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KRUTZSCHIDINIUM, A NEW DINOFLAGELLATE CYST-GENUS FROM THE MIDDLE EOCENE OF THE EGELN-BROWN COAL BASIN (CENTRAL GERMANY)

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ABSTRACT. A new peridinoid dinoflagellate cyst-genus with the type-species *Krutzschidinium spinosum* n. gen. n. sp. is described from a nearly monospecific dinocyt assemblage of the so-called "Leitschicht I", a stratigraphic marker horizon of the Middle Eocene in the Egeln-Brown Coal Basin (Central Germany).

KEY WORDS: *Krutzschidinium* n. gen., Dinoflagellates, Eocene, Germany

INTRODUCTION

In the course of a study of some slides of the so-called "Leitschicht I", a stratigraphic marker horizon in the Middle Eocene section of some boreholes in the Löderburg-area of the Egeln-Brown Coal Basin (Figs 1, 2), a possibly lagoonal-estuarine dinoflagellate cysts assemblage, dominated by a new cyst-genus, was discovered. Samples of the type horizon of this new genus were previously examined for pollen and spores by Dr H. Blumenstengel (GFE Jena) to whom the author is grateful for leaving slides and maceration recidues for preparation and examination with light– and scanning electron microscope.

Gratitude is further expressed to Dr. B. Ullrich (Minning Academy of Freiberg) for making SEM-photomicrographs on a TESLA BS 340 microscope and to Dr. A. Lenk (Minning Academy of Freiberg) for helpful linguistic corrections.

The type material is stored in the collections of the Paleontological Laboratories of GFE Freiberg (Saxony).

To incorporate the new genus in a classification system of dinoflagellate cysts, the author followed the cyst-lineage concept proposed by Wall and Dale (1968) and enlarged by Williams (1977).

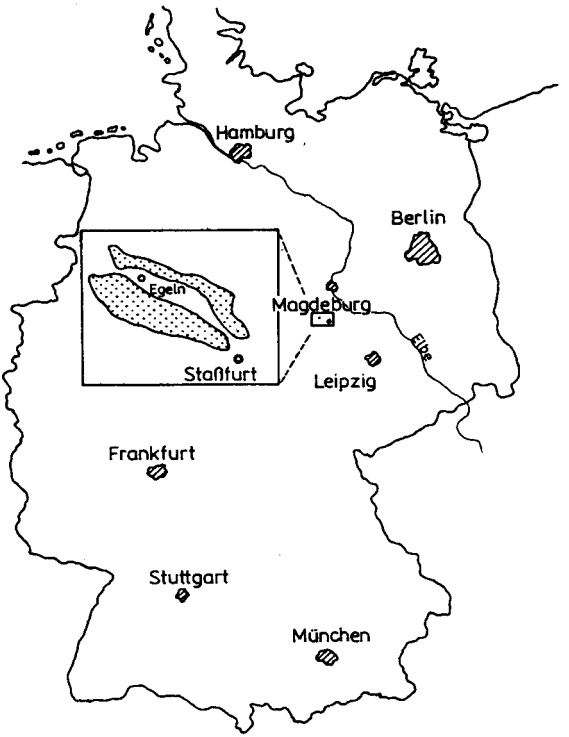


Fig. 1. Schematic sketch of geographic position of the Egeln–Brown Coal Basin in form of two narrow elongated depressions on both flanks of a salt structure

STRATIGRAPHY AND CYST ASSEMBLAGE OF THE "LEITSCHICHT I"

The following gives an incomplete survey about the most common other dinocyst species of the type horizon:

Apectodinium homomorphum (Delf. & Cooks.) Lent. & Will.
Achilleodinium biformoides (Eisenack) Eaton
Ascostomocystis laevigatus Chateauneuf
Areoligera senonensis Lejeune – Carpentier
Cymatiosphaera spp.
Homotryblium pallidum Davey & Williams
Lingulodinium machaerophorum (Delf & Cooks.) Wall
Paralecaniella indentata (Def. & Cooks.) Cooks. & Eis.
Polysphaeridium zoharyi (Rossignol) Bujak et al.
Polysphaeridium zoharyi (Ross.) Lent. & Will.
Spiniferites pseudofurcatus (Klumpp) Sarjeant
cf. *Phelodinium pachyceras* Liengjarern et al.

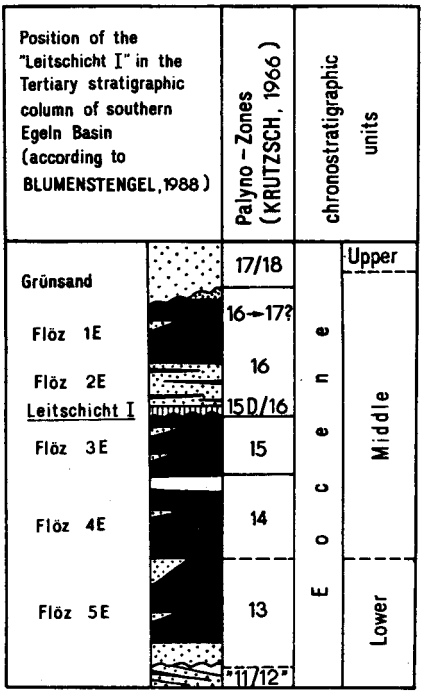


Fig. 2. Simplified scheme of stratigraphic sequence in the Egeln–Basin with major brown coal seams ("Flöze") and the type horizon of *Krutzschidinium spinosum* n. gen. n. sp.

Comparing the known stratigraphic ranges of all these species, a relatively long intervall of Middle Eocene to Middle Oligocene age seems to be possible for this horizon.

Blumenstengel (1988, in print) found a pollen assemblage of zone 15D/16 according to the palynological zonation of Krutzsch (1966). His stratigraphic interpretation restricts the age of the type horizon to Middle Eocene (see text-fig. 2), which is correlated with palyno-zone Bo 1 of Helmstedt in the F. R. G. (Pflug 1968).

Krutzschidinium spinosum n. gen. n. sp. is the predominant element of the cyst assemblage (about 80% of all specimen). The species diversity is very low in contrast to numerous individuals of *Krutzschidinium* . Examining the slides under low magnification, *Krutzschidinium* –specimen seem to be closely related to some *Apectodinium* species (to those with tendency to penetabular or parasutural arrangement of spines), especially in oblique position with no archaeopyle structure to be seen. These new forms may represent an ecological substitute of the *Apectodinium homomorphum plexus* sensu Harland (1979).

Nearly monospecific assemblage with *Apectodinium* species are described by Chateauneuf (1980) from the Auversien of Paris Basin as well as from Lower Eocene deposits (Sparnacien) of the same area (Gruas – Cavagnetto 1967).

These assemblages have been interpreted by various authors indicating a decreasing water salinity in restricted lagoonal or estuarine environments. The author supposes the

same conditions in the type horizon of *Krutzschidinium spinosum* n. gen. n. sp. In the slides all other dinocyst-species occur with very low frequencies.

SYSTEMATIC DESCRIPTION

Division *Pyrrophyta* Pascher 1914
Class *Dinophyceae* Fritsch 1929
Order *Peridiniales* Haeckel 1894
Peridinoid cyst-lineage
***Krutzschidinium* n. gen.**

Derivation of name. In honour of Dr Wilfried Krutzsch, Museum of Natural Sciences of Humbolt Universiyty, Berlin.

Type species. *Krutzschidinium spinosum* n. sp., Middle Eocene (Leitschicht I), Egeln-Brown Coal Basin, borehole Löderburg 582/82.

Diagnosis. Cornucavate to slightly circumcavate cysts with a characteristically rounded pentagonal outline and a considerable dorsoventral compression.

One apical and two antapical distinct horns are located symmetrically to the longitudinal cyst-axis. They are triangular in shape with some spines giving them a more irregular branched appearance. Periphragm and endophragm are very delicate and pale and nearly always in close contact with one another except at the horn bases. Short, bulbose, spine-like processes arise from the periphragm and seem to be distributed in a parasutural pattern.

Cingulum and sulcus are broad, displaying almost no indentation, they may be bordered by parasutural rows of processes. If decipherable, tabulation pattern is typically peridinoid: 4', 3a, 7", Xc, 5"', 2"", Xs, but often very incompletely developed. Archaeopyle of variable type: the most common one is the 31 (1a–3a) – type, but archaeopyle formation rarely varies to include apicals (?tAtI) or to be a simple I (2a)–type.

Remarks to the generic diagnosis. The basic dorsal tabulation style seems to be a penta-style (compare Figs 3E, 3F and 3G with the figures on the plates), but outline of archaeopyle and run of other dorsal parasutures indicated by spiny crests also suggests the presence of quadra (and hexa?) style. Further observations are necessary to elucidate the real conditions.

Discussion. The presence of variable archaeopyle type and parasutural arrangement of process-bearing crests makes *Krutzschidinium* most closely to the *Phthanoperidinium* – complex sensu Evitt (1985).

Significant differences between those two genera are the doubtless presence of a penta dorsal tabulation style in *Krutzschidinium*, the predominance of 3I-archaeopyle type (this type is not included in the emended diagnosis of *Phthanoperidinium* by Islam, 1982, although it is present, for instance, in *P. crenulatum* (De Coninck) Lentin & Williams emend. Heilmann-Clausen), the over all shape (strongly rounded pentagonal versus subshaerical to ellipsoidal), the prominence of the horns (always distinct in *Krutzschidinium*, sometimes reduced to almost lacking in *Phthanoperidinium* and size

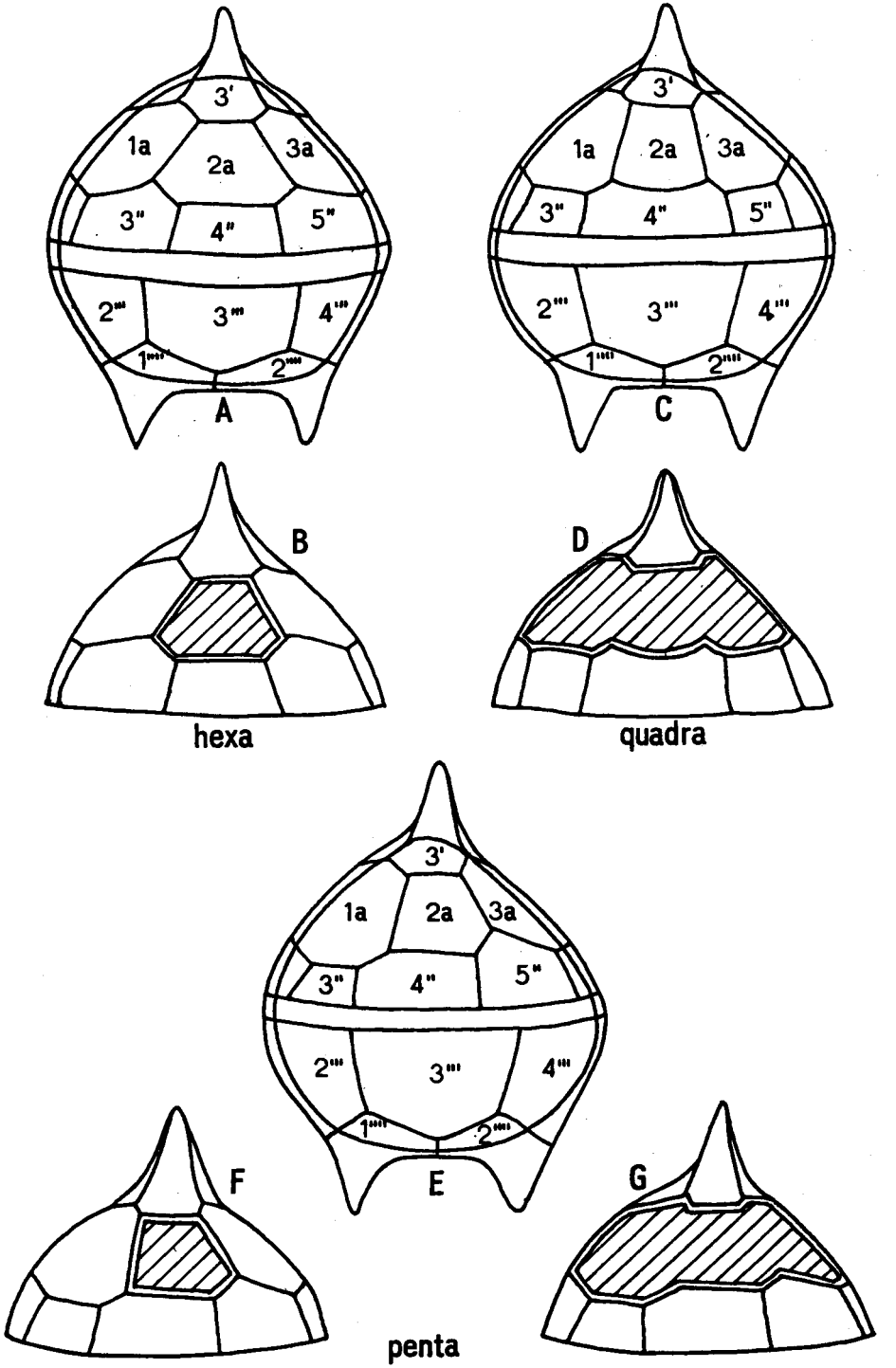


Fig. 3. Sketches of all probably occuring dorsal tabulation styles with the most common intercalary archaeopyle types A, B..hexa style with single plate standard I (2a) – type C, D.. quadra style with the common 3I (1a–3a) – type E, G..penta style with single plate I (2a) – and 3I (1a–3a) – archaeopyle types

(overall lenght of the new genus under study 60–90 µm versus 30–50 µm of most *Phthanoperidinium* species).

The species of *Apectodinium* Costa & Downie, even those with penetabular arrangement of spines, show a non-variable I (2a)–archaeopyle of quadra-style. These features also separate *Wilsonidium* Lentin & Williams from the new genus, which resambles it in parasutural distribution of spines. *Trithyrodinium* Drugg species have almost smooth surfaces but resemble *Krutzschidinium* in predominating archaeopyle type (3I) and cyst-nature.

Ginginodinium Cookson & Eisenack differs from the genus under study in having distinctly prominent paracingulum and parasulcus and in lacking parasutural arranged processes, although showing a similar outline and archaeopyle-type.

Trivalvadinium Islam is closely related to the new genus concerning the dilicate cyst-nature, relationship of both phragma layers and the presence of a 3I (1a–3a)–archaeopyle; however, prominent horns and parasutural arranged processes are lacking.

Nevertheless, both *Trivalvadinium* and *Krutzschidinium* seem to be in close relationship with *Apectodinium plexus*, because all three genera favour an environment with reduced salinity.

Krutzschidinium spinosum n. sp.

Fig. 4a–h; Pl. 1, figs a–h; Pl. 2, figs a–e

Derivation of name. In order to describe the spine-like nature of processes.

Type horizon. "Leitschicht I", Middle Eocene, Egeln-Brown Coal Basin.

Holotype. Borehole Löderburg 582/82; preparation 27/1A; coordinates: 6.2/113.0 (Ergaval-microscope, Carl-Zeiss Jena).

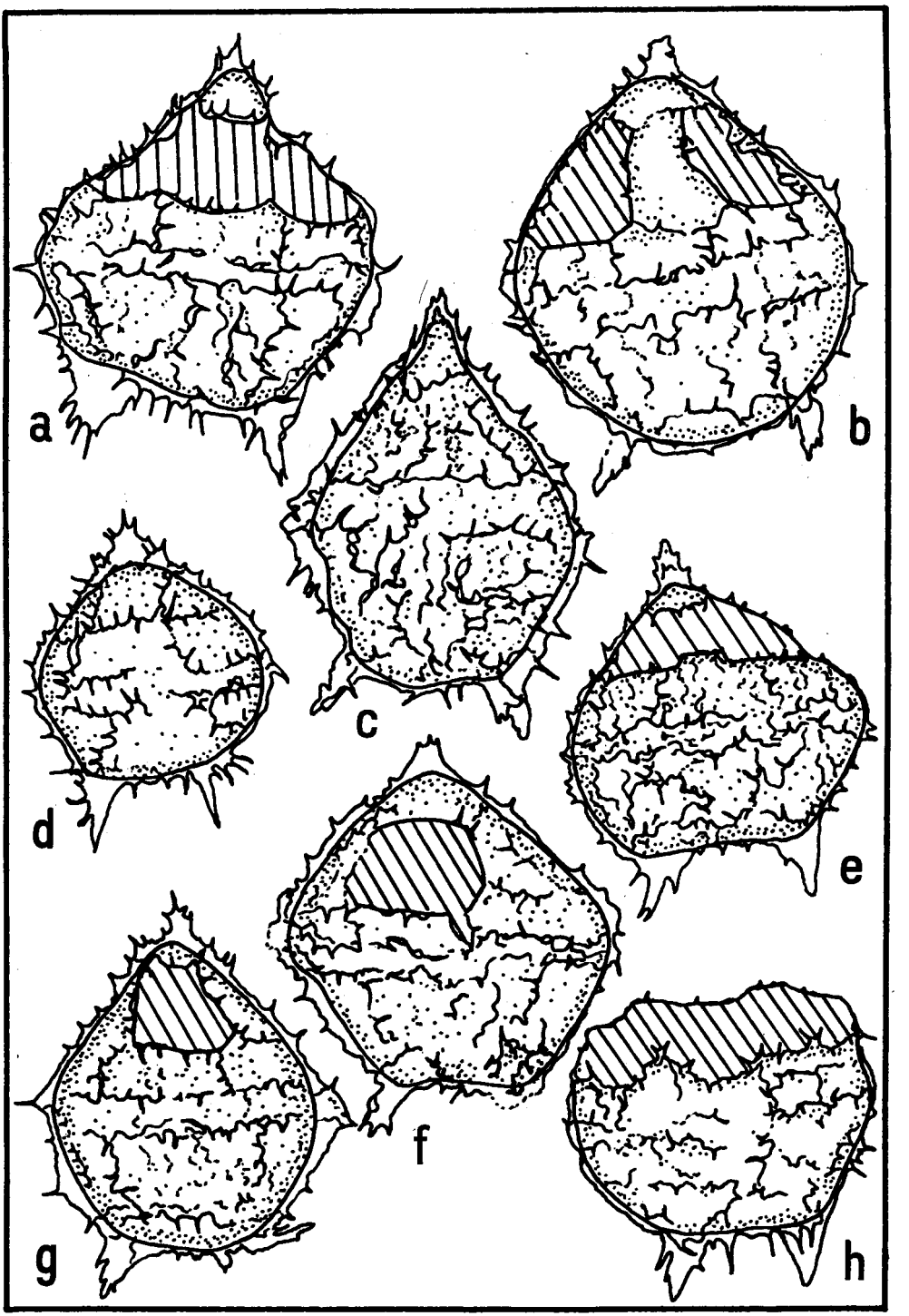
Paratypes. Lö 582/82; 27/1A; 7.3/106.9, Lö 582/82; 27/3; 6.3/104.5, Lö 561/82; 54/2; 15.1/108.1

Diagnosis. A species of *Krutzschidinium* with characteristic bulbose ending spines, which together with discontinous membraneous ridges incompletely delineate a tabulation typical for the genus.

The most frequently observed dorsal paratabulation style seems to be a penta one, but the quarda-(and hexa?) style are probably present, too.

Archaeopyle of variable type: 3I (1a–3a), I (2a) and ? tAtI.

Fig. 4. a – specimen with probably quadra 3I (1a–3a) – archaeopyle; borehole Löderburg 582/82; preparation 27/3; coordinates 6.3/104.5; paratype. b – specimen with penta 3I (1a–3a) – archaeopyle; paraplate 2a in situ, showing a clearly pentagonal outline; Lö 582/82; 27/1A; 6.2/113.0; holotype. c – specimen with operculum in situ, tabulation obscured by wrinkles and incompletely delineated; Lö 582/82; 27/3; 11.4/118.9. d – small specimen, operculum in situ?, probably with quadra dorsal tabulation style; Lö 561/82; 54/2; 11.0/116.8. e – specimen with probably quadra 3I (1a–3a) – archaeopyle; Lö 582/82; 27/2; 173/103.8. f – specimen with questionable. single-plate (standard hexa) I (2a) – archaeopyle; Lö 582/82; 27/2; 12.8/105.9. g – specimen with penta dorsal tabulation style and single-plate I (2a) – archaeopyle; Lö 582/82; 27/1A; 7.3/106.9; paratype. h – specimen without apical patr of epicyst, detachement of apicals and intercalaries as a regular operculum or accidental ?; Lö 561/82; 54/2; 15.1/108.1; paratype. (All drawings with a magnification of about x 500)


a
b
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d
e
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g
h

Description/Discussion. Strongly dorsoventrally flattened cornucavate cysts with pentagonal-rounded shape, which may be either somewhat elongated or compressed in apical-antapical direction.

The horns, whose general shape is roughly triangular, may be branched irregulary by spine-like processes, arising from the periphragm at the parasutures. They are sharply set off from the cyst body but may be difficult to recognize in oblique view.

The sutural arranged spines may be numerous and relatively long (up to 10 µm), but additionally specimen with sparsely distributed tiny processes (0.5–4 µm) occur. The reduction of process-density and –lenght is often connected with a more bellied outline of the cyst and appears to be controlled by environmental variations.

The arrangement of spine-like processes and the discontinuous membraneous ridges incompletely delineate a peridinoid paratabulation with penta–, probably quadra– (and hexa?) dorsal styles. Position and run of parasutural ridges are often very difficult to be observed under the light microscope, because many parasutures are only indicated by one or two spine bases and therefore often obscured by irregular periphragmal folds.

Even observations with interference-phase-contrast microscope and with SEM cannot always elucidate the dorsal patterns as shown in the schemes at Fig. 3, because most of the observed specimen were intensively folded or crumpled.

Paracingulum and parasulcus are not indented and weakly delineated by spinose crests. If the specimen is in oblique position with wrinkled and folded phragma layers paracingulum and parasulcus often cannot easily be discerned.

Periphragm endophragm without any ornamentation besides the spiny processes and closely appressed. Except at the horn bases, occasionally very narrow ambital pericoels occur.

The ventral surface seems to display an ortho-tabulation style, but this has to be proved by further examinations.

Examining about 50 specimens for archaeopyle structure, the 3I (1a–3a)–type appeared to be by far the most common. The tAtI-type could not easily be recognized because many epicysts were damaged by accidental ruptures after detachment of operculum. This type is represented by very few individuals, the apical parts of which may have been cut off along the anterior boundary of precingulars. A remarkable percentage of the observed cysts showed operculi in situ with no or almost no split of archaeopyle sutures. Simple I (2a)–types rarely occur.

Dimentions. endocyst length 51 (63)74 µm; endocyst width 44(57)68 µm; pericyst length 63(80)95 µm; pericyst width 50(65)78 µm, horns (apical and antapicals are nearly equal in length, measured together) 7(12)17 µm, length of spine-like processes 0.5(7)10 µm, (25 specimens measured).

APPENDIX

A comparision of the type-species with some photomicrographs of *Apectodinium sumissum* (Harland) Costa & Downie (see Costa & Downie 1979, pl. 1, fig. 2) shows a close relationship in overall

appearance between these two species.

Unfortunately the author couldn't obtain the type material and the type literature of Harland's species yet.

A restudy of archaeopyle structure and process arrangement of the type material is necessary in order to elucidate whatever the two species are conspecific or not. In the case of being synonymes the correct name of *Krutzschidinium* type species would be *Krutzschidinium sumissum* (Harland).

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PLATES

Plate 1

a, b. holotype in dorsoventral view with focus on paracingulum and antapical horns in fig. a and on the 3I-intercalary archaeopyle with penta–2a paraplate in situ in Fig. b; compare Fig. 4b

c. specimen in dorsal view with focus on paracingulum and archaeopyle margin; compare schematic drawing on Fig. 4e

d. paratype in dorsal view with focus on the single-plate penta? – 2a – archaeopyle, compare schematic drawing on Fig. 4g

e. small specimen in dorsal view with a probably quadra – 2a para-plate; compare schematic drawing on Fig. 4d

f. paratype with detached apicals and anterior intercalaries; compare schematic drawing on Fig. 4h

g, h. paratype in dorso-ventral view with focus on ventral surface with incompletely reflected and obscured parasutures in fig. g and on dorsal surface with margin of 3I-archaeopyle in fig. h, compare schematic sketch on Fig. 4a (all figures x 320)

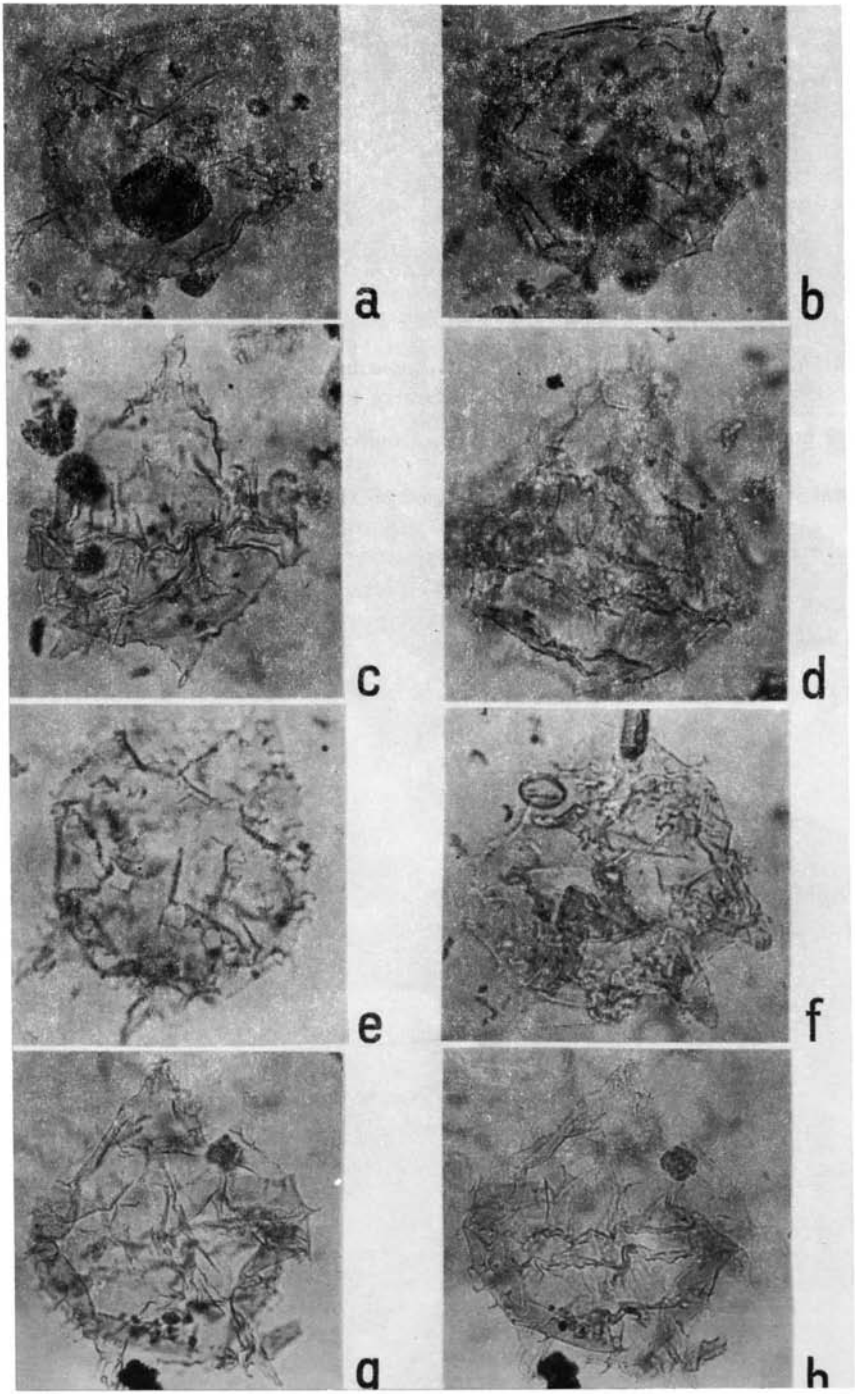

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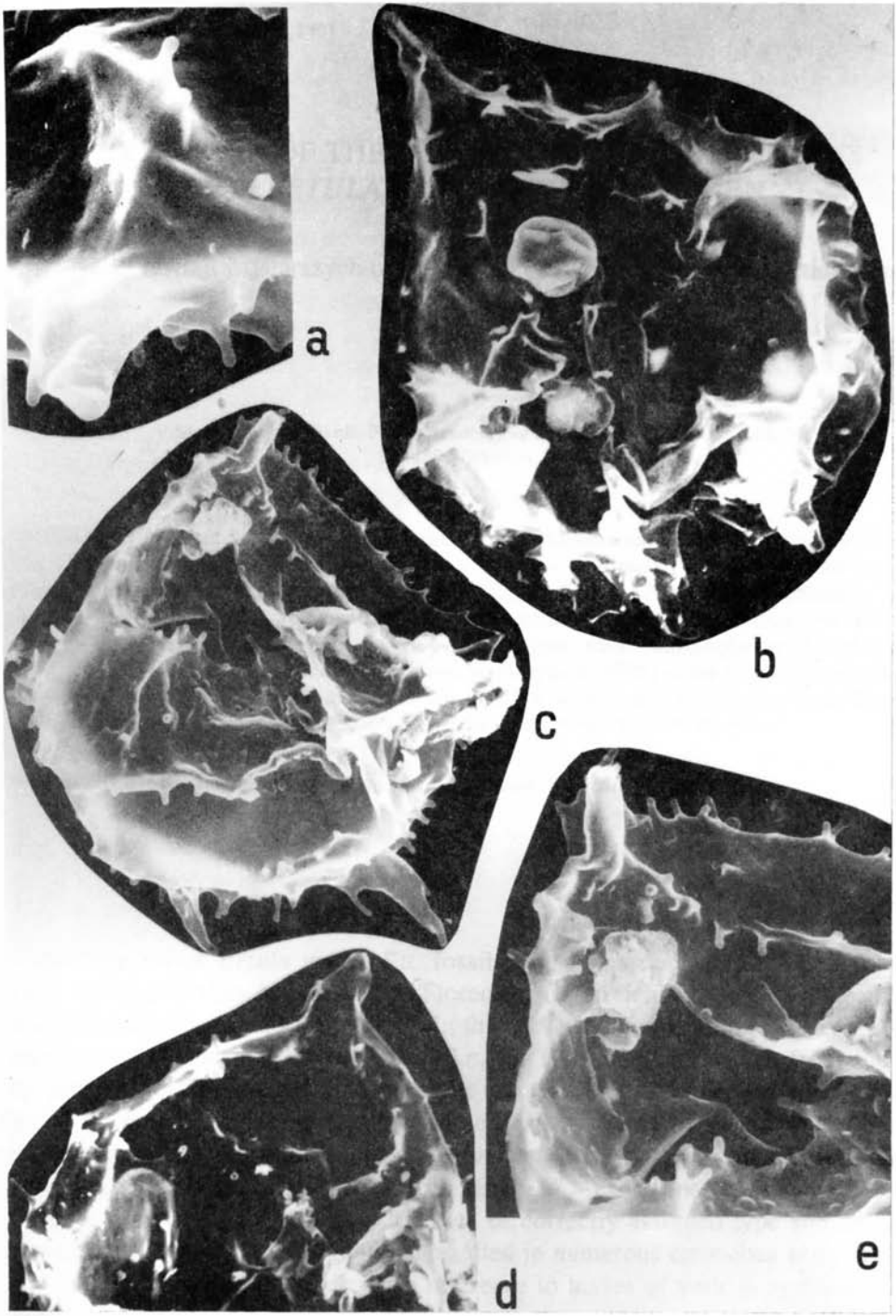
Plate 2

SEM-photomicrographs of *Krutzschidinium spinosum* n. gen. n. sp.
from the SEM-sample Löderburg 1

a. detail of antapical horn showing parasuture 2'''/1'''' and bulbose ending, spine-like processes; x 3000
b. specimen in ventral view, showing incompletely expressed parasutures (slightly obscured by debris); x 1000
c. specimen in dorsal view with clearly parasutural arrangement of processes and penta? – 2a-archaeopyle; x 800
d. detail of epicyst with 3I–intercalary archaeopyle; x 1000
e. detail of fig. c; x 2000



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