Middle Triassic ammonoids from Silesia, Poland

ANDRZEJ KAIM and ROBERT NIEDŹWIEDZKI

Kaim, A. & Niedźwiedzki, R. 1999. Middle Triassic ammonoids from Silesia, Poland. — *Acta Palaeontologica Polonica* **44**, 1, 93–115.

A description of new ammonoid specimens (*Acrochordiceras* aff. *damesi*, cf. *Acrochordiceras* sp. indet., *Discoptychites* cf. *dux*, ?*Paraceratites* sp., cf. *Balatonites* sp. indet., *Beneckeia buchi*) from the Lower Muschelkalk (Anisian, Middle Triassic) of Silesia (southern Poland) is presented. The detailed stratigraphic position of the new finds is given. The description is supplemented with a list of all species of ammonoids found hitherto in Silesia, which was a southern part of the Germanic Basin during the Anisian. *Beneckeia* and *Noetlingites* were typical of epicontinental seas and usually appeared in the early part of transgressions. Other ammonoids entered from the Tethys into the epicontinental sea of the Germanic Basin during the maxima of transgressions. Some of them (balatonitids, paraceratitids, bulogitids, *Discoptychites* and probably *Acrochordiceras*) were successful colonizers which established their own populations in the Germanic Basin and evolved towards morphologies typical of epicontinental seas. Other (*Beyrichites* sp., *Paraceratites binodosus*, and '*Trachyceras*' sp.) are regarded as unsuccessful immigrants or empty shells drifted post-mortem from the Tethys.

Key words: Ammonoids, Triassic, Anisian, Muschelkalk, Silesia, Poland, *Acrochordiceras, Discoptychites, Balatonites, Beneckeia, Paraceratites.*

Andrzej Kaim [kaim@twarda.pan.pl], Instytut Paleobiologii PAN, ul. Twarda 51/55, PL-00-818 Warszawa, Poland.
Robert Niedźwiedzki [rnied@ing.uni.wroc.pl], Instytut Nauk Geologicznych, Uniwersytet Wrocławski, ul. Cybulskiego 30, PL-50-205 Wrocław, Poland.

Introduction

Ammonoids are extremely rare in the Polish Lower Muschelkalk (Lower Anisian, Middle Triassic). The Lower Muschelkalk in Poland crops out in Upper and Lower Silesia, as well as in the Holy Cross Mountains (Fig. 1). From the latter area only *Beyrichites* sp., *Beneckeia buchi*, and *Beneckeia* sp. are known (Trammer 1972; Senkowiczowa 1991). More species are known from Silesia, mainly owing to the pre-Second World War works of Noetling (1880), Holdefleiß (1915), Rassmuss (1915) for Lower Silesia and of Assmann (1937) for Upper Silesia. More recently a few new finds of ammonoids have been published by Leśniak (1978a) from Lower Silesia and by Podstolski (1980) from Upper Silesia. Dzik (1990) described a new specimen of *Acrochordiceras* from Strzelce Opolskie in Upper Silesia. He also redescribed and refigured some of Noetling's (1880) and Rassmuss' (1915) specimens of ammonoids from Raciborowice (formerly Alt Groß-Hartmannsdorf) in Lower Silesia, which are housed at the Museum für Naturkunde of the Humboldt University in Berlin. During field studies on the Silesian Lower Muschelkalk by Kaim (1995, 1997), Chrząstek (1996) and Niedźwiedzki (1998) additional specimens have been found, with well defined stratigraphic positions. The purpose of the present paper is to describe these new specimens, to review the knowledge of Lower Muschelkalk ammonoids in Silesia, and to examine their relations to the ammonoids of the Tethys.

The collection is housed at the Institute of Paleobiology of the Polish Academy of Sciences, Warsaw (abreviated ZPAL) and at the Geological Museum of the Institute of Geological Sciences of Wrocław University (abreviated MGUWr).

Geological setting

The ammonoids described here come from the Upper and Lower Silesia regions in southern Poland. The area of Upper Silesia (Fig. 1) was located during Anisian time directly at the mouth of the Silesian–Moravian Gate connecting the Germanic Basin with the Tethys. According to Urlichs & Mundlos (1985) the area of Upper Silesia was a place where ammonoids entered from the ocean into the Germanic Basin. Lower Silesia (Fig. 1) is located somewhat to the north of the Sudety Mountains, which were a northern part of the Vindelician High during the Middle Triassic.

Upper Silesia. — The Middle Triassic (Muschelkalk) deposits of Upper Silesia are generally fully marine with the maximum transgression coinciding with the Terebratula Beds (Fig. 2; Szulc 1993). They are underlain by shallow-water dolomites and evaporites of the Röt, and overlain by continental deposits of the Keuper (Szulc 1993). The lithostratigraphic scheme of the Lower Muschelkalk was established by Assmann (1944) and it remains valid to this day. He divided the Lower Muschelkalk into four lithological units underlain by the shallow-water dolomites of the Röt (Fig. 2).

The fully marine sediments of the Gogolin Beds start with organodetrital limestone composed of crinoid columnals and bivalve shells (so called 'layer with *Dadocrinus* and *Pecten*'). The rest of the Gogolin Beds is developed as micritic limestones and marls, commonly deformed in a wavy manner ('Wellenkalk' *sensu* Assmann 1944). There are two distinctive marker-beds in this part of succession: a 'cavernous limestone' (see Bodzioch & Kwiatkowski 1992), and an intraformational breccia. Fossils are uncommon in the micritic limestones and marls, and are represented mainly by bivalves and trace fossils. In the upper part of the Gogolin Beds nautilids were found and in some places layers of gastropod coquinas and crinoidal limestone occur.

The Górażdże Beds are composed of three units of oncolitic limestone separated by beds of micritic limestone. In the oncolitic limestone bivalves, gastropods, brachiopods and crinoid elements are common. The highest faunal diversity of the whole Lower Muschelkalk is found in these beds (Niedźwiedzki 1998). The micritic limestones are

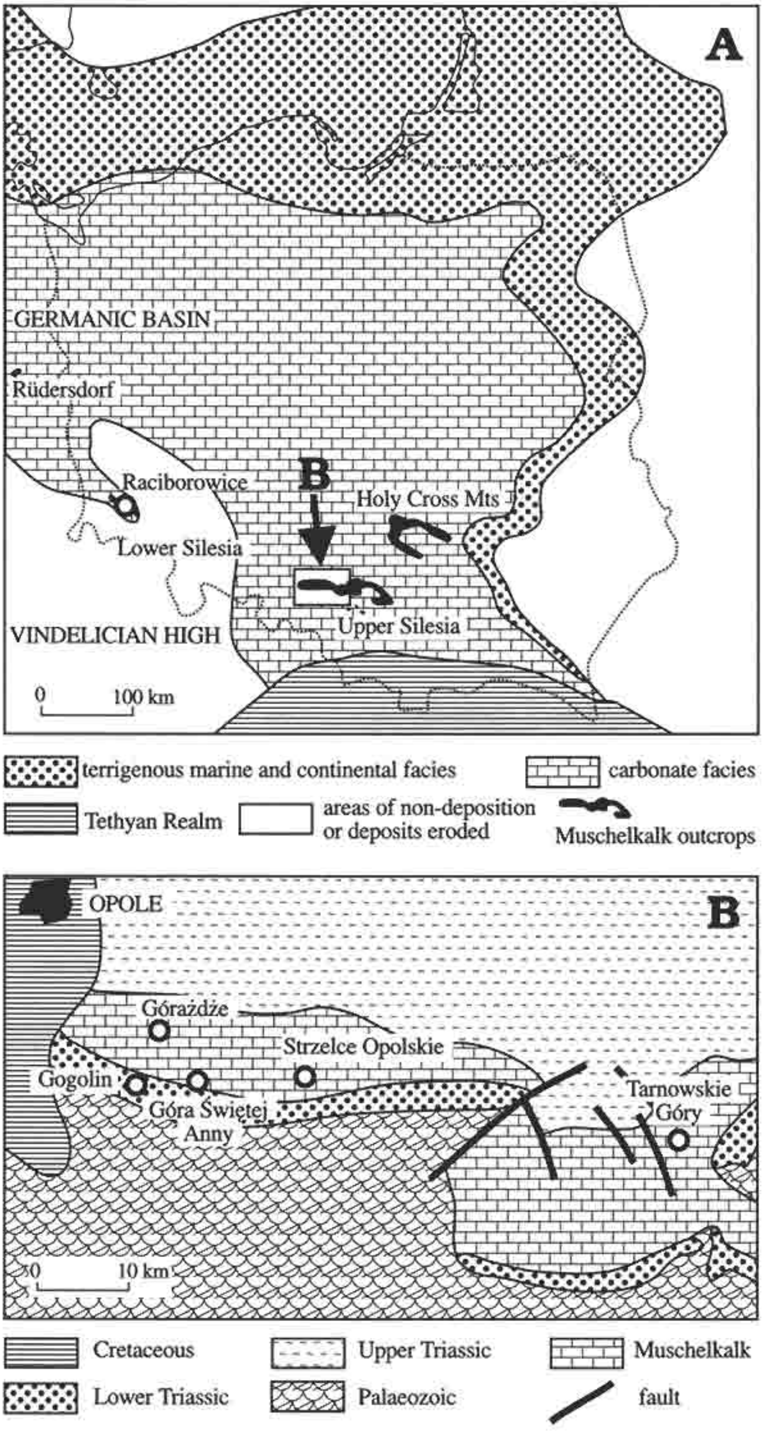


Fig. 1. **A**. Middle Triassic palaeogeography of Poland. Modified after Dzik & Trammer (1980). **B**. Geological sketch map of the western part of Upper Silesia. Modified after Bodzioch (1997).

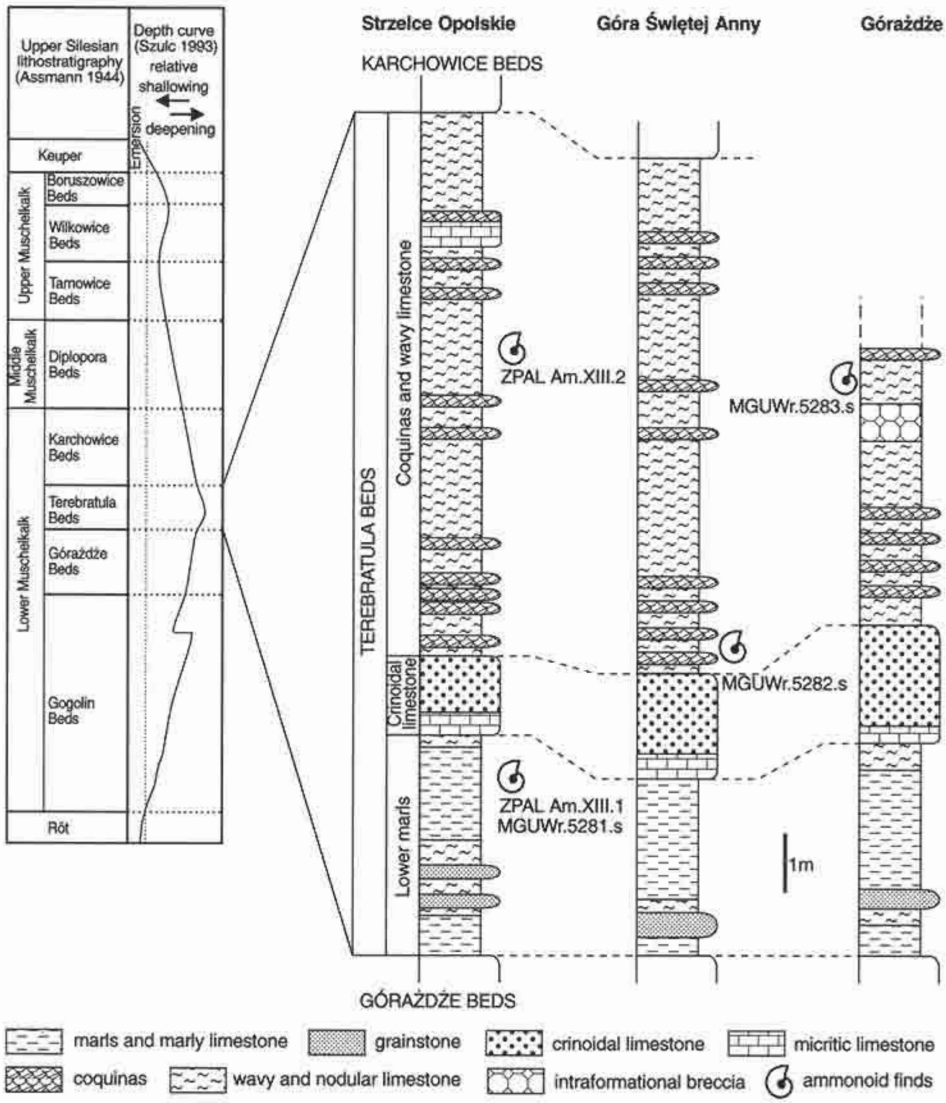


Fig. 2. Lithostratigraphy and depth curve of the Upper Silesian Muschelkalk Basin and localisation of the ammonoids in the Terebratula Beds. For correlation with the Tethyan Realm see Fig. 4.

poor in fossils and yield only badly preserved, uncommon trace fossils. Wave ripple-marks are commonly preserved and in the uppermost part hummocky cross stratification is developed.

The Terebratula Beds (Fig. 2) are tripartite, with the lower part composed of poorly fossiliferous laminated marl or marly limestone. There is a crinoidal limestone in the middle part of the unit, and its upper part consists of nodular and wavy limestone and marls with intercalations of brachiopod and bivalve coquinas (Fig. 2); the reader is referred to Kaim (1997) for a detailed description of the Terebratula Beds and their benthic assemblages.

The Karchowice Beds predominantly comprise crinoidal limestones, coquinas and oncolitic limestones, with subordinate micritic intercalations. This unit is famous for its sponge-coral-echinoderm bioherms (Morycowa 1974; Bodzioch 1997).

The Upper Silesian ammonoids described herein come from the upper part of the Gogolin Beds, the Terebratula Beds and the Karchowice Beds of the Strzelce Opolskie Quarry; from the Terebratula Beds of the Góra Świętej Anny Quarry and the Górażdże Quarry; and from the Lower Gogolin Beds of Gogolin (Figs 1B, 2).

Lower Silesia. — The first description of the Muschelkalk in Lower Silesia was made by Noetling (1880), who established its lithostratigraphic subdivision and described the palaeontological content of the strata. Additional palaeontological data and a more detailed lithostratigraphic subdivision were provided by Holdefleiß (1915). Additional data on lithology, sedimentology and palaeontology from outcrops and/or borehole cores were provided by Leśniak (1978a, b), Szulc (1991) and Chrząstek & Niedźwiedzki (1998). Chrząstek (1996) has provided a microfacies analysis as well as new data on the palaeontology and sedimentology of the Lower Silesian and Sudetian Muschelkalk.

The best outcrop of the Lower Silesian Muschelkalk is that of Raciborowice (Fig. 1A). The lithological units in the Raciborowice quarry fit the scheme applied to the Lower Muschelkalk in Upper Silesia. Following the correlation of Chrząstek (1996: table 4) we also apply Assmann's (1944) scheme to Lower Silesia. The main difference in comparison with the Upper Silesian Muschelkalk is an impoverishment of the benthic fauna in Raciborowice. Up to now the brachiopods *Decurtella decurtata*, *Tetractinella trigonella*, and *Hirsutella hirsuta*, which are common in Upper Silesia, have not been found in Raciborowice. The single specimen of cf. *Balatonites* sp. indet. from Lower Silesia described herein comes from the part of the Raciborowice quarry succession which we regard, following Chrząstek (1996), as an equivalent of the upper part of the Gogolin Beds of Upper Silesia.

Taxonomic description

Family Acrochordiceratidae Arthaber, 1911
Genus *Acrochordiceras* Hyatt, 1877

Type species: *Acrochordiceras hyatti* Meek, 1877.

Acrochordiceras aff. *damesi* Noetling, 1880

Figs 3A–E, 4B, 5B.

Compare:

Ammonites (Acrochordiceras) damesi sp. n.; Noetling 1880: p. 334, pl. 15.

Acrochordiceras cf. *ippeni* Arthaber, 1911; Dzik 1990: p. 65, pl. 16 (non *A. ippeni* Arthaber, 1911).

Material. — Two relatively well preserved specimens (ZPAL Am XIII/1, MGUWr 5281s) have been found in the upper part of the lower marls unit of the Terebratula Beds in the Strzelce Opolskie Quarry (Fig. 2).

Description. — Specimen ZPAL Am XIII/1 (Fig. 3A–C) is a composite mould of an incomplete phragmocone, about 100 mm in diameter. The left side of the specimen is slightly deformed, probably because it was exposed above the sediment before fossilization. The umbilicus is not visible. Ribs and nodes are well represented on the terminal portion of the phragmocone. Thick and rounded prorsiradiate ribs originate in dorso-lateral (periumbilical) nodes (usually two or three ribs per node) and, slightly projected, pass across the venter. Each bunch of ribs is separated by one intercalatory rib. The nodes form prominent knobs, 5 mm in height. The whorl section is subquadrate (Fig. 5B), but the left side is slightly deformed.

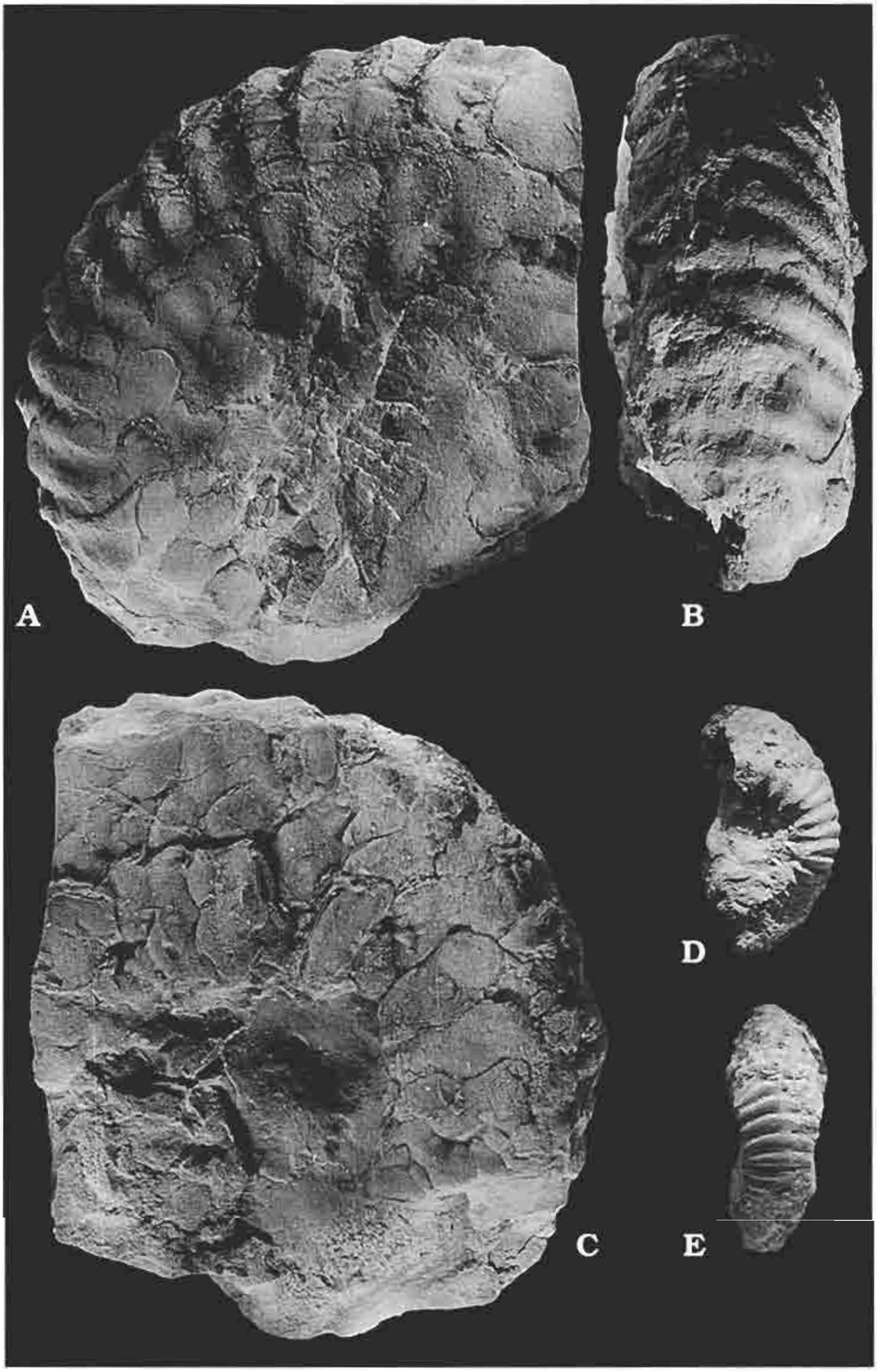
Only the lateral lobe, dorso-lateral lobe and umbilical saddle of the suture are clearly visible (Fig. 4B). The lateral lobe is wide and rather simple, composed only of a few indentations. The dorso-lateral lobe is shallow and wide.

Specimen MGUWr 5481s (Fig. 3D, E) is an incomplete juvenile (1/3 of the whorl) phragmocone about 19 mm in diameter. The umbilicus is about 4 mm in diameter. The lateral surface of the whorl is narrow (about 3.3 mm). Strong ribs originate on the ventral shoulder in nodes with two or three ribs per node, and pass across the wide (7.5 mm) venter. An intercalatory rib occurs only near the node which generates three ribs. There are five nodes visible. Two nodes are slightly elevated above the level of the ribs and form small tubercles. There are about five ribs per tubercle. The suture line is not visible.

Remarks. — In our opinion all Upper Silesian acrochordiceratids are closely related to the Lower Silesian *Acrochordiceras damesi*. Although the specimens from Upper Silesia (Dzik 1990; this paper) come from the Terebratula Beds (see Fig. 2) and Noetling's (1880) specimen from Raciborowice comes from the upper part of the Gogolin Beds, they still represent the same *Balatonites balatonicus* ammonoid Subzone (Mietto & Manfrin 1995). Dzik (1990: fig. 2, pl. 16) has classified specimen ZPAL Am XI/1 from the Terebratula Beds of the Strzelce Opolskie Quarry as *A.* cf. *ippeni*. This specimen has three ribs per node (*A. damesi* has almost four, whereas *A. ippeni* has two ribs per node) and the suture line is somewhat different from that of *A. damesi* (Fig. 4). Specimen ZPAL Am XIII/1 (Fig. 3A–C) is similar to *A. damesi* in having prominent knobs and a suture with a shallow dorso-lateral lobe. It resembles Dzik's (1990) specimen in having three ribs per node. The juvenile specimen MGUWr 5281s (Fig. 3D, E) demonstrates the pattern of sculpture which was proposed by Dzik (1990) to be typical for juveniles of *A. damesi* (five ribs per tubercle). The above data lead to the conclusion that all the specimens from Silesia may belong to one highly variable biospecies, *A. damesi*. As the type material of the species consists of a single specimen only, its population variability is not known. We therefore determine our specimens as *Acrochordiceras* aff. *damesi*.

A great variability of *Acrochordiceras* was previously suggested by Spath (1934), Silberling & Nichols (1982) and Dzik (1990). However, the true range of this variability is difficult to evaluate in population terms as the most of Tethyan material comes from the condensed facies. Although it seems highly probable that all the Silesian acrochordiceratids belong to one biospecies, the suggestion of Hauer (1887) and Dzik (1990) that most of the Tethyan (Pelsonian) specimens of the genus *Acrochordiceras* can also be attributed to the same species, is more controversial. The suture lines of the Silesian acrochordiceratids (Fig. 4) significantly differ from those of the most similar Tethyan species *Acrochordiceras haueri* Arthaber, 1911. The difference may have resulted from simplification of the suture line in acrochordiceratids on entering into an epicontinental basin, like in some other Muschelkalk ammonoids (Urlich & Mundlos 1985). Suture lines of all known Silesian acrochordiceratids (Fig. 4A–C) are plotted against a time scale and compared with the suture line of the most similar Tethyan species *A. haueri* (Fig. 4D). The Tethyan species has deeper ventral and lateral saddles, and higher lateral and dorso-lateral lobes than the Silesian one. Moreover, the stratigraphically older specimen from the Gogolin Beds (Fig. 4C) has better developed indentations of the lateral saddle and lateral lobe than the younger specimens from the Terebratula Beds (Fig. 4A, B). We are aware that the number of specimens is too small to be statistically significant and that the preservation is not particularly good. Therefore more and better preserved specimens have to be found to corroborate our hypothesis.

Fig. 3. *Acrochordiceras* aff. *damesi* Noetling, 1880 from the Terebratula Beds in the Strzelce Opolskie Quarry. **A–C**. Incomplete phragmocone (ZPAL Am XIII/1). **D, E**. Incomplete juvenile (MGUWr 5281s). **A–C** natural size, **D, E** × 2.



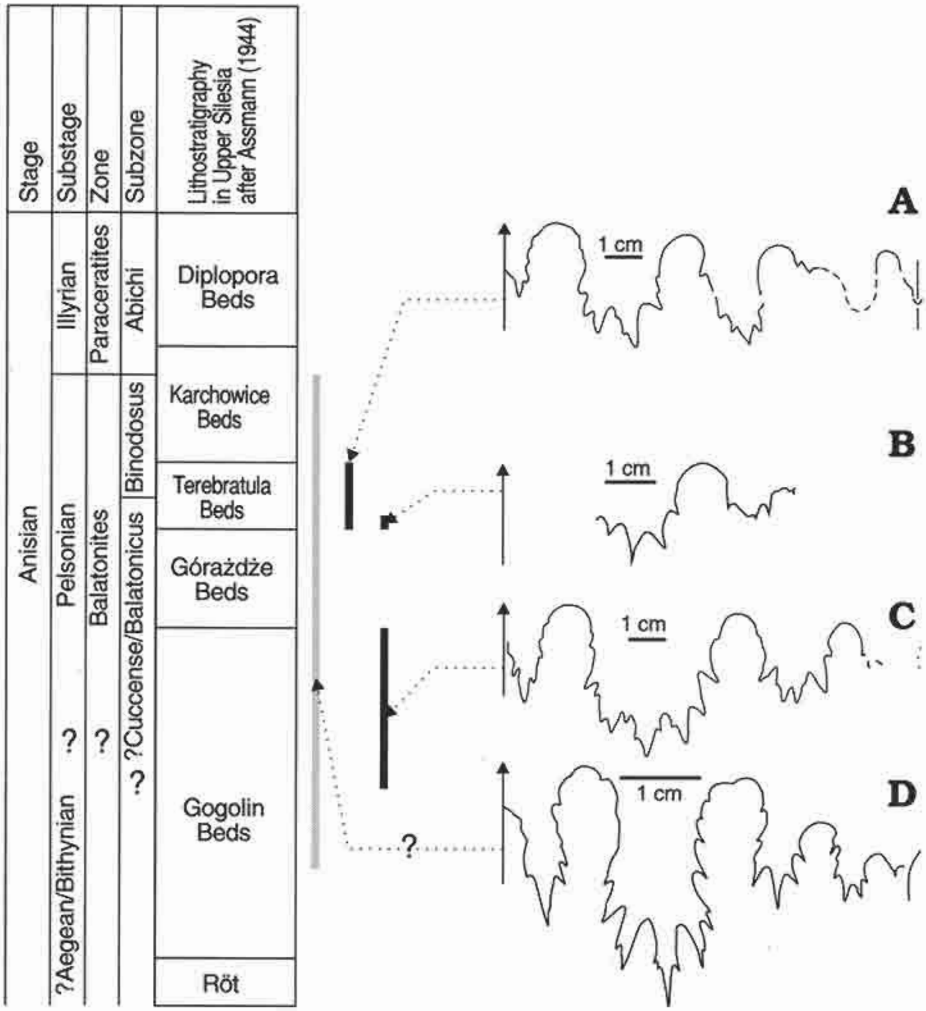


Fig. 4. Suture lines of *Acrochordiceras damesi* Noetling, 1880 and its closest Tethyan relative *Acrochordiceras haueri* Arthaber, 1911 with stratigraphical position of the finds (Muschelkalk forms – solid bars, Tethyan forms – shaded bars). **A**. *A.* aff. *damesi* from the Strzelce Opolskie Quarry. After Dzik (1990). **B**. *A.* aff. *damesi* from Strzelce Opolskie (ZPAL Am XIII/1). **C**. *A. damesi* from Raciborowice. After Dzik (1990). **D**. *A. haueri* from Han Bulog, Bosnia. After Hauer (1887). Ammonoid zonation follows that of Mietto & Manfrin (1995).

Dzik (1990) suggested that *Acrochordiceras* represents a single lineage, and can be subdivided into successive, arbitrarily defined chronotaxa. He proposed *A. anodosum* Welter, 1915, strongly evolute and lacking tuberculation, as the ancestral species of the lineage. Subsequent stages (*A. hyatti* Meek, 1877 through *A. halili* Toula, 1896, and *A. damesi* Noetling, 1880, to *A. ippeni* Arthaber, 1911) are more and more involute and tuberculate. According to Dzik (1990), *A. damesi* is defined by five ribs per tubercle at early ontogenetic stages and is more involute than *A. halili*, whereas it is as involute as *A. ippeni*. This subdivision is provisional and new bed-by-bed collections and additional work on museum collections is necessary. The earliest acrochordiceratids described by Korchinskaya (1983) from Spitsbergen do not fit this scheme, as was admitted by Dzik (1990) himself. Moreover, the youngest member of the lineage, *A. ippeni*, is based on simple specimen and

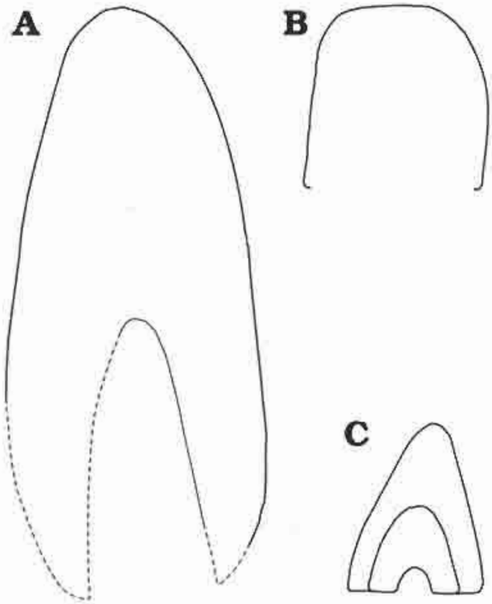


Fig. 5. Cross sections through phragmocone and body chamber. **A**. *Discoptychites* cf. *dux* (Giebel, 1853) from the Góraždže Quarry (MGUWr 5283s). **B**. *Acrochordiceras* aff. *damesi* Noetling, 1880 from the Strzelce Opolskie Quarry (ZPAL Am XIII/1). **C**. *Discoptychites* cf. *dux* (Giebel, 1853) from the Strzelce Opolskie Quarry (ZPAL Am XIII/2). All × 0.6.

comes from a condensed facies. Thus their age is uncertain. There are no known acrochordiceratids younger than the Pelsonian in a non-condensed facies.

cf. *Acrochordiceras* sp. indet.

Fig. 12C.

Material. — One specimen (MGUWr 5282s) from the Terebratula Beds of the Góra Świętej Anny Quarry (Fig. 2).

Description. — The specimen MGUWr 5282s (Fig. 12C) is badly preserved, but the strong ribs characteristic of *Acrochordiceras* are visible on the venter. The conch is about 33 mm in diameter.

Family Ptychitidae Mojsisovics, 1882
Genus *Discoptychites* Diener, 1916

Type species: *Ammonites megalodiscus* Beyrich, 1867.

Discoptychites cf. *dux* (Giebel, 1853)

Figs 6A–F, 7A–D.

Compare:

Ammonites dux Giebel, 1853; Beyrich 1867: p. 130, pl. 5: 1–3.

Ptychites dux (Giebel, 1853); Claus 1921: p. 120, figs 1–6.

Material. — One incomplete juvenile phragmocone (ZPAL Am XIII/2) from the Terebratula Beds in the Strzelce Opolskie Quarry and one subadult or adult body chamber (MGUWr 5283s) from the Terebratula Beds in Góraždže.

Description. — The specimen ZPAL Am XIII/2 (Fig. 6A–F) is a composite mould of an incomplete (about 1/3 of the whorl) juvenile phragmocone. The estimated diameter of the conch

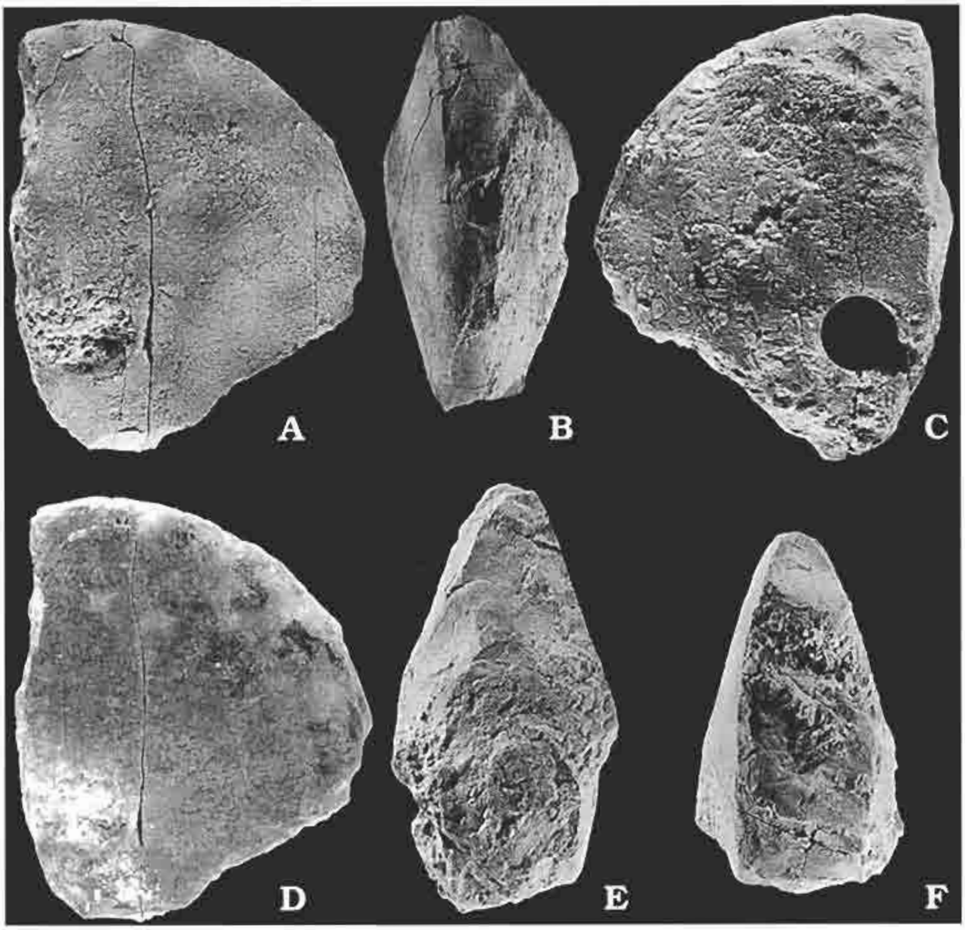
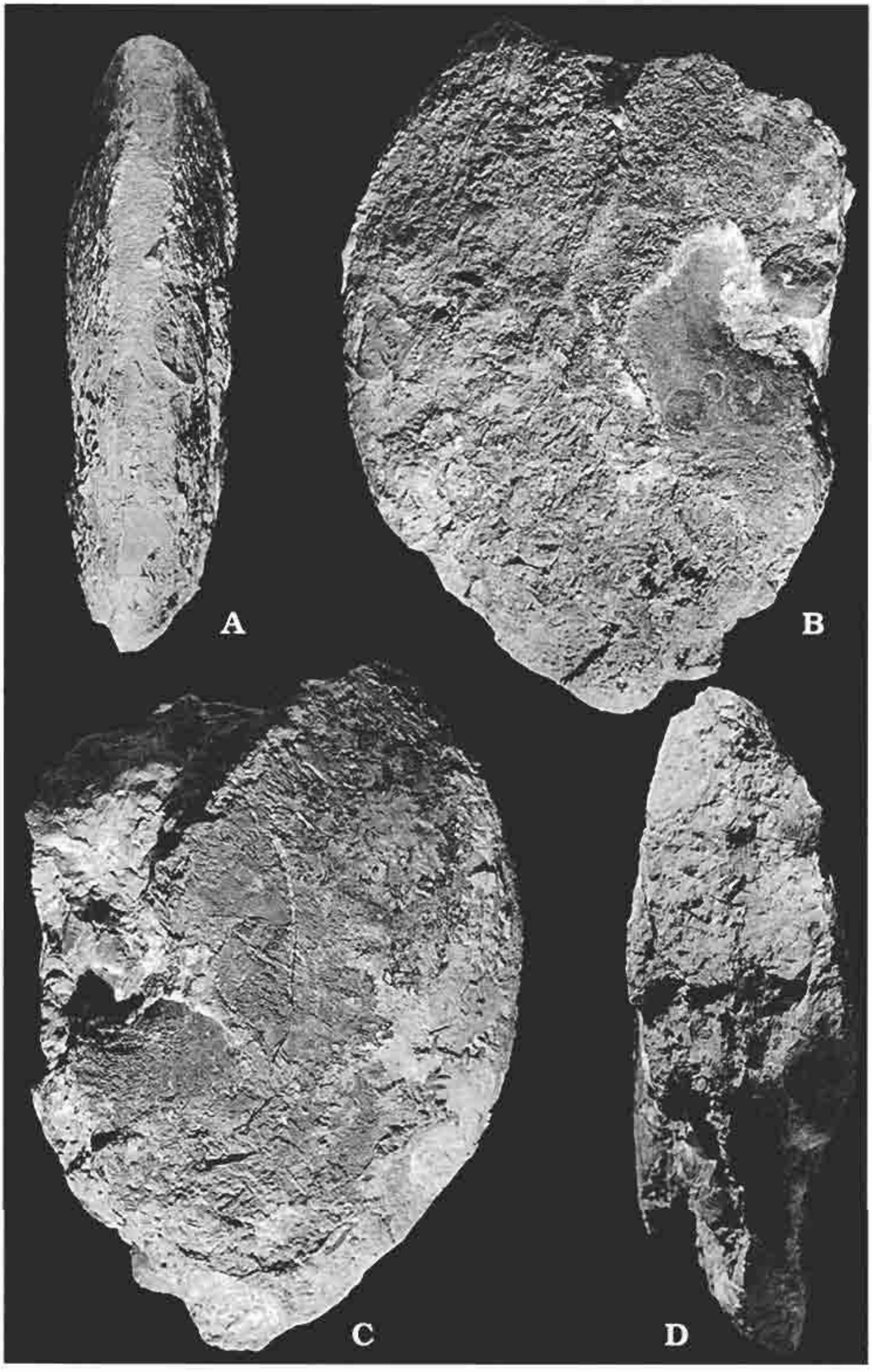


Fig. 6. **A–F**. *Discoptychites* cf. *dux* (Giebel, 1853) from the Strzelce Opolskie Quarry (ZPAL Am XIII/2). **A–C, E, F**. Specimen whitened. **D**. Specimen not whitened. All natural size.

is about 80 mm; diameter of umbilicus 9.6 mm; width 29 mm; height of the last whorl 35 mm. The whorl section is subovoid with a narrowly rounded venter. The conch is smooth with no ornamentation. The suture is ammonitic (Fig. 8D, E), with three distinct lateral lobes; the ventral and dorsal parts of the suture are not visible. The second lateral saddle is bipartite with a deep accessory lobe.

The specimen MGUWr 5283s (Fig. 7A–D) is an internal mould of an incomplete body chamber with part of the last adoral camera. Estimated diameter about 220 mm; width 48.3 mm; estimated diameter of umbilicus 25 mm; height of the last whorl 117 mm. The whorl section is discoidal with a rounded venter. The surface of the mould is smooth and partially corroded. Some attachment scars of cementing bivalves are visible. The suture is ammonitic (Fig. 8C), with three distinct lateral lobes; the ventral and dorsal parts of the suture are not visible. The second lateral saddle is bipartite with a deep accessory lobe. The saddles are somewhat more subdivided with accessory lobes than in the other specimen.

Fig. 7. **A–D**. *Discoptychites* cf. *dux* (Giebel, 1853) from the Górażdże Quarry (MGUWr 5283s). All × 0.5.


A
B
C
D

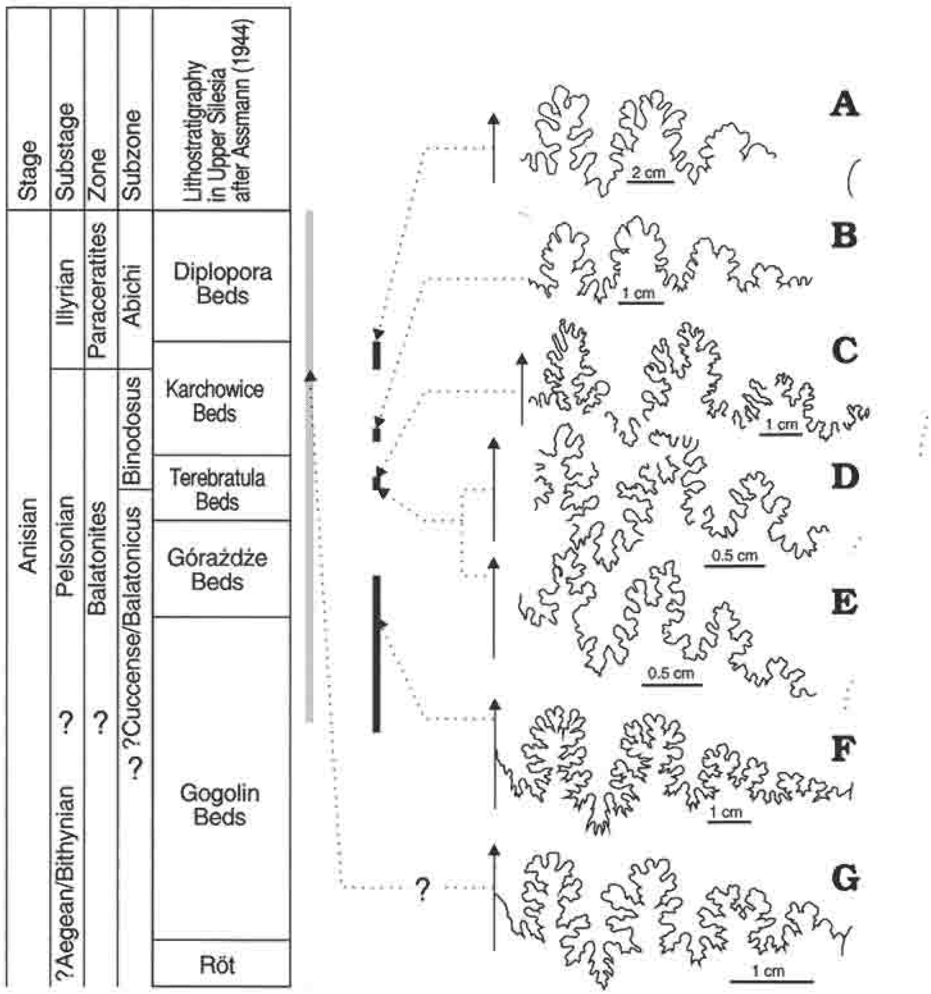


Fig. 8. Suture lines of *Discoptychites dux* (Giebel, 1853) and its closest Tethyan relative *Discoptychites suttneri* (Mojsisovics, 1882) with stratigraphical position of the finds (Muschelkalk forms – solid bars, Tethyan forms – shaded bars). **A**. *D. dux* from Freyburg (Thuringia). After Rothe (1959). **B**. *D. dux* from Heidelberg (Odenwald). After Wurm (1914). **C**. *D.* cf. *dux* from the Górażdże Quarry (MGUWr 5283s). **D**, **E**. *D.* cf. *dux* from the Strzelce Opolskie Quarry (ZPAL Am.XIII.2). **F**. *D. dux* from Rüdersdorf (Brandenburg). After Beyrich (1867). **G**. *D. suttneri* from Schreyer Alm (Northern Tyrol, Austria). After Mojsisovics (1882). Ammonoid zonation follows that of Mietto & Manfrin (1995).

Remarks. — The two specimens described above are more similar to each other than to any other ptychitids. The differences in suture lines (compare Fig. 8C and Fig. 8D, E) can be explained as a result of the difference in the ontogenetic stage. The shape of the conchs and lack of ornamentation agree with the description of *Discoptychites dux* (Giebel, 1853) by Beyrich (1867) and of *Discoptychites suttneri* (Mojsisovics, 1882) by Mojsisovics (1882). It is quite possible that *D. suttneri* from the Tethyan Realm is a younger synonym of *D. dux* from the Germanic Basin. The shapes of the conch and suture lines in both species are very similar (see Figs 5A, C, 6, 7 and 8). In spite of that we have decided to leave our specimens in open nomenclature due to the poor and only fragmentary preservation.

D. suttneri is not common in the Tethyan Realm and the material of Mojsisovics (1882) has never been revised. Its stratigraphic position should be confirmed (Balini *et al.* 1993) and a statistical comparison of morphological variability with other species of the genus *Discoptychites* needs to be carried out. It is possible that many or even all of the named species of *Discoptychites* are actually morphotypes of one highly variable biospecies, as is the case in some other ptychitids (Weitschat & Lehmann 1983; Urlichs & Kurzweil 1997) and other Triassic ammonoids (e.g., Hohenegger & Tatzreiter 1992; Dagys & Weitschat 1993; Checa *et al.* 1996). Mojsisovics (1882) attributed the type material of *D. suttneri* from Schreyer Alm (Northern Tyrol, Austria) to the *Paraceratites trinodosus* Zone. According to Mietto & Manfrin (1995) it is an early part of the Illyrian. As the Schreyeralm Limestone is a condensed formation containing a mixed fauna ranging in ages from Pelsonian to Illyrian, the vertical range of *D. suttneri* remains unclear. The oldest finds of the species from the *Balatonicus* Zone of Tiefengraben (Steiermark, Austria) were decribed by Tatzreiter & Vörös (1991). Specimens of *D. suttneri* were also described by Venzo & Pelosio (1968) from northern Italy and by Pelosio (1973) from Greece, both from Upper Anisian strata. Another specimen has been described from Har Gevanim (Makhtesh Ramon, southern Israel) by Parnes (1965) as *Discoptychites* cf. *suttneri*. Although his specimen differs in suture line from both *D. suttneri* and *D. dux*, Parnes (1965) stated that it may be regarded as an intermediate form between these two species. This form lived in the epicontinental Sephardic Basin of southern Israel during Anisian times.

The type material of *Discoptychites dux* (Giebel, 1853) comes from Schraplau in Thuringia, from the Schaumkalk Horizon, which is correlated with the lowermost part of the Illyrian (Kozur 1974). The specimen from Freyburg (Rothe 1959) was also found at this horizon. *D. dux* from Rüdersdorf described by Beyrich (1867) was collected from another horizon in the Schaumkalk (Beyrich 1858). It is correlated (Kozur 1974) with the lower part of Pelsonian (Fig. 8). Our specimens, as well as the *Ptychites* sp. of Assmann (1927), come from the Terebratula Beds (upper part of the Pelsonian). All this shows that the species has a wide range in space and time (Fig. 8), and it may have common roots with its closest Tethyan relative, *D. suttneri* (if they are separate species). Fritsch (1906) distinguished two species of *Discoptychites*, *D. dux*, and *D. beyrichi*, in the Muschelkalk Basin. We agree with Claus (1921), who regarded this subdivision unnecessary.

We observe some simplification in suture line of successively younger specimens of the Muschelkalk discoptychitids: from the forms with complicated suture lines (Fig. 8F), through forms with slighly reduced suture lines (Fig. 8C–E), to forms with advanced reduction of suture lines (Fig. 8A). We suppose that the observed pattern is of evolutionary origin and reflects the same phenomenon as we postulate for the *A. damesi* lineage. Unfortunately, *D. dux* is rare in the Muschelkalk Basin and the preservation is usually rather poor. Additional specimens with well defined stratigraphic position have to be found to corroborate our hypothesis.

Family Ceratitidae Mojsisovics, 1879

Genus *Paraceratites* Hyatt, 1890

Type species: *Ceratites elegans* Mojsisovics, 1882.

?*Paraceratites* sp.

Figs 9A, B, 10A.

Material. — One incomplete phragmocone (ZPAL Am XIII/3) from a loose block of the Karchowice Beds in the Strzelce Opolskie Quarry.

Description. — The specimen is a composite mould of an incomplete phragmocone (about 1/4 of the whorl). Estimated diameter of the conch is about 45 mm. The inner whorls are not preserved. The venter is smooth, narrow and rounded. The ribs bifurcate with one intercalatory rib between each pair of primaries. Branching takes place at the lateral nodes. The primary ribs are rectiradiate and the secondary ribs project forward. The ribs do not pass across the venter. Three rows of nodes: umbilical (indistinct because of poor preservation of the umbilical part of the whorl), lateral (somewhat below the middle portion of the side) and marginal. The suture is ceratitic, with four

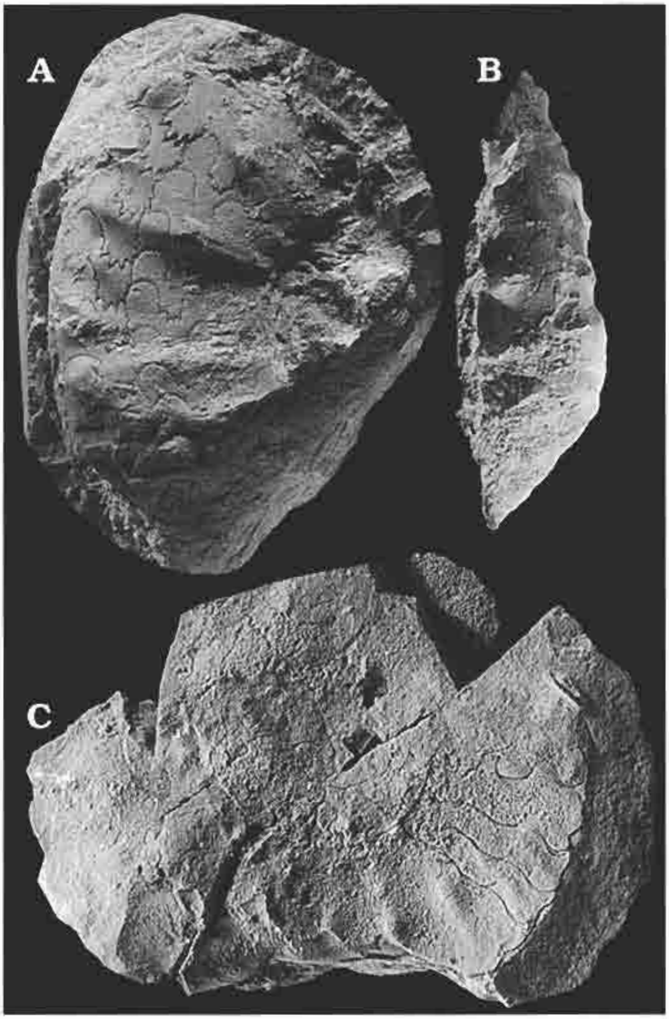


Fig. 9. **A**, **B**. ?*Paraceratites* sp. from the Strzelce Opolskie Quarry (ZPAL Am XIII/3). **C**. cf. *Balatonites* sp. indet. from the Strzelce Opolskie Quarry (ZPAL Am XIII/4). **A**, **B** × 2, **C** natural size.

saddles between the ventral and umbilical lobes (Fig. 10A). The first lateral saddle is wider than the second. The periumbilical part of the suture is slightly worn.

Remarks. — The pattern of ornamentation of the investigated specimen (Fig. 9A, B) is consistent with the description of *Paraceratites trinodosus* by Mojsisovics (1882). Its suture line (Fig. 10A) is also similar to that of the type material of the species (Mojsisovics 1882: pl. 8: 9a). Nevertheless the diagnostic features of *P. trinodosus* given by Mojsisovics (1882) can be found in more than one species. Moreover, the genus *Paraceratites*, to which Spath (1934) assigned Mojsisovics' (1882) type material of the species *P. trinodosus*, is based on the species *Paraceratites elegans* (Mojsisovics, 1882), which has a keel-like venter. In contrast, the type material of *P. trinodosus* illustrated in Mojsisovics (1882), similarly to our specimen, has a smooth, narrow and rounded venter. Thus even the generic status of *P. trinodosus* remains unclear. In such a situation, and because of the poor and only fragmentary preservation, we have decided to leave this specimen in open nomenclature.

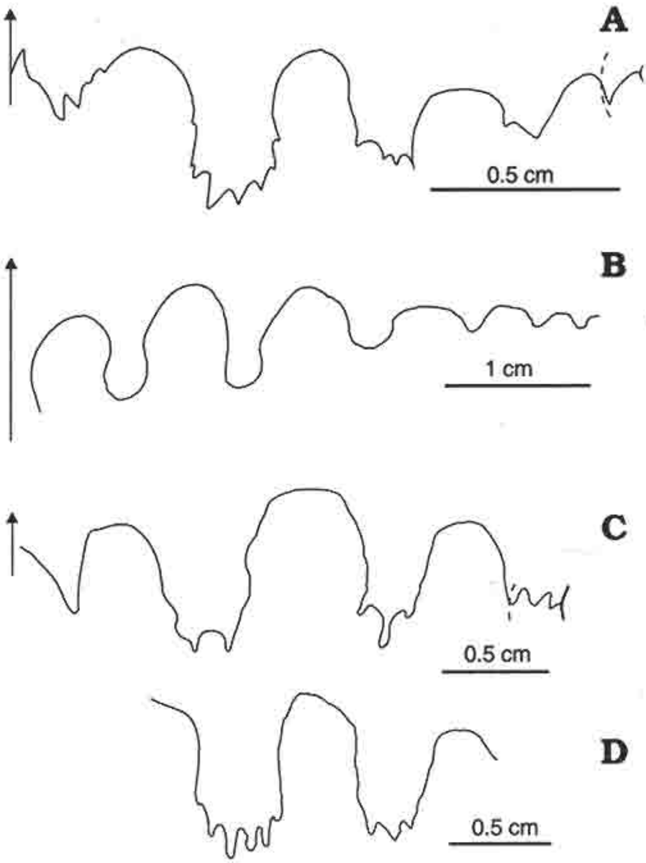


Fig. 10. Suture lines. **A**. ?*Paraceratites* sp. from Strzelce Opolskie (ZPAL Am XIII/3). **B**. *Beneckeia buchi* (Alberti, 1834) from Gogolin (MGUWr 5285s). **C**. *Balatonites ottonis* (Buch, 1849) from Raciborowice (MGUWr 1926s). **D**. *Balatonites jovis* Arthaber, 1896 from Raciborowice (MGUWr 1943s).

Assmann (1937) has described a specimen of *P. trinodosus* from the Gorażdże Beds, but this identification is doubtful (Schmidt 1938). The specimen probably represents a juvenile of *Paraceratites binodosus* (Hauer, 1851).

Family Balatonitidae Spath, 1951
Genus *Balatonites* Mojsisovics, 1879

Type species: *Trachyceras balatonicum* Mojsisovics, 1873.

cf. *Balatonites* sp. indet.

Figs 9C, 11D.

Material. — Two badly preserved phragmocones. One from the Upper Gogolin Beds of Strzelce Opolskie (ZPAL Am XIII/4) and the second from the Upper Gogolin Beds of Raciborowice (MGUWr 5285s). The latter was found and briefly described by Chrząstek (1996).

Description. — Both specimens are preserved as composite moulds. The visible side of the specimens is strongly deformed and compressed, probably because they were exposed above the sea floor and incompletely filled with sediment before fossilization. Remnant traces of the

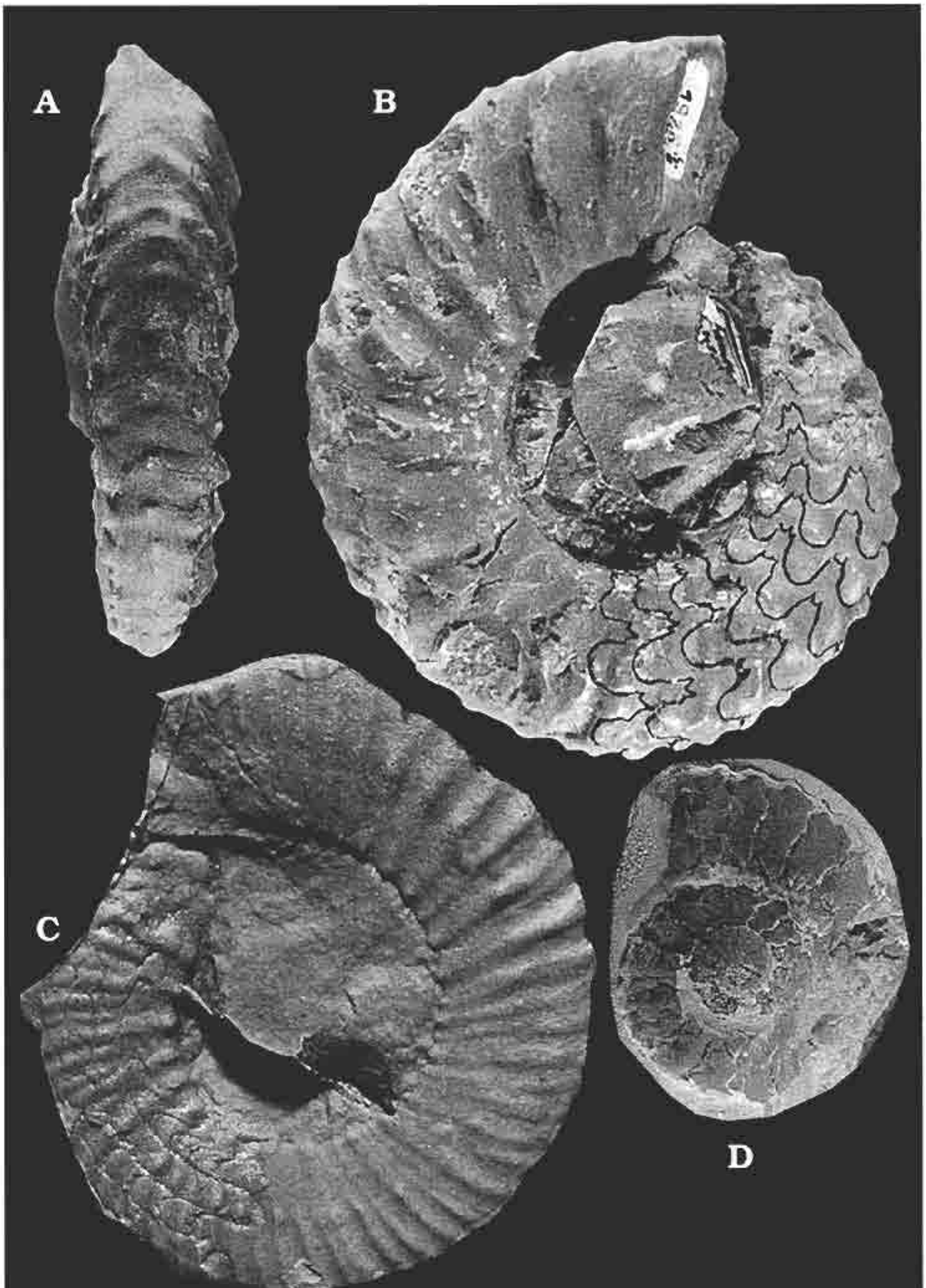


Fig. 11. Balatonitids from Raciborowice. **A**, **B**. *Balatonites ottonis* (Buch, 1849), original from Frech (1903: pl. 1: 5); MGUWr 1926s. **C**. *Balatonites jovis* Arthaber, 1896; rubber cast of the original from Frech (1903: text-fig. 2); MGUWr 1943s. **D**. cf. *Balatonites* sp. indet. MGUWr 5285s. All natural size.

suture lines and ribs are visible. A row of lateral nodes is also visible on the specimen ZPAL Am XII/4. The estimated diameter of the specimen is 75 mm. The diameter of the specimen MGUWr 5285s is 50 mm.

Remarks. — Although during our fieldworks in Silesia only the above two specimens of doubtful affinities were found, many specimens were previously collected and described from the area. Noetling (1880), Holdefleiß (1915), Rassmuss (1915) and Assmann (1927) described fourteen species of *Balatonites* (see Appendix). Four of them are regarded by Hohenegger & Tatzreiter (1992) as morphospecies of one morphologically highly variable biospecies *Balatonitus egregius* Arthaber, 1896. It is quite possible that many of the remaining species are closely related to *Balatonites ottonis* (Buch, 1849) and may also form one biospecies, but revision of the material has to be undertaken to prove this hypothesis. Part of the old German collection of Silesian ammonoids (see Appendix) was lost during the Second World War, part is housed in the collection of the Bundesanstalt für Geowissenschaften in Berlin, part is housed in the Museum für Naturkunde of the Humbolt University in Berlin, and two specimens are in the Geological Museum of the Institute of Geological Sciences of Wrocław University. The first of these (MGUWr 1926s; Fig. 11A, B herein) was found by D. Sachse in 1859 in Raciborowice. The specimen was identified by Frech as *Balatonites ottonis* and it was one of the two specimens that were put together to make the figure of this species in his monograph (Frech 1903: pl. 1: 5). The second specimen (MGUWr 1943s; Fig. 11C), also from Raciborowice, is an external mould of *Balatonites jovis* Arthaber, 1896 which was figured by Frech (1903: text-fig. 2). Both specimens were refigured by Schmidt (1928). According to Holdefleiß (1915), Leśniak (1978a) and Chrząstek (1996) most or even all of the balatonitids at Raciborowice occur in a single layer within the Upper Gogolin Beds (upper part of the Lower Anisian and lowermost part of the Pelsonian). Moreover, Assmann (1927) described balatonitids from the Gogolin Beds and Górażdże Beds from Upper Silesia (upper part of the Lower Anisian and lower part of the Pelsonian).

Family Hedenstroemiidae Waagen, 1895

Genus *Beneckeia* Mojsisovics, 1882

Type species: *Ammonites buchi* Alberti, 1834.

Beneckeia buchi (Alberti, 1834)

Fig. 12A, B.

Beneckeia buchi (Alberti, 1834); Mojsisovics 1882: p. 183, not figured.

Beneckeia buchi (Alberti, 1834); Wagner 1888: p. 30, pl. 4: 1–4a, pl. 5: 3–5.

Material. — One incomplete phragmocone (MGUWr 5285s) found by Mr. A. Nowicki on a field near Gogolin in the limestone debris of the lowermost Gogolin Beds (probably the 'layer with *Dadocrinus* and *Pecten*').

Description. — The specimen (Fig. 12A, B) is a mould with about 1/2 of the whorl. On the left side of the conch the outer surface of the whorl is preserved. On the right side the outer surface is eroded and the suture line is visible. The conch is oxyconic with strongly compressed whorls. The venter possesses a sharp keel. The maximum width of the whorl at the middle part of the lateral flank. The diameter of the conch is 60 mm; the width is 9.5 mm. Suture line (Fig. 10B) with seven wide saddles and six much narrower lobes is visible. The first two lobes are widened at the base. Both the saddles and lobes are smooth and rounded, with no indentations.

Remarks. — *Beneckeia* was widespread in the Germanic Basin from the early to middle Anisian (Urlichs & Mundlos 1985). Its fossil record in Silesia ranges from shallow-water dolomites of the Röt to the open-sea marls of the upper part of the Gogolin Beds. Occurrences of *Beneckeia tenuis* (Seebach, 1857) are restricted to the Röt (Assmann 1937). *Beneckeia buchi* (Alberti, 1834) is known from the Gogolin Beds of Lower Silesia (Noetling 1880; Holdefleiß 1915; Rassmuss 1915) and Upper Silesia (Assmann 1937; this paper). Apart from the Germanic Basin, the members of the

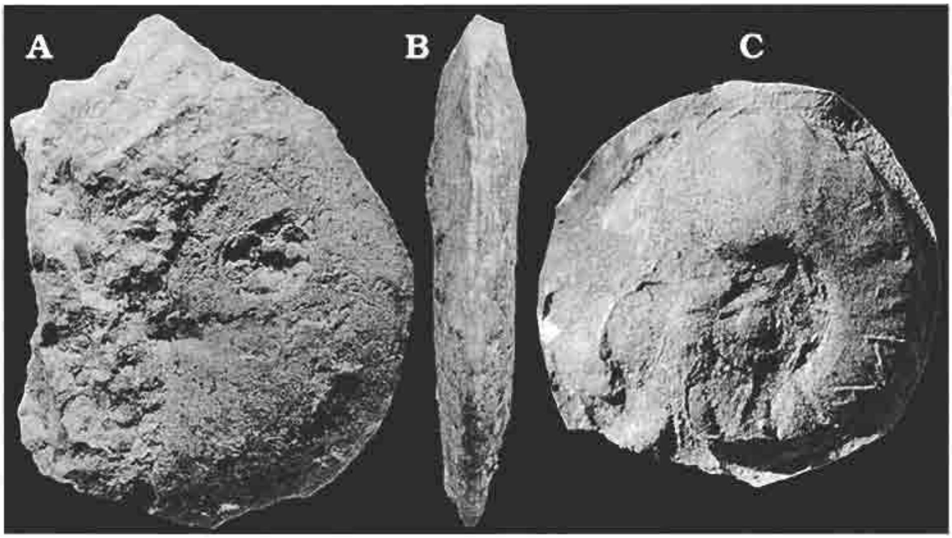


Fig. 12. **A**, **B**. *Beneckeia buchi* (Alberti, 1834) from Gogolin (MGUWr 5285s). **C**. cf. *Acrochordiceras* sp. indet. from the Góra Świętej Anny Quarry (MGUWr 5282s). **A**, **B** natural size, **C** × 1.5.

genus *Beneckeia* are known from epicontinental basins of Israel, Jordan, Egypt (Parnes 1962, 1986) and Bulgaria (Stefanoff 1936; Tronkov 1973).

Discussion and conclusions

During the survey of the literature data we found about thirty species of ammonoids described from Silesia (see Appendix). Some of them are probably typologic taxa as was shown for some balatonitids by Hohenegger & Tatzreiter (1992). Most of the new specimens of ammonoids described here come from two intervals of the maxima of the transgressions in the upper part of the Gogolin Beds and the Terebratula Beds (Fig. 2; Appendix). Acrochordiceratids are known from both periods and discoptychitids were found only in the period of the highest sea level during sedimentation of the Terebratula Beds. This is in agreement with Wang & Westerman (1993) and Vörös (1996) who regarded ptychitids as a marker of a relatively deep environment (deeper waters of neritic basins and outer continental slope).

We divide all the ammonoids found in the Lower Muschelkalk of Silesia into three environmentally dependent groups:

Ammonoids typical of epicontinental seas. — Representative of this group are *Beneckeia buchi* and *Noetlingites strombecki* (Griepenkerl, 1860) which are known exclusively from the Germanic Basin. Species of *Beneckeia* are known also from other regions (Stefanoff 1936; Tronkov 1973; Parnes 1962, 1986) but always from epicontinental seas. Strongly compressed oxycones with a distinctive suture line, similar to that in *Beneckeia*, appeared repetitively in shallow epicontinental seas and disappeared with deepening of the basin. This form of the conch is known already among the earliest ammonoids of the Early Devonian (Chlupáč & Turek 1983) and was developed independently many times until the Late Cretaceous (Maastrichtian).

Marginal populations of the Tethyan biospecies. — Representatives of this group entered into the Germanic Basin during the maxima of transgressions (Gogolin Beds, Terebratula Beds) and they often evolved towards morphologies typical of epicontinental seas, as was shown for the Upper Muschelkalk ceratitids and paraceratitids (Urlichs & Mundlos 1985). The simplification of the suture line in the course of evolution of such Tethys-derived inhabitants of the Germanic epicontinental sea was observed by Urlichs & Mundlos (1985). We observed the simplification of the suture line in successive members of the Muschelkalk *Acrochordiceras* and *Discoptychites* lineages (Figs 4, 8). We suppose that the observed changes are of evolutionary character, but this needs to be corroborated by new finds.

Ammonoids of this group are relatively often found in areas closest to the Tethys and their abundancies and stratigraphic ranges decrease with increasing distance from the ocean. We include here balatonitids, paraceratitids, bulogitids and *Discoptychites dux* as the epicontinental morphotype of *D. suttneri*. *Acrochordiceras damesi* probably belongs here or to the next group. Up to now five specimens of acrochordiceratids in total are known from the Germanic Basin, all from Silesia. In view of the fact that the Acrochordiceratidae in the Eurasian part of Tethys, while cosmopolitan, are also (with the exception of some localities in the Southern Alps) relatively rare ammonoids, it is hard to determine whether these Silesian specimens in the Germanic Basin are members of indigenous populations or they are unsuccessful immigrants/drifted shells (see next group). However, their closest Tethyan relative, *A. haueri* Arthaber, 1911, significantly differs from any Silesian *Acrochordiceras*. This would support the inclusion of the Silesian acrochordiceratids in the present group.

Unsuccessful immigrants or empty shells drifted post-mortem from Tethys. — The rarest ammonoids of the Lower Muschelkalk represented only by single specimens, may belong to this group. These are *Beyrichites* sp. of Trammer (1972), and *Paraceratites binodosus* and '*Trachyceras*' sp. of Assmann (1937).

Acknowledgments

We would like to thank J. Dzik, H. Hagdorn, M. Machalski, and J. Trammer for helpful discussions during the preparation of this paper. Special thanks are extended to an anonymous reviewer, M. Balini and H. Rieber for reviews that greatly improved our paper. We also thank to A. Chrząstek and A. Nowicki who loaned their specimens for this study. The photographs were taken by Grażyna and Marian Dziewiński. A. Kaim also thanks A. Halemba for help during his stay in Cambridge (U.K.).

References

Arthaber, G. 1911. Die Trias von Albanien. — *Beiträge zur Paläontologie und Geologie Österreich-Ungarns und des Orients* **24**, 169–277.

Assmann, P. 1937. Revision der Fauna der Wirbellosen der oberschlesischen Trias. — *Abhandlungen der Preußischen Geologischen Landesanstalt, Neue Folge* **170**, 1–134.

Assmann, P. 1944. Die Stratigraphie der oberschlesischen Trias. Teil 2: Der Muschelkalk. — *Abhandlungen des Reichsamts für Bodenforschung, Neue Folge* **208**, 1–124.

Balini, M., Gaetani, M., & Nicora, A. 1993. Day 2 Tuesday 29 June. *In:* M. Gaetani (ed.), *Anisian/Ladinian boundary field workshop. Southern Alps – Balaton Highlands. 27 June – 4 July 1993*, 43–54 I.U.G.S. Subcomission on Triassic Stratigraphy, Milano.

Beyrich, E. 1858. Ueber Ammoniten des unteren Muschelkalks. — *Zeitschrift der Deutschen geologischen Gesellschaft* **10**, 208–214.

Beyrich, E. 1867. Über einige Cephalopoden aus dem Muschelkalk der Alpen and über verwandte Arten. — *Abhandlungen der Königlichen Akademie der Wissenchaften zu Berlin* **1866**, 103–149.

Bodzioch, A. 1997. Sponge/crinoidal/coral bioherms from the Muschelkalk of Upper Silesia (Middle Triassic, Poland). — *Boletin de la Real Sociedad Española de Historia Natural (Sectio Geología)* **92**, 49–59.

Bodzioch, A. & Kwiatkowski, S. 1992. Sedimentation and early diagenesis of the cavernous limestone (Röth) of Gogolin, Silesian – Kraków Region, Poland. — *Rocznik Polskiego Towarzystwa Geologicznego* **62**, 223–242.

Buch, L. 1849. Über schlesischen und italienischen Muschelkalk. — *Zeitschrift der Deutschen geologischen Gesellschaft* **1**, 246–247.

Buch, L. 1850. Über Ceratiten. — *Abhandlungen der Königlichen Akademie der Wissenchaften zu Berlin* **1848**, 1–33.

Checa, A., Company, M., Sandoval, J., & Weitschat, W. 1997. Covariation of morphological characters in the Triassic ammonoid *Czekanowskites rieberi*. — *Lethaia* **29**, 225–235.

Chlupáč, I. & Turek, V. 1983. Devonian goniatites from the Barrandian area, Czechoslovakia. — *Rozpravy Ústředního ústavu geologického* **46**, 1–159.

Chrząstek, A. 1996. *Fauna, stratygrafia i warunki sedymentacji utworów retu i dolnego wapienia muszlowego w niecce północnosudeckiej.* Unpublished Ph.D. thesis. 186 pp. Institute of Geological Sciences. Wrocław University.

Chrząstek, A. & Niedźwiedzki, R. 1998. Kręgowce retu i dolnego wapienia muszlowego na Śląsku. — *Prace geologiczno-mineralogiczne Uniwersytetu Wrocławskiego* **64**, 69–81.

Claus, H. 1921. Über *Ptychites* und *Arniotites* aus dem Schaumkalke der Umgegend von Jena. — *Centralblatt für Mineralogie, Geologie und Paläontologie* **1921**, 120–126.

Dagys, A.S. & Weitschat, W. 1993. Extensive intraspecific variation in a Triassic ammonoid from Siberia. — *Lethaia* **26**, 113–121.

Dzik, J. 1990. The ammonite *Acrochordiceras* in the Triassic of Silesia. — *Acta Palaeontologica Polonica* **35**, 49–65.

Dzik, J. & Trammer, J. 1980. Gradual evolution of conodontophorids in the Polish Triassic — *Acta Palaeontologica Polonica* **24**, 55–89.

Frech, F. 1903. *Lethaea Geognostica. Handbuch der Erdgeschichte. Das Mesozoicum. Trias.* 623 pp. Schweizerbart, Stuttgart.

Fritsch, K. 1906. Beitrag zur Kenntnis der Tierwelt der deutschen Trias. — *Abhandlungen der Naturforschenden Gesellschaft zu Halle* **24**, 219–285.

Hauer, F.R. 1887. Die Cephalopoden des Bosnischen Muschelkalkes von Han Bulog bei Sarajevo. — *Denkschriften der Mathematisch-naturwissenschaftlischen Classe der Kaiserlichen Akademie der Wissenschaften* **54**, 1–50.

Hohenegger, J. & Tatzreiter, F. 1992. Morphometric methods in determination of ammonite species, exemplified through *Balatonites* shells (Middle Triassic). — *Journal of Paleontology* **66**, 801–816.

Holdefleiß, G. 1915. Das Triasvorkommen von Groß-Hartmansdorf in Niederschlesien. — *Jahresbericht, Schlesische Gesellschaft für vaterländische Cultur. Section für Geologie, Geographie, Berg- und Hüttenwesen* **93**, 1–23.

Kaim, A. 1995. *Interpretacja rozwoju środowiska sedymentacji wapienia muszlowego Strzelc Opolskich w oparciu o następstwo zespołów skamieniałości.* Unpublished M.Sc. thesis. 85 pp. Department of Paleontology, Institute of Geology, University of Warsaw.

Kaim, A. 1997. Brachiopod-bivalve assemblages of the Middle Triassic Terebratula Beds, Upper Silesia, Poland. — *Acta Palaeontologica Polonica* **42**, 333–359.

Korchinskaya, M.V. (Korčinskaâ, M.V.) 1983. New ceratitids from Upper Olenekian sediments of Spitsbergen [in Russian].— *Paleontologičeskij žurnal* 3, 109–112.

Kozur, H. 1974. Biostratigraphie der germanischen Mitteltrias. — *Freiberger Forschungshefte (C)* **280**/1, 1–56; **280**/2, 1–71; **280**/3.

Leśniak, T.C. 1978a. Profil litostratygraficzny utworów retu i wapienia muszlowego w depresji północnosudeckiej. — *Geologia. Zeszyty Naukowe Akademii Górniczo-Hutniczej w Krakowie* **4**, 1, 5–26.

Leśniak, T.C. 1978b. Rozwój osadów retu i wapienia muszlowego w depresji północnosudeckiej na tle ich wykształcenia w Polsce południowej. — *Geologia. Zeszyty Naukowe Akademii Górniczo-Hutniczej w Krakowie* **4**, 2, 29–43.

Mietto, P. & Manfrin, S. 1995. A high resolution Middle Triassic ammonoid standard scale in the Tethys Realm. A preliminary report. — *Bulletin de la Société Géologique de France* **166**, 539–563.

Mojsisovics, E. 1882. Die Cephalopoden der Mediterranen Triasprovinz. — *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt* **10**, 1–322.

Morycowa, E. 1974. Koralowce z warstw karchowickich z Kamienia Śląskiego koło Opola. *In: Przewodnik 46 Zjazdu Polskiego Towarzystwa Geologicznego*, 163–165. Opole.

Niedźwiedzki, R. 1998. *Litostratygrafia, biostratonomia i warunki sedymentacji formacji gorażdżańskiej i formacji wapieni terebratulowych Śląska Opolskiego.* Unpublished Ph.D. thesis, 173 pp. Institute of Geological Sciences, Wrocław University.

Noetling, F. 1880. Die Entwickelung der Trias in Niederschlesien. — *Zeitschrift der Deutschen geologischen Gesellschaft* **32**, 300–349.

Parnes, A. 1962. Note on Middle Triassic ammonites from Makhtesh Ramon (Southern Israel). — *Israel Journal of Earth-Sciences* **14**, 9–17.

Parnes, A. 1965. Triassic ammonites from Israel. — *Geological Survey of Israel Bulletin* **33**, 1–78.

Parnes, A. 1986. Middle Triassic cephalopods from the Negev (Israel) and Sinai (Egypt). — *Geological Survey of Israel Bulletin* **79**, 9–59.

Pelosio, G. 1973. Le ammoniti del Trias medio di Asklepieion (Argolide, Grecia). I. — Fauna del «calcare a *Ptychites*» (Anisico sup.) — *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* **19**, 139–168.

Podstolski, R. 1980. O głowonogach z warstw górażdżańskich (dolny wapień muszlowy) w kamieniołomie „Górażdże" koło Opola. — *Przegląd Geologiczny* **4**, 219–222.

Rassmuss, H. 1915. Alpine Cephalopoden im niederschlesischen Muschelkalk. — *Jahrbuch der Preußischen Geologischen Landesanstalt* **34**, 283–306.

Rothe, H.W. 1959. Ammonoiden aus dem Unteren Muschelkalk. — *Der Aufschluss* **3**, 66–68.

Schmidt, M. 1928. *Die Lebewelt unserer Trias.* 461 pp. Rau, Öhringen.

Schmidt, M. 1938. *Die Lebewelt unserer Trias. Nachtrag.* 144 pp. Rau, Öhringen.

Senkowiczowa, H. 1991. Głowonogi triasu środkowego Gór Świętokrzyskich. — *Biuletyn Państwowego Instytutu Geologicznego* **365**, 95–138.

Spath, L.F. 1934. *Catalogue of the Fossil Cephalopoda in the British Museum (Natural History). Part IV. The Ammonoidea of the Trias.* 521 pp. British Museum (Natural History), London.

Stefanoff, A. 1936. Die Fauna aus der Trias von Golo-Bardo in S. W. Bulgarien, 2. Cephalopoda. — *Mitteilungen aus den Könglichen Naturwissenschaftlichen Instituten in Sofia – Bulgarien* **9**, 147–166.

Szulc, J. 1991. The Muschelkalk in Lower Silesia. *In:* H. Hagdorn (ed.), *Muschelkalk. A Field Guide*, 58–62. Goldschneck, Korb.

Szulc, J. 1993. Early Alpine tectonics and lithofacies succesion in the Silesian part of the Muschelkalk Basin. A synopsis. *In:* H. Hagdorn & A. Seilacher (eds), *Muschelkalk. Schöntaler Symposium 1991*, 19–28. Goldschneck-Verlag, Korb.

Tatzreiter, F. & Vörös, A. 1991. Vergleich der pelsonischen (Anis, Mitteltrias) Ammonitenfaunen von Großreifling (Nördlische Kalkalpen) und Aszófö (Balaton-Gebiet). — *Jubiläumsschrift 20 Jahre Geologische Zusammenarbeit Österreich – Ungarn* **1**, 247–259.

Trammer, J. 1972. *Beyrichites* (*Beyrichites*) sp. from the Lower Muschelkalk of the Holy Cross Mts. — *Acta Geologica Polonica* **22**, 25–28.

Tronkov, D. 1973. Principles of Triassic stratigraphy in Belogradčik Anticlinorium (Northwestern Bulgaria) [in Bulgarian]. — *Izvestiâ na Geologičeskiâ Institut, Seriâ stratigrafiâ i litologiâ* **22**, 73–98.

Urlichs, M. & Kurzweil, W. 1997. Erstnachweis von *Flexoptychites* (Ammonoidea) aus dem Oberen Muschelkalk (Mitteltrias) Nordwürttembergs. — *Stuttgarter Beiträge zur Naturkunde, Serie B* **253**, 1–8.

Urlichs, M. & Mundlos, R. 1985. Immigration of cephalopods into the Germanic Muschelkalk Basin and its influence on their suture line. — *Lecture Notes in Earth Sciences* **1**, 221–236.

Venzo, S. & Pelosio, G. 1968. Nuova fauna a ammonoidi dell'Anisico superiore di Lenna in Val Brembana (Bergamo). — *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* **17**, 73–141.

Vörös, A. 1996. Environmental distribution and bathymetric significance of Middle Triassic ammonoid faunas from the Balaton Highland (Hungary). — *Fragmenta Mineralogica et Palaeontologica* **18**, 5–17.

Wagner, R. 1888. Ueber einige Cephalopoden aus dem Röth und unteren Muschelkak von Jena. — *Zeitschrift der Deutschen geologischen Gesellschaft* **40**, 24–38.

Wang, Y. & Westermann, G.E.G. 1993. Paleoecology of Triassic Ammonoids. — *Geobios, Mémoire Spécial* **15**, 373–392.

Weitschat, W. & Lehmann, U. 1983. Stratigraphy and ammonoids from the Middle Triassic Botneheia-Formation (Daonella Shales) of Spitsbergen. — *Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg* **54**, 27–54.

Wurm, A. 1914. Über einige neue Funde aus dem Muschelkalk der Umgebung von Heidelberg. — *Zeitschrift der Deutschen geologischen Gesellschaft* **66**, 444–448.

Appendix

The list of all ammonoids known from the Lower Muschelkalk (Lower Anisian) of Silesia in stratigraphical order (for lithostratigraphic scheme see Figs 2, 4).

Gogolin Beds

Beneckeia buchi (Alberti, 1834) – Noetling 1880; Holdefleiß 1915; Assmann 1937; Leśniak 1978; this paper

Noetlingites stombecki (Griepenkerl, 1860) – Holdefleiß 1915; Rassmus 1915; Assmann 1937

Bulogites sonderhusanus (Picard, 1892) – Leśniak 1978a; designation doubtful, neither description nor good illustration

Acrochordiceras damesi Noetling, 1880 – Noetling 1880

Balatonites ottonis (Buch, 1849) – Buch 1849, 1850; Eck 1865; Noetling 1880; Holdefleiß 1915; Rassmus 1915; Assmann 1927; Chrząstek 1996

Balatonites beyrichi Frech, 1903 – Rassmus 1915

Balatonites quaternonodatus Rassmus, 1915 – Rassmus 1915

Balatonites zimmeri Rassmus, 1915 – Rassmus 1915

Balatonites zimmermanni Rassmus, 1915 – Rassmus 1915

**Balatonites jovis* Arthaber, 1896 – Holdefleiß 1915; Rassmus 1915

Balatonites doris Arthaber, 1896 – Rassmus 1915

**Balatonites egregius* Arthaber, 1896 – Rassmus 1915

**Balatonites stenodiscus* Arthaber, 1896 – Rassmus 1915

Balatonites constrictus Arthaber, 1896 – Rassmus 1915

Balatonites cf. *lineatus* Arthaber, 1896 – Rassmus 1915

Balatonites trinodosus Hauer, 1892 – Rassmus 1915

Balatonites sp. – Rassmuss 1915; this paper

Górażdże Beds

Paraceratites trinodosus (Mojsisovics, 1882) – Assmann 1937; designation doubtful, according to Schmidt (1938) probably juvenile *Paraceratites binodosus* (Hauer, 1951)

Paraceratites gorazdensis (Assmann, 1937) – Assmann 1937; Podstolski 1980

Bulogites mirabilis (Assmann, 1937) – Assmannn 1937

Balatonites nobilis Assmann, 1937 – Assmann 1937

**Balatonites* cf. *corvini* Arthaber, 1896 – Assmann 1937
'*Trachyceras*' sp. – Assmann 1937; designation doubtful, *Trachyceras* is a Carnian genus (M. Balini personal communication)

Terebratula Beds

Paraceratites ex aff. *binodosus* (Hauer, 1851) – Assmann 1937
Discoptychites cf. *dux* (Giebel, 1853) – Assmann 1937; this paper
Acrochordiceras aff. *damesi* Noetling, 1880 – Dzik 1990; this paper

Karchowice Beds

?*Paraceratites* sp. – this paper
Bulogites zoldianus (Mojsisovics, 1878) – Assmann 1937

*Species asterisked are regarded by Tatzreiter & Hohenegger (1992) as one highly variable species.

Amonitowate środkowego triasu Śląska

ANDRZEJ KAIM i ROBERT NIEDŹWIEDZKI

Streszczenie

W pracy opisano nowe okazy amonitów (*Acrochordiceras* aff. *damesi*, cf. *Acrochordiceras* sp. indet., *Discoptychites* cf. *dux*, ?*Paraceratites* sp., cf. *Balatonites* sp. indet., *Beneckeia buchi*) z dolnego wapienia muszlowego (anizyk, środkowy trias) Śląska. W stosunku do poprzednich znalezisk, nowe wyróżniają się dokładnym umiejscowieniem w profilu. Dokonano również przeglądu wszystkich dotychczas znalezionych amonitów z dolnego wapienia muszlowego na Śląsku. W anizyku rejon Śląska znajdował się w południowej części Basenu Germańskiego. Podczas transgresji Basen Germański łączył się poprzez Bramę Śląsko-Morawską z Tetydą. *Beneckeia* i *Noetlingites* są rodzajami typowymi dla mórz epikontynentalnych i pojawiają się zwykle we wczesnym etapie takich transgresji. Inne amonitowate pojawiają się w maksimach transgresji. Niektóre z nich (balatonity, paraceratyty, bulogity, *Discoptychites* i prawdopodobnie również *Acrochordiceras*) ustanowiły własne populacje w Basenie Germańskim, ewoluując w kierunku morfologii typowych dla mórz epikontynentalnych. Inne (*Paraceratites binodosus* i '*Trachyceras*' sp.) albo nie zdołały zadomowić się w wodach morza epikontynentalnego, albo ich muszle zostały pośmiertnie przyniesione z oceanu przez prądy.