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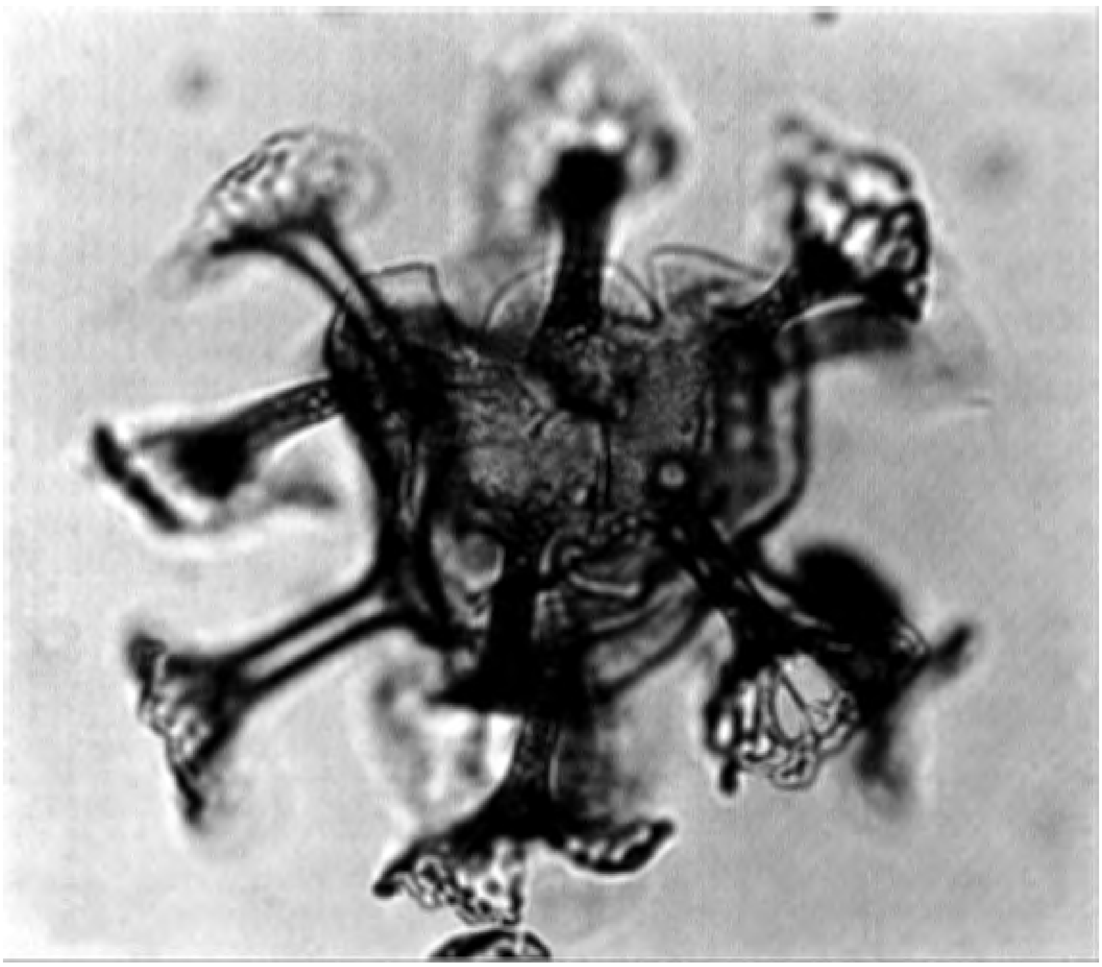
Jan DECONINCK



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frontispice: Areosphaeridium diktyoplokus (Klump, 1953), Plate 1 fig. 16.

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ORGANIC-WALLED MICROFOSSILS IN THE OLIGOCENE GRIMMERTINGEN AND NEERREPEN SAND MEMBERS FROM THE GRIMMERTINGEN TYPE LOCALITY.

Abstract. Rich assemblages of organic-walled microfossils are present in the Grimmertingen Sands and Neerrepen Sands sampled in the type section of the Grimmertingen Member. Comparison with the distribution of the taxa in the Upper Eocene and Lower Oligocene deposits in the Kallo borehole and in the Rupelian type area point to a correlation with the upper part of the Bassevelde Sands Member, and with the Watervliet Clay and Wintham Silt Members. The distribution of taxa with paleoenvironmental significance indicate a cooling trend in the upper part of the Grimmertingen Sands and a subsequent phase of lowering sea level corresponding with the Neerrepen Sands. One new species, and three species under open nomenclature are described.

Key-words: organic-walled microfossils - Eocene-Oligocene - Lower Tongrian - Belgian Basin.

1. INTRODUCTION

The stratigraphic term "Tongrian" was introduced by Dumont in 1839 and more precisely defined in 1852 by Dumont and by Lyell. For the history of the Tongrian as a concept, see Glibert and de Heinzelin (1956, p. 189).

In the Tongrian Stage, the Grimmertingen Sands Member and the Neerrepen Sands Member constitute the lower Tongrian St. Huibrechts-Hern Formation (Figure 4). Both members were deposited in a marine environment. In the Tongeren area the Henis Clay overlies the Neerrepen Sands; in this Henis Clay marine influence was very limited: only a few organic-walled dinoflagellate cyst taxa can be found, with *Gerdiocysta conopeum* and *Glaphyrocysta* aff. *microfenestrata* dominating the assemblage. Between the Neerrepen Sands and the Henis Clay a hiatus occurs, represented at the top of the Neerrepen Sands by a soil which obviously developed under continental conditions. The overlying Henis Clay and the Sands and Marls of Alden Biesen (Oude Biezen) represent the Upper Tongrian Borgloon Formation in the area to the north of Tongeren. In the Sands and Marls of Alden Biesen marine influence is somewhat more pronounced than in the Henis Clay. More to the west, between Leuven and Tienen, the continental Hoogbutsel Horizon is found on top of the Neerrepen Sands. This horizon is famous for its continental fossils representing a fauna postdating the "Grande Coupure", a term introduced by Stehlin (1909, p. 502-508) to emphasise the profound change of the mammalian fauna as observed in the Paris Basin between the Upper Ludian Marnes blanches and the Lower Stampian Calcaire de Brie.

The "Grande Coupure" corresponds in fact with the most important eustatic lowstand of the Late Eocene - Early Oligocene time span. It marks the disappearance among the dinoflagellates of *Areosphaeridium diktyoplokus* and *Rhombodinium perforatum* in deposits from the warm- and cold-temperate marine domain of the northern hemisphere. Some 200.000 to 300.000 years earlier (according to Pomerol & Premoli-Silva, 1986, p.11) one observes the disappearance of the Hantkeninidae and the *Turborotalia cerroazulensis* group among the surface dwelling planktonic foraminifers found in deposits from the tropical to warm-temperate oceanic domain (Brinkhuis & Visscher, 1995). The disappearance of the Hantkeninidae has been chosen in 1989 as the event marking the Eocene-Oligocene transition. This choice was ratified in 1992 and the Massignano section in Italy near the northwest coast of the Adriatic Sea was indicated as the boundary stratotype.

The organic-walled microfossil assemblages in the Grimmertingen and Neerrepen Sands predate the "Grande Coupure" and postdate probably for the greater part the disappearance of the Hantkeninidae (Brinkhuis, 1994; Brinkhuis & Visscher, 1995; Stover & Hardenbol, 1994). Weyns (1970) has studied the organic-walled microfossils in two samples from the Grimmertingen Sands in the type section. A more complete investigation of these microfossils is necessary if correlations with the Eocene-Oligocene transitional deposits in the northwestern Belgian Basin are to be proposed. Organic-walled microfossils in these transitional deposits have been studied in the Woensdrecht and Kallo boreholes and in the Rupelian type area (De Coninck, 1986, 1995, 1999; Stover & Hardenbol, 1996). The sequence in the Kallo borehole seems hitherto the most complete and therefore the best one to use for biostratigraphic purposes and for better definition of the lithostratigraphic type section.

2. MATERIAL

Localisation

The Grimmertingen type section was studied and sampled in 1968 by the Paleontology Lab of Ghent University in the small sand quarry at the bifurcation of hollow roads and in a boring at the base of that quarry (Martini and Moorkens, 1969; Weyns, 1970). The outcrop does not exist anymore. It was situated at 50° 49' 22" latitude N. and 5° 25' 54" longitude E and lies about 450 m E-N-E of the hamlet of Grimmertingen which is part of the commune of Kortessem-Vliermaal about 2 km more to the north (Figure 1).

Sedimentary characteristics and sampling

The 0-m level chosen to measure the thickness of the deposits in the quarry lies at about +66 m T.A.W. (Tweede Algemene Waterpassing) at a bifurcation of the hollow road (Figure 2). The boring was undertaken at the base of the quarry. Its 0-m level was situated 30 cm higher than the 0-m level at the road bifurcation. The boring was stopped at about -12.8 m below surface without reaching the base of the Grimmertingen Sands.

The Grimmertingen Sands are fine, glauconiferous and micaceous. They are bioturbated and shells of the lamellibranch *Cubitostrea ventilabrum* occur, sometimes concentrated in layers. From the base of the boring at -12.8 m up to -9.15 m below the surface the sand is dark blue because of the reducing environment underneath the lowermost groundwater level. Above this level the sand becomes green brown with rusty patches, as a result of the fluctuations of the groundwater level. Around +2.6 m in the Grimmertingen Sands some clay lenses and some concentrations of gastropod shells occur. A reddish, indurated layer forms the top of the Grimmmertingen Sands at +3 m.

From +3 m up to about +6 m one encounters the Neerrepen Sands which are gray green, glauconiferous, micaceous and somewhat coarser than the Grimmertingen Sands, but not as much bioturbated and very finely stratified with cross-bedding. Clay lenses occur around +3.5 m and clayey mud balls near +4.4 m. In the top part of the Neerrepen Sands, just above an oxidised argilaceous layer, tubular structures, called "fleurettes bifides et trifides" by Glibert & de Heinzelin (1954, p. 307), are found. Above +6 m Pleistocene loam covers the Neerrepen Sands.

Martini & Moorkens (1969) studied the calcareous nannofossils from the Grimmertingen section, and Willems (1972) the benthonic foraminifera, ostracoda and bryozoa.

For the present study the following samples have been examined: GMB 27 (-12 m), GMB 23 bis (-9.8 m), GMB 17 (-7.3 m), GMB 7 (-3.3 m), GM 3 (+0.9 m), GM 7 (+2.15 m), GM 9 (+2.6 m) and GM 15 (+4.4 m).

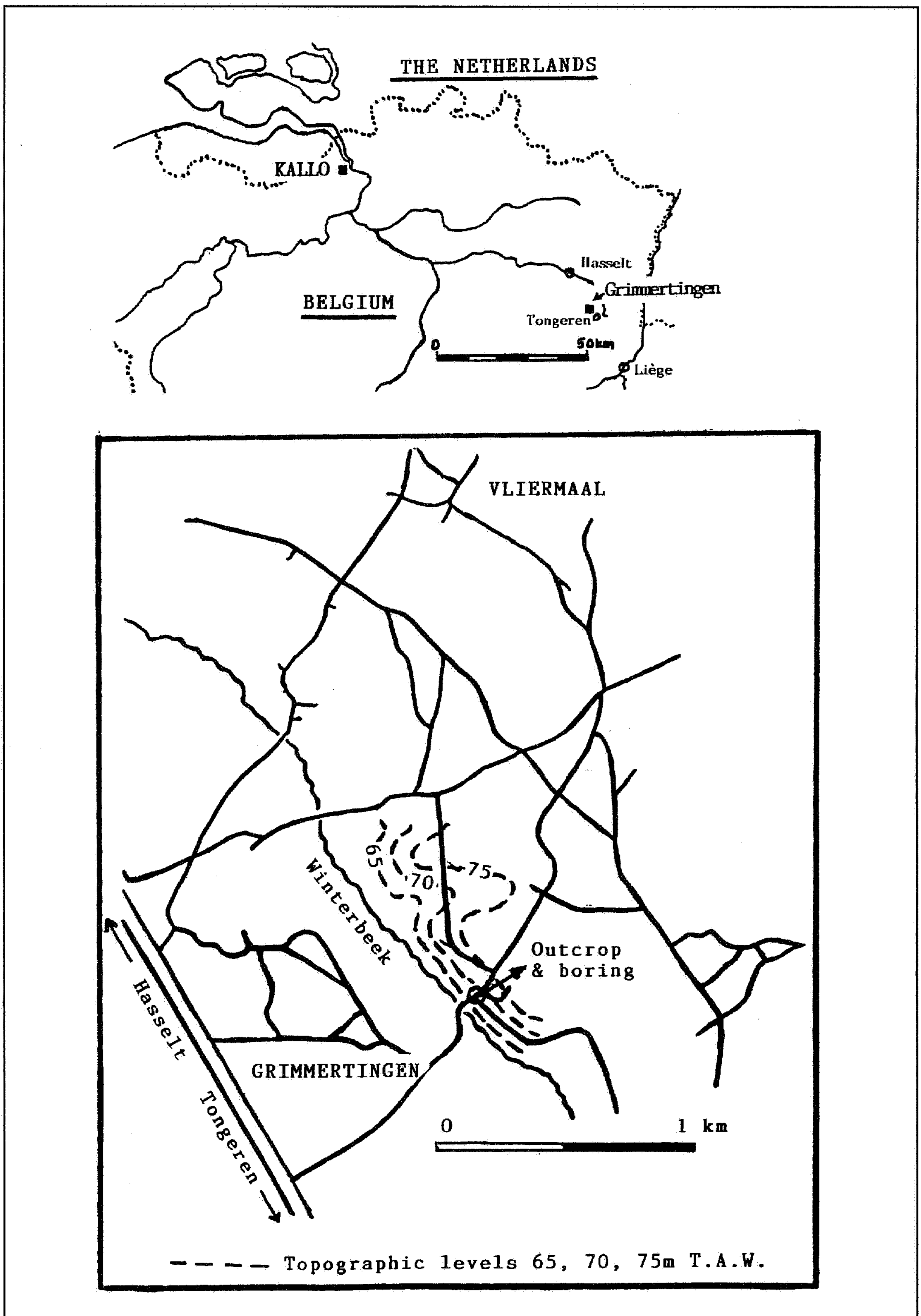

Figure 1: Location of the Grimmertingen section.

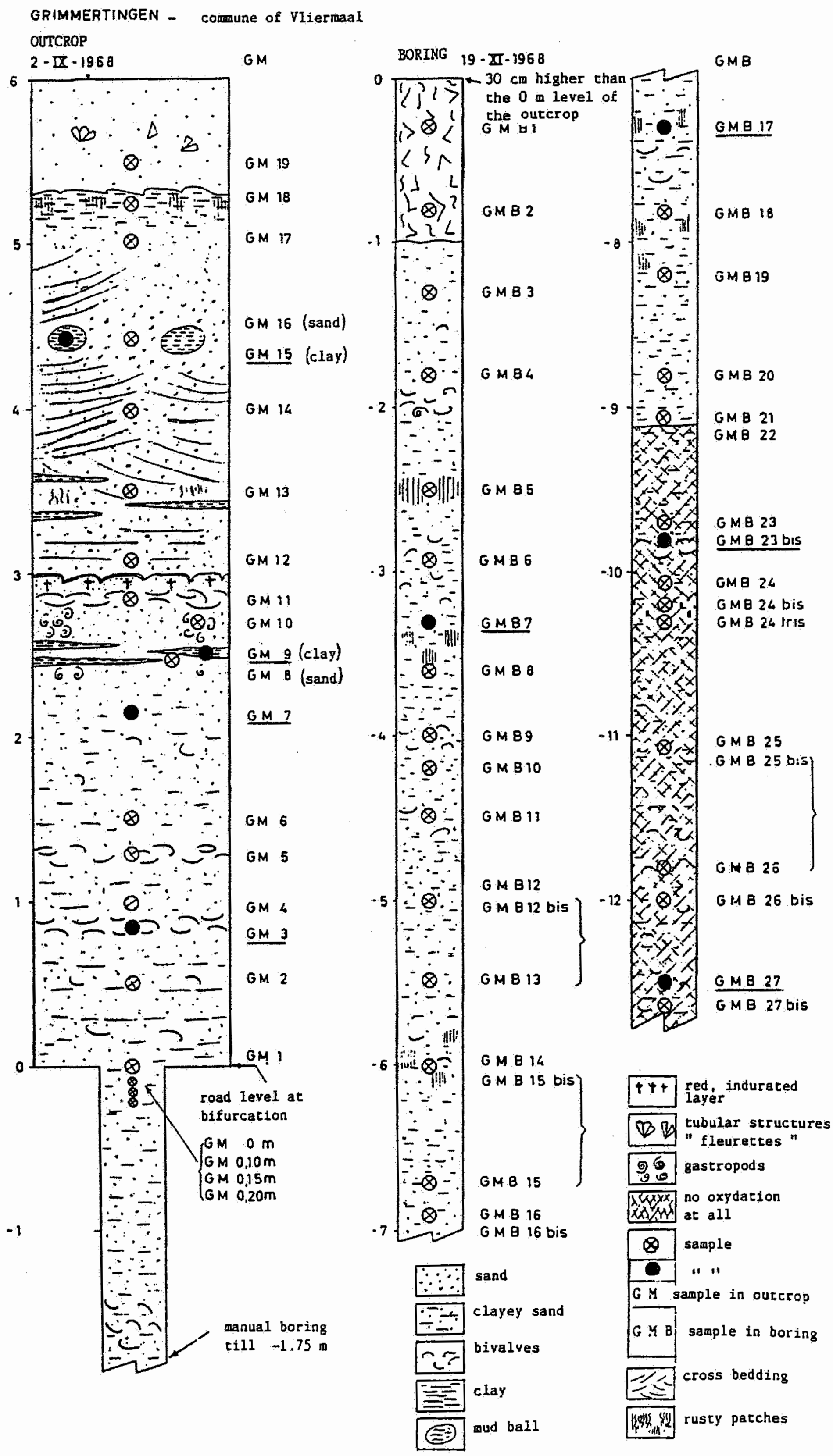

Figure 2: Lithology of the Grimmertingen section and position of the samples.

3. ASSEMBLAGES OF ORGANIC-WALLED MICROFOSSILS

The Chlorophyceae are represented by 3 taxa, the Dinophyceae by 171 taxa among which 13 at least are reworked from Jurassic up to Early Eocene deposits. The Prasinophyceae furnish 17 taxa. One form is probably a Zygnemataceae zygote. Acritarcha are represented by 13 taxa (Table 1).

As a result of the comparison of the assemblages in the Grimmertingen and Kallo sections, several taxa which had not been recognised during earlier investigations in the Kallo section (De Coninck, 1995, 1999) have now been recorded in the assemblages of the Kallo boring; they are listed in Table 2. These taxa are: *Areosphaeridium michoudii*, *Homotryblium* sp. 1 in Damassa *et al.* (1990), *Glaphyrocysta laciniiformis*, *Hystrichosphaeridium* sp. BE in Brideaux (1977), *Flandrecysta* ? sp. A (which was listed among *Lophocysta* sp. indet.), *Corrudinium* ? sp. aff. *C. incompositum* - *Impagidinium* (which was listed among *Impagidinium* (aff.) *torsium*), *Glaphyrocysta microfenestrata* (which was listed among *G.* cf. *reticulosa*), *Spiniferites* sp. aff. *S. elongatus*, *Hystrichokolpoma grimmertingenensis*, *Lingulodinium multivirgatum*, sp. cf. *Thalassiphora patula (with the striking resemblance to the holotype from the London Clay)*, *Nematosphaeropsis pusulosa* (which was listed among *N. reticulensis*), *Impagidinium maculatum* ? (which was listed as *I. maculatum*), *Glaphyrocysta* sp. cf. *Adnatosphaeridium multispinosum* (which was listed as *Emmetrocysta urnaformis*) and *Thalassiphora succincta* (which was listed among *Lophocysta* sp. indet.).

4. BIOSTRATIGRAPHIC CORRELATION WITH THE KALLO BOREHOLE REFERENCE SECTION

Among the taxa of organic-walled microfossils, 31 have been selected which can assist to draw biostratigraphic correlations between the Grimmertingen and the Kallo borehole sections (Table 2, Figure 3).

Examination of Table 2 reveals that only 4 of these datums had been recorded in the Kallo section below -115 m. Among them *Areosphaeridium diktyoplokus* disappears between the Wintham Silt Member and the Ruisbroek Sands Member. 21 taxa first appear in the Kallo section between -115 m and -109.5 m (upper part of the Bassevelde Sands Member up to the Wintham Silt Member). 19 taxa were not found or only sporadically recorded in the Ruisbroek Sands Member, the base of which is situated just below -108.2 m. Only 4 taxa make their first appearance in the Kallo section at -108.2 m (base of the Ruisbroek Sands Member). Twenty species of those listed in Table 2 were retained to emphasise the correlation presented in Figure 3.

Results on the Grimmertingen Sands

-12.5 m: Already present are *Areosphaeridium michoudii* (1), *Homotryblium caliculum* + *Homotryblium* sp. 1 (2) and *Hystrichokolpoma* cf. *rigaudiae* (3). At Kallo these species first appear in the higher part of the Bassevelde Sands.

-7.3 m: First appearance of *Glaphyrocysta microfenestrata* (4). At Kallo the species has been encountered in the Watervliet Clay and Wintham Silt only.

-3.3 m: Last appearance of *Glaphyrocusta* aff. *inculta* (5). First record of *Nematosphaeropsis pusulosa* (6). Both events are observed at Kallo in the Wintham Silt only.

+9.0 m: Last appearances of *Corrudinium*? sp. aff. *C. incompositum* - *Cerebrocysta bartonensis* (7), *Oligosphaeridium* sp. cf. *Hystrichokolpoma rigaudiae* (8), *Hologinella*? *corrugata* (9), *Flandrecysta*? sp. A (10) and of frequent *Areosphaeridium diktyoplokus* (11). In the Kallo section the last occurrences of these species have been recorded in the Watervliet Clay or in the Wintham Silt. *Hystrichokolpoma* aff. *cinctum* (12) recorded at +0.9 m only has been found at Kallo in the Ruisbroek Sands only.

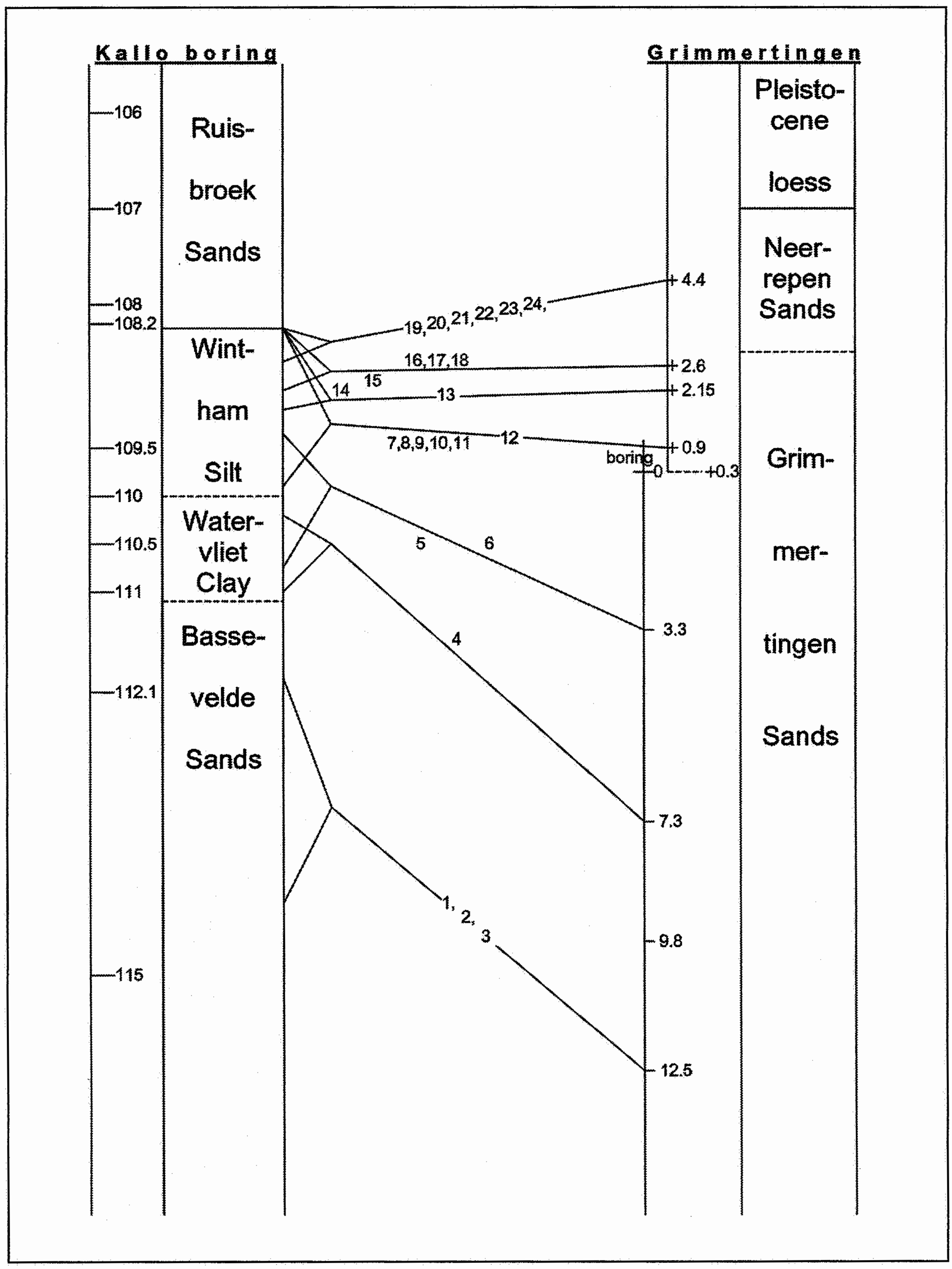

Figure 3: Biostratigraphic correlations between the Grimmertingen section and the Kallo reference section. First appearances in the Grimmertingen section are marked by numbers just above the lines tracing the correlations; last appearances by numbers just below these lines. Numbers written on the lines represent species which may eventually be found below the corresponding level (1 to 3) or above (19-24), or which have been observed at one level only (12 and 13).

+2.15 m: *Impagidinium maculatum*? (13) restricted to that level was found at Kallo in the Ruisbroek Sands only. First appearance of *Spiniferites* sp. aff. *S. elongatus* (14) which at Kallo has been encountered in the Watervliet Clay, in the Wintham Silt and in the Ruisbroek Sands.

+2.6 m: Last occurrences of *Spiniferites* sp. aff. *S. elongatus* (14) and of *Hystrichokolpoma* cf. *rigaudiae* (15). At Kallo *H.* cf. *rigaudiae* has been last recorded in the Wintham Silt. First appearance at +2.6 m of frequent *Membranophoridium aspinatum* forma B of De Coninck (1999) (16), of frequent *Glaphyrocysta* sp. cf. *Adnatosphaeridium multispinosum* (17) and of *Phthanoperidinium levimurum* (18). In the Kallo section these species are more or less regularly encountered in the Ruisbroek Sands only.

Results on the Neerrepen Sands

+4.4 m: Still present are rare *Areosphaeridium diktyoplokus* (19), *Membranophoridium aspinatum* forma A (20), *Homotryblium* sp. 1 (21), *Glaphyrocysta microfenestrata* (22), *Thalassiphora patula* (holotype-resembling form)(23) and *Nematosphaeropsis pusulosa* (24). In the Kallo section these species are still present in the Wintham Silt but are absent from, or have only sporadically been recorded (probably reworked) in the Ruisbroek Sands.

Correlation results

The correlations (Figure 3) indicate that the Grimmertingen and Neerrepen assemblages can best be compared with those encountered in the Kallo section between -115 m and -109.5 m, namely in the top part of the Bassevelde Sands Member, in the Watervliet Clay Member and in the Wintham Silt Member. The sudden drop of the frequency of *A. diktyoplokum* in the Grimmertingen section at +2.15 m and the appearance of *I. maculatum* ? (at +2.15 m), of relatively frequent *Membranophoridium aspinatum* forma B (at +2.6 m), of *P. levimurum* (+2.6 m and +4.4 m), of *G.* sp. cf. *A. multispinosum* (increase of frequency from +2.15 m up to +4.4 m) and of *H.* aff. *cinctum* (+0.9 m) have not been seen in the equivalent units from the Kallo section nor from the Rupelian type area (De Coninck, 1999). However, only one sample was examined from the base of the Wintham Silt Member in the Kallo section. It is conceivable that a frequency fall of *A. diktyoplokum* and the appearance of the four other species mentioned occurred already in the upper part of the Wintham Silt at Kallo. If not, the uppermost part of the Grimmertingen Sands Member and the Neerrepen Sands Member might correspond with a first part of the hiatus between the Wintham Silt Member and the Ruisbroek Sands Member. This hiatus has clearly been established on biostratigraphic grounds in the Rupelian type area (De Coninck, 1999, fig. 2). This hiatus represents the period of the most important sealevel fall round about the Eocene-Oligocene transition. This period of lowermost sealevel corresponds no doubt with the phase of soil development in the top of the Neerrepen Sands, just below the lagoonal Henis Clay Member, in the Francart quarry near Tongeren (Deville, 1996, fig. 2, p. 78). It corresponds with the TA 4.3 - TA 4.4 boundary in sequence stratigraphy according to Vandenberghe *et al.* (1998, fig. 14) and with the "Grande Coupure" in the succession not only of the mammals but also of the amphibians and reptiles (Rage, 1986, p. 310) in the European realm.

5. DEPOSITIONAL ENVIRONMENT

According to Vandenberghe *et al.* (1998, p. 141-144), the Grimmertingen Sands which are fine-grained, rich in clay and thoroughly bioturbated, were deposited on the shelf below wave influence. The grain size evolution in the unit indicates a rapid submergence of the area, followed by a gradual filling of the basin during the sealevel highstand. The Neerrepen Sands, which are somewhat coarser, less bioturbated and presenting tidal structures such as cross-bedding, are interpreted as shallow offshore sediments deposited near the beach. They are thought to represent the further filling of the basin during the sealevel highstand (Vandenberghe *et al.*, 1998, p.141).

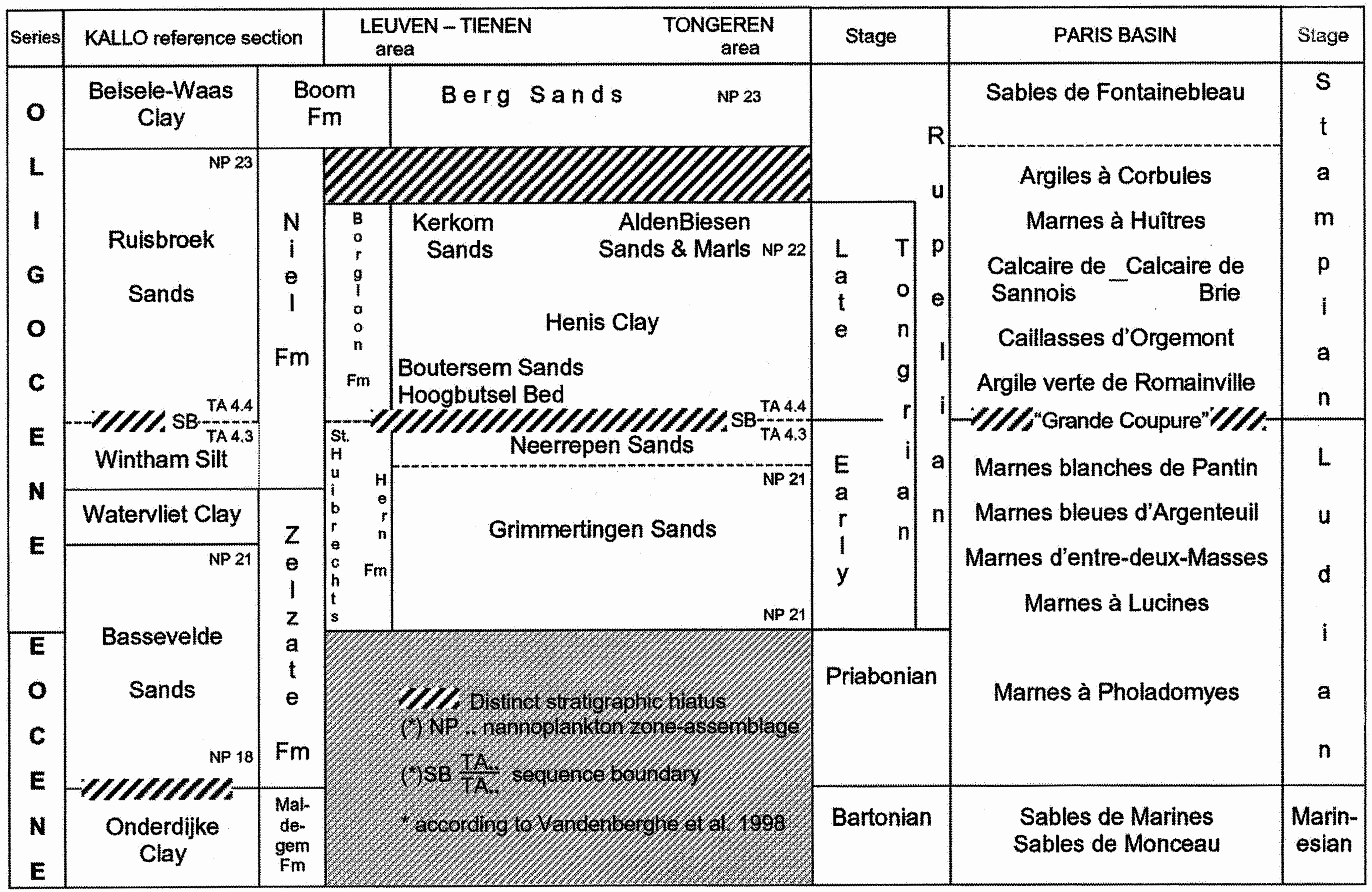

Figure 4: Stratigraphy of Late Eocene and Early Oligocene deposits in the northern and north-eastern Belgian basin, and in the Paris basin.

Table 3 presents the distribution and frequency changes of taxa which can help to interpret the evolution of the environment during deposition of the Grimmertingen and Neerrepen Sands (cf. Brinkhuis, 1994; Köthe, 1990).

1) *Impagidinium* spp.

These taxa are in recent times produced in waters of the outermost continental shelf and further away in the ocean (Wall *et al.*, 1977, p.151). *Impagidinium* spp. are only sporadically recorded in the Grimmertingen and Neerrepen members. Influx of Atlantic watermasses into the area was certainly very limited.

2) *Spiniferites* aff. *elongatus*

S. elongatus is an arctic to cool temperate species (Edwards & Andrle, 1992, p. 283). Closely related taxa to *S. elongatus* are sporadically found in the upper half of the Grimmertingen section. Their appearance probably reflects a fall of temperature with colder water masses penetrating further southwards in the North Sea Basin. In the Kallo section *S. elongatus* - like taxa make their entry in the Watervliet Clay at -110.5 m (see Table 2). The change of facies at the transition of the Grimmertingen Sands to the Neerrepen Sands was explained by Vandenberghe *et al.* (1998, p. 141-144) as the result of continuing of sedimentation through which the basin became gradually shallower during the sealevel highstand. It is not unrealistic to suppose that the drop of temperature, already announced in the upper part of the Grimmertingen Sands, led to a gradual sealevel fall which also contributed to the change of facies. A fall of the water temperature is also documented by Deville (1996, p. 90-91, fig. 5) who found among the bivalves preserved as outer and inner moulds in the Neerrepen Sands in the Francart quarry near Tongeren some species indicative of cold water, species not encountered in the Grimmertingen Sands. With the retreat of the sea from the area a soil developed in the top of the Neerrepen Member. Deville (*ibid.*, p. 90-92) mentions freeze-thaw structures in this soil, the evidence of cold winters.

3) *Homotryblium* sp. aff. *H. floripes-H. plectilum*, *H. vallum* and *Enneadocysta* spp.

These taxa are considered by Köthe (1990, p. 31) and Brinkhuis (1994, p. 148) as indicators of higher saline waters. Both *Homotryblium* taxa become suddenly much more frequent in the samples +2.15 m, +2.6 m and (less markedly) at +4.4 m. The frequencies of *Enneadocysta* spp. (classified by Köthe under the genus *Areosphaeridium*) on the contrary diminish in the same interval. However, the frequency change of the *H. floripes-plectilum-vallum* complex is much more important and thus decidedly more significant for paleoenvironmental reconstructions. Brinkhuis (1994, p. 147) writes that these *Homotryblium* taxa indicate lagoonal environments. According to Vandenberghe *et al.* (1998, p. 141-144) the area of the Grimmertingen and Neerrepen Sands was initially an open sea which became very shallow during deposition of the Neerrepen Sands. It is suggested that the *Homotryblium* taxa were produced in high numbers in lagoons along the coast, and transported to the shallow offshore zone.

4) *Charlesdowniea clathrata* and *Deflandrea phosphoritica* + *D. spinulosa* are thought to represent somewhat lower saline conditions (Köthe, 1990, p. 30). *Pediastrum* sp. and the Desmidiaceae zygote ? sp. are freshwater algae.

In the Grimmertingen section a clear parallelism of the frequency changes of both groups is observed. Probably some stream or river, carrying a few freshwater algae reached the area of sedimentation and caused salinity fluctuations which can have favoured the production of *Charlesdowniea* and *Deflandrea* cysts. The very low frequencies of both groups in samples -3.3 m and +0.9 m correspond with the highest numbers of contemporaneous, not reworked dinocyst taxa. This suggests that during the corresponding time interval a more constant and normal salinity allowed richer cyst producing dinoflagellate population to live in the area.

6. CONCLUSIONS

The rich and well preserved assemblages of organic-walled microfossils in the Grimmertingen Sands and the Neerrepen Sands allow for correlation of these deposits with the upper part of the Bassevelde Sands, with the Watervliet Clay and with the Wintham Silt in the Kallo borehole and in the Rupelian type area. Changes in composition were partly the result of a drop of temperature. The ensuing gradual fall of the sea level together with the further filling of the basin are considered responsible for the change of facies from the Grimmertingen Sands to the Neerrepen Sands. Finally after the sea retreated from the area, a soil developed in the top of the Neerrepen Sands. When later the sea level began to rise again the brackish-lagoonal Henis Clay was laid down on the Neerrepen soil. The continental episode with soil development in the top of the Neerrepen Sands corresponds with the hiatus between the Wintham Silt and the Ruisbroek Sands detected in the Rupelian type area, with the TA 4.3 - TA 4.4 boundary in sequence stratigraphy, with the "Grande Coupure" in the succession of the terrestrial vertebrates in Europe, and with the disappearance among the dinoflagellate cysts of *Areosphaeridium diktyoplokus* and *Rhombodinium perforatum* from the temperate marine domain.

7. SYSTEMATICS

Forms which have been described in De Coninck (1986, 1995, 1999) are not discussed here anymore. One new species, *Hystrichokolpoma grimmertingenensis*, and three species under open nomenclature, *Flandrecysta* ? sp. A, *Nematosphaeropsis* sp. A and *Spiniferites-Achomosphaera* sp. A, are described.

Dinophyceae

Areosphaeridium* aff. *diktyoplokus (Klumpp, 1953) Eaton, 1971.
Pl. 1, fig. 11.
Hystrichosphaeridium diktyoplokus Klumpp, 1953, p. 392, pl. 18, figs. 3-7.
Eaton, 1971, p. 358-359.
Remarks: One specimen was encountered. It differs from *A. diktyoplokus* by its very short and wide processes which are thick-walled but hollow.
Dimensions of the cyst body: about 60 µm high, about 75 µm wide.
Length of the processes: 7 to 10 µm.
Width of the processes stem: 10 to 18 mm.

Areosphaeridium michoudii Bujak, 1994.
Pl. 1, fig. 17.
Bujak, 1994, p. 121, pl. 1, figs. 1-3.
Remark: The species was discussed and classified as '*Areosphaeridium* sp. cf. *A. diktyoplokus* (Klumpp, 1953) and *Cordosphaeridium gracile* (Eisenack, 1954)' in De Coninck (1986, p. 10-11, pl. 1, fig. 14).

Corrudinium* sp. aff. *C. incompositum (Drugg, 1970) Stover & Evitt, 1978 and ***Impagidinium*** Stover & Evitt, 1978.
Pl. 2, figs. 6-7, 8-9, 10-11.
Gonyaulacysta incomposita Drugg, 1970, p. 810, figs. 1 E-O, 2 A.
Stover & Evitt, 1978, p. 148-149, 165-166.
Remark: The tabulation of the cysts resembles that of *Impagidinium*. It is better expressed than in *C. incompositum* because from the parasutural crests only a few short crests deviate towards the plate interior. Some specimens have in their plate centres only a short spine or a more or less circular to irregularly formed short crest.
Dimensions of the cyst body: 27 to 32 µm.
Height of the crests: about 2 mm.

***Flandrecysta* ? sp. A.**
Pl. 2, figs. 19-22; Pl. 3, figs. 1-3, 6-8.
Flandrecysta Slimani, 1994, p.53.

Description: The species is characterised by its wide, epicystal pericoel with large ventral opening. The archeopyle is precingular and simple (3"). A few fine ridges and gonal processes indicate plate boundaries dorsally. Around the antapex one observes a distally open, box-like membrane: laterally it is open at the ventral side between two supporting hollow processes; dorsally it seems supported by some ridges.
Remark: The genus *Flandrecysta* defined by SLIMANI among Late Cretaceous dinoflagellate cysts, approaches best the morphology of *F.*? sp.A.
Dimensions of the cyst body: 40 µm long, 35 µm wide.
Length of the processes: about 15 to 18 µm.
Width of the pericoel: about 70 mm.

Glaphyrocysta* sp. aff. *G. retiintextum (COOKSON, 1965) STOVER & EVITT, 1978 and ***Adnatosphaeridium multispinosum*** WILLIAMS & DOWNIE, 1966.
Pl. 5, figs. 2-3, 4-6.
Cyclonephelium retiintextum COOKSON, 1965, p. 88, pl. 11, fig. 4.
STOVER & EVITT, 1978, p. 50.
WILLIAMS & DOWNIE, 1966, p. 216 pl. 24, fig. 5, text fig. 57.
Remarks: By the variety of their distal connections the processes of this *Glaphyrocysta* sp. resemble more or less those of *G. retiintextum* and *A. multispinosum*. In some specimens the processes leave only a small naked area on the ventral and dorsal parts of the cyst body, in which case these specimens rather resemble *A. multispinosum*.
Dimensions of the cyst body: about 50 µm.
Length of the processes: about 15 mm.

Glaphyrocysta* sp. aff. *G. exuberans (DEFLANDRE & COOKSON, 1955) STOVER & EVITT, 1978 and ***G. laciniiformis*** (GERLACH, 1961) STOVER & EVITT, 1978.
Pl. 5, figs. 9-10.
Cyclonephelium exuberans DEFLANDRE & COOKSON, 1955, p. 285.
Cyclonephelium laciniiforme GERLACH, 1961, p. 206, pl. 29, fig. 4.
STOVER & EVITT , 1978, p. 50.
Remarks: The processes around the naked ventral area are distally connected by trabeculae. The processes around the naked dorsal area are wider than the ventral ones and resemble the processes of *G. laciniiformis*. Their wall is thin and finely perforate; distally they are connected by finely perforate membranous strips, a characteristic feature of *G. exuberans*.
Dimensions of the cyst body: about 60 to 65 µm.
Length of the dorsal processes: about 15 to 20 µm.
Length of the ventral processes: about 20 to 25 mm.

Thalassiphora patula (WILLIAMS & DOWNIE, 1966) STOVER & EVITT, 1978
Pl. 6, figs. 3-5. Pl. 7, figs. 1-4.
Adnatosphaeridium patulum WILLIAMS & DOWNIE, 1966, p. 217, pl. 24, fig. 2, text fig. 58.
STOVER & EVITT, 1978, p. 195.
Remark: Among the *T. patula* specimens recorded at Grimmertingen and Kallo are found specimens with an exceptionally striking resemblance to the holotype from the early Eocene London Clay. They are considered apart in the present study. These holotype-resembling cysts are characterised by high, fibrous, distally relatively thin crests the implantation of which is not clearly observable. The archeopyle is precingular and simple.
Dimensions of the cyst body: about 50 µm to 70 µm.
Height of the crests: about 20 to 40 mm.

Heteraulacacysta* aff. *leptalea EATON, 1976.
no figures
EATON, 1976, p. 305-306, pl. 21, figs. 1-2.

Remarks: *H.* aff. *leptalea* seems intermediary between *H. leptalea* and *H. porosa* BUJAK, 1980 (p. 62, pl. 15, figs. 10-13, text fig. 14 B-C). The periphragm of the cyst body is perforate, as in *H. porosa* but the equatorial wing presents only sporadically some perforations.
Dimensions of the cyst body: 65 to 75 µm.
Height of the equatorial wing: about 20 mm.

Homotryblium* (aff.) *aculeatum WILLIAMS, 1978.
Pl. 5, figs. 7-8.
WILLIAMS, 1978, p. 797, pl. 4, figs. 5-6, 8-9.
Remarks: The processes of *H.* (aff.) *aculeatum* are not as slender as those of the species figured by WILLIAMS. Distally they are aculeate to serrate whereas in *H. aculeatum* they are only aculeate. These few differences can probably be considered as variations.
Dimensions of the cyst body: about 40 µm.
Length of the processes: 20 to 30 µm.
Width of the processes at mid-length: 2 to 5 mm.

Homotryblium* (aff.) *caliculum BUJAK, 1980.
Pl. 6, fig. 2.
BUJAK, 1980, p. 62 and 64, pl. 16, fig. 1.
Remarks: The processes are relatively short just as those in *H. caliculum* figured by BUJAK. Some of them widen progressively already shortly above their base. Other processes however remain relatively narrow, widening only distally. All processes have a wide distal, recurved rim. The form seems also related with *Homotryblium* sp. 1 in DAMASSA *et al.*, 1990 (fig. 4 F-G) of which the processes are longer and have not such a large rim
Dimensions of the cyst body: about 35 µm.
Length of the processes: about 15 µm.
Width of the processes at their base: about 3 to 4 µm.
Width of the processes distally: about 13 to 18 mm.

Homotryblium* sp. aff. *H. floripes (DEFLANDRE & COOKSON, 1955) STOVER, 1975 and ***H. plectilum*** Drugg & Loeblich, 1967.
Pl. 6, figs. 6-7.
Hystrichosphaeridium floripes DEFLANDRE & COOKSON, 1955, p. 276, pl. 7, figs. 1-2, 7.
STOVER, 1975, p. 36.
DRUGG & LOEBLICH, 1967, p. 184-186, pl. 2, figs. 1-9, text fig. 3.
Remark: *H. floripes* and *H. plectilum* are very related species, if not the same. Intermediary forms are found.

Hystrichokolpoma grimmertingenensis nov. sp.
Pl. 6, figs. 10-12.
Derivation of name: Grimmertingen, the type locality of the Grimmertingen Sands Member.
Diagnosis: The cyst body is subspherical. Its wall is composed of an endo- and periphragm. Between the processes formed by the periphragm the surface is smooth, but underneath the large processes the endophragm appears finely granular. The archeopyle is apical. In cingular position occur some 30 very short and relatively narrow processes. These are tubular with a slightly widened top. In sulcal position one encounters about 8 small, conical and distally pointed processes. Above the series of cingular processes occur 6 large, hollow, conical and smooth precingular processes with slightly convex sides. Their narrow top seems ragged off. Below the cingular processes five hollow, conical and smooth postcingular processes, again with slightly convex sides, are found. One of them, representing plate 2''', is distinctly smaller than the four other ones which are a little larger than the precingular processes. The antapical process is slightly striate lengthwise. It is as long as the postcingular processes but not as wide, with rather straight sides, narrowing suddenly below its more or less elongate and narrow end.
Holotype: Grimmertingen -3.3 m. Grimmertingen Sands Member. Slide 3; coord. England Finder Z53(2). (Pl. 6, figs. 10-12).

Paratype: Kallo borehole -110 m. Wintham Silt Member. Slide 3; coord. England Finder beyond Z44. (no figures).
Repository: Collection of the Laboratory of Paleontology of the Ghent University.
Dimensions of the holotype:
Cyst body: 50 µm.
precingular processes: 20 to 25 µm wide in their lower part; 35 to 40 µm long.
cingular processes: about 2 µm wide at the base; 8 µm long.
sulcal processes: 2 to 5 µm wide at the base; 10 to 18 µm long.
postcingular processes: The process on plate 2"" is about 14 µm wide at the base and 22 µm long. The other four processes are 18 to 22 µm wide in their lower part and 40 to 45 µm long.
antapical process: about 17 µm wide and 45 µm long.
Dimensions of the paratype:
cyst body: 45 µm.
antapical process: 30 µm long and 17 µm wide.
other processes: same dimensions as in the holotype.
Comparison: *H. grimmertingenensis* nov. sp. clearly differs from the other species of the genus by its large size in combination with slightly convex, conical pre- and postcingular processes. These processes are smooth, without the lateral or distal tubules which are observed on the large processes of *H. cinctum* Klumpp, 1953 and of several other species of the genus. The numerous, very small cingular processes and the fine granulation of the endophragm underneath the large processes are also characteristic of the new species.

Hystrichokolpoma* aff. *salacium Eaton, 1976.
Pl. 7, figs. 5-7.
Eaton, 1976, p. 271-272, pl. 11, figs. 1-3, text fig. 16.
Remark: The processes in cingular position are very fine in comparison with those of the species.

Hystrichosphaeridiaceae spp. cf. *Hystrichosphaeridium patulum* Davey & Williams, 1966, ***H. latirictum*** Davey & Williams, 1966 and ***Litosphaeridium* ? *parvum*** Matsuoka & Bujak, 1988.
no figures
Davey & Williams, 1966, p. 60, pl. 10, fig. 5.
Davey & Williams, 1966, p. 66-67, pl. 10, fig. 8.
Matsuoka & Bujak, 1988, p. 62-63, pl. 8, figs. 2 a-b, 3 a-b, 4, text fig. 12.
Remark: These are small cysts resembling the species mentioned for the structure, size and forms of the processes. A more precise attribution remains questionable.

? *Hystrichosphaeridium* sp. BE in Brideaux, 1977.
Pl. 8, figs. 9, 10, 11 and 12.
Brideaux, 1977, p. 26-27, pl. 11, figs. 1-2.
Remarks: The species presents numerous solid processes which distally end in a small funnel with denticulate edge. An archeopyle is not identified. The species resembles *H.* sp. BE from Early Cretaceous deposits in northern Canada. It resembles also *Eocladopyxis tesselata* Liengjarern *et al.* (1980 from the Eocene-Oligocene transition at Whitecliff Bay (Hampshire Basin, southern England) but the processes of *E. tesselata* are finer and distally they present repeatedly furcated and reflexed spines instead of the regularly denticulate small distal funnel of the processes in our species.
Dimensions of the cyst body: about 35 to 40 µm.
Length of the processes: 8 to 10 µm.
Width of the processes distally: 2 to 4 µm.
Thickness of the process shaft: about 1 mm.

***Impagidinium dispertitum* ?** (Cookson & Eisenack, 1965) Stover & Evitt, 1978.
Pl. 8, figs. 13-15, 16-18.
Leptodinium dispertitum Cookson & Eisenack, 1965, p. 122-123, pl. 12, figs. 5-7.
Stover & Evitt, 1978, p. 165.

Remarks: *I. dispertitum* ? is smaller than the species. The cingular plates are relatively higher in proportion to the cyst body than those of the species.
Dimensions of the cyst body: between 28 and 40 µm.
Height of the crests: about 2.5 to 3 mm.

***Impagidinium maculatum* ?** (Cookson & Eisenack, 1961) Stover & Evitt, 1978
Pl. 8, fig. 23.
Leptodinium maculatum Cookson & Eisenack, 1961, p. 40, pl. 2, figs. 5-6.
Stover & Evitt, 1978, p. 165-166.
Remarks: *I. maculatum* ? had been recorded as *I. maculatum* in the Early Oligocene Ruisbroek Sands Member in the Kallo and Woensdrecht boreholes in De Coninck (1986, pl. 4, figs. 16-17, 21-22; 1995, pl. 5, figs. 8-9.) The form differs however from the species as described by Cookson & Eisenack by its ornamentation: in *I. maculatum* ? the cyst wall is granulate to vermiculate instead as simply dotted as in the species, and the crests are higher in proportion to the cyst body. In Grimmertingen only one specimen was recorded at +2.15 m.
Dimensions of the cyst body: 50 µm.
Height of the crests: 6 to 10 mm.

Impletosphaeridium* cf. *multispinosum Benedek, 1972
no figures.
Benedek, 1972, p. 31-32, pl. 11, fig. 11; pl. 12, fig. 15.
Remark: *I.* cf *multispinosum* presents processes that are about three to four times shorter than those of the species described by Benedek in the Ratinger Schichten and in the lower part of the Untere Lintforter Schichten of Tönisberg (Northwest Germany).
Dimensions of the cyst body: about 60 µm.
Length of the processes: 3 to 7 µm.
Width of the processes at their base: 0.5 to 2 mm.

Impletosphaeridium* aff. *krömmelbeinii Morgenroth, 1966
no figures.
Morgenroth, 1966, p. 34-35, pl. 9, figs. 4-5.
Remarks: The processes of *I.* aff. *krömmelbeinii* are never flattened. Distally they are furcate but not as many times as described by Morgenroth. Our form seems also related to *Impletosphaeridium* sp. I in Manum (1976), a species that I rather consider as a forerunner of *Reticulatosphaera actinocoronata* (Benedek, 1972), but our form presents a larger number of processes than both these species.
Dimensions of the cyst body: about 25 to 35 µm.
Length of the processes: about 10 mm.

Nematosphaeropsis* cf. *lemniscata Bujak, 1984 emend. Wrenn, 1988.
Pl. 9, figs. 12-13.
Bujak, 1984, p. 189-190, pl. 3, figs. 5-7.
Wrenn, 1988, p. 142 and 144.
Remarks: *N.* cf. *lemniscata* is intermediary between *N. lemniscata* and *N. reticulensis* (Pastiels, 1948). Only parts of certain trabeculae joining the processes distally are flattened. In *N. lemniscata* all the trabeculae are flattened. In our form no ridges or crests corresponding to plate boundaries are seen between the gonal processes. In the species described by Bujak such ridges indicate clearly the tabulation.
Dimensions of the cyst body: about 30 µm.
Length of the processes: about 13 to 20 µm.
Width of the ribbon-like parts of the trabeculae: up to 2 mm.

***Nematosphaeropsis* sp. A**
Pl. 9, fig. 14.
Description: Only one specimen was recorded. Its cyst body is globular. Gonal and intergonal processes are hollow, thin walled and relatively short. Their base is generally enlarged in the direction of the plate boundaries. The distal furcations of the processes continue as fine trabeculae joining the processes in series corresponding to the plate boundaries.
Dimensions of the cyst body: 50 µm.
Length of the processes: about 12 µm.
Width of the base of the processes: 1 to 8 mm.

Operculodinium* cf. *placitum Drugg & Loeblich, 1967
no figures.
Drugg & Loeblich, 1967, p. 186, pl. 1, figs. 9-10, 11 a-b, text fig. 4.
Remark: The spines of *O.* cf. *placitum* are longer than those of the species. Here and there spines are joined proximally by a low ridge.
Dimensions of the cyst body: 30 µm.
Length of the spines: 2.5 to 5 mm.

Operculodinium* spp. aff. *Cordosphaeridium funiculatum Morgenroth, 1966.
Pl. 2, figs. 1-2, 3; Pl. 11, figs. 1-2.
Operculodinium Wall, 1967, p. 110-111.
Morgenroth, 1966, p. 22-23, pl. 6, figs. 2-3.
Remarks: These *Operculodinium* spp. correspond in size and in the general form of their processes with *O. divergens* (Eisenack, 1954), *O. uncinispinosum* (De Coninck, 1969) and *Cordosphaeridium multispinosum* Davey & Williams, 1966. Their cyst body is however widely reticulate, just as in *C. funiculatum*, and the processes are less densely fibrous in comparison with the related species.

Phthanoperidinium* aff. *geminatum Bujak, 1980.
Pl. 12, figs. 7-8, 9-10; Pl. 13, fig. 9.
Bujak, 1980, p. 72 and 74, pl. 19, figs. 8-12, text figs. 20 D and 22 A.
Remarks: At first sight this form resembles *P. levimurum* Bujak, 1980. However the thin sutural and penitabular crests of our form are very low and finely denticulate. This corresponds more with the characteristics of *P. geminatum*, the denticulate crests of which are however much better visible.
Dimensions of the cyst: 55 to 60 mm high, 45 to 50 mm wide.

***Spiniferites-Achomosphaera* sp. A**
Pl. 12, fig. 6; Pl. 13, figs. 15-16.
Description: This species is relatively large and characterised by the coarsely granular to vermiculate surface of its cyst body, and by the presence of hollow, trifurcate gonal and intergonal processes. Proximally the processes are more or less widened in the direction of the plate boundaries. In some specimens ridges indicating between the processes the plate boundaries, are only sporadically developed; in these cases they correspond more to the definition of the genus *Achomosphaera*.
Dimensions of the cyst body: 55 to 62 µm.
Length of the processes: about 15 to 20 µm.
Length of the distal furcations: about 6 to 10 mm.

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Table 1: Inventory of the assemblages of organic walled microfossils in the Grimmertingen section.

	• = <0.2%, •• = 0.2% to <0.7%, **I** = 0.7% to <3%, **II** = 3% to <10%, **X** = 10% to <25%, **XX** : ≥25%	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
	CHLOROPHYCEAE								
	Bottryococcus				•				
	Paralecaniella indentata (DEFLANDRE & COOKSON, 1955)				I	••	•		
	Pediastrum	••	I	•	•			•	•
	DINOPHYCEAE								
	Achilleodinium biformoides (EISENACK, 1954)	•			•	•	•	•	•
	Achomosphaera alcicornu (EISENACK, 1954)			•	•				?
	A. aff. *andalousiensis* JAN DU CHÊNE, 1977							•	•
	A. ramulifera (DEFLANDRE, 1937)	•	•		•	II	••	II	•
	Achomosphaera spp.indet.	I	II	II	X	X	II	X	X
	Areoligera? semicirculata (MORGENROTH, 1966)			•	•		•		•
	Areosphaeridium diktyoplokus (KLUMPP, 1953)	••	I	II	I	II	••	•	••
	A. aff. *diktyoplokus* (KLUMPP, 1953)							•	
	A. michoudii BUJAK, 1994	••	•	••	•	•	•	•	•
	Ascostomocystis potane DRUGG & LOEBLICH, 1967								••
	Batiacasphaera baculata DRUGG, 1970				•				
	B. compta DRUGG, 1970	•		II	•	•	••	•	
	Caligodinium amiculum DRUGG, 1970			•					
	C. endoreticulum STOVER & HARDENBOL, 1994		•						
	Cerebrocysta bartonensis BUJAK, 1980	••			•		•		
	Charlesdowniea clathrata (EISENACK, 1938)	II	I	I	•	•	I	I	II
	C. variabilis (BUJAK, 1980)				?				
C	*Chlamydophorella grossa* MANUM & COOKSON, 1964		•						
C	*Chlamydophorella* sp. indet.	•							
	Cordosphaeridium? aff. *callosum* MORGENROTH, 1966	••							
	C. cantharellum (BROSIUS, 1963)	••	I	I	••	I	••	•	I
	C. inodes (KLUMPP, 1953)		•		•	•		I	I
	C. multispinosum DAVEY & WILLIAMS, 1966	•		•	•	•		•	
	Corrudinium incompositum (DRUGG, 1970)			•	•	I	••		

	• = <0.2%, •• = 0.2% to <0.7%, I = 0.7% to <3%, II = 3% to <10%, X = 10% to <25%, XX : ≥25%	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
	C.? sp. cf. *C. incompositum* (DRUGG, 1970) - *Cerebrocysta bartonensis* BUJAK, 1980		••		•	•			
	C. sp. aff. *C. incompositum* (DRUGG, 1970) - *Impagidinium* STOVER & EVITT, 1978	••	••		•				
	Cribroperidinium giuseppeii (MORGENROTH, 1966)							•	
	C. giuseppeii (MORGENROTH, 1966) forma *areolata*	•	•		•	••	•	•	•
	C. tenuitabulatum (GERLACH, 1961)								•
C	*Cribroperidinium* spp.			•					
	Cyclopsiella vieta DRUGG & LOEBLICH, 1967		•						
	Dapsilidinium pseudocolligerum (STOVER, 1977)	I	••	•	I	•	I	•	•
	Deflandrea phosporitica EISENACK, 1933	I		•	•	•	I	I	••
	D. spinulosa ALBERTI, 1959	•	••						
J	*Dingodinium tuberosum* (GITMEZ, 1970)							•	
	Dinopterygium fehmarnense (LENTIN & WILLIAMS, 1973)	I	I	?		•		••	
	Diphyes colligerum (DEFLANDRE & COOKSON, 1955)	••			••	•	•		•
	Distatodinium spp. indet.	I	••	••	••	I		II	II
	Elytrocysta breva STOVER & HARDENBOL, 1994	I	••	I	•	I	II		•
	Enneadocysta arcuata (EATON, 1971)	?	••		•				•
	E. pectiniformis (GERLACH, 1961)	X	X	X	X	X	II	II	II
	E. sp. C *in* STOVER & WILLIAMS, 1995				?	?			?
	Eocladopyxis peniculatum MORGENROTH, 1966	••	••			?		?	?
	E. tesselata LIENGJARERN, COSTA & DOWNIE, 1980				?	•	?	••	•
	Exochosphaeridium insigne DE VERTEUIL & NORRIS, 1996				•	•	•		
	Fibrocysta vectensis (EATON, 1976)	•		•	•				•
	Flandrecysta? sp. A			•	•	•		•	
C	*Gardodinium* sp. indet.				•				
	Glaphyrocysta inculta (MORGENROTH, 1966)			II		I	••	•	
	G. aff. *inculta* (MORGENROTH, 1966) *sensu* DE CONINCK, 1986	•	I	II	•				
	G. laciniiformis (GERLACH, 1961)		••	••					
	G. microfenestrata (BUJAK, 1976)	?		•	••	•		•	••
	G. semitecta (BUJAK, 1980)	•	•	I		I	••	•	II
	G. sp. aff. *G. retiintextum* (COOKSON, 1965) - *Adnatosphaeridium multispinosum* WILLIAMS & DOWNIE, 1966			•			••	I	II
	G. sp. aff. *G. exuberans* (DEFLANDRE & COOKSON, 1955) - *G. laciniiformis* (GERLACH, 1961)					•			

	• = <0.2%, •• = 0.2% to <0.7%, **I** = 0.7% to <3%, **II** = 3% to <10%, **X** = 10% to <25%, **XX** : ≥25%	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
	Glyphanodinium facetum DRUGG, 1964	••							
	Hemiplacophora semilunifera COOKSON & EISENACK, 1965				•				
	Heslertonia sp. indet.	•	•						
	Heteraulacacysta (aff.) *leptalea* EATON, 1976						•	••	II
	H. porosa BUJAK, 1980	•	I		•	•		II	
C	*Heterosphaeridium conjuctum* COOKSON & EISENACK, 1968					•			
C	*H. heteracanthum* (DEFLANDRE & COOKSON, 1955)	•							
	Homotryblium (aff.) *aculeatum* WILLIAMS, 1978			II	II		II	•	II
	H. (aff.) *caliculum* BUJAK, 1980		••		•				
	H. oceanicum EATON, 1976			•				X	
	H. (aff.) *pallidum* DAVEY & WILLIAMS, 1966	II	II			II	II	II	I
	H. tenuispinosum DAVEY & WILLIAMS, 1966		•	•			I	I	
	H. vallum STOVER, 1977					•	II	II	•
	H. sp. aff. *H. floripes* (DEFLANDRE & COOKSON, 1955) - *H. plectilum* DRUGG & LOEBLICH, 1967		•	•	•		X	XX	X
	Homotryblium sp. 1 *in* DAMASSA, GOODMAN, KIDSON & WILLIAMS, 1990	•	I	I		I	••	II	I
	Horologinella? corrugata DE CONINCK, 1986	••	••	I	•	••			
	H. incurvata COOKSON & EISENACK, 1962		•		•		••		
	Hystrichokolpoma cinctum KLUMPP, 1953	•			•	•		•	•
	H. aff. *cinctum* KLUMPP, 1953 *sensu* DE CONINCK, 1999					•			
	H. reducta ZEVENBOOM, 1995					•			
	H. rigaudiae DEFLANDRE & COOKSON, 1955			•	•	••	I		•
	H. cf. *rigaudiae* DEFLANDRE & COOKSON, 1955	••	••	••	••	•	I	•	
	H. salacium EATON, 1976						•	•	II
	H. aff. *salacium* EATON, 1976	•				•	•	••	•
	Hystrichokolpoma grimmertingenensis sp. nov.	•			•				
P/E	*Hystrichosphaeridium tubiferum* (EHRENBERG, 1838)		•		•	•	•	•	
	H. spp. cf. *H. patulum* DAVEY & WILLIAMS, 1966 - *H. latirictum* DAVEY & WILLIAMS, 1966 - *Litosphaeridium? parvum* MATSUOKA & BUJAK, 1988	I							
	? Hystrichosphaeridium sp. BE *in* BRIDEAUX, 1977			•	•		•	••	••
	Hystrichostrogylon coninckii HEILMANN CLAUSEN, 1985				•	•	•	•	•
	Impagidinium dispertitum? (COOKSON & EISENACK, 1965)			•	•	••			
	I. maculatum? (COOKSON & EISENACK, 1961)						•		
	I.? sp. cf. *I. multiplexum* (WALL & DALE, 1968) *sensu* DE CONINCK, 1986	•		••		•			

	• = <0.2%, •• = 0.2% to <0.7%, **I** = 0.7% to <3%, **II** = 3% to <10%, **X** = 10% to <25%, **XX** : ≥25%	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
	Impagidinium sp. indet.								•
	Impletosphaeridium insolitum EATON, 1976	••							••
	I. aff. *krömmelbeinii* (MORGENROTH, 1966)								••
	I. ligospinosum (DE CONINCK, 1969)	••							
	I. cf. *multispinosum* BENEDEK, 1972							•	•
	Impletosphaeridium sp. A *in* DE CONINCK, 1986	•					•		
	Impletosphaeridium sp. I *in* MANUM, 1976	••			•	•			
	I. sp. aff. I sp. A *in* DE CONINCK, 1986 - *Reticulatosphaera?* sp. A *in* DE CONINCK, 1995	••			•				
	Lentinia serrata BUJAK, 1980	•	I	?	?	?			•
	L. wetzelii (MORGENROTH, 1966)	•	••						
	Lingulodinium machaerophorum (DEFLANDRE & COOKSON, 1955)	I	•	•	I	••	II	•	•
	L. multivirgatum DE VERTEUIL & NORRIS, 1996			•		•		•	•
	L. siculum (DRUGG, 1970)			•			•		
	Litosphaeridium? mamellatum DE CONINCK, 1977			I		•			
	Lophocysta aff. *sulcolimbata* MANUM, 1979			•					
	Lophocysta? sp. indet.			••	•				•
	Melitasphaeridium asterium (EATON, 1976)						•		
	Membranophoridium aspinatum GERLACH, 1961 forma A *in* DE CONINCK, 1999	••	•	I	I	•	•	I	•
	M. aspinatum GERLACH, 1961 aff. forma A - forma B *in* DE CONINCK, 1999	•		•		•	•	•	•
	M. aspinatum GERLACH, 1961 - forma B *in* DE CONINCK, 1999					•		I	I
	Microdinium reticulatum VOZZHENNIKOVA, 1967		••		•	••		••	
	Microdinium spp. indet.		•	•	•		•		
	Nematosphaeropsis balcombiana DEFLANDRE & COOKSON, 1955			•		•			•
	N. cf. *lemniscata* BUJAK, 1984					•		•	
	N. pusulosa (MORGENROTH, 1966)				•	•			••
	N. reticulensis (PASTIELS, 1948)	•							
	Nematosphaeropsis sp. A				•				
C	*Oligosphaeridium complex* (WHITE, 1842)			•					
C	*O. pulcherrimum* (DEFLANDRE & COOKSON, 1955)	•							
	O. sp. cf. *Hystrichokolpoma rigaudiae* DEFLANDRE & COOKSON, 1955				•	•			
C	*Oligosphaeridium* spp. indet.					•			•
	Operculodinium centrocarpum (DEFLANDRE & COOKSON, 1955)	I	I	I	I	I	I	I	I
	O. deconinckii LENTIN & WILLIAMS, 1989				•	•			
	O. divergens (EISENACK, 1954)	•	•		•		•		•

	• = <0.2%, •• = 0.2% to <0.7%, **I** = 0.7% to <3%, **II** = 3% to <10%, **X** = 10% to <25%, **XX** : ≥25%	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
	O. piaseckii STRAUSS & LUND, 1992						•		
	O. placitum DRUGG & LOEBLICH, 1967					I			•
	O. aff. *placitum* DRUGG & LOEBLICH, 1967						•		
	O. cf. *placitum* DRUGG & LOEBLICH, 1967				•				
	O. uncinispinosum (DE CONINCK, 1969)	I	I	••	I	•	••	••	II
	O. spp. aff. *Cordosphaeridium funiculatum* MORGENROTH, 1966	••	I	•	•	•		•	•
	Palaeocystodinium golzowense ALBERTI, 1961	•							
	Pentadinium laticinctum GERLACH, 1961	•		•	•		•	•	•
	P. lophophorum (BENEDEK, 1972)		•	•	•	•			
	Phthanoperidinium comatum (MORGENROTH, 1966)	II	II	I	II	II	•	X	II
	P. aff. *geminatum(?)* BUJAK, 1980							•	•
	P. levimurum BUJAK, 1980							••	•
	Planoperidinium gracile DE CONINCK, 1986		?						
	Platycystidia ? sp. indet.	I	•	•					
	Polysphaeridium zoharyii (ROSSIGNOL, 1962)	•	•	••				•	I
	Pyxidinopsis fairhavenensis DE VERTEUIL & NORRIS, 1996				•				
	Reticulatosphaera actinocoronata (BENEDEK, 1972)		••		•	•	•		•
	Rhombodinium glabrum (COOKSON, 1956)	••	••		•	•			
	R. perforatum (JAN DU CHÊNE & CHÂTEAUNEUF, 1975)	••	•		•			•	••
	R. aff. *porosum* BUJAK 1979 *sensu* DE CONINCK, 1986	?							
	Rottnestia borussica (EISENACK, 1954)	I	•	•	••	•	••		•
	Samlandia chlamydophora EISENACK, 1954	•	I	••	••	•	••	•	•
	Selenopemphix armata BUJAK, 1980								•
J	*Sentusidinium rioultii* (SARJEANT, 1968)	•							
J	*S. villersense* (SARJEANT, 1968)		•						
	Spiniferella cornuta (GERLACH, 1961)				•	•			
	Spiniferites cingulatus O. WETZEL, 1933					•			
	S. delicatus REID, 1974	••	•			•	•	II	•
	S. aff. *elongatus* REID, 1974				•		•	•	
	S. hyperacanthus (DEFLANDRE & COOKSON, 1955)						•	•	
	S. membranaceus (ROSSIGNOL, 1964)	•							•
	S. aff. *mirabilis* (ROSSIGNOL, 1963)				•	•			
	S. pseudofurcatus (KLUMPP, 1953)		•	••	•	•	••	•	
	Spiniferites sp. B *in* PIASECKI, 1986	•				•			
	Spiniferites - Achomosphaera sp. A			••	•	I	••		•

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Spiniferites spp. indet.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Systematophora placacantha (DEFLANDRE & COOKSON, 1955)	**I**	**I**	**II**	**I**	**II**	**II**	**II**	**II**
Tectatodinium pellitum WALL, 1967	••	•	•	•	•	•		•
Thalassiphora fenestrata LIENGJARERN, COSTA & DOWNIE, 1980	•	•	•	•	**I**	•		•
T. ? cf. *pansa* STOVER, 1977			••	•	••			•
T. patula (WILLIAMS & DOWNIE, 1966)	•			•	•			
Thalassiphora patula (WILLIAMS & DOWNIE, 1966) (holotype-resmbling form)			•		•	•	••	••
T. pelagica (EISENACK, 1954)	**I**	**I**	**I**	**I**	**I**	••	•	••
T. reticulata MORGENROTH, 1966	•			••	•	•		•
T.? spinifera (COOKSON & EISENACK, 1965)		•			•	•		•
T.? cf. *spinifera* (COOKSON & EISENACK, 1965) *sensu* DE CONINCK, 1986			••					
T. succincta MORGENROTH, 1966		••	••		•			
Trigonopyxidia fiscellata DE CONINCK, 1986				•				
Turbiosphaera magnifica EATON, 1976				•	•			•
T. symmetrica BUJAK, 1980	•	••			•			
Valensiella? clathroderma (DEFLANDRE & COOKSON, 1955)		••				•		
PRASINOPHYCEAE								
Crassosphaera concinna COOKSON & MANUM, 1960								•
C. aff. *concinna* COOKSON & MANUM, 1960	••					••	••	
C. minima DE CONINCK, 1986	**II**	**I**	**II**	**I**		**II**	**II**	••
C. cf. *pachyderma* (DEFLANDRE & COOKSON, 1955)			••					
Crassosphaera sp. A *in* DE CONINCK, 1976	••	**I**	••		**I**	**II**	**I**	••
Cymatiosphaera bujakii DE CONINCK, 1986	**I**	••	••	?	?		••	
C. eupeplos (VALENSI, 1948)	**I**	**II**	••	**I**		**II**		••
C. aff. *punctifera* DEFLANDRE & COOKSON, 1955	••					••		
Cymatiosphaera spp. indet.		•						•
Pterospermella aureolata (COOKSON & EISENACK, 1958)								•
P. barbarae (GORKA, 1963)			•					••
P. eurypteris (COOKSON & EISENACK, 1958)				•			•	
P. hartii (SARJEANT, 1960)							•	
P. helios (SARJEANT, 1959)		•		•	••			
P. cf. *microptera* (DEFLANDRE & COOKSON, 1955)		•						

P. pastielsii (DURAND, 1958)			?				•	•
• = <0.2%, •• = 0.2% to <0.7%, **I** = 0.7% to <3%, **II** = 3% to <10%, **X** = 10% to <25%, **XX** : ≥25%	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
Tasmanites spp. indet.			•					•
ZYGNEMAPHYCEAE								
Desmidiaceae zygote? sp. indet.	•	•	•	•		•	•	
ACRITARCHA								
Micrhystridium inconspicuum (DEFLANDRE, 1935)		••						
M. piliferum DEFLANDRE, 1937		**I**	•				**I**	
M. recurvatum VALENSI, 1953		••		••				
M. stellatum DEFLANDRE, 1942	**II**	••	**I**	**I**		•		
M. tubulispinosum DE CONINCK, 1976		••						
M. sp. aff. *M. castaninum* VALENSI, 1953 - *M. densispinum* VALENSI, 1953	**I**	**I**		**I**				
M. sp. aff. *M. stellatum* DEFLANDRE, 1942 - *M. fragile* DEFLANDRE, 1947	**II**	**II**	**X**	**X**	**X**	**I**	••	••
Paucilobimorpha granuligera DE CONINCK, 1986				•				
P. spinosa (COOKSON, 1965)				•	••		•	
Veryhachium spp. indet.		•				•	•	
Genus et sp. indet. *in* DE CONINCK, 1986	•							
Incertae Sedis F *in* DE CONINCK, 1977			•					
Incertae Sedis 143 *in* CHÂTEAUNEUF, 1980	•		•		•		•	•
Number of dinocysts taxa from the time of deposition	**76**	**64**	**68**	**88**	**87**	**67**	**66**	**81**
Number of Jurassic dinocysts taxa	1	1	-	-	-	-	1	-
Number of Cretaceous dinocysts taxa	3	1	2	1	2	-	-	1
Number of Paleocene-Early Eocene dinocysts taxa	-	1	-	1	1	1	1	-
Approximate number of palynomorphs on which **II**, **X** and **XX** frequencies have been calculated	**200**	**180**	**150**	**200**	**200**	**110**	**110**	**190**
Approximate number on which •, •• and **I** frequencies have been calculated	**1900**	**1000**	**2500**	**4800**	**1800**	**1900**	**1300**	**1900**

Table 2: Distribution of taxa which are considered biostratigphically significant for the Kallo reference section in both the Kallo and Grimmertingen sections.

-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4	Grimmertingen Kallo	-115	-112.1	-111	-110.5	-110	-109.5	-108.2	-108	-107	-106	
••	•	••	•	•	•	•	•	*Areosphaeridium michoudii*	(+)	?									
	••		•	•				*Corrudinium* ? sp. cf. *C. incompositum* - *Cerebrocysta bartonensis* (←)	+			+							
			•	••		•		*Paucilobimorpha spinosa*	+			(+)	(+)						
			•	•				*Oligosphaeridium* sp. cf. *Hystrichokolpoma rigaudiae*	(+)				(+)						
•		II	•	•	••	•		*Batiacasphaera compta*	(+)				(+)						
••	I	II	I	II	••	•	••	*Areosphaeridium diktyoplokus* ←	+	+	+	+	+	+					
•	I	II	•					*Glaphyrocysta* aff. *inculta*	+	+	+	+	+	+	?			?	
••	••	I	•	••				*Horologinella? corrugata* ←	+		(+)	+	+	+		+			
••	•	I	I	•	•	I	•	*Membranophoridium aspinatum* forma A (←)	+	+	+	+	+	+			(+)		
•	I	I	•	I	••	II	I	*Homotryblium caliculum* + *Homotryblium* sp. 1		(+)		(+)	(+)	+					
••	••	••	•	•	I	•		*Hystrichokolpoma* cf. *rigaudiae*		(+)	(+)			+					
	••	••		•				*Glaphyrocysta laciniiformis* + *G.* sp. aff. *G. exuberans* - *G. laciniiformis*			(+)								
		•	•		•	••	••	? *Hystrichosphaeridium* sp. B E			(+)								
			•	•				*Flandrecysta?* sp. A			(+)			(+)					
••	••		•					*Corrudinium* ? sp. aff. *C. incompositum* - *Impagidinium*			(+)			(+)		(+)			
?		•	••	•		•	••	*Glaphyrocysta microfenestrata*				(+)	+	(+)					
•			••	•	•		•	*Thalassiphora reticulata*				(+)				(+)			
					•	•		*Spiniferites* sp. aff. *S. elongatus*				(+)	(+)	(+)			(+)		
	?							*Planoperidinium gracile*				+		(+)	(+)	(+)	(+)	+	→
							••	*Ascostomocystis potane*				(+)			(+)		+	(+)	→
•			•					*Hystrichokolpoma grimmertingenensis* sp. nov.					(+)						
		•		•		•	•	*Lingulodinium multivirgatum*					(+)						
		•		•	•	••	••	*Thalassiphora patula* (holotype-resembling form)					(+)	(+)					
••			•					*Impletosphaeridium* sp. aff. *I.* sp. A - *Reticulatosphaera?* sp. A					+	(+)	(+)				
			•	•			••	*Nematosphaeropsis pusulosa*						(+)					
				•		I	I	*Membranophoridium aspinatum* forma B	(+)			(+)			+	+	+	+	
					•			*Impagidinium maculatum?*							+	+	+	(+)	
						••	•	*Phthanoperidinium levimurum*							(+)	(+)		?	
		•			••	I	II	*Glaphyrocysta* sp. cf. *Adnatosphaeridium multispinosum*							(+)		(+)	(+)	
				•				*Hystrichokolpoma* aff. *cinctum*							(+)		(+)	(+)	→
	••	••		•				*Thalassiphora succincta*									(+)		

Table 3: Distribution of taxa which indicate particular environmental conditions.

	-12.5	-9.8	-7.3	-3.3	+0.9	+2.15	+2.6	+4.4
Waters from oceanic origin								
Impagidinium spp.	•		••	•	••	•		•
Waters of cold-temperate origin								
Spiniferites aff. *elongatus*				•		•	•	
Spiniferites septentrionalis(?)					•	•		•
? Higher saline (lagoonal) water								
Homotryblium sp. aff. *H. floripes* - *H. plectilum*		•	•	•		**X**	**XX**	**X**
Homotryblium vallum					•	**II**	**II**	•
Enneadocysta spp.	**X**	**X**	**X**	**X**	**X**	**II**	**II**	**II**
? Lower saline water								
Charlesdowniea clathrata	**II**	**I**	**I**	•	•	**I**	**I**	**II**
Deflandrea phosphoritica + *D. spinulosa*	**I**	••	•	•	•	**I**	**I**	••
Fresh water								
Pediastrum sp.	••	**I**	•	•			•	•
Desmidiaceae zygote? sp.	•	•	•	•		•	•	
Number of non-reworked dinocyst taxa	**76**	**64**	**68**	**88**	**87**	**67**	**66**	**81**

PLATES 1 to 13

All figures : magnification 500x

PLATE 1

Fig. 1:	*Achomosphaera ramulifera* (DEFLANDRE, 1937) +2.15 m. Slide 1.
Fig. 2:	*Achomosphaera ramulifera* (DEFLANDRE, 1937) +0.9 m. Slide 1.
Fig. 3:	*Areoligera ? semicirculata* (MORGENROTH, 1966). -7.3 m. Slide 3.
Fig. 4:	*Areoligera ? semicirculata* (MORGENROTH, 1966). -3.3 m. Slide 2.
Fig. 5:	*Batiacasphaera compta* DRUGG, 1970. +0.9 m. Slide 1.
Fig. 6:	*Batiacasphaera compta* DRUGG, 1970. +0.9 m. Slide 2.
Figs. 7-8:	*Cerebrocysta bartonensis* BUJAK, 1980. -3.3 m. Slide 2.
Fig. 9:	*Caligodinium endoreticulum* STOVER & HARDENBOL, 1994. -9.8 m. Slide 3.
Fig. 10:	*Areosphaeridium diktyoplokus* (KLUMPP, 1953). -7.3 m. Slide 1.
Fig. 11:	*Areosphaeridium* aff. *diktyoplokus* (KLUMPP, 1953). +2.6 m. Slide 2.
Figs. 12-13:	*Corrudinium* ? sp. aff. *C. incompositum* (DRUGG, 1970) and *Cerebrocysta bartonensis* BUJAK, 1980. -3.3 m. Slide 2.
Figs. 14-15:	*Corrudinium* ? sp. aff. *C. incompositum* (DRUGG, 1970) and *Cerebrocysta bartonensis* BUJAK, 1980. -3.3 m. Slide 2.
Fig. 16:	*Areosphaeridium diktyoplokus* (KLUMPP, 1953). -7.3 m. Slide 2.
Fig. 17:	*Areosphaeridium michoudii* BUJAK, 1994. -3.3 m. Slide 3.

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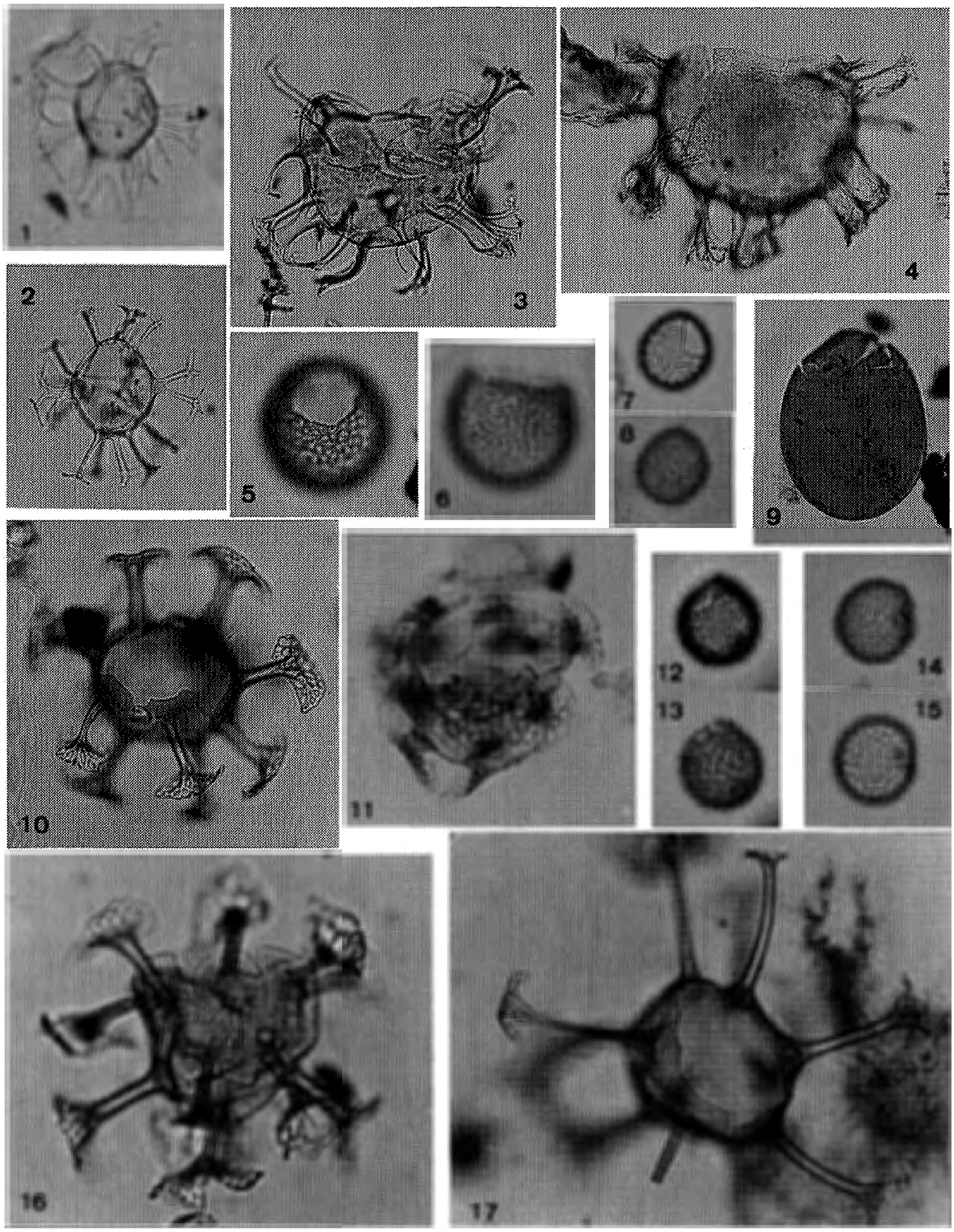
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PLATE 2

Figs. 1-2:	*Operculodinium* sp. aff. *Cordosphaeridium funiculatum* MORGENROTH, 1966. -7.3 m. Slide 2.
Fig. 3:	*Operculodinium* sp. aff. *Cordosphaeridium funiculatum* MORGENROTH, 1966. +4.4 m. Slide 2.
Figs. 4-5:	*Corrudinium incompositum* (DRUGG, 1970). +2.15 m. Slide 1.
Figs. 6-7:	*Corrudinium* sp. aff. *C. incompositum* (DRUGG, 1970) and *Impagidinium* STOVER & EVITT, 1978. -12.5 m. Slide 1.
Figs. 8-9:	*Corrudinium* sp. aff. *C. incompositum* (DRUGG, 1970) and *Impagidinium* STOVER & EVITT, 1978. -3.3 m. Slide 3.
Figs. 10-11:	*Corrudinium* sp. aff. *C. incompositum* (DRUGG, 1970) and *Impagidinium* STOVER & EVITT, 1978. -3.3 m. Slide 2.
Fig. 12:	*Dinopterygium fehmarnense* (LENTIN & WILLIAMS, 1973). -9.8 m. Slide 1.
Fig. 13:	*Cyclopsiella vieta* DRUGG & LOEBLICH, 1967. -9.8 m. Slide 3.
Figs. 14-15:	*Enneadocysta pectiniformis* (GERLACH, 1961). +0.9 m. Slide 1.
Fig. 16:	*Eocladopyxis tesselata* LIENGJARERN, COSTA & DOWNIE, 1980. +2.6 m. Slide 3.
Figs. 17-18:	*Enneadocysta* sp. C in STOVER & WILLIAMS, 1995. -3.3 m. Slide 2.
Figs. 19-22:	*Flandrecysta* ? sp. A. +0.9 m. Slide 1.

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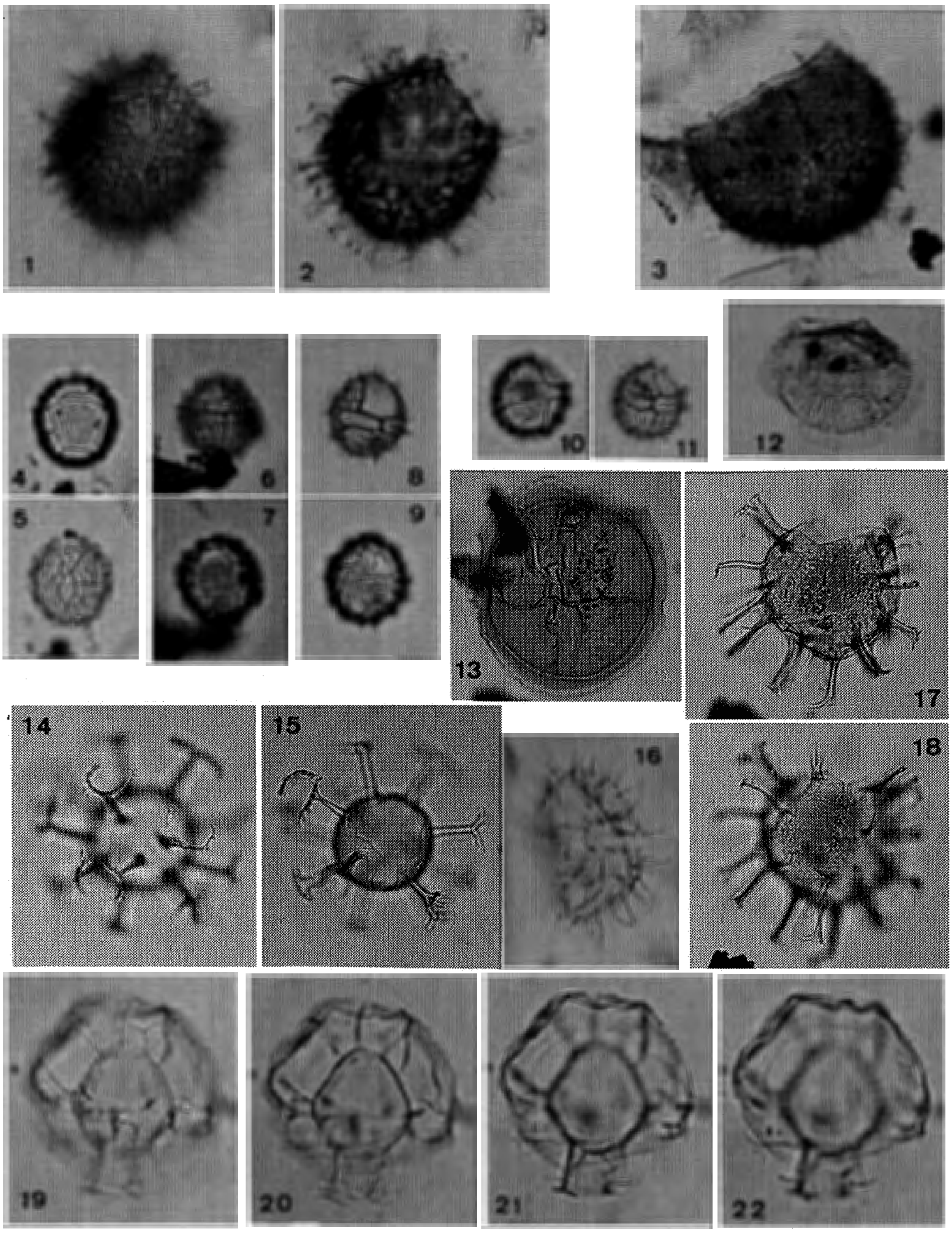
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PLATE 3

Figs. 1-3:	*Flandrecysta* ? sp. A. +0.9 m. Slide 2.
Figs. 4-5:	*Glaphyrocysta inculta* (MORGENROTH, 1966). +0.9 m. Slide 2.
Figs. 6-8:	*Flandrecysta* ? sp. A. -3.3 m. Slide 3.
Figs. 9-10:	*Glaphyrocysta* aff. *inculta* (MORGENROTH, 1966). -9.8 m. Slide 1.
Fig. 11:	*Glaphyrocysta laciniiformis* (GERLACH, 1961). -7.3 m. Slide 1.
Figs. 12-14:	*Glaphyrocysta inculta* (MORGENROTH, 1966). -7.3 m. Slide 1.

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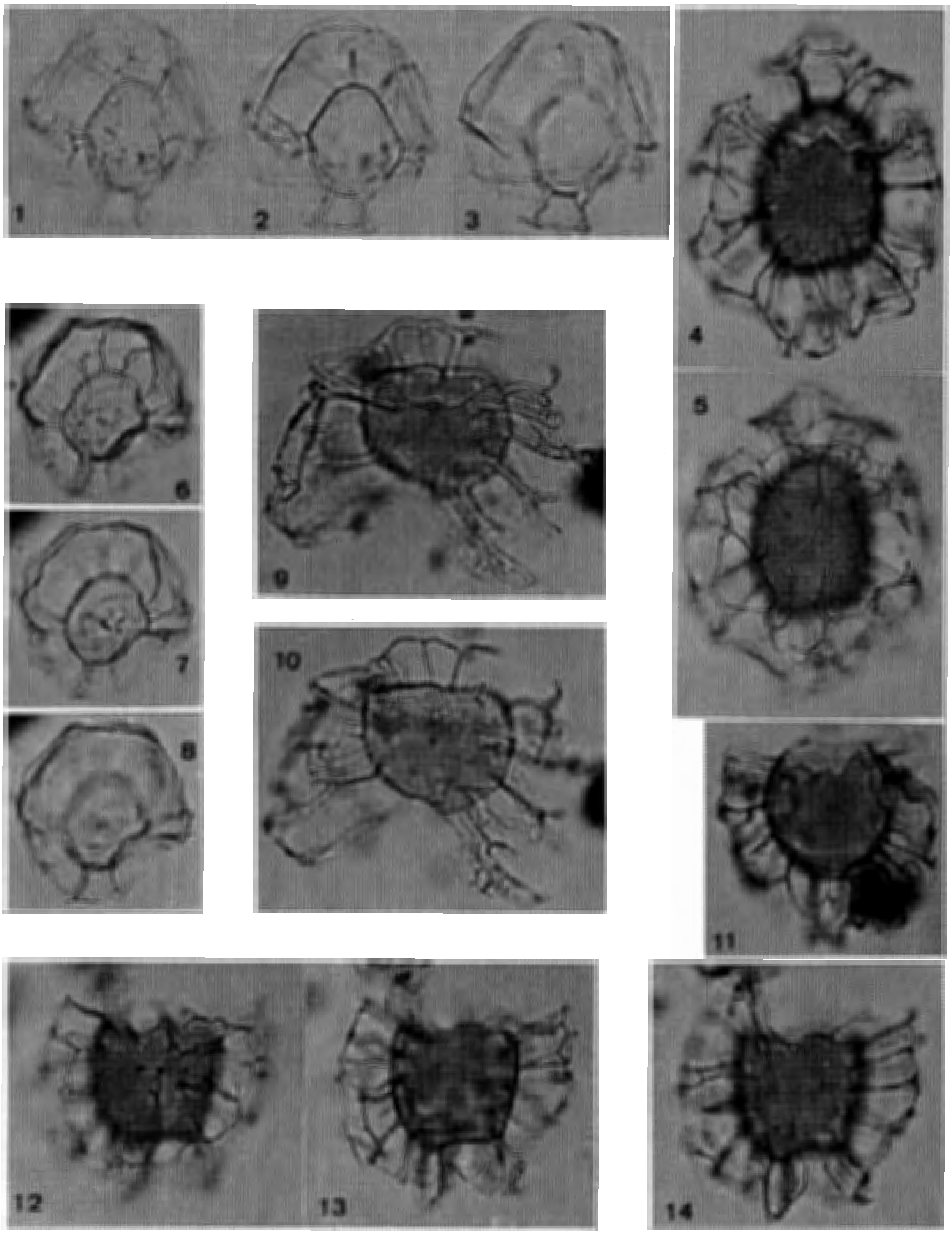
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PLATE 4

Figs. 1-2:	*Glaphyrocysta* aff. *inculta* (MORGENROTH, 1966). -7.3 m. Slide 2.
Figs 3-4:	*Glaphyrocysta semitecta* (BUJAK, 1980). -7.3 m. Slide 2.
Figs. 5-7:	*Hemiplacophora semilunifera* COOKSON & EISENACK, 1965. -3.3 m. Slide 3.
Figs. 8-9:	*Glaphyrocysta semitecta* (BUJAK, 1980). -7.3 m. Slide 2.
Fig. 10:	*Glaphyrocysta microfenestrata* (BUJAK, 1976). +4.4 m. Slide 4.
Figs. 11-13:	*Glaphyrocysta semitecta* (BUJAK, 1980). -3.3 m. Slide 3.

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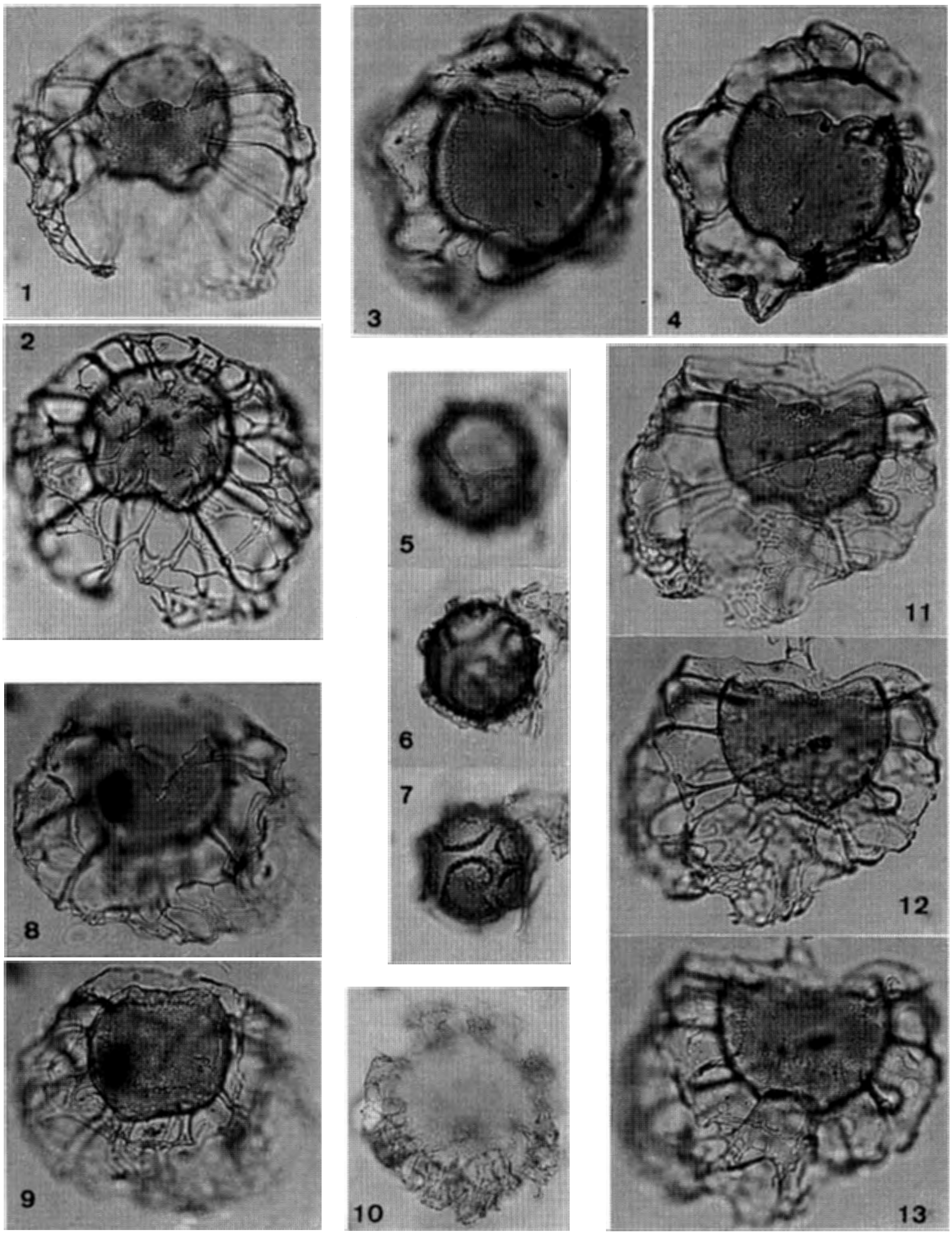
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PLATE 5

Fig. 1: *Glaphyrocysta microfenestrata* (BUJAK, 1976)
-3.3 m. Slide 2.

Figs. 2-3: *Glaphyrocysta* sp. aff. *G. retiintextum* (COOKSON, 1965) and *Adnatosphaeridium multispinosum* WILLIAMS & DOWNIE, 1966.
+2.6 m. Slide 1.

Figs. 4-6: *Glaphyrocysta* sp. aff. *G. retiintextum* (COOKSON, 1965) and *Adnatosphaeridium multispinosum* WILLIAMS & DOWNIE, 1966.
+4.4 m. Slide 1.

Figs. 7-8: *Homotryblium* aff. *aculeatum* WILLIAMS, 1978.
+0.9 m. Slide 1.

Figs. 9-10: *Glaphyrocysta* sp. aff. *G. exuberans* (DEFLANDRE & COOKSON, 1955) and *G. laciniiformis* (GERLACH, 1961).
+0.9 m. Slide 2.

Figs. 11-12: *Homotryblium* sp. 1 in DAMASSA *et al.*, 1990.
+0.9 m. Slide 1.

Fig. 13: *Heteraulacacysta leptalea* EATON, 1976.
+4.4 m. Slide 1.

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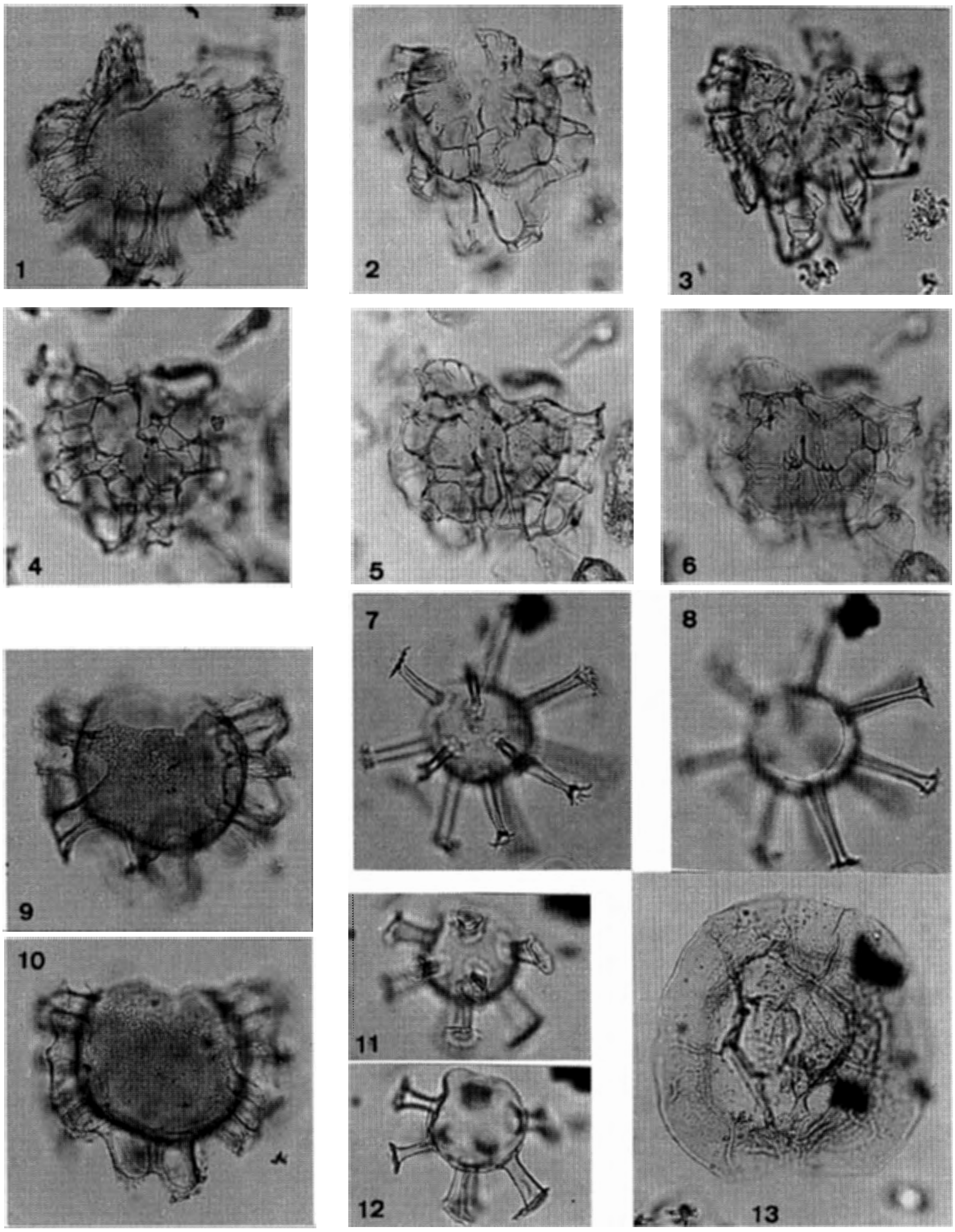
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PLATE 6

Fig. 1: *Homotryblium* sp. 1 in DAMASSA *et al.*, 1990.
-9.8 m. Slide 1.

Fig. 2: *Homotryblium* (aff.) *caliculum* BUJAK, 1980.
-3.3 m. Slide 3.

Figs. 3-5: *Thalassiphora patula* (WILLIAMS & DOWNIE, 1966). holotype-resembling specimen.
-7.3 m. Slide 2.

Figs. 6-7: *Homotryblium* sp. aff. *H. floripes* (DEFLANDRE & COOKSON, 1955) and *H. plectilum* DRUGG & LOEBLICH, 1967.
+2.15 m. Slide 1.

Figs. 8-9: *Homotryblium vallum* STOVER, 1977.
+2.15 m. Slide 1.

Figs. 10-12: *Hystrichokolpoma grimmertingenensis* nov. sp., holotype.
-3.3 m. Slide 3.

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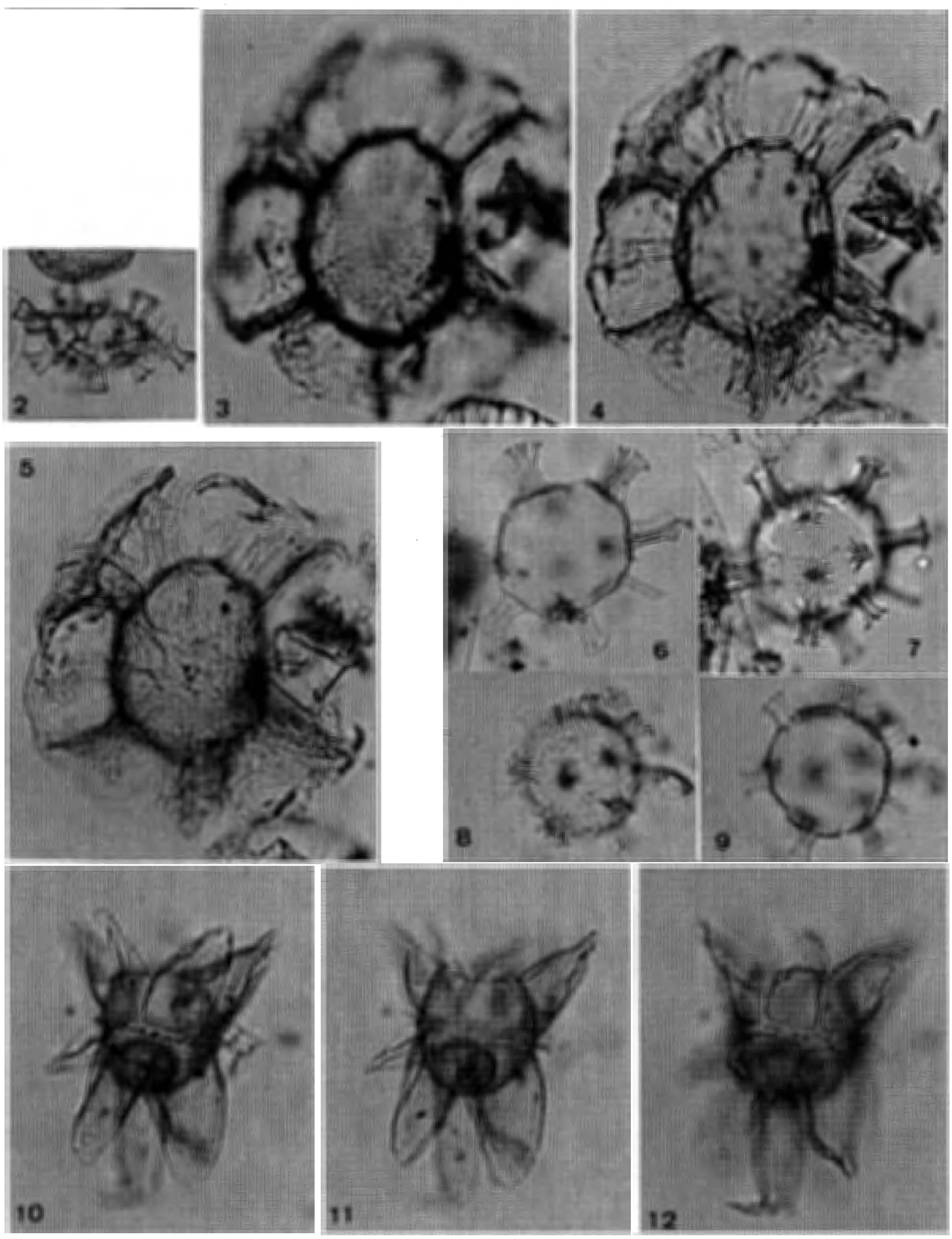
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PLATE 7

Figs. 1-4: *Thalassiphora patula* (WILLIAMS & DOWNIE, 1966). holotype-resembling specimen.
-7.3 m. Slide 2.

Figs. 5-7: *Hystrichokolpoma* aff. *salacium* EATON, 1976.
+0.9 m. Slide 1.

Fig. 8: *Horologinella* ? *corrugata* DE CONINCK, 1986.
-3.3 m. Slide 2.

Figs. 9-10: *Hystrichokolpoma* aff. *cinctum* KLUMPP, 1953.
+0.9 m. Slide 1.

Fig. 11: *Hystrichokolpoma salacium* EATON, 1976.
+4.4 m. Slide 1.

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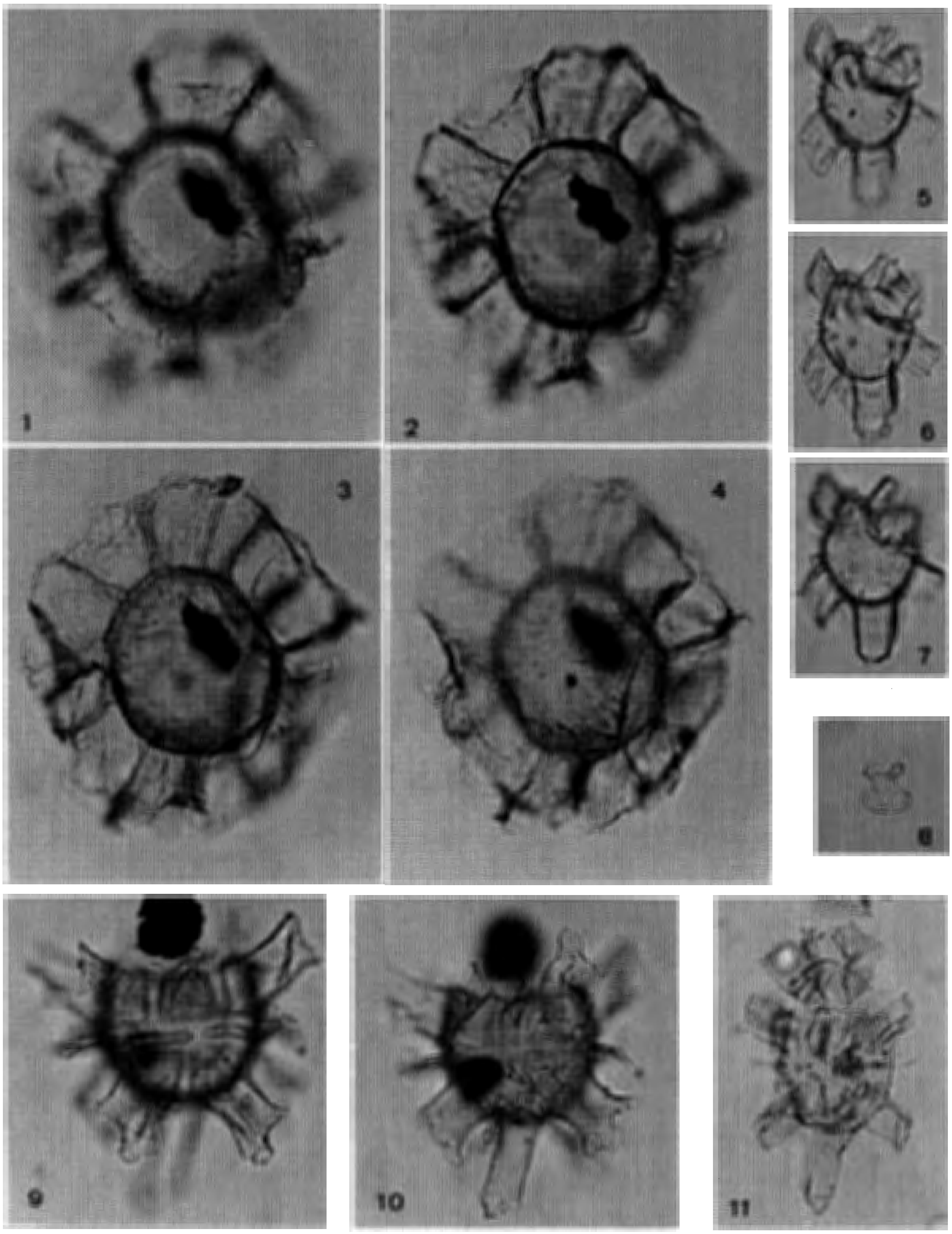
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PLATE 8

Figs. 1-2:	*Hystrichokolpoma* cf. *rigaudiae* DEFLANDRE & COOKSON, 1955. -7.3 m. Slide 3.
Figs. 3-4:	*Hystrichokolpoma* cf. *rigaudiae* DEFLANDRE & COOKSON, 1955. +0.9 m. Slide 1.
Fig. 5:	*Hystrichokolpoma* cf. *rigaudiae* DEFLANDRE & COOKSON, 1955. -3.3 m. Slide 2.
Figs. 6-8:	*Hystrichokolpoma* cf. *rigaudiae* DEFLANDRE & COOKSON, 1955. -9.8 m. Slide 1.
Fig. 9:	? *Hystrichosphaeridium* sp. BE in BRIDEAUX, 1977. -7.3 m. Slide 3.
Fig. 10:	? *Hystrichosphaeridium* sp. BE in BRIDEAUX, 1977 +2.6 m. Slide 1.
Fig. 11:	? *Hystrichosphaeridium* sp. BE in BRIDEAUX, 1977. -7.3 m. Slide 3.
Fig. 12:	? *Hystrichosphaeridium* sp. BE in BRIDEAUX, 1977. +2.6 m. Slide 1.
Figs. 13-15:	*Impagidinium dispertitum* ? (COOKSON & EISENACK, 1965). -3.3 m. Slide 2.
Figs. 16-18:	*Impagidinium dispertitum* ? (COOKSON & EISENACK, 1965). -3.3 m. Slide 3.
Figs. 19-20:	*Lingulodinium siculum* (DRUGG, 1970). -7.3 m. Slide 3.
Figs. 21-22:	*Litosphaeridium* ? *mamellatum* DE CONINCK, 1977. +0.9 m. Slide 2.
Fig. 23:	*Impagidinium maculatum* ? (COOKSON & EISENACK, 1961). +2.15 m. Slide 2.

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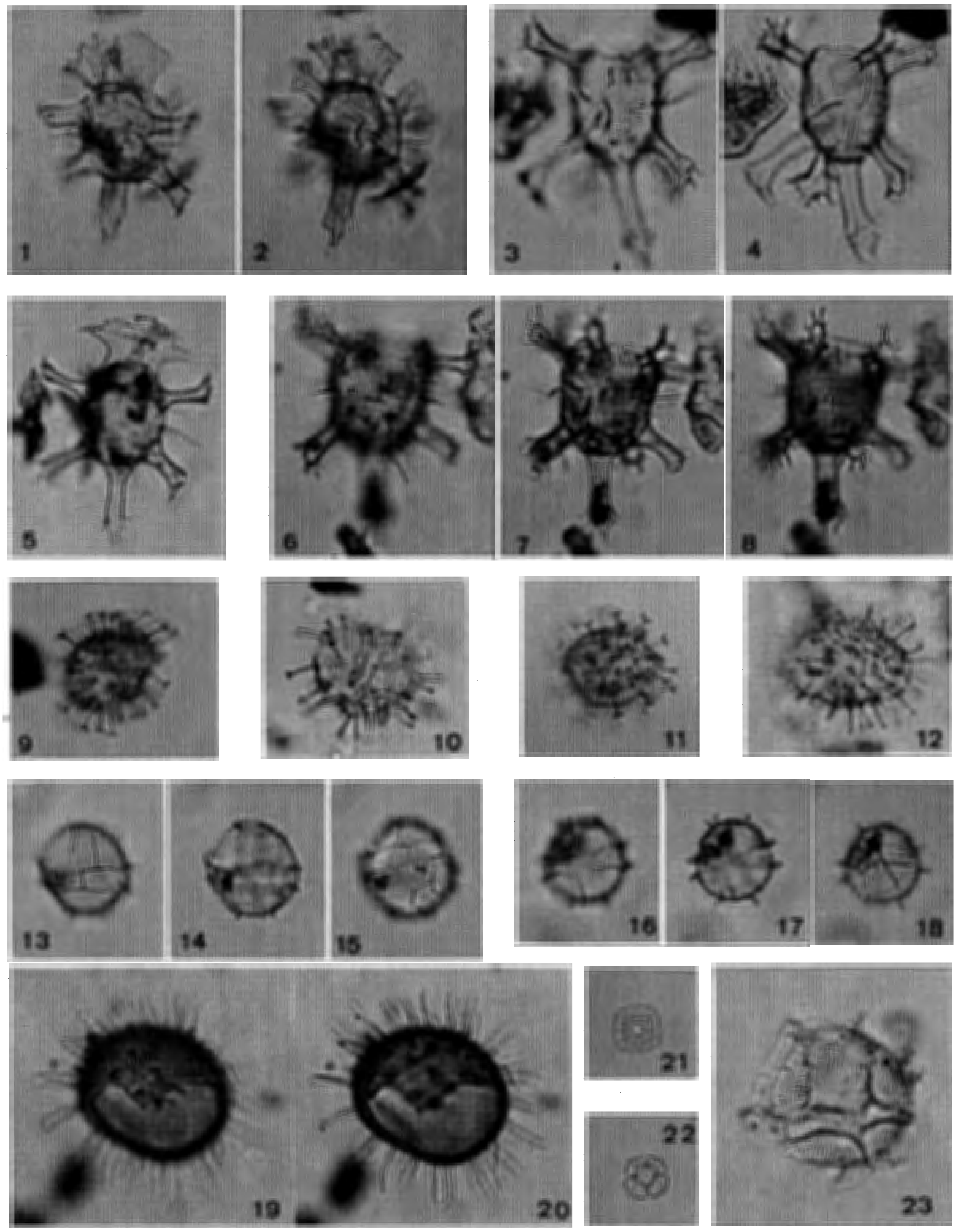
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PLATE 9

Figs. 1-2:	*Membranophoridium aspinatum* GERLACH, 1961 forma A in DE CONINCK, 1999. -3.3 m. Slide 3.
Fig. 3:	*Lingulodinium multivirgatum* DE VERTEUIL & NORRIS, 1996. +4.4 m. Slide 1.
Fig. 4:	*Nematosphaeropsis pusulosa* (MORGENROTH, 1966). +4.4 m. Slide 3.
Figs. 5-7:	*Membranophoridium aspinatum* GERLACH, 1961 forma A in DE CONINCK, 1999. -3.3 m. Slide 3.
Figs. 8-10:	*Membranophoridium aspinatum* GERLACH, 1961 forma A in DE CONINCK, 1999. +2.15 m. Slide 2.
Fig. 11:	*Nematosphaeropsis balcombiana* DEFLANDRE & COOKSON, 1955. +0.9 m. Slide 2.
Figs. 12-13:	*Nematosphaeropsis* cf. *lemniscata* BUJAK, 1984. +0.9 m. Slide 1.
Fig. 14:	*Nematosphaeropsis* sp. A. -3.3 m. Slide 1.

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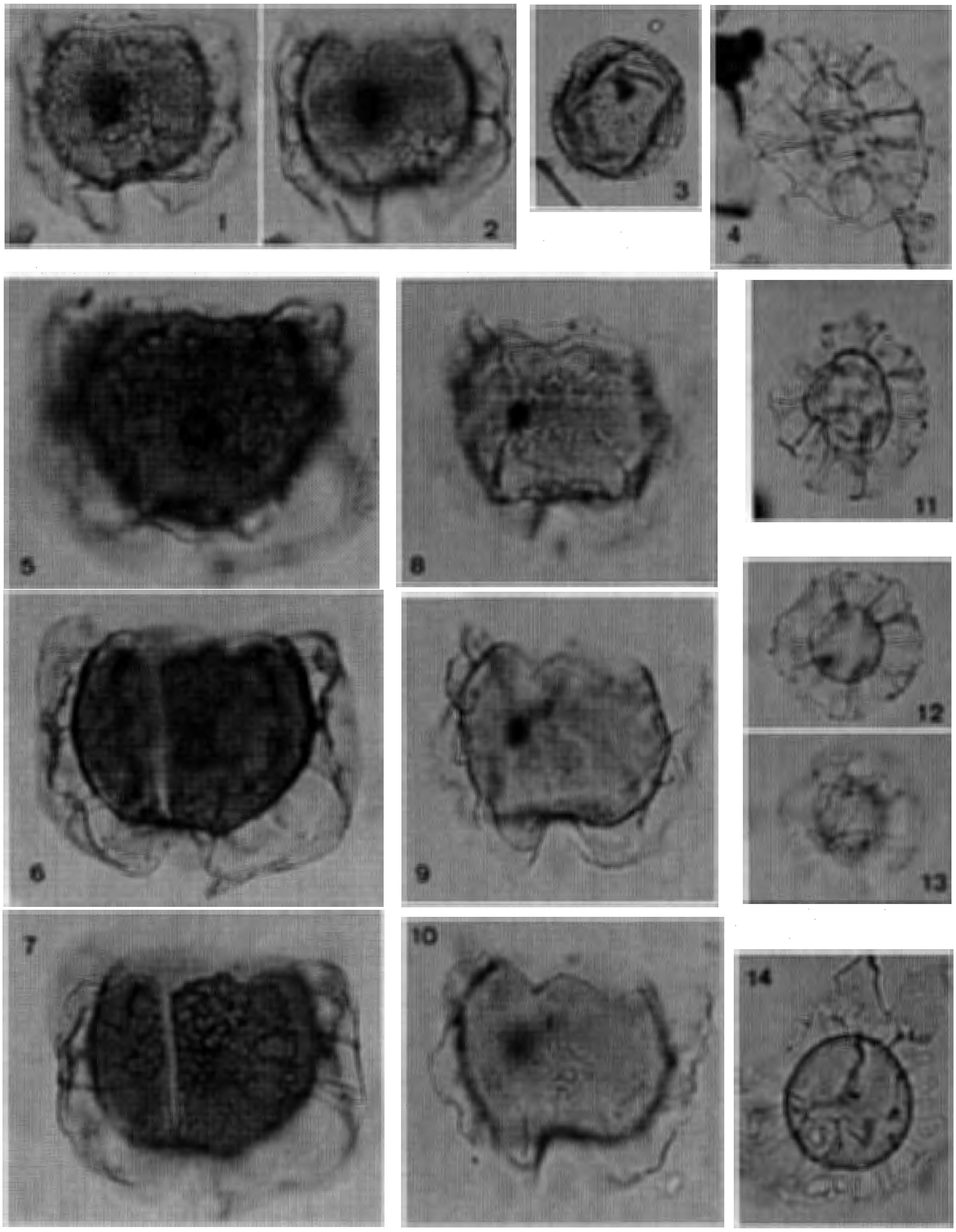
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PLATE 10

Figs. 1-2: *Membranophoridium aspinatum* GERLACH, 1961 forma A in DE CONINCK, 1999.
+4.4 m. Slide 5.

Fig. 3: *Oligosphaeridium* sp. cf. *Hystrichokolpoma rigaudiae* DEFLANDRE & COOKSON, 1955.
-3.3 m. Slide 3.

Figs. 4-5: *Oligosphaeridium* sp. cf. *Hystrichokolpoma rigaudiae* DEFLANDRE & COOKSON, 1955.
+0.9 m. Slide 2.

Fig. 6: *Thalassiphora succincta* MORGENROTH, 1966.
-7.3 m. Slide 1.

Fig. 7: *Turbiosphaera symmetrica* BUJAK, 1980.
+0.9m. Slide 3.

Figs. 8-10: *Valensiella* ? *clathroderma* DEFLANDRE & COOKSON, 1955.
+2.15 m. Slide 2.

Fig. 11: *Thalassiphora* ? cf. *pansa* STOVER, 1977.
-7.3 m. Slide 2.

Fig. 12: *Paucilobimorpha spinosa* (COOKSON, 1965).
+0.9 m. Slide 1.

Fig. 13: *Trigonopyxidia fiscellata* DE CONINCK, 1986.
-3.3 m. Slide 1.

Figs. 14-16: Desmidiaceae zygote ? sp. indet.
-7.3 m. Slide 3.

Fig. 17: Desmidiaceae zygote ? sp. indet.
+2.15 m. Slide 1.

Figs. 18-19: Desmidiaceae zygote ? sp. indet.
-9.8 m. Slide 1.

Figs. 20-21: Incertae Sedis 143 in CHÂTEAUNEUF, 1980.
+4.4 m. Slide 5.

Fig. 22: Incertae Sedis 143 in CHÂTEAUNEUF, 1980.
-12.5 m. Slide 1.

Figs. 23-25: Incertae Sedis 143 in CHÂTEAUNEUF, 1980.
+0.9 m. Slide 3.

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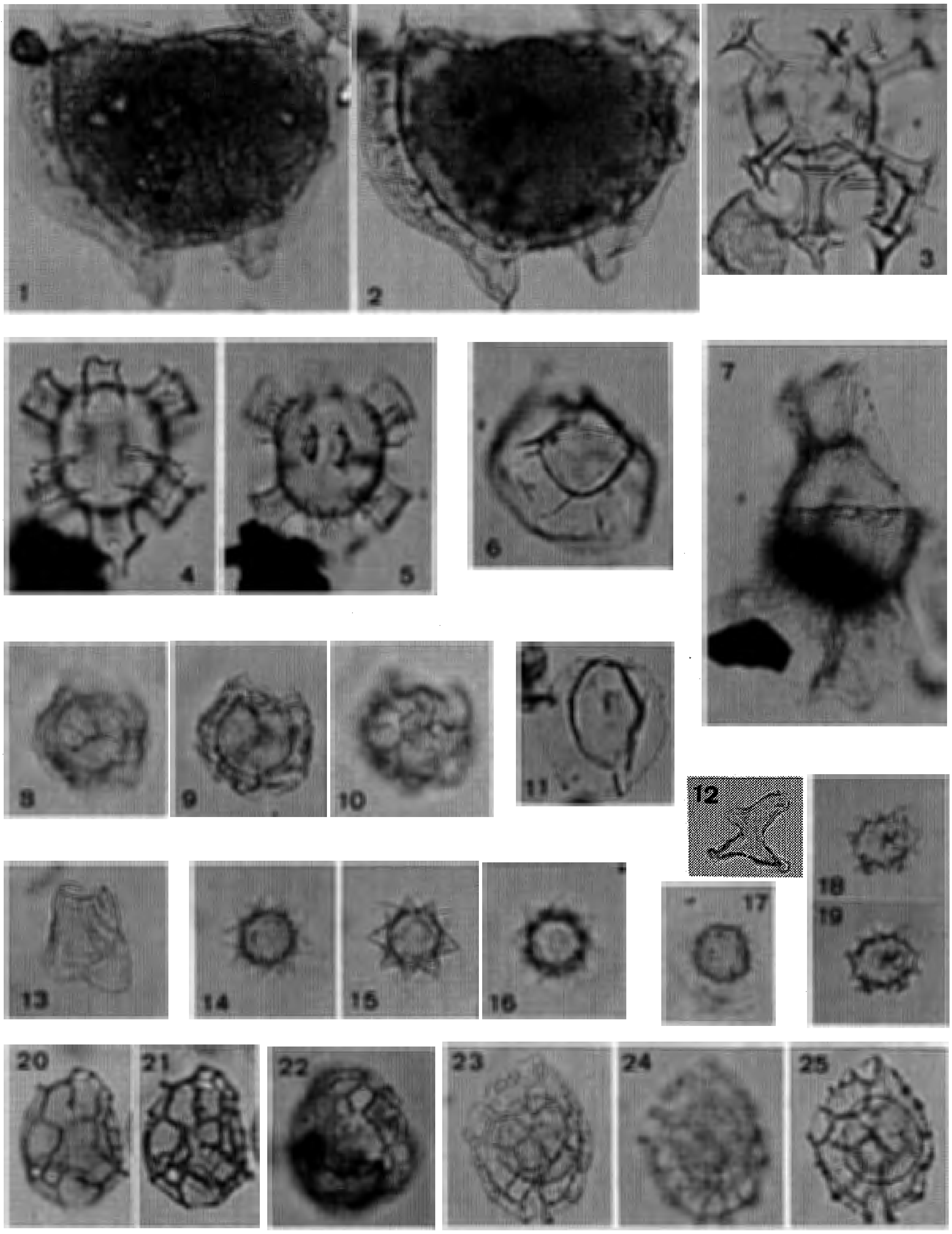
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PLATE 11

Figs. 1-2:	*Operculodinium* sp. aff. *Cordosphaeridium funiculatum* MORGENROTH, 1966. -3.3 m. Slide 2.
Fig. 3:	*Spiniferites* aff. *elongatus* REID, 1974. +2.15 m. Slide 2.
Fig. 4:	*Thalassiphora pelagica* (EISENACK, 1954). -12.5 m. Slide 2.
Figs. 5-6:	*Operculodinium* aff. *placitum* DRUGG & LOEBLICH, 1967. +2.15 m. Slide 2.
Fig. 7:	*Reticulatosphaera actinocoronata* (BENEDEK, 1972). +0.9 m. Slide 3.
Fig. 8:	*Reticulatosphaera actinocoronata* (BENEDEK, 1972). -9.8 m. Slide 1.
Fig. 9:	*Polysphaeridium zoharyii* (ROSSIGNOL, 1962). -7.3 m. Slide 2.
Fig. 10:	*Pterospermella barbarae* (GORKA, 1963). -7.3 m. Slide 2.
Fig. 11:	*Thalassiphora reticulata* MORGENROTH, 1966. -12.5 m. Slide 2.

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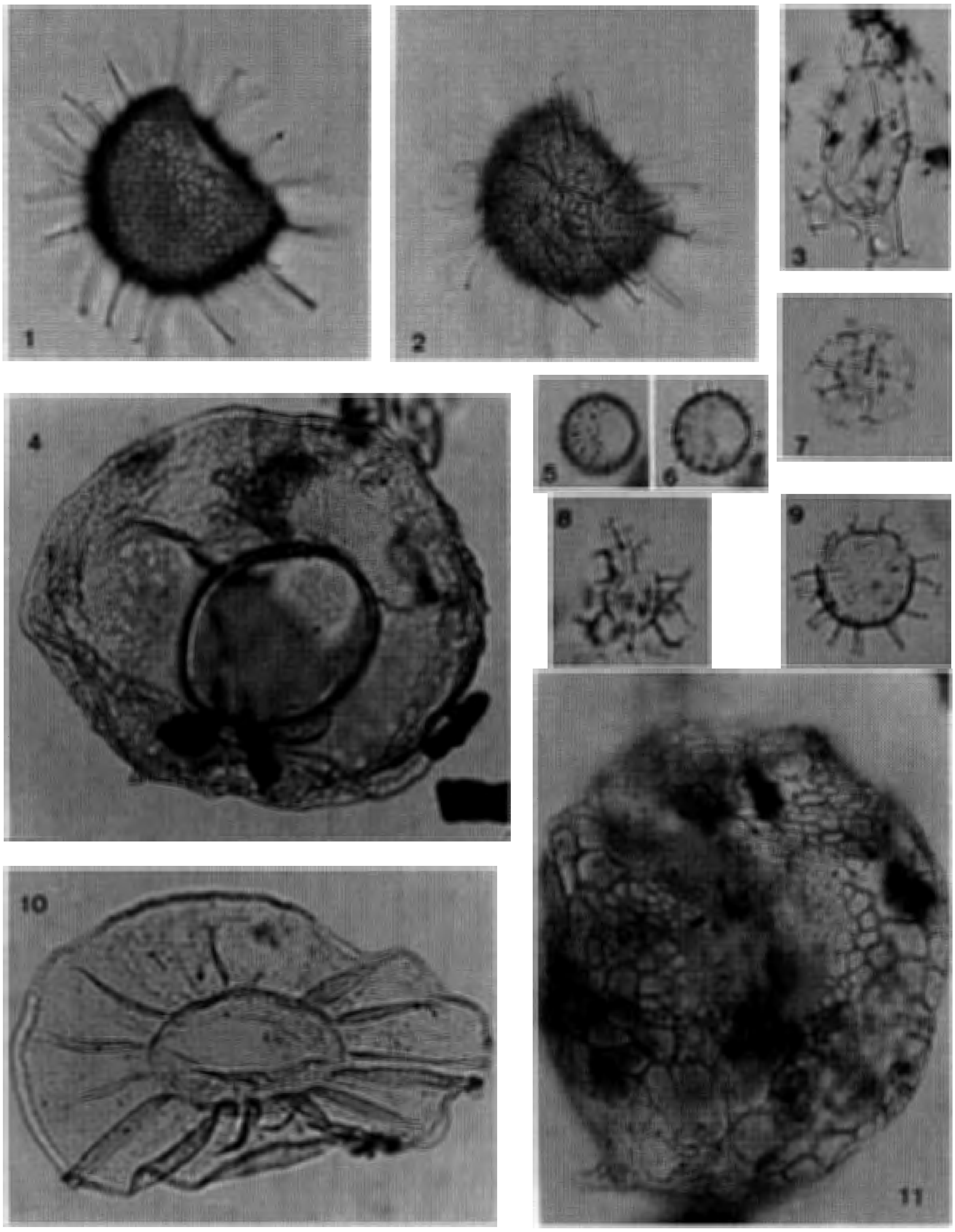
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PLATE 12

Fig. 1:	*Rhombodinium perforatum* (JAN DU CHÊNE & CHÂTEAUNEUF, 1975). -12.5 m. Slide 2.
Fig. 2:	*Thalassiphora reticulata* MORGENROTH, 1966. +4.4 m. Slide 2.
Figs. 3-5:	*Systematophora placacantha* (DEFLANDRE & COOKSON, 1955). -3.3 m. Slide 1.
Fig. 6:	*Spiniferites-Achomosphaera* sp. A. -3.3 m. Slide 1.
Figs. 7-8:	*Phthanoperidinium* aff. *geminatum* BUJAK, 1980. +2.6 m. Slide 1.
Figs. 9-10:	*Phthanoperidinium* aff. *geminatum* BUJAK, 1980. +2.6 m. Slide 3.
Fig. 11:	*Pterospermella helios* (SARJEANT, 1959). +0.9 m. Slide 1.
Figs. 12-13:	*Thalassiphora pelagica* (EISENACK, 1954). +0.9 m. Slide 2.

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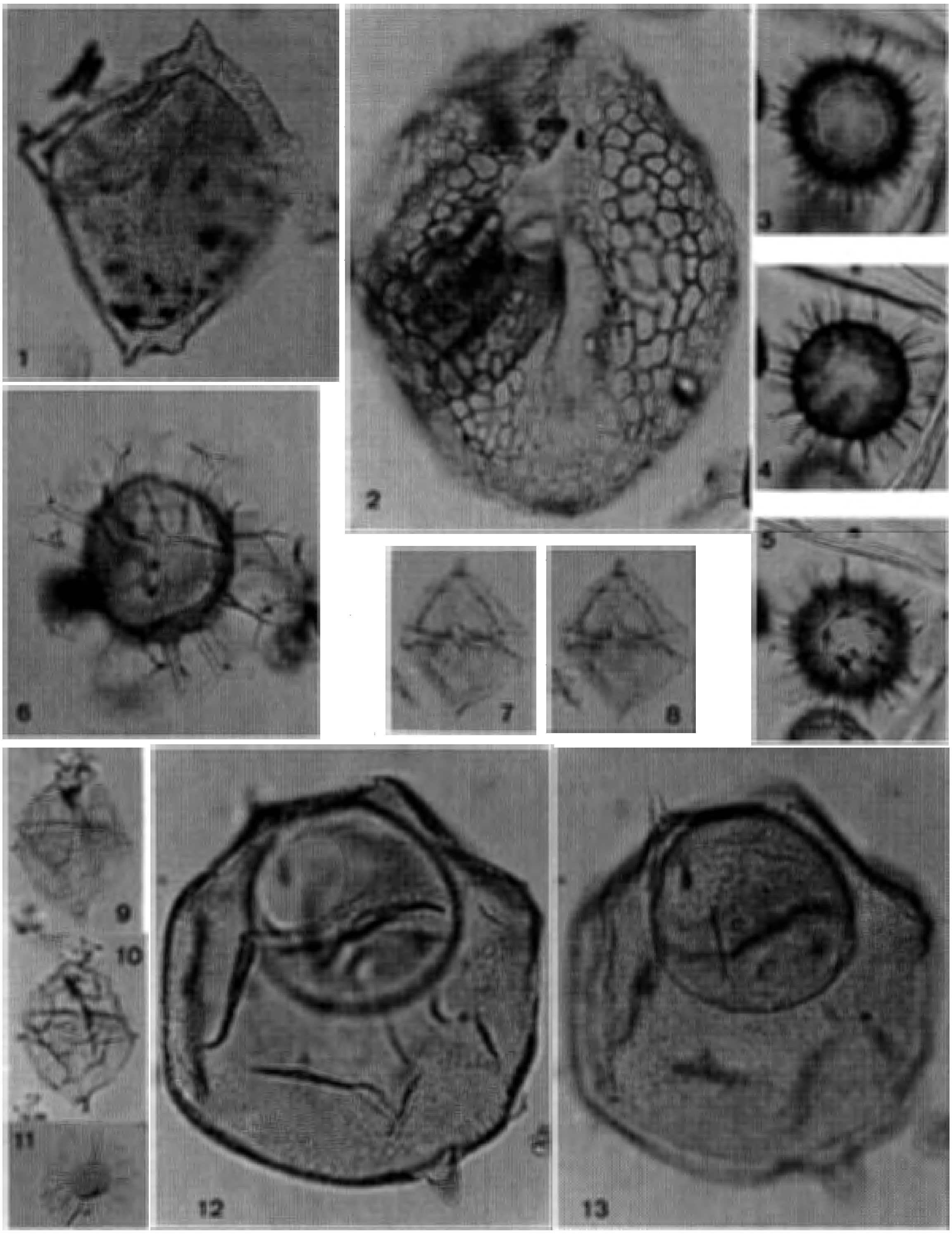
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PLATE 13

Figs. 1-2:	*Pyxidinopsis fairhavenensis* DE VERTEUIL & NORRIS, 1996. -3.3 m. Slide 2.
Fig. 3:	*Samlandia chlamydophora* EISENACK, 1954. -3.3 m. Slide 3.
Figs. 4-5:	*Samlandia chlamydophora* EISENACK, 1954. -3.3 m. Slide 2.
Figs. 6-8:	*Rottnestia borussica* (EISENACK, 1954). +0.9 m. Slide 1.
Fig. 9:	*Phthanoperidinium* aff. *geminatum* BUJAK, 1980. +4.4 m. Slide 3.
Figs. 10-12:	*Rottnestia borussica* (EISENACK, 1954). -3.3 m. Slide 3.
Figs. 13-14:	*Spiniferites membranaceus* (ROSSIGNOL, 1964). -3.3 m. Slide 2.
Figs. 15-16:	*Spiniferites-Achomosphaera* sp. A. +2.15 m. Slide 1.

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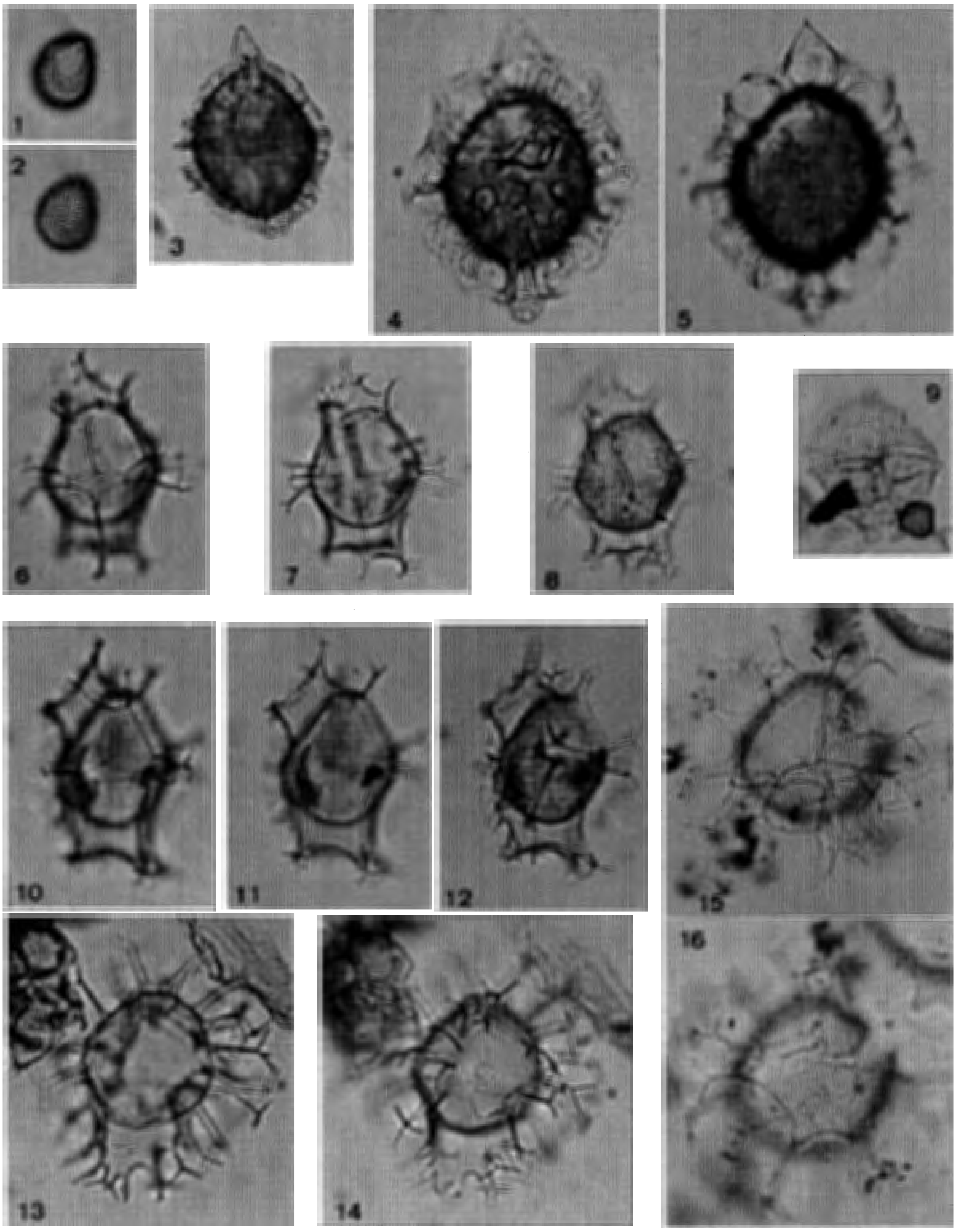
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