunia dzalosinensis* sp. nov.
ZI/50/2; Bobrowniki Pj 92, bed 5; Bimammatum Subzone

Fig. 4. *Vielunia dzalosinensis* sp. nov.
ZI/50/1; Bobrowniki Pj 92, bed 2; Bimammatum Subzone

Specimens in natural size except specified otherwise; phragmocone/body chamber boundary arrowed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1 cm
3
2

PLATE 10

Fig. 1. *Prorasenia crenata* (Quenstedt)
ZI/50/12; Bobrowniki Pj 92, bed 7; Bimammatum Subzone

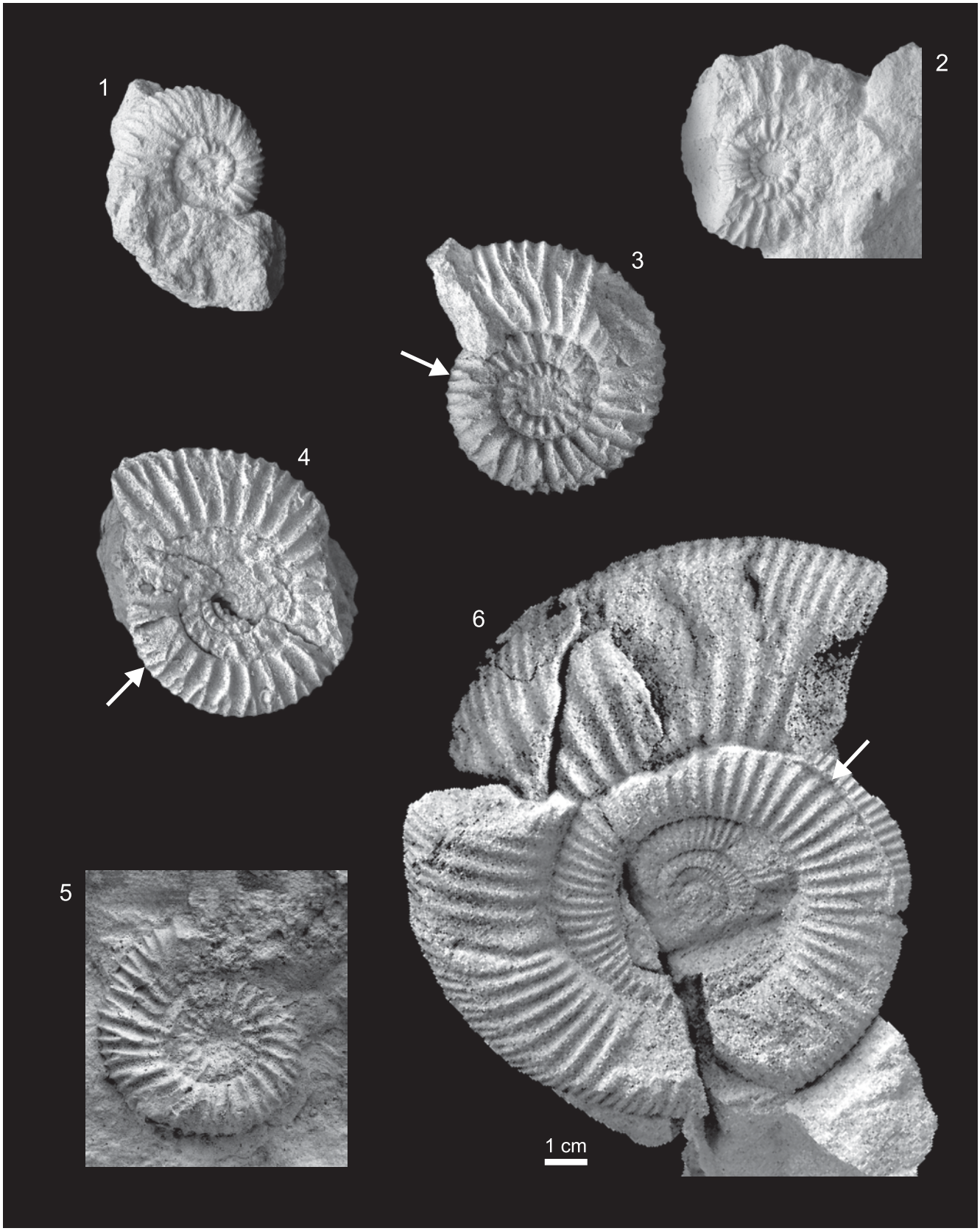
Fig. 2. *Prorasenia crenata* (Quenstedt)
ZI/50/11; Bobrowniki Pj 94, central part, bed 1; Bimammatum Subzone

Figs 3, 4. *Prorasenia crenata* (Quenstedt)
ZI/50/10 and ZI/50/17; Bobrowniki Pj 94, central part, beds 1–2; Bimammatum Subzone

Fig. 5. *Prorasenia crenata* (Quenstedt)
ZI/50/14; Raciszyn Pj 193, bed-set 3; Planula Zone, *matyjai* horizon

Fig. 6. *Orthosphintes* (*Pseudorthosphinctes*) *lisowicensis* Wierzbowski
ZI/50/35; Bobrowniki Pj 92, bed 7, Bimammatum Subzone; × 0.75

Specimens in natural size except specified otherwise; phragmocone/body chamber boundary arrowed



Andrzej WIERZBOWSKI *et al.* — Ammonites and ammonite stratigraphy of the Bimammatum Zone and lowermost Planula Zone...

PLATE 11

Fig. 1. *Orthosphinctes* (*Orthosphinctes*) *colubrinus* (Reinecke)
ZI/50/33; Bobrowniki Pj 94, rubble; Bimammatum Subzone

Fig. 2. *Orthosphinctes* cf. *fontannesi* (Choffat)
ZI/50/36; Bobrowniki Pj 92, rubble; Bimammatum Subzone

Fig. 3. *Wegelea gredingensis* (Wegele)
ZI/50/41; Bobrowniki Pj 92, bed 4 (upper part); Bimammatum Subzone

Fig. 4. *Praeataxioceras* cf. *laufenensis* (Siemiradzki)
ZI/50/47; Bobrowniki Pj 92, bed 7; Bimmamatum Subzone

All specimens in natural size; phragmocone/body chamber boundary arrowed


1
2
3
4

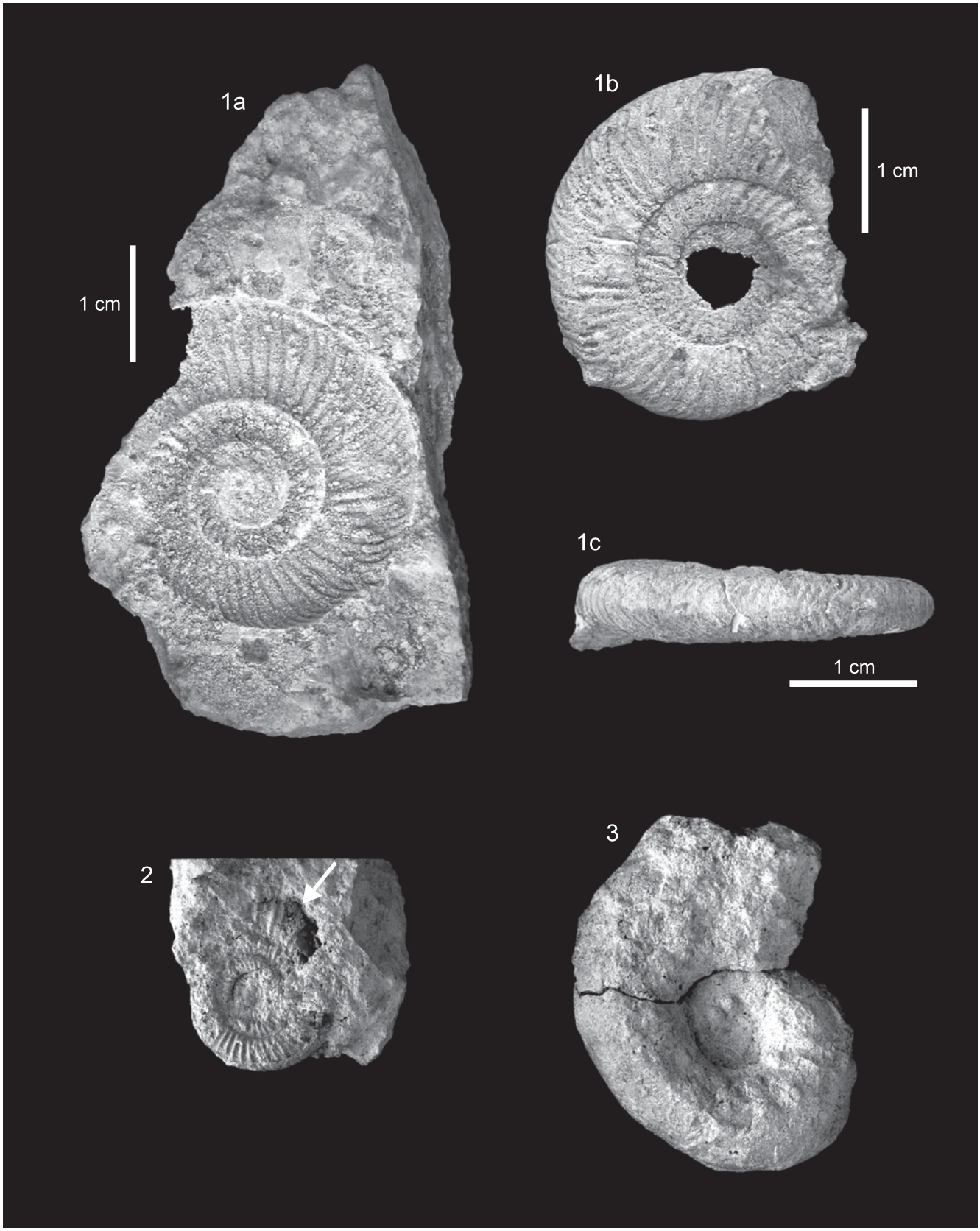
PLATE 12

Fig. 1. *Subnebrodites matyjai* sp. nov.
a, b – lateral view of negative and its cast, c – ventral view; holotype, ZI/50/28; Lisowice Pj 140 (topmost part of unit 1 or lowermost part of unit 2: *cf.* Matyja, Wierzbowski, 1997); Planula Zone, *matyjai* horizon; × 2

Fig. 2. *Subnebrodites matyjai* sp. nov.
ZI/50/27; Raciszyn Pj 193, bed-set 3, horizon 1; Planula Zone, *matyjai* horizon

Fig. 3. *Aspidoceras binodum* (Oppel)
ZI/50/46; phragmocone; Bobrowniki Pj 92, bed 1 (uppermost part); Bimammatum Subzone

Specimens in natural size (Figs 2, 3) and enlarged × 2 (Fig. 1a–c); phragmocone/body chamber boundary arrowed


1a
1 cm
1b
1 cm
1c
1 cm
2
3