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Article

Bajocian – Bathonian (Middle Jurassic) ammonites from the Polish Jura.

Part 2: Families Stephanoceratidae, Perisphinctidae, Parkinsoniidae, Morphoceratidae and Tulitidae

by

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With 15 plates, 18 text-figures and 4 tables

Abstract

The present paper is the second, and last, 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 this part, the systematic description of the ammonite species belonging to the families Stephanoceratidae, Perisphinctidae, Parkinsoniidae, Morphoceratidae and Tulitidae is given. Fifty seven species, twenty one of which left in open nomenclature, representing fifteen genera (*Teloceras*, *Normannites*, *Garantiana*, *Cadomites*, ?*Leptosphinctes*, *Vermisphinctes*, *Procerites*, *Wagnericeras*, *Choffatia*, *Parkinsonia*, *Morphoceras*, *Asphinctites*, *Tulites*, *Bullatimorphites* and *Morrisiceras*) are described. The stratigraphic ranges of the species coming from investigated sections of the Polish Jura were presented, as well. The palaeobiogeographic analysis on the species level shows, that since latest Bajocian (Parkinsoni Chron) up to Late Bathonian (Orbis Chron), the ammonite assemblages of the Polish Jura were most similar to those of the western and north-western regions. Although the influence of Tethyan ammonite faunas is visible in particular chrons, it was insignificant. Only during the latest Bajocian (Parkinsoni Chron), the strong influence of Tethyan ammonites is clearly visible and linked to the transgressive pulse from the south.

Key words: Bajocian, Bathonian, ammonites, palaeobiogeography, Poland

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1. Introduction

The ammonites of the families described in the present part of a monograph, and coming from the Polish Jura haven not been thoroughly studied so far. Many ammonite species were only mentioned at an occasion of stratigraphic works (e.g., REHBINDER 1914, ROŻYCKI 1953, DAYCZAK-CALIKOWSKA et al. 1997, MATYJA & WIERZBOWSKI 2003, MATYJA et al. 2006a, b, c) or illustrated (DAYCZAK-CALIKOWSKA et al. 1988, KOPIK 1998). Only KOPIK (1974, 2006) described the representatives of the genus *Cadomites* and some tulitids, respectively. MATYJA & WIERZBOWSKI (2000) described some representatives of the uppermost Bajocian-Lower Bathonian *Parkinsonia*, *Asphinctites* and *Wagnericeras*, and later they (MATYJA & WIERZBOWSKI 2001) focused on the *Asphinctites-Polysphinctites* dimorphic pair. Recently, ZATOŃ (2007a) reported a precise stratigraphic position of a single species *Tulites cadus*, and later (ZATOŃ 2008) revised the taxonomic status of the Middle Bathonian genus *Morrisiceras*.

The present paper is the second, and the last, part of a monographic study concerning the Bajocian-Bathonian ammonite fauna of the Polish Jura, south-central Poland. In this part, the systematic descriptions of ammonites of the families Stephanoceratidae, Perisphinctidae, Parkinsoniidae, Morphoceratidae and Tulitidae are presented, and the palaeobiogeographical affinities of the whole studied ammonites of that area have been drawn.

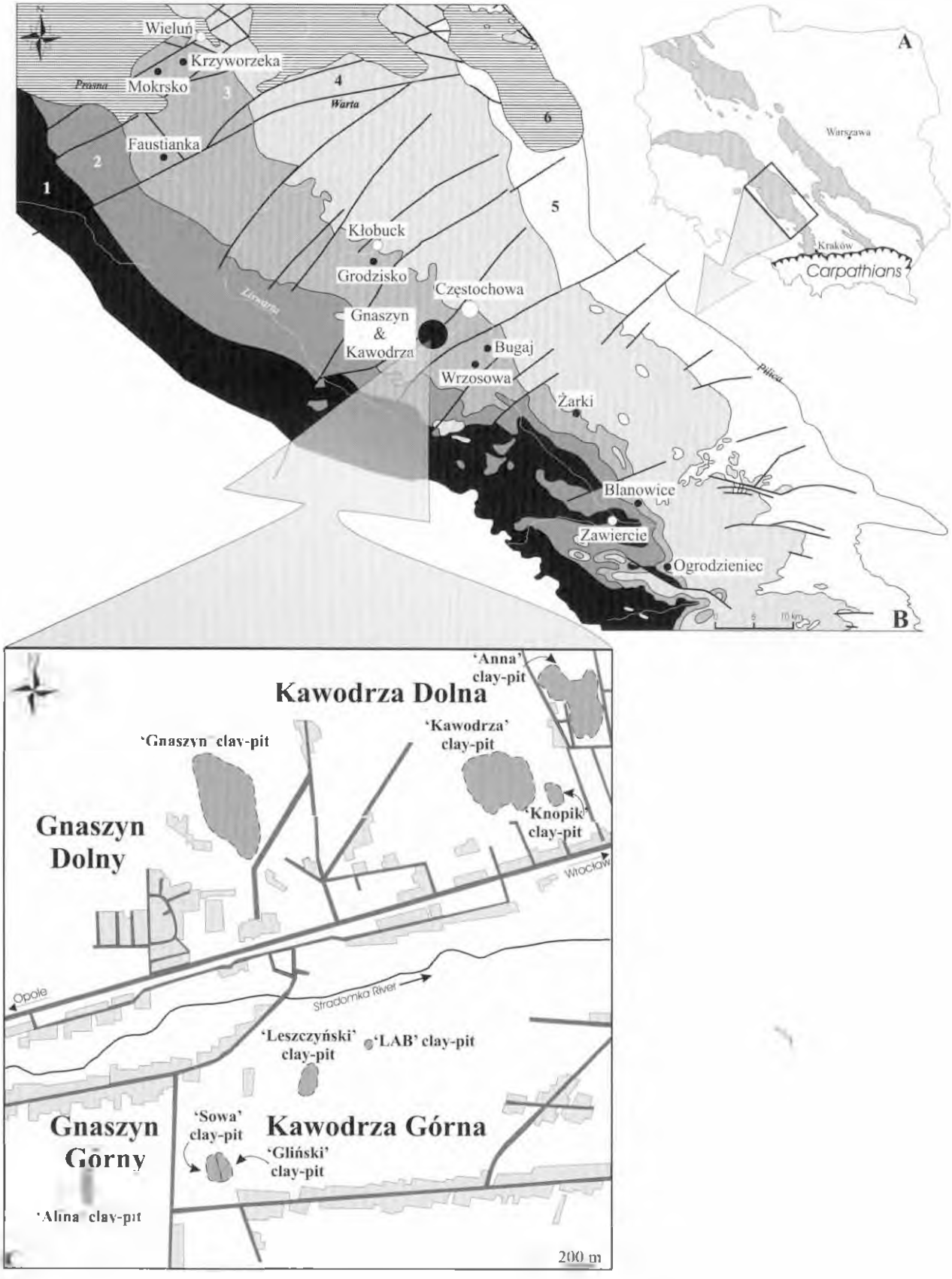
2. Geological setting

The Polish Jura is a monoclinal structure spreading from south-east to north-west of the Cracow-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 (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 or 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, ZATOŃ & 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 (MATYJA et al. 2006a, b, c). On the basis of both organic (MARYNOWSKI et al. 2007) and inorganic geochemical investigation (SZCZEPANIK et al. 2007, ZATOŃ et al. 2009), the clays under discussion were deposited under favourable, oxic conditions prevailing on the sea-floor.

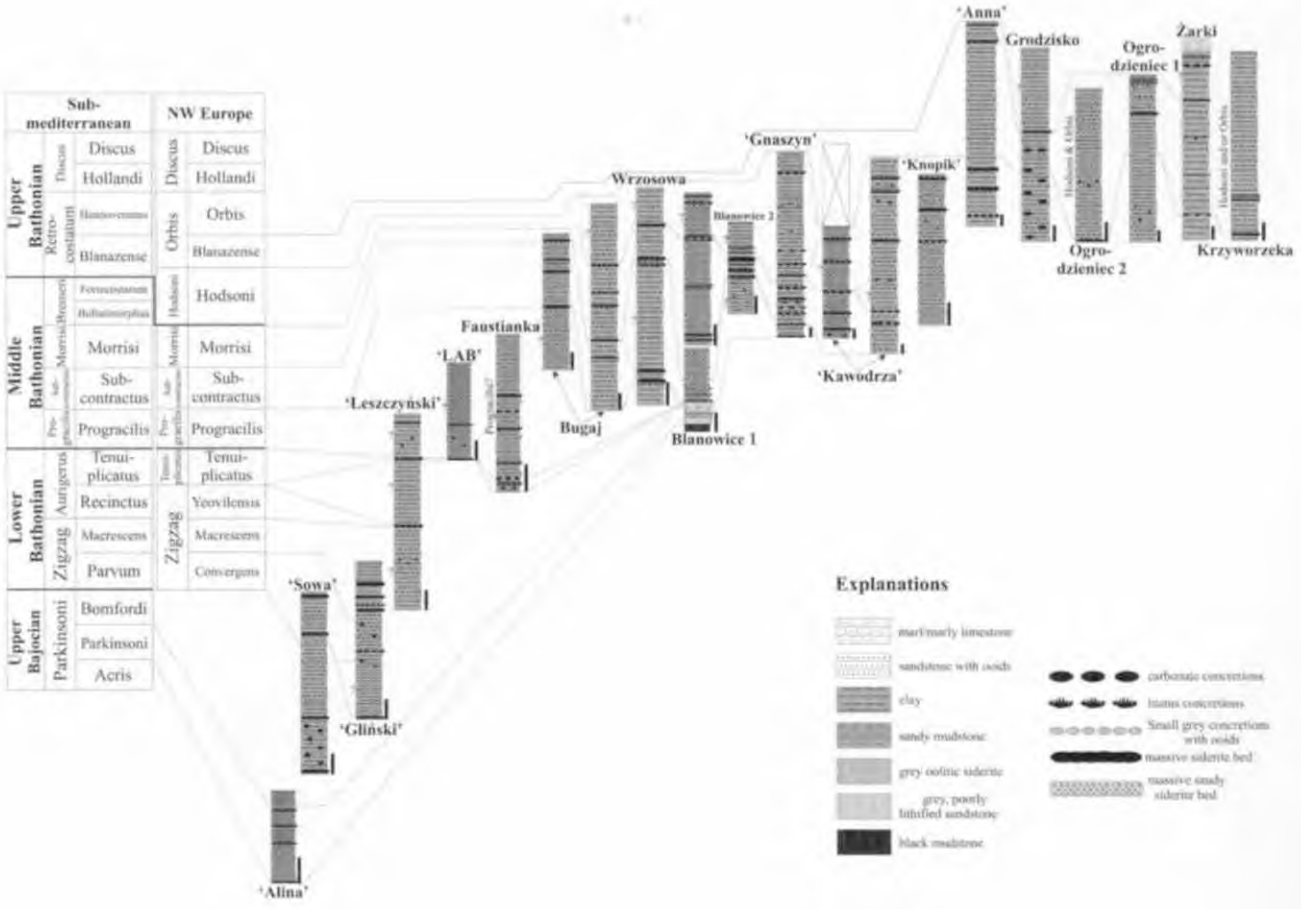
The uppermost Bajocian and Bathonian sediments of the Polish Jura area are currently exposed mainly at clay-pits, the majority of which is still active. The ammonites have been collected in twenty clay-pits situated at eleven localities. Going from south to north of the Polish Jura, they are as follow (Text-fig. 1B): Ogrodzieniec, Blanowice, Żarki, Wrzosowa, Bugaj, Gnaszyn and Kawodrza, Grodzisko, Faustianka, Mokrsko and Krzyworzeka. Some of the specimens studied, however, also come from the now closed iron ore-mines 'Dębowiec' and 'Teodor', located in the Poraj-Kamienica Polska south of the Częstochowa city, the heaps at Rudniki and Poczesna (located just north of Zawiercie and south of Częstochowa, respectively), and currently abandoned and recultivated clay-pit at Korwinów (near Wrzosowa in the environs of Częstochowa). As the detailed characteristic of the localities and ammonite-bearing sections have already been presented in the previous part of the monograph, it will not be repeated here again. However, the biostratigraphic correlation of the sections studied is shown again for clearance on the Text-fig. 2.

3. Material and methods

The ammonite collection has been primarily gathered by the present author during the field-works during the years 2003–2005 in the area of the Polish Jura. The collection is housed at the Faculty of Earth Sciences, University of Silesia at Sosnowiec (acronym GIUS 8). A large collection of ammonites also come from the Institute of Geology, University of Warsaw (acronym IGPUW/J), collected by POTOCKI (1972) in the Kawodrza and Gnaszyn area, the late Prof.



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 outcrops 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 (adopted and modified after ZATON et al. 2006, 2009).



Text-fig. 2. Correlation of the investigated ammonite-bearing sections of the Polish Jura area (Zaton 2007b), on the background of the standard ammonite zonation of the Submediterranean and NW European provinces (Mangold & Rioult 1997). Scale bars at the sections represent 1 m.

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, Korwinow 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 Śnioch (acronym JS), Krzysztof Torbus (acronym KT) and Roman Kijok (acronym RK). The specimens from the private collections are unregistered.

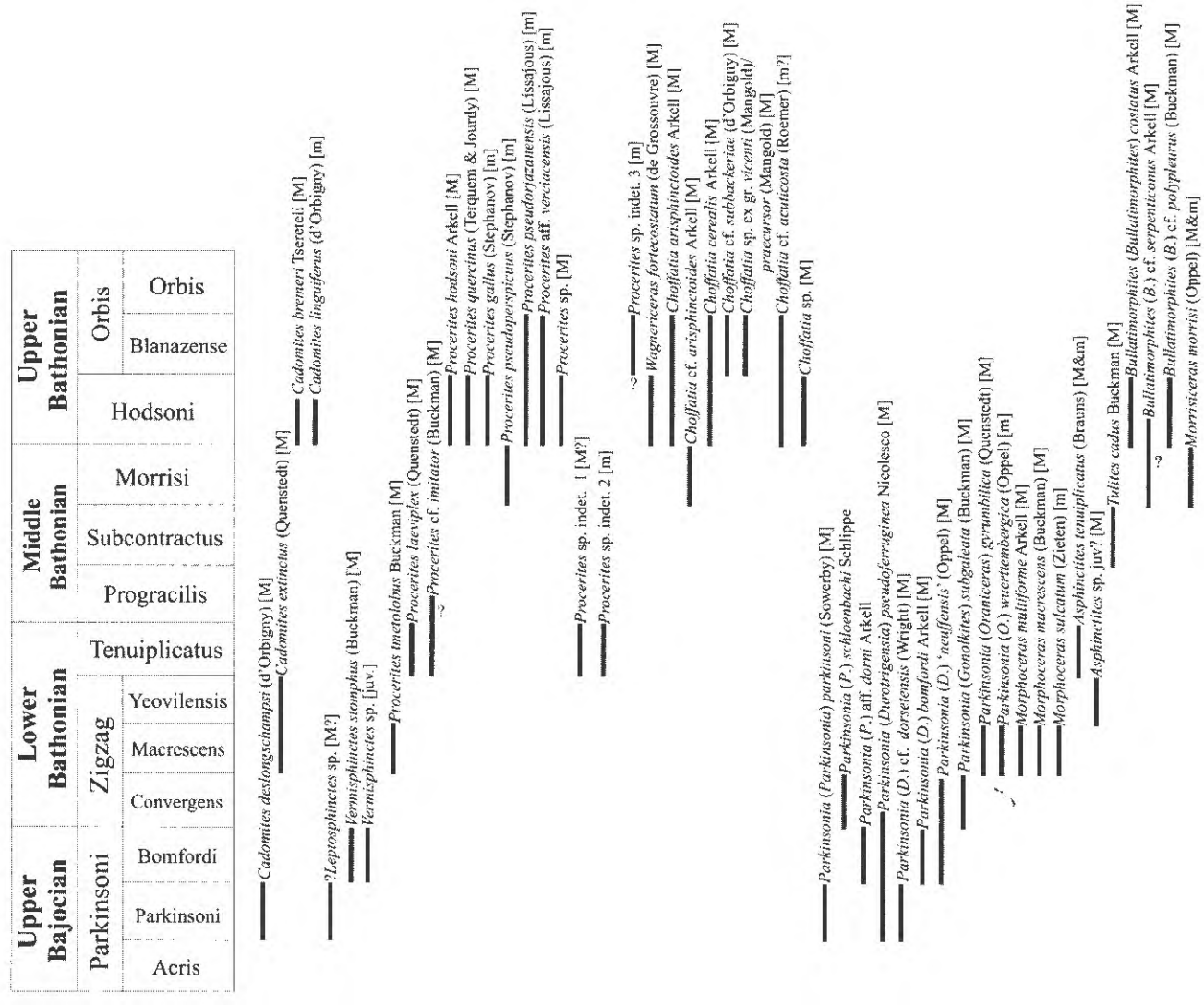
The author has also inspected the collection of ammonites housed at the Museum of the Polish Geological Institute, Warsaw, Poland, and the collections housed at the Natural History Museum, London (acronym NHM) and Oxford University Museum of Natural History (acronym OUMNH).

The palaeobiogeographic analysis of the ammonites investigated was conducted for four time-slices: latest Bajocian (Parkinsoni Chron: ~ 168.4 – 167.7 ± 3.5 Ma), Early Bathonian (Zigzag–Tenuiplicatus chrons: ~ 167.7 – 166.9 ± 3.5 Ma), Middle Bathonian (Subcontractus–Morrisi chrons: ~ 166.5 – 166.1 ± 3.5 Ma) and Late Bathonian (Hodsoni–Orbis chrons: ~ 166.1 – 165.2 ± 3.5 Ma, time-scales after Gradstein et al. 2004). The intervals have been selected on the basis of their well-documented ammonite fossil record. In the analysis, I haven't taken into account those ammonites, the stratigraphic provenance of

which is uncertain. Two sorts of analyses have been conducted: on the family and species level.

Family level analysis. Here, the pie chart diagrams, showing the percentage contribution of the particular ammonite families were drawn. In this case, the number of species per each family was counted. Only those species were encountered, that were illustrated (e.g., KOPIK 1974, partly KOPIK 1998, 2006, DAYCZAK-CALIKOWSKA et al. 1988, MATYJA & WIERZBOWSKI 2000, ZATON & MARYNOWSKI 2006, ZATON 2007a, b) and their assignment was correct. The species lists alone (e.g., DAYCZAK-CALIKOWSKA et al. 1997, KOPIK 1998), on the other hand, have not been taken into account. However, some exceptions have been made but they concerned only such cases, when in the species list a genus occurred that has not been found during the personal investigation. If the genus was represented even by two species in the literature, in the present analysis it was counted as one species only. Such procedure allowed as many species as possible to be involved, on the other hand, however, it excluded the probability of considering the same species repeatedly.

Species level analysis. This analysis concerns the comparison of ammonite species similarity between the Polish Jura and selected localities. It is generally



Text-fig. 3. Stratigraphic ranges of the all uppermost Bajocian-Bathonian ammonite species described in the present paper on the background of the ammonite zonation characteristic for the NW European Province. The Lower (Blagdeni Subzone) to Upper Bajocian (Garantiana and Parkinsoni zones) ammonites from the closed iron ore-mines and heaps have been omitted in this figure.

known, that the number of the common species is the simplest numerical measure of the faunal affinities. Because of the problem of a large degree of subjectivity in the ammonite taxonomical approaches (e.g., CECCA 1999, SANDOVAL et al. 2001), especially on the species level, only those ammonite species were used, that possessed photographic documentation in the literature sources. However, some species that have not been illustrated were used as well, but such localities were marked with the asterisks in the tables provided in the text. The species described or illustrated but left in open nomenclature, as well as those the species names of which were put in quotation marks, were not included in the analysis. The main aim of the analysis is presenting the faunal affinities between the Polish Jura and other regions as precise as possible. The relative affinities of ammonite faunas between the Polish Jura and other regions were presented in the form of palaeogeographic maps, on which the number of common species in particular regions was shown in brackets.

4. Systematic Palaeontology

The specimens were subjected for standard conchological measurements (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 (°). WER indicates the whorl expansion rate. 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 shown here 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, but coming exclusively from the investigated clay-pits, are shown on the Text-fig. 3.

Suborder Ammonitina ZITTEL, 1884

Family Stephanoceratidae NEUMAYR, 1875

Subfamily Stephanoceratinae NEUMAYR, 1875

Genus *Teloceras* MASCKE, 1907

Type species *Ammonites blagdeni* SOWERBY, 1818

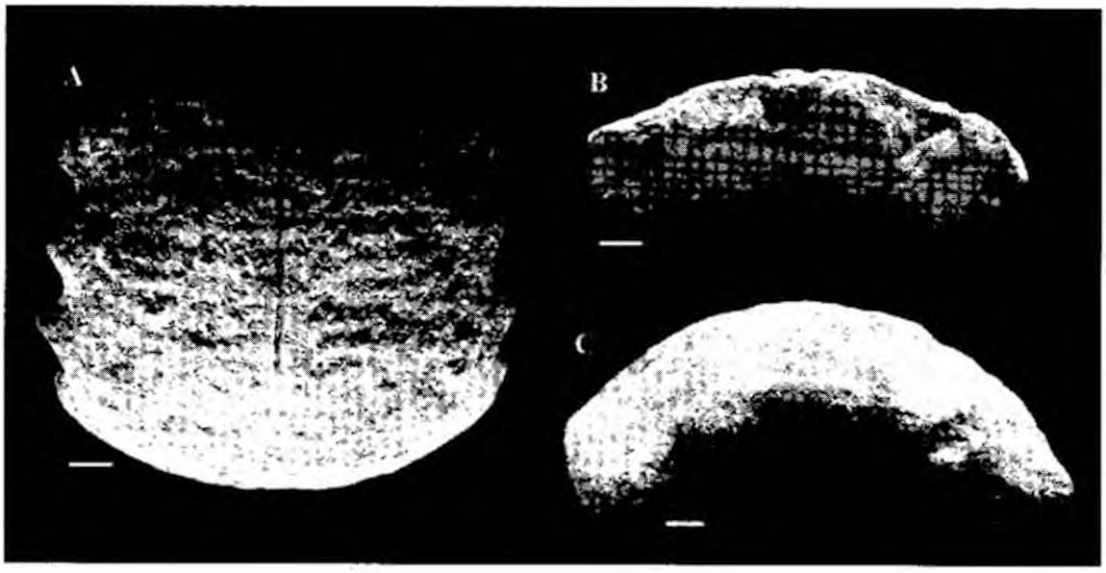
Synonyms: *Blagdenia* ROCHE, 1939

Teloceras aff. *blagdeni* (SOWERBY 1818) [M]
(Plate 1D, Text-fig. 7A)

Material: One whorl fragment embracing terminal part of a phragmocone and beginning of the body chamber.

Nr	D	U	Wh_2	Wh_1	Wb	P	S	U/D	Wh_1/D	Wh/D	Wb/Wh_1	WER
IGPUW/J/K-2	~107.4	~48.0	40.0	30.0	95.0	7	27	~0.45	~0.37	~0.88	2.37	-

Description: The whorl fragment preserved has low, trapezoidal cross-section (Text-fig. 7A). Assuming that the length of the body chamber attained one last whorl, as in other representatives of the genus (e.g., FERNANDEZ-LOPEZ 1985), the shell diameter of the specimen must have attained ~ 140–150 mm. The crowded last three suture lines may suggest that the individual was mature. The maximum whorl breadth lies in the distinctly marked ventro-lateral margin. The umbilicus wide and deep, its slope is wide up to the ventro-lateral margin. The umbilical margin is marked by depressions formed by tubercles of the previous whorl. Primary ribs thick, strong, straight and rursiradiate. At the ventro-lateral margin they are ended with prominent, thick tubercles. Each tubercle divides on 3–4 thinner outer ribs. The suture line is complex,



Text-fig. 4. *Teloceras banksi* (SOWERBY) sensu PARSONS (1975). A. ventral view, B. whorl cross-section, C. lateral view, NHM c. 78541. Scale bar equals 1 cm.

with wide and deep L. E/L is higher than L/U_1, bifid and divided by six auxiliary lobes. U_1 is much wider and shallower than L.

Remarks: The specimen described is close to the holotype of *T. blagdeni* (SOWERBY). It is also similar to *'Ammonites coronatus'* presented by QUENSTEDT (1849), considered as a synonym of *T. blagdeni* (SOWERBY) by WEISERT (1932).

The described specimen, however, differs from the holotype by its more depressed whorl cross-section and significantly smaller size. Very similar specimen to that described here, was presented by KOPIK et al. (1980) as *Teloceras* sp. ex gr. *blagdeni* (SOWERBY). The authors marked that the specimen differs from the other individuals of *T. blagdeni* (SOWERBY) by its smaller size, narrower umbilicus, thicker and more distant ribs, and more depressed whorls. Somewhat later, KOPIK (1998) presented the same specimen as above, but under a different name – *T. parvum* WEISERT. *T. parvum* WEISERT, however, possesses much narrower and higher whorl cross-section (WEISERT 1932, FERNÁNDEZ-LOPEZ 1985). Therefore, the specimen of KOPIK (1998), as the one described here, is definitely much more related to *T. blagdeni* (SOWERBY).

Identical whorl fragment to that described in the present paper, but of a little greater size, is housed at the Natural History Museum, London. This specimen (NHM c.78541) was mentioned by PARSONS (1975) as belonging to *T. banksi* (SOWERBY), because it was associated with other individuals of that species in the same bed. However, this whorl fragment has not been illustrated by PARSONS (1975). It is here illustrated for the first time (Text-fig. 4). *T. banksi* (SOWERBY), the holotype of which was illustrated by BUCKMAN (1909, pl. 1 and 3, fig. 2), is characterized by its narrower and higher (more rounded) whorl cross-section, and more distant inner ribs that are ended with thick tubercles. Thus, it is doubtful that the specimen of PARSONS (number NHM c.78541) represents *T. banksi*. It is more similar to the here described specimen assigned as *Teloceras* aff. *blagdeni* (SOWERBY). The Wb/Wh_1 of both specimens are similar: NHM c.78541: 2.37 and IGPUW/J/K-2: 2.69.

Occurrence: Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone) of the Poraj-Kamienica Polska iron ore-mines.

Teloceras multinodum (QUENSTEDT 1886) [M]

(Plate 1F–G, Text-fig. 5)

1886 *Ammonites coronatus multinodus*, QUENSTEDT, p. 545, pl. 67, fig. 2 (lectotype).

1932 *Teloceras multinodum* Qu. em. WEISERT, Weisert, p. 175, pl. 19, fig. 2.

1985 *Teloceras multinodum* (QUENSTEDT), FERNÁNDEZ-LÓPEZ, p. 295, pl. 32, fig. 1, text-fig. 32A.

1998 *Teloceras multinodum* (QUENSTEDT), KOPIK, pl. 2, figs. 1–2.

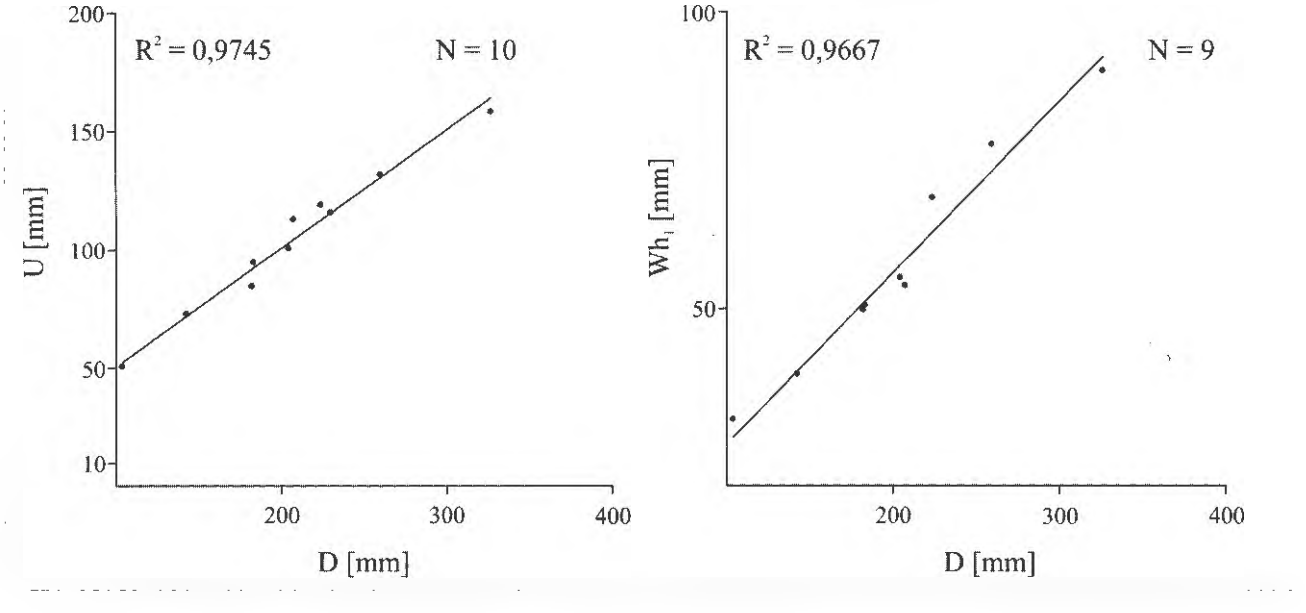
Material: Five, well-preserved specimens.

Nr	D	U	Wh	Wh_1	Wb	P	S	U/D	Wh_1/D	Wb/D	Wh/Wb	WER
IGPUW/J/K-3	207.8	112.6	53.6	44.0	-	13	38	0.54	0.26	-	-	1.56
	183.3	94.1	50.3	39.2	-	13	38	0.51	0.27	-	-	1.66
	142.7	72.8	38.6	35.0	81.2	15	38	0.51	0.27	0.6	2.10	1.64
	103.7	~50.0	31.0	23.0	54.4	15	40	~0.48	0.3	0.52	1.75	1.64
IGPUW/J/K-4	260.0	~131.5	~77.4	-	79.0	14	42	~0.5	~0.3	0.3	~1.02	-
IGPUW/J/K-5a	230.0	115.0	-	57.0	-	13	38	0.5	-	-	-	~1.54
	205.1	100.0	55.0	42.8	83.2	14	38	0.49	0.27	0.4	1.51	1.72
IGPUW/J/K-5b	327.4	158.0	90.0	85.5	-	16	55	0.48	0.27	-	-	-
	224.5	118.5	68.5	59.0	112.0	14	50	0.53	0.3	0.5	1.63	1.56
	183.0	84.3	~49.5	45.0	102.0	14	46	0.46	0.46	0.56	~2.06	1.74

Description: Specimens large-sized (D = 207–327.4 mm), semi-evolute (U/D = 0.48–0.54), cadiconic. Umbilicus wide and not deep. Whorl cross-section strongly depressed at older whorls (at D = 103.7 mm). Ventro-lateral margin distinct. Venter slightly rounded and wide. At D > 200 mm, the whorl cross-section becomes to be higher with nearly oval venter. At D = ~ 5 mm, the outer ribs sharp, recti- or prorsiradiate, not dense (P = ~ 14). They are ended with small tubercles at the ventro-lateral margin. As the size increases, the inner ribs gradually grow thicker and widen distally. They may be even slightly concave adaperturally. At the ventro-lateral margin, they are ended with prominent tubercles. The number of primary ribs is rather stable (P = 13–15). They divide into 2–3, thinner outer ribs. Intercalatory ribs may also be present. The longest preserved body chamber attains ¾ of the last whorl. Suture line complex, but not well-visible.

Remarks: The characteristics of the specimens described agrees well with other individuals of the species. Westermann & Riccardi (1979) considered *T. multinodum* (Quenstedt) as conspecific with *T. blagdeni* (Sowerby). However, the holotype of *T. blagdeni* (Sowerby) is so unique that it is hard to assume that the both species are really conspecific.

T. sparsinodum (Quenstedt) differs by its more distant inner ribs. *T. acuticostatum* Weisert may be



Text-fig. 5. Plots of umbilical width (U) and outer whorl height (Wh_1) against shell diameter (D) in *Teloceras multinodum* (Quenstedt) [M].

distinguished by its finer inner ribs and high whorl cross-section already at the juvenile stage (at D = ~ 95.5 mm, see PAVIA 1983, p. 19, fig. 1).

Occurrence: Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone) of the Poraj-Kamienica Polska iron oremines. Outside Poland, the species is also known from England (BUCKMAN 1928), Germany (WEISERT 1932), France (ROCHE 1939) and Spain (FERNANDEZ-LOPEZ 1985). RIOULT et al. (1997) mentioned this species from the uppermost part of the Blagdeni Subzone (Coronatum Horizon).

?*Teloceras* sp. [juv.]

(Plate 1A)

Material: One, slightly deformed body chamber.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/K-1	~31.0	~13.0	~10.0	-	~17.0	8	~25	~0.42	~0.32	~0.55	~1.7	-

Description: Whorl cross-section coronate, wider than higher, with slightly rounded venter. Umbilicus quite wide. Umbilical slope rounded reminding the proper flanks. Inner ribs fine and sharp. At the beginning and medium part of the preserved whorl, they are rectiradiate. At its end, they become prorsiradiate and slightly concave adaperturally. At the ventro-lateral margins, they are ended with sharply pointed tubercles, from which the bundles composed of 3–4 outer ribs run through the venter.

Remarks: As was already noted by WESTERMANN & RICCARDI (1979), the juvenile whorls of *Teloceras* MASCKE and *Stephanoceras* WAAGEN may be indistinguishable. Moreover, *S.* (*Stemmatoceras*) MASCKE also possesses *Teloceras*-like, coronate whorls at the juvenile stage. Therefore, the identification of the specimen described is uncertain, even at the genus level.

Occurrence: Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone) of the Poraj-Kamienica Polska iron oremines.

Genus *Normannites* MUNIER-CHALMAS, 1892

Type species *Normannites orbignyi* BUCKMAN, 1908

Synonyms: *Epalxites* MASCKE, 1907, *Masckeites* BUCKMAN, 1920, *Itinsaites* MCLEARN, 1927, *Parallites* WESTERMANN, 1954, *Gerzenites* WESTERMANN, 1954, *Germanoides* WESTERMANN, 1956, *Alfeldites* WESTERMANN, 1957.

Normannites orbignyi BUCKMAN, 1908 [m]

(Plate 1B, Text-fig. 7B)

1908 *Normannites orbignyi* nov., BUCKMAN, p. 146.
1927 *Normannites orbignyi* BUCKMAN, BUCKMAN, pl. 734.
1983 *Normannites* (s.s.) *orbignyi* BUCKMAN, PAVIA, p. 142, pl. 27, figs. 3, 5 (with full synonymy).
1985 *Normannites orbignyi* BUCKMAN, FERNANDEZ-LOPEZ, p. 321, pl. 34, fig. 1, text-fig. 36e.
1991 *Stephanoceras* (*Normannites*) *orbignyi* (BUCKMAN), GALACZ, p. 878, pl. 4, figs. 2–3.

Material: One body chamber fragment.

Description: The fragment is characterized by the following dimensions: Wh_1 = 16 mm, Wh_2 = 14 mm and Wb = 20 mm. The whorl cross-section coronate, slightly depressed (Text-fig. 7B). The venter slightly rounded and wide. Flanks rounded. Inner ribs delicately sinuous and sharp. At c. ¾ of the whorl height they bifurcate. At the point of bifurcation, distinct tubercles are visible. Outer ribs are of equal sharpness as the primary ones, slightly convex adaperturally. All ribs projected and quite distant.

Remarks: Although it is a fragment, the ornamentation and whorl cross-section is reminiscent of the species *N. orbignyi* BUCKMAN. PAVIA (1983) and GALÁCZ (1991) provided a detailed discussion of the species, so it is not repeated here. Generally, this species, as the whole group of stephanoceratids, is morphologically very plastic. Especially it concerns the whorl cross-section and ribbing density. PAVIA (1983), on the basis of the material from Digne (France), couples *N. orbignyi* BUCKMAN with *Teloceras* (subgen?) *triptolemus* (BUCKMAN). FERNANDEZ-LOPEZ (1985), on the other hand, found it associated with completely different species of *Teloceras*. With regard to ornamentation, the specimen presented by IMLAY (1973) from the United States is very close to *N. orbignyi* BUCKMAN, however, it differs from the latter by its greater evolutness. It is not clear whether this form is only a geographic morphotype or different species.

Occurrence: Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone) of the Poraj-Kamienica Polska iron oremines. Outside Poland, the species is also known from England (BUCKMAN 1927), Germany, France (PAVIA 1983), Spain (FERNÁNDEZ-LOPEZ 1985) and Hungary (GALACZ 1991).

Subfamily Cadomitinae Westermann, 1956

Genus *Cadomites* Munier-Chalmas, 1892

Type species *Ammonites deslongchampsi* d'Orbigny, 1846

Synonyms: *Polyplectites* Mascke, 1907, *Polystephanus* Buckman, 1922, *Stegostephanus* Buckman, 1922, *Deslongchampsia* Roche, 1939.

Remarks: Because of the distinct morphological similarity between the microconch *Polyplectites* Mascke and the macroconch *Cadomites* Munier-Chalmas, in the present paper the author resigned from the traditional classification treating *Polyplectites* Mascke as a subgenus of *Cadomites* Munier-Chalmas. Instead, *Polyplectites* Mascke is considered as a junior subjective synonym of *Cadomites* Munier-Chalmas.

Cadomites deslongchampsi (d'Orbigny 1846) [M]
(Plate 1E)

1846 *Ammonites Deslongchampsii* Defrance, d'Orbigny, p. 405, pl. 138, figs. 1–2 (lectotype).
1952 *Cadomites deslongchampsi* (d'Orbigny), Arkell, p. 79, text-fig. 21 (lectotype).
1983 *Cadomites* (*Cadomites*) *deslongchampsi* (Defrance in d'Orbigny), Sandoval, p. 269, pl. 18, fig. 2, pl. 21, fig. 8, text-figs. 101B, 102A (with full synonymy).
2000 *Cadomites* (*Cadomites*) *deslongchampsi* (Defrance), Matyja & Wierzbowski, p. 202, pl. 7, fig. 1.

Material: One incomplete specimen and a 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/A-1	100.5	42.0	27.0	25.6	38.5	27	~80	0.42	0.27	0.38	1.42	1.79

Description: Medium-sized specimen (D = 100.5 mm), with evolute (U/D = 0.42), cadiconic shell. Umbilical margin rounded, its slope short, slightly rounded. Whorl-cross section wider than higher, depressed, with slightly rounded venter and flanks. Inner ribs prorsiradiate and adaperturally concave. In the mid-half of the whorl height they are pointed with sharp tubercles. On the preserved shell, the tubercles pass into 3 mm long spines. From the tubercles, 2–3 secondary ribs start to depart. They are prorsiradiate, adaperturally convex on the venter and not dense. Single ribs, unlike intercalatory ones, do not occur at all. Body chamber attains c. ½ of the last whorl. Aperture is ended with a prominent collar.

Remarks: With respect to the involutness, whorl-cross section and ornamentation pattern, the specimen described is nearly identical to the lectotype. It is also conspecific with the English specimens (NHM c.77767 and 87561) presented by Parsons (1975), as well. The thorough discussion on this species has already been presented by Roche (1939) and Arkell (1952). *C. rectelobatus* (Hauer) and *C. bremeri* Tsereteli differ in much wider and trapezoidal whorl-cross sections. *C. psilacanthus* (Wermbter) possesses narrower umbilicus and more oval whorl section. According to Galacz (1980), the small-sized specimen described by Arkell (1952) as *C.* cf. *deslongchampsi* (d'Orbigny), may *de facto* represent the species *C. extinctus* (Quenstedt).

Occurrence: Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone) of Gnaszyn Gorny ('Alina' clay-pit). The species is also known from France (Roche 1939, Sturani 1966, Pavia et al. 2008), Bulgaria (Stephanov 1963), Germany (Hahn 1971), Hungary (Galacz 1980), Spain (Sandoval 1983) and Caucasus (Besnosov & Mitta 1993). It is most abundant in the uppermost Bajocian and lowermost Bathonian (Galacz 1980).

Cadomites extinctus (Quenstedt 1887) [M]
(Plate 1C)

1887 *Ammonites anceps extinctus*, Quenstedt, p. 630, pl. 74, only figs. 30, 32–34.
1971 *Cadomites* (*Cadomites*) *extinctus* (Quenstedt), Hahn, p. 110, pl. 9, figs. 10–13.
1983 *Cadomites* (*Cadomites*) *extinctus* (Quenstedt), Sandoval, p. 279, pl. 22, fig. 2, pl. 23, fig. 8, text-figs. 101H, 102F–G, 104 (with full synonymy).

Material: Two well-preserved specimens (unregistered).

Description: Shell small-sized (D = 29.2–38.0 mm), evolute, cadiconic. Umbilicus deep, widening with ontogeny. Umbilical margin rounded and slope low, nearly vertical. Whorl cross-section depressed with rounded flanks and quite wide, rounded venter. Inner ribs prorsiradiate, thin, slightly adaperturally concave ended with fine tubercles. The Inner ribs become more distant with ontogeny. Fine and numerous outer ribs start from the tubercles in the number of 2–4 at the ventro-lateral margin. Single ribs are lacking. Intercalatory ribs common. The body chamber attained nearly the whole last whorl. The aperture is pre-

ceded by pre-apertural constriction and general weakening of the ribbing. Suture line simple. Ventral saddle high and narrow, E very narrow, L deeper and wider than U_2, but similarly incised as E. U_2 low, wide and single. E/L nearly bifid, divided by five main auxiliary lobes.

Remarks: The detailed discussion on this species was given by GALACZ (1980). *C. extinctus*, as was stressed by SANDOVAL (1983), differs from the other species of the genus by its small shell-size, distant inner ribs and very fine outer ribs. Although the lectotype presented by HAHN (1971) is slightly deformed with the inner whorls not visible, its ornamentation is very similar to the specimens described here. The P/S ratio, at similar shell diameters, is practically identical to the specimens presented by HAHN (1971). At D = 38 mm, P/S = 0.23 (see HAHN 1971), and 0.24 (specimen JS-3221). *C. crassispinosus* KOPIK also possesses distant inner ribs, but they are very strong, ended with thick tubercles. *C. stegeus* (BUCKMAN) also possesses dense outer ribs, but it differs from *C. extinctus* by its denser primary ribs. *C. extinctus* presented by GALACZ (1980) is badly preserved, with ornamentation of the flanks not visible, so in the opinion of the present author its species affiliation is uncertain.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Rudniki. Apart of Poland, this species is also known from the Lower Bathonian of Germany (HAHN 1971), France and Portugal (GALACZ 1980), and Spain (SANDOVAL 1983). Uncertain species were described from England (ARKELL 1952 – as *C. deslongchampsi*, SANDOVAL 1983) and Middle Bathonian (Subcontractus Zone) of Hungary (GALACZ 1980).

Cadomites bremeri TSERETELI, 1968 [M]

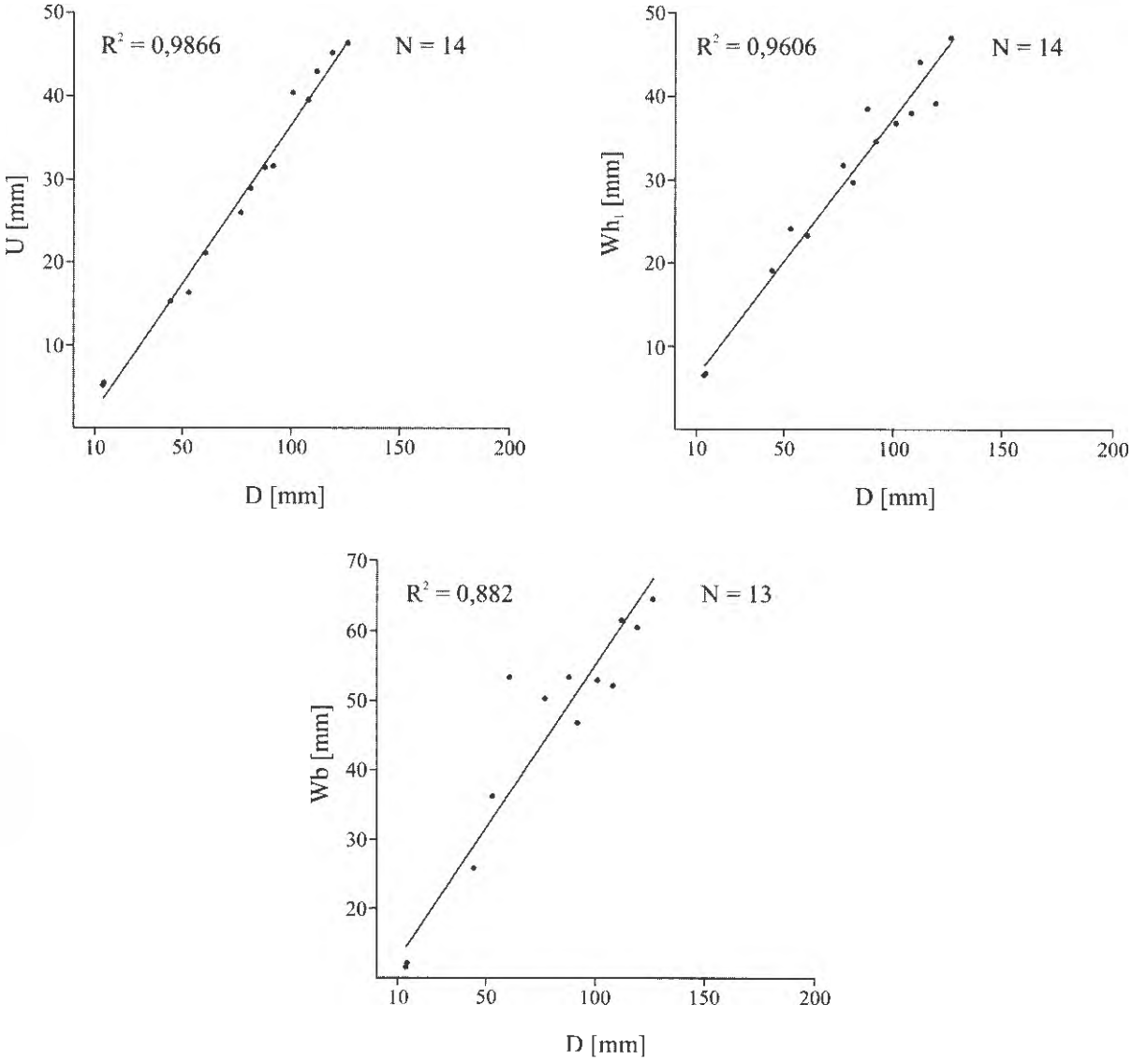
(Plate 2C–H, Text-figs. 6–7C–F)

1968 *Cadomites bremeri* TSERETELI sp. nov., TSERETELI, p. 80, pl. 12, figs. 1 (holotype), 2–4.
1972 *Cadomites rectelobatus* (HAUER), KRYSTYN, p. 251, pl. 7, fig. 1, text-fig. 18.
v. 1974 *Cadomites* (*Cadomites*) *bremeri* TSERETELI, KOPIK, p. 22, pl. 3, fig. 3, pl. 4, fig. 1, pl. 5, fig. 1, pl. 6, fig. 1, pl. 7, fig. 1.
? 1983 *Cadomites* (*Cadomites*) aff. *bremeri* TSERETELI, SANDOVAL, p. 290, pl. 23, fig. 1, text-fig. 108C.
1990 *Cadomites rectelobatus bremeri* TSERETELI, HAHN et al., p. 43, pl. 4, figs. 1–2.
1995 *Cadomites* (*Cadomites*) *rectelobatus* (HAUER), GALACZ, p. 124, pl. 18, figs. 22–24.
2007 *Cadomites bremeri* TSERETELI, DIETZE et al., fig. 8C.

Material: twenty five specimens, consisting mainly of body chambers and whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2958	61.0	21.0	23.2	-	53.2	18	72	0.34	0.38	0.87	2.29	1.10
GIUS 8-2959	76.8	26.0	31.7	26.8	~50.0	18	60	0.31	0.41	~0.65	~1.58	1.56
GIUS 8-2960	92.0	31.5	34.5	32.0	46.6	17	>50	0.34	0.37	0.51	1.35	1.72
GIUS 8-2961	101.0	~40.3	36.8	27.6	52.7	23	83	0.40	0.36	0.52	1.43	1.82
GIUS 8-2963a	-	-	43.2	37.0	60.0	>13	>55	-	-	-	1.39	-
GIUS 8-2964	81.7	28.8	29.7	-	-	22	-	0.35	0.36	-	-	-
IGPUW/J/110	108.3	39.5	38.0	30.5	51.8	18	68	0.36	0.35	0.48	1.36	2.02
IGPUW/J/42	-	-	35.5	30.8	57.9	>13	>49	-	-	-	1.63	-
IGPUW/J/59	119.2	45.0	39.2	34.0	60.3	22	102	0.38	0.33	0.5	1.54	1.90
GIUS 8-2962	52.8	16.2	24.0	-	~36.0	~20	55	0.31	0.45	~0.68	~1.5	-

Description: Shell small- to medium-sized (D = 13.9–126 mm), semi-evolute (U/D = 0.34–0.40), cadiconic. In the juvenile stage, the whorl cross-section strongly depressed with wide and delicately rounded venter. Flanks with umbilical slope strongly inclined. Ventro-lateral margin situated in a mid-half of the whorl. Inner ribs prorsiradiate, adaperturally concave, ended with prominent tubercles at the ventro-lateral margin. They divide on 2–3 thin outer ribs. In the later stages of ontogeny, the shell shape is similar, however, some of the features, as the whorl cross-section and ribbing pattern, may vary between the individuals. In the individuals of the same shell diameter, the whorl cross-section may be very wide, strongly depressed, or more rounded with more rounded flanks. On the body chamber, the whorl becomes higher, narrower and more rounded. Umbilicus is always deep, crater-like. In some of the individuals, the inner ribs



Text-fig. 6. Plots of umbilical width (U), outer whorl height (Wh) and whorl breadth (Wb) against shell diameter (D) in *Cadomites bremeri* Tsereteli [M].

are thinner and denser, and in the other, they are thicker and more distant. On the cast, however, the inner ribs (or rather their bases) are always thicker, while on the preserved shell, they are sharper and look thinner. The same concerns the tubercles, which are sharp and spiny on the preserved shell, and may attain c. 6 mm in length. The outer ribs may be more or less dense, as well. Generally, the number of the ribs increases with ontogeny.

Along with ontogeny, in the all individuals the umbilical width increases proportionally. The body chamber length attains a little more than ½ of the last whorl. Aperture is preceded by a distinct, wide constriction and ended with a prominent lip. Despite of the preservation of the phragmocone, the suture line is similar to the form *rectelobatus*, presented by Sandoval (1983, text-fig. 102 H–J) and Galacz (1994a). E very narrow, L is a little wider and deeper than E, E\L narrow, high, strongly divided and higher than L/U_2.

Remarks: The holotype and paratypes of the species *C. bremeri* (= *C.* aff. *deslongchampsi* sensu

Rożycki 1953) were first described from closer unidentified Bathonian horizons of Caucasus (Tsereteli 1968). Kopik (1974) was the first who showed the occurrence of this form in Poland – above the Morrisi Zone – and introduced the standard zone of the highest Middle Bathonian, the Bremeri Zone (Westermann & Callomon 1988, Mangold & Rioult 1997). Previously, as the exact stratigraphic position of the species was not known, some authors (Krystyn 1972) considered *C. bremeri* as a younger synonym of morphologically similar species *C. rectelobatus* (Hauer). Later, Hahn et al. (1990), on the basis of morphological similarity, considered the form *bremeri* as a subspecies of *C. rectelobatus*. Both decisions were dictated by the fact that so far the species *C. rectelobatus* has been known from condensed deposits, so its exact stratigraphic position was unclear. However, Galacz (1994a) during revision of the ammonite fauna from condensed deposits at Swinitza (Romania), where the lectotype of *C. rectelobatus* was found, dated the sediments as the lowest Middle Bathonian (Progracilis Zone). Thus, the species *C. bremeri* occurred to be younger. In my previous, unpublished work (Zaton 2007b), similarly to Krystyn (1972), I considered *C. bremeri* as a younger subjective synonym of C. *rectelobatus* on the basis of similar general shell-morphology. However, the species *C. bremeri* is characterized by its large shell diameter, significantly larger than that of *C. rectelobatus*. Thus, this feature, together with the distinct occurrence of *C. bremeri* above the Morrisi Zone not only in Poland, rather point to distinctiveness of the both forms. Moreover, as Westermann & Callomon (1988) stated, the genus *Cadomites* has not changed much during its evolution from Late Bajocian till Early Callovian, and its intraspecific variability within all time-intervals was large with additional homeomorphy in Late Bajocian and Late Bathonian (Galacz 1980, Sandoval 1983). Therefore, in the present paper I return to the traditional view and treat *C. bremeri* as a separate species.

Detailed remarks on this species were given by Kopik (1974) and they will not be repeated here again. Kopik (1974), when describing the species *C. bremeri* from the Polish Jura, distinguished three morphotype groups: 1. Group with very large shells (c. 130 mm in diameter), wide umbilicus and quite dense ribbing, 2. group of somewhat smaller shells (up to c. 100 mm in diameter) with narrower umbilicus and similarly dense ribbing, and, 3. group of moderate to large-sized shells with moderately wide umbilicus and very dense ribbing.

In the material investigated here, similar intraspecific variability is observed.

Occurrence: Larger part of the Upper Bathonian Hodsoni Zone (= Bremeri Zone) of Kawodrza Dolna ('Kawodrza' and 'Anna' clay-pits), Gnaszyn Dolny ('Gnaszyn' clay-pit), Grodzisko and Krzyworzeka. This species is also known from Caucasus (Tsereteli 1968), Austria (Krystyn 1972), Portugal (Kopik 1974), Germany (Hahn et al. 1990, Dietze et al. 2007) and possibly Spain (Sandoval 1983).

Cadomites linguiferus (d'Orbigny 1846) [m]

(Plate 2A)

1846 *Ammonites linguiferus* Orb., d'Orbigny, p. 402, pl. 136, figs. 4–5, *non* figs. 1–2.

1919 *Cadomites linguiferus* d'Orbigny, de Grossouvre, p. 393.

1952 *Polyplectites linguiferus* (d'Orbigny), Arkell, p. 79, text-fig. 21 (reproduction of the neotype).

1983 *Cadomites* (*Polyplectites*) *linguiferus* d'Orbigny, Sandoval, p. 297, pl. 23, fig. 6, text-fig. 108 G (with full synonymy).

Material: One well preserved body chamber.

Description: Shell small-sized (D = ~ 49 mm), semi-involute (U/D = ~ 0.38), cadiconic. Whorl cross-section depressed with wide, slightly rounded venter and distinct ventro-lateral margin. Flanks low, steeply dipping toward the umbilicus. Umbilical slope low, nearly vertical. At the end of the body chamber, the whorl cross-section is somewhat more rounded. Inner ribs adaperturally concave, delicately flexuous on the flanks, ended with tubercles/spines on the ventro-lateral margin. They divide on 2–3 fine, dense secondary ribs that are prorsiradiate and slightly adaperturally convex on the venter. Unlike single ribs, the intercalatory ones may appear sporadically. The body chamber attains c. ¾ of the last whorl. Aperture is preceded by shallow constriction and ended with proximal parts of lateral lappets. Suture line not well-visible. E/L high, bifid, L/U_2 shorter but wider than E/L.

Remarks: Kopik (1974) presented two specimens assigned by him to *Cadomites* (*Polyplectites*) cf. *linguiferus*. However, as the one of them (pl. 10, fig. 3) certainly belongs to that species, the second one (pl. 11, fig. 1) is clearly different, without the aperture preserved. It is rather close to immature macroconch. Related microconch is *C. zlatarskii* Stephanov, which differ by its denser inner ribs, somewhat depressed whorls and more involute shell. The Upper Bathonian *C. claromontanus* Kopik has denser inner ribs, narrower and more rounded venter. Its tubercles

are situated below the venter. The occurrence of *C. linguiferus* together with macroconchiate *C. bremeri* in the same clay-pit at Kawodrza Dolna, may suggest about their close dimorphic relationships. However, unless greater numbers of microconchs are discovered (here is only one specimen), and associated with macroconchs in concretions, this problem is still open.

Occurrence: Upper Bathonian (lower part of the Hodsoni Zone = Bremeri Zone) of Kawodrza Dolna ('Kawodrza' clay-pit). Apart of Poland, *Cadomites linguiferus* is also known from France, Bulgaria (STEPHANOV 1963), Austria (KRYSTYN 1972) and Spain (SANDOVAL 1983).

Subfamily Garantianinae WETZEL, 1937

Genus *Garantiana* HYATT, 1900

Type species: *Ammonites Garantianus* D'ORBIGNY, 1846

Subgenus *Garantiana* (*Garantiana*) HYATT, 1900

Synonyms: *Baculatoceras* MASCKE, 1907, *Subparkinsonia* MASCKE, 1907, *Garantia* ROLLIER, 1911, *Odontolkites* BUCKMAN, 1925, *Praeparkinsonia* SCHMIDTILL & KRUMBECK, 1931.

Remarks: Some researchers (MAKOWSKI 1962, STURANI 1971, MORTON 1971, GALACZ 1980, CALLOMON et al. 1987) consider that the microconch of *G.* (*Garantiana*) is a subgenus *G.* (*Pseudogarantiana*) BENTZ. However, as these two forms are characterized by their different stratigraphic ranges (SCHLÖGL et al. 2005, fig. 8), FERNÁNDEZ-LOPEZ (1985) considered them as separate genera. Additionally, STURANI (1971) pointed out, that the microconch of *Garantiana* may be in part the genus *Strenoceras*, as well. These unresolved problems make me currently to consider *Garantiana* and *Pseudogarantiana* as separate morpho-subgenera.

Garantiana (Garantiana) baculata (QUENSTEDT 1858) [M]

(Plate 2B, Text-fig. 7G)

1858 *Ammonites baculatus*, QUENSTEDT, p. 402, pl. 72, fig. 1.
1971 *Garantiana* (*Garantiana*) *baculata* (QUENSTEDT), PAVIA, p. 106, pl. 18, figs. 2, 5, pl. 19, figs. 1–2, 8.
1980 *Garantiana* (*Garantiana*) *baculata* (QUENSTEDT), GALACZ, p. 87, pl. 19, fig. 3, text-figs. 69–70 (with full synonymy).
1985 *Garantiana baculata* (QUENSTEDT), FERNANDEZ-LOPEZ, p. 436, pl. 45, fig. 4, text-fig. 45a.
1993 *Orthogarantiana baculata* (QUENSTEDT), BESNOSOV & MITTA, p. 69, pl. 7, figs. 1–2.
2000 *Orthogarantiana* (*Orthogarantiana*) *baculata* (QUENSTEDT), BESNOSOV & MITTA, pl. 1, figs. 20–21.

Material: One phragmocone.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2956	55.0	21.2	22.5	18.8	23.5	14	23	0.38	0.41	0.43	1.04	1.82

Description: Medium-sized and moderately evolute specimen. Whorl cross-section (Text-fig. 7G) wide with rounded flanks. Umbilicus moderately wide with rounded margin and low, steep slope. Inner ribs sharp, prorsiradiate or slightly sinuous. In the mid-half of the whorl height they bifurcate. Single ribs rarely occur. At the bifurcation points, small tubercles appear, which are more prominent on older whorls. Secondary ribs are similarly sharp as the inner ones, ended with thicker tubercles on the venter. The center of the venter is marked by quite wide and smooth sulcus.

Remarks: This species is morphologically very variable (PAVIA 1971, GALACZ 1980, SANDOVAL 1983, FERNÁNDEZ-LOPEZ 1985, DIETL 1988). The ribbing may be either dense or distant, primary ribs may be straight or flexuous, may bifurcate or trifurcate. Sulcus may be narrow or wide, as well. Within the Baculata Subzone, DIETL (1988) distinguished three successive populations α, β and γ, differing by their whorl cross-section. Because of wider, more rounded whorl cross-section, the specimen described here fits the individuals of the population β. The closest form is *G.* (*G.*) *garantiana* (D'ORBIGNY). However, the latter distinguishes from *G.* (*G.*) *baculata* by its denser and more flexuous ribs and more compressed whorls. Generally, *G.* (*G.*) *baculata* differs from the other species of *Garantiana* by its narrower umbilicus and wide, rounded whorl cross-section (GALACZ 1980). Its tubercles are also delicate and slowly disappear with growth.

Occurrence: The specimen comes from the heap located at Poczesna near Częstochowa (?Garantiana Zone). *G.* (*G.*) *baculata* is also mentioned from the Niortense (= Subfurcatum) Zone of Łęczyca (Couiavia, central Poland) by ZNOSKO (1957). This species is known both from Mediterranean and beyond of Europe, and Middle Asia (BESNOSOV & MITTA 1993). It ranges from the Niortense to Garantiana zones (GALACZ 1980, SANDOVAL 1983, FERNANDEZ-LOPEZ 1985).

Garantiana (*Garantiana*) *dubia* (QUENSTEDT 1849)
[M?]
(Plate 3A, Text-fig. 7H)

1849 *Ammonites Parkinsoni dubius*, QUENSTEDT, p. 147, pl. 11, fig. 9.
1954 *Garantiana* (*Garantiana*) *dubia* (QUENSTEDT), WETZEL, p. 560, pl. 11, figs. 3–6, pl. 12, figs. 1–2, pl.14, fig. 2.
1985 *Garantiana dubia* (QUENSTEDT), FERNANDEZ-LOPEZ, p. 435, pl. 45, fig. 5.

Material: Three fragments and one nearly complete last whorl.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/K-6	19.7	7.7	8.3	-	11.5	15	27	0.39	0.42	0.58	1.38	-
IGPUW/J/K-7	-	-	8.8	7.4	11.9	-	-	-	-	-	-	-
IGPUW/J/K-8	-	-	6.4	6.0	8.3	-	-	-	-	-	1.3	-

Description: Small-sized shells, semi-evolute, probably representing juvenile stages. Whorl cross-section (Text-fig. 7H) depressed, wider than high, with slightly rounded flanks and widely rounded venter. Umbilicus moderately narrow, with rounded margin and steep slope. Inner ribs thin and prorsiradiate. Just above the mid-height of the whorl they bifurcate. The bifurcation point is marked with small, sharp tubercles. Single ribs may also appear. Outer ribs are similarly thin. On the venter they are interrupted by wide, smooth sulcus. At their end, distinct tubercles occur that are stronger than the lateral ones. Aperture is missing.

Remarks: DIETZE et al. (2002a) stated, that the specimens on the basis of which the species was created (WETZEL 1954), represent the inner whorls of closer unidentifiable species of *Garantiana*. Thus, the authors interpreted this species as a *nomen dubium*. From *G.* (*P.*) *minima* (WETZEL), it differs by wider, depressed whorl cross-section.

On the basis of similar ornamentation, some authors (FERNANDEZ-LOPEZ 1985) considered, that the species under discussion may be a microconch of *G.* (*G.*) *baculata* (QUENSTEDT). However, the *Garantiana* microconchs (assigned as *Pseudogarantiana*) appear somewhat later than the nominative subgenus, and include small-sized forms with lappets. To date, however, within the species *G.* (*G.*) *dubia* there are not known specimens with preserved lappets.

Occurrence: Upper Bajocian (Garantiana Zone) of the Poraj-Kamienica Polska area. The species is also known from the same zone of Germany, France and Spain (FERNANDEZ-LOPEZ 1985).

Subgenus *Garantiana* (*Pseudogarantiana*) BENTZ, 1928

Type species *Garantiana* (*Pseudogarantiana*) *dichotoma* BENTZ, 1928

Garantiana (*Pseudogarantiana*) *minima* (Wetzel 1911)
[m]
(Plate 3B, Text-fig. 7I)

1937 *Garantiana* (*Pseudogarantiana*) *minima* WETZEL, WETZEL, p. 92, pl. 10, figs. 10–11.
1971 *Pseudogarantiana minima* (WETZEL), STURANI, p. 158, pl. 13, fig. 19.
2002a *Pseudogarantiana minima* (WETZEL), DIETZE et al., pl. 13, figs. 3–4, 6, pl. 16, figs. 3–4.

Material: Four body chambers, including two fragmentary ones.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2957	18.0	8.8	5.7	-	-	12	21	0.49	0.32	-	-	1.63
IGPUW/J/K-10	~16.9	~8.0	6.0	-	6.4	14	21	~0.47	~0.35	~0.38	1.07	~1.8
IGPUW/J/K-11	23.3	9.0	7.7	-	~7.0	13	23	0.39	0.33	~0.3	~0.91	2.9
IGPUW/J/K-12	-	-	7.1	5.6	7.0	-	-	-	-	-	0.98	-

Description: Small-sized microconchs of semi-evolute shells. Whorl cross-section (Text-fig. 7I) subtrapezoidal with almost flat flanks and quite wide venter. During ontogeny, the whorl cross-section becomes higher. Umbilicus moderately wide with rounded margin and low, steep slope. Ribbing thin, sharp and dense. Inner ribs prorsiradiate and delicately flexuous. They bifurcate in the mid-height of the whorl. The bi-

furcation point is marked with delicate tubercles that disappear gradually during growth. Outer ribs are projected on the venter, accentuated by fine tubercles and interrupted by narrow, smooth band. Body chamber attained nearly ¾ of the last whorl. Aperture ended with short lateral lappets.

Remarks: Similarly small-sized *G.* (*P.*) *dichotoma* BENTZ differs by its more rectiradiate and more projected ribs.

Occurrence: Upper Bajocian (Garantiana Zone) of the Poraj-Kamienica Polska area. The species is also known from Germany (DIETZE et al. 2002a), Italy (STURANI 1971) and France (RIOULT et al. 1997).

Subgenus *Garantiana* (*Hlawiceras*) BUCKMAN, 1921

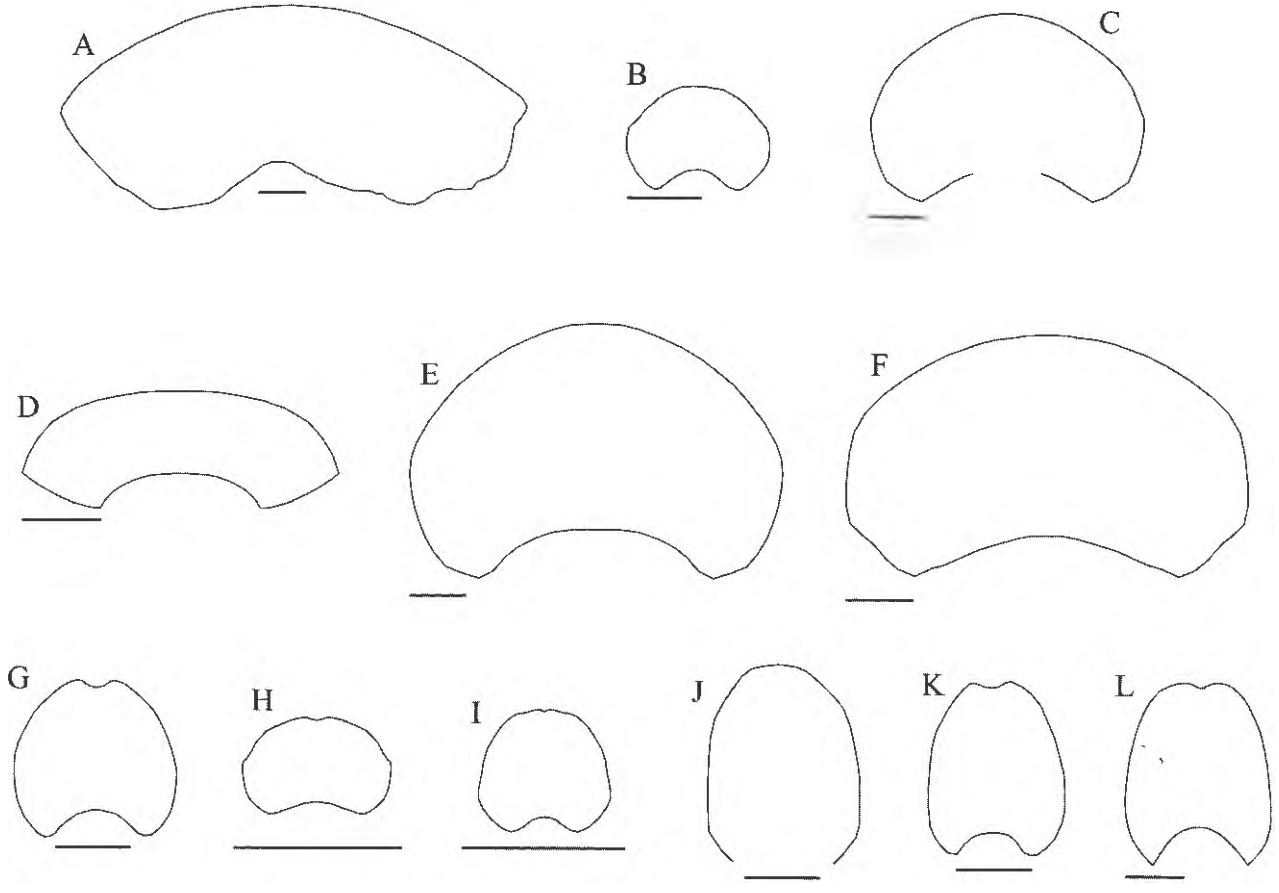
Type species *Hlawiceras platyrrymum* BUCKMAN, 1921

Synonyms: *Subgarantiana* BENTZ, 1928.

Garantiana (*Hlawiceras*) *wetzeli* TRAUTH, 1923 [M]
(Plate 3E, Text-fig. 7J–K)

1886 *Ammonites Parkinsoni densicosta*, QUENSTEDT, p. 604, pl. 72, figs. 1–2.
1954 *Garantiana* (*Subgarantiana*) *wetzeli* TRAUTH, WETZEL, p. 569, pl. 14, fig. 3.
1998 *Garantiana* (*Hlawiceras*) *intermedia* BENTZ, KOPIK, pl. 4, fig. 2.
2002a *Garantiana wetzeli* TRAUTH, DIETZE et al., p. 26, pl. 7, figs. 1–3, pl. 8, figs. 1–2, pl. 9, figs. 1–2 (with full synonymy).

Material: Four body chamber fragments.



Text-fig. 7. Whorl cross-sections of some of the investigated ammonites. A. *Teloceras* aff. *blagdeni* (SOWERBY) [M], IGPUW/J/K-2, B. *Normannites orbignyi* BUCKMAN [m], IGPUW/J/K-x, C-F. *Cadomites bremeri* TSERETELI [M], respectively GIUS 8-2960, 2958, 2963b, IGPUW/J/110, G. *Garantiana* (*Garantiana*) *baculata* (QUENSTEDT) [M], GIUS 8-2956, H. *Garantiana* (*Garantiana*) *dubia* (QUENSTEDT) [M?], IGPUW/J/K-7, I. *Garantiana* (*Pseudogarantiana*) *minima* (WETZEL) [m], IGPUW/J/K-12, J-K. *Garantiana* (*Hlawiceras*) *wetzeli* TRAUTH [M], J. the whorl section just at the peristome, K. the whorl section in the middle part of the body chamber, IGPUW/J/G-8, L. *Parkinsonia* (*Parkinsonia*) *rarecostata* BUCKMAN, IGPUW/J/Pa1b. Scale bars equal 1 cm.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/G-8	-	-	26.5	-	19.2	-	-	-	-	-	0.72	-
IGPUW/J/G-9	-	-	21.8	20.2	19.0	-	-	-	-	-	0.87	-
IGPUW/J/G-10	-	-	22.1	20.0	19.9	-	-	-	-	-	0.90	-

Description: Whorls cross-section high-trapezoidal (Text-fig. 7J–K) with flat flanks. The flanks are convergent forming quite narrow venter. Umbilical margin rounded, umbilical slope low and gently dipped. Ornamentation consists of quite dense, sharp ribs. Inner ribs prorsiradiate and flexuous, bifurcating just above the mid-height of the whorl. Single and intercalatory ribs occur, as well. Bifurcating point is devoided of tubercles on the preserved whorls. Outer ribs are stronger, bent toward the aperture. On the venter, they are interrupted by distinct, deep sulcus which disappears just before the aperture. At the same place, the outer ribs join each other on the venter. Aperture, preserved in one whorl fragment, is simple.

Remarks: Despite the preservation, the characteristic ornamentation enables certain identification to the species level. *Garantiana* (*Hlawiceras*) *wetzeli* TRAUTH differs from the other species of the subgenus *G.* (*Hlawiceras*), like *G.* (*H.*) *alticosta* (WETZEL) or *G.* (*H.*) *suevica* (WETZEL), by its denser ribbing, longer and more bent outer ribs, as well as narrower, convergent whorl cross-section. From *G.* (*G.*) *tetragona* WETZEL, it differs by smaller shell diameter, narrower and more rounded whorl cross-section, longer persistent sulcus and curved inner ribs. However, as DIETZE et al. (2002a) stressed, *G.* (*G.*) *tetragona* could be included into the synonymy of *G.* (*H.*) *wetzeli* after more thorough study.

Occurrence: Upper Bajocian (Garantiana Zone) of the Poraj-Kamienica Polska and Poczesna area. This species is also noted from Germany (DIETZE et al. 2002a).

Family Perisphinctidae STEINMANN, 1890

Subfamily Leptosphinctinae ARKELL, 1950

Genus *Leptosphinctes* BUCKMAN, 1920

Type species *Leptosphinctes leptus* BUCKMAN, 1920

? *Leptosphinctes* sp. [M?]
(Plate 3F)

Material: One specimen with partially preserved body chamber.

Nr	D	U	Wh	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2845	42.3	23.2	11.3	-	11.9	22	40	0.55	0.27	0.28	1.05	-

Description: Shell small-sized (D = 42.3 mm), semi-evolute, planorbiconic. Whorl cross-section depressed, wider than high. Umbilicus shallow with low and vertical slope, and rounded margin. Inner ribs distinct, prorsiradiate, sharp and quite dense (P = 21). At the ventro-lateral area they divide on two outer ribs (S = 39). Bifurcation point is accentuated with fine tubercles. The outer ribs pass the venter uninterrupted. Constrictions are not visible. Aperture is missing.

Remarks: Features like depressed whorl cross-section and presence of tubercles are reminiscent of the species *Bigotites tuberculatus* (NICOLESCO). However, the species under discussion differs from *Bigotites* by a complete lack of ventral sulcus. Although the lack of the sulcus in the species investigated is characteristic for the genus *Leptosphinctes*, the former lacks characteristic for *Leptosphinctes* compressed whorls. Specimen of similarly mixed features has been described as *Leptosphinctes*? (*Leptosphinctes*?) sp. 1 by SANDOVAL (1983), as well. It is not excluded that the species under discussion may represent the transitional form between *Leptosphinctes* and *Bigotites*, as was already suggested by SANDOVAL (1983). *Leptosphinctes* appears in the Lower Bajocian Blagdeni Subzone, attaining its peak diversity in the Upper Bajocian Niortense Zone (GALACZ 1980). *Bigotites*, on the other hand, ranges from the Niortense Zone up to the lowermost Bathonian (SANDOVAL 1983). SCHLOGL et al. (2005) mentioned *Leptosphinctes* (*L.*) sp. from the Upper Bajocian Parkinsoni Zone of the Pieniny Klippen Belt, however, they presented neither description nor illustration of the specimen. Thus, having only one specimen with mixed features, it is difficult to classify it to one of the two genera mentioned above.

Occurrence: Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone) of Blanowice.

Genus *Vermisphinctes* BUCKMAN, 1920

Type species *Vermisphinctes vermiformis* BUCKMAN, 1920

Vermisphinctes stomphus (BUCKMAN 1921) [M]
(Plate 3L, Text-fig. 10A)

1921 *Stomphosphinctes stomphus*, nov., BUCKMAN, pl. 247 (holotype).
1972 *Leptosphinctes* (*Prorsisphinctes*) *stomphus* (BUCKMAN), KRYSTYN, p. 268, pl. 9, fig. 1, text-figs. 20, 23.
1980 *Vermisphinctes* (*Prorsisphinctes*) *stomphus* (BUCKMAN), GALACZ, p. 109, pl. 25, fig. 2, pl. 26, fig. 1, text-figs. 88–89.
1985 *Prorsisphinctes stomphus* (BUCKMAN), FERNANDEZ-LOPEZ, p. 509, pl. 56, fig. 1, text-figs. 56B, 57.
1993 *Leptosphinctes stomphus* (BUCKMAN), BESNOSOV & MITTA, p. 94, pl. 10, fig. 2.

Material: One, not well-preserved specimen.

Nr	D	U	Wh	Wh_i	Wb	P	S	U/D	Wh_i/D	Wb/D	Wb/Wh_i	WER
IGPUW/J/Vs-1	20.2	11.7	6.1	5.5	6.8	24	?	0.58	0.30	0.34	1.11	1.59
	34.2	20.5	10.7	8.7	11.5	23	?	0.60	0.31	0.34	1.07	1.77
	58.1	30.0	18.1	14.3	19.0	24	?	0.52	0.31	0.33	1.05	1.77
	91.3	52.9	22.0	18.7	24.3	25	?	0.58	0.24	0.27	1.10	1.44
	171.0	89.4	63.4	46.4	45.0	24	?	0.52	0.37	0.26	0.71	1.9
	~230.0	114.7	73.0	56.7	49.0	?	?	0.50	~0.32	~0.21	0.67	1.79

Description: Large-sized specimen (D = ~ 230 mm) covered with pyrite incrustation. If complete it would measure more than 260 mm. Despite this, the morphological features are well-visible. Shell evolute (U/D = 0.50–0.60), umbilicus shallow with low and vertical slope and rounded margin. Umbilicus becomes somewhat narrower during ontogeny. Inner and middle whorls (up to D = ~ 91.3 mm) rounded, somewhat wider than higher. The biggest width is situated at the umbilical margin. Inner ribs prorsiradiate, straight and dense (P = 23–25). At D = 171 mm, the whorls are high with convergent flanks and quite narrow venter (Text-fig. 10A). During ontogeny (at D = ~ 230 mm) the whorl height increases faster than its breadth. Inner ribs on the penultimate preserved whorl are prorsiradiate, thick and rounded. Above the mid-height of the whorl they bifurcate. Outer ribs are thinner than the inner ones and pass the venter uninterrupted. Single and intercalatory ribs are not visible due to the pyritic incrustation. Two whorls bear one distinct and deep constriction per a whorl. Body chamber could have attained one whorl. Suture line not visible.

Remarks: Although the specimen is incomplete and incrusted, its characteristics agree well with those of the species *Vermisphinctes stomphus*. The specimen described is very similar to the other representatives of the species. So far, this species has been described on the basis of smaller specimens (KRYSTYN 1972, GALACZ 1980, SANDOVAL 1983, FERNANDEZ-LOPEZ 1985). Thus, its high whorl cross-section in later ontogenetic stages has not been noted. SANDOVAL (1983, text-fig. 121A) presented the specimen of D = 166 mm, the whorl cross-section of which became to be narrow, but the venter was still widely rounded. WIERZBOWSKI et al. (1999) described a large specimen (D = ~ 200 mm) as *V.* (*P.*) cf. *stomphus*, but it was deformed, so its whorl section was hard to deduce. *V*? (*P*?) aff. *stomphus* illustrated by SANDOVAL (1983) is very similar (evolutness, ornamentation) to that described here, except its body chamber that becomes nearly smooth. However, in the light of remarks provided by SANDOVAL (1983), his specimen agrees well with the species *V. stomphus*. According to FERNANDEZ-LOPEZ (1985), *Prorsisphinctes meseres* BUCKMAN may be a younger synonym of the species described here. *V. glyphus* (BUCKMAN) is similar with respect to a whorl section, but its ornamentation is denser with rectiradiate ribs. *V. reparator* (BUCKMAN) is more involute, with robust whorl cross-section and shallower constrictions.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of the Kawodrza Gorna (non-existent 'Anioł' clay-pit, MAJEWSKI 1997, MATYJA & WIERZBOWSKI 2000). The holotype of *Vermisphinctes stomphus* comes from the Garantiana Zone of southern England. The same zone concerns the species presented by GALACZ (1980) from Hungary. In Spain the species is known from the Parkinsoni Zone (FERNANDEZ-LOPEZ 1985), as well as from the condensed deposits of Niortense and Garantiana zones (SANDOVAL 1983).

Vermisphinctes sp. [juv.]
(Plate 3C–D)

Material: Three specimens, including a 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/14.1a	10.7	5.4	2.9	-	-	23	-	0.50	0.27	-	-	1.66
IGPUW/J/12.1	12.0	6.4	3.1	-	-	21	-	0.53	0.26	-	-	1.56
IGPUW/J/13.1	23.2	10.8	7.4	6.4	8.2	22	37	0.46	0.32	0.35	1.11	1.93

Description: Shell small-sized, evolute, planorbiconic, with nearly circular whorl cross-section. Umbilicus wide, moderately shallow, with rounded margin and moderately high, vertical slope. Inner ribs recti- or prorsiradiate, bifurcating at the ventro-lateral side. Outer ribs are similarly thick as the inner ones. They are adaperturally convex on the venter. Single and intercalatory ribs occur relatively often. One constriction has been observed in only one specimen. Aperture is missing.

Remarks: The detailed description and remarks were given by ZATON & MARYNOWSKI (2006), and there is nothing new to be added.

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

Subfamily Zigzagiceratinae SCHINDEWOLF, 1925

Genus *Procerites* SIEMIRADZKI, 1898

Type species *Ammonites procerus* SCHLOENBACH, 1865
(= *Ammonites schloenbachi* DE GROSSOUVRE 1907)

Synonyms: *Siemiradzkia* HYATT, 1900, *Gracilisphinctes* BUCKMAN, 1920, *Parkinsonites* BUCKMAN, 1922, *Zigzagites* BUCKMAN, 1952, *Euprocerites* WETZEL, 1950.

Remarks: Macroconchs are used to be classified as a subgenus *Procerites* (*Procerites*) SIEMIRADZKI, and microconchs as *P.* (*Siemiradzkia*) HYATT (MANGOLD 1970a, SANDOVAL 1983). On the basis of the widely accepted dimorphism between the forms of *Procerites* [M] and *Siemiradzkia* [m] (see e.g., MANGOLD 1970a, SANDOVAL 1983, FERNANDEZ-LOPEZ 2001), in the present paper the latter taxon is considered as a younger subjective synonym of *Procerites*.

Procerites tmetolobus BUCKMAN, 1923 [M]
(Plate 4A, Text-fig. 10H)

1923 *Procerites tmetolobus* nov., BUCKMAN, pl. 416.
1958 *Procerites tmetolobus* S. BUCKMAN, ARKELL, p. 191, pl. 23, figs. 1–4, pl. 25, figs. 2–3, text-fig. 69 (holotype).
1983 *Procerites* (*Procerites*) *tmetolobus* BUCKMAN, SANDOVAL, p. 434, pl. 39, fig. 1, text-figs. 123G, 126C.
2005 *Procerites* (*Procerites*) *tmetolobus* BUCKMAN, SCHLOGL et al., pl. 10, fig. 6.

Material: One large phragmocone.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/KP-3-1	185.0	79.0	67.7	-	58.7	19	51	0.43	0.36	0.32	0.87	-
	160.0	63.9	62.2	-	54.1	17	?	0.40	0.39	0.34	0.87	-

Description: The preserved phragmocone (D = 185 mm) is semi-evolute, with shallow and slightly increasing umbilicus during the shell growth (U/D = 0.40 at D = 160 mm, U/D = 0.43 at D = 185 mm). Umbilical margin rounded and its slope moderately high. Whorl cross-section quite high with parallel flanks and wide, slightly rounded venter (Text-fig. 10H). On the last preserved whorl, the inner ribs are straight, slightly prorsiradiate and quite dense. Toward the aperture, they become weaker, rounded, gradually disappearing. Above the mid-height of the whorl, they divide on 2–3 thinner outer ribs. Intercalatory ribs occur from place to place. Suture line is poorly visible. E/L and L/U_2 are of the same height.

Remarks: *Procerites tmetolobus* BUCKMAN is characterized by large shell-diameter – none of the so

far described specimens of this species is completely preserved. Such features as shell evolutness, whorl cross-section and ribbing of the specimen described here, are very similar to those of the holotype and other specimens described so far. The specimen investigated is most similar to the ARKELL's (1958, pl. 23, fig. 3) specimen. As was noted by SANDOVAL (1983), the representatives of the species may differ by whorl section – it may be more or less depressed. The closest species is *P. subprocerus* (BUCKMAN) [M]. The latter, however, possesses more involute shell, more tertiary ribs and thinner, denser inner ribs. *P. costulatosus* (BUCKMAN) [M] is also more involute, with dense inner ribs and compressed whorl cross-section. *P. fowleri* ARKELL [M] possesses similar ribs, but is much more evolute. *P. incognitus* ARKELL [M] is silmilarly evolute and ornamented, but its whorl cross-section is more compressed. However, SANDOVAL (1983) suggested, that the latter species may be a younger synonym of *P. tmetolobus*.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Kawodrza Gorna ('Glinski clay-pit). *Procerites tmetolobus* is also known from England (ARKELL 1958), France (STURANI 1966), Spain (SANDOVAL 1983) and Iran (SEYED-EMAMI 1988).

Procerites laeviplex (QUENSTEDT 1887) [M]

(Plate 4E, 5B, Text-fig. 10I)

1887 *Ammonites laeviplex* QUENSTEDT, p. 648, pl. 80, tylko fig. 10.
1922 *Parkinsonites fullonicus* nov., BUCKMAN, pl. 302.
1958 *Procerites fullonicus* (S. BUCKMAN), ARKELL, p. 189–190, pl. 24, figs. 1–4, text-fig. 69-6.
1969 *Procerites laeviplex* (QUENSTEDT), HAHN, p. 48–51, pl. 7, fig. 2, pl. 8, fig. 1, text-fig. 2.
1983 *Procerites (Procerites) laeviplex* (QUENSTEDT), SANDOVAL, p. 436-437, text-fig. 126i.

Material: Two nearly complete specimens and three whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WFR
IGPUW/J/LP-1	170.0	53.0	64.0	-	~49.0	14	36	0.31	0,31	0.29	~0.76	1.56
GIUS 8-3198	190.0	60.0	80.0	50.0	61.0	14	37	0.31	0.42	0.32	0.76	1.88

Description: Shells large (D = 320 mm), evolute. Umbilicus wide with rounded margin and slightly inclined slope. Whorl cross-section at early ontogenetical stages wider than higher. Later it becomes to be high-oval, with convergent flanks and narrow venter (Text-fig. 10I). Up to 147 mm of the shell-diameter, the ornamentation consists of strong, rectiradiate inner ribs bifurcating just above the mid-height of the whorl. Outer ribs slightly weaker than the inner ones. Single and intercalatory ribs present, as well. After this shell-diameter, the inner ribs are very weak and disappear gradually. The outer ribs are visible longer, but also tend to disappear completely, leaving the second part of body chamber of the large specimen (D = 320 mm) smooth. The suture line complex (Text-fig. 13D). The body chamber may have attained one last whorl, or slightly more.

Remarks: Characteristics of the large specimen (AK-L3) agree well with the species *Procerites laeviplex*. The specimens investigated show some degree of variation, especially of shell involutness and, in smaller degree, the whorl cross-section. *P. stephanovi* HAHN [M] is very similar to *P. laeviplex*. The former differs only in its circular whorl-cross section (HAHN 1969, SANDOVAL 1983). It is not excluded that *P. stephanovi* is a synonym of *P. laeviplex*. *P. tmetolobus* has finer, denser ribbing and subquadrate whorl cross-section. *P. fowleri* ARKELL [M] differs by its wider umbilicus, weaker inner ribs and smaller diameter of adult specimens.

Occurrence: Lower Bathonian (Tenuiplicatus Zone) of Kawodrza Gorna ('Leszczynski' and 'LAB' clay-pits). This species has wide geographical distribution and is also known from the Lower Bathonian of Spain (SANDOVAL 1983), France (STURANI 1966), England (ARKELL 1958), Germany (HAHN 1969), Bulgaria (STEPHANOV 1961) and Middle Asia (BESNOSOV & MITTA 1993).

Procerites cf. *imitator* (BUCKMAN 1922) [M]

(Plate 4B)

Material: One incomplete phragmocone.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3200	110.0	58.7	39.6	27.8	37.6	~15	-	0.53	0.36	0.34	0.95	-
	~210.0	77.4	67.6	47.7	65.0	-	-	~0.37	~0.32	~0.31	0.96	-

Description: Preserved phragmocone could have attained c. 210 mm if complete. It is evolute with robust, rounded whorl cross-section. Umbilicus moderately shallow with rounded margin and quite steep slope. Inner ribs distinct and strong on older whorls, later becoming weaker but still visible. In the mid-height of the whorl they divide on 2–3, slightly thinner outer ribs. Intercalatory ribs also occur. Suture line not distinct but similar to that in *P. laeviplex*.

Remarks: With respect to the whorl cross-section, ornamentation and shell evolutness, the specimen investigated is similar to *Procerites imitator* (BUCKMAN) described and illustrated by ARKELL (1958). STURANI (1966) noted the transitional forms between *P. laeviplex* and younger representatives of *P. imitator*. The presence of *P. laeviplex* forms with more involute shells of somewhat rounded whorl section in the material investigated, may be an evidence of close affinity of the both species.

Occurrence: Lower (Tenuiplicatus Zone) or Middle Bathonian (Progracilis Zone) of Faustianka. The stratigraphic range of the species *P. imitator* is very wide, from Lower to Upper Bathonian (ARKELL 1958, STURANI 1966, HAHN 1969, KRYSTYN 1972, TORRENS 1987).

Procerites hodsoni ARKELL, 1958 [M]

(Plate 4C–D)

v. 1958 *Procerites hodsoni* sp. nov., ARKELL, p. 190, pl. 25, fig. 1, text-figs. 68.3, 69.8.

1969 *Procerites hodsoni* ARKELL, HAHN, p. 62, pl. 2, fig. 2, text-figs. 6a, 7.

1983 *Procerites* (*Procerites*) *hodsoni* ARKELL, SANDOVAL, p. 437, pl. 46, fig. 1, text-fig. 126d.

1990 *Procerites hodsoni* ARKELL, HAHN et al., p. 45, pl. 1, fig. 1, pl. 4, fig. 3, pl. 5, text-fig. 5b.

Material: Two, somewhat crushed specimens without inner whorls preserved, and a body chamber fragment.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3031	~84.7	32.9	36.0	-	-	14	~44	~0.39	~0.42	-	-	-

Description: Shell semi-involute with high-oval whorls of slightly rounded flanks. Despite the crushing, it is well-visible that the venter was originally narrow narrow. Umbilicus moderately narrow with gently inclined slope and rounded margin. Inner ribs thin, long, dense, recti- or slightly prorsiradiate, sometimes slightly concave adaperturally. They divide on two, thinner outer ribs. Single and intercalatory ribs common. The ribbing is persistent to the end of the body chamber, what is characteristic for the species. Suture line not visible.

Remarks: *Procerites hodsoni* ARKELL is characterized by its compressed whorl section and dense ribbing up to the end of the body chamber. The ornamentation of the specimens described is very similar to that of the holotype. The holotype (ARKELL 1958, pers. observ.) possesses gracile and high whorls with flat flanks, however, the other specimens of this species that have been described, may have more rounded or even robust whorls. The shell diameter of the holotype equals c. 207 mm, but the other ones measure 265–332 mm (HAHN 1969), 255–280 mm (MANGOLD 1970a), 290 mm (SANDOVAL 1983) or even 400 mm (HAHN et al. 1990). GALACZ (1980), when analysing the whorl cross-sections of MANGOLD's (1970a) specimens suggested, that those with robust whorls belong to different species. However, it seems that some small deviations may be only the result of intraspecific variability. The involutness, on the other hand, is the same in different specimens of this species. *Procerites magnificus* ARKELL [M] differs by its greater evolutness and more rounded whorl section, while the ornamentation of the body chamber is similar in the both species.

Occurrence: Upper Bathonian (Hodsoni Zone) of Grodzisko. This species is also known from the same interval of England (ARKELL 1958), Germany (HAHN 1969, HAHN et al. 1990). In Spain, it occurs in the boundary of Middle and Upper Bathonian, but its exact stratigraphic position is unknown (SANDOVAL 1983). Similar forms (*Procerites* cf. *hodsoni*) also occur in France (MANGOLD 1970a) and Hungary (GALACZ 1980).

Procerites quercinus (TERQUEM & JOURDY 1869) [M]

(Plate 5D–F, Text-figs. 8, 10J)

1958 *Procerites quercinus* (TERQUEM & JOURDY), ARKELL, p. 193, pl. 25, figs. 4–5, pl. 26, fig. 1, text-figs. 68. 2 (lectotype), 69. 7, 70–71.

1969 *Procerites quercinus* (TERQUEM & JOURDY), HAHN, p. 53, pl. 3, fig. 4, pl. 8, fig. 2, text-fig. 6.

1972 *Procerites quercinus* (TERQUEM & JOURDY), KRYSTYN, p. 277, pl. 16, fig. 1.

1983 *Procerites* (*Procerites*) *quercinus* (TERQUEM & JOURDY), SANDOVAL, p. 438, pl. 43, fig. 1, text-figs. 126E, 127.

Material: Twenty three specimens in various state of preservation, including six whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3032	180.0	~70.0	61.0	-	~57.0	~17	~54	~0.39	0.34	~0.32	~0.93	-
IGPUW/J/113	221.0	104.5	~64.2	-	~68.3	~18	?	0.47	0.29	~0.31	~1.06	1.46
IGPUW/J/150	158.0	66.2	58.8	53.8	52.4	22	62	0.42	0.37	0.33	0.89	2.3
IGPUW/J/Pq2	208.1	85.2	74.1	63.3	64.0	24	61	0.41	0.36	0.31	0.86	2.07
IGPUW/J/55	189.3	70.9	66.7	~53.0	58.8	~18	~58	0.37	0.35	0.31	0.88	1.77
IGPUW/J/89	-	-	52.0	42.0	51.5	-	-	-	-	-	0.99	-
GIUS 8-3033	~150.0	~71.5	~54.3	48.3	52.8	?	?	~0.48	~0.36	~0.35	~0.97	2.16
GIUS 8-3034	193.3	69.0	73.0	~54.0	66.0	~13	~52	0.36	0.38	0.34	0.90	1.93
GIUS 8-3035	~151.3	~67.4	55.0	-	~44.6	21	?	~0.44	~0.36	~0.29	~0.81	-
GIUS 8-3036	~180.5	~69.3	74.1	~62.7	64.7	?	?	0.38	~0.41	~0.36	0.87	2.34
GIUS 8-3037	306.0	152.5	99.7	~79.0	~78.0	?	?	0.49	0.32	~0.25	~0.78	1.17
GIUS 8-3038	~196.0	86.0	58.8	-	-	?	?	~0.44	~0.30	-	-	-
GIUS 8-3039	251.5	~99.4	~82.0	-	-	?	?	~0.39	~0.33	-	-	-
GIUS 8-3040	233.0	123.7	-	-	-	-	-	0.53	-	-	-	1.99
	200.0	93.0	58.7	-	~49.4	?	~61	0.46	0.29	~0.247	~0.84	-
GIUS 8-3041	143.0	60.7	57.0	50.0	53.2	~19	~44	0.42	0.40	0.37	0.93	1.59
GIUS 8-3042	239.5	~93.5	~78.0	-	-	?	?	~0.39	~0.32	-	-	-

Description: Shells of moderate to large sizes (D = ~ 15–306 mm). Inner whorls (at D = ~ 86.5 mm) rounded with wide venter. Inner ribs thin, prorsiradiate and quite dense (P = 17). Prorsiradiate constrictions, 2–3 per a whorl also occur. Later, the whorl section becomes higher with more or less rounded, but convergent, flanks. Umbilicus becomes more evolute during shell growth (U/D = 0.36–0.53). Umbilical margin rounded and its slope steep. At D = ~ 158 mm, the inner ribs are still dense (P = 22), prorsiradiate and slightly concave adaperturally. They divide on 2–3, thinner outer ribs. During the shell growth, the inner ribs gradually disappear and at D = ~ 200 mm they are lacking. The outer ribs, on the other hand, are still visible at D = 306 mm. Body chamber is slightly longer than one whorl.

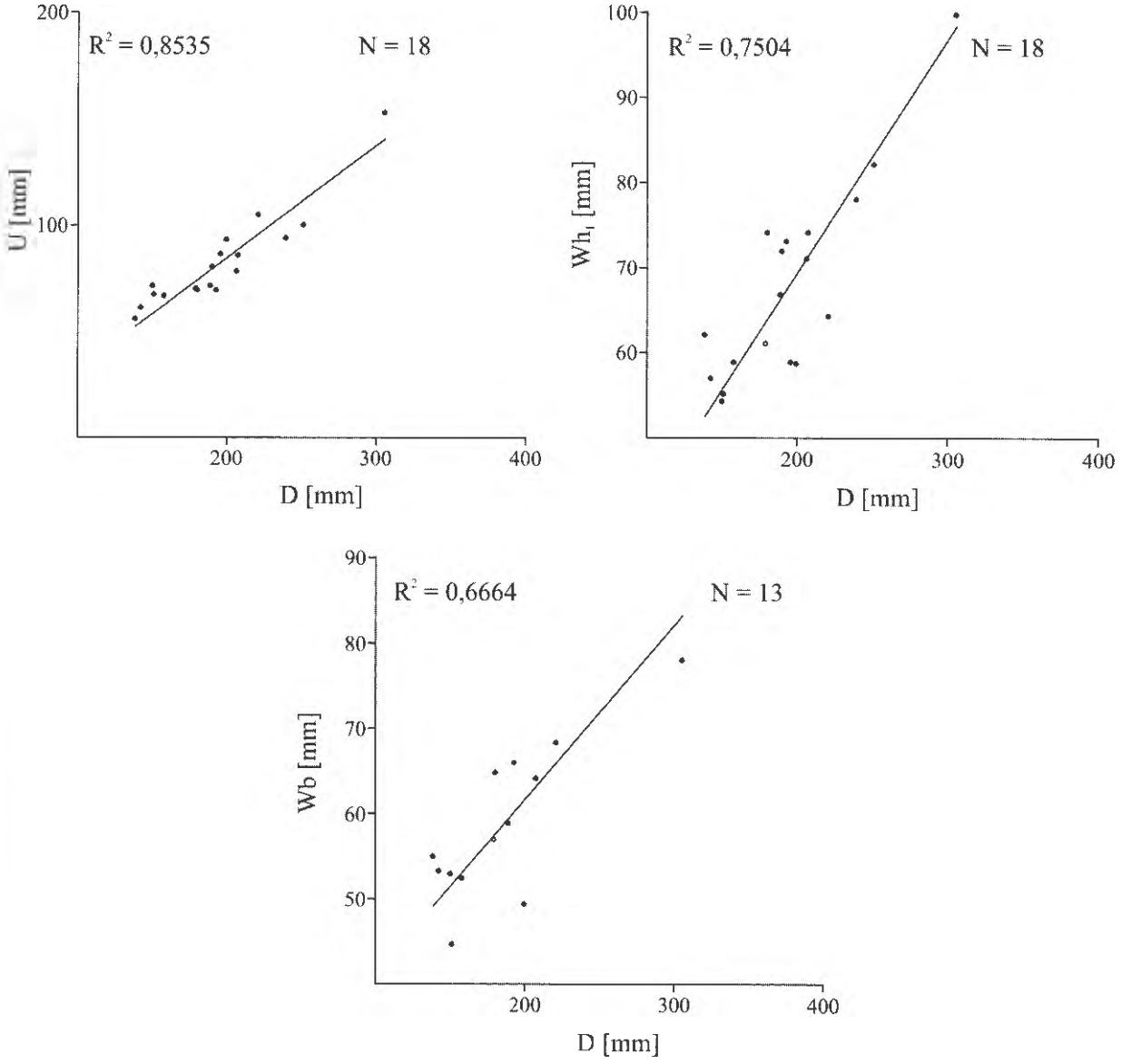
Remarks: According to ARKELL (1958), HAHN (1969), MANGOLD (1970a), KRYSTYN (1972) and SANDOVAL (1983), the species *P. quercinus* (TERQUEM & JOURDY) [M] is characterized by its high degree of variability in evolutness and ornamentation. Majority of specimens investigated here, is represented by medium-sized shells, probably belonging to young individuals because the adult ones may have attained even 402 mm (ARKELL 1958). Nonetheless, concerning the shell evolutness, they are closest to the lectotype and the specimens presented by ARKELL (1958), KRYSTYN (1972) and SANDOVAL (1983). The specimens presented by HAHN (1969), as well as by MANGOLD (1970a) and MANGOLD & RIOULT (1997), are definitely more evolute. The specimen IGPUW/J/150 is identical to that illustrated by KRYSTYN (1972, pl. 16, fig. 1). The similar species is *P. mirabilis* (ARKELL) [M], however, it differs from *P. quercinus* by its higher whorl cross-section and much earlier disappearing inner ribs. Lower Bathonian *P. laeviplex* (QUENSTEDT) [M] possesses more rounded whorl cross-section, much thicker and more distant ribbing. *P. hodsoni* ARKELL [M] differs by its higher whorl cross-section with flatter flanks, higher involutness, and longer, denser and persistent inner ribs.

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Anna' and 'Kawodrza' clay-pits), Gnaszyn Dolny ('Gnaszyn' clay-pit) and Grodzisko. This species is also known from Middle Bathonian of England (ARKELL 1958), Lower to Upper Bathonian of Germany (HAHN 1969), Upper Bathonian of France (MANGOLD 1970a), upper part of the Middle Bathonian of Spain (SANDOVAL 1983) and condensed Middle/Upper Bathonian of Austria (KRYSTYN 1972).

Procerites gallus (STEPHANOV 1972) [m]

(Plate 6A, Text-fig. 10K)

1972 *Siemiradzkia* (*Siemiradzkia*) *galla* nov. sp., STEPHANOV, p. 51, only pl. 9, fig. 1 (holotype).



Text-fig. 8. Plots of umbilical width (U), outer whorl height (Wh.) and whorl breadth (Wb) against shell diameter (D) in *Procerites quercinus* (TERQUEM & JOURDY) [M].

1983 *Procerites* (*Siemiradzkia*) *gallus* (STEPHANOV), SANDOVAL, p. 459, pl. 42, figs. 2, 4, text-figs. 128P, 131A.

non 1994b *Siemiradzkia galla* STEPHANOV, GALACZ, p. 144, pl. 2, fig. 4 (=*P. demariae* (PARONA & BONARELLI) [m]).

Material: Four body chambers.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3054	78.1	33.0	28.1	24.0	23.0	16	47	0.42	0.36	0.29	0.82	2.07
GIUS 8-3055	93.0	~40.5	33.0	-	~27.5	~19	~43	~0.43	0.35	0.29	0.83	-
IGPUW/J/WM-5	79.5	36.0	24.2	21.7	23.0	~21	51	0.45	0.30	0.29	0.95	1.89
IGPUW/J/KP-12-8	109.2	45.7	36.0	29.0	27.8	?	?	0.42	0.33	0.25	0.77	1.85

Description: Shells of moderate sizes (D = 78.1–109.2 mm), semi-involute (U/D = 0.42–0.45), planulate. Whorl cross-section (Text-fig. 10K) oval-rounded (Wb/Wh_1 = 0.77–0.95), however, at the end of the phragmocone and the beginning of the body chamber it may be slightly trapezoidal, with flat flanks and venter. Umbilical slope short and steep, umbilical margin rounded. Inner ribs distinct, quite dense (P = 16–21), thick and irregular. In some places they may be rectiradiate, prorsiradiate or flexuous and even rursiradiate. On the umbilical margin characteristic swellings occur. They divide on two outer ribs (S = 43–51). The bifurcation point is variously situated – at the mid-height of the whorl or above. Intercalatory ribs are often present. On the ventro-lateral margin, parabolic ribs and nodes also occur. Body chamber attains c. ¾ of the last whorl. Aperture is ended with a pair of short, lateral lappets.

Remarks: Ornamentation and whorl cross-section of the specimens described are very similar to those of the holotype, as well as to the specimens from Spain (SANDOVAL 1983). The only difference is somewhat greater degree of involutness of the specimens described here. Unfortunately, the real intraspecific variability of this species is unknown. This species was described on the basis of two specimens only (STEPHANOV 1972): the holotype and paratype. However, the latter was assigned to *P.* (*Siemiradzkia*) *lissajousi* MANGOLD by SANDOVAL (1983). In Spain, *Procerites gallus* (STEPHANOV 1972) is known from only two specimens, as well. Ornamentation of *Perisphinctes* (*Grossouvria*) *matisconensis* LISSAJOUS (1923, pl. 6, only fig. 1) enables to consider this species as a synonym of *P. gallus* (STEPHANOV). The microconch *P. matisconensis* LISSAJOUS (MANGOLD 1970a, pl. 5, figs. 6, 12–13) was rightly considered as a synonym of *P. gallus* (STEPHANOV) by SANDOVAL, because its ornamentation pattern is similar to that of the holotype of *P. gallus* (STEPHANOV). *P. pseudorjazanensis* (LISSAJOUS) differs from *P. gallus* (STEPHANOV) by its finer inner ribs. *P. choffatiformis* (STEPHANOV) on the other hand, is more evolute and its ribs have regular, rectiradiate pattern.

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Kawodrza' clay-pit) and Gnaszyn Dolny ('Gnaszyn' clay-pit). This species is also known from France (STEPHANOV 1972) and Spain (SANDOVAL 1983).

Procerites pseudoperspicuus (STEPHANOV 1972) [m]

(Plate 6B–D, Text-fig. 10M)

1958 *Siemiradzkia* (*Siemiradzkia*) *verciacensis sparcicostata* nov. ssp., WESTERMANN, pl. 37, only fig. 4.

1972 *Siemiradzkia* (*Prevalia*) *pseudoperspicua* sp.n., STEPHANOV, p. 63, pl. 13, figs. 2–4.

Material: Nine specimens including one body chamber.

Nr	D	U	Wh	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3056	72.0	35.0	22.15	-	21.1	21	48	0.49	0.31	0.29	0.95	1.51
GIUS 8-3057	83.7	40.3	26.4	-	~23.0	21	55	0.48	0.31	~0.27	~0.87	1.93
GIUS 8-3058	145.7	71.4	40.6	-	37.6	20	~52	0.49	0.28	0.26	0.93	-
IGPUW/J/KP-9-3	110.0	54.8	34.8	-	-	22	21	0.50	0.32	-	-	-
GIUS 8-3059	124.0	62.6	35.4	-	-	22	~53	0.50	0.28	-	-	-

Description: Shells moderate to quite large sizes (D = 72.0–145.7 mm), semi-evolute (U/D = 0.48–0.52), planulate. Whorl cross-section (Text-fig. 10M) oval-rounded to rounded (Wb/Wh_1 = 0.87–1.14). Umbilicus wide with quite high, steep slope and rounded margin. Inner ribs (P = 20–23) prorsiradiate, straight or slightly sinuous. On the preserved phragmocones the inner ribs divide on two, thinner outer ribs. Their number per half a whorl varies (S = 21–55). Intercalatory ribs present. Constrictions also present, however due to state of preservation it is hard to deduce their number. Parabolic nodes are most developed in the specimen GIUS 8-3056, where they occur as three successive series on the half of the body chamber. The body chamber, attaining c. ¾ of the last whorl is ended with a pair of lateral lappets, and the peristome is preceded by thicker outer ribs.

Remarks: According to STEPHANOV (1972), there is some variability within this species, as evidenced by a degree of involutness, rib density and thickness. Indeed, the all specimens described here show such variability. The only difference is shell size. STEPHANOV (1972) stated, that *Procerites pseudoperspicuus* is the smallest species (shell diameter of the holotype equals 56 mm) within the representatives of his form *Siemiradzkia* (*Prevalia*). Unfortunately, nei-

ther the holotype nor paratypes possess the aperture preserved. Therefore, it is not clear, whether these specimens were mature or maybe only young individuals. Within the specimens described here, the smallest but mature individual measures 72 mm. Shell diameter of the largest one, on the other hand, measures 145.7 mm. Because of a bad state of preservation, two specimens (IGPUW/J/144-145) were assigned as *P.* cf. *pseudoperspicuus* (STEPHANOV) [m] (Plate 6E).

Siemiradzkia (*Siemiradzkia*) *verciacensis sparcicostata* WESTERMANN and '*Perisphinctes*' (*Grossouvria*) *perspicuus* PARONA (LISSAJOUS 1923, pl. 6, fig. 5) were considered as synonym of *P. pseudoperspicuus* (STEPHANOV) by STEPHANOV (1972). However, the specimen of LISSAJOUS (1923) *de facto* is *Choffatia bugesiaca* Dominjon [= *Homoeoplanulites* (*Homoeoplanulites*) *bugesiacus*, MANGOLD 1970a]. *P. pseudoperspicuus* (STEPHANOV) differs from *P. pseudorjazanensis* (LISSAJOUS) by its more distinct and thicker ribs that are prorsiradiate-straight, while in the latter species the ribs are finer, denser and characteristically sigmoidal. *P. repljaensis* (STEPHANOV) is more involute and possesses well-developed parabolic nodes, even in the individuals of larger shells (D = 119 mm).

Occurrence: Middle Bathonian (Morrisi Zone) of Kawodrza Dolna ('Kawodrza' clay-pit). This species is also known from France (LISSAJOUS 1923), Germany (WESTERMANN 1958) and Bulgaria (STEPHANOV 1972).

Procerites pseudorjazanensis (LISSAJOUS 1923) [m]
(Plate 6F–G, Text-fig. 10L)

1923 *Perisphinctes* (*Grossouvria*) *pseudo-rjazanensis* LISSAJOUS, LISSAJOUS, p. 57, pl. 4, fig. 4.
1923 *Perisphinctes* (*Grossouvria*) *berthae* LISSAJOUS, LISSAJOUS, p. 58, pl. 5, figs. 1–2.
1923 *Perisphinctes* (*Grossouvria*) *matisconensis* LISSAJOUS, LISSAJOUS, pl. 5, fig. 3.
? 1958 *Siemiradzkia pseudorjazanensis* (LISSAJOUS), ARKELL, p. 228, pl. 32, fig. 7.
1972 *Siemiradzkia* (*Siemiradzkia*) *pseudorjazanensis* (LISSAJOUS), STEPHANOV, p. 43, pl. 4, figs. 2–3, pl. 5, figs. 1–3.
1972 *Siemiradzkia* (*Siemiradzkia*) *berthae* (LISSAJOUS), STEPHANOV, p. 45, pl. 6, figs. 1–2.

Material: Eighteen specimens, variously preserved, most often as body chambers, and a few whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3060	119.0	~57.0	~38.8	-	-	~21	~42	~0.48	~0.33	-	-	1.72
GIUS 8-3061	103.0	44.0	34.0	-	31.0	29	59	0.43	0.33	0.30	0.91	1.99
GIUS 8-3062	104.0	-	-	-	31.0	23	46	-	-	0.30	-	-
GIUS 8-3063	77.5	~38.5	27.0	-	22.0	20	41	~0.50	0.35	0.28	0.81	-
GIUS 8-3064	89.0	~34.4	36.0	-	-	20	~53	~0.39	0.40	-	-	2.13
GIUS 8-3065	120.0	~47.0	44.4	-	-	20	47	~0.39	0.37	-	-	-
GIUS 8-3066	82.0	38.0	28.3	25.9	27.5	~22	44	0.46	0.34	0.33	0.97	-
GIUS 8-3067	100.3	48.2	32.4	-	27.2	20	›	0.48	0.32	0.27	0.84	-
IGPUW/J/71	89.0	33.0	32.5	-	27.5	~22	55	0.37	0.36	0.31	0.85	-
IGPUW/J/86	86.5	34.5	28.0	-	~21.5	›	›	0.40	0.32	~0.25	~0.77	-

Description: Shells of moderate to quite large in size (D = 77.5–120.0 mm), semi-evolute (U/D = 0.37–~0.50), planulate. Whorl cross-section (Text-fig. 10L) in a terminal part of the phragmocone is trapezoidal, higher than wide (Wb/Wh_1 = 0.77–0.97) with flat and slightly convergent flanks, and nearly flat to slightly rounded venter. At the aperture, the whorl cross-section becomes more oval but still high. Umbilical slope short and inclined, umbilical margin rounded. Inner ribs (P = 20–29) thin, straight but often sigmoidal. Their density on a whorl varies. They divide on two outer ribs (S = 41–59), that are bent adapically. On the venter, they are interrupted by a narrow siphonal belt, which is visible primary on the cast. Parabolic ribs and nodes present and well-marked on the first half of the body chamber. The intercalatory and single ribs also present, especially on the second half of the body chamber. Body chamber attains c. ¾ of the last whorl. Aperture is ended with a pair of spatulate lappets. It is preceded by four much thicker outer ribs.

Remarks: The ribbing pattern of the specimens described here is the same as in the lectotype (LISSAJOUS 1923) and STEPHANOV's (1972) specimens. The variability within this species is marked in the ribbing pattern, as well as in the degree of shell involutness.

Also the parabolic nodes may be either very distinct or completely lacking (STEPHANOV 1972). '*Siemiradzkia*' (*Siemiradzkia*) *berthae* (LISSAJOUS), presented by STEPHANOV (1972), differs from *P. pseudorjazanensis* (LISSAJOUS) only by its more numerous intercalatory or tertiary ribs, however, the ribbing pattern and degree of involutness is similar (STEPHANOV 1972). Comparing the lectotypes of these two species, it is evident that they are the same species. Moreover, STEPHANOV (1972) presented two other specimens of '*S.*' (*S.*) *berthae* (LISSAJOUS), that are much more evolute than the lectotype. Their inner ribs, on the other hand, are denser and the secondary ones bifurcating as in *P. pseudorjazanensis* (LISSAJOUS). The number of parabolic nodes is also the same (STEPHANOV 1972). The greater number of tertiary ribs is not a sufficient criterion for species distinction, so *P. berthae* (LISSAJOUS) is here considered as a younger synonym of *P. pseudorjazanensis* (LISSAJOUS). *P. matisconensis* (LISSAJOUS) is another species, which is much related to *P. pseudorjazanensis* (LISSAJOUS). Their distinction was difficult to some of the researchers. According to SANDOVAL (1983), *P. matisconensis* (LISSAJOUS) differs by its more involute shell, more depressed whorl cross-section and thicker inner ribs on the body chamber. STEPHANOV (1972), on the other hand, stated that *P. matisconensis* (LISSAJOUS) possesses more tertiary ribs, what distinguish it from *P. berthae* (LISSAJOUS). However, STEPHANOV (1972) in his remarks to the species *P. berthae* (LISSAJOUS) denied himself stating that this species possesses more tertiary ribs than *P. matisconensis* (LISSAJOUS). Moreover, as the lectotype of *P. matisconensis* (LISSAJOUS), ARKELL (1958) selected the specimen of LISSAJOUS (1923, pl. 5, fig. 3) and this view was accepted by STEPHANOV (1972). SANDOVAL (1983), on the other hand, considered this lectotype as a species *P. pseudorjazanensis* (LISSAJOUS). The facts presented here point to taxonomic 'mess' in the microconch *Procerites – Siemiradzkia* group. It is not excluded that in the future *P. matisconensis* (LISSAJOUS) will be considered as a synonym of *P. pseudorjazanensis* (LISSAJOUS).

Occurrence: Upper Bathonian (Hodsoni and Orbis zones) of Kawodrza Dolna ('Kawodrza' and 'Anna' clay-pits), Gnaszyn Dolny ('Gnaszyn' clay-pit), Zarki and Krzyworzeka. This species is also known from the Middle and Upper Bathonian of France, Bulgaria, Romania and England (STEPHANOV 1972).

Procerites aff. *verciacensis* (LISSAJOUS 1923) [m]

(Plate 6H)

Material: Two nearly complete and one incomplete specimens.

Nr	D	U	Wh	Wh_1	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/41	125.0	52.0	41.3	-	~33.8	~22	50	0.42	0.33	~0.27	~0.82	-
GIUS 8-3068	115.8	56.6	35.2	-	~36.0	~29	>50	0.49	0.30	~0.31	~1.02	-
GIUS 8-3069	~96.7	47.9	35.5	29.9	32.0	~28	>58	~0.50	~0.37	~0.33	0.90	-

Description: Shells of moderate to quite large sizes (D = ~96.7–125.0 mm), semi-evolute (U/D = 0.42 – ~ 0.50), planulate. On the inner and middle whorls the shell is more evolute and on the last whorl it becomes more involute. In a terminal part of a phragmocone, whorl cross-section is trapezoidal with nearly flat, convergent flanks and slightly rounded venter. At the end of the body chamber, on the other hand, the whorl cross-section is high-oval (Wb/Wh_1 = ~ 0.82 – ~ 1.02). Umbilical slope quite high and steep, and its margin rounded. Inner ribs (P = ~ 22–29) are very dense on the inner and middle whorls. They are sharp, straight or slightly bent adaperturally, prorsiradiate. However, on the last whorl they loose their sharpness. They are thin, slightly rounded. On the inner and middle whorls, shallow constrictions are also present. The inner ribs divide on two or three thinner outer ribs. The body chamber attains ¾ of the last whorl. The aperture is ended with lateral lappets and preceded by a few much thicker outer ribs on the venter.

Remarks: The specimens investigated are represented by forms with the most massive shells of all the *Procerites* microconchs described here. They are similar to the lectotype of *P. verciacensis* (LISSAJOUS 1923, pl. 7, fig. 1), which was designated by ARKELL (1958). However, they differ in lacking distinct constrictions on the body chamber, the number of which equals three per a whorl in the lectotype. As in the lectotype, in the specimens described here there is a lack of para-

bolic nodes. However, the terminal part of the phragmocone is not preserved, thus it is not certain whether they ever were present. *P.* (*Siemiradzkia*) sp. aff. *verciacensis*, described by SANDOVAL (1983) also does not possess constrictions preserved, and its shell is more involute. The specimens described here differ from the other species of *Procerites* microconchs by their massive shell and irregular ribbing pattern. On the basis of involutness and ornamentation, STEPHANOV (1972) considered '*Perisphinctes*' (s.str.) *subfluctuosus* LISSAJOUS as a younger synonym of *P. verciacensis* (LISSAJOUS).

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

Procerites sp. [M]

(Plate 5C)

Material: Four poorly preserved and incomplete specimens.

Description and remarks: The specimens are characterized by semi-involute shells that, if complete, would have attained c. 200 mm in diameter. On the inner whorls, the inner ribs are fine, rectiradiate and quite dense. On the outer whorls they are thicker but still rectiradiate. Whorl cross-section higher than wide, oval in outline (GIUS 8-2841-2842, TK-P1), or wide and massive, oval-rounded (GIUS 8-2840). Umbilical slope nearly vertical, short and its margin rounded. Inner ribs divide on 2–3 outer ribs above the mid-height of the whorl. They are thinner and rectiradiate.

The poor state of preservation prevents the ornamentation to be observed in many parts of the shells. The massive whorl cross-section of the specimen GIUS 8-2840 resembles *P. imitator* (BUCKMAN), but its inner ribs are weaker. From *P.* cf. *imitator* (BUCKMAN) described above, it differs by its greater involutness. The specimens of *P. quercinus* (TERQUEM & JOURDY) described above, possess distinctly adaperturally concave inner ribs, more prorsiradiate outer ribs, more evolute shells and narrower whorl cross-section.

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Kawodrza' clay-pit), Gnaszyn Dolny ('Gnaszyn' clay-pit) and Grodzisko.

Procerites sp. indet. 1 [juv. M?]

(Plate 5A)

Material: One well-preserved specimen.

Description: Small-sized (D = 45.3 mm), semi-evolute (U/D = 0.46), planorbicone shell. Probably it belonged to a juvenile individual. Whorl cross-section rounded. Umbilicus shallow, with short and steep slope and rounded margin. Inner ribs dense, sharp and prorsiradiate on the inner and middle whorls. On the body chamber, they are slightly adaperturally concave. They divide on two outer ribs of similar thickness. Intercalatory and single ribs often occur. The last whorl possesses two distinct constrictions running parallel to the ribbing. Body chamber attains c. one last whorl.

Remarks: The specimen described is identical to that presented by STURANI (1966, pl.10, fig. 3), coming from the uppermost part of the Yeovilensis Zone of France. Like the specimen presented by STURANI, species determination of the specimen described here is impossible on that ontogenetical stage, because many *Procerites* species possess similar inner and middle whorls (ARKELL 1958). Although the aperture is missing, at this body chamber length there should be visible any changes in ornamentation suggesting the presence of lateral lappets. However, they are completely lacking. Therefore, this specimen probably represents a juvenile macroconch.

Occurrence: Lower Bathonian (Tenuiplicatus Zone) of Kawodrza Gorna ('LAB' clay-pit).

Procerites sp. indet. 2 [m]

Material: Five body chamber fragments.

Remarks: Ribbing, as well as whorl cross-section point to the genus *Procerites*, and the adaperturally thickening of the last outer ribs on the venter suggests the specimens are microconchs.

Occurrence: Lower Bathonian (Tenuiplicatus Zone) or Middle Bathonian (Progracilis Zone) of Faustianka.

Procerites sp. indet. 3 [m]

Material: One complete but strongly deformed and crushed specimen.

Description and remarks: The specimen is complete, but strongly deformed, with crushed last part of phragmocone and lacking some parts of inner and middle whorls. Shell moderate in size (D = ~ 73 mm), semi-evolute. Whorl cross-section oval-rounded at the end of the body chamber, higher than wide. Umbilical slope seems to be steep, and a margin rounded. Inner ribs sharp, prorsiradiate on visible inner and middle whorls. On the body chamber, they are somewhat thicker, dense, prorsiradiate, rectiradiate to rursiradiate in some places. Below the ventro-lateral margin,

they bifurcate. Parabolic nodes not visible. At the end of the body chamber, intercalatory and single ribs occur. Aperture is preceded by 4–5 thicker outer ribs and ended with lateral lappets, preserving only their proximal parts. Poor state of preservation precludes the species determination of this microconch.

Occurrence: Upper Bathonian (probably the Orbis Zone) of Zarki.

Genus *Wagnericeras* BUCKMAN, 1920

Type species *Ammonites wagneri* OPPEL, 1857

Wagnericeras fortecostatum (DE GROSSOUVRE 1930) [M]

(Plate 6I–J, Text-fig. 10N)

1958 *Wagnericeras fortecostatum* (DE GROSSOUVRE), ARKELL, p. 204, pl. 29, figs. 2–3, text-fig. 76 (holotype).

1969 *Wagnericeras fortecostatum* (DE GROSSOUVRE), HAHN, p. 69, pl. 1, fig. 7, text-fig. 8.

1983 *Wagnericeras fortecostatum* (DE GROSSOUVRE), SANDOVAL, p. 493, pl. 52, figs. 1, 3, pl. 55, fig. 3, text-figs. 133J, 134D–E, G, 136.

1987 *Wagnericeras fortecostatum* (DE GROSSOUVRE), TORRENS, p. 100, pl. 5, figs. 1, 3–4.

2000 *Wagnericeras fortecostatum* (DE GROSSOUVRE), MATYJA & WIERZBOWSKI, p. 206, pl. 7, fig. 2.

Material: Four specimens consisting of one well-preserved specimen but without the inner whorls visible, one well-preserved body chamber and two body chamber fragments.

Nr	D	U	Wh	Wh_1	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3070	107.3	48.6	33.95	-	-	12	48	0.45	0.32	-	-	-
IGPUW/J/KP-7-8	-	~65.7	51.0	-	45.8	~13	>43	-	-	-	0.90	-

Description: Shells quite large (D = 107.3–155.8 mm), semi-evolute (U/D = 0.45–0.48), planulate. During shell growth, umbilicus slowly widens. Whorl cross-section (Text-fig. 10N) oval-rounded (Wb/Wh_1 = 0.9–~1.06), with wide venter. The whorls become somewhat higher than wide during the shell growth. Umbilical slope steep and a margin rounded. Inner ribs thick, not dense (P = 12 at D = 107.3, P = 14 at D = 155.8), sigmoidal. They divide on 2–3 thinner outer ribs. Between the outer ribs, two intercalatory ribs may occur. On the body chamber, attaining more than one last whorl, one shallow but distinct sigmoidal constriction occurs. The body chamber is ended with smooth aperture, preceded by shallow pre-apertural constriction.

Remarks: The characteristics of the specimens described well-agree with the species *W. fortecostatum* (DE GROSSOUVRE). Especially the involutness and ribbing pattern are the same. *W. bathonicum* ARKELL differs by its denser ribbing and narrower whorl cross-section. *W. suspensum* (BUCKMAN) is more involute and its ornamentation (mainly inner ribs) is marked very weakly. *W. wagneri* (OPPEL) is the closest species, however, it possesses sharper, stronger inner ribs and wider whorl cross-section. *W. arbustigerum* (D'ORBIGNY) has high whorl cross-section and weaker inner ribs.

The species *W. fortecostatum* (DE GROSSOUVRE) is characterized by its quite long stratigraphic range, from the Lower Bathonian (Tenuiplicatus Zone) up to the Upper Bathonian (TORRENS 1987, MATYJA & WIERZBOWSKI 2000).

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Kawodrza' clay-pit) and Gnaszyn Dolny ('Gnaszyn' clay-pit). It was also described from the Lower Bathonian of Faustianka by MATYJA & WIERZBOWSKI (2000). *Wagnericeras fortecostatum* (DE GROSSOUVRE) is also known from England (ARKELL 1958), Germany (HAHN 1969), France (STURANI 1966, TORRENS 1987) and Spain (SANDOVAL 1983).

Subfamily Pseudoperisphinctinae SCHINDEWOLF, 1925

Remarks: Within this subfamily, MANGOLD (1970a) distinguished the following genera/subgenera: *Choffatia* SIEMIRADZKI, 1898 [M], *Subgrossouvria* SPATH, 1924 [M], *Grossouvria* SIEMIRADZKI, 1898 [m], *Homoeoplanulites* BUCKMAN, 1922 [m] and *Parachoffatia* MANGOLD, 1970a [M]. However, classification of specimens to one of the above mentioned taxa may be difficult, due to the presence of

transitional features or very subtle morphological differences (e.g., MANGOLD 1970a, GALÁCZ 1980, SANDOVAL 1983, PARENT 1998). Such variability is often observed in the same species. Later, lacking the equivocal criterions, all the genera/subgenera mentioned above were included in one genus *Choffatia* SIEMIRADZKI by SANDOVAL et al. (1990) and PARENT (1998). Such a procedure seems to be reasonable, because, as PARENT (1998) has already stressed, the taxonomy of Pseudoperisphinctinae on the genus level is typological. The latter author stated that having no sufficient number of specimens from the same stratigraphic horizon, the recognition of within-species variability is very difficult or even impossible. Therefore, because of the lack of enough large number of specimens, it is decided here to classify different morphotypes as a single genus *Choffatia* SIEMIRADZKI.

Genus *Choffatia* SIEMIRADZKI, 1898

Type species *Perisphinctes cobra* WAAGEN, 1875

Synonyms: Apart of the taxa mentioned above: *Anaplanulites* BUCKMAN, 1922 and *Loboplanulites* BUCKMAN, 1925.

Choffatia arisphinctoides ARKELL, 1958 [M]
(Plate 7A–B, D–F, Text-fig. 10O)

1923 *Perisphinctes* (*Procerites*) *moorei* OPPEL, LISSAJOUS, p. 80, pl. 13, fig. 1.
1958 *Choffatia arisphinctoides* n. sp., ARKELL, p. 218, pl. 32, figs. 3 & 10.
1970a *H.* (M. *Parachoffatia*) *arisphinctoides* (ARKELL), MANGOLD, p. 79, pl. 3, fig. 10.
1983 *Homoeoplanulites* (*Parachoffatia*) *arisphinctoides* (ARKELL), SANDOVAL, p. 486, pl. 48, fig. 2, text-fig. 134A.

Material: Thirteen specimens variously preserved, including inner and fragmentary whorls.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/C-4	160.5	71.3	59.0	-	59.5	15	-	0.44	0.37	0.37	1.0	-
IGPUW/J/C-6	205.0	84.2	61.2	-	-	13	-	0.41	0.30	-	-	-
IGPUW/J/C-7	230.0	107.4	82.0	-	~72.8	-	-	0.47	0.36	~0.32	~0.89	-
IGPUW/J/Chc-2	-	89.0	~71.0	-	~78.8	~13	-	-			~1.11	-
IGPUW/J/Chc-3	~182.0	76.3	67.4	-	67.7	14	-	~0.42	~0.42	~0.37	1.0	1.49
GIUS 8-3202	-	-	41.0	-	43.6	-	-	-			1.06	-
GIUS 8-3203	-	-	64.0	-	65.5	-	-	-			1.02	-
GIUS 8-3204	-	-	56.0	-	53.5	-	-	-			0.95	-
GIUS 8-3205	~185.0	90.3	60.0	-	-	-	-	~0.49	~0.32	-	-	-

Description: The specimens are most often preserved as inner whorls or phragmocones of large individuals with body chamber partially preserved. Shells large-sized (D up to 230 mm), semi-evolute (U/D = 0.41–0.49), planorbicone on younger (up to D = ~ 110 mm) and planulate on later ontogenetical stages. Older whorls (up to D = ~ 110 mm) depressed, with circular whorl cross-section (Text-fig. 10O). Later, the whorl height increases and the whorl cross-section is high-oval. Generally, the Wb/Wh_1 ratio ranges from ~ 0.89 to 1.11. Umbilicus shallow with steep slope and rounded margin. Its width varies to some degree (U/D = 0.41–0.49). Inner ribs prorsiradiate, sharp and dense on inner whorls (P = 19). Constrictions in a number 2–3 per a whorl occur. During shell growth, the inner ribs gradually become more distant and less sharp (at D = 159 mm, P = 14, at D = 205 mm, P = 13). Between the inner ribs 2 intercalatory ribs may occur. The inner ribs divide on 2–3 thinner outer ribs in the mid-line of the whorl height. No specimen possesses a complete body chamber.

Remarks: Characteristics of the specimens investigated agree well with those of the holotype (ARKELL 1958). The only difference is greater evolutness of the Polish specimens. However, as already mentioned above, the U/D varies among particular individuals (MANGOLD 1970a, SANDOVAL 1983). It must be noted that only five specimens of this species have been presented in the literature so far, and thus its intraspecific variability (except the evolutness) is essentially unrecognized.

Homoeoplanulites (*Parachoffatia*) aff. *arisphinctoides* (ARKELL) presented by DIETL (1994) from the uppermost Bathonian possesses similar evolutness (U/D = 0.44), but its inner ribs on the last whorl are much denser. DIETL (1994) suggested it may be com-

pletely different, new species. *Ch. subbackeriae* (D'ORBIGNY) differs by its greater evolutness and more compressed whorls. *Ch. arkelli* (MANGOLD) is more evolute as well, with distinctly thicker inner ribs and more compressed whorls. *Ch. cerealis* ARKELL generally is more evolute and its inner ribs are thicker and more distant already in the inner whorls.

Occurrence: Upper Bathonian (Hodsoni and Orbis zones) of Kawodrza Dolna ('Kawodrza' and 'Anna' clay-pits), Gnaszyn Dolny ('Gnaszyn' clay-pit) and Grodzisko. The holotype of *Choffatia arisphinctoides* ARKELL comes from the Discus Zone of England, although ARKELL (1958) also mentioned about other individuals from the Middle Bathonian. The MANGOLD's (1970a) specimens come from the Upper Bathonian. In Spain, this species is known from the Middle Bathonian (SANDOVAL 1983).

Choffatia cf. *arisphinctoides* ARKELL, 1958 [M]

(Plate 7C)

Material: One, not well-preserved specimen.

Remarks: The specimen under discussion is poorly preserved. Its whorls are affected by calcitic veins and thus dislocated. The inner and outer whorls are poorly visible. However, the ornamentation visible on some whorl fragments consists of dense, sharp and prorsiradiate inner ribs. They divide on 2–3 much thinner outer ribs. Adaperturally, the inner and outer ribs get thicker. Whorl cross-section of the body chamber is roundish, with similar height and width. Despite the poor preservation, the specimen described is close to *Ch. arisphinctoides* ARKELL.

Occurrence: Middle Bathonian (Morrisi Zone) of Bugaj.

Choffatia cerealis ARKELL, 1958 [M]

(Plate 8A, D, 9A, Text-figs. 9–10P)

1958 *Choffatia* (*Choffatia*) sp. a., WESTERMANN, p. 84, pl. 41, pl. 43, fig. 3.

v. 1958 *Choffatia* (*Loboplanulites*) *cerealis* sp. nov., ARKELL, p. 219, pl. 31, Fig. 3-6, text-figs. 79.2-3, 80.2.

1969 *Choffatia* (*Choffatia*) *cerealis* ARKELL, HAHN, p. 76, pl. 3, fig. 3, text-fig. 10a.

1970a *C.* (M. *Subgrossouvria*) *cerealis* ARKELL, MANGOLD, p. 159, pl. 3, fig. 9, text-figs. 115–116.

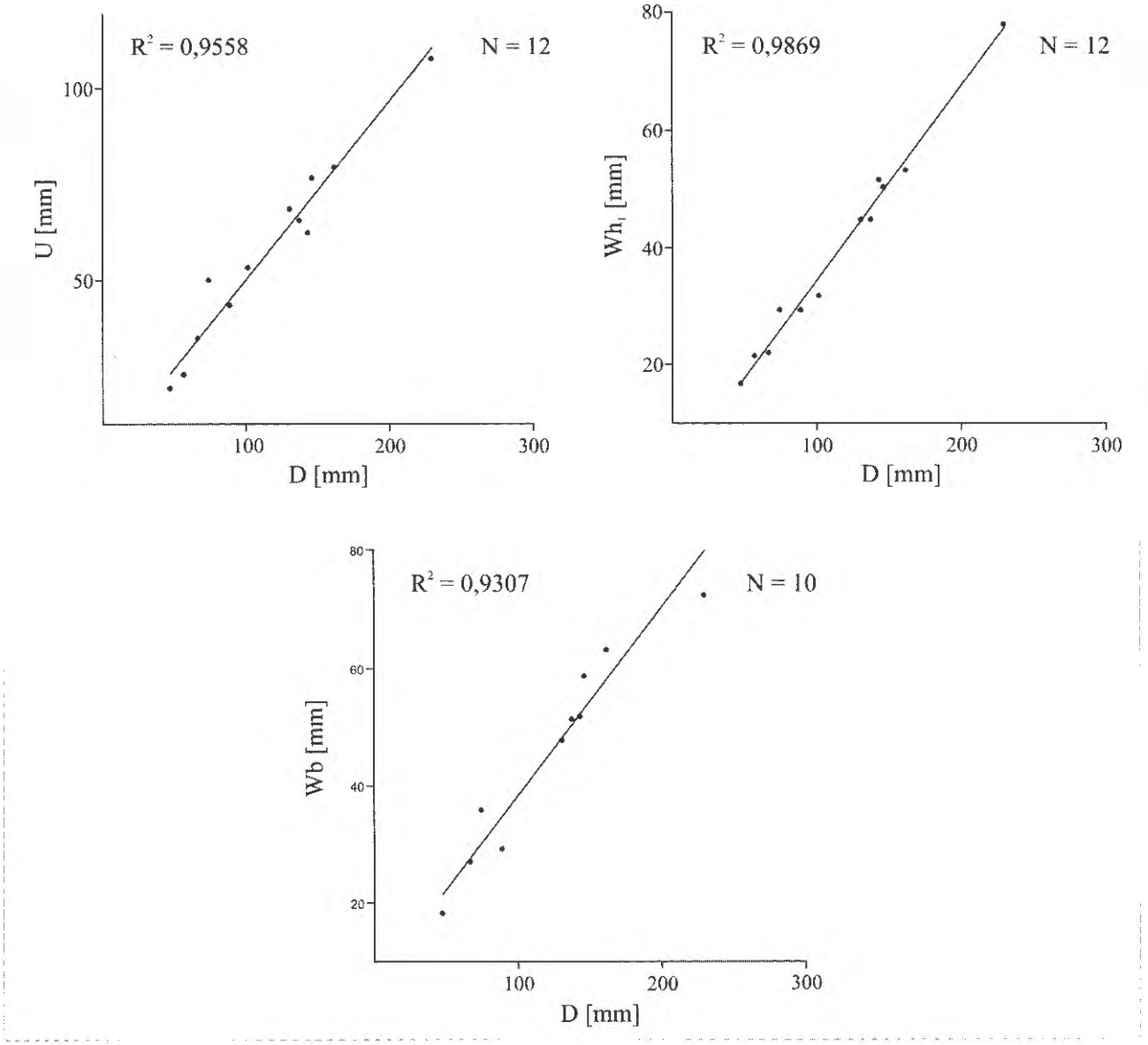
1980 *Choffatia* (*Subgrossouvria*) *cerealis* ARKELL, GALĄCZ, p. 129, pl. 36, fig. 1, text-fig. 110.

1993 *Loboplanulites cerealiformis* BESNOSOV sp. nov., BESNOSOV & MITTA, p. 154, pl. 30, fig. 1.

Material: Eleven, variously preserved specimens, including whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh /D	Wb/D	Wb/Wh_1	WER
IGPUW/J/81	~230.5	107.5	77.8	63.0	72.1	-	-	~0.47	~0.34	~0.31	0.93	~1.9
	137.6	65.6	44.6	35.1	51.0	12	-	0.48	0.32	0.37	1.14	1.71
	74.9	49.8	29.3	24.8	35.6	15	-	0.66	0.39	0.47	1.21	2.3
IGPUW/J/58	131.1	68.2	44.6	36.1	47.4	11		0.52	0.34	0.36	1.06	1.63
	101.9	52.9	31.6	-	-	10	-	0.52	0.31	-	-	-
IGPUW/J/ KP-11-5	~143.6	62.3	51.3	46.5	51.5	~15	~49	~0.43	~0.36	~0.36	1.0	~2.19
	89.5	43.3	29.2	24.8	28.9	16	-	0.48	0.33	0.32	0.99	1.79
	66.6	34.5	21.8	-	26.9	22	~45	0.52	0.32	0.40	1.23	-
GIUS 8-3204	162.5	79.1	52.9	-	63.0	15	-	0.49	0.32	0.39	1.19	-
GIUS 8-3201	57.0	25.0	21.5	-	-	19	51	0.44	0.38	-	-	1.82
	48.0	21.3	16.7	-	18.1	19	47	0.44	0.35	0.38	1.10	-
IGPUW/J/111	~146.2	76.3	50.2	50.2	58.4	12	46	~0.52	~0.34	~0.40	1.16	~2.3

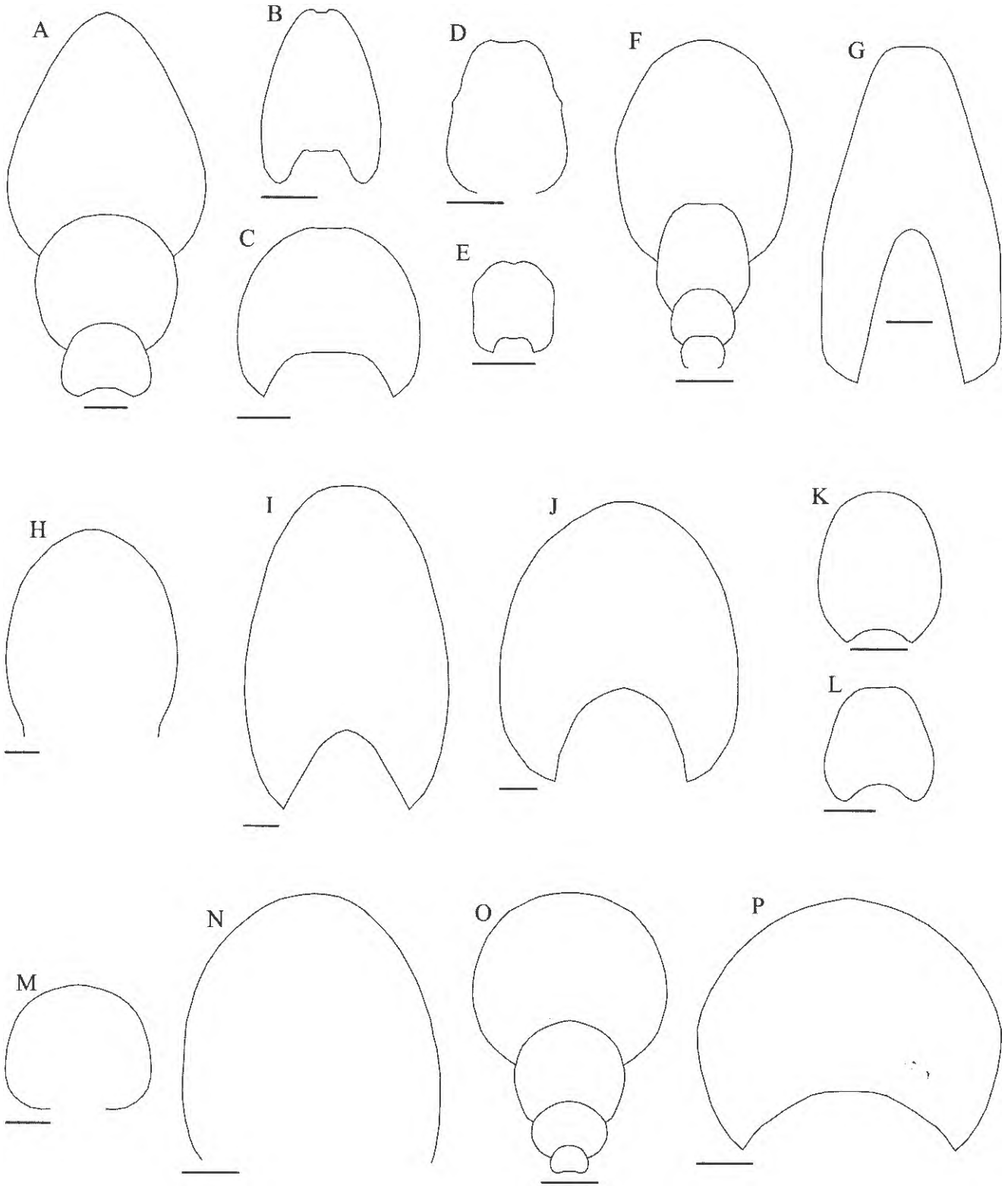
Description: Large forms (D up to ~ 230 mm), with semi-evolute and evolute (U/D = 0.41–0.66) shells on every ontogenetical stages. Umbilicus wide, not deep, its slope is gently inclined and margin rounded. On early whorls (D up to 40 mm), inner ribs prorsiradiate and dense, and whorl cross-section (Text-fig. 10P) wide and rounded (Wb/Wh_1 = 1.1). From the diameter of 40 mm the inner ribs are thick and more distant (P = 19). They divide on two finer outer ribs (S = 47). At D > 130 mm, the whorl cross-section gradually becomes more oval, but its width is still greater than height. The inner ribs also become more distant, blunt but still strong. At D = ≥ 200 mm, the whorl width is lower than its height. Constrictions present but their number is low, up to two per a whorl. None of the specimen has preserved aperture. Suture line poorly visible. E/L is wide, nearly symmetrical and bifid. L/U_2 is narrower and higher than E/L.



Text-fig. 9. Plots of umbilical width (U), outer whorl height (Wh_1) and whorl breadth (Wb) against shell diameter (D) in *Choffatia cerealis* ARKELL [M].

Remarks: On the basis of literature data (ARKELL 1958, WESTERMANN 1958, HAHN 1969, GALACZ 1980, SANDOVAL 1983), it is hard to say more about the intraspecific variability of *Ch. cerealis* ARKELL, because the descriptions are usually based on single specimens. Evolutness, ornamentation and whorl cross-section of the specimens described here are similar to those of the holotype and other individuals presented by the authors mentioned above. The specimen presented by ARKELL (1958, NHM C32424) and assigned as *Ch.* cf. *cerealis* ARKELL, undoubtedly belongs to that species, and its somewhat weaker ribs are only an effect of preservation.

Ch. cerealis ARKELL is a transitional form between the involute group represented by *Ch. longilobata* (BUCKMAN) and the evolute one, represented by *Ch. recuperoi* (GEMMELLARO) (MANGOLD 1970a, GALACZ 1980). Older whorls are very similar to *Ch. rakotondramazavai* (COLLIGNON). This latter species is more evolute, smaller and all the time its whorl cross-section is rounded and depressed. *Ch. uriniacensis* (LISSAJOUS) is also smaller and more evolute, and



Text-fig. 10. Whorl cross-sections of some of the investigated ammonites. A. *Vermisphinctes stomphus* (Buckman) [M], IGPUW/J/Vs-1, B. *Parkinsonia* (*Parkinsonia*) *parkinsoni* (Sowerby) [M], IGPUW/J/21, C. *Parkinsonia* (*P.*) *schloenbachi* Schlippe, IGPUW/J/158, D-E. *Parkinsonia* (*P.*) aff. *dorni* Arkell, D. GIUS 8-21, E. IGPUW/J/234b, F. *Parkinsonia* (*Durotrigensia*) '*neuffensis*' (Oppel) [M], IGPUW/J/N-1, G. *Parkinsonia* (*Oraniceras*) *gyrumbilica* (Quenstedt) [M], IGPUW/J/KP-3-2, H. *Procerites tmetolobus* Buckman [M], IGPUW/J/KP-3-1, I. *Procerites laeviplex* (Quenstedt) [M], AK-L3, J. *Procerites quercinus* (Terquem & Jourdy) [M], GIUS 8-3024, K. *Procerites gallus* (Stephanov) [m], GIUS 8-3054, L. *Procerites pseudorjazanensis* (Lissajous) [m], GIUS 8-3063, M. *Procerites pseudoperspicuus* (Stephanov) [m], AK-P.S-1, N. *Wagnericeras fortecostatum* (de Grossouvre) [M], GIUS 8-3070, O. *Choffatia arisphinctoides* Arkell [M], GIUS 8-3203, P. *Choffatia cerealis* Arkell [M], IGPUW/J/81. Scale bars equal 1 cm.

its ribbing is finer and denser. *Ch. kranaiformis* ARKELL possesses denser and weaker ribbing, and its flanks are less convergent. However, the last three species mentioned above, apart of differences, are morphologically most similar to *Ch. cerealis* ARKELL. Morphologically and stratigraphically, *Loboplanulites cerealiformis* BESNOSOV does not differ from *Ch. cerealis* ARKELL, and thus it is considered here as a younger subjective synonym of the latter. ARKELL (1958) included with a question mark into his synonymy of *Ch. cerealis* ARKELL the species *Perisphinctes* (*Procerites*) *moorei* (OPPEL) (LISSAJOUS 1923). However, the latter species was later considered as a synonym of *Ch. arisphinctoides* ARKELL by MANGOLD (1970a). It cannot be excluded, that the both forms may occur to be synonyms in the future. Then, they would represent two extreme forms within morphologically variable species *Ch. arisphinctoides* ARKELL. However, at the moment, the present material is insufficient to resolve this interesting problem.

Occurrence: Upper Bathonian (Hodsoni Zone) of Kawodrza Dolna ('Kawodrza', 'Anna' and 'Knopik' clay-pits), Gnaszyn Dolny ('Gnaszyn' clay-pit) and Grodzisko. This species is also known from the Upper Bathonian of England (ARKELL 1958), Germany (HAHN 1969), France (MANGOLD 1970a), Hungary (GALACZ 1980) and Spain (SANDOVAL 1983). *Loboplanulites cerealiformis* BESNOSOV [M], considered here as a younger subjective synonym of *Ch. cerealis* ARKELL [M], is known from the Middle Asia (BESNOSOV & MITTA 1993).

Choffatia cf. *subbackeriae* (D'ORBIGNY 1850) [M]

(Plate 8G)

Material: One incomplete and poorly preserved specimen.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3206	~200.0	90.5	47.5	-	-	?	?	~0.45	~0.24	-	-	-

Description: Large-sized (D = ~ 200 mm), semi-evolute (U/D = 0.45) shell with wide and shallow umbilicus. Whorl cross-section on the middle whorls (at D = 68 mm) circular. During growth, the whorl cross-section becomes higher than wide. Inner ribs on the inner whorls prorsiradiate, thin and dense, sometimes rectiradiate. On the preserved body chamber, they are rectiradiate, slightly thickened in the lower part of the whorl and not so dense. They divide on 2–3 thinner outer ribs. Two intercalatory ribs between the inner ones occur, as well. The exact number of inner and outer ribs is unclear due to the poor state of preservation. Shallow constrictions are also visible.

Remarks: The specimen described is quite similar to the species *Choffatia subbackeriae* (D'ORBIGNY), especially with respect to evolutness (U/D = 0.45) and ornamentation, that are the same as in the specimen presented by HAHN (1969, pl. 8, fig. 8). On the last preserved whorl, the inner ribs have weaker relief than in other specimens of this species (e.g., ARKELL 1958, HAHN 1969, GALACZ 1980, SANDOVAL 1983), however, it may be a result of preservation – the ornamentation of this whorl is strongly worn. The whorl cross-section is similar as well, but this feature is variable with respect to geographic distribution of particular populations, as was shown by PARENT (1998, fig. 6).

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

Choffatia sp. ex gr. *vicenti* MANGOLD, 1970a – *praecursor* MANGOLD, 1970a [M]

(Plate 8E, Text-fig. 11A)

Material: Three, poorly preserved whorl fragments of different individuals.

Description and remarks: The best preserved whorl fragment (GIUS 8-3396), partly crushed and incrusted by pyrite, has depressed, rounded cross-section (Text-fig. 11A). Inner ribs thick and quite distant. Above the mid-line of the whorl height they divide on two, thinner outer ribs. Intercalatory ribs also occur in some places.

Although the fragments are closer unidentifiable, their ornamentation and cross-section remind the poorly recognized macroconch species *Ch. vicenti* MANGOLD and *Ch. praecursor* MANGOLD from the Upper Bathonian (Blanazense Subzone) of France (MANGOLD 1970a). Ornamentation of both species mentioned above is similar, but they differ in whorl cross-section. *Ch. vicenti* has high-oval with nearly parallel flanks, and *Ch. praecursor* has more rounded one. It is not excluded that the both species names may be in fact synonyms and are most related with the Argentinian species *Ch. jupiter* (STEINMANN) (PARENT 1998). The whorl cross-section of the fragments investigated here is most similar to that of *Ch. praecursor* MANGOLD.

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

Choffatia cf. *acuticosta* (ROEMER 1911) [m?]
(Plate 8B–C, F)

Material: Five incomplete specimens.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/KP-12-11	41.0	~19.0	~13.5	~13.1	-	21	33	0.46	~0.323	-	-	1.96
IGPUW/J/KP-12-10	41.0	18.2	~12.4	~11.5	12.0	19	51	0.44	~0.28	0.29	~0.97	1.48
IGPUW/J/KP-12-7	~43.4	~20.1	~12.7	-	~12.4	21	-	0.46	~0.29	~0.28	~0.98	~1.61
IGPUW/J/Cha-1	~68.5	-	-	-	-	12	54	-	-	-	-	-

Description: Shells small-sized (D = 41–43.4 mm), represented by inner and middle whorls, and moderate in size (D = ~ 68.5), semi-evolute (U/D = 0.44–0.46), planorbicone. Although some specimens are flattened, the whorl height and width are probably similar. Umbilicus shallow with vertical slope and rounded margin. Inner ribs (P = 12–21) rectiradiate or prorsiradiate, straight and sharp. During growth their number decreases. At the ventro-lateral margin they divide on 2–3 thinner outer ribs (S = 33–54). Intercalatory ribs present, single ribs rare. On one whorl, 2–3 constrictions occur. In the larger (D = ~ 68.5 mm) specimen (IGPUW/J/Ch.a-1), the inner ribs may divide on 3 outer ribs, and the number of intercalatory ones is also greater. Suture line not visible. Body chamber probably attained one last whorl. Aperture is missing, thus it is not certain whether the species under discussion is represented by microconchs. However, it must be stressed that the holotype of *Ch. acuticosta* (ROEMER) also does not possess apertural lappets (WESTERMANN 1958, pl. 42, fig. 3), but the specimens of this species are commonly referred to as microconchs.

Remarks: Because of the state of preservation, as well as juvenile nature of the specimens, their determination to the species level is left in open nomenclature. However, the ribbing and involutness are close to the species *Ch. acuticosta* (ROEMER). The juvenile specimens (IGPUW/J/KP-12-10, IGPUW/J/KP-12-11) are similar to those of WESTERMANN (1958, pl. 44, fig. 2). The larger ones (IGPUW/J/Ch.a-1, RK-C-1), on the other hand, are close to the holotype (WESTERMANN 1958), and to the specimen presented by HAHN (1969, pl. 8, fig. 6).

Occurrence: Upper Bathonian (Hodsoni and/or Orbis zones) of Kawodrza Dolna ('Anna' and 'Knopik' clay-pits) and Gnaszyn Dolny ('Gnaszyn' clay-pit).

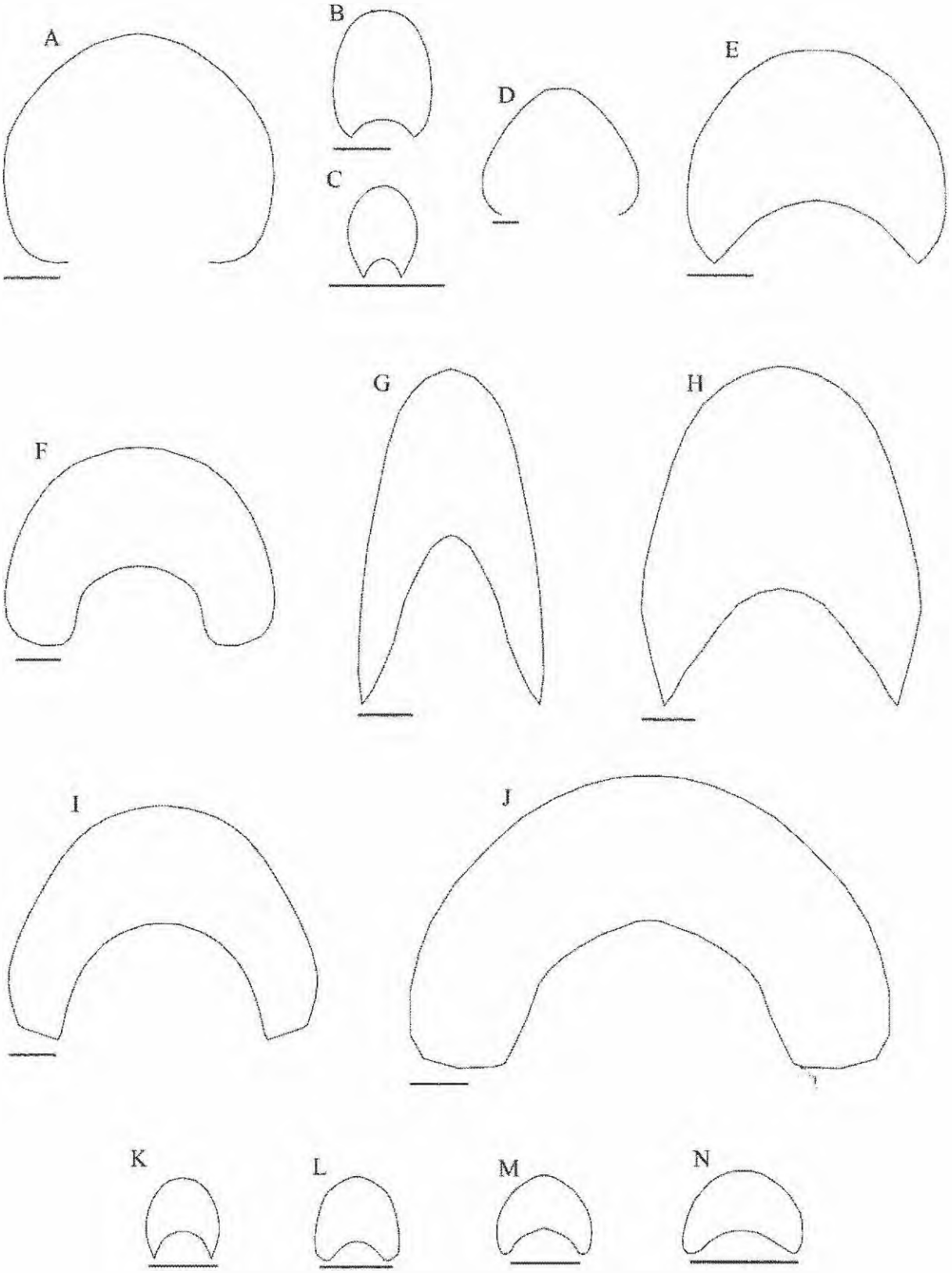
Choffatia sp. [M]
(Plate 9B)

Material: Three very poorly preserved specimens, including one represented by inner whorls only.

Description and remarks: Incomplete shell of the largest specimen could have attained c. 260–270 mm. Up to D = ~ 65 mm, inner whorls are evolute, rounded in cross-section. Inner ribs rectiradiate, dense (P = ~ 27). Umbilicus wide and shallow, with short, gently inclined slope and rounded margin. From D = ~ 87 mm, the shell is still evolute (U/D = ~ 0.48), but the whorl cross-section becomes more oval. The inner ribs become thicker and more distant. They divide on 2–3 outer ribs at the ventro-lateral margin. From D = ~ 150 mm, the inner ribs are of weak relief, and on the body chamber they are hardly visible. The whorl cross-section increases, becoming high-oval with convergent flanks and quite narrow venter. Aperture is missing.

The specimens under discussion are similarly evolute as *Ch. cerealis* ARKELL, however, the latter maintains its widely rounded whorl cross-section much longer, and its inner ribs become thicker and distant much earlier. Ornamentation and whorl cross-section of the specimens described here are also similar to those of *Ch.* (*Choffatia*) sp. 1 described by SANDOVAL (1983, pl. 64, fig. 1, s. 534) from the upper part of Middle Bathonian of Spain.

Occurrence: Upper Bathonian (Hodsoni Zone) of Grodzisko.



Text-fig. 11. Whorl cross-sections of some of the investigated ammonites. A. *Choffatia* sp. ex gr. *vicenti* (MANGOLD) – *praecursor* (MANGOLD) [M], GIUS 8-3396, B-C. *Asphinctites tenuiplicatus* (BRAUNS), B. macroconch, GIUS 8-2735, C. microconch, GIUS 8-2590, D. *Bullatimorphites* (*Bullatimorphites*) *costatus* ARKELL [M], GIUS 8-3029, E. *Bullatimorphites* (*Bullatimorphites*) cf. *serpenticonus* ARKELL [M], GIUS-3403, F. *Bullatimorphites* (*Bullatimorphites*) cf. *polypleurus* (BUCKMAN) [M], IGPUW/J/KP-11-2, G-N. *Morrisiceras morrisi* (OPPEL), G. macroconch, *krumbecki* morphotype, KT-01, H. macroconch, *morrisi* morphotype, GIUS 8-2778, I. macroconch, *sphaera* morphotype, GIUS 8-2794, J. macroconch, *sphaera* morphotype, GIUS 8-2814, K-N. microconchs, respectively GIUS 8-2748, 2758, 2747, 3423.

Family Parkinsoniidae Buckman, 1920
Subfamily Parkinsoniinae Buckman, 1920

Genus *Parkinsonia* Bayle, 1878

Type species *Ammonites parkinsoni* Sowerby, 1821

Synonyms: *Rarecostites* Besnosov & Kutuzova, 1982

Subgenus *Parkinsonia* (*Parkinsonia*) Bayle 1878

Type species *Ammonites parkinsoni* Sowerby 1821

Parkinsonia (*Parkinsonia*) *rarecostata* (Buckman 1881)
(Plate 3G, Text-figs. 7L, 13E)

1846 *Ammonites Parkinsoni*, d'Orbigny, p. 347, pl. 122, only figs. 1–2.
1927 *Parkinsonia subarietis* Wetzel, Nicolesco, p. 23, pl. 1, figs. 12–17, pl. 2, fig. 1, text-fig. 9.
1927 *Parkinsonia Orbignyana* Wetzel, Nicolesco, p. 27, pl. 3, only figs. 2–5.
1971 *Parkinsonia* (*Parkinsonia*) *rarecostata* (Buckman), Pavia, p. 119, pl. 25, fig. 1.
1980 *Parkinsonia* (*Parkinsonia*) *rarecostata* (Buckman), Galacz, p. 91, pl. 20, fig. 4, text-fig. 72 (with full synonymy).
1985 *Parkinsonia rarecostata* (Buckman), Fernandez-Lopez, p. 454, pl. 47, figs. 4–5.
2001 *Parkinsonia* (*Parkinsonia*) *rarecostata* (Buckman), Chandler et al., pl. 1, fig. 1, pl. 4, fig. 2.

Material: Fifty nine whorl fragments of specimens on various stages of development.

Description: The whorl fragments belong to small (Wh_1 = 5.3 mm, Wb = 6.4 mm) and quite large-sized specimens (Wh_1 = 42.3 mm, Wb = 25 mm), with evolute shells. The whorl cross-section is quadrate or trapezoidal, with rounded ventro-lateral margins (Text-fig. 7L). On the juvenile stage, the cross-section is depressed, gradually becoming higher. Venter nearly flat, flanks flat or slightly rounded. Umbilicus wide with low slope and rounded margin. Inner ribs long, prorsiradiate, distant (P = ~ 16–21). On older whorls they are sharp, becoming more rounded with growth. On the ventro-lateral margin they bifurcate. The bifurcation points may be accentuated with small tubercles. Outer ribs (S = ~ 26) short, adaperturally projected. On the venter they are interrupted by narrow sulcus. Intercalatory and single ribs often occur. Suture line (Text-fig. 13E) simple with shallow and wide E. L deeper, narrower and symmetric. E/L wide and weakly divided as L/U_2.

Remarks: After many authors (Sturani 1964a, Pavia 1971, Galácz 1980, Sandoval 1983, Fernandez-López 1985, Rioult et al. 1997), it is here considered that *P.* (*P.*) *subarietis* Wetzel is a younger synonym of *P.* (*P.*) *rarecostata* (Buckman). The same concerns *P.* (*P.*) *orbignyana* Wetzel (Sturani 1964a, Pavia 1971, Galacz 1980, Arkell 1956, Sandoval 1983, Fernandez-Lopez 1985). The thorough discussion on this species was conducted by Galacz (1980). The latter author noted that this species is represented by forms of different sizes with microconchiate aperture. In the material here investigated, there are also small and larger specimens, however, any of the whorls possesses aperture preserved, thus it is unclear whether they represent macro- or microconchs.

P. (*P.*) *rarecostata* (Buckman) differs from the other congeners by its evolutness, quadrate whorl cross-section, sharp and distant inner ribs and short outer ribs. *P.* (*P.*) *acris* Wetzel is a close species, differing in more distinct and sharper ribs, somewhat narrower umbilicus and shallower sulcus. *P.* (*P.*) *arietis* Wetzel possesses more prominent and more distant ribs, as well as a wider sulcus.

Occurrence: Upper Bajocian (Parkinsoni Zone) of Poraj-Kamienica Polska area. This species is also known from the Upper Bajocian of Spain (Sandoval 1983, Fernandez-Lopez 1985), France (Nicolesco 1927), Germany (Dietze 2000), England (Chandler et al. 2001), Italy (Pavia 1971), Hungary (Galacz 1980) and Caucasus (Krymholtz 1988).

Parkinsonia (*Parkinsonia*) *parkinsoni* (Sowerby 1821) [M]
(Plate 3H-K, Text-fig. 10B)

v. 1908 *Ammonites parkinsoni*, J. Sowerby, Buckman, pl. 5, fig. 2.
1927 *Parkinsonia Parkinsoni* Sowerby, Nicolesco, p. 30, pl. 6, figs. 3–13, pl. 7, figs. 1–4, pl. 8, figs. 1–2, text-fig. 32.
1927 *Parkinsonia Parkinsoni* Sow. var. *Pseudoparkinsoni* Wetz. emend. Nicolesco, Nicolesco, p. 33, pl. 5, figs. 3–6, pl. 6, figs. 1–2, text-fig. 12.
v. 1956 *Parkinsonia* (*Parkinsonia*) *parkinsoni* (J. Sowerby), Arkell, p. 143, text-fig. 53 (lectotype).
1980 *Parkinsonia* (*Parkinsonia*) *parkinsoni* (Sowerby), Galacz, p. 93, pl. 20, fig. 5, text-figs. 73–74 (with full synonymy).
1993 *Parkinsonia parkinsoni* (Sowerby), Besnosov & Mitta, p. 189, pl. 39, fig. 1.
2006 *Parkinsonia parkinsoni* (Sowerby), Dietze & Dietl, pl. 2, fig. 1.

Material: Seventeen specimens, including ten whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/21	-	-	53.2	-	34.5	-	-	-	-	-	0.65	-
IGPUW/J/46	-	-	44.5	-	32.7	-	-	-	-	-	0.37	-
IGPUW/J/77	-	-	45.2	-	40.7	-	-	-	-	-	0.9	-
IGPUW/J/11-13	~79.7	~44.7	22.1	20.2	-	~27	~35	~0.56	~0.28	-	-	~1.79
IGPUW/J/80	99.4	45.1	31.3	-	~25.2	~24	~39	0.45	0.31	~0.25	~0.8	-
IGPUW/J/49	~142.7	~63.8	42.8	~38.6	33.8	~28	~51	~0.45	~0.30	~0.24	0.79	~1.88
	81.3	30.8	26.7	-	-	24	-	0.38	0.33	-	-	-
IGPUW/J/44	~210.0	111.0	61.9	-	-	38	71	~0.53	0.29	-	-	-

Description: Small to large-sized specimens (D = 46.8–210 mm), with evolute, planulate shells. During shell growth the umbilical width is rather stable but it slightly widens on outer whorls. However, U/D varies in different individuals (0.38–~0.56). On the juvenile stage (D = 46.8 mm) the shell is moderately evolute with narrow and high-trapezoidal whorl cross-section (Wb/Wh_1 = 0.66) and nearly flat flanks. Inner ribs dense, thin, prorsiradiate (P = 23). They divide on two, more prorsiradiate outer ribs (S = 36), interrupted by a deep and narrow sulcus on the venter. Umbilical slope low, gently inclined, umbilical margin rounded. On the inner and middle whorls the inner ribs are prorsiradiate, straight to slightly bent, sharp and projected. Bifurcation point accentuated with distinct tubercles. Outer ribs also become projected. During growth, the inner ribs become adaperturally concave and the tubercles disappear. As was already noted by Galácz (1980), the tubercles are characteristic for the early ontogenetic stages. Single and intercalatory ribs often occur, but on the last whorl of mature individuals (D = 210 mm), they tend to disappear. The preserved body chamber attains c. ¾ of the last whorl, but probably it attained the whole last whorl. On the preserved fragment of the body chamber (IGPUW/J/77), the aperture is complete, lacking lateral lappets. Thus, it is possible (Matyja & Wierzbowski 2000) that the lateral lappets in this species did not occur at all, and dimorphism was mainly manifested by the shell size of mature individuals.

Remarks: The thorough and detailed discussion of this species was presented by Galacz (1980). The specimens discussed here are identical with the lectotype, the photograph of which was presented for the first time by Arkell (1956). *P. pseudoparkinsoni* Wetzel was solely considered as a variant (*P. parkinsoni* var. *pseudoparkinsoni*) within the species *P. parkinsoni* by Nicolesco (1927). The other Nicolesco's variants, such as *P. parkinsoni* var. *densicosta* and *P. parkinsoni* var. *pseudoferruginea* possess enough different morphology to treat them as separate species. *P.* (*P.*) *rarecostata* (Buckman) differs by its greater evolutness, more distant inner ribs and higher located bifurcation point. Outer ribs are also more directed toward the aperture. *P.* (*P.*) *densicosta* (Quenstedt), on the other hand, has denser ribbing, narrower umbilicus and sharper inner ribs. *P.* (*Durotrigensia*) *pseudoferruginea* Nicolesco is similar to the stage where its inner ribs disappear completely. However, on this stage it differs by much more narrower umbilicus, higher and narrower whorl cross-section, weaker inner ribs and longer outer ribs. *P.* (*P.*) *depressa* (Quenstedt) is characterized by its more evolute shell, more depressed whorls, more distant and rectiradiate ribs. *P.* (*P.*) *schloenbachi* Schlippe differs in rounded, more depressed whorl cross-section and shorter inner ribs that bifurcate in the mid-height of the whorl.

Occurrence: Upper Bajocian (Parkinsoni Zone) of Gnaszyn Gorny ('Alina' clay-pit), Blanowice and Rudniki. Similar forms (*P.* cf. *parkinsoni*) were also mentioned from the border of the Holy Cross Mountains by Rozycki (1955) and Łęczyca (central Poland) by Znosko (1957). The species *P.* (*P.*) *parkinsoni* is also known from England (Arkell 1956), Germany (Dietze et al. 2004), France (Maubeuge 1951), Hungary (Galacz 1980), Spain (Sandoval 1983, Fernandez-Lopez 2000), Italy (Sturani 1964a, b), Iran (Seyed-Emami et al. 1985), Caucasus and Turkmenistan (Krymholtz 1988, Besnosov & Mitta 1993).

Parkinsonia (*Parkinsonia*) *schloenbachi* Schlippe, 1888

(Plate 10G, K, Text-figs. 10C, 13F)

1956 *Parkinsonia schloenbachi* Schlippe, Arkell, text-figs. 55. 1, 55. 2 (reproduction of the lectotype).

1958 *Parkinsonia* (*Parkinsonia*) *schloenbachi* Schlippe, Westermann, p. 68, pl. 23, figs. 1–2, pl. 24, fig. 1.

1966 *Parkinsonia schloenbachi* SCHLIPPE, STURANI, p. 30, pl. 7, fig. 1.
1993 *Haselburgites schloenbachi* (SCHLIPPE), BESNOSOV & MITTA, p. 215, pl. 48, fig. 2.
2006 *Parkinsonia schloenbachi* (SCHLIPPE), DIETZE & DIETL, pl. 5, fig. 2.
Material: Two phargmocones.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/158	97.5	39.7	35.4	24.6	33.2	17	35	0.41	0.36	0.34	0.94	1.61
	58.5	27.7	20.05	14.7	23.0	19	-	0.47	0.34	0.39	1.15	1.82

Description: Semi-evolute (U/D = 0.41–0.47), planulate shells. Whorl cross-section (Text-fig. 10C) is generally robust (Wb/Wh_1 = 0.94–1.25). At D = 37.0–58.5 mm, it is wider than high, nearly circular in outline. At D = 97.5 mm it is only slightly higher than wide, of the same whorl section as the lectotype. Flanks more rounded on inner whorls. Umbilicus not so deep with slightly inclined and short slope, and rounded margin. Inner ribs (P = 16–19) prorsiradiate and sharp on the inner whorls, or delicately adaperturally concave and rounded on the last preserved whorl. In the mid-height of the whorl they divide on outer ribs (S = 26–35). On the inner whorls, the bifurcation point is accentuated with small tubercles. The outer ribs interrupted by shallow sulcus on the venter. Intercalatory and single ribs also occur. In the suture line (Text-fig. 13F), E is equally deep as L, but wider. E/L nearly symmetrical, divided with seven main accessory lobes. L/U_2 of equal size as E/L.

Remarks: The characteristic robust whorl cross-section of the specimen (IGPUW/J/158), as well as its ribbing pattern correspond to the lectotype of *P.* (*P.*) *schloenbachi* SCHLIPPE. The species described differs from the most similar *P.* (*P.*) *pachypleura* BUCKMAN by its more robust whorl section, somewhat greater involutness and earlier disappearance of the tubercles at bifurcation point (ARKELL 1956, p. 148, STURANI 1966, p. 31). *P.* (*P.*) *pachypleura* BUCKMAN also possesses more prorsiradiate and more distant inner ribs. *P. schloenbachi* presented by DORN (1927) belongs to the species *P.* (*P.*) *pachypleura* (STURANI 1966). The specimen presented by MATYJA & WIERZBOWSKI (2000, pl. 3, fig. 1) is a mould and thus it is hard to decipher its whorl section.

Occurrence: Lowermost Bathonian (Zigzag Zone, Convergens Subzone) of Kawodrza Gorna ('Sowa' clay-pit) and Rudniki. Similar forms (*P.* cf. *schloenbachi*) were also mentioned from the border of the Holy Cross Mountains by ROZYCKI (1955). The species *P.* (*P.*) *schloenbachi* is also known from England (ARKELL 1956), Germany (WESTERMANN 1958, DIETZE & DIETL 2006), France (STURANI 1966) and Caucasus (BESNOSOV & MITTA 1993).

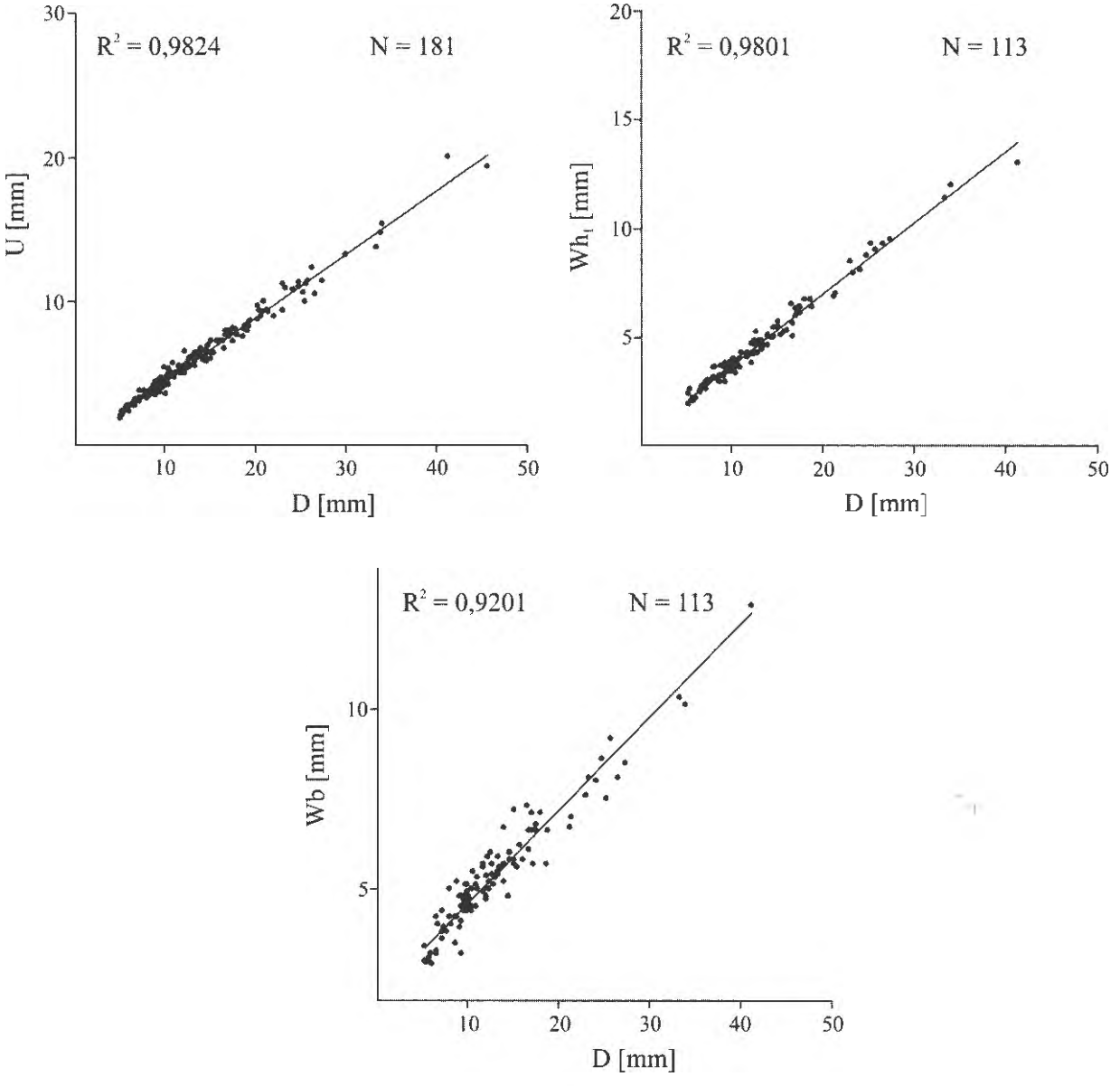
Parkinsonia (*Parkinsonia*) aff. *dorni* ARKELL, 1951b

(Plate 10A–F, Text-figs. 10D–E, 12, 13A)

Material: More than 370, variously preserved specimens on different stages of ontogeny. The measurements of some of the specimens are given below.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/246	~25.8	11.4	9.0	-	9.2	18	-	~0.44	~0.35	~0.36	1.02	-
IGPUW/J/214	25.5	11.2	8.6	-	-	17	29	0.44	0.34	-	-	-
IGPUW/J/277	20.3	8.7	7.7	5.6	-	17	~32	0.43	0.38	-	-	1.90
IGPUW/J/522	20.4	9.4	6.4	-	-	16	29	0.46	0.31	-		1.77
IGPUW/J/294	26.2	12.3	9.6	-	-	19	-	0.47	0.37	-	-	-
IGPUW/J/521	24.8	11.0	8.75	-	~8.6	19	31	0.44	0.35	~0.35	~0.98	~1.49
IGPUW/J/248	22.9	9.4	8.5	7.3	7.6	20	33	0.41	0.37	0.33	0.89	1.66
IGPUW/J/227	~25.4	10.0	9.1	-	-	16	31	~0.39	~0.36	-	-	-
IGPUW/J/520	33.8	14.75	11.5	-	-	17	25	0.44	0.34	-	-	-
IGPUW/J/162a	~45.6	19.3	15.2	-	-	20	-	~0.42	~0.33	-	-	-
IGPUW/J/162b	24.8	11.3	8.8	-	-	-	-	0.45	0.35	-	-	-
GIUS 8-2458a	10.3	5.0	3.3	2.9	4.4	13	25	0.48	0.32	0.43	1.33	1.54

Nr	D	U	Wh_e	Wh_t	Wb	P	S	U/D	Wh_t/D	Wb/D	Wb/Wh_e	WER
GIUS 8-2458b	6.4	2.8	2.5	1.8	3.3	13	-	0.44	0.39	0.51	1.32	1.64
GIUS 8-2573/1	19.2	8.2	-	-	6.2	16	28	0.43	-	0.32	-	1.35
GIUS 8-2573/2	14.75	6.9	5.0	4.5	-	15	29	0.47	0.34	-	-	1.79
GIUS 8-2573/3	13.2	6.2	4.4	-	~5.9	-	-	0.47	0.33	~0.45	1.34	-
GIUS 8-2573/4	12.2	5.0	4.7	-	5.0	14	26	0.41	0.38	0.41	1.06	-
GIUS 8-2573/5	10.2	4.4	4.0	-	4.7	14	24	0.43	0.39	0.46	1.175	1.66
GIUS 8-2573/6	9.3	4.5	3.6	2.8	4.5	13	-	0.48	0.39	0.48	1.25	1.66
GIUS 8-2573/7	9.8	4.6	3.5	2.4	5.1	13	26	0.47	0.36	0.52	1.46	1.61
GIUS 8-2573/8	10.1	4.6	3.8	2.5	4.6	14	28	0.45	0.38	0.45	1.21	1.64
GIUS 8-2573/9	12.7	5.4	4.6	-	5.4	14	24	0.42	0.36	0.42	1.17	-



Text-fig. 12. Plots of umbilical width (U), outer whorl height (Wh_e) and whorl breadth (Wb) against shell diameter (D) in *Parkinsonia* (*Parkinsonia*) aff. *dorni* ARKELL.

Remarks: Majority of the specimens investigated are represented by juvenile forms. The shell of the largest specimen has only 45.6 mm in diameter. All specimens come from the ammonite-bearing calcitic concretions, previously presented by MAJEWSKI (2000) and ZATON & MARYNOWSKI (2004), in which the species *P.* (*P.*) aff. *dorni* ARKELL definitely dominate the whole ammonite fauna (ZATON & MARYNOWSKI 2004, 2006). The detailed description and discussion about the species *P.* (*P.*) aff. *dorni* coming from the calcitic concretions have already been presented by ZATON & MARYNOWSKI (2006). Earlier, MATYJA & WIERZBOWSKI (2000) described much larger specimens, also assigned to *P.* (*P.*) aff. *dorni*, from similar stratigraphic interval. As was noted by MATYJA & WIERZBOWSKI (2000), and later by ZATON & MARYNOWSKI (2006), the species *P.* (*P.*) aff. *dorni* is very similar to the nominative small-sized species *P.* (*P.*) *dorni* from Germany. However, unless larger specimens of the latter species is found in the type area, the Polish specimens should be assigned to this species with caution.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) and possibly the lowermost Bathonian (Zigzag Zone, Convergens Subzone) of Kawodrza Gorna ('Sowa' clay-pit).

Subgenus *Parkinsonia* (*Durotrigensia*) BUCKMAN, 1928

Type species *Ammonites dorsetensis* WRIGHT, 1856

Parkinsonia (*Durotrigensia*) *pseudoferruginea* NICOLESCO, 1928 [M]

(Plate 10H–I, I.)

1928 *Parkinsonia Parkinsoni* SOWERBY var. *pseudoferruginea* n. var., NICOLESCO, p. 37, pl. 9, figs. 2–3 (holotype).

1928 *Parkinsonia neuffensis* OPPEL, NICOLESCO, p. 50, pl. 15, figs. 1–2.

1951 *Parkinsonia pseudoferruginea* NICOLESCO, MAUBEUGE, p. 91, pl. 8, fig. 4, pl. 12, fig. 6.

1994 *Parkinsonia pseudoferruginea* NICOLESCO, PAVIA, pl. 2, fig. 2.

2000 *Parkinsonia* (*Durotrigensia*) *pseudoferruginea* NICOLESCO, MATYJA & WIERZBOWSKI, p. 203, pl. 1, fig. 4.

Material: Nine specimens including seven incomplete ones and 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/157	~108.0	35.2	~41.4	-	30.0	26	~50	~0.32	~0.38	~0.28	~0.72	-
IGPUW/J/142	-	-	58.0	45.8	40.5	-	-	-	-	-	0.7	-
IGPUW/J/151	~124.0	43.2	44.7	-	31.0	27	>43	~0.35	~0.36	~0.25	0.69	-
IGPUW/J/107	>180.0	72.7	-	-	40.5	-	-	-	-	-	-	-
GIUS 8-2973	136.4	50.5	48.9	~31.8	~36.5	20	50	0.37	0.36	~0.27	~0.75	~1.69
	119.2	41.7	48.6	~29.4	~27.0	24	53	0.35	0.41	0.23	0.55	~1.77

Description: Shells large-sized (up to D > 180 mm), semi-evolute (U/D = 0.32–0.41), planulate. Umbilicus shallow with rounded margin and gently inclined slope, gradually widens during growth. Whorl cross-section high and quite narrow (Wb/Wh_1 = 0.23–~0.28) with nearly flat or only slightly rounded flanks. Venter nearly flat with distinct sulcus. On inner whorls, the inner ribs dense (at D = ~ 60 mm, P = 25), straight, prorsiradiate, projected. Bifurcation point marked with small tubercles. During growth, the number of inner ribs rather does not change, however, they become more rounded and adaperturally concave, and the tubercles disappear. Outer ribs straight, more directed toward aperture. Intercalatory ribs occasionally may appear. The outer whorls of large specimens slowly loose the inner ribs, so the flanks up to the bifurcation points are smooth. Body chamber attained one or even more than one last whorl. Aperture is missing. Suture line is visible fragmentary. E/L bifid, nearly symmetrical, L quite wide, shallow, L/U_2 somewhat higher than E/L, bifid, symmetrical and narrower than E/L.

Remarks: *P.* (*D.*) *pseudoferruginea* NICOLESCO is a characteristic and easy to identify species. *P.* (*D.*) *bomfordi* ARKELL differs by its lower and more rounded whorl cross-section, and more distant ribs. *P.* (*D.*) *densicosta* (QUENSTEDT) much earlier losses its inner ribs. STURANI (1966) guessed that *P.* (*D.*) *pseudoferruginea* may be a younger synonym of *P. neuffensis* (OPPEL). However, the latter species is very poorly known (see below), so these two species should be treated as separate species (MATYJA & WIERZBOWSKI 2000).

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Parkinsoni and Bomfordi subzones) of Gnaszyn Gorny ('Alina' clay-pit), Kawodrza Gorna ('Sowa' clay-pit), Mokrsko, and lowermost Bathonian (Zigzag Zone, Convergens Subzone) of Kawodrza Gorna ('Glinski' clay-pit). Apart of Poland, this species is mainly mentioned from the Upper Bajocian and lowermost Bathonian of France (NICOLESCO 1928, PAVIA 1971, 1994).

Parkinsonia (*Durotrigensia*) *bomfordi* ARKELL, 1956 [M]
(Text-figs. 10J, 11C)

1923 *Haselburgites schloenbachi* (*non* SCHLIPPE), BUCKMAN, pl. 493.
1956 *Parkinsonia* (*Parkinsonia*) *bomfordi* sp. nov., ARKELL, p. 157, text-fig. 55. 3a–b.
1971 *Parkinsonia* (*Parkinsonia*) *bomfordi* ARKELL, PAVIA, p. 120, pl. 22, fig. 2.
2000 *Parkinsonia* (*Durotrigensia*) *bomfordi* ARKELL, MATYJA & WIERZBOWSKI, p. 205, pl. 5, figs. 1–2.
2006 *Parkinsonia bomfordi* ARKELL, DIETZE & DIETL, pl. 5, fig. 1.

Material: Two phragmocones, one with partially preserved body chamber.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh	WER
GIUS 8-2825	184.0	68.6	71.6	~61.1	57.1	10	49	0.37	0.40	0.31	0.8	1.54

Description: Smaller specimen (D = 80.8 mm) is a phragmocone with an impression of the next half a whorl. The bigger one (D = 184 mm), on the other hand, possesses a half of the body chamber preserved. Shell semi-involute (U/D = 0.34) on the inner and middle whorls (up to D = 80.8 mm). At D = 184 mm, umbilicus gradually widens (U/D = 0.37). Whorl cross-section oval with rounded flanks and not so wide venter. The umbilicus shallow with low, steep slope and rounded margin. Inner ribs straight, sharp, prorsiradiate and quite dense on the inner and middle whorls. In some places they may be slightly concave adaperturally. From D = 64.8, the inner ribs become thicker, rounded and distant. During shell growth they are more distant and disappear completely at D = 160 mm. Below the ventro-lateral margin they bifurcate. Outer ribs are more directed adaperturally and interrupted on the venter by a sulcus. At D = ~ 120 mm the bifurcation point is not well-visible. The outer ribs are well-visible up to the end of the preserved body chamber. The whorl cross-section at the end of the preserved body chamber is quite wide with only slightly rounded flanks (Wb/Wh_1 = 0.8). Suture line partially visible. L wide and deeper than E. E/L nearly symmetrical, somewhat lower than asymmetric L/U_2.

Remarks: With respect to involutness and ornamentation pattern of the inner and middle whorls, the specimen described (TK-21) is similar to the holotype (U/D = 0.41), as well as to the specimen illustrated by PAVIA (1971, U/D = 0.4). On the basis of incomplete specimens, both ARKELL (1956) and PAVIA (1971) assigned this species to the subgenus *Parkinsonia* (*Parkinsonia*). In the light of new findings (MATYJA & WIERZBOWSKI 2000, also the large specimen described here), it is evident that on the inner to middle whorls the ribs are sharp and on the outer whorls they disappear. Such a feature is characteristic for the subgenus *Parkinsonia* (*Durotrigensia*). The specimen described here is rather similar to that described by MATYJA & WIERZBOWSKI (2000). *Parkinsonia* (*Durotrigensia*?) cf. *crassa* NICOLESCO illustrated by ARKELL (1956, Fig. 58) may be, according to STURANI (1966), a younger synonym of *Parkinsonia bomfordi*. However, its outer whorls are much more evolute than those in the specimen described by MATYJA & WIERZBOWSKI (2000). Similarly evolute is the specimen housed in the NHM, London (c. 75367) and assigned to this species by Dr. MICHAEL HOWARTH. According to the latter researcher, this English specimen (D = 173 mm) is one of the largest and best preserved amongst the other specimens of this species found in environs of Warwickshire. Its inner and middle whorls and gradually thickening ribs on the penultimate whorl are nearly identical to those present in the Polish specimens. The difference is, however, its greater evolutness (U/D = 0.47). Most probably, the English specimen and *Parkinsonia* (*Durotrigensia*?) cf. *crassa* mentioned above are only more evolute morphotypes of the species *Parkinsonia* (*Durotrigensia*) *bomfordi*. Unfortunately, the holotype is a small-sized form with preserved inner and middle whorls only, thus it is unknown whether the outer whorls were

smooth or not. The specimen presented by DIETZE & DIETL (2006) from Germany, is nearly identical with forms described here.

Parkinsonia (*Durotrigensia*) *pseudoferruginea* NICOLESCO is more involute and possesses distinctly denser ribbing on the inner and middle whorls, its whorl cross-section, on the other hand, is compressed, high-trapezoidal. *P.* (*D.*) *bradstockensis* DIETZE is similar to the more evolute forms, however, it has narrower whorl-section and is older (Acris Zone). Similarly *P.* (*D.*) *dorsetensis* (WRIGHT), which occurs in the older subzones of the Upper Bajocian (DIETZE 2000). *Parkinsonia* (*Parkinsonia*) *schloenbachi* SCHLIPPE differs by its more robust and circular whorl cross-section.

Occurrence: Uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) of Kawodrza Gorna ('Sowa' clay-pit) (MATYJA & WIERZBOWSKI 2000). Apart of uncertain forms (synonymy in PAVIA 1971), *P.* (*D.*) *bomfordi* is also known from the uppermost Bajocian of England (ARKELL 1956), France (PAVIA 1971) and Germany (DIETZE & DIETL 2006).

Parkinsonia (*Durotrigensia*) *'neuffensis'* (OPPEL 1857) [M]

(Plate 11A–B, F, Text-figs. 10F, 13B)

1848 *Ammonites Parkinsoni gigas* QUENSTEDT, QUENSTEDT, p. 143, pl. 2, fig. 1.

1857 *Ammonites Neuffensis* OPPEL, p. 378.

1937 *Parkinsonia neuffensis* OPPEL, WETZEL, p. 123, pl. 12, fig. 7, pl. 13, figs. 1–1a.

? 1993 *Parkinsonia* (?) *neuffensis* (OPPEL), BESNOSOV & MITTA, p. 198, pl. 42, fig. 1.

Material: Five specimens: one large phragmocone (D > 300 mm), two incomplete phragmocones with inner and middle whorls visible, and three whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/N-1	~195.0	~79.3	65.0	45.9	-	19	>48	~0.41	~0.33	-	-	-
	104.8	44.1	43.4	29.6	34.0	22	?	0.42	0.41	0.32	0.78	1.77
	59.8	25.7	21.2	16.7	21.5	21	?	0.43	0.35	0.36	1.01	1.93
	30.8	15.0	11.4	9.8	11.3	20	?	0.49	0.37	0.37	0.99	1.93
IGPUW/J/K-39	187.0	82.4	60.5	-	-	22	?	0.44	0.32	-	-	-
IGPUW/J/13	86.3	33.3	32.7	22.1	~22.7	21	?	0.38	0.38	~0.26	~0.69	1.82
	45.9	20.3	17.8	13.0	16.0	21	?	0.44	0.39	0.35	0.9	1.99
	23.0	11.5	8.6	6.6	9.8	18	?	0.50	0.37	0.43	1.13	1.90
	12.6	5.8	4.5	3.2	5.8	16	?	0.46	0.36	0.46	1.29	1.64

Description: The material consists mainly of incomplete phragmocones of large specimens, the largest of which (IGPUW/J/K-39) could have attained more than 300 mm in diameter. The inner whorls, up to ~ 31 mm, are semi-evolute with rounded whorl cross-section. At D = 43.2 mm, the whorls are oval, higher than wide, and during the further shell-growth, they become higher with quite narrow venter and high, slightly convergent flanks. Umbilicus becomes distinctly wider during the growth, as well. Umbilical margin always rounded, its slope low. The latter is steep on the inner and gently inclined on the later whorls. Inner ribs prorsiradiate, straight, sharp and dense on the inner whorls. Near the ventro-lateral margin they divide on two secondaries that are more directed adaperturally. The outer ribs are interrupted on the venter by distinct but shallow sulcus. On the middle whorls, the inner ribs are more distant, thicker and rounded, and the bifurcation point is less visible. Two intercalatory ribs occur between each inner ribs. The whorl fragment of the specimen IGPUW/J/K-39, which still represent a phragmocone, is completely smooth. The length of the body chamber is unknown.

Suture line is complex (Text-fig. 13B). Ventral saddle narrow, E/L wide, bifid, nearly symmetrical, L/U_2 of the same height what E/L but narrower and bifid as well. Auxiliary saddles low. E narrow and shallower than L. U_3 shallower than L, as well.

Remarks: *Parkinsonia neuffensis* was created by OPPEL (1857) on the basis of a whorl fragment belonging to a gigantic parkinsoniid that was earlier illustrated by QUENSTEDT (1846) as *Ammonites parkinsoni gigas*. Unfortunately, according to OPPEL (op. cit.) [see also discussion in ARKELL (1956, p. 157–159], a definition of the species included all the parkinsoniids in which the outer whorls are smooth. In this case, the representatives of such subgenera as *P.* (*Durotrigensia*) or *P.* (*Gonolkites*) could have belonged

here, as well. Later, QUENSTEDT (1886, p. 606) noted this inconsistency and stated, that his *Ammonites parkinsoni gigas* corresponds to the forms, the inner whorls of which are densely ribbed. However, the name *P. neuffensis* sensu OPPEL was still in use by some authors (NICOLESCO 1928, WETZEL 1937). In fact, as ARKELL (1956) has already stated, it is not possible to identify this species on the basis of the holotype presented earlier by QUENSTEDT (1846, p. 143, pl. 11, fig. 1). The better specimen is *Ammonites parkinsoni gigas*, illustrated by QUENSTEDT in 1886 (p. 606, pl. 72, fig. 9), preserving inner and middle whorls of a phragmocone of a large individual. *P. neuffensis* illustrated by DORN (1927) represents young individual, the ornamentation and whorl cross-section of which are closer to *P.* (*D.*) *pseudoferruginea* NICOLESCO. The specimens presented by NICOLESCO (1928) also remind the latter species, however, they differ by robust whorl-section. STURANI (1966) stated that *P.* (*D.*) *pseudoferruginea* may be a younger synonym of *P. neuffensis*. However, as the latter form is poorly recognized, currently it should be treated as a separate species sensu QUENSTEDT 1848 non OPPEL, 1857. Because of its unclear status, the species name in the present paper was written in quotation marks.

Occurrence: Upper Bajocian (Parkinsoni Zone) of the Poraj-Kamienica Polska environs, uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) and/or lowermost Bathonian (Zigzag Zone, Convergens Subzone) of Kawodrza Górna ('Sowa' clay-pit). Similar forms (*P.* cf. *neuffensis*) were mentioned from the border of the Holy Cross Mountains by ROŻYCKI (1955) and Łęczyca in Central Poland by ZNOSKO (1957). Apart of Poland, this species is known mainly from France.

Parkinsonia (*Durotrigensia*) cf. *dorsetensis* (WRIGHT 1856) [M]

(Plate 11D)

Material: One incomplete and poorly preserved specimen.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/120	~193.0	~83.8	63.5	-	48.2	-	-	~0.43	~0.33	~0.25	0.76	-

Description: The shell-size of the specimen preserved equals 193 mm. If complete, it would attain c. 300 mm. Shell semi-evolute (U/D = 0.43), umbilicus shallow with low slope and rounded margin. Whorls not high (Wb/Wh_1 = 0.76), subtrapezoidal with slightly rounded flanks. Venter widens from the end of the phragmocone. Inner ribs quite dense (P = ~ 19 at D = ~ 41 mm), prorsiradiate, thin and sharp on the inner and middle whorls. In the terminal part of the phragmocone, the inner ribs are distant and poorly visible, and from the beginning of the body chamber they disappear. Only the outer and intercalatory ribs are present. They are more prorsiradiate, thickening toward the end of the preserved body chamber. They are interrupted on the venter by quite wide, smooth sulcus. Suture line poorly visible. E narrow, E/L high, bifid, asymmetrical, L narrow but deeper than E. L/U_2 equally high as E/L but its details are not visible.

Remarks: With respect to ornamentation pattern and evolutness, the specimen described is similar to the lectotype figured by BUCKMAN (1928, pl. 768 A–B). U/D of the both specimens is identical (0.43) and the suture line very similar. *P.* (*D.*) *pseudoferruginea* generally is more involute with thinner and denser ribbing, and higher, trapezoidal whorl cross-section. *P.* (*D.*) *bomfordi* possesses similar whorl cross-section, but is more involute, the latter species is also stratigraphically younger. Much older *P.* (*D.*) *opiensis* SCHWEIGERT, DIETZE & DIETL is more involute with long-lasting, adaperturally concave inner ribs (SCHWEIGERT et al. 2002).

Occurrence: Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone) of Gnaszyn Górny ('Alina' clay-pit).

Subgenus *Parkinsonia* (*Gonolkites*) BUCKMAN, 1925

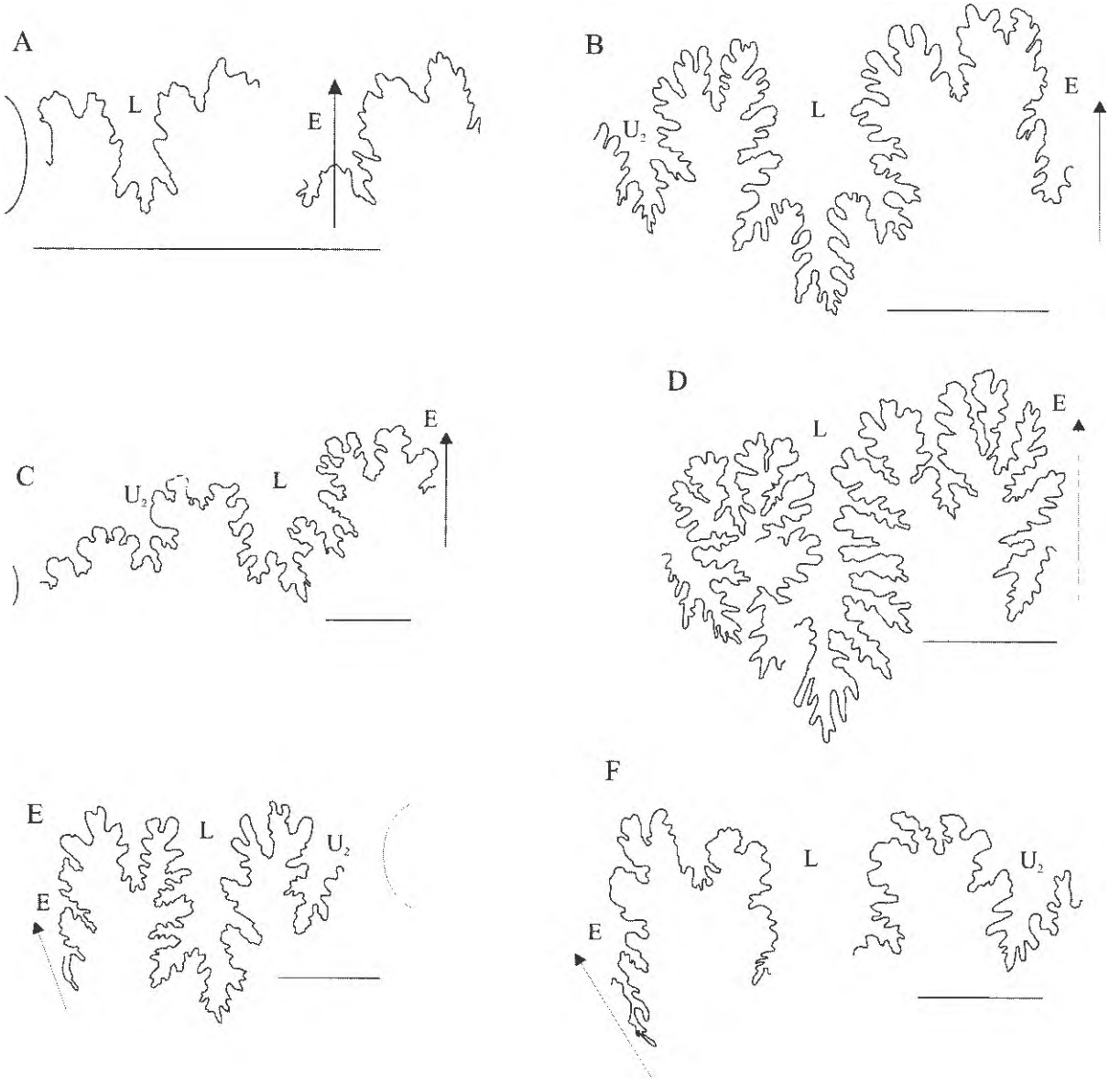
Type species *Gonolkites convergens* BUCKMAN, 1925

Parkinsonia (*Gonolkites*) *subgaleata* (BUCKMAN 1928) [M]

(Plate 12G)

1928 *Haselburgites subgalateus*, nov., BUCKMAN, pl. 790 A–B.
1958 *Parkinsonia* (*Gonolkites*) *subgaleata* (S. BUCKMAN), ARKELL, p. 156, pl. 18, fig. 7, pl. 19, figs. 3-4, text-figs. 57.1, 58-left (holotype).
1966 *Parkinsonia* (*Gonolkites*) *subgaleata* (S. BUCKMAN), STURANI, p. 34, pl. 6, fig. 6, pl. 7, fig. 5, pl. 8, figs. 1, 4.
2000 *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN), MATYJA & WIERZBOWSKI, p. 205, pl. 2, fig. 4, pl. 6, fig. 2.

Material: One incomplete specimen and two body chamber fragments of large individuals.



Text-fig. 13. Suture lines of some of the investigated ammonites. A. *Parkinsonia* (*P.*) aff. *dorni* ARKELL, IGPUW/J/7. B. *Parkinsonia* (*Durotrigensia*) '*neuffensis*' (OPPEL) [M], IGPUW/J/47. C. *Parkinsonia* (*Oraniceras*) *gyrumbilica* (QUENSTEDT) [M], IGPUW/J/KP-3-2. D. *Procerites laeviplex* (QUENSTEDT) [M], IGPUW/J1. E. *Parkinsonia* (*Parkinsonia*) *rarecostata* (BUCKMAN), GIUS 8-2972e. F. *Parkinsonia* (*P.*) *schloenbachi* SCHLIPPE [M], IGPUW/J/158. Scale bars equal 1 cm.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-2975	>230.0	~79.8	-	-	-	-	-	~0.35	-	-	-	-
	~205.0	~72.2	72.1	-	46.6	-	-	~0.35	~0.35	~0.23	0.65	-
	46.8	19.8	17.2	15.9	-	21	29	0.42	0.37	-	-	-

Description: The specimen GIUS 8-2975 is a phragmocone with beginning of body chamber. If complete it would measure more than 230 mm in diameter. Inner whorls (D = 46.8 mm) semi-evolute (U/D = 0.42), with quite wide whorl cross-section. Umbilicus not deep, with rounded margin and inclined slope. Inner ribs prorsiradiate, sharp, thin and dense, sometime delicately concave adaperturally.

Near the ventro-lateral margin they divide on two outer ribs, that are more directed toward the aperture. Bifurcation point marked with delicate tubercles. Whorl cross-section of the middle whorls not visible due to specimen deformation. The inner ribs rounded on the middle whorls and still dense. On this stage, the shell is similarly evolute. The last preserved whorl is high with convergent flanks and quite narrow venter. Here, the ornamentation consists only of outer ribs. At the end of the phragmocone, the shell diameter could have attained c. 210 mm and the shell involutness is here much greater (U/D = ~ 0.35). Suture line is visible fragmentary. E/L wide, bifid, strongly divided by lobes. E narrow, deeply incised. L/U_2 wider but poorly visible.

Remarks: Although the specimen is incomplete, its shell character agrees well with the species *P.* (*G.*) *subgaleata* (BUCKMAN). Ornamentation and involutness are very similar to those in the holotype (U/D = 0.34, BUCKMAN 1928, ARKELL 1956, text-fig. 58). Similar species *P.* (*G.*) *convergens* (BUCKMAN) differs from the latter by three main features (STURANI 1966): 1. whorl cross-section which is higher and narrower, 2. more convergent flanks and narrower venter, 3. more involute shell, more numerous and weaker inner ribs that are visible not earlier than 100 mm of shell diameter.

Both *P.* (*G.*) *subgaleata* and *P.* (*G.*) *convergens* are not sufficiently recognised with respect to intraspecific variability. Generally, the shell in *P.* (*G.*) *subgaleata* is bigger. This made HAHN (1970) to consider them as a dimorphic pair. Recently, however, DIETZE et al. (2001) stated that distinction of these two species is rather arbitral. Thus, it may be possible that these two species in fact represent variability within one species.

Occurrence: Lowermost Bathonian (Zigzag Zone, Convergens Subzone) of Kawodrza Górna ('Sowa' clay-pit, see also MATYJA & WIERZBOWSKI 2000). This species is also known from England (ARKELL 1956) and France (STURANI 1966).

Subgenus *Parkinsonia* (*Oraniceras*) FLAMAND, 1911

Type species: *Oraniceras hamyanense* FLAMAND, 1911

Parkinsonia (*Oraniceras*) *gyrumbilica* (QUENSTEDT 1887) [M]

(Plate 12E–F, Text-Figs. 10G, 13C)

1887 *Ammonites Parkinsoni compressus gyrumbilicus*, QUENSTEDT, p. 609, pl. 72, figs. 12, 15.

1928 *Parkinsonia compressa* Quenst. var. *wuerttembergica* Opp. emend. NICOLESCO, NICOLESCO, p. 60, pl. 16, only fig. 20, text-fig. 35.

1958 *Parkinsonia* (*Oraniceras*) *wurttembergica gyrumbilica* (QUENSTEDT), WESTERMANN, p. 71, pl. 29, figs. a–b.

1966 *Parkinsonia* (*Oraniceras*) *wurttembergica* (OPPEL), STURANI, p. 34, pl. 6, fig. 7, pl. 10, fig. 1.

1970 *Parkinsonia* (*Oraniceras*) *gyrumbilica* (QUENSTEDT), HAHN, p. 18, pl. 1, figs. 1–3, pl. 2, fig. 1, text-figs. 3–5 (with full synonymy).

1993 *Oraniceras gyrumbilicus* (QUENSTEDT), BESNOSOV & MITTA, p. 208, pl. 46, figs. 1–2.

2005 *Parkinsonia* (*Gonolkites*) *gyrumbilica* (QUENSTEDT), SCHLOGL et al., pl. 14, figs. 1–2.

Material: Six variously preserved specimens and numerous whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/O4	10.1	4.5	4.2	3.3	5.0	10	-	0.44	0.41	0.49	1.19	2.13
	16.2	-	6.8	5.1	6.7	-		-	0.42	0.41	0.98	2.28
	22.2	6.6	9.2	7.3	7.7	14	-	0.3	0.41	0.35	0.84	1.93
	31.3	-	14.0	11.3	10.1	-	-	-	0.45	0.32	0.72	1.99
IGPUW/J/O3a	38.5	9.1	20.8	~14.8	13.0	9	-	0.24	0.54	0.34	0.62	2.1
IGPUW/J/O3b	-	-	22.5	16.4	12.0	-		-	-	-	0.53	-
IGPUW/J/O4a	-	-	19.3	15.0	12.5	14	29	-	-	-	0.65	-
IGPUW/J/O4b	-	-	17.0	11.5	12.2	-	-	-	-	-	0.72	-
IGPUW/J/O4c	-	-	21.4	14.2	14.5	-	-	-	-	-	0.68	-
IGPUW/J/O4d	-	-	27.8	18.0	16.7	-	-	-	-	-	0.6	-
IGPUW/J/O4e	-	-	32.3	-	17.6	-	-	-	-	-	0.54	
IGPUW/J/O6	-	17.9	53.2	-	-	-	-	-	-	-	-	-
IGPUW/J/KP-3-3	265.0	68.0	126.5	~73.7	-	-	-	0.26	0.48	-	-	1.44
	220.0	47.5	77.6	42.0	-	-	-	0.21	0.35	-	-	-
IGPUW/J/O8	380.5	66.2	190.0	-	-	-	-	0.17	0.17	-	-	2.25
	280.5	44.0	136.2	78.4	73.9	-	-	0.16	0.48	0.26	0.54	1.69

Description: Shells small- to large-sized (D of the largest, probably gerontic individual IGPUW/J/O8 equals 380.5 mm). The innermost whorls (D = 10.1 mm) wider than high (Wb/Wh_1 = 1.19), roundish, of planorbicone shell shape. Umbilicus quite wide (U/D = 0.44). Inner ribs sharp, prorsiradiate, bifurcating in the mid-height of the whorl. In the middle whorls (D = 112.1 mm), the shell is oxyconic, involute with narrow umbilicus. Whorl cross-section high with convergent flanks forming narrow, but not acute, venter (Text-fig. 10G). On this stage the ornamentation consists exclusively of thick and rounded outer ribs interrupted by sulcus on the venter. Shell of the gerontic individual involute (U/D = 0.17), oxyconic, compressed with triangular whorl cross-section, lacking ornamentation. Umbilicus narrow with rounded margin and steep slope. Suture line with elaborated saddles (Text-fig. 13C). E wider than L but shallower. E/L bifid, much more wider than L/U_2. The latter divided by six auxiliary lobes.

Remarks: *P.* (*Oraniceras*) *gyrumbilica* (Quenstedt) differs from *P.* (*Oraniceras*) *fretensis* Wetzel by its narrower umbilicus, more convergent flanks and narrower venter. Greater shell involutness and flank convergence of inner whorls differentiate this species from *P.* (*Oraniceras*) *wuerttembergica* (Oppel).

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Rudniki, Korwinow and Kawodrza Gorna ('Glinski' clay-pit). Apart of Poland, this species is also known from Germany (Westermann 1958), France (Sturani 1966), Caucasus and Middle Asia (Besnosov & Mitta 1993), and Slovakian part of the Pieniny Klippen Belt (Schlogl et al. 2005).

Parkinsonia (*Oraniceras*) *wuerttembergica* (Oppel 1857)
[m]
(Plate 12A–D)

1849 *Ammonites Parkinsoni planulatus*, Quenstedt, p. 143, pl. 11, only fig. 3.
1887 *Ammonites Parkinsoni compressus*, Quenstedt, p. 603, pl. 71, tylko fig. 34.
1928 *Parkinsonia compressa* Quenstedt, Nicolesco p. 54, pl. 16, only figs. 11–12.
1928 *Parkinsonia compressa* Quenst. var *wuerttembergica* Opp., Nicolesco, p. 59, pl. 16, figs. 13–17.
1928 *Parkinsonia compressa* Quenst. var. *ferruginea* Opp., Nicolesco, p. 57, pl. 16, only figs. 1–2.
non 1958 *Parkinsonia* (*Oraniceras*) *württembergica württembergica* (Oppel), Westermann, p. 70, pl. 28, fig. 2, pl. 30, fig. 1 [=*P.* (*O.*) *pseudomacrocephalus* Wetzel]
1958 *Parkinsonia* (*Oraniceras*) *valida* Wetzel , Westermann, p. 71, pl. 30, figs. 2–3.
1970 *Parkinsonia* (*Oraniceras*) *wuerttembergica* (Oppel), Hahn, p. 25, pl. 3, figs. 2–11, pl. 4, figs. 6–7, text-fig. 6.
1993 *Parkinsonia wuerttembergicus* (Oppel), Besnosov & Mitta, p. 210, pl. 47, fig. 1.

Material: Six specimens: three complete (including one specimen AK-O1 from Łęczyca, central Poland for comparison), one compressed specimens and two whorl fragments.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/O1a	28.6	10.0	11.5	8.4	11.1	15	24	0.35	0.4	0.39	0.96	1.56
IGPUW/J/O1b	-	-	13.6	10.7	10.7	-	-	-	-	-	0.79	
IGPUW/J/O2a	41.8	14.3	17.0	12.7	13.0	18	32	0.34	0.41	0.31	0.76	1.88
IGPUW/J/O2b	-	-	19.0	-	16.0	-	-	-	-	-	0.84	-

Description: Shells small- to medium-sized (D = 28.6–70.3 mm), semi-involute (U/D = 0.3–0.35), discocone. Whorl cross-section high, subtrapezoidal, compressed (Wb/Wh_1 = 0.7–0.96). Umbilicus not wide with rounded margin and slightly inclined slope. Inner ribs prorsiradiate, straight and sharp. On the inner and middle whorls they are sharper and denser, becoming more distant and rounded on later stages. At D = 70 mm the individuals seem to be fully mature, as evidenced from the specimen AK-O1 with preserved lateral lappets. On the first half of the body chamber of the specimen, the inner ribs are markedly weakened and nearly disappear to be much more stronger on the second part of the body chamber. They bifurcate near the mid-height of the whorl. The bifurcation point is accentuated by delicate swellings. Single and intercalatory ribs also occur. The outer ribs slightly bent adaperturally, interrupted by and projected near the ventral sulcus. At the end of the body chamber, the outer ribs are markedly bent adapically. In the middle part of the body chamber shallow but distinct constriction appears. The body chamber attains ¾ of the last whorl and is ended with a pair of short lappets.

Remarks: *P.* (*Oraniceras*) *wuerttembergica* (Oppel) differs from *P.* (*Oraniceras*) *gyrumbilica* (Quenstedt) by its smaller shell-size and lower degree of involutness. Its shell is less discoidal, and the aperture is ended with a pair of short lateral lappets. *P.* (*Oraniceras*) *pseudomacrocephalus* Wetzel is more involute, and individuals of the same shell diameter do not possess ornamentation at lower part of the flanks. *P.* (*Oraniceras*) *teutoburgensis* Wetzel is distinguished by its wider whorl cross-section and wider umbilicus on inner whorls.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Rudniki. Similar forms (*P.* aff. *wurttembergica*) were mentioned from the border of the Holy Cross Mountains, central Poland by Rozycki (1955). Apart of Poland, this species is also known from Caucasus (Meledina 1988, Besnosov & Mitta 1993) and Germany (Hahn 1970).

Family Morphoceratidae Hyatt, 1900

Genus *Morphoceras* Douville, 1880

Type species *Ammonites polymorphus* d'Orbigny, 1846 (= *Morphoceras multiforme* Arkell 1951)

Synonyms: *Ebrayiceras* Buckman, 1920.

Remarks: It is widely accepted (Callomon 1963, Hahn 1970, Sandoval 1983, Westermann & Hillebrandt 1995, Neige et al. 1997, Fernandez-Lopez 2000, Dietze et al. 2002b) that the genus *Morphoceras* Douville encompasses macroconchs and its antidimorph is *Ebrayiceras* Buckman. Because of strong morphological similarity, similar stratigraphic range and geographic distribution, the both forms are treated here as a one genus *Morphoceras*, with indication [M] – *Morphoceras* or [m] – *Ebrayiceras*.

Some species are very similar to the representatives of *Dimorphinites* Buckman, however, they differ by a lack of ventral sulcus. *Berbericeras* Roman is very similar to the macroconchs of *Morphoceras* but the later genus is bigger and possesses ventral sulcus (Dietze et al. 2002b).

Morphoceras multiforme Arkell, 1951b [M]

(Plate 12I, 13A–B, Text-fig. 14)

1846 *Ammonites polymorphus*, d'Orbigny, p. 379, pl. 124, fig. 1–4.
1951b *Morphoceras multiforme* nom. nov., Arkell, p. 17.
1955 *Morphoceras multiforme* Arkell, Arkell, p. 132, pl. 16, figs. 1–2, text-figs. 47, 50.
1970b *Morphoceras multiforme* Arkell, Mangold, p. 59, pl. 4, figs. 1–11.
1983 *Morphoceras* (*Morphoceras*) *multiforme* Arkell, Sandoval, p. 341, pl. 27, fig. 14, text-fig. 113c.
1993 *Morphoceras multiforme* Arkell, Besnosov & Mitta, p. 234, pl. 53, fig. 1.
2005 *Morphoceras* (*Morphoceras*) *multiforme* Arkell, Schlogl et al., pl. 14, figs. 4–5.

Material: Seven well-preserved specimens including one small phragmocone.

Nr	D	U	Wh_1	Wh_4	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/M-3	-	2.8	7.4	4.0	8.0	7	25	-	-	-	1.08	-
IGPUW/J/M-2	31.2	6.2	16.5	-	17.6	~8	28	0.2	0.53	0.56	1.07	1.56
IGPUW/J/M-4	36.8	5.8	18.7	11.1	18.9	9	35	0.16	0.51	0.51	1.01	1.79

Description: Shell small-sized (D = 21.4–36.8 mm), involute (U/D = 0.16–0.31), sphaerocone. At the first developmental stages, the whorl cross-section is roundish, wider than high, becoming more oval in the later stages (Wb/Wh_1 = 1.01). The maximum whorl breadth situated just above the umbilical margin. Venter wide, rounded with distinct sulcus. Flanks convex in smaller specimens or flatter and convergent in bigger ones. Umbilicus narrow, deep. Umbilical margin rounded, umbilical slope vertical. WER fluctuates from low (1.51) to moderate (1.96) values. Inner ribs short, sinuous on the inner and prorsiradiate on the outer whorls. Just above the umbilical margin they are sharp, even clavate. In the 1/3 of the whorl height, they bi- or sometimes trifurcate. Outer ribs are of the same thickness as the inner ones, but close to the venter they are more projected. On the venter, they are interrupted by a sulcus. The intercalatory ribs also occur. The closer to aperture, the more distinct is virgatotome ribbing pattern. The ribs are crossed by numerous (up to 6 per a whorl), deep constrictions.

Remarks: *Morphoceras multiforme* is a common and widely distributed species in the Zigzag Zone (Sturani 1966). This species is characterised by variation in umbilical width (Mangold 1970b). *M. multiforme* differs from the other conspecific macro-

conchs, as *M. macrescens* (BUCKMAN), *M. patescens* (BUCKMAN) or *M. jactatum* (BUCKMAN), by its more involute inner and middle whorls, narrow umbilicus, wider whorl cross-section and well-marked umbilical margin.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Rudniki. This species also occur in Germany, Switzerland (HAHN 1970), England (ARKELL 1951b), France (MANGOLD 1970b, STURANI 1966), Bulgaria (STEPHANOV 1961), Hungary (GALACZ 1994b), Spain (SANDOVAL 1983), Algeria, Morocco (HAHN 1970), Iran (SEYED-EMAMI et al. 1985) and Caucasus (BESNOSOV & MITTA 1993).

Morphoceras macrescens (BUCKMAN 1923) [M]

(Plate 12H, 13C, Text-fig. 14)

1887 *Ammonites Parkinsoni inflatus*, QUENSTEDT, p. 619, pl. 73, only figs. 18 & 21.

1935 *Morphoceras polymorphum* D'ORBIGNY, ROMAN, p. 30, pl. 5, fig. 1.

1955 *Morphoceras macrescens* (BUCKMAN), ARKELL, p. 133, pl. 16, fig. 4, pl. 17, fig. 3.

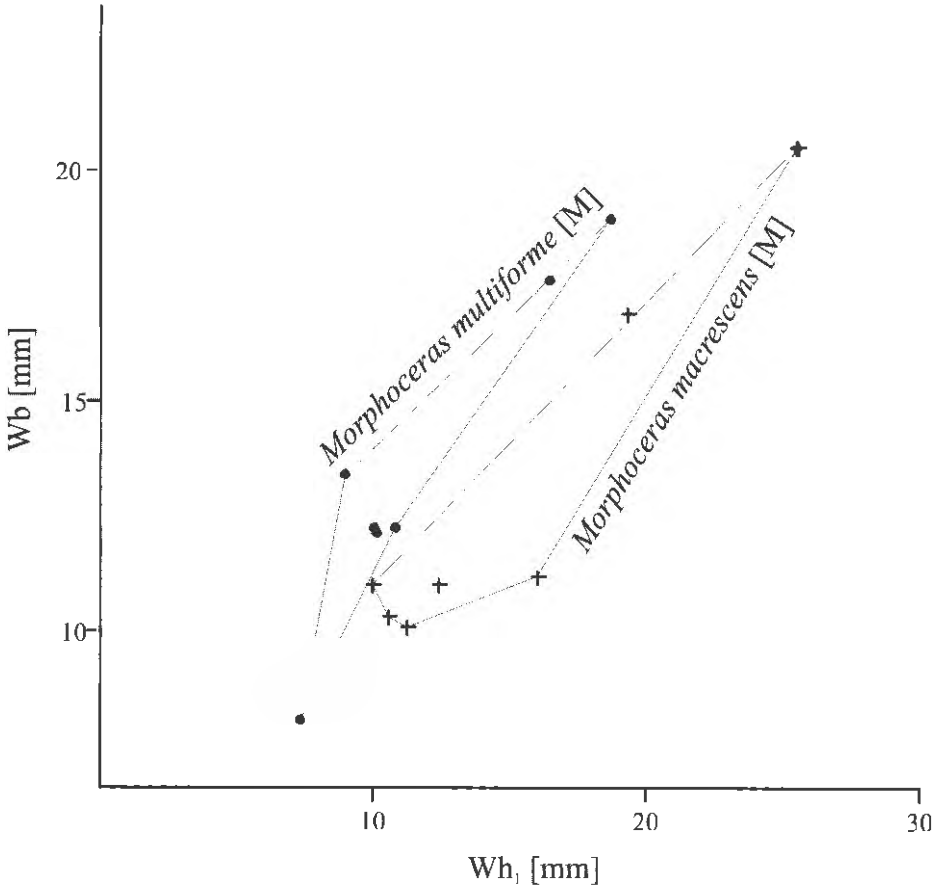
1970b *Morphoceras macrescens macrescens* (BUCKMAN), MANGOLD, p. 69, pl. 5, figs. 11–13, pl. 6, figs. 1–7.

1983 *Morphoceras* (*Morphoceras*) *macrescens* (BUCKMAN), SANDOVAL, p. 335, pl. 28, figs. 1, 4, 7, text-figs. 112 e–g, 113 b.

1999 *Morphoceras macrescens* (BUCKMAN), GALACZ, p. 158, pl. 2, fig. 2.

Material: Five phragmocones of juvenile specimens, one phragmocone of an adult and one, slightly corroded fragment of a body chamber.

Description: Shells small to moderate in size (D = 25–59.4 mm), involute to semi-involute (U/D = 0.19–0.49). Umbilicus very narrow on inner whorls, gradually widening from D ~ 40 mm. Umbilical margin rounded, umbilical slope low, vertical. Whorl cross-section high-oval (Wb/Wh_1 = 0.7–0.97), with nearly flat flanks and narrow, rounded venter. Inner ribs short and thickened but not as distinct as in *M. multiforme*. They begin just below the umbilical margin and already above it they divide on 2-3 outer ribs. Single and intercalatory ribs occur as well. The inner



Text-fig. 14. Plot of whorl breadth (Wb) against outer whorl height (Wh_1) in *Morphoceras multiforme* ARKELL [M] and *Morphoceras macrescens* (BUCKMAN) [M].

ribs are prorsiradiate, however in the middle of the whorl height they become sinuous. Later in ontogeny the inner and outer ribs are thicker. The outer ribs are interrupted by a sulcus on the venter. Constrictions present and their number gets lower during ontogeny from eight (at D = 25–38.4 mm) to six (at D = 59.4 mm). They are less distinct than those in *M. multiforme*, what was considered as one of the features of the species *M. macrescens* by MANGOLD (1970b). Aperture is missing. Suture line not well-visible. E/L and L/U_2 similarly high, bifid, L and U_2 of similar width and depth.

Remarks: On the early ontogenetic stages, *M. macrescens* differs from *M. multiforme* by its narrower and higher whorl cross-section (Text-fig. 14), and wider umbilicus. It was also observed by the present author during inspection of the specimens from Bridport and Burton Bradstock, Dorset (ARKELL's coll., Oxford). During further growth, the shell of *M. macrescens* becomes evolute much earlier than in *M. multiforme*, the shell of which is practically all the time involute and its whorl cross-section much wider. *M. egrediens* WETZEL is a smaller form, with finer and denser ribbing. *M. patescens* possesses thicker ribbing and wider whorl cross-section.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Rudniki. This species is also known from England (ARKELL 1955), France (MANGOLD 1970b), Switzerland, Germany (HAHN 1970), Italy (STURANI 1966), Bulgaria (STEPHANOV 1961), Hungary (GALACZ 1994b), Portugal, Spain (SANDOVAL 1983), Iran (SEYED-EMAMI et al. 1985) and Caucasus (BESNOSOV & MITTA 1993).

Morphoceras sulcatum (ZIETEN 1830) [m]

(Plate 13D)

1955 *Ebrayiceras pseudo-anceps* (EBRAY), ARKELL, p. 139, pl. 17, figs. 7–11.

1970b *Ebrayiceras sulcatum* (ZIETEN), MANGOLD, p. 89, pl. 7, figs. 1–6.

1983 *Morphoceras* (*Ebrayiceras*) *sulcatum* (ZIETEN), SANDOVAL, p. 352, pl. 27, fig. 10, text-figs. 112 s, 113 g.

1994b *Ebrayiceras sulcatum* (ZIETEN), GALACZ, p. 143, pl. 3, figs. 3–4.

2005 *Ebrayiceras sulcatum* (ZIETEN), SCHLOGL et al., pl. 14, fig. 12.

Material: One well-preserved specimen.

Description: Shell small-sized (D = 37 mm), semi-evolute (U/D = 0.39) with high-subtrapezoidal whorl cross-section (Wb/Wh_1 = 0.81). Flanks slightly convex. Umbilicus narrow on inner whorls but gradually widening afterwards. Its margin rounded and slope nearly vertical. Venter narrow, slightly widened toward the aperture. Inner ribs short, prorsiradiate, distinctly thickened. They start just below the umbilical margin and in the ¼ of the whorl height they bi- and trifurcate. Outer ribs thinner, slightly sinuous. Just above the vetro-lateral margin they are slightly projected. Single and intercalatory ribs sporadic. The ribbing is interrupted by a deep sulcus on the venter. The middle whorls bear single constrictions, while the outer ones are devoid of them. Aperture is missing.

Remarks: This species is characterized by large variation in the ribbing pattern, as was earlier underlined by ARKELL (1955). Within the species *M. sulcatum* MANGOLD (1970b) distinguished three morphotypes, characterized by their different ribbing: 1. *sulcatum* morphotype with fine, dense ribbing, 2. *ocellatum* morphotype with variable ribbing density and without single ribs, 3. morphotype with projected ribs on the venter, the ribbing of which is less dense than in the morphotype *sulcatum*. The specimen described here is situated between a morphotype *sulcatum* and a morphotype with projected ribs on the venter. This indicated the presence of a morphological continuum between particular morphotypes within the species.

M. filicosta (WETZEL) possesses even finer ribbing and more compressed whorl cross-section. *M. rursum* (BUCKMAN) is more evolute and less eccentric, with thicker ribs. *M. problematicum* (GEMMELLARO) differs in thicker and more projected ribs, greater involutness and more depressed whorl cross-section.

Occurrence: Lower Bathonian (Zigzag Zone, Macrescens Subzone) of Rudniki. This species is also known from England, Bulgaria, France, Germany, Portugal, Switzerland and Iran (HAHN 1970).

Asphinctites tenuiplicatus (BRAUNS 1865) [M & m]

(Plate 13E–I, Text-Figs. 11B–C, 15–16A–E)

1865 *Ammonites tenuiplicatus*, n. sp., BRAUNS, p. 135, pl. 25, figs. 8–11 [holotype of *Asphinctites tenuiplicatus* (BRAUNS)].

1865 *Ammonites tenuiplicatus* BRAUNS, SCHLOENBACH, p. 186, pl. 29, fig. 3 [lectotype of *Polysphinctites secundus* (WETZEL)].

1950 *Grossouvria secunda* n. sp., WETZEL, p. 79.

1951a *Siemiradzkia bajociformis* sp. nov., ARKELL, p. 13, pl. 3, fig. 1.

1958 *Asphinctites tenuiplicatus* (BRAUNS), WESTERMANN, p. 86, pl. 45, fig. 3 [neotype of *A. tenuiplicatus* (BRAUNS)], pl. 46, figs. 1–2.

1958 *Asphinctites gaertneri* n. sp., WESTERMANN, p. 87, pl. 46, fig. 3.

1958 *Asphinctites bathonicus* n. sp., WESTERMANN, p. 88, pl. 46, fig. 4.

1970 *Asphinctites tenuiplicatus* (BRAUNS), HAHN, p. 50, pl. 7, figs. 1–5, pl. 8, fig. 14, text-fig. 8.
1970 *Polysphinctites secundus* (WETZEL), HAHN, p. 57, pl. 8, figs. 11–13.
1997 *Asphinctites tenuiplicatus* (BRAUNS), DIETZE et al., p. 12, pl. 2, figs. 1–8, pl. 3, figs. 1–3 (with full synonymy).
1997 *Asphinctites secundus* (WETZEL), DIETZE et al., p. 14, pl. 1, figs. 5–11, pl. 3, fig. 1 (with full synonymy).
2000 *Asphinctites tenuiplicatus* (BRAUNS), MATYJA & WIERZBOWSKI, p. 207, pl. 7, figs. 4–5.
2000 *Polysphinctites secundus* (WETZEL), MATYJA & WIERZBOWSKI, p. 207, pl. 7, fig. 3.

Material: More than 232 specimens (106 macroconchs, 121 microconchs, 36 of which have preserved lappets, and nine juveniles), variously preserved.

Description:

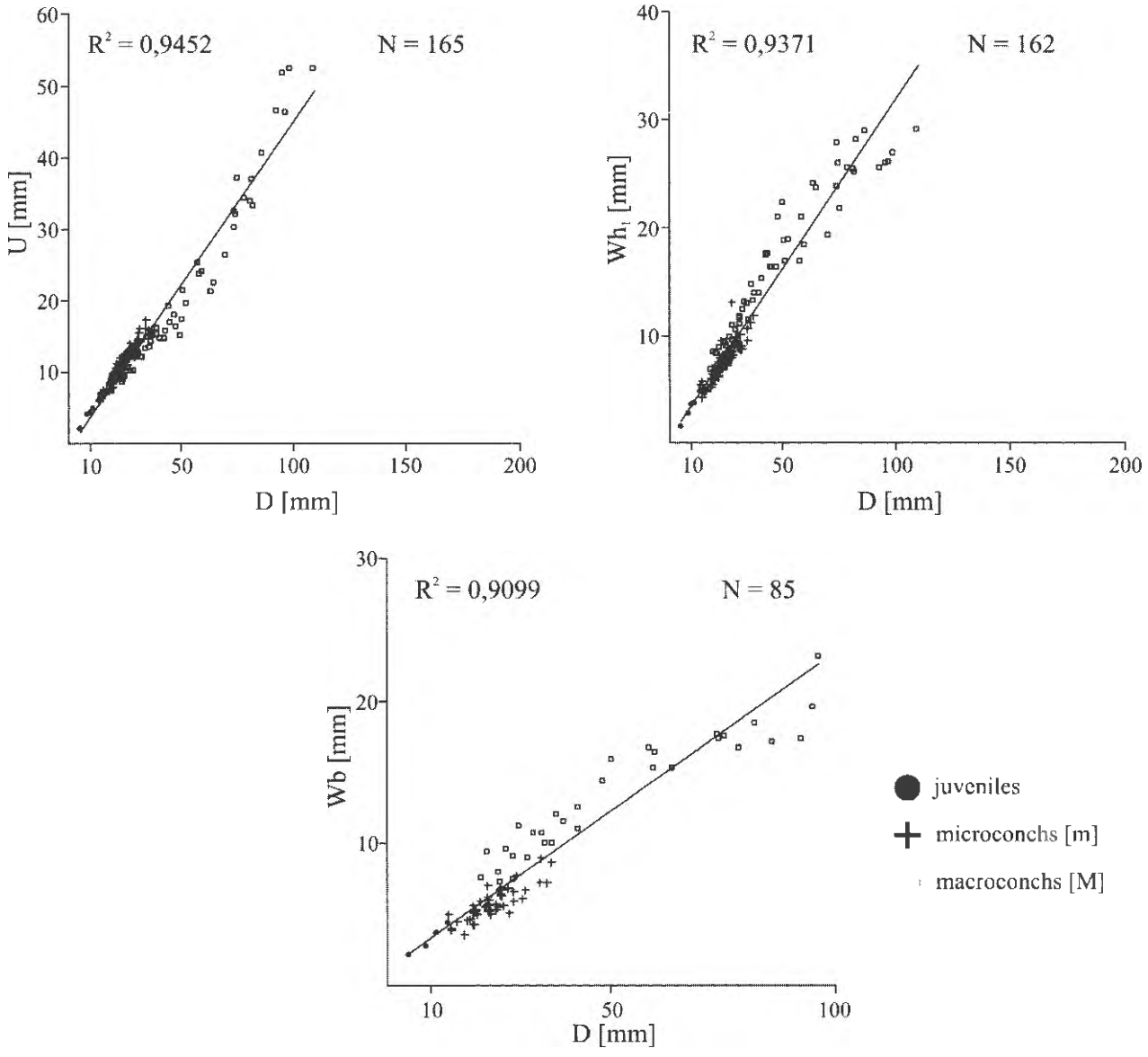
Macroconchs: Shells of moderate size (D of the largest specimen equals 109.2 mm), semi-evolute (U/D = 0.3-0.54). During ontogeny the shell evolutness increases. Umbilical slope steep on middle whorls and more gently inclined on the outer ones. Umbilical margin always rounded. Whorl cross-section (Wb/Wh_i = 0.59–1.07) rounded on the inner whorls, progressively becoming high-oval (Text-fig. 11B). Inner ribs (P = 10–21) recti- and prorsiradiate, sharper on inner and middle whorls, and more rounded on the outer ones. During ontogeny, the number of inner ribs gradually increases. However, before the aperture of large individuals, they nearly disappear. The inner ribs virgatotomously divide on the outer ribs, what is best marked on the middle whorls. Each inner rib divides on 3-4, thinner outer ribs. Constrictions, if present, are prorsiradiate, shallow, maximum three per a whorl. The body chamber long, attaining a little more than the last whorl (~360 - 440°). Aperture simple and may be preceded by a shallow constriction.

Microconchs: Shells of small size (D of the largest individual equals 36.65 mm and the mean value for the 36 measured, mature individuals equals 28 mm), semi-evolute to evolute (U/D = 0.42–0.52). Umbilical slope always gently inclined, and margin rounded. Whorl cross-section roundish on inner whorls (at D = 13 mm), becoming high-oval in later stages (Text-fig. 11C). Inner ribs (P = 11–21) thin, recti- or slightly prorsiradiate. In the mid-height of the whorl they divide virgatotomously on 3–4 thinner outer ribs. In mature individuals, beginning from c. half of the body chamber, the inner ribs start to be characteristically thickened and adaperturally convex. This feature does not occur in macroconchs and may be a sign of maturity, because this rib convexity passes to lateral lappets at the apertural margin. The body chamber long, attaining c. 9/10 of the last whorl (255–295°). Aperture is ended with a pair of spatulate lappets. Suture line in both micro- and macroconchs is very similar (Text-fig. 16A-E).

Variability: The variability within the studied population of macro- and microconchs is generally low. It mainly concerns macroconchs, in which some differences in whorl cross-section are visible at the same shell diameter. However, many of the specimens are laterally flattened due to compaction, so this feature must be taken with caution. Some macroconchs may also possess sporadic, shallow constrictions. Taking 36 mature microconchs into account, very low variability of U/D is noted, the coefficient of variation (CV) of which is 0.048 %. In the measured macroconchs, the CV is much greater, attaining 0.13 %. Such disproportion is a result of measurements of many immature individuals, thus this values can not be directly compared with those of the microconchs. It only may be supposed, that if both the macro- and microconchs form the same population, so the variability of that feature in macroconchs would have been low as well. In the both morphs, on the other hand, the inner ribs may be more or less sharper.

Remarks: Traditionally, the both morphs described above are treated in the literature (e.g., DIETZE et al. 1997, MATYJA & WIERZBOWSKI 2000, 2001) as a dimorphic pair but named as separate (sub)genera and species: *Asphinctites tenuiplicatus* (BRAUNS) – macroconch and *Polysphinctites secundus* (WETZEL) – microconch. However, the similar morphology of their juvenile stages, similar ontogenetic development in later stages and co-occurrence in large numbers not only in Poland, but in Germany as well (DIETZE et al. 1997), strongly attest they are a dimorphic pair in a biological sense and thus one species – *Asphinctites tenuiplicatus* (BRAUNS) [M & m].

The thorough discussion about the both dimorphs has already been presented by DIETZE et al. (1997, HAHN 1970). According to these authors, many of the *Asphinctites* macroconchiate species (see also synonymy) does not differ from the macroconchs of *Asphinctites tenuiplicatus* and thus they are treated in the present paper as synonyms. The macroconchiate species *A. recinctus* BUCKMAN, an index species of the Lower Bathonian Recinctus (= Yeovilensis) Subzone, was considered as a synonym of *A. tenuiplicatus* [M] by DIETZE et al. (1997), what has been earlier postulated by TORRENS (1987). The holotype of the first



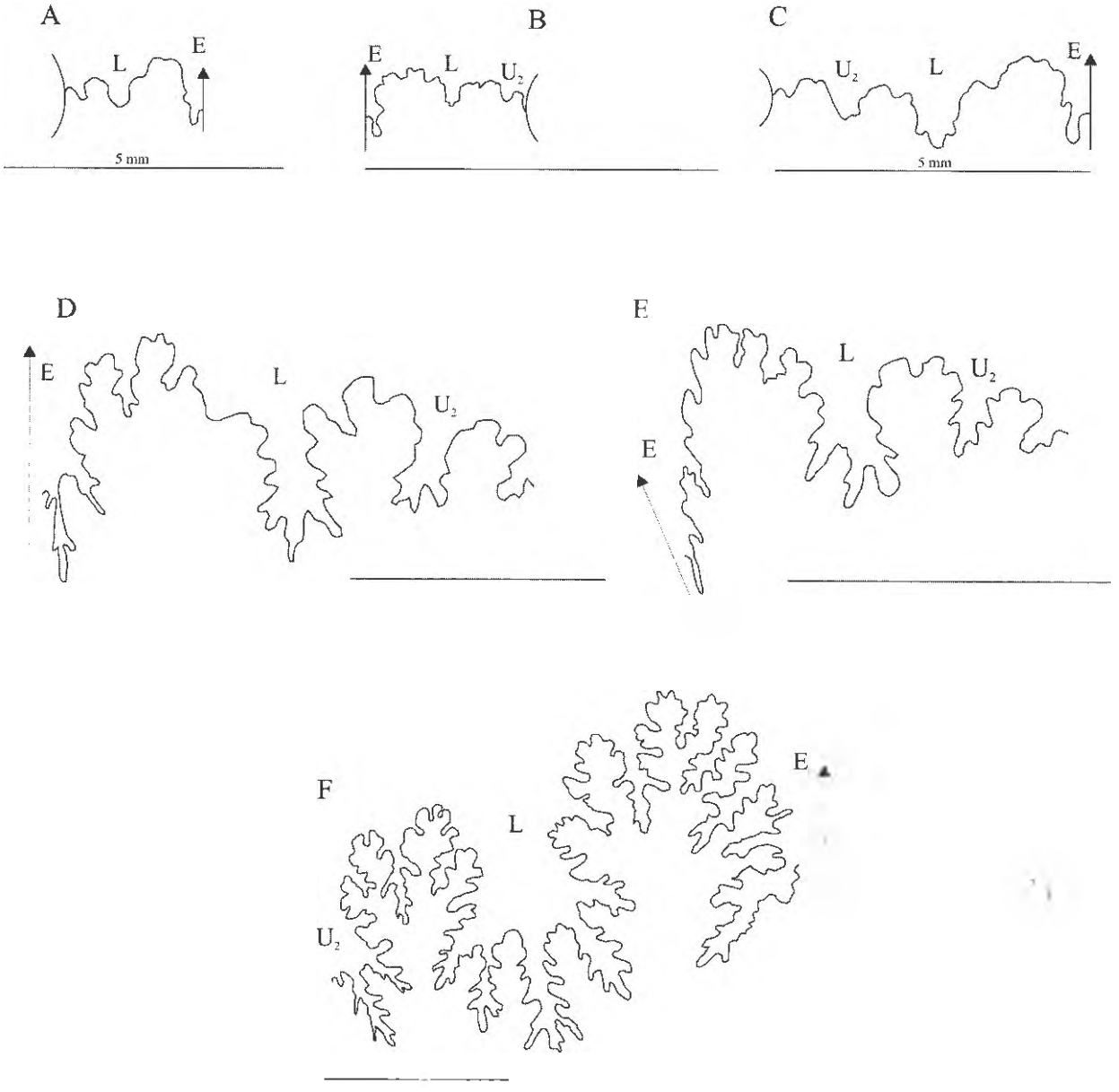
Text-fig. 15. Plots of umbilical width (U), outer whorl height (Wh_1) and whorl breadth (Wb) against shell diameter (D) in *Asphinctites tenuiplicatus* (BRAUNS).

species reminds *A. tenuiplicatus* [M], however, its precise stratigraphic position is not known. Moreover, *A. recinctus* presented by MANGOLD & RIOULT (1997, pl. 16, fig. 9) does not remind the holotype of that species and may represent completely different species (VOLKER DIETZE, pers. inf. 2005). *A. patrulii* HAHN [M], the species known from the Yeovilensis Subzone through the Tenuiplicatus Zone (HAHN 1970, DIETZE et al. 1997) differs from *A. tenuiplicatus* [M] by its more delicate and denser ribs, more involute inner whorls, and the presence of deep constrictions. *A. replictum* (BUCKMAN) [M] also differs by its greater involutness not only of the inner, but the outer whorls as well. Unfortunately, its stratigraphic provenance ('Zigzag Bed' according to ARKELL 1955) is not exactly precised. *A. pinguis* (DE GROSSOUVRE) [M] is characterized by its wide whorl cross-section and involute inner whorls, becoming rapidly evolute. The latter spe-

cies is also older, known from the Convergens-Yeovilensis subzones (TORRENS 1987, MANGOLD & RIOULT 1997).

The microconch *Polysphinctites polysphinctus* BUCKMAN differs from *A. tenuiplicatus* [m] by its distinct, deep and prorsiradiate constrictions which in the number of 3 per a whorl are visible beginning from their inner whorls, and by denser ribs as well. The occurrence of *P. polysphinctus* is confined to the Convergens-Yeovilensis subzones (SCHAIRER 1994, SCHLÖGL et al. 2005). Because of the lack of morphological differences, at least the part of the specimens of *P. polysphinctus*, presented by HAHN (1970, pl. 8, figs. 8–10) from the Tenuiplicatus Zone, may represent the microconchs of *A. tenuiplicatus*.

Occurrence: Lower Bathonian (Tenuiplicatus Zone) of Blanowice, Kawodrza Gorna ('Leszczynski' and 'LAB' clay-pits) and Faustianka. The species is also known from the Belchatow area, central Poland (KOPIK 1979), Germany (HAHN 1970, DIETZE et al. 1997), France (MANGOLD & RIOULT 1997) and England (BUCKMAN 1924, DIETZE et al. 1997).



Text-fig. 16. Suture lines of some of the investigated ammonites. A–E. *Asphinctites tenuiplicatus* (BRAUNS) [M & m]. A. juvenile individual of unknown sex, GIUS 8-2595. B–C. microconchs, GIUS 8-2590, 2616. D–E. macroconchs, IGPUW/J/129, GIUS 8-2702. F. *Morrisiceras morrisi* (OPPEL) [M], IGPUW/J/KP-6-2. If not indicated, the scale bars equal 1 cm.

Asphinctites sp. juv.? [M]

(Plate 14A)

Material: One incomplete specimen.

Description: Shell small-sized (D = 19.7 mm), semi-involute (U/D = 0.41). Whorl cross-section seems to be oval-rounded. Umbilicus shallow with rounded margin and steep slope. Inner and middle whorls not preserved. Inner ribs short, sharp and prorsiradiate. On the umbilical margin they are markedly thickened and projected, and just above the margin they divide virgatotomously on 2–3 outer ribs. The latter ones are recti- and prorsiradiate, and pass the venter without interruption. Constrictions are lacking.

Remarks: The involutness and ornamentation clearly indicate the specimen, presumably a young form, belongs to the genus *Asphinctites*. Taking the features such as short and projected ribs on the umbilical margin into account, the present specimen could represent the species *A. recinctus* BUCKMAN (STURANI 1966, p. 38). Moreover, the specimen comes from the Yeovilensis Subzone, for which the species *A. recinctus* is characteristic (MANGOLD & RIOULT 1997). *A. recinctus* presented by SCHLOGL et al. (2005, pl. 14, fig. 14), although with not well-preserved inner whorls, is quite similar to the specimen described here. However, having only one specimen representing a young stage, more detailed comparison is not possible. From *A. tenuiplicatus*, occurring higher in the section, the specimen described differs by its shorter inner ribs and greater involutness at similar shell-diameter.

Occurrence: Lower Bathonian (Yeovilensis Subzone) of Kawodrza Gorna ('Leszczyński' clay-pit).

Family Tulitidae BUCKMAN

Genus *Tulites* BUCKMAN, 1921

Type species *Tulites tula* BUCKMAN, 1921

Synonyms: *Tulophorites* BUCKMAN, 1921; *Sphaeromorphites* BUCKMAN, 1921; *Madarites* BUCKMAN, 1921.

Tulites cadus BUCKMAN, 1921 [M]

(Plate 14B-C)

1921 *Tulites cadus* nov., BUCKMAN, p. 45.
v. 1922 *Tulites cadus* nov., BUCKMAN, pl. 268 A–C.
v. 1952 *Tulites cadus* BUCKMAN, ARKELL, p. 91, pl. 9, figs. 2, 4, 6, pl. 10, fig. 1, pl. 12, fig. 8, text-fig. 28.
1969 *Tulites modiolaris* W. SMITH, MAUBEUGE, p. 72, text-fig. G 6937.
1971 *Tulites* (*Tulites*) *cadus* BUCKMAN, HAHN, p. 73, pl. 1, fig. 5, pl. 2, fig. 1, text-fig. 12.
1997 *Tulites* (*Tulites*) *cadus* BUCKMAN, MANGOLD & GYGI, p. 506, fig. 3. 9, figs. 4.1–2, figs. 5. 2, 4.
2007a *Tulites cadus* BUCKMAN, ZATON, p. 195, fig. 3 (with full synonymy).

Material: Eighteen specimens: one almost complete adult, one not well-preserved phragmocone with partial body chamber belonging to sub-adult, three whorl fragments presumably belonging to different specimen, and thirteen flattened juvenile specimens.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3013	~38.0	~12.0	~11.7	-	~35.0	8	~20	~0.31	0.31	0.92	~2.99	-
GIUS 8-3028	137.0	50.8	~43.0	~31.0	~84.0	-	-	0.37	~0.31	~0.61	~1.95	-

Remarks: The specimens possess cadiconic shells, which may attain 137 mm in diameter, with crater-like umbilicus (U/D = 0.37) and depressed trapezoid whorl cross-section (Wb/Wh_1 = ~ 1.95). The detailed description of and discussion on the present specimens were recently given by ZATON (2007a), and there is nothing new to be added here.

Occurrence: Middle Bathonian (Subcontractus Zone) of Blanowice and Gnaszyn Dolny ('Gnaszyn' clay-pit). This species is also known from France (LISSAJOUS 1923), England (ARKELL 1952), Germany (HAHN 1971, DIETZE & SCHWEIGERT 2000) and Switzerland (MANGOLD & GYGI 1997).

Genus *Bullatimorphites* BUCKMAN, 1921

Type species *Bullatimorphites bullatimorphus* BUCKMAN, 1921

Subgenus *Bullatimorphites* (*Bullatimorphites*) BUCKMAN, 1921

Bullatimorphites (*Bullatimorphites*) *costatus* ARKELL, 1954 [M]

(Plate 14D, G, Text-fig. 11D)

1923 *Sphaeroceras bullatum* D'ORBIGNY, LISSAJOUS, p. 91, pl. 8, figs. 1–2, *non* pl. 7, figs. 1–2.

1954 *Bullatimorphites costatus* sp. nov., ARKELL, p. 107.
1983 *Bullatimorphites* (*Bullatimorphites*) *costatus* ARKELL, SANDOVAL, p. 556, pl. 69, figs. 1–2, pl. 71, fig. 2, text-figs. 147 d–e, 149 e-f, 151.
2006 *Bullatimorphites* (*Bullatimorphites*) *costatus* ARKELL, KOPIK, p. 31, pl. 32, fig. 3, pl. 33, fig. 1, pl. 34, fig. 1.

Material: One phragmocone covered by pyritic incrustation and one large, complete specimen.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
GIUS 8-3029	70.8	10.5	37.7	23.6	51.2	10	30	0.15	0.53	0.72	1.36	1.69
GIUS8-3030	172.4	45.2	72.5	55.7	82.4	11	56	0.26	0.42	0.48	1.14	2.19

Description: The preserved phragomocone (GIUS 8-3029) is moderate in size (D = 70.8 mm), involute (U/D = 0.15), sphaerocone. Whorls depressed (Wb/Wh_1 = 1.36) with wide and rounded venter (Text-fig. 11D). At this diameter, the umbilicus is deep and narrow but the shell begins to uncoil. Umbilical margin rounded and slope nearly vertical. Inner ribs rectiradiate or slightly prorsiradiate. In the 1/3 of the whorl height they bifurcate. Outer ribs slightly sinuous and adaperturally convex. Single and intercalatory ribs also occur.

The large (D = 172.4 mm) and complete specimen (GIUS 8-3030) consist mainly of the last whorl (the inner and middle ones are not visible), which is eccentrically coiled. The shell is semi-involute (U/D = 0.26), with quite deep umbilicus. Umbilical margin rounded, slope nearly vertical in the first half of the last whorl and gently inclined in the second half. Whorl cross-section depressed (Wb/Wh_1 = 1.14). Venter wide and rounded. Inner ribs (P = 11) thick, rounded, distinct up to the end of the body chamber. Toward the aperture, they are more distant. Above the half of the whorl height they divide on two thinner outer ribs (S = 56). Intercalatory ribs also occur, in the number of two between the inner ribs. The body chamber attains one last whorl. Aperture simple, preceded by four thickened inner ribs.

Remarks: Nearly completely occluded umbilicus of the phragmocone (GIUS 8-3029) described distinguishes the specimen from the representatives of *Bullatimorphites* (*Kheraiceras*) SPATH. The morphology and biometry of the specimen described here is similar to those of the specimens presented by SANDOVAL (1983). The large specimen (GIUS 8-3030) has the same ornamentation as the holotype (LISSAJOUS 1923, pl. 8, fig. 1), the latter differs only by its smaller involutness. According to SANDOVAL (1983), the most similar to *B.* (*B.*) *costatus* is *B.* (*B.*) *bullatimorphus* BUCKMAN. The latter, however, differs by its much greater shell size and denser, as well as finer ribbing. *B.* (*Kheraiceras*) *bullatus* (D'ORBIGNY) is more involute, its whorl cross-section is wider and the ribbing, especially the outer ribs, significantly thicker. *B.* (*B.*) *perisphinctoides* ARKELL, possessing denser and finer inner ribs, was considered as a synonym of *B.* (*B.*) *bullatimorphus* (MANGOLD & GYGI 1997, tab. 8). The same concerns *B.* (*B.*) *stephanovi* GALACZ. The latter species was interpreted as a synonym of *B.* (*B.*) *costatus* (SANDOVAL 1983). Poor state of preservation of the holotype of *B.* (*B.*) *stephanovi* does not allow for comparison with the specimen discussed here (GIUS 8-3029-3030). Somewhat similar *Bullatimorphites hermi* SEYED-EMAMI differs by its stronger inner ribs, and sharp, straight and very distant outer ribs.

Occurrence: Upper Bathonian (Hodsoni/Orbis zones) of Ogrodzieniec and Zarki. This species is characteristic for the Sub-Mediterranean Upper Bathonian (lower part of the Retrocostatum Zone, Blanazense Subzone, see HAHN et al. 1990). In France, it occurs in the upper part of the Middle Bathonian. Similarly in Spain, where many forms pass through the lowermost part of the Upper Bathonian (SANDOVAL 1983). Similar forms were also described from Indonesia (WESTERMANN & CALLOMON 1988) and Iran (SEYED-EMAMI et al. 1998).

Bullatimorphites (*Bullatimorphites*) cf. *serpenticonus* ARKELL, 1954 [M]

(Plate 14F, Text-fig. 11E)

Material: One body chamber fragment with preserved aperture.

Description: The preserved fragment of the body chamber has wide, depressed whorl cross-section (Wb/Wh_1 = 1.13), the height of which gradually increases toward the aperture. The shell if complete could have attained c. 100 mm in diameter. Flanks and venter rounded. Umbilical margin rounded and slope gently inclined. Inner ribs rectiradiate, thin, sometimes delicately convex adaperturally. In the middle of the whorl height they divide on 2, rarely 3 slightly finer outer ribs. Intercalatory ribs occur as well. The ribbing persists up to the end of the body chamber.

Just before the apertural rim, two last outer ribs are markedly thickened. Aperture is ended with a collar.

Remarks: The ribbing pattern and whorl-section of the specimen described, as well as its stratigraphic position, agree with the species *B. serpenticonus* (ARKELL, 1954, p. 111, text-fig. 38). The Middle Bathonian holotype was found within the Subcontractus-Morrisi stratigraphic interval in England. This species has been variously interpreted by different authors. GALACZ (1980) assigned it to the subgenus *Tulites* (*Rugiferites*) BUCKMAN. SANDOVAL (1983), on the contrary, considered the GALACZ's (1980) specimen as *T.* (*R.*) *sofanus* (BOEHM). MANGOLD & GYGI (1997), on the other hand, the SANDOVAL's (1983) specimens of *T.* (*R.*) *sofanus* considered as the species *B.* (*B.*) *rugifer* (BUCKMAN). The problem whether *B.* (*B.*) *serpenticonus* is a synonym of *B.* (*B.*) *sofanus* is still an open question. The latter species occurs much more lower, in the Progracilis Zone (np. MANGOLD & GYGI 1997). In the present paper *B.* (*B.*) *serpenticonus* is treated as a separate species, occurring in higher zones of the Middle Bathonian and lower zones of the Upper Bathonian.

Occurrence: Middle Bathonian (Morrisi Zone) or lower part of the Upper Bathonian (Hodsoni Zone = Bremeri Zone) of Gnaszyn Dolny ('Gnaszyn' clay-pit). DAYCZAK-CALIKOWSKA et al. (1997) and KOPIK (1996) mentioned *B.* (*B.*) *serpenticonus* from similar stratigraphic intervals of the Polish Jura, as well.

Bullatimorphites (*Bullatimorphites*) cf. *polypleurus* (BUCKMAN 1921) [M]

(Plate 14E, Text-fig. 11F)

Material: Two specimens: larger, incomplete and slightly deformed body chamber with preserved fragments of the inner and middle whorls, and very deformed young individual.

Nr	D	U	Wh_1	Wh_2	Wb	P	S	U/D	Wh_1/D	Wb/D	Wb/Wh_1	WER
IGPUW/J/KP-11-2	121.6	33.1	45.3	35.8	60.3	~19	~33	0.27	0.37	0.49	1.33	-

Description: The shell of the larger specimen (IGPUW/J/KP-11-2) is moderate in size (D = 121.6 mm), semi-involute (U/D = 0.27), cadiconic with depressed whorl cross-section (Wb/Wh_1 = 1.33) (Text-fig. 11F). The older whorls were more evolute. The ornamentation of the latter ones consists of dense, prorsiradiate, slightly concave adaperturally inner ribs. Umbilical margin rounded and slope nearly vertical, smooth. Inner ribs on the body chamber quite dense (P = ~ 19), slightly rursiradiate, concave adaperturally. Just above the umbilical margin they bifurcate on prorsiradiate outer ribs. Aperture is missing.

Remarks: The whorl cross-section, ornamentation pattern and involutness make the specimen described similar to the species *B.* (*B.*) *polypleurus* (BUCKMAN). The involutness is practically identical with the holotype (BUCKMAN, 1921, p. 47, pl. 370–371, U/D = 0.28). However, the poor state of preservation of the specimens described does not allow for certain determination. Moreover, the species *B.* (*B.*) *polypleurus* comes from the older, Middle Bathonian Subcontractus Zone (MANGOLD & GYGI 1997), and the specimens described here are derived from the lower part of the Upper Bathonian Hodsoni Zone.

Occurrence: Upper Bathonian (lower part of the Hodsoni Zone = Bremeri Zone) of Kawodrza Dolna ('Anna' clay-pit).

Genus *Morrisiceras* BUCKMAN, 1920

Type species *Morrisiceras sphaera* BUCKMAN, 1920

Synonyms: *Morrisites* BUCKMAN, 1920, *Pionoceras* LISSAJOUS, 1923, *Lycetticeras* ARKELL, 1953, *Holzbergia* TORRENS, 1971.

Morrisiceras morrisi (OPPEL 1857) [M & m]

(Plate 15A–H, Text-figs. 11G–N, 16F)

1857 *Ammonites Morrisi* n.sp., OPPEL, 478.

2008 *Morrisiceras morrisi* (OPPEL) [M & m], ZATON, p. 701, figs. 2, 5–7, 9, 11–13 (with full synonymy).

Material: 181 specimens: 20 juveniles, 34 microconchs and 127 macroconchs. All the measurements are given in ZATON (2008).

Remarks: The thorough discussion and taxonomic revision of the genus *Morrisiceras*, based upon Polish and English specimens, were recently given by ZATON (2008). The author included all the previous macroconchiate genera/subgenera, such as *Morrisites*, *Pionoceras* and *Lycetticeras*, as well as a microconch *Holzbergia*, into one genus *Morrisiceras*. Moreover, a rich collection of specimens from the Middle Bathonian Morrisi Zone from the Polish Jura and complementary material from England, enabled the revision of macroconch species to be undertaken. The result is that all the previously created species belong to a sin-

gle, but morphologically very variable species *Morrisiceras morrisi*. In contrast, a microconch previously named as *Holzbergia* is characterized by low morphological variability. In Poland, both the macro- and microconchs of *Morrisiceras morrisi* are confined to the same time-interval (Morrisi Zone), thus proving their dimorphic relationships.

Occurrence: Middle Bathonian (Morrisi Zone) of the Polish Jura (KOPIK 2006), the Couiavia region in central Poland (ZNOSKO 1957) and Pomerania in northern Poland (DAYCZAK-CALIKOWSKA et al. 1960).

The species is also known from England (e.g., ARKELL 1954), Germany (HAHN 1971), Switzerland (MANGOLD & GYGI 1997), France (e.g., MANGOLD & RIOULT 1997) and Middle Asia (BESNOSOV & MITTA 1993). The macroconchs were also mentioned from Italy (CLARI et al. 1984).

5. Palaeobiogeographic affinity of the latest Bajocian and Bathonian ammonites of the Polish Jura

5.1. Late Bajocian (Parkinsoni Chron: ~168.4 - 167.7 ± 3.5 Ma)

During the Parkinsoni Chron, in the Polish Jura area the dominant ammonite group were parkinsoniids. The least numerous were Mediterranean forms represented by the families Phylloceratidae, Nannolytoceratidae and Strigoceratidae, as well as Lissoceratidae (Text-fig. 17A). The representatives of the families Phylloceratidae, Nannolytoceratidae and Strigoceratidae, except some sporadic occurrences of phylloceratids (only *Calliphylloceras disputabile*) and lissoceratids (*Lissoceras*, ROZYCKI 1953, ZATON & MARYNOWSKI 2006) in the Early Bathonian to Late Bathonian and Early Bathonian respectively, have not appeared later in the Polish Jura during sedimentation of the ore-bearing clays. The occurrence of these Mediterranean taxa during the Parkinsoni Chron in the area, is thought to be connected with the Late Bajocian transgressive pulse (ZATON & MARYNOWSKI 2006). The complete disappearance of nannolytoceratids and strigoceratids just after the latest Bajocian, must have been caused by ecological factors. Thus, in the Polish Basin, they represented parademic or miodemic populations, in contrast to dominant representatives of Parkinsoniidae, as well as Perisphinctidae and Stephanoceratidae, represented by eudemic populations (FERNANDEZ-LOPEZ 1991, FERNANDEZ-LOPEZ & MELENDEZ 1996, CALLOMON 1985).

During the Parkinsoni Chron, the Polish Basin was characterized by the presence of ammonite assemblage most similar in species composition (Tab. 1, Text-fig. 18A) to France (11 common species), then to Spain and Hungary (7 common species), Germany (6 common species), England and Caucasus (5 and 4 common species, respectively). The least similarity occurred between Polish Jura – Pieniny Basin and Polish Jura – Austria (2 and 3 common species, respectively), as well as between Polish Jura – Italy, and Polish Jura – Iran (2 and 1 common species, respectively). Thus, the Polish ammonite assemblage was most similar to the western territories, however, some good migratory sea-ways must have existed in the south-east, as well (Text-fig. 18A). This resulted from palaeogeographic conditions. The Polish Basin, as a part of the Mid-European Basin (DADLEZ 1989), located at c. 40°N (GOLONKA 2000), was not too extensive. To the north, south, south-west and east, it was bordered by landmasses (ZIEGLER 1990, DADLEZ 1989, FELDMAN-OLSZEWSKA 1997, GOLONKA 2000, see also Text-fig. 18). The Polish Basin, however, may have easily communicated with the adjacent western territories via quite wide strait situated between the Bohemian Massif and Fennoscandian Shield through the Germanic Basin (ZIEGLER 1990, GOLONKA 2000). Its connection with the south and south-east, on the other hand, was more limited. The Moravian Gate is thought to be closed at least till the Late Bathonian transgression (DAYCZAK-CALIKOWSKA & MORYC 1988, ZIEGLER 1990, GOLONKA 2000), and only the narrow East-Carpathian Gate to the south-east served as a connection with the northern Tethys shelf (DAYCZAK-CALIKOWSKA & MORYC 1988, ZIEGLER 1990, FELDMAN-OLSZEWSKA 1997, GOLONKA 2000, see also Text-fig. 18A). This gate may have been a good sea-way for migrating ammonite fauna toward southern and eastern localities, and *vice versa*, not only in the latest Bajocian but in Bathonian as well. Hungary, the ammonite assemblage of which was strongly similar to that of the Polish Jura as well, was then situated in the south on the Tisza plate, located within the Tethyan Province. From the southern margins of western Laurasia, the Tisza plate was separated by deep basins – Ligurian basin to the west and Pieniny and Magurian Basins to the east (GOLONKA 2000, GOLONKA et al. 2003). The faunal affinity between the Polish Jura – Germany and Polish Jura – England is a bit lower than that with Hungary, and is mirrored in the absence of such taxa in Germany and England, as *Nannolytoceras tripartitum* or *Lissoceras oolithicum*. Generally, the location of the Tisza plate enabled, but

Table 1. Distribution of the common ammonite species for the Polish Jura and other regions during Late Bajocian (Parkinsoni Chron), PKB – Pieniny Klippen Belt, * indicates the taxon was mentioned from the region but not illustrated.

Region / Species	Polish Jura	PKB	Germany	Austria	France	England	Spain	Hungary	Italy	Caucasus	Iran	Morocco*
Nannolytoceras tripartitum (RASPAIL)	+	+		+	+		+	+	?	+		
Oxycerites (*O.*) *yeovilensis* ROLLIER	+				+	+						
Strigoceras truellei (D'ORBIGNY)	+		+	+	+	+	+	+	+			
Lissoceras oolithicum (D'ORBIGNY)	+				+			+				
Lissoceras solitarium ZATON & MARYNOWSKI	+											
Cadomites deslongchampsi (D'ORBIGNY)	+		+		+		+	+		?		
Garantiana (*G.*) *alticosta* WETZEL	+		+		+		+	+				
Parkinsonia (*P.*) *parkinsoni* (SOWERBY)	+	+	+		+	+	+	+		+	+	
Parkinsonia (*P.*) *rarecostata* (BUCKMAN)	+		+		+	+	+	+	+	+		+
Parkinsonia (*D.*) *pseudoferruginea* NICOLESCO	+				+					?		
Parkinsonia (*D.*) *bomfordi* ARKELL	+		+		+	+				+		
Vermisphinctes stomphus (BUCKMAN)	+			+	+		+		?			

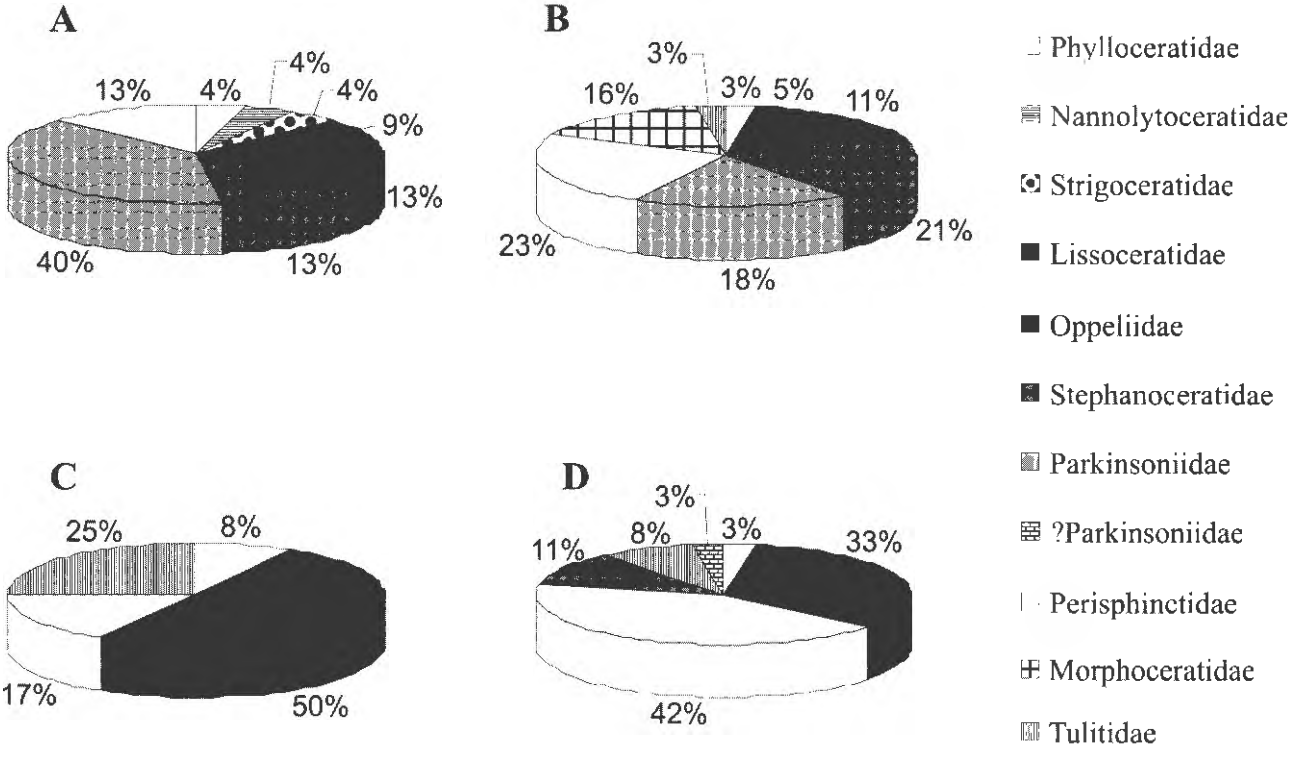
to various degree (weaker toward the west), the migration of ammonite faunas along the northern Tethys shelf (Text-fig. 18, see also GOLONKA 2000). The palaeogeographic situation for the latest Bajocian pictured above is rather similar for the Early to Late Bathonian as well (GOLONKA 2000), so it will not be repeated here again.

Very low number of common species between the Polish Jura and the rest of the areas (Pieniny Klippen Belt, Austria, Italy and Morocco), certainly results in either considerable distance and/or the presence of land barriers or oceanic depths (the so-called bathymetric-distance filter sensu MARCINOWSKI & WIEDMANN 1990). It is worth stressing, that the common species is *Parkinsonia* (*P.*) *parkinsoni*, which is characterized by the greatest number of co-occurrences (Tab. 1). This may mean that this species was characterized by wide ecological tolerance. However, it must not be excluded that it may result from insufficient recognition of the deposits of Parkinsoni Zone with respect to ammonite assemblages. Summarizing, during the Parkinsoni Chron, the ammonite fauna of the Polish Jura had Sub-mediterranean character, an eco-province characteristic for the epicontinental basins of southern Europe (e.g., ENAY & CARIOU 1997). The influence of North-West European Province (Sub-boreal sensu MANGOLD & RIOULT 1997), as well as the Mediterranean one, was marked in epicratonic Poland as well. The degree of endemism in the Polish Jura area, on the other hand, was very low. So far, only two species were recognized that are either unknown in other areas (*Lissoceras solitarium*, ZATON & MARYNOWSKI 2006) and related with German forms (*Parkinsonia* aff. *dorni*, MATYJA & WIERZBOWSKI 2000, ZATON & MARYNOWSKI 2006).

5.2. Early Bathonian (Zigzag – Tenuiplicatus chrons: ~167.7 – 166.9 ± 3.5 Ma)

During the Early Bathonian (Zigzag – Tenuiplicatus chrons), the Polish Jura area was dominated by the representatives of the families Perisphinctidae and Stephanoceratidae. Parkinsoniids are less common, but together with morphoceratids they are still well-represented. Instead, the representatives of Oppeliidae begin to be more common, and phylloceratids, tulitids and lissoceratids belong to minority (Text-fig. 17B).

During this time, the species assemblage of the Polish Jura shows even stronger faunal similarity to western and north-western European regions (Spain, France, Germany and England) (Text-fig. 18B). This similarity is lower as compared to southern and south-eastern regions (Hungary, Bulgaria and Iran), but Caucasus, however, is characterized by as strong faunal affinity with Poland, as Spain and England (Text-



Text-fig. 17. A percentage contribution of particular ammonite families in the Polish Jura area during A. Late Bajocian (Parkinsoni Chron), B. Early Bathonian (Zigzag – Tenuiplicatus chrons), C. Middle Bathonian (Subcontractus – Morrisi chrons) and D. Late Bathonian (Hodsoni – Orbis chrons).

fig. 18B). In Caucasus, the Zigzag – Tenuiplicatus zones are represented by shelfal clastic deposits (Besnosov & Mitta 1993). Somewhat smaller number of species in Turkmenistan/Uzbekistan (5 common species) may result from facies differences, because a considerable part of the Zigzag – Tenuiplicatus zones is represented by tidal, deltaic and prodeltaic deposits, and thus reflecting extremely unsuitable environments for ammonites.

Relatively stronger similarity seems to be marked with the northern Gondwana (Morocco), as well. Apart of pandemic *Calliphylloceras disputabile*, the representatives characterized by their widest distribution and showing a genuine palaeobiogeographic affinity between the Polish Jura and the rest of the regions analyzed, belong to Oppeliidae (*Oxycerites yeovilensis*) and Morphoceratidae (*Morphoceras macrescens*, *M. multiforme*) (Tab. 2).

The similar number of species between the Polish Jura and Hungary, Bulgaria, Iran and Caucasus (Text-fig. 18B) may attest, that epicratonic seas covering the southern margins of Laurasia allowed for easy communication of ammonite faunas between the regions. In comparison with the Late Bajocian, the faunal communications with such a distant Iran or Morocco were even better (Text-fig. 18B). This may be a result of gradual transgression during the Early Bathonian times (e.g., Hallam 1992, 2001). During the Zigzag – Tenuiplicatus chrons, the Polish Jura area was influenced by both the Sub-mediterranean and north-west European provinces. In comparison with the Parkinsoni Chron of Late Bajocian, it seems that during the Early Bathonian the ammonite fauna of the Polish Jura had already been stronger related with western and north-western regions. The influence of the Mediterranean Province, on the other hand, although still present, was very small. The only indicator of influence of the latter province are sporadically found representatives of *Calliphylloceras disputabile*. As during the latest Bajocian, the degree of endemism in the Polish Basin during the Early Bathonian was very low, as indicated by the presence of only one species *Lissoceras solitarium* in the latest Early Bathonian (Zaton & Marynowski 2006).

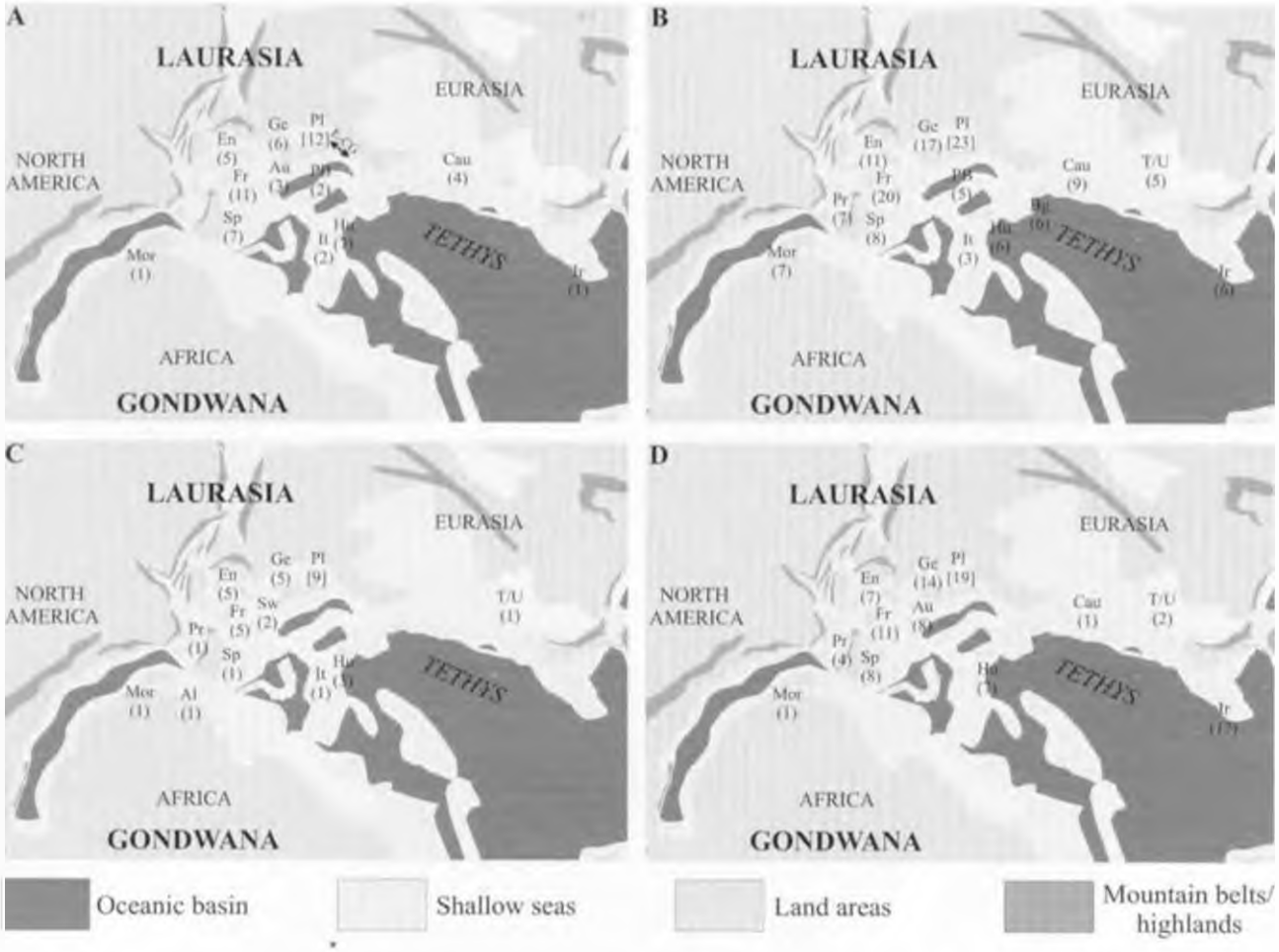
Table 2. Distribution of the common ammonite species for the Polish Jura and other regions during Early Bathonian (Zigzag – Tenuiplicatus chrons), abbreviations as in Table 1.

Region / Species	Polish Jura	PKB	Germany	Austria	France	England	Spain	Portugal*	Bulgaria	Hungary	Italy	Caucasus	Turk./Uz	Morocco*	Iran
Calliphylloceras disputabile (ZITTEL)	+	+	+	?	+		+			+	+	+	+	?	+
Oxycerites (O.) yeovilensis ROLLIER	+	+	+		+	+		+	+	+	+	+	+	+	+
Oxycerites (P.) formosus (ARKELL)	+		+		+		?					?	+		
Oxycerites (O.) seebachi (WETZEL)	+		+		+			+	+			+		+	+
Lissoceras solitarium ZATON & MARYNOWSKI	+														
Cadomites extinctus (QUENSTEDT)	+		+		+		+	+		+					
Cadomites stegeus (BUCKMAN)	+				+										
Cadomites cornutus KOPIK	+						+								
Cadomites dorni (ROCHE)	+		+		+										
Cadomites rozyckii KOPIK	+				+		+					?			
Parkinsonia (P.) pachypleura BUCKMAN	+		+		+	+		+				+			
Parkinsonia (P.) schloenbachi SCHLIPPE	+		+		+	+						+			
Parkinsonia (D.) pseudoferruginea NICOLESCO	+				+										
Parkinsonia (G.) subgaleata (BUCKMAN)	+		+		+	+		+							
Parkinsonia (O.) gyrumbilica (QUENSTEDT)	+	+	+		+							+	+	+	
Parkinsonia (O.) wuerttembergica (OPPEL)	+		+									+			
Morphoceras macrescens (BUCKMAN)	+		+		+	+	+	+	+	+	+	+		+	+
Morphoceras multiforme ARKELL	+	+	+		+	+	+		+	+	+	+		+	+
Morphoceras sulcatum (ZIETEN)	+	+	+		+	+	+	+		+	+			+	
Asphinctites tenuiplicatus (BRAUNS)	+		+		+	+									
Procerites tmetolobus BUCKMAN	+				+	+	+		+					+	+
Procerites laeviplex (QUENSTEDT)	+		+		+	+			+						
Procerites procerus (v. SEEBACH)	+		+		+	+		?			?		+		

5.3. Middle Bathonian (Subcontractus – Morrisi chrons: ~166.5 – 166.1 ± 3.5 Ma)

During the Middle Bathonian Subcontractus – Morrisi chrons, the Polish Jura was dominated by oppeliids and tulitids (Text-fig. 17C). Perisphinctids are rather rare and phylloceratids are known only from single fragments belonging exclusively to *Calliphylloceras disputabile*.

During the time-interval under consideration, with respect to ammonite species, the Polish Jura area seems to be the most similar exclusively to western and north-western regions (France, Germany and Eng-



Text-fig. 18. The quantitative affinity of the ammonite faunas of the Polish Jura and other regions on the background of palaeogeography during the Middle Jurassic (modified after GOLONKA 2000). A. Late Bajocian (Parkinsoni Chron), B. Early Bathonian (Zigzag – Tenuiplicatus chrons), C. Middle Bathonian (Subcontractus – Morrisi chrons) and D. Late Bathonian (Hodsoni – Orbis chrons). Numbers in the square brackets [ ] refer to the total ammonite species in the Polish Jura during particular chrons. Numbers in the round brackets ( ) refer to the number of common ammonite species in other analyzed regions when compared with the Polish Jura. Pl – Polish Jura, Ge – Germany, En – England, Fr – France, Sp – Spain, Pr – Portugal, Sw – Switzerland, Au – Austria, PB – Pieniny Basin, Hu – Hungary, It – Italy, Bg – Bulgaria, Mo – Morocco, Al – Algeria, Cau – Caucasus, T/U – Turkmenistan/Uzbekistan, Ir – Iran, E-CG – East-Carpathian Gate.

land, see Text-fig. 18C). However, such a picture may be somewhat misleading, because in many areas of Europe and Middle Asia, the deposits of the Subcontractus – Morrisi zones are either undocumented by ammonite fauna (Pieniny Klippen Belt, SCHLOGL et al. 2005), are only partially documented (undocumented Morrisi Zone in Hungary, GALACZ 1980; documented only the Morrisi Zone in Italy, CLARI et al. 1984; the lack of index taxa in Iran, MAJIDIFARD 2003), are strongly condensed (Bulgaria, STEPHANOV 1972; Austria, KRYSTYN 1972; Switzerland, MANGOLD & GYGI 1997; Germany, HAHN 1971) or simply they do not occur (Bulgaria, STEPHANOV 1961; Caucasus, BESNOSOV & MITTA 1993). It must be stressed, however, that in the regions where the ammonite fauna is much reduced (e.g., Italy or Turkmenistan/Uzbekistan), the genus *Morrisiceras*, well-known from western and north-western Europe, is present here, as well (Tab. 3, ZATON 2008). Therefore, apart of regressive pulse during the Subcontractus – Morrisi zones (HALLAM 1992, 2001), that certainly limited the migration and diversity of ammonites, the Polish Jura was still in contact with both south-eastern Laurasia (Middle Asia) and southerly located Apulian plate (Italy, see Text-fig. 18), at least during the Morrisi Chron. In Spain and Portugal, on the other hand, nei-

Table 3. Distribution of the common ammonite species for the Polish Jura and other regions during Middle Bathonian (Subcontractus – Morrisi chrons), abbreviations as in Table 1.

Region / Species	Polish Jura	Germany	Switzerland	France	England	Spain	Portugal	Italy*	Hungary	Turk./Uz.
Calliphylloceras disputabile (ZITTEL)	+								+	
Oxycerites (P.) formosus (ARKELL)	+	+			+					
Oxycerites (P.) densecostatus (LISSAJOUS)	+									
Prohecticoceras ochraceum ELMI	+	+		+		+	+		+	
Tulites cadus BUCKMAN	+	+	+	+	+					
Tulites tulotus (BUCKMAN)	+	?			+					
Bullatimorphites (B.) serpenticonus ARKELL	+				+				+	
Morrisiceras morrisi (OPPEL)	+	+	+	+	+			?		+
Procerites psedoperspicuus (STEPHANOV)	+	+		+						

ther of the species known from the Polish Jura occur. Regarding Portugal, however, during the Subcontractus Zone a hiatus occurred, and the deposits of the Morrisi Zone do not contain an index taxon or any other forms of the genus *Morrisiceras* (MANGOLD 1990). The genus *Morrisiceras* seems to be characteristic (common) constituent of the central and north-western Europe, and its occurrence in such palaeogeographic distant areas as southerly located Italy and easterly located Turkmenistan/Uzbekistan, must be considered as incidental (ZATON 2008).

Summarizing, during the Subcontractus – Morrisi chrons, the Polish Jura shared the majority of ammonite species with western and north-western Europe (North-West European Province), and the influence of the Mediterranean (Tethyan) Province was insignificant. The latter may have resulted from the regressive pulse during this time as mentioned above. The degree of endemism in the Polish Jura area was either extremely low, or nonexistent. The only indicator of some endemism may be the presence of the representatives of the species *Oxycerites* (*O.*) sp. ex gr. *yeovilensis*, but only if they really represent the true prolongation of the Early Bathonian species *Oxycerites* (*O.*) *yeovilensis*. If they are closely related with the Mid-Bathonian *Oxycerites* (*O.*) *waterhousei* known from England and France (ARKELL 1951b), what is not completely excluded, so the endemism in the Polish Basin during the Subcontractus and Morrisi chrons has not existed at all.

5.4. Late Bathonian (Hodsoni – Orbis chrons: ~ 166.1 – 165.2 ± 3.5 Ma)

In the Late Bathonian, during the Hodsoni – Orbis chrons, the ammonite fauna of the Polish Jura is definitely dominated by the representatives of the families Perisphinctidae and Oppeliidae (Text-fig. 17D). Phylloceratids, as during the Early and Middle Bathonian, are represented by single finds of *Calliphylloceras disputabile*.

The species composition of the Polish assemblage in the Hodsoni – Orbis chrons points to the strong affinity with the western (Spain, France, Germany), as well as with southern (Austria, Hungary) regions (Text-fig. 18D). Although deposits of the lower part (analogue of the uppermost Middle Bathonian Bremeri Zone) of the interval under discussion may be present in the Pieniny Klippen Belt, though they have not been sufficiently documented using ammonites so far (SCHLOGL et al. 2005). In comparison to the Early Bathonian, in the Late Bathonian the relations with the northern Gondwana (Morocco) are weak. The same concerns the Middle Asiatic part of the Laurasia (Iran, Turkmenistan/Uzbekistan). A weak exchange of the species with that part of Laurasia reminds the situation from the Middle Bathonian (see above). The

Table 4. Distribution of the common ammonite species for the Polish Jura and other regions during Late Bathonian (Hodsoni – Orbis chrons), abbreviations as in Table 1.

Region / Species	Polish Jura	Germany	Austria	France	England	Spain	Portugal*	Hungary	Morocco*	Turk./Uz.	Iran
Calliphylloceras disputabile (ZITTEL)	+		?		+			+			
Oxycerites (*O.*) *orbis* (GIEBEL)	+	+		+				+			
Oxycerites (*O.*) *fuscoides* WESTERMANN	+	+									
Oxycerites (*A.*) *tenuistriatus* (DE GROSSOUVRE)	+	+	+					+			
Oxycerites (*A.*) *costatus* (Roemer)	+	+	+								
Oxycerites (*P.*) *maubeugei* (STEPHANOV)	+	+		+	+			+		+	
Oxycerites (*P.*) *waageni* (STEPHANOV)	+	+		+			+	+			
Oxycerites (*P.*) *serrigerus* (WAAGEN)	+	+	+								
Bullatimorphites (*B.*) *serpenticonus* ARKELL	+						+				
Bullatimorphites (*B.*) *costatus* ARKELL	+	+		+		+					
Cadomites bremeri TSERETELI	+	+	+			?	+				
Cadomites linguiferus (D'ORBIGNY)	+	+	+	+		+					?
Procerites hodsoni ARKELL	+	+	+	?	+	+		?			
Procerites quercinus (TERQUEM & JOURDY)	+	+	+	+	+	+					
Procerites gallus (STEPHANOV)	+			+		+		+			
Procerites pseudorjazanensis (LISSAJOUS)	+		+	+	?		+		+		
Wagnericeras fortecostatum (LISSAJOUS)	+	+		+	+	+					
Choffatia cerealis ARKELL	+	+		+	+	+		+		+	
Choffatia arisphinctoides ARKELL	+	?		+	+	+					

most widespread and commonest both for the western, southern and south-eastern regions are such species as *Oxycerites* (*P.*) *maubeugei* (STEPHANOV) and *Choffatia cerealis* ARKELL (Tab. 4). Higher number of common species with western and southern regions, as well as the occurrence of the species common for the areas where previously (Middle Bathonian) they were absent (Spain, Portugal), must resulted from progressive transgression in that time (HALLAM 1992). Moreover, during the Late Bathonian, the Polish Basin had attained its greatest area (MATYJA & WIERZBOWSKI 1998).

During the Hodsoni – Orbis chrons, the affinity of the ammonite faunas of the Polish Jura was greatest with western regions, while that with southern regions was somewhat smaller. The influence of Tethyan Province was similar as in the earlier chrons. The endemic taxa are lacking in the Polish Basin, though two species (*Prohecticoceras* aff. *angulicostatum* and *Procerites* aff. *verciacensis*) may in fact represent new forms. However, more material is needed to prove this.

Summing up the palaeobiogeographic similarity of the Bathonian ammonite faunas, it must be indicated that many of the European genera occur in

Andean Province, as well. Moreover, many Andean species showing affinities with the European forms are known, as well (PAGE 1996). In the Lower Bathonian of Argentina, RICCARDI & WESTERMANN (1999) described the species similar to the European ones, such as *Oxycerites* (*O.*) cf. *aspidoides*, *Procerites* cf. *schloenbachi*, as well as an endemic species of *Morphoceras*. PARENT (1998) on the other hand, described from the Upper Bathonian of Argentina *Oxycerites* (*Alcidellus*) *tenuistriatus* and *Choffatia subbackeriae*, the species that are commonly known from the Mediterranean, Sub-mediterranean and North-West European provinces of Europe. Earlier, SANDOVAL et al. (1990) described from the Mixteca terrane (Mexico) many representatives of the genus *Choffatia* (including *Ch.* cf. *subbackeriae*), *Oxycerites* [*Oxycerites* (*Alcidellus*) cf. *tenuistriatus*, *O.* (*Paroecotraustes*) cf. *waageni*], *Epistrenoceras histricoides*, *Prohecticoceras blanazense* and *Bullatimorphites* (*Kheraiceras*) *bullatus*. This data point to the marine connection ('Hispanic Corridor') between the eastern Pacific and western Tethys Ocean, allowing for, at least periodically (PAGE 1996), migration of ammonites between these two provinces in the Middle Jurassic. Other European species, such as *Asphinctites* cf. *pinguis* from the Lower Bathonian, or *Oxycerites* (*Alcidellus*) cf. *tenuistriatus*, *Oxycerites* (*A.*) gr. *biflexuosus* – *costatus*, *Bullatimorphites* (*B.*) *ymir*, *B.* (*B.*) cf. *costatus* and *Cadomites* cf. *rectelobatus* are known from the Lower to Upper Bathonian of the Sula Islands (Indonesia, Indo-Malgach Province) (WESTERMANN & CALLOMON 1988). The representatives of the genus *Oxycerites* are known from the Upper Bathonian of New Guinea, as well (WESTERMANN & CALLOMON 1988), located then in south-eastern limit of Gondwana. The data presented above point to the migration of Bathonian ammonites both to the extreme east (Indonesia) and extreme west (Andean regions), as well as far south (New Guinea).

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Plate 1

A. ?*Teloceras* sp. juv., IGPUW/J/K-1, Poraj-Kamienica Polska area, heap of the 'Teodor' ore-mine, Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone).

B. *Normannites orbignyi* Buckman [m], B1: lateral view, B2: ventral view, IGPUW/J/K-x, Poraj-Kamienica Polska area, heap of the 'Teodor' iron ore-mine, Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone).

C. *Cadomites extinctus* (Quenstedt) [M], C1: lateral view, C2: adapertural view, WK-117, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone).

D. *Teloceras* aff. *blagdeni* (Sowerby) [M], D1: ventral view, D2: adapertural view, D3: lateral view, IGPUW/J/K-2, Poraj-Kamienica Polska area, heap of the 'Teodor' iron ore-mine, Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone).

E. *Cadomites deslongchampsi* (d'Orbigny) [M], IGPUW/J/A-1, Gnaszyn Gorny ('Alina' clay-pit), Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone).

F–G. *Teloceras multinodum* (Quenstedt) [M], F: IGPUW/J/K-5, G: IGPUW/J/K-5a, Poraj-Kamienica Polska area, heap of the 'Teodor' and 'Dębowiec' iron ore-mines, Lower Bajocian (Humphriesianum Zone, Blagdeni Subzone).

Scale bars equal 1 cm.

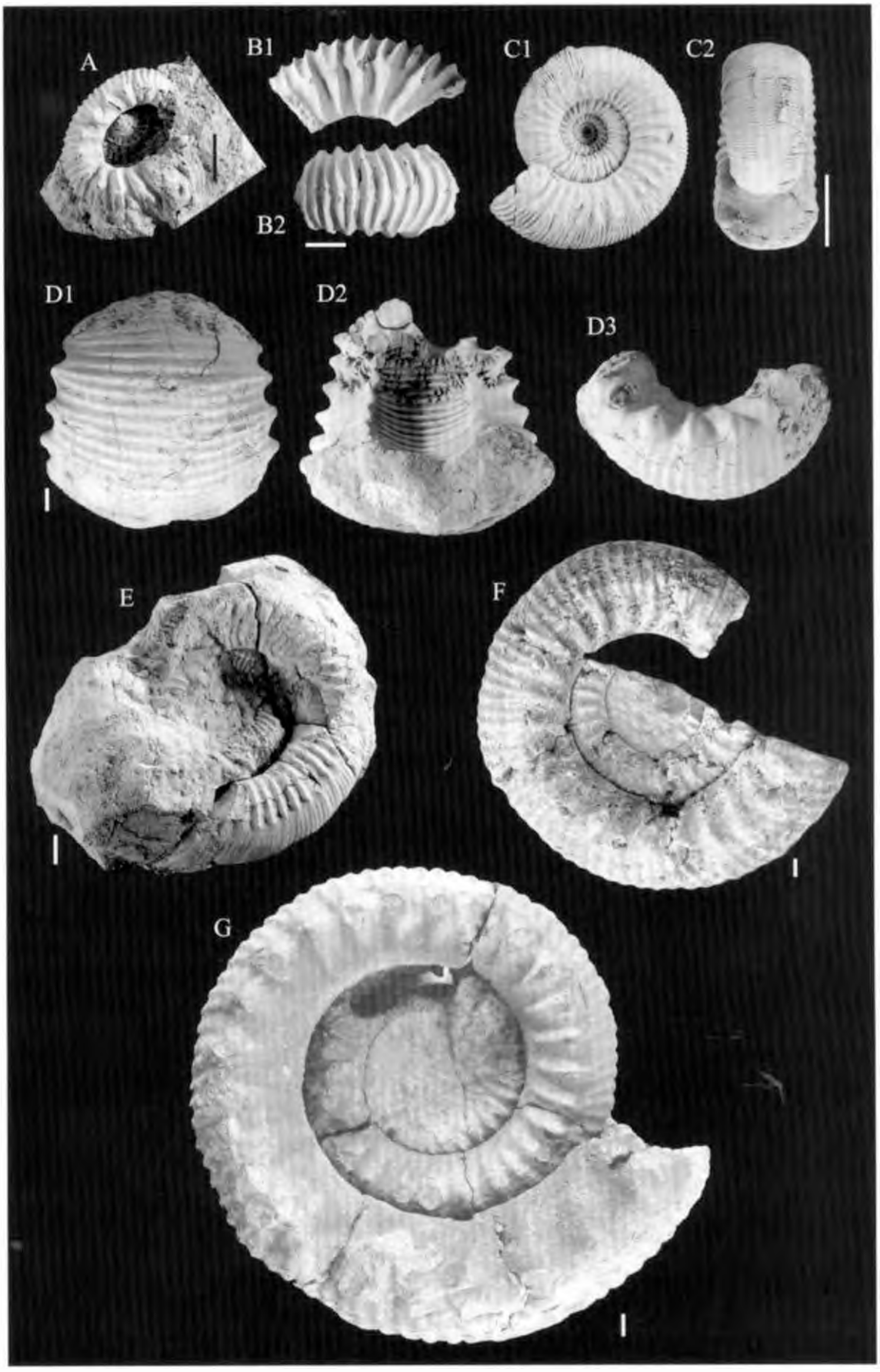

Plate 1, MICHAŁ ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 2

A. *Cadomites linguiferus* (D'ORBIGNY) [m], IGPUW/J/31-A-1, Kawodrza Dolna ('Kawodrza' clay-pit), basal Upper Bathonian Hodsoni Zone (= Bremeri Zone).

B. *Garantiana* (*Garantiana*) *baculata* (QUENSTEDT), B1: lateral view, B2: adapertural view, GIUS 8-2956, heap at Poczesna near Częstochowy, Upper Bajocian (Garantiana Zone).

C–H. *Cadomites bremeri* TSERETELI [M], C: GIUS 8-2958, Grodzisko, D1: lateral view, D2: adapertural view, GIUS 8-2959, Kawodrza Dolna ('Anna' clay-pit), E1: lateral view, E2: adapertural view, GIUS 8-2963b, Grodzisko, F: IGPUW/J/59, Kawodrza Dolna ('Kawodrza' clay-pit), G1: lateral view, G2: adapertural view, IGPUW/J/110, Kawodrza Dolna ('Kawodrza' clay-pit), H: GIUS 8-2960, Kawodrza Dolna ('Anna' clay-pit). Basal Upper Bathonian Hodsoni Zone (= Bremeri Zone).

Scale bars equal 1 cm.

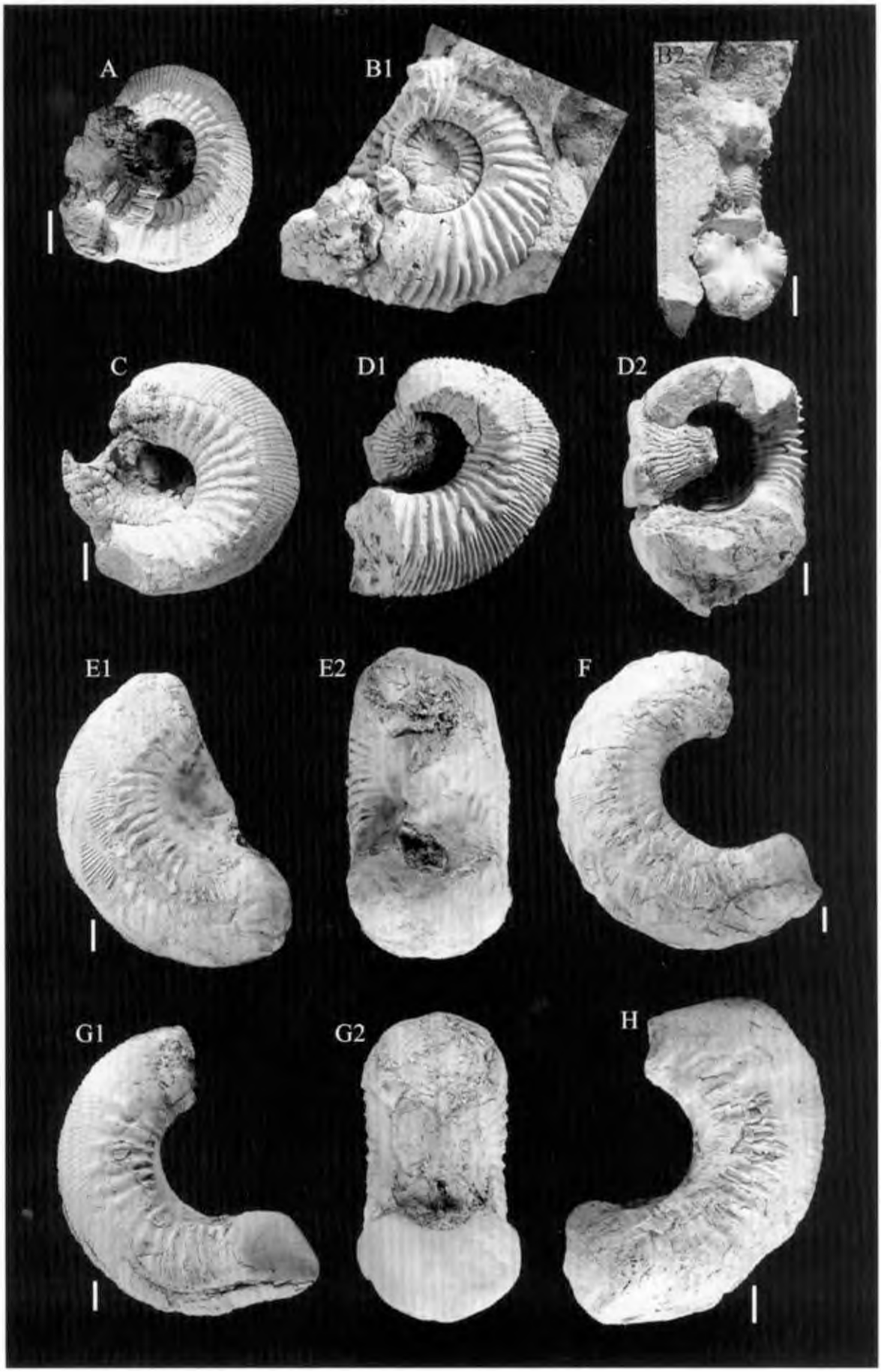

Plate 2. Michał Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 3

A. *Garantiana* (*Garantiana*) *dubia* (Quenstedt) [M?], A1: ventral view, A2: lateral view, IGPUW/J/K-7, Poraj-Kamienica Polska area, heap of 'Teodor' iron ore-mine, Upper Bajocian (Garantiana Zone).

B. *Garantiana* (*Pseudogarantiana*) *minima* (Wetzel) [m], B1: lateral view, B2: ventral view, IGPUW/J/K-11, Poraj-Kamienica Polska area, heap of 'Teodor' iron ore-mine, Upper Bajocian (Garantiana Zone).

C–D. *Vermisphinctes* sp. [juv.], C: IGPUW/J/12.1, D1: lateral view, D2: ventral view, IGPUW/J/13.1, Kawodrza Górna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

E. *Garantiana* (*Hlawiceras*) *wetzeli* Trauth [M], E1: ventral view, E2: lateral view, IGPUW/J/G-8, Poraj-Kamienica Polska area, heap of 'Teodor' ore-mine, Upper Bajocian (Garantiana Zone).

F. ?*Leptosphinctes* sp. [M?], F1. lateral view, F2: ventral view, GIUS 8-2845, Blanowice (clay-pit nr 1), Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone).

G. *Parkinsonia* (*Parkinsonia*) *rarecostata* (Buckman), G1: lateral view, G2: adapertural view, IGPUW/J/Pa-14, Poraj-Kamienica Polska area, heap of 'Teodor' ore-mine, Upper Bajocian (Parkinsoni Zone).

H–K. *Parkinsonia* (*Parkinsonia*) *parkinsoni* (Sowerby) [M], H: JK-PP1, Rudniki, I: GIUS 8-3371, Blanowice (clay-pit nr 1), J: IGPUW/J/80, K: IGPUW/J/49, Gnaszyn Górny ('Alina' clay-pit), Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone).

L. *Vermisphinctes stomphus* (Buckman) [M], IGPUW/J/Vs-1, Kawodrza Górna (abandoned 'Anioł' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

Scale bars equal 1 cm.

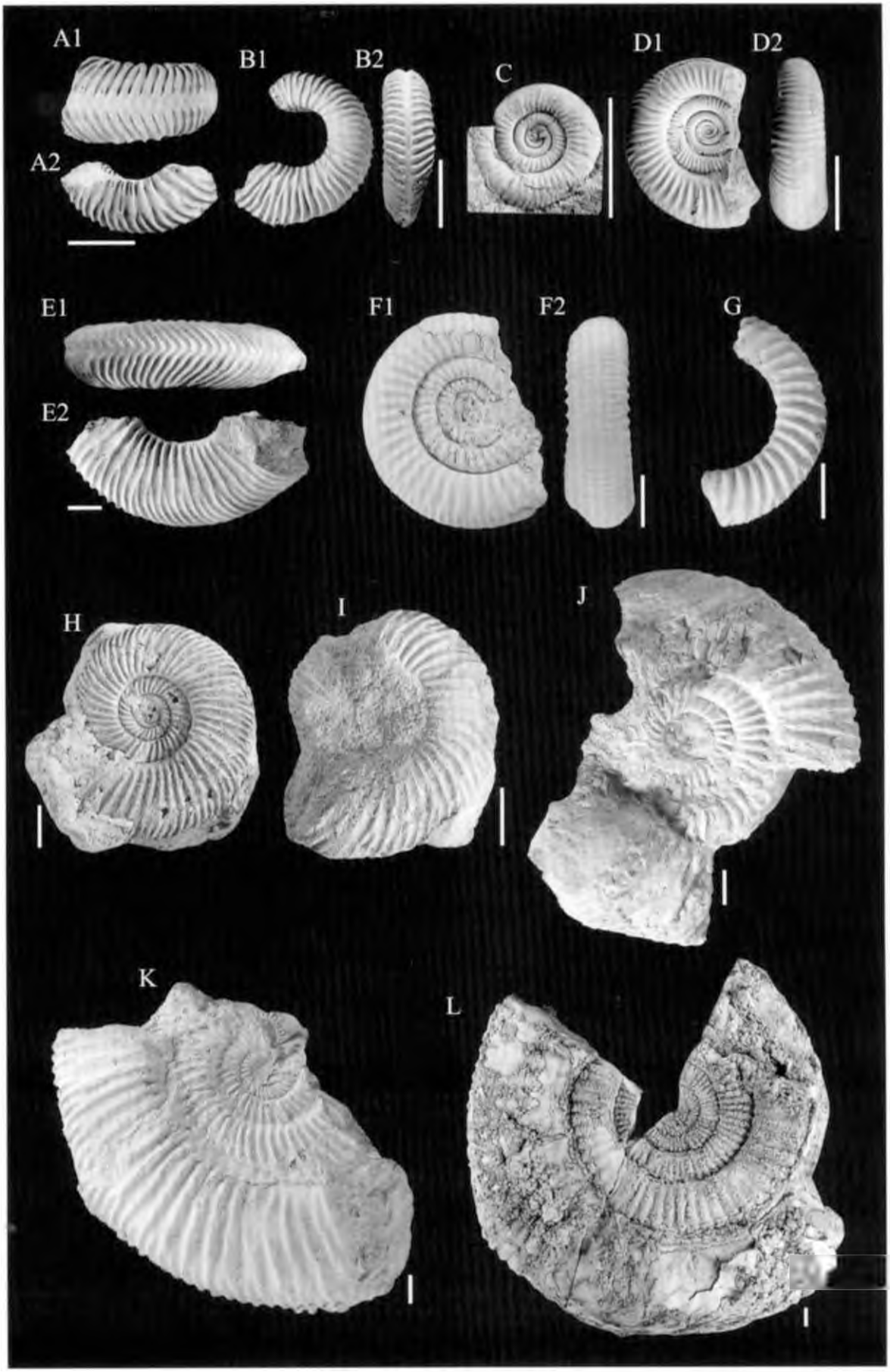

Plate 3, MICHAŁ ZATOŃ: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 4

A. *Procerites tmetolobus* Buckman [M], IGPUW/J/KP-3-1, Kawodrza Gorna ('Glinski' clay-pit), Lower Bathonian (Zigzag Zone, Macrescens Subzone).
B. *Procerites* cf. *imitator* (Buckman) [M], GIUS 8-3200, Faustianka, Lower Bathonian (Tenuiplicatus Zone) or Middle Bathonian (Progracilis Zone).
C–D. *Procerites hodsoni* Arkell [M], C: TK-20, D: GIUS 8-3401, Grodzisko, Upper Bathonian (Hodsoni Zone).
E. *Procerites laeviplex* (Quenstedt) [M], AK-L3, Kawodrza Gorna ('Leszczynski' clay-pit), Lower Bathonian (Tenuiplicatus Zone).
Scale bars equal 1 cm.

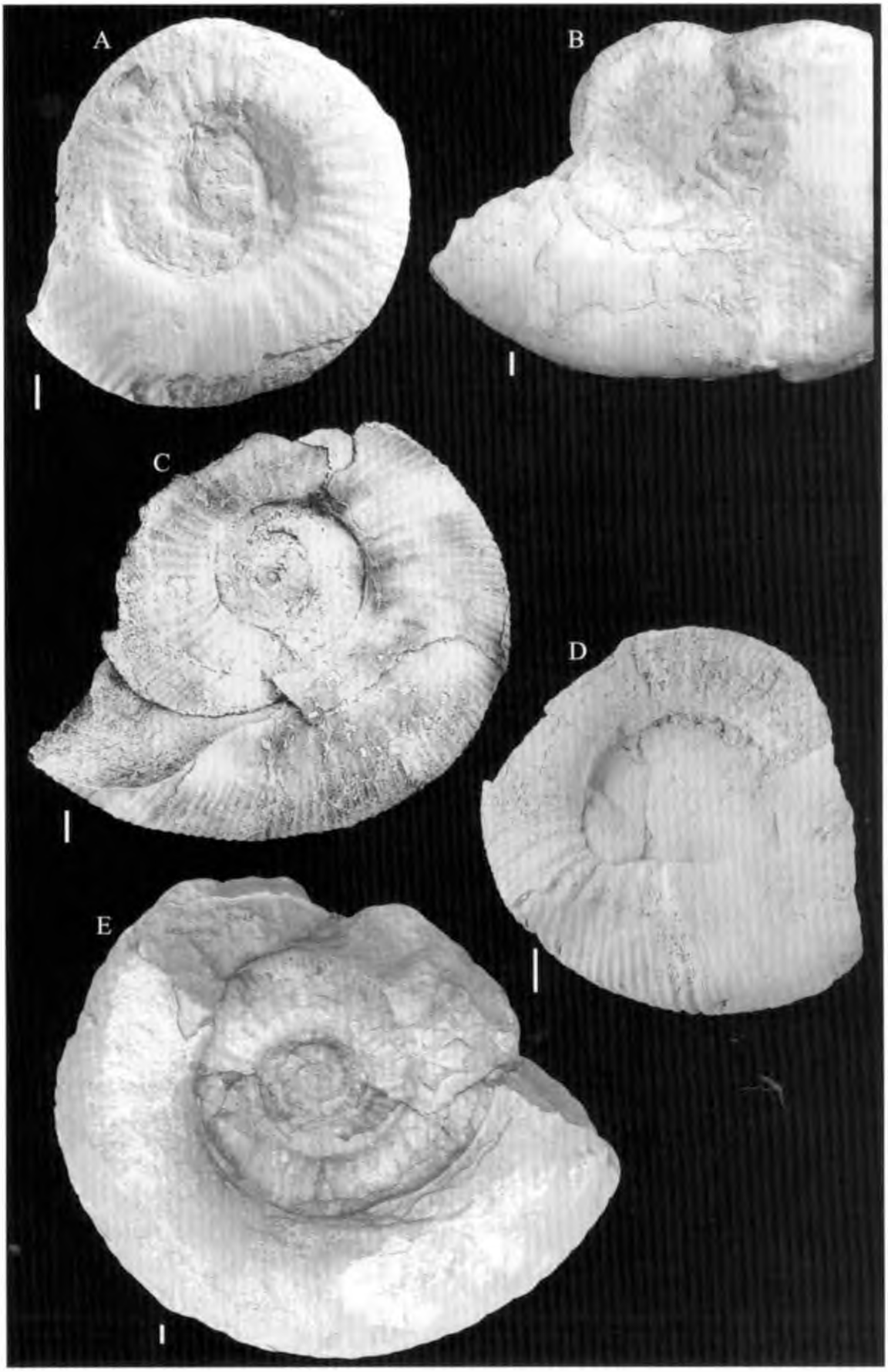

Plate 4. MICHAL ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 5

A. *Procerites* sp. indet. 1 [M?], GIUS 8-3043, Kawodrza Gorna ('LAB' clay-pit), Lower Bathonian (Tenuiplicatus Zone).
B. *Procerites laeviplex* (QUENSTEDT) [M], IGPUW/J/LP-1, Kawodrza Gorna ('Leszczyński' clay-pit), Lower Bathonian (Tenuiplicatus Zone).
C. *Procerites* sp. [M], GIUS 8-2841, Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).
D–F. *Procerites quercinus* (TERQUEM & JOURDY) [M], D: IGPUW/J/Pq-2, Kawodrza Dolna ('Kawodrza' clay-pit), E: IGPUW/J/150, F: IGPUW/J/55, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone).
Scale bars equal 1 cm.

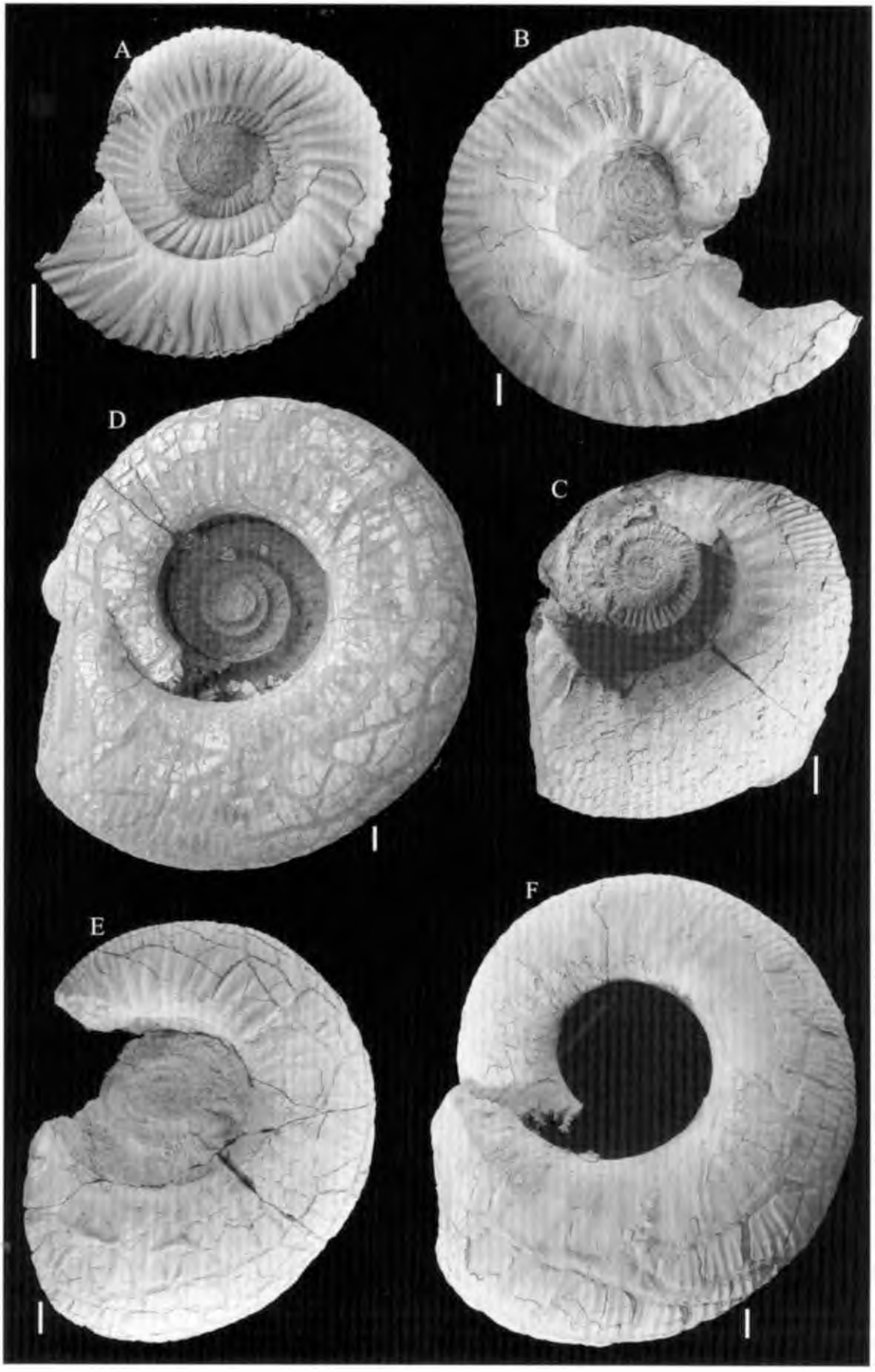

Plate 5. MICHAL ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 6

A. *Procerites gallus* (Stephanov) [m], A1: lateral view, A2: adapertural view, GIUS 8-3054, Gnaszyn Dolny ('Gnaszyn' clay-pit), Upper Bathonian (Hodsoni Zone).
B–D. *Procerites pseudoperspicuus* (Stephanov) [m], B: GIUS 8-3057, C: GIUS 8-3056, D: AK-PS-1, Kawodrza Dolna ('Kawodrza' clay-pit), Middle Bathonian (Morrisi Zone).
E. *Procerites* cf. *pseudoperspicuus* (Stephanov) [m], IGPUW/J/145, Kawodrza Dolna ('Kawodrza' clay-pit), Middle Bathonian (Morrisi Zone).
F–G. *Procerites pseudorjazanensis* (Lissajous) [m], F: AK-PSP-1, Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone), G: GIUS 8-3060, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone).
H. *Procerites* aff. *verciacensis* (Lissajous) [m], IGPUW/J/41, Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).
I–J. *Wagnericeras fortecostatum* (de Grossouvre) [M], I: GIUS 8-3070, J: JK-WK-1, Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).
Scale bars equal 1 cm.

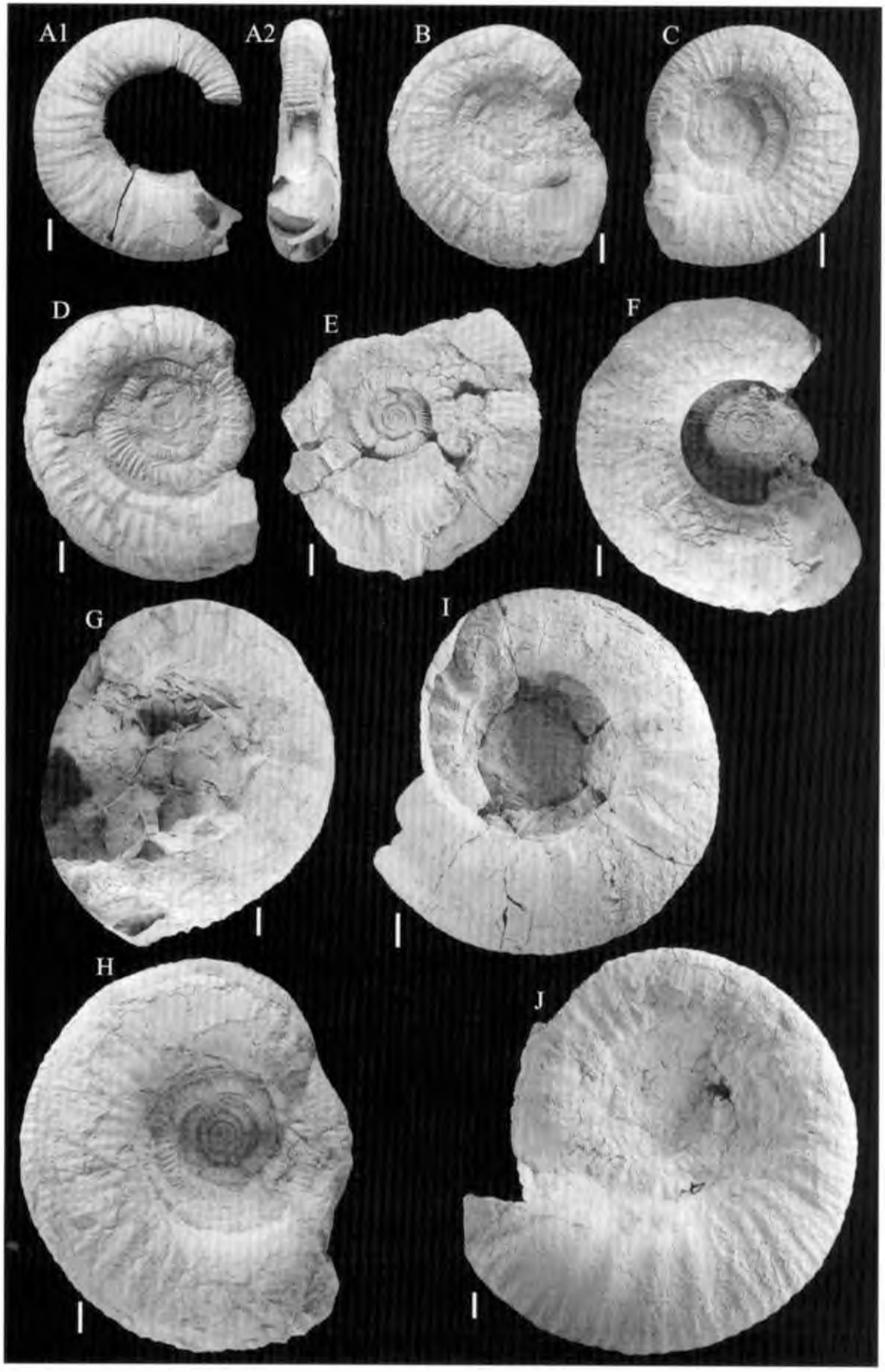

Plate 6, MICHAŁ ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 7

A -B, D–F. *Choffatia arisphinctoides* Arkell [M], A1: lateral view, A2: ventral view, IGPUW/J/KP-12-12, young individual, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone), B: JK-Ch-1, inner whorls (phragmocone), Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone), D: IGPUW/J/140, F: TK-18, Gnaszyn Dolny ('Gnaszyn' clay-pit), Upper Bathonian (Hodsoni Zone).
C. *Choffatia* cf. *arisphinctoides* Arkell [M], GIUS 8-3209, Bugaj ('Michalina' clay-pit), Middle Bathonian (Morrisi Zone).
Scale bars equal 1 cm.

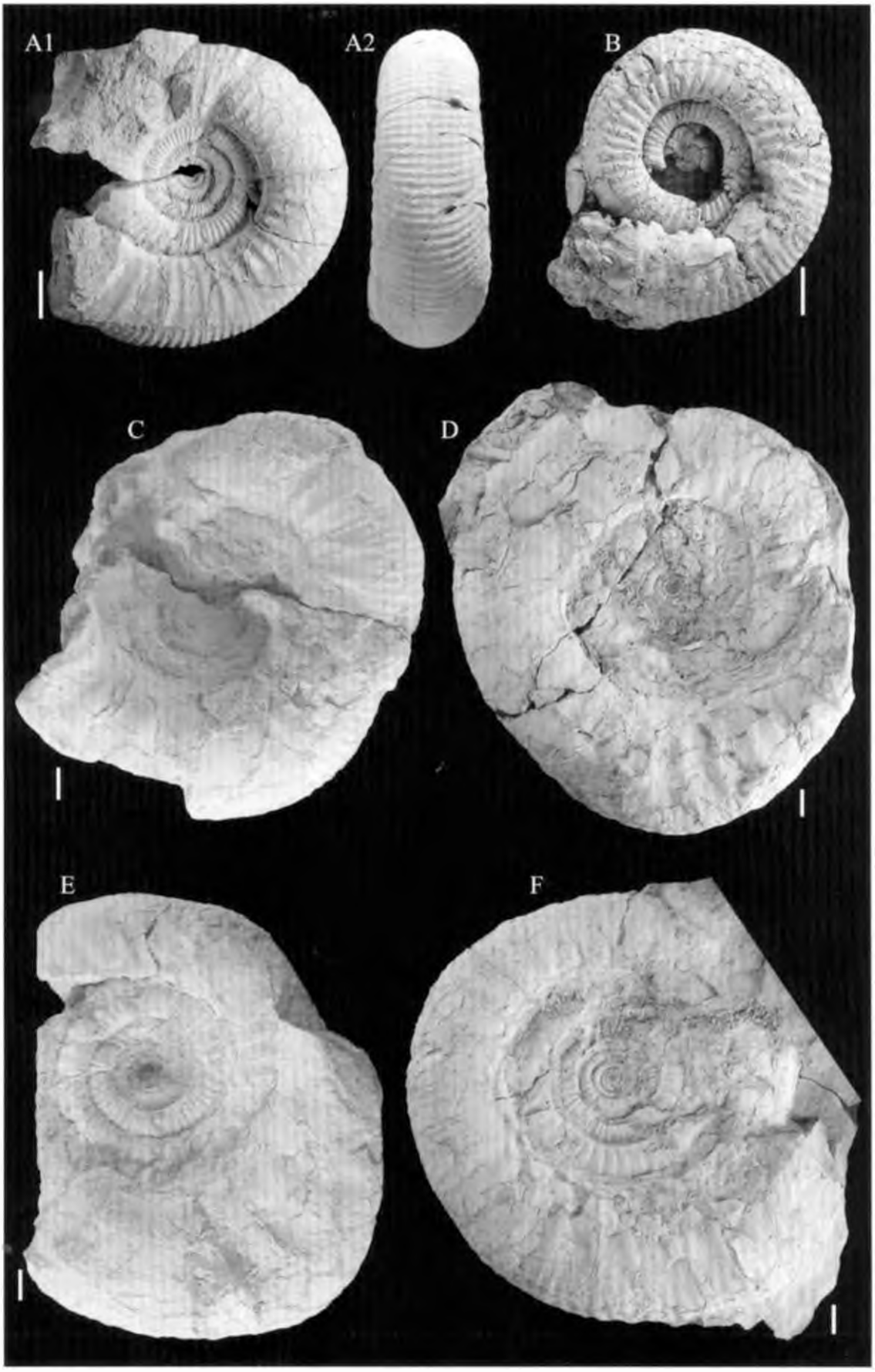

Plate 7, MICHAŁ ZATOŃ: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 8

A, D. *Choffatia cerealis* Arkell [M], A: GIUS 8-3201, inner whorls (phragmocone), D: IGPUW/I/58, middle whorls (phragmocone). Kawodrza Dolna ('Kawodrza' clay-pit), Upper Bathonian (Hodsoni Zone).

B–C, F. *Choffatia* cf. *acuticosta* (Roemer) [m?], B: IGPUW/J/KP-12-11, C: IGPUW/J/KP-12-10, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone), F: IGPUW/J/Cha-1, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone).

E. *Choffatia* sp. ex gr. *vicenti* Mangold – *praecursor* Mangold [M], GIUS 8-3396, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone).

G. *Choffatia* cf. *subbackeriae* (d'Orbigny) [M], GIUS 8-3206, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Orbis Zone).

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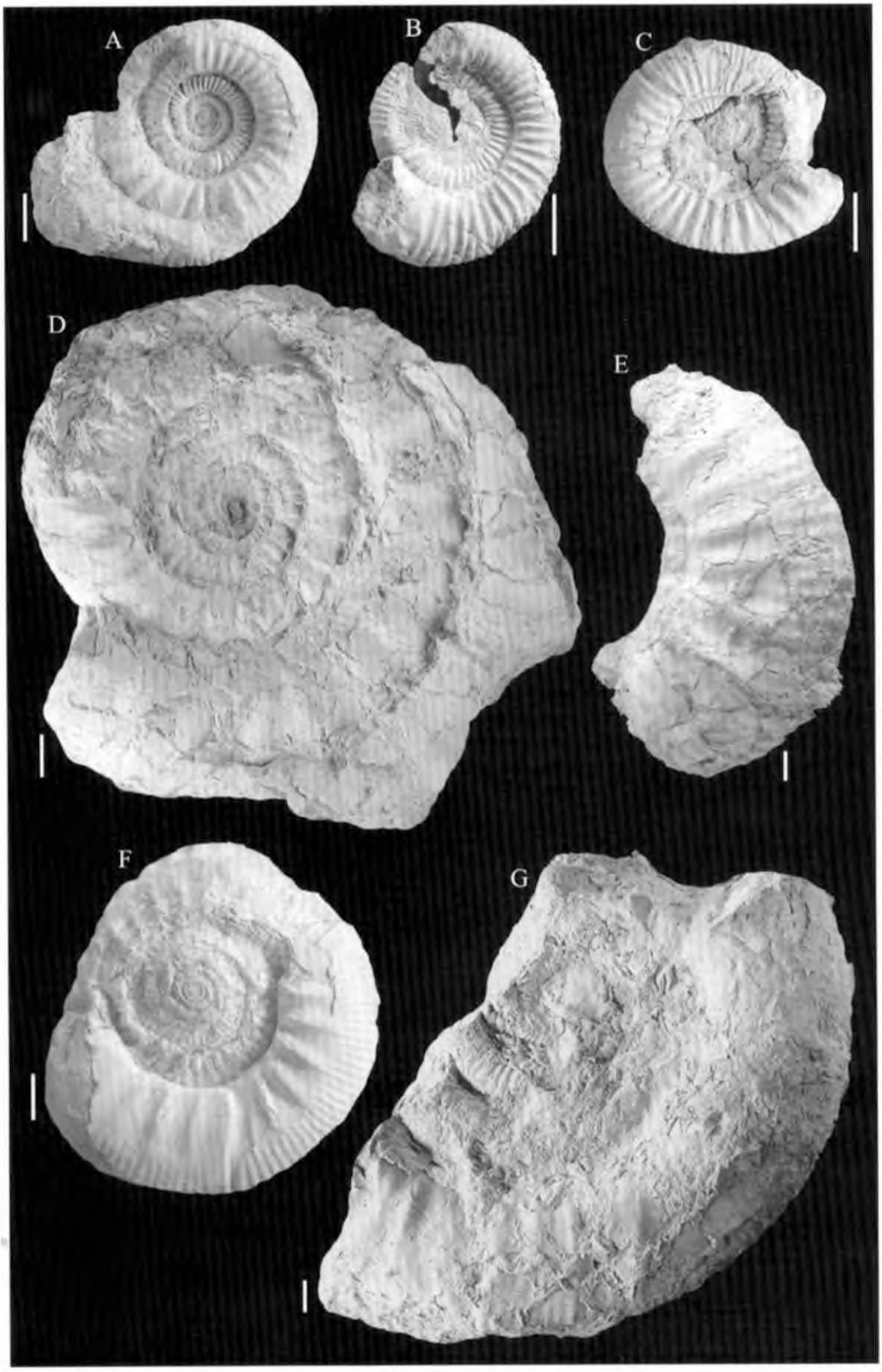

Plate 8, MICHAŁ ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 9

A. *Choffatia cerealis* Arkell [M], IGPUW/J/81, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone).
B. *Choffatia* sp. [M], B1: inner and middle whorls, B2: outer whorl, GIUS 8-3400, Grodzisko, Upper Bathonian (Hodsoni Zone).
Scale bars equal 1 cm.

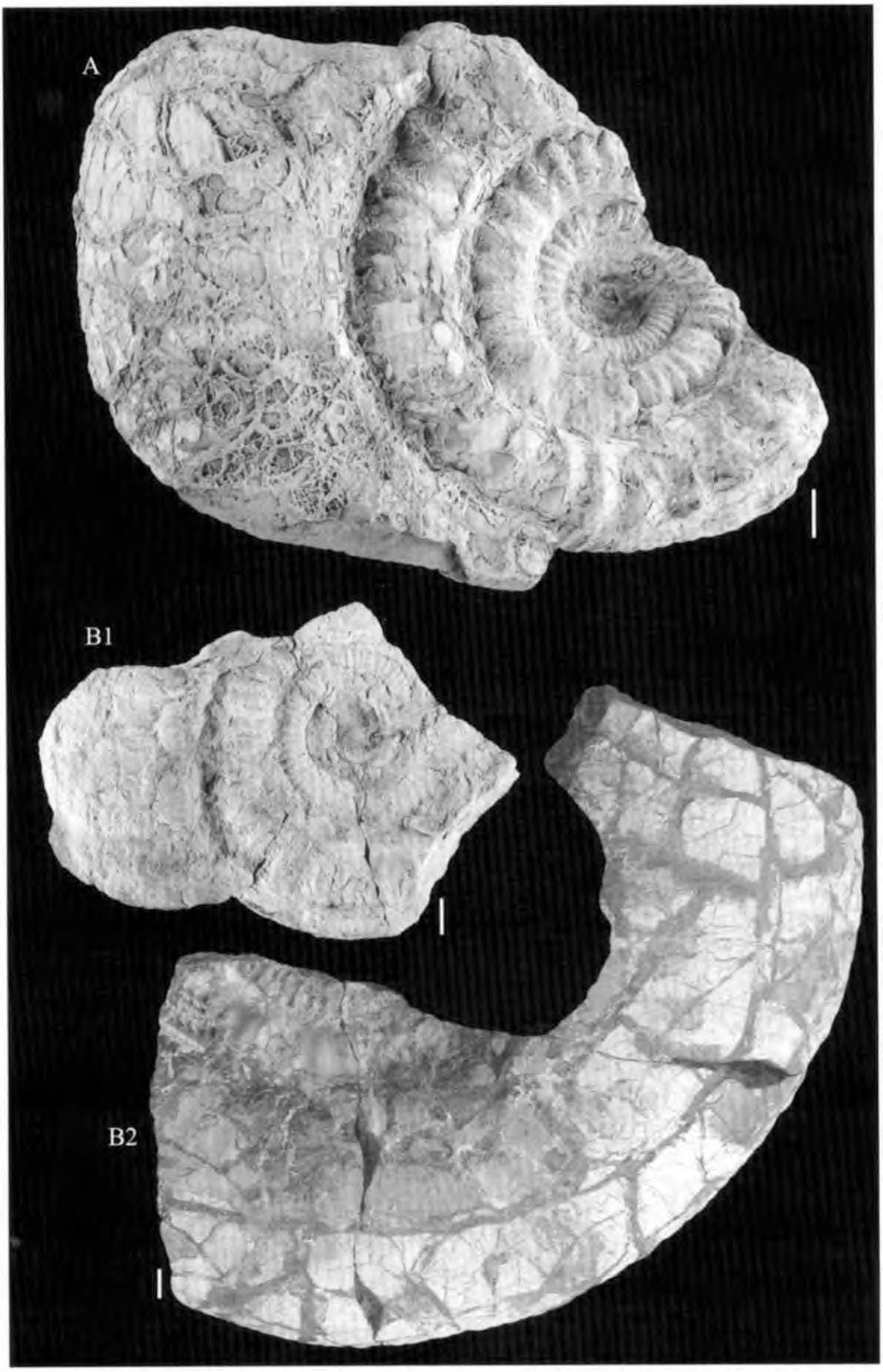

Plate 9, MICHAŁ ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 10

A–F. *Parkinsonia* (*Parkinsonia*) aff. *dorni* ARKELL, A: IGPUW/J/521, B: IGPUW/J/520, C: IGPUW/J/522, D: IGPUW/J/234, E1: lateral view, E1: ventral view, IGPUW/J/225, F1: lateral view, F2: ventral view, IGPUW/J/162, Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

G, K. *Parkinsonia* (*Parkinsonia*) *schloenbachi* SCHLIPPE, G: WK-111, Rudniki, lowermost Bathonian (Zigzag Zone, Convergens Subzone), K1: lateral view, K2: adapertural view, IGPUW/J/158, Kawodrza Gorna ('Sowa' clay-pit), lowermost Bathonian (Zigzag Zone, Convergens Subzone).

H–I, L. *Parkinsonia* (*Durotrigensia*) *pseudoferruginea* NICOLESCO [M], H: TK-30, Kawodrza Gorna ('Glinski' clay-pit), lowermost Bathonian (Zigzag Zone, Convergens Subzone), I: IGPUW/J/157, Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone), L: IGPUW/J/151, Gnaszyn Gorny ('Alina' clay-pit), Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone).

J. *Parkinsonia* (*Durotrigensia*) *bomfordi* ARKELL [M], TK-21, Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

Scale bars equal 1 cm.

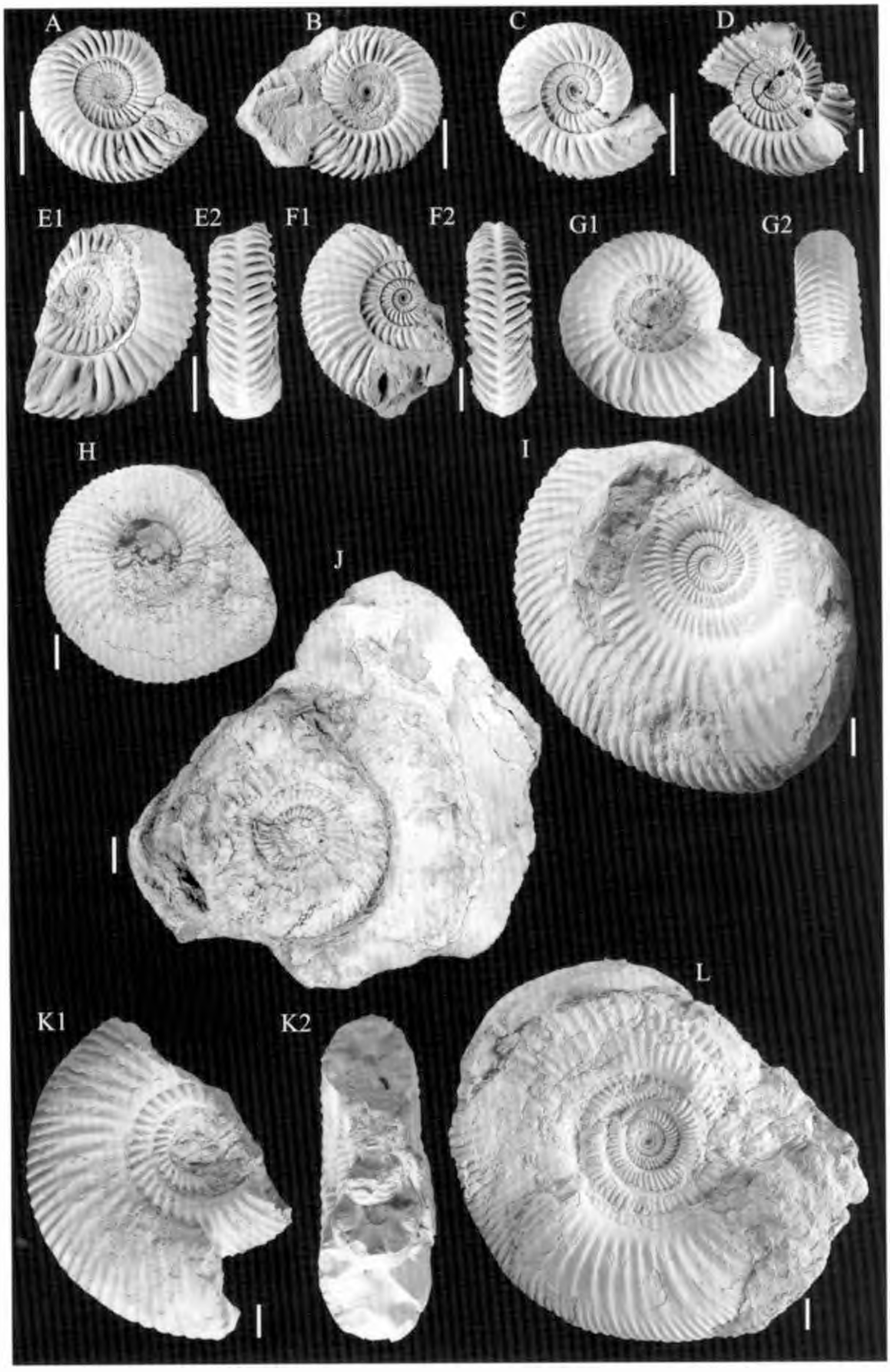

Plate 10, MICHAŁ ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 11

A–B, E. *Parkinsonia* (*Durotrigensia*) *„neuffensis"* (Oppel) [M], A: IGPUW/J/13, B: IGPUW/J/N-1, Kawodrza Gorna ('Sowa' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone) and/or lowermost Bathonian (Zigzag Zone, Convergens Subzone), E: IGPUW/J/K-39, Poraj-Kamienica Polska area, heap of 'Dębowiec' iron ore-mine, Upper Bajocian (Parkinsoni Zone).

C. *Parkinsonia* (*Durotrigensia*) *bomfordi* Arkell [M], GIUS 8-2825, Kawodrza Gorna ('Gliński' clay-pit), uppermost Bajocian (Parkinsoni Zone, Bomfordi Subzone).

D. *Parkinsonia* (*Durotrigensia*) cf. *dorsetensis* (Wright) [M], IGPUW/J/120, Gnaszyn Gorny ('Alina' clay-pit), Upper Bajocian (Parkinsoni Zone, Parkinsoni Subzone).

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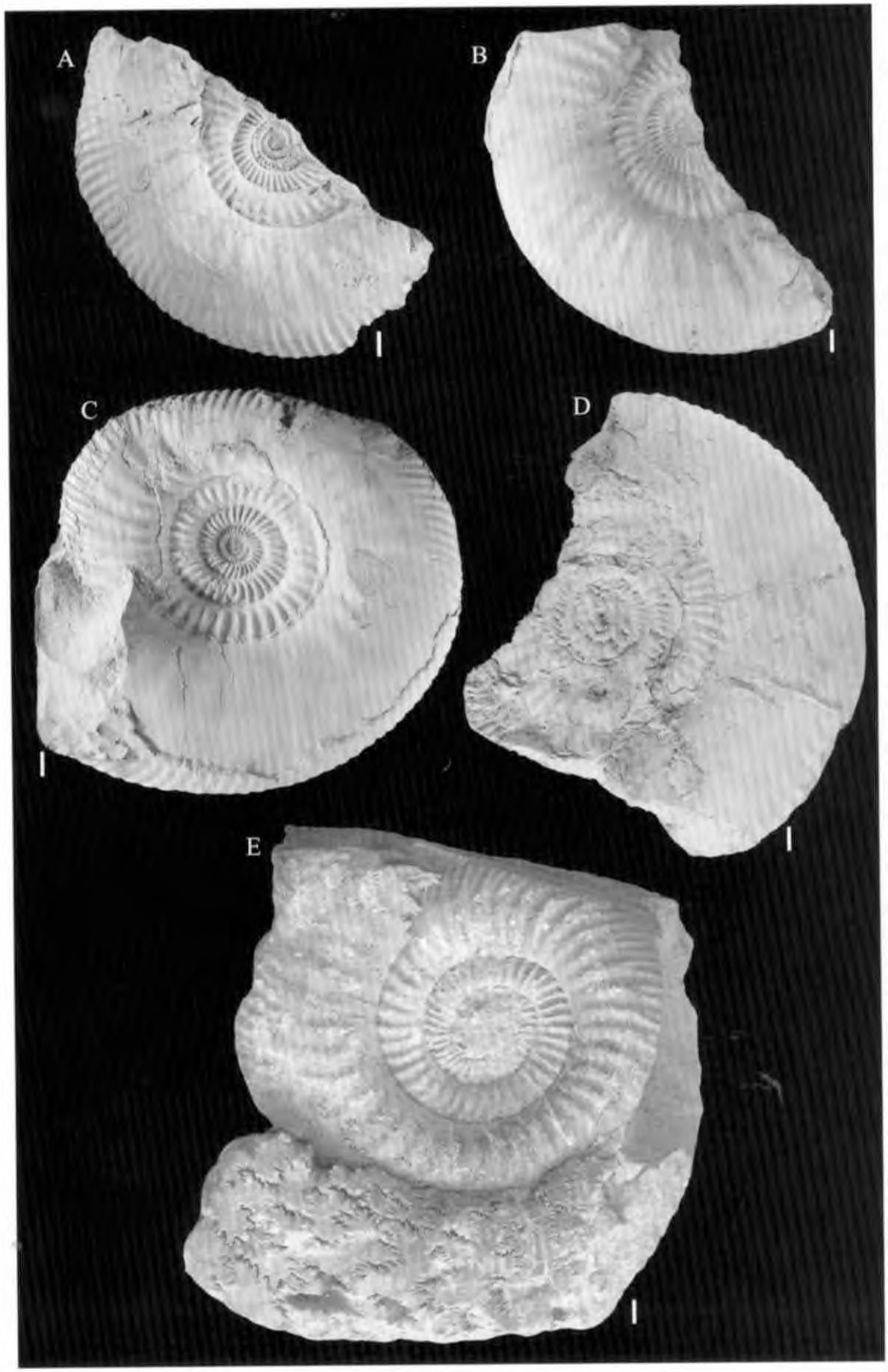

Plate 11, Michał Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 12

A–D. *Parkinsonia* (*Oraniceras*) *wuerttembergica* (Oppel) [m], A1: lateral view, A2: adapertural view, IGPUW/J/O2, B: IGPUW/J/O1a, C1: lateral view, C2: adapertural view, WK-109, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone), D: AK-01, Łęczyca, Lower Bathonian (Zigzag Zone, Macrescens Subzone).
E–F. *Parkinsonia* (*Oraniceras*) *gyrumbilica* (Quenstedt) [M], E1: lateral view, E2: adapertural view, IGPUW/J/O3a, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone), F: IGPUW/J/KP-3-2, Kawodrza Górna ('Glinski' clay-pit), Lower Bathonian (Zigzag Zone, Macrescens Subzone).
G. *Parkinsonia* (*Gonolkites*) *subgaleata* (Buckman) [M], GIUS 8-2975, Kawodrza Gorna ('Sowa' clay-pit), lowermost Bathonian (Zigzag Zone, Convergens Subzone).
H. *Morphoceras macrescens* (Buckman) [M], H1: lateral view, H2: adapertural view, young individual, WK-S/118, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone).
I. *Morphoceras multiforme* Arkell [M], I1: lateral view, I2: ventral view, IGPUW/J/M-2, young individual, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone).
Scale bars equal 1 cm.

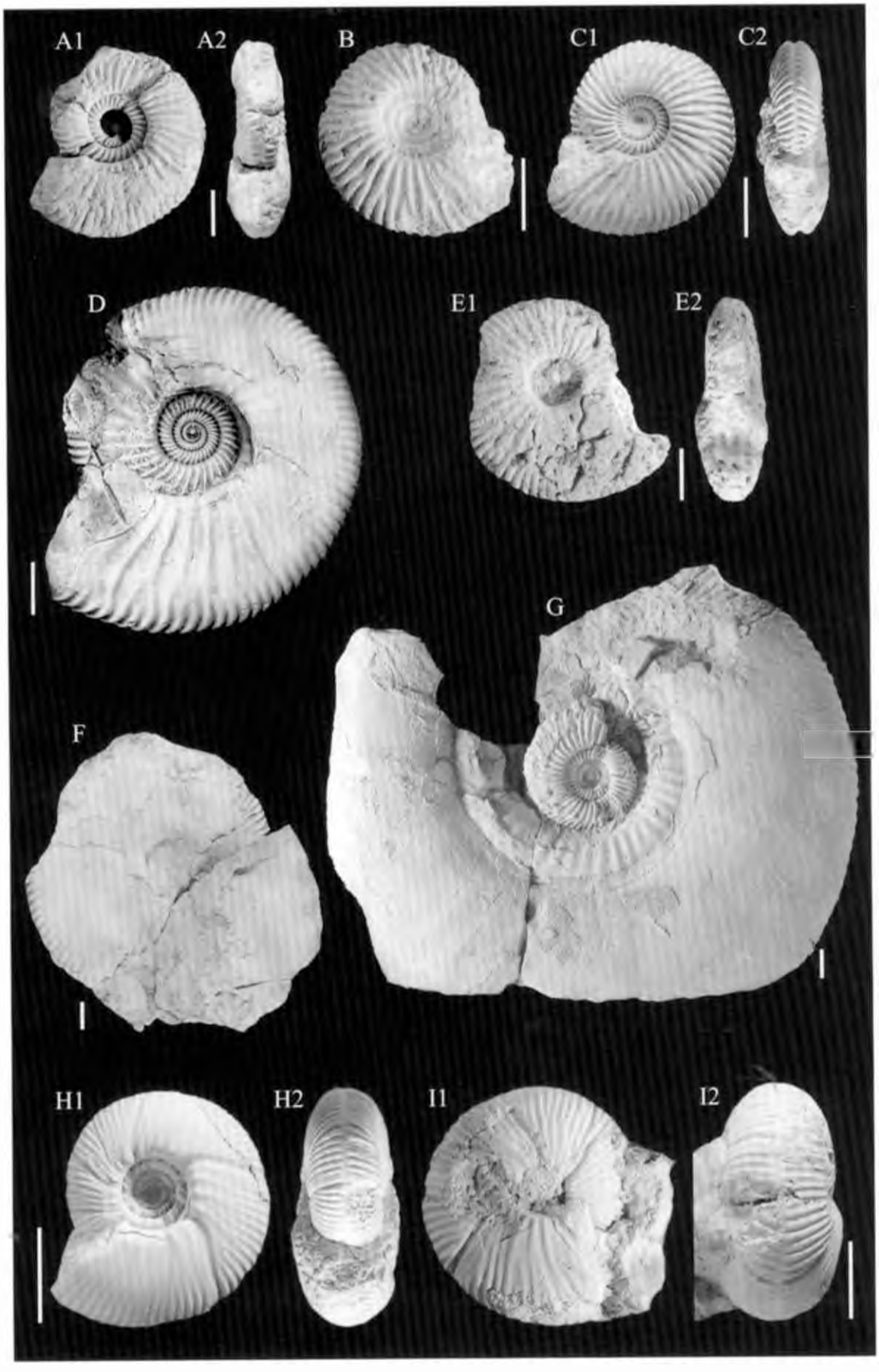

Plate 12, MICHAL ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 13

A–B. *Morphoceras multiforme* ARKELL [M], A1: lateral view, A2: adapertural view, IGPUW/J/M-4, B1: lateral view, B2: adapertural view, WK-S/113, young individuals, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone).
C. *Morphoceras macrescens* (BUCKMAN) [M], C1: lateral view, C2: ventral view, mature individual, JS-621, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone).
D. *Morphoceras sulcatum* (ZIETEN) [m], D1: lateral view, D2: adapertural view, WK-S/121, Rudniki, Lower Bathonian (Zigzag Zone, Macrescens Subzone).
E–I. *Asphinctites tenuiplicatus* (BRAUNS), E: microconch, GIUS 8-2643, F: microconch, GIUS 8-2646, G: microconch, GIUS 8-2622, Kawodrza Gorna ('Leszczynski' clay-pit), Lower Bathonian (Tenuiplicatus Zone), H: GIUS 8-2733, I: GIUS 8-2729, mature macroconchs, Faustianka, Lower Bathonian (Tenuiplicatus Zone).
Scale bars equal 1 cm.

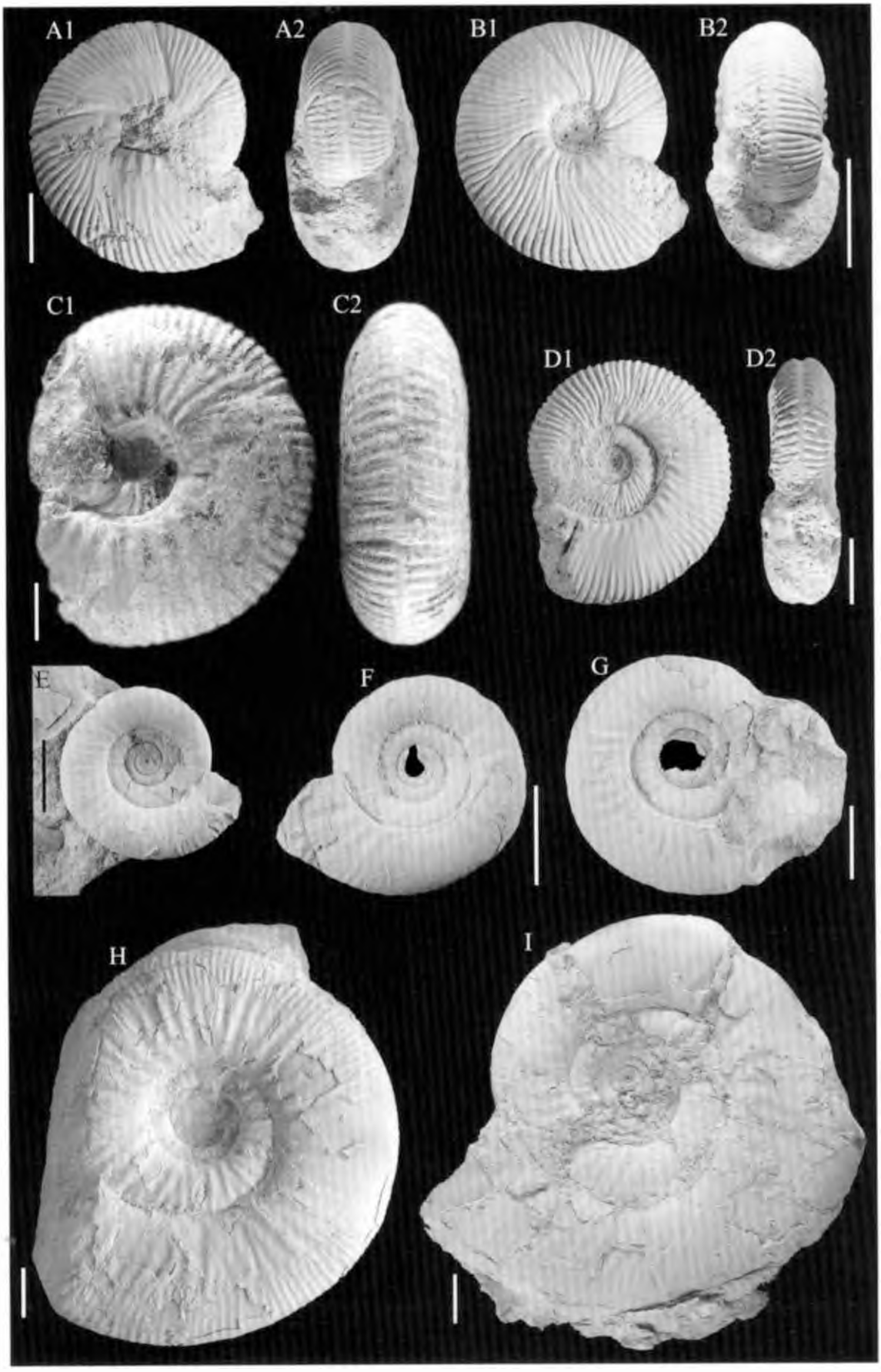

Plate 13, Michał Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 14

A. *Asphinctites* sp. [M], GIUS 8-3402, Kawodrza Gorna ('Leszczynski' clay-pit), Lower Bathonian (Yeovilensis Subzone).
B–C. *Tulites cadus* BUCKMAN [M], B1: lateral view, B2: ventral view, young macroconch, GIUS 8-3013, Blanowice, Middle Bathonian (Subcontractus Zone), C1: lateral view, C2: adapertural view, mature macroconch, Gnaszyn Dolny ('Gnaszyn' clay-pit), Middle Bathonian (Subcontractus Zone).
D, G. *Bullatimorphites* (*Bullatimorphites*) *costatus* ARKELL [M], D: GIUS 8-3029, Ogrodzieniec, Upper Bathonian (Hodsoni Zone), G: GIUS 8-3030, Żarki, Upper Bathonian (Hodsoni Zone).
E. *Bullatimorphites* (*Bullatimorphites*) cf. *polypleurus* (BUCKMAN) [M], IGPUW/J/KP-11-2, Kawodrza Dolna ('Anna' clay-pit), Upper Bathonian (Hodsoni Zone), E1: lateral view, E2: adapertural view.
F. *Bullatimorphites* (*Bullatimorphites*) cf. *serpenticonus* ARKELL [M], GIUS 8-3403, Gnaszyn Dolny ('Gnaszyn' clay-pit), Upper Bathonian (Hodsoni Zone).
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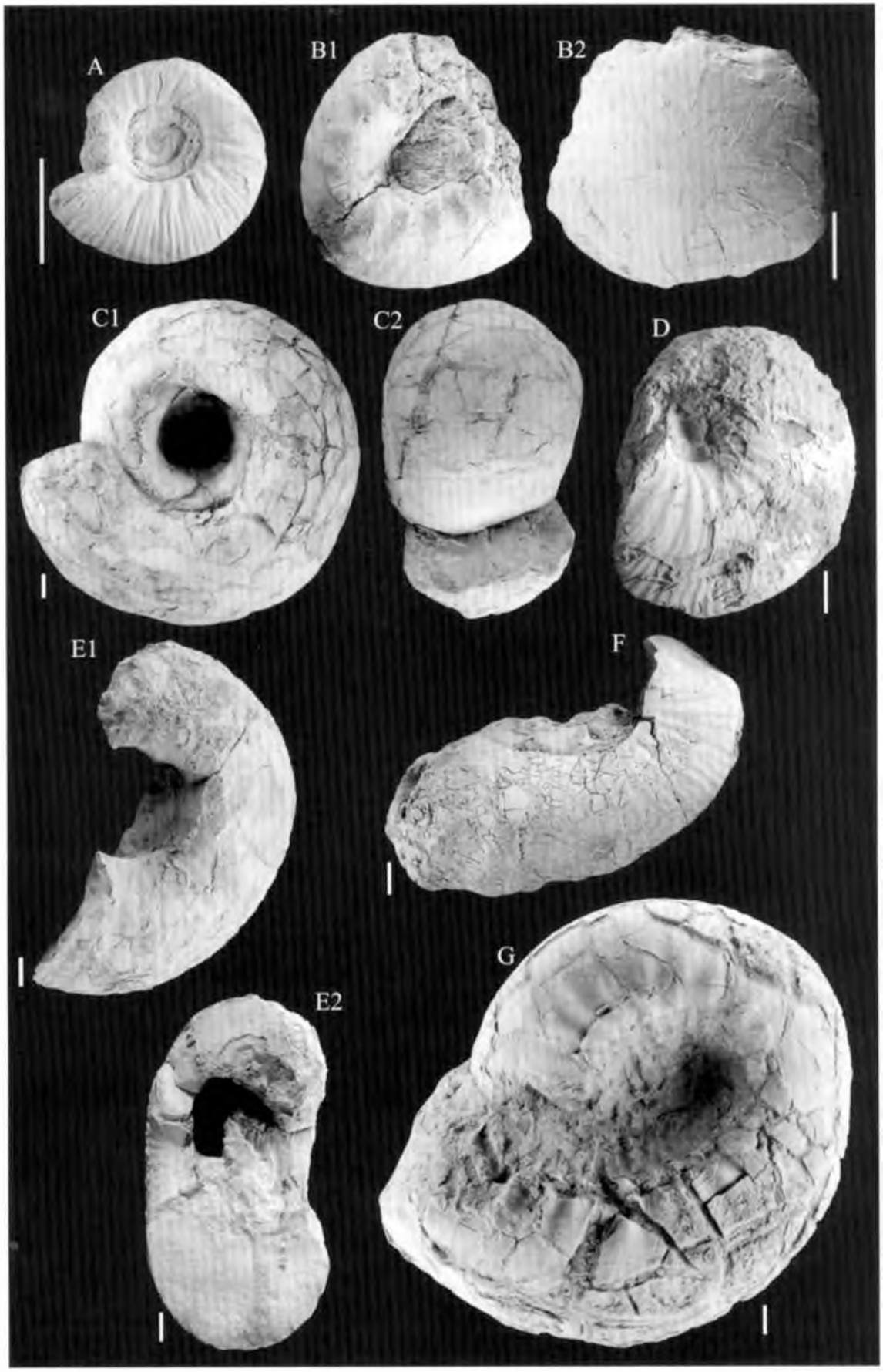

Plate 14, Michał Zaton: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2

Plate 15

A–H. *Morrisiceras morrisi* (Oppel), A: mature microconch, A1: lateral view, A2: ventral view, GIUS 8-2756, Blanowice, B: mature microconch, GIUS 8-2754a, C: mature microconch, GIUS 8-2758, Bugaj, D: young macroconch, *sphaera* morphotype, D1: lateral view, D2: ventral view, IGPUW/J/WB-2c, Blanowice, Middle Bathonian (Morrisi Zone), E: mature macroconch, *morrisi* morphotype, E1: lateral view, E2: adapertural view, WK-S/931, Kawodrza Dolna ('Kawodrza' clay-pit), F: mature macroconch, *morrisi* morphotype, F1: lateral view, F2: adapertural view, F3: ventral view, IGPUW/J/WB-1, Blanowice, G: mature macroconch, *krumbecki* morphotype, G1: lateral view, G2: adapertural view, GIUS 8-2789, Kawodrza Dolna ('Kawodrza' clay-pit), H: mature macroconch, AK-M3, Gnaszyn Dolny ('Gnaszyn' clay-pit), Middle Bathonian (Morrisi Zone).
Scale bars equal 1 cm.

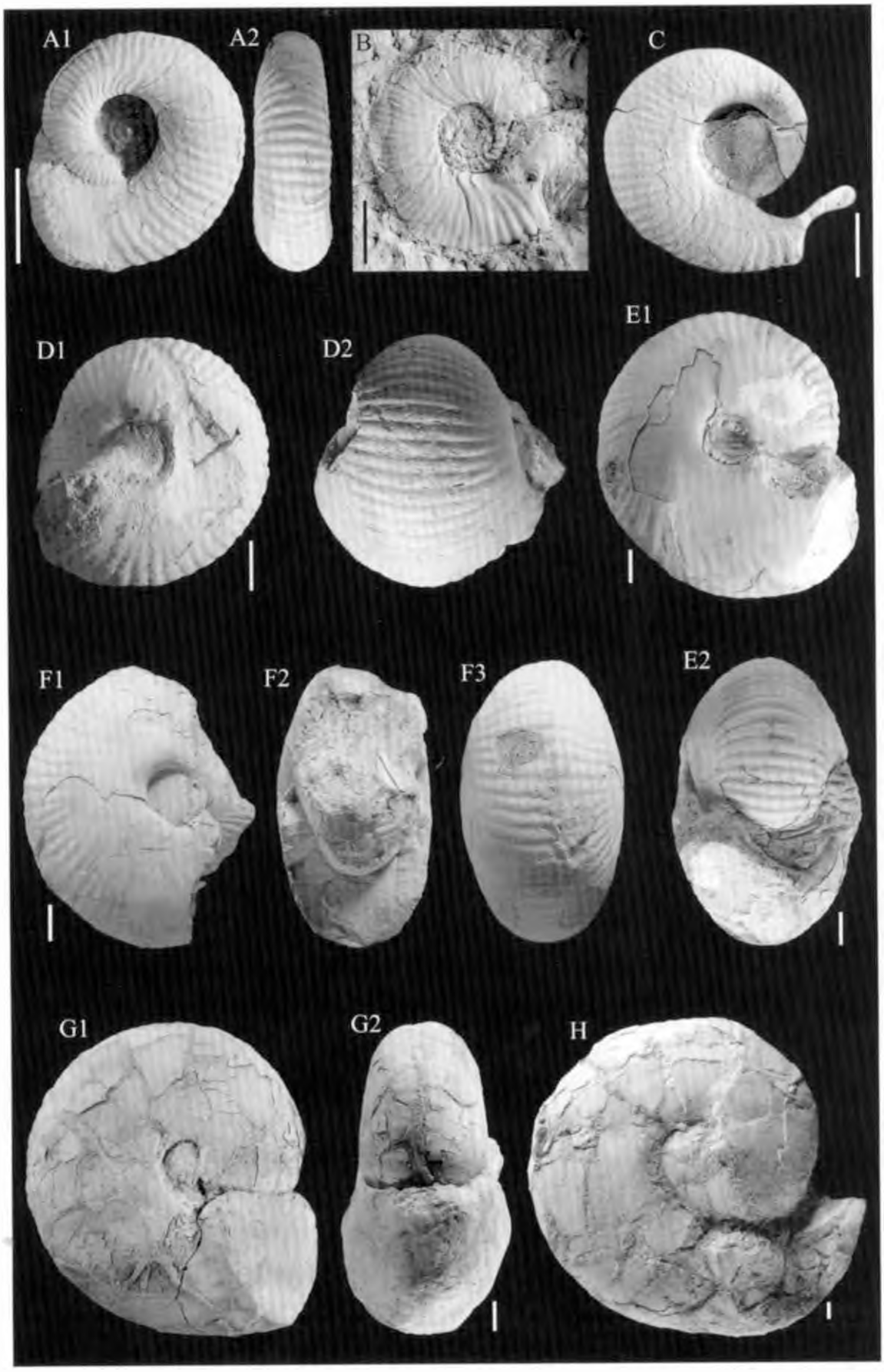

Plate 15, MICHAL ZATON: Bajocian-Bathonian (Middle Jurassic) ammonites, Part 2