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Stratigraphy of the Callovian in the Wieluń Upland

ABSTRACT: The stratigraphic analysis of the Callovian strata in the Wieluń Upland (Central Poland) shows that the stratigraphic gaps comprise the upper part of the calloviense Zone and jason, athleta and mariae zones. The gaps recorded in the Lower and Middle Callovian may be best explained by an increase in the rate of erosion in relation to sedimentation. The gap comprising the athleta Zone depends moreover on some paleogeographic factors, such as widening of the basin and some increase in its depth, and a drop in supply of terrigenous material not compensated by carbonate deposition. The analysis of some species of the subgenus *Kepplerites* (*Gowericeras*) made it possible to assign the forms hitherto treated as two separate species, *K.* (*Gowericeras*) *goweri anus* (Sowerby) and *K.* (*Gowericeras*) *toricelli* (Oppel), solely to the former one.

INTRODUCTION

The Wieluń area is situated at the northern margin of the occurrences belt of Middle Jurassic deposits in the Polish Jura Chain (*cf.* Text-fig. 2*A*). The Middle and Upper Jurassic rocks of that area have been studied by many researchers beginning with Staszic (1815). However, their stratigraphy has not been established on the basis of guide ammonite species until the early 1920's when Premik (1922, 1924) presented succession of the uppermost Bathonian, Callovian and lowermost Oxfordian strata, and subdivided the Callovian of this area into the M. macrocephalus, R. anceps, P. athleta, and Q. lamberti zones, as it was evidenced by such guide species as *Macrocephalites macrocephalus, M. tumidus, M. lamellosus, Kepplerites goweri, Proplanulites subcuneatus, Kosmoceras gulielmi, Quenstedtoceras lamberti, Q. mariae,* and *Hecticoceras* sp. div.

After the world war II, numerous drillings made in the area made possible detailed analysis of lithostratigraphy and distribution of thickness of individual members of the Middle Jurassic (Deczkowski 1960, 1963, 1976). In studies on Jurassic stromatolites in Poland, Szul-

czewski (1968) described the stromatolitic layer in the Callovian section at Wieluń and presented an attempt to reconstruct its sedimentary environment.

It should be however noted, that the works of J. Premik were not followed by any more detailed stratigraphic or paleontological analyses and no ammonites were figured up to present. The exception is here the graduate paper of Wilczyńska (1971) who presented fairly large ammonite collection, a part of which is reported in this paper. Moreover, Matyja & Giżejewska (1979) discussed *i.a.* the distribution of the Lower Callovian ammonites recorded in the investigated area.

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DESCRIPTION OF THE SECTIONS

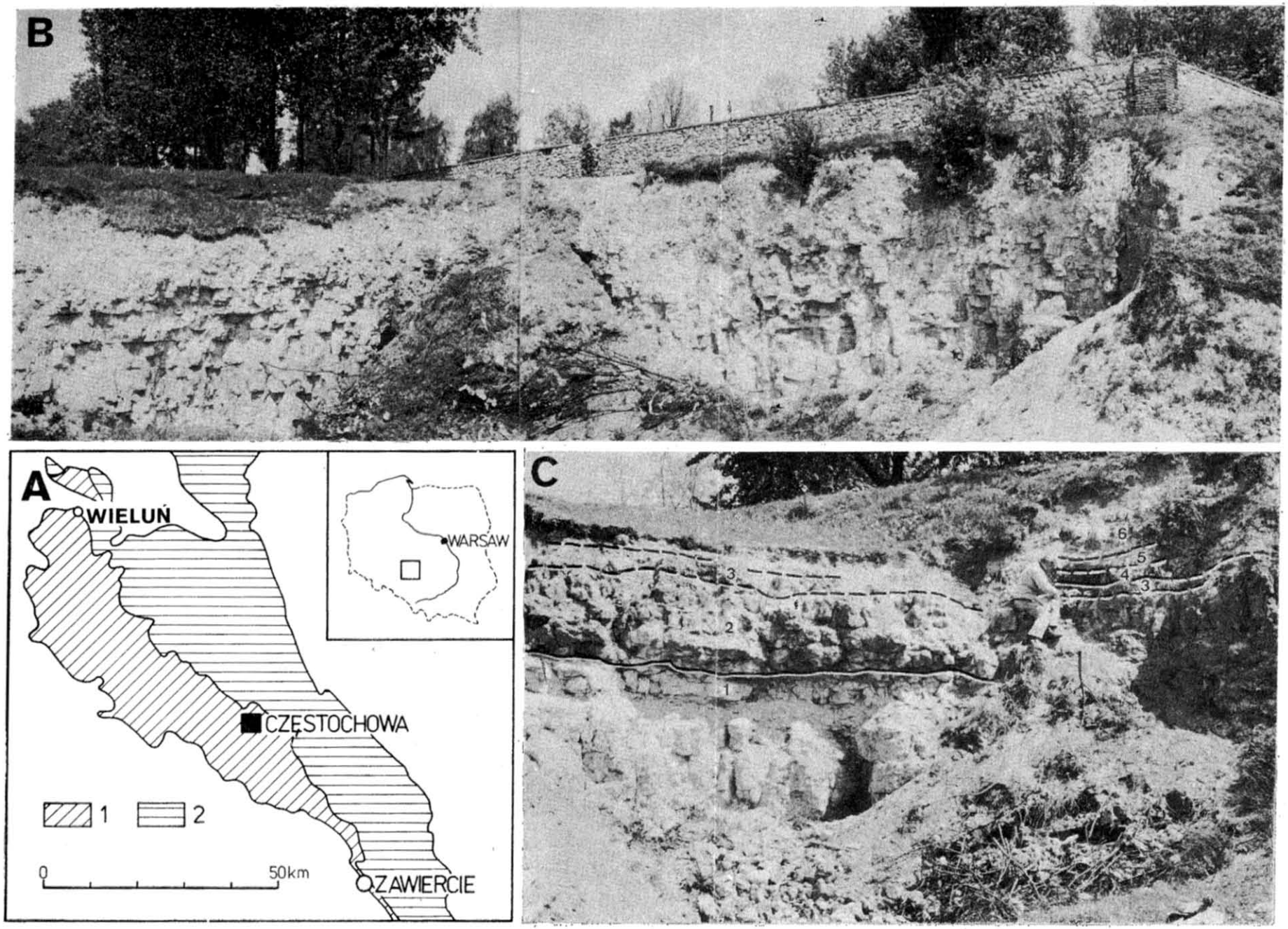
The Callovian rocks are nowadays exposed in the so-called Kowalski Quarry by the road to Częstochowa, on the southern outskirts of Wieluń town (Text-fig. 2). They are characterized by a marked both vertical and lateral variability, connected with presence or absence of certain stratigraphic members (Text-fig. 1).

The section *Wl 2* is described on the basis of observation gathered in large, old quarry situated about 100 m from the road, and the sections *Wl 1a* and *Wl 1b* in quarry situated near cemetery, about 500 m from the road.

THE SECTION *WL 2*

1. Medium- to thick-bedded, light gray to yellowish calcareous gaizes about 6 m thick. The gaizes display the cherts and bioturbations (rare in lower part and common in the upper). Bioturbations are somewhat obliterated due to silification but, nevertheless, those present in lower part of gaizes appear most similar to small *Thalassinoides* and those present in the upper part — large *Thalassinoides*. Thin sections of the gaizes show silt or, sometimes, fine sand grains of quartz (15—20% of all the components), numerous bivalve shells, detritus of crinoids and, sometimes, foraminifer tests and sponge spicules, at the background of micrite or authigenetic silica (chalcedony or fine-grained quartz). In upper part of the gaizes, glauconite grains and irregular concentrations of iron hydroxides appear. Macrofauna is here represented by moulds of ammonites *Macrocephalites macrocephalus* (Schlotheim), *M. subtrapezinus* (Waagen), bivalves of the genera *Lima* and *Pecten*, echinoids of the genus *Collyrites*, and fragments of crinoid stems. Shaly sandy marls, about 20 cm thick, form the top part of this member.

Location of the investigated sections at Wieluń



A — Geological sketch-map of the Częstochowa-Wieluń area (*1* occurrence zone of Middle Jurassic, *2* of Upper Jurassic deposits); **B** — Northern wall of the Kowalski Quarry, to show the sequence of Callovian strata; **C** — Section *Wl 1b*, exposed along the southern wall of the Kowalski Quarry (*cf.* Text-fig. 1); photos taken by J. Śliwiński, M.Sc.

2. Gray-green or, in places, brownish, medium-bedded organodetrital marly limestones about 1.5 m thick. The limestones yield silt-size quartz grains (the amount of which is decreasing upwards), fairly numerous glauconite grains and crinoid fragments, sponge spicules and detritus of bivalve and gastropod shells. Small concentrations of authigenic silica are sometimes found and some parts of rocks are dolomitized.

The limestones are cut by numerous vertical channels, sometimes up to 0.5 m deep and branching at the base. Rock surrounding such channels is enriched in glauconite. The channels resemble large *Thalassinoides*. In these limestones, especially in their upper part, there occur numerous bivalves (*Plagiostoma, Pecten*), echinoids (*Collyrites*), ammonites (macro- and microconchs of *Macrocephalites macrocephalus* (Schlotheim) and *M. subtrapezinus* (Waagen), *Cadoceras* sp.) and numerous belemnites.

3. Organodetrital limestones with knobby-nodular structure, about 14 cm thick. Burrows of the *Thalassinoides* type, are infilled with marly deposit softer than surrounding rocks, which results in marked disintegration after some weathering. Microscopic composition of rocks is similar as that of limestones of the beds *2*, except for some enrichment in sponge spicules and fragments of echinoderms at the expense of quartz grains, and relative increase in share of goethite in cement. Small phosphatic nodules are also present. Fauna is fairly common in this layer: brachiopods (mainly terebratulids, accompanied by some rhynchonellids), bivalves (*Ctenostreon, Pholadomya, Pecten*), gastropods (*Pleurotomaria*), echinoderms (large crinoid trochites and echinoids of the genus *Collyrites*), numerous broken belemnite quards, and such ammonites as *Macrocephalites macrocephalus* (Schlotheim), *M. compressus* (Quenstedt), *Kamptokephalites herveyi* (Sowerby), *Macrocephalites* sp. sp., *Proplanulites subcuneatus* Teisseyre, Cadoceras *elatme* (Nikitin), *Kepplerites* (*Gowericeras*) *gowerianus* (Sowerby) — macro- and microconches, *Choffatia* sp., *Indosphinctes* sp., *Grossouvria* sp., and *Hecticoceras* sp. (innumerous). Some ammonite moulds are phosphatized.

4. Greenish, soft marl with numerous glauconite grains, 2 to 6 cm thick.

5. Stromatolite bed about 5—8 cm thick, laterally passing into gray-yellow marly limestone. The latter contains pebbles of organodetrital limestone identical as that of the bed *3*. Pebbles display goethite and calcite coatings overgrown by numerous serpulids and, sometimes, they are bored by *Gastrochaena*. Limestone cementing the pebbles and infilling space between individual stromatolite domes yields numerous ammonites of the genus *Quenstedtoceras*, primarily *Q. lamberti* (Sowerby), *Q. henrici* Douvillé, and *Q. vertumnum* (Leckenby).

6. Light-gray limestones and marls with sponges, brachiopods, and ammonites of the genera *Cardioceras, Peltoceratoides*, and *Perisphinctes*.

SECTION *WL 1a*

1. Medium- to thick-bedded calcareous gaizes with thin intercalations of shaly marls, about 1.8 m thick. Composition of the gaizes is the same as of those forming the bed *1* in Section *Wl 2*.

2. Marly organodetrital limestones, analogous at those of the bed *2* in the above section, about 1.0 m thick. Biosedimentary structures are, however, rather rare except for the uppermost layer, in which small structures are fairly common

and the rock becomes more nodular in character. In these limestones, there were found innumerous representatives of *Macrocephalites macrocephalus* (Schlotheim), macro- and microconchs, and in the uppermost layer — *Macrocephalites compressus* (Quenstedt) microconchs, and *Cadoceras* sp. The bed is passing without any marked break into the next one.

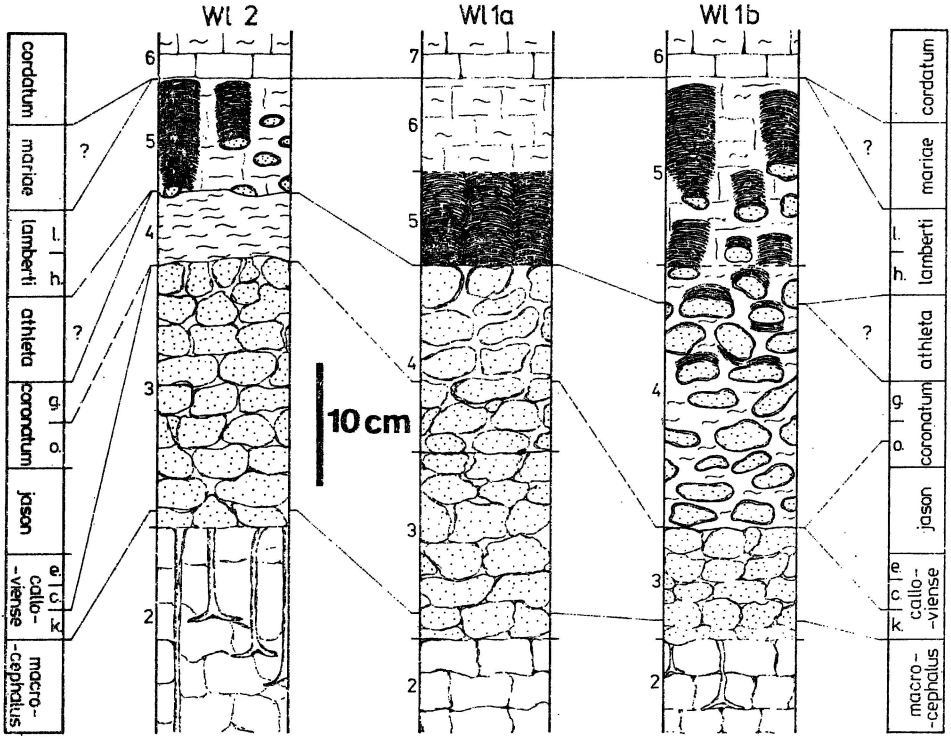
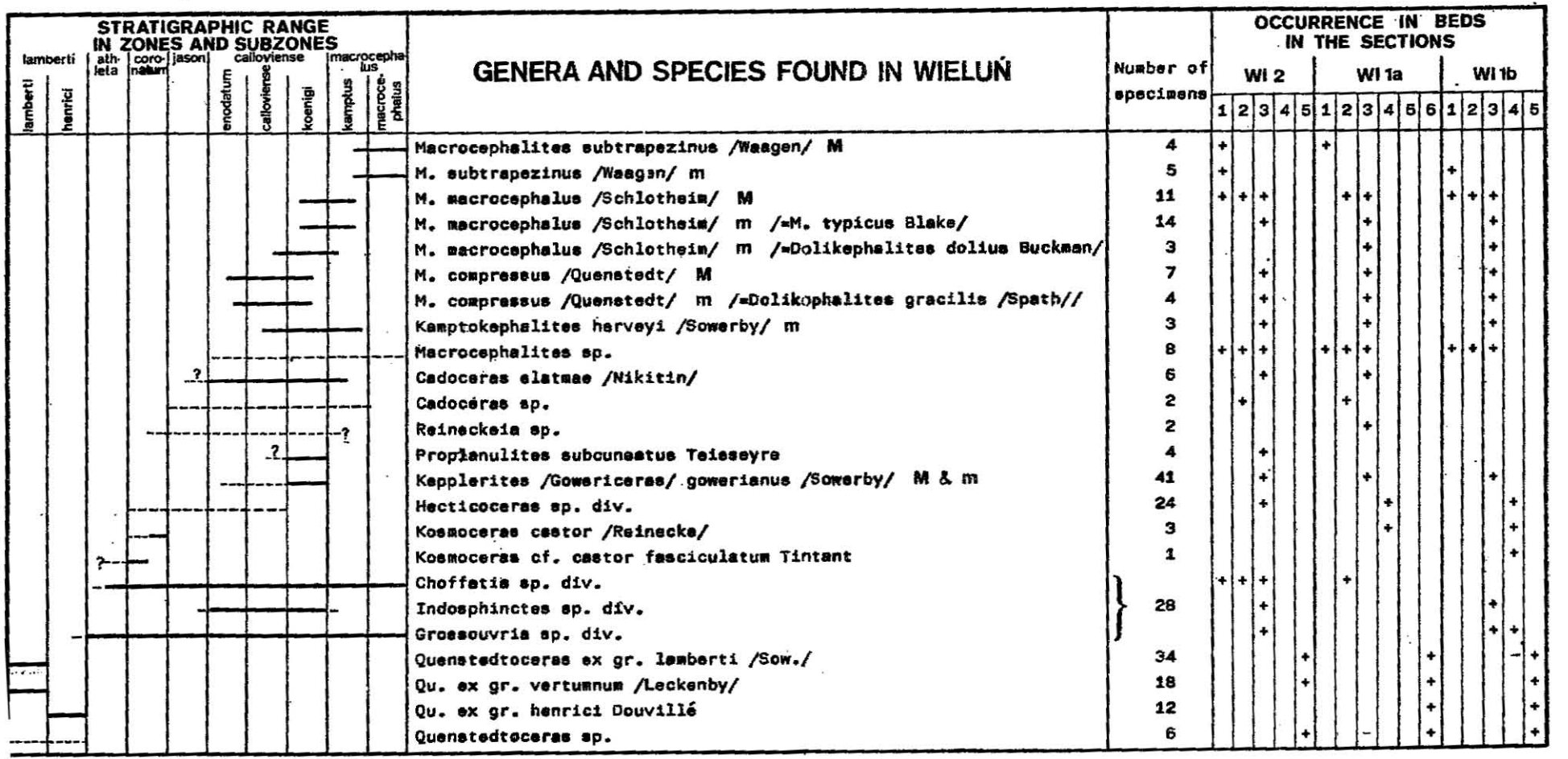


Fig. 1. Callovian sections (*Wl 2, Wl 1a, Wl 1b*) exposed at Wieluń

3. Knobby-nodular, gray-greenish marly-organodetrital limestone about 10 cm thick. Individual irregular nodules are in places interconnected and the space between them is infilled with greenish glauconitic marls. The amount of iron hydroxides is increasing in top of the limestones. Fossils are fairly common: bivalves (*Ctenostreon*), gastropods, belemnites, crinoids and echinoids, and ammonites *Kepplerites* (*Gowericeras*) *gowerianus* (Sowerby), *Cadoceras elatmae* (Nikitin), *Reineckeia* sp., *Macrocephalites macrocephalus* (Schlotheim) — microconchs [= *M. typicus* Blake], *M. compressus* (Quenstedt) and *Kamptokephalites herveyi* (Sowerby).

4. Bed of nodules of marly-organodetrital limestone, 10 to 15 cm thick. The bed is more disintegrated that the underlaying one, being somewhat similar to the nodular bed known from the vicinities of Kłobuck and Częstochowa (*cf.* Różycki 1953, Kopik 1979). Nodules are cemented with soft greenish-brown marls containing redeposited, horizontally oriented fragments of infillings of crustacean burrows (Dr. J. Wieczorek, *pers. inf.*), as well as echinoderms (large crinoid trochites, echinoids), belemnites, and innumerous, poorly preserved fragments of



M - macroconchs, m - microconchs

ammonites *Hecticoceras* sp. div. and *Kosmoceras* ex gr. *castor* (Reinecke), coated with iron hydroxides.

5. Stromatolite bed about 5 cm thick. Stromatolite domes are overgrowing nodules of the bed 4. The stromatolite is built of gray-greenish marly limestone with some admixture of silt-size quartz grains.

6. Gray-greenish marly limestone, 4—6 cm thick. Thin section displays numerous sponge spicules, bivalve prodissoconchs, innumerous foraminifers and, occasionally, crinoid trochites in the micritic groundmass. Quartz grains of silt size are rare. The limestone yields very numerous ammonites of the genus *Quenstedtoceras*, viz. *Q. lamberti* (Sowerby), *Q. henrici* Douvillé, *Q. vertumnum* (Leckenby), and *Q. carinatum* (Eichwald).

7. White hard sponge limestone layer about 12 cm thick, with ammonites of the genera *Cardioceras, Peltoceratoides* and *Perisphinctes*. The layer is overlain by light gray marls.

SECTION *Wl 1b*

1. Calcareous gaizes resembling those from the Section *Wl 1a* in composition and thickness, yielding *Macrocephalites subtrapezinus* (Waagen), both macro- and microconchs.

2. Organodetrital marly limestones about 1 m thick, with numerous bioturbations of the large *Thalassinoides* type, resembling those from the bed *2* in Section *Wl 2*. Here were found macroconchs of *Macrocephalites macrocephalus* (Schlotheim). In the upper part of the bed is passing without any break into the next one.

3. Organodetrital knobby-nodular marly limestones about 6 cm thick. The limestones yield ammonite assemblage similar as in their equivalents in the former sections: *Kepplerites (Gowericeras) gowerianus* (Sowerby), *Macrocephalites macrocephalus* (Schlotheim) — microconch [= *M. typicus* Blake], *Kamptokephalites herveyi* (Sowerby), and others.

4. Conglomerate bed about 20 thick, built of irregular pebbles and nodules of marly organodetrital limestone. Ferruginous coatings of the pebbles are often overgrown by serpulids. Upwards, besides the coatings, there also appear thin stromatolitic crusts on upper surface of pebbles or, sometimes, also on sides and lower surface (discoliths of Szulczewski, 1968). Limestone pebbles are also accompanied by flat nodules formed almost exclusively of concentric laminae of iron hydroxides, some of which are sometimes separated by sparry carbonate laminae with serpulids.

The conglomerate is cemented with fairly soft greenish or, in places, brownish sandy marls with irregular concentrations of deep-green glauconitic marls. Small (up to 2 cm in size) phosphatic nodules occurring here also often display ferruginous coatings. Macrofauna is represented by numerous belemnites and phosphatized moulds of such ammonites as *Cadoceras* sp., *Kosmoceras* cf. *castor fasciculatum* Tintant (or *K.* cf. *superbum* Kopik), *Kosmoceras castor* (Reinecke), and *Hecticoceras* sp. div. The conglomerate with pebbles and onkolites is passing upwards without any break into the next bed.

5. Gray-yellow marl limestone about 15 cm thick, with stromatolitic domes merging without any sharp boundary into surrounding rocks. The limestone is characterized by nodular structure, and individual nodules are overgrown by stromatolites isolated from one another. Microscopic composition of the limestone is identical as that of the bed *6* in Section *Wl 1a*. Marly limestone nodules yield numerous quenstedtoceratids, the specific composition of which is the same as

in equivalent strata in the former sections. Within the bed and between stromatolites, there are sometimes found pebbles of marly organodetrital limestones with limonitic coatings.

6. Light-gray spongy limestone, about 15 cm thick with ammonites of the genera *Cardioceras, Perisphinctes* and *Peltoceratoides,* overlain by gray marls with numerous ammonites, including representatives of the genus *Cardioceras.*

BIOSTRATIGRAPHY

The analysis of the collected ammonites and their stratigraphic ranges (Table 1) shows the presence of the following Callovian zones and subzones in the Wieluń sections.

MACROCEPHALUS ZONE is represented in all the sections by calcareous gaizes (beds *1*), organodetrital marly limestones (beds *2*), and presumably lower part of the knobby-nodular layer (beds *3*). The species of the genus *Macrocephalites,* viz. *M. subtrapezinus* (Waagen) — macro- and microconchs, *M. macrocephalus* (Schlotheim) — macro- and microconchs, and *M. compressus* (Quenstedt), evidence the presence of the macrocephalus and kamptus subzones (*vide* Thierry 1978).

CALLOVIENSE ZONE is evidenced in all the studied sections (beds *3*). Stratigraphic ranges of the species (Table 1) indicate the presence of the koenigi Subzone shown by numerous representatives of *Kepplerites* (*Gowericeras*) *gowerianus* (Sowerby), the peak in development of which has been reached in that subzone (*cf.* Callomon 1955, 1964; Tintant 1963), and occurrence of forms such as *Macrocephalites macrocephalus macrocephalus* (Schlotheim) — macroconchs, *M. macrocephalus* (Schlotheim) — microconchs [= *M. typicus* Blake and *M. dolius* Buckman], *M. compressus* (Quenstedt) — macroconchs, *Kamptokephalites herveyi* (Sowerby) — microconchs, and proplanulitids of the species *Proplanulites subcuneatus* Teisseyre. Although the index species, *Proplanulites koenigi* (Sowerby), is not recorded, the occurrence of the above species indicates that the knobby--nodular limestones (beds *3*) represent the koenigi Subzone only.

It should be admitted that sigaloceratids are generally rare in the Callovian of Poland (cf. Różycki 1953, Siemiątkowska-Giżejewska 1974, Kopik 1979), but some other species indicative of the two upper subzones, known from other parts of the Polish Jura and the Holy Cross Mts, were not recorded here. This is the case of some macrocephalitids (*see* Thierry 1978) and hecticoceratids (genus *Chanasia*), appearing not below the calloviense Subzone, and the earliest kosmoceratids (or the latest sigaloceratids, according to Kopik, 1979) of the *enodatum* group.

JASON ZONE is comprised within a stratigraphic gap as in all the studied sections deposits of the koenigi Subzone are overlain by strata younger than the jason Zone.

CORONATUM ZONE is evidenced in the beds *4* of the sections *Wl 1a* and *Wl 1b*. The recorded kosmoceratids and hecticoceratids are poorly preserved, broken and they often bear limonitic cover. The latter feature indicate their redeposition but they are filled with marls similar to those forming cement of the conglomerate so it may be assumed that the ammonites are coeval with deposition of marls cementing pebbles of Lower Callovian rocks. The bed *4* in the section *Wl 2* was assigned to that zone on the basis of indirect evidences.

ATHLETA ZONE: no ammonites indicative of that zone was found in the studied sections but it is not excluded that sedimentation of the uppermost part of the conglomerate (bed *4*) in the section *Wl 1b* was continuing in the earliest athleta time. This is supported by the record of a fragment of *Kosmoceras* with

a specific sculpture (secondary ribbing bundled into tubercles at ventro-lateral margin) in the cement of the conglomerate. The preservation makes specific identification hazardous but it may be stated that the specimen resembles both the representatives of *Kosmoceras castor fasciculatum* Tintant, reported by Tintant (1963) from the uppermost part of the coronatum Zone, and *K.* (*Kosmoceras*) *superbum* Kopik, reported from condensed nodular layer near Częstochowa (*cf.* Text-fig. 2*A*) but allocated by its creator (Kopik 1979) in the basal part of the athleta Zone. However, neither kosmoceratids typical of the Upper Callovian nor peltoceratids were recorded, so the presence of a stratigraphic gap coinciding with the athleta Zone in the Wieluń area is inferred.

LAMBERTI ZONE is evidenced with numerous ammonites of the genus *Quenstedtoceras* (see Table 1), indicating the presence of both the henrici (probably upper part) and lamberti subzones.

MARIAE ZONE: in white sponge limestones and marls overlaying deposits of the lamberti Zone, no ammonites typical of the mariae Zone were found. Therefore, a next stratigraphic gap is assumed in the area, and it is delineated from above by deposits of the cordatum Zone.

REMARKS ON SEDIMENTATION

According to the data from outcrops and boreholes (Deczkowski 1976), the Callovian deposits in the Wieluń area rest on dark siltstones or marls with ferruginous ooids, dated as the Upper Bathonian. The newly obtained data show that the macrocephalus Zone is about 12 m thick and the remaining zones are merely less than 0.5 m thick. It follows that sedimentation became markedly impeded and, according to biostratigraphic data, several times broken after the macrocephalus time.

The nature of sediments, faunal assemblage, and bioturbation structures of the *Thalassinoides* type (related to activity of crustaceans according to Kennedy & *al.* 1969), recorded in the macrocephalus Zone, indicate sedimentation in high-energy (*see* Ager & Wallace, 1970) sublittoral zone (down to 100 m; *cf.* Ginsburg, 1975). This is especially the case of upper parts of that zone (beds *2*), with bioturbations more numerous and better developed than in underlaying calcareous gaizes.

The calloviense Zone (koenigi Subzone) displays marked decrease in rate of sedimentation, resulting in its smaller thickness and high concentration of fossils, including ammonites.

At Wieluń, higher subzones of the calloviense and jason Zones are absent (*cf.* Text-fig. 1). This gap may be explained by removal of both sediments and fossils by currents, resulting in nondeposition. The development of sediments assigned to the coronatum Zone, different in each section, display evidence for different agents which acted during the jason and coronatum times. The section *Wl 2* displays removal of deposits and fauna, connected with erosion of a part of older strata (distinct boundary between the beds *3* and *4*). Redeposition of infillings

of the crustacean burrows is noted in the section *Wl 1a* (bed 4) and intense erosion of older strata have taken place in the section *Wl 1b*. The erosion resulted in origin of pebbles of Lower Callovian organodetrital marly limestones forming the conglomerate (bed 4). Marked breaks in sedimentation are further evidenced by the *Gastrochaena* borings in pebbles as well as development of limonitic crusts around the pebbles and their overgrowing with serpulids.

In the section *Wl 1a* (bed 4), no distinct traces of erosion were found, although intense action of burrowing crustaceans was presumably taking place there.

The structure of the above deposits appears related to the same processes (*i.e.* activity of burrowing organisms and eogenic, nonuniform cementation leading to origin of nodules being the concretions) as those described from both ancient (Fürsich 1971, 1973; Kaźmierczak 1974; Kennedy & Klinger 1972) and modern (Brown & Farrow 1978) environments.

A slight predominance of sedimentation upon erosion took place once again in the coronatum time, and resulted in deposition of marls cementing pebbles in the conglomerate (section *Wl 1b*) and infilling channels between nodules (section *Wl 1a*, bed 4). A thin layer of glauconitic marls in the section *Wl 2* (bed 4) is also assigned to the coronatum Zone.

The short-lasting phase of low rate sedimentation (coronatum time) has been followed by a successive break in sedimentation, comprising almost the whole time span of the athleta Zone. This gap was also recorded beyond the Wieluń area, in the vicinities of Częstochowa and Zawiercie (*see* Różycki 1953, Kopik 1979). Prevailing terrigenous and shallow-water nature of Lower and Middle Callovian deposits in the Polish Jura, and the change in type of sedimentation into the marly-limestone one at the beginning of the Late Callovian seem to implicate that the gap was due to large-scale paleogeographic reasons. The gap may be explained by widening and certain increase in depth of the basin, resulting in flooding of alimentary areas and drop in supply of terrigenous material not compensated by carbonate deposition.

Carbonate sedimentation was developing in the Wieluń area in the lamberti time. The lamberti Zone is represented by condensed marly-limestone deposits with almost exclusively nektic fauna. This suggest some further changes in bathymetry and chemistry of the marine basin which at that time became connected more strongly with the Tethys.

PALEONTOLOGICAL DESCRIPTIONS

The representatives of the family Macrocephalitidae Buckman were identified with references to Thierry's (1978) monograph, so only some

remarks and comments are given here. The representatives of the genera *Cadoceras* and *Quenstedtoceras* are only figured as their preservation and quantity is not sufficient for reliable specific identifications.

Superfamily **Stephanocerataceae** Neumayr, 1875
Family **Macrocephalitidae** Buckman, 1922
Genus *MACROCEPHALITES* Zittel, 1884

Diagnosis of the genus: *see* Thierry (1978)

Macrocephalites subtrapezinus (Waagen, 1875)
dimorphic macroconch = *Indocephalites transitorius* Spath, 1928

1978. *Macrocephalites subtrapezinus* (Waagen, 1975), dimorphe macroconque (= *Indocephalites transitorius* Spath, 1928); Thierry, p. 155, Pls 2—5, Text-figs 48—56.

Material: four fragments of whorls of fully grown individuals, 3 of which are poorly preserved.

Specimen	D	H	h	W	w	O	o	W/H
32 Wl2	144	82	0.569	80	0.555	21	0.145	0.975

Remarks. — The type of whorl section and ornamentation make it possible to assign the investigated specimens to macroconchs of the species *M. subtrapezinus* (Waagen) as interpreted by Thierry (1978).

Macrocephalites subtrapezinus (Waagen, 1875)
dimorphic microconch = *Kamptokephalites subtrapezinus* (Waagen) sensu Spath, 1928
(Text-fig. 3 and Pl. 2, Fig. 3)

1875. *Stephanoceras lamellosum* (Sowerby); Waagen, p. 122, Pl. 33, Fig. 1a—b.
1875. *Stephanoceras subtrapezinum* Waagen; Waagen, p. 137, Pl. 33, Fig. 4a—c.

Specimen	D	H	h	W	w	O	o	W/H	$r_i/2$
1 Wl1b	57	30	0.526	32	0.561	11	0.193	1.06	17
Wl2 VI/5	77	40	0.519	44	0.571	13	0.168	1.10	-

1978. *Macrocephalites subtrapezinus* (Waagen), dimorphe microconque; Thierry, p. 175, Pls 6—7, Figs 1—3, Text-figs 57—63.

Material: five phragmoconchs, including three poorly preserved.

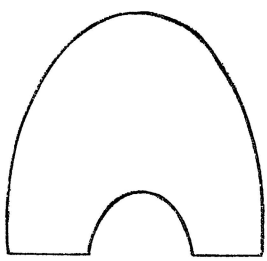


Fig. 3
Section of outer whorl of *Macrocephalites subtrapezinus* (Waagen), microconch; specimen No. *1 Wl 1b*, nat. size

Remarks. — The specimens from Wieluń in dimensions and ornamentation fall within the limits of variability of this species as interpreted by Thierry (1978).

Macrocephalites macrocephalus macrocephalus (Schlotheim, 1813) sensu Zittel, 1884
dimorphic macroconch = *Macrocephalites macrocephalus* (Schlotheim) sensu Zittel, 1884
(Pl. 2, Fig. 6)

1830. *Ammonites macrocephalus* Schlotheim; Zieten, p. 7, pars (Pl. 5, Fig. 4a-c, non Fig. 1).
1978. *Macrocephalites macrocephalus macrocephalus* (Schlotheim) 1813, sensu Zittel 1884, dimorphe macroconque (= *Macrocephalites macrocephalus* (Schlotheim) sensu Zittel; Thierry, p. 203, Pl. 8, Pl. 9, Figs 1—3, Pl. 10, Figs 1—4, Pl. 11, Text-figs 66—76.

Material: eleven specimens — poorly preserved phragmocones and one specimen with fragment of final body chamber.

Specimen	D	H	h	W	w	O	o	W/H	$r_i/2$	$r_o/2$	i
Wl2 III/1 16	81	43	0.53	36	0.469	11	0.135	0.88	19	44	2.3
Wl2 III/1 22	85	46	0.522	48	0.564	11	0.128	1.04	-	-	-
	70	42	0.600	42	0.600	11	0.157	1.00	-	-	-
33 Wl2	141	75	0.531	63	0.446	24	0.170	0.84	-	-	-

Remarks. — The specimens from Wieluń correspond to those described as *Macrocephalites macrocephalus macrocephalus* (Schlotheim), dimorphic macroconch, by Thierry (1978).

Macrocephalites macrocephalus macrocephalus (Schlotheim, 1813) sensu Zittel, 1884
dimorphic microconch = *Dolikephalites typicus* (Blake, 1905)
(Pl. 2, Figs 1—2)

1905. *Macrocephalites typicus* Blake; Blake p. 42, Pl. 3, Fig. 1, and 3, non Fig. 2, Pl. 4, Fig. 5.
1978. *Macrocephalites macrocephalus macrocephalus* (Schlotheim sensu Zittel, dimorphe microconque, transiant *typicus* (= *Dolikephalites typicus* (Blake, 1905), sensu Arkell, 1933; Thierry, p. 227, Pl. 9, Figs 4—5, Pls 12—14, Pl. 17, Figs 3—7.

Material: fourteen specimens, including seven fully grown ones with body chambers and seven phragmocones.

Specimen	D	H	h	W	w	O	o	W/H	$r_i/2$	$r_o/2$	i
Wl1 II/1 87	78	42	0.525	37	0.474	14	0.179	0.88	17	44	2.5
Wl2 II/1 80	?88	?42	-	41	-	20	-	-	18	47	2.6
	69	37	0.536	35	0.507	15	0.218	0.94	16	40	2.5
Wl1 II/1 36	?	39	-	33	-	-	-	0.84	-	-	-
35 Wl1s	78	42	0.538	41	0.512	18	0.230	0.98	-	-	-

Remarks. — The specimens from Wieluń are similar to the representatives of *Kamptokephalites lamellosus* (Sowerby), especially in body chamber ornamented with thick and markedly incurved ribs. However, taking into account the above given dimensions, especially whorl height and the ratio of whorl height and thickness, they should be assigned to the dimorphic microconchs of the species *M. macrocephalus macrocephalus* (= *D. typicus*) in accordance with interpretation of the two species given by Thierry (1978).

Macrocephalites macrocephalus macrocephalus (Schlotheim, 1813) sensu Zittel, 1884
dimorphic microconch = *Dolikephalites dolius* Buckman, 1922
(Pl. 2, Fig. 4)

1922. *Dolikephalites dolius* Buckman; Buckman Pl. 372.

1978. *Macrocephalites macrocephalus macrocephalus* (Schlotheim) sensu Zittel, dimorphe microconque transiant *dolius* (= *Dolikephalites dolius* Buckman 1922); Thierry, p. 241, Pls 15—16, Pl. 17, Figs 1—2, Text-figs 83—88.

Material: three phragmocones.

Specimen	D	H	h	W	w	O	o	W/H	$r_1/2$	$r_o/2$	i
Wl2 II/$_1$ 32	39	20	0.512	19	0.487	8	0.205	0.95	17	40	2.3
17 Wl1a	44	22	0.500	25	0.568	10	0.227	1.13	-	-	-

Remarks. — The available material is too scarce and insufficiently preserved for any more accurate analysis of this morphotype. In accordance with the point of view of Thierry (1978), it may be only stated that the studied specimens resemble the morphotype *"typicus"* in ornamentation differing in finer and more densely spaced ribs and in markedly broader and more depressed whorl section. Moreover, according to Thierry (1978), they represent younger form descendant of *"typicus"*.

Macrocephalites compressus (Quenstedt, 1885—88) dimorphic macroconch (Text-fig. 4 and Pl. 2, Fig. 7)

1885—88. *Ammonites macrocephalus compressus* Quenstedt; Quenstedt, p. 648 and 651, Pl. 76, Figs 14—15.

1978. *Macrocephalites compressus* (Quenstedt), transiant *compressus* (Quenstedt) 1846, dimorphe macroconque (= *Ammonites macrocephalus compressus* Qu.); Thierry, p. 325, Pls 27—28.

Material: seven phragmocones.

Specimen	D	H	h	W	w	O	o	W/H
Wl2 VI/5	62	33	0.532	28	0.451	13	0.208	0.84

Remarks. — Ornamentation and dimensions of the studied specimens match the diagnosis of the species as interpreted by Thierry (1978).

Macrocephalites compressus (Quenstedt, 1885—88) dimorphic microconch = *Dolikephalites gracilis* Spath, 1928

1928. *Dolikephalites gracilis* Spath; Spath, p. 173.

1978. *Macrocephalites compressus*, dimorphe microconque (= *Dolikephalites gracilis* Spath 1928; Thierry, p. 340, Pls 30—31, Text-figs 125—131.

Material: four poorly preserved fragments of phragmocone whorls.

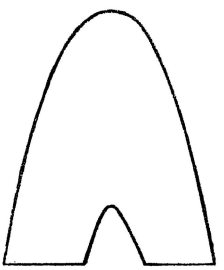


Fig. 4
Section of outer whorl of *Macrocephalites compressus* (Quenstedt), microconch; specimen No. *Wl III/$_1$ 87*, nat. size

Remarks. — Despite of poor preservation, ornamentation and type of whorl section make it possible to assign the specimens from Wieluń to microconchs of this species.

Genus *KAMPTOKEPHALITES* (Buckman, 1923) sensu Thierry, 1978
dimorphic microconch
Kamptokephalites herveyi (Sowerby, 1818)
(Text-fig. 5 and Pl. 2, Fig. 5)

1943. *Macrocephalites chrysoolithicus* (Waagen); Douvillé, p. 35, Pl. 5, Fig. 10, Pl. 6, Figs 2—5, Pl. 7, Fig. 7.
1943. *Macrocephalites Herveyi* (Sowerby); Douvillé, p. 37, Pl. 6, Fig. 15.
?1954. *Macrocephalites (Kamptokephalites) Herveyi* Sow. sp.; Jeannet, p. 250, Pl. 20, Fig. 2, Text-figs 29—30.
1978. *Kamptokephalites herveyi* (Sowerby); Thierry, p. 44, Fig. 15, pp. 433, 435.

Material: three specimens, including two whorl fragments.

Specimen	D	H	h	W	w	O	o	W/H	$r_i/2$	$r_o/2$	i
Wl2 $II/_1$ 78	48	25	0.520	34	0.70	9	0.18	1.36	16	37	2.3

Remarks. — The specimens from Wieluń match the diagnoses of the species *Kamptokephalites herveyi* (Sowerby) as given by the authors listed in the synonymy, in whorl section and ornamentation. Taking into account whorl section and ornamentation, the specimen described and figured as *M. chrysoolithicus* (Waagen) by Douvillé (1973) should be also assigned to the species

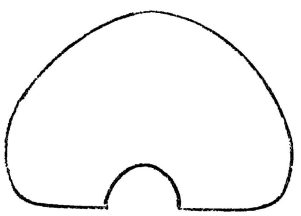


Fig. 5
Section of outer whorl of *Kamptokephalites herveyi* (Sowerby), microconch; specimen No. *Wl 2 II/1 78*, nat. size

Kamptokephalites herveyi. This is further supported by the fact that the distribution of unquestionable representatives of the former species is limited to India and Madagascar according to Dr. J. Thierry (*pers. inf.*).

Family **Kosmoceratidae** Haug, 1887
Subfamily **Keppleritinae** Tintant, 1963
Genus *KEPPLERITES* Neumayr, 1892
Genoholotype: *Ammonites keppleri* Oppel, 1862

Diagnosis (*after* Tintant 1963): coiling strongly involute, gradually becoming more evolute along with both ontogenic and phylogenic development of this group. Venter flattened on inner whorls only, whereas outer whorls are circular in cross-section, similarly as in macrocephalitids. Ornamentation consisting of short inner ribs, bifurcating at early growth stages, polyfurcate at the late ones. Umbilical nodes always missing, lateral tubercles missing or underdeveloped, similarly as external tubercles which may appear at very early growth stages only. Lobe line more or less developed. Lateral lobe markedly shorter or equal in length with the external.

Stratigraphic range: Lower Callovian, mainly calloviense Zone.

Remarks: Tintant (1963) differentiated the following subgenera: *Kepplerites* s.s. — macroconchs; *Seymourites* — ? macroconchs — boreal forms, unknown in Europe; *Gowericeras* — macroconchs, *Toricellites* — microconchs.

Subgenus *GOWERICERAS* Buckman, 1921
Subgenotype: *Gowericeras metorchum* Buckman, 1921 = *Ammonites Gowerianus* Sowerby, 1827

Diagnosis (after Tintant, 1963): Macroconchs moderate in size, up to 100 mm at the most. Umbilicus relatively wide at early growth stages. Whorl sections subcircular. Flattening of the venter marked on inner whorls only, usually disappearing at diameter of about 40 mm. Ornamentation consisting of long inner ribs reaching the mid-height and often ended with more or less strongly developed lateral tubercles. External ribs fairly short, radial. The ratio of inner and external ribs usually markedly lower than in the subgenus *Kepplerites* sensu stricto.

Subgenus *TORICELLITES* Buckman, 1922
Subgenotype: *Toricellites approximatus* Buckman, 1922

Diagnosis (after Tintant, 1963): Small keppleritids, up to about 50 mm in size at the most, with fairly wide umbilicus. Whorl section hexagonal to rectangular, whorl sides relatively flat, ventral side flattened up to the peristome. Ornamentation usually heavy, consisting of inner whorls ending at more or less strongly developed lateral tubercles in the mid-height, and pairs of external ribs beginning at the tubercles. The ratio of inner and external ribs close to 2, usually below 3 even for the body chamber. External ribs end at external tubercles at the margin of ventral flattening, passing trough the venter also at the body chamber. Peristome with well-developed lateral apophyses.

Remarks: As it follows from the above diagnosis and remarks given by Tintant (1963), the differences between the two subgenera, *Gowericeras* and *Toricellites*, are limited to the size of individuals and the type of peristome, so they may be explained in terms of sexual dimorphism (Callomon 1963; Makowski 1962, 1963). Therefore, it seems unnecessary to differentiate two subgenera, the more so as some pairs of micro- and macroconchs may be identified among the species described by Tintant (1963, p. 466):

Macroconchs	Microconchs
K. (Gowericeras) gowerianus (Sow.)	— *K. (Toricellites) approximatus* Buckman
K. (Gowericeras) toricelli (Opp.)	— *K. (Toricellites) lahuseni* (Par. & Bon.)

Therefore, taking the principle of priority into account, the name *Toricellites* is put into the synonymy of the subgenus *Gowericeras*. The genus *Gowericeras*, interpreted in this way, would comprise both macro- and microconchs characterized by ornamentation and size as discussed above.

Kepplerites (Gowericeras) gowerianus (Sowerby, 1887)
(Text-fig. 6 and Pl. 1, Figs. 1—18)

1962. *Kepplerites gowerianus* (Sow.); Makowski, p. 18, Text-plate I.
1963. *Kepplerites (Gowericeras) gowerianus* (Sow. 1887); Tintant, p. 106, Pls 7—13, 14, Figs 1—2.
1963. *Kepplerites (Gowericeras) toricelli* (Oppel 1862); Tintant, p. 151, Pl. 15, Fig. 3, Pl. 16, Pl. 17, Figs 1—2.
1963. *Kepplerites (Toricellites) lahuseni* (Parona et Bonarelli 1895); Tintant, p. 170, Pl. 18, Figs 1—8.
1963. *Kepplerites (Toricellites) approximatus* (Buckman 1922); Tintant, p. 179, Pl. 18, Fig. 9a-b.

The rest of the synonymy — vide Tintant (1963) under the above given specific names.

Material: forty one specimens, including 25 macroconchs, 7 microconchs and 8 fragments of juvenile individualis.

Remarks. — As it follows from the synonymy, the species *Kepplerites (Gowericeras) gowerianus* (Sow.), as interpreted here, also comprises forms allocated by Tintant (1963) and earlier authors to *K. (Gowericeras) toricelli* (Oppel) — macroconchs. and in accordance with the accepted definition of the subgenus *Gowericeras*, two microconchs corresponding to these macroconchs — *K. (Toricellites) approximatus* and *K. (Toricellites) lahuseni.*

Specimen	D	H	h	W	w	O	o	W/H	r_1	r_2	i
10 Wl1	80	29	0.362	30	0.75	32	0.400	1.03	18	-	-
	71	29	0.400	32	0.45	26	0.36	1.10	/16/	/54/	3.37
$Wl1/II_1$ 81	49	22	0.440	24	0.48	17	0.34	1.09	/18/	/40/	2.22
$Wl1/II_1$ 84	61	26	0.420	32	0.52	20	0.33	1.23	28/16/	/44/	2.7
$Wl1/III/_1$ 15	48	19	0.390	24	0.50	18	0.37	1.26	28/15/	-	-
$Wl2VI/_5$ 28	60	21	0.350	25	0.43	23	0.38	1.23	/17/	-	-
	51	21	0.411	24	0.470	19	0.36	1.14	/16/	-	-
$Wl1II/_1$ 13	57	23	0.40	26	0.45	18	0.33	1.13	/16/	-	-
$Wl1II/_1$ 21	71	26	0.366	28	0.394	27	0.38	1.07	/17/	-	-
11 Wl2	65	28	0.430	30	0.451	26	0.40	1.07	/18/	-	-
	58	27	0.465	31	0.534	19	0.32	1.14	30/16/	-	-
12 Wl2	49	21	0.428	21	0.428	18	0.36	1.00	/16/	-	-
Wl2VI/5	45	20	0.444	21	0.466	14	0.31	1.05	/14/	-	-
15 Wl2	50	18	0.360	18	0.360	17	0.34	1.00	29/16/	-	-
13 Wl2	30	13	0.430	14	0.460	10	0.33	1.07	/17/	/36/	2.1
14 Wl2	68	26	0.382	31	0.455	25	0.36	1.2	30/17/	-	-
$Wl1II/_1$ 83	65	26	0.400	25	0.384	21	0.32	0.96	34/21/	40/17/	3.3
$Wl1III/_1$ 13	64	?	?	36	0.562	25	0.39	?	/17/	-	-
$Wl1II/_1$ 79	55	23	0.418	24	0.436	20	0.363	1.04	/20/	-	-
$Wl1II/_1$ 82	69	26	0.37	28	0.400	25	0.36	1.08	/16/	-	-
16 Wl1	58	22	0.38	25	0.43	?	?	1.13	/13/	-	-
17 Wl2	70	28	0.40	31	0.44	23	0.33	1.10	/13/	/42/	3.23
$Wl2II/_1$ 86	69	27	0.39	32	0.46	24	0.34	1.18	/18/	-	-
Wl2VI/52	34	14	0.41	14	0.41	11	0.32	1.00	/16/	/39/	3.00
Wl2VI/58	33	14	0.42	15	0.45	12	0.36	1.07	/15/	/33/	2.2
7 Wl1a	39	14	0.359	13	0.33	14	0.359	0.92	/18/	-	-

According to Tintant (1963, p. 162), the differences between the species *G. gowerianus* and *G. toricelli* include:

K. (Gowericeras) gowerianus

Maximum diameter: 80—95 mm
Whorl section: wide, flat-sided whorls
Ornamentation: sharp, relatively loosely spaced inner and external ribs, number of inner ribs at 60 mm diameter — 20—25
Lateral lobe markedly shorter than siphonal
Area of occurrence: England, Ardennes, Russia, Northern Germany less common, Southern Germany
Stratigraphic range: calloviense Zone, mainly koenigi Subzone calloviense Subzone

K. (Gowericeras) toricelli

60—72 mm
high, compressed, whorl sides almost parallel to one another markedly finer and more densely spaced ribs
30—40
siphonal and lateral lobes equal in length
form „more Mediterranean", known from Burgundy, Jura Mts not further northwards than the Hannower area
calloviense Zone, ? enodatum ? medea Subzones

The analysis of figures and the published descriptions and the material from Wieluń shows that the majority of the above listed differences are not significant enough to justify differentiation of two taxa of the species rank. The above given features are displayed by extremal forms and the whole arrays of intermediate forms may be traced (*e.g.* see the descriptions and figures given by Tintant, 1963, and figures and dimensions of specimens from Wieluń, given here). It follows that no sharp boundary may be drawn between these forms. Differences in stratigraphic ranges and geographic distribution are disputable and they may be explained by failures in collecting. At Wieluń, for example the two forms were recorded in the same bed which displays some features of stratigraphic condensation but not mixing of heterochroneous fauna and suggests their similar or almost identical (in the scale of a single subzone) stratigraphic age.

Differences in the type of whorl section and, therefore, the W/H ratio, are also unclear and no separate fields corresponding to the two hitherto identified species may be noted in W/H diagrammes. The only traceable regularity is

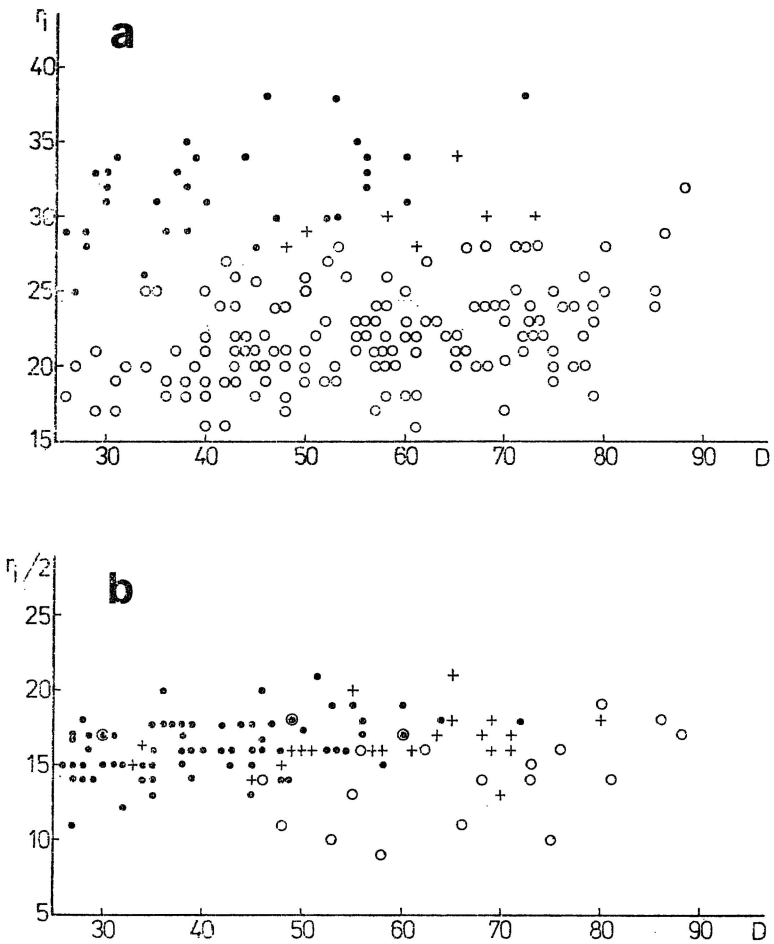


Fig. 6. Variability in number of inner ribs in relation to the shell diameter: **a** — inner ribs per whorl, **b** — inner ribs per half of whorl; *dots* denote *Kepplerites* (*Gowericeras*) *toricelli* (Oppel), after Tintant (1963); *circles* — *Kepplerites* (*Gowericeras*) *gowerianus* (Sowerby), after Tintant 1963); *crosses* — investigated specimens from Wieluń

connected with the fact that adult large individuals are usually more bulgy, with more depressed and rounded whorls and heavier and more loosely spaced elements of ornamentation, and small adult individuals are characterized as a rule by finer and more crowded elements of ornamentation and more slender and compressed whorls.

The specimens from Wieluń do not displays differences in suture lines (in length of lateral and siphonal lobes). Some forms regarded as undoubtful representatives of the species *K.* (*Gowericeras*) *gowerianus* display lateral lobes shorter than the siphonal, while other are characterized by lateral and siphonal lobes equal in length.

The differences in ornamentation, especially in number of inner ribs per whorl at adult stage, were usually regarded as the most spectacular and significant. The comparison of rib curves of both Tintant's specimens (based on data

given in his monograph, 1963) and those from Wieluń (Text-fig. 6) also failed to give any distinct boundary between the species. It should be noted that the position of the specimens from Wieluń is transitional between the two species with reference to rib curves. It follows that the species may be best interpreted as morphotypes of a single species, *K. (Gowericeras) gowerianus* (Sowerby). From the measured and figured specimens from Wieluń, the specimens no. 10 Wl 1 (Pl. I, Fig. 1a—b), 17 Wl 2, Wl 1 II/$_1$ 84, Wl 1 II/$_1$ 82, Wl 1 II/$_1$ 21, Wl 2 VI/$_5$ are to closest to the morphotype *"gowerianus"*, and the specimens no. 12 Wl 2, 15 Wl 2, Wl 1$_1$ II/$_1$ 79, Wl 1 II/$_1$ 83 — to the morphotype *"toricelli"*, whereas the remaining ones may be regarded as transitional (*see* dimensions and Plate 1). The microconchs are more similar to those hitherto named *Kepplerites (Toricellites) lahuseni* (Parona & Bonarelli, 1895). No specimens comparable with the morphotype hitherto named *K. (Toricellites) approximatus* (Buckman, 1922) were found in the Callovian at Wieluń.

Occurrence. — In Poland, apart from Wieluń region, the representatives of the subgenus *Gowericeras* are known from the Lower Callovian of the Zalas section in the Cracow Jura Chain (Giżejewska & Wieczorek 1977).

Stratigraphic range. — See above. At Wieluń — koenigi Subzone.

Family **Perisphinctidae** Steinmann, 1890
Subfamily **Proplanulitinae** Buckman, 1921
Genus *PROPLANULITES* Teisseyre, 1887
Type species: *Ammonites koenigi* J. Sowerby, 1820
Proplanulites subcuneatus Teisseyre, 1887
(Pl. 2, Figs 25a—b, 26a—b)

1888. *Proplanulites subcuneatus* nov. f.; Teisseyre, p. 92, Pl. 4, Figs 10—14, Tab. 5, Figs 10—14.
1894. *Proplanulites subcuneatus* Teisseyre; Tornquist, p. 558, Pl. 46, Figs 4a—c, 5.
1921. *Proplanulites subcuneiformis* Buckman; Buckman, Pl. 227, Figs 1—2.
?1921. *Proplanulites trifurcatus* Buckman; Buckman, Pl. 360, Figs 1—2.
?1921. *Proplanulites capistratus* Buckman; Buckman, Pl. 213, Figs 1—2.
1932. *Proplanulites subcuneatus* Teiss.; Corroy, p. 154, Pl. 20, Figs 5—6.
1951. *Proplanulites subcuneatus* Teiss.; Gołąb, pp. 1—3.

Material: two outer whorls with fragments of body chambers of adult microconchs and two whorl fragments.

Specimen	D	H	h	W	w	O	o	W/H	r$_1$/2
Wl1/III/$_1$ 2	85	26	0.30	20	0.23	37	0.43	0.76	15
	72	23	0.33	18	0.24	30	0.40	0.78	13
WlIII/$_1$ 77	61	19	0.31	?	?	26	0.44	?	12

Description. — Microconchs with compressed, narrow whorls and whorl sides almost parallel to one another (between tubercles). Ornamentation consisting of primary ribs dividing into two external ribs in the mid- height of the side. External ribs are often separated by single intercalaries; intercalaries do not extending beyond the point of furcation of primaries. Primaries distinct, sharp--crested, somewhat swollen and slightly prorsiradiate. Secondaries bent backwards in the form of a sickle, somewhat swollen and bent forwards close to ventral margin. On inner whorls both primary and secondary ribs are almost radial. On the body chamber, secondaries disappear and only somewhat swollen primaries may be noted. Ventral side rounded, smooth. The final body chamber begins at about 55 mm diameter (specimen no. *Wl 1 II/$_1$ 2*).

Comparisons. — The species *Proplanulites subcuneatus* Teisseyre differs from *P. koenigi* (Sowerby) in less thick whorls, sharper-crested and less "swollen" inner ribs and more loosely spaced sharper-crested and more prorsiradiate external

ribs; from *P. arciruga* Teisseyre — also in narrower and higher whorl section and more loosely spaced and stronger ornamentation.

On the basis of descriptions and figures given in papers listed in the synonymy it may be supposed that the species *P. koenigi* (Sowerby) and *P. arciruga* Teisseyre comprise macroconchs whereas *P. subcuneatus* Teisseyre and Buckman's species put into its synonymy here — microconchs.

Occurrence. — According to Teisseyre (1888), the proplanulitid species listed by him occur in the so-called macrocephalus beds in England, France, NW Germany, Baltic countries, central Russia and, less often, southern Germany. In Poland, they were reported from the "Cracow Oolite", representing a part of the Lower (calloviense Zone) and Middle Callovian.

Stratigraphic range. — In Poland as given above. In England, proplanulitids (including the representatives of the studied species) occur in the Lower Callovian — Kelloway Rock (calloviense Zone, koenigi Subzone). In France, the species has been reported with *P. koenigi, Cadoceras modiolare* and *Kepplerites gowerianus* in the Lower Callovian of the eastern margin of the Paris Basin (Corroy 1932). At Wieluń, the species was found in the calloviense Zone, koenigi Subzone.

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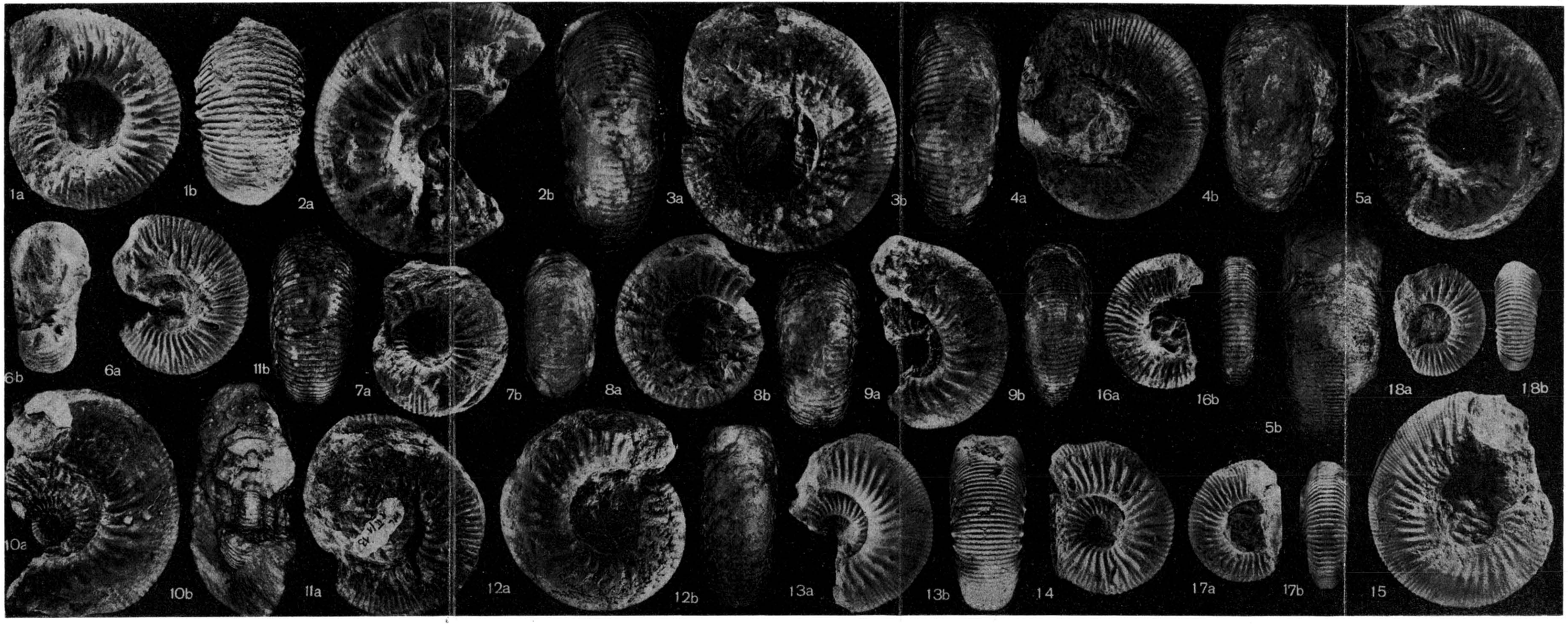
M. GIŻEJEWSKA

STRATYGRAFIA KELOWEJU WYŻYNY WIELUŃSKIEJ

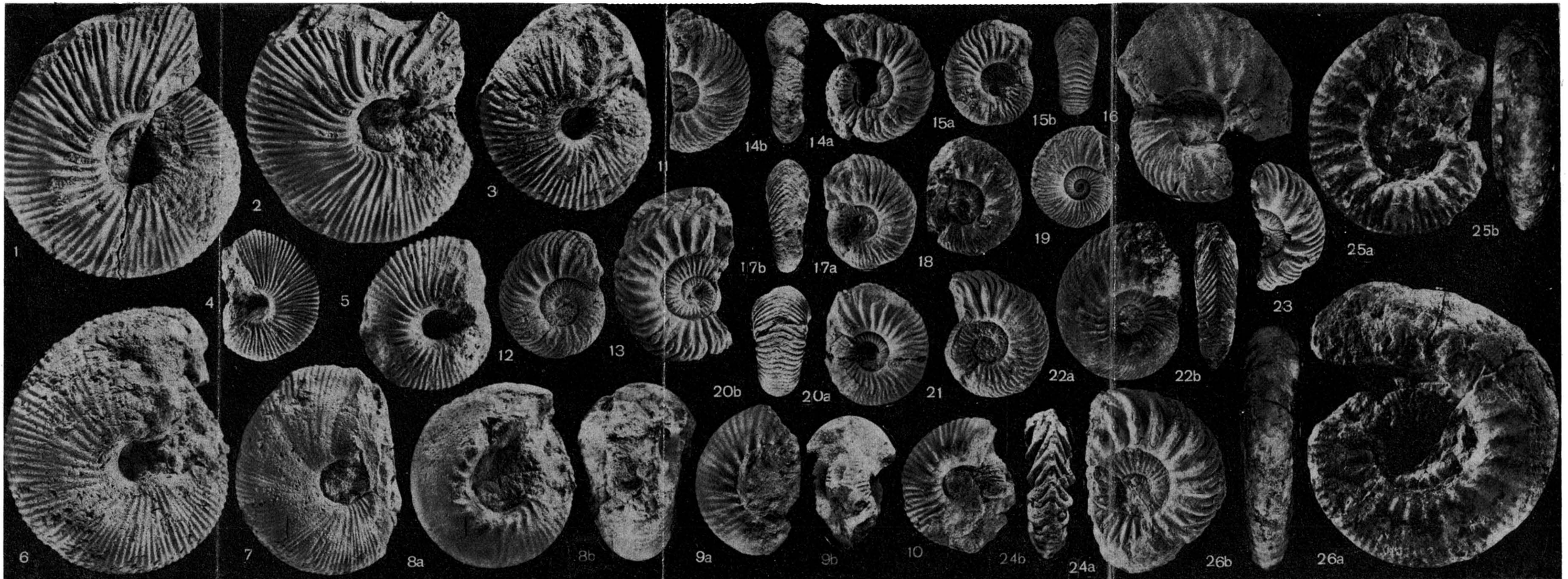
(Streszczenie)

Przedmiotem pracy jest szczegółowa analiza stratygraficzna profilów keloweju odsłaniających się w obrębie tzw. kamieniołomów Kowalskiego w Wieluniu (*patrz* fig. 1—2). Zasięgi wiekowe zebranych gatunków i rodzajów amonitów wskazują (*patrz* tab. 1), że w profilach tych obecne są poziomy: macrocephalus, najniższa część poziomu calloviense (podpoziom koenigi), poziom coronatum oraz poziom lamberti. Na wyższe części poziomu calloviense (podpoziom calloviense i enodatum), na doby jason oraz athleta przypadają tutaj luki stratygraficzne, z których jedna obejmuje przypuszczalnie również dobę mariae. Stwierdzone luki dolno- i środkowo-kelowejskie są wynikiem przewagi erozji nad sedymentacją, co prowadziło niekiedy nawet do redepozycji starszych osadów. Lukę przypadającą na dobę athleta wiązać natomiast należy także z szerszymi zjawiskami paleogeograficznymi, takimi jak pogłębienie i rozszerzenie się zbiornika morskiego oraz jego połączeń z Tetydą, co prowadziło do zmiany chemizmu wód.

W części paleontologicznej pracy podano w oparciu o monografię J. Thierry'ego (1978) charakterystykę amonitów z rodzajów *Macrocephalites* oraz *Kamptokephalites* (patrz fig. 3—5, tab. 2—8 oraz pl. 2), opisano okazy z gatunku *Proplanulites subcuneatus* Teisseyre (patrz tab. 10 oraz pl. 2) oraz dokonano analizy amonitów z podrodzaju *Kepplerites* (*Gowericeras*) stwierdzając, że wyróżniane dotychczas dwa gatunki — *K.* (*Gowericeras*) *gowerianus* (Sowerby) i *K.* (*Gowericeras*) *toricelli* (Oppel) — w rzeczywistości stanowią (*patrz* fig. 6, tab. 9, oraz pl. 1) jeden, *K.* (*Gowericeras*) *gowerianus* (Sowerby).



Kepplerites (Gowericeras) gowerianus (Sowerby); macroconchs: **1** — Specimen No. Wl 1 II/$_1$ 84, **2** — 10 Wl1, **3** — Wl 1 II/$_1$ 21, **4** — Wl 1 III/$_1$ 13, **5** — 14 Wl 1, **6** — Wl 1 II/$_1$ 81, **7** — Wl 2 VI/5, **8** — Wl 1 III/$_1$ 15, **9** — 12 Wl 2, **10** — 11 Wl 2, **11** — Wl 1 II/$_1$ 13, **12** — Wl 2 VI/$_5$ 28, **13** — Wl 1 II/$_1$ 79, **14** — 15 Wl 2, **15** — Wl 1 II/$_1$ 83; microconchs: **16** — 7 Wl 1a, **17** — Wl 2 VI/$_1$, 58, **18** — Wl 2 VI/52



1—2 — Macrocephalites macrocephalus macrocephalus (Schlotheim) *sensu* Zittel, microconch (= *M. typicus* Blake): Fig. 1 — specimen No. Wl 2 II/$_1$ 80, Fig. 2 — Wl 1 II/$_1$ 87; **3 — Macrocephalites subtrapezinus** (Waagen), microconch, specimen No. 1 Wl 1b, **4 — Macrocephalites macrocephalus macrocephalus** (Schlotheim) *sensu* Zittel, microconch (= *Dolikephalites dolius* Buckman), specimen No. Wl 2 II/$_1$ 32, **5 — Kamptokephalites herveyi** (Sowerby), microconch, specimen No. Wl 2 II/$_1$ 78; **6 — Macrocephalites macrocephalus macrocephalus** (Schlotheim) **sensu** Zittel, macroconch, specimen No. Wl 2 III/$_1$ 16; **7 — Macrocephalites compressus** (Quenstedt), macroconch, specimen No. Wl 2 VI/5; **8—10 — Cadoceras elatmae** (Nikitin); **11, 16, 22, 23 — Quenstedtoceras lamberti** (Sowerby), macroconchs, **12 — Quenstedtoceras lamberti** (Sowerby) or *Q. praelamberti* Douvillé, microconch, **13, 15, 24 — Quenstedtoceras vertumnum** (Leckenby), macroconchs [= *Q carinatum* (Eichwald)], **14 — Q. vertumnum** (Leckenby), microconch?, **17, 20, 21 — Quenstedtoceras henrici** Douvillé, microconchs, **18, 19 — Quenstedtoceras** ex gr. **lamberti** (Sowerby); **25, 26 — Proplanulites subcuneatus** Teisseyre