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Article

Bajocian-Bathonian (Middle Jurassic) ammonites from the Polish Jura

Part 1: Families Phylloceratidae, Nannolytoceratidae, Sonniniidae, Strigoceratidae, Oppeliidae and Lissoceratidae

by

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with 6 plates and 11 text-figures

Abstract

The present paper constitutes a first part of a larger monographic work concerning the systematic descriptions of the Bajocian-Bathonian (Middle Jurassic) ammonite fauna from the Polish Jura, south-central Poland. In the present part, the geological background together with the all ammonite-bearing sections studied is presented, and the systematic description of the ammonite families Phylloceratidae, Nannolytoceratidae, Sonniniidae, Strigoceratidae, Oppeliidae and Lissoceratidae is given. Twenty four species, nine of which left in open nomenclature, representing eight genera (*Phylloceras*, *Calliphylloceras*, *Nannolytoceras*, *Sonninia*, *Strigoceras*, *Oxycerites*, *Prohecticoceras* and *Lissoceras*) are described. Their stratigraphic ranges are also shown. Many of the ammonites, especially the oppeliid species, are described in the present paper for the first time.

Key words: Middle Jurassic, Bajocian, Bathonian, ammonites, Poland

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1. Introduction

The Middle Jurassic siliciclastic deposits of the Bajocian-Bathonian age of the Polish Jura, south-central Poland have been a subject of geological and palaeontological investigation since the XIX century, when PUSH (1837) as the first included descriptions and illustrations of many Jurassic fossils, including the genus *Parkinsonia*, in his monograph '*Polens Paläontologie*'. The sediments under discussion are well-known from their rich and diverse fossil content (see

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e.g., Matyja et al. 2006a, b, c; Zaton et al. 2007, 2009). However, few fossil groups, as ammonites, have awaited a thorough study. Although ammonites have been used in biostratigraphy of these deposits (see e.g., Rehbinder 1914; Rożycki 1953; Dayczak-Calikowska et al. 1997; Kopik 1998; Matyja & Wierzbowski 2000, 2003; Matyja et al. 2006a, b, c), they have never been palaeontologically worked-out in detail. Exceptions are a few papers dealing with some ammonite species and assemblages (Kopik 1967; Dayczak-Calikowska et al. 1988; Matyja & Wierzbowski 2000; Zaton & Marynowski 2006; Kopik 2006) or single genera and species (Kopik 1974; Matyja & Wierzbowski 2001; Zaton 2007a, 2008). Their complex, systematic study, however, is still lacking. Thus, the main aim of the present work is fulfill this gap in a form of a monographic description of the Bajocian-Bathonian ammonites from the Polish Jura.

The present, first part of the monographic work is devoted to the characteristics of the ammonite-bearing sections of the Polish Jura and systematic description of the representatives of the families Phylloceratidae, Nannolytoceratidae, Sonniniidae, Strigoceratidae, Oppeliidae and Lissoceratidae. The systematic description of the next ammonite families, as well as palaeobiogeographic affinities of the whole Late Bajocian-Bathonian ammonite assemblages of the area studied will be given in the second part.

2. Geological background and characteristics of the ammonite-bearing sections

The Polish Jura is a monoclinal structure spreading from south-east to north-west of the Kraków-Wieluń Upland in south-central Poland (Text-fig. 1A–B). The Middle Jurassic sediments in that area rest upon the Lower Jurassic, and are overlain by Upper Jurassic or directly by thin Quaternary cover (e.g., Rożycki 1953; Dayczak-Calikowska et al. 1997). In the Polish Jura, the Bajocian is exposed mainly by its uppermost part (see also below). The Upper Bajocian through Bathonian epicratonic deposits under discussion, consist of monotonous sequence of dark-grey and unconsolidated clays with variable content of coarser fraction. They are intercalated by massive siderites, as well as carbonate concretions, either occurring as single bodies and more or less continuous horizons. This complex in the Polish Jura is known as the 'Ore-Bearing Częstochowa Clay Formation' (e.g., Dayczak-Calikowska et al. 1997; Kopik 1998; Majewski 2000; Matyja & Wierzbowski 2000; Zaton & Marynowski 2006; Szczepanik et al. 2007). The sediments gently dip at an angle of < 2° in the north-eastern direction (Znosko 1960). They are often capped by condensed Callovian deposits, consisting of limestones, sandstones and sandy-limestones (Dayczak-Calikowska et al. 1997) or directly by Quaternary sands or gravels. The Bajocian-Bathonian ore-bearing clays are thought to be deposited in a quiet marine, generally below the storm-wave base, environment (see Matyja et al. 2006a, b, c). The clays under discussion were deposited under favourable, oxic conditions prevailing on the sea-floor, as is evidenced from both organic (Marynowski et al. 2007a) and inorganic (Szczepanik et al. 2007; Zaton et al. 2009) geochemical investigations.

The uppermost Bajocian and Bathonian sediments of the Polish Jura area are currently exposed mainly at clay-pits, the majority of which is still active. The ammonites have been collected in twenty clay-pits situated at eleven localities. Some of the specimens studied, however, also come from the currently abandoned iron mines 'Dębowiec' and 'Teodor', located at the Poraj – Kamienica Polska area, and the heaps at Rudniki and Poczesna.

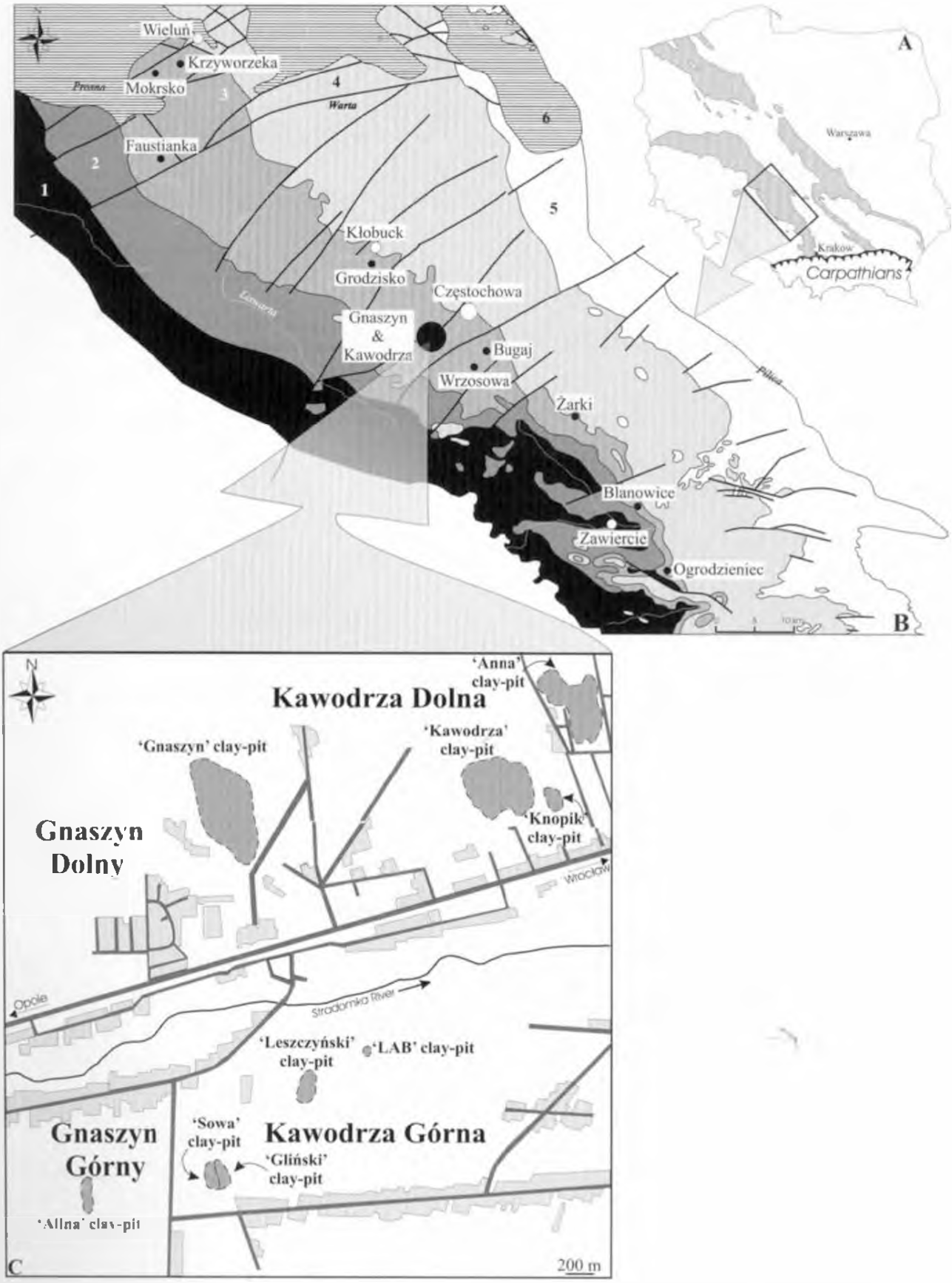
From the south to the north of the Polish Jura, the ore-bearing clays containing ammonite fauna are exposed in the following localities (Text-fig. 1B–C):

Ogrodzieniec

In that locality, situated in the southernmost part of the investigated area, two clay-pits occur. There, dark-grey clays, ~ 14 and 8 m thick, respectively are exposed (Text-fig. 2), intercalated with a few horizons of siderite beds and carbonate concretions, as well as a single horizon of hiatus concretions (Zaton et al. 2006a). They are covered by Callovian and Oxfordian strata (Rożycki 1953; Dembicz & Praszkier 2003; Barski et al. 2004). The ammonite-bearing clays represent Upper Bathonian (Hodsoni to Orbis zones) (Zaton et al. 2006a).

Blanowice

In Blanowice locality, situated near Zawiercie, two clay-pits occur. In one of them, only the Middle Bathonian Morrisi Zone has been documented. It is represented by dark-grey clays, ~ 5 m thick, interca-



Text-fig. 1. A. Map of Poland with Jurassic deposits indicated (shaded) after removal of the Cenozoic cover. B. Geological map of the Polish Jura area with investigated localities indicated (black circles); 1 – Triassic, 2 – Lower Jurassic, 3 – Middle Jurassic, 4 – Upper Jurassic, 5 – Cretaceous, 6 – Neogene. C. Locality map of the Kawodrza/Gnaszyn area showing the sampled clay-pits.

lated with several thin horizons of grey siderites and carbonate concretions; in the second one, however, clays (~ 12 m thick) spanning from at least the uppermost Lower Bajocian (consisting of sandstones and mudstones) to Middle Bathonian (Morrisi Zone) are exposed (Zaton 2007a). They are underlain by the Lower Jurassic (Toarcian?) mudstones and clays (Dr. Przemysław Gedl, pers. inf. 2006). However, between the exposed Lower Bajocian and uppermost Bajocian (Parkinsoni Zone), and between the latter one and the Lower Bathonian (Tenuiplicatus Zone), the hiatuses occur (Zaton 2007a; Text-fig. 2).

Zarki

The clay-pit is situated just before the main centre. There, dark-grey clays (~ 15 m thick), intercalated with a few horizons of grey siderites and carbonate concretions occur (see Text-fig. 2). However, the clays are covered by landslides and vegetation in many places. The clays represent Upper Bathonian (Hodsoni to Orbis zones) (Zaton 2007b). They are covered by the Callovian and Oxfordian strata (Różycki 1953).

Wrzosowa

The clay-pit at Wrzosowa, situated near the Brzeziny-Kolonia village, exposes dark-grey clays intercalated with a few horizons of grey siderites and carbonate nodules (see Text-fig. 2). The sediments represent Middle Bathonian (Subcontractus to Morrisi Zone) (Zaton 2007b).

Bugaj

The clay-pit, named as *'Michalina'*, is situated near the main road leading to Częstochowa city. There, dark-grey clays, intercalated with a horizon of hiatus concretions (Majewski 2000; Zaton et al. 2006a) and a few horizons of grey siderites and carbonate concretions, are exposed. Two sections, at the southern and eastern walls, have been sampled. The sequence represents the Middle Bathonian (Subcontractus to Morrisi zones) (Zaton 2007b). Currently, the major part of the clay-pit is heaped. For the sections see Text-fig. 2.

Kawodrza and Gnaszyn

In these neighbouring localities, nine clay-pits are situated. Their characteristics are as follow:

'Alina' clay-pit. This clay-pit is situated at Gnaszyn Górny (Text-fig. 1C). The appearance of the exposure since the works of Matyja & Wierzbowski (2000) changed drastically. From ~ 12 m of section, only slightly more than 3 m of its upper part (see Text-fig. 2), consisting of sandy dark-grey clays, is currently available (Zaton 2007b). The section represents Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone and probably the very beginning of Bomfordi Subzone) (Matyja & Wierzbowski 2000; Zaton 2007b).

'Sowa' clay-pit. This clay-pit is situated in the western part of Kawodrza Górna (Text-fig. 1C). The sequence consists of dark-grey clays, ~ 8 m thick, intercalated with three massive siderite beds (see Text-fig. 2). In the lower part of the section, extremely rich in fossils calcitic concretions occurred (Zaton & Marynowski 2004, 2006). Since 2004, the large part of the exposure is covered by clays from the higher levels that are being exploited. The section represents the uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) – lowermost Bathonian (Zigzag Zone, Convergens Subzone) (see Matyja & Wierzbowski 2000; Matyja et al. 2006a; Zaton & Marynowski 2004, 2006).

'Glinski' clay-pit. The clay pit is situated just next to the 'Sowa' (Text-fig. 1C). The section consists of ~ 8 m thick dark-grey clays, with the admixture of sandy material from place to place, intercalated with a few horizons of massive siderites with limonitized crusts and loosely scattered carbonate concretions (see Text-fig. 2). The section represents the Lower Bathonian (Zigzag Zone, Convergens to Macrescens subzones) (see Matyja & Wierzbowski 2000; Matyja et al. 2006a). However, an ammonite found in the lowermost part of the section (Zaton 2007b) points to the presence of additional uppermost Bajocian (Bomfordi Subzone).

'Leszczyński' clay-pit. The clay-pit is located in the northern part of Kawodrza Górna (Text-fig. 1C). The section exposed consists of ~ 12 m of dark-grey clays intercalated with two main massive siderite horizons, and one horizon of small carbonate concretions in its uppermost part (see Text-fig. 2). The exposure represents the Lower Bathonian (Zigzag Zone, Yeovilensis Subzone and Tenuiplicatus Zone) (see Matyja & Wierzbowski 2000, 2001; Matyja et al. 2006b; Zaton et al. 2006b).

'LAB' clay-pit. It is a small, active clay-pit, situated at Kawodrza Górna (Text-fig. 1C), where ~ 5 m of clays, being the topmost part of the 'Leszczyński' clay-pit, are exposed (see Text-fig. 2). Thus, they represent

the Lower Bathonian (Tenuiplicatus Zone) (see e.g., Matyja & Wierzbowski 2000; Zaton et al. 2006b).

'Gnaszyn' clay pit. This is the largest and most known (see Gedl et al. 2003; Zaton et al. 2006b; Matyja et al. 2006c; Marynowski et al. 2007b; Zaton 2007a, b; Zaton et al. 2007) active clay-pit in the whole region, situated at Gnaszyn Dolny (Text-fig. 1C). It exposes ~ 20 m of dark-grey clays intercalated by several more or less continuous and loosely scattered carbonate nodules (see Text-fig. 2). The sequence represents the Middle Bathonian (Subcontractus Zone) – Upper Bathonian (Hodsoni Zone) (see e.g., Zaton 2007b, Zaton et al. 2006b; Matyja et al. 2006c; Szczepanik et al. 2007).

'Kawodrza' clay-pit. This is a large, inactive clay-pit, situated at Kawodrza Dolna (Text-fig. 1C), where dark-grey clays, intercalated with several horizons of carbonate nodules are exposed. Currently, the clay-pit is gradually heaped with the material transported from the neighbouring 'Gnaszyn' clay-pit. Two sections were made during the fieldworks in the years 2003–2004 (see Text-fig. 2). The clays represent Middle (Morrisi Zone) to Upper Bathonian (Hodsoni Zone) (Zaton 2007b).

'Knopik' clay-pit. This is abandoned, and currently filled with water, small clay-pit, situated at Kawodrza Dolna (Text-fig. 1C). During the fieldworks in 2003, only the northern wall was accessible and the section is shown on the Text-fig. 2.

'Anna clay-pit. This clay-pit is situated at Kawodrza Dolna (Text-fig. 1C). The exposed clays, ~ 15 m thick, are intercalated by three horizons of carbonate nodules in the lower part of the section, and massive sandy siderite bed in its uppermost part (Text-fig. 2; see also Matyja & Wierzbowski 2003; Zaton 2007b). The section represents the Upper Bathonian (Hodsoni – Orbis zones).

Grodzisko

This locality is situated NW of the Częstochowa city, near Wręczyca Wielka. There is only one, active clay-pit, where ~ 10 m of dark-grey clays, intercalated with huge carbonate concretions in the lower part of the section, are exposed (see Text-fig. 2). The sediments represent Upper Bathonian (Hodsoni to Orbis zones) (Zaton 2007b).

Faustianka

This locality is situated NW of Krzepice (Text-fig. 1B). The clay-pit is still active, but the lower part (representing the Tenuiplicatus Zone) of the exposure for many years was covered by overlying clays. Only recently, they were uncovered and the succession of this zone is recognized. Currently, ~ 6 m of clays, intercalated with six horizons of more or less continuous carbonate nodules are exposed (see Text-fig. 2). They represent the Lower Bathonian (Tenuiplicatus Zone) to Middle Bathonian (Progracilis Zone) (Matyja & Wierzbowski 2000, 2001). However, the ammonites of the latter zone have never been illustrated, and the present author has failed in finding them.

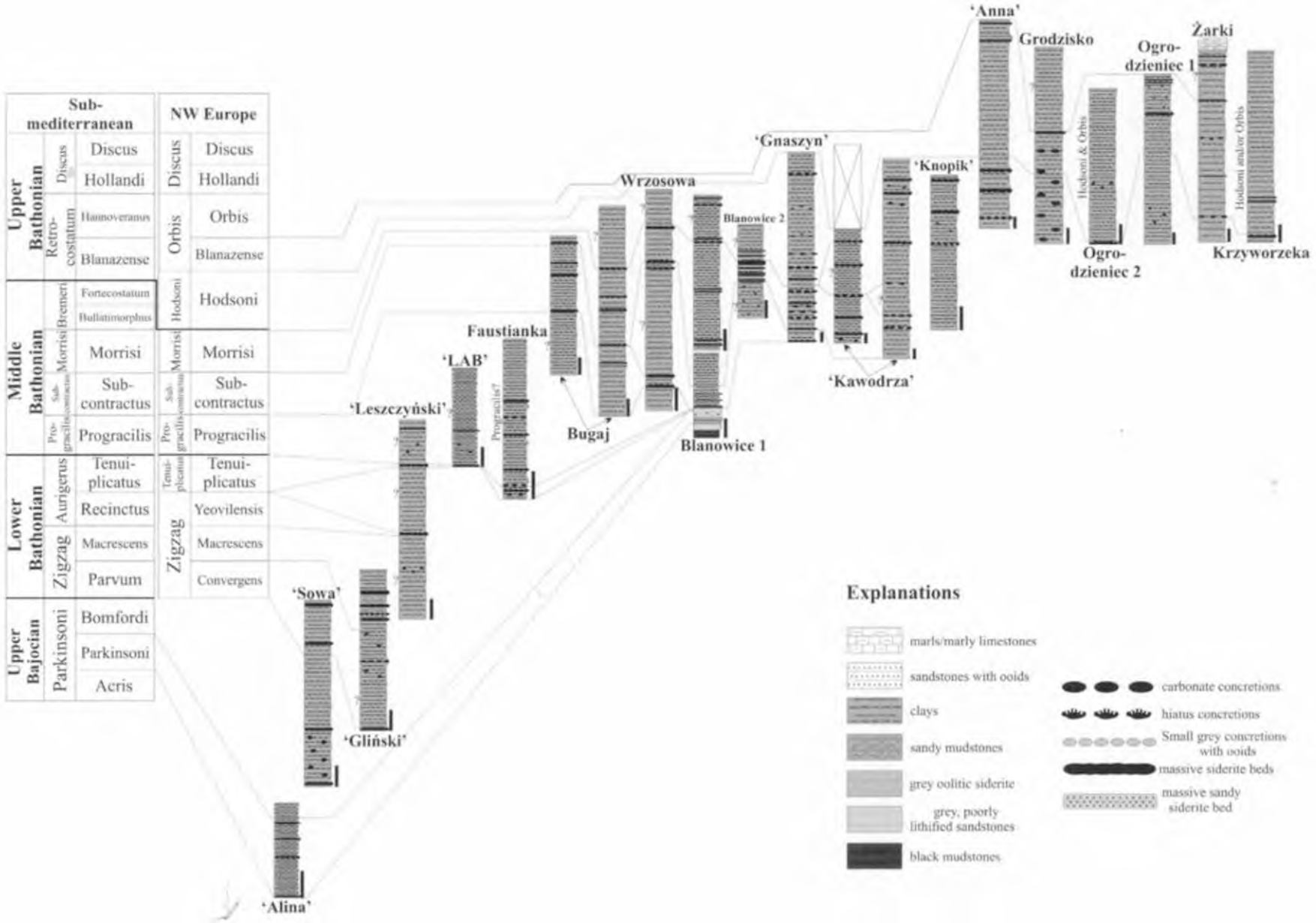
Mokrsko

This locality is situated c. 14 km SW of Wieluń city in the northern part of the Polish Jura (Text-fig. 1B). This is a large, active clay-pit, exposing dark-grey clays, intercalated with horizons of carbonate nodules, including hiatus concretions (Zaton et al. 2006a). However, the thickness of the sequence is hard to deduce, because of severe glacitectonic deformation of the sediments. The ammonite fauna is rare, consisting of parkinsoniids. Generally, the sediments represent uppermost Bajocian (Parkinsoni Zone) (see Kaim 2004; Zaton 2007b).

Krzyworzeka

Krzyworzeka is situated c. 4 km NE of Mokrsko (Text-fig. 1B). There is an active clay-pit, exposing a few meters of dark-grey clays (see Text-fig. 2), intercalated with carbonate nodules and hiatus concretions (Sniężek 1980; Zaton et al. 2006a), and covered by Quaternary deposits. The clays represent Upper Bathonian (Hodsoni and possibly Orbis zones). Poulsen (1998), on the basis of dinocyst dating, concluded that at Krzyworzeka the Upper Bathonian Discus Zone occurs, as well. Unfortunately, using ammonites this zone has not been detected yet.

The Bajocian-Bathonian sediments under discussion have already been biostratigraphically subdivided using ammonite fauna (see Dayczak-Calikowska et al. 1997; Kopik 1998, 2006; Matyja & Wierzbowski 2000; Matyja et al. 2006a, b, c; Zaton 2007b) and the details are not repeated here again. However, the biostratigraphic correlation of the all sections studied, based on the ammonite fauna studied recently by Zaton (2007b), using both the



Text-fig. 2. Correlation of the investigated ammonite-bearing sections of the Polish Jura area, on the background of the standard ammonite zonation of the Submediterranean and NW European Provinces (after MANGOLD & RIOULT 1997). Scale bars at the sections represent 1 m.

schemes for the North-West Europe and Submediterranean areas (see MANGOLD & RIOULT 1997), is shown on the Text-fig. 2. Although the ammonite fauna has a Submediterranean character (see MATYJA & WIERZBOWSKI 2000), many species are rather characteristic for the NW European Province. Therefore, in the present paper the scheme for the latter province is used when discussing the stratigraphic provenance of the ammonites described.

3. Material and its preservation

The ammonite collection has been primarily gathered by the present author during the field-works during the years 2003–2005. The collection is housed at the Faculty of Earth Sciences, University of Silesia at Sosnowiec (acronym GIUS 8). A large collection of ammonites come also from the Institute of Geology, University of Warsaw (acronym IGPUW/J), collected by POTOCKI (1972) in the Kawodrza and Gnaszyn area, the late Prof. HENRYK MAKOWSKI and KORCZ (1973) in the environs of Poraj-Kamienica Polska (abandoned 'Dębowiec' and Teodor' iron ore-mines) and MAJEWSKI (1997) from the Kawodrza/Gnaszyn and Grodzisko localities. Additional specimens gathered by BOGUSŁAW WAKSMUNDZKI, M.Sc. in the localities mentioned above, as well as from BLANOWICE, RUDNIKI and FAUSTIANKA, have also been included in that collection. Additionally, several private collections have been used as invaluable comparative source, gathered by Dr WOJCIECH KRAWCZYNSKI (acronym WK), TOMASZ KRZYKAWSKI, M.Sc. (acronym TK), JANUSZ KRZYSTANEK, M.Sc. (acronym JK), ADRIAN KIN, M.Sc. (acronym AK), JANUSZ SNIOCH (acronym JS), KRZYSZTOF TORBUS (acronym KT) and ROMAN KIJOK (acronym RK). The specimens from the private collections are formally unregistered.

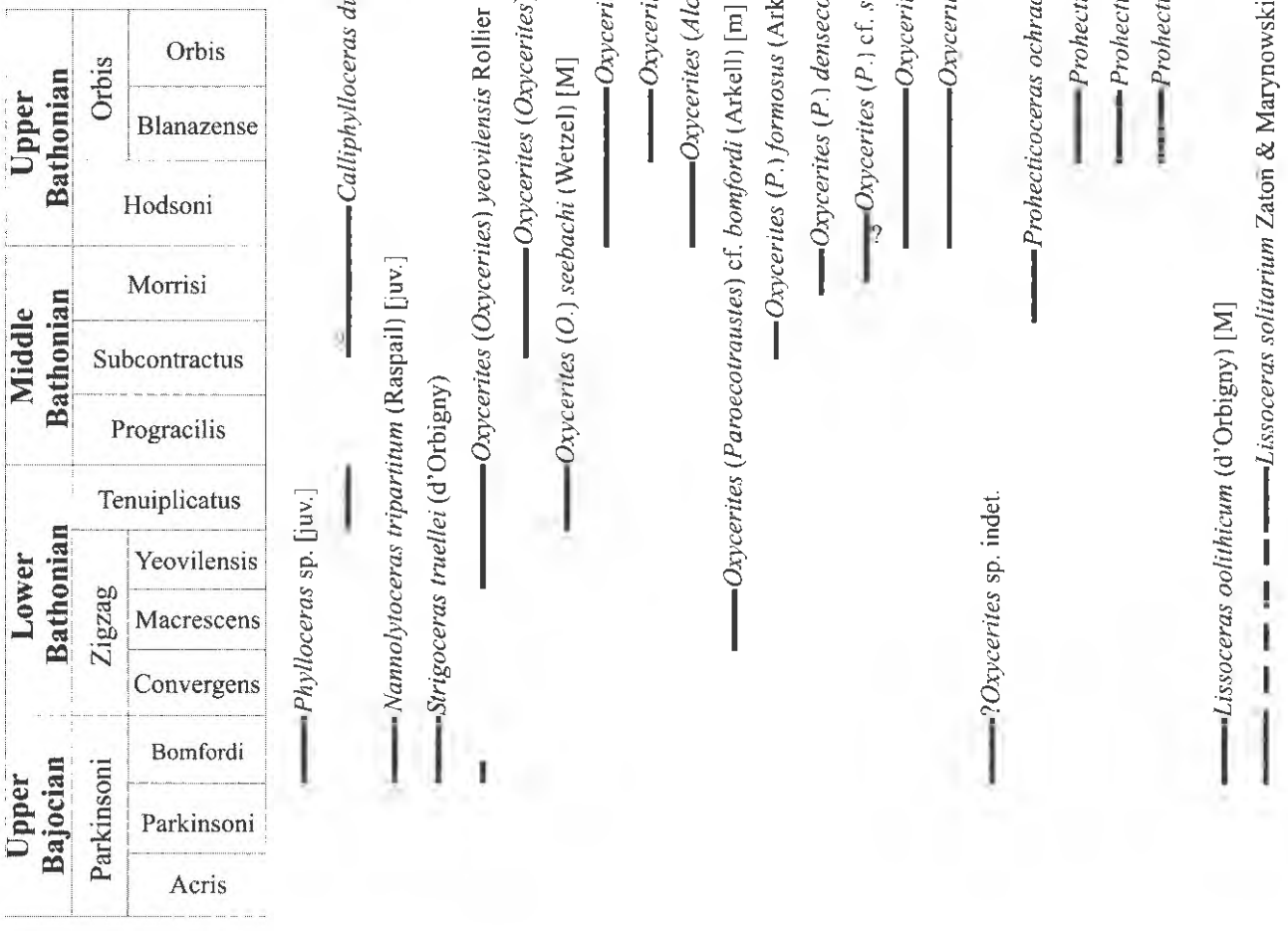
The author has also inspected the collection housed at the Museum of the Polish Geological Institute, and ammonite collections housed at the Natural History Museum, London (acronym NHM) and Oxford University Museum of Natural History (acronym OUMNH).

The preservation of the ammonites studied is variable. Those coming from the carbonate concretions are three-dimensionally preserved; however, the phragmocones of many of them may be crushed. Mineral veins may also cut through the shells, deforming the specimens. The exception are the ammonites coming from the uppermost Bajocian calcite concretions (see ZATON & MARYNOWSKI 2004, 2006), where the specimens are very well-preserved, without any signs of neither compaction nor later deformation. The specimens coming from the host clays, on the contrary, are invariably flattened, both laterally or dorso-ventrally (rarer). However, both from the carbonate concretions, except those from the calcite ones, and host clays possess original aragonitic nacreous layer of the shell still preserved. The ammonites coming from the horizons of hiatus concretions, are usually preserved as moulds, and very often are bored and encrusted.

4. Systematic Palaeontology

The specimens were subjected for standard conchological measurements (see e.g., PARENT 1998) and the following abbreviations are used throughout the text: shell diameter (D), umbilical width (U), whorl breadth (Wb), outer whorl height (Wh_1), inner whorl height (Wh_2), number of primary (inner) ribs per half a whorl (P), number of secondary (outer) ribs per half a whorl (S), body chamber length is given in degrees (°), whorl expansion rate (WER). The percentage coefficient of variation (CV) was used for comparison of variability range within the ammonite populations. [M] – macroconchs, [m] – microconchs, [juv.] – juveniles. The plots showing the ratios of particular shell features were drawn using PAST software (HAMMER et al. 2001).

The terminology used in this paper follows ARKELL et al. (1957) and WESTERMANN (1996). Systematics up to the subfamily level follows DONOVAN et al. (1981). As many of the species have previously been described by various authors, the synonymy is brief and limited to the more important papers. The measurements of particular ammonite species are here shown only for those specimens that are registered. However, some of the photographs have been taken using unregistered, albeit very well-preserved specimens coming from the private collections mentioned above. Stratigraphic ranges of the ammonites described in the present paper are shown on the Text-fig. 3.



Text-fig. 3. Stratigraphic ranges of the all (except the *Sonninia* sp. indet.) Upper Bajocian-Bathonian ammonite species described in the present paper on the background of the ammonite zonation characteristic for the NW European Province.

Suborder Phylloceratina ARKELL, 1950
Family Phylloceratidae ZITTEL, 1884
Subfamily Calliphylloceratinae SPATH, 1927

Genus *Phylloceras* SUESS, 1865

Type species *Ammonites heterophyllus* SOWERBY,1821

Phylloceras sp. [juv.]
(Plate 1A–B; Text-figs. 9B, 11A)

Material: Three phragmocones.

Description and remarks: These juveniles have already been described by ZATON & MARYNOWSKI (2006). The preserved phragmocones are very small (the largest measures 15.7 mm; IGPUW/J/1), strongly involute. Whorl cross-section high-oval. Flanks convex, convergent toward venter. Ventral side narrowly rounded. Only delicate growth lines are visible on preserved shell. Suture complex, with quite narrow and shallow E and wider, more incised L. Lateral saddles bifid, symmetrical, divided by 8–9 auxiliary lobes. The specimens are close to *Phylloceras trifoliatum* NEUMAYR, but their poor state of preservation and juvenile nature preclude precise identification.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Kawodrza Gorna ('Sowa' clay-pit).

Genus *Calliphylloceras* SPATH, 1927

Type species *Calliphylloceras disputabile* (ZITTEL 1868)

Calliphylloceras disputabile (ZITTEL 1868) [M]
(Plate 11–K; Text-fig. 9A)

1852 *Ammonites tatricus* PUSCH; KUDERNATSCH, p. 4, pl. 1, figs. 1-4.
1980 *Calliphylloceras disputabile* (ZITTEL); GALACZ, p. 37, pl. 5, figs. 3, 6, text-figs. 25–29 (with full synonymy).
1983 *Calliphylloceras disputabile* (ZITTEL); PAVIA, p. 54, pl. 2, Plate 2, text-figs. 20–22.
2005 *Calliphylloceras disputabile* (ZITTEL); SCHLOGL et al., pl. 1, Plate 11.

Material: Three phragmocones and five whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2948	~280.0	20.4	152	127.6	-	-	-	~0.07	~0.54	-	-	-
IGPUW/J/C-1	~220.0	13.9	~128.6	?	-	-	-	~0.06	~0.58	-	-	-

Description: The preserved phragmocones are discocone in shape, medium to large-sized, strongly involute and laterally flattened. Whorl cross-section high-oval, with rounded flanks and venter. Umbilicus quite deep, with vertical slope and rounded margin. Ornamentation only visible in places where the shell is preserved. It consists of thin and dense striae, starting from the umbilical slope. They are radial but from the middle of whorl-height they become prorsiradiate, crossing the venter. Where the shell is lacking, the whorls are smooth except characteristic for this species constrictions, the number of which may be six per a whorl. With the shell growth, they gradually disappear – on large specimens they are not visible except shallow and wide depressions. Suture typical for phylloceratids, with bifid E/L.

Remarks: Very detailed discussion concerning this species was presented by GALACZ (1980) in his monograph. Thus, it is not needed to repeat it again in this paper. The specimens described here come from the interval Lower-Upper Bathonian. Such a long time-span is not surprising for this species, as *C. disputabile* (ZITTEL) is known to range from the Lower Bajocian (Sauzei Zone) to Callovian, or maybe even Oxfordian (see GALACZ 1980). Although the dimorphism in phylloceratids has not been resolved yet, the large diameters of some of the specimens (GIUS 8-2948; IGPUW/J/C-1) may suggest that they represent macroconchs.

C. disputabile (ZITTEL) differs from other Bathonian forms, such as *C. irganajense* Besnosov by its fewer and weakly curved constrictions, as well as a trifid first lateral saddle. *C. platilateralis* BESNOSOV, on the other hand, possesses laterally flattened whorl cross-section and rectiradiate constrictions that are associated with characteristic collars on the venter.

Occurrence: Lower Bathonian (Tenuiplicatus Zone) of Kawodrza Gorna ('LAB' and 'Leszczynski' clay-pits), Middle Bathonian (Morrisi Zone) of Bugaj ('Michalina' clay-pit) and Gnaszyn Dolny ('Gnaszyn' clay-pit), and Upper Bathonian of

Kawodrza Dolna ('Anna' clay-pit). *Calliphylloceras disputabile* (Zittel) is a pandemic species, known also from Pieniny Klippen Belt (Wierzbowski et al. 1999; Schlogl et al. 2005), Hungary (Galácz 1980), France (Pavia 1983; Pavia et al. 2008) and even Argentina (Westermann & Riccardi 1982). Similar forms (*C.* cf. *disputabile*) were also described from the Upper Bajocian of Egypt (Parnes 1988).

Suborder Lytoceratina Hyatt, 1889
Family Nannolytoceratidae Spath, 1927

Genus *Nannolytoceras* Buckman, 1905

Type species *Nannolytoceras pygmaeum* (d'Orbigny 1845)

Nannolytoceras tripartitum (Raspail 1831) [juv.]
(Plate 1C–H; Text-figs. 4, 9C, 11B–F)

1848 *Ammonites tripartitus* Raspail; d'Orbigny, p. 196, pl. 197, figs. 1–4.
1849 *Ammonites polystoma*, Quenstedt, p. 270, pl. 20, Plate 8.
1964 *Nannolytoceras tripartitum* (Raspail); Pugin, p. 48, pl. 3, figs. 1–6, text-figs. 9–10.
1980 *Nannolytoceras tripartitum* (Raspail); Galácz, p. 53, pl. 11, figs. 2–3, Text-fig. 42 (with full synonymy).
2006 *Nannolytoceras tripartitum* (Raspail); Zaton & Marynowski, p. 432, Plate 3.3–8.

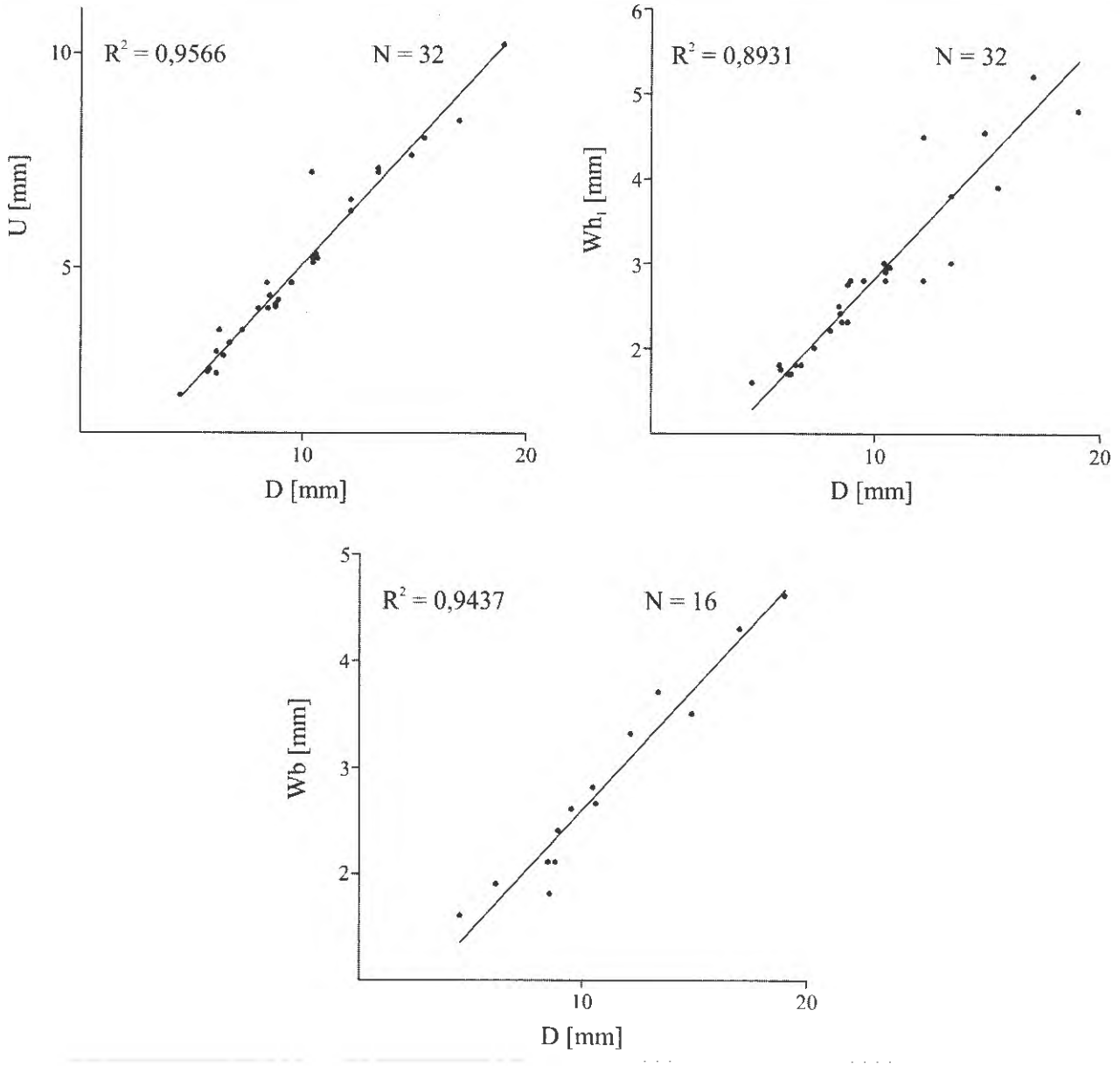
Material: 33 more or less complete specimens and 31 whorl fragments. Some of the measurements are given below.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/ Wh_1	WER
GIUS-8-2451	19.0	10.2	4.8	4.25	4.6	-	-	0.54	0.25	0.24	0.96	1.6
IGPUW/J/N-2	15.45	8.0	3.9	-	-	-	-	0.52	0.25	-	-	1.61
GIUS-8-2449	14.9	7.6	4.55	4.0	3.5	-	-	0.51	0.3	0.23	0.77	1.6
GIUS-8-2453	10.6	5.3	2.95	-	2.65	-	-	0.5	0.28	0.25	0.90	1.69
GIUS-8-2450	9.5	4.6	2.8	2.45	2.6	-	-	0.48	0.29	0.27	0.93	1.85
IGPUW/J/N-4	9.5	4.6	2.8	2.7	2.6	-	-	0.48	0.29	0.27	0.93	1.90
GIUS 8-2452	13.4	7.2	3.0	-	-	-	-	0.54	0.22	-	-	
IGPUW/J/N-276	14.9	7.6	4.55	-	3.5	-	-	0.51	0.30	0.23	0.77	1.96
IGPUW/J/N-506	10.65	5.2	2.95	-	-	-	-	0.49	0.28	-	-	1.85
GIUS 8-2986	8.8	4.05	2.75	-	-	-	-	0.46	0.31	-	-	1.77
GIUS 8-2987	7.3	3.5	2.0	-	-	-	-	0.48	0.27	-	-	1.77
GIUS 8-2988	8.55	4.3	2.3	-	~ 1.8	-	-	0.5	0.27	~ 0.21	~0.78	1.42
GIUS 8-2989	10.4	7.2	3.0	-	-	-	-	0.69	0.29	-	-	2.07
GIUS 8-2990	6.15	2.5	1.7	-	-	-	-	0.41	0.28	-	-	2.0
GIUS 8-2991	12.15	6.55	2.8	-	-	-	-	0.54	0.23	-	-	1.6
GIUS 8-2992	6.7	3.2	1.8	-	-	-	-	0.48	0.27	-	-	1.49
GIUS 8-2993	8.8	4.1	2.3	-	2.1	-	-	0.46	0.26	0.24	0.91	2.07
GIUS 8-2994	8.0	4.0	2.2	-	-	-	-	0.5	0.27	-	-	1.61

Description: Material consists mainly of juveniles. Shells small (D = 5.75–19 mm), strongly evolute, serpenticone. The longest preserved body chamber attains ¾ of the last whorl, what means that the specimens are complete (see Pugin 1964, p. 51). The aperture, however, is missing. The whorl cross-section changes from circular to high-oval during ontogeny. Umbilicus shallow and wide. The shell is smooth on the innermost whorls, except of very thin and dense growth lines. From the second whorl, however, the aggregations of growth lines started to appear, forming characteristic convex lirae. The lirae, however, may gradually fade away during ontogeny. The 'S'-shaped, prorsiradiate constrictions, the number of which varies from 1 to 3 per whorl, are also present. On the venter, they are slightly adaperturally concave and are associated with a distinct sharp ridge. Suture is typical for nannolytoceratids, with shorter E and deeper incised L. First and second lateral saddle nearly symmetrical, divided by seven auxiliary lobes.

Remarks: Detailed description and discussion of the specimens, along with their ontogenetic patterns, have already been given by Zaton & Marynowski (2006), and hence there is nothing new to be added.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Kawodrza Gorna ('Sowa' clay-pit). *Nannolyto-*



Text-fig. 4. Plots of umbilical width (U), outer whorl height (Wh_1) and whorl breadth (Wb) against shell diameter (D) in *Nannolytoceras tripartitum* (RASPAIL) [juv.].

ceras tripartitum (RASPAIL) is also known from uppermost Bajocian and Lower Bathonian of the Polish and Slovakian parts of the Pieniny Klippen Belt (WIERZBOWSKI et al. 1999; SCHLOGL et al. 2005), France (STURANI 1966; PAVIA et al. 2008) and Hungary (GALACZ 1980).

Suborder Ammonitina ZITTEL, 1884
Family Sonniniidae BUCKMAN, 1892

Genus *Sonninia* BAYLE, 1879

Type species *Waagenia propinquans* BAYLE, 1878

Synonyms: *Euhoploceras* BUCKMAN, 1913; *Papilliceras* BUCKMAN, 1920; *Sherbornites* BUCKMAN, 1923; *Stiphromorphites* BUCKMAN, 1923; *Prepapillites* BUCKMAN, 1927.

Sonninia sp. indet.
(Plate 2A; Text-figs. 9D, 11G)

Material: One, badly preserved mould of incomplete phragmocone.

Description: The preserved specimen, attaining ~ 70 mm of diameter, is semi-involute (U/D = 0.25), discocone. Whorl cross-section lanceolate, higher than wide, with rounded and convergent flanks. Venter moderately wide with low keel. Umbilical slope vertical and its margin sharp. Ornamentation is visible in some places on the mould. In oblique light, nearly rectiradiate, short inner ribs are visible, which below the half of the whorl-height divide on two, falcate secondary ribs. The latter ones end at the ventro-lateral margin, already below the keel. The ornamentation of the inner whorls is completely blurred. Although the suture line is fragmentary, though, its elements perfectly correspond to the representatives of the genus *Sonninia*, e.g., *S. arenata* (Quenstedt; see Morton 1975, Text-fig. 8A) or *S. furticarinata* (Quenstedt; see Fernandez-Lopez 1985, pl. 9, Plate 1).

Remarks: The whorl cross-section (Text-fig. 9D) and complex suture (Text-fig. 11G) enable to distinguish the specimen under discussion from the representatives of the genus *Witchellia* Buckman and *Dorsetensia* Buckman. From *Witchellia*, the specimen is distinguished by the lack of flat, bisulcate venter and, as from *Dorsetensia*, by more elaborated suture line, as well as more rounded flanks (see Morton 1975, p. 44–45; Fernandez-Lopez 1985, p. 67). Unfortunately, a poor state of preservation, especially the blurred ornamentation and invisible inner whorls, preclude the precise identification. Therefore, it is not known from which Lower Bajocian zone it comes from. Nevertheless, except the only so far known species *S. sowerbyi* (Sowerby) from the Sauzei Zone of Rudniki (southern part of the Polish Jura; see Kopik 1967, 1998), the specimen described here is the second representative of the genus from the extra-Carpathian Polish Bajocian deposits.

Occurrence: Lower Bajocian (?Humphriesianum Zone) of Blanowice.

Family Strigoceratidae Buckman, 1924

Genus *Strigoceras* Quenstedt, 1886

Type species *Strigoceras truellei* (d'Orbigny 1845)

Synonyms: *Cadomoceras* Munier-Chalmas, 1892; *Varistrigites* Buckman, 1924; *Strigites* Buckman, 1924; *Plectostrigites* Buckman, 1924; *Leptostrigites* Buckman, 1924.

Strigoceras truellei (d'Orbigny 1845) [M]
(Plate 2B)

1845 *Ammonites Truellei*; d'Orbigny (1842–1851), p. 361, pl. 117, figs. 1–3 (lectotype), pl. 129, figs. 1–2.
1980 *Strigoceras truellei* (d'Orbigny 1845); Galacz, p. 54, pl. 11, Plate 4.
1985 *S.* (*Strigoceras*) *truellei* (d'Orbigny 1845); Sandoval, p. 98, pl. 2, figs. 3–4, text-figs. 2–3.
2007 *Strigoceras truellei* (d'Orbigny 1845); Schweigert et al. p. 36, figs. 18B, 21–24 (with full synonymy).

Material: One juvenile specimen.

Description: Shell small (D = 14.3 mm), involute (U/D = 0.18), oxycone-like. The whorl cross-section lanceolate, higher than wide. Flanks convex. Venter with distinct, sharp keel. During ontogeny, the keel gradually becomes higher. Umbilicus is narrow, deep with rounded margin and steep slope. The lower, umbilical part of the whorl is smooth and flat. The upper part, on the other hand, is ornamented with falcate, rounded and adaperturally concave ribs. They get wider toward the venter but disappear at the keel. The suture is not visible due to preserved calcitized shell.

Remarks: Recently, due to the juvenile nature of the specimen, it was assigned to *Strigoceras* sp. juv. ex gr. *strigifer* (Buckman)/*pseudostrigifer* (Maubeuge) species-group by Zaton & Marynowski (2006), on the basis of very similar forms presented by Sturani (1971). Stratigraphically, however, the specimen better fits to the species *Strigoceras truellei* (d'Orbigny) (see Sandoval 1985, p. 110), what was later indicated by Zaton (2007b). Zaton (2007b), however, due to juvenile nature of the specimen, was not sure and did not change the previous designation. Later, the specimen was kindly shown to Dr Günter Schweigert (Stuttgart), who confirmed that the specimen under discussion certainly represents the species *Strigoceras truellei* (d'Orbigny), and this name was used for that specimen in the recently published revision of the genus *Strigoceras* by Schweigert et al. (2007). Thus, it is decided to retain the last name here.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Kawodrza Gorna ('Sowa' clay-pit). *Strigoceras truellei* (d'Orbigny) occur in the whole Upper Bajocian, but is

most common in the Parkinsoni Zone (GALACZ 1980). Apart of Poland, it is known to occur in England, Hungary (GALACZ 1980), France (PAVIA 1971), Spain (SANDOVAL 1985), Austria (KRYSTYN 1972), Germany (QUENSTEDT 1886) and Italy (STURANI 1964).

Family Oppeliidae DOUVILLE, 1890

Genus *Oxycerites* ROLLIER, 1909

Type species *Ammonites aspidoides* OPPEL, 1857

Subgenus *Oxycerites* (*Oxycerites*) ROLLIER, 1909

Type species *Ammonites aspidoides* OPPEL, 1857

Synonyms: *Pleuroxyites* BUCKMAN, 1924; *Limoxyites* WESTERMANN, 1958; *Mesoxyites* WESTERMANN, 1958; *Otoxyites* WESTERMANN, 1958.

Remarks: FERNÁNDEZ-LÓPEZ (1985, p. 226) considered the subgenus *O.* (*Mesoxyites*) WESTERMANN (1958, p. 52) as a synonym of *O.* (*Oxycerites*), because its type species *Oxycerites waterhousei* (MORRIS & LYCETT), hardly ever differs morphologically from *O.* (*Oxycerites*) *aspidoides* (OPPEL). Moreover, in adult stage the both species are also indistinguishable (ARKELL 1951a, p. 66; see also TSERETELI 1989, p. 31). In HAHN et al. (1990) opinion, the subgenus *Mesoxyites* should be retained for small-sized, Middle Bathonian forms. In the material here investigated, however, the Middle Bathonian forms are as big as Lower or Upper Bathonian ones. Moreover, the topotypes of *O. waterhousei* (NHM 50745 and c.89608) in fact are represented by big forms (D = 91.8 and 103.1mm, respectively). Therefore, I agree with the opinion of FERNÁNDEZ-LÓPEZ (1985) and I treat *Mesoxyites* as a synonym of *Oxycerites*.

O. (*Oxycerites*) ROLLIER differs from *O.* (*Alcidellus*) WESTERMANN (1958, p. 51) by its sharper (keeled) venter, more elaborated suture and more delicate outer ribs near the vetro-lateral side. Both forms are treated as morphological subgenera.

Dimorphism: Generally, the macroconchs of the genus *Oxycerites* are classified within the subgenus *O.* (*Oxycerites*) ROLLIER and *O.* (*Alcidellus*) WESTERMANN. The latter, however, is restricted to the Upper Bathonian. HAHN et al. (1990) proposed that two microconch forms, *Oecotraustes* WAAGEN and *Paroecotraustes* SPATH, previously classified as separate genera (HAHN 1968), have to be classified within the widely recognized genus *Oxycerites*. From this point, HAHN et al. (1990) have proposed that some Lower Bathonian microconchs should be classified as *O.* (*Limoxyites*) WESTERMANN and the rest of the Lower Bathonian and Upper Bathonian microconchs – within *O.* (*Paroecotraustes*) SPATH. The latter, however, would have been also an antidimorph of *O.* (*Alcidellus*) WESTERMANN. FERNANDEZ-LOPEZ (1985, p. 209, 229) concluded that *Oecotraustes* WAAGEN should be paired with the Bajocian genus *Oppelia* WAAGEN.

Although the form *Limoxyites* WESTERMANN possesses identical shell geometry and ornamentation as typical macroconch *Oxycerites*, the form *Paroecotraustes* SPATH is more problematic. Until now, it is not known whether all Middle and Upper Bathonian representatives of *Paroecotraustes* really represent microconchs of *Oxycerites* ROLLIER (see GALACZ 1980). It is considered (HAHN et al. 1990) that some forms of *Paroecotraustes* SPATH are also paired with *Alcidellus* macroconchs, and maybe even with the genus *Prohecticoceras* SPATH (see GALACZ 1980). Therefore, in the present paper, both macro- and microconchs are classified as the one morphological subgenus *O.* (*Oxycerites*) Rollier but only in the case, when they show clear co-occurrence and morphological resemblance. Similar procedure was undertaken by Westermann & Callomon (1988) in the case of their new Lower Bathonian species *O.* (*Oxycerites*) *sulaensis*. The rest of microconchs, the affinity of which to specific macroconchs is hard to indicate, will be traditionally treated as *O.* (*Paroecotraustes*) Spath.

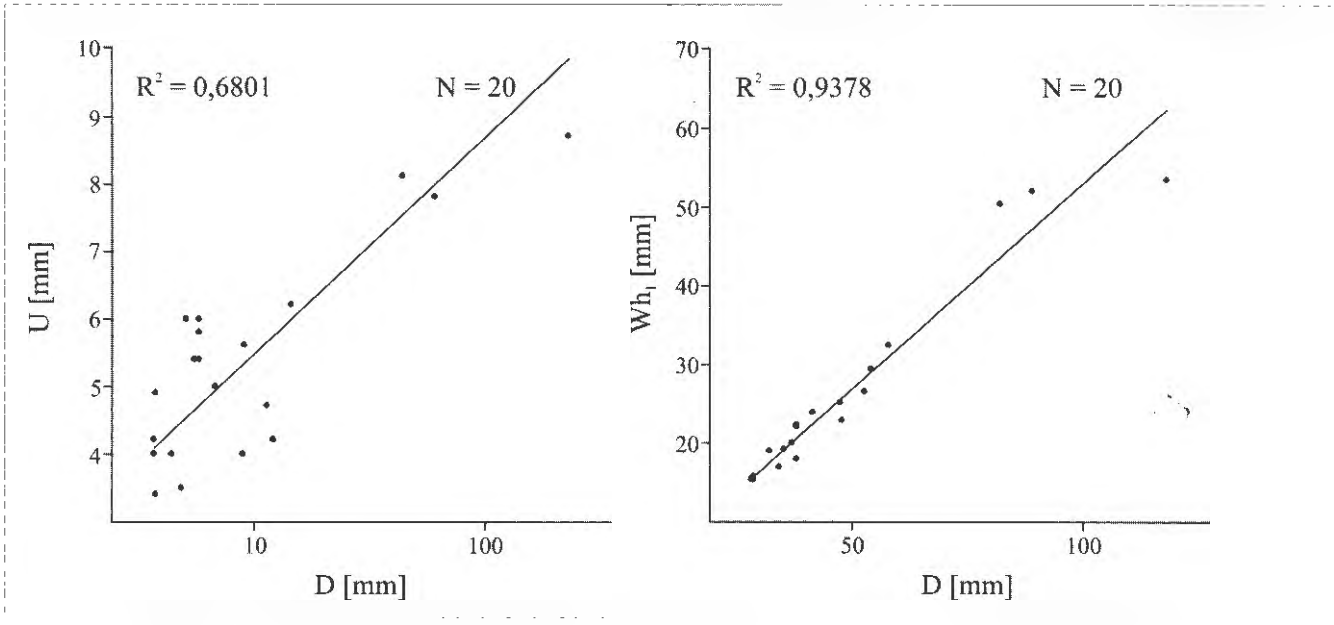
Oxycerites (Oxycerites) yeovilensis ROLLIER, 1911 [M & m]
(Plate 2 C–I; Text-figs. 5, 11H)

1911 *Oxycerites yeovilensis* n.sp.; ROLLIER, p. 305.
1919 *Oppelia nivernensis* n. sp.; DE GROSSOUVRE, p. 407, pl. 14, Plate 1.
1924 *Harpoxyites fallax* GUERANGER; BUCKMAN, pl. 499.
1925 *Gonoxyites limosus*, nov.; BUCKMAN, pl. 613.
1951a *Oppelia* (*Oxycerites*) *fallax* (GUERANGER); ARKELL, p. 56, pl. 5, figs. 1–3, pl. 8, Plate 11.
1951a *Oppelia* (*Oxycerites*) *limosa* (BUCKMAN); ARKELL, p. 60, pl. 5, figs. 7–8; pl. 6, figs. 5–6.
1951a *Oppelia* (*Oxycerites*) *nivernensis* DE GROSSOUVRE; ARKELL, p. 61, pl. 5, Plate 9.
1958 *Oxycerites* (*Limoxyites*) *fallax* (GUERANGER); WESTERMANN, p. 46, pl. 8, Plate 2, pl. 9, Plate 1.

1958 *Oxycerites* (*Limoxyites*) *nivernensis* (DE GROSSOUVRE); WESTERMANN, p. 46, pl. 9, figs. 2–4, pl. 10, figs. 1–2.
1968 *Oxycerites yeovilensis* ROLLIER; HAHN, p. 29, pl. 2, figs. 1–4, Text-fig. 7 (with full synonymy).
1968 *Oxycerites limosus* (BUCKMAN); HAHN, p. 33, pl. 2, Plate 7, pl. 5, Plate 8, text-figs. 6–7 (with full synonymy).
1968 *Oecotraustes* (*Oecotraustes*) *nivernensis* (DE GROSSOUVRE); HAHN, p. 41, pl. 3, figs. 7–9; Text-fig. 8a-b (with full synonymy).
1993 *Oxycerites yeovilensis* (ROLLIER); BESNOSOV & MITTA, p. 46, pl. 3, Plate 2.
1993 *Oxycerites limosus* (BUCKMAN); BESNOSOV & MITTA, p. 47, pl. 3, figs. 3, 4.
1999 *Oxycerites yeovilensis* (ROLLIER); GALACZ, p. 154, pl. 1, Plate 5.
2005 *Oxycerites yeovilensis* ROLLIER; SCHLOGL et al., pl. 4, figs. 3–4.
2005 *Oxycerites limosus* (BUCKMAN); SCHLOGL et al., pl. 5, Plate 4.

Material: Twenty specimens (thirteen macro- and seven microconchs) and eight whorl fragments belonging to macroconchs, in various state of preservation.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/175	28.0	4.0	15.2	-	-	-	-	0.14	0.54	-	-	2.43
GIUS 8-3084	31.6	-	15.5	-	7.0	-	16	-	0.49	0.22	0.45	-
GIUS 8-3085	38.0	5.4	22.3	-	-	-	?	0.14	0.59	-	-	1.93
GIUS 8-3086	47.7	5.6	22.9	-	-	-	11	0.12	0.48	-	-	-
GIUS 8-3087	52.8	4.7	26.5	-	10.5	-	12	0.09	0.50	0.20	0.40	2.31
GIUS 8-3088	41.4	5.0	23.9	-	-	-	15	0.12	0.58	-	-	-
GIUS 8-3089	34.1	3.5	17.0	-	-	-	>16	0.10	0.50	-	-	-
IGPUW/J/OY-1	28.5	4.9	15.6	12.4	7.1	~11	21	0.17	0.55	0.30	0.45	1.66
IGPUW/J/OY-2	28.1	4.2	15.4	-	6.6	~11	26	0.15	0.55	0.23	0.43	-
	36.8	5.4	20.0	13.0	~7.0	-	24	0.15	0.54	0.19	~0.35	2.13
GIUS 8-3090	89.2	7.8	51.8	31.7	~15.0	-	11	0.09	0.58	~0.17	~0.30	2.16
GIUS 8-3091	102.6	-	57.9	33.3	18.3	-	8	-	0.56	0.18	0.32	2.07
GIUS 8-3092	54.0	4.2	29.4	-	12.6	-	~16	0.08	0.54	-	-	-
GIUS 8-3093	28.6	3.4	15.3	13.0	6.5	-	?	0.12	0.53	0.23	0.42	-



Text-fig. 5. Plots of umbilical width (U) and outer whorl height (Wh_1) against shell diameter (D) in *Oxycerites* (*O.*) *yeovilensis* ROLLIER [M & m].

Description:

Macroconchs: Medium to quite large-sized (D = 28.1–118.3 mm), strongly involute (U/D = 0.07–0.8), oxyconic. Umbilicus width varies, independently of ontogeny of particular specimens. Umbilical slope short and vertical. Umbilical margin rounded. Whorl cross-section high, lanceolate, with slightly rounded flanks and sharp venter. In adults, the venter gradually becomes less sharp. The greatest whorl-width is accentuated by a lateral ridge. The inner ribs occur as thin striae on every ontogenetic stage; however, in some mature and young individuals, they may appear as single and somewhat thicker ribs. The outer ribs are characterized by different intensity on different ontogenetic stages. On earlier whorls, at D = 20.3 mm (specimen OUM, J2448), they may be very thin, almost as striae, while at D = 22.2 mm (IGPUW/J/OY-1), they are sharper and distinct. In younger individuals, additional short tertiary ribs may be present on the ventrolateral ridge. During ontogeny, the outer ribs gradually thicken and the distance between them increases. Body chamber, attaining a half of the last whorl, is ended with a simple aperture.

Microconchs: small-sized (D = 28–52.8 mm), strongly involute (U/D = 0.09–0.14), oxyconic. Umbilical slope short and vertical; its margin is well-marked, rounded. Whorl cross-section high, lanceolate, strongly flattened laterally. Flanks slightly rounded; venter sharp, slightly rounded just before aperture. The greatest whorl-width is situated in a middle part of the whorl-height, where a lateral ridge occurs. Inner ribs, occurring as thin striae, are hardly visible. Outer ribs are thicker. On older whorls, they are weaker, denser and falcate, and toward aperture they become stronger, more distant, slightly falcate or even straight adapically. At the same aperture, they may be formed by a bunch of thinner striae. Body chamber attains a half of the last whorl. Aperture is ended with straight lateral lappets, directed slightly upward.

The suture of both micro- and macroconchs is identical, elaborated. E/L is bifid, asymmetrical with shorter saddle near the venter; L/U_2 as high as E/L, but single; umbilical saddles, 4–5 in number, are short; lobes are narrow; L deeper than U_2.

Variability: The specimens of *O.* (*Oxycerites*) *yeovilensis* Rollier described here, show the greatest variability of U/D (CV (coefficient of variation) = 24.6 %; N = 20), while the variability of Wh_1/D and Wb/D is the smallest (CV = 7.7 %; N = 22 and 16.4 %; N = 10, respectively). Umbilical width varies between individuals, what has been one of the diagnostic feature distinguishing *O.* (*Oxycerites*) *yeovilensis* Rollier from *O.* (*Oxycerites*) *nivernensis* (de Grossouvre) (= *limosus* (Buckman). The second feature is variable intensity of outer ribs on earlier whorls (see below).

Remarks: So far, the forms *O.* (*Oxycerites*) *yeovilensis* Rollier, *O.* (*Oxycerites*) *limosus* (Buckman) and *O.* (*Limoxyites*) *nivernensis* (de Grossouvre) have been treated as separate species. Only Westermann (1958) and later Sturani (1966) treated macroconchiate *O.* (*Oxycerites*) *limosus* (Buckman) as a younger synonym of microconchiate *O.* (*Limoxyites*) *nivernensis* (de Grossouvre). The morphological differences, distinguishing *O.* (*Oxycerites*) *yeovilensis* from *O.* (*Oxycerites*) *nivernensis* (= *limosus*) were the wider umbilicus and sharper outer ribs already at earlier developmental stages in the first of them. However, the differences are not so distinct to equivocally differentiate the above species from each other. Also diagnoses given by Hahn (1968, p. 32), concerning more or less strong and dense outer ribs, do not enable a simple distinction between the species.

The literature review and observations made on the collected specimens, including those from the same horizon, as well as on specimens from the museum (Oxford) and private collections, prompted me to the conclusion that the species under discussion have been assigned typologically. Moreover, such ornamentation differences could be an effect of taphonomy, as well. The both forms, however, are characterized by similar stratigraphic range. Both forms *yeovilensis* and *nivernensis* (= *limosus*) appear in Late Bajocian (Bomfordi Subchron) lasting through the whole Early Bathonian (see Sturani 1966; Mangold & Rioult 1997; pers. observ.). The form *limosus* ranges even to the earliest Middle Bathonian (Progracilis Chron) (see Arkell 1951a; Torrens 1987; Mangold & Rioult 1997).

Taking the synonymy of both species into account, the problem of dimorphism may also be resolved. Hahn (1968) coupled his *Oxycerites limosus* (Buckman) (macroconch) and *Oecotraustes* (*Oecotraustes*) *nivernensis* (de Grossouvre) in dimorphic pair; however, so far any microconch for *Oxycerites* (*Oxycerites*) *yeovilensis* has been recognized.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Gnaszyn Górny ('Alina' clay-pit), Lower Bathonian (Zigzag Zone, Yeovilensis Subzone and Tenuiplicatus Zone) of Rudniki, Kawodrza Górna ('Leszczyński' and 'LAB'

clay-pits) and Faustianka (Tenuiplicatus Zone). Besides the extra-Carpathian Poland (see also KOPIK 1998; MATYJA & WIERZBOWSKI 2000), *Oxycerites* (*Oxycerites*) *yeovilensis* ROLLIER is also known from the Tatra Mts. (PASSENDORFER 1938), France (STURANI 1966; TORRENS 1987), Germany (HAHN 1968), England (ARKELL 1951a), Romania (POPOVITZI-HATZEG 1905), Bulgaria (STEPHANOV 1961a), Iran (SEYED-EMAMI et al. 1985), Crimea and Caucasus (TSERETELI 1989) and Middle Asia (BESNOSOV & MITTA 1993).

Oxycerites (*Oxycerites*) sp. ex gr. *yeovilensis* ROLLIER, 1911 [M & m]

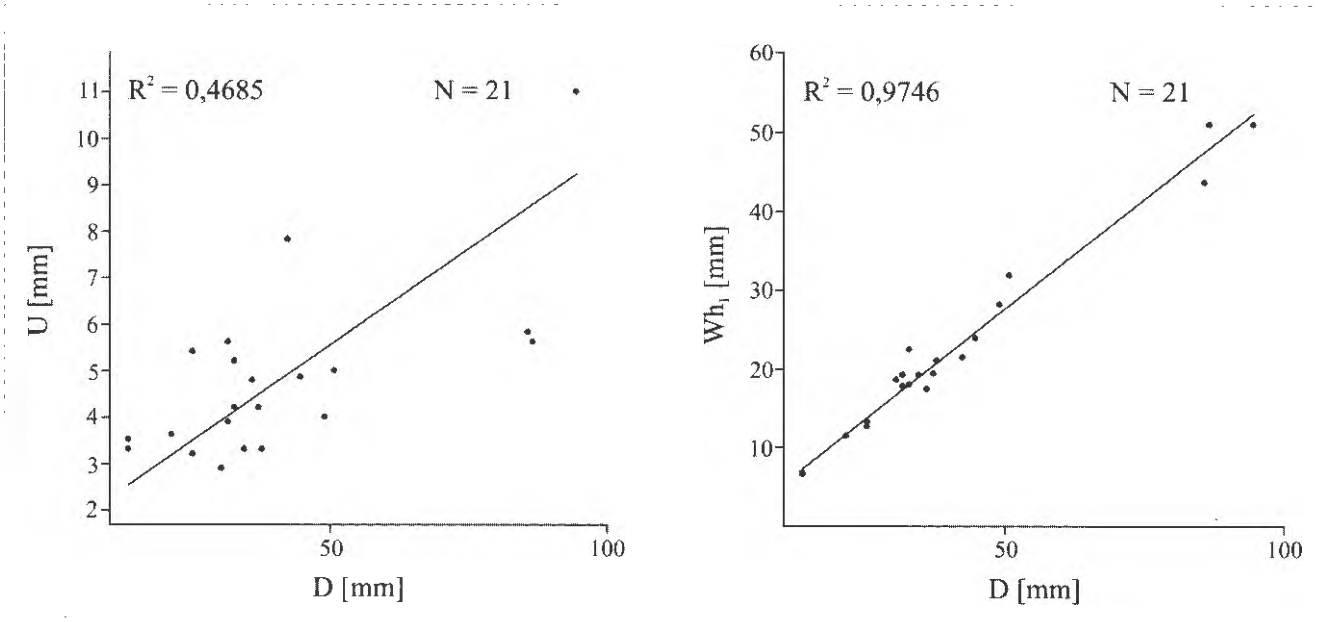
(Plate 3 A–D, F–H, K–L; Text-figs. 6–7, 9E, 11J–J)

Material: Fifty two specimens (including five certain microconchs), together with whorl fragments.

Nr	D	U	Wh	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh	WER
GIUS 8-3094	-	5.0	16.1	-	8.8	-	-	-	-	-	0.55	-
GIUS 8-3095	25.0	5.4	12.7	-	4.4	-	20	0.22	0.51	0.18	0.35	-
GIUS 8-3096	32.7	5.2	17.8	14.0	-	-	?	0.16	0.54	-	-	2.28
GIUS 8-3097	~37.8	3.3	20.9	-	-	-	?	~0.09	~0.55	-	-	-
IGPUW/J/148	50.9	5.0	31.7	24.9	-	-	13	0.10	0.62	-	-	1.99
IGPUW/J/149	36.0	4.8	17.2	-	-	-	17	0.13	0.48	-	-	1.96
GIUS 8-3098	30.5	2.9	18.5	15.3	7.0	-	13	0.09	0.61	0.23	0.38	1.93
GIUS 8-3099	~31.5	3.9	17.6	14.2	-	-	~16	~0.12	~0.56	-	-	-
GIUS 8-3100	85.7	~5.8	43.6	-	-	-	-	~0.07	0.51	-	-	-
GIUS 8-3101	~32.6	~4.2	22.4	-	-	-	>13	~0.13	~0.69	-	-	-
GIUS 8-3102	25.0	3.2	13.2	-	10.6	-	?	0.13	0.53	0.42	0.80	2.28
GIUS 8-3103	13.5	3.3	6.7	5.7	3.6	-	~18	0.24	0.50	0.27	0.54	2.10
GIUS 8-3104	~31.6	5.6	19.1	-	7.7	-	>13	~0.18	~0.60	~0.24	0.40	-
GIUS 8-3105	49.0	~4.0	28.0	20.4	11.3	-	10	~0.08	0.57	0.23	0.40	1.77
GIUS 8-3106	>44.0	~4.6	26.3	-	10.5	-	?	~0.10	0.60	0.24	0.40	-
GIUS 8-3107	37.1	4.2	19.4	-	~11.2	-	?	0.11	0.52	~0.30	~0.58	-
GIUS 8-3108	44.8	4.85	23.8	-	-	-	?	0.11	0.53	-	-	-
GIUS 8-3109	34.5	3.3	19.2	-	-	-	?	0.09	0.56	-	-	-
GIUS 8-3110	21.4	3.6	11.4	-	-	-	?	0.17	0.53	-	-	-
GIUS 8-3111	~108.3	-	~62.0	~57.0	27.8	-	~8	-	~0.57	~0.26	~0.45	~1.85
GIUS 8-3112	94.4	11.0	50.8	-	-	-	?	0.12	0.54	-	-	-
GIUS 8-3113	13.6	3.5	6.6	-	-	~9	>16	0.26	0.48	-	-	-
GIUS 8-3128	42.2	7.8	21.4	14.8	10.6	?	?	0.18	-	-	0.49	2.10
GIUS 8-3129	86.7	~5.6	50.8	-	-	?	?	~0.06	-	-	-	-

Description: Macroconchs: Shells involute to strongly involute (U/D = 0.07–0.26), oxyconic. Diameter of the largest macroconch equals c. 108.3 mm. Whorl cross-section high, lanceolate, with sharp (keeled) venter. Toward the aperture of mature individuals, the venter is gradually getting slightly rounded. Umbilical slope short and vertical, and its margin rounded. Inner ribs occur as dense, prorsiradiate thin striae. From the middle part of the whorl-height, they divide on two, rursiradiate and falcate outer ribs. They widen and disappear near the ventro-lateral margin. With the shell growth and toward the aperture, the outer ribs slightly get thicker, and in some specimens they even fade away, dividing on thinner bunches of ribs or striae. Body chamber attains c. ¾ of the last whorl, and is ended with the aperture of concave margin, that forms short ventral and dorsal rostra.

Microconchs: Shells small-sized (D up to ~ 38 mm), strongly involute to involute (U/D = 0.09–0.16), oxyconic. Whorl cross-section identical as in macroconchs. Only ventral side just before the aperture gets rounded. Moreover, it is more rounded than that in microconchs of *O.* (*Oxycerites*) *yeovilensis* ROLLIER described above. Similarly the



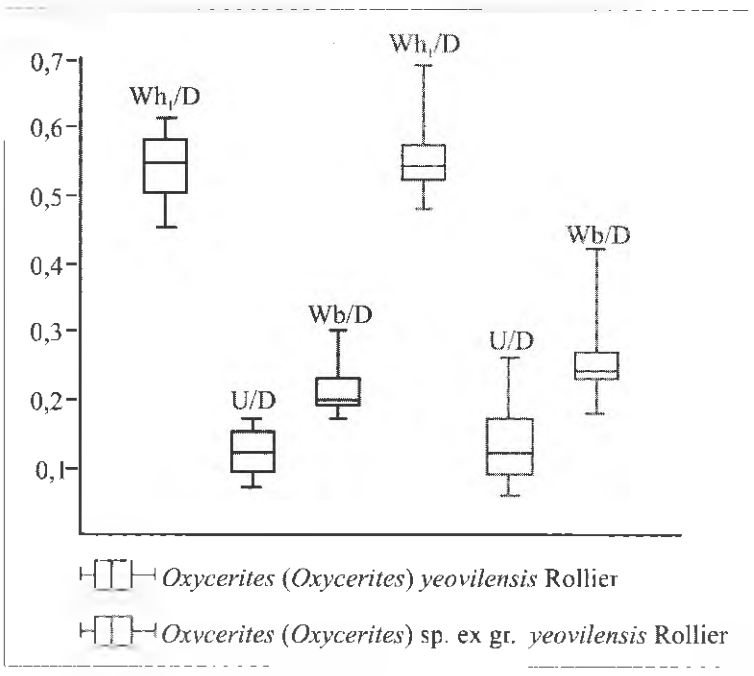
Text-fig. 6. Plots of umbilical width (U) and outer whorl height (Wh_1) against shell diameter (D) in *Oxycerites* (*Oxycerites*) sp. ex gr. *yeovilensis* ROLLIER [M & m].

flanks that are slightly rounded in the second half of the last whorl. In the middle of the flanks a delicate but distinct lateral groove occurs. Inner ribs the same as in macroconchs. Outer ribs falcate and rursiradiate, quite dense, more or less distinct. However, the latter feature may be in part an effect of taphonomy, as well. Body chamber attains ¾ of the last whorl and ends with the aperture bearing a ventral rostrum, as well as a pair of short lateral lappets.

On the juvenile (D = ~ 14 mm) whorls of specimens of unidentified sex, the evolutness of the shell is greater (U/D = 0.24 or 0.29). Although the suture line is very similar to that of *O.* (*Oxycerites*) *yeovilensis* ROLLIER, their elements are wider and more simplified in some individuals.

Variability: The intraspecific variability is similar to that in *O.* (*Oxycerites*) *yeovilensis* ROLLIER. It concerns mainly the shell evolutness and ribbing pattern. On the older whorls, there also can be seen a differential intensity of outer ribs, from stronger and sharper to bunch of fine striae. The greatest variability concerns U/D (CV = 40 %; N = 22). However, it must be noted that the CV value is much more higher than in *O.* (*Oxycerites*) *yeovilensis* ROLLIER. Wh_1/D and Wb/D, on the other hand, show lower variability (CV equals 9 %; N = 21 and 24.1 %; N = 9, respectively).

Remarks: On the basis of morphological features of the shell, it is difficult to differentiate the specimens (especially macroconchs) under discussion from the species *O.* (*Oxycerites*) *yeovilensis* ROLLIER. Taking the morphological conservatism of the genus through time into account, it is plausible that the population under study is a phyletic descendant of the species *O.* (*Oxycerites*) *yeovilensis* ROLLIER during gradual evolution. However, due to the lack of specific feature, at the moment it is impossible to separate the population described here into a separate species. Therefore, it is proposed to retain it as a species of *yeovilensis* group. The results of simple statistical analysis show that the Middle Bathonian *O.* (*Oxycerites*) sp. ex gr. *yeovilensis* ROLLIER does not differ from the Early Bathonian *O.* (*Oxycerites*) *yeovilensis* ROLLIER – standard deviations of particular shell features overlap each other (Text-fig. 7). On the basis of qualitative features, both species (populations), especially macroconchs, also show great similarity. Outer ribs are similarly variable as in *O.* (*Oxycerites*) *yeovilensis* ROLLIER. Umbilical width is variable between particular individuals in population, as well. The suture line, although somewhat wider and less elaborated in a few individuals, is identical to that in *O.* (*Oxycerites*) *yeovilensis* ROLLIER (see Text-fig. 11J). Young macroconchs, however, may possess a little bit more rouned flanks, but as mature individuals they are indistinguishable. The microconchs, on the other hand, possess a shallow lateral groove, characteristic only for Middle and Upper Bathonian



Text-fig. 7. Box-plot of umbilical width (U), outer whorl height (Wh_1) and whorl breadth (Wb) against shell diameter (D) in *Oxycerites* (*O.*) *yeovilensis* ROLLIER [M & m] and *Oxycerites* (*Oxycerites*) sp. ex gr. *yeovilensis* ROLLIER [M & m], showing the maximum and minimum values, standard deviations and medians of the particular shell features. Note that the standard deviations of particular shell features in both species overlap.

microconchs traditionally classified as *Paroecotraustes* SPATH. Additionally, denser outer ribs are preserved to the end of the body chamber, what may distinguish this population from the microconchs of *O.* (*Oxycerites*) *yeovilensis* ROLLIER.

The macroconchs are similar to the rather poorly known Middle Bathonian *O.* (*Oxycerites*) *waterhousei* (MORRIS & LYCETT 1851, p. 13, pl. 1, Plate 4), known so far only from England and France (see ARKELL 1951a). According to ARKELL (1951a), this species is close to *O. fallax* (GUERANGER) (=*O. yeovilensis* ROLLIER), but differs in having a stronger and more rursiradiate outer ribs, very narrow umbilicus already in juvenile stage and rounded venter. On the contrary, the juveniles of *O.* (*Oxycerites*) sp. ex gr. *yeovilensis* ROLLIER are characterized by sharp, keeled venters, wider umbilici and more distant outer ribs. In this case, they share greater similarity to the stratigraphically older *O.* (*Oxycerites*) *yeovilensis* ROLLIER, than to the Middle Bathonian *O.* (*Oxycerites*) *waterhousei* (MORRIS & LYCETT).

The Middle Bathonian *O.* (*Oxycerites*) *oxus* (BUCKMAN) clearly differs in irregular ribbing pattern. Macroconchs of the Upper Bathonian *O.* (*Oxycerites*) *orbis* (GIEBEL) possess more distant outer ribs and narrower whorl cross-section.

Occurrence: Middle Bathonian (Subcontractus and Morrisi zones) of Blanowice, Wrzosowa, Bugaj and Kawodrza Dolna ('Kawodrza' clay-pit) and Gnaszyn Dolny ('Gnaszyn' clay-pit).

Oxycerites (Oxycerites) seebachi (WETZEL 1950) [M]
(Plate 3 E, I; Text-fig. 11K)

1958 *Oxycerites* (*Pleuroxyites*) *seebachi* (WETZEL); WESTERMANN, p. 49, pl. 10, Plate 5 (holotype).
1968 *Oxycerites seebachi* (WETZEL); HAHN, p. 37, pl. 2, figs. 5–6; Text-fig. 7d.
1993 *Oxycerites seebachi* (WETZEL); BESNOSOV & MITTA, p. 48, pl. 3, Plate 5.
2000 *Oxycerites* (*Oxycerites*) *seebachi* (WETZEL); MATYJA & WIERZBOWSKI, p. 201, pl. 2, figs. 2–3.
2005 *Oxycerites seebachi* (WETZEL); SCHLOGL et al., pl. 5, Plate 6.

Material: Five specimens: three without the aperture preserved, one phragmocone and one whorl fragment.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh	WER
GIUS 8-3080	27.0	6.0	14.2	11.2	-	10	16	0.22	0.52	-	-	2.62
GIUS 8-3081	20.2	4.5	10.0	6.9	4.4	-	21	0.22	0.49	0.22	0.44	2.16
GIUS 8-3082	34.3	6.7	13.2	-	6.8	-	18	0.19	0.38	0.20	0.51	-
GIUS 8-3083	27.7	5.8	13.6	-	-	-	20	0.21	0.49	-	-	-

Description: Specimens small-sized, semi-involute, oxyconic. Umbilical margin rounded, umbilical slope short and steep. Umbilicus becomes narrower during ontogeny. Whorl cross-section narrow, lanceolate with keeled venter and slightly rounded flanks. Inner whorls are devoid of inner ribs; instead, fine, dense and prorsiradiate striae occur. In a middle part of a whorl-height, they bifurcate. Outer ribs, denser on inner whorls, are falcate and strongly rursiradiate. On ventro-lateral margin, the tops of the outer ribs are directed toward the aperture. During ontogeny, the outer ribs become less concave adaperturally.

The body chamber length may have attained ¾ of the last whorl. Suture line elaborated (Text-fig. 11K). E higher and shallower than L. E/L bifid, nearly symmetrical and of equal height what L/U_2. U_3 as shallow as E, but wider.

Remarks: *O.* (*O.*) *seebachi* (WETZEL) is a characteristic and easy to identify species, because of its evolute shell on inner and outer whorls, and dense, strongly falcate ribs.

This species is coupled in dimorphic pair with *O.* (*Paroecotraustes*) *fuscus* (QUENSTEDT) (see HAHN 1968), which may be conspecific with *O.* (*P.*) *formosus* (ARKELL) (see MATYJA & WIERZBOWSKI 2000). However, although *O.* (*O.*) *seebachi* (WETZEL) and *O.* (*P.*) *formosus* (ARKELL) do co-occur in the Lower Bathonian of the Polish Jura (see MATYJA & WIERZBOWSKI 2000), in the Middle Bathonian only the last one can be found. Therefore, if we assume the conspecifity of *O.* (*P.*) *fuscus* (QUENSTEDT) and *O.* (*P.*) *formosus* (ARKELL) as real, the dimorphic relationship between those species is not as likely.

Occurrence: Lower Bathonian (Tenuiplicatus Zone) of Rudniki, Kawodrza Gorna ('Leszczynski' and 'LAB' clay-pits) and Faustianka. The species is also noted from the Lower Bathonian of Germany (HAHN 1968), France (ZANY et al. 1995), Bulgaria (STEPHANOV 1961a), Iran (SEYED-EMAMI et al. 1985) and Caucasus (BESNOSOV & MITTA 1993).

Oxycerites (Oxycerites) fuscoides WESTERMANN, 1958 [M]

(Plate 4 A–E; Text-figs. 8–9F)

1958 *Oxycerites* (*Pleuroxyites*) *fuscoides* n. sp.; WESTERMANN, p. 50, pl. 11, figs. 1–4.

1990 *Oxycerites* (*Mesoxyites*) *fuscoides* WESTERMANN; HAHN et al., p. 40, pl. 1, Plate 7; pl. 2, Plate 5.

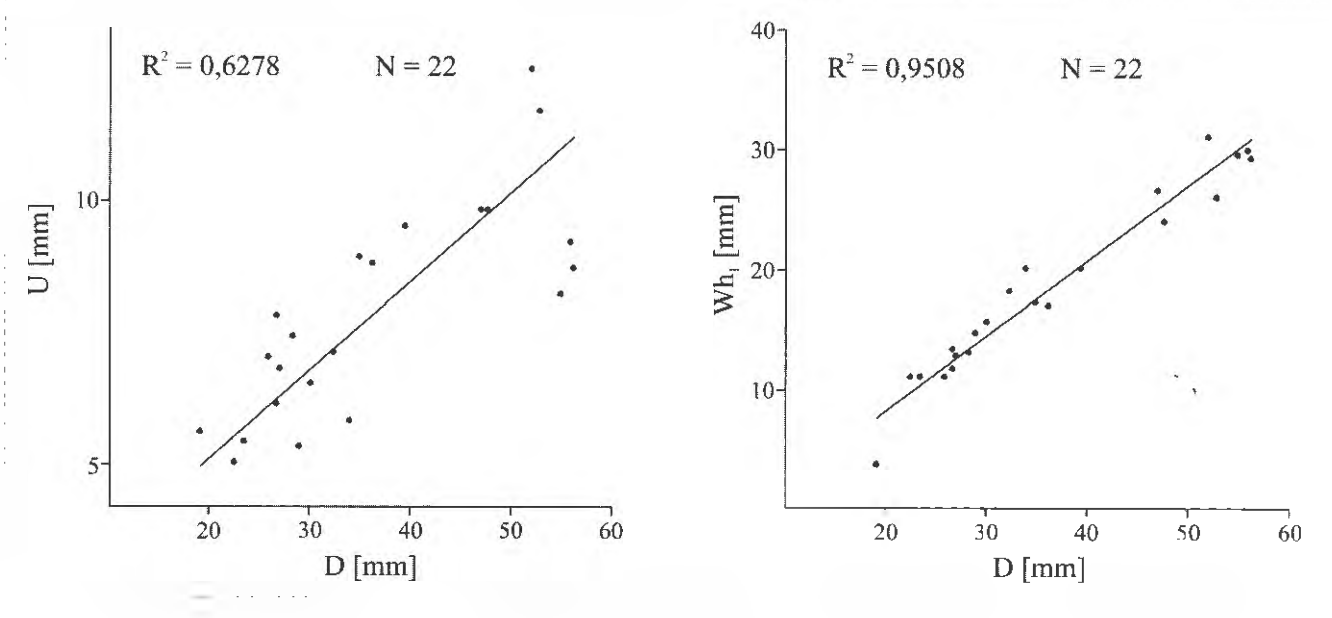
Material: Fifty three specimens on various stages of ontogeny, including eleven whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3141	55.0	8.2	29.5	-	9.4	-	21	0.15	0.54	0.17	0.32	-
GIUS 8-3142	~34.0	~5.8	20.0	14.5	5.6	-	~20	~0.17	~0.59	~0.16	0.28	-
GIUS 8-3143	36.2	8.8	17.0	-	-	-	21	0.24	0.4	-	-	-
GIUS 8-3144	30.0	6.5	15.6	-	6.1	-	19	0.22	0.52	0.20	0.39	-
GIUS 8-3145	~28.3	7.4	13.0	-	-	-	~19	~0.26	~0.46	-	-	-
GIUS 8-3146	27.0	6.8	12.8	-	-	-	~18	0.25	0.47	-	-	-
GIUS 8-3147	52.0	12.5	31.0	23.6	10.2	-	22	0.24	0.60	0.20	0.33	2.19
GIUS 8-3148	47.0	9.8	26.6	20.0	-	-	?	0.21	0.56	-	-	2.82
GIUS 8-3149	39.4	9.5	20.0	15.3	-	-	22	0.24	0.51	-	-	2.82
GIUS 8-3150	26.7	6.1	13.3	11.7	5.0	-	~24	0.23	0.50	0.19	0.37	2.46
GIUS 8-3151	22.5	5.0	11.0	-	4.8	-	19	0.22	0.49	0.21	0.44	-
GIUS 8-3152	56.2	8.7	29.3	22.1	9.7	-	19	0.15	0.52	0.17	0.33	2.96
IGPUW/J/108	~56.0	9.2	30.0	23.0	10.2	-	19	~0.16	~0.53	~0.18	0.34	-

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/KP-11-1	25.9	7.0	11.0	-	-	-	17	0.27	0.42	-	-	-
GIUS 8-3153	19.1	5.6	3.6		-	-	11	0.29	0.19	-	-	-
GIUS 8-3154	~32.4	7.1	18.2	12.5	7.9	-	17	~0.22	~0.56	~0.24	0.43	~2.02
GIUS 8-3155	52.8	11.7	26.1		13.2	-	22	0.22	0.49	0.25	0.50	-
IGPUW/J/8	42.5	-	-	21.8	-	-	24	-	-	-	-	-
GIUS 8-3156	29.0	5.3	14.7	12.8	-	>7	~16	0.18	0.51	-	-	-
GIUS 8-3157	23.5	5.4	11.0	-	-	-	21	0.23	0.47	-	-	-
GIUS 8-3158	-	-	10.0	-	5.2	>10	>14	-	-	-	0.52	-

Description: Specimens small to medium-sized, with semi-involute, oxyconic shell. The largest (GIUS 8-3354) is a phragmocone of D = 67 mm. The shell of complete, mature individual may have attained more than 100 mm in diameter. In the material investigated, two morphotypes occur, differing in a whorl cross-section width. The whorl cross-section of the majority of specimens is strongly compressed, with sharp and keeled venter. Three specimens (GIUS 8-3155, IGPUW/J/8, TK-9), however, possess wider whorls with more distinct ventro-lateral margins. Though, both morphotypes possess similarly rounded flanks. Older whorls (D ≥ 25 mm) are somewhat more evolute, with more distinct ventro-lateral margin. Umbilical margin is distinct, rounded, and slope is short, slightly rounded. Outer ribs are dense and distinct. On inner whorls (at D = ~ 12 mm), the shell is practically smooth, except fine inner and outer striae, as well as growth lines. The length of outer ribs in some individuals may vary, what was also observed by HAHN et al. (1990). Fine, prorsiradiate inner striae are visible only in oblique light. Body chamber attains ¾ of the last whorl. Aperture is missing.

Remarks: The characteristics of the specimens studied agree well with the holotype and other specimens presented by WESTERMANN (1958) and HAHN et al. (1990). The last authors suspected the presence of microconchs within this species. In the material from Ogrodzieniec, in the same oolitic siderite bed, fragmentary forms with more rounded venter and rursiradiate outer ribs, resembling *O.* (*Paroecotraustes*)



Text-fig. 8. Plots of umbilical width (U) and outer whorl height (Wh_1) against shell diameter (D) in *Oxycerites* (*O.*) *fuscoides* WESTERMANN [M].

maubeugei (STEPHANOV) (determined here as *O.* (*Paroecotraustes*) cf. *maubeugei* (STEPHANOV)), occur. In concretions from Grodzisko, Kawodrza Dolna nd Krzyworzeka, the occurrence of these species is also observed. Maybe this dimorphic pair is real what was also suggested by HAHN et al. (1990). However, a large number of well-preserved specimens from exact horizons is still needed to resolve this problem.

Occurrence: Upper Bathonian (Hodsoni and Orbis zones) of Ogrodzieniec, Zarki, Kawodrza Dolna ('Anna' clay-pit), Gnaszyn Dolny ('Gnaszyn' clay-pit), Grodzisko and Krzyworzeka. The species is also known from Germany (WESTERMANN 1958; HAHN et al. 1990).

Oxycerites (Oxycerites) orbis (GIEBEL 1852) [M]
(Plate 4 F–I)

1967 *Oxycerites oppeli* nov. sp.; ELMI, s. 534, pl. 1, figs. 1–5.
1982 *Oxycerites orbis* (GIEBEL); DIETL, pl. 3, figs. 1–3; Text-fig. 4.
1988 *Oxycerites orbis* (GIEBEL); DIETL & CALLOMON, s. 13, pl. 1, Plate 1.
1997 *Oxycerites* (*Oxycerites*) *oppeli* ELMI; MANGOLD & RIOULT, pl. 18, Plate 7–8.

Material: Ten specimens: two complete, young individuals; one nearly complete adult, three phragmocones and four body chamber fragments. One specimen (GIUS 8-3139) has been assigned to as *Oxycerites* (*Oxycerites*) cf. *orbis* (GIEBEL).

Nr	D	U	Wh_1	Wh_x	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3136	45.9	3.95	26.5	~19.2	-	-	>10	0.09	0.58	-	-	-
GIUS 8-3137	102.5	11.2	51.0	33.3	~18.6	-	9	0.11	0.50	~0.18	~0.36	1.69
IGPUW/J/Or-1	112.3	-	63.7	-	-	-	8	-	0.57	-	-	-
GIUS 8-3138	37.45	5.8	20.3	-	-	-	22	0.15	0.54	-	-	-
GIUS 8-3139	63.3	9.1	35.0	-	-	-	?	0.14	0.55	-	-	-
GIUS 8-3140	50.2	7.3	29.1	-	11.0	-	23	0.14	0.58	0.22	0.38	-

Description: Shells medium to large-sized, strongly involute, oxyconic. On earlier ontogenetic stages, umbilicus is quite wider (U/D = 0.14–0.15 at D = 37.45–63.3). Umbilical margin well-developed, rounded; umbilical slope short and vertical. Whorl cross-section narrow, lanceolate in adult individuals. In the middle part of the whorl-height, a lateral ridge occurs on the flanks. In younger individuals, the flanks may be slightly rounded. Venter sharp up to the end of the body chamber. Inner ribs in a form of fine, prorsiradiate or radial striae, running from the umbilical margin to the lateral ridge. Then, they bifurcate. In young individuals, the outer ribs are dense, strong and rursiradiate. Later, they become more falcate, less dense and of low relief. When the shell is preserved, fine ternary riblets occur on the ventro-lateral margin. Body chamber attains ¾ of the last whorl. Aperture is missing. Suture line is not visible.

Remarks: This species is a good example of morphological stasis in oppeliids. For a long time, it was mistaken with *O.* (*Oxycerites*) *aspidoides* (OPPEL). DIETL (1982) was the first who showed that in reality the range of *O.* (*Oxycerites*) *aspidoides* (OPPEL) is confined to the uppermost Bajocian-lowermost Bathonian. Thus, the latter species cannot be an index taxon for the Upper Bathonian Aspidoides Zone (= Orbis Zone, see DIETL 1982) any longer. Moreover, it differs from *O.* (*Oxycerites*) *orbis* (GIEBEL) by its more evolute shell.

The young individuals of *O.* (*Oxycerites*) *orbis* (GIEBEL) may possess either more distant (see DIETL 1982) and denser outer ribs (WESTERMANN & CALLOMON 1988). The specimens studied here, fall within the second group. Dense, short and less falcate outer ribs on inner whorls of *O.* (*Oxycerites*) *orbis* (Giebel) distinguish this species from the Lower or Middle Bathonian species, such as *O.* (*Oxycerites*) *yeovilensis* ROLLIER, *O.* (*Oxycerites*) sp. ex gr. *yeovilensis* ROLLIER or *O.* (*Oxycerites*) *waterhousei* (MORRIS & LYCETT). However, the adult forms of those species may be hard to distinguish from each other.

Oxycerites oppeli ELMI was considered as a junior synonym of *O. orbis* (GIEBEL) (DIETL 1982; DIETL & CALLOMON 1988). The endemic *O.* (*Oxycerites*) *sulaensis* WESTERMANN & CALLOMON from the Lower Bathonian of the Sula Islands is similar to *O.* (*Oxycerites*) *orbis* (GIEBEL) but, despite of palaeobiogeographic and stratigraphic distance, the latter one possesses more blunt ribbing (see WESTERMANN & CALLOMON 1988).

Occurrence: Upper Bathonian (Orbis Zone) of Ogrodzieniec, Zarki, Kawodrza Dolna ('Anna' clay-pit) and Grodzisko.

This species is also known from Germany and France (DIETL 1982).

Subgenus *Oxycerites* (*Alcidellus*) WESTERMANN, 1958

Type species *Ammonites tenuistriatus* DE GROSSOUVRE, 1888

Oxycerites (*Alcidellus*) *tenuistriatus* (DE GROSSOUVRE 1888) [M]
(Plate 5 J–K; Text-fig. 9G)

1958 *Paroecotraustes* (*Alcidellus*) *tenuistriatus tenuistriatus* (DE GROSSOUVRE); WESTERMANN, p. 41, pl. 3, figs. 3–5, pl. 4, Plate 1.
1958 *Paroecotraustes* (*Alcidellus*) *tenuistriatus lateumbilicatus* (ROEMER); WESTERMANN, p. 41, pl. 4, figs. 2–4, pl. 5, Plate 1–2.
1972 *Alcidellus tenuistriatus* (DE GROSSOUVRE); KRYSTYN, p. 237, pl. 3, figs. 6–7, pl. 4, figs. 3, 6.
1998 *Alcidellus tenuistriatus* (DE GROSSOUVRE); GECZY & GALACZ, p. 492, pl. 1, figs. 11–15, text-figs. 5, 6c (with full synonymy).
1998 *Oxycerites* (*Alcidellus*) *tenuistriatus* (DE GROSSOUVRE); PARENT, p. 76, figs. 4A, 5A–B; App.1.

Material: Three incomplete body chambers with fragmentary inner whorls.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/24	~71.5	15.6	42.1	-	25.0	-	~7	~0.22	~0.59	~0.35	~0.34	-
IGPUW/J/65	85.4	16.8	48.0	37.6	27.8	-	~9	0.20	0.56	0.32	0.32	-

Description: Specimens of medium size, with semi-involute, discocone shells. Whorl cross-section wide, with rounded flanks and distinct ventro-lateral ridges. Toward the aperture, the whorl cross-section widens. Umbilicus quite deep, with high and vertical slope, and well-marked, rounded margin. On fragmentary inner whorls, umbilical swellings are visible, what suggest the presence of strong primary ribs at earlier ontogenetic stages. At D = 53.2 mm, however, the inner ribs are weaker and occur as fine striae only. Ornamentation of the outer whorls, on the other hand, only consists of wide, falcate and distant secondary ribs.

Remarks: Despite the rather poor state of preservation, the whorl cross-section and ornamentation indicate that the specimens described belong to the species *O.* (*Alcidellus*) *tenuistriatus* (DE GROSSOUVRE). Taking the shell evolutness into account, the specimens are most similar to the morphotype '*lateumbilicatus*', presented by WESTERMANN (1958). The whorl cross-section and outer ribs are identical with the specimen figured by PARENT (1998). *O.* (*Alcidellus*) *biflexuosus* (D'ORBIGNY) differs in narrower umbilicus and stronger and more persistent ribbing.

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Kawodrza' clay-pit). This species is widely distributed, and known from Germany (WESTERMANN 1958), France (STURANI 1966), Austria (KRYSTYN 1972), Hungary (GECZY & GALACZ 1998) and Argentina (PARENT 1998). Similar and related forms are also known from Spain (SANDOVAL 1983), Mexico (SANDOVAL et al. 1990) and Indonesia (WESTERMANN & CALLOMON 1988).

Subgenus *Oxycerites (Paroecotraustes)* SPATH, 1928

Type species *Oecotraustes serrigerus* WAAGEN, 1869

Oxycerites (Paroecotraustes) cf. *bomfordi*
(ARKELL 1951a) [m]
(Plate 6 A; Text-fig. 11L)

Material: One small phragmocone.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3350	13.3	3.6	6.4	6.0	3.8	?	>17	0.27	0.48	0.28	2.82	1.56

Description and remarks: The phragmocone is small-sized, semi-involute, discocone. Umbilical margin well-marked, not sharp. Umbilical slope short and steep. Whorl cross-section narrow, lanceolate, with nearly flat flanks and sharp, keeled venter. Inner ribs visible only in oblique light; they are prorsiradiate and quite wide. Outer ribs start above the half of the whorl-height. They are short and falcate, distally widened;

on the ventro-lateral ridge they are strongly prorsiradiate. The outer ribbing visible only beginning from the middle part of the last preserved whorl. The lack of ribbing on earlier whorls is an effect of limonitic incrustation. Generally, the features agree with those of *O.* (*Paroecotraustes*) *bomfordi* (ARKELL), which differ from *O.* (*Paroecotraustes*) *bradleyi* (ARKELL) by its stronger ribbing. Ventral saddle of the sututre line (Text-fig. 11L) short and wide; E much narrower than L; E/L bifid, wider than L/U_2, but of similar height. L/U_2, as E/L, is bifid and asymmetrical.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Kawodrza Gorna ('Glinski' clay-pit).

Oxycerites (Paroecotraustes) formosus (ARKELL 1951b) [m]
(Plate 3J)

1951b *Oecotraustes* (*Paroecotraustes*) *formosus* sp. nov.; ARKELL, p. 8, pl. 1, figs. 4 (holotype) – 5.
1968 *Oecotraustes* (*Paroecotraustes*) *formosus* ARKELL; HAHN, p. 56, pl. 4, figs. 9–9; Text-fig. 9.
2000 *Oxycerites* (*Paroecotraustes*) *formosus* (ARKELL); MATYJA & WIERZBOWSKI, p. 201, pl. 2, Plate 1.

Material: Three specimens.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3074	32.1	9.0	15.0	-	-	~12	21	0.28	0.47	-	-	1.56
GIUS 8-3075	~20.4	5.2	~8.2	-	-	-	-	~0.25	~0.40	-	-	-

Description: Shells small to medium-sized, semi-evolute. Umbilical margin rounded and its slope short and gently inclined. Whorl cross-section unknown due to the flattening of the specimens. Inner ribs, best developed in the specimen GIUS 8-3074, thicker, prorsiradiate and not so dense. They start from the umbilical slope and run to lateral groove. Umbilical groove, characteristic for this species, is also present. Outer ribs, starting from the lateral groove, strongly rursiradiate, falcate, widened toward the venter. In the second half of the body chamber, they are rursiradiate, straight, bent adapically. Some of the outer ribs divide, what is also characteristic for the species. Body chamber, attaining ¾ of the last whorl, is ended with lateral lappets. Suture line is not visible.

Remarks: The specimen described is very similar to the holotype. It only differs by its more evolute shell. This species may be easily distinguished from the other related species. The most similar are *O.* (*Paroecotraustes*) *splendens* (ARKELL), *O.* (*Paroecotraustes*) *ziegleri* (STEPHANOV) and *O.* (*Paroecotraustes*) *fuscus* (QUENSTEDT). The first one possesses wider and more distant outer ribs, and distinctly thicker inner ribs. The second one, apart of less distinct lateral groove, also possesses distant inner and outer ribs. The latter ones are additionally ended with small, mace-like swellings. Moreover, those two species do not possess the characteristic umbilical groove and bifurcating outer ribs. *O.* (*Paroecotraustes*) *fuscus* (QUENSTEDT) differs in stronger inner ribs; however, this feature may be an effect of intraspecific variability (see MATYJA & WIERZBOWSKI 2000).

Occurrence: Lower Bathonian (Tenuiplicatus Zone; see MATYJA & WIERZBOWSKI 2000) of Faustianka, and Middle Bathonian (?Subcontractus Zone) of Wrzosowa and Bugaj. The species is also known from England (ARKELL 1951a), Bulgaria (STEPHANOV 1966), Germany (HAHN 1968), Caucasus and Middle Asia (BESNOSOV & MITTA 1993).

Oxycerites (Paroecotraustes) densecostatus
(LISSAJOUS 1923) [m]
(Plate 5A–C)

1923 *Oecotraustes serrigerus* WAAGEN, var. *densecostatus* LISSAJOUS; LISSAJOUS, p. 121, pl. 26, Plate 6.
1966 *Oecotraustes* (*Paroecotraustes*) *densicostatus* (*sic*!) LISSAJOUS; STEPHANOV, p. 53, Text-fig. B. 4–5.
1989 *Oecotraustes* (*Paroecotraustes*) *densicostatus* (*sic*!) LISSAJOUS; TSERETELI, p. 59, pl. 8, figs. 1–4; Text-fig. 4.

Material: Four specimens with preserved apertures.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3077	35.0	12.2	15.0	-	-	-	-	0.35	0.43	-	-	-
GIUS 8-3078	37.95	12.2	15.8	-	-	-	~19	0.32	0.42	-	-	-
GIUS 8-3079	36.8	13.0	12.8	-	9.0	-	~19	0.35	0.35	0.24	0.70	-

Description: Specimens small-sized, semi-evolute. Umbilicus widens during ontogeny. Umbilical margin rounded; slope short and steep. Inner whorls, seen only in one specimen (unregistered specimen TK-24), are smooth. Whorl cross-section narrow. Venter of the phragmocone and the first half of the body chamber possesses keel, which gradually fades away, leaving the second half of the body chamber rounded. Lower side of the whorls smooth. Fine and dense outer ribs start from the weakly-marked lateral groove. They are well-visible already from the beginning of the last whorl. The outer ribs rursiradiate, sometimes delicately bent adaperturally or rectiradiate, widening toward the venter; however, they do not form any swellings at their terminations. In three specimens, the ribs fade away in such a manner, that the apertural part of the body chamber is completely smooth. Only in the specimen TK-24 they are visible, although very poorly, in this part of the shell. The body chamber is 200° long. The apertural margin is slightly bent outside and provided with a pair of spatulate lappets. Suture line is hard to see due to the crushed phragmocones.

Remarks: This species was created by LISSAJOUS (1923) on the basis of three specimens, the one of which was illustrated. This specimen (LISSAJOUS 1923, pl. 26, Plate 6) was designated as a lectotype by STEPHANOV (1966), because the rest of the Lissajous' specimens have probably been lost. This species was considered as uncertain (see discussion in STEPHANOV 1966), because both the photo of the lectotype and also the laconic description of the species given by LISSAJOUS (1923), were not enough for STEPHANOV (1966) to give its precise definition. The description provided by LISSAJOUS (1923) could have concerned also other species, such as *O.* (*Paroecotraustes*) *maubeugei* (STEPHANOV) or *O.* (*Paroecotraustes*) *ziegleri* (see STEPHANOV 1966). However, STEPHANOV (1966) considered this form as a separate species, illustrating similar specimen from the Little Caucasus, which, according to STEPHANOV, was entirely conspecific with *O.* (*Paroecotraustes*) *densecostatus* (LISSAJOUS). The specimen presented by STEPHANOV (1966, Text-fig. B.5) in fact is similar to the lectotype. The latter, however, does not possess the ornamentation at the end of the body chamber. Despite the fact that the photograph of the lectotype is not of good quality, it does not seem that the lack of ornamentation is an effect of poor preservation. The three Bathonian specimens from Kawodrza described here also do not possess the ribbing at this part of the body chamber, what is not an effect of taphonomy, as well. Only one specimen (TK-24), the features of which are identical with the rest of specimens, possesses the ornamentation in that part of the shell. TSERETELI (1989) also presented four specimens, the three of which also do not possess the outer ribs in the same part of the body chamber. Therefore, it is clear that this species shows variability of that feature in only a small degree. On the contrary, HAHN et al. (1990) stated that the microconch of *Oxycerites* (*Mesoxyites*) *lechstedtensis* HAHN & WESTERMANN 'may be identical with a poorly known '*Oecotraustes densecostatus*''. However, I cannot agree with them, because *O.* (*Mesoxyites*) *lechstedtensis* HAHN & WESTERMANN markedly differs from *O.* (*Paroecotraustes*) *densecostatus* (LISSAJOUS) in its ornamentation and evolutness.

O. (*Paroecotraustes*) *densecostatus* (LISSAJOUS) is easily distinguished from other, similar forms. *O.* (*Paroecotraustes*) *maubeugei* (STEPHANOV) possesses eccentrically coiled shell, more distant and rursiradiate outer ribs ended with mace-like swellings, and more or less developed inner ribs. Moreover, the presence of dense outer ribs in *O.* (*Paroecotraustes*) *densecostatus* (LISSAJOUS) at the beginning of the last whorl, and their disappearance almost in the middle part of the body chamber, sufficiently distinguish this species from the others.

Occurrence: Middle Bathonian (Morrisi Zone) of Kawodrza Dolna ('Kawodrza' clay-pit). Apart of Poland, this species is known from the Upper Bathonian of France (LISSAJOUS 1923), Azerbajdian and Georgia (STEPHANOV 1966; TSERETELI 1989). WESTERMANN (1958) mentioned *O.* (*P.*) cf. *densecostatus* from the Upper Bathonian of Germany. MANGOLD et al. (1971, p. 15) also mentioned this species from the Morrisi Zone.

Oxycerites (Paroecotraustes) cf. *serrigerus* (WAAGEN 1869) [m]

(Plate 5D–F)

Material: Two incomplete and poorly preserved specimens.

Nr	D	U	Wh	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3076	35.3	10.5	14.5	-	7.6	-	16	0.30	0.41	0.21	0.52	-
IGPUW/J/94	-	10.1	16.2	-	-	-	-	-	-	-	-	-

Description: Shells regularly coiled, semi-evolute. Whorl cross-section narrow, with flat flanks and narrow venter, that is adaperturally delicately rounded. Umbilical margin rounded; umbilical slope short and vertical. The inner whorls (at D = 15 mm) of the specimen IGPUW/J/94 possess poorly visible prorsiradiate primary ribs, bifurcating to rursiradiate, falcate and moderately dense outer ribs. On the last preserved whorls, the outer ribs are numerous, rursi- to rectiradiate, short and of low relief. The state of preservation, however, obliterates their appearance in many places. Toward the venter, they widen forming small swellings at their ends. Lateral groove is very weak (GIUS 8-3076), or does not occur at all (IGPUW/J/94). Body chamber seems to occupy ¾ of the last whorl. Aperture is missing.

Remarks: *O.* (*Paroecotraustes*) *serrigerus* was described (as *Oecotraustes serrigerus*) for the first time from the classic locality at Balin near Krakow by WAAGEN in 1869 (see STEPHANOV 1961b). As was stressed by STEPHANOV (1966, p. 48), and later by HAHN (1968, p. 61), this species is rare, known only from a few specimens. Since the end of the 19th century, the species was mentioned many times by various authors, but STEPHANOV (1961b, 1966) was the first who noted that the species name was inconsistently given to various different species (see the synonymy in STEPHANOV 1966). Its stratigraphic position is also unclear. As was noted by STEPHANOV (1966), the species seems to be derived exclusively from the Retrocostatum Zone. However, other specimens come from the condensed deposits, embracing several ammonite zones (Subcontractus-Hodsoni). HAHN (1968), for example, described *Oecotraustes* (*Paroecotraustes*) aff. *serrigerus* from the Middle Bathonian (Morrisi Zone).

The specimens described here come from the Middle Bathonian Morrisi and/or lower part of the Upper Bathonian Hodsoni Zone (= Bremeri Zone). Although some features, such as the occurrence of ornamentation on early stages, quite dense ribs ended with swellings and narrow venter may point to the species *O.* (*Paroecotraustes*) *serrigerus* (WAAGEN), the poor state of preservation, however, precludes the exact assignment of the specimens to the species under discussion.

Occurrence: Middle Bathonian (Morrisi Zone) and/or Upper Bathonian (Hodsoni Zone) of Gnaszyn Dolny ('Gnaszyn' clay-pit).

Oxycerites (Paroecotraustes) maubeugei (STEPHANOV 1966) [m]

(Plate 5F–I; Text-fig. 11M)

1966 *Oecotraustes* (*Paroecotraustes*) *maubeugei* sp. nov.; STEPHANOV, p. 51, pl. 5, figs. 1–7; pl. 6, figs. 1–8.
1968 *Oecotraustes* (*Paroecotraustes*) *maubeugei* STEPHANOV; HAHN, p. 58, pl. 1, figs. 4–5; pl. 5, Plate 1; Text-fig. 9.
1996 *Oxycerites* (*Paroecotraustes*) *maubeugei* STEPHANOV; MANGOLD et al., p. 57, pl. 1, figs. 3, 6–8.
1998 *Oecotraustes* (*Paroecotraustes*) *maubeugei* STEPHANOV; GÉCZY & GALACZ, p. 489, pl. 1, figs. 3–5; Text-fig. 4a (with full synonymy).

Material: Seventeen specimens in different state of preservation, and three whorl fragments assigned to as *O.* (*Paroecotraustes*) cf. *maubeugei* (STEPHANOV 1966).

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS-8-3045	36.0	12.7	13.7	13.1	-	-	17	0.35	0.38	-	-	2.22
GIUS-8-3046	39.0	12.3	15.2	-	-	-	18	0.31	0.39	-	-	3.31
GIUS-8-3047	35.2	11.5	15.7	14.2	9.8	9	16	0.33	0.45	0.40	0.62	2.34
GIUS-8-3048	36.4	10.3	15.4	12.0	-	-	15	0.28	0.42	-	-	2.1
GIUS-8-3049	45.5	12.3	18.8	-	-	-	-	0.27	0.41	-	-	1.96
IGPUW/J/70	25.2	6.0	11.2	-	-	-		0.24	0.44	-	-	-
GIUS 8-3050	17.6	5.75	7.7	-	-	-	-	0.33	0.44	-	-	-
GIUS 8-3051	23.7	6.7	11.2	-	-	-	~13	0.28	0.47	-	-	2.13
GIUS 8-3052	17.5	5.7	7.55					0.32	0.43	-	-	-
IGPUW/J/98	34.1	8.4	15.3	12.6	-	-	12	0.25	0.45	-	-	2.19
GIUS 8-2844	38.5	7.9	18.5	13.7	-	-	19	0.20	0.48	-	-	1.79
GIUS 8-2843	35.5	8.7	14.7	-	-	-	17	0.24	0.41	-	-	1.77

Description: Shells medium-sized, semi-evolute, discocone. The body chamber coiling is somewhat eccentric. Whorl cross-section of the phragmocone lanceolate with sharp, keeled venter that gradually disappears, leaving a smooth and rounded body chamber. Flanks slightly rounded. The lateral groove may be either absent, poorly developed or well-marked. Umbilicus may be more or less wide, with rounded margin and short, steep slope. Inner whorls (up to D = ~ 10 mm) are completely smooth, except fine and dense striae. From D = ~ 14 mm, fine, short and rursiradiate outer ribs occur. They widen toward the venter and end with small, mace-like swellings. Only two specimens (unregistered TK-O1 and GIUS 8-3047) possess primary ribs, which are fine, moderately distant and prorsiradiate, bifurcating from the lateral groove. The body chamber length is 200°; it is ended with a pair of lateral lappets. Suture line is not complex (see Text-fig. 11M).

Remarks: This species, what has already been noted by GECZY & GALACZ (1998), is characterized by a high degree of morphological plasticity. The individuals may be more or less evolute throughout their ontogeny.

Somewhat similar *O.* (*Paroecotraustes*) *waageni* (STEPHANOV) possesses more distant outer ribs of low relief. *O.* (*Paroecotraustes*) *densecostatus* (LISSAJOUS) has very dense, short outer ribs and complete lack of inner ribs. Morphologically, *O.* (*Paroecotraustes*) *prevalensis* (STEPHANOV) is, according to its creator, closest to *O.* (*Paroecotraustes*) *maubeugei* (STEPHANOV). It differs in a complete lack of the inner ribs and having denser outer ribs. Moreover, the ornamentation appears very late, in the second half of the last whorl. However, taking the high degree of morphological variability of *O.* (*Paroecotraustes*) *maubeugei* (STEPHANOV) into account, it seems very plausible that *O.* (*Paroecotraustes*) *prevalensis* (STEPHANOV) is only a different morphotype of this species. It may be supported by the following facts: STEPHANOV (1966), creating the species *O.* (*Paroecotraustes*) *maubeugei*, stated that some individuals do not possess inner ribs at all. In the same time, during description of *O.* (*Paroecotraustes*) *prevalensis*, he wrote that the species lack the inner ribs, what, according to STEPHANOV (1966), differ this species from *O.* (*Paroecotraustes*) *maubeugei*. Moreover, describing *O.* (*Paroecotraustes*) *prevalensis*, he stated that it is a rare species (four specimens only), while *O.* (*Paroecotraustes*) *maubeugei* is numerous (STEPHANOV's seventy four specimens) and most common in the whole Europe. What is important, the both species come from the condensed Bathonian deposits, representing Subcontractus to Hodsoni zones (see STEPHANOV 1966).

Occurrence: Upper Bathonian (Hodsoni and Orbis zones) of Ogrodzieniec, Zarki, Kawodrza Dolna ('Kawodrza' and 'Anna' clay-pits), Grodzisko, Krzyworzeka and Balin near Cracow (see MANGOLD et al. 1996). The species is also known from England (Stephanov 1966; author's pers. observ. 2005), France (LISSAJOUS 1923; STURANI 1966), Germany (HAHN 1968; DIETL & KAPITZKE 1983), Hungary (GECZY & GALACZ 1998), Bulgaria (STEPHANOV 1966), Caucasus and Middle Asia (TSERETELI 1989; BESNOSOV & MITTA 1993).

Oxycerites (Paroecotraustes) waageni (STEPHANOV 1961b)
[m]
(Plate 6K, N; Text-fig. 9H)

1961b *Oecotraustes* (*Paroecotraustes*) *waageni* sp. nov.; STEPHANOV, p. 829, Text-fig. 2.
1966 *Oecotraustes* (*Paroecotraustes*) *waageni* STEPHANOV; STEPHANOV, p. 54, pl. 3, figs. 9–11; Text-fig. B3 (with synonymy).
1967 *Paroecotraustes* (*Paroecotraustes*) *waageni variabilis* nov. subsp.; ELMI, p. 702, pl. 14, figs. 1–12; text-figs. 168–170.
1998 *Oecotraustes* (*Paroecotraustes*) *waageni* STEPHANOV; GECZY & GALACZ, p. 490, pl. 1, Plate 7.

Material: Two, incomplete body chambers.

Nr	D	U	Wh	Wh_1	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh	WER
GIUS 8-3053	39.0	10.4	19.3	15.2	9.2	-	-	0.26	0.49	0.23	0.48	-

Description and remarks: Shells medium-sized, semi-involute, discocone. They possess characteristic for the species, distant and widened at the ventro-lateral margin outer ribs. The inner ribs not visible. Lateral groove shallow. Body chamber is rounding toward the aperture. Unregistered specimen AK-O1 possesses proximal parts of lateral lappets preserved.

The specimens described here do not differ from those presented by STEPHANOV (1966). It is considered (see GECZY & GALACZ 1998) that this species is characterized by the weakest ribbing amongst the all conspecific Late Bathonian forms. In fact, in the specimens investigated, the inner ribs do not occur at all, and the outer ones are of low relief. The most similar

species is *O.* (*Paroecotraustes*) *maubeugei* (STEPHANOV). It differs, however, with its denser and thicker outer ribs, possessing distinct swellings at their ends, as well as greater evolutness of its shell. A detailed discussion about the species has already been presented by STEPHANOV (1961b, 1966) and GECZY & GALACZ (1998). As the form *P.* (*Paroecotraustes*) *waageni variabilis* ELMI is a junior synonym (a morphotype) of *O.* (*Paroecotraustes*) *waageni* STEPHANOV (see GECZY & GALACZ 1998), the specimens presented by KOPIK (1998, pl. 7, figs. 6–7), although quite poorly preserved, certainly concerns this latter species. Similarly, the species *P.* (*Paroecotraustes*) *heterocostatus* (REHBINDER), presented by KOPIK (1998), is also a synonym of *O.* (*Paroecotraustes*) *waageni* (see STEPHANOV 1966).

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Kawodrza' clay-pit) and Zarki (Orbis Zone). This species is also known from Germany, Bulgaria, Romania, Hungary and Portugal (see STEPHANOV 1966; MANGOLD 1990; GECZY & GALACZ 1998).

?*Oxycerites* sp. indet.

(Plate 6B)

Material: One, poorly preserved mould.

Nr	D	U	Wh	Wh_1	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2846	16.8	3.5	8.2	-	-	-	-	0.21	0.49	-	-	-

Remarks: The mould is small-sized, semi-involute, without any traces of ornamentation. Flanks are slightly convex. At this state of preservation (especially lack of ornamentation), it cannot be stated with certainty, whether the specimen represents the genus *Oxycerites* or *Oppelia*.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Kawodrza Gorna ('Sowa' clay-pit).

Subfamily Hecticoceratinae HYATT, 1900

Prohecticoceras SPATH, 1928

Type species *Ammonites retrocostatus* DE GROSSOUVRE, 1888

Prohecticoceras ochraceum ELMI, 1967 [M]

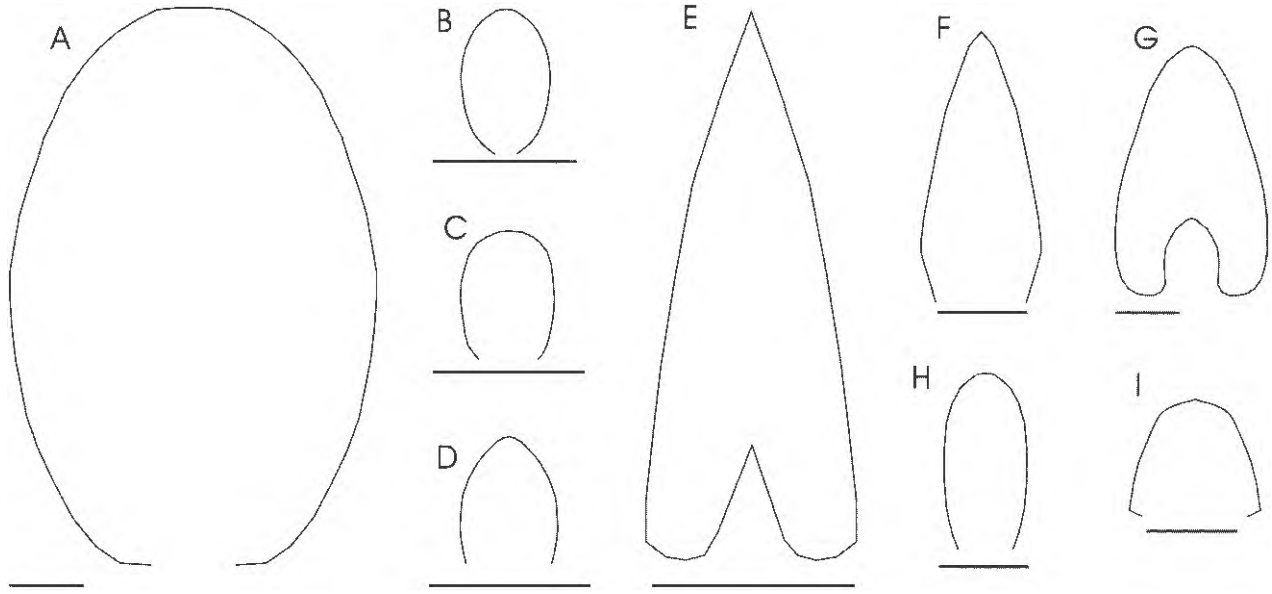
(Plate 6L; Text-fig. 9I)

1967 *Hecticoceras (Prohecticoceras) ochraceum* nov. sp.; ELMI, p. 584, pl. 5, figs. 1–2, pl. 17, Plate 4, text-figs. 122–127.
1971 *Hecticoceras (Prohecticoceras) ochraceum ochraceum* ELMI; ELMI, p. 250, pl. 19, figs. 2–5, Text-fig. 1.
1980 *Prohecticoceras ochraceum ochraceum* ELMI; GALACZ, p. 65, pl. 14, figs. 3–4, text-figs. 52–53.

Material: Eigth, variably preserved specimens.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3193	16.0	4.7	7.0	5.7	5.7	-	21	0.29	0.44	0.36	0.81	2.22
IGPUW/J/KP-Y	~18.4	~5.8	8.0	6.2	5.6	>7	>15	~0.3	~0.43	~0.30	0.7	-
GIUS 8-3194	-	-	20.2	~16.1	-	-	-	-	-	-	-	-
IGPUW/J/17	21.3	7.1	~8.0	-	~5.6	-	-	0.3	~0.37	0.26	~0.70	-
GIUS 8-3195	56.8	11.8	29.0	-	12.0	-	>10	0.21	0.51	0.21	0.41	-
IGPUW/J/7	102.4	13.5	62.0	~39.5	?	-	?	0.13	0.60	-	-	-

Description: The material is represented by the specimens on various stages of ontogeny. In juvenile, and somewhat later stages (at D = 16 and 46 mm), umbilicus is relatively wide and retain its width during shell growth (U/D = 0.29). Umbilical margin rounded and its slope short, rounded. Whorls a little higher than wide, of trapezoidal cross-section (at D = 16 and 46 mm, Wh_1/D = 0.44). Venter relatively wide, fastigate, with short keel. Flanks nearly flat or slightly convex. In juvenile stage they may be more convergent. Inner ribs weak, visible only in oblique light. They are prorsiradiate, thick, dividing on 2–3 secondary ribs.



Text-fig. 9. Whorl cross-sections of some of the studied ammonites. A. *Calliphylloceras disputabile* (Zittel) [M], AK-Cd.1; B. *Phylloceras* sp. [juv.], IGPUW/J/1; C. *Nannolytoceras tripartitum* (Raspail) [juv.], GIUS 8-2451; D. *Sonninia* sp. indet. [M], GIUS 8-3345; E. *Oxycerites* (*Oxycerites*) sp. ex. gr. *yeovilensis* Rollier [M], GIUS 8-3105; F. *Oxycerites* (*O.*) *fuscoides* Westermann [M], GIUS 8-3354; G. *Oxycerites* (*Alcidellus*) *tenuistriatus* (de Grossouvre) [M], IGPUW/J/65; H. *Oxycerites* (*Paroecotraustes*) *waageni* (Stephanov) [M], GIUS 8-3053; I. *Prohecticoceras ochraceum* Elmi [M], JK-K1; Scale bars equal 1 cm.

The latter ones are strongly rursiadiate, falcate and widened at ventro-lateral margins with distinct swellings at their ends. During ontogeny, they move away from each other and the whorl cross-section becomes narrower. Suture line not well-visible. E/L bifid, asymmetric, divided by numerous auxiliary lobes.

Remarks: The shell-shape and ornamentation well-agree with the holotype as well as with the specimens presented by Galácz (1980). The only difference is weaker primary ribs in the specimens studied here, especially in the unregistered specimen JK-K1. However, this may be the result of state of preservation, because in some places these ribs are visible anyway. Moreover, the strength of the primaries varies widely between the individuals presented by Elmi (1967). Galacz (1980) also pointed out that between Hungarian specimens and the type material, the number of the primary and secondary ribs may differ as well. Thus, apart of the difference mentioned above, the specimens can undoubtedly be assigned to *P. ochraceum*. The specimens described here are characterized by their similar stratigraphic provenance as either the French type, or Hungarian specimens, the latter ones derived from the Subcontractus Zone of the Middle Bathonian.

P. retrocostatum (de Grossouvre) differs in much wider whorl cross-section and flat venter. It is also known only from the Upper Bathonian. The Upper Bathonian *P. blanazense* Elmi is more involute, with denser ribbing. Also more involute *P. angulicostatum* (Loczy) possesses narrower, but higher, whorl cross-section, finer inner ribs and more numerous outer ribs.

Occurrence: Middle Bathonian (Morrisi Zone) of Bugaj and Kawodrza Dolna ('Kawodrza' clay-pit). Apart of the epicratonic Poland, this species is also known from Tethyan segment of Poland (Passendorfer 1935), France, Portugal, Spain, Morocco, Algeria (Elmi 1971) and Hungary (Galacz 1980).

Prohecticoceras cf. blanazense Elmi, 1967 [M]
(Plate 6J)

Material: One flattened specimen.

Nr	D	U	Wh	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3196	35.5	8.2	16.9	-	-	-	26	0.23	0.48	-	-	-

Description: Shell medium-sized, semi-evolute, discocone. Umbilical margin rounded. Whorl cross-section high. In oblique light, the inner ribs are weak, hardly visible. They are prorsiradiate, bifurcating to dense, rursiradiate and slightly falcate outer ribs. Toward the venter, the outer ribs widen, ending with swellings on the ventro-lateral ridge. Body chamber, although incomplete, attained ~ ¾ of the last whorl. Suture line visible only in the form of fragmentary lateral saddle.

Remarks: Despite the lateral flattening of the specimen, the shell-form and ribbing pattern remind the species *P. blanazense* ELMI. Especially, it is similar to the specimen 5 from the plate 5 of ELMI (1967). The latter specimen, as well as the holotype, has only slightly narrower umbilicus. ELMI (1967, 1971) treated this species as a subspecies of *P. ochraceum* ELMI. However, I decided to treat it as a separate species as SANDOVAL et al. (1990) and FERNANDEZ-LOPEZ (2001) did it before.

Occurrence: Upper Bathonian (Orbis Zone) of Kawodrza Dolna ('Anna' clay-pit).

Prohecticoceras aff. *angulicostatum* (LOCZY 1915) [M]
(Plate 6M; Text-fig. 11N)

Material: One, incomplete specimen.

Nr	D	U	Wh	Wh_1	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/KP-12-4	58.7	13.2	30.4	25.7	~16.0	-	~26	0.22	0.52	~0.27	~0.27	2.75
	35.3	10.7	15.6	11.0	8.6	-	-	0.30	0.44	0.24	0.55	3.84
	18.0	8.0	7.1	6.2	5.1	-	-	0.44	0.39	0.28	0.2	2.40

Description: Medium-sized specimen with oxyconic shell. Umbilical width gets smaller during ontogeny (at D = 18.0 mm, U/D = 0.44; at D = 35.3 mm, U/D = 0.3; at D = 58.7, U/D = 0.22). Whorl cross-section lanceolate, the height of which increases in relation to its width (at diameters mentioned above, Wh_1/Wb is 1.39, 1.81 and 1.9, respectively). Flanks slightly rounded; ventro-lateral ridges distinct; keel short. Umbilical margin rounded and its slope nearly vertical. Outer ribs, distinct only on the outer whorl, are falcate, widening toward the venter and ended with distinct swellings, that enlarges toward the aperture. Inner ribs nearly invisible on the last whorl. In oblique light, however, at the beginning of the body chamber, they appear as fine and prorsiradiate. The aperture is missing. Suture line (Text-fig. 11N) with wide, bifid and asymmetric E/L, divided by numerous auxiliary lobes; L/U_2 very narrow and much higher than E/L. Its top is bifid, nearly symmetrical; umbilical saddles not visible.

Remarks: With regard to ornamentation, the specimen is closer to *P. angulicostatum* (LOCZY). However, it differs from it by distant outer ribs, greater evolutness (nearly twice as in the holotype) and somewhat narrower whorl cross-section. The suture line is similar, except the narrower and higher L/U_2 in the specimen described. However, having only one specimen it is hard to state, whether it represents only a different morphotype or maybe even a different species. *P. retrocostatum* (DE GROSSOUVRE) possesses very wide whorl cross-section and denser ribbing. *P. haugi* (POPOVICI-HATZEG) is similarly evolute, but its outer ribs do not possess swellings at their ends.

Occurrence: Upper Bathonian (Orbis Zone) of Kawodrza Dolna (currently non-existent clay-pit, investigated by POTOCKI 1972).

Prohecticoceras sp. [M]
(Plate 6I)

Material: One, flattened specimen and one whorl fragment.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wh/D	Wb/Wh_1	WER
GIUS 8-3197	32.2	8.5	15.9	13.2	-	-	25	0.26	0.49	-	-	2.75

Description: Specimen small-sized, semi-involute. Umbilical margin rounded; umbilical slope short, slightly rounded. Whorl cross-section moderately high. Because of state of preservation, the inner ribs are poorly visible. The outer ribs dense, rursiradiate and slightly falcate up to the second half of the body chamber, ended with small tubercles at the ventrolateral margin. On the second half of the body chamber, they are rectiradiate, running almost radially and still close to each other. The tubercles become thicker, even rounded, toward the aperture, and the ribs themselves are shorter.

Remarks: The specimen under discussion differs markedly with respect of ornamentation from the associated in the same horizon *P.* cf. *blanazense* ELMI. It is not known, whether the inner ribs are really very weak, or affected by taphonomy. The pattern of the outer ribs, on the other hand, is very characteristic, what distinguished this specimen from the other congeneric forms, such as *P. retrocostatum* (DE GROSSOUVRE), *P. angulicostatum* (LOCZY) or *P. mondegoense* ELMI.

Occurrence: Upper Bathonian (Orbis Zone) of Kawodrza Dolna ('Anna' clay-pit) and Ogrodzieniec.

Family Lissoceratidae DOUVILLÉ, 1885
Subfamily Lissoceratinae DOUVILLÉ, 1885

Genus *Lissoceras* BAYLE, 1879

Type species *Ammonites psilodiscus* SCHLOENBACH, 1865

Synonymy: *Microlissoceras* STURANI, 1971

Lissoceras oolithicum (D'ORBIGNY 1845) [M]
(Plate 6C, G–H; Text-fig. 11O)

1845 *Ammonites oolithicus* D'ORBIGNY; D'ORBIGNY, p. 383, pl. 126, figs. 1–4.
1980 *Lissoceras oolithicum* (D'ORBIGNY); GALACZ, p. 57, pl. 11, figs. 5–6, text-figs. 43, 45.
1985 *Lissoceras oolithicum* (D'ORBIGNY); FERNANDEZ-LOPEZ, p. 164, pl. 15, Plate 2, text-figs. 15, 16e.
1986 *Lissoceras oolithicum* (D'ORBIGNY); SANDOVAL, p. 439, pl. 1, figs. 6–7, Text-fig. 3 (with full synonymy).
2006 *Lissoceras (Lissoceras) oolithicum* (D'ORBIGNY); ZATON & MARYNOWSKI, p. 433, figs. 3.9–3.10.

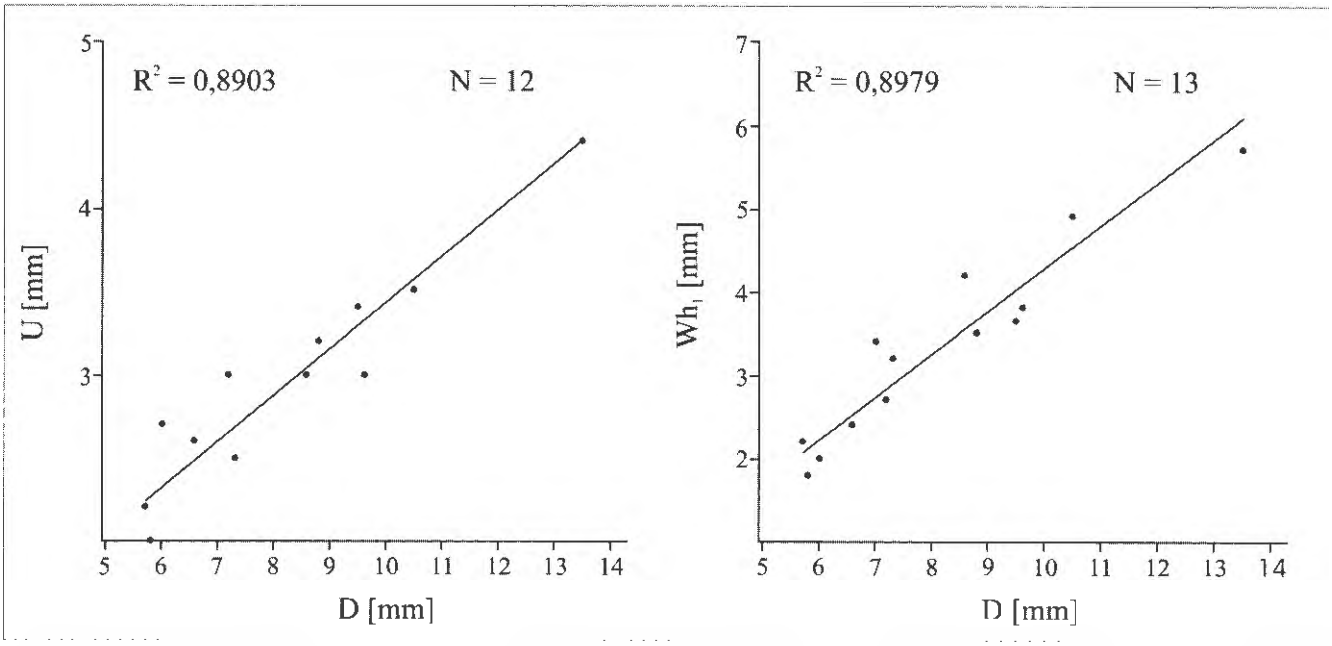
Material: Eight, mainly juvenile specimens, including one whorl fragment.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/4.1	27.6	7.3	7.1	-	-	-	-	0.26	0.26	-	-	1.9
IGPUW/J/15.1	~10.6	~3.1	4.3	-	-	-	-	~0.29	~0.4	-	-	-
IGPUW/J/14.1	10.0	3.0	4.8	-	5.0	-	-	0.3	0.48	0.5	1.04	1.56
IGPUW/J/3.1	7.8	2.7	3.4	-	3.2	-	-	0.35	0.43	0.41	0.94	1.7
IGPUW/J/18.1	7.5	1.75	3.35	-	3.3	-	-	0.23	0.45	0.44	0.98	1.99
IGPUW/J/16.1	~11.6	3.1	4.3	-	-	-	-	0.27	~0.37	-	-	~1.99
IGPUW/J/17.1	7.4	2.7	3.3	-	3.4	-	-	0.36	0.44	0.46	1.03	1.3

Description: Shells small to medium-sized (D = 7.4–27.6 mm), semi-evolute, platyconic-discocone. Umbilical width decreases during ontogeny. Its margin is rounded and slope gently dipped. In juveniles, whorl cross-section only slightly higher than wide; later it becomes more oval in outline. Flanks slightly rounded. Venter rounded. Shell smooth except fine growth lines. Some juveniles possess more or less marked prorsiradiate constrictions (up to 3 per whorl). Body chamber attained c. half of the last whorl. Aperture is missing. Suture line typical for lissoceratids (Text-fig. 11O), with wide and shallow E; L deeper incised and nearly symmetrical. E/L bifid and shorter than L/U_2.

Remarks: Detailed description and discussion of the specimens have already been given by ZATON & MARYNOWSKI (2006), and hence there is nothing new to be added.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Kawodrza Gorna ('Sowa' clay-pit). The species is especially known from the Upper Bajocian (Niortense – Parkinsoni zones), but single occurrences have been also reported from the Lower Bajocian (Sauzei Zone) (see MORTON 1971; GALACZ 1980; FERNANDEZ-LOPEZ 1985). ROZYCKI (1953) has noticed this species from the Lower Bathonian of the Polish Jura. However, it can not be excluded that it may have represented such Lower Bathonian forms, as *Lissoceras monachum* (GEMMELLARO). Unfortunately, because of a lack of illustration the problem remains.



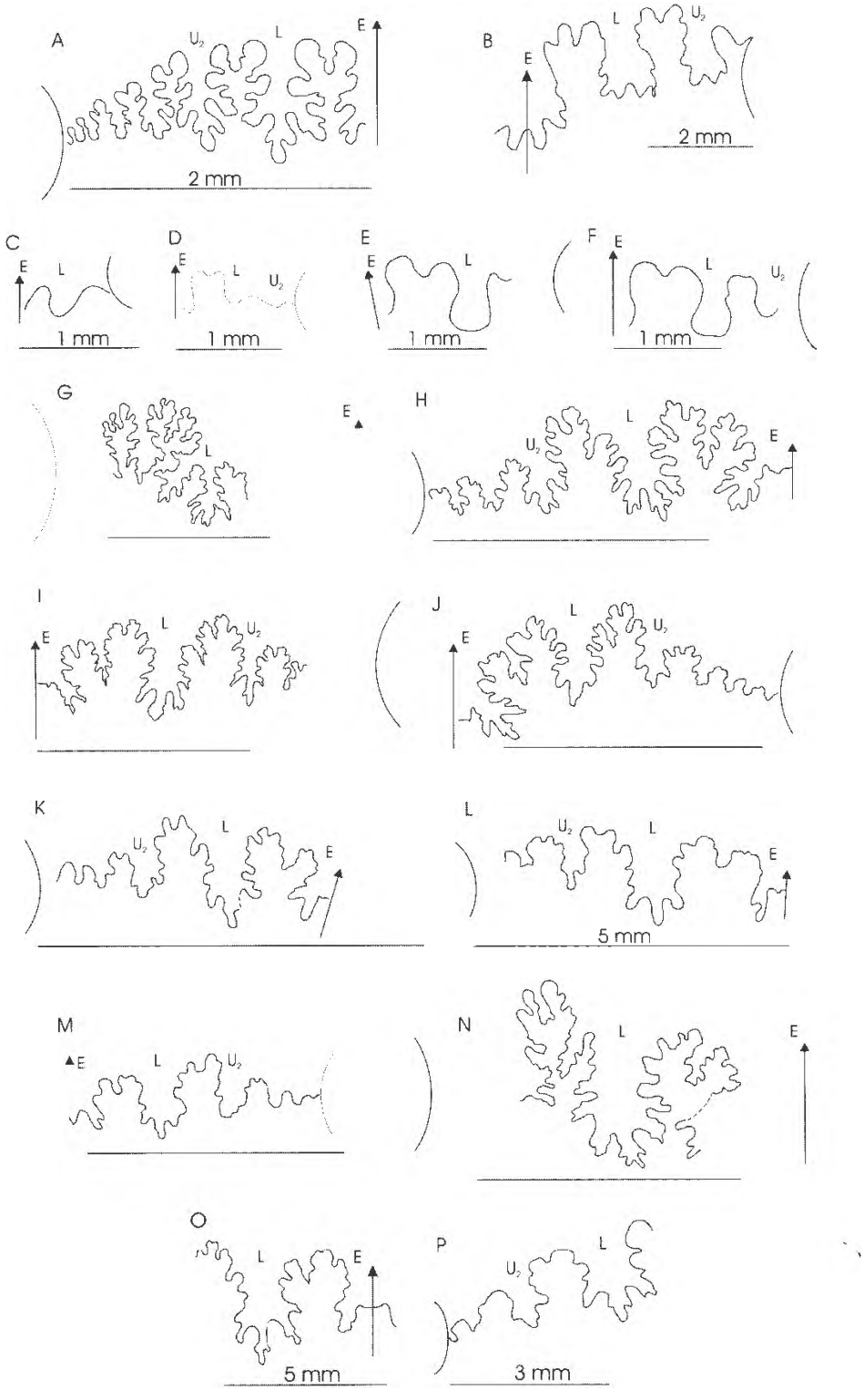
Text-fig. 10. Plots of umbilical width (U) and outer whorl height (Wh_1) against shell diameter (D) in *Lissoceras solitarium* Zaton & Marynowski [M].

Lissoceras solitarium Zaton & Marynowski, 2006 [m]
(Plate 6D–F; Text-figs. 10–11P)

2006 *Lissoceras* (*Microlissoceras*) *solitarium* nov. sp.; Zaton & Marynowski, p. 434, figs. 3.11–3.13.

Material: Twelve well-preserved and three incomplete specimens.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS-8-2454	13.5	4.4	5.7	4.3	4.0	-	-	0.32	0.42	0.30	0.70	2.0
IGPUW/J/5.1	10.5	3.5	4.9	-	-	-	-	0.33	0.47	-	-	2.25
GIUS-8-2455	9.5	3.4	3.65	-	-	-	-	0.36	0.38	-	-	2.34
IGPUW/J/20	7.3	2.5	3.2	-	2.8	-	-	0.34	0.44	0.38	0.875	1.4
IGPUW/J/21.1	5.8	2.0	~1.8	-	-	-	-	0.34	~0.31	-	-	1.7
GIUS 8-2976	8.6	3.0	4.2	-	-	-	-	0.35	0.49	-	-	1.51
GIUS 8-2977	6.0	2.7	2.0	-	-	-	-	0.45	0.33	-	-	1.44
GIUS 8-2978	7.2	3.0	2.7	1.8	-	-	-	0.42	0.375	-	-	1.59
GIUS 8-2979	6.6	2.6	2.4	-	-	-	-	0.39	0.36	-	-	2.25
GIUS 8-2980	8.8	3.2	3.5	-	3.0	-	-	0.36	0.40	0.34	0.86	2.0
GIUS 8-2981	9.6	3.0	3.8	-	3.5	-	-	0.31	0.39	0.36	0.92	2.1
GIUS 8-2982	-	3.7	5.0	3.3	3.6	-	-	-	-	-	0.72	-
GIUS 8-2983	-	3.8	5.0	3.4	4.1	-	-	-	-	-	0.82	-
GIUS 8-2984	5.7	2.2	2.2	-	-	-	-	0.38	0.38	-	-	1.85
GIUS 8-2985	7.0	-	3.4	2.15	2.7	-	-	-	0.49	0.38	0.79	1.61



Text-fig. 11. Suture lines of some of the described ammonites. A. *Phylloceras* sp. [juv.], IGPUW/J/1. B-F. *Nannolytoceras tripartitum* (Raspail) [juv.]; B. IGPUW/J/N-2, the last chamber of the shell preserved; C-F. GIUS 8-2450; C. The beginning of the first whorl, D. The beginning of the second whorl, E. The end of the second whorl, F. The beginning of the third whorl. G. *Sonninia* sp. indet. [M], GIUS 8-3345. H. *Oxycerites* (*Oxycerites*) *yeovilensis* Rollier [M], IGPUW/J/OY-1. I-J. *Oxycerites* (*O.*) sp. ex gr. *yeovilensis* Rollier [M]; I. GIUS 8-3104, J. GIUS 8-3107. K. *Oxycerites* (*O.*) *seebachi* (Wetzel) [M], GIUS 8-3083. L. *Oxycerites* (*Paroecotraustes*) cf. *bomfordi* (Arkell), GIUS 8-3350. M. *Oxycerites* (*Paroecotraustes*) *maubeugei* (Stephanov) [M], GIUS 8-3046. N. *Prohecticoceras* aff. *angulicostatum* (Loczy) [M], IGPUW/J/KP-12-4. O. *Lissoceras oolithicum* (d'Orbigny) [M], IGPUW/J/4.1. P. *Lissoceras solitarium* Zaton & Marynowski [M], IGPUW/J/5.1. There, where not indicated, the scale bars equal 1 cm.

Description: Shells small-sized (D = 5.8–13.5 mm), semi-involute (U/D = 0.34–0.37), platiconic-discocone. Umbilicus wide and deep, with rounded margin and very short, vertical but slightly rounded slope. Whorl cross-section high-oval, with slightly rounded to almost flat flanks. Venter narrow, rounded. Shells are smooth, except fine growth lines and sinusoidal riblets bent adaperturally. Three specimens possess chevron-like constrictions, cutting the venter forming slight, adapically bent depressions. Aperture is missing. Suture line (Text-fig. 11P) poorly visible.

Remarks: Detailed description and discussion of this new species have already been given by ZATON & MARYNOWSKI (2006), and hence there is nothing new to be added.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) and Lower Bathonian (Tenuiplicatus Zone) of Kawodrza Gorna ('Sowa' clay-pit and 'LAB' clay-pit, respectively).

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Plate 1

A–B. *Phylloceras* sp. [juv.]. **A1:** lateral view, **A2:** apertural view, IGPUW/J/1, **B:** lateral view, GIUS 8-2448. Both specimens come from Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).
C–H. *Nannolytoceras tripartitum* (RASPAIL) [juv.]. **C1:** lateral view, **C2:** ventral view, **C3:** SEM microphotograph showing the protoconch and the first whorl, GIUS 8-2450; **D1:** lateral view, **D2:** apertural view, GIUS 8-2449; **E:** GIUS 8-2452; **F:** IGPUW/J/N-2; **G:** GIUS 8-2454; **H:** GIUS 8-2451. All the specimens come from Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).
I–K. *Calliphylloceras disputabile* (ZITTEL) (M?). **I:** IGPUW/J/C-1, Kawodrza Gorna ('Leszczyński' clay-pit), Lower Bathonian (Tenuiplicatus Zone); **J:** RK-07, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone); **K:** GIUS 8-2948, Kawodrza Gorna ('LAB' clay-pit), Lower Bathonian (Tenuiplicatus Zone).
Scale bars equal 1 cm.

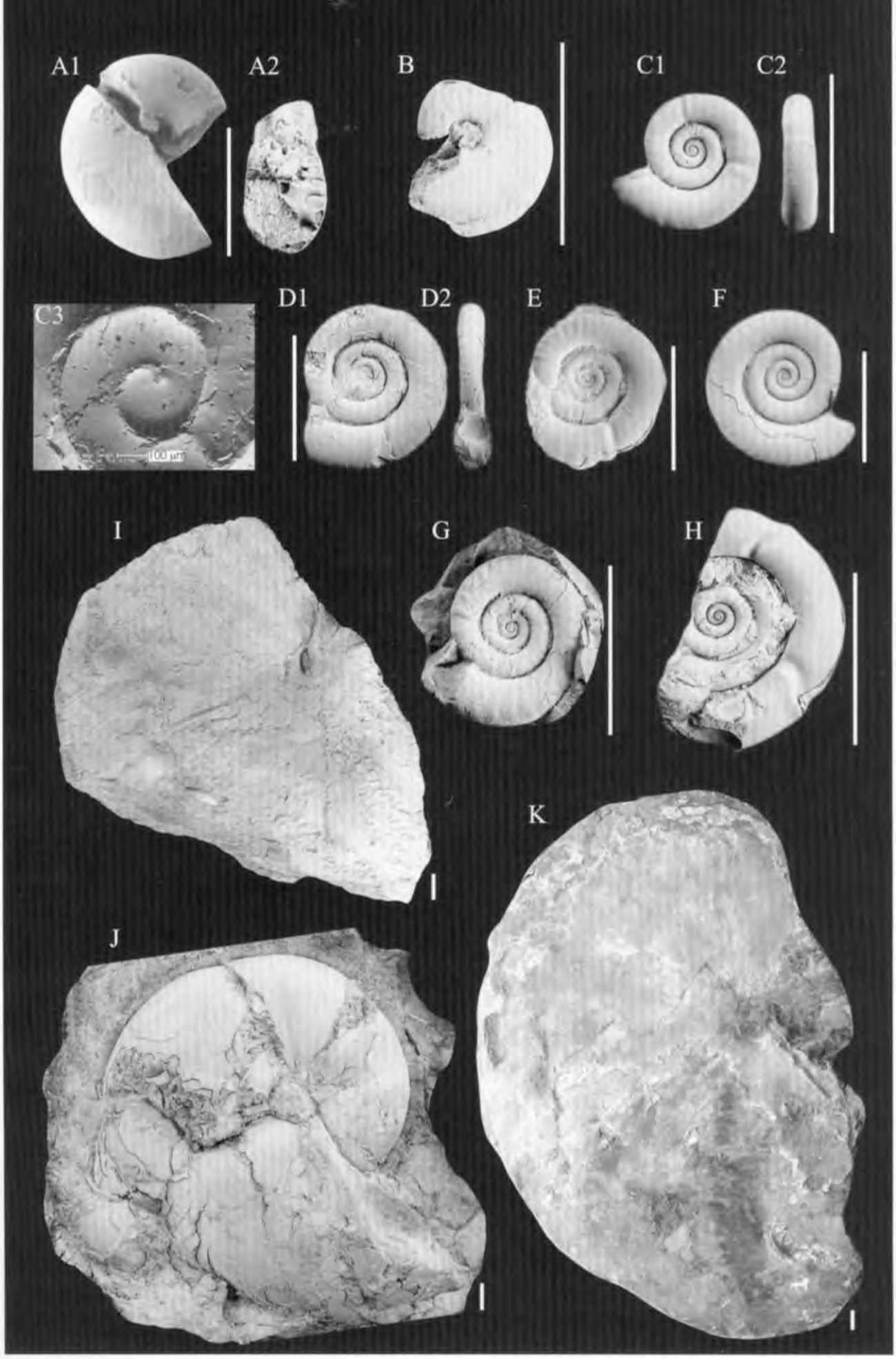

Plate 1. Michal Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 1

Plate 2

A. *Sonninia* sp. indet., GIUS 8-3345, Blanowice (clay-pit nr 1), lateral view, Lower Bajocian (?Humphriesianum Zone).
B. *Strigoceras truellei* (D'ORBIGNY), **B1:** lateral view, **B2:** ventral view, GIUS 8-2456, Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).
C–I. *Oxycerites* (*Oxycerites*) *yeovilensis* ROLLIER; **C1**: lateral view, **C2**: apertural view, macroconch, WK-120; **D1:** lateral view, **D2**: apertural view, macroconch, IGPUW/J/OY-1, Rudniki, Lower Bathonian (Zigzag Zone, Yeovilensis Subzone); **E**: macroconch, GIUS 8-3350, Gnaszyn Dolny ('Alina' clay-pit); **F**: microconch, GIUS 8-3087, Kawodrza Gorna ('LAB' clay-pit), Lower Bathonian (Tenuiplicatus Zone); **G**: microconch, GIUS 8-3086, Lower Bathonian (Tenuiplicatus Zone); **H**: macroconch, WK-124, Faustianka, Lower Bathonian (Tenuiplicatus Zone); **I**: macroconch, GIUS 8-3090, Lower Bathonian (Tenuiplicatus Zone).
Scale bars equal 1 cm.

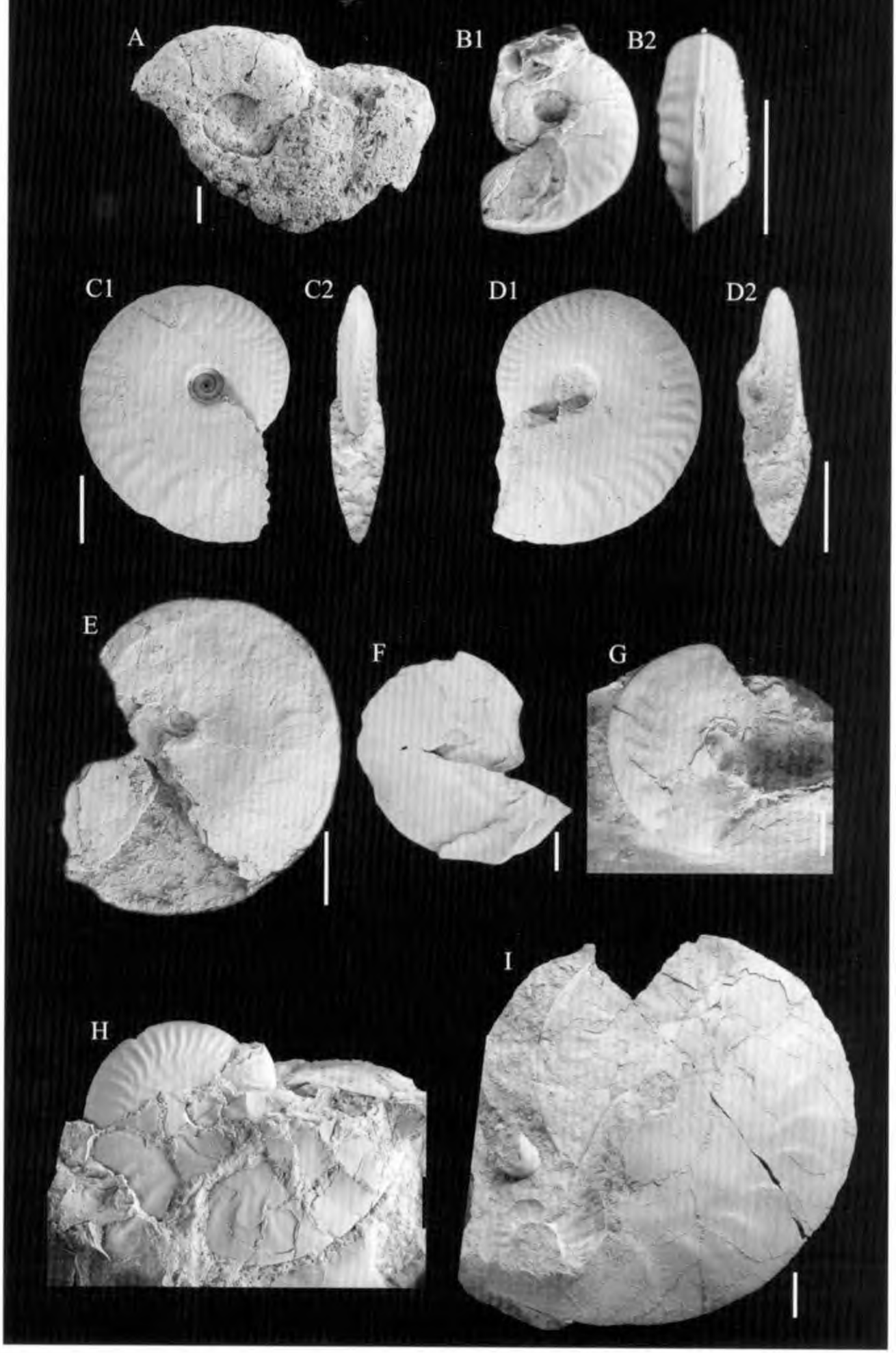

Plate 2, MICHAL ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 1

Plate 3

A–D. *Oxycerites* (*Oxycerites*) sp. ex. gr. *yeovilensis* Rollier; **A:** macroconch, GIUS 8-3095, Blanowice (clay-pit nr 2), Middle Bathonian (Morrisi Zone); **B:** macroconch, GIUS 8-3116, Wrzosowa, Middle Bathonian (Subcontractus Zone); **C:** microconch (arrow points the proximal part of the apertural lappet), GIUS 8-3121, Gnaszyn Dolny ('Gnaszyn' clay-pit), Middle Bathonian (Morrisi Zone); **D:** macroconch GIUS 8-3126, Blanowice (clay-pit nr 1), Middle Bathonian (Morrisi Zone).
E. *Oxycerites* (*Oxycerites*) *seebachi* (Wetzel) [M]; GIUS 8-3083, Faustianka, Lower Bathonian (Tenuiplicatus Zone).
F–H. *Oxycerites* (*Oxycerites*) sp. ex. gr. *yeovilensis* Rollier; **F:** macroconch, GIUS 8-3105, Wrzosowa, Middle Bathonian (Morrisi Zone); **G:** microconch, Kawodrza Dolna ('Kawodrza' clay-pit), Middle Bathonian (Morrisi Zone); **H:** microconch, IGPUW/J/149, Kawodrza Dolna ('Kawodrza' clay-pit), Middle Bathonian (Morrisi Zone).
I. *Oxycerites* (*Oxycerites*) *seebachi* (Wetzel) [M]; GIUS 8-3082, Kawodrza Gorna ('LAB' clay-pit), Lower Bathonian (Tenuiplicatus Zone).
J. *Oxycerites* (*Paroecotraustes*) *formosus* (Arkell) [M]; lateral view, GIUS 8-3074, Wrzosowa, baton srodkowy (Subcontractus Zone).
K–L. *Oxycerites* (*Oxycerites*) sp. ex. gr. *yeovilensis* Rollier; **K:** macroconch, KT-11, Blanowice (clay-pit nr 1), Middle Bathonian (Morrisi Zone); **L:** macroconch, GIUS 8-3100, Blanowice (clay-pit nr 2), Middle Bathonian (Morrisi Zone).
Scale bars equal 1 cm.

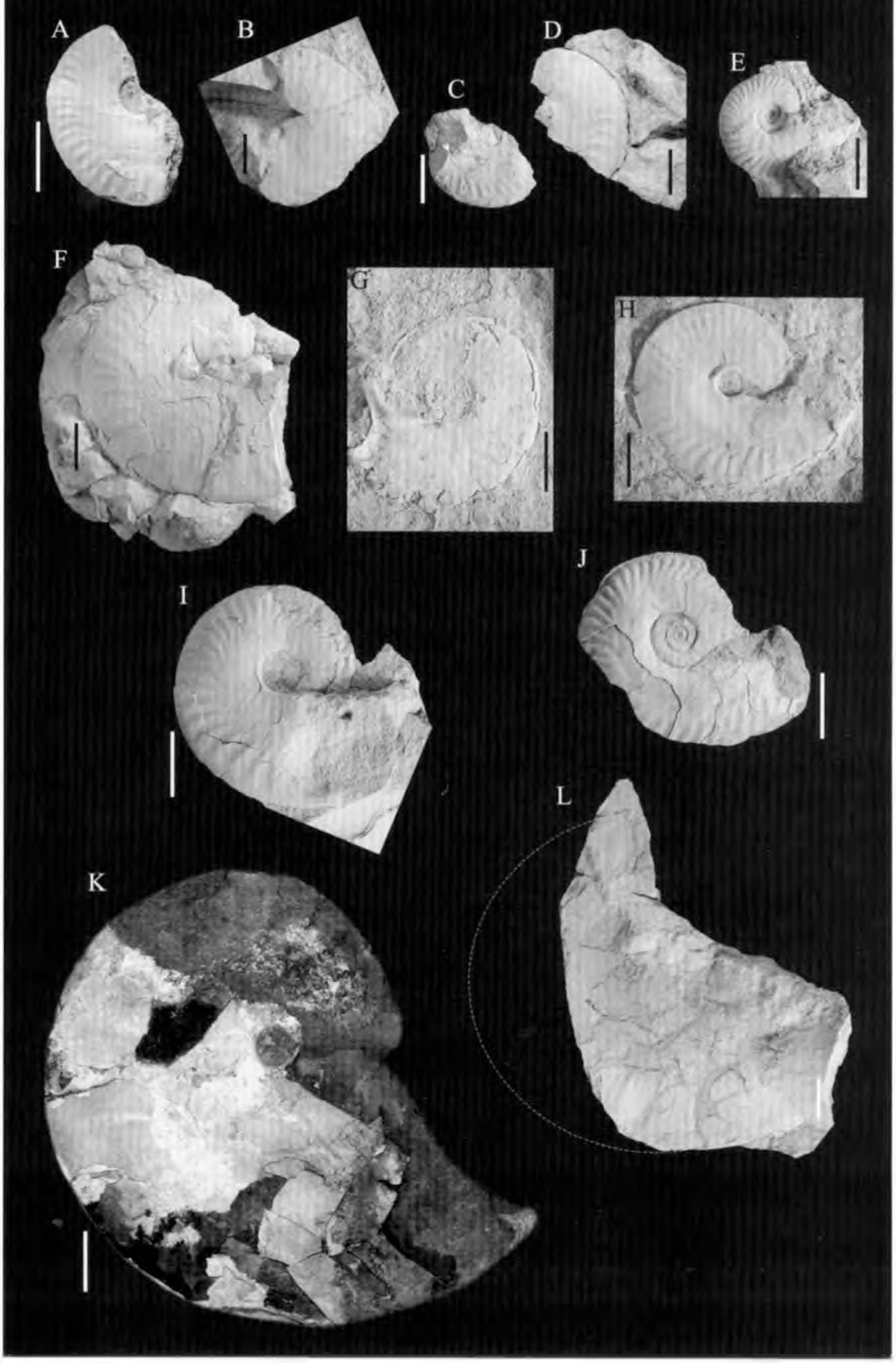

Plate 3, Michał Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 1

Plate 4

A–E. *Oxycerites* (*Oxycerites*) *fuscoides* WESTERMANN [M]; **A1:** lateral view, **A2:** ventral view, GIUS 8-3141, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone, Blanazense Subzone); **B1:** lateral view, **B2:** ventral view, GIUS 8-3147, Zarki, Upper Bathonian (Orbis Zone); **C:** GIUS 8-3354, Ogrodzieniec (clay-pit nr 1), Upper Bathonian (Hodsoni Zone); **D:** GIUS 8-3152, Grodzisko, Upper Bathonian (Orbis Zone); **E1:** lateral view, **E2:** ventral view, GIUS 8-3155, Gnaszyn Dolny ('Gnaszyn' clay-pit), Upper Bathonian (Hodsoni Zone).
F–I. *Oxycerites* (*Oxycerites*) *orbis* (GIEBEL); **F:** GIUS 8-3136, Żarki, Upper Bathonian (Orbis Zone); **G:** GIUS 8-3357, Ogrodzieniec (clay-pit nr 1), Upper Bathonian (Orbis Zone); **H:** GIUS 8-3137, Grodzisko, Upper Bathonian (Orbis Zone); **I:** GIUS 8-3358, Ogrodzieniec (clay-pit nr 1), Upper Bathonian (Orbis Zone).
Scale bars equal 1 cm.

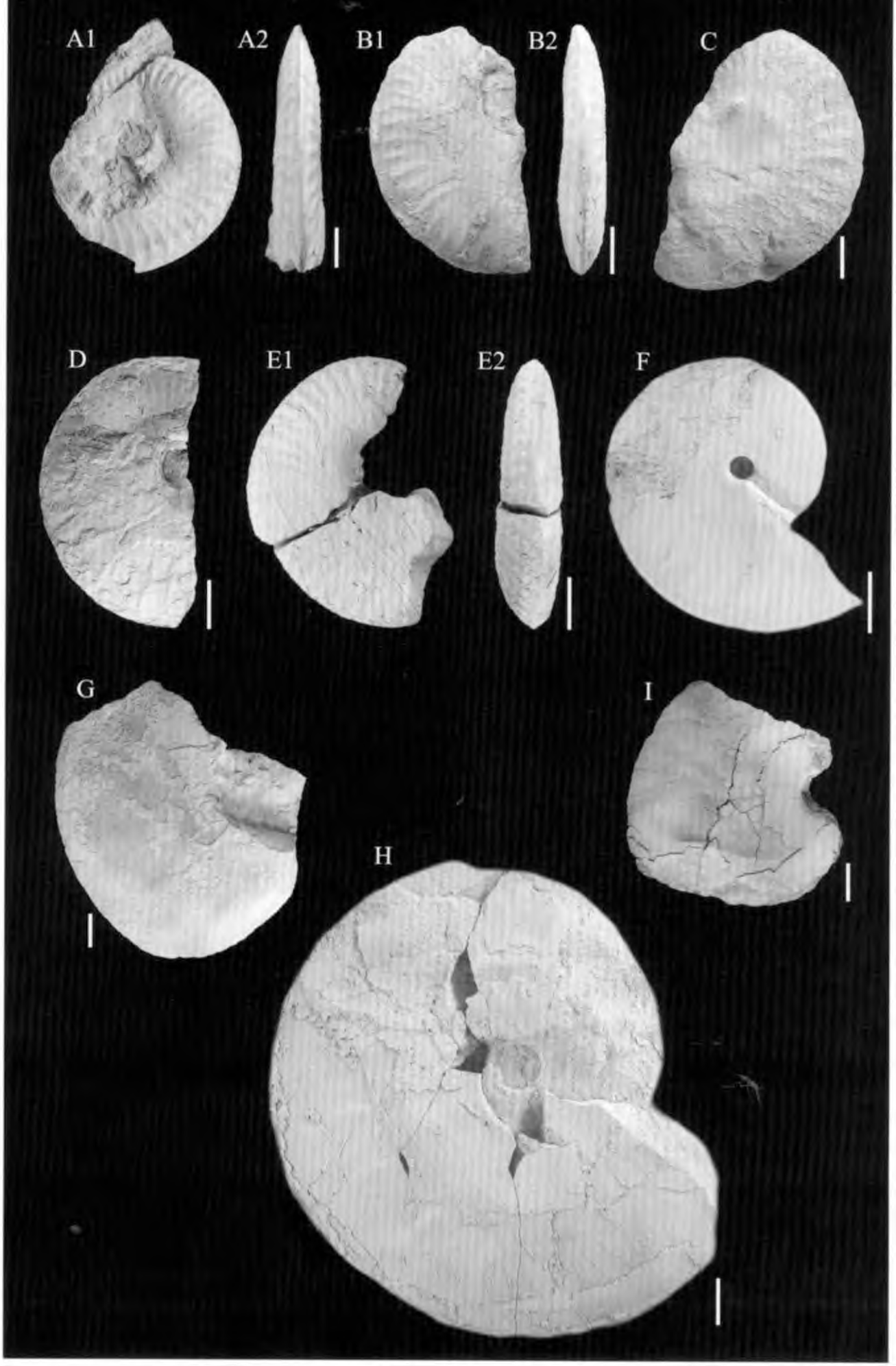

Plate 4. Michal Zatoń: Bajocian-Bathonian (Middle Jurassic) ammonites. Part 1

Plate 5

A–C. *Oxycerites* (*Paroecotraustes*) *densecostatus* (Lissajous); **A:** GIUS 8-3079; **B:** GIUS 8-3077; **C:** GIUS 8-3078; all the specimens come from Kawodrza Dolna ('Kawodrza' clay-pit), Middle Bathonian (Morrisi Zone).
D–E. *Oxycerites* (*Paroecotraustes*) cf. *serrigerus* (Waagen); **D:** IGPUW/J/94; **E:** GIUS 8-3076; all specimens come from Gnaszyn Dolny ('Gnaszyn' clay-pit), Middle or Upper Bathonian (Morrisi or Hodsoni Zone).
F–I. *Oxycerites* (*Paroecotraustes*) *maubeugei* (Stephanov); **F:** GIUS 8-3046, Grodzisko, Upper Bathonian (Orbis Zone); **G:** GIUS 8-3048, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone); **H:** GIUS 8-2844, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone); **I:** GIUS 8-3049, Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).
J–K. *Oxycerites* (*Alcidellus*) *tenuistriatus* (de Grossouvre); **J:** IGPUW/J/24; **K1–2:** lateral views, **K3:** ventral view, IGPUW/J/65; Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).
Scale bars equal 1 cm.

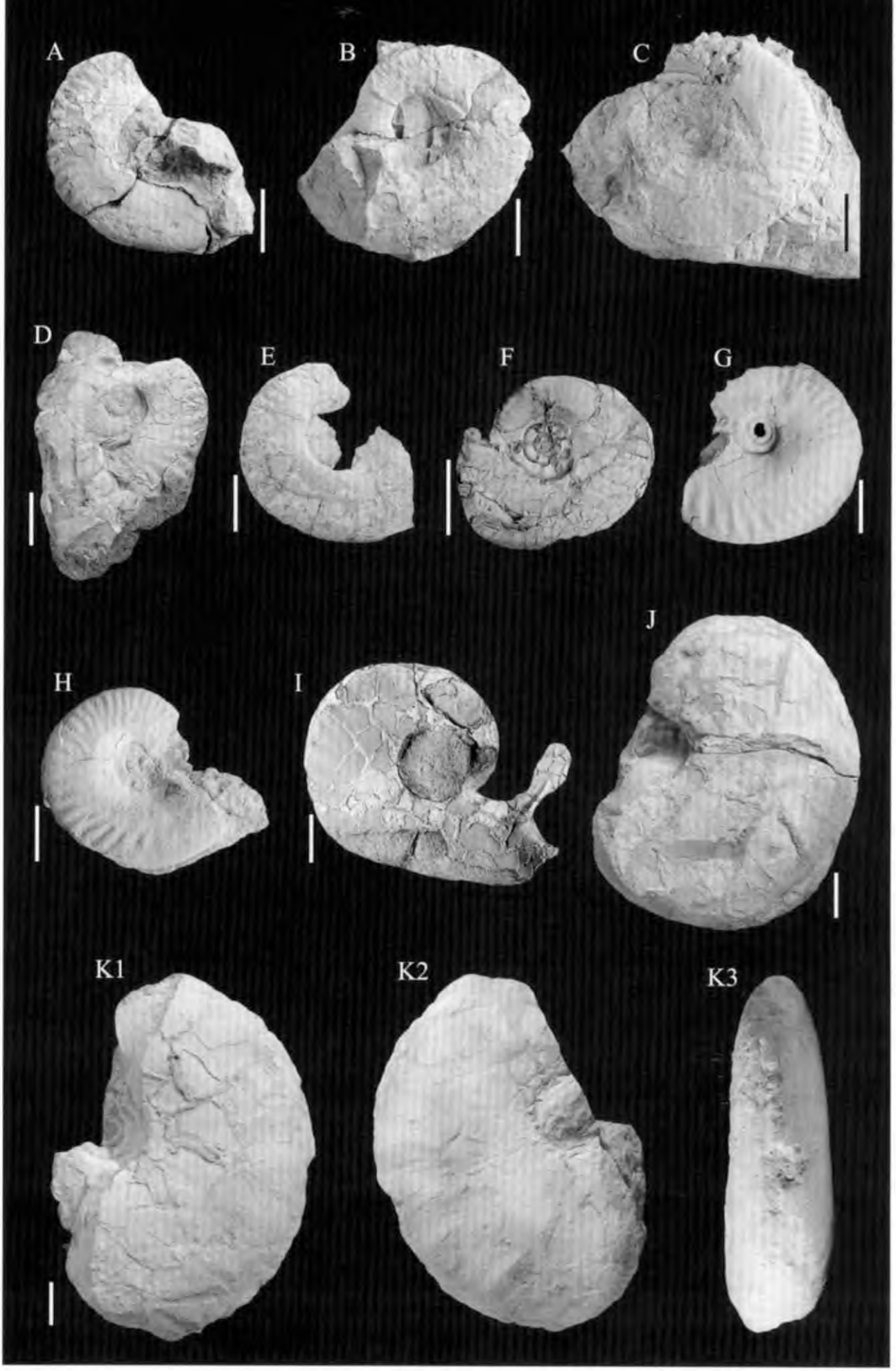

Plate 5, MICHAL ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 1

Plate 6

A. *Oxycerites* (*Paroecotraustes*) cf. *bomfordi* (ARKELL) [m], GIUS 8-3350, Kawodrza Górna ('Glinski' clay-pit), Lower Bathonian (Zigzag Zone, Macrescens Subzone).

B. ?*Oxycerites* sp. indet., GIUS 8-2846, Kawodrza Górna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

C, G–H. *Lissoceras oolithicum* (D'ORBIGNY) [M]; **C**: macroconch, IGPUW/J/3; **G1**: lateral view, **G2**: ventral view, macroconch, IGPUW/J/4.1; **H**: SEM microphotograph showing the protoconch and the first whorl, IGPUW/J/3; Kawodrza Górna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

D–F. *Lissoceras solitarium* ZATON & MARYNOWSKI [m]; **D1–2**: IGPUW/J/5.1, **D2**: SEM microphotograph showing the protoconch and the first whorls; **E**: GIUS 8-2455, Kawodrza Górna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone); **F1**: lateral view, **F2**: ventral view, GIUS 8-2454, holotype, Kawodrza Górna ('LAB' clay-pit), Lower Bathonian (Tenuiplicatus Zone).

I. *Prohecticoceras* sp. [M], GIUS 8-3197, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone).

J. *Prohecticoceras* cf. *blanazense* ELMI [M], GIUS 8-3196, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone).

K, N. *Oxycerites* (*Paroecotraustes*) *waageni* (STEPHANOV) [M]; **K**: GIUS 8-3053, Zarki, Upper Bathonian (Orbis Zone); **N**: AK-O1, Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).

L. *Prohecticoceras ochraceum* ELMI [M], **L1**: lateral view, **L2**: ventral view, JK-K1, Kawodrza Dolna (ceg. „Kawodrza"), Middle Bathonian (Morrisi Zone).

M. *Prohecticoceras* aff. *angulicostatum* (LOCZY) [M], **M1**: lateral view, **M2**: ventral view, IGPUW/J/KP-12-4, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis). Scale bars equal 1 cm.

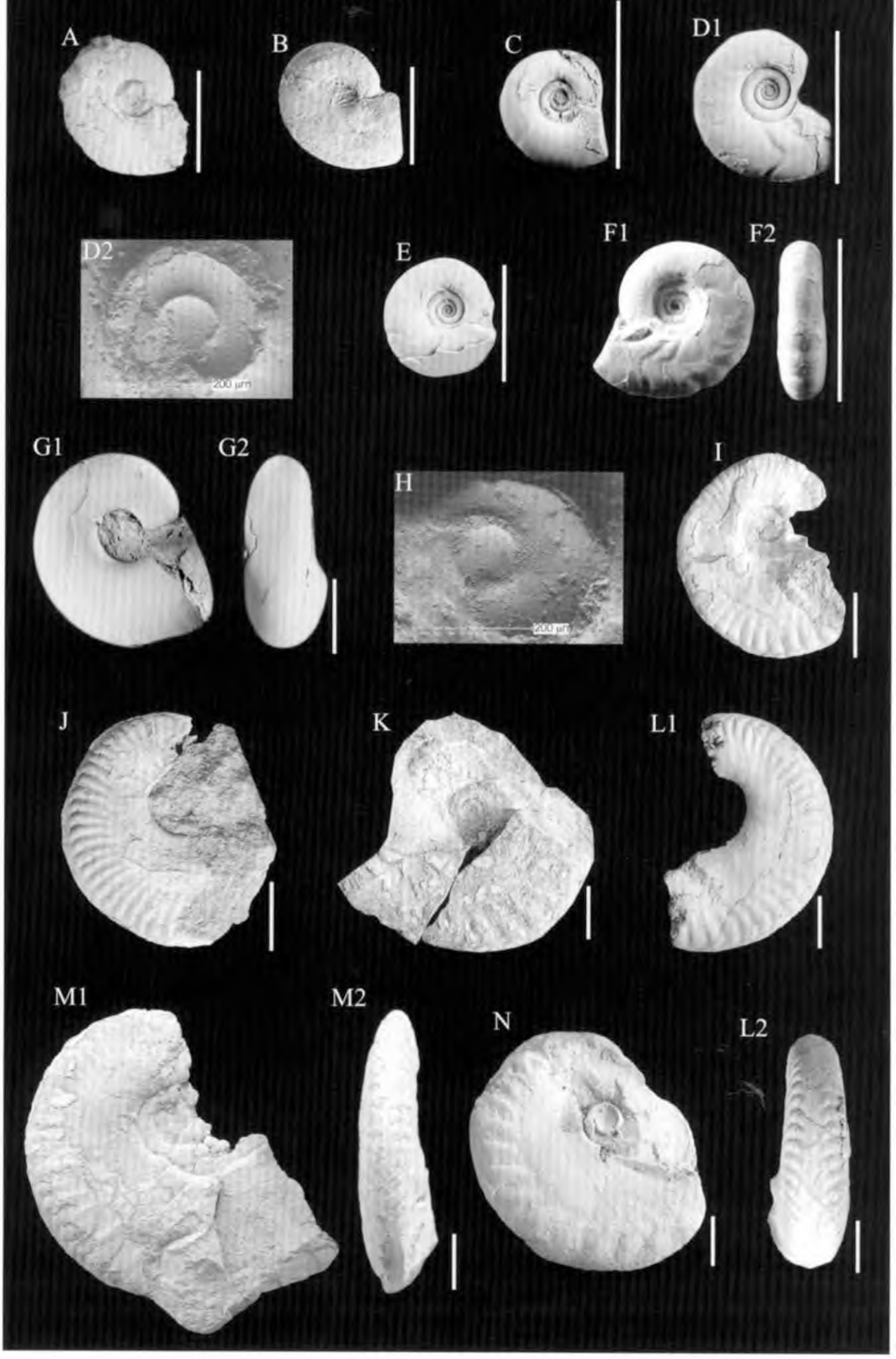

Plate 6, Michał Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 1