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Ammonites and stratigraphy of the Upper Oxfordian of the Wieluń Upland, Central Poland

ABSTRACT: Lithostratigraphy and ammonite zonation of the Upper Oxfordian (*bimammatum* and *planula* Zones) of the Wieluń Upland, Central Poland, are presented. The *bimammatum* and *hauffianum* Subzones of *bimammatum* Zone are recognized. The *Idoceras*-like and *Enayites-Idoceras* passage forms are found throughout the *hauffianum* Subzone, and the top of the Subzone is marked by the first appearance of true *Idoceras*. Three ammonite horizons, viz. *planula-costatum*, aff. *tenuinodosum*, and *planula-quenstedti* ones are distinguished within the *planula* Zone. Of the ammonites found in the Wieluń Upland, the following genera are discussed in greater detail in paleontological part of the paper: *Taramelliceras*, *Idoceras* and related forms, *Prorasenia*, *Ringsteadia*, *Pomerania*, *Progeronia*, and *Orthosphinctes*. Two new species are established, namely *Ringsteadia (Ringsteadia) submediterranea* sp.n. and *Orthosphinctes (Pseudorthosphinctes) lisowicensis* sp.n.

INTRODUCTION

The investigated part of the Wieluń Upland (northern Polish Jura Chain), Central Poland, extends along the Warta valley between Prusicko in the east and Bobrowniki in the west (Text-fig. 1). This region is among the most suitable areas for studying the Upper Oxfordian stratigraphy in Central Poland. In fact, this is a monoclinal structure gently dipping at a few degrees and only locally additionally tectonized; the lithostratigraphic sequence is relatively simple and the massive limestones (*Massenkalk*) occur only subordinately; the strata are well-exposed due to a lot of acting quarries; the ammonites occur abundantly in a large part of the sequence (Text-figs 1—3).

The present author worked in the Wieluń Upland during some 15 years. Some results of the investigations on the stratigraphy of the uppermost Oxfordian (and especially upper part of the *planula* Zone) and Lower Kimmeridgian have already been published (Wierzbowski 1965, 1966, 1970, and other papers cited therein; Kutek & Wierzbowski 1971; Kutek & *al.* 1977, Fig. 2); however, the data on the Upper Oxfordian (*bimammatum* and *planula* Zones) remain mostly unpublished. To present those data is the aim of this paper.

The collected material is large (over 1,200 identified ammonite specimens; c 200 quarries and 40 boreholes studied; geological maps of scale 1 : 25,000) and it can be here dealt with only in general terms. Therefore, some strictly regional aspects of the problem are beyond the scope of the present paper and will be considered elsewhere.

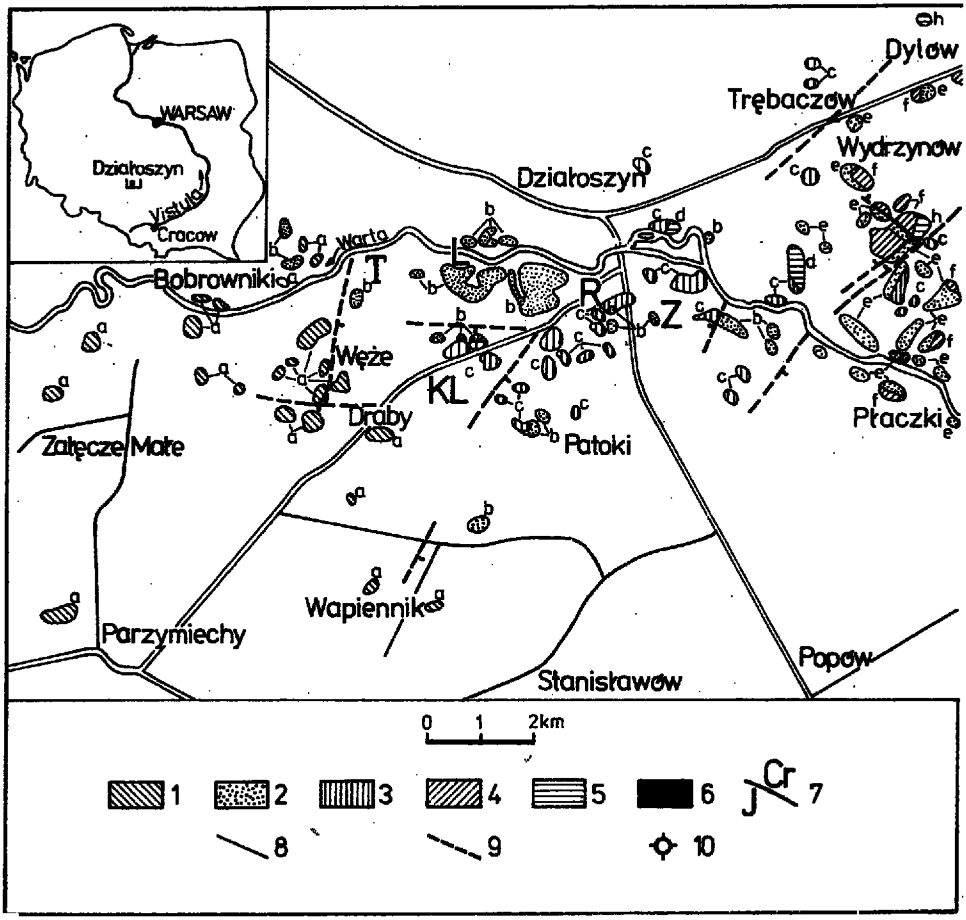
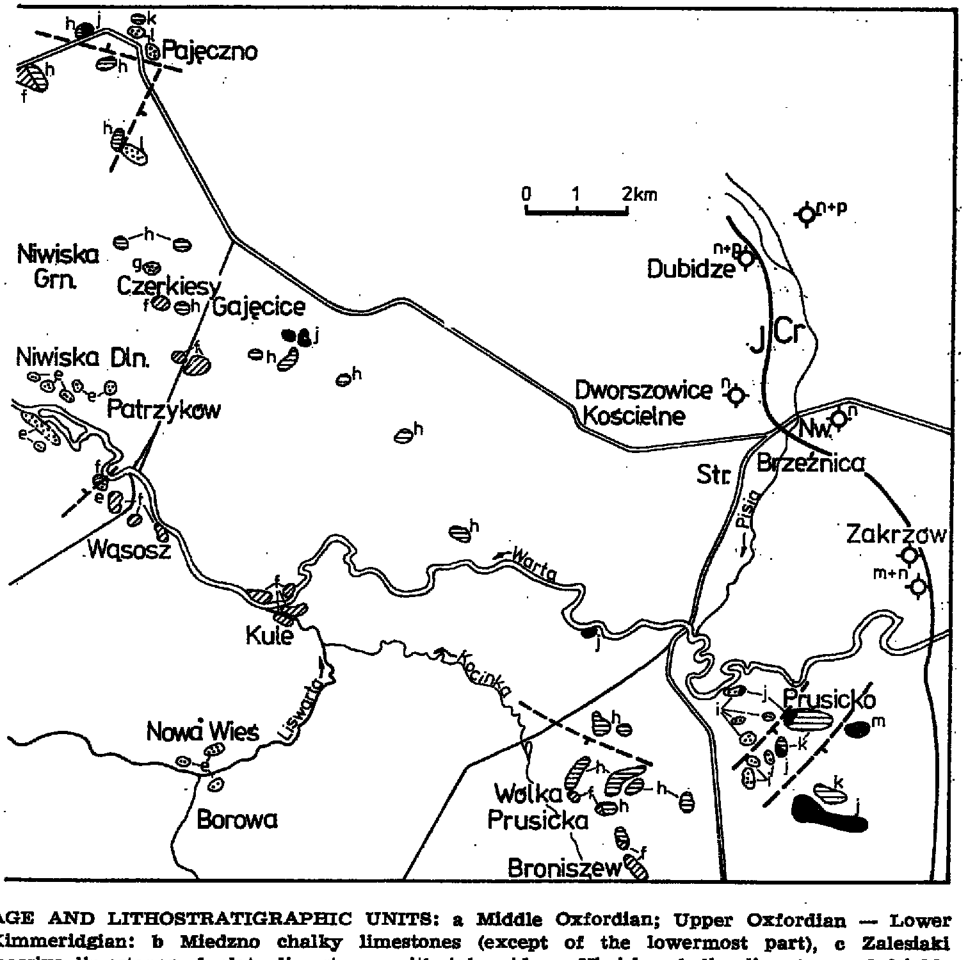


Fig. 1. Geological map of the Jurassic outcrops in the Wieluń Upland; inset shows the position of the Wieluń Upland in Poland

LITHOLOGY AND OTHER GENERAL DESIGNATIONS: 1 spongy-tuberolitic limestones, massive limestones and chalky limestones not differentiated; 2 chalky limestones; 3 massive limestones; 4 thick-bedded friable micritic limestones; 5 thin-bedded micritic limestones with marly intercalations (platy limestones); 6 marls; 7 Jurassic/Cretaceous boundary under Quaternary deposits; 8 faults; 9 faults covered by Quaternary deposits; 10 boreholes penetrating the youngest Jurassic deposits of the investigated area

The *hypselum* Subzone (lowermost part of *bimammatum* Zone) is not considered in the present paper, as no strata ascribed to that subzone are exposed in the Wieluń Upland. However, the ammonites of that age collected in other areas of the Polish Jura Chain and housed at the Institute of Geology of the Warsaw University will be subject to a separate study carried jointly by the present author and Professor J. Kutek.

Acknowledgements. The author is grateful to Professor J. Kutek and Dr. B. A. Matyja, Institute of Geology, Warsaw University, for discussion. The study was partly carried within the M.R.1.16 Problem *"Geodynamics of Poland"*.



AGE AND LITHOSTRATIGRAPHIC UNITS: a Middle Oxfordian; Upper Oxfordian — Lower Kimmeridgian: b Miedzno chalky limestones (except of the lowermost part), c Zalesiaki massive limestones, d platy limestones with tuberoids, e Niwiska chalky limestones, f friable micritic limestones, g Czerkiesy chalky limestones, h lower platy limestones, i Prusicko chalky limestones, j lower marly unit, k middle platy limestones, l Pajęczno chalky limestones, m middle marly unit, n Kule chalky limestones and upper platy limestones, p upper marly unit

Abbreviations for some localities: *L* Lisowice, *KL* Kolonia Lisowice, *R* Raciszyn, *T* Tasarze, *Z* Zalesiaki

SEDIMENTS AND LITHOSTRATIGRAPHY

The investigated Upper Oxfordian sequence can be divided into two lithologic portions. The lower one is dominated by soft, friable, chalky limestones and massive limestones containing a rich and diverse benthic fauna typical of the spongy megafacies; thus, the deposits continue the sedimentation type that started in the investigated area in the Lower Oxfordian. In the upper part of the sequence, there appear micritic limestones and marls with poor mostly pelagic-nektic fauna, and flat carbonate banks and bioherms comprising initially sponges but higher in the section also with hermatypic corals; this sedimentation type continues up into the Lower Kimmeridgian.

The Upper Oxfordian total thickness approximates 320 m. The informal lithostratigraphic units presented below (Text-figs 1—2; *cf.* also Kutek & *al.* 1977, Fig. 2) are probably to be recognized for members in the future.

MIEDZNO CHALKY LIMESTONES

The unit has been originally distinguished by Malinowska (1972) as the Miedzno Beds called after Miedzno village, 15 km south of Działoszyn (Text-figs 1 and 3); however, its boundaries (in particular the top) have not insofar been clearly defined. In the study area, the base of Miedzno chalky limestones is within the uppermost Middle Oxfordian, at the top of Zelce massive limestones in Węże-Draby area. The top of the unit is at the base of Zalesiaki massive limestones in Raciszyn--Zalesiaki area (Text-figs 1—2). Both the boundaries appear slightly diachronous (Text-fig. 2). The outcrops are mostly clustered around Bobrowniki, Tasarze, Lisowice and Wapiennik for the lower part of the unit; and between Lisowice, Raciszyn, and Działoszyn, and at Zalesiaki for the upper part. The lower part of the unit is only incompletely exposed. The most important unexposed part of the sequence approximates 15—20 m in thickness and is comprised between the chalky limestones of Węże-Draby area and the overlying chalky limestones of Bobrowniki and Wapiennik area. Totally, the Miedzno chalky limestones attain some 100 m in thickness.

The limestones are medium- to thick-bedded, white, usually soft, friable, and porous; somewhat more compact variety occurs in the uppermost part of the unit; black cherts are common. The fauna is rich and diverse, including siliceous sponges, serpulids, bryozoans, brachiopods, pelecypods, ammonites, crustaceans, and echinoderms. The grain components include usually small onkoids, aggregated lumps, peloids, and bioclasts; the matrix is mostly micrite (probably with calcite crystals loosely arranged) but some possible primary voids partly filled with sparry calcite do also occur.

There are marly intercalations of high local stratigraphic value within the Miedzno chalky limestones. A set composed of two marly layers, each of them a dozen centimeters thick, occurs in the lower part of the unit. It has been found at Bobrowniki and Wapiennik (Text-fig. 2), that is over some 6 km in distance. Four other more distinct sets formed by alternating marly shales and limestones occur at the top of the lower part and in the upper part of the unit. The two lower ones are accessible at Lisowice (Text-fig. 3; outcrops *140 Dz* and *5 Mi*); their maximum thickness is 3.5 and 1.5 m, respectively. The two higher sets are best exposed at the left side of Warta valley by Raciszyn (Text-fig. 3; outcrops *113 Dz* and *128 Dz*) and attain 1.5 and ca 4 m in maximum thickness. The top of the highest marly set marks the top of Miedzno chalky limestones in Raciszyn area. The limestones comprised within the considered marly sets are mostly micritic with some fossils (sponges, brachiopods, ammonites) and relatively few grain components.

ZALESIAKI MASSIVE LIMESTONES

This unit is mostly exposed between Kolonia Lisowice, Patoki, Raciszyn, and Zalesiaki. In that area, one can also see the contact with underlying Miedzno chalky limestones. The Zalesiaki massive limestones are also exposed between Działoszyn and Trębaczów. The unit attains some 25 m in thickness.

The Zalesiaki massive limestones are thick-bedded to non-bedded, whitish to light brown, hard, and dense but sometimes, with fairly abundant vugs and cavities; cherts are absent. The fauna resembles generally that of the underlying chalky limestones. Stromatolite-like structures do commonly occur. The grain components include small ooids, onkoids, lithoclasts, aggregated lumps, and bioclasts. Sparry cement often occurs.

There are two marly intercalations a dozen centimeters thick and separated by micritic limestones 1 m thick, in the middle of Zalesiaki massive limestones; micritic limestones occur also just below and above the marly layers. The entire set is of a local stratigraphic value and occurs in the quarries at Trębaczów, Zalesiaki, and Kolonia Lisowice (Text-fig. 3; outcrops *13 Dz, 94 Dz, 178 Dz*), that is over some 6 km in distance.

PLATY LIMESTONES WITH TUBEROIDS

Thin platy beds of dense micritic limestones occur in waste deposits and small quarries east of Działoszyn at the right side of Warta river. The limestones contain sometimes tuberoids and spongy mummies. The unit does probably not exceed 5 m in thickness. It disappears eastwards, as the Zalesiaki massive limestones are directly overlaid by the Niwiska chalky limestones in the boreholes situated near Niwiska and Patrzyków.

NIWISKA CHALKY LIMESTONES

This unit is exposed in the neighborhood of Trębaczów, Niwiska Górne and Niwiska Dolne at the right side of Warta river, and between Zalesiaki and Wąsosz at the left side of the river. The top of the unit is at the base of friable micritic limestones; it can be observed in outcrops at Niwiska Dolne (*e.g.* outcrop *60 Dz* in Text-fig. 3) and Antonie. Both the boundaries of this unit (Text-fig. 2) are clearly diachronous. The Niwiska chalky limestones range in thickness from 30 to ca 40 m.

The unit comprises well-bedded, typical soft chalky limestones very similar to those of Miedzno unit. The fauna is also similar; however, the calcareous sponges seem to appear in large amounts in the considered unit for the first time in the Upper Oxfordian sequence (*cf.* Hurcewicz 1975). In the uppermost part of the unit, thin marly intercalations may occur abundantly and the proportion of micrite matrix may increase relative to the grain components. The Niwiska chalky limestones correspond mostly to the lower part of lower chalky limestones as conceived previously by the present author (Wierzbowski 1966).

FRIABLE MICRITIC LIMESTONES

The main exposures are clustered between Wydrzynów and Niwiska, in the neighborhood of Wąsosz, and near Wólka Prusicka. In Trębaczów-Niwiska area, marly intercalations appear in the lowermost part of the unit equivalent probably to those of the uppermost part of Niwiska chalky limestones from the environs of Patrzyków and Nowa Wieś (Text-fig. 2). Then, the base of friable micritic limestones is slightly diachronous. The top boundary of the unit is marked by a considerable increase in marl amounts; it is exposed near Wydrzynów (cement--works quarries) and in some small outcrops south of Wólka Prusicka. The unit attains some 70 m in thickness.

The limestones are thick-bedded (but flaggy when weathered), white, soft, and friable. They consist mainly of porous micrite, the porosity caused probably by loose arrangement of the eu- or subhedral calcite crystals (*cf.* Matyja 1977); the calcium carbonate content is usually extremely high (more than 99%). The limestones are very poorly fossiliferous; the ammonites, small-sized pelecypods (*Astarte*), and crinoids (*Pentacrinus*) occur rarely. Cherts are absent.

CZERKIESY CHALKY LIMESTONES

Chalky limestones with sponges, brachiopods, serpulids, and bryozoans forming probably a flat bank within the friable micritic limestones have been found in the boreholes and wells situated between Czerkiesy and Głuszyny villages, over a distance of at least 2 km. The thickness of this unit can hardly be estimated more precisely than as more than 10 m.

LOWER PLATY LIMESTONES

This unit is exposed between Pajęczno and Dylów in the north and Wólka Prusicka in the south. The base of the unit is at the top of friable micritic limestones. The top of the unit is at the base of lower marly unit; it has been observed in the boreholes and wells at Pajęczno, Gajęcice, and Ważne Młyny (Text-fig. 2; Wierzbowski 1966). The lower platy limestones consist of alternating thin beds of micritic limestones and marls. Their thickness range from 26 m at Gajęcice to some 30 m at Ważne Młyny.

The limestones are usually somewhat argillaceous, compact, hard, and flaggy. Both the limestones and intercalated marls are blue-grey when fresh but yellow and creamy when weathered. The rocks are very poorly fossiliferous.

The deposits discussed were previously (Wierzbowski 1966) regarded as the upper part of lower platy limestones, while the strata ascribed at present to the friable micritic limestones were then regarded as the lower part of lower platy limestones.

PRUSICKO CHALKY LIMESTONES

The lower platy limestones are replaced laterally with chalky limestones in the neighborhood of Prusicko and further to the south. The base of the latter unit has not been recognized in the study area; its top is at the base of lower marly unit at Prusicko (Text-fig. 2). The minimum thickness of Prusicko chalky limestones is ca 20 m.

The limestones are thick-bedded to non-bedded, usually soft, friable, and porous but a more compact variety does also occur. Black cherts occur commonly. The fauna is rich and diverse, including calcareous sponges, corals (mainly *Microsolena*), bryozoans, brachiopods, serpulids, and echinoderms. The matrix is micrite or sparry-

-micritic. The grain components include commonly onkoids, aggregated lumps, and bioclasts.

The Prusicko chalky limestones correspond mostly to the upper part of lower chalky limestones as conceived previously by the present author (Wierzbowski 1966).

LOWER MARLY UNIT

The lower platy limestones and Prusicko chalky limestones are directly overlaid by marly deposits recognized for the lower marly unit (Wierzbowski 1966). The latter deposits have been found in several wells and boreholes situated between Prusicko and Pajęczno, the profiles of which are given elsewhere (Wierzbowski 1966, Fig. 4). The thickness of the unit ranges from a few meters up to some 20 m. It is smaller over the chalky limestones, while greater over the platy limestones.

The lower marly unit consists of poorly fossiliferous marls intercalated subordinately with marly limestones; the only thicker limestone intercalation (up to 2 m thick) occurs in the middle part of the unit (Text-fig. 2). The microfossils (mostly foraminifers) were studied in detail by Garbowska (1970).

MIDDLE PLATY LIMESTONES

In the neighborhood of Prusicko and Ważne Młyny, the lower marly unit is overlaid by alternating thin beds of micritic limestones and marls recognized previously for the middle platy limestones (Wierzbowski 1966). The same unit may also comprise the lithologically close but younger strata underlying the middle marly unit, found mostly in the boreholes situated between Prusicko and Pajęczno. The Pajęczno chalky limestones occur between those two parts of middle platy limestones in the northwest of the study area; however, the chalky limestones seem to disappear entirely southeastwards, towards Prusicko (Text-fig. 2). The thickness of middle platy limestones varies depending upon the local facies development; it ranges from a few meters near Pajęczno up to some 50—60 m at Prusicko.

The deposits of this unit resemble very closely the lower platy limestones in both their lithology and fauna.

PAJĘCZNO CHALKY LIMESTONES

The relationship of the unit to the middle platy limestones has been discussed above (*see* also Text-fig. 2). The Pajęczno chalky limestones are exposed only at Pajęczno but they have also been found in the boreholes situated all over the area towards Ważne Młyny. The chalky limestones occurring near Gawłów, 6 km northeast of Pajęczno, may also be attributed to the considered unit. The Pajęczno chalky limestones range in thickness from 30 to (?) 50 m.

The deposits of this unit resemble very closely the Prusicko chalky limestones in both their lithology and fauna. There is, however, a considerable increase in marl content in the uppermost part of the unit; marly limestones appear with a rich benthic fauna including calcareous sponges, brachiopods, serpulids, pelecypods, crustaceans, echinoids, and crinoids (*cf.* Wierzbowski 1966, pp. 149—150 and Fig. 3).

The chalky limestones exposed at Pajęczno were previously (Wierzbowski 1966) regarded as older of (and partly equivalent to) lower marly unit and hence, referred erroneously to the lower chalky limestones. As shown by the boreholes, the chalky limestones of Pajęczno overlie actually the lower marly unit and correspond to the middle chalky limestones of Wierzbowski (1966). The latter name is here replaced with the name Pajęczno chalky limestones.

YOUNGER LITHOSTRATIGRAPHIC UNITS

All the units overlying the Pajęczno chalky limestones and the middle platy limestones are already attributed to the Lower Kimmeridgian (Text-fig. 2) and hence, will not be here considered. In fact, they have been characterized elsewhere (Wierzbowski 1966, Garbowska 1970, Kutek & *al.* 1977). Most lithostratigraphic names are retained (middle marly unit, upper marly unit, upper platy limestones), except of the name upper chalky limestones replaced at present with the name Kule chalky limestones (called after Kule village, 10 km north of Pajęczno).

AMMONITE SUCCESSION AND THE NATURE OF BIOSTRATIGRAPHIC BOUNDARIES

The ammonite collection permits the recognition in quantitative terms of their stratigraphic distribution in the Upper Oxfordian of the Wieluń Upland. The ammonite frequency varies throughout the investigated sequence. Therefore, the data are generally presented for family-group taxa, while the additional data for genus-group taxa are given in the cases of larger samples (Table 1).

Table 1

Composition of ammonite faunas in the Upper Oxfordian sequence of the Wieluń Upland (*cf.* Text-fig. 2). The presence (marked "+") of particular genus-group taxa is indicated when the number of specimens is too small to give the percentage

Deposits	Family-group taxa in %				Genus-group taxa in %												Number of specimens
	Haplocerataceae	Cardioceratidae	Perisphinctidae	Aspidoceratidae	Glochiceras	Taramelliceras except Metahaploceras	Metahaploceras	Ochetoceras Trimarginites	Amoeboceras	Prorasenia Rasenioides	Pictonites Eurasenia	Ringsteadia Pomerania	Orthosphinctes Progeronia	Idoceras Enayites	Aspidoceras Paraspidoceras	
micritic limestones and marls / younger chalky limestones	38.8 / –	–	61.2 / 95.7	– / 4.3	+ / –	+ / –	+ / –	–	–	+	+	+	+	+	– / +	36 / 23
Niwiska chalky limestones	50.9	1.8	46.7	0.6	19.4	22	9.6	–	1.8	7	0.6	4.3	17.7	17.1	0.6	327
Zalesiaki massive limestones	44	–	56	–	+	+	+	+	–	+	–	+	+	+	–	60
Miedzno chalky limestones, upper part	66.1	7	27.7	0.15	24.9	15	24.7	0.55	7	3.6	–	4.7	13.3	6.1	0.15	622
Miedzno chalky limestones, lower part, Lisowice and Tasarze sections	77.5	–	22.5	–	30.5	23.5	21.1	2.4	–	2.4	–	2.4	7.1	10.6	–	85
Miedzno chalky limestones, lower part, Bobrowniki and Wapiennik sections	60.8	–	39.2	–	14.5	40.6	4.3	1.5	–	8.7	–	14.5	16	–	–	69

The ammonites occur so abundantly in the lowermost part of the investigated sequence as to permit the estimation of both data types for particular portions of Miedzno chalky limestones. In contrast, they are so rare in the upper part of the investigated Oxfordian deposits that they have to be considered jointly from some lithologically close lithostratigraphic units; thus, the data are presented separately for the ammonites of biogenic chalky limestones and those of micritic limestones, marly limestones, and marls (Table 1).

The data gathered (Table 1) indicate clearly that there are rather slight changes in ammonite diversity and somewhat greater ones in frequency distribution of particular ammonite taxa in the Upper Oxfordian of the Wieluń Upland. Actually, both these characteristics are often mutually related and influenced by either evolutionary or ecological factors.

The appearance of the genus *Idoceras* in the upper part of Miedzno chalky limestones results undoubtedly from evolutionary factors. This is indicated by the occurrence of *Idoceras*-like forms in the underlying strata, which may be regarded as parental for various *Idoceras* species (*see* Text-fig. 2; *cf.* also the notes on the ammonites). The increase in abundance of *Taramelliceras litocerum*-group (belonging to the subgenus *Metahaploceras*) upwards in the section of Miedzno chalky limestones (Table 1, Text-fig. 2) may also result from some evolutionary process; in fact, it appears related to the bloom of the entire group reflected *e.g.* in development of new species.

In contrast, the decrease in abundance of the Haplocerataceae and the successive disappearance of some genera and subgenera of this superfamily upwards in the investigated sequence (genus *Ochetoceras* disappears at the top of Miedzno chalky limestones, genus *Trimarginites* disappears in the lower part of Zalesiaki massive limestones, subgenus *Taramelliceras* represented mostly by *T. costatum*-group disappears at the base of friable micritic limestones; *cf.* Table 1 and Text-fig. 2) appear to be caused by ecological factors, presumably by a decrease in the basin depth (*cf.* Ziegler 1967, pp. 448—449 and 456). In fact, this hypothesis is also supported by other changes in faunal assemblages, in particular the gradual appearance of hermatypic corals in the higher chalky-limestone units (starting with the Prusicko chalky limestones; *cf.* Text-fig. 2).

Some faunal changes correspond exactly to the changes in lithology. Thus, the Haplocerataceae occur in the upper part of the investigated sequence exclusively in micritic limestones, marly limestones, and marls, whereas they are lacking at all in the laterally interfingering chalky limestones (Czerkiesy chalky limestones, Prusicko chalky limestones, Pajęczno chalky limestones; *cf.* Table 1 and Text-fig. 2). The subgenus *Taramelliceras* disappears with the appearance of friable micritic limestone facies. Furthermore, the genus *Amoeboceras* occurs twice in the investigated sequence, always in proximity of or just within the marly intercalations in chalky limestones (the uppermost part of Miedzno chalky limestones and the uppermost part of Niwiska chalky limestones; *cf.* Text-fig. 2); however, *Amoeboceras* is absent from other marly intercalations in Miedzno chalky limestones.

In most cases, those major changes in stratigraphic distribution of the genus- or family-group taxa reflect distinct biostratigraphic boundaries. An appearance or disappearance of particular taxa are undoubtedly more significant biostratigraphically than changes in frequency distribution of a single taxon (e.g. an acme). Actually, all the biostratigraphic boundaries marked by changes at a high taxonomic level can also be precisely determined by appearances or disappearances of particular species (Text-fig. 2). Thus, the appearance of the species *Idoceras planula-I. laxevolutum* and *I. minutum* is equivalent to the appearance of the entire genus *Idoceras*, this biostratigraphic boundary reflecting an evolutionary process. In turn, the upper boundary of the range of the species *Taramelliceras broilii* and *T.* aff. *costatum* is equivalent to the disappearance of the entire subgenus *Taramelliceras*, the biostratigraphic boundary depending undoubtedly upon some ecological factors.

Some biostratigraphic boundaries may be traced on the sole basis of appearance or disappearance of a single species without any simultaneous change at higher taxonomic levels. The most reliable are those boundaries traced within lithologically homogeneous sequences and based upon species representing members of a single lineage. In the investigated Upper Oxfordian sequence, such boundaries may be determined *e.g.* at the appearance of the species *Taramelliceras hauffianum* or disappearance of typical *T. costatum* (cf. Text-fig. 2).

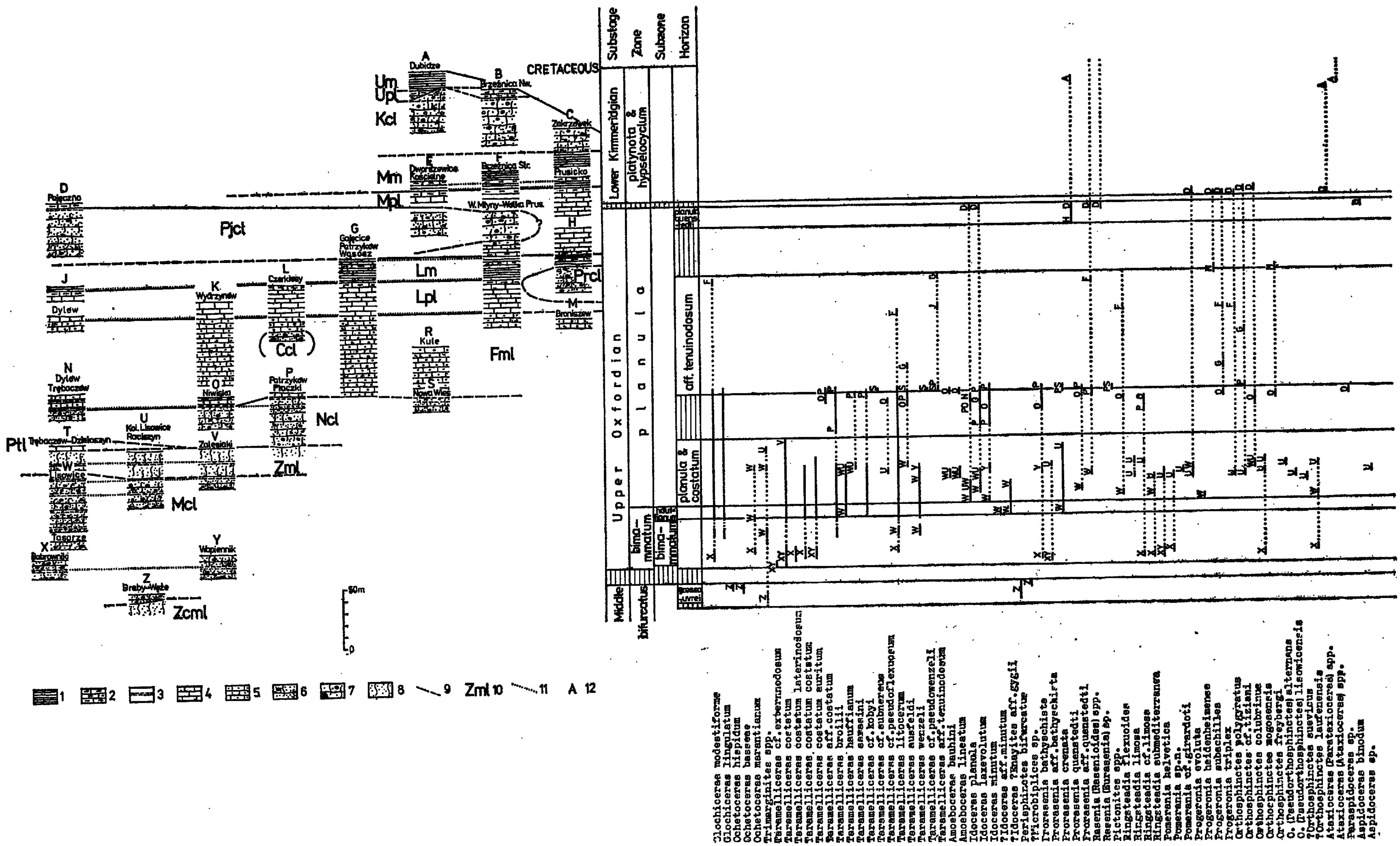
The Upper Oxfordian biostratigraphic units discussed below are, as far as possible, defined in such a way as to depend mostly upon the evolutionary process itself and hence, to be widely applicable for correlation purposes.

AMMONITE ZONATION

The collected ammonite fauna permits the recognition of *bimammatum* and *planula* Zones of the Submediterranean zonal scheme (Text-fig. 2). Both the Zones are attributed to the Upper Oxfordian with the base of *bimammatum* Zone recognized for the base of the substage (Gygi 1969, Table 9; Kutek & *al.* 1973). The latter stratigraphic boundary can be easily traced in various areas of Central Poland, the Polish Jura Chain including (Brochwicz-Lewiński 1976, Kutek & *al.* 1977, Matyja 1977).

Unfortunately, the base of *bimammatum* Zone cannot be drawn in the Wieluń Upland, as the adequate strata are nowhere exposed. The unexposed part of the sequence occurs within the Miedzno chalky

Stratigraphic distribution of ammonites in the Upper Oxfordian—Lower Kimmeridgian sequence of the Wieluń Upland



LITHOLOGY: 1 marls, 2 marly limestones, 3 principal marly intercalations within limestones, 4 thin-bedded micritic limestones with marly intercalations, 5 thick-bedded friable micritic limestones, 6 chalky limestones, 7 limestones with onkolites, 8 massive limestones

STRATIGRAPHY: 9 boundary of lithostratigraphic units, 10 symbol of the lithostratigraphic unit (*Zcml* Zelce massive limestones, *Mcl* Miedzno chalky limestones, *Zml* Zalesiaki massive limestones, *Ptl* platy limestones with tuberoids, *Ncl* Niwiska chalky limestones, *Fml* friable micritic limestones, *Ccl* Czerkiesy chalky limestones, *Lpl* lower platy limestones, *Prcl* Prusicko chalky limestones, *Lm* lower marly unit, *Mpl* Middle platy limestones, *Pjcl* Pajęczno chalky limestones, *Mm* middle marly unit, *Kcl* Kule chalky limestones, *Upl* upper platy limestones, *Um* upper marly unit), 11 isochronous lithologic surface, 12 alphabetical symbol of the section used for denoting the position of the most characteristic ammonite findings (right part of the figure) limestones and approximates 15—20 m in thickness. The directly underlying exposed sediments contain fossils indicating the *grossouvrei* horizon of *bifurcatus* Zone of the uppermost Middle Oxfordian; in turn, the overlying deposits are attributed to the middle part of *bimammatum* Zone (Text-fig. 2). Then, one may conclude that the base of *bimammatum* Zone is in the lowermost part of the unexposed portion of the investigated sequence.

The base of *planula* Zone coincident by definition with the top of *bimammatum* Zone can be traced precisely in the upper part of Miedzno chalky limestones, at the appearance of true *Idoceras* replacing partly the earlier *Enayites-Idoceras* passage forms (Text-fig. 2; *cf.* also the notes on the ammonites). In its turn, the top of *planula* Zone coincident by definition with the top of the Oxfordian is taken below the lowest occurrence of *Ataxioceras* and the highest occurrence of *Idoceras planula-I. laxevolutum*. It is traced in the sequence within a 5 m thick confidence interval in the uppermost part of Pajęczno chalky limestones and its time equivalent middle platy limestones (Text-fig. 2). Thus, it is determined somewhat higher in the section than it was traced previously (Wierzbowski 1966), which is due to new ammonite findings as well as to the higher lithostratigraphic position of Pajęczno chalky limestones than it was previously accepted.

BIMAMMATUM ZONE

The *bimammatum* Zone comprises the lower part of Miedzno chalky limestones; however, the lowermost strata of the Zone, those equivalent to the *hypselum* Subzone, are not exposed in the investigated area (Text-fig. 2). The deposits of *hypselum* Subzone with abundant ammonite fauna are exposed in Kłobuck-Częstochowa area bordering the Wieluń Upland from the south (for the ammonite fauna of *hypselum* Subzone *see* Kutek & *al.* 1977; *cf.* also Brochwicz-Lewiński & Różak 1976*a*).

In the investigated area, the accessible deposits of *bimammatum* Zone can be attributed to the *bimammatum* and *hauffianum* Subzones. With the thickness of unexposed strata taken into account, the total thickness of *bimammatum* Zone can be estimated for some 65—70 m in the study area.

The base of *bimammatum* Subzone cannot be determined precisely. Actually, it may occur but slightly below the first occurrences of *Prorasenia*, as indicated by the occurrence of *Taramelliceras* cf. *externnodosum* (Dorn) therein (Text-fig. 2; *cf.* also Zeiss 1966, Enay & *al.* 1971, Kutek & *al.* 1977). The top of *bimammatum* Subzone coincides with the base of *hauffianum* Subzone and is taken at the appearance of *Taramelliceras hauffianum* (Opp.). The ammonite fauna appears diverse but most species and subspecies are in common with the *hauffianum* Subzone and the lower part of *planula* Zone (Text-fig. 2). The subspecies *Taramelliceras costatum laterinodosum* Kar. occurs exclusively in the lower part of *bimammatum* Subzone, while *Glochiceras lingulatum* (Qu.), *Taramelliceras wenzeli* (Opp.), and *T. broilii* (Weg.) appear in the upper part of the Subzone. No representatives of the genera *Euaspidoceras*, *Epipeltoceras*, and *Amoeboceras* have been found in the *bimammatum* Subzone in the study area. The typical representatives of the genus *Microbiplices* abounding in the *hypselum* Subzone in the Polish Jura Chain (*cf.* Kutek & *al.* 1977) are replaced with the genus *Prorasenia* in the considered higher subzone.

The *hauffianum* Subzone is the highest one in the *bimammatum* Zone. It has insofar not been in universal use (*cf.* Enay & *al.* 1973, Cariou & *al.* 1973) and therefore, the criteria used for its recognition in the investigated sequence are to be discussed in some detail. Originally, Oppel (1863, p. 175) defined the *hauffianum* Subzone as characterized by the occurrence of an ammonite assemblage including *Taramelliceras hauffianum* (Opp.), *Trimarginites trimarginatus* (Opp.), *Ochetoceras marantianum* (d'Orb.), *Amoeboceras bauhini* (Opp.), *Orthosphinctes tiziani* (Opp.) among others, and the absence of *Epipeltoceras bimammatum* (Qu.). The present author believes, however, that the latter criterion (*cf.* Cariou & *al* 1971) can hardly be applied to recognize the *hauffianum* Subzone; in fact, it appears completely useless in Central Poland, as *E. bimammatum* has never been found in that area; in other areas (*e.g.* southern Germany), the upper boundary of stratigraphic range of the species and of the entire genus *Epipeltoceras* remains unclear (*cf.* Hölder 1964, Nitzopoulos 1974, Ziegler 1977). Then, one may claim that the appearance of the index species is the basic criterion for delimiting the base of *hauffianum* Subzone. The top of the Subzone is delineated by the base of *planula* Zone, whereas all the species mentioned by Oppel (1863) as characteristic for the *hauffianum* Subzone (the index species including) range above the so-defined boundary. When based upon the above criteria, the *hauffianum* Subzone (Text-fig. 2) is characterized by the occurrence of ammonites ascribed here to *? Idoceras* aff. *minutum* Diet. and *? Idoceras ? Nebrodites (Enayites)* aff. *gygii* Brochwicz-Lewiński & Różak representing undoubtedly forerunners of *Idoceras* itself. The occurrence of those forms with the lack of typical representatives of the genus *Idoceras* appear as the most notable paleontologic characteristics of *hauffianum* Subzone.

PLANULA ZONE

The *planula* Zone comprises most of the Upper Oxfordian sequence in the Wieluń Upland (Text-fig. 2) attaining some 250 m in thickness (*cf.* Wierzbowski 1966, Kutek & Wierzbowski 1971). Its most striking paleontological characteristics is the occurrence of the ammonite genus *Idoceras;* in fact, the *planula* Zone can be defined as the *Idoceras planula-Idoceras laxevolutum* range Zone.

Because of rather slight variability in the ammonite fauna of *planula* Zone, the biostratigraphic subdivision of the Zone has insofar not been unequivocally worked out. In northern Germany and in France, the *galar* Subzone has been distinguished in the upper part of the Zone; or the *planula* (lower) and *galar* (upper) horizons have been recognized (Geyer 1961*a*, *b*; Zeiss 1965*a*, *b*; Karvé-Corvinus 1966; Cariou & *al.* 1971). In turn, three distinct faunal horizons ("subzones") have been recognized within the *planula* Zone in southern Germany; these are: the *tenuinodosum* (lower) horizon attributed to the upper part of the *planula* "zone", and *wenzeli* and *falcula* (upper) horizons attributed to the *galar* "zone" (Dieterich 1940, Hölder 1964, Schmidt-Kaler 1962).

A threefold subdivision of *planula* Zone has been proposed in Central Poland (Wierzbowski 1970; *cf.* also Kutek & *al.* 1977) as follows: (*i*) the lower part with *Idoceras* and *Taramelliceras costatum*-group, (*ii*) the middle part with *Idoceras* but without ammonites indicative of the lower or upper parts of the Zone, and (*iii*) the upper part with *Idoceras, Prorasenia quenstedti* Sch., and *Eurasenia.* The subdivision is here further evaluated and somewhat modified (Text-fig. 2) as to more precisely define the biostratigraphic boundaries. The three units established in the lowermost, middle, and uppermost parts of *planula* Zone are based upon the ammonites of especially high biostratigraphic value. However, the units are separated by the sequence portions comprising only less characteristic ammonite faunas. Therefore, the biostratigraphic units are here recognized for horizons. The subdivision of *planula* Zone cannot be then regarded as ultimate; it is but a step towards a final biostratigraphic pattern.

The *Idoceras planula-Taramelliceras costatum* concurrent range horizon is established in the lowermost part of *planula* Zone. Its base coincides with the base of *planula* Zone and is traced at the appearance of the genus *Idoceras*. The last occurrence of *Taramelliceras costatum* (Qu.) marks the top of the horizon. The species *Taramelliceras hauffianum* (Opp.) and *Enayites-Idoceras* passage forms do also not range above the top of *planula-costatum* horizon. Some other ammonites (e.g. *Taramelliceras wenzeli* (Opp.), *Ringsteadia submediterranea* sp.n.) have also not been recorded above the horizon (Text-fig. 2); however, those ammonites either occur in undoubtedly younger strata in other areas (*cf.* Dieterich 1940, Schuler 1965, Nitzopoulos 1974), or are new and with poorly known stratigraphic range and hence, they cannot be widely applied for correlations. The beds with *Amoeboceras* found in the middle part of the horizon appear as a very good local stratigraphic marker.

The *Taramelliceras* aff. *tenuinodosum* range horizon is distinguished in the middle part of *planula* Zone. The index fossil appears very close to the species *T. tenuinodosum* (Weg.); it may even be regarded as conspecific with the latter forms when the species is broadly understood (*cf.* the notes on the ammonites and Pl. 2, Figs 12—13 ab; *cf.* also Dieterich 1940, p. 9, and Hölder 1964, p. 238). Some faunal changes observed in the aff. *tenuinodosum* horizon (*e.g.* disappearance of the subgenus *Taramelliceras* s.s.) seem to be caused by ecological factors. The appearance of *Taramelliceras* cf. *pseudowenzeli* (Weg.), *T.* cf. *subnereus* (Weg.), and *Pictonites* sp. at the base of the horizon may be more significant stratigraphically. This may also be the case of *Progeronia triplex* (Qu.) and *Orthosphinctes freybergi* Geyer appearing a little below the base. The species *Taramelliceras ausfeldi* (Würt.) *sensu* Wegele (1929), *Idoceras minutum* Diet., and *Prorasenia crenata* (Rein.) occurring already in the older strata range up through the lowermost part of the discussed horizon. The species *Ringsteadia flexuoides* (Qu.) has not been recorded above the aff. *tenuinodosum* horizon. The occurrence of *Amoeboceras* in the lowermost part of the horizon appears highly useful for local stratigraphic correlations.

The *Idoceras planula-Prorasenia quenstedti* concurrent range horizon is established in the uppermost part of *planula* Zone. Its base is defined by the first appearance of *Prorasenia quenstedti* Sch.; whereas the top of the horizon coincides exactly with the top of *planula* Zone. The species *Progeronia subachilles* (Weg.) occurs throughout the entire *planula-quenstedti* horizon; actually, it has also been recorded in somewhat lower strata. *Aspidoceras binodum* (Opp.) and *Eurasenia* spp. occur in the upper part of the horizon.

Basing upon the relationship of the subdivision presented herein to those proposed in Germany and France (*cf.* Zeiss 1965, Cariou & *al.* 1971, Enay & *al.* 1971), one may also consider a possible twofold subdivision of *planula* Zone into subzones. In Germany and France, the boundary might be traced between the *planula* and *galar* horizons. That boundary cannot, however, be recognized precisely in Central Poland, as there are no ammonites of the genus *Sutneria* and *Taramelliceras litocerum*-group in the upper part of *planula* Zone. In contrast, the most sharp faunal changes occur in the Wieluń Upland in the lowermost strata of aff. *tenuinodosum* horizon. As judged from the appearance of ammonites close to *Taramelliceras tenuinodosum* (Weg.) and *T. pseudowenzeli* (Weg) and the disappearance of *Idoceras minutum* Diet. and *Taramelliceras ausfeldi* (Würt.) *sensu*

Wegele (1929), those strata may be equivalent to the *tenuinodosum* horizon of southern Germany (for stratigraphic ranges of the above mentioned species *see* Dieterich 1940, Schmidt-Kaler 1962, Schuler 1965, Nitzopoulos 1974; *cf.* also Text-fig. 2). Furthermore, the *tenuinodosum* horizon of southern Germany is also characterized by some other faunal changes, the appearance of the genus *Sutneria* including *S. praecursor* Diet. Then, the changes recorded in the Wieluń Upland may also appear relevant for a possible twofold subdivision of *planula* Zone.

COMPARATIVE STRATIGRAPHY AND CORRELATIONS

In the Middle Polish Uplands, the Upper Oxfordian ammonites come from the exposures in the Polish Jura Chain and Holy Cross Mountains. The former area comprises wide outcrop belt between Cracow and Wieluń, the Wieluń Upland representing its northernmost part. As to the rest of the Polish Jura Chain, the region of Częstochowa appears as the best documented with the Upper Oxfordian ammonites (Wierzbowski 1965, 1970; Wiśniewska-Żelichowska 1971; Malinowska 1972; Brochwicz--Lewiński 1976; Brochwicz-Lewiński & Różak 1976*a*, *b*; Kutek & *al.* 1977), eventhough the succession of ammonite faunas has insofar not been presented in details. As judged from both published and unpublished (deposited at the Institute of Geology of the Warsaw University) data, most biostratigraphic units distinguished in the Wieluń Upland can also be recognized in Częstochowa area. There are, however, some problems with clear distinction between the upper part of *bimammatum* Zone and the lower part of *planula* Zone due to the scarcity of good exposures in the north and the considerable development of the massive limestones (*Massenkalk*) in the south. The middle and upper parts of *planula* Zone are well exposed east of Częstochowa between Rudniki, Latosówka, and Wancerzów (*cf.* lithostratigraphic columns *in*: Kutek & *al.* 1977, Fig. 2). In that area, the uppermost part of so-called "main massive limestones" and the overlying lower platy limestones up to the lower marly unit are attributed to the aff. *tenuinodosum* horizon of *planula* Zone. The overlying middle platy limestones do not comprise any ammonites. Higher in the section, the ammonites occur but in the Kuchary chalky limestones; the fauna indicative of the Lower Kimmeridgian (*platynota* Zone) has been recorded in the uppermost part of that unit (Wierzbowski 1964).

The *bimammatum* Zone has been recognized in the southwestern rim of the Holy Cross Mountains (Matyja 1977). The ammonites indicate the *hypselum* Subzone and *bimammatum-hauffianum* Subzones; the occurrence of *? Idoceras* aff. *minutum* Diet. representing undoubtedly forerunner of true *Idoceras* may permit recognition of *hauffianum* Subzone itself. The *planula* Zone has insofar been very poorly documented with ammonites in the Holy Cross Mountains (Kutek 1968).

In the Polish Lowland, the Upper Oxfordian occurs mostly in subsurface. The *bimammatum* and *planula* Zones have insofar not been recognized in that area eventhough the ammonite fauna (*cf.* Dembowska & Malinowska 1973) makes certainly possible such stratigraphic attribution of the deposits; in fact, there are *Glochiceras modestiforme* (Opp.), *G. canale* (Qu.), *G. lingulatum* (Qu.), *Taramelliceras callicerum* (Opp.), *T. tricristatum* (Opp.), *T. lochense* (Opp.), *T. pseudowenzeli* (Weg.), *T. wenzeli* (Opp.), *T. litocerum* (Opp.), *Amoeboceras bauhini* (Opp.), *A. lineatum* (Qu.), *A. ovale* (Qu.), *A. alternans* (Buch), *Microbiplices microbiplex* (Qu.), and *Idoceras* spp. One may add that those ammonite species occur mostly or exclusively in the Submediterranean Europe and their usefulness for the recognition of *bimammatum* and *planula* Zones in that area is obvious.

Apart from the above discussed Submediterranean biostratigraphic scheme, some students (Różycki 1953; Malinowska 1968, 1972; Bielecka & *al.* 1970*a*; Dembowska & Malinowska 1973) recognize also in the Upper Oxfordian („Astartian") of Poland the Subboreal *pseudocordata* Zone. However, the latter zone is recognized mostly after the ammonites (*cf.* Bielecka & *al.* 1970*a*; Malinowska 1972, pp. 13, 66—67) typical of the Submediterranean *bimammatum* and *planula* Zones; namely various representatives of the genera *Glochiceras, Taramelliceras, Orthosphinctes* etc. along with „*Decipia*" sensu Enay (1966) referable probably to *Pomerania* s.l. but not to true *Decipia* (*cf.* the notes on the ammonites), *Ringsteadia* (only Submediterranean species; *cf.* Wierzbowski 1970), and *Amoeboceras* (species found commonly in the Submediterranean Europe, e.g. *A. bauhini* Opp.). The recognition of *pseudocordata* Zone in Poland was claimed to be substantiated by the occurrence of some species of the genus *Ringsteadia* typical of Subboreal areas (*cf.* Bielecka & *al.* 1970*a*, Dembowska & Malinowska 1973). The illustrated specimens assigned to those Subboreal species come from Czarnogłowy (*Zarnglaff*), West Pomerania (Dohm 1925, Wilczyński 1962). Nevertheless, the subsequent paleontologic revisions demonstrated those identifications to be erroneous (Arkell 1956, Geyer 1961*a*; *cf.* also Wierzbowski 1970). Furthermore, the oldest ammonite fauna from Czarnogłowy composed not only of the discussed representatives of *Ringsteadia* but also of true *Pomerania* is found in some undoubtedly Submediterranean assemblages of the Lower Kimmeridgian *platynota* Zone and possibly also the uppermost part of the Upper Oxfordian *planula* Zone in southern Germany and the Middle Polish Uplands (Geyer 1961*a*, Kutek 1968, Wierzbowski 1970). Then, the considered ammonite fauna from Czarnogłowy is mostly (or even entirely) younger than that of the Subboreal *pseudocordata* Zone. Any other data on the occurrence of Subboreal *Ringsteadia* (including *R. pseudocordata* itself; *cf.* Różycki 1953, p. 9) in Central Poland cannot be regarded as reliable, since the specimens have never been illustrated and have been destroyed during the war. In fact, they have not been taken into account in the recent catalogue of Mesozoic fossils of Poland (Bielecka & *al.* 1970*b*). Then, the present author is of the opinion that there are no sufficient paleontologic premises to distinguish the Subboreal *pseudocordata* Zone in Poland.

The general correlation of the investigated Upper Oxfordian strata of the Wieluń Upland with the classic Submediterranean sequences of the West Europe appears trivial. Of particular interest is only the precise determination of the boundary between *bimammatum* and *planula* Zones in the investigated area; whereas this is often impossible in the West Europe because of the ecologically controlled absence of *Idoceras* from the strata equivalent to the earliest *planula* Chronozone. In southern Germany, especially in the Franconian Alb, the genus *Idoceras* (in particular *I. planula* — *I. laxevolutum*) appears usually but in the middle part of Malm β (Schmidt-Kaler 1962, Schuler 1965, Zeiss 1966, Nitzopoulos 1974); however, singular individuals of the genus *Idoceras* have been recorded near the Malm α/β boundary in the Swabian Alb (Koerner 1963; *cf.* also Nitzopoulos 1974, Fig. 13), where one may trace the base of *planula* Chronozone [1]. Furthermore, one may recognize the *planula-costatum* horizon in the lower part of *planula* Zone in the Swabian Alb; while in the Franconian Alb, the species *Taramelliceras costatum* (Qu.) occurs usually below the first specimens of *Idoceras* (*cf.* Schmidt-Kaler 1962; Schuler 1965, Table 1; Zeiss 1966). The appearance of *Idoceras* is also distinctly diachronous among particular sections in the northern Switzerland (Gygi 1969, Fig. 5). In some areas of southern France (Enay 1966, Carvé-Korvinus 1966), the genus *Idoceras* appears above the upper boundary of the range of *Taramelliceras costatum* (Qu) and *T. hauffianum* (Opp.); hence, one may suspect that the *hauffianum* Subzone of *bimammatum* Zone distinguished sometimes therein (Cariou & *al.* 1971) does partly comprise the strata equivalent to the earliest part of *planula* Chronozone. In turn, no representatives of the genus *Idoceras* have been found in the *planula* Zone in Poitiers area (Cariou 1972).

BIOGEOGRAPHIC REMARKS

As demonstrated above (*cf.* also Wierzbowski 1966, 1970; Kutek & Wierzbowski 1971; Kutek & *al.* 1977), the Upper Oxfordian ammonite fauna of the Wieluń Upland is undoubtedly of Submediterranean type. When comparing the investigated fauna to the classic Submediterranean assemblages of southern Germany, the following conclusions can be drawn: (i) All the ammonite genera and species present in the Wieluń Upland (Text-fig. 2) have also been reported from the Swabian Alb and Franconian Alb. (ii) In general, the frequency distributions of family-group taxa are strikingly similar to each other between both the areas (Text-fig. 2); Ziegler 1977, Fig. 34); some discrepancies found in the upper part of *planula* Zone result from the earlier development of shallow-water facies in the Wieluń Upland. Moreover, the characteristic ammonite assemblages may be equally frequent in time equivalent strata between both the areas, *e.g.* the small-sized haploceratids (*Taramelliceras litocerum*-*Glochiceras lingulatum*-*G. modestiforme* assemblage) in the uppermost *bimammatum* and lowermost *planula* Zones (Text-fig. 2; *cf.* also Zeiss 1966). (iii) A few genera and species known from southern Germany have not been found in the Wieluń Upland; they include the genus *Sutneria* and the species *Epipeltoceras bimammatum* (Qu.), *Idoceras schroederi* Weg., and *Taramelliceras falcula* (Qu.) among others. (iv) There are probably some slight discrepancies in the frequency distributions of genus-group taxa. Thus, the genus *Ringsteadia* occurs rarely in southern Germany, while it appears somewhat more common in the Wieluń Upland (Table 1,

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1 This difference in stratigraphic range of the genus *Idoceras* (in particular the species *I. planula*) between the sequences of Franconian Alb and Swabian Alb caused probably the misattribution of the species *I. proteron* Nitz. to the *bimammatum* Zone, inducing in its turn considerable phylogenetic consequences (Brochwicz-Lewiński & Różak 1976b). Actually, the latter species occurs in the lower part of Oberweiler Beds, above the boundary Malm α/β (Nitzopoulos 1974, pp. 105—106, Figs 16—18), that is probably in the *planula* Chronozone.

Text-fig. 2; *cf.* also Dieterich 1940, Zeiss 1965*b*, Ziegler 1977); this may also be the case of the genus *Prorasenia*.

These slight differences between the ammonite faunas of southern Germany and the Wieluń Upland may be partly related to a more borealward position of the latter area within the Submediterranean Province. If so, some species of the genera *Ringsteadia, Prorasenia,* and *Amoeboceras* more abundant in the Wieluń Upland than in southern Germany (and some other Submediterranean areas) may be in common with the southernmost parts of the Subboreal Province. Nevertheless, the Wieluń Upland was not influenced to any considerable extent by the Subboreal Province at Late Oxfordian time and it cannot be regarded as a typical transitional zone.

NOTES ON THE AMMONITES

The collection consists of 1,212 specimens housed at the Institute of Geology of the Warsaw University. Most specimens (1,200) have been collected by the author himself; they are marked with the letter *W*, the exposure number, the region abbreviation (*P* Pajęczno, *Mi* Mierzyce, *Dz* Działoszyn, *R.S.* Rębielice Szlacheckie, *D.K.* Dworszowice Kościelne, *Bz* Brzeźnica), and the consecutive specimen number for particular exposure (*cf.* Text-fig. 3).

Twelve specimens have been collected by W. Bardziński, M. Sc., in the environs of Bobrowniki; they are marked as *Bd*, exposure number (*66* or *68*; being equivalent to *92 Mi* and *85Mi* of the present paper), and consecutive specimen number for particular exposure.

The preservation state is variable, and many specimens are fragmentary; adult individuals with aperture preserved are inabundant (except for the small-sized haploceratids). The specimens are preserved as internal casts; those derived from chalky limestones are usually undeformed, those from micritic limestones are often flattened.

The following abbreviations are used in paleontologic descriptions: *D* diameter in mm, *Wh* whorl height in D%, *Ud* umbilicus diameter in D%, *NR* number of primary ribs per whorl, *S/P* secondary to primary ribs ratio (calculated for 5 primary ribs). Changes in rib number relative to the shell size (i.e. rib curves) are presented graphically (Text-figs 4—7).

Most investigated ammonites are well known and hence, no detailed paleontologic descriptions are given. Actually, only two newly erected species are described in detail. Both the new observations and taxonomic discussions are in the form of paleontologic comments to the genera and subgenera. Some identifications are also revised for the Upper Oxfordian ammonites of Central Poland (mostly the Polish Jura Chain).

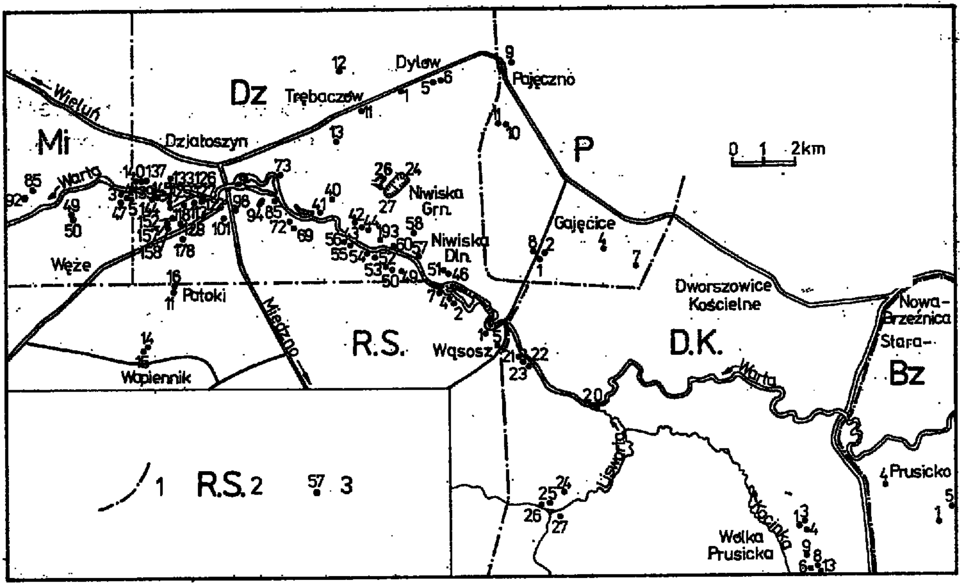

Fig. 3. Index map showing the position of the fossil localities in particular regions of the Wieluń Upland

1 boundary of the region, 2 alphabetical symbol of the region (*Mi* Mierzyce, *Dz* Działoszyn, *R.S.* Rębielice Szlacheckie, *P* Pajęczno, *D.K.* Dworszowice Kościelne, *Bz* Brzeźnica), 3 fossil locality and its number within the region

GLOCHICERAS

The genus is represented by *c* 250 specimens, the bulk of which are complete with peristome preserved. All identifiable specimens belong to *G. (Coryceras) modestiforme* (Opp.) (Pl. 1, Figs 2—4) and *G. (Lingulaticeras) lingulatum* (Qu.). The poorly preserved form described previously (Wierzbowski 1966, pp. 190—191, Pl. 10, Fig. 4) as *G. (Lingulaticeras)* cf. *nudatum* (Opp.) does probably belong to the genus *Taramelliceras* rather than *Glochiceras*, and possibly to the species *T. litocerum* (Opp.).

OCHETOCERAS

Only a few specimens mostly representing the inner whorls and belonging to *O. marantianum* (d'Orb.) have been collected (Pl. 1, Fig. 1).

TRIMARGINITES

Of the few specimens, no one is well enough preserved for closer identification.

TARAMELLICERAS

The majority of the collected specimens belong to the subgenera *Taramelliceras* and *Metahaploceras*. Only some poorly preserved specimens can be ascribed to *Taramelliceras externnodosum* (Dorn), which species was assigned by Hölder (1955,

1958) to the subgenus *Strebliticeras*. However, the name *Strebliticeras* appears as a junior synonym of the name *Streblites* and hence, it should not be used for this species (Ziegler 1974, p. 12).

Of the subgenus *Taramelliceras*, the most common are the species belonging to the *T. costatum* group of Hölder (1955). The species *T. costatum* (Qu.) is represented by the subspecies *T. costatum costatum* (Qu.), *T. costatum auritum* (Qu.) and *T. costatum laterinodosum* Karvé-Corv. The former two were interpreted by Hölder (1955, p. 96) as variants of *T. costatum*; however, it seems more justified to regard them as true subspecies (*cf.* also Ziegler & Hölder 1973). One may add that the two subspecies clearly differ in the type of ventrolateral tubercles (Pl. 1, Figs 5—8), and any transitional forms have not been found in the material under study. The third subspecies *T. costatum laterinodosum* has the ribs strongly swollen in the mid-height of whorls, comparable to those of *T. externnodosum*, and the ventrolateral and median tubercles as in *T. costatum s.s.* (*cf.* Karvé-Corvinus 1966, p. 122, Pl. 26, Fig. 3; also Pl. 1, Fig. 9 herein). The form referred to as *T.* aff. *costatum* (Pl. 1, Fig. 10) differs from *T. costatum* in that its ventrolateral tubercles are elongate concordantly with ribs up to 50—60 mm in diameter; subsequently, the tubercles become rounded. Such ventrolateral tubercles occur in *T. kobyi quenstedti* Hölder; however, the latter form displays an other type of ribbing (*cf.* Hölder 1955, pp. 129—130). The form *T.* aff. *costatum* resembles also *T. compsum* (Opp.) but it differs from the latter species in stronger development of the primary ribs on the inner whorls, the presence of median tubercles, and the narrower umbilicus approximating 10% of the diameter. Other species of the *T. costatum* group encountered in the collection belong to the species *T. hauffianum* (Opp.) and *T. broilii* (Weg.). Both the species (Pl. 1, Figs 11—14) have been discussed in details by Hölder (1955) and nothing new to their knowledge can be added. The species *T. sarasini* (Lor.) is represented in the collection by some good specimens (Pl. 2, Figs 1—2) matching the figures of the lost holotype (Loriol 1902, Pl. 3, Figs 19—19*a*) in all respects. The species is very close to *T. subnereus* (Weg.), the difference consisting in presence of small, sparcely distributed median tubercles; its attribution to the *T. costatum* group (*cf.* Hölder 1955) seems doubtful.

Some poorly preserved specimens ascribed to *T.* cf. *kobyi* (Chof.), *T.* cf. *subnereus* (Weg.), and *T.* cf. *pseudoflexuosum* (Favre) form another group of species. The first two species along with *T. rigidum* (not encountered in the material studied) were placed in a single group named as the *T. kobyi* group by Hölder (1955) or the *T. subnereus* group by Nitzopoulos (1974). The latter name appears more appropriate, as there exist some difficulties in interpretation of *T. kobyi*. The species *T. kobyi* as originally interpreted by Choffat (1893) is close to *T. externnodosum* but the "Swabian" forms usually ascribed to *T. kobyi* differ somewhat from the "true" representatives of the species and seem to be closer to *T. subnereus* and *T. rigidum* (*cf.* Hölder 1955, 1958). The investigated specimens (Pl. 2, Fig. 4) are comparable with the "Swabian" *T. kobyi*.

The discovery of *T.* cf. *pseudoflexuosum* (Favre) in the Upper Oxfordian of the Wieluń Upland (Text-fig. 2) is noteworthy, as this species has been never reported from beds older than the *platynota* Zone of the Lower Kimmeridgian (see "*Oppelia*" *pseudoholbeini* Wegele 1929, Pl. 27, Fig. 17, regarded by Hölder, 1955, as a junior synonym of *T. pseudoflexuosum*). The species is represented in the collection by two fragmentary specimens of ca 60 mm and 70 mm in diameter (Pl. 2, Fig. 3). The ornamentation is well visible on the last half-whorl and it consists of thin primary ribs splitting into two somewhat thicker secondaries, and intercalatory ribs; near the venter, radially elongate ventrolateral tubercles and fine outer ribs appear; the venter displays rather small but distinct rounded tubercles. The species *T. pseudoflexuosum* was assigned by Hölder (1955) to the *T. compsum* group but this opinion seems strongly disputable. The finding of *T.* cf. *pseudoflexuosum* in the Upper Oxfordian and the close similarity of *T. pseudoflexuosum* and *T. rigidum* (*cf.* Hölder 1955, p. 118; Schairer 1972, p. 51) favour a close relation of the species with the *T. subnereus* (or *T. kobyi*) group rather than with the *T. compsum* group. The species placed here in the *T. subnereus* group, i.e. *T. subnereus*, *T. kobyi* (? partim), *T. rigidum*, and *T. pseudoflexuosum*, were usually ascribed to various subgenera, but mostly to *Metahaploceras* and *Taramelliceras* (*cf.* Hölder 1955, 1958; Schairer 1972; Ziegler 1974). It seems that all these species should be interpreted as belonging to a single subgenus.

Small-sized ammonites of the *T. litocerum* group (Wegele 1929, Hölder 1955) are very common in the material studied. The following species and forms have been recorded: *T. litocerum* (Opp.), *T. ausfeldi* (Würt.) sensu Wegele (1929), *T. wenzeli* (Opp.), *T.* cf. *pseudowenzeli* (Weg.), and *T.* aff. *tenuinodosum* (Weg.). The members of this group were usually ascribed to the subgenus *Metahaploceras* (*cf.* Hölder 1955, p. 70; Ziegler & Hölder 1973; Nitzopoulos 1974) or interpreted as close to it (Ziegler 1974). The species *T. litocerum* represents rather simple morphological type characterized by the fine falcate ribbing, the lack of tubercles, and the narrow umbilicus (Pl. 2, Figs 5—7), and it occupies undoubtedly the central position in the group (Wegele 1929). The species was reported previously from the Upper Oxfordian of the Polish Jura Chain (Wierzbowski 1966, Pl. 10, Fig. 3; Wiśniewska--Żelichowska 1971, Pl. 18, Figs 6—7). The form *T. ausfeldi* is very similar to *T. litocerum*, differing from the latter in the presence of obliquely elongate ventrolateral tubercles (Pl. 2, Fig. 9). However, there are some specimens close to *T. ausfeldi* in the collection studied (Pl. 2, Fig. 8a, b) with poorly-developed swellings of ribs near the venter instead of ventrolateral tubercles; the specimens may be regarded as transitional to *T. litocerum*. The species *T. wenzeli* differs from other members of the *T. litocerum* group in its sparcely distributed biplicate and single falcate ribs and the smooth ventral side (Pl. 2, Figs 10—11); ventrolateral tubercles are usually lacking but in some stronger ribbed specimens, the rib swellings near the venter occur (Pl. 2, Fig. 10). The specimens of *T. wenzeli* from Central Poland are also reported by Malinowska (1960, Pl. 1, Fig. 4a-b; 1972, Pl. 12, Fig. 4). The species *T. pseudowenzeli* as originally interpreted by Wegele (1929) was thought to lie somewhere in between *T. wenzeli* and *T. ausfeldi* in morphology. Afterwards, it has been usually interpreted as more close to *T. wenzeli* (*cf.* Hölder 1955, Nitzopoulos 1974). Of the two specimens of *T. pseudowenzeli* figured by Wegele (1929, Pl. 17, Figs 7—8), the first one seems, indeed, close to *T. ausfeldi* and/or *T. wenzeli;* the other differs from both *T. ausfeldi* and *T. wenzeli* in its much more numerous and well developed secondary ribs, and possibly also a wider umbilicus. The latter specimen should probably be considered as the type specimen of *T. pseudowenzeli.* The fragmentary specimens found by the present author and described as *T.* cf. *pseudowenzeli* resemble the second illustrated specimen of Wegele. The small-sized form referred to as *T.* aff. *tenuinodosum* in the present paper (Pl. 2, Figs 12—13a, b) differs from *T. pseudowenzeli* in its obliquely elongate ventrolateral tubercles and the minute ventral tubercles disappearing close to the aperture. These features are typical of *T. tenuinodosum;* however, the holotype of the latter species (Wegele 1929, Pl. 17, Figs 10—11) has somewhat stronger ribbing than the specimens studied by the present author. On the other hand, the range of variability of *T. tenuinodosum* has been never presented and in fact, no one specimen of the species, except of the holotype, has been figured. Hence, one can not exclude that the specimens referred here to as *T.* aff. *tenuinodosum* belong actually to *T. tenuinodosum.* Specimens from the Polish Jura Chain were previously ascribed to *T. subnereus* (cf. Wierzbowski 1966, Pl. 10, Fig. 2; Wiśniewska-Żelichowska 1971, p. 34, Pl. 18, Figs 3—5) but they differ from the latter species in their markedly smaller size and the presence of ventral tubercles.

AMOEBOCERAS

Representatives of the subgenus *Amoeboceras* are fairly common in the material studied. Some of them belong to *A. lineatum* (Qu.) (Pl. 2, Fig. 14) and *A. bauhini* (Opp.) (Pl. 2, Fig. 15); some others represent probably new species and will be described elsewhere. All these ammonites differ from older forms of the *A. alternans-ovale* group in their secondary ribs continuing up to the keel, and the indistinct ventral sulci (cf. also Salfeld 1915, pp. 180—183).

IDOCERAS AND RELATED FORMS

The ammonites collected include: *I. planula* (Hehl), *I. laxevolutum* (Font.) sensu Ziegler (1959) [2], *I. minutum* Diet., *? Idoceras* aff. *minutum* Diet., *? Idoceras ? Nebrodites (Enayites)* aff. *gygii* Brochwicz-Lewiński & Różak. The highly variable species *I. planula* and *I. laxevolutum* have many features in common, while they differ only in the maximum size, the character of peristome, and the trend of rib-curve at larger diameters (Ziegler 1959, Nitzopoulos 1974; see also Text-fig. 4

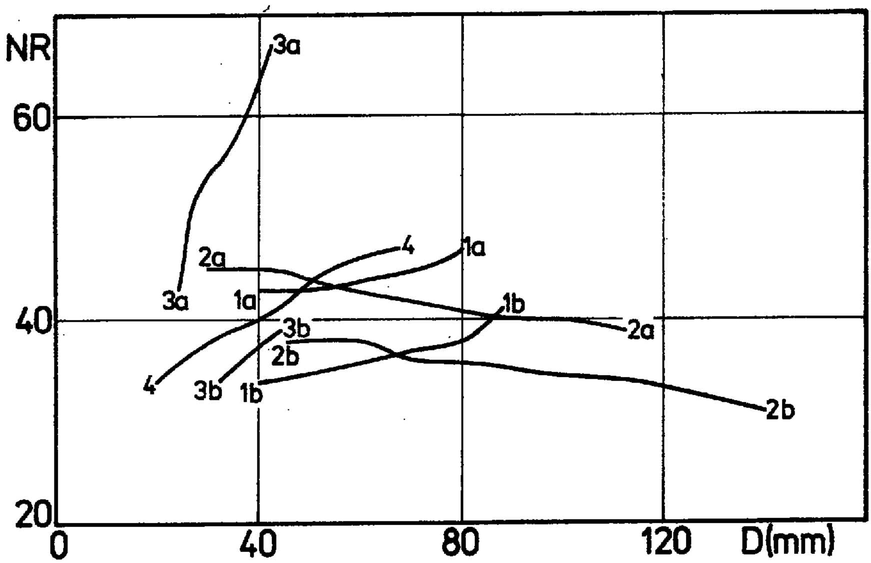

Fig. 4. Rib-curves for some *Idoceras* species and related forms

1 *Idoceras laxevolutum* (Font.) sensu Ziegler (1959); rib-curves for the most densely (*a*) and loosely ribbed (*b*) specimens from the collection studied; 2 *Idoceras planula* (Hehl), ditto; 3 *Idoceras minutum* Diet., ditto; 4 *? Idoceras ? Nebrodites* (Enayites) aff. *gygii* Br. & R., specimen No. W 140 Dz/1 (cf. Pl. 2, Fig. 17)

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[2] After examining the holotype of *Idoceras laxevolutum* (Fontannes), the present author agrees with the opinion of Enay (1966, p. 571) that the specimens referred to this species by Ziegler (1959, pp. 28—29, Pl. 1, Fig. 6) and common in Quenstedt's Malm β are probably not conspecific with the holotype.

and Pl. 2, Figs 18—19 herein). In fact, the average rib-curves given by Nitzopoulos (1974, Fig. 10) for *I. planula* and *I. laxevolutum* differ somewhat also in their initial parts, which seems, however, related to too small sample size of *I. laxevolutum*. The considered species represent probably a dimorphic pair (*cf.* Ziegler 1959, Callomon 1963). The species *I. planula* and *I. laxevolutum* were reported previously from the Polish Jura Chain (Wierzbowski 1966, Pl. 6, Fig. 2, Pl. 7, Figs 1—2, Pl. 8, Fig. 1; Wiśniewska-Żelichowska 1971, Pl. 22, Fig. 1a - c; Brochwicz-Lewiński & Różak 1976b, Pl. 37, Fig. 2). The species *I. minutum* reveals considerable variation in coiling character and ribbing density (Ziegler 1959, *see* also Text-fig 4 herein). An extremely densely ribbed specimen of *I. minutum* is shown in Pl. 2, Fig. 16. The form ascribed here to *? Idoceras* aff. *minutum* is very close to the species recalled differing only in the lack of smooth band at the venter.

Another form (Text-fig. 4; Pl. 2, Fig. 17) with ornamented ventral side is here described as *? Idoceras ? Nebrodites (Enayites)* aff. *gygii* Br. & R. It resembles some *Idoceras* species, especially *I. proteron* Nitz. and *I. laxevolutum* (Font.) *sensu* Ziegler (1959), in the type of ribbing and the whorl section; the difference consists in its poorly developed, sparcely distributed parabolic swellings. The occurrence of swellings close to parabolic nodes is typical of the subgenus *Enayites* of the genus *Nebrodites* (*cf.* Brochwicz-Lewiński & Różak 1976b) but other features of the form under study, including its oval whorl section, secondary ribs bent forward, presence of few singular ribs, are uncommon in the representatives of *Enayites*. The discussed form resembles only *Nebrodites (Enayites)* cf. *gygii* of Brochwicz-Lewiński & Różak (1976b, p. 384, Pl. 37, Fig. 3) which has been interpreted by those authors as close to early *Idoceras*; actually, however, the investigated form appears much closer to *Idoceras* than the latter one. The intermingling nature of morphological features found in *? Idoceras ? Nebrodites (Enayites)* aff. *gygii* makes its generic status difficult to be established. In any case, that form should be interpreted as transitional between *Enayites* and *Idoceras* proper.

PRORASENIA

The ammonites collected include: *P. bathyschista* (Koer.), *P.* aff. *bathyschista* (Koer.), *P. quenstedti* Schind., *P.* aff. *quenstedti* Schind., and *P. crenata* (Reinecke *emend.* Quenst.). The species *P. bathyschista* (Pl. 3, Figs 6—7) is well characterized by the oval whorl section, rather dense ribbing (the number of primaries per whorl ranges between 18 and 21 at 20 mm diameter, and between 25 and 30 at 40 mm diameter), and early onset of biplicate ribs (the secondaries to primaries ratio equals 2.1—2.3 at 20 mm diameter). The form referred to as *P.* aff. *bathyschista* (Pl. 3, Fig. 8) differs only in its low oval whorl section and more protruding primary ribs. The species *P. quenstedti* described previously from the Polish Jura Chain (Wierzbowski 1966, Pl. 8, Figs 3—4) has many features in common with *P. bathyschista*, while it differs from the latter species in the low oval whorl section, lower point of rib division, narrower umbilicus, and generally less densely costate appearance (*cf.* also Koerner 1963). The form *P.* aff. *quenstedti* (Pl. 3, Fig. 9) differs from *P. quenstedti* in the triplicate ribbing disappearing rather early, i.e. at the initial part of the last whorl (at 20 mm diameter). It is noteworthy that the form *P.* aff. *quenstedti* resembles strongly but possibly only morphologically the boreal species *Prorasenia hardyi* Spath (*cf.* Spath 1935, Pl. 15, Fig. 5a - b).

The species *P. crenata* (Pl. 3, Figs 10—11) differs from *P. bathyschista* and *P. quenstedti* (and the allied forms) in its kidney-shaped, somewhat coronate whorl section. The ribbing of *P. crenata* is sharp, rather distant (14—20 primaries per whorl at 20 mm diameter, and 20—25 primaries at 40 mm diameter), with triplicate division persisting up to the middle of the last whorl (the secondaries to primaries ratio equals 2.5—3.3 at 20 mm, 2.1—3.0 at 30 mm, and 2.0 at 35—40 mm diameter). Its most close relative is *P. stephanoides* (Opp.), the difference consisting in much more protruding primaries, typical coronate whorl section, and somewhat less dense ribbing of the latter species. In fact the ammonites with prorasenioid or related ornamentation found in the Upper Oxfordian of Central Poland were commonly referred to *P. stephanoides* (*cf.* Malinowska 1960, Pl. 1, Figs 1—2; Wiśniewska-Żelichowska 1971, Pl. 26, Figs 3—4; Malinowska 1972, Pl. 9, Fig. 6, Pl. 10, Fig. 5); however, the bulk of those specimens, except possibly of those figured by Malinowska (1960), do not belong to that species. Some of them (Malinowska 1972, Pl. 9, Fig. 6; Pl. 10, Fig. 5) represent *Microbiplices* or *Microbiplices-Prorasenia* transitional forms; some other (Wiśniewska-Żelichowska 1971, Pl. 26, Fig. 3) represent probably *Prorasenia bathyschista*; but the specimens are generally too small or too fragmentary to make their unequivocal identification possible.

The discussed species of Submediterranean *Prorasenia* represent probably two distinct phyletic lineages. The first lineage leads from the Upper Oxfordian *P. bathyschista* to the uppermost Oxfordian-Lower Kimmeridgian *P. quenstedti* (and very close to it *P. heeri*; see Schairer 1969). The other one includes the Upper Oxfordian *P. crenata* and its uppermost Oxfordian-Lower Kimmeridgian probable descendants, *P. witteana* and *P. stephanoides* (cf. Beurlen 1924, Sazonov 1960).

OTHER RASENIOID AMMONITES

A few fragmentary specimens may be ascribed to the subgenus *Rasenioides* or the genus *Rasenia*. Another, better preserved but somewhat deformed specimen (Pl. 3, Fig. 5) is *Eurasenia* resembling *Rasenia (Eurasenia) engeli* Geyer or *R. (Eurasenia) gothica* Schneid (as interpreted by Geyer 1961) in its ornamentation and umbilicus size. In fact, there are 23 primary ribs per whorl in the specimen studied and the secondaries to primaries ratio is 3.6 at 53 mm diameter; the umbilicus approximates 27% of the diameter. Two other poorly preserved specimens with evolute coiling and rasenioid ornamentation belong probably to the subgenus *Pictonites*. The latter taxon comprises those Submediterranean ammonites attributed usually to the genus *Pictonia* which display many features in common with *Ringsteadia* and *Rasenia* (cf. Mesezhnikov 1969, pp. 101—102).

RINGSTEADIA

Most investigated specimens belong to the nominate subgenus [3] and represent the species *Ringsteadia flexuoides* (Qu.), *R. limosa* (Qu.) and *R. submediterranea* sp. n. The former two species were previously described in details (Wierzbowski 1970, pp. 273—276, Pls 1—3; *see* also Pl. 3, Fig. 4 herein); the latter one is established in the present paper. The incomplete specimens of *Ringsteadia* representing mostly inner whorls and described previously as *Ringsteadia* sp. indet. (Wierzbowski 1970, pp. 277—278, Pl. 4, Figs 1—2) appear comparable to the inner whorls of *R. limosa* (Qu.) and are at present tentatively assigned to that species.

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[3] The relationship between *Ringsteadia* Salfeld, 1913, and *Vineta* Dohm, 1925, seems disputable; according to the present author, the name *Vineta* is to be regarded as a junior synonym of *Ringsteadia* (*cf.* Arkell 1957, p. L324) rather than independent subgeneric name (*cf.* Geyer 1961).

Ringsteadia (Ringsteadia) submediterranea sp. n.
(Pl. 3, Figs 1—3)

1888. *Ammonites involutus* Quenstedt; Quenstedt, p. 964, pl. 107, fig. 2.
1891. *Olcostephanus involutus* Quenstedt; Siemiradzki, pp. 78—79.
Holotype: The specimen No. W 85 Mi/2, presented in Pl. 3, Fig. 1.
Paratype: The specimen No. W 137 Dz/1, presented in Pl. 3, Fig. 3.
Type locality: Wieluń Upland, the region between Bobrowniki and Lisowice along Warta river (*cf.* Text-figs 1 and 3).
Type horizon: Miedzno chalky limestones; Upper Oxfordian (*bimammatum* Subzone of *bimammatum* Zone and *planula* & *costatum* horizon of *planula* Zone).
Derivation of the name: After the species occurrence in the Submediterranean province.
Material: Three specimens.
Dimensions:

Table 2

Specimen No.	D (mm)	Ud (%)	Wh (%)	S/P at D (mm) 40	60	80	100
holotype W 85 Mi/2	68	15.5	52				
	89	17	52		3.2	3.6	
paratype W 137 Dz/1	58	18	52.5	2.4	2.8		
W 113 Dz/10	83	16	50				
	108	16.5	51				
Ammonites involutus in: Quenstedt 1888 (107/2)	82	19	50.5				
	107	19	51.5			?3.0	3.4
Olcostephanus involutus in: Siemiradzki 1891	80	?20	?50		2.6	2.6	

Description. — Strongly involute (Table 2), compressed; whorl section oval, tapering towards the venter; umbilical angle rounded, with umbilical slope fairly steep but not vertical; dense, thin, somewhat prorsiradiate primaries (36—37 per whorl at 60—110 mm diameter) and better developed numerous secondaries (Table 2); ribs mostly bi- and trifurcate; intercalatory ribs common; constrictions present but poorly visible, thin and very shallow, marked mainly by somewhat oblique course of adjacent them ribs.

Remarks. — Both the specimen illustrated by Quenstedt (1888, Pl. 107, Fig. 2) and that one described by Siemiradzki (1891; *see* Pl. 3, Fig. 2 herein) were originally erroneously referred to *Ammonites involutus* Quenstedt 1849 = *Rasenia (Involuticeras) involuta* (Quenstedt 1849). The former specimen had been transferred to *Ringsteadia* by Salfeld (1917, pp. 74 and 76) and tentatively assigned to *R. pseudoyo* Salf.; such specific identification was, however, questioned by Dieterich (1940, p. 35). According to the present author, both the discussed specimens are to be attributed to *R. submediterranea* sp. n. (*cf.* Table 2).

The specimen described previously by the present author as *R. (? Ringsteadia)* sp. (Wierzbowski 1970, pp. 279—280, Pl. 5, Fig. 2) resembles very closely *R. submediterranea* sp. n., differing mostly in its wider umbilicus.

The species *R. submediterranea* sp. n. differs from *R. flexuoides* (Qu.) and *R. limosa* (Qu.) in its more involute coiling and more numerous primary ribs. The species *R. weinlandi* (Fischer) is as involute as *R. submediterranea* sp. n., differing in its more widely spaced ribbing.

POMERANIA

The taxonomic status of *Pomerania* Arkell, 1937, has remained up to date strongly controversial. Some authors (*e.g.* Arkell 1947, 1957) regarded *Pomerania* as a subgenus of *Decipia*, while others (notably Enay 1966) interpreted it as a subjective synonym of *Decipia*. Still other authors (Geyer 1961, Kutek 1968) recognized *Pomerania* for a separate genus including two subgenera, viz. *Pomerania* s.s. and *Pachypictonia*.

The crucial point of the taxonomic controversions is in the nature of a perisphinctid group occurring mostly in the Upper Oxfordian of the Submediterranean Europe and referred usually (*e.g.* Enay 1962, 1966; Malinowska 1972) to *Decipia*. Some of those ammonites were often identified as *Decipia decipiens* (Sow.) — *D.* cf. *decipiens* (Sow.) and *D. lintonensis* Ark., *i.e.* as species of *Decipia* s.s.; some others, as *D. latecosta* (Dohm) and *D. schmidti* (Dohm), *i.e.* as typical representatives of *Pomerania*. Ammonites of the same group have been found by the present author and are discussed below.

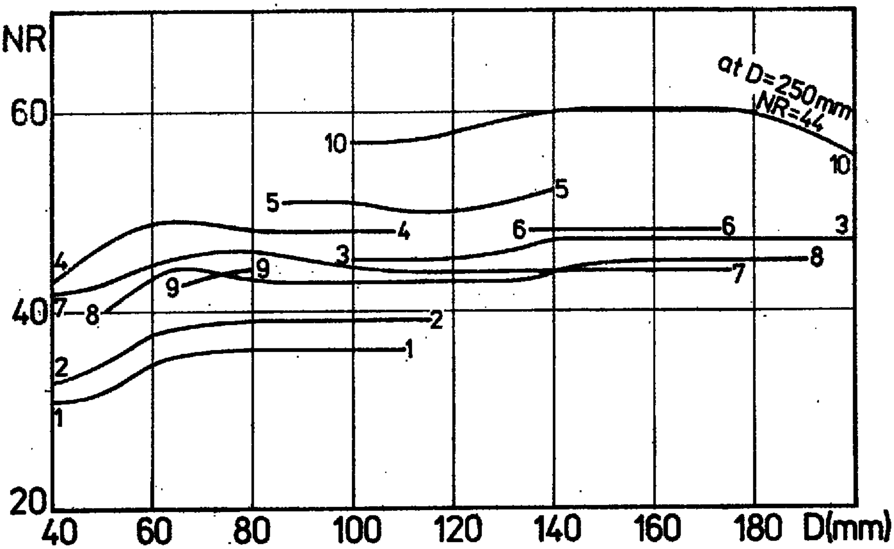

Fig. 5. Rib-curves for some *Pomerania* species

Pomerania sp. n. = *Decipia* cf. *decipiens* sensu Enay (1962, 1966): 1 specimen No. Bd 66/1 (*cf.* Pl. 3, Fig. 12); 2 W 125 Dz/1

Pomerania helvetica (Geyer) = *Decipia latecosta* sensu Enay (1962, 1966): 3 holotype; 4 W 113 Dz/5 (*cf.* Pl. 4, Fig. 2); 5 W 15 RS/1 (*cf.* Pl. 5, Fig. 2); 6 W 113 Dz/6; 7 W 125 Dz/2 (*cf.* Pl. 4, Fig. 1); 8 W 113 Dz/7 (*cf.* Pl. 5, Fig. 1); 9 Bd 66/3 (*cf.* Pl. 4, Fig. 3)

Pomerania cf. *girardoti* (Enay): 10 W 113 Dz/3 (*cf.* Pl. 6, Fig. 1)

Three specimens from the collection studied (Text-fig. 5; Pl. 3, Fig. 12) are comparable with "*Decipia decipiens* — *D.* cf. *decipiens*" of Enay (1962, Pl. 1, Fig. 1; Pl. 2, Fig. 3; Pl. 3, Figs 1, 3—4; 1966, Pl. 38, Fig. 4) and Malinowska (1972, Pl. 11, Fig. 5). However, no one specimen is true *Decipia decipiens* (Sow.) from which all of them differ in more *Perisphinctes*-like, biplicate ribbing on the inner whorls up to 60—80 mm diameter, and "a sudden change to huge, swollen ribs on the body chamber" (Wright 1973, p. 451). An analogous simple ornamentation of the inner whorls occurs in other species of Submediterranean "*Decipia*" (e.g. "*D. latecosta*" sensu Enay, "*D.*" *helvetica* Geyer, "*D.*" *girardoti* Enay), but never in true boreal *Decipia* where ornamentation is much more complex (*cf.* inner whorls of macro- and microconche *in:* Arkell 1937*a*, Pl. 3, Figs 1—4; 1937*b*, Pl. F, Figs 3—4; 1947, Pl. 78; Wright 1972, Pl. 14, Fig. 4; Surlyk, Callomon & al. 1973, Pl. 1, Figs 1—2; Sykes & Surlyk 1976, Fig. 5B).

The most common form found in the material studied (Pl. 4, Figs 1—3; Pl. 5, Figs 1—2; Text-fig. 5) is well comparable with *"Decipia latecosta"* of Enay (1962, Pl. 2, Figs 1—2; 1966, Text-figs 171/2—4, Pl. 39, Fig. 2) and Malinowska (1972, Pl. 12, Figs 1, ? 2), while it is probably not conspecific with *Pomerania latecosta* of Dohm (1925, Pl. 9, Fig. 6). The holotype of *P. latecosta* (Dohm) shows well preserved outer whorl with distant swollen ribs but its inner whorls are obscured. One may only claim that the ribbing is distant on its inner whorls similarly to other specimens of *Pomerania* s.s. found in the same profile at Czarnogłowy (*Zarnglaff*) by Dohm (1925, Pl. 5, Fig. 6; Pl. 7, Fig. 3; Pl. 8, Fig. 3) and representing species closely related to *P. latecosta*. On the other hand, the specimens of *"Decipia latecosta"* of Enay (1962, 1966) and Malinowska (1972) and related specimens found by the present author have rather dense ribbing on their inner whorls (Text-fig. 5) and actually, they are almost certainly conspecific with *"Decipia" helvetica* of Geyer (1961, Pl. 22, Fig. 5; see also Enay 1966, p. 559).

The third form present in the investigated collection appears very similar to *"Decipia" girardoti* Enay, differing only in somewhat smaller size (Text-fig. 5; Pl. 6, Fig. 1).

Some more general conclusions can be drawn on the basis of the information available. Distinction between the discussed Submediterranean ammonites and the true boreal *Decipia* can be justified not only on morphological but also on stratigraphical grounds. The Submediterranean ammonites evolved in the Late Oxfordian as a group parallel to the genus Ringsteadia (see Text-fig. 2) and are clearly younger than the true boreal *Decipia*. It seems highly probable that those Submediterranean ammonites gave rise at Oxfordian/Kimmeridgian boundary to *Pomerania* s.s. occurring in the same biogeographic province and hence, they are here tentatively assigned to *Pomerania*. Because of the unclear (but probably rather distant) phylogenetic relationship between *Pomerania* and *Decipia*, it seems also reasonable to recognise both the taxa for separate genera.

PROGERONIA

The range of the genus *Progeronia* Arkell, 1953, is here extended to include not only the microconch species related to *Perisphinctes progeron* v. Ammon (i.e *Progeronia* sensu Arkell 1953) but also their possible macroconch counterparts (*cf.* Zeiss 1968, p. 48). Those micro- and macroconchs were previously placed (Geyer 1961; *cf.* also Koerner 1963; Wierzbowski 1964; Enay 1966; Kutek 1968, and others) in the genus *Lithacoceras*, which appears to contradict the phylogenetic data (Zeiss 1968; *cf.* also Bantz 1970). Recently, Schairer (1974; *cf.* Nitzopoulos 1974) assigned tentatively macroconch species regarded by him as dimorphic counterparts of different *Orthosphinctes* s.s., *Parataxioceras*, and possibly *Progeronia* s.s., to the genus *Lithacoceras*. The present author believes, however, that no one of the ammonites discussed by Schairer (1974) is true *Lithacoceras*. Most forms (e.g. *"Lithacoceras" evolutum* Qu., *"L." subachilles* Weg.) appear to represent macroconchs of *Progeronia* s.s. rather than of *Ortosphinctes* s.s. and hence their attribution to the genus *Progeronia* seems more appropriate (see also remarks on the genus *Orthosphinctes*); a minority (e.g. *"L." planulatum* Qu.) are really macroconchs of *Parataxioceras* and should be transferred to the genus *Ataxioceras*.

The following species of *Progeronia* have been found in the material studied: *P. triplex* (Qu.), *P. evoluta* (Qu.), *P. subachilles* (Weg.), and *P. heidenheimense* (Weg.). Except of the latter form the species are well known and, hence, they will be not

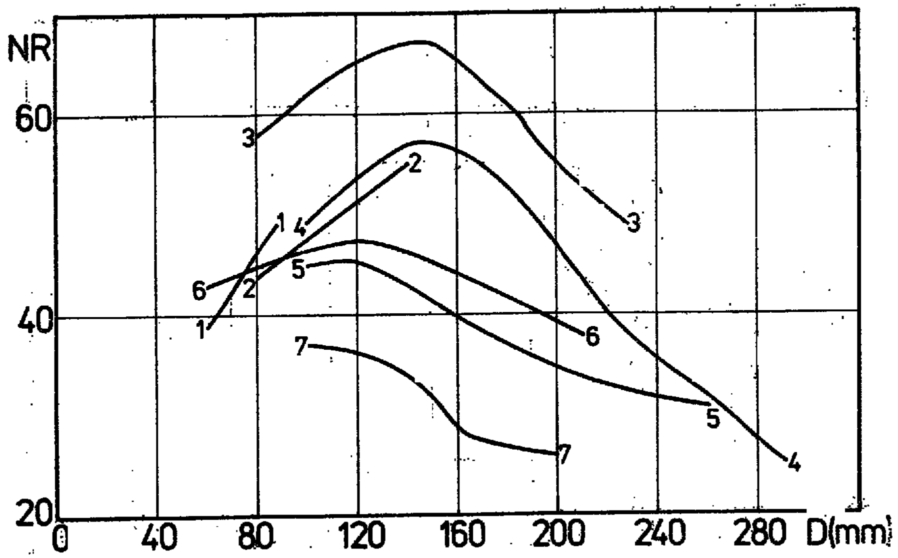

Fig. 6. Rib-curves for some *Progeronia* species
Progeronia triplex (Qu.): 1 specimen No. W 60 Dz/1 (*cf.* Pl. 5, Fig. 3); 2 W 1 RS/1
Progeronia subachilles (Weg.): 3 W 4 Bz/1 (*cf.* Pl. 7, Fig. 1); 4 W 4 Bz/2
Progeronia. evoluta (Qu.): 5 W 113 Dz/4, 6 W 16 RS/1
Progeronia heidenheimense (Weg.): 7 W 139 Dz/1 (*cf*, Pl. 7, Fig. 2).

discussed in the present paper (*see* descriptions *in*: Geyer 1961, Bantz 1970, Schairer 1974; *see* also Text-fig. 6; Pl. 5, Fig. 3; Pl. 6, Fig. 2; Pl. 7, Fig. 1 herein; cf. Wierzbowski 1964, p. 161, Pl. 2, Fig. 1). The species *P. heidenheimense* (Weg.) is rather poorly known and based on a fragmentary specimen as its holotype (Wegele 1929, p. 50, Pl. 2, Fig. 1). The single specimen referred here to that species (Text-fig. 6, Pl. 7, Fig. 2) displays high oval, somewhat rectangular whorl section and is moderately evolute ($Ud = 44\%$ and $Wh = 32\%$ at 190 mm diameter); the ribs are strong and distant, mostly tri-, and quadriplicate on the last whorl (the secondaries to primaries ratio is 4.7 at 140 mm diameter, and 5.5 at 200 mm diameter); the constrictions are narrow and deep. The specimen seems very similar to the holotype of *P. heidenheimense* (Weg.), differing from the specimens assigned to that species by Koerner (1963, pp. 364—365, Pl. 24, Fig. 1) in its stronger and more distant ribbing.

ORTHOSPHINCTES

The genus is represented by fairly abundant specimens belonging to the subgenera *Orthosphinctes* and *Pseudorthosphinctes*.

Microconch species of the nominate subgenus are here recognized in their traditional meaning (*cf.* Geyer 1961, Koerner 1963, Enay 1966), without any attempt to lump them into enlarged species (*cf.* Schairer 1974). There are undoubtedly too many specific names for *Orthosphinctes* microconchs but their revision will have to be based upon stratigraphically and geographically controlled ammonite populations rather than upon individual specimens derived from a single region and representing but a short time-interval. The following microconch species are re-

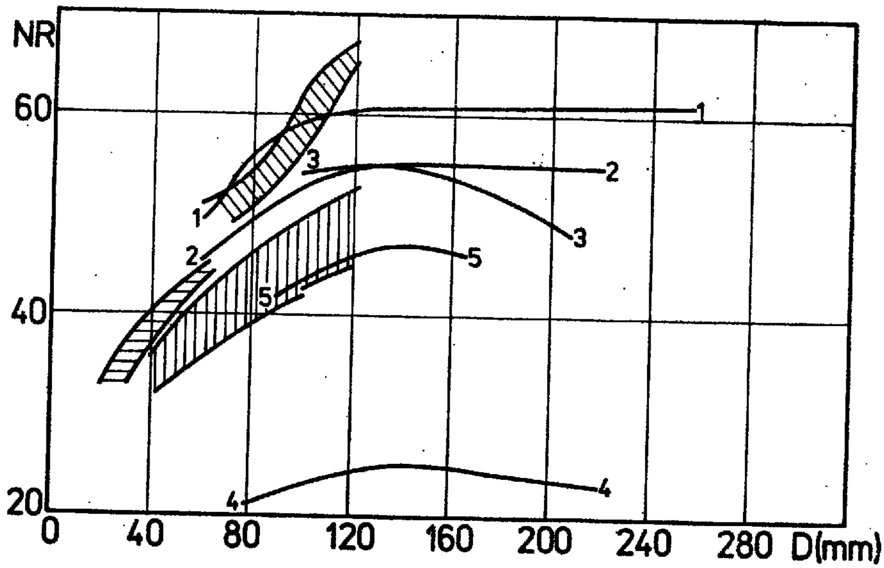

Fig. 7. Rib-curves for some *Orthosphinctes* species

O. (Pseudorthosphinctes) alternans Enay: 1 specimen No. W 118 Dz/1 (*cf.* Pl. 8, Fig. 3); 2 W 145 Dz/1; 3 W 128 Dz/1

O. (Pseudorthosphinctes) lisowicensis sp. n.: 4 holotype W 113 Dz/1 (number of ribs per half of whorl; *cf.* Pl. 9, Fig. 1); 5 paratype W 113 Dz/2 (*cf.* Pl. 9, Fig. 2)

For comparison the variation of ribbing density in some microconchs of *Orthosphinctes* found in the material studied is given (vertically lined — *O. polygyratus*, horizontally lined — *O. colubrinus*, obliquely lined — *O. freybergi*)

cognized in the material studied: *Orthosphinctes (Orthosphinctes) polygyratus* (Rein.), *O. (O.)* cf. *tiziani* (Opp.), *O. (O.) colubrinus* (Rein.), *O. (O.) mogosensis* (Chof.) and *O. (O.) freybergi* (Geyer). The latter species (Text-fig. 7, Pl. 8, Fig. 1) was originally ascribed by Geyer (1961) to *Progeronia* but its ornamentation appears more typical of *Orthosphinctes* (*cf.* Schairer 1974). The form *Orthosphinctes* aff. *polygyratus* (Pl. 8, Fig. 2) differs from *O. polygyratus* (Rein.) in having slightly closer ribbing, especially on the inner whorls.

The macroconch subgenus *Pseudorthosphinctes* was originally recognized by Enay (1966) for a dimorphic counterpart of *Orthosphinctes* s.s. This interpretation has, however been, questioned by Schairer (1974) considering *Orthosphinctes* s.s. as paired with some macroconchs of his "*Lithacoceras*", while regarding microconch counterpart of *Pseudorthosphinctes* as unknown. According to Schairer (1974, pp. 92—93), the coupling of *Pseudorthosphinctes alternans* Enay (M) with *Orthosphinctes polygyratus* (Rein.) (m) as suggested by Enay (1966) has to be revised on account of a difference in ribbing density between the species discussed (*see* also Text-fig. 7). Nevertheless the present author follows Enay in conceiving *Pseudorthosphinctes* and *Orthosphinctes* s.s. as corresponding macro- and microconch subgenera because of the following reasons: (i) Both the type of ribbing and the rib-curves of the inner whorls of *Pseudorthosphinctes* resemble generally those displayed by the corresponding whorls of *Orthosphinctes* s.s. (*cf.* Enay 1966, Fig. 158; Text-fig. 7 herein). (ii) The species of *Pseudorthosphinctes* distinguished by Enay (1966) well match the more densely ribbed microconchs of *Orthosphinctes* s.s., whereas *Pseudorthosphinctes* *lisowicensis* sp. n. may be a dimorphic counterpart of less densely ribbed microconchs such as *O. (O.) polygyratus* (Rein.). (iii) There is undoubtedly a close relationship between *Orthosphinctes* s.s. and *Progeronia* microconchs, as those groups are connected by intermediates (*cf.* Geyer 1961). The same relationship seems to exist between the macroconch groups, viz. *Psudorthosphinctes* and some *"Lithacoceras"* sensu Geyer (Pl. 10, Fig. 1 herein); it seems reasonable to consider the former group as a dimorphic counterpart of *Orthosphinctes* s.s., and the latter as a counterpart of *Progeronia*, basing upon the analogies in size and ribbing type.

In the investigated collection the subgenus *Pseudorthosphinctes* is represented by two species, namely *O. (Pseudorthosphinctes) alternans* Enay (Pl. 8, Fig. 3) and *O. (Pseudorthosphinctes) lisowicensis* sp. n.

Orthosphinctes (Pseudorthosphinctes) lisowicensis sp. n. (Text-fig. 7 and Pl. 9, Figs 1—2)

1966. *Orthosphinctes (Pseudorthosphinctes)* sp.; Enay, pp. 524—525, figs 158, 160/1—2, 171/1a-b.
Holotype: The specimen No. *W 113 Dz/1*, presented in Pl. 9, Fig. 1.
Paratype: The specimen No. *W 113 Dz/2*, presented in Pl. 9, Fig. 2.
Type locality: Wieluń Upland, the region between Lisowice and Raciszyn along Warta river (*cf.* Text-figs 1 and 3).
Type horizon: Miedzno chalky limestones; Upper Oxfordian (*planula-costatum* horizon of *planula* Zone).
Derivation of the name: After Lisowice village.
Material: Two specimens.
Dimensions.

Table 3

Specimen No.	D (mm)	Ud (%)	Wh (%)	S/P at D (mm) 100	120	140	160	180	200
holotype W 113 Dz/1	130	49	27		2.8			3.0	3.6
paratype W 113 Dz/2	134	49.5	29						
	167	51.5	25.5	2.6	2.8	3.0	3.2		

Description. — Evolute (Table 3); whorl section ovate; ribbing sharp and fairly dense on inner whorls, progressively strengthening, more distant on outer whorl (Text-fig. 7); ribs mostly biplicate, with triplicate ones near peristome; intercalatory ribs common; constrictions well marked, deep.

Remarks. — The species is as densely ribbed as *Progeronia* (= *"Lithacoceras"*) *evoluta* (Qu.), differing mostly in the lower value of the secondaries to primaries ratio at larger diameters (*cf.* Schairer 1974, Fig. 41; *see also* Text-fig. 7, Table 3 herein). Moreover, the secondary ribs persist up to the peristome in *O. (P.) lisowicensis* sp. n.; whereas in *Progeronia evoluta* (Qu.), the coarse primaries appear usually on the outer whorl and the venter becomes smooth. However, a single incomplete but fully grown specimen (Pl. 10, Fig. 1) shows some features of *O. (P.) lisowicensis* (the secondaries to primaries ratio rather low, 3.4 at 170 mm diameter and 3.6 at 200 mm diameter) along with some features of *Progeronia evoluta* (the presence of singular ribs on the last part of body chamber).

The species *O. (P.) lisowicensis* sp. n. differs from *O. (P.) alternans* Enay in its more distant ribbing. The species *O. (P.) kirkdalensis* (Arkell) and *O. (P.) masticonensis* Enay are much more densely ribbed; furthermore, the former species has also the secondaries to primaries ratio lower than *O. (P.) lisowicensis* sp. n.

OTHER PERISPHINCTIDS

The species *"Perisphinctes" suevicus* Siemiradzki and *"Perisphinctes" laufenensis* Siemiradzki are represented by a few rather poorly preserved specimens (Pl. 10, Figs 2—3). The species have been usually ascribed to the genus *Orthosphinctes* but they differ from the typical representatives of that genus in some important features including the rib curves (*cf.* Siemiradzki 1898, Pl. 24, Fig. 35; Pl. 26, Fig. 46). In fact, they resemble some early representatives of *Parataxioceras* (*cf.* Koerner 1963, p. 361; Schairer 1974, p. 75).

ASPIDOCERATIDAE

These ammonites are extremely rare in the material studied. A fragmentary specimen assigned previously to *Euaspidoceras* (*cf.* Wierzbowski 1966, pp. 135, 165) represents actually *Paraspidoceras* possibly close to *P. mamillanum* (Qu.). Only two specimens belong undoubtedly to the genus *Aspidoceras*, only one being sufficiently well preserved to permit the specific identification (Pl. 10, Fig. 4) and representing *A. binodum* (Opp.). Another specimen of the latter species has been figured and described from the Upper Oxfordian of the Cracow Upland as "*Aspidoceras longispinum* (Sow.)" by Panow (1930; *cf.* also Głazek & Wierzbowski 1972, pp. 47 and 68).

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A. WIERZBOWSKI

STRATYGRAFIA I FAUNA AMONITOWA GÓRNEGO OKSFORDU WYŻYNY WIELUŃSKIEJ

(Streszczenie)

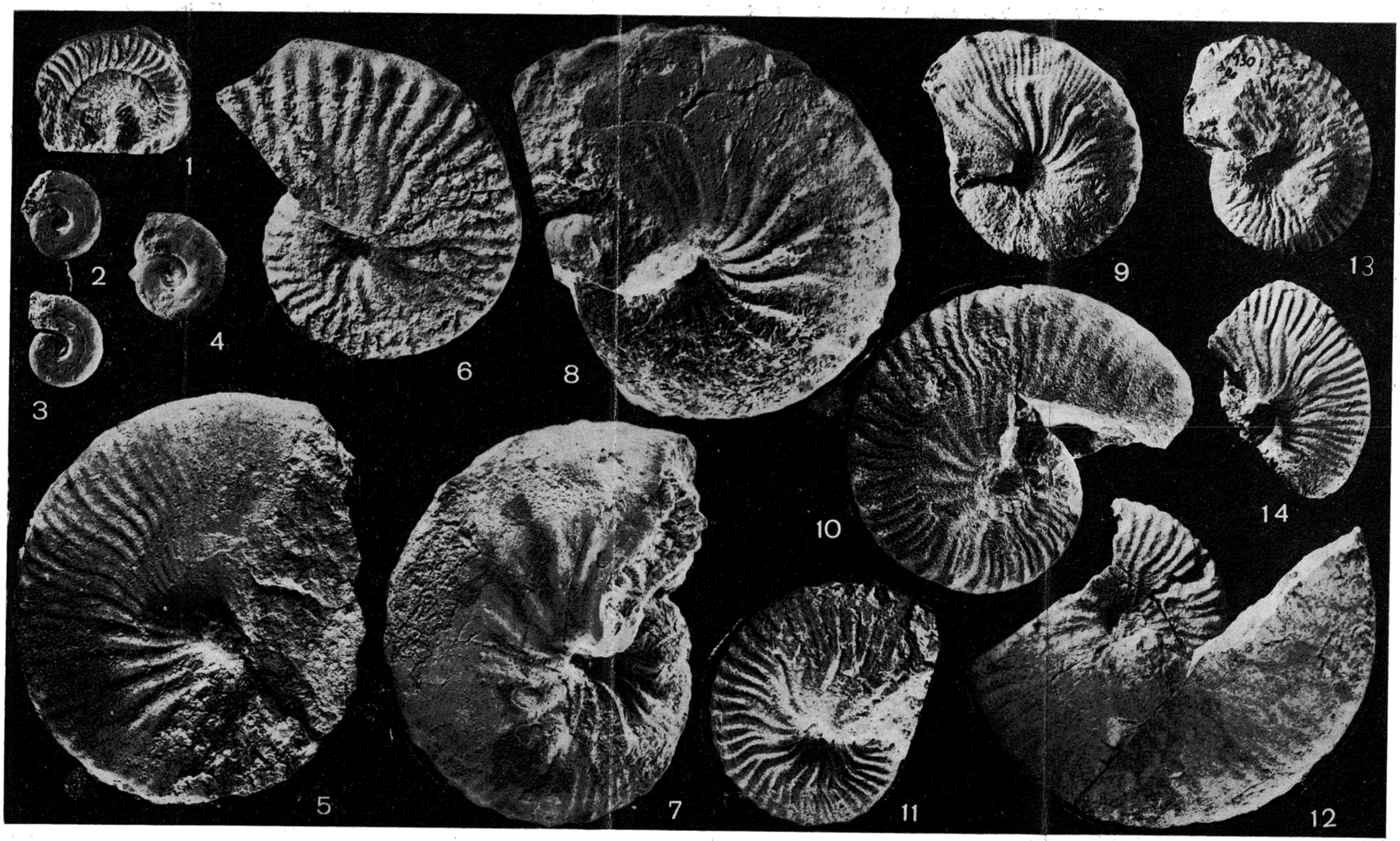
Praca niniejsza jest próbą syntetycznego ujęcia stratygrafii górnego oksfordu Wyżyny Wieluńskiej (*por.* Wierzbowski 1966, 1970; Kutek & al. 1977). Wyróżniono szereg nieformalnych jednostek litostratygraficznych, przedstawiono ich ogólny charakter litologiczny i omówiono granice, podano miąższość oraz wskazano zasięg występowania (patrz fig. 1—3). Opracowano także biostratygrafię w oparciu o zebraną liczną faunę amonitową.

Na badanym obszarze występuje w górnym oksfordzie submedyterańska fauna amonitowa umożliwiająca rozpoznanie poziomów *bimammatum* oraz *planula* (tab. 1 oraz fig. 2—3). Utwory niższej części poziomu *bimammatum* — odpowiadające podpoziomowi *hypselum* — nie są na Wyżynie Wieluńskiej odsłonięte; widoczne są one natomiast w bezpośrednim sąsiedztwie, pomiędzy Kłobuckiem i Częstochową, gdzie zostały dobrze udokumentowane fauną amonitową (Kutek & *al.* 1977; Brochwicz & Różak 1976*a*). Dostępne obserwacji na badanym terenie osady poziomu *bimammatum* zostały zaliczone do podpoziomów *bimammatum* oraz *hauffianum*. Ten ostatni podpoziom został wydzielony w Polsce po raz pierwszy, a jego definicję rozszerzono o nowe elementy faunistyczne. Podpoziom *hauffianum* można obecnie traktować jako niesamoistny podpoziom zespołowy, charakteryzujący się obecnością gatunku *Taramelliceras hauffianum* (Opp.), form przejściowych *Enayites-Idoceras* i innych amonitów bliskich idocerasom. Górna granica podpoziomu *hauffianum*, będąca jednocześnie dolną granicą poziomu *planula*, wyznaczona jest pojawieniem się typowych przedstawicieli rodzaju *Idoceras*, reprezentowanych przez gatunki *Idoceras planula* (Hehl), *I. laxevolutum* (Font.) sensu Ziegler (1959) oraz *I. minutum* Diet.

W poziomie *planula* wydzielone zostały trzy horyzonty faunistyczne: w niższej części poziomu horyzont współwystępowania *Idoceras planula* — *Taramelliceras costatum*, w środkowej części horyzont zasięgu *Taramelliceras* aff. *tenuinodosum* (? = *T. tenuinodosum* Weg. sensu lato), w wyższej części horyzont współwystępowania *Idoceras planula* — *Prorasenia quenstedti*. W pracy dyskutowany jest problem podziału poziomu *planula* na podpoziomy; zdaniem autora, oprócz stosowanego niekiedy podziału na podpoziomy *planula* i *galar* (por. Cariou & *al.* 1971), istnieje także możliwość wyróżnienia dwóch podpoziomów w oparciu o zmiany faunistyczne dokonujące się w najniższej części horyzontu *T.* aff. *tenuinodosum* (por. fig. 2).

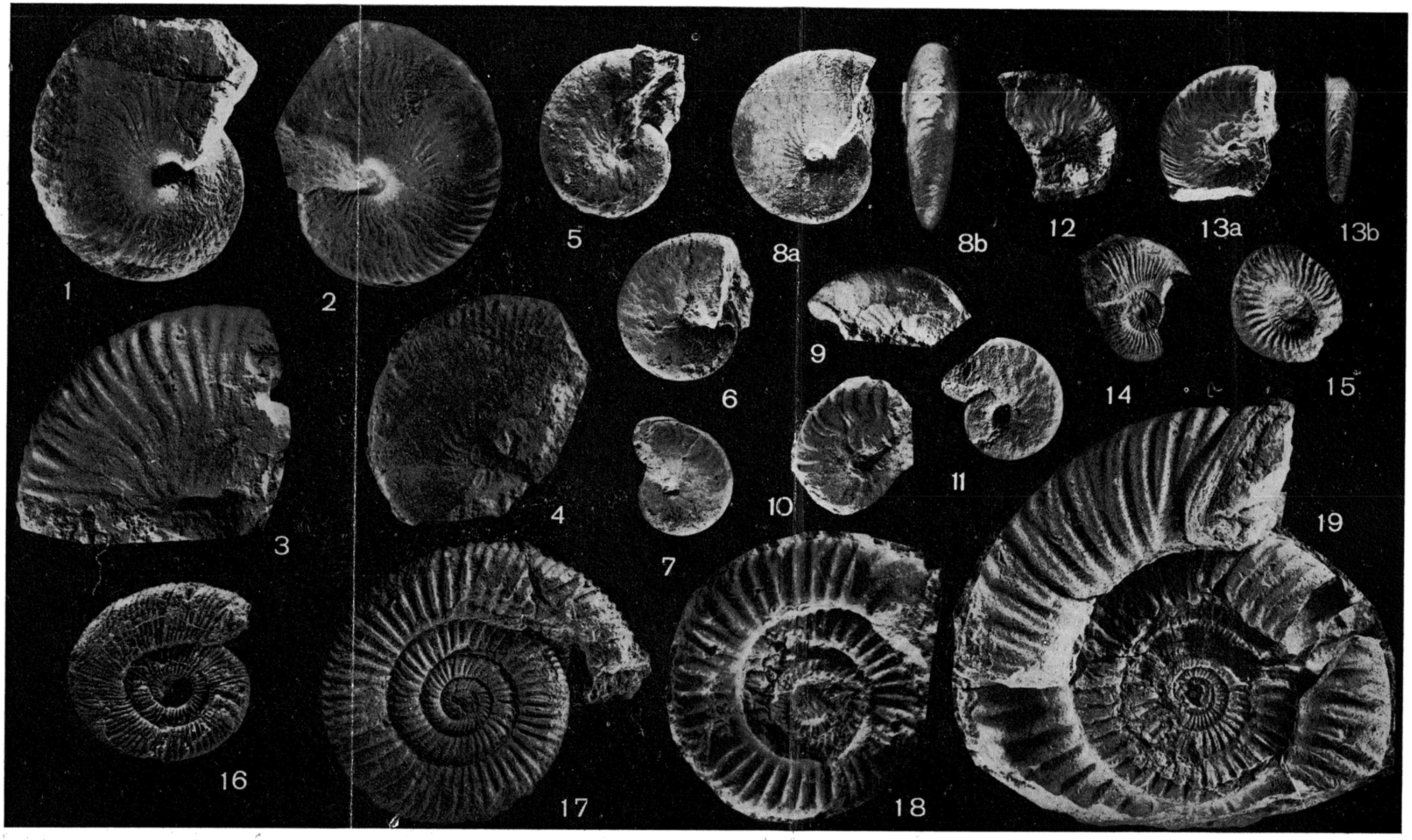
W analizie biogeograficznej wykazano bliskie podobieństwo omawianej fauny amonitowej do fauny Jury Frankońskiej i Jury Szwabskiej. Nieznaczne różnice między tymi faunami są być może częściowo uwarunkowane położeniem Wyżyny Wieluńskiej w bardziej zewnętrznej strefie prowincji submedyterańskiej.

W paleontologicznej części pracy przedstawione są nowe obserwacje i dyskusje taksonomiczne dotyczące amonitów, a szczególnie rodzajów i podrodzajów *Taramelliceras, Metahaploceras, Idoceras, Prorasenia, Ringsteadia, Pomerania, Progeronia, Orthosphinctes, Pseudorthosphinctes* (tab. 2—3, fig. 4—7 oraz pl. 1—10). Wyróżnione zostały dwa gatunki nowe, *Ringsteadia submediterranea* sp. n. oraz *Orthosphinctes* (*Pseudorthosphinctes*) *lisowicensis* sp. n.



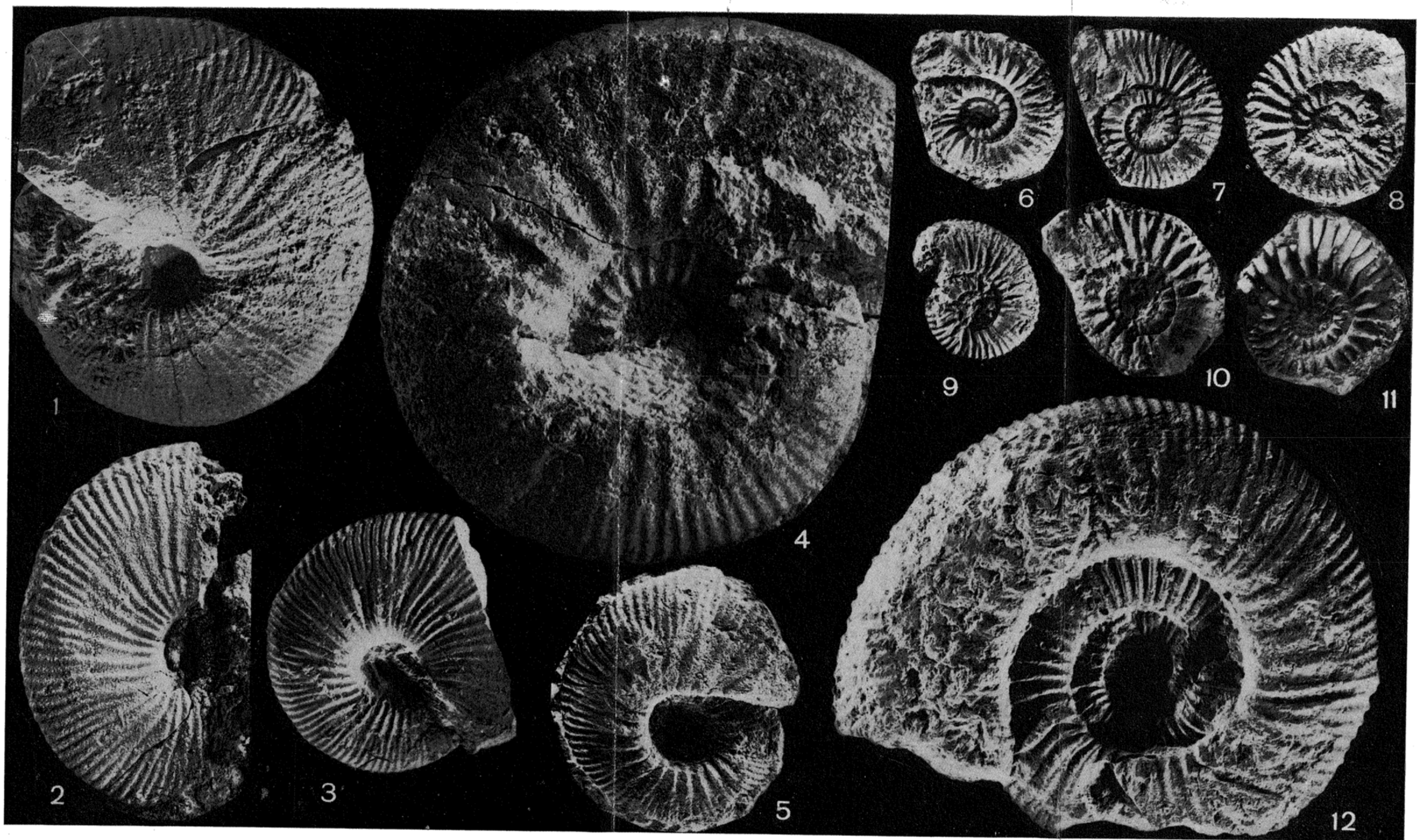
1 *Ochetoceras marantianum* (d'Orb); specimen No. W 92 Mi/1, Bobrowniki, Miedzno chalky limestones, *bimammatum* Zone; **2—4** *Glochiceras (Coryceras) modestiforme* (Opp.); W 158 Dz/1 and W 127 Dz/1, Kolonia Lisowice, Miedzno chalky limestones; W 53 Dz/1, Antonie, Niwiska chalky limestones; *planula* Zone; **5—6** *Taramelliceras (Taramelliceras) costatum costatum* (Qu.); W 92 Mi/2, Bobrowniki, Miedzno chalky limestones, *bimammatum* Zone; W 144 Dz/1, Lisowice, Miedzno chalky limestones, *planula* Zone; **7—8** *Taramelliceras (Taramelliceras) costatum auritum* (Qu.); W 85 Mi/3, Bobrowniki; W 15 RS/3, Wapiennik; Miedzno chalky limestones, *bimammatum* Zone; **9** *Taramelliceras (Taramelliceras) costatum laterinodosum* Karvé-Corv.; Bd 67/1, Bobrowniki, Miedzno chalky limestones, *bimammatum* Zone; **10** *Taramelliceras (Taramelliceras)* aff. *costatum* (Qu.); W 7 RS/1, Płaczki, Niwiska chalky limestones, *planula* Zone; **11—12** *Taramelliceras (Taramelliceras) broilii* (Weg.); W 157 Dz/1 and W 152 Dz/1, Kolonia Lisowice, Miedzno chalky limestones, *planula* Zone; **13—14** *Taramelliceras (Taramelliceras) hauffianum* (Opp.); W 130 Dz/1 and W 123 Dz/1, Raciszyn, Miedzno chalky limestones, *planula zone*

All photos of nat. size; taken by B. Drozd, M. Sc.



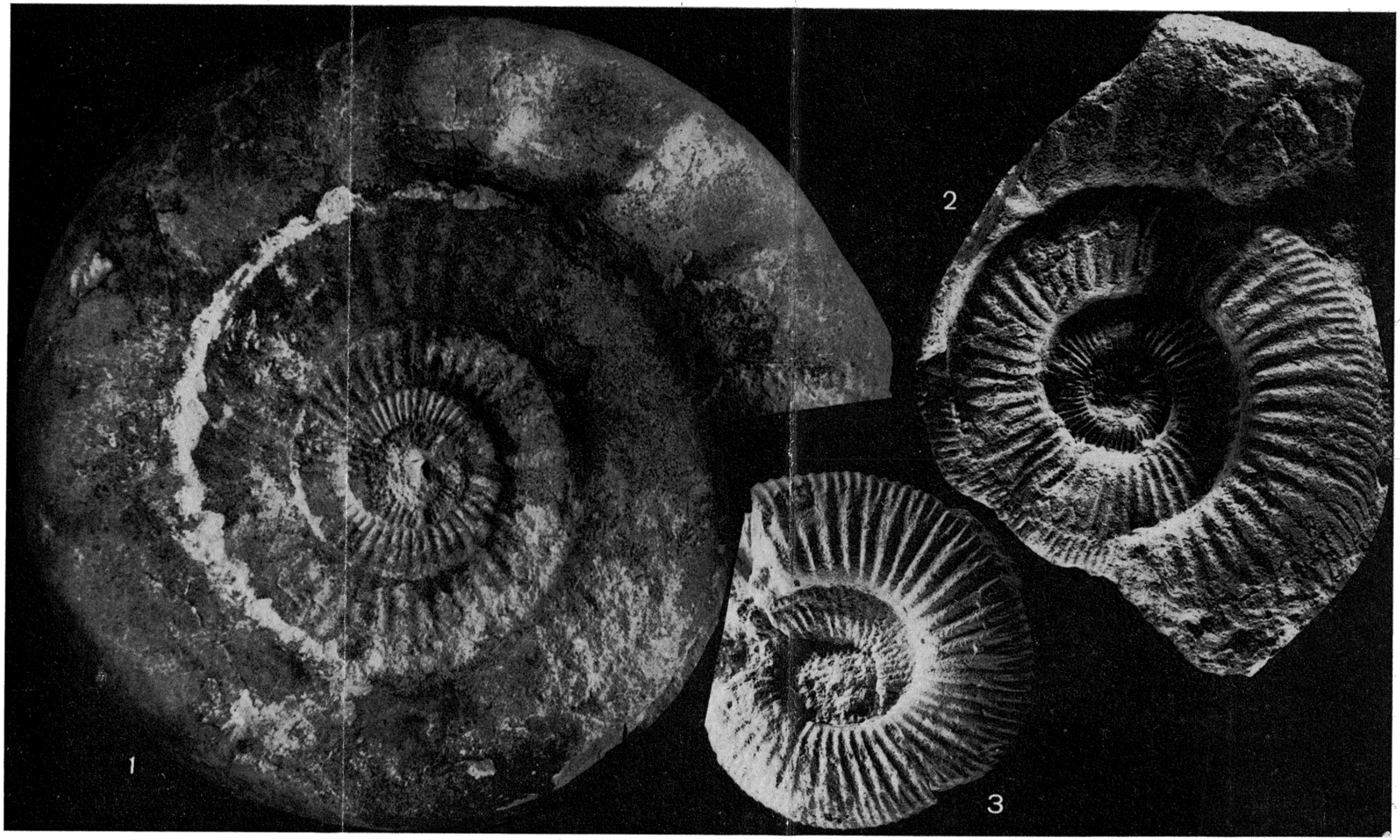
1—2 *Taramelliceras sarasini* (Lor.): *1* specimen No. W 98 Dz/1, Raciszyn; *2* specimen No. W 133 Dz/1, Działoszyn; Miedzno chalky limestones, *planula* Zone; **3** *Taramelliceras* cf. *pseudoflexuosum* (Favre); W 101 Dz/1, Raciszyn, Miedzno chalky limestones, *planula* Zone; **4** *Taramelliceras* cf. *kobyi* (Chof.); W 55 Dz/1, Lelity, Niwiska chalky limestones, *planula* Zone; **5—7** *Taramelliceras (Metahaploceras) litocerum* (Opp.); W 157 Dz/2, W 113 Dz/12, W 113 Dz/13, Kolonia Lisowice-Raciszyn, Miedzno chalky limestones, *planula* Zone; **8 a-b** *Taramelliceras (Metahaploceras)* cf. *ausfeldi* (Würt.) sensu Wegele (1929); *a* lateral view, *b* ventral view; W 44 Dz/2, Grądy—Łazy, Niwiska chalky limestones, *planula* Zone; **9** *Taramelliceras (Metahaploceras) ausfeldi* (Würt.) sensu Wegele (1929); W 49 Dz/1, Antonie, Niwiska chalky limestones, *planula* Zone; **10—11** *Taramelliceras (Metahaploceras) wenzeli* (Opp.); W 113 Dz/1, Raciszyn, Miedzno chalky limestones, *planula* Zone; W 3 Mi/1, Lisowice, Miedzno chalky limestones, *bimammatum* Zone; **12—13 a-b** *Taramelliceras (Metahaploceras)* aff. *tenuinodosum* (Weg.), *a* lateral view, *b* ventral view; W 1 Dz/1 and W 5 Dz/1, Dylów, friable micritic limestones, *planula* Zone; **14** *Amoeboceras lineatum* (Qu.);W 113 Dz/11, Raciszyn, Miedzno chalky limestones, *planula* Zone; **15** *Amoeboceras bauhini* (Opp.); W 52 Dz/1, Antonie, Niwiska chalky limestones, *planula* Zone; **16** *Idoceras minutum* Diet.; W 2 RS/1, Płaczki, Niwiska chalky limestones, *planula* Zone; **17** *?Idoceras ?Nebrodites (Enayites)* aff. *gygii* Br. & R.; W 140 Dz/1, Lisowice, Miedzno chalky limestones, *bimammatum* Zone; **18** *Idoceras laxevolutum* (Font.) sensu Ziegler (1959); W 139 Dz/3, Lisowice, Miedzno chalky limestones, *planula* Zone; **19** *Idoceras planula* (Hehl); W 5 Mi/1, Lisowice, Miedzno chalky limestones, *planula* Zone

All photos of nat. size; taken by B. Drozd, M. Sc.



1—3 *Ringsteadia (Ringsteadia) submediterranea* sp. n.; *1* specimen No. W 85 Mi/2 (*holotype*), Bobrowniki, Miedzno chalky limestones, *bimammatum* Zone; *2* „*Olcostephanus involutus*" as described by Siemiradzki (1891, pp. 78—79), Podgórze (*Geol. Mus. PAN Cracow, A I-2/292*); *3* W 137 Dz/1 (*paratype*), Lisowice, Miedzno chalky limestones, *planula* Zone; **4** *Ringsteadia (Ringsteadia) limosa* (Qu.); W 113 Dz/9, Raciszyn, Miedzno chalky limestones, *planula* Zone; **5** *Rasenia (Eurasenia)* sp.; W 11 P/2, Pajęczno, Pajęczno chalky limestones, *planula* Zone; **6—7** *Prorasenia bathyschista* (Koer.); W 4 RS/1, Płaczki, Niwiska chalky limestones, *planula* Zone; W 85 Dz/1, Zalesiaki, Zalesiaki massive limestones, *planula* Zone; **8** *Prorasenia* aff. *bathyschista* (Koer.); W 15 RS/2, Wapiennik, Miedzno chalky limestones, *bimammatum* Zone; **9** *Prorasenia* aff. *quenstedti* Sch.; W 139 Dz/2, Lisowice, Miedzno chalky limestones, *planula* Zone; **10—11** *Prorasenia crenata* (Rein. emend Qu.); W 11 RS/1, Patoki, Zalesiaki massive limestones, *planula* Zone; W 27 DK/1, Borowa, Niwiska chalky limestones, *planula* Zone; **12** *Pomerania* sp. n.; Bd 66/1, Bobrowniki, Miedzno chalky limestones, *bimammatum* Zone

All photos of nat. size; taken by B. Drozd, M. Sc.



1—3 *Pomerania helvetica* (Geyer): *1—2* specimens No. W 125 Dz/2, × 0.66, and No. W 113 Dz/5, Raciszyn, Miedzno chalky limestones, *planula* Zone; *3* specimen No. Bd 66/3, Bobrowniki, Miedzno chalky limestones, *bimammatum* Zone

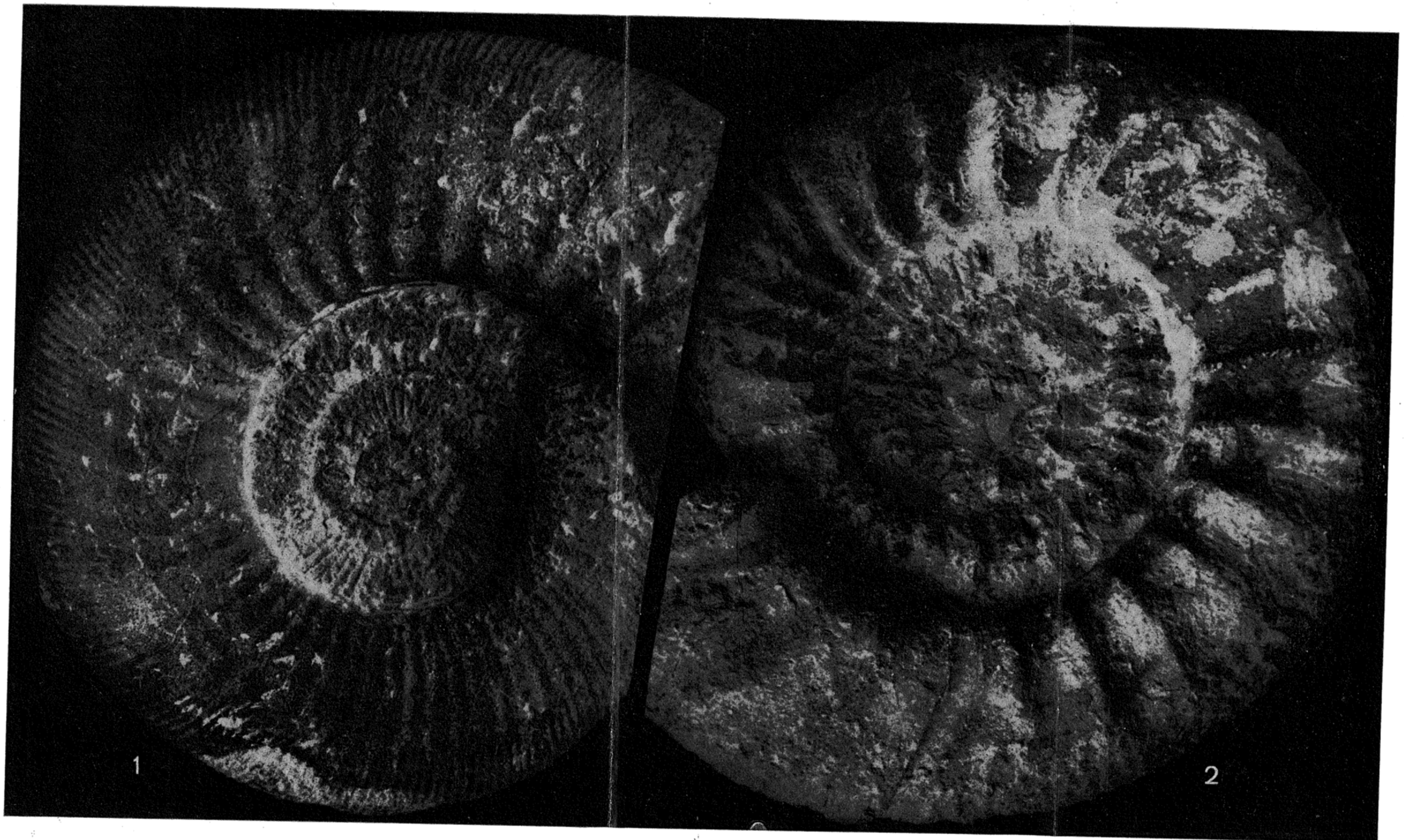
Photos 2 and 3 of nat. size; *1* taken by S. Ulatowski, *2—3* by B. Drozd, *M. Sc.*

1—2 *Pomerania helvetica* (Geyer): *1* specimen No. 113 Dz/7, Raciszyn, Miedzno chalky limestones, *planula* Zone; *2* specimen No. 15 RS/1, Wapiennik, Miedzno chalky limestones, *bimammatum* Zone
3 *Progeronia triplex* (Qu); W 60 Dz/1, Niwiska Dolne, Niwiska chalky limestones, *planula* Zone

All photos of nat. size; *1* taken by S. Ulatowski, *2—3* by B. Drozd, *M. Sc.*

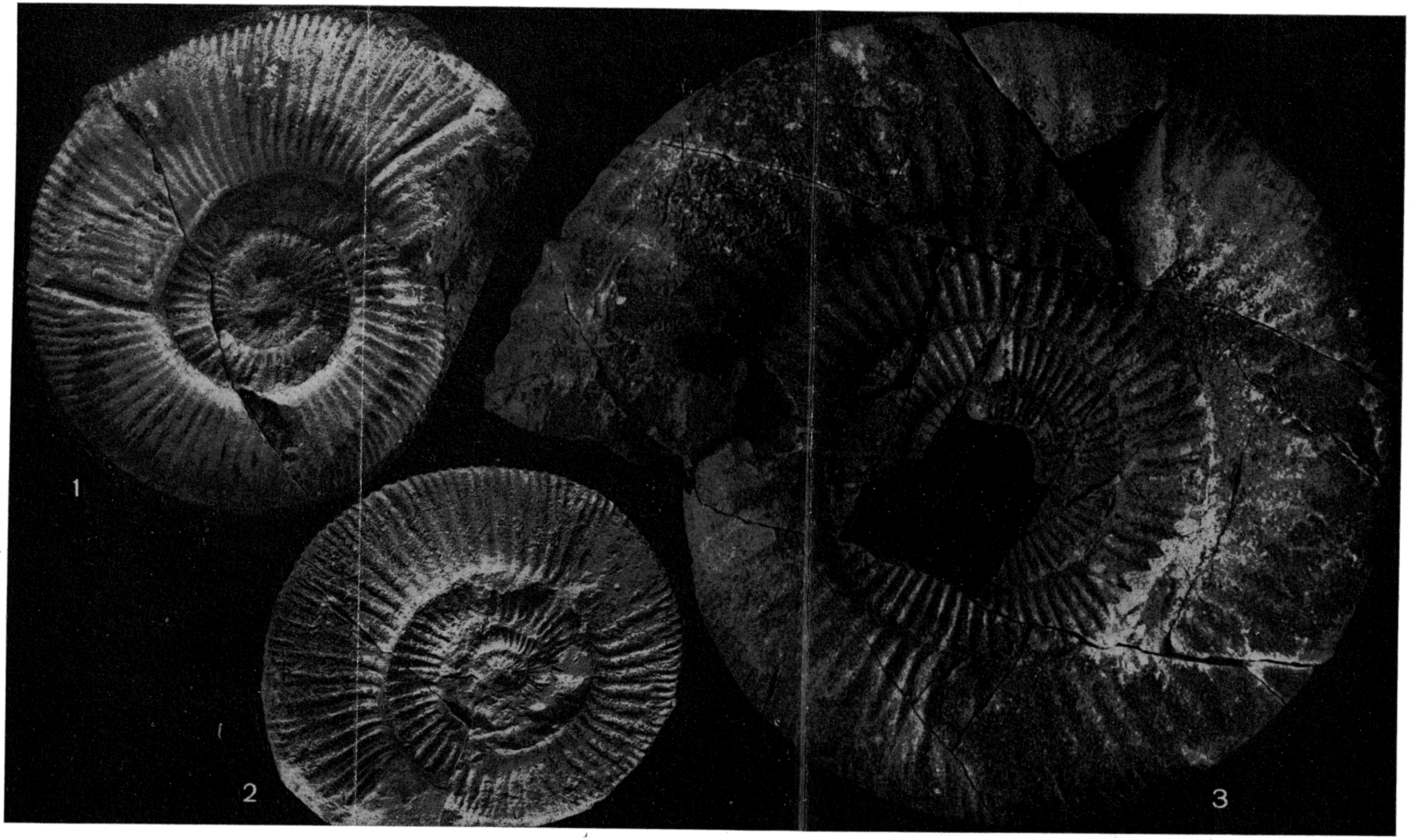
1 *Pomerania* cf. *girardoti* (Enay); specimen No. W 113 Dz/3, Raciszyn, Miedzno chalky limestones, *planula* Zone
2 *Progeronia evoluta* (Qu.); W 126 Dz/1, Raciszyn-Lisowice, Miedzno chalky limestones, *planula* Zone

All photos × c 0.75; taken by S. Ulatowski



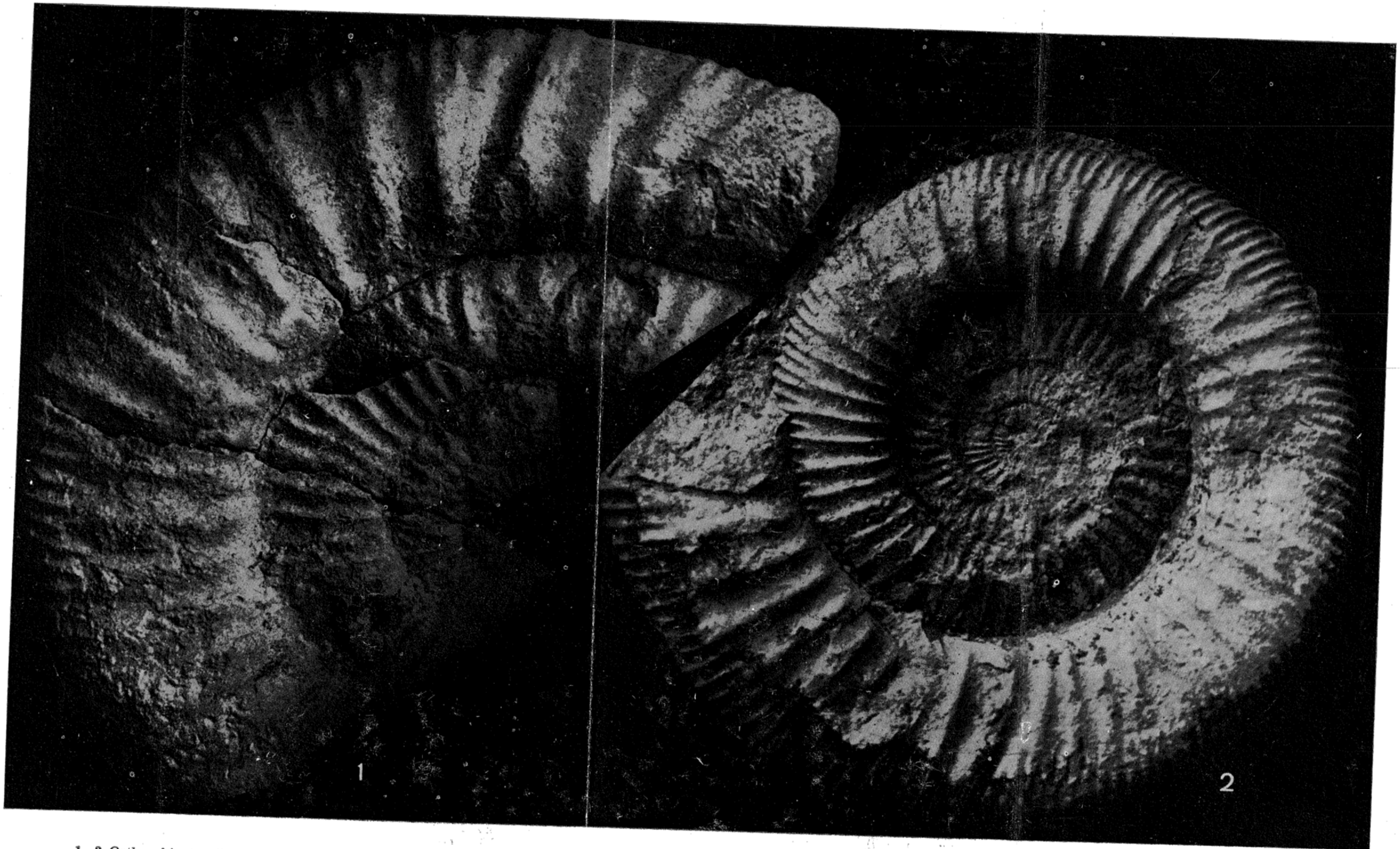
1 *Progeronia subachilles* (Weg.); specimen No. W 4 Bz/1, × 0.85, Prusicko, Prusicko chalky limestones, *planula* Zone
2 *Progeronia heidenheimense* (Weg.); W 139 Dz/1, nat. size, Lisowice, Miedzno chalky limestones, *planula* Zone

Photos taken by S. Ulatowski



1 *Orthosphinctes (Orthosphinctes) freybergi* (Geyer); specimen No. W 44 Dz/1, Grądy-Łazy, Niwiska chalky limestones, *planula* Zone
2 *Orthosphinctes (Orthosphinctes)* aff. *polygyratus* (Rein.); W 113 Dz/15, Raciszyn, Miedzno chalky limestones, *planula* Zone
3 *Orthosphinctes (Pseudorthosphinctes) alternans* Enay; W 118 Dz/1, × 0.75, Raciszyn, Miedzno chalky limestones, *planula* Zone

Photos 1 and 2 of nat. size; *1–2* taken by B. Drozd, M. Sc., 3 by S. Ulatowski



1—2 *Orthosphinctes (Pseudorthosphinctes) lisowicensis* sp. n.; specimens No. W 113 Dz/1 (*holotype*) and W 113 Dz/2 (*paratype*), Raciszyn, Miedzno chalky limestones, *planula* Zone

All photos of nat. size; taken by S. Ulatowski