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Coleoid and Orthocerid Cephalopods of the Rhaetian Zlambach Marl from the Fischerwiese near Aussee, Styria (Austria)

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(4 plates and 1 fig.)

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Introduction and Acknowledgments

The true nature of most belemnite-like remains previously described and figured from the Zlambach marl is in dispute (see Mojsisovics, 1902, pp. 196, 342; HAAS, 1909, pp. 157-158). The affinities of the unquestionably coleoid (= dibranchiate) phragmocone fragments described and figured from these beds (Mojsisovics. 1902, p. 196; HAAS, 1909, p. 165, pl. VI, fig. 4) are obscure. No Orthocerida are known from these beds to the best of the writers' knowledge.

A substantial number of partly well preserved coleoid and orthocerid remains was collected in the course of many years by H. ZAPFE from the coralline marls of the Fischerwiese. This collection was shown to J. A. JELETZKY during his visit to the Palaeontology Department of the Vienna Museum of Natural History in April, 1964. Because of the outstanding palaeontological, biostratigraphical and palaeoclimatological importance of this collection it was decided to make it a subject of a joint paper. J. A. JELETZKY is responsible for the palaeontological sections and for that dealing with the general biostratigraphy of the Zlambach marl Coleoidea and Orthocerida. He has, however, profited from the valuable advice of H. ZAPFE and a number of his suggestions are incorporated in the text of these sections. H. ZAPFE is responsible for the section dealing with the age of the Zlambach marl, and instigated the investigation of the chemical composition of some of the coleoid tela described and figured in the paper, and the climatological evaluation of the isotopic composition of these same tela.

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Palaeontological Institute of the Vienna University for opening their rich collections of Triassic Coleoidea to them and for loaning types and comparative material. The work of G. KURAT of the Mineralogical and Petrographical Section, Natural History Museum, Vienna, and Dr. W. KALTENEGGER of the Mineralogical Institute, University of Vienna, who carried out the chemical and physical investigations, is gratefully acknowledged. Sincere thanks are due to Mr. EDWARD THORPE and FREDERICK COOKE, Geological Survey of Canada who prepared all photographs used in this paper.

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The Rhaetian Age of Zlambach Marl of the Fischerwiese near Aussee, Steiermark

The Rhaetian age of the coralline marl of the Fischerwiese was recognized early by several authors (FUCHS, 1904; ARTHABER, 1906, p. 283). This locality is renowned, first of all, for yielding the richest coral fauna of the Alpine Upper Triassic. This fauna was described by FRECH (1890) in an excellent but already outdated work. This work was written before the time of clarification of the respective age and stratigraphic relationships of the Carnian and Norian stages. FRECH has accordingly placed the coral fauna of the Fischerwiese in the Norian. Thereafter he has steadfastly adhered to this assignment (*see* FRECH's editorial remark in ARTHABER, 1906, p. 362). Thereafter, similar Upper Triassic coral faunas were placed in the Norian throughout the world (Alaska, Idaho, California, Timor; compare DIENER, 1915 and SQUIRES, 1956). Therefore, it seems important to point out the previously recognized Rhaetian age of this coralline marl (*see* also ROSENBERG, 1959).

Compared with strongly predominant corals, and also with hydrozoans and sponges, all other invertebrates are rare. In the course of personal collecting by H. ZAPFE, which was continued for many years, and using the accumulated collections of Viennese institutions, it was, however, possible to accumulate a relatively rich fauna, especially that of molluscs and brachiopods. The biostratigraphically less valuable, partly ill-determinable remains of echinoderms, trace fossils, a supposed jelly-fish imprint, etc. will have to be ignored for the time being. However, where molluscs and brachiopods are concerned, precisely the best preserved and determinable elements of this fauna provide a weighty indication of Rhaetian age of the Zlambach marl of this locality. Some of the Rhaetian elements have already been pointed out elsewhere (ZAPFE, 1960, p. 237). The results of a special investigation of molluscs (other than Coleoidea and Orthocerida) and brachiopods presented elsewhere in this volume (ZAPFE, 1967) has yielded the following results: Out of 7 Brachiopoda 6 species are determinable. One species is known from the Carnian, another from the undivided Norian-Rhaetian fauna of Drnava (Carpathians, Czechoslovakia), One terebratulid can be best compared with that occuring in the Norian and Rhaetian and the three remaining Brachiopoda-species are Rhaetian. These include the most diagnostic *Bactrynium bicarinatum* EMMR. (= *Pterophloios emmrichii* GüMBEL), which is so far only known from the Rhaetian.

Out of 26 Bivalves, 7 do not permit any specific determination, while of the remaining 19 species 11 either occur in the Rhaetian or are characteristic Rhaetian forms. The following should be named as especially diagnostic: Oxytoma inaequivalve Sow., Mysidia aequilateralis STOPP., "Cardium" reticulatum DITTM.

Out of 15 gastropods only 8 are specifically determinable. Of these 2 are new species, 2 can be compared with species known from the Rhaetian while 1 species is hitherto known only from the Lower Lias. A well represented new amberleyid, *Amberleyopsis ottohaasii* ZAPFE cannot be compared with any Triassic genus and species and rather has Jurassic affinities. The fauna of cephalopods contains, in addition to the Coleoidea and Orthocerida described in this paper, 6 ammonites which are only partly specifically determinable. While fragments of *galeatus*-like arcestids can be either Norian or Rhaetian in age, *Arcestes polysphinctus* Moss. and *Rhacophyllites neojurensis* (QUENST.) are so far only known from the Norian. *Choristoceras marshi* HAUER is, however, a typical fossil of the Upper Rhaetian. The fragments of several other so far specifically indeterminable choristoceratids can also be interpreted as an indication of the Rhaetian age of the rocks concerned.

Summarizing, one can state that the specifically determinable forms of molluscs and brachiopods are dominated by the elements which are either already known from the Rhaetian or are typical Rhaetian index fossils. The Rhaetian age of the Fischerwiese fauna has found an additional support in the recent study of its foraminiferes by KRISTAN-TOLLMANN (1964).

The characteristically Norian or Carnian molluses and brachiopods are in a minority in the Fischerwiese fauna. They comprise only 9 out of the total of 32 biostratigraphically valuable species or faunal elements (22 faunal elements are specifically indeterminable, represent new species or are known from Norian-Rhaetian and Liassic faunas). These 9 species or faunal elements can evidently be interpreted as mere survivors of the Norian and Carnian faunas in the Rhaetian fauna. The customary evaluation of some of these species and faunas as being characteristically Norian or Carnian needs, furthermore, to be modified (*see* ZAPFE, in press).

Affinities and Biostratigraphic Value of the Coleoidea and Orthocerida Fauna

As pointed out elsewhere in this paper, most of the molluscs, as well as the brachiopods and foraminifers, of the Zlambach marl have strong Rhaetian affinities. This indicates the Rhaetian age of the Zlambach marl. It is therefore important to try to appraise the affinities and biostratigraphic value of the Coleoidea and Orthocerida fauna of the Zlambach marl of the Fischerwiese.

As it is now known, the Coleoidea fauna of the Zlambach marl consists of: Atractites alveolaris (QUENSTEDT, 1849) (MOJSISOVICS, 1902, p. 196 and p. 342), Prographularia triadica (FRECH, 1890), and Austroteuthis kuehni nov. gen.et nov. sp. Atractites alveolaris has not been found in the Rhaetian Zlambach marl of the Fischerwiese proper. The occurrence in the fossiliferous Rhaetian part of the Zlambach Beds, which may also include lower levels, is therefore not certain but is likely. This is shown by the stratigraphical range given below. Further MOJSISOVICS (1902, p. 196) recorded the presence of A. alveolaris in the "Fleckenmergel" of the Zlambach Beds, which probably refers to the Rhaetian Choristoceras marl. Atractites alveolaris (QUENSTEDT, 1849) was until recently only known from the Zlambach marl and the Norian Hallstatt limestone (Mojsisivics, 1871, p. 54; 1902, pp. 195-196) and so would appear to be a possible survivor of the Norian fauna in the Rhaetian stage. KÜHN's (1964) study of the large phragmocones contained in the type lot of Atractites alpinus GÜMBEL, 1860 derived from the basal Jurassic rocks suggests, however, their being conspecific with the phragmocones of A. alveolaris (QUENSTEDT, 1849) (see also JELETZKY, 1966, p. 27). A. alveolaris is, accordingly, likely to be a long-living form ranging from the Norian stage through the Rhaetian stage and at least into the basal Lower Jurassic beds. It offers, therefore, but little help from a biostratigraphical standpoint and shall not be further considered here.

The remaining two forms of the Zlambach marl Coleoidea fauna of the Fischerwiese are most peculiar representatives of the order Aulacocerida STOLLEY, 1919. Both species are not known to occur anywhere outside of the Zlambach marl. Therefore, they cannot be used directly as index fossils of the Rhaetian stage, all the more so as its type area appears to be devoid of Coleoidea remains (PUGIN, 1964). The completely forgotten old report of an unfortunately quite unrecognizable (no figure!) "Belemnites" meriani MAYER (see MAYER, 1864, pp. 75-76) seems to be the only exception. The same is, incidentally, true of the only other Rhaetian coleoid — "Belemnites" infraliassicus STOPPANI (1860, pl. 54, figs. 9, 10) from the Avicula contorta beds of Lombardy — which is generically and specifically unrecognizable from its figures and description alone.

The apparently complete absence of any species related to *Prographularia* triadica and Austroteuthis kuehni either in the underlying Norian or in the overlying basal Jurassic rocks provides, of course, some support to the independence of the Zlambach marl Coleoidea fauna, and thus indirectly to the

independence of the Rhaetian stage, to which the Zlambach marl belongs according to the evidence of other fossil invertebrates.

On the generic level these two forms are almost equally peculiar and unique. Neither *Prographularia* nor *Austroteuthis* are known either from the underlying Norian and Upper Carnian rocks or from the overlying Lower Jurassic rocks. *Austroteuthis* is so far only known from the Zlambach marl of the Fischerwiese *). It provides, therefore, the same indirect and tentative biostratigraphic evidence as *Austroteuthis kuehni* and *Prographularia triadica* do on specific level (see above).

An apparently new unnamed species of *Prographularia* is present in the Otapirian stage of New Zealand which was correlated with the Rhaetian stage by MARWICK (1953, p. 83, pl. 8, figs. 8, 10, 11). However, this does not permit us to use the genus as an index fossil of the Rhaetian stage. As mentioned in the discussion of *Prographularia*, this genus must have lived right through the Triassic time even if it is only known from the Upper Permian and latest Triassic (Rhaetian) rocks.

Among Orthocerida of the Fischerwiese fauna, *Trematoceras* cf. *triadicum* (MOJSISOVICS, 1873) is a representative of the Carnian fauna of the European Tethyan province. It relates the Fischerwiese fauna to the older faunas of the Carnian and Norian stages. Probably the same species has been described by ZAPFE (1965, p. 299) from the Norian-Rhaetian Dachstein reef — limestone of the Gosaukamm, Dachstein Mts., Upper Austria.

The peculiar orthocerid specimen described in the palaeontological section as "Orthocerida, new family and genus indet. ?" is a unique, possibly pathological, form. It has, therefore, no direct biostratigraphic value, although it certainly has the same indirect value as other unique elements of the here discussed Coleoidea and Orthocerida fauna of the Zlambach Beds.

On the whole, the Coleoidea and Orthocerida forms of the Zlambach Beds of the Fischerwiese described and figured in this paper do not provide any decisive support either for the Rhaetian age of the Zlambach marl or for the independence of the Rhaetian stage. However, the fact that the Rhaetian Coleoidea and Orthocerida fauna of the Zlambach marl is so peculiar and distinct from those of the next older and next younger stages seems to support the idea of the independence of the Rhaetian stage.

All above described Coleoidea forms, with possible exception of the apparently long-ranging *Atractites alveolaris* (QUENSTEDT, 1849), belong to the exclusively Triassic to Upper Palaeozoic family Aulacoceratidae Mojsisovics, 1882 emend. JELETZKY, 1965. The *Trematoceras* cf. *triadicum* (Mojsisovics, 1873) is likewise an exclusively Triassic form. The Coleoidea and Orthocerida fauna of Zlambach marl, is this, almost entirely Triassic in its affinities.

^{*)} Since this was written, one specimen became known from an other locality of coralline marks of the Zlambach Beds. This small fragment of a telum collected by KITTL in the Edalm near Zwieselalm, Dachstein Mts., Upper Austria, is kept in the Geological and Palaeontological Section of the Natural History Museum in Vienna.

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This certainly supports the idea stoutly defended recently by PUGIN (1964), TUCHKOV (1964) and ZAPFE (1960, in press, and in the previous sention), that the Rhaetian stage forms part of the Triassic system.

The Preservation of Aragonite in the Tela of Coleoid Cephalopods and the Determination of Palaeotemperature

The preservation of aragonitic hard parts of fossil invertebrates is not uncommon in the Alpine Mesozoic. ZAPFE (1936) was able to demonstrate its occurrence in corals from the Zlambach marl (Rhaetian), the Gosau Beds (Upper Cretaceous), and in the inner layer of *Hippurites* (Upper Cretaceous). Necessary for this preservation is burial in clay and marl which prevents or hinders the circulation of water and thus diagenesis. The preservation of the tela of the Coleoidea from the marl of the Fischerwiese indicates that they consisted of aragonite — in contrast to the calcitic tela of the genuine belemnites. This was subsequently confirmed by investigations carried out by G. KUBAT (Mineralogical and Petrographical Section, Museum of Natural History, Vienna). An accompanying study of seven fragments of tela of *Austroteuthis kuehni* used by W. KALTENEGGER (Mineralogical Institute, University of Vienna), together with other organic hard parts for palaeotemperature determination, gave the following diffractometric analysis results (using the method of LOWENSTAM, 1954):

aragonite	calcite
89,2%	10,8%
97,5%	2,5%
97,2%	2,8%
77,0%	23,0%
97,2	2,8%
57,0%	43,0%
95,6%	4,4%

The investigations indicate a palaeotemperature for the Rhaetian Zlambach marl of the Fischerwiese of $21,5^{\circ}$ to $24,5^{\circ}$ C.

This temperature is compatible with the growth of coral reefs in the Rhaetian. This investigation, together with more detailed discussion of the material used, is to be published by W. KALTENEGGER elsewhere (in press).

Palaeontology

Only a few genera of Triassic Coleoidea can be said to be reasonably well known. The taxonomical value of most of their morphological features, and consequently their classification, are in dispute. An attempt at a re-evaluation of the comparative morphology, phylogeny and classification of Triassic Coleoidea was recently undertaken by JELETZKY (1965, 1966). The classification and morphological terms proposed by this worker are used unchanged in this paper, even though his results admittedly (JELETZKY 1966, p. 6) reflect

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only the present, rather unsatisfactory, state of knowledge of this fossil group and may be subject to adjustment and revision as our understanding of the Triassic Coleoidea increases.

The few fragments of Orthocerida present no similar taxonomic problems. All but one of them seem to belong to the well known species and genus but are too poorly preserved to be identified definitively. The remaining fragment seems to represent a major new taxon, which cannot be proposed in this publication because of poor preservation of the only fragment available. The classification and nomenclature used by TEICHERT et al. (1964) in the Nautiloidea volume of the Treatise on Invertebrate Palaeontology was used so far as possible, except for the treatment of Orthocerida as an order of subclass Ectocochlia, which is interpreted to include all other ,,nautiloids" and Ammonitida among its orders (see JELETZKY, 1966, pp. 11-12.).

SUBCLASS COLEOIDEA BATHER 1888 (= ENDOCOCHLIA SCHWARTZ 1894 = DIBRANCHIATA OWEN 1832) ORDER AULACOCERIDA STOLLEY 1919 (= PROTOBELEMNOIDEA ERBEN, 1964) FAMILY AULACOCERATIDAE MOJSISOVICS 1882 EMEND. JELETZKY 1965

Genus Prographularia FRECH 1890

(= Genus novum aff. Aulacocerati sp. nov.; Mojsisovics, 1871)

Type species (by monotypy). Prographularia triadica FRECH 1890.

Diagnosis. Aulacoceratidae with a long and slender, very gently clavate adult telum; the earliest juvenile tela extremely long and needle-like shaped; apical line is well developed; longitudinal depressions situated dorso-laterally throughout the lenght of telum and are strongly angular in cross-section except near its apical and alveolar ends. Surface of conotheca apparently completely smooth.

Stratigraphic Range. Upper Permian, late Upper Triassic (Rhaetian).

Geographic Range. East Greenland, western regions of the United States (Montana), Austria, New Zealand.

Historical Remarks. Mojsisovics (1871, p. 43, pl. IV, fig. 3) was apparently the first to recognize the generic independence of here discussed small aulacoceratid coleoids from Zlambach beds of the Fischerwiese. Mojsisovics (1871, p. 43 footnote) has noted the Belemnitida-like appearance of the internal structure of their telum. He has, however, correctly treated the only telum fragment known to him as belonging to an unnamed new genus closely allied to *Aulacoceras* von HAUER 1860 because of the similar appearance of its surface and the presence of two similarly shaped dorso-lateral furrows.

FRECH (1890, p. 90, pl. XXI, fig. 17) proposed a new generic name *Prographularia* n. gen. and a new specific name *P. triadica* n. sp. for a telum fragment obviously congeneric and conspecific with that described and figured

by MOJSISOVICS (1871, 1902). He has, however, interpreted it as a calcareous axis of an alcyonarian coral closely related to the genus *Graphularia*. FRECH (1890) was apparently unaware of MOJSISOVICS (1871) assignment of the same fossil to the aulacocerid coleoids as he does not mention his work.

In his definitive work on Coleoidea of the Alpine Triassic, MOJSISOVICS (1902, p. 179, pl. XIV, fig. 19) has apparently come to doubt the generic independence of the telum fragment concerned as he changed its identification to *Aulacoceras* (?) sp. indet. He was apparently unaware of FRECH'S (1890) work as he does not mention it.

HAAS (1909, pp. 151-158) described another fragment of *Prographularia* triadica, which he interprets as an alcyonarian coral following FRECH (1890). Unlike FRECH (1890), HAAS (1909) was fully aware of MOJSISOVICS (1871, 1902) research. He seriously considers but rejects the possibility of an aula-cocerid nature of *P. triadica*.

Discussion. FRECH's (1890) and HAAS's (1909, pp. 157-58) treatment of *Prographularia triadica* as an alcyonarian coral was not unreasonable in view of extreme paucity of the material available and considerable morphological similarity of calcareous axes of pennatulid corals to the guard-like structures of Coleoidea. The subsequent discovery of readily recognizable shells of extremely similar, apparently congeneric aulacocerid coleoids in the Upper Permian of East Greenland (ROSENKRANTZ, 1946; FISCHER, 1947), has, however, provided the hitherto lacking proof of the coleoid nature of these poor fragments. Their original interpretation as a new aulacocerid genus closely allied to *Aulacoceras* (MOJSISOVICS, 1871, p. 43, footnote, pl. IV, fig. 3) was, therefore, fully justified.

The following discussion and interpretation of *Prographularia* morphology and taxonomy is largely based not on its fragmentary type species P. triadica but on the much more complete and better preserved P. groenlandica (FISCHER, 1947). Some of the conclusions may, thus, be subject to a revision if and when better material of P. triadica should become available.

Prographularia FRECH, 1890 agrees closely with Aulacoceras, Dictyoconites s. str., and Buelowiteuthis in such important morphological features as:

1. The characteristic folding of the concentric lamellae of its telum resulting in its radially "septate" structure;

2. Presence of characteristic ,,splitting surfaces' or ,,splitting zones', the strongest of which occur underneath the dorso-lateral longitudinal depressions;

3. Presence of strong, dorso-lateral, longitudinal depressions extending the full length of the telum; and

4. The presence of fine, longitudinal riblets and furrows, closely resembling those of *Dictyoconites* s. str. and *Buelowiteuthis* all over telum's surface.

The above mentioned morphological features, at the same time, sharply differentiate *Prographularia* from all known representatives of Xiphoteuthididae NAEF, 1922. Only the apparently completely smooth appearance of Prographularia conotheca (FISCHER, 1947, p. 18, Fig. 5) allies it with the Xiphoteuthididae rather than with the Aulacoceratidae s. restr. which invariably possess a longitudinally ribbed conotheca. *Prographularia* is, therefore, assigned to the family Aulacoceratidae MOJSISOVICS, 1882 emend. JELETZKY, 1965, for the time being at least.

Among hitherto known genera of Aulacoceratidae MOJSISOVICS, 1882 emend. JELETZKY, 1965 Prographularia differs from Aulacoceras (= Asteroconites) in the dorso-lateral position of the longitudinal depressions of its telum, their deeply incised, somewhat V-like shape in cross-section, relatively much more shallow alveolus, different shape and greater length of the postalveolar part of the telum, needle-like appearance of earliest juvenile tela, much finer ribbing of the telum, and in the absence of additional dorso-lateral, oblique furrows.

In Aulacoceras, the longitudinal depressions of the telum are shallow, well rounded and laterally to ventro-laterally situated (von Bülow, 1915, p. 21, Figs. 5, 6, 18, 19; pl. LVII, figs. 1a, 2, 7a). The depth of alveolus in Aulacoceras approaches or even exceeds three-quarters of the estimated total length of complete tela (von Bülow, 1915, pl. LVII, fig. 3 and personal observations) and the outline of its telum follows closely that of its phragmocone which results in telum's shortness and subconical shape. The alveolus of *Prographularia* is, in contrast, restricted to less than one-half of the estimated length of its best preserved tela. The postalveolar part of its telum expands somewhat. This results in the slender subfusiform shape and considerable relative length of the postalveolar part of *Prographularia* telum (FISCHER, 1947, Fig. 2).

The narrow dorsal part of *Prographularia* telum is almost to quite flat (FISCHER, 1947, p. 11, Fig. 2, pl. II, figs. 1-6). It is almost to quite perpendicular to the enclosing dorsal sides of the longitudinal depressions, except near the alveolar end of telum where the depressions become broader and shallower. In *Aulacoceras*, in contrast, the dorsal part of telum is broader than the ventral part, more or less regularly rounded and grades into shallow, trough-like, sublateral depressions.

Prographularia is characterized by well developed apical line and the long and needle-like shape of the earliest juvenile tela (FISCHER, 1947, p. 13-14, Figs. 2, 3) in contrast to *Aulacoceras* which possesses neither.

The longitudinal ribbing habit of *Prographularia* telum is very fine and dense, resembling that of *Dictyoconites* and *Buelowiteuthis*. The longitudinal ribs and furrows of *Aulacoceras* are incomparably coarser and differently shaped.

Prographularia telum is, finally, completely devoid of the additional pair of somewhat oblique dorso-lateral furrows occuring on the anterior half of Aulacoceras telum (von Bülow, 1915, p. 21, Fig. 5).

Prographularia is much more similar to Dictyoconites s. str. than it is to Aulacoceras, as it should be apparent from the above discussion. This was already clearly recognized by FISCHER (1947, p. 21) who has actually placed P. groenlandica in Dictyoconites s. lato (inclusive of Buelowiteuthis JELETZKY, 1966), in spite of recorded differences in the shape of dorso-lateral depressions and in the appearance of the surface of conotheca. The writer considers, however, that the smooth appearance of the surface of conotheca in P. groenlandica is, in itself, sufficient for its generic separation from Dictyoconites s. lato. Besides, Prographularia differs from Dictyoconites also in an apparently complete absence of centrally situated, prominent longitudinal ridges inside of its dorso-lateral depressions. Such ridges are very strongly developed in all typical representatives of Dictyoconites s. str. such as D. reticulatus (VON HAUER, 1858), D. suessi (MOJSISOVICS, 1871), etc. (see MOJSISOVICS, 1871, pl. I, figs. 1-12, pl. IV, figs. 2a, 2b) and protrude well above the level of the margins of their dorso-lateral depressions. Finally, the pronouncedly mace-like, often laterally compressed tela of all typical Dictyoconites s. str. differ strongly from the long, only slightly subfusiform telum of Prographularia.

All known representatives of *Buelowiteuthis* are even more closely similar to *Prographularia* than are the typical representatives of *Dictyoconites* s. str. Their tela are very long and only slightly expanding in the postalveolar part. The alveoli of all *Buelowiteuthis* species are relatively even more shallow than that of *Prographularia*. Their dorso-lateral, longitudinal depressions are, finally, similar to those of *Prographularia* in their general shape and in the relatively feeble development or apparent absence of the secondary, longitudinal furrows and ridges within them (VON BÜLOW, 1915, Fig. 21, pl. LIX, figs. 2c, 2d, 6c, 9c; pl. LX, figs. 2b, 3d, 4d, 4e, 5b).

All known representatives of *Buelowiteuthis* differ from *Prographularia* in the strong dorso-ventral compression (i. e. depression) and often nearly complete flattening of their tela (JELETZKY, 1966, p. 25, pl. 18, figs. 1A-1C). The invariably longitudinally ribbed appearance of the surface of their conotheca (von BüLow, 1915, pp. 42-43), represents another taxonomically important distinction. In spite of their above mentioned morphological similarity to those of *Prographularia*, the longitudinal depressions of all known *Buelowiteuthis* species occur in the sublateral to exactly lateral position. The dorsal part of *Buelowiteuthis* telum is, finally, either only slightly narrower in cross-section than its ventral part or about equally wide. This is in contrast to *Prographularia*, the dorsal part of which is invariably much narrower than the ventral part (FISCHER, 1947, Fig. 2, pl. II, figs. 1-6).

The morphological distinctions of *Prographularia* from *Austroteuthis* nov. gen. are discussed in the description of the latter genus.

Among the other known Carboniferous and Permian aulacoceratids only Stenoconites GORDON, 1966 and Hematites FLOWER and GORDON, 1959 are sufficiently well known to be compared with Prographularia. The former genus differs markedly in the presence of rather prominent lateral ridges on its flanks (GORDON, 1966, p. B33, Fig. 2n, 2o, 2p, 2q, 2s, 2t). Other distinctions consist in the presence of well developed episeptal and hyposeptal cameral deposits, strongly excentric but not marginal siphuncle, and in a considerably stronger lateral compression of the differently shaped telum. The smooth appearance of conotheca and the ornamentation of the telum of *Stenoconites* suggest, however, its being closely allied to *Prographularia*. The former feature opposes it, at the same time, to all other Aulacoceratidae genera. Further study of *Stenoconites* and *Prographularia* may provide sufficient reasons to segregate these two genera into a new subfamily, or even a new family, of Aulacocerida, combining the smooth appearance of the conotheca with the structure and sculpture of the telum characteristic of Aulacoceratidae Mojsisovics, 1882 emend. JELETZKY, 1965.

The genus *Hematites* FLOWER and GORDON, 1959 differs from *Prographularia* in most of the same morphological features as *Aulacoceras*. It possesses, furthermore, several pronounced ventral and dorsal longitudinal furrows, which are absent in *Prographularia*. *Hematites* and *Prographularia* are, in the writer's opinion, so strongly dissimilar that even poor fragments of their tela can be easily distinguished.

On the whole, the Upper Permian Prographularia groenlandica FISCHER 1947 and the Rhaetian P. triadica FRECH 1890 (and possibly the related Lower Permian Stenoconites idahoensis GORDON, 1966 as well) seem to represent a scant fossil record of a long-living aulacoceratid lineage, which is closely related to Dictyoconites s. str. and Buelowiteuthis and could possibly represent the root stock from which these two genera have branched off. If so, the root stock must have continued to exist side by side with its assumed offsprings throughout the Triassic time but failed to leave any fossil record before its terminal (Rhaetian) beds. The reappearance of Prographularia triadica in the latest Triassic (Rhaetian) rocks of the Tethyan province of central Europe and the reappearance of another unnamed species of Prographularia in apparently contemporary Otapirian (= ? Rhaetian) rocks of New Zealand (MAR-WICK, 1953, p. 83, pl. 8, figs. 8, 10, 11) could hardly be explained otherwise.

Prographularia does not seem to be closely related to Hematites and Aulacoceras (= Asteroconites). These two, apparently closely related, aulacoceratid genera probably represent another ancient and long-living lineage of Aulacoceratidae MOJSISOVICS, 1882 emend. JELETZKY, 1965, which existed as a separate entity already in the Lower Carboniferous time.

The geographical range of *Prographularia* is remarkably wide in both the Upper Permian and latest Triassic (Rhaetian) time, especially if one considers the extreme scarcity of its occurences. In the Upper Permian *P. groenlandica* was found in *Posidonomya* beds of northeastern Greenland (ROSENKRANTZ, 1946, p. 161, figs. 8–10; FISCHER, 1947) while a closely similar and probably specifically identical *P. cf. P. groenlandica* was found in the contemporary beds of Phosphoria Formation of the mid-continental basin of North America (GORDON, 1966, p. B 31-B 33, figs. 2a-2k).

In the Rhaetian time the genus was apparently even more widespread. It must have ranged all around the globe, judging by the occurence of *Pro*- graphularia triadica in Zlambach beds of Austria and by the presence of another apparently new but unnamed representative of *Prographularia* in the Southern Hemisphere (see MARWICK, 1953, p. 83, pl. 8, figs. 8, 10, 11; as *Aulacoceras* sp.).

Prographularia triadica FRECH, 1890

Plate I, fig. 2 A-2 H

1871 Genus novum aff. Aulacocerati sp. nov., Mojsisovics, p. 34 (footnote), pl. IV, fig. 3. 1890 Prographularia triadica FRECH, p. 90, pl. XXI, fig. 17.

1902 Aulacoceras ? sp. indet., Mojsisovics, p. 179, pl. XIV, fig. 19.

1909 Prographularia triadica, HAAS, pp. 157-158.

Material: Four fragments of postalveolar part of the telum, of which only two were studied by the writer.

Locality and age: Coral marls of Zlambach beds, Fischerwiese at Alt-Aussee. Zlambach marls of the Kleinen Zlambach. Rhaetian stage of the Upper Triassic.

Type specimen: The fragment of telum described and figured by FRECH (1890, p. 90, pl. XXI, fig. 17) is the holotype of *Prographularia triadica* by monotypy. This specimen was probably destroyed during World War II together with the rest of Dr. F. FRECH's collection, which was preserved in the Geological Institute of Breslau University. The writer was, however, unable to confirm this assumption. If the type specimen is destroyed, it would be necessary to designate one of the other three specimens of *P. triadica* known as its neotype. Although it is not from the same locality as the holotype, the specimen figured by MOJSISOVICS (1871, pl. IV, fig. 3) appears to be preferable either to the topotype described but not figured by HAAS (1909, p. 157) or to the poor topotype described and figured in this report. MOJSISOVICS (1871) specimen is preserved in the collection of Geologische Bundesanstalt of Austria in Vienna.

Diagnosis: *Prographularia* with the ventral walls of the dorso-lateral, longitudinal depressions of its telum devoid of secondary shoulders or terraces. Telum is covered by fairly sparce, relatively strong and deep, somewhat weavering and locally ramifying longitudinal furrows of first order separated from each other by much wider essentially level interspaces carrying several much finer and shallower, stronger weavering, often striae-like, longitudinal furrows.

Description: Prographularia triadica (FRECH, 1890) is indistinguishable from P. groenlandica (FISCHER) in most of the recognizable features of its telum, except for the absence of secondary shoulders or terraces on the ventral walls of its longitudinal dorso-lateral depressions as well as the much more distant spacing and greater strength of longitudinal furrows covering its telum (see below in the description.)

Although ample for specific differentiation of P. triadica from P. groenlandica, these distinctions do not seem to justify even a subgeneric separation of these two forms. This conclusion may, however, be subject to a revision as

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other more important morphological distinctions of the forms concerned may well be concealed by the extreme incompleteness of the few known specimens of P. triadica.

In the present state of our knowledge, it is impossible to give a complete description of P. triadica shell. Nothing at all is known about its phragmocone as well as about the alveolar and adapical parts of its telum. All four fragments known represent the stem part of the postalveolar region of the telum but their position within the former is uncertain.

In cross-section, the dorso-lateral longitudinal depressions of all known fragments of P. triadica do not exhibit any secondary shoulders or terraces on their ventral sides, such as were described and figured by FISCHER (1947, pp. 11-12, pl. II, figs. 1-7; Fig. 2) in P. groenlandica. In the holotype of P. triadica figured by FRECH (1890, pl. XXI, fig. 17a, 17B, 17E, 17d) the shape and depth of the depressions does not seem to differ otherwise from those of P. groenlandica. In the other two specimens, however (MoJSISOVICS, 1871, pl. IV, fig. 3; this paper pl. I, fig. 2), the depressions are considerably more shallow and narrow and have accordingly a somewhat furrow-like appearance. In these two specimens the walls of the depressions are, furthermore, not oriented more or less perpendicular to each other as it is the case in the corresponding parts of P. groenlandica telum. The walls appear, instead, to form an acute angle with each other when seen in cross-section (pl. I, figs. 2F, 2H) and are oriented dorso-laterally; their bottoms seem to carry one or more fine longitudinal ridges and furrows.

The studied specimen of P. triadica (pl. I, fig. 2) differs from P. groenlandica in its distinctly subquadrate shape with a completely flattened ventral surface. This shape contrasts with the more or less regularly rounded ventral surface of P. groenlandica's telum. (FISCHER, 1947, pl. II, figs. 1-3, 5-7). It is, however, probably caused by the considerable secondary deformation of our specimen to be mentioned later. The undeformed specimen figured by MOJSISOVICS (1871, pl. IV, fig. 3b, 3c) has a much more regularly rounded cross-section indistinguishable from that of the apical third of the telum of P. groenlandica. The same is, furthermore, true of the holotype of P. triadica (FRECH, 1890, pl. XXI, fig. 17). On the whole it seems probable that the proportions and outline of the cross-section of P. triadica telum did not differ materially from that of P. groenlandica. This hypothesis permits us to orient the holotype of the former species and to infer its approximate position in the complete telum of P. triadica.

The holotype of *P. triadica* was interpreted by FRECH (1890, pl. XXI, fig. 17) as gradually and evenly contracting toward its upper end. The comparison of the cross-sections of its ends with the cross-sections of various parts of *P. groenlandica* telum figured by FISCHER (1947, pl. II, figs. 1-7; Fig. 2) indicates that this interpretation is erroneous. The dorso-ventral diameter of the "lower" end of the holotype (FRECH, 1890, p. XXI, figs. 17a, 17B) exceeds

markedly its lateral diameter. The ratios of these diameters are reversed in the cross-section of the ,,upper'' end (FRECH, 1890 pl. XXI, figs. 17d, 17E).

In P. groenlandica the cross-section of the anterior section of postalveolar part of the telum is compressed similarly to that of the "lower" end of P. triadica's holotype while that of the posterior part is depressed just as is the cross-section of the "upper" end of P. triadica's holotype. This indicates that the "upper" end of the holotype is, in fact, the adapical end while the "lower" end is the adoral one. The fragment concerned represents accordingly the posterior part of the stem region of the telum which tapers gently and evenly apicalwards.

The fragment figured by MOJSISOVICS (1871, pl. IV, fig. 3) and that illustrated in this paper (pl. I, fig. 2) are markedly depressed in cross-sections. They should correspond, therefore, only to the adapical part of the holotype of P. triadica.

All known fragments of *P. triadica* (FRECH, 1890, pl. XXI, fig. 17; MOJSISOVICS, 1871, pl. IV, fig. 3; this paper, pl. I, fig. 2) show clearly at least the nepionic and the ephebic-gerontic growth stages of the telum recognized by FISCHER (1947, pp. 13–16, pl. II, figs. 1–7) in *P. groenlandica*. In the fragment described in this paper (pl. I, fig. 2 F, 2 H) the homogeneous nepionic growth stage is secondarily crushed and almost flattened in dorso-ventral direction. It is, however, well developed and regularly rounded in crosssection in the fragment figured by MOJSISOVICS (1871, pl. IV, fig. 3b, 3c), which the writer was able to study. The same appearance and shape of the nepionic growth stage of the telum is, finally, clearly discernible in crosssection of the holotype figured by FRECH (1890, pl. XXI, fig. 17a, 17B).

The writer was able to study the original of P. triadica specimen figured by Mojsisovics (1871, pl. 43, footnote; pl. IV, fig. 3) under the name of Genus novum aff. Aulacocerati sp. nov. The material consists of three short fragments of the trunk and apical parts of the telum, one of which does not match the other two. The latter fragment could possibly belong to another specimen, but is tentatively considered to represent the same specimen as the other two. The matching fragments taper gradually and slowly toward one of the ends, which is interpreted as the adapical end. All fragments should represent the adapical third of the postalveolar part of the telum (see above).

MOJSISOVICS (1871, pl. IV, fig. 3) figures of the two matching fragments are satisfactory so far as they go; they do not reflect, however, in full measure the extreme density and the extremely strong development of the concentric growth lines and radial concentric prisms inside of the telum, which superficially strongly resemble those of Belemnitida. The apical line is strongly and typically developed in all cross-sections. Strong "splitting surfaces", such as were well described and figured by VON BÜLOW (1915, p. 24, Fig. 8, 18, 19) in *Aulacoceras* sulcatum and other Aulacoceratidae, connect each of the dorso-lateral depressions with the apical line; they cause pronounced inward bends of all concentric growth lines outside of the nepionic growth stage.

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When studied at X 10 magnification, the similarity of the above described internal structure of the telum to that of Belemnitida proves to be only superficial. The radially oriented fibres are strongly wavering and an aulacoceratid folding of the concentric, growth lines corresponding to the first order grooves and the level interspaces (see below) covering the surface of the telum (see von BÜLOW, 1915, p. 28, Fig. 14) is well developed. The resulting typically "septate" appearance of the telum is clearly visible in better preserved parts of all cross-sections available. The darker coloured radial "septa" connect the first order furrows with the apical line while the lighter coloured, wider "septa" extend inward from the intervening essentially level interspaces. This structure only differs from that of Aulacoceras (= Asteroconites) in the much greater density and in smaller dimensions of its radial elements. It does not seem to differ materially from the neanic and ephebic-gerontic growth stages of Prographularia groenlandica described and figured by FISCHER (1947, p. 14-16, pl. II, figs. 1-7; Fig. 4).

The surface of the *P. triadica* fragment described and figured in this paper is covered by 30 to 32, somewhat unevenly spaced, relatively strong and deep longitundinal furrows of the first order (pl. I, figs. 2 A-2 E). These furrows may locally subdivide in two. They are separated from each other by much wider, essentially level interspaces carrying several much finer and shallower, stronger weavering, often striae-like longitudinal furrows of the second order. These second order furrows may locally merge into the first order furrows.

The second order furrows are mostly too small to be clearly seen by the naked eye. In the specimen studied (pl. II, figs. 2 A-2 G) the level interspaces are, as a rule, 6 to 10 times wider than the furrows of the first order. The width of individual level interspaces may change noticeably in adoral or adapical direction within the fragment studied. The surface of the fragment of *P. triadica* telum figured by MOJSISOVICS (1871, pl. IV, fig. 3) is sculptured in an exactly the same fashion, which was confirmed by a personal investigation of this fragment. The same is probably true of its holotype (FRECH, 1890, pl. XXI, fig. 17, 17 c).

Austroteuthis nov. gen.

? Graphularia ? sp. (Pachysceptron nov. gen.), HAAS, 1909, p. 158, pl. VI, figs. 2a, b, 3a-3c.

Type species (by monotypy). Austroteuthis kuehni nov. sp.

Diagnosis. Aulacoceratidae in which the longitudinally ribbed surface of conotheca is devoid of longitudinal dorso-lateral ridges. Surface of telum carries long double mediodorsal and single medioventral longitudinal grooves. Lateral furrows or depressions apparently completely absent and so are the lateral ridges. In cross-section the telum exhibits a somewhat feather-like arrangement of wavering, fairly coarse radial fibres but lacks a regular *Aulacoceras*-like folding and "septate" appearance of the concentric lamellae. Dorsal parts of septal necks achoanitic in the middle growth stages. Stratigraphic Range. Latest Upper Triassic (Rhaetian stage).

Geographic Range. Central Austria (State of Steiermark).

Discussion. HAAS (1909; see in the synonymy) has described and figured two fragments apparently representing the deformed postalveolar parts of Austroteuthis kuehni telum. He has, however, interpreted them tentatively as remnants of a pennatulid coral. These fragments were interpreted as follows (HAAS 1909, p. 158): "Da mir aber aus dem vorliegenden, recht dürftigen Material die Pennatulidennatur der beiden erwähnten Bruchstücke nicht mit genügender Sicherheit hervorzugehen scheint, so stelle ich sie vorläufig als fraglich zu der typischen Gattung Graphularia und gestatte mir für den Fall, daß für diese Formen der Nachweis ihrer Zugehörigkeit zu den Pennatuliden gelingen sollte, die Errichtung einer neuen Gattung - Pachysceptron vorzuschlagen." The only tentatively suggested new generic name Pachysceptron does not seem to be validly proposed under the Rules. It is not part of the binominal nomenclature in any case as fragments concerned were not named specifically in HAAS (1909, p. 158) paper. Under any circumstances these fragments are too poorly preserved to be unreservedly referred either to the species Austroteuthis kuehni or to the genus Austroteuthis. This has necessitated the introduction of a new generic name Austroteuthis for the here described aulacoceratid form.

Austroteuthis is a rather peculiar form, which is somewhat difficult to place satisfactorily. In the general shape of its telum, its strongly but very finely granulated surface, and in the apparently complete absence of lateral, longitudinal furrows or depressions it resembles closely the Anisian Atractites ? ex gr. tenuirostris-crassirostris-cylindricus-macilentus (VON HAUER, 1888, pp. 6-10, pl. I, figs. 1-15). All of these forms differ, however, in their nonribbed conotheca and considerably lower camerae. They lack, furthermore, the mediodorsal and medioventral furrows characteristic of Austroteuthis. The irregularly ramifying vascular imprints and irregularly shaped, rounded, large mounds covering the surface of Austroteuthis telum are, finally, absent in all representatives of this species group. Its similarity to Austroteuthis is, therefore, superficial and is obviously homoeomorphical in nature. All other known species and genera of Xiphoteuthididae, including Palaeoconus FLOWER and GORDON, 1959, are even more unlike Austroteuthis. They cannot be easily confused with it even when respresented by a fragmentary, poorly preserved material.

Among representatives of Aulacoceratidae MOJSISOVICS, 1882 emend. JELETZKY 1965, Austroteuthis differs sharply from the Triassic representatives of Aulacoceras (= Asteroconites), Dictyoconites s. str. and Buelowiteuthis in the complete absence of the accentuated, dorso-lateral, longitudinal ribs on the surface of the conotheca (dorso-lateral ridges of JELETZKY, 1966, pp. 14-15) and in the apparently equally complete absence of the corresponding lateral or dorso-lateral depressions or grooves on the surface of the telum. Other important distinction consists in the presence of a single medioventral and a double medio-dorsal longitudinal furrows, which are unknown in the Triassic representatives of any of the above mentioned genera. The telum of Austroteuthis lacks, furthermore, the characteristic folding of its concentric lamellae resulting in the radially "septate" structure of telums of all above mentioned aulacoceratid genera (see von Bülow, 1915, p. 28, Fig. 14; pl. LXII, fig. 2). Nor does it seem to possess any "splitting surfaces" of "zones" which are equally characteristic of these genera (see VON BÜLOW, 1915, p. 24, Figs. 8, 18, 19, 21; pl. LVIII, fig. 3) and are genetically connected with the folded "septate" structure of their tela. Among Aulacoceratidae Mojsisovics 1882 emend. JELETZKY 1965, the phragmocone of Austroteuthis is most closely similar to that of Dictyoconites inducens (BRAUN 1841) which is characterized by the similarly fine and dense longitudinal ribbing, apical angle of about 12° and a common absence of one or both dorso-lateral longitudinal ridges (MOJSISOVICS, 1882, p. 297; JELETZKY 1966, p. 16). The phragmocone of Dictyoconites inducens differs sharply, however, in the presence of well developed reticulate pattern of first and second order, which is completely absent in that of Austroteuthis. The camerae of D. inducens are, furthermore, considerably shorter (somewhat less that 50% of their width) than the "adult" camerae of Austroteuthis.

From Prographularia Austroteuthis differs sharply in all of the above mentioned features, and in the appearance of the conotheca as well. The latter appears to be completely smooth in P. groenlandica but its character is unknown in P. triadica.

The lower Carboniferous (late Mississippian) aulacoceratid genus Hematites FLOWER and GORDON, 1959 is somewhat more similar to Austroteuthis because it possesses several ventral and dorsal furrows. On the ventral side, the strongest longitudinal furrow occurs in the medioventral plane. However, Hematites differs sharply from Austroteuthis in the presence of several additional longitudinal grooves, in the essentially Aulacoceras-like pattern and appearance of fine, longitudinal furrows and ribs, and in the Aulacoceras-like, "septate" internal structure of its telum (FLOWER and GORDON, 1959, pl. 116, fig. 3).

Austroteuthis appears therefore to occupy a rather isolated taxonomic position among the Aulacoceratidae Mojsisovics, 1882 emend. JELETZKY 1965, in spite of its characteristically ribbed conotheca which necessitates its placement into this family. It seems likely to be a strongly specialized offshoot of a still unknown primitive Aulacoceratidae stock, which combined the presence of longitudinally ribbed conotheca with that of the more nearly xiphoteuthidid inner structure of the telum and with the apparently primitive (JELETZKY, 1966, p. 22) achoanitic appearance of the dorsal parts of septal necks.

A new subfamily, or even a family, may have to be errected to receive Austroteuthis when it would become possible to apprise the taxonomic value of its other, apparently peculiar, internal features (e. g. the presence of adoral and adapical flanges in the mural parts of its septa). J. A. Jeletzky – H. Zapfe

Austroteuthis kuehni nov. sp.

Plate I, figs. 1 A - 1 H, 3; Plate II, figs. 1 A - 1 D; Plate III, figs. 1 A, 1 B, 2.

Aulacoceras ? sp., HAAS, 1909, p. 165, pl. VI, figs. 14a-d.

? Graphularia ? sp. (Pachysceptron nov. gen.), HAAS, 1909, p. 158, pl. VI, figs. 2a, 2b, 3a-3c.

Material: Austroteuthis comprises the bulk of the studied Coleoidea collection from Fischerwiese, which includes 17 recognizable fragments and one almost complete telum of this form. Most of the fragments are, however, small and strongly weathered; they were obviously collected on the float.

Locality and age: All material studied is from the coralline marl of the Zlambach Beds, Fischerwiese near Alt-Aussee. The specimens figured by HAAS (1909) as Aulacoceras? sp. and Graphularia? sp. (Pachysceptron nov. gen.) and now referred to A. kuehni (see in the synonymy) are from the same locality. A further specimen has been collected from the Zlambach marl of the Edalm, near Zwieselalm, Dachstein Mts., Upper Austria.

Type specimen: The almost complete, well preserved but somewhat deformed and strongly sheared telum figured in pl. I, fig. 3 and pl. II, fig. 1 A-1 D is herewith selected as the holotype of *Austroteuthis kuehni*. It is from "Fischerwiese-West" very close to the main locality (see ZAPFE, 1967, text-fig. 1). The specimen is preserved in the type collection of the Geological and Palaeontological Section of the Natural History Museum, Vienna (Nr. 708/1967).

Diagnosis: The same as for the genus.

Description

Telum: The adult telum is long and slender, more or less regularly cylindrical in the oral half but gradually and evenly tapering to a point throughout the apical half (pl. II, figs. 1 A - 1 D). This results in an extremely long and acute appearance of the apical portion of telum, which essentially corresponds to its postalveolar part. The apical angle in ventral aspect is about 14° (pl. II, fig. 1 A) and about 17° in lateral aspect (pl. II, fig. 1 D).

The only nearly complete telum, which is nearly completely preserved at its oral end, as the telum is only 1,2 mm thick there, is approximately 144 mm long. Its dorso-ventral diameter in the middle (just above the level where the telum is broken in two markedly displaced halves; pl. II, figs. 1 A-1 D) is about 21,2 mm. The lateral diameter at the same place is about 21,6 mm. The cross-section appears to be nearly circular to perfectly circular throughout the telum's length in this and all other undeformed specimens (pl. IV, fig. 1). All observable major deviations from this shape (e. g. pl. I, fig. 1 G) are caused by secondary deformations of the telum. Some smaller, fragmentary specimens may have been about one-third shorter and correspondingly smaller in crosssection. No half-grown or juvenile specimens are represented in the material studied.

No traces of lateral, ventro-lateral, or dorso-lateral grooves or depressions, such as characterize all other known representatives of the family Aulacoceratidae MOJSISOVICS, 1882 emend. JELETZKY, 1965, were noted in any of the specimens studied. The irregularly shaped, short, longitudinal excavations situated more or less symmetrically closely below the oral end of the holo-type on its both flanks (pl. II, figs. 1 B, 1 D) may, however, possibly represent rudiments of these depressions. They occur, indeed, in about the same positions near the alveolar end of another unfigured alveolar fragment. No traces of these excavations were, however, seen on the surface of the corresponding parts of two other equally well preserved and complete alveolar fragments of A. kuehni.

A broad and shallow, approximately flat-bottomed longitudinal groove occurs in the middle of the adoral third of the ventral surface of the holotype (pl. I, fig. 3; pl. II, fig. 1 A). This medioventral groove begins at its oral rim and continues for about 44 mm apicalward gradually shallowing and narrowing in this direction. It is 2 to $2\frac{1}{2}$ mm wide in the proximity of its oral end but only about $\frac{1}{2}$ mm deep.

A double, longitudinal groove occurs in the middle of the dorsal side of A. *kuehni*. In its holotype (pl. II, fig. 1 C) this double groove persists over the oral two-thirds of the telum before disappearing. An approximately medio-dorsal, sharptopped ridge, which appears to be the continuation of this groove on the adapical third of the holotype appears to be caused by a postmortal lateral deformation of this part of the telum. This is clearly indicated by the presence of a corresponding crack on its ventral side (pl. II, Fig. 1 A).

The double, mediodorsal groove consists of two narrow, about 1 mm wide and about $\frac{1}{2}$ mm deep, approximately roundbottomed grooves separated by a slightly elevated, broadly rounded interspace about 2 to $2\frac{1}{2}$ mm wide. One could therefore also designate this feature as a longitudinal, mid-dorsal ridge flanked by two grooves.

The appearance of double mediodorsal groove may be rather variable either within a single specimen or from one specimen to another. In the holotype, for example, the grooves are sharp in their lower part and ill defined farther adorally. The same is true of the elevated interspace separating them. In other specimens they may be well defined and straight in some parts of telum but almost imperceptible and wavering elsewhere.

The single mid-ventral groove and the double mid-dorsal grooves are constant, taxonomically important morphological features of A. kuehni. In addition to the holotype, they were observed in every sufficiently well preserved adoral fragment studied (4 fragments, alltogether), including the figured paratype (pl. I, figs. 1 B, 1 C). Except for the above mentioned variations in the appearance and intensity, both features remain approximately the same in all specimens studied; they always retain approximately the same position and have about the same extent.

The alveolar fragment of telum figured in pl. I, figs. 1 A-1 H permitted a reliable orientation of above discussed medioventral and mediodorsal grooves. In the material studied this specimen alone exhibits excellently preserved siphuncle, conothecal growth lines and suture lines in conjunction with clearly recognizable, albeit strongly deformed mediodorsal and medioventral grooves.

The surface of all sufficiently well preserved tela (pl. I, fig. 1 A - 1 D, 1 F; 3; pl. II, figs. 1 A - 1 D) is completely covered by irregularly rounded to irregularly shaped slightly elevated mounds averaging 1-2 mm in largest diameter. They are separated from each other by fine, irregularly ramifying grooves closely resembling the vascular impressions of Belemnitellidae. Short, somewhat wavering longitudinal striae and fine grooves may occur locally. Extremely fine, mostly regularly rounded, closely spaced granules completely cover the surface of above described mounds, grooves and striae whenever the preservation of tela is sufficiently good (pl. I, fig. 3). This granulation is, as a rule, too small to be clearly discerned by the naked eye; it also covers the surfaces of the previously described medioventral and mediodorsal grooves and that of the mediodorsal ridge in the holotype of the species. Only feeble traces of this granulation were observed locally in the figured paratype (pl. I, fig. 1 F), and in other unfigured specimens. This was obviously caused by the postmortal weathering or rolling of these specimens. Even the much coarser mounds and vascular imprints may be partly or completely destroyed in some of the studied, poorly preserved specimens.

Most of the specimens studied are postmortally deformed. A number of them are twisted and bent in such as fashion as to suggest that the substance of their tela was fairly pliable in life and that its present hard and brittle state is the result of the postmortal recrystallisation *). It is concluded therefrom that the telum of *Austroteuthis kuehni* like that of all other representatives of Aulacocerida (*see JELETZKY*, 1966, p. 18), was originally partly built of organic matter (conchioline ?).

The length of the alveolus apparently exceeded somewhat one half of the preserved length of telum in the holotype, which as already mentioned is almost complete at its oral end. The same is probably true of the figured, fragmentary paratype, the apical cross-section of which is situated closely adorally of the tip of the alveolus (pl. I, fig. 1 G). However, it was impossible to estimate more closely the relative length of the alveolus in any of the specimens available. The ontogenetic development of telum is unknown.

^{*)} The macroscopic and microscopic appearance of A. kuehni tela suggests their more or less strong postmortal recrystallisation. The predominantly aragonitic composition of these tela revealed by the analyses (see p. 74) indicates that this recrystallisation proceeded without or largely without replacement of the original aragonite by secondary calcite.

However, the presence of an apparently well developed apical line in some natural cross-sections of postalveolar fragments suggests that the so far unknown juvenile to half-grown tela of A. kuehni were more or less similar to the adult tela in their general shape and proportions.

The internal structure of telum in longitudinal and transversal thinsections was already described in the discussion of the genus *Austroteuthis*.

Phragmocone: The phragmocone appears to be perfectly circular in cross-section throughout its length (pl. I, fig. 1 H; pl. IV, fig. 1). Its apical angle fluctuates between 10° and 11° in the material available (pl. III, fig. 1 A, 2; pl. I, figs. 1 A, 1 F) in the dorso-ventral aspect. The conotheca is very thin (less than 1 mm thick) and pure white. Its inner surface appears to be quite smooth while the outer surface is covered by very thin and sharp, longitudinal ribs 0,05 to 0,1 mm wide at the base and about $\frac{1}{2}$ mm high whenever best preserved. These ribs are separated from each other by flat, about 0,6 mm wide interspaces of conotheca. About 72 longitudinal ribs were counted near the oral end of the phragmocone of the paratype reproduced in pl. I, figs. 1 A - 1 H. So far as known, they do not branch or run together but continue straight on their gradually converging apicalward courses throughout the exposed part of this pragmocone and on the surface of the earlier part of the phragmocone in another unfigured fragment. All longitudinal ribs appear to be about equally strong. No traces of the accentuated longitudinal ribs, so called dorsolateral ridges (see JELETZKY, 1966, pp. 14-15), occur within the dorso-lateral segments of the only studied phragmocone where the conothecal growth lines were seen to form slight and broad, posteriorly convex U-shaped bends. As mentioned in the generic description of Austroteuthis, this feature sets our form sharply apart from all other known representatives of the family Aulacoceratidae Mojsisovics, 1882 emend. JELETZKY, 1965.

The general appearance of conothecal growth lines and their course across the surface of conotheca do not differ materially from those described by JELETZKY (1966, p. 16) for *Dictyoconites inducens* (BROWN, 1841). The only, slight differences noted consist in the dorsal crest of *A. kuehni* (pl. I, fig. 1 E) being somewhat higher and less obtuse than that of *D. inducens* (JELETZKY, 1966, pl. 6, fig. 6 A) and in its posteriorly convex U-shaped bends (pl. I, fig. 1 F) being considerably wider and shallower than those of *D. inducens* (JELETZKY, 1966, pl. 6, fig. 6 A). The ventral crest of the conothecal growth lines is about equally feebly developed in these two forms.

The structure of early parts of the phragmocone and its protoconch are unknown because of the lack of suitably preserved specimens in the material studied.

Only one out of five sectioned specimens exhibits well preserved microscopic structure of the conotheca (pl. III, figs. 1 A, 1 B; pl. IV, figs. 2 A, 2 B). In this specimen the conotheca consists of four well defined layers, which are clearly distinguishable throughout the dorsal and ventral sides of the phragmocone. It is inferred, accordingly, that the seemingly unilayered, calcitic structure of conotheca observed in all other specimens sectioned is caused by its strong recrystallization resulting in a complete or almost complete disappearance of the component layers.

The innermost, or first, conotheca layer is thin, light-brown-grey to whitish grey, semitransparent, apparently well calcified structure. At about X 180 magnification (pl. III, fig. 1 B) it exhibits faint vestiges of thin, longitudinal lamination and a well developed, dense, transversal striation. The boundary with the adhering mural ends of dorsal parts of septa is invariably very sharp. The same seems to be true of the ventral parts of septa but the latter are either completely torn off the conotheca or strongly damaged in this specimen because of a postmortal dorsalward displacement of its siphuncle. The innermost conotheca layer is extremely thin (about one-quarter of the average thickness of the adjacent, second layer) wherever it is in contact with mural flanges of septa (pl. III, figs. 1 A, 1 B). Away from the latter the innermost layer thickens gradually and evenly until it becomes about twice as thick as the adjacent (or second) conotheca layer (i.e. about eight times thicker than at the mural parts of septa; pl. III, fig. 1 A) in the middle of each camera. The inner surface of innermost layer is gently convex while its outer surface is approximately straight. The contact with the second conotheca layer is abrupt.

The second conotheca layer is dull yellow to honey-coloured. It appears to be less thoroughly calcified than the adjacent, innermost conotheca layer and may contain considerable amount of conchioline. The second layer is very finely and regularly longitudinally laminated and at the same time closely and finely transversely striated. It appears to be about equally thick throughout the phragmocone fragment concerned (pl. III, fig. 1 A) and is sharply delimited from the third, or principal, conotheca layer.

The third, or principal, conotheca layer is at least twice as thick as all other three layers combined. This layer is beige — to buff — coloured, clouded, and nearly homogeneous in ordinary light at X 180 magnification whenever it is best preserved (pl. III, fig. 1 B). Elsewhere, it may be brown-coloured and replete with fine rounded to vermiform inclusions because of deep weathering. This layer appears to be well calcified. In polarized light this layer appears to be built of fairly coarse, transversally oriented prismatic crystals of calcite which end abruptly at its boundaries. Both boundaries of the principal layer are very sharp but even. Its thickness does not seem to change within the phragmocone fragment concerned (pl. III, fig. 1 A).

The fourth, or outermost, layer has a general steel-grey to green-grey colour but is built of thinly alternating, very thin green, blue and orange or pink longitudinal laminae. These laminae can be either approximately straight or markedly weavering. Whenever the layer is weathered or damaged by cracks, the lamination may be replaced by the very fine, mesh-like structure. immediatedly overlying cream to beige-coloured and distinctly transversely fibrose innermost layers of the telum. The thickness of the fourth or outermost conotheca layer is approximately one half of that of the second layer.

The feather-like, transversal fibres of the telum appear to stop abruptly at the outer boundary of the outermost conotheca layer which stresses the abruptness of the boundary between the conotheca and the telum. In the oral half of the fragment, however, this boundary is strongly affected, and sometimes completely destroyed, by recrystallization and secondary infiltrations. There the identity of the outermost layer may be completely lost in places.

The apparently complete correspondence of the conotheca structure of *Austroteuthis kuehni* with that observed by MUTVEI (1964, p. 97, fig. 8 B) in *Megateuthis gigantea* is remarkable. It seems as if the writer's (JELETZKY, 1966, p. 125) inability to observe the fourth, or outermost, conotheca layer in Belemnitida was caused by the unsatisfactory preservation of the material available.

The ventral abbreviated parts of septa were not clearly observed in any of the sectioned specimens. In the best preserved phragmocone fragment (pl. III, fig. 1 A, 1 B) they are either completely destroyed or damaged beyond recognition. In the much less satisfactorily preserved but almost undeformed phragmocone fragment shown in pl. III, fig. 2 the ventral parts of septa cannot be definitively delimited either from the conotheca or from the connecting rings. It seems, however, that already the ventral parts of septa of the three apicalmost camerae are so strongly deflected adapically as to become almost contiguous with the inner surface of the conotheca. The same seems to be true of the remaining ventral parts of the septa of this phragmocone.

The dorsal parts of septa are built of cream-, beige-, or honey-coloured, transparent to clouded, sometime irregularly crystalline but more commonly homogeneous-looking, obviously well calcified (calcitic?) matter. Judging by their commonly yellow colouring, the septa may be somewhat conchiolinic. With one exception discussed below and in the explanation of pl. III, fig. 1 A, these septa do not exhibit any traces of original layering.

The dorsal parts of septa are more or less evenly convex adapically throughout their length; their convexity fluctuates between two-fifths and one third of the height of next adoral camerae. The maximum depth of dorsal parts of the septa is situated almost exactly in the middle of all camerae (pl. III, fig. 2). Except for the moderate thickening just before the mural ends (pl. III, fig. 1 B), dorsal parts of the septa retain the same thickness throughout their length. The structure of the mural ends of dorsal parts of the septa is discussed in the explanation of pl. III, fig. 1 B.

The relative height of camerae appears to increase markedly in the course of ontogeny of A. *kuehni*. In the almost undistorted phragmocone fragment reproduced in pl. III, fig. 2 the length to width ratio of the camerae (length

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was measured along the siphonal wall while width was measured from the mural end of adapical septum to the siphonal wall) increases adorally as follows (in mm.):

1. 2nd camera from apical end $\frac{8,2}{23,8} = 0,34$ 2. 3rd camera from apical end $\frac{13,3}{25,5} = 0,44$ 3. 4th camera from apical end $\frac{15,0}{27,8} = 0,54$ 4. 5th camera from apical end $\frac{19,2}{31,7} = 0,60$ 5. 6th camera from apical end $\frac{21,8}{34,5} = 0,63$ 6. 7th camera from apical end $\frac{26,7}{36,8} = 0,73$ 7. 8th camera from apical end $\frac{28,8}{42,0} = 0,68$ 8. 9th camera from apical end $\frac{32,5}{47,0} = 0,70$

It is unfortunately unknown how far adorally of the phragmocone apex occurs this fragment. At any rate the relative length of the camerae appears to become stabilized at about 0,70. This conclusion is supported by the fact that the last complete adoral camera of the specimen shown in pl. I, fig. 1 A, 1 F has the length to width ratio $\frac{8,2}{11,7} = 0,70$. This, presumably adult, growth stage of the phragmocone is, therefore, characterized by the long camerae closely comparable in their relative length with those of Aulacoceras, Dictyoconites, and Buelowiteuthis (compare Mojsisovics 1871, 1888, 1902 and VON

BÜLOW, 1915). The ontogenetic development from fairly short to long camera could possibly suggest the descent of *Austroteuthis* from somewhat *Atractites*-like, brachyconic ancestors.

The siphuncle is narrow and more or less circular in cross-section. Judging by the specimens shown in pl. III, fig. 1 A, 2, its dorso-ventral diameter comprises about one-tenth of the corresponding diameter of the phragmocone. In the specimen shown in pl. III, fig. 1 A the siphuncle appears to be perfectly tubular in dorso-ventral cross-section. However, in the better preserved siphuncle of the specimen shown in pl. III, fig. 2 its ventral wall contracts slightly at the level of each ventral part of the septa and expands equally slightly between each pair of the septa. This contraction and expansion is barely noticeable in some segments on the dorsal side of this siphuncle.

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In specimens shown in pl. III, fig. 1 A, 1 B, 2 the connecting rings are ribbon-like and thin and essentially similar to those of other Aulacocerida in their appearance. In the specimen shown in pl. III, fig. 1 A, 1 B the connecting rings appear to have exactly the same bilayered structure as those of some exceptionally well preserved phragmocones of *Metabelemnites philippii* described and figured by JELETZKY (1966, p. 29, pl. 4, fig. 2 B). No other details of their microscopic structure were, unfortunately, clearly discernable either in these or in other specimens studied.

As mentioned in the descriptions of pl. III, fig. 1 A and pl. IV, fig. 2 B, the adoral surfaces of all four dorsal parts of septa visible in this specimen are covered by somewhat lenticular, thin lamellae of mostly transparent, white calcite. These lamellae could possibly represent thin episeptal cameral deposits. Similar calcitic lamellae occur also on the adoral surfaces of dorsal parts of several septa of the phragmocone fragment shown in pl. III, fig. 2. There, however, they do not seem to occur in every septum and their thickness varies fairly markedly. It is uncertain whether these calcitic lamellae are secondary inorganic deposits or thin episeptal cameral deposits.

In phragmocone fragment shown in pl. III, fig. 1 A, 1 B; pl. IV, fig. 2 A, 2 B, the dorsal parts of the septa locally exhibit distinct component layers. These are best visible in the second septum from its apical end (pl. III, fig. 1 A; pl. IV, fig. 2 B). There the axial part of septum is occupied by layer of buff-coloured, coarsely crystalline matter, apparently corresponding to the central layer "c" of the Metabelemnites septum (see JELETZKY, 1966, pp. 20-21, fig. 3). This layer comprises about one half of the septum's thickness and extends throughout its length, including most or all of the adoral flange of its mural end. This layer is flanked by somewhat darker coloured, well calcified, distinctly and closely transversely striated layers on each side. Each of these layers is about half as thick as the central layer "c". These flanking layers are separated from the central layer "c" by a very thin, medium brown, well defined lamina. Another similar lamina occurs in the middle of each of these layers, separating them into two about equal parts (sublayers). The outer sublayer of the adapical layer does not differ materially from its inner sublayer wherever it is discernible. That of the adoral layer is, however, dark-brown-coloured and exhibits a fine mesh-like structure of thin, ramifying dark brown fibres in several sections of the septum. The largest such section occupies the adsiphuncular quarter of the septum (pl. IV, fig. 2 B). Elsewhere, this sublayer has about the same appearance as the inner adoral sublayer. This, above described structural and colour phase of the adoral flanking sublayer is probably only caused by its stronger weathering. The local replacement of both sublayers of the adapical flanking layer and of the adapical part of the central layer "c" by similarly textured and coloured matter (see in the description of pl. III, fig. 1 B) supports this conclusion.

Both flanking layers surround the rounded distal end of the central layer in the immediate proximity of the distal end of the septum (pl. IV, Fig. 2 B).

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Therefrom they extend continuously along the adoral and adapical sides of the distal part of the septum to the point 1,0 to 2 mm before its mural end where they loose their identity, because of stronger weathering and recrystallization of the septum. In the third and fourth septum from the apex, vestiges of the adoral flanking layer are present on the inner surface of the adoral flange which confirms this conclusion.

As they surround the clearly recognizable central layer "c" the adoral and adapical flanking layers should correspond respectively to the adoral (n_1) and adapical (n_2) outer layers of the "adult" septa of *Metabelemnites* investigated by JELETZKY (1966, pp. 20, 29, fig. 3). The transitional zones $(m_1 \text{ and} m_2)$ would then be completely absent all along the free part of this *A. kuehni* septum, just as they are in "adult" septa of *Metabelemnites*. The mural and distal ends of *A. kuehni* septa concerned, to which the transitional zones $(m_1, m_2 \text{ and } m)$ should be restricted if it is built like the "adult" septum of *Metabelemnites*, are apparently too strongly weathered and recrystallized to permit of their recognition.

The persistent presence of two sublayers in each of the flanking layers makes it possible, of course, to interpret their inner sublayers as strongly altered and recrystallized equivalents of the transitional zones " m_1 " and " m_2 ". This hypothesis necessitates, however, the somewhat less probable comparison of the here discussed septum of *A. kuehni* with the early septa of *Metabelemnites (see* JELETZKY 1966, p. 29).

Dorsal parts of the other three septa of the phragmocone fragment shown in Pl. III, fig. 1 A only locally exhibit more or less indistinct vestiges of the component layers. These do not add anything to the information provided by the above described septum.

Suture Line: Four suture lines are visible through the semitransparent conotheca in the specimen shown in pl. I, figs. 1 A-1 G. Several other, less satisfactorily preserved but apparently similar suture lines were observed in another unfigured fragment.

A shallow and broad but somewhat U-like shaped true ventral lobe is clearly visible in the apicalmost suture line of the specimen shown in pl. I, figs. 1 A-1 G (see lower suture in Fig. 1). It is followed by a very low arched, broad saddle which occupies the ventro-lateral quadrant of the phragmocone. This saddle is followed by a very shallow, evenly concave, very broad lobe which occupies most or all of the phragmocone's flank. The rest of this suture is covered by the telum. It is, however, dimly visible through the conotheca farther adorally in the adjacent three suture lines. There the above mentioned broad, lateral lobe seems to be followed by a very shallow, rounded but relatively narrow dorso-lateral saddle which seems to be followed first by a similarly shaped but more narrow dorsal lobe then by a similar dorsal saddle and finally by a very shallow, regularly concave, somewhat wider dorsal lobe (see upper suture in Fig. 1). There does not seem to be any trace of the dorsal saddle in

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any of these sutures but they are too poorly visible to be certain of their exact course. For this reason they are shown dotted in the upper suture shown in Fig. 1.

What appears to be a narrow, parallel-sided, adapically open neck lobe is clearly visible in all sutures of the specimen shown in pl. I, figs. 1 A-1 Gand in most sutures of the other unfigured fragment of the phragmocone. The writer agrees with the interpretation of this structure proposed by FLOWER and GORDON, 1959, p. 815).

A well preserved septal line in the sense of FLOWER and GORDON (1959), pp. 813-814) occurs closely adorally of all suture lines in both specimens



Text-Fig. 1. Austroteuthis kuehni nov. gen. et nov. sp. Camera lucida drawing of two suture lines of the specimen shown in pl. I, figs. 1 A - 1 H (× 8).

The lower (incomplete) suture line is the most adapical of four suture lines visible in pl. I, fig. 1 C. The remainder of this well exposed suture line is covered by the telum. The position of the siphuncle is marked by an upward directed arrow. The adapically open neck lobe is outlined underneath the shallow, somewhat U-like true ventral lobe. The position of septal line is outlined by dots.

The upper (complete) suture line is the second adoral of four suture lines visible in pl. I, fig. 1 C. It is only dimly visible through the conotheca, expecially on the dorsal side of the phragmocone (see pl. I, figs. 1 B, 1 E). The dorsal part of the suture line is, therefore, shown as a dashed line.

studied. As shown in Fig. 1, the septal line is situated only 0,3 to 0,4 mm adorally of the suture line on the venter. In the ventro-lateral and lateral quadrants, however, the distance between the two gradually increases to 0,9-1,0 mm. Farther dorsalward, the course of the septal line is not definitely established. The length of the camera concerned being about 5,5 mm, the distance between the suture line and the septal line fluctuates between 7% and 18% of camera's length. This figure closely corresponds to the observed relative length of adoral flanges of mural parts of septa (see there). The septal line appears, therefore, to mark the anterior limit of the mural part of the septum, in Austroteuthis kuehni at least.

SUBCLASS ECTOCOCHLIA SCHWARTZ, 1894 ORDER ORTHOCERIDA KUHN, 1940 New Family and Genus Indet. ? Plate II, figs. 2 A-2 H

A unique, poorly preserved and partly deformed shell fragment from the coralline marl of Fischerwiese is extremely interesting in combining an orthocerid central siphuncle with what appears to be a many layered and radially prismatic, although thin, external guard-like sheath of a general coleoid type. Unless this combination of features should prove to be pathological in nature, the form concerned would represent at least a basically new morphological type of Orthocerida, apparently paralelling the forms recently described among Bactritida by SHIMANSKIY (1954, p. 27, 83-85, pl. X, figs. 4-5). In this case, this form would represent the first evidence of a phylogenetic trend toward the secretion of a coleoid-like, external shell known in Orthocerida. This would necessitate the erection of at least a new family (more likely a suborder) to receive it. Unfortunately, the preservation of the only fragment available is poor and it is not impossible that its guard-like sheath is simply a pathological thickening of an essentially unilayered but fairly thick conotheca such as is known to be present in some other orthoconic ectocochlians.

Description: The, for the most part considerably distorted, wholly septate phragmocone fragment consists of three complete and two incomplete camerae. It is about 34 mm long. The cross-section at the oral end is feebly egg-shaped and slightly compressed, its more obtuse side presumably representing shell's venter (pl. II, figs. 2 G, 2 H). The apical end is strongly distorted and its original shape uncertain. The lateral (?) and dorso-ventral (?) diameters of the phragmocone (excluding the thickness of the guard-like sheath) are respectively 8,9 and 9,5 mm (compression ratio of about 0,94). The maximum observed thickness of the guard-like sheath is situated in the left, dorsolateral quadrant of the oral end where it is about 1,2 mm thick (pl. II, figs. 2 G, 2 H). The shell is apparently straight, conical, and moderately longiconic, its about equal lateral and dorsoventral angles being about 5° to 51/2°. Camerae are long, their lengths being only slightly less than their widths measured at the adapical suture lines. The best preserved second camera from the oral end is, for example, about 8,7 mm long and about 9,2 mm wide (in lateral crosssection), which results in its length/width ratio of about 0,92. The other two complete camerae appear to be similarly long but are too poorly preserved to be measured.

The rounded, fairly narrow siphuncle comprises about 0,14 % of the dorso-ventral phragmocone diameter (pl. II, figs. 2 G-2 H). Its slight displacement toward the more obtuse (ventral?) side of the phragmocone is possibly the result of postmortal deformation of the shell.

The septa are only exposed on the ventral side and partly within the

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ventro-lateral quadrants of the shell where the conotheca-like layer and the guard-like sheath are stripped off almost completely (pl. II, figs. 2 C, 2 D). They are, however, too strongly weathered to say anything definite about their pattern.

The iridescent (nacreous), whitish grey conotheca-like layer underlying the guard-like sheath is 0,3 to 0,4 mm thick whenever best preserved. It is very sharply delimited from the latter (pl. II, figs. 2 D, 2 H). The surface of the conotheca-like layer appears to be perfectly smooth. The layer does not seem to exhibit any component layers under the magnification of X 10.

The conotheca-like layer contracts regularly between each two septa and expands at each septum (pl. II, fig. 2 D). The resulting annular ridges of the phragmocone coincide, therefore, with the septa and the intervening annular, regularly concave depressions coincide with the camerae. This appears to be a primary, most peculiar feature of the phragmocone concerned (see below). The radially prismatic and at the same time concentrically layered (3 to 4 concentric layers visible locally) guard-like sheath appears to have an even, nearly smooth (possibly slightly transversely striated) surface whenever it is best preserved (pl. II, figs. 2 A, 2 B, 2 D). The inner surface of this sheath swells up and fills out the annular concave depressions of the camerae (for details see description of pl. II, fig. 2 D). This behavoir of the apparently undistorted guard-like sheath clearly indicates that the above described annular concavities and ridges of the phragmocone represent its original feature and are not caused by its postmortal distortion.

The internal structure of the phragmocone was not investigated as it did not seem feasible to section any part of the only fragment available.

FAMILY ORTHOCERATIDAE M'Coy, 1844 Genus Trematoceras EICHWALD, 1851

The orthocerid specimens described below appear to be referable to the genus *Trematoceras* EICHWALD, 1851 rather than to *Michelinoceras* FOERSTE, 1932 sensu SWEET, 1964 because of the characteristic appearance of the episeptal und mural cameral deposits (pl. IV, fig. 3) in the only specimen sectioned. Other external and internal features available, such as the almost perfectly cylindrical connecting rings, the long camerae, the short orthochoanitic septal necks, the straight transverse sutures, the small apical angles of phragmocone, the smooth to faintly transversely striated (or faintly cancellate) surface of the shell, etc., would permit their reference to either of these two genera (see SWEET, 1964, pp. K 225-26, K 229, Figs. 156, 3; 156, 4).

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Trematoceras cf. triadicum Mojsisovics, 1873 Pl. IV, fig. 3

Orthoceras triadicum Mossisovics, 1873, pp. 4-5, Pl. I, figs. 1-3.

Material. Five mostly more or less distorted small fragments.

Locality and age. All specimens are from coralline marl of Zlambach beds, Fischerwiese near Alt-Aussee. Latest Upper Triassic (Rhaetian Stage).

Type specimen. No selection of the lectotype was made from three cotypes of Mojsisovics (1873, pl. I, figs. 1-3) to the best of the writers' knowledge.

Discussion. The Trematoceras cf. triadicum specimens from Fischerwiese include one small fragment with the adoral cross-section of only 4,4 mm, another slightly larger fragment with the adoral cross-section of 4,6 mm (Pl. IV, fig. 3), two medium sized, somewhat distorted fragments with the adoral cross sections of 12 to 13 mm, and one large fragment with the adoral cross-section of about 181/2 mm. All fragments are chambered throughout and comprise one to three camerae only. These fragments appear to be indistinguishable from "Orthoceras" triadicum Mojsisovics 1873 in the perfectly circular crosssection, extremely small apical angle $(2^{\circ}-3^{\circ})$ in undistorted specimens) and almost smooth shell surface ornamented only by faint transversal striae. The relatively long camerae of our form, the length of which fluctuates between 90 per cent and 95 per cent of the width (measured at the level of the lower suture), seem to be somewhat shorter than those of "Orthoceras" triadicum. In the sectioned, small specimen (Pl. IV, fig. 3) the length of the only complete camera comprises 91 per cent of its dorso-ventral width. In the larger, somewhat deformed specimen with estimated adoral diameter of about 12 mm the length of the adapical camera comprises approximately 96 per cent. As measured in the drawing, two complete camerae of the "O." triadicum cotype figured by MOJSISOVICS (1873, pl. I, fig. 2b) have the relative lengths of 97 per cent and 1,08 per cent respectively.

The appreciably lesser relative length of the camera of the sectioned Fischerwiese specimen (pl. IV, fig. 3) could, however, be due to its much smaller size as compared with the second Fischerwiese specimen and with that of MOJSISOVICS (1873, p. I, fig. 2b).

In spite of an apparently complete external similarity of the Fischerwiese specimens of T. cf. triadicum with "Orthoceras" triadicum Mojsisovics 1873, the writer refrains from their positive identification. Firstly, no living chambers are known in the Fischerwiese specimens. Secondly, all specimens available are either much smaller than Mojsisovics (1873) specimens or more or less distorted. And thirdly, the internal morphology of "Orthoceras" triadicum Mojsisovics 1902 is completely unknown. The two forms could, therefore, possibly be homoeomorphs only.

The internal structure of the only sectioned specimen (pl. IV, fig. 3)

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exhibits some interesting features, some of which were not recorded before in any orthocerids.

The shell consists of a single, well calcified layer, which is very sharply delimited from the underlying conotheca. This dark brown, clouded, finely crystalline layer is only about twice as thick as the underlying conotheca. The shell is only preserved on the left side of the thin section.

The thin conotheca is built of the pure white, transparent, irregularly crystalline calcium carbonate (calcite?) and does not exhibit any traces of component layers.

The septum is strongly and more or less evenly arched adapically (pl. IV, fig. 3). Its centrally situated maximum depth comprises about one-third of the camera's length. From a point in the proximity of the mural part the septum thickens gradually but increasingly fast all the way to the brim of septal neck. The maximum thickness of the septum at the brim is about double of its minimum thickness in the proximity of the mural end. The adoral and adapical surfaces of free part of the septum are feebly outwardly convex throughout. This results in the somewhat club-shaped cross-section of the septum. From the point of minimum thickness near the mural end the septum thickens gradually and evenly until its adapical side touches the conotheca. Thereafter the septum turns upward becoming parallel to the conotheca, to which it now adheres, and begins to thin out. Its mural part consists only of a wedge-like adoral flange which tapers gradually and evenly to a point. The length of the flange is about one-sixth of camera's length. The mural part of septum is very sharply delimited from the conotheca throughout the length.

The septal neck is short orthochoanitic. It tapers gradually and more or less evenly to a sharp apical end and has a tendency to bend inward in its oral half and then outward closer to its tip. This results in a somewhat sicklelike appearance of the neck in cross-section.

In its adsiphonal, thickened third, the principal central part of septum consists of beige-coloured, well calcified (calcitic ?) transversely striated material. This central layer "c" is flanked by what seems to be thin (one-seventh to one-tenth of septum's thickness) adoral and adapical outer layers $(n_1 \text{ and } n_2)$ built of somewhat darker-coloured, granular calcium carbonate (calcite ?). These layers disappear, seemingly by wedging out, just before the neck part of septum. They also become indistinct and then disappear closer to the mural end of the septum. The appearance and distinctiveness of these marginal layers is somewhat variable in two halves of the only septum studied. Either of them may disappear locally, even within the area of their normal occurrence. The writer is, therefore, uncertain whether or not these marginal layers are true equivalents of adoral (n_1) and adapical (n_2) outer layers of the Belemnitida and Aulacocerida (see JELETZKY, 1966, pp. 20-22, 29, fig. 3) septa or merely the result of weathering.

The remainder of septum, including its neck and the adoral flange of its

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mural end, are built solely of the above described central layer "c". This layer becomes dark brown and clouded in these thinned out parts of the septum.

The siphuncle is fairly wide for the order, its width comprising about one-sixth of that of the phragmocone. It is exactly centrally situated.

The connecting rings are thin and ribbon-like. They are nearly perfectly cylindrical within the camerae but bulge feebly outward immedially adorally of the next adapical septal neck. The apical end of connecting ring is attached to the brim of the next adapical septum and does not appear to extend for any distance either onto its adoral surface or onto the inner surface of the neck. The somewhat thickened oral end of the next adapical segment of connecting ring is attached to the sharpened apical end of the same neck and to its outer surface, forming a relatively broad adnation area. The most part of neck's inner surface is not now covered by either of the adjacent segments of connecting rings. This gap appears to be a primary morphological feature rather than the result of a postmortal destruction of the corresponding parts of connecting rings.

Whenever best preserved, the connecting ring is obviously bilayered like that of Belemnitida and Aulacocerida (see JELETZKY, 1966, pp. 20-22, 29, Fig. 3). The thinner inner layer is honey-coloured and, apparently, largely or completely organic (conchiolinic ?); it is often finely and closely longitudinally striate. The two to three times thicker outer layer is built of white and transparent, irregularly granular calcium carbonate (calcite ?) and is sharply delimit-ed from the inner layer. Both layers exhibit thin dark brown fringes, which may be the result of infiltration of some solutions along their margins. Because of a far reaching morphological and positional similarity of the component layers of connecting ring of Trematoceras cf. triadicum to those of Belemnitida (see JELETZKY, 1966, pp. 126-127, Figs. 6 A, B; pl. 7, fig. 1 B-1 E) the writer considers the two structures to be homologous. The different colour of both layers as compared with their equivalents in Belemnitida and the calcareous instead of organic composition of the outer layer in Trematoceras cf. triadicum (pl. IV, fig. 3) could be caused by a stronger alteration of its connecting ring as compared with that of Belemnitida. It could, however, also be a primary feature of this taxon, possibly characteristic of other Orthocerida as well.

The occurrence of *Trematoceras* cf. *triadicum* in the Rhaetian rocks of Fischerwiese appears to extend the time-range of this species. *T. triadicum* and comparable forms were known from the Carnian rocks of the Alpine region of Europe (MOJSISOVICS, 1873, p. 8, 1902; p. 200; VON BÜLOW, 1915, p. 9, see list of references), from the undivided Carnian-Norian rocks of Timor (VON BÜLOW, 1915, p. 9), and from the undivided Norian-Rhaetian Dachstein Reef-limestone of the Dachstein Mts. Upper Austria (ZAPFE, 1965, p. 299).

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References

- ARTHABER, G. v., (1906): Die alpine Trias des Mediterran-Gebietes. Lethaea geognostica II. Teil, Mesozoicum Bd. I, S. 223-475, zahlr. Textfig., 27 Taf., Stuttgart.
- BÜLOW, E. VON, (1915): Orthoceren und Belemnitiden der Trias von Timor: Paläeontologie von Timor, no. 4(7), 72 p., 24 fig., 6 pl., Stuttgart.
- DIENER, C., (1915): Die marinen Reiche der Triasperiode. Denkschr. Akad. Wiss. Wien, mathem.-nat. Kl., v. 92, S. 1-145, 1 Taf., Wien.
- FISCHER, A. G., (1947): A belemnoid from the Late Permian of Greenland: Meddel. Grønland, v. 133, pt. 5, 24 p., 6 fig., 2 pl., 1 table, Copenhagen.
- FLOWER, H. R., and GORDON, MACKENZIE, JR., (1959): More Mississippian belemnites: Jour. Paleontology, v. 33, p. 809-42, pl. 112-117, Menasha.
- FRECH, F., (1890): Die Korallenfauna der Trias, Die Korallen der juvavischen Triasprovinz (Zlambachschichten, Hallstätter Kalke, Rhaet.) Palaeontogr. v. 37 (1), p. 1-116, 75 figs., 21 tables, Stuttgart.
- FUCHS, TH., (1904): Einige Bemerkungen über die Abgrenzung der rhätischen Schichten von den tieferen Triasbildungen. Verh. Geol. Reichsanst., S. 293-297, Wien.
- GORDON, MACKENZIE, JR., (1966): Permian coleoid cephalopods from the Phosphoria Formation in Idaho and Montana, U. S. Geol. Survey Prof. Paper 550-B, pp. B 28-B 35, 3 figs., Washington.
- HAAS, O., (1909): Bericht über neue Aufsammlungen in den Zlambachmergeln der Fischerwiese bei Alt-Aussee. Beitr. z. Paläont. u. Geol. Österr. Ungarns u. d. Orients, v. 22, S. 143-167, Taf. V-VI, Wien.
- HAUER, FRANZ VON, (1888): Die Cephalopoden des Bosnischen Muschelkalkes von Han Bulog bei Sarajevo; Denkschr. Akad. Wiss. Wien, v. 54, 56 p., 8 pl., Wien.
- JELETZKY, J. A., (1965): Taxonomy and phylogeny of fossil Coleoidea (= Dibranchiata). Geol. Surv. Canada, Paper 65-2, no. 42, p. 72-76, fig. 1, Ottawa.
 - (1966): Comparative Morphology, Phylogeny, and Classification of Fossil Coleoidea. The Univ. of Kansas Paleont. Contributions, Article 7, pp. 1–162, pls. 1–25, figs. 1–15, Lawrence.
- KALTENEGGER, W.: Paläotemperatur-Bestimmungen an aragonitischen Dibranchiaten-Rostren. "Naturwissenschaften", Heidelberg (in press).
- KITTL, E., (1903): Führer zu den Exkursionen des IX. Internationalen Geologen-Kongresses in Wien. IV. Salzkammergut. S. 1-118, 11 Textabb., 1 Karte, Wien.
- KRISTAN-TOLLMANN, E., (1964): Die Foraminiferen aus den rhätischen Zlambachmergeln der Fischerwiese bei Aussee im Salzkammergut. Jahrb. Geol. Bundesanst., Sonderband 10, S. 1-189, 39 Taf., 5 Textfig., Wien.
- КÜHN, O., (1964): Die Cephalopodengattung Atractites GÜMBEL, 1861, Anz. Österr. Akad. Wiss., mathem.-nat. Kl., Jahrg. 1964, Nr. 7, S. 149-150, Wien.
- LOWENSTAM, H. A., (1954): Factors affecting the aragonite: calcite ratios in carbonatesecreting marine organisms. The Journal of Geology, v. 62, p. 284-322, Chicago.
- MARWICK, J., (1953): Divisions and Faunas of the Hokonui System (Triassic and Jurassic). New Zealand Geol. Surv., Palaeontological Bulletin v. 21, 142 p., 17 pls., 3 maps, 1 table, Wellington.
- MAYER, C., (1864): Diagnoses de deux Bélemnites nouvelles. J. de Conchiol., (3^o série),
 t. IV^o, volume 12, p. 75-76, Paris.
- MUTVEI, H., (1964): Remarks on the anatomy of recent and fossil Cephalopoda; with description of the minute shell structure of belemnoids. Acta Univ. Stockholmiensis, Contributions to Geology, v. 11, no. 4, p. 79-102, fig. 1-8, Stockholm.
- MOJSISOVICS, E. VON, (1871): Über das Belemnitiden-Geschlecht Aulacoceras FR. v. HAUER. Jahrb. k. k. Geol. Reichsanst., v. 21, p. 41-57, pl. 1-4, Wien.
 - (1873): Die Cephalopoden der Hallstätter Kalke. 1. Bd. Abhandlg. k. k. Geol. Reichsanst., v. 6, pp. 1-174, 70 Taf., Wien.

- MOJSISOVICS, E. VON, (1888): Cephalopoden der mediterranen Trias-Provinz. Abhandlg. k. k. Geol. Reichsanst., v. 10, 317 pages, 94 plates, Wien.
 - (1902): Die Cephalopoden der Hallstätter Kalke. Supplement (1902). Abhandlg.
 k. k. Geol. Reichsanst., v. 6, pp. 175-356, pls. 1-23, Wien.
- PUGIN, L., (1964): Le Rhétien, étage du Trias ou du Jurassique ? Colloque du Jurassique, Luxembourg 1962. Volume de Comptes Rendus et Mémoires. pp. 91-99, Luxembourg.
- ROSENKRANZ, A., (1946): Krogbaerende cephalopoder fra Østgrønland Perm. (Hookbearing cephalopods from the Permian of East Greenland). Dansk. Geol. Foren. Meddl., v. 11, (1946-1950), pp. 160-161, figs. 1-10, Kjøbenhavn.
- ROSENBERG, G., (1959): Tabellen der Nord- und Südalpinen Trias der Ostalpen. Jahrb. Geol. Bundesanst., v. 102, S. 477-479, 3 Taf., Wien.
- SHIMANSKIY, V. N., (1954): Priamye nautiloidei i bactritoidei sakmarskogo i artinskogo yarusov Yuzhnogo Urala. (Straight nautiloids and bactritoids of the Sakmarian and Artinskian stages of Southern Urals). Akad. Nauk SSSR., Palaeont. Inst., Trudy, v. 44, 156 p., 1 fig., 12 pls., 42 tables, Moskva.
- SQUIRES, D. F., (1956): A New Triassic Coral Fauna from Idaho. Amer. Mus. Novitates, No. 1797, pp. 1-27, 51 Textfigs., New York.
- STOPPANI, A., (1860–1865): Géologie et Paléontologie des couches à Avicula contorta en Lombardie. pp. 1–267, 60 pls., Milan.
- SWEET, WALTER C., (1964): Nautiloidea Orthocerida. in Treatise on Invertebrate Paleontology, R. C. MOORE (ed.). Part K, Mollusca 3, p. K 216-261, figs. 152 A-188., Lawrence.
- TEICHERT, CURT et al., (1964): Cephalopoda General Features, Endoceratoidea Actinoceratoidea – Nautiloidea – Bactritoidea. Treatise on Invertebrate Paleontology, R. C. MOORE (ed.), Part K, Mollusca 3, p. I-XXVII+K1-K 519, 361 figs., Lawrence.
- TUCHROV, I. I., (1964): Rhaetian stage problem and the lower boundary of the Jurassic System. Colloque du Jurassique, Luxemburg 1962, Volume des Comptes Rendus et Mémoires, pp. 101-112, 1 corr. table, Luxemburg.
- ZAPFE, H., (1936): Die Erhaltungsmöglichkeit des Aragonit im Fossilisationsprozeß untersucht mit Hilfe des Reagens von Feigl und Leitmeier. Anz. Akad. Wiss. Wien, mathem.-nat. Kl., 2 S. Wien.
 - (1960): Untersuchungen im obertriadischen Riff des Gosaukammes (Dachsteingebiet, Oberösterreich). I. Beobachtungen über das Verhältnis der Zlambach-Schichten zu den Riffkalken im Bereich des Großen Donnerkogels. Verh. Geol. Bundesanst., S. 236-241, Wien.
 - (1965): Beiträge zur Paläontologie der nordalpinen Riffe. Die Fauna der "erratischen Blöcke" auf der Falmbergalm bei Gosau, Oberösterreich. Annalen Naturhist. Mus. Wien, v. 68, S. 279-308, 1 Taf., Wien.
 - (1967): Beiträge zur Paläontologie der nordalpinen Riffe. Die Fauna der Zlambach-Mergel der Fischerwiese bei Aussee, Steiermark (exkl. Coelenterata und Mikrofossilien). Festschr. zum 75 Geburtstag von Prof. Dr. Dr. h. c. mult. O. KÜHN, S. 413-480, 9 Taf., Wien.
 - Befunde von allgemeiner Bedeutung f
 ür die Biostratigraphie der alpinen Obertrias. Verh. Geol. Bundesanst., Wien (in press).

Explanation of Plate I

Fig. 1. Austroteuthis kuehni nov. gen. et nov. sp. Zlambach marl. Fischerwiese near Alt-Aussee, Steiermark. Rhaetian. No. 713/1967.

Well preserved fragment of alveolar part of the telum with phragmocone in place. Telum stripped off the oral part of the phragmocone to expose longitudinal ribbing of

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the conotheca and its aulacocerid growth lines. A. Lateral view (X 1). Venter is on the right side. The ridge-like structure visible on the adapical part of the flank is an inorganic deposit. B. Dorsal view (X 1). The grooved appearance of the adoral part of the dorsum is a primary diagnostic feature strongly stressed by secondary deformation of the specimen (see pl. II, fig. 1 C). C. Ventral view (X 1). Strong medio-ventral groove partly filled out by matrix is clearly visible on the lower part of the specimen. D. Lateral view of other side (X 1). Venter is on the left side. The longitudinal ridge-like structures visible in the middle of the flank are believed to be the result of secondary deformation of this specimen. 1 E. Dorsal part of the phragmocone (X 3) showing dorsal crests of conothecal growth lines crossing longitudinally ribbed surface of conotheca. 1 F. Dorso-lateral view of the flank shown in Fig. 1 A (X 3) showing conothecal growth lines crossing the longitudinal ribs of the conotheca. Conothecal growth lines form only slight apicalward directed dorso-lateral embayments in the dorso-lateral segment of the flank. No Aulacoceras or Dictyoconites- like dorso-lateral longitudinal ridges are present within the dorso-lateral segment of the flank where the growth-lines from the embayments. 1 G. Cross-section of fairly strongly deformed apical end (X 1). The strongly laterally distorted lower part of the alveolus is clearly visible. Venter is oriented exactly downward. 1 H. Cross-section of essentially undeformed oral end of the phragmocone (X 1). Venter is oriented exactly downward.

Fig. 2. Prographularia triadica FRECH, 1890. Same locality and age as for specimen shown in Fig. 1. No. 717/1967.

Small but readily recognizable fragment of the lower segment of post-alveolar part of the telum. A. Ventral view (X 1). B. Dorsal view (X 1). C. Right lateral view (X 1). D. Left lateral view (X 1). E. Dorso-lateral view of the same flank as shown in D (X 1). F. Cross section of the better preserved "lower" end of fragment (X 1). G. Same view as in F enlarged (X 3) to show fine detail of internal structure of the telum and of the dorsolateral depressions. The radially directed, wavering fibres and the splitting surface underneath the left dorso-lateral depression are clearly visible. The radially fibrose ("septate") structure does not extend into the strongly dorso-ventrally deformed central (nepionic) part of the telum.

Fig. 3. Austroteuthis kuehni nov. gen. et nov. sp. Same locality and age as for specimen shown in Fig. 1. Holotype, No. 708/1967 (Geological-Palaeontological Section, Museum of Natural History, Vienna).

Ventral view of the alveolar end of the specimen shown in pl. II, fig. 1 A (X 3) to show fine detail of its ornamentation. Extremely fine granulation covers the much coarser, irregularly shaped mounds and ramifying vascular impressions on this part of the telum. Its apparent absence on some other parts of this telum and on the surface of most other tela studied (compare Figs. 1 A-1 B, 1 F) is probably caused by their less satisfactory preservation. A perfectly preserved, broad medio-ventral furrow is clearly visible.

Explanation of Plate II

Fig. 1. Austroteuthis kuehni nov. gen. et nov. sp. Zlambach marl, Fischerwiese near Alt-Aussee, Steiermark. Rhaetian. Holotype. No. 708/1967. (Geological-Palaeontological Section, Museum of Natural History, Vienna).

Almost complete, well preserved but somewhat deformed and strongly sheared (microfaulted) telum. A. Ventral view (X 1). B. Right lateral view (X 1). Venter is on the left. C. Dorsal view (X 1). The somewhat irregularly developed, double medio-dorsal groove extending over most of the telum's surface appears to be an original feature of the species (*compare* pl. I, fig. 1 B). D. Left lateral view (X 1). Venter is on the right. The irregularly shaped, longitudinal excavation occurring in ventro-lateral position

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near the alveolar end of the telum could be a pathological feature. It is, however, matched by another similarly shaped and localized excavation on the right flank (see Fig. 1 B).

Fig. 2. Orthocerida, family and genus nov. ? Same locality and age as for specimen shown in Fig. 1. No. 718/1967.

A somewhat deformed, fully septate fragment of phragmocone covered by conotheca-like layer and guard-like sheath in places. A. Dorso-lateral? view (X 1). This part of the phragmocone is almost completely covered by fairly thin but apparently concentrically layered guard-like sheath with more or less smooth surface. B. Lateral ? view of the opposite side (X 1). The oral third of this flank is covered by the guard-like sheath. The middle third is mostly covered by thin, nacreous conotheca-like layer which disappears beneath the guard-like sheath closer to the oral end of the specimen. The apical third is, finally, an internal cast covered by small patches of the conotheca-like layer here and there. C. Approximately ventral view (X 1). Most of the surface is stripped bare of both the guard-like sheath and the conotheca-like layer. The guard-like sheath is, however, clearly visible in cross-section on both sides of the photograph. D. The same view as in C (X 3). Magnified to elucidate finer structural detail. The radially prismatic and at the same time concentrically layered structure of guard-like sheath is clearly visible on both sides of the photograph. Small patches of well preserved, nacreous, conotheca-like layer protrude from underneath the guard-like sheath on the oral half of the right side of the phragmocone. Four septa are clearly visible in the middle part of the venter. The surface of the phragmocone is distinctly and regularly concave between adjacent septa. This appears to be a primary feature of this phragmocone as the obviously undistorted guard-like sheath swells up and fills out these concavities in the oralmost two camerae. These relationships are especially well displayed on the right flank of the phragmocone. E. Same view as in A (X 3). Magnified to eludicate finer structural detail. The well preserved, apparently bilayered conotheca-like layer protrudes from underneath of the guard-like sheath at the oral end of the specimen (in the middle). Other patches of this layer occur in the apical third of the specimen.

F. Strongly deformed cross-section of the apical end (X 1). G. Essentially undeformed cross-section of the oral end (X 1). The assumed ventral side is oriented directly downward. H. Same view as in G (X 3). Magnified to elucidate finer structural detail of the shell. The conotheca-like layer is very sharply delimited from the overlying 2 to 3 times thicker guard-like sheath. Radially prismatic structure and one of the concentric layers of the latter are clearly visible in the upper left segment of the shell. The rounded, central siphuncle is clearly visible.

Explanation of Plate III

Fig. 1. Austroteuthis kuehni nov. gen. et nov. sp. Zlambach marl, Fischerwiese near Alt-Aussee, Steiermark. Rhaetian. No. 715/1967.

A. Centered, longitudinal, dorso-ventral thin section of an alveolar telum fragment containing somewhat distorted but otherwise exceptionally well preserved section of phragmocone (X 10). The siphuncle is postmortally bent and displaced toward the dorsal side of the phragmocone which resulted in an almost complete destruction or a severe mutilation of all ventral parts of septa. See Fig. 2 for the normal position of the siphuncle and the normal appearance of ventral parts of septa and connecting rings.

The dorsal parts of all four septa visible are built of honey-coloured (medium greyin the photograph) but well calcified (probably conchiolin-enriched) matter locally retaining distinct traces of central layer (c) and outer layers $(n_1 \text{ and } n_2)$. No traces of transitional zone (m) were observed anywhere. The adoral surfaces of all four septa are overlain by about equally thick laminae of white transparent calcite. These laminae are the thickest adventrally and gradually wedge out to nothing adorally; they are sharply delimited from the differently coloured septa proper.

As it is clearly visible in dorsal parts of three adapical septa, their more or less regularly rounded distal ends abut against outer surfaces of connecting rings without forming any septal necks. The mural ends of these septa form adorally and adapically protruding, wedge-like flanges. See Fig. 1 B for fine structual detail of one of these flanges. The flanges are sharply delimited from the four-layered conotheca, the medium grey outermost layer of which is, in turn, sharply delimited from the somewhat lighter-coloured, innermost layers of the telum. The well-developed, closely spaced laminae obscurae and laminae pellucidae of the telum are almost equally thick. The marked and regular wavering of these laminae and the presence of darker coloured, feather-like arranged radial fibers distinguish, however, the telum structure of A. kuehni from that of Belemnitida. B. Mural end of the dorsal part of second adapical septum shown in Fig. 1 A (X 180). The tip of the adorally directed, wedge-like flange (marked "f" on the photograph) is just outside of the upper margin of the photograph. Its total length is about one-eighth of the camera's length (see Fig. 1 A). The dark grey (actually dark brown) colouring of the adoral part of this flange is believed to be caused by its strong weathering rather than its being built of the undivided outer layer (n). The same appears to be true of the irregularly distributed, medium-grey to black (actually light-brownish-grey to darkbrownish-grey) colouring of the adapical part of the septum which could also be interpreted as largely built of the strongly thickened adapical outer layer (n₂). A small adapical wedge-like flange built of this, presumably altered material is clearly visible at the lower margin of the photograph. Like the adoral flange, it is invariably very sharply delimited from the thin, whitish-grey (actually brownish-grey to whitish-grey), homogeneous but well calcified, innermost layer of the conotheca. The next layer of conotheca is about twice as thick as its innermost layer. It is considerably darker grey in the photograph (actually honey-coloured), very finely and regularly longitudinally laminated and at the same time very finely transversely striated. The third, whitish grey (actually buffcoloured), almost homogeneous conotheca layer is more than twice as thick as its two preceding layers combined. This layer is marked "C" in the photograph. The outermost, medium grey (actually steel grey or blue) layer of the conotheca consists of the somewhat irregular alternation of very finely but somewhat wavily laminated or equally finely meshed matter. It is very sharply delimited from the adjacent whitish-grey (actually buff-coloured) indistinctly layered innermost part of the telum occupying the left third of the photograph (marked by "t").

Fig. 2. Austroteuthis kuehni nov. gen. et nov. sp. The same locality and age as for the specimen shown in Fig. 1. No. 713/1967.

Centered, longitudinal, dorso-ventral thinsection of an alveolar telum fragment containing ten early to intermediate camerae of an apparently essentially undistorted phragmocone (X 14). The phragmocone and telum are strongly recrystallized, which resulted in an almost complete obliteration of most of the fine structural detail clearly visible in the phragmocone fragment shown in Fig. 1 A, 1 B; pl. IV, figs. 2 A, 2 B, and discussed in descriptions of these figures. Neither the component layers of the conotheca nor those of the septa are distinguishable. It was also impossible to recognize clearly the limits and shape of abbreviated ventral parts of the septa.

Explanation of Plate IV

Fig. 1. Austroteuthis kuehni nov. gen. et nov. sp. Zlambach marl, Fischerwiese near Alt-Aussee, Steiermark. Rhaetian. No. 714/1967.

An almost undistorted cross-section of the middle part of well preserved telum closely above the apex of alveolus (X 5). The characteristic, feather-like arrangement of coarse, radial fibres of the telum is clearly visible, except on the right side of the alveolus where the white-coloured telum is completely recrystallized. Because of poor preservation of the surface of this specimen it was not possible to orient this thin section.

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Fig. 2. Austroteuthis kuehni nov. gen. et nov. sp. The same specimen as in pl. III, figs. 1 A, 1 B. A. Mural end of the dorsal part of first adapical septum reproduced in pl. III, fig. 1 A (X 185), showing all structural elements discussed in the description of that figure. The tip of adoral flange (marked "f" in the photograph) is clearly visible at the upper margin of the photograph. The small adapical flange is much better preserved than in the septum shown in pl. III, fig. 1 B. Unlike the latter septum, it is built of the same light grey (actually honey-coloured), well calcified (calcitic?) material identical with that of the remainder of the septum. The dark grey to black (actually dark brownish grey), presumably strongly altered material is here restricted to a wedge-like shaped area occuring between the adapical flange and the adoral part of the septum. This clearly indicates the secondary nature of this colour phase. The adapical flange is very sharply delimited from the medium grey, very thin innermost layer of the conotheca. Conotheca is marked "c" and innermost layers of the telum are marked "t". B. The adventral end of the dorsal part of second adapical septum reproduced on a smaller scale in pl. III. fig. 1 A (X 185). The light grey septum is clearly differentiated into thick homogeneous central layer ,.e" (so marked in the photograph), which is clearly differentiated from the somewhat darker flanking layers presumably corresponding to the adoral (n_1) and adapical (n₂) outer layers of Belemnitida and Aulacocerida septa (see in the text). The adapical flanking layer is clearly subdivided into the inner and outer, similarly coloured sublayers by a thin medium grey lamina. In the adoral flanking layer, however, only the inner sublayer is light-grey coloured. Its presumably altered outer sublayer is dark grey coloured and has somewhat irregular boundaries. The central layer ...c" appears to end in a rounded tip some 17 mm short of the dark grey connecting ring. The remaining interval of the septum forms a rounded achoanitic neck apparently filled out by strongly thickened undivided outer layer "n" (so marked on the photograph). This part of the septum is, however, somewhat crushed by the pressure of adorsally displaced siphuncle (see pl. III. fig. 1 A) and is therefore difficult to interpret definitively. It is also possible that the somewhat altered and crushed central layer "c" extends right to the connecting ring and that the flanking layers are completely squeezed out of its neck part.

The thick lamina of mostly white transparent calcite overlying the septum is marked "cd" on the photograph. As already mentioned in the description of pl. III, fig. 1 A and in the text, this lamina could possibly be an episeptal cameral deposit. The strongly altered and partly damaged, dark grey coloured connecting ring only exhibits indistinct layering near the upper margin of the photograph where the darker grey inner layer is split in two. There the left part of the ring is built of lighter grey, partly semitransparent, somewhat thicker outer layer, which is somewhat indistinctly delimited from the inner layer.

Fig. 3. Trematoceras cf. triadicum (MOJSISOVICS, 1873). The same locality and age as for the specimen shown in Fig. 1. No. 719/1967.

A centered, longitudinal thin section of small (juvenile ?) but well preserved fragment (X 10). Pertinent morphological details of this specimen are discussed in the text.

J. A. JELETZKY and H. ZAPFE: Coleoid and Orthocerid Cephalopods of the Rhaetian Zlambach Marl from the Fischerwiese near Aussee, Styria (Austria) Plate I



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J. A. JELETZKY and H. ZAPFE: Coleoid and Orthocerid Cephalopods of the Rhaetian Zlambach Marl from the Fischerwiese near Aussee, Styria (Austria) Plate II



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J. A. JELETZKY and H. ZAPFE: Coleoid and Orthocerid Cephalopods of the Rhaetian Zlambach Marl from the Fischerwiese near Aussee, Styria (Austria) Plate III





J. A. JELETZKY and H. ZAPFE: Coleoid and Orthocerid Cephalopods of the Rhaetian Plate IV Zlambach Marl from the Fischerwiese near Aussee, Styria (Austria)

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