ERVÍN SCHEIBNER*

CONTRIBUTION TO THE KNOWLEDGE OF THE MURCHISONAE BEDS IN THE KLIPPEN BELT OF WEST CARPATHIANS IN SLOVAKIA

PRÍSPEVOK K POZNANIU MURCHISÓNIOVÝCH VRSTIEV BRADLOVÉHO PÁSMA ZÁPADNÝCH KARPÁT NA SLOVENSKU

(Text-figs. 1—28, pls. I—VI)

Abstract. Description of the murchisonae beds from the locality Litmanová in eastern Slovakia, and comparison of this with other localities. Review of the Aalenian stratigraphy and a short discussion of the problem of the independence of the Aalenian as a stratigraphical stage. Description of the faunas from the murchisonae beds. Precise diagnosis of *Ptychophylloceras tatricum* (Pusch) and *Calliphylloceras connectens* (Zittel).

Introduction

In 1960 a rich macrofauna was found, composed mainly of Cephalopoda, in the murchisonae beds of the Czertezik series in the klippen belt of the West Carpathians near Litmanová (Ľubovnianska vrchovina, district of Stará Ľubovňa, eastern Slovakia). The fauna is excellently preserved, and fossilized in pyrite. During the study of this fauna there arose many questions, not only paleontological, but also sedimentological and paleogeographical. Some of these problems have been dealt with in other publications (E. Scheibner, 1962, pp. 233—235; 1963 a, b).

I wish to express my thanks to Dr. B. Géczy (Budapest) for his help and valuable advice in the determination of the fauna and to Dr. P. L. Maubeuge (Saint Max, France) for sending me valuable and important literature.

Rewiew of the geology of the klippen belt

The klippen belt (interior klippen belt, southern klippen belt, Pieniny klippen belt) represents an independent paleogeographical and tectonical zone, extending between the Central Carpathians and the external flysch Carpathians (text-fig. 1). The characteristic features of the klippen belt are: unusual lateral compression, almost vertical orientation of beds, „chaotic" tectonics (caused by an unstable substratum) and undoubtedly repeated tectonic movements, in consequence of which there originated widespread boudinage and tectonic brecciation. The rigid beds are partly in stratigraphical sequence. In some parts, accordingly to D. Andrusov (1938) and K. Birkenmejer (1959) occurred diapiric tectonics. The klippen belt is further characterized by a variety of facies and by a zonal distribution of sedimentation. The complicated tectonic construction became evident after the development of the characteristic geomorphology, which in fact gave a name to the whole klippen belt. The essential feature, which explains the origin of the complicated tectonic construction of the klippen belt,

* Prom. geol. E. Scheibner, Department of Geology of the Faculty of Natural Sciences of J. A. Comenius University, Gottwald sq. 2, Bratislava.

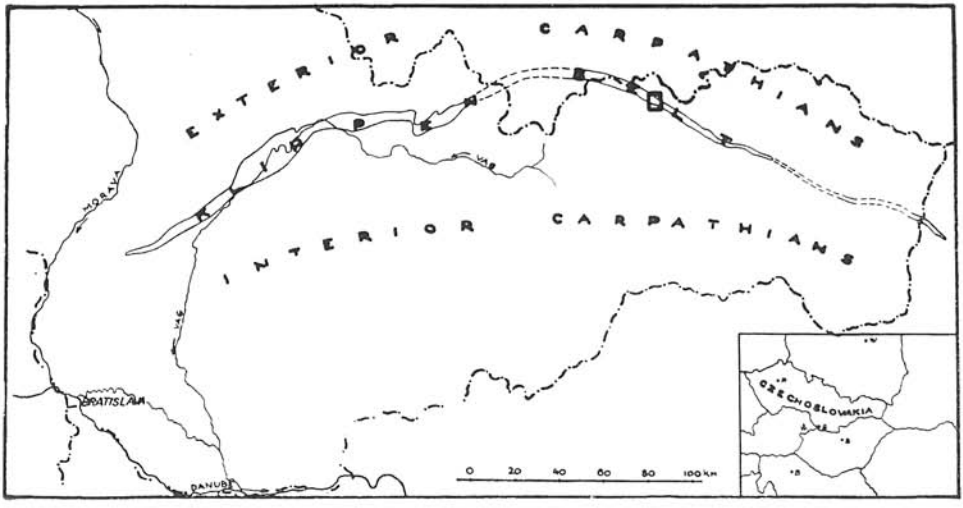


Fig. 1. Regional division of the West Carpathians. The area studied is in the quadrangle.

is the fact, that the klippen belt was tectonically affected during the orogenic movements (subhercynian phases, laramid and savian phases).

Two main Pieniny series are distinguished in the klippen belt: in the northern part of the Pieniny geosyncline the Czorsztyn (or Subpieniny), rich fossiliferous series was deposited and in the central part of this geosyncline, south of the first series, the Pieniny series. There are many transitional developments and series between these two main series: the Czertezik, Niedzica, Pruské and Podbiel developments and the Branisko and Kysuca (V. Uhlig, 1890, D. Andrusov, 1931, 1938 a. o., K. Birkenmajer, 1960, 1961 a. o. and E. Scheibner, 1961). At the southern margin of the Pieniny geosyncline a shallow-water series was laid down; this has many identical features with the mantle Tatrid series (mainly those of High Tatra) of the core mountains: the Haligovce and Klape series (K. Birkenmajer, 1959, E. Scheibner, 1961, A. Began, 1962).

Review of investigations of the murchisonae beds

The Czorsztyn series Aalenian (Czertezik and Niedzica developments) was already well known and quite perfectly studied in the last century (L. Zeuschner, 1847, L. Hohenegger, 1855, E. v. Mojsisovics, 1867, C. Zittel, 1869, M. Neumayr, 1871 a, b and V. Uhlig, 1890). There were distinguished two lithological and lithobiostratigraphical units in the Czorsztyn series Aalenian: the opalinum marls below and the murchisonae clays above (Lex. Stratigr. Internat., Europe, f. 6b, Tchécoslovaquie).

The murchisonae beds (synonyms: murchisonae clays (V. Uhlig, 1890), marls with *Ludwigia murchisonae* (D. Andrusov, 1959) in the typical development are composed of dark to black clays and shaly, fine micaceous argillites. They frequently contain sphaerosiderite and pyrite concretions. Sometimes we may see intercalations of bedded, slightly micaceous sandstones. The age of this sequence at many places was determined on the basis of a rich fauna. M. Neumayr (1871, p. 484) described the species from grey clays at the Zaskal locality: *Belemnites* cf. *exilis* d'Orb., *Belemnites* cf. *Trautscholdi* Opp., *Phylloceras connectens*

Zitt., *Phylloceras tatricum* Pusch, *Phylloceras ultramontanum* Zitt., *Lytoceras ophioneum* Benecke, *Harpoceras Murchisonae* Sow., *Harpoceras Goralicum* n. sp. cf. *discites* Waagen, *Posidonomya Suessi* Opp., *Stephanoceras Brochii* Sow. and *Eucyclus capitaneus* Münster. The murchisonae beds lie above the opalinum beds and are connected with them by a gradual transition. Above the murchisonae beds occur white crinoidal limestones.

The murchisonae beds are best known from the Pieniny section of the klippen belt, less important occurrences are known from Orava (northern Slovakia) and Považie (western Slovakia). Detailed descriptions were recently published by D. Andrusov (1945) and K. Birkenmajer (1957 a, b, 1960) who dealt with the problem of flysch sedimentation in the „Aalenian".

Aalenian biostratigraphy

The problem of the independence of the Aalenian as a stratigraphical stage

Although Aalenian biostratigraphy is quite well known, there is some confusion in its conception. The stage Aalenian was established in 1864 by Ch. Mayer-Eymar. In the Aalenian he included four diverse beds. 4. beds with *Ammonites sowerbyi* from Gingen, 3. beds with *Ammonites murchisonae* from Cheltenham, 2. beds with *Trigonia navis* from Gundershoffen and 1. beds with *Ammonites torulosus* from Boll. The type localities of these beds are very widely separated and the relationships between them are not fully clear. The establishment of this stage was unnecessary, as the Toarcian and Bajocian introduced by d'Orbigny (1844) and defined by A. Oppel (1958) are well characterized and closely allied.

In 1874, Ch. Mayer-Eymar changed the contents of the Aalenian; the beds with *Ammonites sowerbyi* he transferred to the Bajocian.

E. Haug (1892) tried to redefine the Aalenian on the basis of new paleontological data. He distinguished in the Aalenian these zones: *Harpoceras concavum* zone, *Harpoceras murchisonae* zone, *Harpoceras opalinum* zone and *Dumortieria pseudoradiosa* zone. The Aalenian was thus enlarged.

At the present there exist several essentially different opinions about the Aalenian. On the one hand there are the English authors (represented by W. J. Arkell's opinion, 1933, 1956), who do not recognize the Aalenian. On the other hand there are French and German authors, who recognize and use this stage. The Aalenian in the conception of the French and German authors is not identical. The French authors accept E. Haug's (1910) opinion and include the Aalenian in the Lias. The German authors support the older standpoint of F. A. Quenstaedt (1856) and A. Oppel (1856—1858) and place the Aalenian zones at the base of the Dogger.

Although the French authors admit the insufficiency of the Aalenian as an independent stage, they do not abandon it for practical reasons: the Aalenian fits in with the lithobiostratigraphical conditions of the Paris and Aquitaine basins and other epicontinental regions of the Western and Central Europe.

The Colloquium on the Jurassic in August 1962 in Luxembourg proposed the inclusion of the Aalenian in the Dogger and at the same time in the Lower Jurassic. The Aalenian begins with the zone of *Leioceras opalinum* and ends with the zone of *Graphoceras concavum.*

A. Oppel's zones (with *Ammonites torulosus, Trigonia navis* and *Ammonites*

murchisonae), which were included by Ch. Mayer-Eymar in his Aalenian, were gradually transformed and at the present day we may distinguish (following several authors) in the Aalenian these zones and subzones:

Zone	Subzone
Graphoceras concavum	*Graphoceras concavum* (Sow.)
Ludwigia murchisonae	*Brasilia bradfordensis* Buckman *Ludwigia murchisonae* (Sow.) *Ancolioceras* sp.
Tmetoceras scissum	*Tmetoceras scissum* (Benecke) [*Costileioceras sinon* (Bayle)]
Leioceras opalinum	*Leioceras opalinum* (Reinecke) [*Costileioceras costosum* (Quenst.)]

These subzones and zones are well characterized biostratigraphically and easily recognizable. E. Neaverson (1955, pp. 444—446) distinguishes two characteristic faunal groups: Ludwigian and Leioceratan. The Leioceratan is characterized by a group of flattened Hildoceratids with sharp periphery, which resemble Toarcian Grammoceratids in the shape of the test, but they differ in details of ornamentation, degree of coiling and keel. The index species *Leioceras opalinum* (Reinecke) has a flattened shell, ornamented by sigmoidal striae and descended from the Grammoceratids through the Toarcian genera *Pleydellia* and *Cotteswoldia*. They might be derived from Leioceratinae, which we place into special subfamily as they are of a different character. The top of the zone is characterized by the occurrence of *Tmetoceras scissum* (Benecke) with ring-shaped ribs terminating in tubercles at the margins of peripheral furrows. The zone with *Tmetoceras scissum* is characterized by the occurrence of other species of the genus *Tmetoceras* [*Tmetoceras regleyi* (Thiol.) a o.], and genus *Costileioceras* [*Costileioceras sinon* (Bayle)]. The Ludwigian is characterized by species of the genus *Ludwigia* with a moderately wide umbilicus. Another important genus is *Brasilia*, which has less coarse ornamentation and is less involute, with a discoidal shape like *Graphoceras*. It is characteristic of the zone with *Graphoceras concavum*. The genus *Graphoceras* has distinctly ornamented radial ribs in the form of wide V.

These genera belong to Graphoceratinae and from these developed the smooth, keeled genus *Hyperlioceras*. Other Hildoceratids which occur with Ludwigia fauna, include scarce Hammatoceratids, which represent a transition to the Sonninians.

In the Mediterranean region, the west European and central European forms mentioned are of less importance than the Phylloceratids and Lytoceratids. The biostratigraphic value of the typical Mediterranean fauna is less than that of the west European and central European one described above. Characteristic for the Lower Bajocian — Aalenian are species of the genera *Holcophylloceras* [*Holcophylloceras ultramontanum* (Zittel)], *Ptychophylloceras* [*Ptychophylloceras tatricum* (Pusch)] and others. In the murchisonae beds the essential part of the assemblage is composed of two species: *Ptychophylloceras tatricum* (Pusch) and *Calliphylloceras connectens* (Zittel). M. Neumayr (1871 a, b), however, cites them from both the murchisonae and the opalinum beds from various localities in the klippen belt.

Subzones represented in the murchisonae beds are characterized by the following fauna: the subzone with *Ancolioceras* sp. is indistinct; with plenty of Phylloceratids *Ludwigia murchisonae* occurs rarely. The subzone with *Ludwigia murchisonae* contains *Ludwigia murchisonae* (S o w.), and *Ludwigia reflua* (B u c k m a n). The subzone with *Brasilia bradfordensis* contains *Brasilia bradfordensis* (B u c k m a n), and *Ludwigia obtusiformis* (B u c k m a n). The subzone with *Graphoceras concavum* contains *Graphoceras concavum* (B u c k m a n), *Graphoceras robustum* (B u c k m a n), *Graphoceras v-scriptum* (B u c k m a n), *Graphoceras casta* (B u c k m a n), *Graphoceras tenuis* (B u c k m a n), *Ludwigia eschense* M a u b e u g e a. o., and the last subzone with Hyperlioceras discites contains *Hyperlioceras discites* (W a a g e n) and *Hyperlioceras* sp.

In all the subzones there occur *Calliphylloceras connectens* (Z i t t e l), *Ptychophylloceras tatricum* (P u s c h), *Ptychophylloceras chonomphalum* (V a c e k), *Lytoceras rasile* V a c e k. *Lytoceras rubescens* (D u m o r t i e r) and *Lytoceras* sp. In the lower part of the sequence was found *Cenoceras lineatus* (S o w.). Throughout the described sequence *Posidonia alpina* (G r a s.) occurs in great numbers.

Together with the macrofauna was found a microfauna composed of the species: *Quinqueloculina* sp., *Lenticulina subalata* (R e u s s), *Lenticulina varians* (B o r n e m a n n), *Lenticulina d'orbignyi* (R o e m e r), *Lenticulina muensteri* (R o e m e r), *Lagena psekentschiensis* M a m o n t o v a, *Patellinella* sp. and *Epistomina nuda* T e r q u e m; the microfauna was determined by V. S c h e i b n e r o v á.

Biostratigraphically the murchisonae beds are characterized by the ammonite fauna of the Lower Bajocian — Aalenian, i. e. by the three uppermost subzones of the Lower Aalenian, namely: murchisonae, bradfordensis and concavum subzones. There in the uppermost portions of the murchisonae beds was found *Hyperlioceras discites* W a a g e n, which is an index species of the lowermost subzone of the Middle Bajocian: discites subzone. As we see from the former mentioned, the murchisonae beds have a greater stratigraphical extension than the murchisonae zone itself. They extend even into the Middle Bajocian. The distinct change at the base of the Middle Bajocian is found very frequently also in other regions, for instance in Germany, where the discites subzone is included in the Aalenian.

In the murchisonae beds at Litmanová, Phylloceratids constitute 71,42 % and Lytoceratids 7,51 % of the cephalopod fauna, i. e. the Mediterranean forms make up 78,93% which is in accordance with the figures quoted by B. G é c z y (1958) from the Bakony mountain, where Phylloceratids make up 62% and Lytoceratids 16%, making 78% together. Now it is clear that the percentage of the cephalopod fauna varies in the Téthys region in relation to depth and relative degree of pelagicity.

M u r c h i s o n a e b e d s l o c a l i t y n e a r L i t m a n o v á

At Ľubovnianska vrchovina, north-east of Litmanová village in the district of Stará Ľubovňa (eastern Slovakia) there occurs a sequence of the murchisonae beds of the Czertezik series with a rich macrofauna. The murchisonae beds are in tectonic contact with the Upper Cretaceous to the north, and in stratigraphical contact with Bajocian crinoidal limestones to the south (text-figs. 2, 3). The murchisonae beds at this locality are in general identical with those described by older authors (L. Z e u s c h n e r, 1847, E. v. M o j s i s o v i c s, 1867, M. N e u m a y r, 1871 and V. U h l i g, 1890). They are composed of a sequence of black or blue-

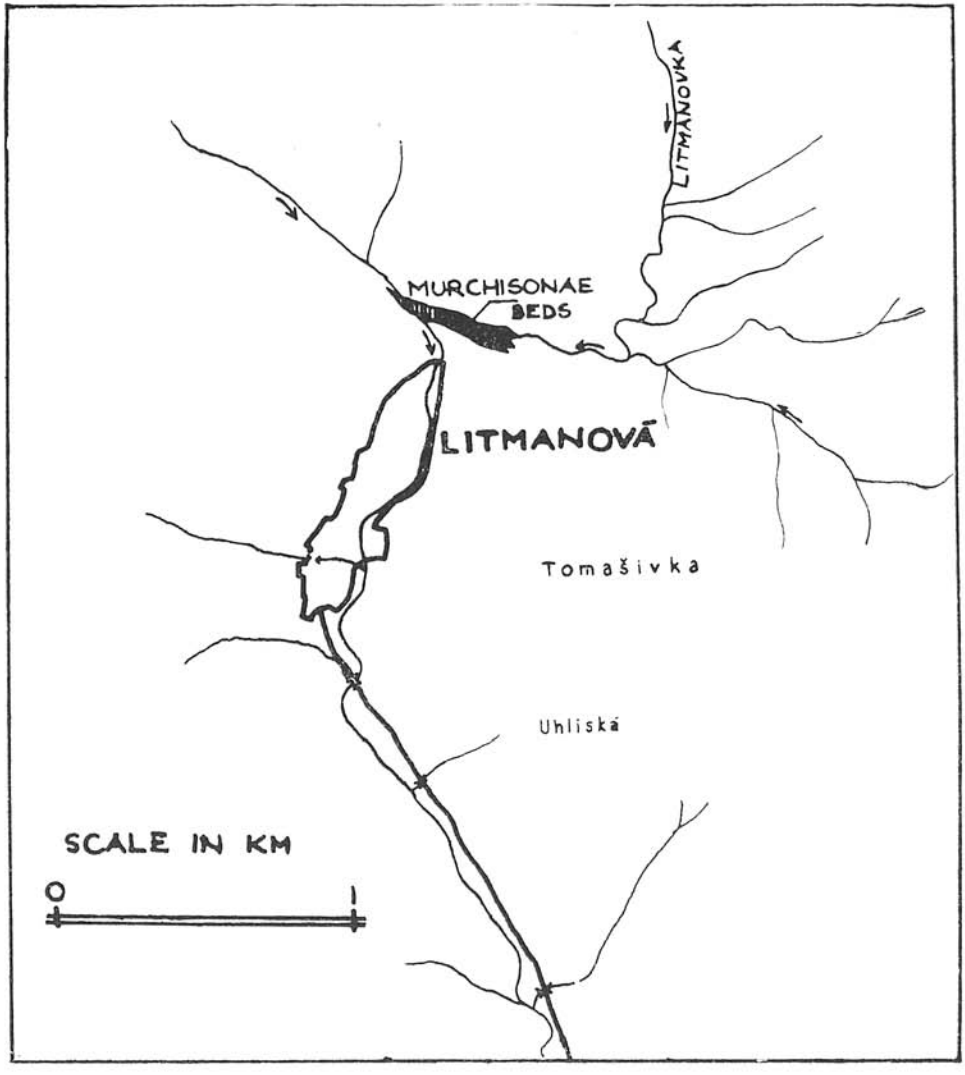


Fig. 2. Locality map of the murchisonae beds described near Litmanová.

grey bituminous shales with scarce intercalations of dark, fine- to medium-grained sandstones and sandy limestones. Clay-carbonate concretions there occur in abundance of ankeritic character, frequently with pyrite filling of cracks. The concretions are usually irregularly dispersed in the shales and sometimes they form continuous layers. The overall size of the concretions varies between 15 and 50 cm.

Pyrite concretions are also irregularly dispersed in the sequence. The overall size of them varies from 10—15 cm, up to a maximum of 30 cm. The pyrite frequently replaces organic remains, mainly those of cephalopods. The organic remains so

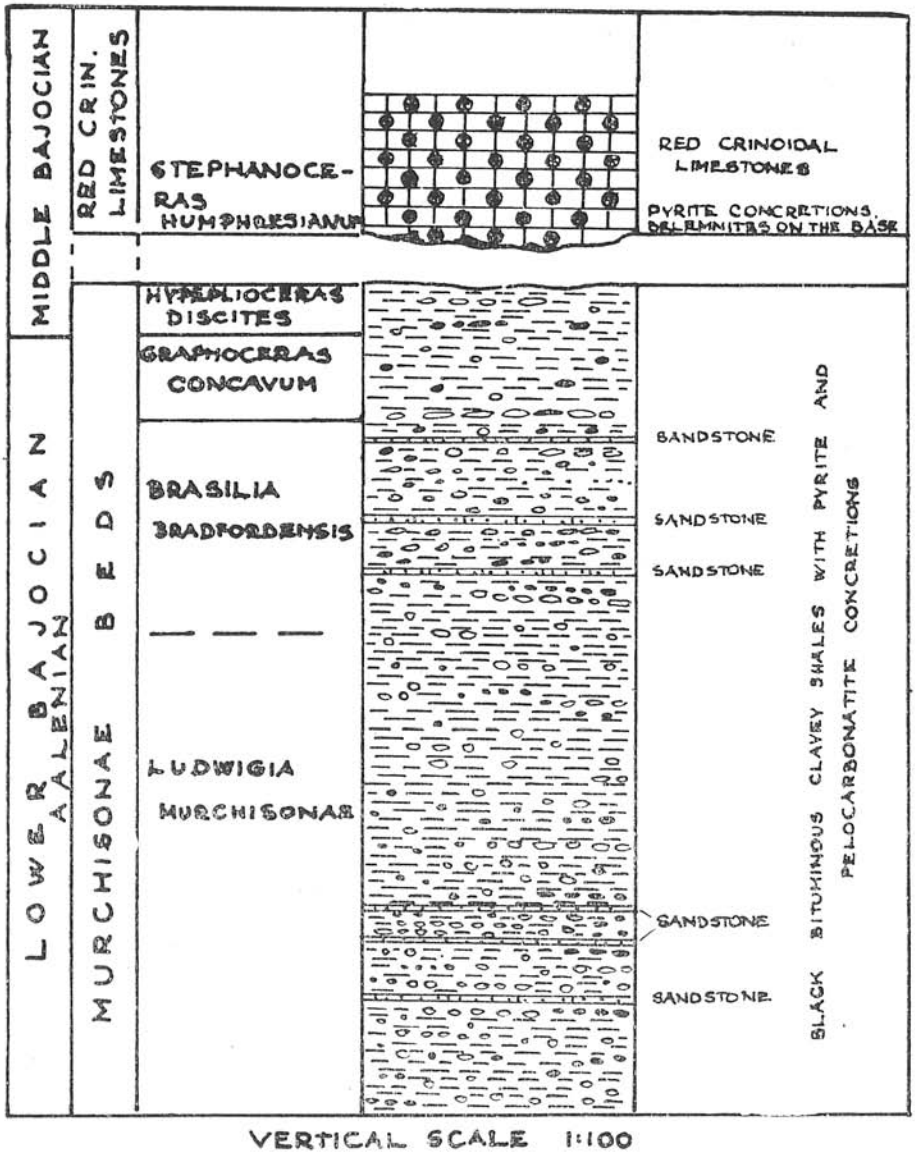


Fig. 3. Lithological profile of the murchisonae beds at the type locality at Litmanová.

fossilized are perfectly preserved. The pyrite occurs not only in the form of concretions, but also finely dispersed in the clay shales in the form of small globules and cubes of microscopic size. The microfauna is also fossilized by the pyrite, as are small juvenile specimens of *Posidonia alpina* (G r a s), which form an essential part of the microassemblage.

The question of the larger amount of pyrite may be explained by a hydrosulphu-

ric concentration in the sedimentary basin, or on the other hand by a special processes of diagenesis by hydrosulphuric acid concentrations in the already deposited sediment. Since there occur benthonic Foraminifera, larger specimens of *Posidonia alpina* (G r a s) with both valves preserved (the occurrence of Bivalvia with both valves are one of the signs of a autochthonous nature) and also gastropods, this may serve as evidence against hydrosulphuric acid concentrations of the Black sea type. Most probably, the hydrosulphuric acid concentrations occurred in the deposited sediment due to a greater amount of organic remains and at the same time to a greater amount of pelitic material covering the organic remains, so that decay of the latter was retarded and this resulted in a reducing environment in the sediment. Rash burial of the shells in the sediment together with pyritization represent the reason for the perfect preservation of the fauna.

Strata of a similar caracter known from many regions, all over the world. H. S c h n e i d e r h ö h n (1955) named them „Schwartzschiefer Formation". Schwartzschiefer Formations are known from the European Cambrian, Silurian and „Culm". They are composed of bituminous rocks containing a considerable amount of dispersed pyrite in the form of cubes, globules and „pyritized bacteria". By spectrographic analysis we may see that they contain V, Mo, Cr, Cu, Ni, Co, Zn, Au, Ag, U and many other elements. Both vanadium and uranium are restricted within the organic remains. The murchisonae beds in general correspond to S c h n e i d e r h ö h n ' s data.

P a l e o n t o l o g i c a l p a r t

Order Nautilidae d ' O r b i g n y, 1840

Genus *Cenoceras* H y a t t, 1883

Cenoceras lineatus (S o w e r b y, 1813)

(Plate I, fig. 1 a—c, text-fig. 4)

1813 *Nautilus lineatus* S o w e r b y — J. S o w e r b y : Mineral Conchology, p. 89, tab. 41.
1843 *Nautilus lineatus* S o w e r b y — A. d'O r b i g n y : Terr. jurassique Céphalop., p. 155, Tab. 31, figs. 1—5.
1856 *Nautilus lineatus* S o w e r b y — A. O p p e l : Juraformation, p. 486.
1874 *Nautilus lineatus* S o w e r b y — F. D u m o r t i e r : Étud. Paléont., p. 248, Tab. 49, figs. 11—13.
1927 *Nautilus lineatus* S o w e r b y — W. S c h n e i d e r : Étude stratigr. et paléont., p. 13.
1956 *Cenoceras lineatus* S o w e r b y — B. K u m m e l : Post-Triassic Nautiloid Genera, p. 374.

R e m a r k s : the cross-section of the shell (text-fig. 4) is almost quadrangle with rounded angles, slightly wider in the lower portion. The surface of the shell is ornamented with fine striae, strongly curved back-wards at the ventral margin. The suture has slight ventral and lateral lobe. In all the material there were found only two specimens of this species with features identical with those described by J. S o w e r b y (1813, p. 89, pl. 41). The most characteristic feature is the fine line extending through the center of the central portion of the shell, which gives in an indistinct keel-shaped form. This line is visible mainly on the nucleus. On the shell itself it is expressed only as an indistinct elevation.

O c c u r r e n c e. Lower Dogger of western and central Europe. This species has

not previously been recorded in the Carpathians. The first find is described in this paper. In the Carpathians it occurs in the murchisonae beds (Lower Bajocian — Aalenian) in the klippen belt at the Litmanová locality.

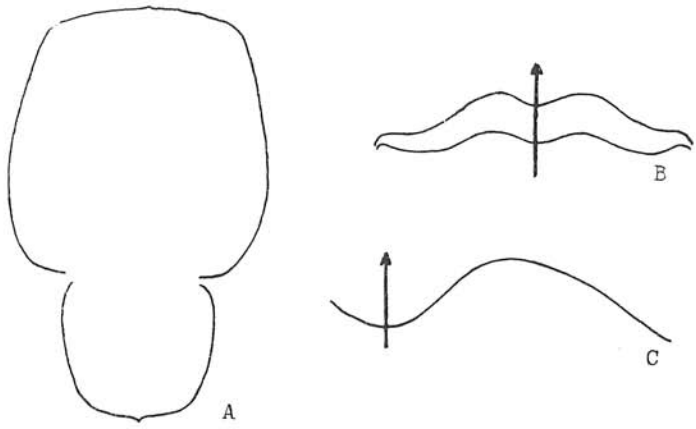


Fig. 4. *Cenoceras lineatus* (Sowerby), murchisonae beds, Litmanová, klippen belt. KPUK 15104. A — whorl section. B — external suture-line at 28 mm diameter. C — diagramm of striae. All natural size.

Order *Ammonoidea* Zittel, 1884
Suborder *Phylloceratina* Arkell, 1950
Superfamily *Phylloceratinae* Zittel, 1884
Family *Phylloceratidae* Zittel, 1884
Subfamily *Calliphylloceratinae* Spath, 1927
Genus *Calliphylloceras* Spath, 1927

Calliphylloceras connectens (Zittel, 1869)

(Pl. I, fig. 2, pl. III, figs. 1, 3, pl. VI, figs. 4, 6, text-figs. 5—13)

1869 *Phylloceras connectens* Zittel — K. Zittel: Bemerkungen über Phylloceras., pp. 67—68, Tab. 1, Fig. 7—10.
1871 *Phylloceras connectens* Zittel — M. Neumayr: Jurastudien, p. 331, Tab. 14, Fig. 6.
1938 *Calliphylloceras connectens* (Zittel) — F. Roman: Les Ammonites Jurass. et Créta., p. 18.

Type: 1869 *Phylloceras connectens* Zittel, pp. 67—68, Pl. I, fig. 7.

Locus et stratum typicum: Záskal near Szaflary (Poland), Aalenian, opalinum and murchisonae beds.

Diagnosis: discoidal shell, strongly compressed, high, involute, with very narrow umbilicus and rounded venter. Whorl section high, oval, in the ventral part slightly constricted. On the internal mold there are 8—13 periodic sigmoidal constrictions with corresponding indistinct flares on the ventral portion of the test. Surface covered with lirae. First lateral saddle triphyllic.

Description: the material consisted of 31 specimens, mostly pyritized. The majority were of grown individuals with a diameter more than 7 cm (text-fig. 5).*

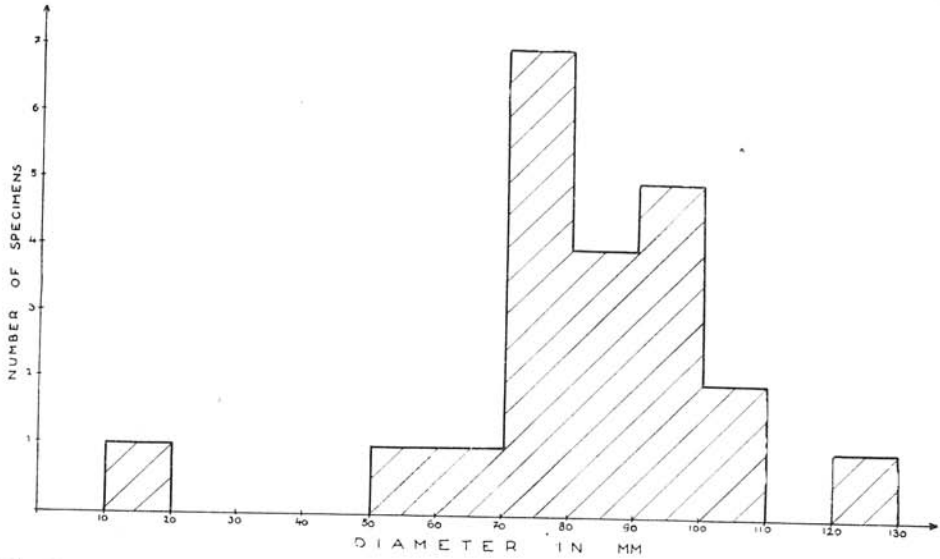


Fig. 5. Frequency distribution graph schowing the diameter of schells of *Calliphylloceras connectens* (Zittel). Based on 22 specimens (out of 31 specimens altogether), locality Litmanová, murchisonae beds.

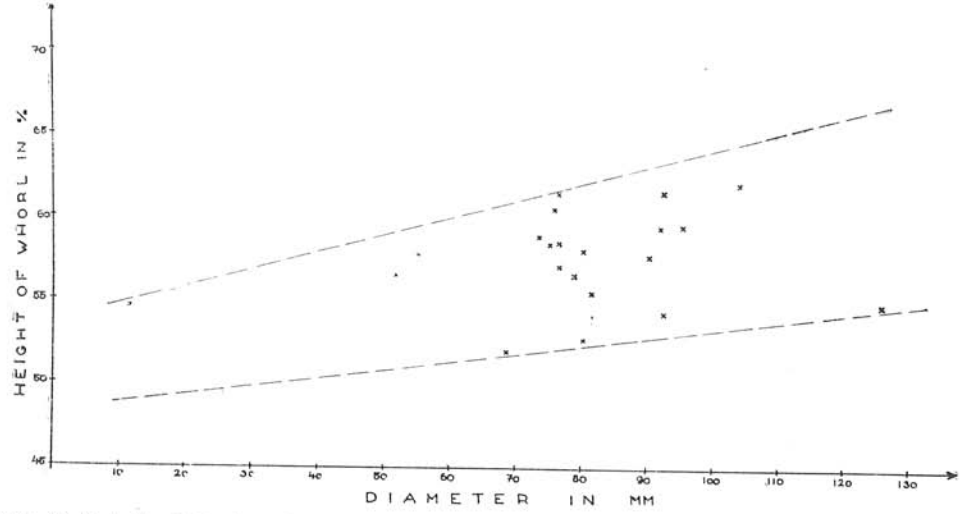


Fig. 6. Height plotted against diameter of shells of *Calliphylloceras connectens* (Zittel). Based on 21 specimens (out of 31 specimens altogether), locality Litmanová, murchisonae beds.

* All measurements of the relevant species are given on the graphs. Measurements were made following the scheme given in the Treatise on Invertebrate Paleontology. P. L., p. 113 (R. C. Moore, editor).

During ontogeny the height of whorl increased (text-fig. 6). The proportions of height, thickness and width of the shell are identical with those given by older authors (text-figs. 6—9). The variability of the umbilicus width is liable to considerable errors due to the small measured values.

On the internal mold there are visible flattened, forwardely directed radial constrictions, which on the ventral side are bordered by flares, visible also on the shell. There are some discrepances between the data given by K. Zittel and

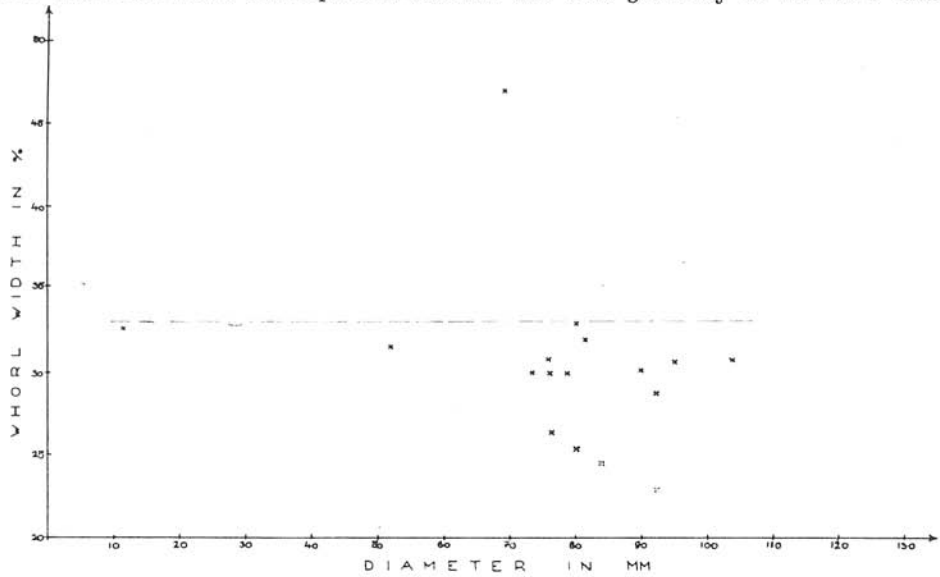


Fig. 7. Whorl section plotted against diameter of shells of *Calliphylloceras connectens* (Zittel). Based on 17 specimens (out of 31 specimens altogether), locality Litmanová, murchisonae beds.

M. Neumayr and myself. In the majority of adult specimens the number of constrictions reached 13 (text-fig. 9), with fluctuation ± 2. The above-mentioned authors quoted 6—8 constrictions. Constrictions in young specimens are not visible. Distances between the constrictions vary, as well as their form. Sometimes they are of the form of oval grooves or angular furrows and the elevations between two constrictions in such cases are flattened with angular margins.

The shell is ornamented by fine, closely spaced lirae, curved forwards. The shell is very fine and thin, reaching in adult specimens the thickness of about 1 mm.

The suture is very complicated. The number of lobes is 9. The first lateral saddle is triphyllic, the others are diphyllic. In some cases also in grown specimens, the second lateral saddle is triphyllic (text-figs. 10—12). K. Zittel (1869, pp. 67—68) asserted that the form of the first lateral saddle allowed one to distinguish *C. heterophyllum* and *C. kudernatschi* and M. Neumayr (1871) mentioned that there are many common features with *C. trifoliatum*. On the whole, we have to emphasize the asymmetry of the first lateral saddle. Thanks to Dr. B. Géczy I had an opportunity to see *C. perplanum*, which G. Prinz (1904) compared as a closely allied form. *C. connectens* has 9 saddles, while *C. perplanum* only 8 ones.

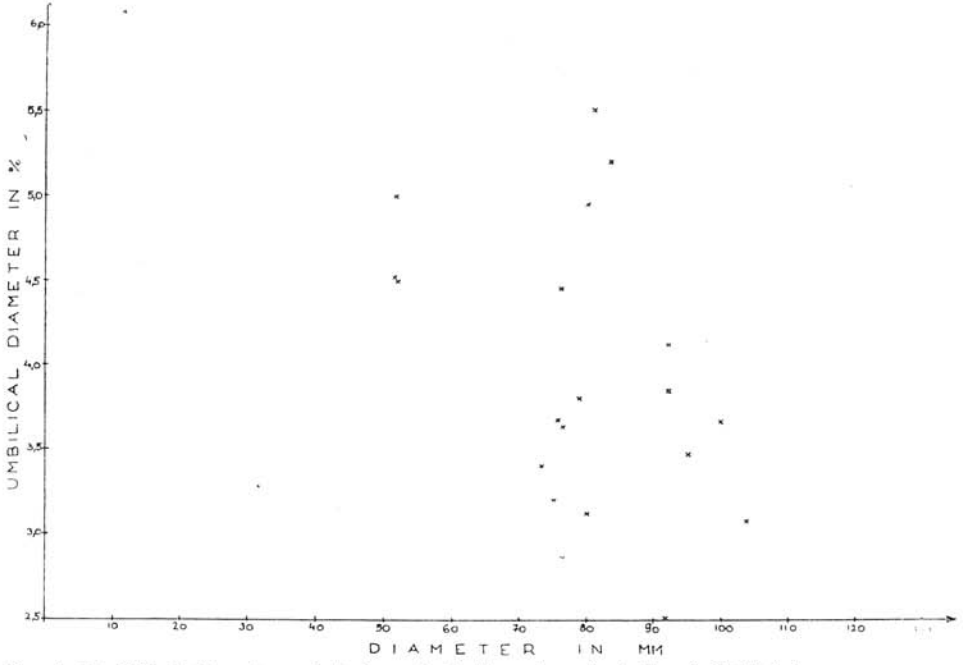


Fig. 8. Umbilical diameter plotted against diameter of shells of *Calliphyloceras connectens* (Zittel). Based on 19 specimens (out of 31 altogether), locality Litmanová, murchisonae beds.

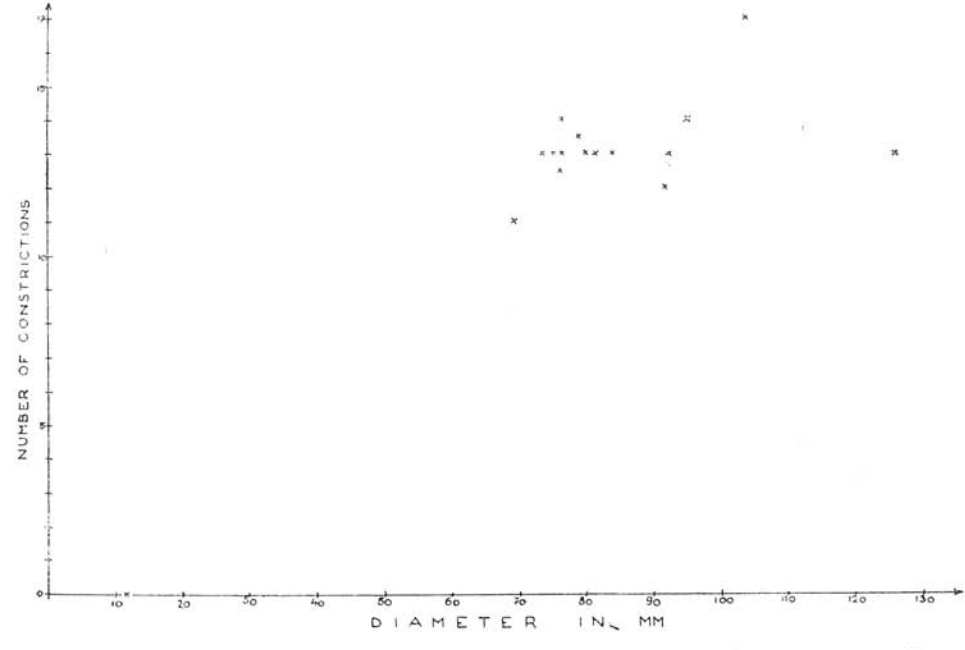
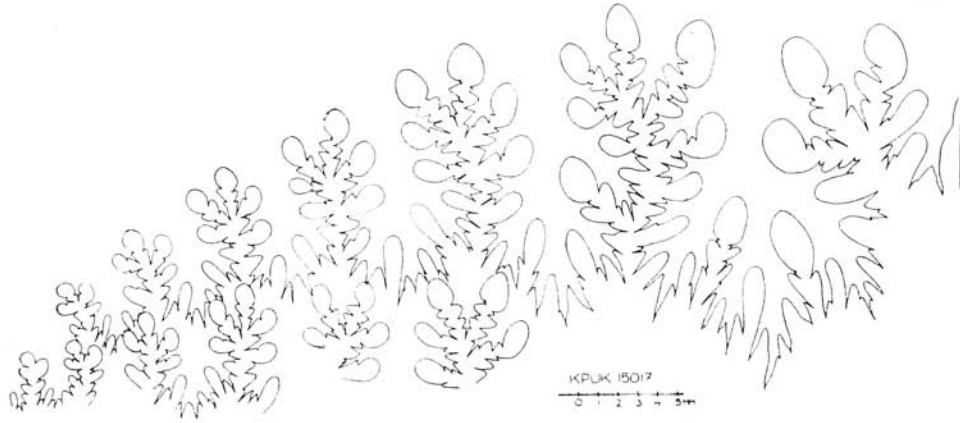


Fig. 9. Frequency distribution of constrictions plotted against diameter of shells of *Calliphylloceras connectens* (Zittel). Based on 16 specimens (out of 31 altogether), locality Litmanová, murchisonae beds.

Prinz's original specimen is identical in dimension with *C. connectens* from the Carpathians. The umbilicus in *C. perplanum* is wider. In morphological features the species is similar to both *C. heterophyllum* and *C. tripholiatum.*

Occurrences: *Calliphylloceras connectens* (Zittel) occurs in abundance in the Lower Dogger of the Czorsztyn series and of some transitional develop-



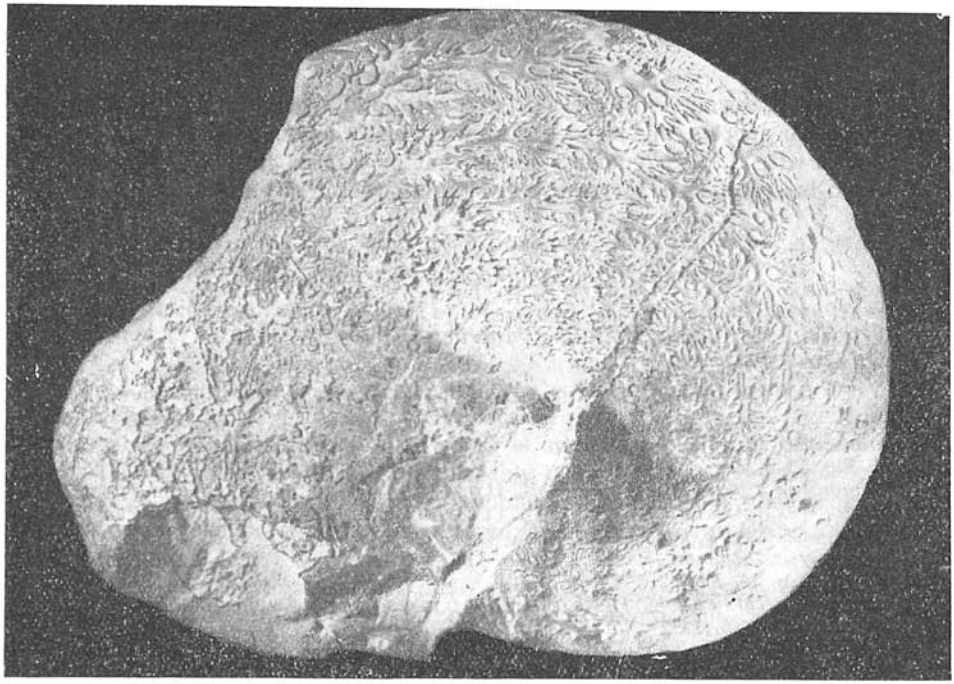


Fig. 10. External suture-line of *Calliphylloceras connectens* (Zittel) at 80 mm diameter. KPUK 15017, locality Litmanová, murchisonae beds (suture drawn with the help of binocular microscope and drawing chamber).
10 a. *Calliphylloceras connectens* (Zittel), side, natural size.

ments in the klippen belt. Older authors recorded it from grey marly limestones with *Leioceras opalinum* from the Záskal locality near Szaflary (Poland), also from blue-grey to black clays and shales with Ludwigia murchisonae at the same locality. Our material comes from the uppermost horizon in a neighbouring region, from a new locality at Litmanová. This form is with others known from the same horizon at Monte Nerone near Cagli and at Furlo near Fossembrone in the Central Apennines, and also at Cap San Vigilio near Lake Garda. F. Roman (1938)

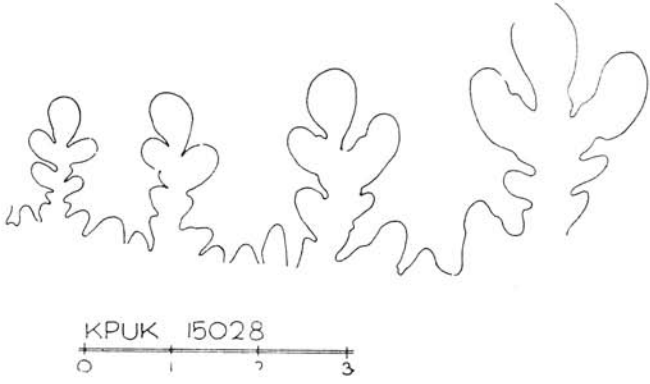


Fig. 11. Inner part of external suture-line of *Calliphylloceras connectens* (Zittel) at 74 mm diameter. KPUK 15028, locality Litmanová, murchisonae beds.

quotes it from the zone with *Pleydellia aalense,* and regards it as a stratigraphically important species. The species is known also from Hungary. G. Prinz (1904) compared it with *C. perplanum.* It seems that in general this is a very rare species, which in some cases seems to have the character of an endemic form.

Genus *Ptychophylloceras* Spath, 1927

Ptychophylloceras tatricum (Pusch, 1837)

(Pl. II, figs. 1—4, pl. III. fig. 2, pl. VI, figs. 3, 9a, b, text-figs. 13—23)

1837 *Ammonites tatricus* Pusch m. — G. Pusch: Polens Paläontologie, p. 158, Tab. 13, Fig. 11 a, b.
1855 *Ammonites tatricus* Pusch — L. Hohenegger: Neue Erfahrungen, p. 308.
1869 *Phylloceras tatricum* Pusch — Zittel: Bemerkungen ü. Phylloceras tatricum, pp. 61—62, Tab. 1, Fig. 1—3.
1871 *Phylloceras tatricum* Pusch sp. — M. Neumayr: Phyll. d. Dogger u. Malm, p. 322, Tab. 16, Fig. 2.
1874 *Ammonites tatricum* Pusch — E. Dumortier: Études Paléont. sur les dépôsit. Jurass., p. 271, Tab. 57, Fig. 5, 6.
1886 *Phylloceras tatricum* Pusch — M. Vacek: Oolithe von Cap San Vigilio, p. 68, Tab. 5, Fig. 1—6.
1904 *Phylloceras tatricum* Pusch — G. Prinz: Az északkeleti Bakony, p. 44, Tab. 9, Fig. 1 a, b.
1937 *Phylloceras tatricum* Pusch — L. Horwitz: Le faune et l'âge, p. 28.
1938 *Calliphylloceras (Ptychophylloceras) tatricum* (Pusch) — F. Roman: Les Ammonites Jurassiques et Crétacées, p. 19.

Type: 1837 *Ammonites tatricum* P u s c h., p. 158, Tab. 13, fig. 11 a, b.

S t r a t u m e t l o c u s t y p i c u s : Záskal near Szaflary in Poland, Aalenien, opalinum and murchisonae beds, klippen belt.

D i a g n o s i s : „Testa tenuis umbilicata nautiliformis, omnino involuta, plicis 6 distantibus obtusis simplicibus dorso rotundato, apertura ampla, subelliptica ab anfractu penultimo profunde incisa, cruribus longis acutis" (G. P u s c h, 1837, p. 158).

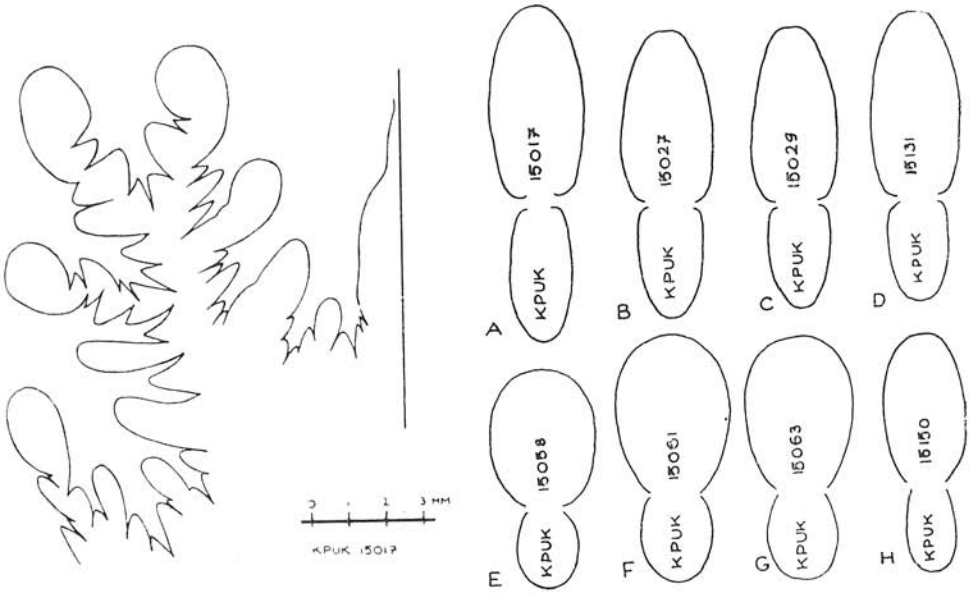


Fig. 12. First lateral saddle of *Calliphylloceras connectens* (Z i t t e l) at 80 mm diameter. KPUK 15017, locality Litmanová, murchisonae beds.
Fig. 13. A—D — Cross-section of *Calliphylloceras connectens* (Z i t t e l). E—G — that of *Ptychophylloceras tatricum* (P u s c h). H — that of *Ptychophylloceras chonomphalum* (V a c e k), locality Litmanová, murchisonae beds, natural size.

It is necessary to note this diagnosis, because the species in the fact lacks some of the quoted features. The final whorl is not so high and aperture has no „thighs". The original specimen was probably badly preserved, evidently pyritized with part of the body broken away. The umbilicus was probably filled up by matrix, although it is possible that it was covered by thick shell material (text-fig. 13, E—G).

D i a g n o s i s : shell massive, thick, involute, with broadly rounded venter crossed by periodic rib-like flares. The latter are usually 6 in number, the maximum 9. They are best developed on the body chamber. The whorl section is higher than broad, with its largest diameter quite near the ventral margin. The first lateral saddle is diphyllic. The surface of the shell is covered by fine growth lines.

D e s c r i p t i o n : the material consisted of 62 specimens, mostly pyritized. The majority of them consisted of adults with a diameter of about 60—70 mm (text-fig. 14). Both thickness and height of the shell did not vary during ontogeny

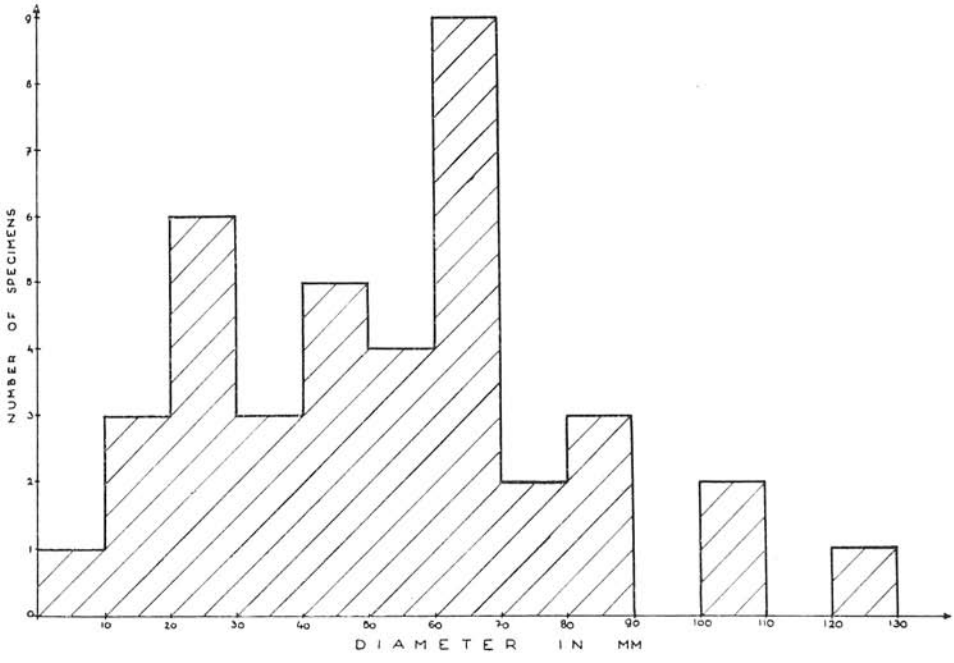


Fig. 14. Frequency distribution graph showing the diameter of shells of *Ptychophylloceras tatricum* (P u s c h.). Based on 39 specimens (out of 62 altogether), locality Litmanová, murchisonae beds.

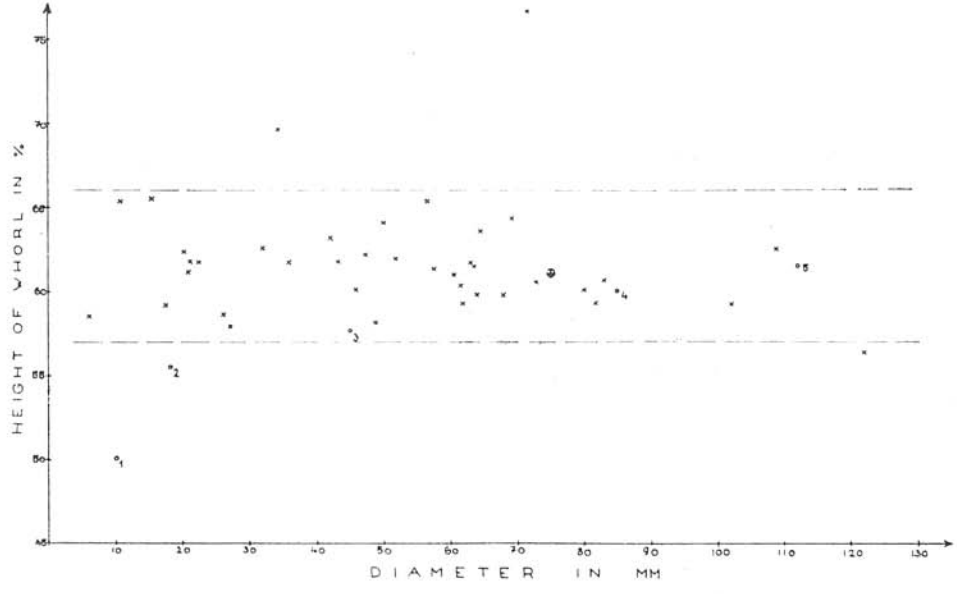


Fig. 15. Height plotted against diameter of shells of *Ptychophylloceras tatricum* (P u s c h). Based on 46 specimens (out of 62), locality Litmanová, murchisonae beds, sonae beds.

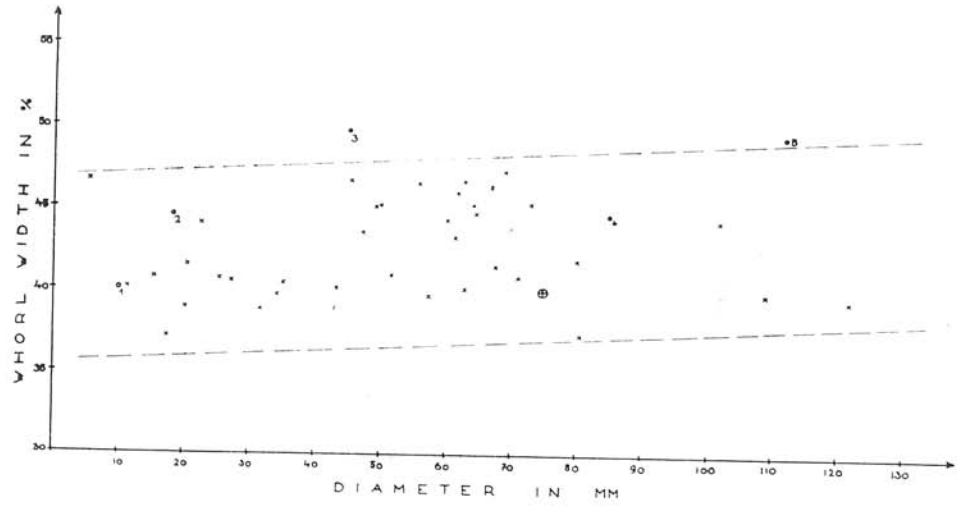


Fig. 16. Width plotted against diameter of shells of *Ptychophylloceras tatricum* (P u s ch). Based on 46 specimens (out of 62), locality Litmanová, murchisonae beds.

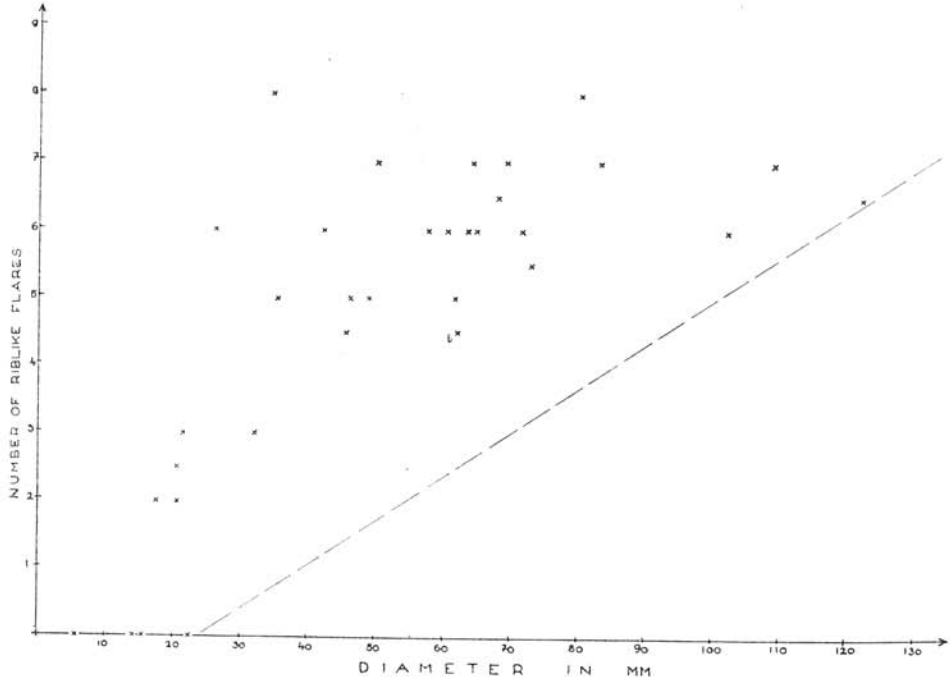


Fig. 17. Frequency distribution of rib-like flares plotted against diameter of shells of *Ptychophylloceras tatricum* (P u s c h). Based on 33 specimens (out of 62), locality Litmanová, murchisonae beds.

(text-figs. 15, 16). It is interesting that the data of M. V a c e k (1886) fall outside the field of measured values of individuals from Litmanová. Accordingly to the data of this author that the height of the whorl changes with growth. But a greater number of measurements show that in reality this is not so. The data of K. Z i t t e l (1869) and M. N e u m a y r (1871) are in agreement with our measurements.

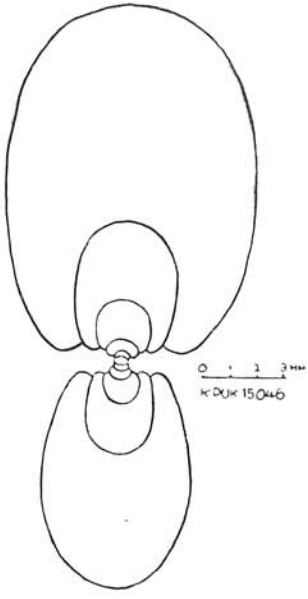


Fig. 18. Cross-section of *Ptychophylloceras tatricum* (P u s c h). KPUK 15046, locality Litmanová, murchisonae beds.

G. P u s c h, K. Z i t t e l and M. N e u m a y r (l. c.) stated that the umbilicus is closed. However, M. V a c e k (l. c.) gave a width for the umbilicus, although from his measurements it is clear that the umbilicus was very narrow. Material from Litmanová shows that the umbilicus is developed, but is very narrow, and when the shell is wider, the umbilicus is more closed. In adult specimens the shell is very thick, and in consequence the umbilicus is closed.

The body chamber occupies up to $^4/_5$ths of the final whorl. In the studied material the body chambers were mostly broken off and deformed. The deformations were probably mostly posthumous, although we cannot exclude deformations connected with the death of the animal.

On the body chamber we may see (mainly in large individuals) rounded rib-like flares, which are strongly developed at the ventral margin. These extend along the sides and dwindle near the umbilicus. Ribs on the chambered part of the test are less distinct and slinghtly curved forwards; these begin to develop only in forms 17 mm in diameter (K. Z i t t e l, l. c., stated 40 mm). The usual number of rib-like flares is 6, the maximum 9 (text-fig. 17). The rib-like flares begin as fine lines in the region of the umbilicus, at first they are radial, then they become oblique and curve forwards, thicken and reach a maximum thickness on the ventral part of the shell. Ribs are usually accompanied by cavities in the nucleus.

The shell is ornamented by fine growth lines. Ribs are distinct in larger individuals. The thickness of the shell is considerable. If the diameter reaches about 70 mm, the thickness is about 3 mm. The suture is simple. The first and second lateral saddles are diphyllic, the others are monophyllic; the leaves of the saddle are broad (text-fig. 20 and 19).

O c c u r r e n c e s : the species was described from the Lower Dogger of the Czorsztyn series, from light-grey marly limestones at the Záskal locality near Szaflary (district of Nowy Targ) and from the vicinity of Chocholow near Czarny Dunajec (G. P u s c h, l. c.). The last locality is doubtful, as the klippen belt sequence does not occur there. M. V a c e k (l. c.) described this species from Cap

San Vigilio and E. Dumortier (1874) described it from the beds with Harpoceras opalinum (at La Verpilliére). From the Aalenian this form was recorded by G. Prinz (1904) and also by B. Géczy (1959). On the whole this species occurs in all Lower Dogger Téthyan and epicontinental regions, especially in Europe.

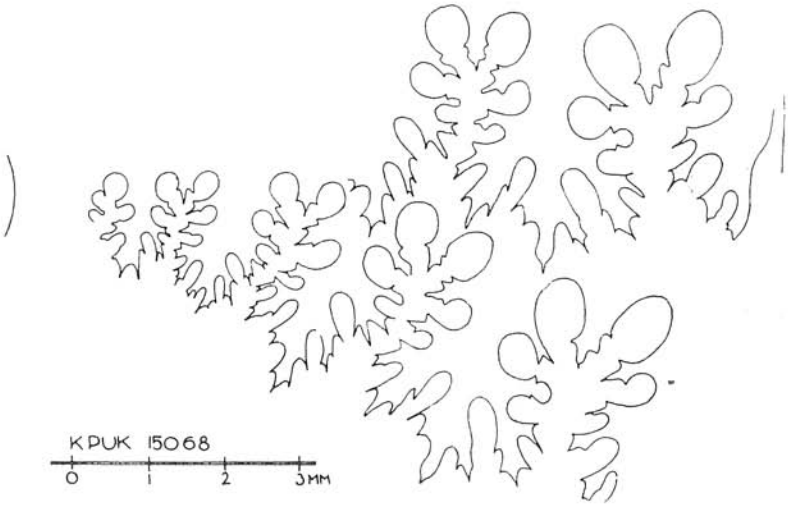


Fig. 19. External suture-line of *Ptychophylloceras tatricum* (Pusch) at 18 diameter. KPUK 15068, locality Litmanová, murchisonae beds.

Ptychophylloceras chonomphalum (Vacek, 1886)

Text-fig. 13 H

1886 *Phylloceras chonomphalum* — M. Vacek: Oolithe von Cap San Vigilio, p. 69, tab. 5, figs. 7—13.

Remarks: the species differs from *Ptychophylloceras tatricum* in having a very small umbilicus and whorl section. Both sides in P. chonomphalum are straight and flattened, in the lower part they run obliquely towards the umbilicus. Rib-like flares are less developed than in P. tatricum and are distinct on the ventral portion of the shell.

In the material from Litmanová was found the only specimen.

Measurements: diameter 66 mm, height of whorl 39 mm, width 24 mm, umbilicus 2,57 mm.

Occurrence: the species was described from Cap San Vigilio. Accordingly to M. Vacek (l.c.) some specimens of *Ptychophylloceras tatricum* belong to this species, for instance from the opalinum zone of La Verpilliére E. Dumortier, 1874). G. Prinz (1904) and B. Géczy (1959) quoted it from the Bakony mountains in Hungary. In the region of the West Carpathians it was not known up to the present. This first find came from the murchisonae beds of the Czorsztyn series of the klippen belt, at the Litmanová locality.

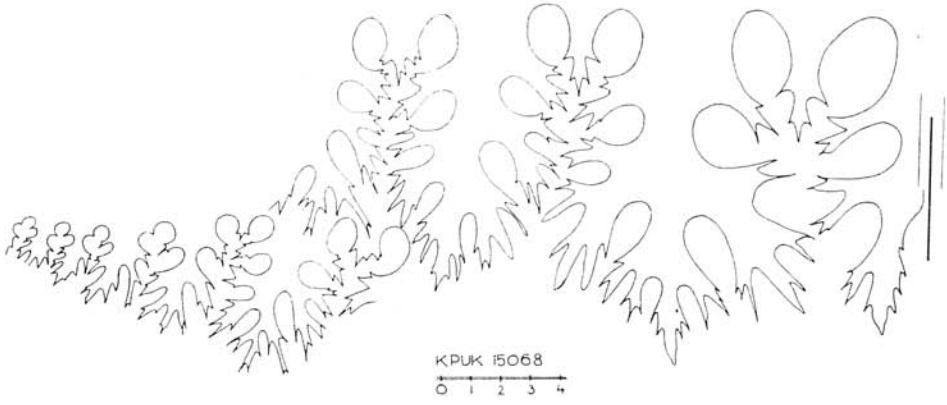


Fig. 20. External suture-line of *Ptychophylloceras tatricum* (P u s c h) at cca 60 mm diameter, locality Litmanová, murchisonae beds.

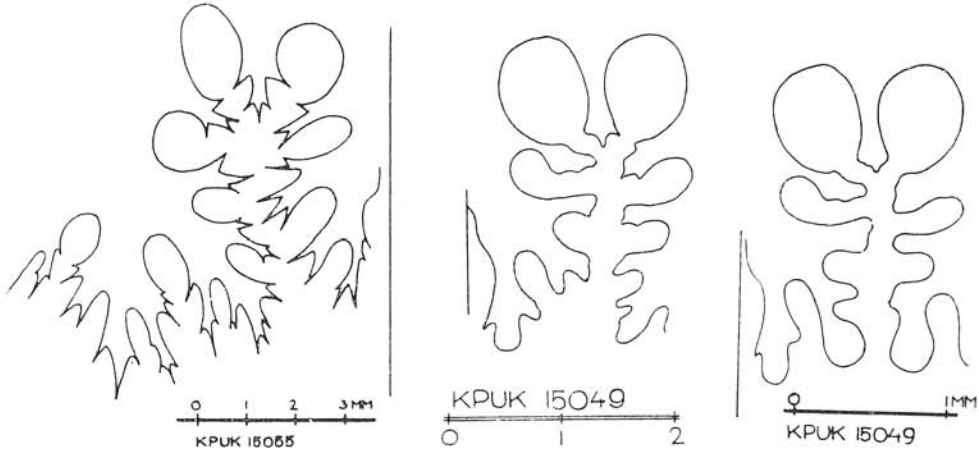


Fig. 21. First lateral saddle of *Ptychophylloceras tatricum* (P u s c h) at 31 mm diameter. KPUK 15055, locality Litmanová, murchisonae beds.
Fig. 22. First lateral saddle of *Ptychophylloceras tatricum* (P u s c h) at 15 mm diameter. KPUK 15049, locality Litmanová, murchisonae beds.
Fig. 23. First lateral saddle of *Ptychophylloceras tatricum* (P u s c h) at 11 mm diameter. KPUK 15049, locality Litmanová, murchisonae beds.

Suborder *Lytoceratina* H y a t t, 1889
Superfamily *Lytocerataceae* N e u m a y r, 1875
Lytoceratidae N e u m a y r, 1875
Subfamily *Lytoceratinae* N e u m a y r, 1875
Genus *Lytoceras* S u e s s, 1865

Lytoceras rasile V a c e k, 1886

1886 *Lytoceras rasile* — M. V a c e k : Oolithe von Cap San Vigilio, pp. 63—64, tab. 3, figs. 5—8.

Remarks: one specimen in my material is identical with Vacek's form, tab. 3, fig. 6. The specimen is pyritized, with part of the final whorl missing. Five whorls. On one whorl there are 3 constrictions.

Occurrence: the species was described by M. Vacek (l. c.) from Cap San Vigilio, where it occurs in a mixed fauna of the Upper Lias and Lower Dogger. In the West Carpathian region the species has not previously been described. It occurs in the murchisonae beds at the Litmanová locality.

Lytoceras rubescens (Dumortier, 1874)

Pl. VI, fig. 7, text-fig. 24)

1874 *Lytoceras rubescens* nov. sp. — E. Dumortier: Depôts jurass. du Bass. du Rhône, IV, Lias. sup., p. 114, tab. 29, figs. 4, 5.
1886 *Lytoceras rubescens* — M. Vacek: Oolithe..., p. 63, tab. 1, figs. 5 a, b.

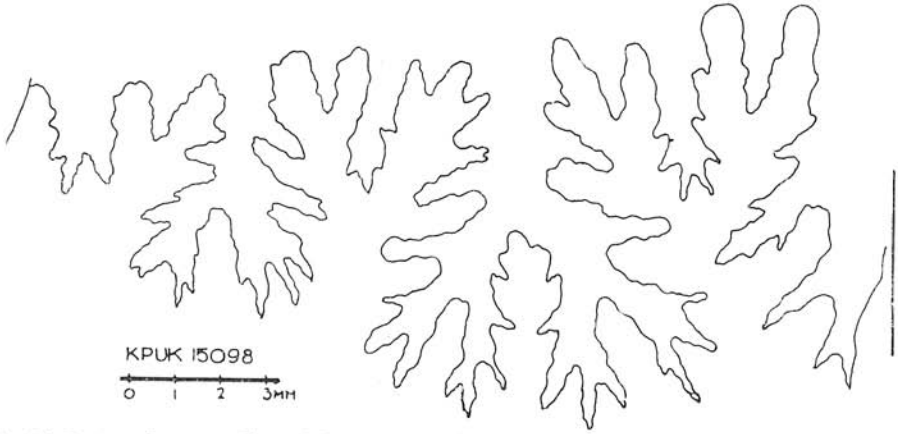


Fig. 24. External suture-line of *Lytoceras rubescens* (Dumortier) at 91 mm diameter. KPUK 15098, locality Litmanová, murchisonae beds.

Material: 6 specimens.

Remarks: on the whole my specimens agree with the descriptions by E. Dumortier and M. Vacek (l. c.). The species is quite variable. The dimensions vary and so, to some degree, does the form of the whorl section.

Occurrence: E. Dumortier described this species from the Upper Lias of the Rhône valley. M. Vacek found 4 specimens at Cap San Vigilio. From the West Carpathians it is known from the Aalenian of the klippen belt.

Suborder *Ammonitina* Hyatt, 1889
Superfamily *Hildoceratacea* Hyatt, 1867
Family *Graphoceratidae* Buckman, 1905
Subfamily *Graphoceratinae* Buckman, 1905
Genus *Ludwigia* Bayle, 1878

Ludwigia eschense Maubeuge, 1950

Text-fig. 25 B

1950 *Ludwigia eschense* n. sp. — P. Maubeuge: Nouv. recherches strat. paléont. Aalénien Luxemb., tab. 16, p. 389.

Remarks: one specimen perfectly preserved, pyritized, identical with P. L. Maubeuge's description and figure.

Measurements: diameter 14,8 mm, height 6,3 mm, width 2,9 mm, umbilicus 5,9 mm.

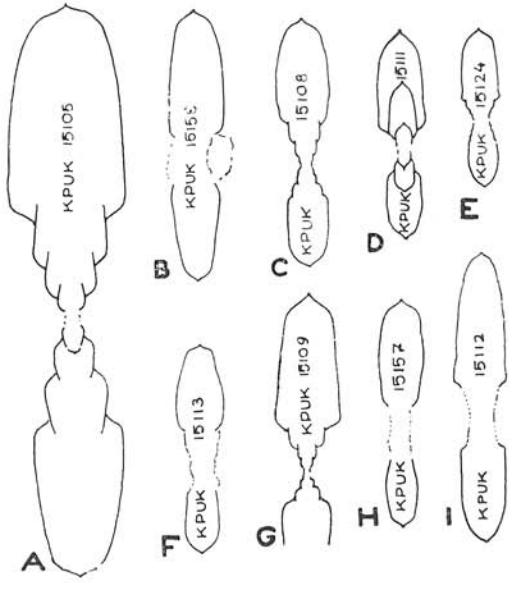


Fig. 25. Cross-section of A — *Ludwigia murchisonae* (Sowerby). B — *Ludwigia eschense Maubeuge*. C — *Ludwigia reflua* (Buckman). D — *Brasilia bradfordensis* (Buckman). G — *Graphoceras casta* (Buckman). F — *Graphoceras robustum* Buckman. G — *Graphoceras v-scriptum* Buckman. L — *Hyperlioceras discites* (Waagen). All from the Litmanová locality, murchisonae beds, natural size.

Occurrences: the species was described from the „Couches rouges marnosableuse" of Luxembourg. In the West Carpathians it was found together with species typical of the concavum zone. This species is new for the West Carpathians.

Ludwigia murchisonae (Sowerby, 1827)

Pl. V, fig. 1, text-figs. 25 A, 26

1827 *Ammonites Murchisonae* — J. Sowerby: Min. conch., p. 264, tab. 550.
1874 *Ammonites Murchisonae* Sowerby — F. Dumortier: Lias sup., p. 255, tab. 51, figs. 5, 6.
1886 *Harpoceras Murchisonae* (Sowerby) — M. Vacek: Oolithe..., p. 74, tab. 7, figs. 4—10.
1886 *Ludwigia Murchisonae* Sowerby — S. Buckman: Inf. Oolite Ammonites pp. 16—17, tab. 1, 2, figs. 1—5, tab. 3, figs. 1—3.
1913 *Ludwigia Murchisonae* Sowerby — G. Hoffmann: Stratigr. und Amm. Fauna, pp. 145—169, tab. 14, figs. 1—9, 12—26, tab. 15, figs. 1—5, tab. 16, figs. 1—3, tab. 17, fig. 9.

Remarks: the material consisted of two well-preserved specimens and 8 specimens which I could not be certain as belonging to this species. In the West Carpathians it is very common. The complex of dark clayey shales — the murchisonae beds — was named after this species. It seems that the stratigraphical range of this species is much larger than that of the zone itself.

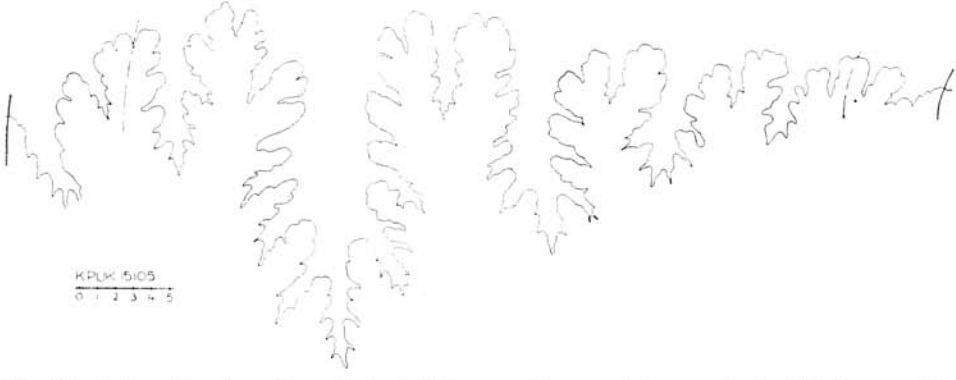


Fig. 26. External suture-line of *Ludwigia murchisonae* (Sowerby) at 140 mm diameter. KPUK 15105, locality Litmanová, murchisonae beds.

Ludwigia obtusiformis (Buckman, 1886)

Pl. IV, fig. 4

1880—87 *Ludwigia murchisonae* var. *obtusa* Buckman — S. Buckman: Monogr. of Inf. Oolite, p. 17, tab. 1.
1899 *Welschia obtusiformis* Buckm. — Suppl., p. 51, tab. 4, fig. 19, tab. 12, figs. 1—3.
1940 *Welschia obtusiformis* (Buckman) — C. Gérard and J. Bichelonne: Les Ammonites Aalen., p. 47, tab. 23, figs. 1, 1'.

Remarks: one pyritized specimen with broken body chamber. On the whole it is identical with the data given by S. Buckman (1886).

Occurrence: the species is typical of the subzone with Brasilia bradfordensis at the locality of Custines (Vieux Château). In the West Carpathians was firstly found in the upper part of the murchisonae beds.

Ludwigia reflua (Buckman, 1904)

Pl. VI, fig. 1, text-fig. 25 C

1904 *Crickia reflua* Buckman — S. Buckman: Monogr. of Inf. Oolite Suppl., p. 73, tab. II, figs. 16—18.
1940 *Ludwigia murchisonae reflua* (Buckman) — W. Althoff: Die Ammoniten der Oberen Ludw. sch., p. 10, tab. 1, figs. 1, 2, text-fig. A, figs. 1—4.

Remarks: at the locality studied one very perfectly preserved specimen was found, fossilized in calcareous concretion. The very typical morphology allows to determine the specimen as this species.

Occurrence: the species is known from the Upper Aalenian of West and Central Europe. In the West Carpathian region it was not previously found. It occurs in the subzone of *Ludwigia murchisonae* in the lower part of the murchisonae beds at Litmanová locality.

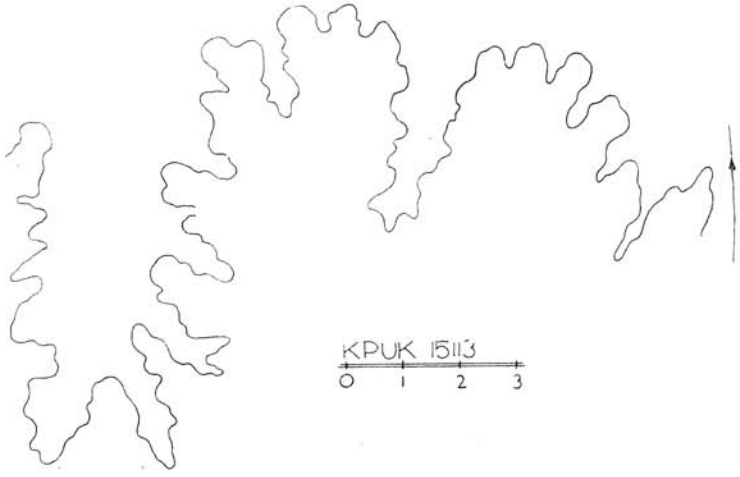


Fig. 27. Ventral part of external suture-line of *Graphoceras robustum* Buckman at 50 mm diameter. KPUK 15113, locality Litmanová, murchisonae beds.

Genus *Brasilia* Buckman, 1898

Brasilia bradfordensis (Buckman, 1887)

Pl. IV, fig. 4, text-fig. 25 D

1887 *Lioceras bradfordense* Buckman — S. Buckman: Monogr. of Inf. Oolite, p. 22, tab. 4, figs. 5, 6, Suppl. p. 80, tab. 17, fig. 28.
1940 *Brasilia bradfordensis* (Buckman) — C. Gérard and J. Bichelonne: Les Amm. Aalen., p. 47, tab. 24, figs. 1, 1'.

Remarks: one excellently preserved specimen and some fragments of very characteristic morphology.

Occurrences: the species represents an index form of the bradfordensis subzone. It extends all over Europe. From the West Carpathians it was not previously known. It occurs in the central part of the studied profile.

Genus *Graphoceras* Buckman, 1898

Graphoceras casta (Buckman, 1904)

Pl. IV, fig. 1, text-fig. 25 E

1904 *Ludwigella (Ludwigia) casta* Buckman — S. Buckman: Inf. Oolite, Suppl., p. 89, tab. 20, figs. 31, 32.
1935 *Ludwigia concava* var. *casta* (Buckman — P. Dorn: Die Hammatoceraten..., p. 78, tab. 14, fig. 3.

Remarks: specimen fossilized by carbonate concretion, only the inner whorls preserved in pyrite. The morphological features are very characteristic.

Occurrences: the species occurs in the concavum zone. It was not previously known from the West Carpathians. It occurs in the upper part of the murchisonae beds the Litmanová locality.

Graphoceras robustum (Buckman, 1886)

Pl. IV, fig. 3, text-figs. 25 F, 27

1904 *Graphoceras robustum* (Buckman) — S. Buckman: Inf. Oolite, Suppl., p. 95, tab. 15, figs. 9—11.
1904 *Graphoceras robustum* (Buckman) — C. Gérard and J. Bichelonne: Les Amm. Aalen., p. 45, tab. 22, figs. 2, 2'.

Remarks: the described and figured specimen represents a very characteristic species with distinctive morphology.

Occurrences: the species occurs in the zone of *Graphoceras concavum* and in the subzone of *Hyperlioceras discites* in western and central Europe. This specimen represents the first record of the species in the West Carpathians.

Graphoceras tenuis (Buckman, 1904)

1904 *Ludwigella (Ludwigia) tenuis* — S. Buckman: Inf. Oolite, p. 90, tab. 20, figs. 27—39.
1908 *Ludwigia tenuis* (Buckman) — E. Horn: Die Harp., p. 81, tab. 21, fig. 8, text-fig. 6, figs. 24, 25.

Pyritized, incomplete specimen resembling, to some degree, *G. dicipiens*. However, the latter species has a deep umbilicus with an angular margin, while in *G. tenuis* it is smooth.

Occurrence: the species was found in the upper part of the murchisonae beds at Litmanová within the zone of *Graphoceras concavum*.

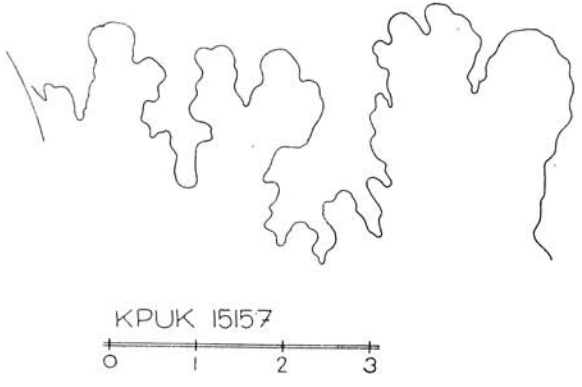


Fig. 28. Internal part of external suture-line of *Graphoceras v-scriptum* (Buckman) at 49 mm diameter. KPUK 15157, locality Litmanová, murchisonae beds.

Graphoceras v-scriptum (Buckman, 1887)

1887 *Lioceras concavum* Sowerby in S. Buckman: Inf. Oolite, p. 50, tab. 8, figs. 3, 4.
1904 *Graphoceras decorum* Buckman: Inf. Oolite, Suppl., tab. 48, tab. 15, fig. 19.
1912 *Ludwigia (Graphoceras) V scriptum* (Buckman) variété *decorum* — F. Roman and M. Gennevaux: Études sur les Terr. Jurass., pp. 68—71, tab. 1, figs. 6, 9, 10.

Material of this species is represented by two specimens preserved in carbonate concretion. The ribs and whorl section are very characteristic.

Occurrences: the species is typical of the *G. concavum* zone all over Europe. It occurs in the upper part of the murchisonae beds at Litmanová locality.

Hyperlioceras discites (Waagen, 1867)

Pl. IV, fig. 2, text-fig. 25 J

1867 *Ammonites discites* Waagen: Zone der Amm. sowerbyi, p. 599, tab. 282, fig. 2.
1913 *Ludwigia discites* (Waagen) — G. Hoffmann: Ammoniten Fauna Dogg., p. 181, tab. 18, figs. 9—13.

This species is represented by one incomplete specimen identical with the desriptions by older authors.

Occurrences: the species is characteristic of the lowermost subzone of the Middle Bajocian. From the West Carpathians it was described by K. Zittel (1869) and M. Neumayr (1871), but very insufficiently from the stratigraphical point of view.

Translated by V. Scheibnerová.

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Explanations of the plates

Pl. I

Fig. 1 a—c. *Cenoceras lineatus* (Sowerby), side, peristome and venter, locality Litmanová, murchisonae beds. KPUK 15104, natural size.
Fig. 2. *Calliphylloceras connectens* (Zittel), side. Locality Litmanová, murchisonae beds. KPUK 15029. Photo L. Osvald.

Pl. II

Fig. 1. *Ptychophylloceras tatricum* (Pusch), side, locality Litmanová, murchisonae beds. KPUK 15073, natural size. Fig. 2. *Ptychophylloceras tatricum* (Pusch), side, locality Litmanová, murchisonae beds. KPUK 15063, natural size. Fig. 3. *Ptychophylloceras tatricum* (Pusch), side, locality Litmanová, murchisonae beds. KPUK 15068, natural size. Fig. 4. *Ptychophylloceras tatricum* (Pusch), side, locality Litmanová, murchisonae beds. KPUK 15060, natural size. Photo L. Osvald.

Pl. III

Fig. 1. *Calliphylloceras connectens* (Zittel), *side. Remains of Posidonia alpina* (Gras) the body chamber, locality Litmanová, murchisonae beds. KPUK 15018, natural size. Fig. 2. *Ptychophylloceras tatricum* (Pusch), side, locality Litmanová, murchisonae beds. KPUK 15054, natural size. Fig. 3. *Calliphylloceras connectens* (Zittel), side; the picture shows fine striae on the shell. Locality Litmanová, murchisonae beds. KPUK 15026, natural size. Photo L. Osvald.

Pl. IV

Fig. 1. *Graphoceras casta* (Buckman), side, locality Litmanová murchisonae beds. KPUK 15124, natural size. Fig. 2. *Hyperlioceras discites* (Waagen), side, locality Litmanová, murchisonae beds. KPUK 15112, natural size. Fig. 3. *Graphoceras robustum* (Buckman), side, locality Litmanová, murchisonae beds. KPUK 15113, natural size

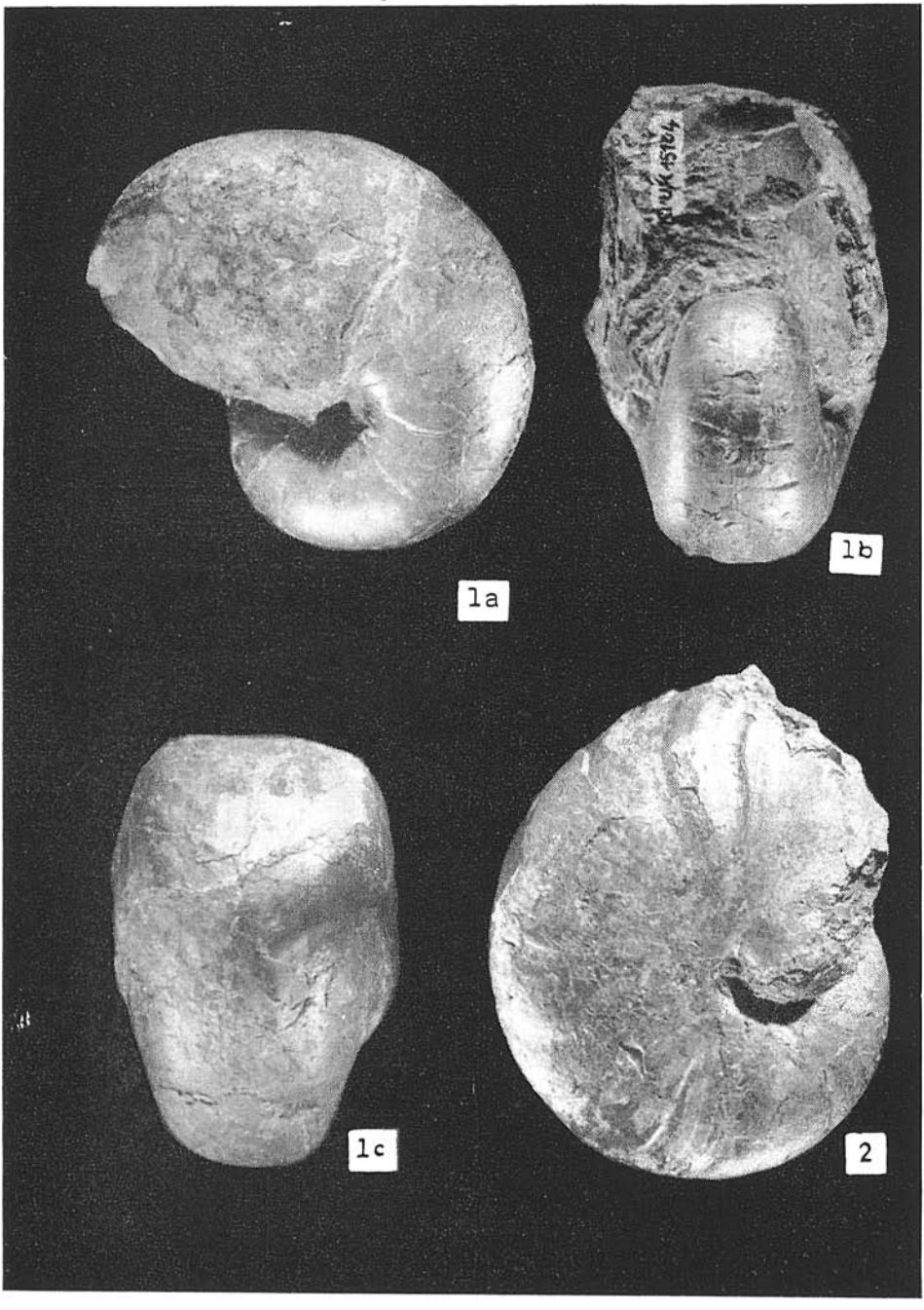
Fig. 4. *Brasilia bradfordensis* (B u c k m a n), side, locality Litmanová, murchisonae beds KPUK 15111, natural size. Fig. 5. *Graphoceras v-scriptum* (B u c k m a n), locality Litmanová, murchisonae beds. KPUK 15109, natural size. Photo L. O s v a l d.

Pl. V

Fig. 1. *Ludwigia murchisonae* (S o w e r b y), side, locality Litmanová, murchisonae beds. KPUK 15105, natural size. Photo L. O s v a l d.

Pl. VI

Fig. 1. *Ludwigia reflua* (B u c k m a n), side, locality Litmanová, murchisonae beds. KPUK 15108, natural size. Fig. 2. *Lytoceras* sp., side, locality Litmanová, murchisonae beds. KPUK 15100, natural size. Fig. 3. *Ptychophylloceras tatricum* (P u s c h), cross-section, locality Litmanová, murchisonae beds. KPUK 15110, natural size. Fig. 5. *Calliphylloceras connectens* (Z i t t e l), cross-section, locality Litmanová, murchisonae beds. KPUK 15024, natural size. Fig. 4. *Ludwigia obtusiformis* (B u c k m a n), cross-section, locality Litmanová, murchisonae beds. KPUK 15110, natural size. Fig. 6. *Ptychophylloceras tatricum* (P u s c h), side, locality Litmanová, murchisonae beds. KPUK 15050, natural size. Fig. 7. *Lytoceras rubescens* (D u m o r t i e r), side, locality Litmanová, murchisonae beds. KPUK 15098, natural size. Fig. 8. *Posidonia alpina* (G r a s), locality Litmanová, murchisonae beds. KPUK 15005, natural size. Fig. 9 a, b. *Ptychophylloceras tatricum* (P u s c h), peristome and side, locality Litmanová, murchisonae beds. KPUK 15049, natural size. Photo L. O s v a l d.



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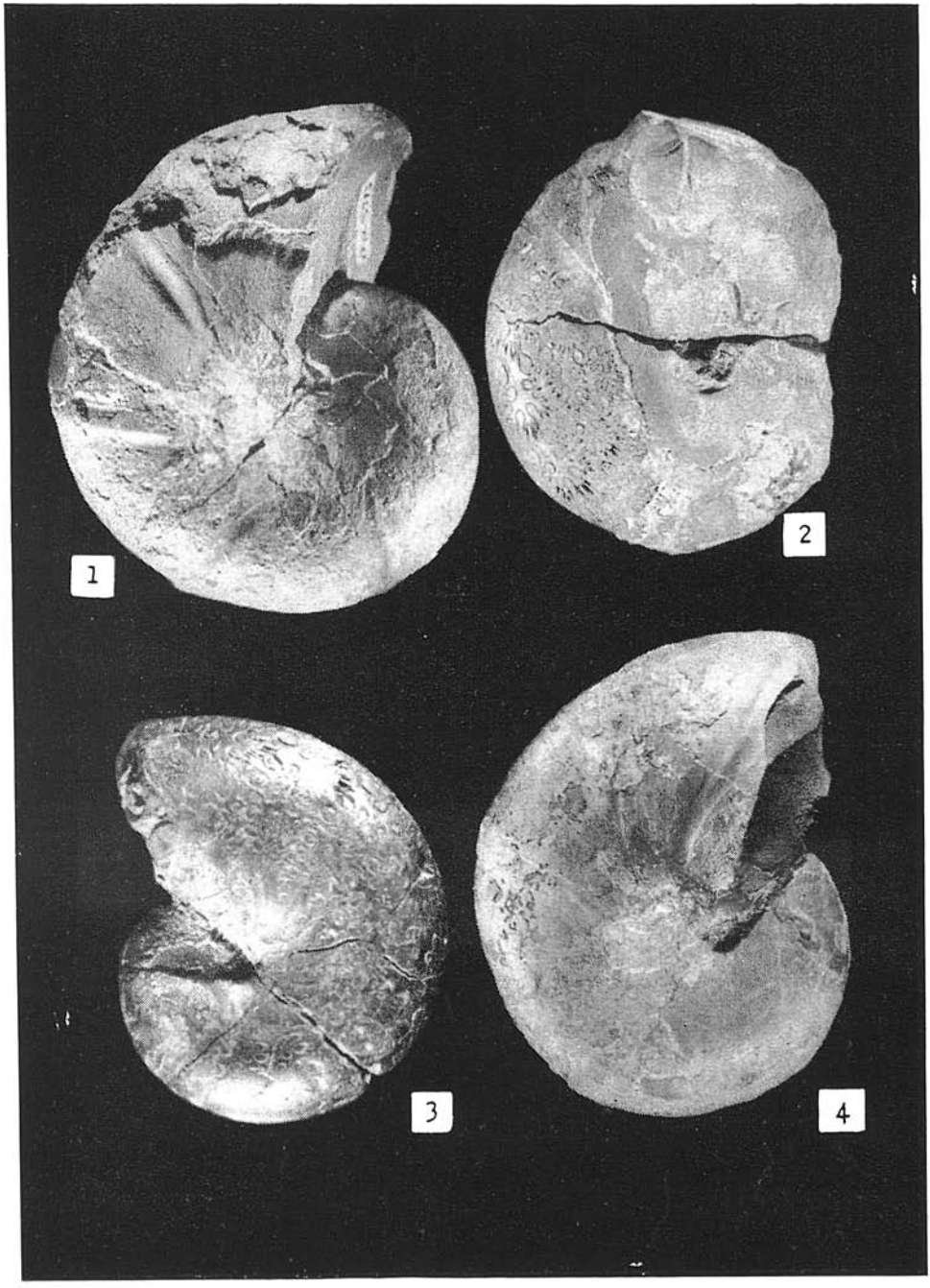
Pl. II



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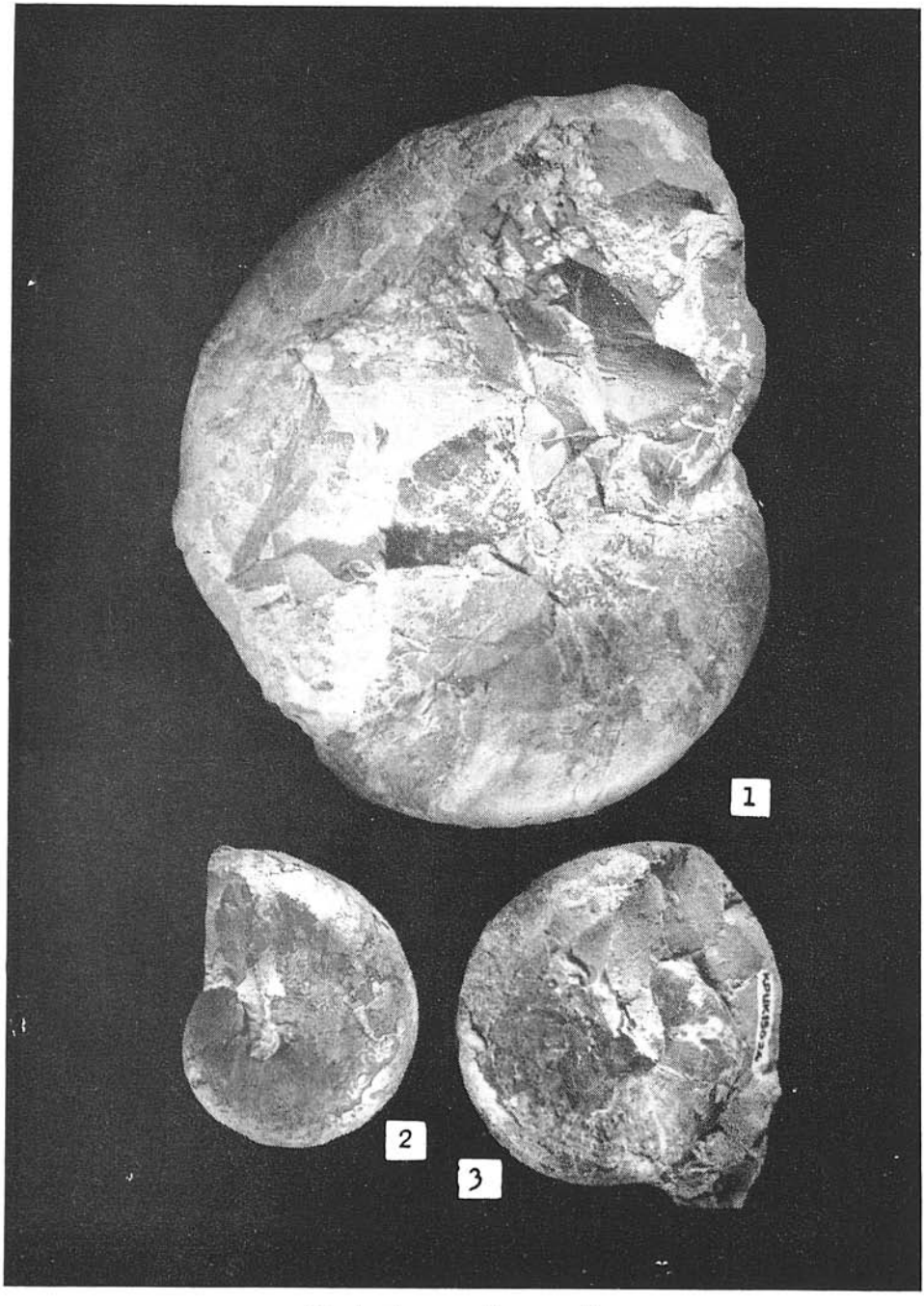

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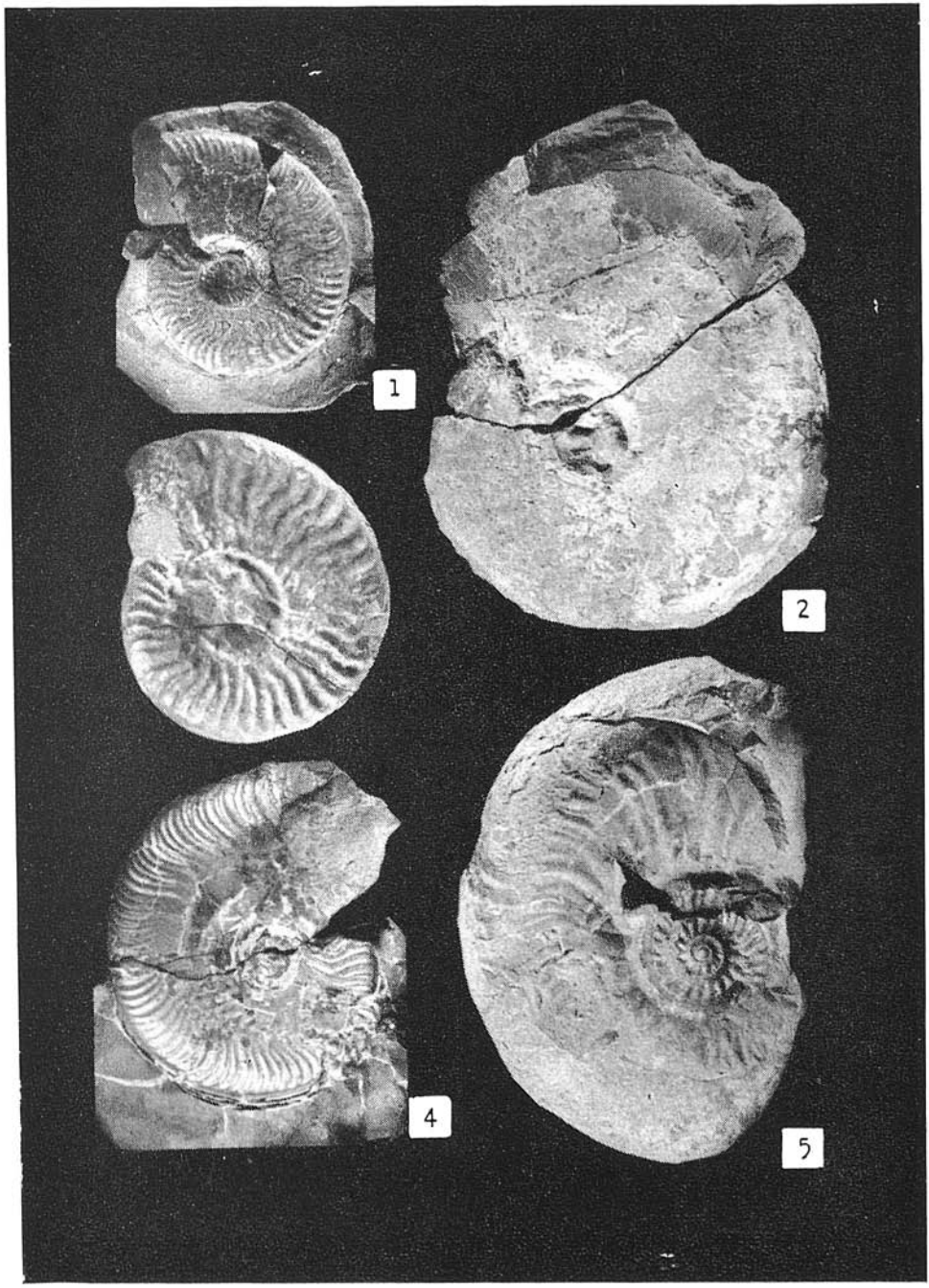
Pl. IV



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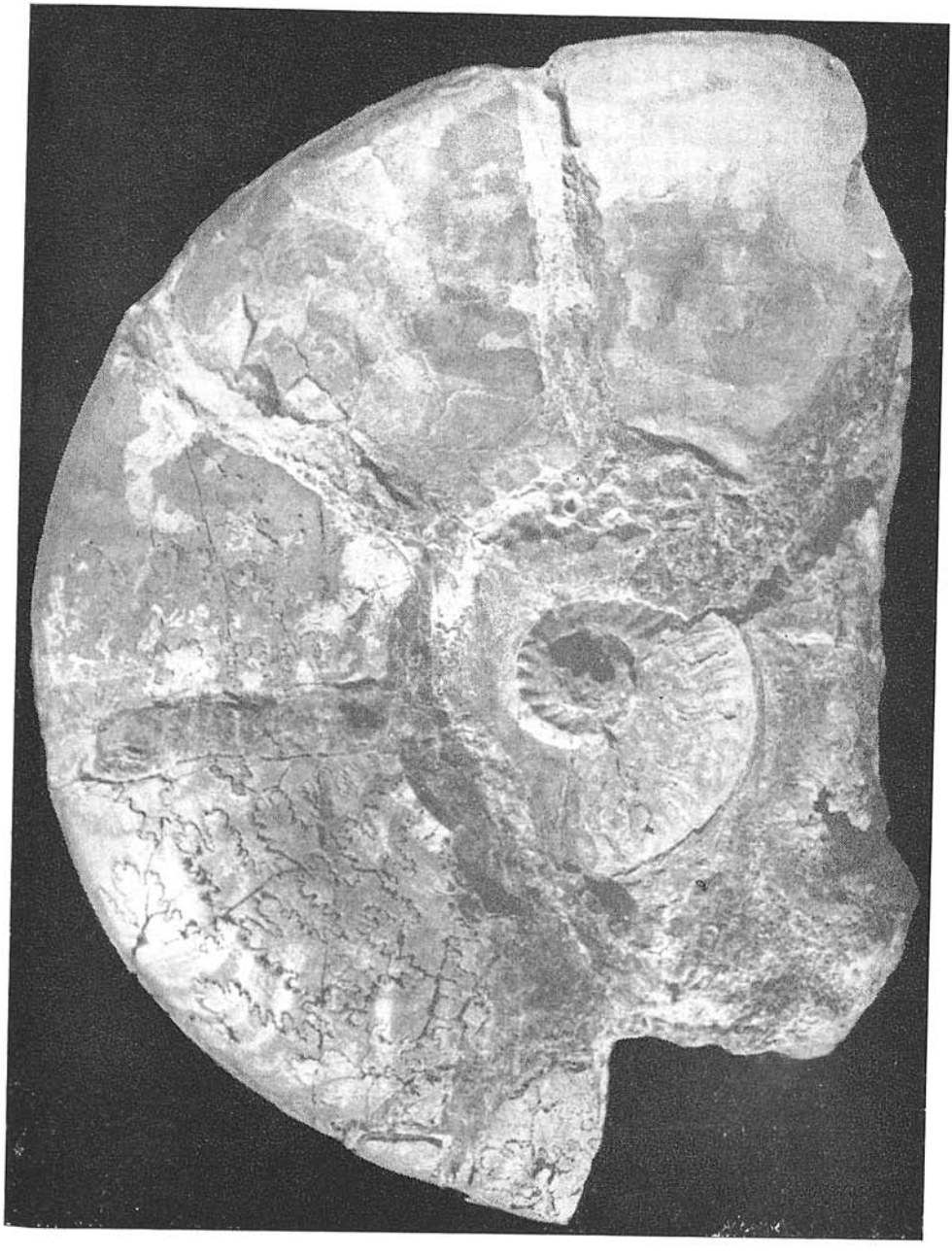

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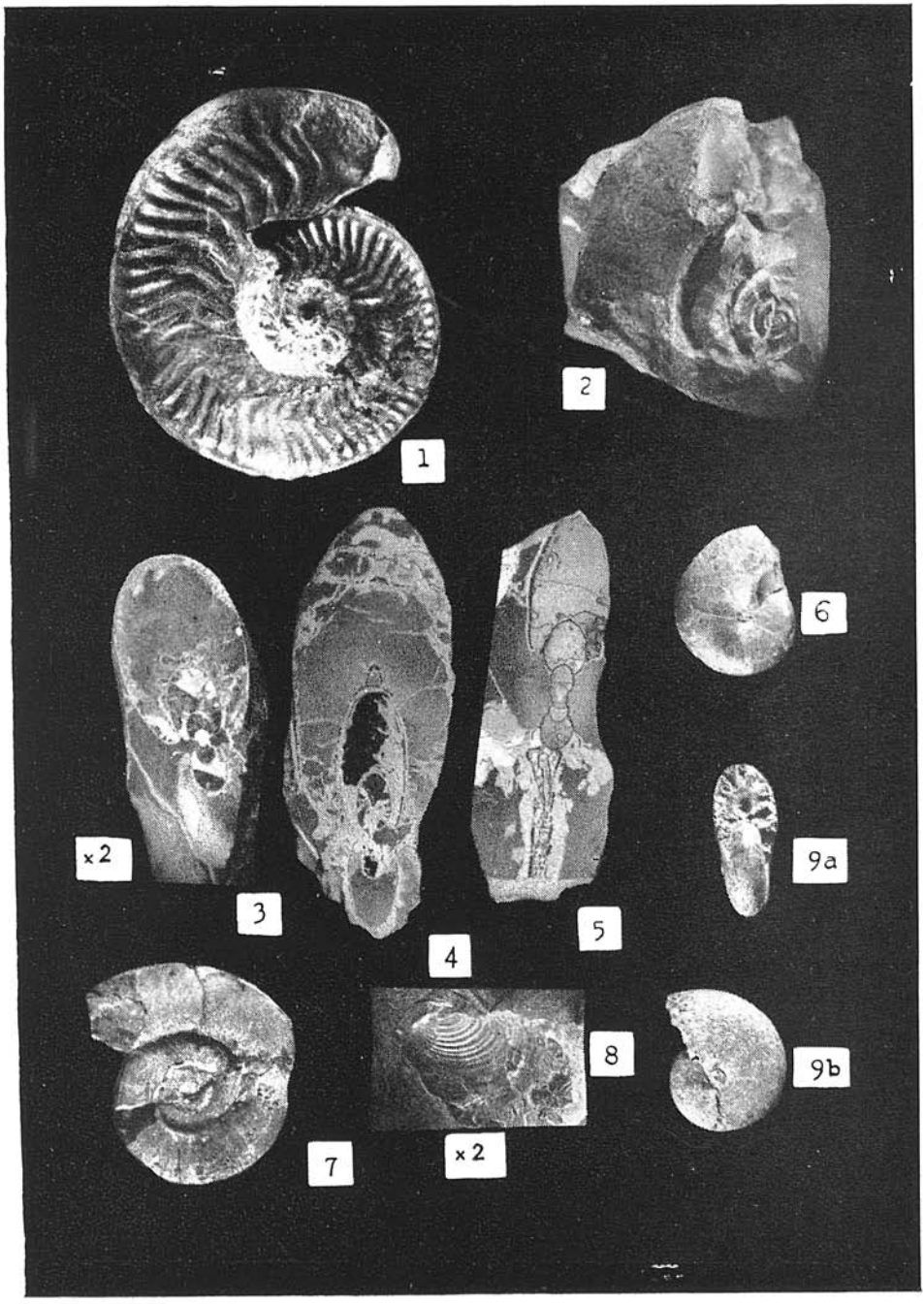

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