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THE AMMONITE *ACROCHORDICERAS* IN THE TRIASSIC
OF SILESIA

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A new specimen of *Acrochordiceras* from the Pelsonian of Strzelce Opolskie, Poland, and the holotype of *Silesiacrochordiceras damesi* (Noetling, 1880) are described. Ontogenetic changes in shell morphology, based on studies of museum specimens from the Gulf of Ismid, Turkey, are also presented. The pattern of temporal changes in the morphologic variability of acrochordiceratids suggests that they many represent a single lineage, with possible sexual dimorphism expressed in a degree of involuteness of adult specimens. It is proposed to subdivide the lineage into five successive chronospecies of a single genus. Attribution of the specimen from Strzelce Opolskie to *A. ippeni* Arthaber, 1911 is proposed.

Key words: Triassic, ammonites, Ceratitida, Muschelkalk, Poland, phylogeny.

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INTRODUCTION

The Acrochordiceratidae are almost cosmopolitan, but generally rare, ammonites of Anisian age. Until recently, only a single specimen representing this group has been known from the Middle Triassic Germanic basin, namely the holotype of *Acrochordiceras damesi* Noetling, 1880 from Raciborowice near Bolesławiec in the Lower Silesia (the former, German name of this classic cephalopod locality is Alt Gross-Hartmannsdorf). It has been generally accepted that this specimen is the only known representative of its own species, for which a separate generic name *Silesiacrochordiceras* Diener, 1915 is available. Because of the scarcity of data concerning acrochordiceratids in the Muschelkalk, discovery of another specimen in the old quarry at Strzelce Opolskie in the Opole Silesia is of special interest, so more that apart from the locality Raciborowice (see Rassmus 1915), ammonites are extremely rare in the Polish Lower Muschelkalk (Trammer 1972). The new specimen, however, somewhat differs from its earlier known relative in some

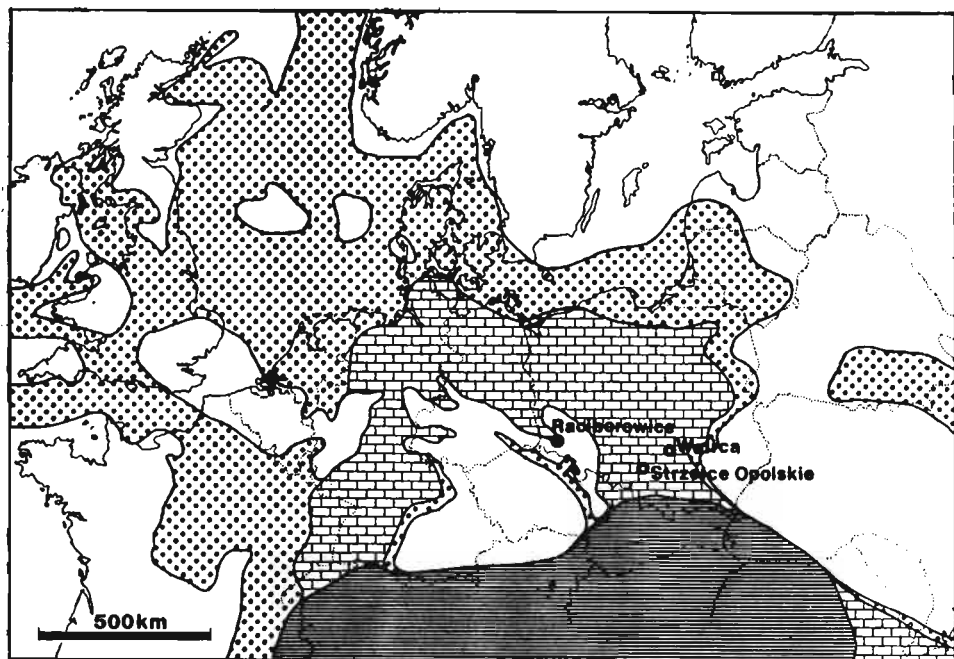


Fig. 1. Position of Polish ammonite localities of the Lower Muschelkalk superimposed on the facies distribution map for the Late Anisian (from Dzik and Trammer 1980).

aspects, which are difficult to evaluate in taxonomic terms without reference to the much better known acrochordiceratids of the Tethyan realm.

The purpose of the present paper is to confront the data on these two Muschelkalk specimens of *Acrochordiceras* with the present knowledge of the evolution of the Acrochordiceratidae. It has been attempted to establish a reference standard of the population variability, sexual dimorphism, and evolution in the Tethyan *Acrochordiceras* lineage on the basis of specimens housed at the Museum für Naturkunde, Berlin (mostly from the Gulf of Ismid, Turkey area), and available literature data. The holotype of *A. damesi* is redescribed and reconstructions of its shell morphology and suture line, as well as those of the specimen from Strzelce Opolskie, are presented.

Abbreviations:

MB — Museum für Naturkunde of the Humbolt Universität, Berlin.

ZPAL — Institute of Paleobiology, Polish Academy of Sciences, Warsaw.

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DESCRIPTIONS

The *Acrochordiceras* specimen from Strzelce Opolskie was found in 1974 by Dr. Krzysztof Małkowski in debris fallen of the wall of the old quarry of cement plant. Its preservation in blue-grey marly calcilutite indicates its probable derivation from the *Terebratula* beds rather than from the predominantly lightcolored oolitic Górażdże Beds. According to Zawidzka (1975: 232), all the strata which can be considered as a possible source of the specimen correspond to the *Neospathodus kockeli* Zone, that is, the Middle Anisian (Pelsonian).

The specimen is somewhat deformed: hence its precise dimension can not be given but the ribbing is nevertheless clearly visible (pl. 16). It represents incomplete (or immature) phragmocone, 95 mm in diameter. In its adapertural part the venter is slightly worn; it cannot be excluded, however, that the ribs in this area were originally somewhat flattened or even disappearing.

The conch surface was densely ornamented at juvenile stages of diameter 40—50 mm, with rounded ribs with morphology typical of the genus. There are generally pairs of ribs originating in dorso-lateral (periumbonal) nodes, which are separated by singular intercalatory ribs at this stage. Later, there is a tendency to develop three ribs in every bunch, separated by a single intercalatory rib, and to have ribs more widely separated by gently concave areas (fig. 2a-b).

The suture line is rather simple, with the lateral saddle having some indentations while the remaining saddles are smooth (fig. 2c).

THE HOLOTYPE OF *ACROCHORDICERAS DAMESI*

Noetling (1880) found his specimen in grey marly nodular limestones of the lower Raciborowice beds (die unteren Gross-Hartmannsdorfer Schichten). It co-occurred there with numerous *Balatonites* specimens, attributed by Rassmuss (1915) to 14 species (pl. 14—15 herein). The specimen of *Acrochordiceras* represents an immature conch with partially preserved living chamber. The left side of the conch is not preserved, probably because it was exposed above the sediment before fossilization.

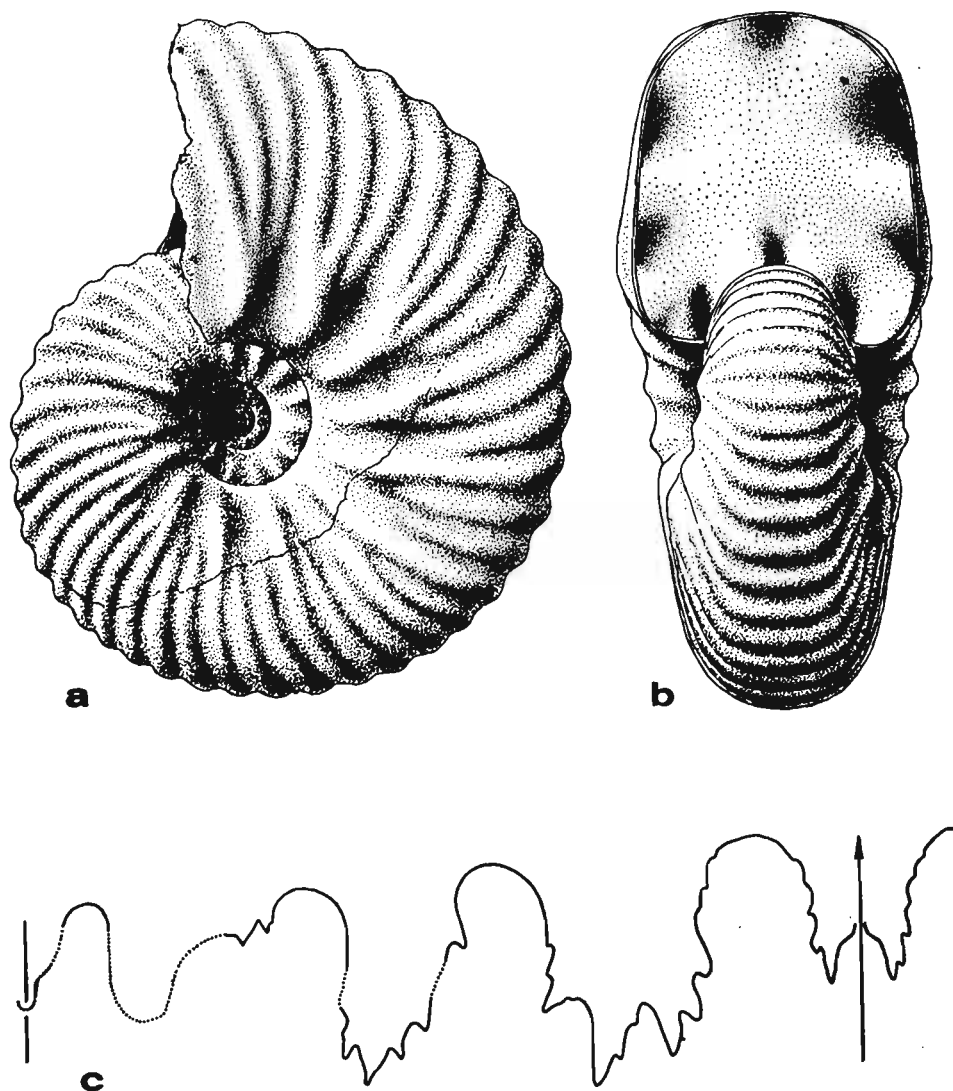


Fig. 2. Reconstruction of the *Acrochordiceras* conch from Strzelce Opolskie as it was prior to deformation (a—b) and its suture line (c). Approximately natural size.

The preserved parts are crushed in the area of the body chamber and strongly compressed in its ventral part and the adjacent regions of the phragmocone. The phragmocone bears impressions indicating original presence of at least one additional half whorl of the living chamber. Thus, the diameter of the conch was at least 180 mm. As there is no change in spacing of the septa at the end of the phragmocone the conch was evidently still immature. A few enantiostreid bivalves are cemented to the interior of the body chamber; it is thus possible that the conch had

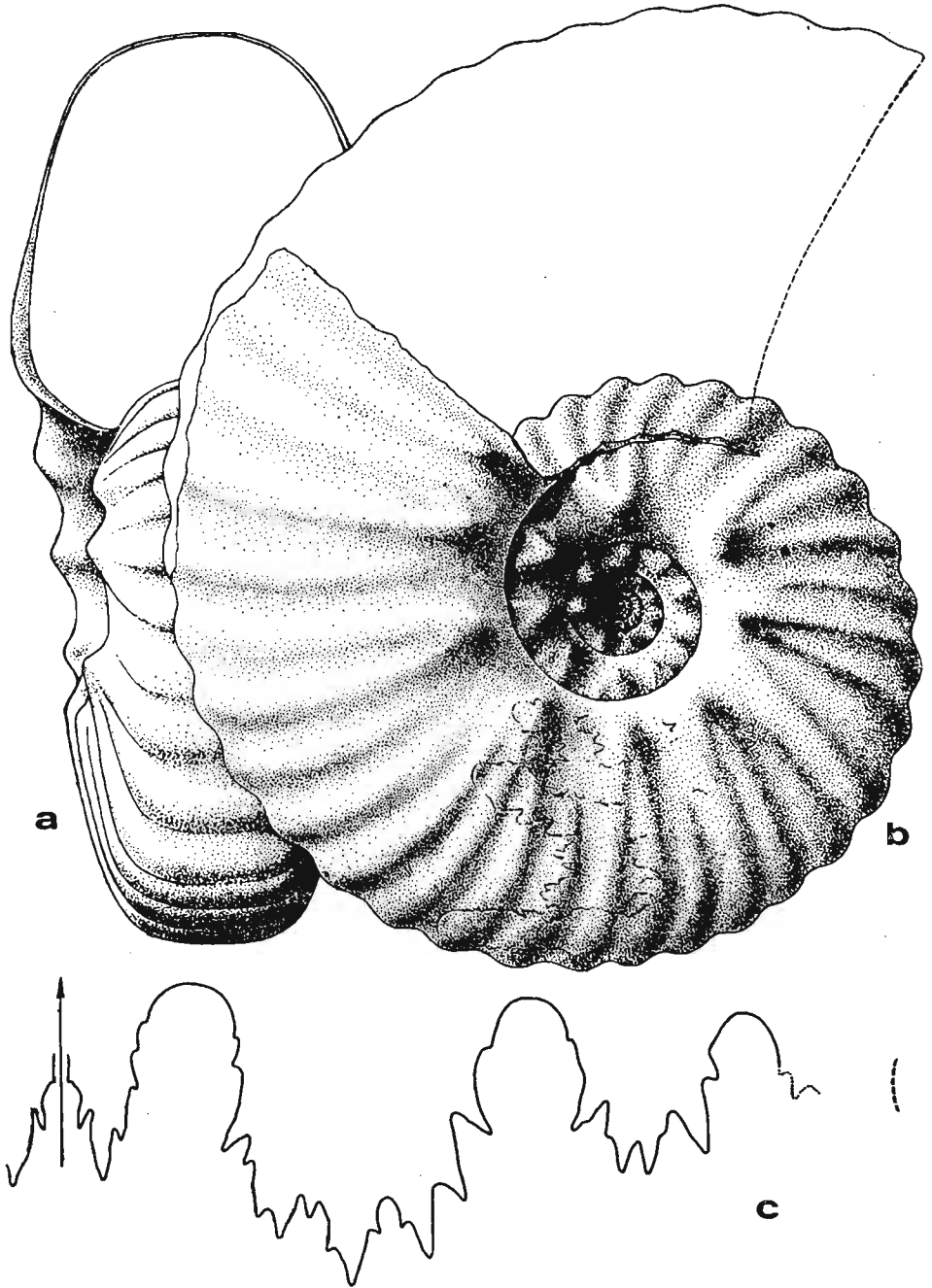


Fig. 3. Reconstruction of the original undeformed appearance of the holotype of *Acrochordiceras damesi* Noetling, 1880 from Raciborowice near Bolesławiec, Lower Silesia, Poland (a—b) and its suture line (c). Approximately natural size.

drifted for some time and/or been exposed on the sea bottom before it was covered with lime mud.

The ornamentation of the conch is rather robust. At juvenile stages (diameter of some 60 mm), ribs are arranged in triple bunches originating at prominent lateral knobs and singular intercalatory ribs in between. Later in ontogeny the number of ribs in a bunch tends to be reduced to two; as a result, the knobs become more densely spaced. Subsequently, however, there is a tendency to somewhat wider spacing of the ribs, with rather gently concave areas between them (fig. 3).

The suture line of *A. damesi* was a matter of confusion (see Spath 1934: 406) in spite of its quite accurate presentation by Noetling (1880). It is quite clear where the siphuncle is located, and Spath was right in suggesting that the suture of *A. damesi* is basically of the same type as in other species of the Acrochordiceratidae. Nevertheless, even while taking into account the specimen's apparent deformation which has resulted in a narrowing of the first saddle, some unusual features of the *A. damesi* suture remain. The most remarkable is a very wide lateral lobe contrasted with narrow saddles at its both sides. This discrepancy in size of particular elements of the suture does not seem to be so apparent at earlier ontogenetic stages. It is rather difficult to evaluate precisely the contribution of deformation processes to the present shape of the line. Unfortunately, the suture line can be accurately traced only in the most deformed parts of the specimen.

THE REFERENCE STANDARD

The acrochordiceratids occur always as a subordinate element of cephalopod faunas of the Anisian. Although Spath (1934) reported the presence of numerous specimens of these ammonites in the collection of V. Havelka from the locality Stavljan in Bosnia, Yugoslavia, deposited in the British Museum (Natural History), no description of their population variability has yet been published. Without at least a rudimentary knowledge of the ontogenetic transformations, population variability, and evolution of the acrochordiceratids it would, however, be impossible to interpret the above described new findings from the Muschelkalk. Regrettably, it has become a custom in ammonite biostratigraphic works that names are attributed to specimens by comparing them with published illustrations of other specimens while neglecting the biological meaning of the procedure. Age correlation is then based on interpretation of long lists of taxonomic names from particular localities. The real biological basis of the inference remains thus hidden, being replaced by a super-

ficially strict methodology of counting empty names. It would, of course, be easy, using such a methodology, to attribute taxonomic names to the Silesian specimens. There is more than enough published illustration of morphologically similar specimens. Instead of doing so, however, I rather intend to expose the ways of reasoning employed when a surely inadequate empirical basis (singular specimens from each locality) is used and conclusions are reached by comparing it with equally inadequate and possibly wrongly interpreted standards of reference.

ONTOGENY OF ACROCHORDICERAS CONCHS

The ornamentation and whorl cross section of the robust and the discoidal shells of the Acrochordiceratidae changed differentially in the course of their ontogeny. The changes in distribution of ribs and nodes at subadult stages of tuberculated forms were presented by Zharnikova (1981). She noticed that the number of intercalatory ribs decreases and the ribs become more widely spaced in larger conchs, some 90 mm in diameter. These features are also visible in the both Silesian specimens. I was able to uncover a well preserved umbilicus of another tuberculated form of *Acrochordiceras* from the Gulf of Ismid, Turkey, housed in the Museum für Naturkunde, Berlin (MB C 441.2). It appears that there is no change in distribution of ribs and tubercles between the size stages of 10 to 27 mm in diameter, although the ribbing seems to be less apparent at early stages and the conch is more evolute. The changes in conch evoluteness are visible on plots of the available published measurements of the Acrochordiceratidae. It seems clear that the involuteness of tuberculated robust shells increases quite suddenly at the stage of 10 to 20 mm in diameter and later changes more slowly (fig. 4).

A quite different pattern occurs in ontogeny of discoidal acrochordiceratids. Their involuteness significantly increases during the whole ontogeny (see Arthaber 1915: pl. 14:, 3, 4). Another specimen from the Gulf of Ismid (MB C 617) shows that at the early stages, less than 25 mm in diameter, tuberculation still is apparent and nodes are separated by intercalatory ribs occurring in the same number as in the co-occurring tuberculate forms. Later on, however, the points of rib bifurcation move to the margin of the umbo and, although still recognizable as slightly elevated nodes, they gradually disappear at a diameter of about 50 mm.

It thus appears that the juvenile stages of the tuberculated and discoidal acrochordiceratids co-occurring in the same beds are morphologically quite similar. The differences in conch shape and ornamentation develop gradually in their ontogeny.

POPULATION VARIABILITY OF THE ACROCHORDICERATIDS

In his review of specimens from the British Museum (Natural History), Spath (1934) in several places indicated a high population variability of the acrochordiceratids. Regarding, for instance, *A. carolinae* Mojsisovics, 1882, he noticed that "this species is connected by transitions with the more inflated *A. haueri* and the more compressed *A. undatum*" (Spath 1934: 395). Concerning *A. haueri* Arthaber, 1911, he stated that "it may be convenient to accept Arthaber's name for those numerous forms, intermediate between *A. carolinae* and *A. fischeri*" (Spath 1934: 396). In another passage, he made a comment regarding the whole sample from the locality Stavljan: "among a hundred specimens of *Acrochordiceras* from Bosnia and Montenegro in the Havelka Collection there were about twenty-five tuberculate forms to seventy-five of the enode type, and probably no two examples of the latter group were identical" (Spath 1934: 403). Silberling and Nichols (1982: 22) also noticed a great population variability in their samples from the Anisian of Nevada. Their species concept of *A. hyatti* Meek, 1877 includes a wide range of forms, from flat discoidal to robust, tuberculate with subrectangular whorl section.

A compilation of the available published measurements suggests that the discoidal and tuberculate forms, despite the high variability in either group, were separated at every time horizon by a gap in the range of morphologies, with no, or at least rare, intermediate morphs (fig. 3; only a single published measurements is omitted, namely that for *A. fischeri* identified by Spath in Stavljan sample: it deviates so much from the remaining ones that a misprint seems possible). Little more can be said about the morphologic variability of the acrochordiceratids on the basis of these scarce data. There is in fact a good evidence that at least some of the considered samples are heterogenous; this concerns also the most productive in acrochordiceratids section of the Gebze area (labelled also as the Diliskelesi fauna) of the Gulf of Ismid, Turkey, which may represent actually three distinct ammonite zones (Assereto 1974, Fantini Sestini 1988).

SEXUAL DIMORPHISM IN ACROCHORDICERAS

It is remarkable that clusters of measurements for discoidal and tuberculate forms of *Acrochordiceras* from different time levels, while having the same V-shape, are displaced from each other in an almost parallel fashion (fig. 3). Moreover, they are arranged strictly according to their time succession. If the discoidal and tuberculated forms are not members of the same species perhaps representing dimorphic pairs, this would require an assumption of unrealistically strictly concerted parallel evolution of two different lineages.

THE EVOLUTION OF THE ACROCHORDICERATIDAE

As noted above, the V-shaped clusters of measurements of conch involuteness plotted against shell diameter are arranged strictly according to geological age of the studied samples (fig. 4) These heterochronous populations differ not only in their conch involuteness but also in the number of intercalatory ribs at early ontogenetic stages. In the Gebze area of the Gulf of Ismid, Turkey (Ismidicum and Balatonites Zones),

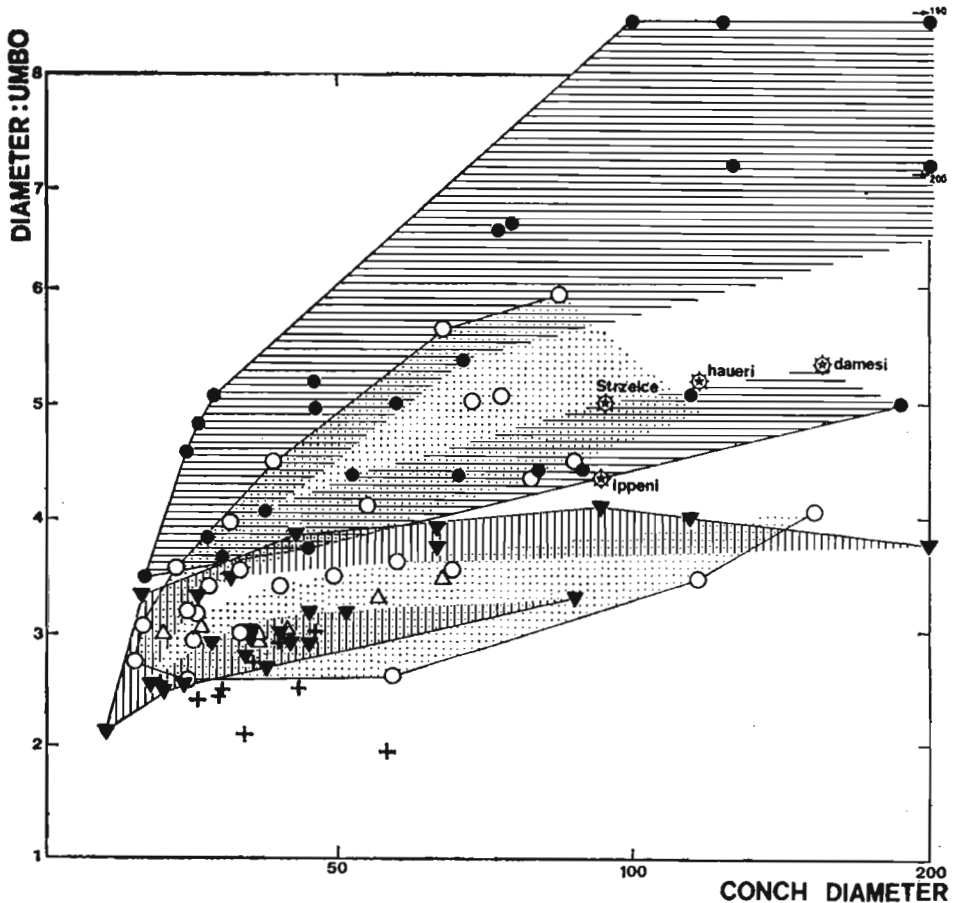


Fig. 4. Indices of conch involuteness (D/V) plotted against diameter (D) for *Acrochordiceras* specimens of different age. Extreme values for particular time units connected by lines and the areas shadowed. Crosses for specimens from Nikifoeko, Timor (Spath 1934) and Chios (Bender 1970, Fantini Sestini 1981), triangles for specimens from Xinyuan, China (Wang 1978), reverse triangles for specimens from Russian Island (Zharnikova 1981) and the Caurus and Hyatti Zones of Nevada (Silberling and Nichols 1982), circles for specimens from the Ismidicum and Balatonites Zones of the Gulf of Ismid (Tuola 1896, Arthaber 1914, Fantini Sestini 1988) and other localities of the Balatonicus (= *Paraceratites binodosus*) Zone (Mojsisovics 1882, Martelli 1906, Spath 1934), dots for specimens from diverse localities of the *P. trinodosus* Zone (Mojsisovics 1882, Hauer 1887, 1892, Arthaber 1911, Spath 1934, Gu et al. 1980). Lower branches in each of clusters represent tuberculate forms while the upper branches are composed of discoidal ones ("*Epacrochordiceras*"). Note their parallel orientation along the chronomorphocline.

specimens with seven outer ribs per every tubercle dominate (three of these ribs form usually a bunch, the remaining four are intercalatory; see also Toula 1896 and Fantini Sestini 1988). According to Assereto (1974), acrochordiceratids of this morphology are typical of the upper part of his middle member if the "Nodular Limestone". *Acrochordiceras* occurs also higher up in the section in the Gebze area, but no apparent regularity in distribution of particular morphs can be identified in the described materials (see Fantini Sestini 1988). Most probably, the observed diversity expresses population variability rather than evolution.

At later stages of ontogeny of at least some specimens, and probably also in the phylogeny of the Acrochordiceratidae the number of intercalatory ribs is reduced to two ribs only and this condition is typical of the juveniles in most faunas to the Paraceratites trinodosus Zone in the Alps (see Mojsisovics 1882, Arthaber 1896, Smith 1914).

In the fauna from Han Bulog near Sarajevo, Yugoslavia, Hauger (1887, 1892) found another assemblage of *Acrochordiceras* with subadult tuberculate forms having only slightly more than four outer ribs per tubercle. A similar form was also reported from Braic in Dalmatia, Yugoslavia, by Bukowski (1895). The only known specimen of *A. ippeni* Arthaber, 1911, found as a loose boulder in Bardanjolt, Albania (Arthaber 1911), bears exclusively ribs that branch dichotomously from a tubercle; it may be even younger in age, as in fact suggested by Spath (1934: 397).

There is thus a clear temporal trend toward a more and more dense distribution of tubercles in the tuberculate morphs of *Acrochordiceras*. Quite in accordance with this general trend, the oldest acrochordiceratids lacked any tubercles at all. Juvenile specimens without tubercles frequently occur in the oldest populations that include tuberculate acrochordiceratids (Arthaber 1915, Zharnikova 1981, Silberling and Nichols 1982), and it is generally accepted that these forms derived from evolute nontuberculate forms, which have been separated by Spath (1934; see Assereto *et al.* 1970, Nicora 1977) into a distinct genus *Paracrochordiceras*. It is remarkable that the measurements of shell involuteness in *A. anodosum* Welter, 1915 from Timor (Spath 1934: 400) as well as in related forms from the basal Anisian of Chios (Fantini Sestini 1981) fit well the proposed scheme of acrochordiceratid evolution, for they clearly show much higher evoluteness than any other population of *Acrochordiceras*. *P. americanum* McLearn, 1946 from the Caurus Zone of Nevada, however, is much more involute and falls well within the range of variability of somewhat younger *A. hyatti* of its own zone, which has a variably developed tuberculation at early ontogenetic stages (see Silberling and Nichols 1982).

Of special interest are specimens described by Wang (1978) from Xinyuan, Guizhou, China, and claimed to represent the oldest Early

Triassic acrochordiceratids. They do not fit the picture presented above; that is, unless they are exclusively 'discoidal' morphs of a species that includes also conchs of another morphology (there are, in fact, some more evolute specimens in this assemblage, which were attributed to the genera *Preflorianites* and *Eodanubites*). Their close relationship to early acrochordiceratids is beyond any doubt, however.

Much more problematic is the taxonomic position of *Proacrochordiceras* from the Early Triassic of Svalbard, Spitsbergen, described by Korchinskaya (1983) and claimed to be the ancestor of the Acrochordiceratidae. Neither the shape of its conchs, nor the pattern of ribbing is consistent with extrapolations from the model of the phylogeny of the group which is presented above.

INTERPRETATION OF THE SILESIAN SPECIMENS

There is no reason to believe that the Silesian specimens represent an acrochordiceratid lineage distinct from the Tethyan one. It is hard to determine if they represent remnants of marginal populations of their biospecies, inhabiting permanently the epicontinental sea of the central Europe, or if they rather represent floating empty shells, dispersed post-mortem to this area from the open ocean. The rarity of these fossils supports the latter possibility. It is also indirectly supported by overgrowth of possibly epiplanktonic bivalves at the inner side of the specimen from Raciborowice.

Although the acrochordiceratid population variability, as inferred from the scarce available data, seems to be large enough to allow for inclusion of both the Silesian specimens into a single biospecies (in a later part of the lineage), such a solution does not appear to be very plausible. It is more likely that these specimens are more or less typical representatives of populations of slightly different geological age. The acrochordiceratid forms that are morphologically closest to the Silesian specimens are those from Han Bulong (Hauger 1887) and Braic (Bukowski 1895), Yugoslavia, and that one from Albania (Arthaber 1911). Only a few specimens are comparable in size to the Silesian ones. When arranged according to the features of their ribbing, they all form a morphocline which can be extended back to other members of the family; and it almost certainly is a part of a chronomorphocline. Although no good evidence for time ordination of these supposedly most advanced acrochordiceratids is presently available, it is here proposed to assume that this gradient does really express the course of their evolution. If so, the specimen from Raciborowice appears to be quite close to that from Han Bulog, being thus older than the specimen from Strzelce Opolskie which tends closer toward its proposed Albanian relative (fig. 5).

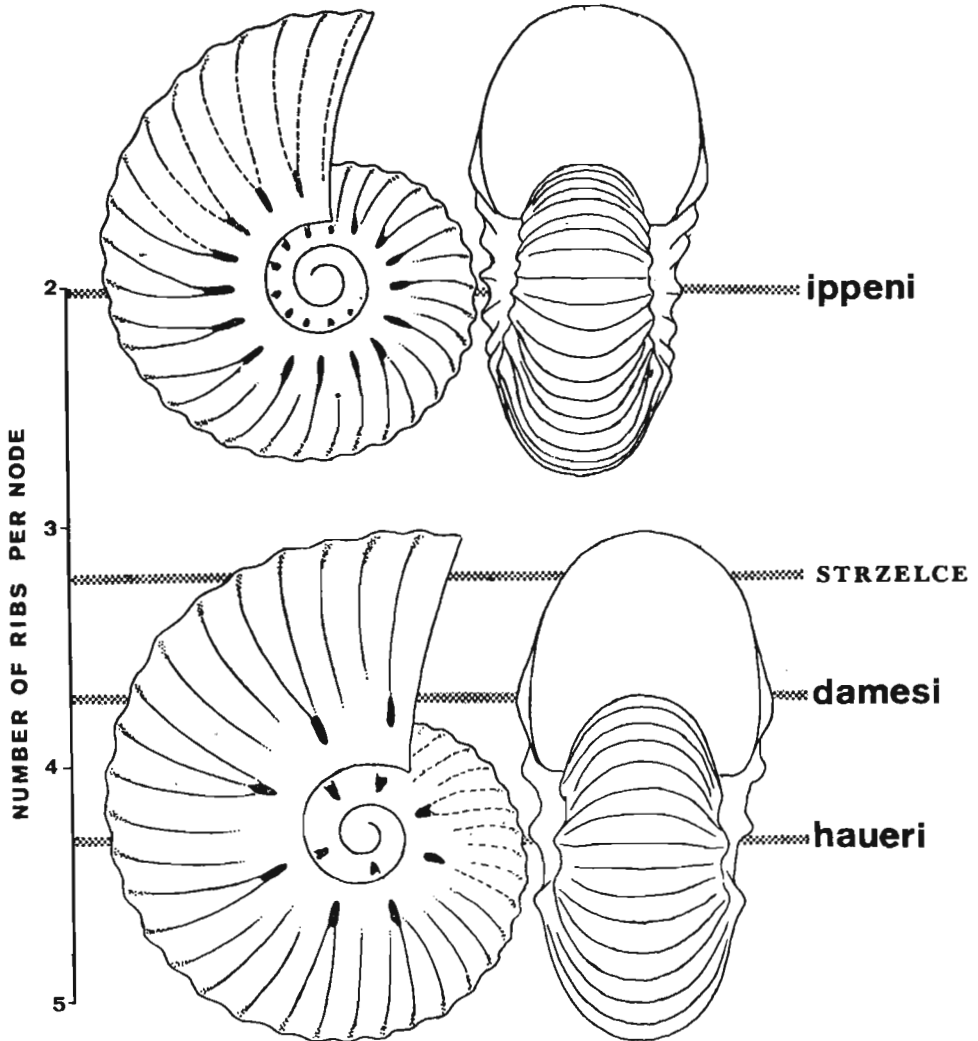


Fig. 5. Relationship of the Silesian specimens of *Acrochordiceras* to the morphologically closest Tethyan ones. Arranged according to values of ribbing indices (mean ratio of external ribs per tubercle).

TAXONOMIC NOMENCLATURE

However inadequate is the empirical basis for evolutionary interpretation of the taxonomy of the *Acrochordiceratidae* there is nothing in their morphology and established time sequence, which would not allow to consider them as representing a single lineage, monospecific at every time plane. Occam's Razor, the basic tool of any sound scientific action, asks for decisive evidence when existence of any new lineage has

to be introduced. Such an evidence is lacking in the case of acrochordiceratid phylogeny. Even the discoidal forms, separated traditionally into the genus *Epacrochordiceras*, seem to represent a dimorphic pair with their tuberculate counterparts rather than a separate lineage evolving in parallel.

If the Acrochordiceratidae really consist only of a single lineage, then all taxonomic decisions based on the populational methodology (see Dzik 1986, 1990) refer to arbitrarily defined chronotaxa. It seems reasonable to subdivide the lineage into five chronospecies. This number of segments allows for an easy recognition of particular taxa and, at the same time, adequately exploits the biostratigraphic potential of the lineage. Their full definitions, as well as complete synonymies, would require a thorough revision of all the existing museum collections and may still be impossible without additional field materials. Therefore, no more than provisional definitions and a selection of names are given below.

1. *Acrochordiceras anodosum* Welter, 1915

Holotype: Welter 1915: pl. 89: 3a—c.

Type horizon and locality: Nikifoeko, Timor.

Only juvenile specimens of this probably the oldest species of the lineage are known (Welter 1915, Spath 1934, Fantini Sestini 1981). Their great evoluteness and the lack of tuberculation ensure that they are easily distinguishable from other species. Relationship to *Eoacrochordiceras zijunense* Wang, 1978 is unclear.

2. *Acrochordiceras hyatti* Meek, 1877

Lectotype: selected by Silberling and Nichols 1982: pl. 4: 27—28.

Type horizon and locality: unknown, probably New Pass Range, Nevada, Hyatti Zone.

Early ontogenetic stages are weakly tuberculated or nontuberculated; the conchs are rather evolute at all stages (Zharnikova 1981, Silberling and Nichols 1982).

3. *Acrochordiceras haliti* Toulou, 1896

Holotype: Toulou 1896: pl. 19: 10.

Type horizon and locality: Gulf of Ismid between Kazmalı and Malumkios.

Relationship to the Himalayan species of Diener (1895, 1907) remains uncertain. Juveniles have approximately seven ribs per tubercle; their conch involuteness is intermediate between the preceding and the following species.

4. *Acrochordiceras damesi* Noetling, 1880

Holotype: Museum für Naturkunde, Berlin (here fig. 3 and pl. 13).

Type horizon and locality: Lower Raciborowice Beds, Raciborowice, Lower Silesia.

Juveniles have approximately five ribs per tubercle; the conchs are more involute than in the preceding species but do not seem to differ in this respect from the following one. At present, it seems rather unrealistic to distinguish any more than this single chronospecies in the bulk of Tethyan acrochordiceratids of the Paraceratites trinodosus Zone.

5. *Acrochordiceras ippeni* Arthaber, 1911

Holotype: Arthaber 1911: pl. 24: 11a—b.

Type horizon and locality: Bardanjolt, Albania (loose block).

This is probably the youngest member of the lineage, with almost bifurcate ribs, intercalatory ribs being quite sporadic. Presumably, the specimen from Strzelce Opolskie belongs here.

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JERZY DZIK

AMONITY ACROCHORDICERAS W TRIASIE ŚLĄSKIM

Streszczenie

W 1880 roku F. Noetling opisał znaleziony w Raciborowicach (Niecka Północno-Sudecka) okaz ceratytu, który stał się podstawą utworzenia nowego gatunku *Acrochordiceras damesi*, wydzielonego później nawet w osobny rodzaj *Silesiacrochordi-*

ceras. Amonity z tej grupy, cechującej się szczególną ornamentacją muszli z oblymi grubożebrowanymi zwojami raczej jurajsko-kredowego niż triasowego typu, nie były odtąd znajdowane w triasie germańskim. Upłynęło stulecie zanim został znaleziony, przez dr Krzysztofa Małkowskiego, drugi okaz w warstwach terebratulo-wych Strzelec Opolskich (fig. 1). Okaz ten różni się gęstością żebrowania od holotypu *A. damesi* (pl. 13).

Szeroko rozprzestrzeniony w anizyku Tetydy, szybko ewoluujący *Acrochordiceras* jest potencjalnie doskonałym wskaźnikiem wiekowym. Niesposób jednak ocenić, bez odwołania się do wzorcowych populacji tetydzkich, czy odmienność okazu ze Strzelec jest przejawem znajdowania się na odmiennym stadium rozwoju ewolucyjnego czy też jedynie przejawem zmienności populacyjnej. Praca niniejsza zawiera więc, prócz opisu obydwu śląskich okazów *Acrochordiceras*, ich porównanie z opar-tym na danych literaturowych oraz kolekcji Museum für Naturkunde, Berlin, szacunkiem zmienności wewnątrzpopulacyjnej i kierunku przemian ewolucyjnych pokrewnych populacji rodzaju w Tetydzie (pls. 14—16; figs. 2—5). Z porównań tych wynika, że przynależność obydwu okazów do jednego gatunku biologicznego jest mało prawdopodobna i że okaz ze Strzelec wykazuje większe zaawansowanie ewolucyjne zbliżając się do znanego z Albanii, również z pojedynczego okazu, *A. ippeni*.

EXPLANATION OF PLATES 13—16

All photographs in natural size

Plate 13

Acrochordiceras damesi (Noetling, 1880), Lower Raciborowice Beds,
Raciborowice, Lower Silesia, Poland

1. Holotype in lateral (a) and apertural (b) views;

Plate 14

Balatonites sp. sp. from Raciborowice Beds, Raciborowice Beds,
Lower Silesia, Poland

1. Specimen MB C 856 in lateral view.
2. Latex cast housed at the Museum für Naturkunde of a specimen from an old private collection (probably lost).
3. The only preserved specimen of *Balatonites zimmeri* Rasmuss, 1915 in ventral (a) and lateral (b) views (MB).

Plate 15

Balatonites ottonis (von Buch, 1849) from Poland

1. Holotype MB C 438 in lateral (a) and ventral (b) views, Upper Silesia.
2. Specimen MB C 855 from Raciborowice, Lower Silesia.

Plate 16

Acrochordiceras cf. *ippeni* Arthaber, 1911 from *Terebratula*
Beds of Strzelce Opolskie, Poland

1. Specimen ZPAL Am. II/1 in lateral (a, c), apertural (b), and ventral (d) views.

