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NEW PALAEONTOLOGICAL DATA FROM THE HOCHSTEGEN MARBLE (TAUERN WINDOW, EASTERN ALPS)

Wolfgang Kießling & Arnold Zeiss

With 3 figures and two plates

Abstract:
Two new species and one new genus of Radiolaria are described from the greenschist-metamorphic Hochstegen Marble of the Tauern Window. Despite of strong shearing deformation the microstructure is sufficiently preserved for species determination, due to early diagenetic pyritization of the siliceous skeletons. The new radiolarians belong to a Kimmeridgian to Lower Tithonian assemblage. They are part of a highly diverse fauna of radiolarians and sponge spicules recovered from the HCl-insoluble residue of the Hochstegen Marble.
The famous 'ammonite from the streetwall' could firstly be determined on a species level as *Orthosphinctes (Lithacosphinctes) siemiradzkii* n.nom. [pro '*O. (L.) evolutus* QUENSTEDT]. The ammonite is proof of Uppermost Oxfordian age for the dolomite quarry near Mayrhofen. The taxonomical and nomenclatorical problems of the *O.(L.) siemiradzkii* as well as that of the related species *O. (O.) polygyratus* and *O. (O.) tiziani* are explained in detail.

Zusammenfassung:
Aus dem grünschieferfaziell metamorphen Hochstegenmarmor des nordwestlichen Tauernfensters werden zwei Arten und eine Gattung von Radiolarien neu beschrieben. Trotz der starken Deformation sind die Feinstrukturen für eine Artbestimmung ausreichend erhalten, da die Radiolarien frühdiagenetisch in Pyrit umgewandelt wurden. Die neu beschriebenen Radiolarien gehören einer vermutlich untertithonischen Vergesellschaftung an, die von cryptocephalischen und cryptothoracischen Formen dominiert wird. Sie sind Teil einer hochdiversen Radiolarien- und Schwammnadelfauna, die aus dem Salzsäurerückstand des Hochstegenmarmors geborgen werden konnte.
Der berühmte „Ammonit aus der Straßenmauer" konnte erstmals auf Artniveau als *Orthosphinctes (Lithacosphinctes) siemiradzkii* n.nom. [pro „*O. (L.) evolutus* QUENSTEDT"] bestimmt werden. Der Ammonit belegt somit für den Dolomitsteinbruch bei Mayrhofen ein Alter von oberstem Oxford. Die taxonomischen und nomenklatorischen Probleme der Art *O.(L.) siemiradzkii*, sowie der ihr nahestehenden Arten *O. (O.) polygyratus* und *O. (O.) tiziani* werden eingehend erörtert.

1. Introduction

The palaeontological research on the Hochstegen Marble has a lively history. After some doubtful fossil discoveries at the beginning of geological work in the Central Alps (STACHE, 1874, HERITSCH, 1919) and the discovery of an ammonite in a streetwall (v. KLEBELSBERG, 1940), SCHÖNLAUB et al. (1975) were the first to report on a microfauna in the insoluble residue of the Hochstegen Marble and on an undeterminable belemnite rostrum from the Hochstegen dolomite. Their fauna consisted of pyritized sponge spicules and a few radiolarians the authors attached to *Cenosphaera* sp. KIESSLING (1992a, 1992b) reported on a rich microfauna, also nearly entirely consisting of radiolarians and sponge spicules. Many specimens of the diverse radiolarian fauna could be determined on a species level and confirmed previous age assignments to Late Jurassic (Lower Tithonian).

The first part of the paper deals with a systematic description of cryptocephalic and cryptothoracic nassellarians which are very abundant in the Hochstegen Marble of the Finkenberg section (Fig. 1). The family Williriedellidae DUMITRICĂ is extended by the new genus *Complexapora* and a short discussion of the sutural pore is appended.

The second part of this work is dedicated to a restudy of the 'ammonite from the streetwall'. Within a research project on the Upper Jurassic ammonites of the Ammonitico Rosso Superiore in the region of Cortina d'Ampezzo (cf. ZEISS et al., 1990, p. 497) it originally had been planned to undertake also a comparing revision of this unique ammonite found in the Upper Jurassic of the Central Alps in

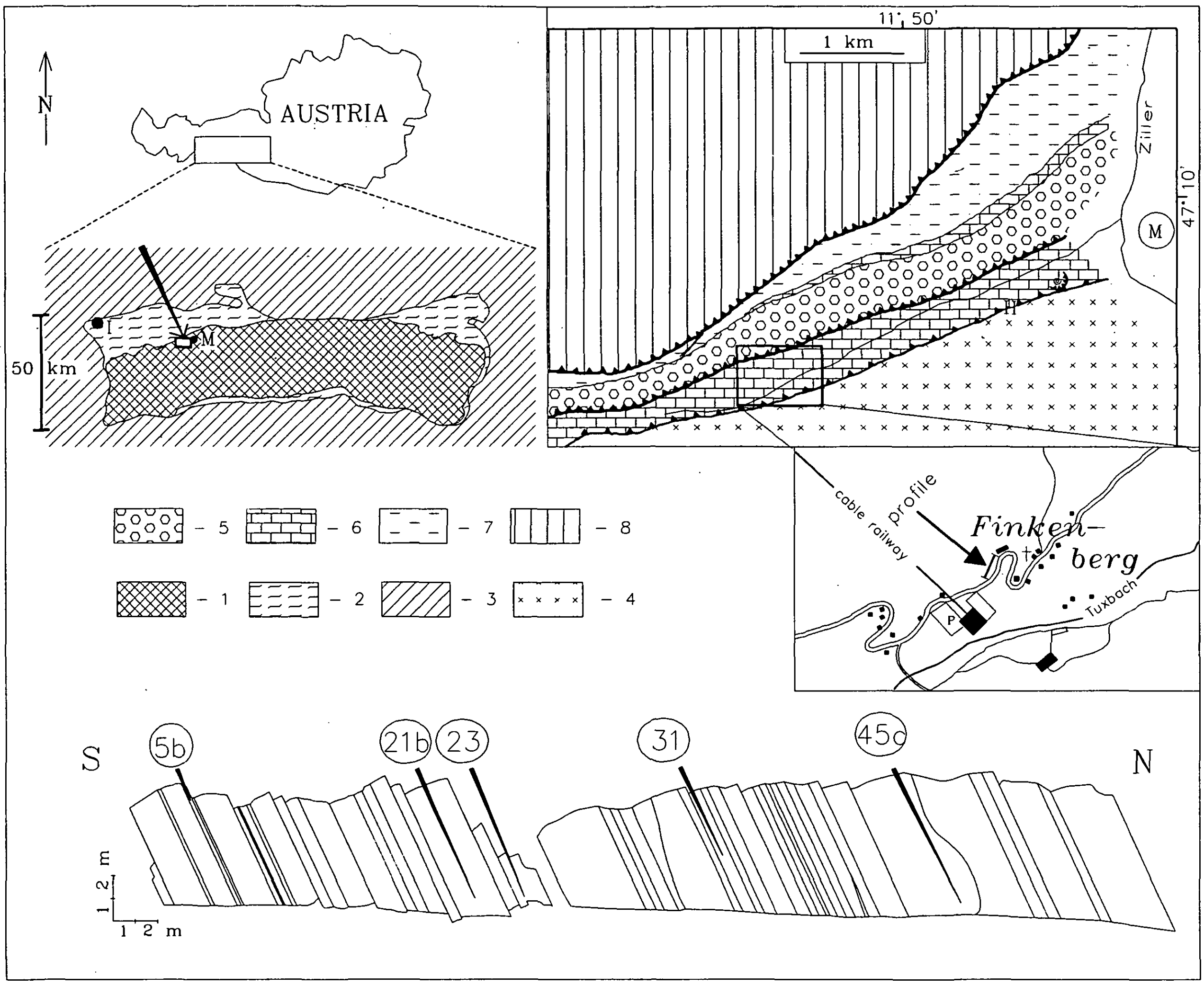

Fig. 1: Location and geological sketch map of the section studied with the most important sampling points. The arrow in the small box points to the Finkenberg section detailed below. 1 – Helvetic and Penninic units; 2 – Lower Austroalpine; 3 – Middle and Upper Austroalpine; 4 – Hercynian metaintrusives ('Zentralgneis'); 5 - meta-volcano-sedimentary 'Porphyrmaterialschieferserie'; 6 – Hochstegen series; 7 – metaclastic 'Kaserer Serie'; 8 –Upper Schist Cover (clastics, carbonates and greenschists). H – Hochstegen; I – Innsbruck; M – Mayrhofen; @ – presumed original location of the 'ammonite of the streetwall' in the dolomite quarry in the southwest of Mayrhofen.

the Zillertal region (Tyrol, Austria). Since it was not possible to finish these studies until now, we take the opportunity of these supplementary palaeontological studies of the fauna of the 'Hochstegenkalk' to contribute some notes on the ammonite, too.

2. Geological setting

The Hochstegen Marble belongs to the Hochstegen Zone which represents the parautochthonous cover of the Upper Carboniferous 'Zentralgneis' of the Tauern Window (Fig. 1). According to LAMMERER (1986, 1988) the Hochstegen Limestone was deposited in the Helvetic basin on the southern margin of the European continent and is comparable in facies and lithology to the 'Quinter Kalk' of Switzerland. This palaeogeographical interpretation is in contrast to TOLLMANN's (e.g. 1977, 1989) opinion, who compares the Hochstegen Zone with the Briançonnais Swell of the Western Alps. However, early diagenetic pyritization and palaeontological data (see below) point to a slope or basin facies rather than to a swell position.

The marble series can be divided into a lower, minor, lithologically variable part with mica-quartz rich limestones and dolomites and an upper dominant part of monotonous bluish-grey limestone marbles. Few fossil discoveries in the past indicate Oxfordian age for the dolomitic base (v. KLEBELSBERG, 1940, MUTSCHLECHNER, 1956, A.Z. this paper) and Kimmeridgian to Lower Tithonian age for the upper parts of the series (Kiessling 1992b), giving evidence for an upright stratification in the area of the type locality near Mayrhofen. The marble suffered higher greenschist-facies metamorphism during alpine orogenesis. In the marble deformation is almost not visible but kyanite quartzites (metamorphic palaeosol?) and quartzitic mylonites at the base and porphyroclastic mylonites (BEIL-GRZEGORCZYK, 1988) overlying the marble above a nappe boundary, give evidence of high shearing deformation and pressure accentuated metamorphism (estimated 5 kb and 450°C in the highest stage for the area of Mayrhofen). The only sedimentary macro-fabrics preserved in the Hochstegen Marble are rare nodular cherts, mostly occurring in the upper parts of the stratigraphical column (FRISCH, 1968, 1975).

Most probably the dolomite containing the ammonite was deposited in shallower water (deep neritic, estimated 50–100 m) than the overlying radiolarian-rich limestone marbles (upper bathyal, estimated 200–500 m).

3. Palaeontological notes

3.1. Radiolaria
(W. K.)

The radiolarian taxa described below were all obtained from a section of cherty limestone marbles. The fossils are restricted to the limestones, no fossils were found in the cherts.

Best preserved radiolarians occur in 'beds' 1, 16, 17, 23, 31, and 45 of the Finkenberg section (Fig. 1). With the exception of 'bed' 45 all of the samples are rather pure limestone marbles. In thin sections only few irregularly distributed silt-sized particles of quartz, feldspar and mica are visible. Micron sized pyrite and graphitic clusters are arranged in lamina which are sometimes isoclinally folded.

Due to the rarity of microfossils, it is not possible to recognize the fossil content in the field (maximum content is 1800 specimens/100 g of rock). Therefore, samples from each 'bed' of the section were treated with 5% HCl for 12–15 hours. The residue was carefully washed using 63 and 350 μm sieves. After drying, the radiolarian tests were picked up under the binocular for SEM-studies. Due to pyritization optical microscope observation was not possible. However, the internal structure of some radiolarians could be studied at broken tests using SEM-observations (Pl. 1, Fig. 8, Pl. 2, Figs. 1–2).

Type and figured specimens are stored in the 'Institut für Paläontologie' at the University of Erlangen/Nürnberg.

In the earlier described fauna of the Finkenberg section (KIESSLING, 1992a) the following species could be identified: *Acanthocircus suboblongus* SQUINABOL, *Archaeodictyomitra apiaria* (RÜST), *Archaeodictyomitra minoensis* (MIZUTANI), *Cenosphaera* sp. cf. *C. gregaria* RÜST, *Gongylothorax favosus* DUMITRICĂ, *Gongylothorax siphonofer* DUMITRICĂ, *Hsuum okamurai* (MIZUTANI), *Mirifusus mediodilatatus baileyi* PESSAGNO, *Podobursa* sp. cf. *P. pantanellii* (PARONA), *Protonuma japonicus* MATSUOKA & YAO, *Pseudodictyomitra primitiva* MATSUOKA & YAO, *Ristola altissima* (RÜST), *Thanarla* sp. aff. *T. brouweri* (TAN SIN HOK), T*riactoma jonesi* (PESSAGNO), *Tricolocapsa ruesti* TAN SIN HOK, *Tricolocapsa yaoi* (KOZUR), cf. *Williriedellum crystallinum* DUMITRICĂ, *Zhamoidellum ovum* DUMITRICĂ, ?*Podocapsa amphitreptera* FOREMAN, cf. *Stichomitra*(?) *tairai* AITA, and many other morphotypes which are not determinable on a species level. The description of the fossils and a taxonomic listing is given by KIESSLING (1992a).

Since DUMITRICĂ's fundamental work on cryptocephalic and cryptothoracic radiolarians in 1970, there was not paid much attention to the systematics of that groups. Some new species have been described since that time (DUMITRICĂ, 1972, YAO, 1979, MATSUOKA, 1982, SCHAAF, 1981, AITA, 1987) but neither a considerable extension of DUMITRICĂ's classification has been carried out, nor the function of important structural elements was further investigated. It is surprising that it has been possible to discover the first new genus of the family Williriedellidae DUMITRICĂ in a strongly metamorphic limestone.

Several radiolarian morphotypes which were found by one of the authors (W.K.) probably belong to new species, but are either too poorly preserved or too few in number for a taxonomic description. Only two new species and one new genus are preserved sufficiently and at least with two specimens preserved admitting a taxonomic description.

3.1.1. Systematic part

Genus *Gongylothorax* DUMITRICĂ, 1970

Gongylothorax favosus DUMITRICĂ
(Pl. 2, Fig. 11–13)

* 1970 *Gongylothorax favosus* n.sp. – DUMITRICĂ, p. 56, pl. 1, fig. 1a–c, 2 (Upper Callovian and Oxfordian; Romania).

1986 *Gongylothorax favosus* DUMITRICĂ – MATSUOKA, pl. 2, fig. 5, pl. 3, fig. 9 (middle Upper Jurassic; SW-Japan).

Gongylothorax(?) *marmoris* n. sp.
(Pl. 2, Fig. 8–10)

Description: Small, dicyrtide oval test with longitudinal plicae and flattened basis. Cephalis small, poreless, strongly encased in the thoracic cavity. Thorax oval with a thick wall. Ornamentation continous from proximal to distal parts. Longitudinally arranged plicae continuous, without branching. Nine to ten plicae visible in lateral view. One row of pores present between neighboring two plicae. Medium sized pores in the center of tetragonal pore frames. Aperture circular, narrow, about doubled diameter of the thorax pores. Frame of aperture flat, tetragonally rimmed.
Type specimens: Holotype 5.31-1, Pl. 2, Fig.s. 8–10; no paratype.
Dimensions (in µm, based on 2 specimens): Total height, 104–118; width of widest portion, 88–99; diameter of aperture, 7–8; maximum diameter of aperture frame, 29–33.
Remarks: In spite of of poor preservation and only two specimens present in the material the determination is unequivocal, because of the rich ornamentation of the thorax. The new species is assigned to *Gongylothorax* DUMITRICĂ because of its dichambered test, its constricted aperture and its encased cephalis. An indubitable sutural pore was not observed. There is a relationship to *Cryptocephalus* Haeckel but we prefer to follow the taxonomy of DUMITRICĂ which was especially established for Mesozoic radiolarians. Though the internal structure of the cephalis could not be observed, an assignment to the genus *Gongylothorax* seems to be the only possibility.
Derivatio nominis: The species name marmoris (genitive form of the latin word 'marmor') has been chosen, because the new species has been recovered from a marble.

Gongylothorax siphonofer DUMITRICĂ
(Pl. 2, Fig. 4–5)

* 1970 *Gongylothorax siphonofer* n.sp. – DUMITRICĂ, p. 57, pl. 1, fig. 3–5 (Cenomanian; Romania).

1979 *Gongylothorax siphonofer* DUMITRICĂ – YAO, p. 26–27, pl. 1, fig. 17–24 (Upper Jurassic?; central Japan).

Family Williriedellidae DUMITRICĂ, 1970

Genus *Complexapora* n. gen.

Diagnosis: Cryptothoracic tricyrtid nassellaria with large inflated abdomen with a complex sutural pore field, without aperture. Cephalis free, small, poreless, without apical horn. Thorax porous, campanulate, small, without descending spines, partly depressed into abdomen, but in external view distinctly separated from abdomen.
Type species: *Complexapora tirolica* n.sp.
Remarks: *Complexapora* is morphologically very similar to *Williriedellum* DUMITRICĂ, *Zhamoidellum* DUMITRICĂ and *Tricolocapsa* Haeckel. It differs from the first in having no aperture, whereas the sutural pore field is very similar and indicates a close relationship. From *Zhamoidellum* DUMITRICĂ *Complexapora* differs only in the sutural pore field which is not present in *Zhamoidellum*. *Tricolocapsa* has no encased thorax which is characteristic of the family Williriedellidae.

Complexapora n. gen. seems to be a transitional form between *Zhamoidellum* and *Williriedellum*. Though the stratigraphic range of this genus is not known, it occurs together with *Zhamoidellum*, which is restricted to Middle and Upper Jurassic strata. In the Finkenberg section it coexists with abundant specimens of *Zhamoidellum ovum* DUMITRICĂ and *Gongylothorax favosus* DUMITRICĂ.
Derivatio nominis: *Complexapora* (feminine gender) is named after its very complex sutural pore field, which constitutes the most prominent distinctive attribute of the genus.

Complexapora tirolica n. sp.
(Pl. 1, Figs. 1–9; Pl. 2, Figs. 1–2)

Description: Shell oval, thick-walled, tricyrtid. Cephalis poreless, smooth, conical and very small. Thorax porous, campanulate, approximately a third depressed into the abdominal cavity. Lower part of the thorax constricted, thoracic opening circular with a slightly protruding rim. Thoracic pores round, irregularly distributed, smaller than abdomial pores. Abdomen subspherical, inflated, thick-walled, with cylindrical pores in hexagonal pore frames. Pore diameters gradually increasing to the distal end. Pores diagonally aranged. Ten to twelve pores side by side on widest portion of abdomen. Sutural pore field oval, well defined, located in the proximal abdomen; at the inner side it is closed by a porous plate with nine to twelve pores visible in lateral view.
Type specimens: Holotype, HM 5.23-2, Pl. 1, Figs. 1–5; Paratype, HM 5.21b-1, Pl. 1, Fig. 6.
Measurements (in µm based on four specimens): Total height, 143–150 (mean 146); width of widest portion, 105–115 (mean 109); height of cephalothorax in external view, 37–41 (mean 39); maximum width of thorax, 58–71 (mean 65); widest diameter of sutural pore field 24–29 (mean 26).
Remarks: *Complexapora tirolica* n.sp. is similar to *Zhamoidellum ovum* DUMITRICĂ in many details like overall shape, dimension, construction of the cephalothorax, and distally increasing pore sizes on the abdomen. The main difference permitting a distinction on a generic level is the complex sutural pore field of *Complexapora tirolica,* whereas *Zhamoidellum ovum* has no sutural pore.

The arrangement of sutural pores of *Complexapora tirolca* is slightly variable. Fig. 2 and Pl. 1, Fig. 2, show details of the organisation. The pore sizes and their arrangement variy distinctly from that of the surrounding skeletal elements.
Derivatio nominis: The species name *tirolica* is derived from the county of Tirol in which the new species has been discovered.

Complexapora sp. A
(Pl. 1, Figs. 10–11)

This form is slightly smaller than *C. tirolica*, the thorax is more cylindrical and the sutural pore field is relatively larger and less oval.

Complexapora sp. B
(Pl. 1, Fig. 12)

This morphotype is much smaller than *C. tirolica* and *C.* sp. A (total height 98 µm). The cephalis is more distinct, the thorax is enlarged in relation to the abdomen. The sutural pore-field is relatively smaller with only six pores visible in top view.

Genus *Hemicryptocapsa* DUMITRICĂ, 1970

Hemicryptocapsa(?) sp. A
(Pl. 2, Fig. 3)

1982 Cryptocephalic and cryptothoracic nassellarian – ADACHI, pl. 4, fig. 2 (Tithonian; central Japan).

Description: Tricyrtoid nassellarian with imperforate cephalis, small perforate encased thorax and large inflated perforate abdomen. Large simple sutural pore, no aperture.

Genus *Zhamoidellum* DUMITRICĂ, 1970

Zhamoidellum ovum DUMITRICĂ
(Pl. 2, Fig. 7)

* 1970 *Zhamoidellum ovum* n.sp. – DUMITRICĂ, p. 79–80, pl. 9, fig. 52a–b, 53, 54 (Upper Callovian and Oxfordian; Romania).
1980 *Archicapsa* cf. *ficiformis* PARONA – DIERSCHE, pl. 1, fig. d (Upper Jurassic; Northern Calcareous Alps, Austria).
1982 *Zhamoidellum ovum* DUMITRICĂ – DUMITRICĂ & MELLO, pl. 3, fig. 13 (Oxfordian; Czechoslovakia).
1988 *Zhamoidellum ovum* DUMITRICĂ – OŽVOLDOVA, pl. 7, fig. 3 (Upper Oxfordian to Kimmerdigian; Czechoslovakia).
aff. 1991 *Zhamoidellum ovum* DUMITRICĂ – WIDZ, p. 257, pl. 4, fig. 19 (Oxfordian to Kimmeridgian; Carpathians, Poland).

3.1.2. Sutural pore

FOREMAN (1968) firstly described a differentiated large pore of some cryptocephalic Nassellaria. DUMITRICĂ (1970) called the pore occurring at the suture between thorax and cephalis (dicyrtids) or at the suture between abdomen and thorax (tricyrtids) sutural pore. A sutural pore field of comparable complexity as that of *Complexapora* n. gen. is only known from the genera *Holocryptocanium* DUMITRICĂ and *Williriedellum* DUMITRICĂ. It is especially similar to the complex structure (= pore field) of *Williriedellum carpathicum* DUMITRICĂ which is thought (DUMITRICĂ, 1970, S. 50) to be an incipient stage of a sutural pore resulting from a deepened part of the abdominal wall.

Due to the taxonomical importance of that morphological element on a generic level (DUMITRICĂ, 1970, p. 50), a short discussion of primary versus secondary genesis of the pore field has to be made. Indeed, there are many tricyrtids in the material with a suture-like fracture in a sutural position (Pl. 2, Fig. 14). This originated in a tectonically caused collapse of a weak part of the test situated at the suture between thorax and abdomen. The collapsed part showing no distinct sutural pore might be called a pseudo-sutural pore. This pseudo-sutural pore is only indicated by broken specimens, but might also be visible in better preserved material by a thinner skeletal part. It might indicate an initial phase of the development of a real sutural pore, which evolved in the Middle and Upper Jurassic (DUMITRICĂ, 1970).

The real sutural pore field is deeply depressed into the shell, has smaller pores in a different arrangement than the surrounding abdomen and is sometimes concentrically surrounded by pores of the abdomen and the thorax (Pl. 1, Fig. 2). Usually it can easily be distinguished from the pseudo-sutural pore.

The sutural pore only appears at cryptocephalic and cryptothoracic species (DUMITRICĂ, 1970). It disappeared from the evolutional history with the extinction of cryptothoracic Nassellaria near the Cretaceous/Tertiary boundary. DUMITRICĂ could not provide any evidence of the role of this 'strange formation' (DUMITRICĂ, 1970, S. 50) and no work has been done on its function until now. It may be an adaption to deeper water because it is coherent with the encasement phenomenon which is thought to be controlled by water depth (DEFLANDRE, 1953, p. 428; DUMITRICĂ, 1970). In the case of the Hochstegen Marble deeper water conditions are indicated by high radiolarian diversity in spite of metamorphism (maximal Fisher-Index = 6); but the enrichment of cryptocephalic and cryptothoracic morphotypes is a result of strong shearing deformation as the massive encased shells are more resistant to brittle failure.

Further work on the morphology of nassellarians in non-metamorphic material has to investigate, whether the sutural pore or pore-field is a SiO_2-deficiency symptom during skeletal growth or has some functional reason (biochemophysical interchange, sexual reproduction?).

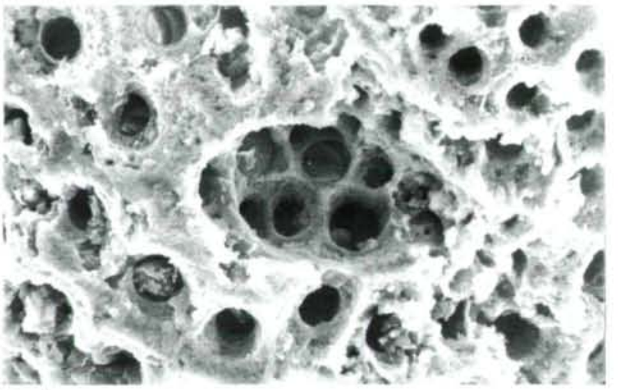

Fig. 2a

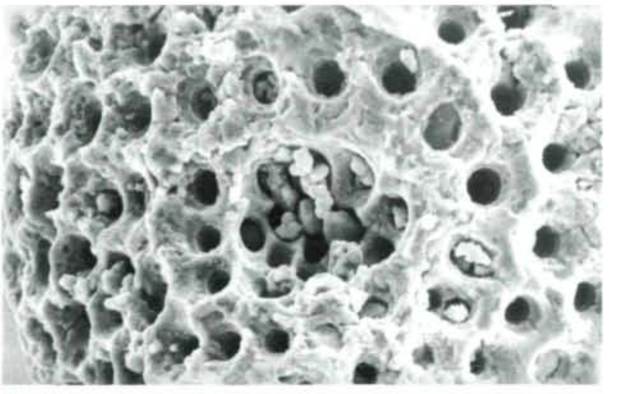

Fig. 2b

Fig. 2: Details of the sutural pore field of *Complexapora tirolica* n.gen. n.sp. Slight differences seem to be normal, as it is not possible to recognize a regular arrangement.
a) WH2-H-1, x 1350
b) 5.23-2, x 850

3.2. Taxonomic revision of the ammonite from the Hochstegen Marble
(A.Z.)

3.2.1. General remarks

The ammonite had been described and figured for the first time by v. KLEBELSBERG (1940). In spite of the very careful description by this author some details have been overlooked (especially the presence of an additional outer whorl with rather coarse and widely spaced, thickened umbilical ribs), which deserves to undertake a restudy of the specimen.

According to v. KLEBELSBERG (1940) the nearest group for a comparision would be that of *Perisphinctes orbignyi* de LORIOL, and within that the 'Reihe des *P. tiziani* (OPPEL)'. The age of the fossil had been considered with high probability as 'Upper Jurassic'.

As the taxonomic and age determination have been doubted later by other authors (e.g. THIELE, 1951, KUPKA, 1956), MUTSCHLECHNER (1956) dealed once again very carefully with the strongly debated history of the discovery of the ammonite and with the rocks, in which it has been found. He also discussed once more the systematic position and the age of the ammonite. By an expertise of the late Dr. E. Weber, München, the ammonite was then considered definitively to be a representative of *Perisphinctes* of the 'Unterer Weissjura', i.e. Oxfordian. This determination and age attribution has then been adopted by later investigators of the Hochstegenkalk, like THIELE (1970, 1974), SCHÖNLAUB et al. (1975) and KIESSLING (1992b). Also TOLLMANN (1977, 22, Fig.7a) mentioned the specimen and refigured it.

3.2.2. Revised description of the ammonite (Fig. 3)

***Orthosphinctes (Lithacosphinctes) siemiradzkii* n.nom.**

1888 *Ammonites lictor evolutus*. – F.A. QUENSTEDT, p. 957, pl. 105, fig. 2. (Holotype, but third name preoccupied).

non 1873 *Perisphinctes evolutus* n.sp. – NEUMAYR, p. 41, pl. 1, fig. 2.

1899 *Perisphinctes* sp.nov. – J.v. SIEMIRADZKI, S. 330.

1905 *Perisphinctes evolutus*, KIL. – KILIAN & REBOUL, p. 789 (Homonym).

1907 *Perisphinctes carsiensis* n.sp. – SIMIONESCU, p.53 (nomen nudum, nomen oblitum).

1966 *Lithacoceras (Lithacoceras)* cf. *evolutum* (QUENSTEDT, 1887). – ENAY, p. 527.

1982 *Orthosphinctes (Lithacocsphinctes) evolutus* (QUENSTEDT). – ATROPS, p. 125–131, pl. 25 fig. 1–2, pl. 26 fig. 1, pl. 27 fig. 1, pl. 28, fig. 1, pl. 29 fig. 1, pl. 45, fig. 1 (with complete list of synonyms!).

Type specimen: *Ammonites lictor evolutus*.- F.A. QUENSTEDT, 1888, p. 957, pl. 105, fig. 2, revised and refigured by ATROPS, 1982, p. 126–127, pl. 127, fig. 1.
Stratum typicum: Weisser Jura Beta (Upper Oxfordian, Planula or Galar Zone).
Locus typicus: Wasseralfingen (eastern Swabian Alb).
Date of first issue of the name: 1888, not 1887; this is obvious from the footnote imprint on p. 945 of QUENSTEDT's monograph: 'Lief.18.19., Mai 1888').
Derivatio nominis: After J.v. SIEMIRADZKI, who was the first to discover that '*Ammonites lictor evolutus*' represents a new species.
Description of the Hochstegenkalk specimen: The ammonite has been preserved only as an impression on a rock surface; therefore the silicon cast from which the photograph of Fig. 3 was taken, represents the positive.

The innermost whorls cannot be observed. Then three whorls follow, of which the last one displays only the umbilical parts (umbilical seam, wall and margin with thickened ribs or nodes, see arrows on Fig. 3).

If one attempts to reconstruct the tectonic distorted specimen, an approximative diameter of 215 mm is obtained.

The following, though very tentative, values for the dimensions of the conch can be obtained (purely reconstructed values in square brackets; all measurements in mm; abbreviations: DM = diameter, WH = whorl height, U = umbilicus, WW = width, IR = internal ribs, ER = external ribs):

DM	WH	U	WW	IR	ER
[c.215	56 (0,26)	115 (0,53)	–	>14/2	?]
c.130	40 (0,26)	55 (0,42)	–	58	?116-140
c.105	35 (0,33)	45 (0,43)	–	62	?
c. 80	25 (0,32)	35 (0,44)	–	60	?

The shell had a rather wide umbilicus, especially the outer whorl. The values for the whorl height are medium-sized. Nothing can be said about the shape and measurement of whorl width; probably the shell was subquadratic or high-rectangular with rounded marginal and umbilical

Fig. 3: *Orthosphinctes (Lithacosphinctes) siemiradzkii* n.nom. [pro *O.(L.) evolutus* (F.A. Quenstedt)], Upper Oxfordian, Hochstegenkalk, natural size, silicon cast. Arrows indicate thickened ribs and/or nodes at the umiblical margin of the inner half of the last whorl.

edges. The ribs originate on the inner part of the umbilical wall, which they cross. On the last whorl they are somewhat thickened at the umbilical edge. On the inner whorls 60–70 ribs have been counted; they probably have been dichotomous as one can observe at some points. At the end of the penultimate whorl the branching of the ribs is trifurcate, but of the polygyrate type. About the sculpture of the last whorl not more can be remarked, than that on the inner half 14 somewhat thickened ribs or nodes are recognizable at the umbilical edge; the interspaces of these ribs or nodes are doubled in comparision with that of the inner whorls. The presence of the outer half of the last whorl is only recognizable by the trace line of the umbilical seam. The ammonite was thus much larger than v. KLEBELSBERG had supposed and does not belong to a microconch species, but is obviously a representative of a macroconch perisphinctid genus.

For a more detailed determination the high bifurcation points and the polygrate branching of the ribs are important and point to the group of *Orthosphinctes polygyratus* (REINECKE); *O.(O.) polygyratus* is mostly considered as microconch. But the still preserved widely spaced, somewhat thickened ribs at the umbilical margin of the last whorl indicate that our specimen belongs to the corresponding macroconch partner which is supposed by most authors to be '*O.(Lithacosphinctes) evolutus* (QUENSTEDT)'. Actually, in more recent literature comparable forms to our specimen can be found; they have been described mainly by ATROPS from SE France (1982, p. 127, pl. 25 fig. 1–2). With these forms the dimensions as well as the ribbing style correspond well (dimensions in mm):

DM	WH	U	WW	IR
126	42 (0,33)	55 (0,44)	–	56
109	34,5 (0,32)	49 (0,45)	23,5 (0,22)	59
79	30 (0,33)	42 (0,47)	20 (0,25)	57

Because of the rather poor preservation the last whorl is comparable only very restrictedly. For the holotype the following measurements have been published by ATROPS (1982, p. 127).

DM	**WH**	**U**	**WW**	**IR**
221	58,5 (0,26)	11,3 (0,51)	44 (0,23)	35

By these comparisions it can be deduced that the specimen from the Hochstegenkalk belongs to '*Orthosphinctes (Lithacosphinctes) evolutus* (Quenstedt)' or at least in its nearest relationship. This species is considered to represent the macroconch of *O. polygyratus*.

Remarks: It should be noted that the species group *polygyratus/evolutus* is somewhat younger than that of *Orthosphinctes tiziani* (OPPEL). Nevertheless, both groups seem to be more or less closely related. SCHAIRER (1974) put them even into one species, that of *O. (O.) polygyratus*. Also, if this procedure seems to be too far-reaching and has not been followed by succeeding authors, the original assumption of v. KLEBELSBERG (1940) has been not too far away from our present determination.

As a lot of taxonomic and nomenclatorial problems are still open at present in both species groups, it is necessary to treat them in the next paragraph.

3.2.3. Comments on the taxonomy and nomenclature of *O. (O.) tiziani* (OPPEL), *O. (O.) polygyratus* (REINECKE) and '*O.(L.) evolutus* (QUENSTEDT)' [=*Orthosphinctes (L.) siemiradzkii* n.nom.]

The following comments on various problems of the species mentioned have to be presented:

a) *Ammonites tiziani* OPPEL, 1863 ,is the type specimen of the genus *Orthosphinctes* SCHINDEWOLF, 1925. If this species would be placed, as SCHAIRER (1974) did, under synonymy of *O.polygyratus* (REINECKE, 1818) the latter would automatically become the type species of *Orthosphinctes*.

Already – but frequently overlooked – v. KLEBELSBERG had discussed the species '*Perisphinctes tiziani*' (1912, p. 174–176, pl. 18 fig. 1a–b) and its relationship; he has figured one of the syntypes of OPPEL (1863, p. 246) in lateral view and the cross section of another one for the first time. Before WEGELE (1929) figured one of the syntypes again SCHINDEWOLF (1925) had selected the species as type species of his new genus *Orthosphinctes*. The syntype figured by WEGELE (1929, p. 44, pl. 1. fig. 4–5) has been selected as lectotype by GEYER (1961, p. 20); it represents a form with a bifurcate ribbing style until the last quarter of the ultimate whorl; tripartite (non polygyrate!) ribs are very scarce and always connected with constrictions. In these characters most specimens of other authors are similar. It has to be remarked that the peristome of the last whorl shows no lappets. However, two deep constrictions just before the end of the whorl limiting a four-branched bundle of ribs and the rather long body-chamber of nearly a whorl provide a strong evidence that the lectotype is a fully grown microconch and not an adolescent macroconch.

The lectotype comes from the Hundsrücken, near Streichen, east of Balingen, central Swabian Alb (OPPEL, 1863, p. 246); following the studies of KOERNER (1963, p. 382, Abb. 73) there are exposed today the boundary-beds between the White Jura Alpha and White Jura Beta, (i.e. approximately the boundary-beds between the Bimammatum and Planula Zone). An ammonite bed yielding *O.(O.) tiziani* lies around two meters below that boundary, i.e. in the uppermost Bimammatum Zone. As this locality is a classic one, the holotype of '*Ammonites Tiziani*' most probably came from this layer.

b) The neotype of *O. (O.) polygyratus* (REINECKE, 1818) as designated by GEYER (1961, p. 21, pl. 1, fig. 4) is very evolute and like the (smaller) holotype of REINECKE, 1818 (cf. HELLER & ZEISS, 1980, pl. 2, fig. 45), displays a polygyrate ribbing style on the whole ultimate whorl. Thus, we can state that at least the types of '*tiziani*' and '*polygyratus*' are quite noticeable different in their mode of sculpture. Until a comprehensive revision of the micro- and macroconchs of the species '*tiziani*' by material collected bed-by-bed in the type region no decision can be made on the variation and real connections of this species to *O. (O.) polygyratus* and *O. (L.) evolutus* (see also ATROPS, 1982, p. 55). Until then we consider it best to maintain the three species as separate, all the more the types of these species come from different zones. As far as I can see, succeeding authors did not follow SCHAIRER (1974). Already OLORIZ (1978) separated species put under synonymy of *O. polygyratus* by SCHAIRER as morphotypes; also WIERZBOWSKI (1978), MELENDEZ (1989), SCHLAMPP (1991) and other authors kept the species '*tiziani*' and '*polygyratus*' separated. Also the inclusion of *O. (O.) colubrinus* in *O. (O.) polygyratus* seems not to be justified by the complete different ribbing style of these two species (cf. GRÖSCHKE, 1984, p. ,60).

The neotype and with high probability the holotype of *O. (O.) polygyratus* as well come from the lowermost Kimmeridgian (Platynota Zone); the latter can be concluded by the fact, that REINECKE (1818) figured a lot of Lower Kimmeridgian ammonites from Northern Franconia but not any typical species from the Planula or Galar Zone.

c) *Ammonites lictor evolutus* F.A. QUENSTEDT, 1888, is the type specimen of the genus *Lithacosphinctes* OLORIZ,1978. Most authors agree to consider it as the macroconch partner of *Orthosphinctes polygyratus*; but it would also be the macroconch partner of *Orthosphinctes tiziani* if both species would be synonymised. However, many authors who have contributed studies on *Orthosphinctes tiziani* like ENAY (1966), LOPEZ MARQUES (1983) and WIERZBOWSKI (1978) consider *Pseudorthosphinctes* ENAY, 1966, as macroconch partner of *O. tiziani*. From the type locality of *O. tiziani* (see above), KOERNER (1963) described both types of possible macroconchs under different names. New collections are necessary before also this problem can be solved.

The holotype of *O.(L.) evolutus* has been collected from the White Jura Beta of Wasseralfingen near Aalen (eastern part of Württemberg). In the surrounding (east of Wasseralfingen) today various outcrops cover the complete White Jura Beta (Planula and Galar Zone) as shown bei ETZOLD (1980, Beil. 2); thus, it is not possible to make more detailed statements about the 'stratum typicum'.

d) The nomenclatorial status of the species *Lithacosphinctes 'evolutus'* was ambiguous, although it has been mentioned as *'Lithococeras'* or *Lithacosphinctes 'evolutus* QUENSTEDT' by all authors of the past thirty years. However, the third name *'evolutus'* had been preoccupied six times within the genus *Ammonites* (cf. HÖLDER, 1958, p. 22) already at the establishment of *'Ammonites lictor evolutus'* by QUENSTEDT in 1888 (p. 957, pl. 105, fig. 2). The species has then been transferred into the genus *'Perisphinctes'* by SIEMIRADZKI (1899, p. 330), who already was aware that it represents a new species, but called it only *'Perisphinctes* sp.nov.'. Later KILIAN (in KILIAN & GUEBHARD, 1905, p. 789) named the form *'Perisphinctes evolutus* KIL.' – not considering that already NEUMAYR in 1871 had introduced a new species name *'Perisphinctes evolutus'* for a Callovian form –, thus producing a homonym also within the genus *Perisphinctes*. Two years later SIMIONESCU (1907) established a new species *'Perisphinctes carsiensis'*, in the synonymy of which *Ammonites lictor evolutus* was placed, too; but no type had been selected. Thus, ENAY (1966, 527) considered the name as a 'nomen nudum'and 'to simplify the nomenclature' he designated *Ammonites lictor evolutus* as lectotype of the species *'carsiensis'*; but he did not use this name himself. Instead he preferred the name *'Lithacoceras evolutus* QUENSTEDT, 1887', probably as the name *'Perisphinctes carsiensis'* had no more been used in the past fifty years and therefore could be considered as a 'nomen oblitum' following the IRZN.

However, as already HÖLDER (1958) had explained, in many cases the third names of QUENSTEDT are preoccupied homonyms and therefore illegitimate. To those names *'evolutus'* also belongs. Nevertheless, since its re-establishment by Koerner (1963) the species has always been quoted as *'evolutus* QUENSTEDT. HOELDER (1958, p. 20, 3b) proposed to preserve the name and to use in such cases as author name the name of the first revising student. Therefore, in our case the name should be *'evolutus* KOERNER, 1863). As it is not clear at present whether this *procedere* would be valid due to the rules, I propose to use the name *Lithacosphinctes siemiradzkii* nom. nov. (Holotype etc., see above) to avoid further confusion.

3.2.4. On the age evidence and palaeozoogeographic situation

The morphotype of *O. (L.) evolutus*, on which our determination of the specimen from the Hochstegen Marble is based, comes from the uppermost limestone bed of the Upper Oxfordian (Subzone of *Sutneria galar*) of Saint Privas in the Ardèche departement of SE-France. ATROPS (1982) mentions the uppermost Oxfordian (Planula Zone, Galar Subzone) as the main distribution of the species. As already stated earlier, we consider the Galar Zone as independent zone (ZEISS, 1966). The species *O. (L.) 'evolutus'* has been quoted also from the Bimammatum, Planuala, Platynota and even Hypselocyclum Zone (e.g. ENAY, 1966, GEYER, 1961, KOERNER, 1963, SCHAIRER, 1974). This is a very long vertical range (around 10 subzones) and almost improbable for one species. Furthermore, the most recent investigations of ATROPS (1982) and other workers have shown that most perisphinctid species have a vertical range of one or two and rather rarely three subzones. It is therefore more probable that the main distribution of the species is, as indicated by the research work of ATROPS (1982), in the Planula and Galar Zone, i.e. in the upper part of the Upper Oxfordian.

Following the subdivision of sequence stratigraphy in this time interval ('LZA-4.4', above) there is a 'Transgressive System Tract' and a 'Highstand' of an eustatic sea-level change (cf. HAQ et al., 1988, fig. 16); it seems quite possible that during these events, which may also have been caused by tectonic activities, a possibility was provided for nectonic cephalopods to immigrate from the southern margin of the Central European Platform into the somewhat remote areas of the southern Helvetic sedimentary basin. In this context it is also of interest to note that *O. (O.) polygyratus* has been reported (cf. WEBER, 1939, TRAUTH, 1948) from the southern margin of the Helvetic nappe in Southern Bavaria (near Großweil at Lake Kochel, south of Munich), and similar forms like *O. (O.) tizianiformis* (CHOFFAT) have been described in the 'Pienidic Klippen Belt' farther to the east (Waidhofen a.d.Ybbs, Upper Austria). It may be assumed that all these occurrences had their original place like the ammonite of the Hochstegen Marble on or near the southern margin of the Helvetic sedimentary basin.

An immigration from the originally more southerly situated sedimentary basin of the Northern Calcareous Alps would be theoretically possible, but not much is known about the ammonite fauna of Oxfordian time in this area (cf. TRAUTH, 1948), since most sediments of this time are represented by radiolarites.

In the area of the sedimentary basin of the Southern Alps *O.(O.) polygyratus* and *O. (L.) evolutus* are known from the Trento region (SARTI, 1988); but the rather long palinspastic distances make an immigration from this area not very probable.

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Authors' address:
Dipl.-Geol. Wolfgang Kiessling, Prof. Dr. Arnold Zeiss, Institut für Paläontologie, Loewenichstr. 28, D-8520 Erlangen, Bundesrepublik Deutschland

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Explanation of plates

Plate 1

Fig. 1–5: *Complexapora tirolica* n.gen. n.sp., Holotype, HM 5.23-2. 1 – Antapical view showing no aperture, x 470; 2 – oblique apical view showing details of the cephalothorax and of sutural pore-field, x 750; 3, 4 – lateral views with 90° tilt, x 305 and x 340; 5 – oblique apical view of the whole specimen, x 340.

Fig. 6: *Complexapora tirolica* n.gen. n.sp., Paratype, HM 5.21b-1. Lateral view. Arrow points to sutural pore field, x 315.

Fig. 7–9: *Complexapora tirolica* n.gen. n.sp., HM WH2-H-1. 7 – Oblique lateral view, x 385; 8 – look into the test showing basal opening of the depressed thorax, x 750; 9 – oblique apical view with deeply depressed sutural pore field, x 410. This specimens differs slightly from the others in its irregulary distributed thorax pores and its more elliptical sutural pore-field, but is assigned to the same species.

Fig. 10–11: *Complexapora* sp. A, HM 5.5b-1. 10 – Lateral view showing a very large sutural pore-field, the ledge with massive pyrite crystals is part of the sheared back of the abdominal segment, x 450; 11 – apical view, x 435.

Fig. 12: *Complexapora* sp. B, HM 5.31-2. Lateral view, x 435 x. This specimen could also be a juvenile form of *Complexapora tirolica.*

Plate 2

Fig. 1–2: *Complexapora tirolica* n.gen. n.sp., HM WH2-H-2. Broken specimen showing good view of the cephalothorax morphology. 1 – oblique lateral view of the cephalothorax, x 800; 2 – lateral view of the whole specimen, x 360.

Fig. 3: *Hemicryptocapsa*(?) sp. A, HM 5.5b-2. Very well preserved radiolarian with a large simple sutural pore surrounded by abdominal pores, x 330.

Fig. 4–5: *Gongylothorax siphonofer* DUMITRICĂ, HM 5.45b-1. 4 – Lateral view showing broken imperforate cephalis and slightly oblique aperture, x 660; 5 – oblique antapical view with aperture tube, x 470.

Fig. 6: Radiolarian, nearly recrystallized to a pyrite monocrystal. Grain growth of the pyrite is mainly due to postdeformational heating. HM 5.38, x 375.

Fig. 7: *Zhamoidellum ovum* DUMITRICĂ, HM 5.23-5. Nearly perfectly preserved specimen showing distinct pore enlargement to the distal part of the test, x 340.

Fig. 8–10: *Gongylothorax*(?) *marmoris* n.sp., holotype, HM 5.31-1. 1 – Lateral view, x 480 x; 2 – antapical view with tetragonally rimmed aperture, x 550; 3 – apical view showing a possible sutural pore (arrow), x 470.

Fig. 11–13: *Gongylothorax favosus* DUMITRICĂ, HM 5.23-7. 11 – Lateral view showing a very small cephalis at the top, x 425; 12 – apical view with a distinct sutural pore (arrow), x 425; 13 – antapical view with a small but distinct aperture in the centre, x 425.

Fig. 14: Broken tricyrtoid nassellarian with a pseudo-sutural pore in a sutural position, HM 5.23-20, x 485.

Plate 1

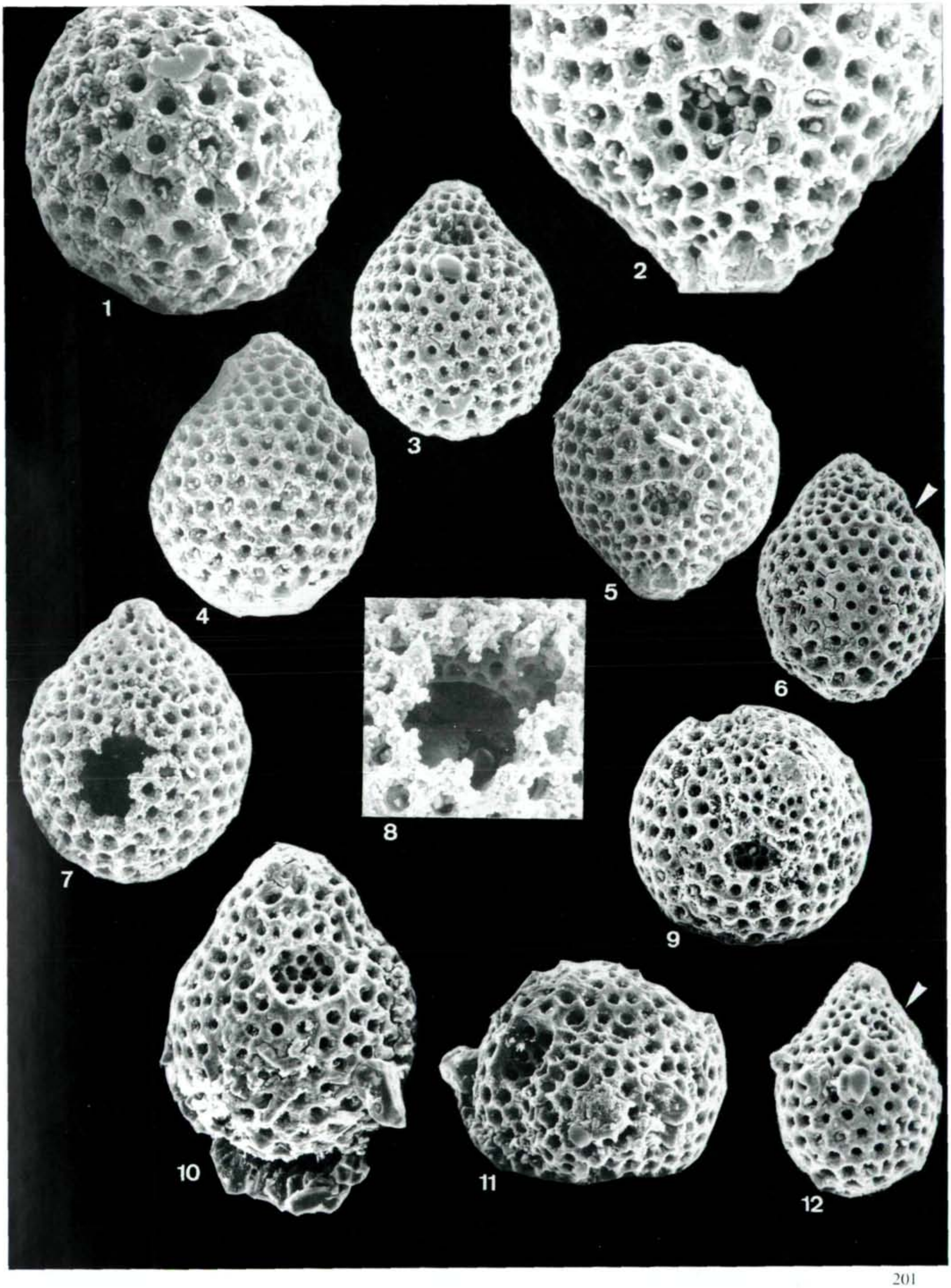

Plate 2