acta
geologica
polonica

Vol. 27, No. 1 Warszawa 1977

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The Oxfordian in the south-western margin of the Holy Cross Mts

ABSTRACT: The paper deals with the Oxfordian deposits cropping out along the south-western margin of the Holy Cross Mts, Central Poland. In the lithostratigraphic sequence of these deposits, seven members have been distinguished and characterized as to their lithology and facies development. The assemblage of ammonites, that comprises 106 taxa belonging to the families: Phylloceratidae, Lytoceratidae, Oppeliidae, Haploceratidae, Cardioceratidae, Perisphinctidae, and Aspidoceratidae, allows to recognize a sequence of successive biostratigraphic units. In the Lower Oxfordian, documented are the *mariae*, and the *cordatum* Zone. In the latter, the presence of the subzones *bukowskii*, *costicardia*, and *cordatum* is stated in the same range and ammonite content as commonly accepted in Europe. In the Middle and Upper Oxfordian, submediterranean zones: *plicatilis*, *transversarium*, *bifurcatus*, and *bimammatum*, have been recognized. The latter zone in the investigated area is for the first time documented by ammonites. In the paleontological part of the paper, some new forms, and those, the stratigraphic range of which is different from that hitherto known, are described and discussed.

INTRODUCTION

The paper presents the results of studies on stratigraphy of the Oxfordian deposits cropping out along the south-western margin of the Holy Cross Mts, between Mnin and Chmielnik (Fig. 1). In that area the Oxfordian deposits, involved in several synclinal and anticlinal structures, are exposed in a number of both small and large quarries.

The present author started his studies on the Oxfordian in the course of preparation of his graduate work in years 1968—1969 (Matyja 1970) and continued them in years 1971—1974 for the D. Sc. thesis (Matyja 1976).

Acknowledgements. Warm thanks are due to Professor J. Kutek for indication of most important problems and ways to solve them, and for kind suggestions given in the course of the studies. Thanks are also due to Dr. A. Wierzbowski and Dr. J. Bednarek for discussions and useful suggestions, as well as to Docent E. Roniewicz for identifications of corals.

PREVIOUS INVESTIGATIONS

The Oxfordian strata of the region are the subject of interest since the first half of the last century. They were studied by Pusch, Zejszner, Michalski and Siemiradzki [1]. Much attention to their stratigraphy was devoted by Lewiński (1908a, b, 1912). The newer studies include the work of

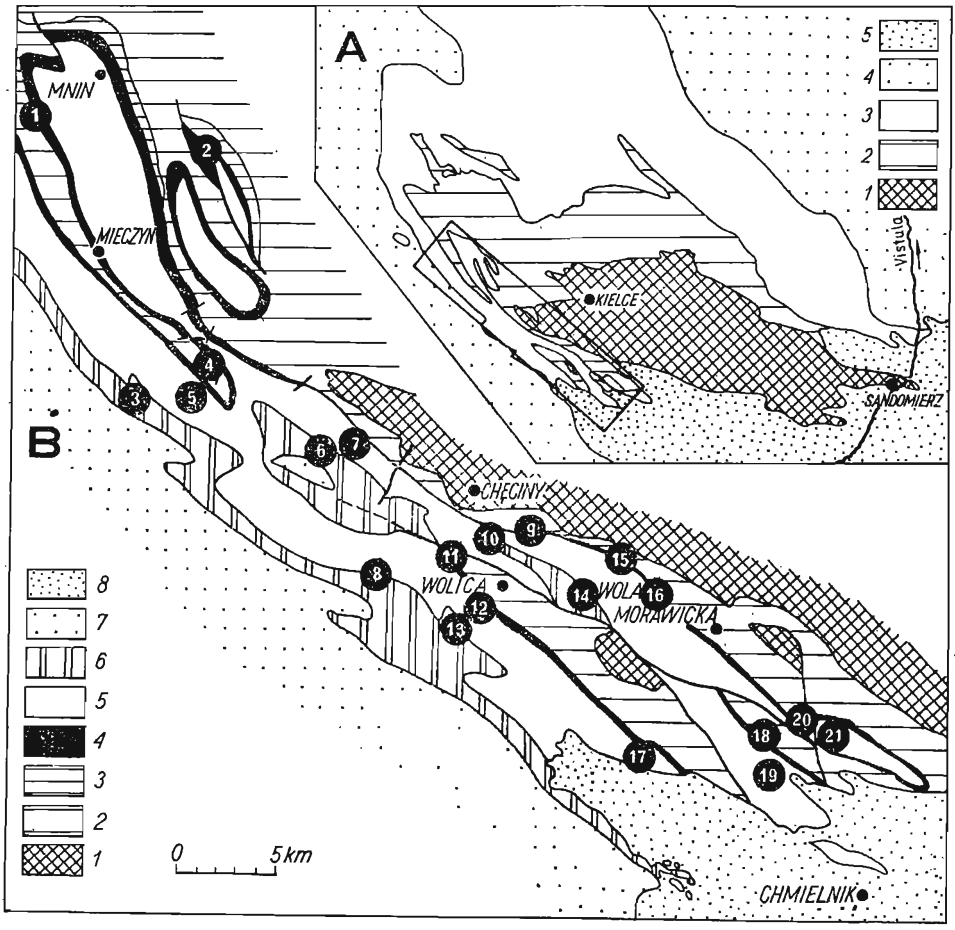


Fig. 1

A — general map of the Holy Cross Mts
1 Palaeozoic, *2* Triassic, *3* Jurassic, *4* Cretaceous, *5* Miocene

B — geological sketchmap of the SW margin of the Holy Cross Mts
1 Palaeozoic, *2* Triassic, *3* Liassic, *4* Callovian, *5* Oxfordian, *6* Kimmeridgian, *7* Cretaceous, *8* Miocene (marine Tortonian)
Numbers in black circles denote location of the investigated exposures: *1* Lasocin, *2* Wielebnów, *3* Występy, *4* Laskowa Hill, *5* Grabowa Hill, *6* Grzęby Bolmińskie, *7* Chrostynka Hill, *8* Żerniki, *9* Przymiarki, *10* Leśna Hill, *11* Tokarnia, *12* Siedlce, *13* Sokołów, *14* Nida, *15* Brzeziny, *16* Morawica, *17* Krasnowicka Hill, *18* Lisów, *19* Piotrkowice, *20* Zaborze, *21* Maleszowa

[1] For full references of these papers as well as detailed summary of previous studies see Dąbrowska: History of studies — Upper Jurassic (*In:* Geology of Poland, vol. 1, part 2, Warsaw 1973).

Peszat (1964) dealing with petrology, physical properties and chemical composition, as well as of Malinowska (1961, 1967, 1970) on stratigraphy of Upper Jurassic rocks. The Kimmeridgian and uppermost Oxfordian strata were monographed by Kutek (1968, 1969), who dealt with stratigraphy, sedimentology and paleogeographic development of this area.

LITHOSTRATIGRAPHY

In the area studied the strata of the Oxfordian stage are underlied by Callovian gaizes with sedimentary continuity (*cf.* Peszat 1960, 1964; Peszat & Moroz-Kopczyńska 1959). This member consists of alternating layers of calcareous gaizes with cherts and thin layers of marly shales. Gaizes are mainly built of siliceous sponge spicules; fossils occurring here include belemnites and brachiopods (mainly terebratulids) and much scarcer ammonites.

The bedding is highly regular in lower and middle parts of the member, becoming less clear in the upper part; and surfaces of layers are uneven and knobby. In the upper part of that member siliceous sponge spicules are still the main rock-forming component but they are accompanied by echinoderm fragments and sponge mummies, and the contribution of bioclasts generally increases. The content of carbonates also successively increases upwards.

The Gaizes member is up to 16 m thick (Siemiątkowska-Giżejewska 1974), and the knobby part of the member is 25 do 70 cm thick.

MARLY LIMESTONES

This member is formed of alternating marly limestones and marly shales (*see* Fig. 5). The boundary with underlying gaizes is sharp despite of the nodular (knobby) appearance of deposits forming the lowermost part of the Marly Limestones member. Upwards the nodular (knobby) nature of the deposits vanishes, and the limestone layers become progressively thicker.

Strata of that member yield numerous siliceous sponge spicules (Triaxonia and Tetraxonia), ammonites, belemnites, brachiopods as well as some pelecypods, echinoids, crinoid stems, brittle-star vertebrae, holothurian sclerites, bryozoans, serpulids and foraminifers. Micrite forms the ground mass of the limestones. Grain components include pellets (0.07—0.2 mm in size), lumps (0.3—1.4 mm) and bioclasts. Chalcedony and iron compounds are confined only to brachiopod shells and sponge mummies. Sparry calcite usually infills voids left after siliceous sponge spicules or the interior of bryozoan zoaria.

The results of chemical analyses (Peszat 1964) have shown an increase in calcium carbonate content towards the top of this member which is accompanied by decrease in content of insoluble components. The thickness of the member ranges from 5.5 to 6.5 m.

GREY LIMESTONES

This member is formed by graphite-grey to dark-grey layered limestones with not numerous marly shale intercalations a few cm to over a dozen cm thick. It is also characterized by accumulations of iron sulphides, oxides and hydroxides.

The limestones mainly consist of pellets 0.07–0.13 mm in size. Bioclasts are represented by loose sponge spicules and foraminifers. Spicules are usually calcitized or, sometimes, chalcedonized. Sponge mummies do not occur here, and the macrofossil assemblage comprises not numerous ammonites, belemnites and terebratulids.

The thickness of the Grey Limestones member changes from 5.5 m at Wola Morawicka to 6.8 m at Mieczyn and 8.5 m at Laskowa Hill. The lower boundary of the member is very clear as the change from grey to dark-grey colour of the limestones and accompanying impoverishment of fossil assemblage are very rapid, being confined to one or two layers. The upper boundary is less clear. The first appearance of sponge mummies, calcareous encrustations and tuberoids or cherts, that is of typical components of overlying Morawica Limestones member, is here accepted as the criterion of delineating of that boundary.

MORAWICA LIMESTONES

This member is formed by thick- to medium-bedded light-grey to beige-grey limestones (*cf.* Fig. 2). The member is characterized by sponge mummies, tuberoids

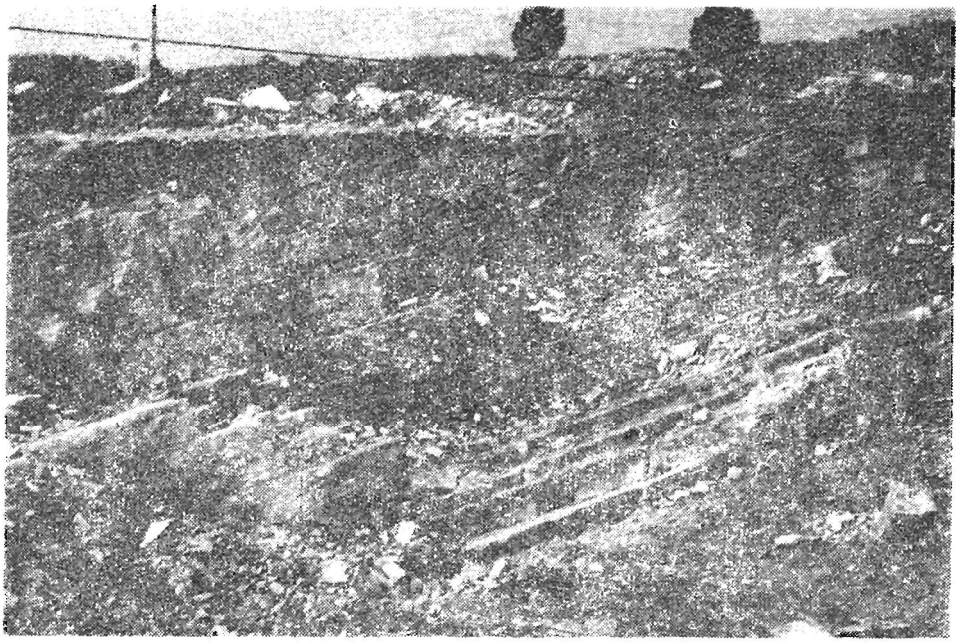


Fig. 2. Lower part of the Morawica Limestones member exposed at Wola Morawicka quarry

and calcareous encrustations occurring with variable frequency and resulting, due to their darker colour, in the spotty appearance of these rocks.

When rock is especially rich in these components it is very hard and nodular in result of weathering and the platy splitting of the limestones, usually very clear, becomes obscure.

The fossils common here include: siliceous sponges (Triaxonia and Tetraxonia), brachiopods, ammonites, belemnites, echinoids, crinoids, holothurians (Matyja 1972), brittle stars, pelecypods, crustaceans, and, as revealed by thin section analysis, bryozoans, serpulids and foraminifers.

Micrite forms the ground mass of the limestones whilst pellets (0.03—0.09 mm) and lumps (over 0.2 mm in size) are the main rock forming components. The typical lumps with complex internal structure (*cf.* Leighton & Pendexter 1962), are accompanied by numerous lumps with clotted internal structure, corresponding to tuberoids as defined by Fritz (1958). Lumps of the latter type often display irregular concentric lamination. Between neighbouring laminae and on surface of such lumps it is possible to note encrustating bryozoans, serpulids and foraminifers of the genus *Tolypammina*.

This limestone member is 110 to 150 m thick (Fig. 4).

MASSIVE LIMESTONES

Massive Limestones (*Felsenkalk* of Zejszner — *see* Dżułyński 1952, *Reef Limestone* of Różycki, 1948; *Rocky limestones* of Peszat, 1964, and Malinowska 1970) are known from the margins of the Holy Cross Mts and from the Polish Jura Chain. They have several features in common with Upper Jurassic limestones described from several parts of Europe under the names of *Massenkalke* (Gwinner 1971), *Algen-Schwamm-Riffe* (Aldinger 1968) or *biohermes à spongiaires* (Gaillard 1971).

Massive Limestones occurring here are characterized by a high content of calcium carbonate (94.18% according to Peszat, 1964) and low porosity (1.78% — Peszat 1964). They are unbedded or, sometimes, thick-bedded or with local flaser bedding (*cf.* Fritz 1958).

A number of varieties of the Massive Limestones may be distinguished. The transition from Morawica to Massive Limestones is gradual in some sections (Krasnowicka Hill, Zaborze, Piotrkowice-Lisów, Maleszowa — Fig. 4). This is connected with the fact that the bedding already disappear whilst some cherts still occur. Limestones of the transitional type attain up to 40 m in thickness when present in the Massive Limestones member (Fig. 4).

The variety *A* comprises limestones dark-beige or even sometimes brown in colour. Fossils occurring here include primarily siliceous sponges (Triaxonia and Tetraxonia), serpulids and bryozoans. Calcareous encrustations are also common. There are no grain components other than the above mentioned organic remains, and micrite is the main rock forming component. Micrite calcite grains are irregular in outline and they are bound in the form of amoeboid mosaic (*cf.* Fischer & al. 1967).

The variety *A* together with the variety *B* described below predominate in the Massive Limestones member. Thickness of the varieties *A*, *B* and *C* are difficult to estimate because of incompleteness of sections and that is why it is not shown on summative profiles. In sections where the transitional limestones are missing the variety *A* occurs directly above the Morawica Limestones, sometimes with some lateral interfinging (Fig. 3).

The variety *B* comprises light, almost white micritic limestones rich in fossils. The fossil assemblage includes: brachiopods, echinoderms, siliceous and calcareous sponges, pelecypods, crustaceans, serpulids and bryozoans. Stromatolites are also common. Grain components (lumps, pellets, onkolites or bioclasts) form streaky or nest-like accumulations. The cement is then sparry, consisting of both equant and fibrous calcite. The variety *B* occurs above the variety *A* in the profiles.

The variety *C* is represented by sparry organodetrital limestones. Organic remains comprise numerous corals of the families Latomeandridae, Microsolenidae and Stylinidae, calcareous sponges, echinoids, crinoids, serpulids, pelecypods, brachiopods, bryozoans and foraminifers. Inorganic grain components include numerous intraclasts and lumps. Sparite is represented by both equant and fibrous calcite developed around grain components. The variety *C* is limited to the top parts of the

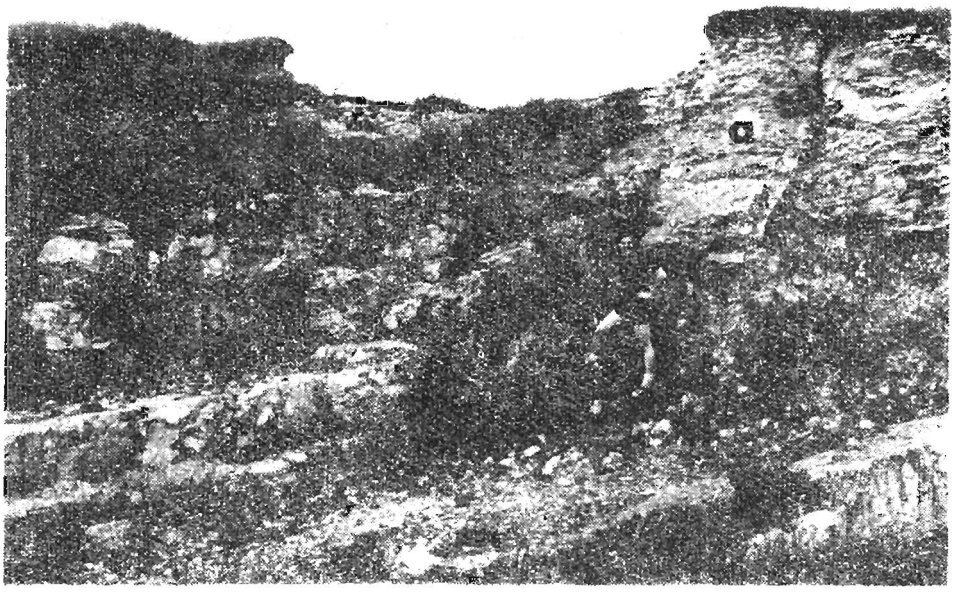


Fig. 3. Facies transition of the massive limestones (*a*) into the layered Morawica Limestones (*b*) at Wielebnów

Massive Limestones member. The occurrence of breccia formed of unselected fragments of massive limestones is also limited to the top parts of the member.

The Massive Limestones member is characterized by highly variable thickness, from 0 to 250 m.

SIEDLCE LIMESTONES

This member is formed by thick-bedded, well-stratified limestones among the following varieties of which may be distinguished:

The variety *A* comprises thick-bedded (200—300 cm) white limestones smearing fingers when touched. The limestones yield siliceous sponges (Triaxonia and Tetraxonia) and cherts as well as not numerous ammonites, brachiopods and pelecypods. Fine pellets with indistinct outline and micrite are main components of that variety. The variety occurs above the Morawica Limestones in areas where the Massive Limestones are missing. In Siedlce quarry where the large part of the Siedlce Limestones is exposed the limestones of the variety *A* are intercalated by 3 layers of marls; the lower layer attains 150 cm in thickness, whilst the middle and upper — 35 cm and 105 cm, respectively. The marly layers occur in the interval 190 to 205 m above the top of Gaizes in the profile. The marls are rusty-yellow to sometimes dark-blue in colour and yield echinoderm fragments. Numerous aggregates of iron compounds and some sand-fraction quartz grains remain in residuum.

Marls displayed in quarry at Siedlce were found further to the east at Krasnowicka Hill above the Massive Limestones (*see* Fig. 4), about 390 m above the top of the Gaizes, *i. e.* about 200 m higher than in the Wolica-Siedlce section. The marls were found to occur directly above the Massive Limestones member also in other localities, irrespectively of the thickness of that member (*see* Fig. 4). There are no other marly layers in the Siedlce Limestones member except for those occurring in the 190—205 m interval above the top of the Gaizes which would correspond to those from the top of the Massive Limestones. Therefore it may be safely assumed that

we are dealing with the same marly layers in Siedlce quarry, Krasnowicka Hill and in several other localities where the marly layers occur directly above the Massive Limestones.

The variety *B* comprises thick-bedded, white, porous limestones which smear fingers when touched. The groundmass consists mainly of micrite, in which small (30—50 μm) pellets with poorly visible outline, and occasional, hardly identifiable and not much larger bioclasts are embedded. The scanning electron microscope studies have shown that calcite crystals are usually eu- or subhedral and relatively loosely packed. This may explain high porosity of these limestones. Fossils are extremely rare here which was taken into account in differentation of the varieties *A* and *B* of the Siedlce Limestones member.

The variety *C* comprises white, grey or brown compact limestones with smooth surface of breakage and characterized by platy splitting when they weather. Micrite is the only component of these limestones and fossils, similarly as in the case of the variety *B*, are exceptionally rare.

The varieties *B* and *C* form the bulk of the Siedlce Limestones member. Differences between these varieties are primarily connected with their porosity, and the spatial relationships between them are exceptionally unclear.

The variety *D* is macro- and microscopically similar to the variety *A* of the Massive Limestones member, differing in less numerous siliceous sponges. The variety *D* occurs among the Siedlce Limestones (*cf.* Fig. 4 — profiles of Wolica, Wolica-Siedlce and Piotrkowice-Lisów) but it does not achieve such large thickness as the Massive Limestones.

CHALKY LIMESTONES

The Siedlce Limestones are overlied by Chalky Limestones member distinguished by Kutek (1968). The latter member mainly comprises white, soft, porous grained limestones yielding numerous corals, gastropods, pelecypods and algae. This member also often comprises oolitic limestones as well as compact pelitic limestones resembling the variety *C* of the Siedlce Limestones member. A detailed characteristics of the Chalky Limestones member was given by Kutek (1968, 1969).

The first appearance of grain components and above mentioned characteristic fossils is accepted as the criterion of the boundary between the Siedlce and Chalky Limestone members. Pelitic limestones when occurring in the latter member seem to predominate in its upper parts, being separated from structurally similar varieties of the Siedlce Limestones by detrital fossiliferous limestones.

The boundary between the Chalky and Siedlce Limestones is exposed in a few places only since usually it passes through morphological depressions with thicker cover of Quaternary deposits. This boundary passes about 600—620 m above the top of Gaizes.

BIOSTRATIGRAPHY

The chronostratigraphic subdivision of the Oxfordian is based on ammonite zones and subzones. This subdivision is not uniform for the whole Europe because of the existence of paleobiogeographic provinces (*cf.* references *in:* Pożaryska & Brochwicz-Lewiński 1974). The subdivision accepted in this paper (*cf.* Fig. 7) represents the newest modification of that used in the Submediterranean province, proposed by Cariou, Enay & Tin-

tant (1971). The only difference in relation to that modified subdivision is connected with the boundary between the Middle and Upper Oxfordian here drawn between the *bifurcatus* and *bimammatum* zones. The validity of such approach has been proved by Kutek, Matyja & Wierzbowski (1973).

LOWER OXFORDIAN

The subdivision of the Lower and lowermost Middle Oxfordian is based on cardioceratids. The representatives of this group of ammonites are not numerous in the strata studied (*see* Table 1); that is why only some small segments of the stratigraphic column could have been assigned to zones or subzones with certainty. The biostratigraphic interpretation of zones and subzones of the Oxfordian is the same as presented by Arkell (1935—1947, 1939, 1941), Zeiss (1957, 1966), Callomon (1964) and Enay (1966).

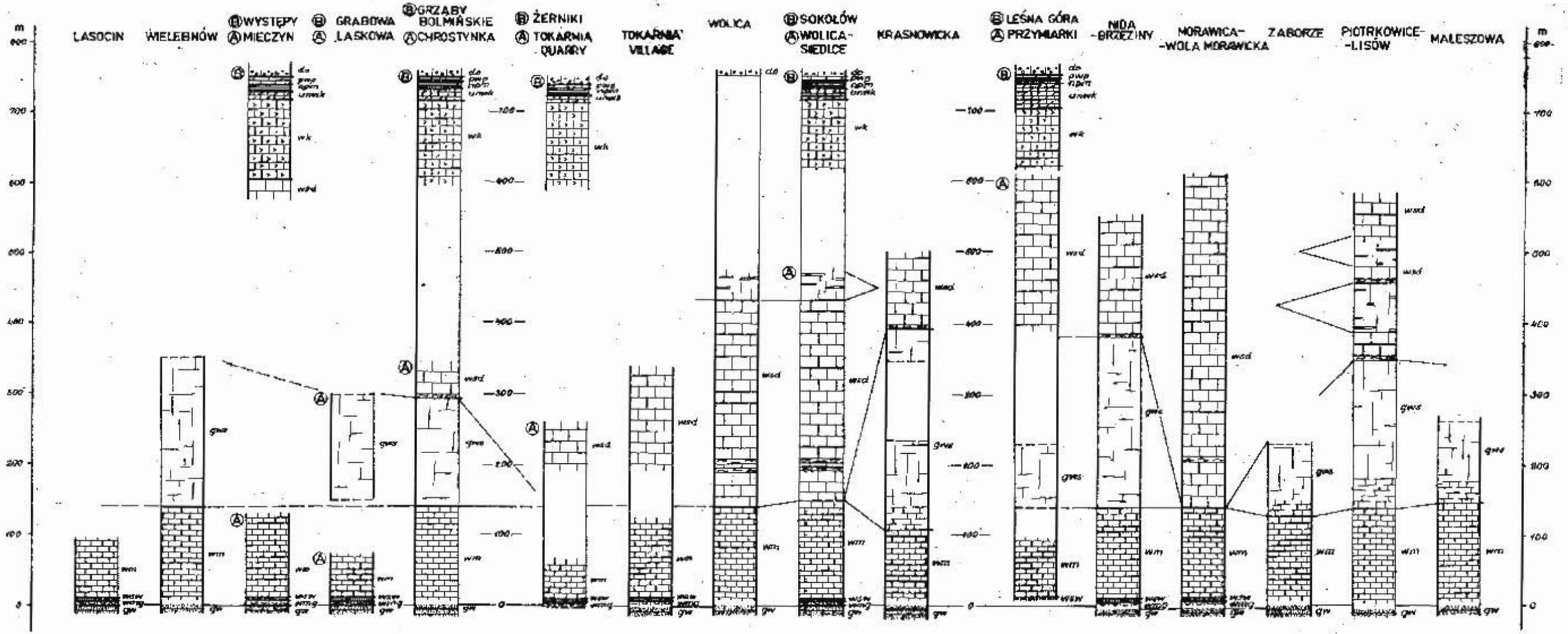
Table 1

Percentage of various ammonite groups in the distinguished lithostratigraphic units

Members / Ammonites	Marly Limestones	Grey Limestones	Morawica Limestones	Siedlce Limestones
Phylloceratidae & Lytoceratidae	1	-	1	6
Haploceratacea	19	17	8	78
Cardioceratidae	7	9	1	-
Aspidoceratidae	38	-	1	-
Perisphinctidae	35	78	88	16
Number of specimens	642	63	1150	50

The oldest Oxfordian strata were recognized along the quarryroad at Wolica (Figs 5—6). In knobby deposits forming the uppermost part of the Gaizes member were found: *Quenstedtoceras mariae* (d'Orb.), *Q. omphaloides* (Sowerby), *Cardioceras (Scarburgiceras) scarburgense* (Young & Bird), *Cardioceras (Scarburgiceras)* sp., *Taramelliceras argoviense* Jeannet, *Hecticoceras punctatum* (Stahl), *Sowerbyceras tortisulcatum* (d'Orb.), *Perisphinctes (Properisphinctes)* sp. and *Lissoceratoides erato* (d'Orb.). The occurrence of the genera *Quenstedtoceras* and *Cardioceras* and especially of the species *Q. mariae* (d'Orb.) and *C. (Scarburgiceras) scarburgense* (Young & Bird) indicate the *scarburgense* Subzone of the

Lithostratigraphic profiles of the Oxfordian and lowermost Kimmeridgian deposits in the SW margin of the Holy Cross Mts



Lithostratigraphic members: Galzes *(gw)*, Marly Limestones *(wmg)*, Grey Limestones *(wsw)*, Morawica Limestones *(wm)*, Massive Limestones *(gws)*, Siedlce Limestones *(wsd)*, Chalky Limestones *(wk)*, Deposits Overlying Chalky Limestones *(wwk)*, Lowermost Marly horizon *(npm)*, Underlying Pelitic Limestones (pwp), Lower Oolite (do); for Chalky Limestones and all the overlying members — see also Kutek (1968, Table 2).

Polish names of the presented lithostratigraphic members (cf. Kutek 1968, Table 2): gezy *(gw)*, wapienie margliste *(wmg)*, wapienie siwe *(wsw)*, wapienie morawickie *(wm)*, wapienie skaliste *(gws)*, wapienie siedleckie *(wsd)*, wapienie kredowate *(wk)*, utwory nad wapieni kredowatych *(wwk)*, najniższy poziom marglisty *(npm)*, podścielające wapienie pelitowe *(pwp)*, oolit dolny *(do)*

mariae Zone. Below, in the layer *V* of the profile was found *Kosmoceras* sp. evidencing the Upper Callovian. The Callovian/Oxfordian boundary passes between the layers *III* and *V*, within the Gaizes member (*see* Figs 5—6).

Upper part of the *mariae* Zone (the *praecordatum* Subzone) as well as the lowermost part of the *cordatum* Zone (*bukowskii* Subzone) are characterized by cardioceratids of the subgenus *Scarburgiceras*. Representatives of that subgenus occur in layers 1—16 of the Marly Limestones member. From these layers are also reported: *Sowerbyceras tortisulcatum* (d'Orb.), *Holcophylloceras zignodianum* (d'Orb.), *Metalytoceras orbignyi* Loriol, *Creniceras renggeri* (Oppel), *Creniceras crenatum* (Brug.), *Taramelliceras minax* (Buk.), *T. argoviense* Jeannet, *T. pseudoculatum* (Buk.), *Cardioceras (Scarburgiceras) harmonicum* Maire, *C. (Sc.) bukowskii* Maire, *C. (Sc.)* sp., *Goliathiceras (Goliathites) goliathus* (d'Orb.), *G. (G.) cyclops* Arkell, *Neocampylites delmontanus helveticus* (Jeannet), *Parawedekindia arduennensis* (d'Orb.), *Peltoceratoides constantii* (d'Orb.), *Peltomorphites athletoides* (Lahusen), *Rursiceras bodeni* (Prieser), *Rursiceras* sp. *A*, *Peltomorphites hoplophorus* Buckman, *P. subeugenii* Arkell, *P. eugenii* (Raspail), *Aspidoceras (Euaspidoceras) ovale* Neum., *Lissoceratoides erato* (d'Orb.), *Mirosphinctes frickensis* (Moesch), *Mirosphinctes* sp. *A*, *Mirosphinctes* sp. *B*, *Perisphinctes (Kranaosphinctes) decurrens* Buck-

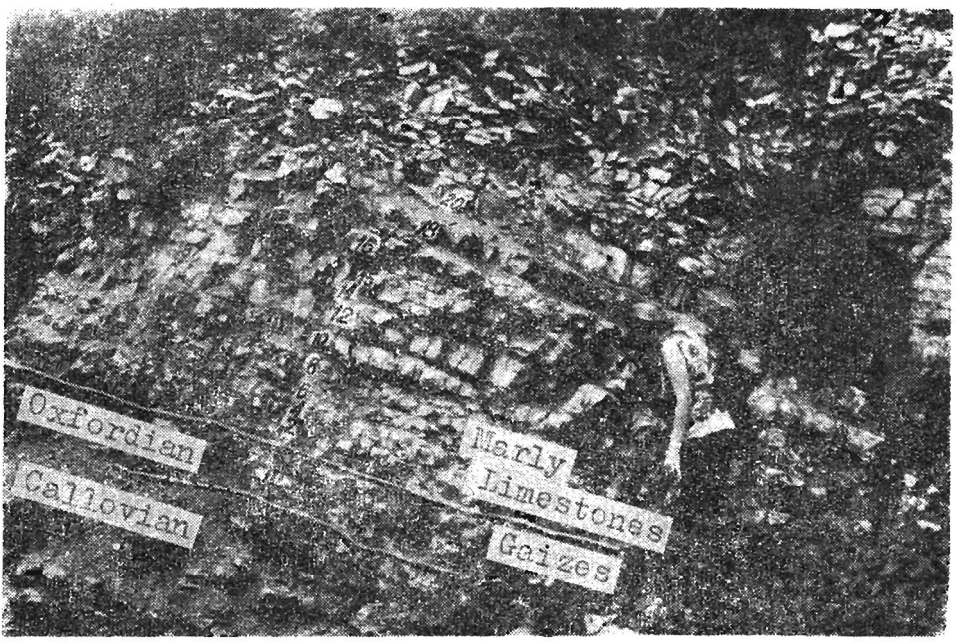


Fig. 5. Uppermost part of the Gaizes member, and the lower part of the Marly Limestones member exposed at the Wolica quarryroad: numbering of the layers the same as in Text-fig. 6

man, *Perisphinctes (Properisphinctes)* aff. *bernensis* Loriol, *Perisphinctes (Alligaticeras)* sp.

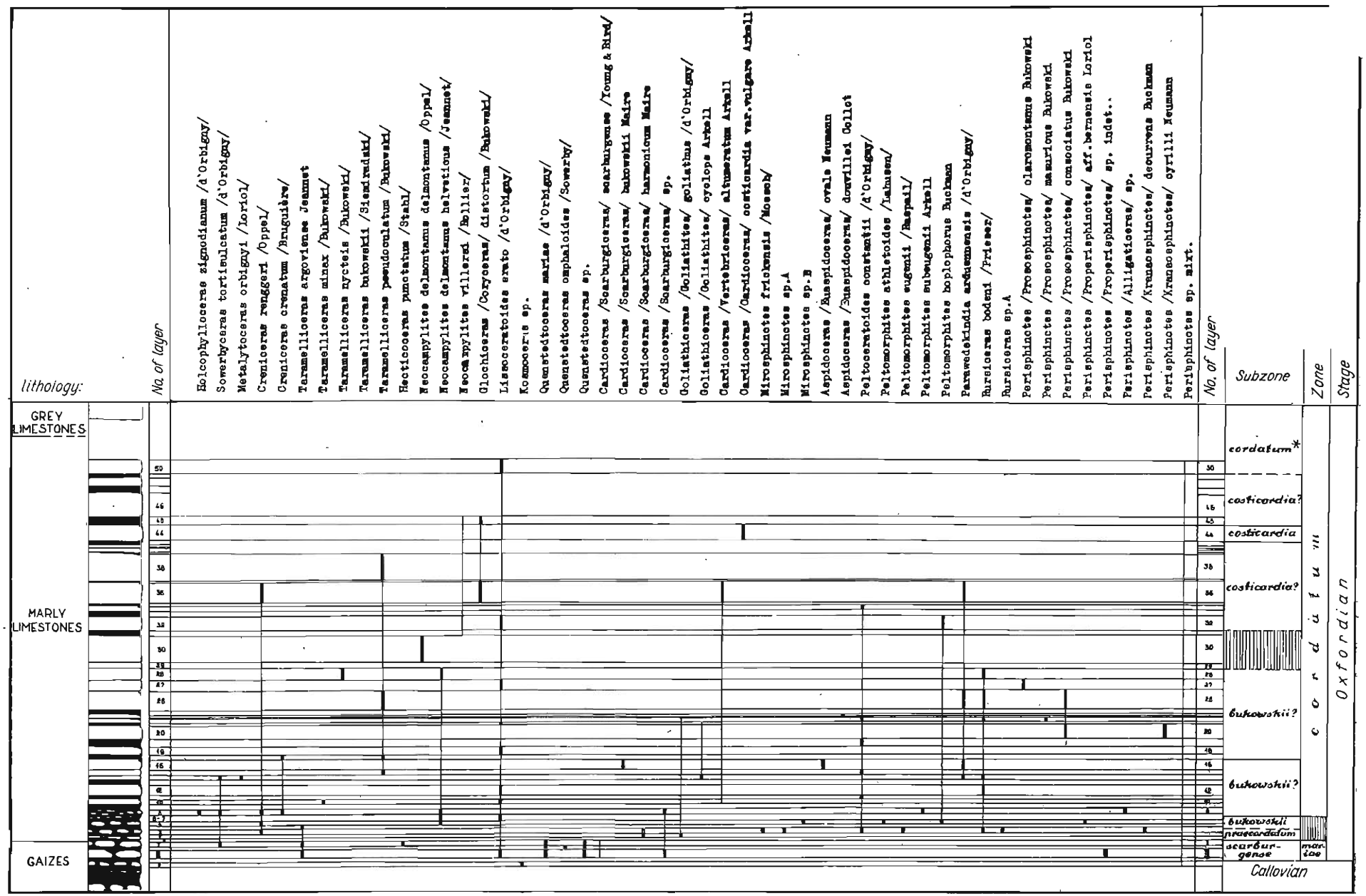
The presence of the *praecordatum* Subzone is difficult to evidence because of the lack of the index form. It is only possible to take into account the observation made by Arkell (1941) that the representatives of *C. (Scarburgiceras)* from the *praecordatum* Subzone are characterized by heavier sculpture and less distinct keel than the younger representatives from the *bukowskii* Subzone. The species *Cardioceras (Scarburgiceras) harmonicum* Maire recorded from the layer *1* or *2* of the Wolica quarryroad profile displays sculpture of the older type but it is known from both subzones (Arkell 1946). The specimen *Cardioceras (Scarburgiceras)* sp. derived from the layer *8* at Wolica quarryroad displays sculpture typical of the representatives of *Scarburgiceras* from the *bukowskii* Subzone. The index species of the *bukowskii* Subzone, *Cardioceras (Scarburgiceras) bukowskii* Maire, was found in the layer *16* of that profile. Thus it may be stated that the layers *8—16* belong to the *bukowskii* Subzone. Taking into account a very small (usually about a dozen cm) thickness of strata of the *mariae* Zone in the area of the Polish Jura Chain or in other sections from the margins of the Holy Cross Mts (*cf.* Różycki 1953, Malinowska 1970, Siemiątkowska-Giżejewska 1974) it may be assumed that the lower boundary of the *bukowskii* Subzone passes somewhere below the layer *8*.

The upper, *costicardia* Subzone is evidenced directly by the species *Cardioceras (Cardioceras) costicardia* var. *vulgare* Arkell only in the case of the layer *44*. From layers *17—44* besides that species there were found: *Creniceras renggeri* (Oppel), *Creniceras crenatum* (Brug.), *Taramelliceras nycteis* (Buk.), *T. bukowskii* (Siem.), *T. pseudoculatum* (Buk.), *Neocampylites delmontanus delmontanus* (Oppel), *N. delmontanus helveticus* (Jeannet), *N. villersi* (Rollier), *Glochiceras (Coryceras) distortum* (Buk.), *Lissoceratoides erato* (d'Orb.), *Goliathiceras (Goliathites) goliathus* (d'Orb.), *G. (G.) cyclops* Arkell, *Cardioceras (Vertebriceras) altumeratum* Arkell, *Aspidoceras (Euaspidoceras) douvillei* Collot, *Peltoceratoides constantii* (d'Orb.), *Parawedekindia arduennensis* (d'Orb.), *Peltomorphites hoplophorus* Buckman, *Rursiceras bodeni* (Prieser), *Perisphinctes (Prososphinctes) claromontanus* Buk., *P. (P.) mazuricus* Buk., *P. (P.) consociatus* Buk., *P. (Kranaosphinctes) cyrilli* Neum.

Malinowska (1963) in defining the *bukowskii* Zone [2] corresponding

[2] The subdivision of the Lower Oxfordian used in the present paper is widely accepted in Europe, and it differs from that introduced and still kept by Malinowska (1963, 1976). In the latter, the *bukowskii* Zone is distinguished above the *mariae* Zone, and it is "marked by the occurrence of the species *Cardioceras (Scarburgiceras) bukowskii* Maire" (Malinowska 1963, p. 124). Hence, the *bukowskii* Zone of Malinowska strictly corresponds to the *bukowskii* Subzone of Arkell (1941), but it does not correspond to *Cardioceras bukowskii* and *Cardioceras costicardia* Subzones, contrary to the view presented by Malinowska (1976, p. 27). The *excavatum* Zone of Malinowska succeeding the *bukowskii* Zone in her subdivision of the Lower Oxfordian "has been distinguished on the basis of the occurrence within the section of the species *Cardioceras (Scoticardioceras) excavatum* Sow." (Malinowska 1963, p. 125). The representatives of the subgenus *Scoticardioceras* appear in Great Britain (Arkell 1935—1947, Turner

Occurrence of ammonites in the Lower Oxfordian deposits exposed at the Wolica quarryroad (*cf.* Text-fig. 5)



* Subzone *cordatum* documented in other exposures.

to the *bukowskii* Subzone of Arkell (1941) listed the following species as characteristic of that zone: *Taramelliceras minax* (Buk.), *T. pseudoculatum* (Buk.), *Parawedekindia arduennensis* (d'Orb.), *Peltoceratoides bodeni* Prieser, *Peltoceratoides eugenii* (Raspail), *Perisphinctes (Prososphinctes) claromontanus* Buk. and *P. (P.) consociatus* Buk. The majority of these species are numerous in the layers *20—28* of the Wolica quarryroad profile but some of them pass upwards: *Taramelliceras pseudoculatum* (Buk.) to the layer *38* and *Parawedekindia arduennensis* (d'Orb.) to the layer *36*.

The upper limit of occurrence of ammonites of the genera *Peltoceratoides, Parawedekindia* and *Peltomorphites* of the subfamily Peltoceratinae may be of some stratigraphic value. The representatives of these genera do not occur above the layer *36* in the Wolica quarryroad profile nor in upper parts of the sections of marly limestones profiles from Tokarnia, Mieczyn, Wola Morawicka and other localities. The analysis of sections from abroad (*e.g.*, Arkell 1935—1947, Zeiss 1957, Turner 1966) has shown that these genera do not pass the *costicardia/cordatum* boundary. This is confirmed by the data concerning the profiles from the Polish Jura Chain (*see* Malinowska 1963), in which only not numerous representatives of these genera of Peltoceratinae were found above the *bukowskii* Zone and not much above the base of the *excavatum* Zone.

It may therefore be stated that the upper boundary of the *bukowskii* Subzone most probably passes above the layer *28* at Wolica quarryroad. The occurrence of the representatives of the above mentioned genera of the subfamily Peltoceratinae in the *costicardia* Subzone, evidenced elsewhere, makes possible to assign to that subzone the layers *32—36* in which the last Peltoceratinae were recorded.

The *cordatum* Subzone was evidenced at Tokarnia, Wielebnów and Brzeziny only. Ammonites on which that dating was based were found in two uppermost layers of the Marly Limestones member. They include: *Cardioceras (Cardioceras) ashtonense* Arkell and *C. (C.) persecans* Buckman; both species known from the *cordatum* Subzone of Great Britain (Arkell 1946, Callomon & Cope 1971) and the latter also from that subzone of the Jura Mts (Enay 1966). The *cordatum* Zone as a sum of the *bukowskii, costicardia* and *cordatum* Subzones comprises the whole Marly Limestones member (with a reservation made in the case of a few lowermost layers). Its upper boundary may pass even in the Grey Limestones member.

1966, Callomon & Cope 1971), France (Cariou & *al.* 1971), West Germany (Siegfried 1953, Zeiss 1957) and Soviet Union (Kniazev 1975) in the *cordatum* Subzone. Thus there is the interval of the one subzone (*costicardia* Subzone) between the *Scarburgiceras* below and the *Scoticardioceras* above. Some representatives of *Scoticardioceras* were also found by the present author in the layers directly overlying those with *Scarburgiceras* in the south-western margin of the Holy Cross Mts. Poor preservation of the specimens described and figured as *Cardioceras (Scoticardioceras) excavatum* (Sow.) by Malinowska (1963, Pl. 19, Figs 108—109) makes their subgeneric interpretation disputable. It follows that the subdivision of the late Lower Oxfordian into *bukowskii* and *excavatum* Subzones is insufficient, as it does not cover this time-interval in which *Scarburgiceras* becomes extinct and *Scoticardioceras* not yet appears.

MIDDLE OXFORDIAN

The oldest deposits assigned to the Middle Oxfordian are those forming upper part of the Grey Limestones member that yielded: *Cardioceras (Plasmatoceras) tenuistriatum* Borissjak, *C. (P.)* cf. *popilaniense* Boden, *C. (Scoticardioceras)* sp., *C. (Vertebriceras)* sp., *Perisphinctes (Otosphinctes)* sp. *A*, *P. (Otosphinctes)* sp. *C*, *P. (Dichotomosphinctes) dybowskii* Siem. In the lowermost part of the Morawica Limestones member (12—15 m above the top of the Gaizes [3]) there were found: *Cardioceras (Scoticardioceras) serrigerum* Buckman, *C. (Scoticardioceras) expositum* Buckman, *Perisphinctes (Otosphinctes)* sp. *B*, *P. (Arisphinctes) maximus* (Young & Bird), *P. (Kranaosphinctes)* cf. *promiscuus* Buk. and *Perisphinctes (Arisphinctes)* sp. These ammonites are typical of the *plicatilis* Zone.

Above, in the interval 15—38 m above the top of the Gaizes, occur ammonites known from both the *plicatilis* and *transversarium* Zones, i.e.: *Taramelliceras anar* (Oppel), *T. pseudotrachinotum* Hölder, *T. dentostriatum* (Qu.), *T. romani* (de Riaz), *Neoprionoceras lautlingense* (Rollier), *Trimarginites trimarginatus* (Oppel), *Ochetoceras canaliculatum* (v. Buch), *Lissoceratoides erato* (d'Orb.), *Perisphinctes (Perisphinctes) alatus* Enay, *Perisphinctes (Perisphinctes)* sp. (*cf.* Table 2).

The *transversarium* Zone comprises at least strata of the Morawica Limestones member occurring in the interval from 38 to 63 m above the top of the Gaizes. This zone is characterized by ammonites of the *Perisphinctes (Dichotomosphinctes) wartae* Buk. group (*cf.* Enay 1966). From the interval 38—63 m there are reported: *Taramelliceras anar* (Oppel), *T. romani* (de Riaz), *T. dentostriatum* (Qu.), *Neoprionoceras lautlingense* (Rollier), *Trimarginites trimarginatus* (Oppel), *Ochetoceras canaliculatum* (v. Buch), *Glochiceras (Glochiceras)* cf. *subclausum* (Oppel), *Lissoceratoides erato* (d'Orb.), *Perisphinctes (Dichotomosphinctes) elisabethae* de Riaz, *Perisphinctes (Dichotomosphinctes)* ex gr. *wartae* Buk., *Perisphinctes (Perisphinctes) martelli* (Oppel), *Perisphinctes (Perisphinctes)* sp., *Perisphinctes (Liosphinctes)* cf. *berlieri* Loriol, *Subdiscosphinctes (Subdiscosphinctes)* sp., *Subdiscosphinctes* sp.

The base of the *bifurcatus* Zone is defined by the first appearance of the subgenus *Dichotomoceras* and the *Perisphinctes (Perisphinctes) variocostatus* (Buckl.) group as indicated *e.g.* by Cariou & *al.* (1971) and Brochwicz-Lewiński (1975). The representatives of the former are easy to identify and fairly numerous in the area studied which made possible to state that the *bifurcatus* Zone comprises Morawica Limestones occurring from 65 to 125 m above the top of Gaizes. The correlation error inter-

[3] The thickness of Marly Limestones, Grey Limestones and Morawica Limestones members is constant and there are no reference points within monotonous series of the Morawica Limestones; therefore the figure of meters above the top of the Gaizes member is here accepted as the reference level for ammonites found in the latter member.

val for the *transversarium* and *bifurcatus* Zones is small, comprising strata from 63 to 65 m above the Gaizes.

From the interval from 65 to 125 m above the top of the Gaizes are reported: *Perisphinctes (Dichotomoceras) bifurcatus* (Qu.), *P. (Dichotomoceras) bifurcatoides* Enay, *Perisphinctes (Perisphinctes) malinowskae* Brochwicz-Lewiński, *P. (Perisphinctes)* ex gr. *variocostatus* (Buckl.), *Orthosphinctes (Pseudorthosphinctes?)* sp., *Nebrodites (Passendorferia)* cf. *ziegleri* Brochwicz-Lewiński, *Nebrodites (Passendorferia)* sp. *A*, *Taramelliceras externnodosum* (Dorn), *Streblites tenuilobatus frotho* (Oppel), *Ochetoceras canaliculatum* (v. Buch), *O. hispidiforme* (Font.), *Amoeboceras ovale* (Qu.), *Sowerbyceras tortisulcatum* (d'Orb.).

UPPER OXFORDIAN

Upper Oxfordian strata from the Holy Cross Mts had a very poor ammonite record until the studies of Kutek (1968) gave evidence in that area for the *planula* Zone, the higher zone of the Upper Oxfordian. The ammonites subsequently gathered made possible to distinguish also the lower, *bimammatum* Zone.

In the uppermost part of the Morawica Limestones occurring about 125—130 m above the top of the Gaizes in the Wolica-Siedlce profile (Table 2) there were found: *Taramelliceras externnodosum* (Dorn), *Amoeboceras ovale* (Qu.), *Microbiplices microbiplex* (Qu.) and *Microbiplices* sp. The genus *Microbiplices* commonly appears in the *hypselum* Subzone (Enay 1966) whilst all the remaining species are known from both the *bifurcatus* and *bimammatum* Zones.

In the lowermost part of the Siedlce Limestones (155—160 m above the top of the Gaizes) were found: *Taramelliceras externnodosum* var. *mediocris* Hölder and *Taramelliceras costatum* (Qu.). The latter is known from the *bimammatum* Zone and lower parts of the *planula* Zone (Schmidt -Kaler 1962, Schuler 1965, Enay 1966, Zeiss 1966).

The Siedlce Limestones (occurring 185—300 m above the top of the Gaizes) exposed in quarries situated south of Wolica and Siedlce villages yielded: *Sowerbyceras tortisulcatum* (d'Orb.), *Glochiceras (Coryceras) canale* (Qu.), *G. (Coryceras) modestiforme* (Oppel), *G. (Glochiceras)* cf. *tectum* (Oppel), *G. (Lingulaticeras) lingulatum* (Qu.), *Ochetoceras marantianum* (d'Orb.), *Ringsteadia (Ringsteadia) flexuoides* (Qu.), *Taramelliceras costatum* (Qu.), *T. pichleri* (Oppel) and *?Idoceras* aff. *minutum* Dieterich. The ammonites except for the first and the last ones form an assemblage typical of the upper part of the *bimammatum* Zone from the Swabian Alb (*see* Zeiss 1966). The species *Ochetoceras marantianum* is considered as typical of the *bimammatum* and *hauffianum* Subzones (Cariou & al. 1971) and cited together with *Epipeltoceras berrense* from the *hypselum* Sub-

zone by Zeiss (1966). The species *Glochiceras modestiforme* (Oppel) and *G. lingulatum* (Qu.) appear in the *bimammatum* Zone and pass into the *planula* Zone (Ziegler 1958, Zeiss 1966), where the latter becomes very

Table 2

Stratigraphic ranges of ammonites occurring in the Oxfordian deposits of the SW margin of the Holy Cross Mts

Ammonites occurring in: *m* — *mariae* Zone, *c* — *cordatum* Zone, *p* — *plicatilis* Zone, *p/t* — *plicatilis* or *transversarium* Zone, *t* — *transversarium* Zone, *b* — *bifurcatus* Zone, *bm* — *bimammatum* Zone.

Ammonites \ Members	Gaizes	Marly Limestones	Grey Limestones	Mormica Limestones	Siedlce Limestones
Holcophylloceras zignodianum /d'Orbigny/		c			
Sowerbyceras tortisulcatum /d'Orbigny/	m	c			
Metalytoceras orbignyi /Loriol/		c			
Creniceras renggari /Oppel/		c			
Creniceras crenatum /Bruguière/		c			
Taramelliceras argoviense Jeannet	m	c			
Taramelliceras minax /Bukowski/		c			
Taramelliceras nycteis /Bukowski/		c			
Taramelliceras pseudoculatum /Bukowski/		c			
Taramelliceras anar /Oppel/				p/t; t	
Taramelliceras dentostriatum /Quenstedt/				p/t; t	
Taramelliceras pseudotrachinotum Hölder				p/t	
Taramelliceras romani /de Riaz/				p/t; t	
Taramelliceras externnodosum /Dorn/				b; bm	
Taramelliceras costatum /Quenstedt/					bm
Taramelliceras pichleri /Oppel/					bm
Streblites tenuilobatus frotho /Oppel/				b	
Hecticoceras punctatum /Stahl/	m				
Neocampylites delmontanus delmontanus /Oppel/		c			
Neocampylites delmontanus helveticus /Jeannet/		c			
Neocampylites villersi /Rollier/		c			
Neoprionoceras lautlingense /Rollier/				p/t; t	
Ochetoceras canaliculatum /v.Buch/				p/t;t;b	
Ochetoceras hispidiforme /Fontannes/				b	
Ochetoceras marantianum /d'Orbigny/					bm
Trimarginites trimarginatus /Oppel/				p/t; t	
Glochiceras /Coryceras/ distortum /Bukowski/		c			
Glochiceras /Coryceras/ canale /Quenstedt/					bm
Glochiceras /Coryceras/ modestiforme /Oppel/					bm
Glochiceras /Glochiceras/ tectum /Oppel/					bm
Glochiceras /Glochiceras/ cf.subclausum /Oppel/				t	
Glochiceras /Lingulaticeras/ lingulatum /Quenstedt/					bm
Lissoceratoides erato /d'Orbigny/		c		p/t; t	
Quenstedtoceras mariae /d'Orbigny/	m				
Quenstedtoceras omphaloides /Sowerby/	m				
Quenstedtoceras sp.	m				
Cardioceras /Scarburgiceras/ scarburgense /Young & Bird/	m				
Cardioceras /Scarburgiceras/ bukowskii Maire		c			
Cardioceras /Scarburgiceras/ harmonicum Maire		c			
Cardioceras /Scarburgiceras/ mirabile Arkell		c			
Cardioceras /Scarburgiceras/ sp.	m	c			
Cardioceras /Vertebriceras/ altumeratum Arkell		c			
Cardioceras /Vertebriceras/ quadrarium var.filatum Arkell		c			
Cardioceras /Vertebriceras/ costicordis var.vulgare Arkell		c			
Cardioceras /Cardioceras/ eshtonense Arkell		c			
Cardioceras /Cardioceras/ persecans Buckman		c			
Cardioceras /Scoticardioceras/ expositum Buckman				p	
Cardioceras /Scoticardioceras/ serrigerum Buckman				p	
Cardioceras /Scoticardioceras/ sp.			p		
Cardioceras /Plasmatoceras/ tenuistriatum Borissjak			p		
Cardioceras /Plasmatoceras/ cf. popilaniense /Boden/			p		
Goliathiceras /Goliathites/ goliathus /d'Orbigny/		c			
Goliathiceras /Goliathites/ cyclope Arkell		c			
Amoeboceras ovale /Quenstedt/				b; bm	

Ammonites \ Members	Gaizes	Marly Limestones	Grey Limestones	Morawica Limestones	Siedlce Limestones
Miroosphinctes mirus /Bukowski/		c			
Miroosphinctes frickensis /Moesch/		c			
Miroosphinctes sp. A		c			
Miroosphinctes sp. B		c			
Aspidoceras /Euaspidoceras/ ovale Neumann		c			
Aspidoceras /Euaspidoceras/ douvillei Collot		c			
Parawedekindia arduennensis /d'Orbigny/		c			
Parawedekindia choffati /Loriol/		c			
Ruraiceras bodeni /Prieser/		c			
Ruraiceras sp. A		c			
Peltoceratoides constantii /d'Orbigny/		c			
Peltomorphites athletoides /Lahusen/		c			
Peltomorphites eugenii /Raspail/		c			
Peltomorphites subeugenii Arkell		c			
Peltomorphites hoplophorus Buckman		c			
Periphinctes /Proboscphinctes/ claromontanus Bukowski		c			
Periphinctes /Prosoosphinctes/ mazuricus Bukowski		c			
Periphinctes /Prosoosphinctes/ consociatus Bukowski		c			
Periphinctes /Properisphinctes/ aff. barnensis Loriol		c			
Periphinctes /Properisphinctes/ sp.		c			
Periphinctes /Alligaticeras/ sp.	▪				
Periphinctes /Kranaosphinctes/ decurrens Buckman		c			
Periphinctes /Kranaosphinctes/ cyrilli Neumann		c			
Periphinctes /Kranaosphinctes/ cf. praviscus Bukowski				p	
Periphinctes /Kranaosphinctes/ sp.			p		
Periphinctes /Arisphinctes/ maximus /Young & Bird/				p	
Periphinctes /Ariaphinctes/ sp.				p	
Periphinctes /Otosphinctes/ sp. A			p		
Periphinctes /Otosphinctes/ sp. B				p	
Periphinctes /Otosphinctes/ sp. C			p		
Periphinctes /Dichotomosphinctes/ dybowskii Siemiradzki			p		
Periphinctes /Dichotomosphinctes/ aliasbethae de Riaz				t	
Periphinctes /Dichotomosphinctes/ ex gr. wartae Bukowski				t	
Periphinctes /Periphinctes/ alatus Enay				t	
Periphinctes /Periphinctes/ martelli /Oppel/				t	
Periphinctes /Periphinctes/ malinowskae Brochwicz-Lewiński				b	
Periphinctes /Periphinctes/ ex gr. variocostatus /Buckland/				b	
Periphinctes /Periphinctes/ sp.				t	
Periphinctes /Dichotomoceras/ bifurcatoides Enay				b	
Periphinctes /Dichotomoceras/ bifurcatus /Quenstedt/				b	
Periphinctes /Dichotomoceras/ sp.				b	
Periphinctes /Lissphinctes/ cf. berlieri Loriol				t	
Subdiscosphinctes /Subdiscosphinctes/ sp.				t	
Subdiscosphinctes sp.				t	
Nebrodites /Passendorferia/ cf. ziegleri Brochwicz-Lewiński				b	
Nebrodites /Passendorferia/ sp. A				b	
Orthosphinctes /?Pseudorthosphinctes/ sp.				b	
Ringsteadia /Ringsteadia/ flexuoides /Quenstedt/					bm
Microbiplices microbiplex /Quenstedt/				bm	
Microbiplices sp.				bm	
?Idoceras aff. minutum Dieterich					bm

common (Kutek & Wierzbowski 1974). The species *Ringsteadia flexuoides* (Qu.), common in the *planula* Zone, is also known from the *bimammatum* Subzone (Wierzbowski 1970). Constrictions visible on the outer whorl of the specimen figured (Pl. 8, Fig. 6) are known to be marked on earlier representatives of that species (Dr. A. Wierzbowski, *oral inf.*). The specimen described as ?*Idoceras* aff. *minutum* Dieterich is actually very close to the species *I. minutum* Dieterich, differing in the lack of ventral smooth band typical of the genus *Idoceras*. Specimens described as *Idoceras* (?)

sp. were described by Zeiss (1966) and Karve-Corvinus (1966) from the *bimammatum* Zone or the *bimammatum-planula* junction beds.

It follows from the above analysis that the Siedlce Limestones occurring from 185 to 300 m above the top of the Gaizes belong to higher parts of the *bimammatum* Subzone.

The thickness of the Upper Oxfordian zones (250 m and about 330 m for the *bimammatum* and *planula* Zones, respectively) is valid in the case of the profiles without the Massive Limestones. When the Massive Limestones are present the thickness of the strata of the *bimammatum* Zone increases at the expense of the *planula* Zone. Thus it is most convenient to use a summative thickness for both zones of the Upper Oxfordian, equal about 545—620 m (Fig. 7).

REMARKS ON SOME AMMONITES

The study on ammonite fauna from the investigated area was undertaken to establish zonation of the Oxfordian using the existing biostratigraphic schemes. Oxfordian ammonites, and especially those of a marked stratigraphic value, were often described in several excellent monographs (*e.g.*, Arkell 1935—1947, Enay 1966) therefore only some ammonites identified (Table 2) are figured here (Pls 1—10) and the descriptions are limited only to new forms or those found in stratigraphic position different from that hitherto assumed.

SYSTEMATIC DESCRIPTIONS

Family **Oppeliidae** Bonarelli, 1894
Subfamily **Streblitinae** Spath, 1925
Genus *STREBLITES* Hyatt, 1900
Streblites tenuilobatus frotho (Oppel, 1962)
(Pl. 3, Fig. 13)

1862. *Ammonites tenuilobatus* Oppel; Oppel, p. 160, Pl. 50, Fig. 1.
1863. *Ammonites frotho* Oppel; Oppel, p. 199.
1964. *Streblites tenuilobatus frotho* (Oppel); Höroldt, p. 25, Pl. 1, Figs 4—5.

Remarks. — The species *Streblites tenuilobatus* (Oppel) is considered as descendant of the species *Taramelliceras (Strebliticeras) externnodosum* (Dorn) (*cf.* Höroldt 1964, p. 32); however, there remained a large gap between the stratigraphic ranges of these species as *Taramelliceras externnodosum* (Dorn) was not known to overpass the *bimammatum* Zone, and *Streblites tenuilobatus* (Oppel) not to occur in strata below the middle part of the Lower Kimmeridgian. The specimen figured here was found in the *bifurcatus* Zone. This record fills the gap between the stra-

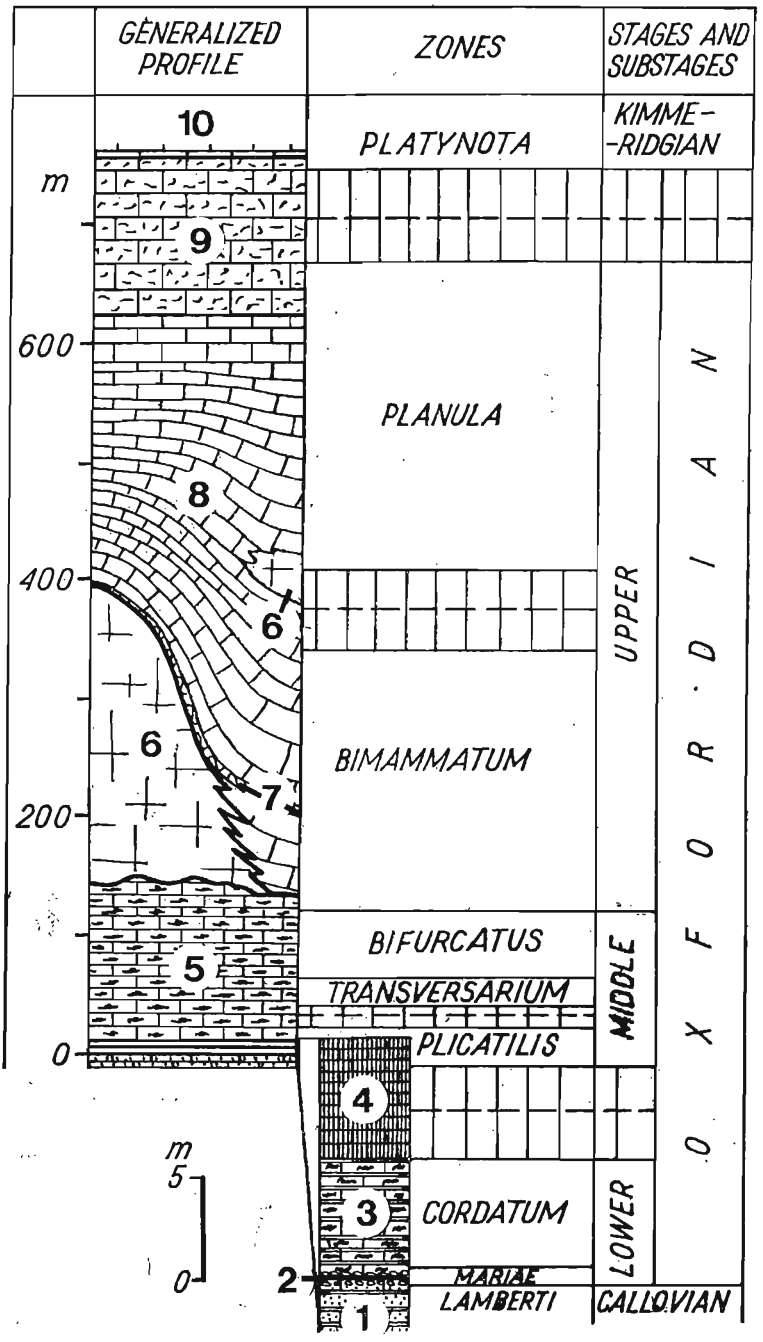


Fig. 7. Correlation of litho- and biostratigraphic units of the investigated Oxfordian deposits in the SW margin of the Holy Cross Mts; intervals of correlation error are indicated

1 Gaizer member, *2* knobby („nodular") deposits, *3* Marly Limestones member, *4* Grey Limestones member, *5* Morawica Limestones member, *6* Massive Limestones member, and massive limestones of the Siedlce Limestones member, *7* marls, *8* Siedlce Limestones member, *9* Chalky Limestones member, *10* member of the Deposits Overlying Chalky Limestones

tigraphic ranges of the two species and, at the same time, it indicates that *Streblites* separated from *Taramelliceras* much earlier than it was hitherto assumed.

Occurrence. — The specimen Mt90 comes from Tokarnia village, Morawica Limestones, *bifurcatus* Zone.

Family **Perisphinctidae** Steinmann, 1890
Subfamily **Pseudoperisphinctidae** Schindewolf, 1925
Genus *MIROSPHINCTES* Schindewolf, 1926

The collection comprises several representatives of the genus *Mirosphinctes*, two of which are the largest hitherto recorded. They cannot be accomodated in any existing species of that genus. The specimens are complete but single; that is why new specific names are not proposed.

Mirosphinctes sp. *A*
(Pl. 4, Fig. 2)

Dimensions: Diameter (S) = 57 mm; whorl height (W) = 19 mm; W/S = 0.32; whorl width (G) = 18 mm; G/S = 0.32; width of umbilicus (P) = 23 mm; P/S = 0.45.

Description. — Form evolute. Whorls only somewhat higher than wide, widest somewhat below the mid-height. Whorl sides slightly convex. Inner whorls sculpture typical of the genus *Mirosphinctes*. Comma-shaped ribs first appearing at umbilical margin, radial on sides, bifurcating and becoming slightly rectiradiate somewhat below ventral margin. Weak parabolic nodes sometimes originating at the point of furcation. Ventral side ornamented with slightly prorsiradiate, fine second-order ribs. Body chamber a half-whorl long, ornamented with ribs very slightly rectiradiate on whorl sides and bifurcating earlier, just above the mid-height; parabolic nodes disappear. Peristome is preceded by a distinct constriction.

Remarks. — This specimen seems most similar to *Perisphinctes variabilis* Lahusen (1883), from which it differs in wider whorls and regular subdivision of ribs on body chamber.

Occurrence. — The specimen No. Mt215 comes from Wolica quarryroad, Marly Limestones (bed 2), *mariae* Zone or *bukowskii* Subzone of the *cordatum* Zone.

Mirosphinctes sp. *B*
(Pl. 4, Fig. 3)

Dimensions: S = 57 mm; W/S = 0.35; G/S = 0.38; P/S = 0.40.

Description. — Coiling evolute, umbilicus relatively narrow; the specimen is chunky, with somewhat convex whorl thickest at the mid-height. Ribs beginning at umbilical wall, initially radial, somewhat rectiradiate from the mid-height, bifurcating and becoming prorsiradiate at the ventral margin. Ventral side ornamented with prorsiradiate second-order ribs. Body chamber comprising 3/4 of the last whorl, ornamented with weaker ribs; point of furcation shifted downwards to the mid-height. Peristome preceded by wide and deep constriction.

Occurrence. — The specimen No. Mt502 comes from Wolica quarryroad, Marly Limestones (bed 4), *mariae* Zone or *bukowskii* Subzone of the *cordatum* Zone.

Subfamily **Perisphinctinae** Steinmann, 1890
Genus *PERISPHINCTES* Waagen, 1869

Lower Oxfordian perisphinctids are still poorly known. That is why no equivalents for a large number of specimens from the collection were found in

the literature. Some of these specimens are figured (Pl. 7), the remaining require a separate analysis.

Perisphinctes (Properisphinctes) aff. *bernensis* Loriol (Pl. 7, Fig. 1)

Remarks. — De Loriol (1898) described several small specimens representing inner whorls of different species under the name *Perisphinctes bernensis.* Arkell (1936) refigured the specimen presented by de Loriol (1898, Pl. 5, Fig. 18 and 18a) as the lectotype of the species *Perisphinctes bernensis.* The same specimen was interpreted as inner whorls of *Perisphinctes (Kranaosphinctes) promiscuus* Buk. by Malinowska (1963). The specimen figured here displays inner whorls identical as those of de Loriol's specimens, differing in 2.5 times larger dimeter, and essentially differing in outer whorls from *Perisphinctes (Kranaosphinctes) promiscuus* Buk. The body chamber over a half of whorl long; peristome with thickened lip.

Occurrence. — The specimen No. Mt503 comes from Wolica quarryroad, Marly Limestones (layer 4), *mariae* Zone or *bukowskii* Subzone of the *cordatum* Zone.

Perisphinctes (Properisphinctes) sp. indet. (Pl. 7, Fig. 4)

Remarks. — The specimen figured is lappeted. It is similar to *Perisphinctes (Properisphinctes) latilinguatus* Noetling in inner whorls, differing in markedly higher outermost whorl and flattened whorl sides. The author did not find any other similar form in the available literature.

Occurrence. — The specimen No. Mt500 comes from Wolica quarryroad, Gaizes (layer *III*), *mariae* Zone.

Perisphinctes (Alligaticeras) sp. (Pl. 7, Fig. 2)

Remarks. — The specimen figured is close to that from the Creniceras renggeri beds (Lower Oxfordian), erroneously assigned to the species *Perisphinctes plicatilis* (d'Orbigny) by de Loriol (1900, Pl. 5, Fig. 17).

Occurrence. — The specimen No. Mt187 comes from Wolica quarryroad, Marly Limestones (layer 8), *bukowskii* Subzone of the *cordatum* Zone.

Subgenus *OTOSPHINCTES* Buckman, 1926

In the author's collection there are 5 representatives of the subgenus *Otosphinctes;* all these specimens are derived from lower parts of the *plicatilis* Zone. The specimens figured (Pl. 7, Figs 3 and 5; Pl. 8, Fig. 7) are lappeted. The species *Perisphinctes (Otosphinctes)* sp. *A* (Pl. 8, Fig. 7) represents the group of coarsely ribbed forms close to the species *Perisphinctes (Otosphinctes) ouatius* (Buckman) and *P. (O.) magnouatius* Arkell.

The specimen regarded as *Perisphinctes (Otosphinctes)* sp. *B* (Pl. 7, Fig. 5) is close to *P. (Otosphinctes) paturattensis* Loriol, differing in shallower constrictions and in some details of ornamentation of the body chamber.

Genus *ORTHOSPHINCTES* Schindewolf, 1925
Orthosphinctes (Pseudorthosphinctes?) sp.
(Pl. 9)

Dimensions: S = 170 mm; W/S = 0.24; G/S = 0.23; P/S = 0.56.

diameter	170	152	130	122	97	87
number of ribs	59	58	56	54	52	52

Remarks. — The specimen displays several features typical of the subgenus *Pseudorthosphinctes* (*cf.* diagnosis given by Enay, 1966, p. 519), somewhat differing in the trend of rib curve. Dimensions and rib curve appear similar to *Perisphinctes (Arisphinctes)* ex gr. *cotovui* (Sim.). These observations give further support to the phylogenetic relationships between the subgenera *Perisphinctes (Arisphinctes)* and *Orthosphinctes (Pseudorthosphinctes)* recently postulated by Brochwicz-Lewiński & Różak (1975).

Occurrence. — The specimen No. Mt100 comes from Tokarnia village, Morawica Limestones, *bifurcatus* Zone.

Subfamily **Idoceratinae** Spath, 1924
Genus *NEBRODITES* Burckhardt, 1910
Nebrodites (Passendorferia) sp. *A*
(Pl. 8, Fig. 10)

Dimensions: S = 66 mm; W/S = 0.24; G/S = ?0.15; P/S = 0.56.

diameter	70	57	51	46
number of ribs	59	57	53	52

Remarks. — The specimen represents the subgenus *Passendorferia* Brochwicz-Lewiński, 1973, but it differs from all the species hitherto described. It seems close to *Nebrodites (Passendorferia) birmensdorfensis* (Moesch) from which it differs in heavier sculpture, point of furcation situated lower on the whorl side, and in smaller number of single ribs.

Occurrence. — The specimen No. Mt43 was found west of Wolica, Morawica Limestones, *bifurcatus* Zone.

Family **Aspidoceratidae** Zittel, 1895
Subfamily **Peltoceratinae** Spath, 1924
Genus *RURSICERAS* Buckman, 1919
Rursiceras sp. *A*
(Pl. 5, Fig. 8)

Remarks. — The specimen is presumably an intermediate form, in the evolutionary series (*cf.* Prieser 1937, p. 131) that lies between *Rursiceras reversum* (Leckenby) and *Rursiceras bodeni* (Prieser). It differs from the former species in lower point of furcation of ribs on inner whorls and exclusively single ribs on the outer whorl, and from the latter species — in more loosely spaced and coarser ribs and more rounded whorl section.

Occurrence. — The specimen No. Mt453 comes from Wolica quarryroad, Marly Limestones (layer 2), *mariae* Zone or *bukowskii* Subzone of the *cordatum* Zone; Mt 609 and Mt 615 — from Lasocin, Marly Limestones, *cordatum* Zone.

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B. A. MATYJA

STRATYGRAFIA OKSFORDU POŁUDNIOWO-ZACHODNIEGO OBRZEŻENIA MEZOZOICZNEGO GÓR ŚWIĘTOKRZYSKICH

(Streszczenie)

Przedmiotem pracy jest stratygrafia utworów oksfordu odsłaniających się w południowo-zachodnim obrzeżeniu mezozoicznym Gór Świętokrzyskich (*por.* fig. 1). Wydzielono następujące nieformalne jednostki litostratygraficzne: *gezy wapniste, wapienie margliste, wapienie siwe, wapienie morawickie, wapienie skaliste, wapienie siedleckie,* oraz *wapienie kredowate.* Ostatnią z wymienionych jednostek, jak i młodsze (*por.* fig. 4) przyjęto zgodnie z wcześniejszymi wydzieleniami J. Kutka (1968). Podano charakterystykę litologiczną i facjalną wydzielonych jednostek (*por.* fig. 2—3 oraz 5).

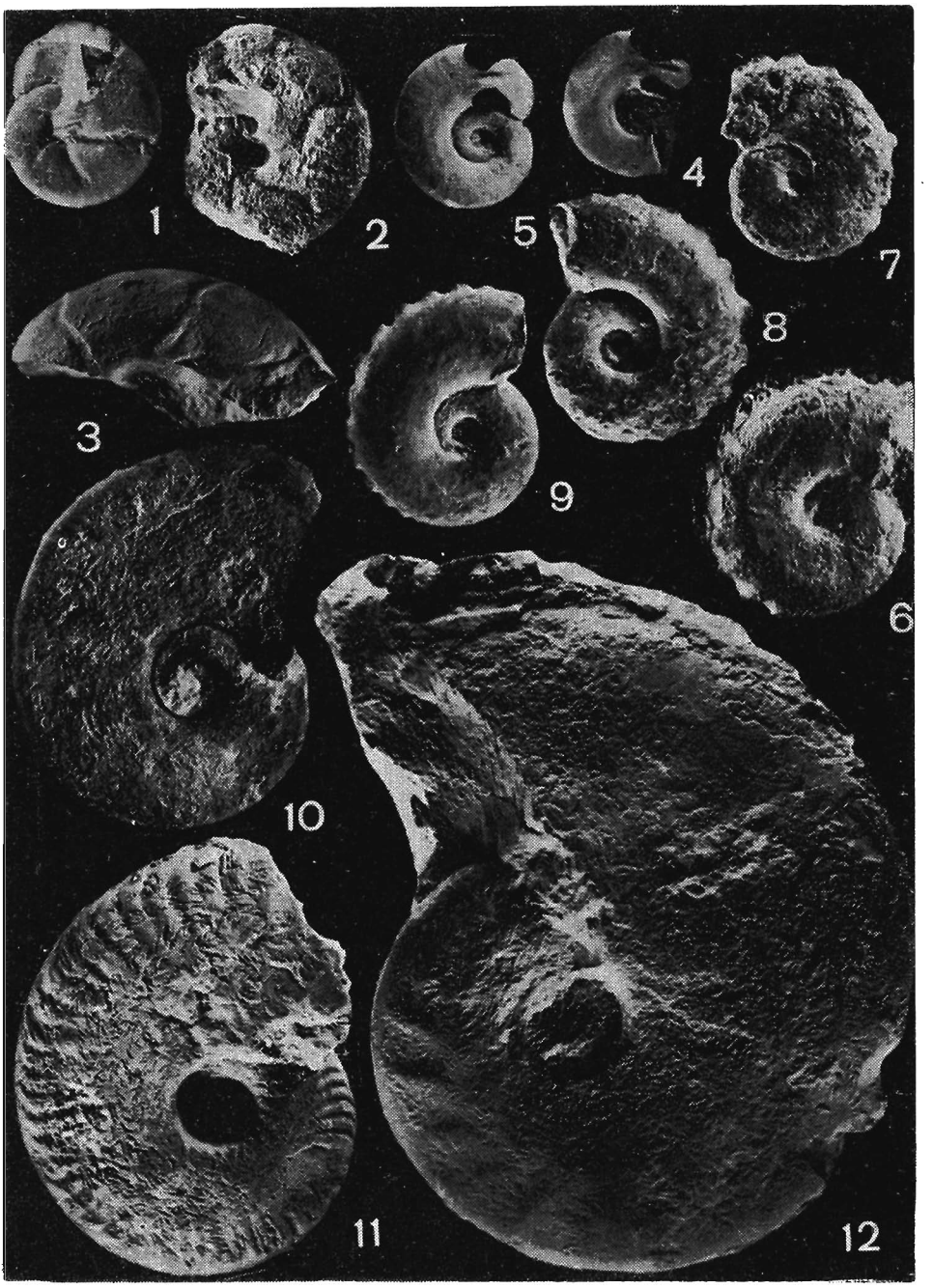
Na podstawie bogatego zbioru amonitów (*por.* tab. 1—2 oraz pl. 1—10) wyróżniono szereg poziomów biostratygraficznych oksfordu. W oksfordzie dolnym wyróżniono poziomy *mariae* i *cordatum.* W tym ostatnim poziomie wyróżniono podpoziomy *bukowskii, costicardia* i *cordatum* (patrz fig. 6), nawiązując tym samym do podziału stosowanego powszechnie w Europie. W oksfordzie środkowym i górnym wyróżniono submedyterańskie poziomy: *plicatilis, transversarium, bifurcatus* i *bimammatum.* Po raz pierwszy na badanym obszarze znaleziono amonity reprezentujące ostatni z wymienionych poziomów. Wyróżnione jednostki litostratygraficzne skorelowano z jednostkami biostratygraficznymi (fig. 7).

PLATE 1

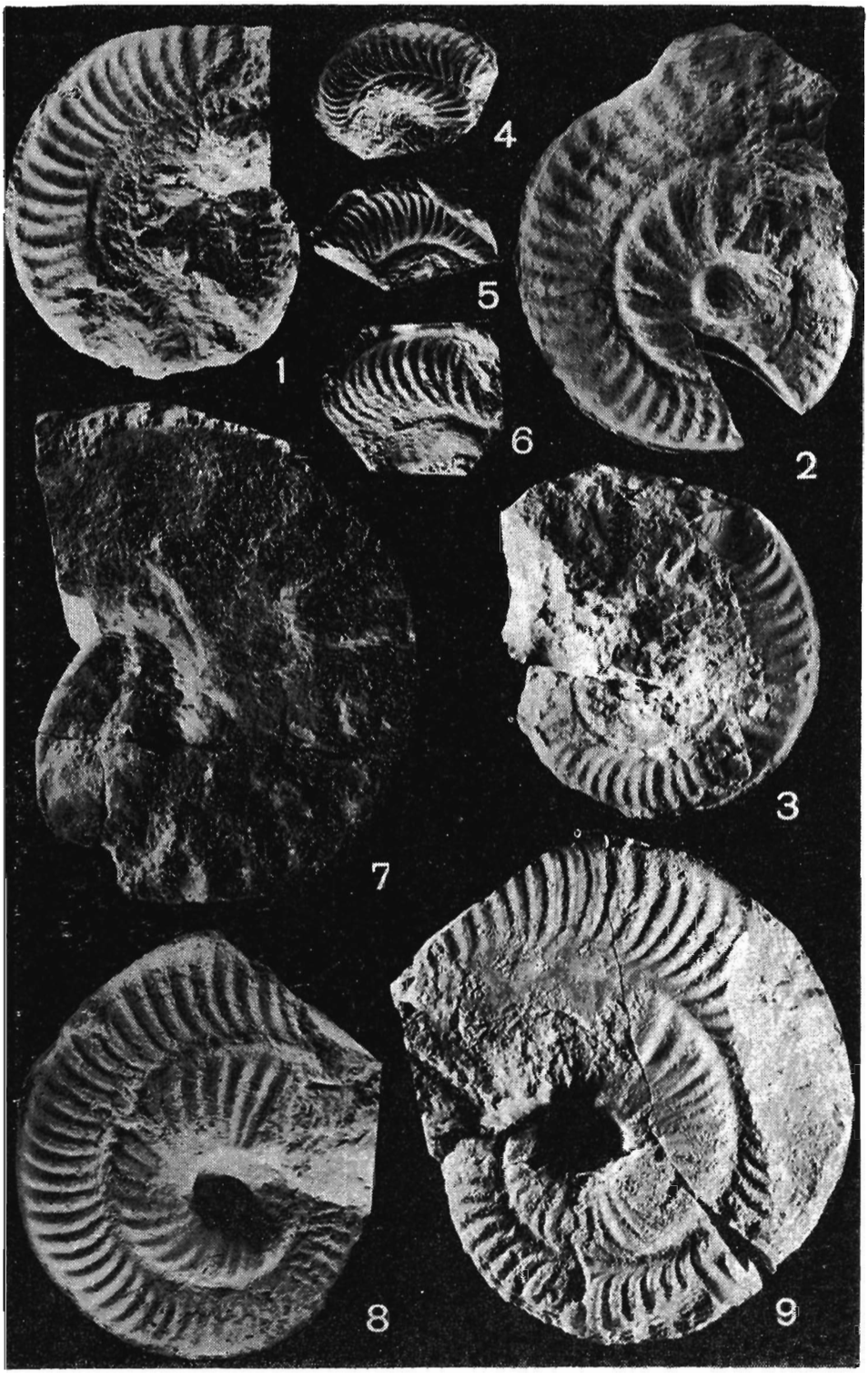
1 *Holcophylloceras zignodianum* (d'Orbigny); Specimen No. Mt305, Wolica quarryroad, Marly Limestones (layer *8*).
2—3 *Sowerbyceras tortisulcatum* (d'Orbigny): *2* — Mt97, Wolica quarryroad, Gaizes (layer *1*); *3* — Mt155, Siedlce quarry, Siedlce Limestones.
4—5 *Glochiceras (Coryceras) modestiforme* (Oppel): *4* — Mt413, Siedlce quarry, Siedlce Limestones; *5* — Mt70, Wolica quarry, Siedlce Limestones.
6—7 *Creniceras renggeri* (Oppel): *6* — Mt262, Wolica quarryroad, Marly Limestones (layer *2*); *7* — Mt642, the same locality, (layer *4*); both × 2.
8—9 *Creniceras crenatum* (Bruguière): *8* — Mt6, Wolica quarryroad, Marly Limestones (layer *17*); *9* — Mt425, Wola Morawicka quarry, Marly Limestones; both × 2.
10 *Lissoceratoides erato* (d'Orbigny); Mt287, Wolica quarryroad, Marly Limestones (layer *28*).
11 *Neocampylites delmontanus helveticus* (Jeannet); Mt363, Mieczyn quarry, Marly Limestones.
12 *Neocampylites villersi* (Rollier); Mt362, Wola Morawicka quarry, Marly Limestones.

PLATE 2

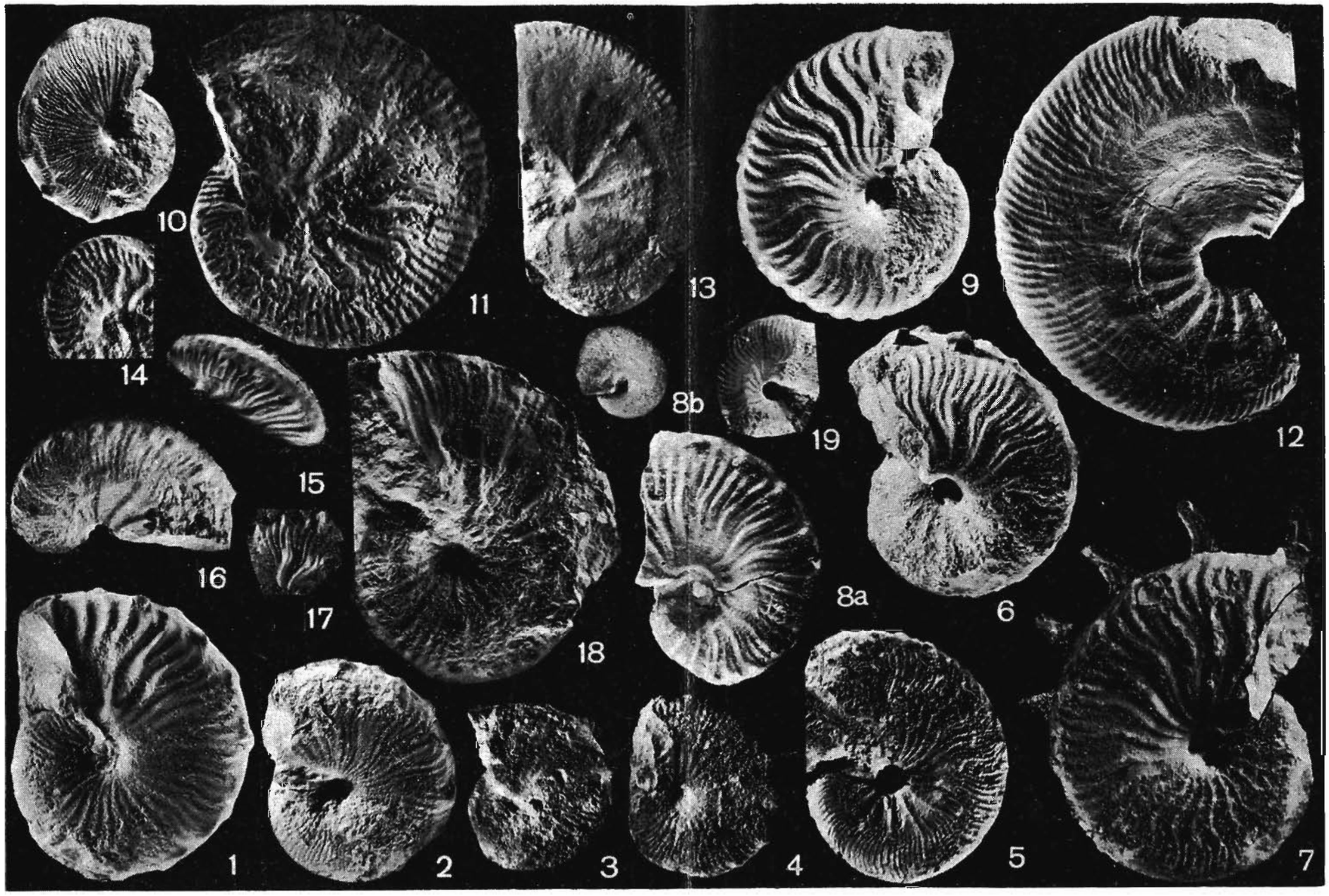
1—3 *Neoprionoceras lautlingense* (Rollier): *1* — Specimen No. Mt358, *2* — Mt360, both from south of Brzeziny, Morawica Limestones; 3 — Mt249, Wolica quarryroad, Morawica Limestones.
4—6 *Ochetoceras marantianum* (d'Orbigny): *4* — Mt58, *5* — Mt13, *6* — Mt19, all from Siedlce quarry, Siedlce Limestones.
7 *Trimarginites trimarginatus* (Oppel); Mt416, Morawica quarry, Morawica Limestones.
8—9 *Ochetoceras canaliculatum* (v. Buch): *8* — Mt353, Wielebnów, Morawica Limestones; *9* — Mt82, Tokarnia quarry, Morawica Limestones.



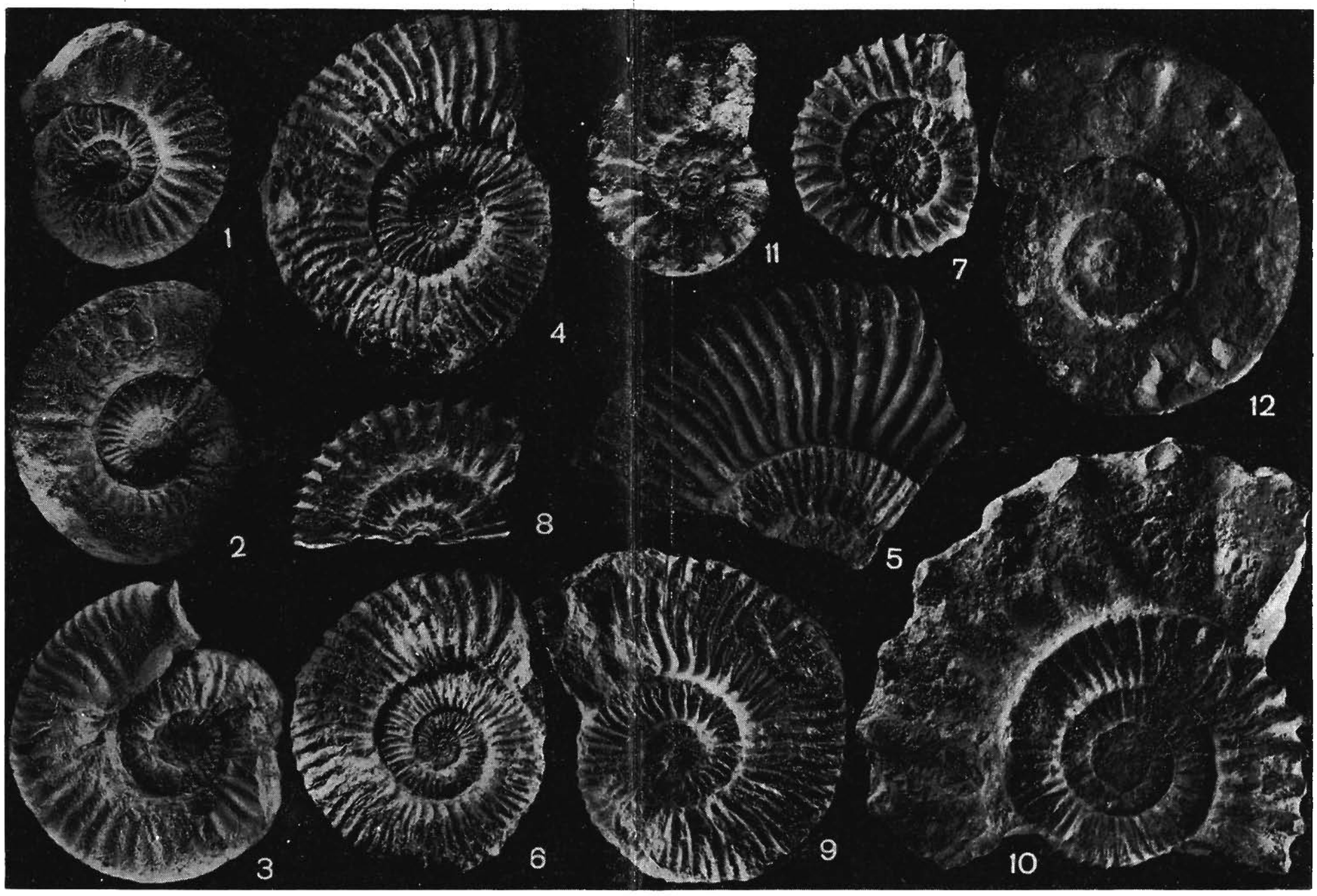
(Explanation in the opposite page)



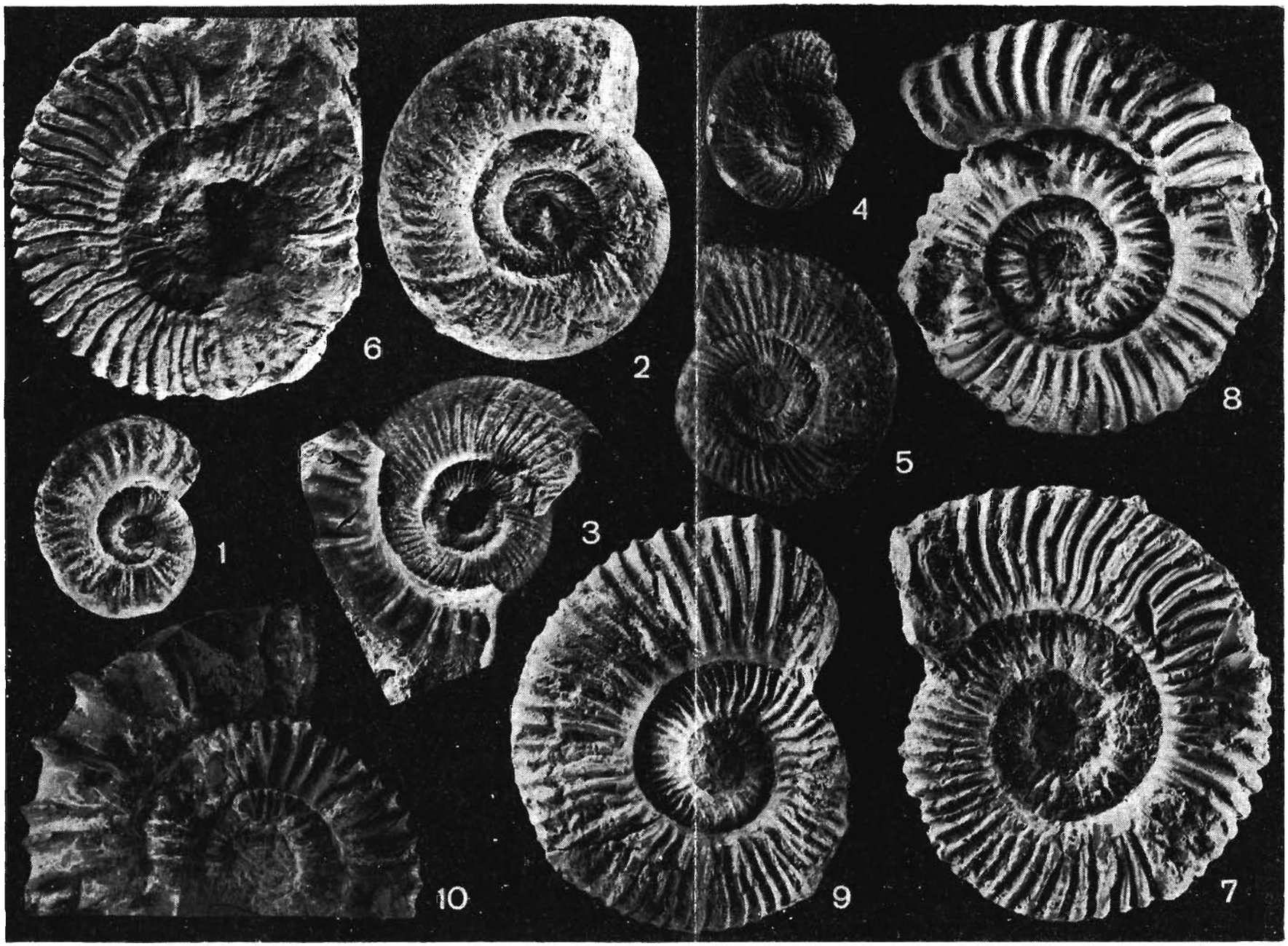
(*Explanation in p. 64*)



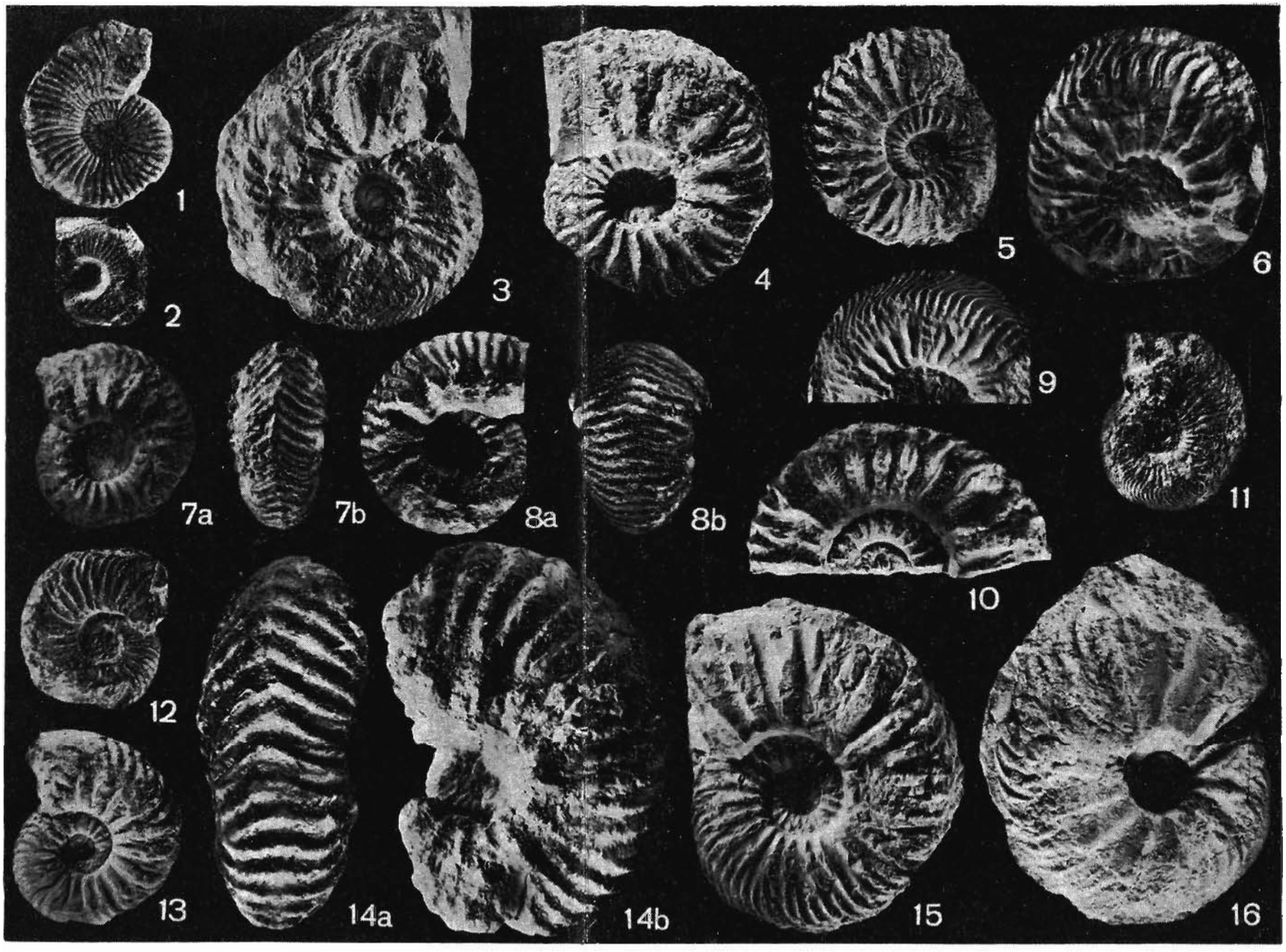
1—2 *Taramelliceras argoviense* Jeannet: *1* — Specimen No. Mt17, Wolica quarryroad, Gaizes (layer *1); 2* — Mt370, Wolica quarryroad, Marly Limestones (layer *3*).
3—4 *Taramelliceras minax* (Bukowski): *3* — Mt383, Mieczyn quarry, Marly Limestones; *4* — Mt616, Lasocin, Marly Limestones.
5 *Taramelliceras nycteis* (Bukowski); Mt203, Wolica quarryroad, Marly Limestones (layer *28*).
6 *Taramelliceras pseudoculatum* (Bukowski); Mt372, Wolica quarryroad, Marly Limestones (layer *38*).
7 *Taramelliceras romani* (de Riaz); Mt312, Mieczyn quarry, Morawica Limestones.
8 *Taramelliceras pseudotrachinotum* Hölder; Mt402, Morawica, Morawica Limestones (*8b* shows inner whorls of the specimen presented in *8a*).
9 *Taramelliceras dentostriatum* (Quenstedt); Mt48, Wolica quarryroad, Morawica Limestones.
10 *Taramelliceras anar* (Oppel); Mt32, Wolica quarryroad, Morawica Limestones.
11—12 *Taramelliceras externnodosum* (Dorn): *11* — Mt396, Morawica quarry, Morawica Limestones; *12* — Mt390, var. *mediocris* Hölder, west of Wolica, Siedlce Limestones.
13 *Streblites tenuilobatus frotho* (Oppel); Mt90, Tokarnia village, Morawica Limestones.
14—18 *Taramelliceras costatum* (Quenstedt): *14* — Mt67, *15* — Mt412, *16* — Mt162, *17* — Mt265, *18* — Mt4, all from Siedlce quarry, Siedlce Limestones.
19 *Taramelliceras pichleri* (Oppel); Mt7, Wolica quarry, Siedlce Limestones.



1 *Mirosphinctes frickensis* (Moesch); Specimen No. Mt327, Wolica quaryroad, Marly Limestones (layer *2*).
2 *Mirosphinctes* sp. A; Mt215, Wolica quarryroad, Marly Limestones (layer *2*).
3 *Mirosphinctes* sp. *B;* Mt502, Wolica quarryroad, Marly Limestones (layer *4*).
4–5 *Parawedekindia arduennensis* (d'Orbigny): *4* — Mt490, Mieczyn quarry, Marly Limestones; *5* — Mt146, Wolica quarryroad, Marly Limestones (layer *24*).
6 *Rursiceras bodeni* (Prieser); Mt480, Mieczyn quarry, Marly Limestones.
7 *Peltomorphites athletoides* (Lahusen); Mt457, Wolica quarryroad, Marly Limestones (layer *4*).
8 *Peltomorphites subeugenii* Arkell; Mt242, Wolica quarryroad, Marly Limestones (layer *8*).
9 *Peltoceratoides constantii* (d'Orbigny); Mt22, Wolica quarryroad, Marly Limestones (layer *22*).
10 *Peltomorphites hoplophorus* Buckman; Mt245, Wolica quarryroad, Marly Limestones (layer *36*).
11 *Aspidoceras (Euaspidoceras) douvillei* Collot; Mt1, Wolica quarryroad, Marly Limestones (layer *24*).
12 *Aspidoceras (Euaspidoceras) ovale* Neumann Mt452, Wolica quarryroad, Marly Limestones (layer *16*).

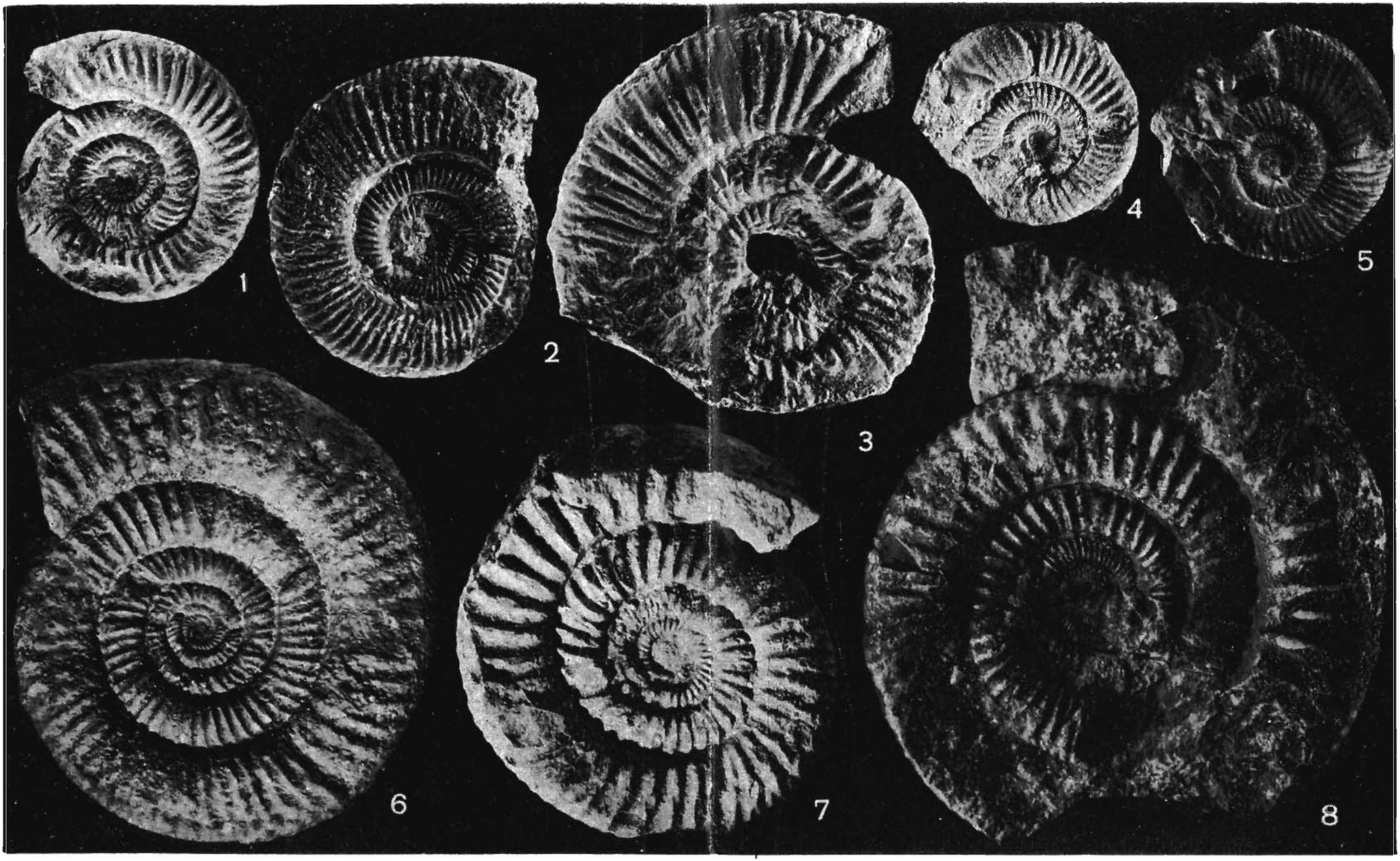


1 *Mirosphinctes mirus* (Bukowski); Specimen No. Mt600, Mieczyn quarry, Marly Limestones.
2—3 *Perisphinctes (Prososphinctes) consociatus* Bukowski: *2* — Mt186, Wolica quarryroad, Marly Limestones (layer *26*); *3* — Mt640, the same locality (layer *20*).
4 *Perisphinctes (Prososphinctes) mazuricus* Bukowski; Mt221, Wolica quarryroad, Marly Limestones (layer *22*).
5 *Perisphinctes (Prososphinctes) claromontanus* Bukowski; Mt516, Wolica quarryroad, Marly Limestones (layer *27*).
6—7 *Rursiceras bodeni* (Prieser): *6* — Mt126, Wolica quarryroad, Marly Limestones (layer *26*); *7* — Mt233, the same locality (layer *28*).
8 *Rursiceras* sp. *A;* Mt453, Wolica quarryroad, Marly Limestones (layer *2*).
9 *Peltoceratoides constantii* (d'Orbigny); Mt157, Wolica quarryroad, Marly Limestones (layer *2*).
10 *Peltomorphites eugenii* (Raspail); Mt128, Wolica quarryroad, Marly Limestones (layer *4*).

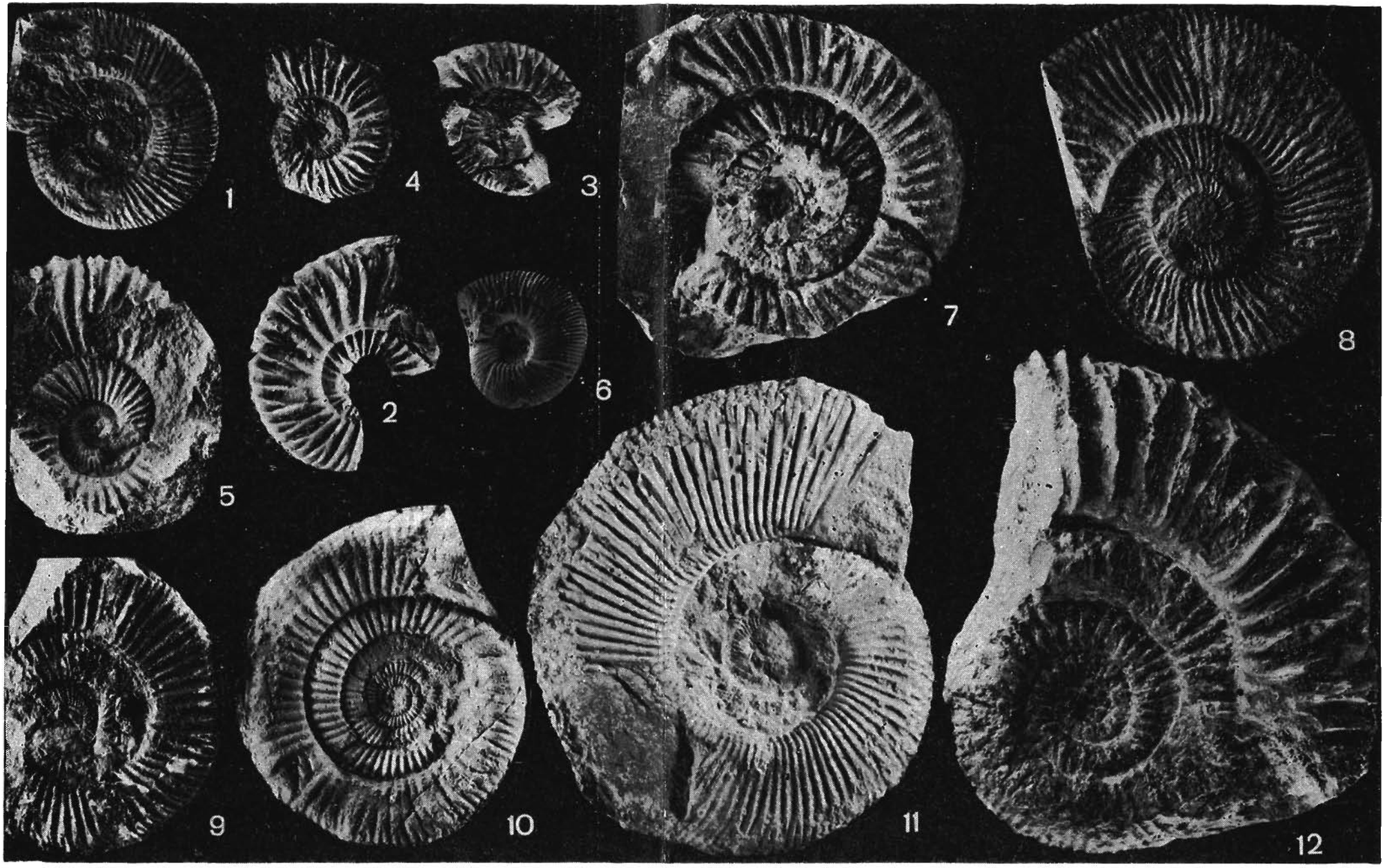


1 *Amoeboceras ovale* (Quenstedt); Specimen No. Mt223, west of Wolica, Morawica Limestones.
2 *Cardioceras (Plasmatoceras) tenuistriatum* Borissjak; Mt260, Tokarnia quarry, Grey Limestones.
3 *Cardioceras (Scoticardioceras) expositum* Buckman; Mt229, south of Brzeziny, Morawica Limestones.
4 *Cardioceras (Cardioceras) costicardia* Buckman var. *vulgare* Arkell; Mt272, Wolica quarryroad, Marly Limestones (layer *44*).
5 *Cardioceras (Vertebriceras) quadrarium* Buckman var. *filatum* Arkell; Mt329, Mieczyn quarry, Marly Limestones.
6 *Cardioceras (Cardioceras) persecans* Buckman; Mt352, Wielebnów, Marly Limestones.
7 *Goliathiceras (Goliathites) cyclops* Arkell; Mt14, Wolica quarryroad, Marly Limestones.
8 *Goliathiceras (Goliathites) goliathus* (d'Orbigny); Mt25, Wolica quarryroad, Marly Limestones.
9 *Cardioceras (Cardioceras) ashtonense* Arkell; Mt74, Tokarnia village, Marly Limestones.
10 *Cardioceras (Vertebriceras) altumeratum* Arkell; Mt259, Wolica quarryroad, Marly Limestones (layer *30*).
11 *Cardioceras (Scarburgiceras) bukowskii* Maire; Mt339, Wolica quarryroad, Marly Limestones (layer *16*).
12 *Cardioceras (Scarburgiceras) scarburgense* (Young & Bird); Mt200, Wolica quarryroad, Gaizes (layer *III* or *I*).
13 *Quenstedtoceras mariae* (d'Orbigny); Mt78, Wolica quarryroad, Gaizes (layer *III* or *I*).
14 *Quenstedtoceras omphaloides* (Sowerby); Mt118, Wolica quarryroad, Gaizes (layer *III*).
15 *Cardioceras (Scarburgiceras) harmonicum* Maire; Mt322, Wolica quarryroad, Marly Limestones (layer *1* or *2*).
16 *Cardioceras (Scarburgiceras) mirabile* Arkell; Mt117, Tokarnia quarry, Marly Limestones.

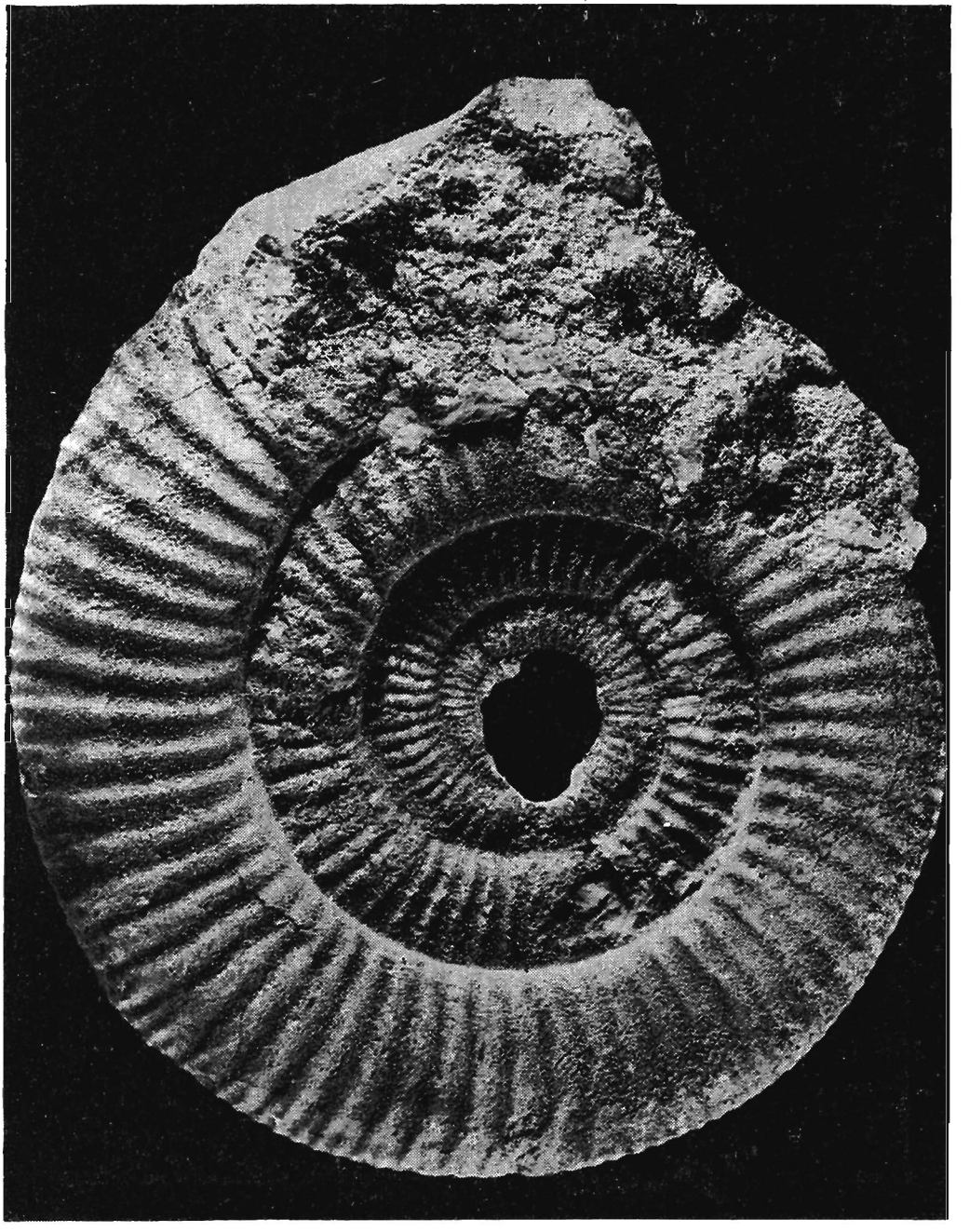
B. A. MATYJA, PL. 6



1 *Perisphinctes (Properisphinctes)* aff. *bernensis* Loriol; Specimen No. Mt503, Wolica quarryroad, Marly Limestones (layer 4).
2 *Perisphinctes (Alligaticeras)* sp.; Mt187, Wolica quarryroad, Marly Limestones (layer 8).
3 *Perisphinctes (Otosphinctes)* sp. *C*; Mt596, south of Brzeziny, Grey Limestones.
4 *Perisphinctes (Properisphinctes)* sp. indet.; Mt500, Wolica quarryroad, Gaizes (layer *III*).
5 *Perisphinctes (Otosphinctes)* sp. *B*; Mt573, north of Przymiarki, Morawica Limestones.
6 *Perisphinctes (Kranaosphinctes) cyrilli* Neumann; Mt180, Wolica quarryroad, Marly Limestones (layer 19).
7 *Perisphinctes (Kranaosphinctes) decurrens* Buckman; Mt641, Wolica quarryroad, Marly Limestones (layer 2).
8 *Perisphinctes (Arisphinctes) maximus* (Young & Bird); Mt21, Maleszowa, Morawica Limestones.



1 ?*Idoceras* aff. *minutum* Dieterich; Specimen No. Mt156, Siedlce quarry, Siedlce Limestones.
2–3 *Microbiplices microbiplex* (Quenstedt):*2* — Mt129, *3* — Mt2; both from Wolica quarryroad, Morawica Limestones.
4–5 *Perisphinctes (Dichotomoceras) bifurcatus* (Quenstedt): *4* — Mt604, Wola Morawicka quarry, Morawica Limestones; *5* — Mt108, the same locality
6 *Ringsteadia (Ringsteadia) flexuoides* (Quenstedt); Mt54, Siedlce quarry, Siedlce Limestones.
7 *Perisphinctes (Otosphinctes)* sp. *A;* Mt49, north of Przymiarki, Grey Limestones.
8 *Perisphinctes (Dichotomosphinctes) dybowskii* Siemiradzki; Mt87, Tokarnia village, Grey Limestones.
9 *Perisphinctes (Dichotomoceras) bifurcatoides* Enay; Mt567, Mieczyn quarry, Morawica Limestones.
10 *Nebrodites (Passendorferia)* sp. *A;* Mt43, west of Wolica, Morawica Limestones.
11 *Perisphinctes (Dichotomosphinctes) elisabethae* de Riaz; Mt575, south of Wola Morawicka, Morawica Limestones
12 *Perisphinctes (Perisphinctes) malinowskae* Brochwicz-Lewiński; Mt588, Krasnowicka Hill, Morawica Limestones.



Orthosphinctes (?Pseudorthosphinctes) sp.; Specimen No. Mt100, Tokarnia village, Morawica Limestones; slightly reduced

Perisphinctes (Perisphinctes) martelli (Oppel); Specimen No. Mt538, south of Brzeziny, Morawica Limestones; slightly reduced