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**Bathonian ammonites of the families  
Sphaeroceratidae Buckman and Tullitidae Buckman  
from the Polish Jura Chain (Southern Poland)**

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Janusz KOPIK — **Bathonian ammonites of the families Sphaeroceratidae Buckman and Tullitidae Buckman from the Polish Jura Chain (Southern Poland).** *Polish Geological Institute Special Papers*, 21: 1–68

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**Abstract.** Early to Middle Bathonian ammonites of the families Sphaeroceratidae Buckman and Tullitidae Buckman have been carefully examined. Specimens were collected from fine grained sediments, which belong to Middle Jurassic “Częstochowa Ore-bearing Clay Formation” of the Polish Jura Chain. Usually ammonites were found within sphaerosiderite nodules. Nodules were collected from numerous clay-pits of Częstochowa suburbs, and from underground mines of Włodowice and Zawiercie regions. Single, well preserved specimen of the rare, Early Bathonian genus *Praetulites* Westermann (*P. rugosus* sp. nov.) is the only representative of the family Sphaeroceratidae Buckman. It was discovered in iron-ore mine, in Włodowice, and it represents the youngest known evolutionary member of the genus *Praetulites*. Family Tullitidae Buckman is widely represented among examined ammonites. It consists of representatives of two subfamilies: Tullitinae Callomon, Dietl, Niederhöfer (genera and subgenera: *Tulites* Buckman, *Rugiferites* Buckman, *Morrisiceras* Buckman, and *Holzbergia* Torrens), and Bullatimorphitinae Callomon, Dietl, Niederhöfer (genera: *Sphaeroptychius* Lissajous and *Bullatimorphites* Buckman). New evaluation of the age of subgenera *Tulites* and *Rugiferites* is of special interest. Despite previous opinions about their occurrence only within *Tulites subcontractus* Zone (Middle Bathonian), they have been found within Lower Bathonian of Włodowice, Rudniki, and vicinity of Częstochowa regions. These subgenera were represented by both: new species, and widely known taxa, characteristic for Middle Bathonian of Western Europe. Other representatives of the subfamilies Tullitinae (*Morrisiceras*, *Holzbergia*), and Bullatimorphitinae (*Sphaeroptychius*, *Bullatimorphites*) were present mostly within upper parts of Middle Bathonian, which confirms previous observations. State of preservation (as sideritic internal moulds with final growth stages of conchs preserved) allowed in many cases to make existing species’ diagnosis more complete.

**Key words:** ammonites, taxonomy, biostratigraphy, Bathonian, Middle Jurassic, southern Poland.

**Abstrakt.** Szczegółowym badaniom poddano znaleziska dolno- i środkowobatońskich amonitów, należących do rodzin Sphaeroceratidae Buckman i Tullitidae Buckman, pochodzące z serii osadów mułowcowo-ilastych, wchodzących w skład środkowojurajskiej formacji osadowej Jury Polskiej (Polish Jura Chain) częstochowskich iłów rudonośnych. Amonity występowały najczęściej w sferosyderytach, odsłaniających się w licznych gliniankach na obrzeżach Częstochowy oraz w podziemnych wyrobiskach kopalnianych w rejonie Włodowic i Zawiercia. Rodzinę Sphaeroceratidae Buckman, w tym zespół fauny, charakteryzował jeden, dobrze zachowany, pochodzący z dolnego batonu okaz. Należy on do bardzo rzadko stwierdzanego rodzaju *Praetulites* Westermann (*P. rugosus* sp. nov.). Znaleziony w kopalni rud żelaza we Włodowicach reprezentuje najmłodsze, z dotychczas poznanych, ogniwo ewolucyjne rodzaju *Praetulites*. Rodzina Tullitidae była w badanym zespole amonitów znacznie liczniej reprezentowana. Tworzy ją szereg gatunków, często nowych, należących do rodzajów i podrodzajów: *Tulites* Buckman, *Rugiferites* Buckman, *Morrisiceras* Buckman i *Holzbergia* Torrens (podrodzina Tullitinae Callomon, Dietl, Niederhöfer) oraz taksony podrodziny Bullatimorphitinae Callomon, Dietl, Niederhöfer, na którą składają

się gatunki rodzajów *Sphaeroptychius* Lissajous i *Bullatimorphites* Buckman. Szczególnie interesująca okazała się ocena wieku znalezionej we Włodowicach i Rudnikach, oraz w bliżej nieokreślonym stanowisku w okolicach Częstochowy, zespołu gatunków z podrodzajów *Tulites* i *Rugiferites*. Wbrew dotychczasowym poglądom o ich wyłącznym występowaniu w europejskim środkowym batonie (poziom *Tulites subcontractus*), znaleziska te odkryte zostały w dolnym batonie. Reprezentowane były zarówno przez nowe gatunki, jak i przez taksony dotychczas uznawane za typowe dla zachodnioeuropejskiego batonu środkowego. Kolejni reprezentanci podrodziny Tulitinae (*Morrisiceras*, *Holzbergia*) i Bullatimorphitinae (*Sphaeroptychius*, *Bullatimorphites*) zgodnie z dotychczasowymi obserwacjami grupowały się w wyższych odcinkach środkowego batonu. Bardzo dobry na ogół stan ich zachowania (zsyderytyzowane ośrodki z końcowymi stadiami wzrostowymi muszli) pozwalał częstokroć uzupełniać dotychczasowe diagnozy gatunkowe.

**Key words:** amonity, taksonomia, biostratygrafia, baton, jura środkowa, południowa Polska.

## INTRODUCTION

First research by the author on Sphaeroceratidae and Tulitidae families within Polish Jura Chain<sup>1</sup> (Fig. 1) has been done in the late sixties of XX century. Its results were introduced in unpublished report (Kopik, 1969). Examined collection (supplemented later) consists of specimens from collections of following institutions and people: Geological Museum of Polish Geological Institute in Warsaw, Regional Municipal Museum in Częstochowa, prof. Jerzy Znosko, Piotr Nowacki, and the author. The most valuable materials are unique Tulitinae ammonites of Early Bathonian age from

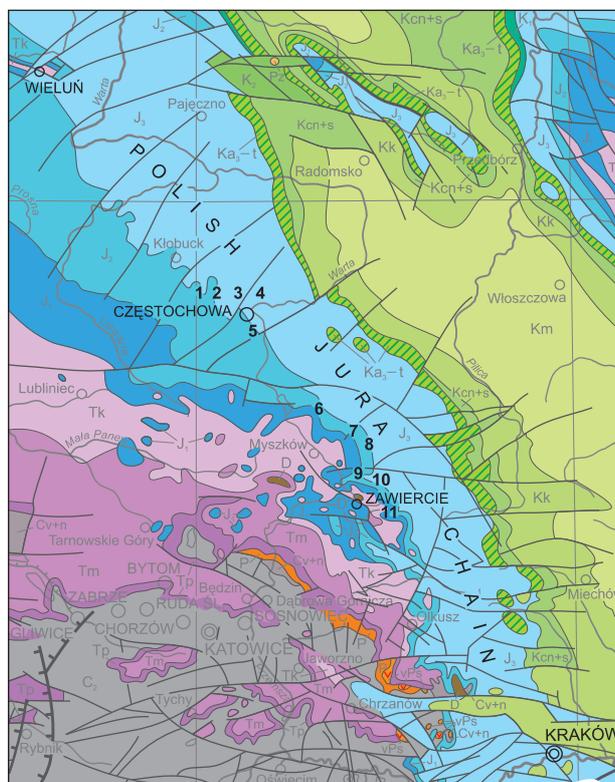
Włodowice, which were part of Eng. Stanisław Kontkiewicz, Jr.'s collection (Museum of Geology of Polish Geological Institute in Warsaw, and Regional Municipal Museum in Częstochowa collections at present).

Bathonian strata of northern part of Polish Jura Chain basin are placed within upper part of sedimentary complex named Częstochowa Ore-bearing Clay Formation. They consist of dark-grey claystones, and mudstones with numerous intercalations and nodules of ferruginous sediments — mostly clayey siderites (Fig. 2). Bathonian sediments' thickness va-



**Fig. 1. Localities of findings Bathonian ammonites of families Sphaeroceratidae and Tulitidae (map after Dadlez *et al*, 2000)**

1 — Częstochowa-Gnaszyn Dolny, 2 — Częstochowa-Kawodrza Dolna, 3 — Częstochowa-Zacisze, 4 — Częstochowa-Lisieniec, 5 — Częstochowa-Bugaj, 6 — Dąbrówka, 7 — Włodowice, 8 — Rudniki, 9 — Blanowice, 10 — Łońnice, 11 — Bzów



<sup>1</sup> Polish Jura Chain is the term introduced in 1960 by Różycki. Its synonyms are as follows: Cracow–Wieluń Jurassic Range, Cracow–Częstochowa Upland. Its name was inspired by classical Jurassic locations, as Frankonian Jura, Swabian Jura, etc.

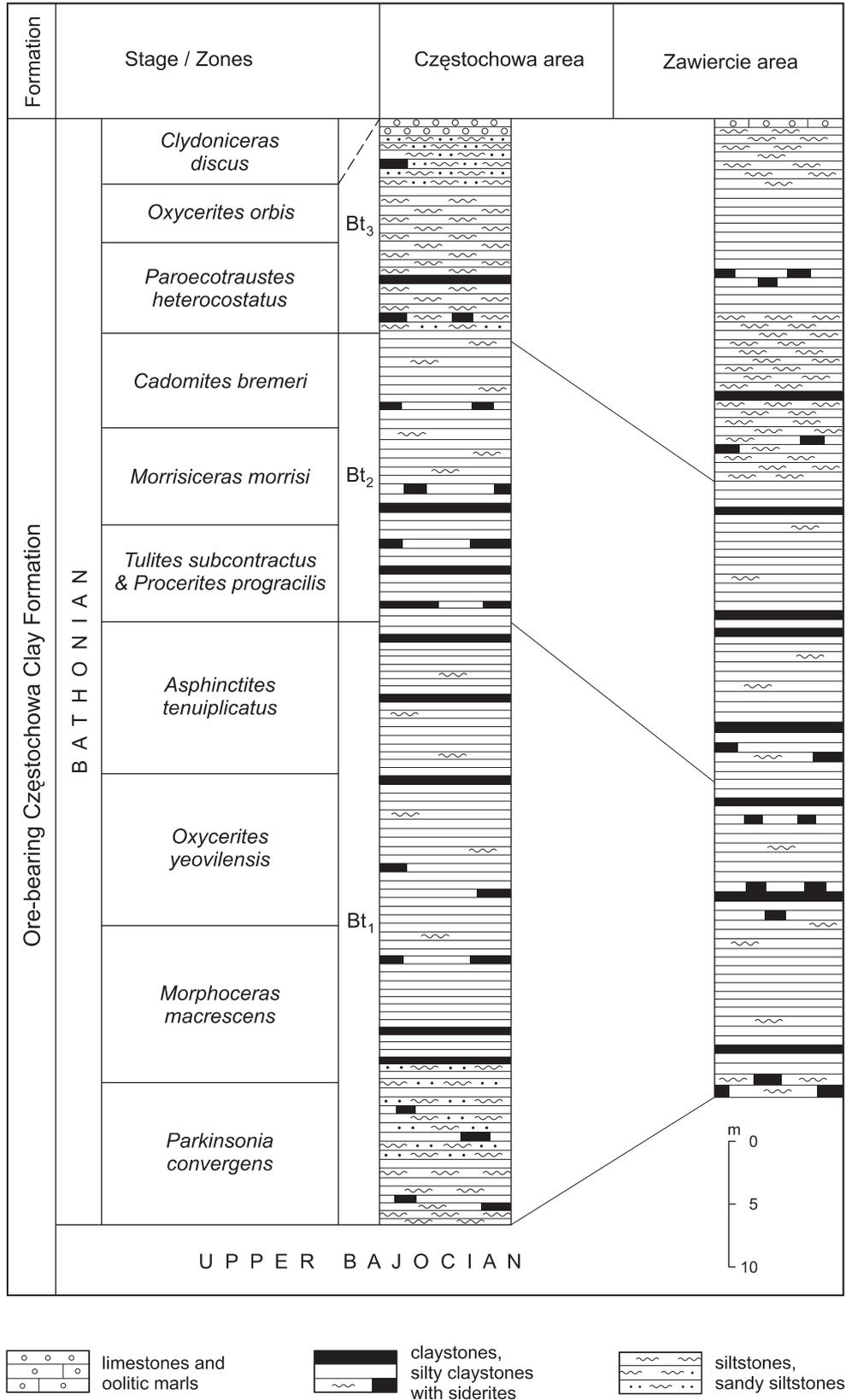


Fig. 2. Bathonian stratigraphy in Częstochowa and Zawiercie regions

ries between 60–80 m in Zawiercie region to over 100 m in vicinity of Częstochowa (Kopik, 1998). Abundant mollusk faunas, mainly ammonites, belemnites, and bivalves are to be found within these sediments (Rehbinder, 1914; Różycki, 1953; Kopik 1974, 1988 *in*: Dayczak-Calikowska *et al.*; Matyja, Wierzbowski, 2000).

There is number of remarks on Tullitidae family in Polish literature. In 1914, Rehbinder used representatives of this family from Częstochowa Ore-bearing Clay Formation to define and introduce new Middle Bathonian chronozone: „*Macrocephalites morrisi*“. Siemiradzki (1922), in one of chapters of his work: “Geology of Polish Lands”, described Częstochowa Ore-bearing Clay Formation between Częstochowa and Zawiercie. In this chapter he is citing Lower Bathonian ammonites, which were found in iron-ore mines in Wręczyca and Rudniki. The names „*Cadoceras*“ sp. nov. and „*Stephanoceras*“ sp. nov. aff. *coronatum* (Schlotheim) were recorded among them. Now they can be identified with some Lower Bathonian findings of *Tulites* and *Rugiferites* subgenera, described herein.

In 1953, Różycki, in his monography of Polish Jura Chain, is recording much greater number of Tullitidae family taxa. Nobody, however, did state their presence (except of the *Bullatimorphites* subgenus) in older than Middle Bathonian strata, either in that paper or in other papers of that time from different parts of Europe.

In 1969, the author described in his unpublished report on the family Tullitidae, a number of taxa, which belong to this group, including Lower Bathonian species from Częstochowa (Fig. 3) and Zawiercie regions. Further remarks and short characteristics of some of them were included in later papers of the author (Kopik *in*: Dayczak-Calikowska *et al.*, 1988; Kopik, 1998). Potocki (1972), in his unpublished Master Thesis, has noted that representatives of this family occur sporadically.

First data about similar single discoveries of Tullitinae ammonites from Western Europe also come from the seventies of XX century. Hahn, (1971) noted presence of microconch of *Tulites* within Lower Bathonian strata of Fuscus-bank in southern Germany. Fernández-López *et al.* (1978) reported about occurrence of Lower Bathonian ammonites belonging to subgenus *Rugiferites* in eastern Spain. This taxon probably occurs also in the Lower Bathonian of southeastern France. These observations were confirmed by revision of the age of ammonite discoveries from Dhurma Formation of Saudi Arabia. At first, the age was defined as Middle Bathonian (Arkell, 1952a; Imlay, 1970), but later investigations by Enay and Mangold (1985, 1994) proved that these strata can be treated as the equivalent of European *Zigzagoceras zigzag* Zone.

Stratigraphic conclusions about the age of ammonite assemblage from Zawiercie region (Fig. 4) were drawn on the basis of analysis of mentioned Stanisław Kontkiewicz, Jr.’s collection. This collection consists of more than ten well

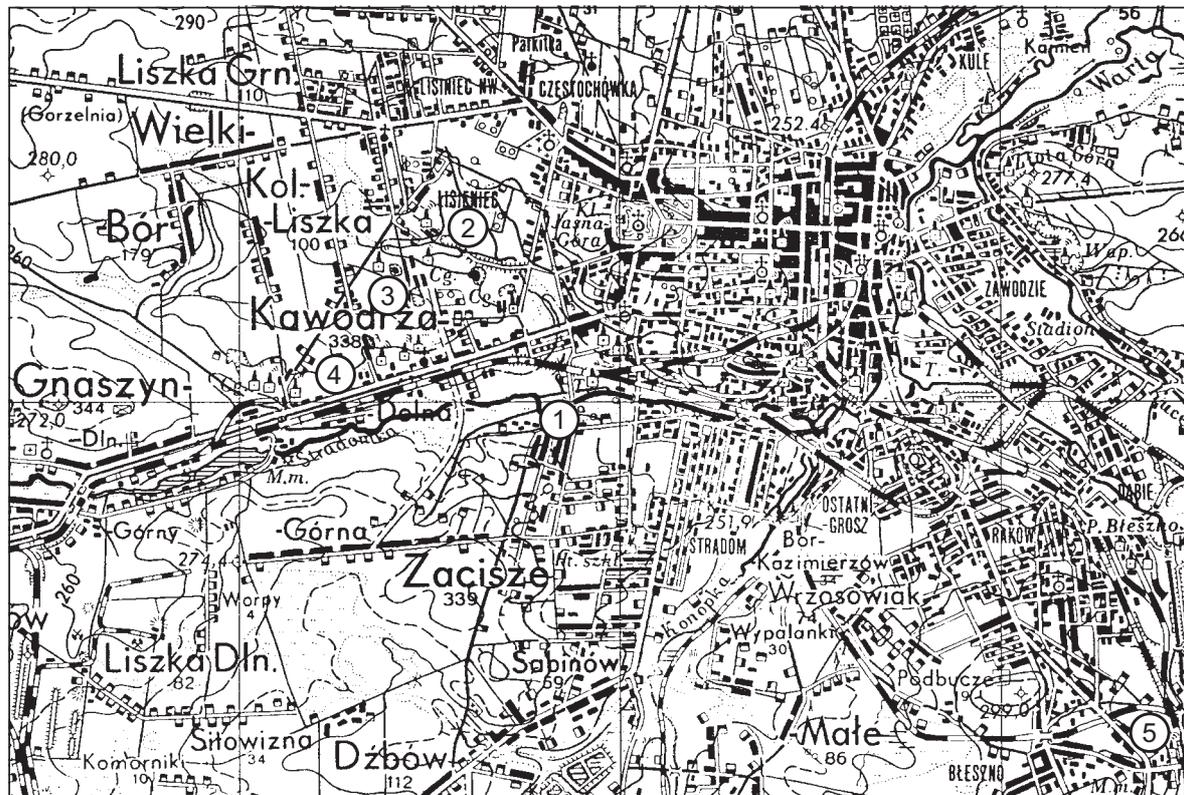


Fig. 3. Localisation of Bathonian Tullitidae occurrence sites in Częstochowa area

1 — Zacisze (clay-pit of Bogusławski); 2 — Lisieniec (clay-pit “Janina”); 3 — Kawodrza Dolna; 4 — Gnaszyn Dolny; 5 — Bugaj

Specimen	BATHONIAN			
	Lower	Middle		Upper
		<i>Procerites protractus</i> & <i>Tulites subcontractus</i> Zone	<i>Morrisiceras morrisoni</i> Zone	
<i>Praetulites rugosus</i> sp. nov.	+			
<i>Tulites (Tulites)</i> sp.	+			
<i>Tulites (T.) cadus</i> Buckman	+			
<i>Tulites (T.) tulotus</i> (Buckman)	+			
<i>Tulites (Rugiferites) wlodowicensis</i> sp. nov.	+			
<i>Morrisiceras fornicatum</i> (Buckman)			+	
<i>Morrisiceras irregulare</i> Spath			+	
<i>Morrisiceras korustes</i> Buckman			+	
<i>Morrisiceras morrisoni</i> (Oppel)			+	
<i>Morrisiceras sphaera</i> Buckman			+	
<i>Morrisiceras comma comma</i> Buckman			+	
<i>Morrisiceras comma schlippei</i> (Arkell)			+	
<i>Morrisiceras lycetti</i> (Arkell)			+	
<i>Morrisiceras cybeus</i> sp. nov.			+	
<i>Morrisiceras czestochowiense</i> sp. nov.			+	
<i>Morrisiceras makowskii</i> sp. nov.			+	
<i>Morrisiceras bulbosum</i> (Arkell)			+	
<i>Holzbergia schwandorfensis</i> (Arkell)			? +	
<i>Sphaeroptychius marginatus</i> (Arkell)			? +	
<i>Bullatimorphites (Bullatimorphites) serpenticonus</i> Arkell			+	
<i>Bullatimorphites (B.) bullatimorphus</i> Buckman				+

**Fig. 4. Stratigraphic position of ammonites of families Sphaeroceratidae and Tutilidae within Polish Jura Chain**

preserved specimens, which were found within iron-ore mine “Jan” in Włodowice near Zawiercie. The mine operated over fifty years ago. The main ore was clayey siderites from so-called “topmost ore-bearing horizon” of Lower Bathonian part of Czestochowa Ore-bearing Clay Formation (Kontkiewicz, 1949). Majority of analyzed *Tulites* and *Rugiferites* subspecies (Fig. 4) were found in these sediments (Fig. 2). Speci-

mens from this collection were preserved as sideritic internal moulds (most of them complete), with final body chamber, and (quite often) gerontic apertures preserved. Różycki (1953), used data from surface outcrops to show detailed stratigraphy of the Bathonian section and succession of ammonite faunas in Włodowice region. According to his results, layers of clayey siderites, which can be correlated with topmost ore-bearing horizon, are of Early Bathonian age (*Asphinctites tenuiplicatus* Zone) and whole Upper Vesulian<sup>1</sup> in general. Although he did not state any important for stratigraphy cephalopods, he correlated section studied with neighbouring (documented by fauna) sections. This correlation showed that Early Bathonian age of layers in question is undoubted.

Very good faunistic documentation of topmost ore-bearing horizon was done on the basis of discoveries collected from iron-ore mine in Rudniki near Zawiercie (placed just few kilometers from Włodowice mine), which operated till the fifties (Różycki, 1953; Zakrzewski, 1976). Ammonite assemblage collected by the author in the sixties from mine’s dumping place consists of: *Parkinsonia (Gonolkites) convergens* Buckman, *P. (Oraniceras) wuerttembergica* (Oppel), *Ebrayiceras pseudoanceps* (Ebray), *Oxycerites yeovilensis* (Rollier), *Polysphinctites tetragonoides* (Quenstedt), *Asphinctites tenuiplicatus* (Brauns) and others. Their presence is documenting all Lower Bathonian ammonite zones/subzones i.e. *Parkinsonia convergens*, *Morphoceras macrescens*, *Oxycerites yeovilensis* and *Asphinctites tenuiplicatus*. Also one of representatives of *Tulites cadus* Buckman described in present

paper was recognized therein.

Additional data about age of Tutilinae ammonites from Włodowice, Rudniki and Czestochowa areas were obtained by analyses of microfauna extracted from sediment filling body chambers of selected *Tulites* and *Rugiferites* specimens. These results unambiguously confirmed Early Bathonian age of faunas investigated. Especially, presence of foraminifer *Ophthalmi-*

<sup>1</sup> Vesulian — stage previously distinguished within Middle Jurassic (zones: *Sonninia sowerbyi*–*Parkinsonia (P.) parkinsoni*–*Zigzagiceras zigzag*) in Great Britain and Poland (Arkell, 1933; Różycki, 1953). Later this division was abandoned because of its incompatibility with stratotype in Vesoul region (France). See also Kopik, Znosko, 1974. At present this term is not in use.

*dium terquemi* Pazdro (sometimes numerous), proves this judgment, because this species does not cross Lower/Middle Bathonian boundary.

Among rare in Polish Jura Chain, Middle Bathonian representatives of nominate subgenus *Tulites*, the species *Tulites subcontractus* (Morris, Lycett) was the most often cited in literature (Rehbinder, 1914; Różycki, 1953). No other defined by age or locality representative of this subgenus was available for the author, except one specimen from not precisely known locality, which most probably belonged to *T. modiolaris* (Smith).

Except unique discoveries of Lower Bathonian tulitides (*Tulites*, *Rugiferites*) from Włodowice, the Kontkiewicz, Jr.'s collection contained representative of poorly known group of ammonites, belonging to the genus *Praetulites* Westermann *Praetulites rugosus* sp. nov. This first-time-described species is the youngest evolutionary member of *Praetulites* genus.

Other ammonites of Tulitinae subfamily (*Morrisiceras*, *Holzbergia*), and Bullatimorphitinae subfamily (*Sphaeroptychius*, *Bullatimorphites*) were found within upper parts of Middle Bathonian (i.e. in: *Morrisiceras morrisoni* Zone and *Cadomites bremeri* Zone; Fig. 4). Among twenty three de-

scribed herein taxa of Sphaeroceratidae i Tulitidae, five are new described for the first time. The rest were described before — mostly from localities in southern Great Britain, eastern France, and southern Germany. Mature individuals of the genus *Morrisiceras* are of special interest, because previously they have been treated as representatives of *Lyceiticeras* Arkell subgenus.

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### Explanation of taxonomic abbreviations and symbols to Taxonomic Descriptions

<b>D</b> — diameter of specimen	(½) — part of whorl
<b>H</b> — height of the last whorl	(+2) — assumed number of destroyed or badly preserved ornamentation elements
<b>h</b> — H:D ratio	<b>max.</b> — maximum diameter of specimen
<b>T</b> — thickness of the last whorl	<b>mi</b> — microconchs
<b>t</b> — T:D ratio	<b>Ma</b> — macroconchs
<b>t<sub>1</sub></b> — T:H ratio	<b>Lw</b> — last whorl
<b>U</b> — diameter of umbilicus	<b>bch</b> — body chamber
<b>u</b> — U:D ratio	<b>phg</b> — phragmocone
<b>R</b> — number of internal ( $r_1$ ) and external ( $r_2$ ) ribs	<b>d</b> — deformation of the whorl
<b>r</b> — $r_2:r_1$ — ratio	<b>msc</b> — manuscript
<b>tr</b> — traces	<b>MUZ PIG</b> — Geological Museum of the Polish Geological Institute, Warsaw
<b>+</b> — measurement incomplete by some ways	<b>CZ.</b> — Regional Municipal Museum in Częstochowa
<b>-</b> — measurement of conch or ornamentation elements not taken	<b>PN</b> — private collection of Piotr Nowacki, Warsaw

Dimensions of **D**, **H**, **T**, **U** measurements are: [mm]

## TAXONOMIC DESCRIPTIONS

Suborder **AMMONITINA** Hyatt, 1889

Superfamily Stephanocerataceae Neumayr, 1875

Family **Sphaeroceratidae** Buckman, 1920

Subfamily SPHAEROCERATINAE Buckman, 1920

Genus *Praetulites* Westermann, 1956

**Type species:** *Chondroceras?* (*Praetulites*) *kruizingai* Westermann, 1956 [= *Sphaeroceras godohense* Boehm in Kruizinga, 1926, p. 52, pl. 14, figs. 3, 4, non *Sphaeroceratidae* Boehm 1912, pl. 35, fig. 5, = *Tulites (Rugiferites) godohensis* (Boehm), Indonesia].

**Remarks.** — Specimens belonging to this genus possess middle-sized macroconchs with oval, depressed whorls, involute in septate part of conch. Body chamber is partially uncoiled. Usually internal ribs are strongly marked, and thickened on phragmocone. Regular-shaped *bullae* are present on umbilical edge. External ribbing consists of biplicate, intercalatory, and rarely triplicate ribs. Final body chamber, with weakening ribbing, is narrowed and uncoiled in periapertural part. It is occupying not less than  $\frac{3}{4}$  of the last whorl. Simple aperture is followed by periapertural constriction and sometimes apertural node-like, blunt elements. Suture line, similar

to *Tulites*, is asymmetric, with biplicate second lateral lobe. Taxonomically, genus is poorly diversified, only few species are known: ?*Praetulites submicrostoma* (Gottsche), *P. kruizingai* Westermann, ?*P. dalpiazi* Sturani, and described herein *P. rugosus* sp. nov. Genus *Satoceras* (Westermann, Callomon, 1988), cited from Lower to Middle Bathonian of eastern Indonesia and Japan is related to *Praetulites*.

**Occurrence.** — *Praetulites* Westermann genus was cited from following regions: Pacific (Indonesia), (?) Andean (Argentina), Mediterranean and Submediterranean zones of European Western Tethys (Italy, Poland). Mostly its representatives were found within Lower Bathonian, except single specimen of *P. dalpiazi*, Sturani. The later (found in northern Italy) was cited from Upper Bajocian (*Parkinsonia (P.) parkinsoni* Zone — Sturani, 1964), but its taxonomic position within genus *Praetulites* is questioned.

### *Praetulites rugosus* sp. nov.

Pl. I, Fig. 1

**Holotype:** specimen MUZ PIG 297.II.321; Pl. I, Fig. 1a–d.

**Derivation:** *rugosus* [latin] — wrinkled.

**Type locality:** Włodowice, iron-ore mine „Jan”; Polish Jura Chain.

**Type strata:** Częstochowa Ore-bearing Clay Formation, Lower Bathonian.

**Material.** — 1 specimen, MUZ PIG 297.II.321, iron-ore mine “Jan”, Włodowice, coll. S. Kontkiewicz, Jr.

are strongly depressed, umbilical edge is rounded, and umbilical wall is clearly separated. In terminal part of body chamber whorl is slightly compressed and slightly uncoiled. In this part of conch, characteristic narrow constriction, framed by two flat periapertural nodes, occurs. Umbilicus is moderately wide (in septate part) to wide (as the result of uncoiling) at later stages. Suture line is hardly visible.

**Remarks.** — The same as in the case of earlier discoveries of species belonging to this genus, *Praetulites rugosus* sp. nov. is represented by single specimen. Its ornamentation on phragmocone is similar to the one, observed among the oldest, Early Bathonian representatives of *Rugiferites (Tulites (Rugiferites) wlodowicensis* sp. nov.). Differences are visible while comparing their body chambers.

Body chamber of *P. rugosus* sp. nov. is distinctly uncoiled and its ornamentation is weaker. More similarities can be observed in comparison to Early Bathonian Pacific species *Praetulites kruizingai* Westermann; however, they do not allow identifying both specimens as belonging to one species. Much more differences are visible in comparison to West European specimen from Upper Bajocian of northern Italy, which was in-

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG	max. 92.5						26.5	0.29			$\frac{3}{5}$ – bch
297.II.321	87.3	33	0.38	55.5	0.64	1.68	23.5	0.27	13/60 (+2)	4.8	$\frac{1}{2}$ – bch
holotype	67.0	31	0.46	54.0	0.80	1.74	18.4	0.27	11/29 ( $\frac{1}{2}$ )	2.6	$\frac{1}{3}$ – bch

**Description (holotype).** — Macroconch is of middle size, slightly deformed, with phragmocone preserved in fragments, and complete body chamber, which occupies about  $\frac{3}{5}$  of the last whorl. Ribs are strongly marked and sharp on initial part of phragmocone (up to 60 mm), mostly biplicate, rarely triplicate or intercalatory. Ribs are getting weaker and more flat on body chamber, and finally numerous, single, linear elements (sometimes of *striae* type) occur. Phragmocone whorls

cluded in this genus by Sturani (*P. dalpiazi* Sturani, 1964). His diagnosis of phylogenetic position of mentioned specimen is questionable.

**Occurrence.** — In Poland *Praetulites rugosus* sp. nov. was found in iron-ore mine “Jan”, near Zawiercie (coll. S.

Kontkiewicz, Jr.), inside siderite nodule from topmost ore-bearing layer of Lower Bathonian of Częstochowa Ore-bearing Clay Formation (Kontkiewicz, 1949; Zakrzewski, 1976). Ammonites of *Tulites* i *Rugiferites* genera were also found within these strata.

### Family **Tulitidae** Buckman, 1921

Synonymy: *Morrisiceratidae* Westermann, 1956

#### Subfamily TULITINAE Callomon, Dietl, Niederhöfer, 1992

Following taxons belong to this family: genus and nominate subgenus *Tulites* Buckman, 1921; subgenus *Rugiferites* sp. Buckman, 1921; subgenus *Trolliceras* Torrens, 1971 (= *Krumbeckia* Arkell, 1951, non Diener, 1915); genus and nominate subgenus *Morrisiceras* Buckman, 1920; genus *Holzbergia* Torrens, 1971 (= *Berbericeras*: Arkell, 1958, non Roman, 1933).

Phylogenetic position of representatives of family Tulitidae Buckman, 1921 is still discussed. Two opposite theories have been introduced.

Hahn (1971), Krystyn (1972), Callomon (*in* Donovan *et al.*, 1980), Sandoval (1983), Westermann, Callomon (1988), Mangold (1993), and even earlier — Pompeckj (1910) and Roemer (1911) included this family into Perisphinctaceae Steinmann, sometimes treating them as descendants of late Bajocian Leptosphinctinae and Zigzagiceratinae (*Procerozigzag*). Perisphinctoidal type (according to interpretation of Sandoval, 1983) of microconchs (*Trolliceras* Torrens), and typical for this superfamily, parabolic ornamentation elements and constrictions on conchs of juvenile forms, were main morphological features supporting this opinion. These features are the most clearly visible at all growth stages of the genus *Bullatimorphites*.

Buckman (1923), Arkell (1952, 1957) and Westermann (1958), Schindewolf (1965), Thierry (1976) and Galácz (1980)

included this family into Stephanocerataceae. Main morphological features supporting this opinion were as follows: similar to some Sphaeroceratidae (*Chondroceras*) suture line without lateral lobe U<sub>2</sub>, also — cadiconic (at least within phragmocone stage), often uncoiled terminal parts of whorls, and finally — narrowing and uncoiled body chamber. Other analogues were found in type of aperture, and general character of ornamentation on septate part of conch, which is similar to one observed among typical sphaeroceratidae representative *Praetulites*. Good preservation of specimens from southern Poland allowed revealing important data about early evolutionary stages of subfamily Tulitinae (*Tulites*, *Rugiferites*). However, its phylogenetic position cannot be precisely determined, because of two reasons — feasibility of detailed examination of juvenile whorls is limited, and suture line is not clearly readable.

On the other hand, two important facts are documented by these specimens — (1) taxonomically diversified assemblage of ammonites belonging to this subfamily occurs already in Lower Bathonian (as it was recorded in Middle East), and (2) many well known species of the genus *Tulites*, previously cited only from lower part of Middle Bathonian (*Tulites subcontractus* Zone), have been proven to be much older.

#### Genus and nominate subgenus **Tulites** Buckman, 1921

Synonymy: *Tulophorites* Buckman, 1921; *Sphaeromorphites* Buckman, 1921; *Madarites* Buckman, 1921

**Type species:** *Tulites tula* Buckman, 1921; Somerset, Great Britain.

**Remarks.** — Macroconchs are middle-sized to moderately big, serpenticonic or cadiconic, and semievolute to moderately evolute. Whorls are more or less rounded, depressed, with comparably wide and deep umbilicus. Lateral wall is convex, umbilical wall usually is clearly separated, especially within phragmocone, often with a row of subtuberculate beads on umbilical edge. Cadiconic forms are characterized by strong ribbing. Serpenticonic forms possess weak ribs or ribbing is not present (on body chamber). In periapertural part of conch, body chamber is narrowing and uncoiled. Suture line is rather simple, with wide lobes. Aperture is also simple. Microconchs *Trolliceras* Torrens (= *Krumbeckia* Arkell) are suppose to be dimorphic counterparts of macroconchs *Tulites*.

**Occurrence.** — Genus and nominate subgenus was treated as indicative for lower part of Middle Bathonian (*Tulites subcontractus* horizon). However Arkell (1952) already suggested (on the basis of his observations in southern Great Britain), possible occurrence of this genus (?*Tulites pravus* Buckman) within older strata — probably within *Procerites progracilis* Zone (see also: Torrens, 1980). This suggestion was supported by other workers, who reported from Lower Bathonian strata presence of microconchs related to this genus: from southern Germany (Hahn, 1971), and *Tulites* (*Rugiferites*)-like forms from eastern Spain (Fernández-López *et al.*, 1978) and southeastern France (author's observation). Enay and Mangold (1985, 1994) confirmed that age-assumption by revision of many *Tulites*' locations in Saudi Arabia: previously described by Arkell (1952) as Middle Bathonian, they have been proved to be of Early Bathonian age. Finally, discovery of the same age assemblage of *Tulites*

and *Rugiferites* in southern Poland, proves existence of Early Bathonian tulitids also in Europe. This assemblage totally differs from Asian forms of the same age, but great analogues

(sometimes even identity) to some European species previously described as Middle Bathonian, can be observed.

### *Tulites (Tulites)* sp.

Pl. II, Fig. 1; Pl. III, Fig. 1

**Material.** — 1 specimen, CZ. 272, coll. Society of Friends of Częstochowa, Częstochowa vicinity (exact locality unknown).

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
CZ. 272	146	51	0.35	79	0.54	1.55	55	0.37			$\frac{9}{10}$ - bch
	115	41	0.35	77	0.67	1.88	41	0.35	-12 ( $\frac{1}{5}$ )		$\frac{1}{2}$ - bch

**Description.** — Specimen is represented by moderately large macroconch, which consists of poorly preserved phragmocone, and long body chamber occupying almost whole last whorl. Strongly depressed whorls possess moderately wide umbilical wall and rounded umbilical edge. Wall disappears in periapertural part of whorl. Whole phragmocone and initial part of body chamber are covered with thickened, low external ribs; later they disappear. The ribs disappear in final, exposed part of phragmocone. Body chamber is smooth in its second half, slightly narrowed and slightly eccentric near aperture. Umbilicus is moderately wide, and moderately deep, staircase-shaped. Aperture is simple, followed by narrow periapertural constriction.

**Remarks.** — Specimen from Częstochowa shows similarities (in its type of coiling, and early disappearance of rib-

bing) to some Middle Bathonian taxa of *Tulites modiolarius* (Smith) group, especially included into this species by Hahn (1971): *T. praeclarus* (Buckman), *T. glabretus* (Buckman) and *T. calvus* (Buckman). As same as the most similar *T. praeclarus* (Buckman), this specimen also represents serpenticonic type of conch, but differs in being less eccentric within terminal part of body chamber, and having lower, strongly vaulted whorls. Holotype of *T. praeclarus* (Buckman) (Buckman, 1923, pl. 368, Arkell, 1952; text-fig. 29) represents identical growth stage, at the same diameter of conch, with developed periapertural constriction at the end of body chamber. Similar to other related species: *T. glabretus* (Buckman) and *T. pravus* (Buckman), recorded holotype is strongly contracted at the end of whorl, which feature cannot be observed in specimen from Częstochowa.

**Occurrence.** — Specimen from Częstochowa was the only Lower Bathonian *Tulites* within Polish Jura Chain that was found outside Zawiercie region. Early Bathonian age was confirmed by results of microfaunistic analysis of sediment from body chamber, especially by presence of foraminifers *Ophthalmidium terquemi* Pazdro. The later taxon in the region occurs in Upper Bajocian to Lower Bathonian strata.

### *Tulites (Tulites) cadus* Buckman, 1921

Pl. IV, Fig. 2; Pl. V, Fig. 1, 2; Pl. VI, Fig. 1

1921 *Tulites cadus* Buckman; S.S. Buckman, p. 45

1922 *Tulites cadus* Buckman; S.S. Buckman, pl. 268A, B (holotype), C, figs. 1, 2

?1923 *Sphaeroceras subcosmopolita* Lissajous; M. Lissajous, p. 95, pl. 20, fig. 1, 1a

1952 *Tulites cadus* Buckman; W.J. Arkell, p. 84, 91, pl. 9, fig. 2a, b, 6a, b; pl. 10, fig. 1a-c; pl. 12, fig. 8a, b

1969 *Tulites modiolarius* Smith; P.L. Maubeuge, p. 72, 73, text-fig. p. 73

1971 *Tulites (Tulites) cadus* Buckman; W. Hahn, p. 73, pl. 1, fig. 5a, b; pl. 2, fig. 1a, b

1997 *Tulites (Tulites) cadus* Buckman; Ch. Mangold, M. Rioult, p. 58, pl. 7, fig. 4

**Material.** — 7 specimens: MUZ PIG 297.II.324, 325, 327, 440, 441, Włodowice, iron-ore mine “Jan”, coll. S. Kontkiewicz, Jr.; MUZ PIG 1630.II.19, Rudniki near Zawiercie, iron-ore mine, coll. J. Kopik; CZ.V.103.50, Częstochowa vicinity, coll. Society of Friends of Częstochowa.

**Description.** — Specimen from Włodowice is middle-sized, semievolute, cadiconic macroconch with low, depressed whorls, and deep, funnel-shaped umbilicus. First

(?two) whorls are not preserved, and the next four are visible in umbilical depression. They do possess low-vaulted whorls, wide and covered by internal ribs umbilical wall, and bullae (thickened elements, regular in shape) on umbilical edge. Body chamber is occupying almost whole last whorl. Internal ribs are getting distinctly weaker along body chamber and finally disappear. External ribs (present on almost whole chamber) are wide, semicircle in cross-section, biplicate, and sometimes intercalatory. Within the zone of weakened ribbing delicate, ventral striation occurs. Umbilical wall is wide, oblique, and smooth or with delicate *striae* on body chamber. Similar features can be observed while examining specimen MUZ PIG 1630.II.19, but it is slightly bigger, and possesses more rounded umbilical edge. Specimen CZ.V.103.50, the biggest of all that have been described, is low-coiled, cadiconic, and possesses deep, funnel-shaped, and moderately wide umbilicus. Body chamber is occupying about  $\frac{1}{3}$  of the last whorl. Strongly vaulted whorls can be observed also in partially exposed internal part of conch (e.g.: at  $\emptyset$  about 18 mm,  $w_1 \approx 1.90$ ). Slightly rounded, oblique umbilical wall

Specimen	D	H	H	T	t	t <sub>1</sub>	U	u	R	r	Lw
CZ.V.103.50	110.0	44.5	0.40	83.0	0.75	1.86	43.6	0.40	tr/55		$\frac{3}{4}$ – b.ch
	84.0	31.0	0.37	67.0	0.80	2.16	33.5	0.40	tr/28 ( $\frac{1}{2}$ )	~2.5	$\frac{1}{2}$ – b.ch
MUZ PIG 1630.II.19	89.0	37.0	0.41	72.0	0.81	1.94	30.0	0.34	tr/60		$\frac{3}{4}$ – b.ch
	70.0	26.0	0.37	60.0	0.86	2.30	23.5	0.33	tr/30 ( $\frac{1}{2}$ )		$\frac{2}{5}$ – b.ch
MUZ PIG 297.II.441	71.5	26.0	0.36	~64.0	~0.89	~2.46	28.2	0.39	10 ( $\frac{2}{5}$ )49	~2.0	b.ch
	57.0	19.2	0.34	46.5	0.81	2.42	22.0	0.39	10/25 ( $\frac{1}{2}$ )	2.5	$\frac{2}{3}$ – b.ch
MUZ PIG 297.II.325	73.0	28.5	0.39	61.5	0.84	2.15	26.5	0.36		2.5	$\frac{3}{5}$ – b.ch
<i>Tulites cadus</i> Buckman, holotype (Arkell, 1952)	125.0		0.45		0.86			0.32			? – b.ch
	77.0		0.37		0.85			0.35			
<i>Tulites</i> sp. (mi) MUZ PIG 297.II.327	30.0	10.0	0.33	24.0	0.80	2.40	13.0	0.43	26(+1)/52(+2)	2.0	$\frac{9}{10}$ – b.ch

within phragmocone is covered with strongly marked internal ribs, which disappear completely on body chamber. Mostly biplicate, sometimes triplicate or intercalatory, thickened outer ribs also disappear on final part of body chamber, but even then some marks or linear imprints can be observed. Umbilical edge is rounded, with *bullae*-shaped elements, (mostly on phragmocone), present on the edge.

Among Lower Bathonian ammonites from Włodowice, small, but most probably adult *Tulites*-like microconch (MUZ PIG 297.II.327, Pl. VI, Fig. 2a, b) has been found. It is characterized by long, semievolute body chamber, which shows strong weakening of ribbing on its terminal part. Another similar microconch, described by Hahn (1971, pl. 3, fig. 3ab) as *Tulites* sp., was found within lower Bathonian strata (Fusc-Bank) of southwestern German Jura.

**Remarks.** — Among all known species of *Tulites*, the most similar to specimens described herein is *Tulites (Tulites) cadus* Buckman, described from middle Minchinhampton

(southwestern Great Britain). Cadonic whorls, deep, funnel-shaped umbilical depression, and clearly marked — separated umbilical edge with *bullae*-shaped tuberculation, sharp ribs, which are present on major part of body chamber, and regular coiled body chamber, are characteristic features for both — Lower- and Middle Bathonian forms, especially among specimens with large conchs. Lesser, but still conspicuous analogues to Middle Bathonian representatives of species described by Buckman, can be found among specimens (MUZ PIG 297.II.441, 440, 325), which are characterized (at mature stage) by smaller size, slightly higher whorls, and presence of ribbing on whole body chamber. Common feature for both (Lower- and Middle Bathonian) groups of *T. (T.) cadus* Buckman is its regularity in coiling. This feature can be diagnostic (Arkell, 1952) at higher-than-species level for this group, and can be observed in described herein, Lower Bathonian species of *Tulites* sp.

**Occurrence.** — *Tulites (Tulites) cadus* Buckman was described from lower part of Middle Bathonian strata (*Tulites subcontractus* Zone) of southwestern Great Britain. In southeastern France, northern Switzerland, and southern Germany this species was found in the same stratigraphic position. In Polish Jura Chain it is well represented within Lower Bathonian strata of Częstochowa Ore-bearing Clay Formation. Lower Bathonian age of some specimens (MUZ PIG 297.II.324, 325, 440; CZ.V.103.50) was confirmed by microfaunistic analysis of foraminifers assemblage extracted from sediment from body chambers of investigated ammonites.

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### *Tulites (Tulites) tulotus* (Buckman, 1921)

Pl. III, Fig. 2; Pl. IV, Fig. 1

1888 *Stephanoceras subcontractus* Morris, Lycett; O. Schlippe, p. 197, pl. 6, figs. 1, 1a

1921 *Tulophorites tulotus* Buckman; S.S. Buckman, p. 45

1923 *Tulophorites tulotus* Buckman; S.S. Buckman, pl. 369 A, pl. 369B, fig. 1 (holotype)

1952 *Tulites praeclarus* (Buckman); W.J. Arkell, p. 93, pl. 9, fig. 5a–c

1952 *Tulites schlippei* sp. nov.; W.J. Arkell, p. 98

pars 1971 *Tulites (Tulites) modiolaris* (Smith); W. Hahn, p. 69

**Material.** — 1 specimen, CZ.V.104.50, Częstochowa vicinity.

**Description.** — Macroconch is of middle size, semievolute, with body chamber occupying about  $\frac{5}{6}$  of

last whorl. Strongly depressed phragmocone whorls are covered with thick, gradually weakening, arc-shaped, and mostly biplicate external ribs, and also thickened internal ribs. Body chamber at the beginning is characterized by similar ribbing, but soon ribs are getting more flat and disappear, and only sin-

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
CZ.V.104.50	106.5	34.0	0.32	54.0	0.51	1.58	39.0	0.37	6( $\frac{1}{4}$ )/7( $\frac{1}{5}$ )	~1.4	$\frac{5}{6}$ – b.ch
	99.0	33.0	0.33	56.0	0.56	1.70	32.5	0.33			$\frac{3}{4}$ – b.ch
	80.0	26.5	0.33	49.5	0.62	1.87	24.5	0.31			$\frac{2}{5}$ – b.ch
<i>Tulites tulotus</i> (Buckman, 1921) holotype	max. 118.0				0.45						
	110.0		0.36		0.51	1.42		0.35			? – b.ch
	66.0		0.42		0.88	2.09		0.35			? – phg

gle, semicircular in cross-section and small *striae*-like elements can be observed. Umbilicus is deep, graduate, and comparably wide. In aperture zone it becomes wider, as the result of slight flattening and uncoiling of terminal part of body chamber. Umbilical wall is moderately wide, with rounded umbilical edge. Aperture is simple.

**Remarks.** — Specimen from Częstochowa shows clear similarities to *Tulites tulotus* (Buckman), which was described from Middle Bathonian strata of Fuller's Earth Rock in southern Great Britain. Similar to holotype, it possesses middle-sized conch, comparably wide and deep, graduate umbilicus, depressed, slightly narrowing whorls, which are uncoiling at the end of conch. Its ribbing is strong (internal and external) and disappears (external) within terminal part of body chamber. It differs from *T. modiolaris* (Smith) in smaller size of conch, and later disappearing of ribbing. Arkell (1952) identifies described species with *T. praeclarus* Buckman, but the later is characterized by bigger conchs and early

weakening and disappearing of internal ribbing (as same as *T. modiolaris* (Smith). Sometimes both Buckman's species — *T. tulotus* (Buckman) and *T. praeclarus* Buckman — are treated (Hahn, 1971), as synonyms of *T. modiolaris* (Smith), in the author's opinion — inequitably. Schlipp's (1888, pl. 6, fig. 1) specimen from upper Rhine region, described by Arkell (1952) as holotype of new species — *T. schlippei* Arkell, shows so many similarities to *T. tulotus* Buckman, that should be rather treated as junior synonym of the later.

**Occurrence.** — This species was described for the first time from Middle Bathonian strata (*Tulites subcontractus* Zone) of southern Great Britain. Most probably it is present within similar in age sediments of southwestern Germany. In southern Poland it was found within lower Bathonian strata of Częstochowa Ore-bearing Clay Formation. Its age was confirmed by microfaunistic analysis of sediment from body chamber of investigated specimen.

### Subgenus *Rugiferites* Buckman, 1921

Synonymy: *Pleurophorites* Buckman, 1921

**Type species:** *Rugiferites rugifer* Buckman, 1921, Dorset, southern Great Britain.

**Remarks.** — Macroconchs are of middle size, semi-evolute, with wide-oval in shape whorls, which are narrowing in their periaptural part. Umbilicus is comparably wide (among Middle Bathonian forms it is getting even wider in terminal part of whorl). Ribbing is comparably thin on phragmocone, getting thickened with beginning of body chamber, and finally — later gets weaker and disappears. Umbilical wall is rounded, and not separated. Internal ribs are more — less dense, external — biplicate, rarely intercalatory or triplicate. Ribbing usually is not regular, with external ribs often sloping backward. Body chamber is long and compressed near aperture, sometimes, among Middle Bathonian species, strongly uncoiled. Aperture is simple. Usually *Trochoceras* (Callomon, 1963; Torrens, 1971) or rarely — *Sphaeropychius* (Hahn, 1971) are thought to be microconch counterparts of this taxon. In comparison to Middle Bathonian *Rugiferites* from Great Britain and Germany, Lower Bathonian specimens from Polish Jura Chain show some differences in shape and ornamentation of conchs. Among others, smaller size of adult specimens, earlier weakening of ornamentation and strong uncoiling of body chamber are main features of lower Bathonian forms. Existing similarities can be found in comparison of septate parts of conchs. It is worth to mention, that characteristic for *T. (R.) wlodowicensis* sp. nov., irregular external ribbing on phragmocone shows some similarity to ribbing of representatives of Sphaeroceratinae *Praetulites rugosus* sp. nov., which is of the same age. Phylogenetic-relations between *Rugiferites* and *Bullatimorphites* (which is of Early Bathonian age too), also are not completely clear. Therefore sometimes huge differences in classification of particular species (which are linked to one or another sub-

genus) occur. It concerns (among others) following taxa: *Bullatimorphites sofanum* (Boehm), *B. perispinctoides* Arkell and *B. serpenticonus* Arkell, which are sometimes included in subgenus *Rugiferites* (Galácz, 1980; Sandoval, 1983). The most extreme opinion on taxonomical position of later subgenus was introduced by Mangold (1993), who denied necessity of distinguishing *Rugiferites* Buckman, 1921, treating this taxon as junior synonym of genus/subgenus *Bullatimorphites* Buckman, 1921. These difficulties were also noticed by Torrens (1974), who wrote, that early species of *Bullatimorphites* (genus, which occurs already in Lower Bathonian) are very difficult to distinguish from *Rugiferites*. Also Callomon (*in: Donovan et al.*, 1980) stated that *Rugiferites*-like forms, which connect Lower Bathonian *Zigzagoceras*, and Middle Bathonian *Tulites*, exist.

**Occurrence.** — Subgenus has been discovered in both — strict Mediterranean area, and Submediterranean European foreland of Tethys (Hungary, Italy, southern Germany, France, southeastern Spain, and southern Poland), and also: in southern Great Britain, Pacific region (Indonesia), ?South America (Chile). Generally accepted as index species for lower part of Middle Bathonian (*Tulites subcontractus* Zone), also was stated within older parts of Bathonian: *Cadomites orbigny* horizon of Western France (*Procerites progracilis* Zone) (Gabilly *in: Mangold et al.*, 1974) and partial equivalent of these zones — *Bullatimorphites sofanum* Zone in Spain (Sandoval, 1983). Also Fernández-López *et al.* (1978) cited from eastern Spain an undefined *Rugiferites* within Lower Bathonian ammonite assemblage. Most probably specimens of *Rugiferites* from southeastern France (Mâcon region) are of Early Bathonian age. They have been identified by author in collection of Claude-Bernard University, in Villeurbanne near Lyons. Finally, *Rugiferites* from Polish Jura Chain were found within Lower Bathonian strata together with nominate *Tulites* subgenus taxa.

*Tulites (Rugiferites) wlodowicensis* sp. nov.

Pl. VII, Fig. 1, 2, 3; Pl. VIII, Fig. 1, 2

?1971 *Tulites (Rugiferites) polypleurus* (Buckman); W. Hahn, p. 81, pl. 3, fig. 6

*Holotype*: specimen CZ.V.108.50; Pl. VII, Fig. 1a–c.

*Derivation*: after the name of village Włodowice; Polish Jura Chain.

*Type locality*: Włodowice, iron-ore mine “Jan”, Polish Jura Chain.

*Type strata*: Częstochowa Ore-bearing Clay Formation, Lower Bathonian.

**Material.** — 5 specimens, CZ.V.108.50, Włodowice; MUZ PIG 297.II.319, 323a, c, 326, Włodowice, coll. S. Kontkiewicz, Jr.

shape, and are covered with stronger ribs. On ventral part of body chamber external ribs are numerous, wavy-shaped, and slightly sloped backward.

One specimen of tulitid microconch (MUZ PIG 297.II.320; Pl. VIII, Fig. 3a–c) — the smallest in diameter, and possessing long body chamber raised questions about its taxonomical qualification. Similar to larger specimens, within body chamber its whorls are wide, depressed, and with rounded latero-umbilical edge. It possesses dense, wavy, and irregular in some parts, external ribs, separated by deep “inter-rib” depressions, which (sometimes) remind odd constrictions. Also some elements

of ribbing are of parabolic-type ornamentation. Its relation to *Tulites (Rugiferites)* is not sure, but highly probable.

**Remarks.** — Macroconchs from Włodowice usually possess numerous common features with septate stages of Middle Bathonian *Rugiferites*, but they differ in smaller size, presence of ribbing on body chamber, regular shape of whorls (they are not uncoiled in clear way at the end of conch). One of

Specimen	D	H	h	T	T	t <sub>1</sub>	U	u	R	r	Lw
CZ.V.108.50 holotype	68.0	24.5	0.36	~28(1/2)	(~0.82)	(~2.28)	22.0	0.32	33/83(+4)	2.6	b. ch
	53.0	21.5	0.40	45.0	0.84	2.09	17.0	0.32	17/45 (~1/2)	2.6	1/2 – b.ch
MUZ PIG 297.II.326	62.0	23.7	0.38	43.0	0.85	1.81	~19.0	~0.30	34/76 (+3)	2.3	1/2 – b.ch
	48.5	20.0	0.41	34.0	0.70	1.70	16.0	0.33			
MUZ PIG 297.II.323a	42.0	16.0	0.38	26.0	0.62	1.62	14.5	0.34	35/70	2.0	4/5 – b.ch
	38.0	14.0	0.37	22.5	0.59	1.61	13.0	0.34		~2.0	1/2 – b.ch
MUZ PIG 297.II.323c	40.0	~16.0	~0.40	30.0	0.75	~1.87	15.0	0.37	18/34 (1/2)	1.8	3/4 – b.ch
? <i>T. (?Rugiferites)</i> sp. (mi), MUZ PIG 297.II.320	31.0	11.0	0.35	21.5	0.69	1.95	11.5	0.37	31/62	2.0	b. ch

**Description.** — Holotype (CZ.V.108.50): macroconch is of middle size, with strongly depressed whorls, and moderately wide and deep umbilicus. Umbilical wall is slightly rounded, with smooth passage to lateral wall, and it is covered with internal ribs. Body chamber is long, and occupies almost whole last whorl. It is covered with dense, usually biplicate, rarely intercalatory ribs along whole (except short periumbilical section) length. Sometimes ribs split to tiny, flat, *striae*-like elements. Point of splitting of ribs is placed little bit outward of the highest curvature of lateral wall. On ventral wall ribs are sloping forward, and are slightly wavy. Terminal part of body chamber (about 1/8 of its length) is characterized by disappearance of ribbing (mostly external). Aperture is simple. Other specimens are generally similar to holotype, only some of them possess thicker ornamentation (MUZ PIG 297.II.319) or are little bit smaller (adolescent forms?), even though they developed as long as holotype body chamber (MUZ PIG 297.II.323a, c). Sometimes, juvenile whorls (MUZ PIG 297.II.323a; Pl. VII, Fig. 3d) can be observed while examining specimens of later type. At diameter of about 42 mm this specimen possesses most probably 6–6,5 whorls, and its body chamber occupies about 4/5 of last whorl. Initial whorls (3–4), observed inside umbilical depression, are evolute, and moderately smooth. Lower part of lateral wall is slightly rounded, with narrow umbilical wall, which is tucked up. Ribbing is tiny, *striae*-like. Here and there oblique hollows (which most probably are deepened, inter-rib sections) and unclear signs of lateral subtuberculation can be observed. Later whorls of phragmocone become more round in

the species, which shows some similarities to Włodowice specimens (type of coiling, and some details of ornamentation) is *Tulites (Rugiferites) godohensis* (Boehm) (= *Sphaeroceras godohense* Boehm, 1912), described (Westermann, Callomon, 1988) from Middle (?Lower) Bathonian of Indonesia. Also specimen from Germany (southwestern Swabian Jura), described by Hahn (1971) as *Tulites (Rugiferites) polypleurus* (Buckman), shows numerous similarities in ornamentation. They are as follows: arc-shaped internal ribs, high density of ribbing, similar shape of conch, and semievolute type of coiling. The later specimen was found within condensed strata of Early–Middle Bathonian age.

**Occurrence.** — The same as specimens of nominate subgenus *Tulites* from Włodowice, representatives of *Rugiferites* subgenus are of Early Bathonian age. Their stratigraphic position also was confirmed by microfaunistic analysis of sediment filling their body chambers (specimens: MUZ PIG 297.II.319, 323a, 326; CZ.V.108.50). Except Polish Jura Chain, presence of undefined *Rugiferites* ammonites among Early Bathonian assemblages was stated in Ternel region, in northeastern Spain (Fernández-López *et al.*, 1978). Lower Bathonian tulitins from Saudi Arabia (Arkell, 1952a, Enay, Mangold, 1985, 1994) were represented only by species belonging to nominate subgenus *Tulites*, and they did not show major similarities to European taxa. Ammonites of Mâcon region (southeastern France), examined by the author in Villeurbanne (Claude-Bernard University) near Lyons (coll. Nr 14552), also show similarities to *T. (R.) wlodowicensis* sp. nov. They have been found within strata of most probably similar age.

Genus *Morrisiceras* Buckman, 1920

Synonymy: *Morrisites* Buckman, 1921, *Pionoceras* Lisajous, 1923, *Lycetticeras* Arkell, 1953

Type species: *Morrisiceras sphaera* Buckman, 1920, Dorset, southern Great Britain.

**Remarks.** — Macroconchs of spheroid shape and possessing narrow and deep (within spetate part of conch) umbilicus have more-less involute and generally wide whorls. Mature specimens with final body chamber are uncoiling at final growth stages. Body chambers of these specimens except being uncoiled are often depressed, and are getting smaller. These features are the best to observe among taxa included previously in *Lycetticeras* subgenus. Ribbing is usually thick and blunt, generally visible on ventral side of conchs. Within juvenile stages, and rarely later, it can be observed also on lateral side. Along body chamber, and sometimes within final part of phragmocone, internal ribbing disappears, and conchs become generally smooth — only unclear rib-like thickened elements and *striae* elements can be observed. Aperture is simple.

After Arkell (1953, 1954), this genus usually was divided into two subgenera: — nominate *Morrisiceras* Buckman, 1920 and *Lycetticeras* Arkell, 1953. Practically, incomplete or immature individuals were included mostly in nominate subgenus *Morrisiceras*, and adult (mature) forms with final body chambers — in *Lycetticeras*. In 1971, Torrens declared

that diagnostic features of subgenus *Lycetticeras* Arkell can be treated as maturity features (large size, eccentric spiral of coil, etc.), therefore there is no need to distinguish two subgenera. Similar opinion was presented later by Mangold and Rioult (1997). Also the author, who examined numerous and often complete ammonites from Polish Jura Chain is supporting this idea, that in the case of macroconch specimens, only one genus and nominate subgenus *Morrisiceras* Buckman 1920 should be distinguish. Consequently, subgenus *Lycetticeras* Arkell, 1953 should be treated as junior synonym of nominate subgenus *Morrisiceras* Buckman, 1920.

**Occurrence.** — Representatives of *Morrisiceras* subgenus occur mostly in western and central European regions of Tethys' foreland: southern Poland (Polish Jura Chain), southern Germany (Swabian Jura), southeastern France (Jura, Mâconnais), and also in northwestern Europe (Lorraine, south and central Great Britain). Single specimens were found in northwestern Switzerland, and western part of Central Asia. Stratigraphic range of *Morrisiceras* genus is very short, limited to (defined by one of the species belonging to this genus) *Morrisiceras morrisoni* Zone. In Poland it was found only in Częstochowa and Zawiercie regions, within Middle Bathonian (*Morrisiceras morrisoni* Zone) part of Częstochowa Ore-bearing Clay Formation.

*Morrisiceras fornicatum* (Buckman, 1921)

## Pl. IX, Fig. 1

1921 *Morrisites fornicatus* Buckman, S.S. Buckman, p. 48

1923 *Morrisites fornicatus* Buckman, S.S. Buckman, pl. 378, fig. 1, 2 (holotype)

1951 *Morrisiceras fornicatum* (Buckman), W.J. Arkell, p. 48

1954 *Morrisiceras fornicatum* (Buckman), W.J. Arkell, p. 122, pl. 14, fig. 12a–c, non fig. 11a–c (= *Morrisiceras irregulare* Spath, 1932)

**Material.** — 1 specimen, MUZ PIG 1630.II.66, Częstochowa-Zacisze, Middle Bathonian, coll. J. Kopic.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.66	67	31	0.46	52.5	0.78	1.70	14	0.21	tr/55(+6?)		phg
<i>Morrisiceras fornicatum</i> (Buckman) holotype	45		0.44		0.77	1.75		0.22	tr/48 (~ <sup>4</sup> / <sub>5</sub> )		phg

**Description.** — Conch is of middle size, and spheroid in shape, septate at whole length, with wide, blunt-arc'd cross-section of last whorl. Umbilical wall is moderately wide, with rounded umbilical edge. Umbilicus is moderately narrow, funnel-shaped, and deep. External ribbing is thick and well-developed on ventral side of conch. Within lateral part, ribs are poorly marked or disappear. Sometimes, as remains of lateral ribbing, bunches of wavy thickened elements can be observed on periumbilical part of the side wall.

**Remarks.** — Specimen of *M. fornicatum* (Buckman) from Częstochowa shows some similarities to *M. korustes* Buckman in general view. It differs from the later in slightly less depressed whorls within phragmocone part of conch, gently arc-shaped cross-section of last whorl, and denser external ribbing. Arkell (1954) includes in species being described also *Morrisiceras irregulare* Spath — taxon that also was found within our assemblage. Comparison of holotype of *M. fornicatum* (Buckman), specimen of the same species from Częstochowa (MUZ PIG 1630.II.66), and holotype of *M. irregulare* Spath, shows clear differences between them. They are as follows: gently-oval cross-section of whorls of Spath' species, less dense ribbing, and narrower umbilicus.

Lack of specimens representing later growth stages of species being described makes detailed comparison to other taxa of this genus impossible.

**Occurrence.** — It was recorded from Middle Bathonian (*Morrisiceras morrisoni* Zone) of southern Great Britain and southern France. In Poland, single specimen was found in Częstochowa, within Middle Bathonian (*Morrisiceras morrisoni* Zone) strata of Częstochowa Ore-bearing Clay Formation.

*Morrisiceras irregulare* Spath, 1932

Pl. IX, Fig. 2

1932 *Morrisiceras irregulare* Spath, L.F. Spath, p. 15, text-fig. 2 (holotype)1954 *Morrisiceras fornicatum* (Buckm.), W.J. Arkell, p. 122, pl. 14, fig. 11a–c (holotype *Morrisiceras irregulare* Spath, 1932)? 1971 *Morrisiceras (Lycetticeras) bulbosum* (Arkell), W. Hahn, p. 92, pl. 5, fig. 1a, b

**Material.** — 2 specimens: MUZ PIG 1630.II.67, Częstochowa-Zacisze; MUZ PIG 1630.II.68, Blanowice, Middle Bathonian, coll. J. Kopik.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.67	78	43(d)	0.55(d)	61(d)	0.78	1.37	13	0.17	tr/43		phg
	60	32	0.53	43(d)	0.72	1.34	10	0.17			phg
MUZ PIG 1630.II.68	73	39(d)	0.53	52(d)	0.71	1.33	12	0.16	tr/23(~ <sup>1</sup> / <sub>2</sub> )		phg
<i>Morrisiceras irregulare</i> Spath, holotype	60		0.57		0.80	1.40		0.15	tr/46		phg
	44		0.57		0.77	1.35					

**Description.** — Conch is of middle size, septate along whole its length, with wide-oval cross-section of last whorl. Umbilicus is moderately narrow, funnel-shaped and deep. Umbilical wall is gently curved, wide. Umbilical edges become more rounded with the growth of conch. Ribbing on ventral side is strong and thick. Lateral part of whorls is lacking of clear internal ribbing.

**Remarks.** — In comparison to Spath' holotype, Polish specimens possess similar — thick external ribbing, but oppositely to English specimen, ribs are not prolonged to the si-

de of conch. Cross-section of the last whorl (excluding its deformed terminal part) as well as its height are comparable to the holotype. Arkell (1954) included Spath' species in *Morrisiceras fornicatum* (Buckman), declaring that both species represent different growth stages of the same species. Comparison of three specimens: *M. fornicatum* (Buckman), representing similar growth stage from Częstochowa, not-very-representative Buckman's holotype, and *M. irregulare* Spath, unrels clear differences, which prove that such distinction is correct. These differences are as follows: different shape of cross-section of whorls, different width of umbilicus, and different density of ribbing. *M. makowskii* sp. nov. possesses much weaker, denser and earlier-disappearing external ribbing on phragmocone, and also narrower umbilicus. The most similar to Spath' species (probably representing more mature stage of

growth) was specimen described by Hahn (1971, pl. 5, fig. 1a, b) from southern Germany.

**Occurrence.** — Holotype, described by Spath was found within Middle Bathonian part of Great Oolite in southwestern Great Britain. Possibly this species is also present in southern Germany. Specimens from southern Poland were found in Częstochowa and Zawiercie regions, within upper part of Częstochowa Ore-bearing Clay Formation (*Morrisiceras morrissi* Zone).

*Morrisiceras korustes* Buckman, 1921

Pl. X, Fig. 1, 2; Pl. XI, Fig. 1, 2

1921 *Morrisiceras korustes* Buckman; S.S. Buckman, p. 481922 *Morrisiceras korustes* Buckman; S.S. Buckman, pl. 274, figs. 1, 2 (holotype)1954 *Morrisiceras korustes* Buckman; W.J. Arkell, p.123, text-fig.43 — reproduction of holotype's photo1988 *Morrisiceras (Morrisiceras) korustes* Buckman; J. Kopik (in: Dayczak-Calikowska *et al.*), p. 148, pl. 49, figs. 3, 4.

**Material.** — 10 specimens, MUZ PIG 1630.II.46, 49, 50, 51, 55, Częstochowa-Zacisze, coll. J. Kopik; MUZ PIG 1630.II.53, Częstochowa vicinity; MUZ PIG 297.II.418a, locality unknown (?Częstochowa vicinity); MUZ PIG 1630.II.52, 54, Blanowice, coll. J. Kopik; MUZ PIG 297.II.418b, Częstochowa-Bugaj, coll. S. Kontkiewicz, Jr.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.46	ca 110.0	?48.0	?0.44	?93.0	?0.84	?1.93	?25.0	?0.21			? <sup>3</sup> / <sub>4</sub> – b.ch
	60.0	26.0	0.43	57.0	0.95	2.19	12.0	0.20	–/20(~ <sup>2</sup> / <sub>5</sub> )		phg
MUZ PIG 1630.II.54	72.0	38.5	0.53	~65.0	~0.90	~1.69	12.0	0.17	tr/13(~ <sup>1</sup> / <sub>4</sub> )		<sup>1</sup> / <sub>5</sub> – b.ch
	68.0	37.0	0.54	60.0	0.88	1.62	11.5	0.17			phg
MUZ PIG 1630.II.49	max. 73.0										<sup>1</sup> / <sub>8</sub> – b.ch
	66.0	28.0	0.42	65.0	0.98	2.32	15.0	0.22	–/47		<sup>1</sup> / <sub>10</sub> – b.ch
MUZ PIG 1630.II.51	63.0	31.0	0.49	(?55)	(?0.87)	(?1.77)	13.0	0.21	–/50(~ <sup>4</sup> / <sub>5</sub> )		phg
MUZ PIG 297.II.418a	62.0	26.0	0.42	61.0	0.98	2.35	13.0	0.21	–/24(~ <sup>1</sup> / <sub>2</sub> )		phg
MUZ PIG 297.II.418b	59.5	27.5	0.46	51.5	0.86	1.87	11.5	0.19	–/48		phg
	52.0	23.5	0.45	43.0	0.83	1.83	10.0	0.19	–/24(~ <sup>1</sup> / <sub>2</sub> )		
MUZ PIG 1630.II.50	49.0	19.5	0.40	42.5	0.87	2.18	11.0	0.22	–/31(~ <sup>4</sup> / <sub>5</sub> )		phg
<i>Morrisiceras korustes</i> Buckman, holotype	max. 63.0										
	59.0		0.49		0.79	1.61		0.21			?b.ch+phg
	44.0		0.41		0.73	1.78		0.25			

**Description.** — Conchs are middle- to moderately large in size, spheroid in shape, with low and very wide, depressed whorls. Umbilicus is moderately narrow, deep and graduate. Umbilical wall is wide, slightly oblique and rounded, with tiny *striae* on surface of umbilical edge. Walls of conch are thick. External ribs are moderately wide, strongly marked. Internal ribs do not exist — only *striae* elements, which are extended down to umbilical edge, can be observed. Usually, only phragmocones are preserved, but sometimes (MUZ PIG 1630.II.46, 49, 54) fragments of body chamber also are visible. Even then conch does not show clear signs of uncoiling.

**Remarks.** — This species (very rare in Western Europe) was represented by single (not preserved to present day) specimen (Buckman's holotype, *vide* Arkell, 1954). In Częstochowa and Zawiercie regions it is the most common representative of *Morrisiceras* genus. In comparison to holotype, which is comparably small and probably immature (with unripe body chamber?) individual, our specimens differ

mostly in whorls being more depressed. Other features, as: thick external ornamentation, signs of disappearance of lateral ribbing, graduate and moderately narrow umbilicus, and wide whorls are similar. *Morrisiceras fornicatum* (Buckman) seems to be the most related to our species, but it differs in possessing less wide whorls, and more delicate and denser ribbing. *M. czestochowiense* sp. nov. possesses very similar phragmocones and comparably wide whorls, but its umbilicus is narrower at every stage of growth, and its body chamber is uncoiling earlier. *M. sphaera* Buckman is characterized by narrower whorls and umbilicus. Also its spiral of the last whorl is shorter and is uncoiling at earlier stage of growth.

**Occurrence.** — Specimens belonging to this species (the same as other taxa of this genus) occur only within *Morrisiceras morrisoni* Zone. They are known from southern Great Britain (Somerset) and southern Poland (Częstochowa and Zawiercie regions), within upper part of Częstochowa Ore-bearing Clay Formation.

### *Morrisiceras morrisoni* (Oppel, 1857)

Pl. XI, Fig. 3, 4; Pl. XII, Fig. 1

- 1851 (1851–1855) *Ammonites macrocephalus* Schlotheim var.; M. Morris, J. Lycett, p. 12, pl. II, figs. 3, 3a (holotype)  
 1857 (1856–1858) *Ammonites Morrisoni* Oppel; A. Oppel, p. 478  
 1921 *Morrisiceras homoeoticum* Buckman; S.S. Buckman, p. 48  
 1921 *Morrisiceras tolmerum* Buckman; S.S. Buckman, p. 48  
 1921 *Morrisites morrisoni* Oppel; S.S. Buckman, p. 49  
 1922 *Morrisites morrisoni* Oppel; S.S. Buckman, pl. 273, figs. 1, 2 (reproduction of holotype)  
 1923 *Pionoceras Morrisoni* Oppel; M. Lissajous, p. 104, pl. 22, figs. 2, 2a, non figs. 1, 1a (= *Morrisiceras bulbosum* Arkell)  
 1933 *Morrisiceras morrisoni* (Lycett); W.J. Arkell, p. 608, pl. 35, fig. 4  
 1953 *Morrisiceras morrisoni* (Oppel); S.Z. Różycki, p. 9 and next  
 1954 *Morrisiceras morrisoni* (Oppel); W.J. Arkell, p. 119, text-fig. 40 (= *M. homoeoticum* Buckman) pl. 14, figs. 3a–c (reproduction of holotype), 4a, b, 5a, b, 6a, b  
 1971 *Morrisiceras (Morrisoniceras) morrisoni* (Oppel); W. Hahn, p. 88, text-fig. 10, pl. 4, figs. 5a, b, 7 (non fig. 6a, b)  
 1983 *Morrisiceras (Morrisoniceras) morrisoni* (Oppel); E. Dietl, M. Kapitzyk, p. 14, pl. 4, figs. 2a, 2b; pl. 5, fig. 1  
 1997 *Morrisiceras (Morrisoniceras) morrisoni* (Oppel); Ch. Mangold, M. Rioult, pl. 17, fig. 3

**Material.** — 4 specimens. MUZ PIG 1630.II.62, Częstochowa-Zacisze, coll. J. Kopik; MUZ PIG 1630.II.63, Częstochowa-Kawodrza Dolna, coll. J. Kopik; MUZ PIG 1630.II.64, Blanowice, coll. J. Znosko; MUZ PIG 297. II.335, Częstochowa-Bugaj, coll. S. Kontkiewicz, Jr.

**Description.** — Conchs are of middle size, involute, with deep, moderately narrow umbilicus. The last whorl is comparably wide, triangular-oval in shape, and shows no changes in type of coiling until the end of its septate part (up to about 80 mm in diameter, specimen MUZ PIG 1630.II.62). Umbilical wall is moderately wide, with imprints of *striae*

elements. The later can be observed also on lateral side of conch, as extension of disappearing internal ribs. Ribs are rather dense, moderately thick, rounded, and they are sloping forward at first, and backward — later. At the side of conch, they are divided into tiny *striae* elements. Initial fragment of body chamber was visible only in one, incomplete specimen from Częstochowa-Zacisze (MUZ PIG 1630.II.62). Body chamber of this specimen is characterized by slow disappearance of ribbing, and also — distinct change in umbilicus diameter ( $p = 0,15-0,19$ ). The later feature can be treated as a sign of uncoiling.

**Remarks.** — The most related taxons to species being described are: *Morrisiceras czestochowiense* sp. nov. and *M. sphaera* Buckman. First one possesses similar shape of phragmocone and similar ornamentation, but its whorls are slightly thicker and lower. More data could be obtained if mature specimens of both species were compared. However, either in the case of Oppel's holotype or the other representatives of this taxon, such specimens are unavailable. Assigned to *M. morrisoni* (Oppel) *M. homoeoticum* Buckman possesses, ac-

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.62	83	45.5	0.55	65.0	0.78	1.43	15.5	0.19	-/24 (~1/2)		1/8 – b.ch
	54	28.0	0.52	36.5	0.68	1.30	8.0	0.15			phg
MUZ PIG 297.II.335	67	34.5	0.51	46.0	0.69	1.33	9.5	0.16	-/54 (+3)		phg
	60	31.5	0.52	43.5	0.72	1.38	9.0	0.15			
MUZ PIG 1630.II.64	56	22.5	0.40	42.0	0.75	1.87	9.0	0.16	-/30 (~1/2)		phg
<i>Morrisiceras morrisoni</i> (Oppel), holotype (after Arkell, 1954)	max. 62 60		0.54		0.67	1.24		0.15	-/~28 (1/2)		phg
<i>Morrisiceras homoeoticum</i> Buckman (Arkell, 1954)	max. 95 85		0.58		0.64	1.10		0.13			?3/4 – b.ch
	74		0.50		0.64	1.28					

ording to Arkell (1954), well developed, long (about  $\frac{3}{4}$  of the last whorl) body chamber, which occupies over-95-mm part of conch, but is not eccentric at any degree. Therefore it is impossible to state without any doubts that this is final body chamber, especially if similar in size specimen of *M. morrиси* (Oppel) from Zacisze (MUZ PIG 1630.II.62) is slightly uncoiled already at initial stage of body chamber (process of uncoiling is much more distinct at later stages of growth). *M. sphaera* Buckman has much narrower umbilicus at similar growth stages. Also (in comparison to Oppel's species) conch of the later taxon probably is uncoiling at later stages.

**Occurrence.** — This is the most common, and the most often cited species of the genus *Morrisiceras*, previously acknowledged as zonal index species of one of the zones of Middle Bathonian. It has been discovered in southern and central Great Britain, southern Germany (Bavaria, Wurttemberg), southeastern and southern France (Mâconnais, Nièvre, Southern Jura), and Switzerland. In Poland it is recorded from upper parts of Częstochowa Ore-bearing Clay Formation (*Morrisiceras morrиси* Zone) from Wieluń and Zawiercie regions (Rehbinder, 1914; Różycki, 1953; Kopik, 1969, 1988 (in: Dayczak-Calikowska *et al.*, 1988).

### *Morrisiceras sphaera* Buckman, 1920

Pl. XII, Fig. 2, 3; Pl. XIII, Fig. 1; Pl. XIV, Fig. 1; Pl. XV, Fig. 1

- 1920 *Morrisiceras sphaera* Buckman; S.S. Buckman, pl. 167, figs. 1, 2 (holotype)  
 1921 *Morrisiceras sphaera* Buckman; S.S. Buckman, p. 48  
 1954 *Morrisiceras sphaera* Buckman; W.J. Arkell, p. 121, text-fig. 39 (holotype), pl. 14, figs. 2a, b, 7, 8a, b, 9a, b  
 1971 *Morrisiceras sphaera* Buckman; H.S. Torrens, p. 143  
 1971 *Morrisiceras (Morrisiceras) sphaera* Buckman; W. Hahn, p. 87, pl. 4, fig. 1a, b  
 1979 *Morrisiceras (Morrisiceras) sphaera* Buckman; G. Dietl *et al.*, p. 188  
 1983 *Morrisiceras (Morrisiceras) sphaera* Buckman; G. Dietl, M. Kapitzke, p. 13, pl. 4, fig. 1  
 1998 *Morrisiceras sphaera* Buckman; J. Kopik, pl. 7, fig. 1

**Material.** — 6 specimens. MUZ PIG 1630.II.8, Dąbrówka near Żarki, coll. J. Znosko; MUZ PIG 1630.II.75, Częstochowa-Zacisze, coll. J. Kopik; MUZ PIG 1630.II.88; PN 78, 81, 82, 83, Częstochowa-Kawodrza Dolna, coll. P. Nowacki (private collection).

**Description.** — Specimen MUZ PIG 1630.II.8 is preserved as strongly damaged phragmocone (up to 70 mm in diameter of conch) and body chamber, which occupies half of the last whorl. Both — phragmocone and preserved part of

body chamber are spheroid in shape, with wide, oval-triangular in cross-section, low whorls, and very narrow, not expanding umbilicus. Thick, blunt external ribs can be observed only on ventral part of conch — on lateral side they disappear, and only tiny *striae* elements are visible. Ribbing continues until the end of preserved part of conch (half of the body chamber). Specimen is not distinctly eccentric. Mature stages are represented by specimens PN 81, 82. Their body chambers occupy whole or almost whole last whorl. External ribbing can be observed on body chamber up to  $\frac{1}{3}$  of its length, later it disappears and only *striae* can be observed. Body chambers are tightly coiled, and only terminal  $\frac{1}{3}$  of their length is strongly uncoiled. At this stage, whorls are slightly depressed and are lowering. Also their comparably wide umbilical walls are getting much narrower. Aperture is simple with slightly wavy edges (specimens PN 81, 82).

Specimen MUZ PIG 16.II.88 at diameter of 122 mm also possesses large fragment of body chamber, which occupies  $\frac{4}{5}$  of the last whorl, and is slightly uncoiled within its terminal part. External ribs, similar to previously described specimens, are thick and blunt, and they are still visible on initial part of body chamber. Later, ribs get flattened and disappear. Umbilicus is moderately narrow but still wider in comparison to other specimens, slightly widening along terminal part of body chamber.

**Remarks.** — *Morrisiceras sphaera* Buckman has been recognized type species of *Morrisiceras* genus. Diameter of the holotype, according to Buckman (1920) and Arkell (1954) was about 100 mm. Its body chamber occupied almost whole last whorl and did not show any signs of uncoiling. Because diameters of phragmocones of the other specimens from southern Great Britain were comparably large (up to 87 mm), Arkell decided that Buckman's holotype must represent immature stage of growth. This assum-

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
PN 82	157.0	65.0	0.41	81.0	0.52	1.25	29.5	0.19	-14 ( $\frac{1}{3}$ )		b.ch
	129.0	75.0	0.58	85.0	0.66	1.13	12.0	0.09	-14 ( $\frac{2}{3}$ )		$\frac{1}{2}$ - b.ch
PN 81	150.0	58.0	0.39	82.0	0.55	1.41	26.0	0.17			b.ch
	118.0	65.0	0.55	81.0	0.69	1.25	12.5	0.11			$\frac{1}{2}$ - b.ch
PN 83	142.5	63.5	0.45	81.0	0.57	1.27	29.0	0.20			$\frac{9}{10}$ - b.ch
	112.0	69.0	0.62	76.0	0.68	1.10	13.5	0.12			$\frac{2}{5}$ - b.ch
MUZ PIG 1630.II.88	max.122.0						21.0	0.17			b.ch
	118.0	66.0	0.56	81.0	0.69	1.23	16.5	0.14			$\frac{4}{5}$ - b.ch
	79.0	40.0	0.50	68.0	0.86	1.70	11.5	0.14			$\frac{1}{6}$ - b.ch
	71.0	34.0	0.48	67.0	0.94	1.97	10.0	0.14	-23 ( $\frac{2}{5}$ )		phg
MUZ PIG 1630.II.8	97.0	55.0	0.57	72.0	0.74	1.31	9.0	0.10			$\sim\frac{1}{2}$ - b.ch
	79.0	36.5	0.46	58.0	0.73	1.59	7.5	0.09			phg
<i>Morrisiceras sphaera</i> Buckman, holotype (Arkell, 1954)	100.0	53.0	0.53	64.0	0.64	1.21	11.0	0.11			? - ? b.ch
	80.0	30.3	0.55	60.0	0.75	1.36	10.4	0.13			phg
	60.0	33.0	0.55	46.2	0.77	1.40	10.2	0.17			

ption seems to be confirmed by Polish specimens. Diameters of their phragmocones are larger than 75 mm, and mature individuals (with uncoiled body chamber) might reach large size (up to 150 mm in diameter).

Septate stages of *M. sphaera* Buckman and *Morrisiceras makowskii* sp. nov. are similar (narrow umbilicus, triangular-oval cross-section of whorls), but later stages differ. *M. makowskii* sp. nov. is of smaller size and its body chamber is shorter and much stronger uncoiled at earlier stage of growth.

Also *M. czestochowiense* sp. nov. is similar to Buckman's holotype in development of septate part of conch (wide whorls, moderately narrow umbilicus). Basic differences between these two species can be observed within terminal part of body chamber — Częstochowa specimen's body chambers are uncoiling at much earlier stage of growth, than Buckman's holotype. *M. bulbosum* (Arkell) is similar to *M. sphae-*

*ra* Buckman at later stages (similar shape of cross-section of whorls, early disappearance of external ribbing), but within phragmocone, and initial part of body chamber the later species' whorls are usually wider, and umbilicus is narrower. *M. comma schlippei* (Arkell) also can reach large size, and it is characterized by late uncoiling of conch, too. From Buckman's holotype it differs in less spherical shape of conch and more depressed whorls.

**Occurrence.** — The species is known from southern and central Great Britain, and eastern (Lorraine) and southern France (Jura). Unconfirmed discoveries were cited from Swiss Alpes and western part of central Asia (Turkmenistan). In Poland it was identified in Middle Bathonian strata of Częstochowa and Zawiercie regions, within upper part of Częstochowa Ore-bearing Clay Formation.

### *Morrisiceras comma comma* Buckman, 1921

Pl. XVI, Fig. 1, 2; Pl. XVII, Fig. 1

1921 *Morrisiceras comma* Buckman; S.S Buckman, p. 48

1922 *Morrisiceras comma* Buckman; S. S. Buckman, pl. 285, figs. 1, 2, 2a (holotype)

1954 *Lyceticeras comma* (Buckman); W. J. Arkell, p. 124, text-fig. 44 (holotype), pl. 15, figs. 1a, b, 2a, b

?1971 *Morrisiceras (Lyceticeras) comma* Buckman; W. Hahn, p. 90, pl. 5, fig. 3

1998 *Lyceticeras comma* (Buckman); J. Kopik, pl. 6, fig. 7

**Material.** — 5 specimens. MUZ PIG 1630.II.7, 76, Blanowice near Zawiercie, coll. J. Kopik; MUZ PIG 1630.II.57, Blanowice near Zawiercie, coll. J. Znosko; MUZ PIG 1630.II.58, Dąbrówka, coll. J. Znosko; MUZ PIG 1630.II.70, exact locality unknown (Częstochowa-Zawiercie region), specimen from destroyed collection of S.Z. Różycki.

cus, sub-trapezoidal in cross-section whorls, and moderately thick external ribbing, which sometimes is marked also on lateral wall as imprints (*striae*). Umbilical wall is rounded and slightly oblique. At this stage specimen being described reminds forms included in *morrissi* group. The border between phragmocone and body chamber (which occupies over one whorl) is located at diameter of ca. 50 mm. Coiling of initial part of body chamber is still regular, but at about half of its length — clearly expands. The terminal half of body chamber is slightly compressed, but general shape of cross-section (still sub-trapezoidal, with slightly rounded ventral side) does not change. External ribbing disappears along terminal half of body chamber, and only some imprints of thickened *striae* are visible. The other specimen of this subspecies (MUZ PIG

1630.II.58) generally differs from the later in more evolute phragmocone. Later stages of conch are similar — body chamber is uncoiling more-less at half of the length of the last whorl, shape of cross-section of whorls is the same, and ribbing also disappears.

**Remarks.** — Specimens from southern Poland in general do not differ from holotype of *M. comma* Buckman. Sizes of mature individuals, shape of cross-section of septate whorls (which are involute) are similar. Nominate subspecies differs from *M. comma schlippei*

(Arkell) in much smaller size of mature individuals and sub-trapezoidal shape of cross-section of whorls. *Morrisiceras sphaera* Buckman is also similar, especially if to compare septate stages of growth of both species (involute whorls, which are triangular-oval in shape of cross-section). Differences appear at later stages (after growth process is finished). They are as follows: size of conch and the point, where conch is uncoiling.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.58	90	41	0.45	50	0.55	1.22	16.0	0.18			<sup>3</sup> / <sub>4</sub> – b.ch
	64	33	0.51	46	0.72	1.39	5.0	0.08	–/49		phg
MUZ PIG 1630.II.7	79	40	0.51	?41	?0.52	?1.02	15.0	0.19	–/21 ( <sup>2</sup> / <sub>5</sub> )		b.ch
	55	28	0.51	(?33)	(?0.60)	(?1.18)	7.5	0.14	–/43		phg
MUZ PIG 1630.II.76	max. ~80						19.0	?0.23			
	65	37	0.57	36	0.55	0.97	8.0	0.12	–/24 (~ <sup>1</sup> / <sub>2</sub> )		
<i>Morrisiceras comma comma</i> Buckman, holotype	max. 95										<sup>3</sup> / <sub>4</sub> – b.ch
	91		0.40		0.45	1.12		0.23			
	51		0.50		0.69	1.38		?0.08	–/49		phg

**Description.** — Two groups of specimens can be distinguished among representatives of *M. comma* Buckman species. First one consists of middle-sized individuals (*M. comma comma* Buckman) and agrees with typical *Morrisiceras comma* Buckman. Second one consists of large specimens, which were assigned to *M. comma schlippei* (Arkell) subspecies. Phragmocone of specimen MUZ PIG 1630.II.7 is of spheroid shape and possesses moderately narrow umbili-

**Occurrence.** — Representatives of nominate subgenus were found in two European regions: southern Great Britain and southern Poland. Their presence in southern Germany (Swabian Jura) is not thoroughly proved. All specimens were

found within middle Bathonian strata (*Morrisiceras morrisoni* Zone). In Poland specimens belonging to this species were found within upper part of Ore-bearing Clay Formation.

*Morrisiceras comma schlippei* (Arkell, 1954)

(Pl. XVIII, Fig. 1; Pl. XIX, Fig. 1)

1888 *Macrocephalites Morrisoni* Oppel; O. Schlippe, p. 199, pl. 7, figs. 1, 2 (holotype: *Lycetticeras schlippei* Arkell, 1954)

1923 *Sphaeroceras bullatum* d'Orbigny; M. Lissajous, p. 91, pl. 23, fig. 7

1954 *Lycetticeras schlippei* Arkell; W.J. Arkell p. 120

1971 *Morrisiceras (Lycetticeras) comma* Buckman; W. Hahn, p. 90, text-fig. 7, pl. 6, fig. 4 (holotype: *L. schlippei* Arkell); pl. 4, figs. 2, 4, pl. 5, fig. 5

1971 „*Lycetticeras*” *comma* Buckman; H. S. Torrens, p. 146

**Material.** — 3 specimens: MUZ PIG 1630.II.73, Blonowice near Zawiercie; MUZ PIG 1630.II.74, Częstochowa-Zacisze, coll. J. Kopik; PN 72, Częstochowa-Kawodrza Dolna, coll. P. Nowacki (private collection).

**Remarks.** — Species was established in 1954 by Arkell as *Lycetticeras schlippei*. For holotype of new species, specimen from southern Germany, described by Schlippe (1888) as *Macrocephalites Morrisoni* Oppel, has been chosen. Holotype was re-illustrated by Hahn (1971). The later author, followed by Torrens (1971), re-analyzed specimen and stated major similarities to *Morrisiceras comma* Buckman. Therefore he claimed that Arkell's species *Lycetticeras schlippei* is younger synonym of Buckman's species. Although this diagnosis is true in general, some differences between Buckman's holotype of *Morrisiceras comma* and Schlippe's specimen from upper Rhine region occur. They differ in size of mature

individuals and in the shape of cross-section of whorls at similar growth stages. In the author's opinion, these differences are supporting Arkell's thesis and this taxon should be distinguish — at least as subspecies of *M. comma* Buckman. Polish specimens of large size show morphological similarities to the same-size specimens of *M. comma* Buckman from southern Germany (Hahn, 1971) and southeastern France (Lissajous, 1923). Except slightly bigger size of Polish specimens and — in the case of one specimen (MUZ PIG 1630.II.73) — much narrower umbilicus in septate part of conch,

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.73	max. 160	63	0.39				25.0	0.16			b.ch
	157	70	0.44	68(Ø140)	0.48	0.97	21.0	0.13			
	124	84	0.68	?77.0	?0.62	?0.92	?8(d)	?0.06			1/2 – b.ch
MUZ PIG 1630.II.74	153	66	0.43	63.0	0.41	0.95	35.0	0.23			9/10 – b.ch
	124	62	0.50	58.0	0.48	0.93	23.5	0.19	-/11(1/6)		
	110	58	0.53	53.0	0.48	0.91	17.0	0.15	-/11(1/4)		3/5 – b.ch
PN 72	140	65	0.46	63.5	0.45	0.98	29.0	0.21			b.ch
	116	61	0.52	56.0	0.48	0.92	15.3	0.13	-/9(1/6)		1/2 – b.ch
<i>Lycetticeras schlippei</i> Arkell holotype (Hahn, 1971)	119		0.46		0.45	0.98		0.18			b.ch
	92		0.56		0.58	1.03		0.11			

**Description.** — Group of specimens linked to Arkell's subspecies consists of large individuals (up to 160 mm in diameter), with circular-oval, slightly convex on sides whorls. Within terminal fragments of phragmocone and initial part of body chamber whorls are involute. In the half of the length of body chamber (as the result of uncoiling) umbilicus is strongly widening. Body chamber is occupying almost whole last whorl. In periapertural part of body chamber, in spite of uncoiling, whorl's thickness-to-height ratio (t<sub>1</sub> = 0,91–0,98) is not distinctly changing. External ribbing is comparably thick on phragmocone, disappears on body chamber, and only some tiny *striae* elements are visible. Umbilical edge is rounded. Umbilical wall is narrow, slightly widening at the end of whorl, and oblique. Aperture is simple.

other features are the same as features of specimen illustrated by Schlippe. *M. sphaera* Buckman reaches similar size and also is characterized by late uncoiling of body chamber, but differs in more spheroid shape of conch at mature stage of growth, which is also characterized by thicker whorls.

**Occurrence.** — *M. comma schlippei* (Arkell) has been found in Middle Bathonian strata of southern and southeastern Germany (Swabian Jura and upper Rhine regions), southeastern France and — at present — in southern Poland (Częstochowa and Zawiercie regions). Everywhere this taxon was cited from *Morrisiceras morrisoni* Zone. In southern Poland it occurs within upper part of Częstochowa Ore-bearing Clay Formation.

*Morrisiceras lycetti* (Arkell, 1953)

Pl. XX, Fig. 1; Pl. XXI, Fig. 1

1953 *Lycetticeras lycetti* Arkell; W.J. Arkell, p. 37, pl. 1, fig. 2

1954 *Lycetticeras lycetti* Arkell; W.J. Arkell, p. 127, text-fig. 41 (holotype), pl. 15, figs. 3, 9

**Material.** — 2 specimens: MUZ PIG 1630.II.69, exact locality unknown (Częstochowa-Zawiercie region), specimen from destroyed collection of S.Z. Różycki; PN 71, Częstochowa-Gnaszyn Dolny, coll. P. Nowacki (private collection).

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
PN 71	138	71.5	0.52	58.5	0.42	0.82	19.5	0.14	-/11( <sup>1</sup> / <sub>4</sub> )		<sup>3</sup> / <sub>4</sub> - b.ch
	114	64.0	0.56	55.0	0.48	0.86	12.2	0.11			<sup>1</sup> / <sub>3</sub> - b.ch
MUZ PIG 1630.II.69	100	41.0	0.41	40.0	0.40	0.97	22.0	0.22	-/30( <sup>1</sup> / <sub>2</sub> )		b.ch
	86	42.0	0.49	35.0	0.41	0.83	14.0	0.16	-/26( <sup>1</sup> / <sub>2</sub> )		<sup>1</sup> / <sub>2</sub> - b.ch
	45	23.0	0.51	20.0	0.44	0.87	8.0	0.17	-/27(+?3)( <sup>1</sup> / <sub>2</sub> )		phg
<i>Lycetticeras lycetti</i> Arkell, holotype	max.137 110		0.49		0.33	0.67		0.18			b.ch

**Description.** — Conch is of middle size (MUZ PIG 1630.II.69), with moderately narrow umbilicus, wide umbilical wall and high-oval whorls within phragmocone. At the mature stage, scaphitoidal uncoiling of body chamber be observed. Also whorls are not as high as earlier, and ribbing disappears. External ribbing on phragmocone is comparably thick, but thinner and sometimes only imprinted — on lateral wall. It disappears along last half of body chamber. Also lateral wall becomes less convex, umbilical wall gets narrower and ventral wall is widening and flattening along this part of conch. Body chamber occupies almost whole last whorl. Specimen PN 71 is slightly bigger than the one, previously described. It also possesses flat lateral wall, and its last whorl

also is distinctly uncoilig. External ribbing on terminal part of body chamber is not visible.

**Remarks.** — In comparison to holotype, our specimens differ in slightly thicker whorls and narrower umbilicus; also external ribbing is more poorly developed. Among all known species of this genus, the most similar to *Morrisiceras lycetti* (Arkell) are: *M. comma comma* Buckman, *M. comma schlippei* (Arkell), and *M. sknipum* (Buckman). These similarities are the best to observe, while studying mature individuals, with final body chambers. The basic differences are visible, while comparing internal whorls. *M. lycetti* (Arkell), at diameter of 45 mm, possesses

high-oval whorls and tiny ribbing (MUZ PIG 1630.II.69), but similar stages of *M. comma comma* Buckman and most probably — *M. comma schlippei* (Arkell) are developed more like *M. morrisi* (Opell). Early stages of *M. sknipum* (Buckman) are more evolute, and its ribbing (both: external and internal) is denser (vide Arkell, 1954, tabl. XIV, fig. 10a, b).

**Occurrence.** — This species were recognized only in two regions: southern Great Britain and southern Poland. Age of sediments in both locations is of *Morrisiceras morrisi* Zone. Częstochowa specimen, similar to ammonite from S.Z. Różycki's collection (exact locality unknown), occurred within upper part of Ore-bearing Clay Formation.

### *Morrisiceras cybeus* sp. nov.

Pl. XXII, Fig. 1; Pl. XXIII, Fig. 1

? 1971 *Morrisiceras* (? *Lycetticeras*) cf. *bulbosum* (Arkell); W. Hahn, p. 93, pl. 5, fig. 2a, b

**Holotype:** specimen MUZ PIG 42.II.24; Pl. XXII, Fig. 1a, b.

**Derivation:** *cybeus* [latin] — rounded, "fat", barrel-shaped.

**Type locality:** Częstochowa-Kawodrza Dolna, Polish Jura Chain.

**Type strata:** Częstochowa Ore-bearing Clay Formation, *Morrisiceras morrisi* Zone.

**Material.** — 2 specimens: CZ. 168; MUZ PIG 42.II.24 (holotype), Częstochowa-Kawodrza Dolna.

**Description.** — Holotype (MUZ PIG 42.II.24): conch is spheroid in shape and moderately large, completely preserved, with final body chamber, occupying slightly more

than one whorl (1.1). It possesses wide and semi-circular whorls. They are slightly higher than "Cz. 168" specimen's whorls. Umbilical wall is clearly separated. Umbilicus is comparably wide and shallow, and it gets distinctly wider along terminal part of coil. Strong uncoiling of conch at some point within second half of the last whorl can be observed, but later coiling is more regular. Ornamentation of the last whorl consists of thickened slightly convex external ribs, which are weakening, and finally disappear. Internal ribs do not exist.

Terminal part of phragmocone, and its (most probably incomplete) body chamber occupies about <sup>4</sup>/<sub>5</sub> of the last whorl. At about <sup>2</sup>/<sub>3</sub> of its length, body chamber is distinctly, but not strongly uncoiled. Whorls are very wide, but not very high, oval in shape of cross-section. Umbilicus is wide and graduate at every stage of growth: phragmocone and body chamber, and it is gently widening along terminal part of coil. Umbilical wall is moderately wide, with rounded umbilical edge. External ribbing (strong and thickened) is present on phragmocone and on half

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 42.II.24 holotype	max. ~160						37.0	~0.23			<sup>1</sup> / <sub>10</sub> - b.ch
	140	66	0.47	100	0.71	1.51	25.0	0.18			<sup>9</sup> / <sub>8</sub> - b.ch
	117	54	0.46	92	0.79	1.70	19.5	0.17	-/32( <sup>1</sup> / <sub>2</sub> )		<sup>1</sup> / <sub>2</sub> - b.ch
CZ. 168	95	40	0.42	70	0.74	1.75	23.0	0.24	-/32( <sup>1</sup> / <sub>2</sub> )		<sup>4</sup> / <sub>5</sub> - b.ch
	85	38	0.45	77	0.90	2.02	19.5	0.23			<sup>1</sup> / <sub>2</sub> - b.ch
	69	28	0.41	65	0.94	2.32	15.5	0.22			<sup>1</sup> / <sub>3</sub> - b.ch

of body chamber. Ribbing is disappearing on lateral wall. Terminal part of body chamber is devoid of any ornamentation.

**Remarks.** — Characteristic for this species features, as: rounded shape of conch, sparse, thickened and early-disappearing external ribs, and early-stage uncoiling, make this species quite unusual (and therefore hard to compare) among other *Morrisiceras* species. *Morrisiceras bulbosum* (Arkell) possesses narrower and more oval whorls. Also its conch is uncoiling at later stages. The only specimen, which can be compared to Polish specimens (especially to specimen CZ.168), is the one, described by Hahn (1971, pl. 5, fig. 2a, b)

from southern Germany as *Morrisiceras* (?*Lycetticeras*) cf. *bulbosum* (Arkell).

**Occurrence.** — Except one specimen from southern Germany (discussed above), which's taxonomical position is unclear, no other specimen can be compared and identified with Polish specimens. The later were found in clay-pit, in Częstochowa-Kawodrza Dolna, within upper part of Częstochowa Ore-bearing Clay Formation. The specimens are of Middle Bathonian age — most probably *Morrisiceras morrisi* Zone, because only *Morrisiceras morrisi* and *Cadomites bremeri* zones are present in this locality.

### *Morrisiceras czestochowiense* sp. nov.

Pl. XXIII, Fig. 2; Pl. XXIV, Fig. 1

*Holotype:* specimen MUZ PIG 1630.II.77; Pl. XXIII, Fig. 2, Pl. XXIV, Fig. 1a, b.

*Derivation:* named after main city of the region.

*Type locality:* Częstochowa-Zacisze, Polish Jura Chain.

*Type strata:* Częstochowa Ore-bearing Clay Formation, Middle Bathonian, *Morrisiceras morrisi* Zone.

**Material.** — 1 specimen, MUZ PIG 1630.II.77, Częstochowa-Zacisze, coll. J. Kopik.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.77 holotype	163.0	73.5	20.45	281	20.50	21.10	32.0	0.20			b.ch
	85.0	38.5	0.45	60	0.71	1.56	12.0	0.14			<sup>1</sup> / <sub>10</sub> – b.ch
	69.0	31.0	0.45	56	0.81	1.90	10.0	0.14	–/39(– <sup>3</sup> / <sub>4</sub> )		phg
	58.5	28.2	0.48	49	0.84	1.74	8.5	0.14	–/26( <sup>1</sup> / <sub>2</sub> )		phg

**Description.** — Holotype (MUZ PIG 1630.II.77): middle-sized conch consists of phragmocone and terminal part of final body chamber. Phragmocone reaches ca. 69 mm in diameter. Its whorls are triangular-oval in shape, wide, and comparably low, covered by thick, blunt external ribs. Umbilical wall is moderately wide and oblique. Umbilical edge is rounded and — as well as lateral wall — is covered by tiny *striae* elements. Umbilicus is moderately narrow. Body chamber occupies whole last whorl. In its initial part, body chamber is covered by gradually flattening external ribs, which soon get weaker and finally disappear. Starting at <sup>1</sup>/<sub>3</sub> of length of the last whorl, grad-

ual uncoiling, and therefore — distinct widening of umbilicus can be observed. Also slight depression of whorls in terminal part of body chamber is visible. Aperture is simple.

**Remarks.** — Septate stages of this species are similar to *Morrisiceras sphaera* Buckman, and also (at smaller degree) to *M. morrisi* (Oppel). Common features of all listed species are as follows: moderately wide and comparably low whorls, moderately narrow umbilicus, and thick external ribbing. Differences can be observed at mature stages of growth. For example: first signs of uncoiling can be observed at <sup>1</sup>/<sub>3</sub> of the length of body chamber in *M. czestochowiense* sp. nov., and within terminal half of body chamber in *M. sphaera* Buckman. Therefore, in comparison to gradual uncoiling of the last whorl in *M. czestochowiense* sp. nov., the same process

is much later and more rapid in Buckman's species. Also there is no known specimen of *M. morrisi* (Oppel), which possesses comparable mature stages developed; therefore only phragmocones can be compared. In this comparison both species are similar in shape of conch and type of ribbing, and differ in height and thickness of whorls.

**Occurrence.** — Newly described species was discovered in southern Poland (Częstochowa and Zawiercie regions), within upper part of Częstochowa Ore-bearing Clay Formation (*Morrisiceras morrisi* Zone). Except Poland, no other occurrence in Europe has been cited.

### *Morrisiceras makowskii* sp. nov.

Pl. XXV, Fig. 1; Pl. XXVI, Fig. 1

1954 *Lycetticeras* aff. *bulbosum* sp. nov. W.J. Arkell, p. 128, text-fig. 46

*Holotype:* specimen MUZ PIG 1630.II.60; Pl. XXV, Fig. 1a–c.

*Derivation:* from the name of polish researcher — Professor Henryk Makowski.

*Type locality:* Blanowice koło Zawiercia, Polish Jura Chain.

*Type strata:* Częstochowa Ore-bearing Clay Formation, *Morrisiceras morrisi* Zone.

**Material.** — 2 specimens, MUZ PIG 1630.II.59, 60, Blanowice, coll. J. Kopik.

**Description.** — Holotype (MUZ PIG 1630.II.60): conch is spheroid in shape, middle-sized, preserved as phragmocone, and very initial and terminal parts of body chamber. Aperture simple, preserved only in fragments. Within phragmocone umbilicus is narrow and deep, and whorls are com-

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.60 holotype	125	~53	~0.42	(?90)	(?0.72)	(?1.70)	27.5	0.22			<sup>3</sup> / <sub>5</sub> – b.ch
	94	51	0.54	56	0.60	1.10	9.0	0.09	–/10+		<sup>1</sup> / <sub>4</sub> – b.ch
	73	36	0.49	52	0.71	1.44	6.5	0.09			phg
MUZ PIG 1630.II.59	78	37	0.47	54	0.69	1.46	9.2	0.12	–/53		phg
	59	29	0.49	47	0.80	1.62	7.0	0.12			phg
<i>Lycetticeras</i> aff. <i>bulbosum</i> sp.n. Arkell, 1954 (text-fig. 46, measurement taken from photo)	79	41	0.52				9.0	0.12			? phg+b.ch

pressed and involute. Umbilical wall is slightly rounded, comparably wide, but getting narrower at the end of coil. Narrow at earlier stages umbilicus is distinctly widening at about half of the length of body chamber, as the result of uncoiling. Ornamentation is weak and consists of moderately wide, flattened external ribs, which are weakening along terminal part of phragmocone. They are already hardly visible on initial part of short body chamber (which occupies <sup>3</sup>/<sub>5</sub> of the last whorl). On later stages of body chamber only *striae* elements can be observed. Terminal fragment of body chamber shows uncoiling and is triangular-oval in cross-section. In this part of conch whorl is lower and wider, which feature is clearly visible in spite of deformations.

Second specimen (*M. cf. makowskii* sp. nov. MUZ PIG 1630.II.59) is incomplete — only phragmocone is preserved. It possesses comparably wide (similar to holotype), triangular-oval in cross-section whorls. Coiling is regular. External ribbing is strong on initial fragment of phragmocone, and getting more flat at later stages. Internal ribbing is not present. Umbilicus is moderately narrow, outlined by gradually widening, slightly rounded umbilical wall. However, its umbilicus (in comparison to similar stages of growth of the holotype) is distinctly wider.

**Remarks.** — Specimens from southern Poland show great similarities to specimen from Bath, described by Arkell

Great Britain possesses body chamber, which occupies almost whole last whorl, but characteristic for mature individuals features, as uncoiling, change in type of ribbing and change in shape of cross-section of terminal fragment of body chamber, are not visible. Therefore, specimen described by him must be either: immature individual or individual with septae mechanically removed within terminal part of phragmocone. Umbilicus of *Morrisiceras bulbosum* (Arkell) is wider within phragmocone and initial part of body chamber than umbilicus of Arkell's specimen from Dunkerton (at later stages such difference cannot be observed). Also, *M. bulbosum* Arkell differs in longer body chamber and in the shape of cross-section of their terminal fragments. Specimens of *M. makowskii* sp. nov. differ from *M. sphaera* Buckman in (among others): smaller size of mature individuals and shorter body chamber, which is uncoiling stronger, and at earlier stage of growth. *M. irregulare* Spath possesses wider umbilicus at septate stage of growth. Also its ribbing is thicker and disappears later.

**Occurrence.** — Specimens from Blanowice were found within Middle Bathonian part of Czeřstochowa Ore-bearing Clay Formation (*Morrisiceras morrisi* Zone). Specimen from Dunkerton near Bath was found within "Fuller's Earth Rock" series, which represent the same time interval of Middle Bathonian strata.

### *Morrisiceras bulbosum* (Arkell, 1954)

Pl. XXVII, Fig. 1; Pl. XXVIII, Fig. 1; Pl. XXIX, Fig. 1

1923 *Pionoceras Morrisi* Oppel; M. Lissajous, p. 104, pl. 22, figs. 1, 1a (holotype), non figs. 2, 2a (= *Morrisiceras morrisi* (Oppel))

1954 *Lycetticeras bulbosum* sp. nov.; W.J. Arkell, p. 120  
non 1971 *Morrisiceras (Lycetticeras) bulbosum* (Arkell); W. Hahn, p. 92, pl. 5, fig. 1a, b (= ? *Morrisiceras irregulare* Spath)

non 1971 *Morrisiceras* (?*Lycetticeras*) cf. *bulbosum* (Arkell); W. Hahn, p. 93, pl. 5, fig. 2a, b (= ? *Morrisiceras cybeus* sp. nov.)

**Material.** — 2 specimens, PN 79, 80, Czeřstochowa-Kawodrza Dolna, coll. P. Nowacki (private collection).

**Description.** — Conchs are large, sphaeroconic, with final body

chambers and simple aperture. Specimen PN 80 within septate part of conch is characterized by wide-oval whorls, deep and moderately narrow umbilicus, which is outlined by wide, flat and rounded at the edge umbilical wall. Body chamber occu-

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
PN 79	194.0	84	0.43	104	0.54	1.24	42.0	0.22	tr/30( <sup>1</sup> / <sub>2</sub> )		<sup>9</sup> / <sub>10</sub> – b.ch
	146.5	69	0.47	100	0.68	1.45	25.0	0.17	tr/30( <sup>1</sup> / <sub>2</sub> )		phg
PN 80	158.0	65	0.41	81	0.51	1.25	33.5	0.22	–/27(+2)( <sup>1</sup> / <sub>2</sub> )		<sup>9</sup> / <sub>10</sub> – b.ch
	125.0	58	0.46	73	0.58	1.26	22.0	0.17	–/27(+2)( <sup>1</sup> / <sub>2</sub> )		<sup>1</sup> / <sub>2</sub> – b.ch
<i>Morrisiceras bulbosum</i> (Arkell) holotype (Lissajous, 1923, pl. 22, fig.1)	max. 116.0 100.0		43	50	0.50	1.16	26.0	0.26			? <sup>2</sup> / <sub>3</sub> – b.ch

pies almost whole last whorl. At half of its length gradual uncoiling of conch can be observed. As umbilicus is widening, umbilical wall is narrowing. Aperture is simple. External ribbing is thick and strongly marked on initial part of body chamber. On its second half is diminishing, and disappears completely near the end of whorl. As conch is uncoiling, wide-oval whorls become slightly narrower and lower. Other specimen (PN 79) is even bigger than the one previously described, but similarly is represented by mature individual with simple aperture preserved in fragments. Its body chamber also occupies almost whole whorl. Its conch is uncoiling at comparable stage and with similar intensity as previously described. Only cross-section of terminal part of whorl is more semicircular in shape, and its sides are more convex.

**Remarks.** — Comparison of specimens from Częstochowa and holotype from southeastern France (Lissajous, 1923, tabl. XXII, fig. 1, 1a) shows no major differences. Only specimen from Davayé is slightly smaller, which might be result of its state of preservation (terminal fragment of last whorl is not preserved). Other features, as: sphaeroconic shape of conch, wide-oval cross-section of whorls and moderately wide umbilicus, and also way of uncoiling are similar.

The most similar taxon to *M. bulbosum* (Arkell) is without any doubts *M. sphaera* Buckman. The later differs from spe-

cies being described mostly in: later and stronger uncoiling of conch and narrower umbilicus within phragmocone and initial fragment of body chamber. *M. makowskii* sp. nov. is similar in general shape of conch and in type of ornamentation, but differs in narrower umbilicus in phragmocone stage, shorter final body chamber and smaller size of mature individuals. Whorls of *M. cybeus* sp. nov. are much wider. Also its umbilicus is wider within phragmocone, as the result of early uncoiling of conch. Specimen from southern Germany (Hahn, 1971, tabl. 5, fig. 1a, b) was identified as *M. bulbosum* (Arkell), but it differs from holotype of this species in much stronger ribbing, which sometimes can be observed even down to umbilical edge. Possibly this specimen represents more mature growth stage of *Morrisiceras irregulare* Spath. Another specimen from southern Germany conditionally included in *M. bulbosum* (Arkell) (Hahn, op. cit., tabl. 5, fig. 2 a, b), in the author's opinion, most probably represents new taxon — *Morrisiceras cybeus* sp. nov.

**Occurrence.** — Specimens from Kawodrza Dolna were found within Middle Bathonian (*Morrisiceras morrisoni* Zone) part of Częstochowa Ore-bearing Clay Formation. French holotype from Mâconnais was also found in similar stratigraphic position. Except mentioned — problematic findings from southern Germany, no other occurrences of *M. bulbosum* (Arkell) have been cited.

### Genus *Holzbergia* Torrens, 1971

Synonymy: *Praesutneria* Schmidtil, Krumbeck, 1931 — nomen nudum; *Berbericeras*: Arkell, 1951a, non Roman, 1933

**Type species:** *Holzbergia schwandorfensis* (Arkell, 1951a), northern Bavaria, Germany.

**Remarks.** — Microconchs are of small size, evolute, with wide and shallow umbilicus. Body chamber occupies about  $\frac{3}{4}$  of the last whorl and contain also two shuffle-shaped, widened apertural lappets. Whorls are ellipsoidal in cross-section, slightly widening in periumbilical part. Umbilical wall is narrow, oblique. Ribbing is present along whole length of conch — until very end of body chamber. Ribs are dense (and their density is even greater near umbilicus), wavy, in their lateral part sloped forward, in their ventral part curved

back, mostly biplicate, rarely intercalatory or simple. Genus is monospecific, slightly similar to Lower Bathonian morphoceratid *Berbericeras* Roman, 1933. Previously (Arkell, 1951a, 1958) it was included in Roman's taxon. In 1971, Middle Bathonian specimens of this genus were declared by Torrens as representatives of new genus *Holzbergia*. This genus is widely accepted as microconch counterpart of macroconch *Morrisiceras* Buckman (Torrens, 1971), as they co-occur.

**Occurrence.** — Representatives of this genus were often found in southern and central Great Britain (Dorset, Somerset), in southeastern France (Chézery, Jura), in southern Germany (Bavaria, Jura) and southern Poland. Stratigraphic position — Middle Bathonian, *Morrisiceras morrisoni* Zone.

### *Holzbergia schwandorfensis* (Arkell, 1951a)

#### Pl. XXX, Fig. 1, 2

- |       |   |      |  |
|-------|---|------|--|
| 1931  | <i>Praesutneria schwandorfensis</i> Krumbeck; E. Schmidtil, L. Krumbeck, p. 851 (nomen nudum)   | 1971 | <i>Morrisiceras (Holzbergia) schwandorfense</i> (Arkell); W. Hahn, p. 95, text-fig. 3a, 11, pl. 4, fig. 3        |
| 1951a | <i>Berbericeras schwandorfense</i> Arkell (ex Krumbeck msc.); W. J. Arkell, p. 12, pl. 1, figs. 6a, b, 8 (holotype), 11a, b                                     | 1979 | <i>Morrisiceras (Holzbergia) schwandorfense</i> (Arkell); G. Dietl et al., p. 190, text-fig. 3 (c)               |
| 1958  | <i>Berbericeras schwandorfense</i> Arkell (ex Krumbeck msc.); W. J. Arkell, p. 230, pl. 33, figs. 1a–c, 2a, b, 3  | 1983 | <i>Morrisiceras (Holzbergia) schwandorfense</i> (Arkell); G. Dietl, M. Kapitzke, p. 14, pl. 3, fig. 6a, b, 7a, b |
| 1958  | <i>Berbericeras sekikense</i> Roman; W. J. Arkell, p. 231, pl. 33, figs. 4, 5, 6a, b  | 1987 | <i>Morrisiceras (Holzbergia) schwandorfense</i> (Arkell); J. W. Callomon et al., pl. 2, fig. 4                   |
| 1971  | <i>Holzbergia schwandorfensis</i> (Arkell); H. S. Torrens, p. 138, pl. 36, figs. 1ad, 2a, b, 3ac, 4ab (= <i>Berbericeras sekikense</i> : Arkell, 1958), 5, 6a–c |      |  |

**Material.** — 6 specimens, MUZ PIG 1630.II.21, 22, 23, 25, locality unknown (specimens from destroyed during

II WW collection of S.Z. Różycki); MUZ PIG 1630.II.17, Częstochowa-Gnaszyn Dolny, coll. J. Kopik; MUZ PIG 1630.II.37, Łośnia, coll. J. Znosko.

ening very slightly at the end of whorl. Body chamber (the same as terminal part of phragmocone) is high-oval in cross-section and is covered by ribbing until very end.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.17	40.5	15.0	0.37				14.0	0.34	19(1/2)/68	1.8	? 3/4 - b.ch
MUZ PIG 1630.II.21	32.0	11.8	0.37	11.5	0.36	0.97	11.3	0.35	17(1/2)/64	1.8	3/4 - b.ch
MUZ PIG 1630.II.25	33.0	12.8	0.39	12.0	0.36	0.94	12.4	0.37	32/59(+4)	1.9	3/4 b.ch
	28.0	11.0	0.39	10.5	0.37	0.95	10.5	0.37			1/2 - b.ch
MUZ PIG 1630.II.37	31.5	10.5	0.33	11.0	0.35	1.05	12.8	0.40	30(3/4)/58 (3/4)	1.9	3/4 - b.ch
	28.0	10.0	0.36	10.8	0.38	1.08	10.8	0.38			1/2 - b.ch
<i>Holzbergia schwandorfensis</i> (Arkell), holotype (Hahn, 1971, pl. 4, fig. 3)	30.0		0.42		0.30	0.71		0.33	34/?		3/4 - b.ch
	24.0		0.42		0.34	0.81		0.32	36/?		

**Remarks.** — Among analyzed specimens from Polish Jura Chain clear differences can be observed. Mostly, these differences are visible as small change in number and thickness of ribs, and as change of width and height of particular fragments of coil. Comparison of Polish to British, German and French specimens shows no major differences. Middle Bathonian *Berbericeras sekikense* Roman from Bath region, described by Arkell (1958), most probably represents tiny-ribbed morphotype group of *H. schwandorfensis* (Arkell) Torrens, 1971.

**Description.** — Microconchs are of small size and consist of 6 1/2 whorls. Body chamber occupies 3/4 of the last whorl and it is finished with two shuffle-shaped, widened apertural appendixes. Whorls exposed in umbilical depression are smooth at the beginning, but later, strongly marked umbilical ribs occur. Soon these ribs are narrowing and getting denser. Outward rounded umbilical edge these ribs (now — as internal) are sloping forward. Slightly below the middle of the lateral wall, bifurcation of ribs is visible: they are strongly curved backward, and as external ribs continue on ventral side. Except biplicate ribs, rarely simple and intercalatory ribs occur. Umbilicus is moderately wide and shallow, and is wid-

**Occurrence.** — In investigated region *Holzbergia schwandorfensis* (Arkell) is represented in great number in upper part of Middle Bathonian (*Morrisiceras morrisi* and *Cadomites bremeri* zones). Probably its stratigraphical range is restricted to the first of listed zones. Specimens belonging to this species and described by Torrens (1971), also were found (coll. L. Rollier) in Kromolowo vicinity, near Zawiercie. Except Poland, presence of this taxon was stated in many regions of Western Europe: southern Germany, southern and central Great Britain, and southeastern France. Usually it occurs together with species of *Morrisiceras* genus.

#### Subfamily BULLATIMORPHITINAE Callomon, Dietl, Niederhöfer, 1992

This subfamily consists of macroconch genus *Bullatimorphites* Buckman, 1921 (with its two subgenera: nominate — *Bullatimorphites* Buckman, 1921 and *Kheraiceras* Spath, 1924) and microconch genera and subgenera: *Sphaeroptychius* Lissajous, 1923 (= *Schwandorfia* Arkell, 1951a), and *Bomburites* Arkell, 1952 (*Treptoceras* Enay, 1959, not *Treptoceras* Flower). The oldest representatives of this subfamily — *Bullatimorphites* (*Bullatimorphites*) *latecentratus* (Quenstedt) and *Sphaeroptychius* sp. — are reported from Lower Bathonian. They become the most common in Middle Bathonian (especially within its upper part), but they occur higher in

Upper Bathonian where they are still important for stratigraphy. The youngest representatives of this subfamily (subgenera: *Kheraiceras*, *Bullatimorphites* sensu stricto and *Bomburites*) were found within Lower, and some of them — even within Middle and Upper Callovian. Opposite to majority of Tulitinae ammonites, Bullatimorphitinae representatives are of very wide geographical range. Except Europe (where they have been found in the greatest number), ammonites of this subfamily were cited from central Asia (Uzbekistan, Iran), north Africa, Madagascar, India, Pacific, North America and South America.

#### Genus *Sphaeroptychius* Lissajous, 1923

Synonymy: *Schwandorfia* Arkell, 1951a

**Type species:** *Sphaeroptychius buckmani* Lissajous, 1923; Mâconnais, southeastern France.

**Remarks.** — Microconchs are semievolute, of very small size, and ellipsoid in shape. Also type of coiling is ellipsoid.

Body chamber occupies 3/4 of the last whorl. Often conch is uncoiling strongly, starting at the half of the length of last whorl. Aperture is terminated with large and wide, shuffle-shaped apertural lappets, which are followed by ventral bullae. Immediately behind them shallow, oblique apertural

constriction can be observed. Whorls are wide, covered with mostly tiny, biplicate ribs, which are getting denser and strongly banded at the umbilical edge. The later feature can effect as umbilical, tuberculation-like ornamentation. Umbilicus is comparably wide, outlined by often flattened-near-aperture umbilical edge. Genus *Sphaeroptychius* sometimes is treated as microconch counterpart of *Bullatimorphites* Buckman, rarely as *Rugiferites* Buckman.

### *Sphaeroptychius marginatus* (Arkell, 1951)

Pl. XXX, Fig. 3

- 1935 *Sphaeroptychius buckmani* Lissajous; E. Passendorfer, p. 97, pl. 4, fig. 7a, b  
 1951a *Schwandorfia marginata* Arkell; W. J. Arkell, p. 10, pl. 1, figs. 9a, b, 10a, b (holotype)  
 1952 *Schwandorfia marginata* Arkell; W. J. Arkell, p. 87, text-fig. 25 (middle)  
 1959 *Sphaeroptychius* (*Schwandorfia*) *marginatus* (Arkell); R. Enay, p. 255, pl. 7, figs. 1a–c, 2a, b  
 non 1963 *Schwandorfia marginata* Arkell; H. Makowski, p. 50, pl. 11, fig. 4  
 1969 *Schwandorfia marginata* Arkell; D. Patruilius, pl. 1, fig. 6  
 1971 *Schwandorfia marginata* Arkell; D. Patruilius, E. Popa, pl. 3, figs. 6, 8a, b  
 1972 *Sphaeroptychius marginatus* (Arkell); L. Krystyn, p. 296, text-fig. 29, pl. 24, fig. 6a–c  
 1982 *Bullatimorphites* (*Sphaeroptychius*) *marginatus* (Arkell); A. Galácz, p. 177, pl. 2, fig. 4  
 1983 *Bullatimorphites* (*Sphaeroptychius*) *marginatus* (Arkell); G. Dietl, F. Kapitzke, p. 15, pl. 5, fig. 2  
 1983 *Bullatimorphites* (*Sphaeroptychius*) *marginatus* (Arkell); J. Sandoval, p. 563, text-fig. 153 B, pl. 71, fig. 3  
 1994 *Sphaeroptychius marginatus* (Arkell); A. Galácz, p. 173, pl. 1, fig. 4

**Material.** — 1 specimen, MUZ PIG 1630.II.24, Częstochowa-Lisieniec, clay-pit “Janina”, Middle Bathonian, ? *Cadomites bremeri* Zone, coll. J. Kopik.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.24	32.0	10.7	0.33	~9.5d	~0.30	~0.89	12.0	0.37	16(1/2)~75	~2.3	3/4 – b.ch
	24.3	11.0	0.45	13.8	0.57	1.25	6.7	0.27			1/2 – b.ch
	22.5	10.8	0.48	14.2	0.63	1.31	6.5	0.28			

**Description.** — Microconch is semievolute, of small size, elliptic in shape, with body chamber occupying 3/4 of the last whorl. Two ventral bullae, followed by oblique periapertural constriction can be observed within periapertural part of

**Occurrence.** — *Sphaeroptychius* is cited from whole Bathonian. Particular species were found mostly in Mediterranean area, including sub-Mediterranean foreland. They are cited from Switzerland, Eastern Carpathians (Romania), Western Carpathians (Tatra Mts.), Austria, and also from southeastern and southwestern France, southern Germany, Spain and Portugal.

conch. In the case of one of them — only massive base is preserved as its relic. Aperture is terminated with two, directed slightly down, wide apertural lappets. At the border of phragmocone and body chamber conch is distinctly uncoiling. Umbilicus is moderately wide, strongly widening at the end of whorl. Ornamentation consists of tiny, comparably sharp ribs, which bifurcate slightly inward of center of lateral wall. They are dense, strongly sloped forward, straightening on periventral part of conch. Umbilical wall is wide, smooth, and outlined by clear, sharp umbilical edge. In proximity of umbilical edge ribs are denser and can create small sub-tubercular beads. In the periapertural zone, umbilical edge is disappearing, and whorl is getting compressed.

**Remarks.** — *Sphaeroptychius marginatus* (Arkell) shows similarities to *S. buckmani* Lissajous i *S. lucasi* (Grossouvre). From the first listed taxon it differs in more regular coiling and smaller apertural lappets. *S. lucasi* (Grossouvre) possesses slightly less dense ribbing, is more evolute, and its coiling is regular. Also its umbilical edge is more rounded, and its umbilical wall is distinctly ribbed.

**Occurrence.** — Described species is popular and it is cited mostly from Mediterranean zones of Tethys and its sub-Mediterranean foreland. It was cited only from Europe: Portugal, Spain, west-central (Vendée) and southeastern (Crus-

sol, Digne, S Jura) France, Austria (Klaus Beds) and southern Germany. In Poland, it was described by Passendorfer (1935) as *Sphaeroptychius buckmani* Lissajous from Mediterranean Bathonian of High Tatric series of Tatra Mts, also cited from upper part of Częstochowa

Ore-bearing Clay Formation (Częstochowa). Stratigraphic position: upper part of Middle Bathonian (*Cadomites bremeri* Zone) or lower part of Upper Bathonian (*Paroecotraustes heterocostatus* Zone).

### Genus and nominate subgenus *Bullatimorphites* Buckman, 1921

**Type species:** *Bullatimorphites bullatimorphus* Buckman, 1921, Gloucestershire, southwestern Great Britain.

**Remarks.** — Macroconchs differ in size, at phragmocone stage — sphaeroconic, more or less involute. Within terminal stage (final body chamber) they are mostly serpenticonic,

strongly uncoiling. Early stages (up to 20 mm in diameter), as Hahn (1971) stated, are characterized (similar to some of Zigzagiceratinae) by parabolic ornamentation. Later stages ribbing consists of biplicate or triplicate ribs, which are separated by simple or intercalatory ribs. At the early stages of

growth ribbing is dense, later it gets sparser. Sometimes, this subgenus type of ribbing (which was stated by Buckman, 1921) reminds *Rugiferites* type of ribbing. Nominate subgenus *Bullatimorphites* is widely accepted as macroconch counter of *Sphaeroptychius* microconch.

Recent research showed great disagreement about systematic position of some Middle Bathonian species of this genus, as *B. (B.) sofanus* (Boehm), *B. (B.) serpenticonus* Arkell or *B. (B.) davaiacensis* (Lissajous). According to Galácz (1980) and Sandoval (1983) later taxa should be included in *Tulites (Rugiferites)* genus/subgenus. Other researchers (Mangold, 1993; Mangold, Rioult, 1997) not only denied this opinion, but they are treating whole Buckman's subgenus *Rugiferites* as younger synonym of *Bullatimorphites* Buck-

man. In the author's opinion both thesis are disputable and hardly acceptable.

**Occurrence.** — Genus and nominate subgenus *Bullatimorphites* occurs within whole Bathonian, and its representatives can be found within Callovian. The oldest specimens belonging to (*B. (B.) latecentratus* (Quenstedt), were found within Lower Bathonian. Genus' growth acme can be observed within Middle/Upper Bathonian strata. Genus is pandemic, discovered in almost all Europe — Great Britain, France, Portugal, Italy, Germany, Poland, Romania, Hungary, etc.). It was cited also from central Asia, North Africa, Pacific region (Papua — New Guinea), India, Madagascar, North America, and South America (Argentina, Chile).

### *Bullatimorphites (Bullatimorphites) serpenticonus* Arkell, 1954

Pl. XXX, Fig. 4; Pl. XXXI, Fig. 1

1954 *Bullatimorphites serpenticonus* Arkell; W.J. Arkell, p. 111, text-fig. 38 (holotype)

1968 *Bullatimorphites suevicus* (Roemer); I.D. Tsereteli, p. 86, pl. 13, fig. 1a; pl. 14, fig. 1b

? non 1980 *Tulites (Rugiferites) serpenticonus* (Arkell); A. Galácz, p. 83, pl. 16, fig. 7a, b; pl. 18, fig. 3a, b, 4; pl. 19, fig. 1

1988 *Bullatimorphites (Bullatimorphites) serpenticonus* Arkell; J. Kopik (*in: Dayczak-Calikowska et al.*), p. 148, pl. 49, fig. 5, 6

**Material.** — 1 specimen, CZ.V.106.42, Middle Bathonian, Częstochowa region (exact locality unknown), coll. S. Kontkiewicz, Jr.

wall is rounded, narrowing close to aperture, with disappearing, tiny ribbing. Aperture is simple, preserved in fragments.

**Remarks.** — Analyzed specimen differs from (similar otherwise) *Bullatimorphites costatus* Arkell in slightly earlier and more regular uncoiling, and slightly narrower (in periapertural part of conch) umbilicus. Also external ribbing on phragmocone is less dense. Spiral of coil of *B. ymir* (Oppel) (species characteristic for lower horizons of Middle Bathonian) is expanding at earlier stage of growth, and its external ribs on body chamber are less numerous. Sometimes, described species is being included, under some restrictions (Sandoval, 1983), in *B. (B.) sofanus* (Boehm). However, comparison with lectotype of the later species (Westermann, Callomon, 1988) shows some differences, as smaller size and different shape of cross-section of terminal part of coil. Also point of division of ribs is placed slightly outward.

Suggested by some researchers (Galácz, 1980; Sandoval, 1983) possibility of including this species in *Rugiferites* Buckman subgenus does not seem to be acceptable, at least — according to specimens

from Poland and Great Britain. Comparison of Polish specimen and holotype from Dorset, except different size, does not show major differences.

**Occurrence.** — This species was cited from central France, southern Great Britain (Fuller's Earth Rock), and from Portugal, Hungary and Georgia. The later occurrence (*vide: synonymy*) was defined as Upper Bathonian (Middle?) in age (Tsereteli, 1968). Except this one, all others were dated as being of Middle Bathonian age (zones: *Tulites subcontractus* – *Cadomites bremeri*). Polish specimen was found in closer-unknown locality (therefore is of closer-undefined stratigraphic position) — the only data available is that it was found within Upper Bathonian strata of Częstochowa Ore-bearing Clay Formation.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
CZ.V.106.42	max. 160	60(?d)	0.37	68	0.42	1.13	60	0.37	28/65(+3)		<sup>9</sup> / <sub>10</sub> – b.ch
	134	39	0.29	58	0.43	1.49	50	0.37			
	118	43	0.36	58	0.49	1.35	37	0.31	25/32 ( <sup>1</sup> / <sub>2</sub> )		<sup>1</sup> / <sub>2</sub> – b.ch
	~90	40	~0.44	62	~0.69	1.55	~22	~0.24	14(~ <sup>1</sup> / <sub>2</sub> )/–		phg
<i>Bullatimorphites serpenticonus</i> Arkell, 1954, text-fig. 38 holotype	max. 117										
	100		0.37		0.47	1.27		0.36			<sup>2</sup> / <sub>5</sub> – b.ch
	80		0.40		0.56	1.40		0.32			phg

**Description.** — Macroconch is of large size, with thick, narrowing during growth, whorls and gradually widening umbilicus. Early stages of growth of phragmocone are not visible. Body chamber, except its late expansion (? deformation) is narrowing during growth. It occupies almost whole last whorl. Its ribbing consists of thick, mostly biphlicate external ribs, which are separated by sometimes intercalatory, rarely simple ribs. Division of ribs can be observed more-less in the half of the height of lateral wall. Internal ribs on body chamber in its periumbilical part are getting thicker and more rounded. They are weakening and disappear in terminal part of body chamber. External ribbing is visible until the end of body chamber. External and internal ribbing of late stages of phragmocone is little bit more delicate and denser. Umbilical

*Bullatimorphites (Bullatimorphites) bullatimorphus* Buckman, 1921

## Pl. XXXII, Fig. 1

- 1863 *Ammonites bullatus* d'Orbigny; J. Lycett, p. 3, pl. 31, fig. 1  
 1921 *Bullatimorphites bullatimorphus* Buckman; S.S. Buckman, p. 47  
 1922 *Bullatimorphites bullatimorphus* Buckman; S.S. Buckman, pl. 272 A, B (holotype)  
 1923 *Sphaeroceras bullatum* d'Orbigny; M. Lissajous, s. 91, pl. 18, figs. 2, 2a  
 1952 *Bullatimorphites bullatimorphus* Buckman; W.J. Arkell, p. 87, text-fig. 24 (holotype)  
 1954 *Bullatimorphites bullatimorphus* Buckman; W.J. Arkell, p. 105  
 1983 *Bullatimorphites (Bullatimorphites) bullatimorphus* Buckman; J. Sandoval, pl. 72, fig. 1  
 1997 *Bullatimorphites (Bullatimorphites) bullatimorphus* Buckman; C. Mangold, M. Rioult, pl. 17, fig. 5

**Material.** — 2 specimens, MUZ PIG 1630.II.86, Middle Bathonian, Częstochowa-Kawodrza Dolna, coll. J. Kopik; MUZ PIG 1630.II.87, Middle Bathonian, Częstochowa, coll. J. Kopik.

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.86	92.0	43	0.47	~62	~0.67	~1.44	13.0	0.14	19/67(~ <sup>3</sup> / <sub>4</sub> )	~3.5	phg
	71.5	37	0.52	~47	~0.66	~1.27	10.4	0.14			
MUZ PIG 1630.II.87	53.0	29	0.55	(?35)	(?0.66)		9.0	0.17	11/39(~ <sup>1</sup> / <sub>2</sub> )	~3.5	phg
<i>Bullatimorphites bullatimorphus</i> Buckman, 1922; pl. 272A, holotype (Arkell, 1954)	max. 183.0										1 <sup>1</sup> / <sub>4</sub> – b.ch
	179.0		0.34		0.33	0.97		0.39			
	150.0		0.39		0.37	0.95		0.30			
	100.0		0.48		>0.59			0.19			? <sup>1</sup> / <sub>8</sub> – b.ch

**Description.** — Specimen MUZ PIG 1630.II.86 is middle-sized macroconch with narrow umbilicus. Up to 92 mm in diameter, conch is septate. Starting at 100 mm in diameter, body chamber is strongly uncoiling. Body chamber occupies at least whole last whorl. Phragmocone is wide-oval in shape of cross-section, whorls are involute, und umbilicus is narrow. Its umbilical edge is gently rounded. Comparably wide umbilical wall can be distinguished from lateral wall only along final/terminal part of phragmocone (at earlier stages such distinction cannot be done). Ribbing is dense, mostly

rectiradiate, only on periumbilical and lateral-ventral part — slightly sinusoid. Internal ribs at early stages can be observed even on umbilical wall, at later stages (as wall is widening) ribs are weakening. Ribs are splitting below the middle of lateral wall. External ribs at early stages are not too thick, but later they get thicker and slightly more flat. Umbilicus is narrow and deep within phragmocone. Specimen MUZ PIG 1630.II.87 is incomplete, and earlier stages of growth of phragmocone can be observed. They are characterized by dense, and comparably tiny ribbing (internal and external), wide-oval in cross-section whorls and narrow umbilicus.

**Remarks.** — Detailed comparison of specimens from Częstochowa and *B.(B.) bullatimorphus* Buckman holotype is quite difficult, because Polish specimens are incomplete. In spite of that, numerous common features are visible, which allow to link them to holotype. They are as follows: size of septate stages is comparable, shape and type of ornamentation of conch is similar, length of final body chamber is analogue, as well as degree of its uncoiling, and probably degree of whorl depression within its terminal part. Another specimen from southeastern France, preserved as phragmocone (Lissajous, 1923, pl. 18, figs. 2, 2a) too, seems to be also similar.

Among other species of this genus, most of all, *B. (B.) costatus* Arkell shows major similarities. It differs from described species only in wider coiling along body chamber and slightly more wavy ribbing on phragmocone.

**Occurrence.** — This is index (sub-zonal) species for upper part of Middle Bathonian of Sub-Mediterranean zones of Western and Central Europe, characterizing lower part of *Cadomites bremeri* Zone (*Bullatimorphites bullatimorphus* Subzone). It was cited from southwestern Great Britain (Gloucestershire), southeastern (Mâcon, Digne) and western (Vendée) France, and southern Spain (Granada, Cordoba). In Poland it was found within upper part of Częstochowa Ore-bearing Clay Formation (*Cadomites bremeri* Zone).

*Bullatimorphites (Bullatimorphites) supersphaera* (Stephanov, 1963)

## Pl. XXXII, Fig. 2

- 1963 *Morrisiceras supersphaera* sp. nov. J. Stephanov, p. 187, text-fig. D, pl. 3, fig. 2a, b (holotype)  
 1972 *Bullatimorphites supersphaera* (Stephanov), L. Krystyn, p. 290, text-fig. 27e, pl. 23, fig. 1

**Material.** — 1 specimen, MUZ PIG, 1630.II.85, Middle Bathonian, Częstochowa-Zacisze, coll. J. Kopik.

**Description.** — Macroconch is of middle size, preserved mostly as incomplete phragmocone and little fragment of

body chamber. Whorls are depressed and very wide (at maximum, their width is twice as long as their height). Umbilicus is narrow and deep, and outlined by wide umbilical wall. At this stage (whole phragmocone and ?<sup>1</sup>/<sub>5</sub> of body chamber) coiling is still regular — no sign of its expansion can be observed. Umbilical edge is smooth and rounded. Ribbing already moderately thick at early stages later gets much thicker and more flat. Finally, weakening of ribbing is visible. Internal ribs,

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.85	(ca100)	?40	(?0.40)	(?90)	(?0.90)	?2.25	16	(?0.16)			? <sup>1</sup> / <sub>5</sub> – b.ch
	86	38	0.44	~78	~0.91	2.05	13	0.15	?/~50	?3	phg
<i>Morrisiceras supersphaera</i> Stephanov, 1963, pl. 3, fig. 2a, b; holotype	max. 70										
	65		0.67		1.05	1.58		0.16			phg
<i>Bullatimorphites supersphaera</i> (Stephanov) Krystyn, 1972, pl. 23, fig.1	50		0.65		1.00	1.54		0.16			phg
	95	45	0.47	74	0.78	1.65	19	0.20	10/33	3.3	phg(+b.ch)
	74	36	0.49	71	0.96	1.97	13	0.17			phg
	50								17/33	1.9	phg

which can be observed only on initial stages of preserved part of phragmocone, are moderately narrow and gently sloped forward. Later they are disappearing. External ribs usually are biplicate, but slightly sinusoid.

**Remarks.** — Holotype from Preval vicinity differs from Częstochowa-Zacisze specimen in quite denser, slightly narrower ribs, and more compressed whorls. However, this specimen represents earlier stages of phragmocone, which are not preserved in Polish specimen.

Next specimen of this species (discovered within Klaus Beds near Vienna) is smaller in size and possesses slightly eccentric body chamber, which is incomplete. Body chamber of later specimen differs from Częstochowa specimen's body chamber in whorls being more compressed, well developed in-

ternal ribs and also narrower, denser and mostly triplicate external ribs, which are splitting much higher. Except these differences all specimens seem to represent the same taxon with high level of intraspecific variation. Systematic affiliation of this species as given by Stephanov (1963) (*Morrisiceras supersphaera*), as already has been stated by Torrens (1971) and Krystyn (1972), should be corrected and this species should be placed within genus/subgenus *Bullatimorphites* Buckman.

**Occurrence.** — Stratigraphical position of locality, where holotype was found, was defined by Stephanov (1963) as *Oxyerites aspidoides* Zone. At that time stratigraphic range of later zone was thought to be much wider, therefore both discoveries might be of the same age (?*Cadomites bremeri* Zone). Specimen from Klaus Beds near Vienna was found within condensed strata, which contain ammonites of Middle and Upper Bathonian (zones: *Procerites progradilis*–*Oxyerites aspidoides*). Polish specimen was found within upper part of Częstochowa Ore-bearing Clay Formation. These strata are exposed in Bogusławski clay-pit in Częstochowa-Zacisze and are thought to represent upper part of Middle Bathonian (zones: *Morrisiceras morrisi*–?*Cadomites bremeri*).

### *Bullatimorphites (Bullatimorphites) costatus* Arkell, 1952

Pl. XXXII, Fig. 3; Pl. XXXIII, Fig. 1; Pl. XXXIV, Fig. 1

- 1923 *Sphaeroceras bullatum* d'Orbigny; M. Lissajous, p. 91, pl. 17, fig. 2, pl. 18, fig. 1 (lectotype), non figs. 2, 2a  
 1952 *Bullatimorphites costatus* nom. nov.; W. J. Arkell, p. 87 (pro *Sphaeroceras bullatum*, Lissajous, 1923, pl. 18, fig. 1)  
 1954 *Bullatimorphites costatus* sp. nov.; W. J. Arkell, p. 107  
 ? 1980 *Bullatimorphites stephanovi*. n. sp.; A. Galácz, p. 81, text-fig. 63, pl. 17, fig. 2, pl. 18, fig. 1  
 1983 *Bullatimorphites (Bullatimorphites) costatus* Arkell; J. Sandoval, p. 556, text-fig. 147 D, B, 149 E, F, pl. 69, fig. 1, 2  
 1983 *Bullatimorphites (Bullatimorphites)* sp. 2; J. Sandoval, p. 561, text-fig. 149D, pl. 69, fig. 3

**Material.** — 2 specimens, MUZ PIG 1630.II.84, Middle Bathonian, exact locality unknown (Polish Jura Chain), coll. S. Z. Różycki; MUZ PIG 127.II.227, Middle Bathonian, Bzów, coll. E. Ciuk.

**Description.** — Macroconch (MUZ PIG 1630.II.84) is of large size, with involute phragmocone and strongly evolute body chamber. Phragmocone whorls are wide and depressed. Umbilicus is moderately narrow. Ribbing is dense and ribs are rather narrow. Internal ribs are radial: from umbilical seam to ven-

tral side. At less than half way they are splitting into usually two external ribs. Within terminal part of phragmocone, the later are divided into tiny, *striae*-like elements. The intercalatory ribs are also present. Umbilical wall is lacking of distinct umbilical edge and it can be treated as continuation of curved lateral wall. Body chamber occupies almost whole last whorl, and its ribbing is disappearing along the length. Body chamber is uncoiling; therefore within its periapertural part conch becomes to be evolute and umbilicus — maximally wide. Relative height of whorls (**h**) at this stage does not

Specimen	D	H	h	T	t	t <sub>1</sub>	U	u	R	r	Lw
MUZ PIG 1630.II.84	173.5	57	0.33	80	0.46	1.40	74.0	0.43			<sup>4</sup> / <sub>5</sub> – b.ch
	137.0	54	0.39	79	0.58	1.46	37.0	0.27			<sup>1</sup> / <sub>2</sub> – b.ch
	103.0	43	0.42	73	0.71	1.70	25.0	0.24			phg
	~85.0	~31	~0.36	~65	~0.76	2.10	19.0	0.22		~3	phg
MUZ PIG 127.II.227	~65.0	33	~0.51	(?50)	(?0.77)		11.5	~0.17	14/41 ( <sup>1</sup> / <sub>2</sub> )	3	phg
<i>Sphaeroceras bullatum</i> d'Orbigny, Lissajous, 1923; pl. 18, fig. 1 lectotype	140.0	47	0.33	56	0.40	1.19	53.0	0.38			b.ch
Lissajous, 1923; pl. 17, fig. 2	75.0	40	0.53	56	0.75	1.40	13.0	0.17	25/?	~3.5	phg

change, but their relative thickness (**t**) is getting distinctly smaller. Second specimen (MUZ PIG 127.II.227) is septate at whole length, and its ribbing (similar to internal whorls of previously described specimen) is dense and curved. Also its umbilicus is moderately narrow. Specimen being described shows similarities to French specimens from Mâcon (Lissajous, 1923, tabl. 17, fig. 2, pl. 18, fig. 1) and findings from southern Spain (Sandoval, 1983, pl. 69, fig. 2), which were preserved in analogue way (septate stages, without body chamber).

**Remarks.** — Tiny and wavy ribbing on phragmocone — thick on body chamber, and strong uncoiling along terminal part of conch are characteristic features for this species, which can be observed either on lectotype from Mâcon or specimens from Cordoba and Murcia. Some similar features can be observed among *Bullatimorphites* sp. 2, Sandoval and *B. stephani* Galácz. *B.(B.) bullatimorphus* Buckman differs mostly in

much more strongly compressed body chamber. Also ribbing along body chamber is tinier, umbilicus within phragmocone is narrower and ribs less wavy. *B.(B.) serpenticonus* Arkell possesses similar body chamber with thick ribs, but differs in coiling, which starts to expand earlier, and in the more regular way. Its phragmocone at comparable stage of growth possesses less dense ribbing and wider umbilicus.

**Occurrence.** — Described species is cited mostly from Sub-Mediterranean zones of Tethys foreland. It was listed among species from southeastern France, southern Spain, and (under some restrictions) — Pacific region (New Guinea). Everywhere it was found within lower part of *Cadomites bremeri* Zone (zone *Procerites hodsoni*, pars), within *Bullatimorphites bullatimorphus* Subzone. Polish specimens were found within Middle Bathonian (? *Cadomites bremeri* Zone) part of Czysta-Ore-bearing Clay Formation.

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