

GÖRAN KJELLSTRÖM

MAASTRICHTIAN MICROPLANKTON
FROM THE HÖLLVIKEN BOREHOLE NO.1
IN SCANIA, SOUTHERN SWEDEN

РЕЗЮМЕ



STOCKHOLM 1973

GÖRAN KJELLSTRÖM

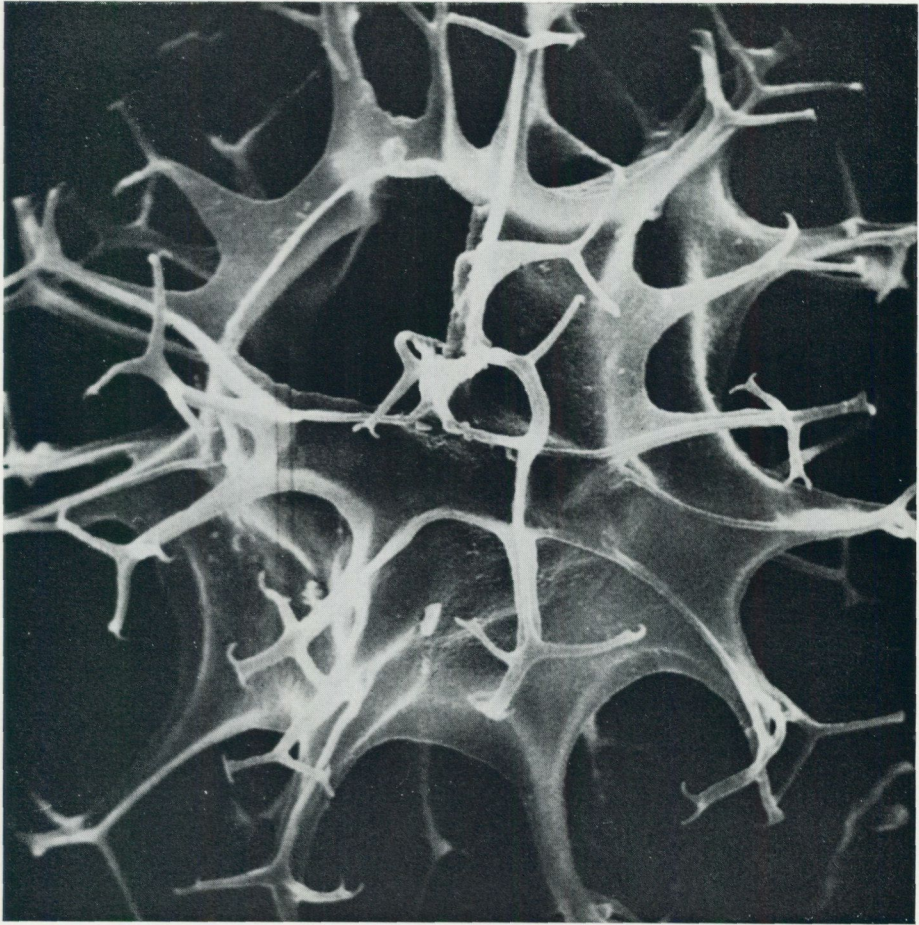
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ABSTRACT

The present study deals with Maastrichtian microplankton with organic-walled tests, obtained from a continuously cored well drilled at Höllviken in South-Western Scania (Skåne), Sweden. Forty-one species are stratigraphically analyzed. Sixteen of these species are here reported for the first time as occurring in the Maastrichtian. Three species are proposed as new and one species is treated as a new variety: *Deflandrea raijæ* n.sp., ?*Scriniodinium irisae* n.sp., ?*Scriniodinium nilsii* n.sp., and *Deflandrea rectangularis* var. *samuelsonii* n. An attempt is made to draw some palaeoclimatic conclusions from the data available.

РЕЗЮМЕ

Настоящая работа посвящена фитопланктону с органической оболочкой, обнаруженному в отложениях маастрихта, вскрытых скважиной, пробуренной в Höllviken на юго-западе Scania, Южная Швеция.

В маастрихтских отложениях из керна скважины в Höllviken установлен 41 вид, из которых 26 видов отмечаются здесь впервые, а остальные 15 видов встречались уже в разновозрастных отложениях. При этом отмечается, что 16 видов ранее принимались стратиграфически ограниченными более древними или более молодыми горизонтами. На основании рассматриваемых в данной работе материалов и данных, приведенных в списках синонимов, дается новый вариант для всей рассмотренной стратиграфической области.

В отложениях нижнего маастрихта в Höllviken были установлены лишь следующие виды: *Odontochitina operculata*, *Spiniferites wetzeli*, *Spongodinium delitiense* и *Tanyosphaeridium regulare*. До сих пор нижний маастрихт является самым молодым стратиграфическим уровнем, в котором были известны эти виды за исключением *Tanyosphaeridium regulare*, который был описан из эоцена Англии.

В отложениях, отнесенных к среднему маастрихту, обнаружены следующие представители: *Crassosphaera concinna*, *Hexagonifera chlamydata* и *Pareodinia aphelia*. В настоящее время отложения среднего маастрихта являются самым молодым стратиграфическим уровнем для последних двух видов; однако *Crassosphaera concinna* была уже известна в более молодых (и в более древних) отложениях.

В отложениях верхнего маастрихта отсутствуют виды, свойственные лишь этому подъярису.

Что касается разнообразия типов цист динофлагеллят, упомянутых в микропланктоне, кроме *Crassosphaera concinna* (=Tasmanaceae) преобладающим типом является каватные (cavate) динофлагелляты. Они составляют 40% от общего состава. Проксимальные (proximate) цисты составляют 20% и хоратные (chorate) динофлагелляты — 17,5%; проксимо-хоратные (proximo-chorate) — 15% и трабекулятные (trabeculate), маргинатные (marginate) и мембралатные (membranate) составляют 2,5% каждый. Соотношения между разными типами цист в отложениях нижнего, среднего и верхнего маастрихта указывают на преобладание каватных цист, особенно в среднем маастрихте. Относительно стратиграфического распространения различных типов археопилей, то в нижнем и верхнем маастрихте доминируют интеркаларный и пресингулярный типы, во время как интеркаларный тип преобладает в среднем маастрихте.

ACKNOWLEDGEMENTS

This investigation has been carried out at the Geological Survey of Sweden (SGU). I wish to express my sincere thanks for generous help in providing excellent working conditions to Dr. Roland Skoglund, head of the Section for Stratigraphy and Palaeontology of the SGU. Thanks are also due to Mr. Uno Samuelson, the Swedish Museum of Natural History, for skillful assistance in the dark-room processing. Mrs. Raija Sethi, SGU, is gratefully acknowledged for painstaking laboratory work. Mrs. Greta Hellström, SGU, kindly prepared the drawings. I wish to record my gratitude to Professor T. F. Vozzhennikova, Academy of Sciences of the U.S.S.R., for readiness in translating the summary of the present paper into the Russian language. I am also very much indebted to Mrs. Carole Wilson for revising the English.

INTRODUCTION

A large number of anomalies exist as regards the distribution of dinoflagellates within the Mesozoic, precluding, as a consequence, an adequate stratigraphic picture. In particular the lack of knowledge of the Maastrichtian dinoflagellates is extensive, from which stage only approximately 10 % of the total record of dinoflagellates is known (cf. EISENACK & KLEMENT 1964; EISENACK 1967; EISENACK & KJELLSTRÖM 1971a, 1971b; SARJEANT 1967a, 1967b). These microplanktonic organisms, however, were by no means in decline during the Maastrichtian, but on the contrary, they have been found in the present study to be significant constituents of matching abundance, retaining their importance throughout the entire stage.

Forming part of a series of publications dealing with organic-walled microplankton obtained from material originating from Balto-Scandia (KJELLSTRÖM 1968, 1971a, 1971b, 1971c, 1972a, 1972b, MARTIN & KJELLSTRÖM 1973), this paper thus reports dinoflagellates derived from the Maastrichtian of the Höllviken Borehole No. 1 in South-Western Scania (Skåne) in Southern Sweden (Fig. 1). The material investigated consists of white chalks and grey limestones with clayey intercalations (Upper and Middle Maastrichtian) and grey limestones interbedded with calcareous marls (Lower Maastrichtian). A detailed account on the stratigraphy and lithology has been given by BROTZEN (1945).

The Maastrichtian of the Höllviken boring comprises a thickness of about 540 m. The material was obtained by core drilling, with the exception of the first 235 m of the Upper Maastrichtian (in total 250 m) which was rotary drilled. As a consequence only a limited portion (about 15 m) was available for this study with respect to the Upper Maastrichtian. The following eighteen levels were examined (Fig. 43), all of them yielding a rich and well-preserved microplankton flora: 586.00 m, 570.00 m, 550.00 m, 540.00 m, 525.00 m

(Lower Maastrichtian), 509.00 m, 475.25 m, 455.00 m, 427.10 m, 406.70 m, 378.37 m, 359.00 m, 330.00 m, 327.30 m (Middle Maastrichtian), 297.80 m, 296.00 m, 293.50 m, and 282.25 m (Upper Maastrichtian).

Thirty-three slides (each slide containing approx. 3000 specimens) were processed from these samples and they are stored under the label SGU Höllviken-1 in the Department of Research & Applied Geology, the Geological Survey of Sweden, Stockholm.

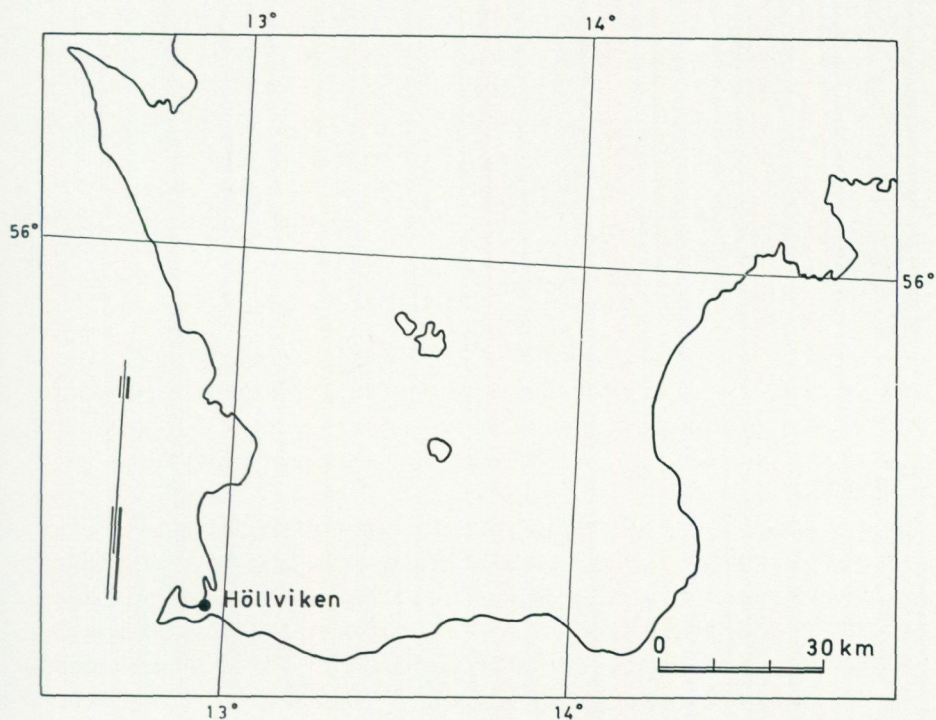


Fig. 1. Location map.

SYSTEMATICS

Genus *Achomosphaera* EVITT, 1963*Achomosphaera ramulifera* (DEFLANDRE, 1937) EVITT, 1963

Fig. 2

- 1935 *Hystrichosphaera* cf. *ramosa*. – DEFLANDRE: p. 232, Pl. 5, fig. 11.
 1937 *Hystrichosphaeridium ramuliferum*. – DEFLANDRE: p. 74, Pl. 14, fig. 5, 6; Pl. 17, fig. 10.
 1941 *Hystrichosphaeridium ramuliferum*. – CONRAD: p. 2, Pl. 1, fig. J.
 1948 *Hystrichosphaeridium ramuliferum*. – PASTIELS: p. 39, Pl. 3, fig. 17–19.
 1952 *Hystrichosphaeridium ramuliferum*. – WETZEL, W.: p. 398, Pl. A, fig. 9; text-fig. 9.
 1955 *Hystrichosphaeridium ramuliferum*. – VALENSI: p. 394, Pl. 4, fig. 6.
 1959 *Hystrichosphaeridium ramuliferum*. – GOCHT: p. 71, Pl. 3, fig. 9.
 1961 *Hystrichosphaeridium ramuliferum*. – GERLACH: p. 185, Pl. 28, fig. 3.
 1963 *Hystrichosphaeridium ramuliferum*. – BALTES: p. 586, Pl. 7, fig. 13, 17, 18.
 1963 *Hystrichosphaeridium ramuliferum*. – GÓRKA: p. 59, Pl. 8, fig. 3; text-fig. 6:3, 4.
 1963 *Baltisphaeridium ramuliferum*. – DOWNIE & SARJEANT: p. 92.
 1963 *Achomosphaera ramulifera*. – EVITT: p. 163.
 1964 *Achomosphaera ramulifera*. – COOKSON & HUGHES: p. 45, Pl. 9, fig. 10.
 1966 *Achomosphaera ramulifera*. – DAVEY & WILLIAMS in DAVEY et al.: p. 49, Pl. 21, fig. 3.
 1967 *Achomosphaera ramulifera*. – COOKSON & EISENACK: p. 249, Pl. 41, fig. 2.
 1967 *Achomosphaera ramulifera*. – CLARKE & VERDIER: p. 40, Pl. 8, fig. 1.
 1969 *Achomosphaera ramulifera*. – DAVEY: p. 174, Pl. 10, fig. 7.
 1970 *Achomosphaera ramulifera*. – ZAITZEFF & CROSS: Pl. 3, fig. 24.
 1971 *Achomosphaera ramulifera*. – DAVEY & VERDIER: p. 10.
 1971 *Achomosphaera ramulifera*. – FOUCHER: p. 85, Pl. 1, fig. 1–4.

REMARKS. – *Achomosphaera ramulifera* is a common species throughout the entire Maastrichtian of the Höllviken core (Fig. 43). This species has been recorded from a great many localities and appears to have an extensive vertical range (Fig. 45). It has been reported from following stages: Upper Oligocene – Middle Miocene of Germany (GERLACH 1961); Eocene of Belgium (PASTIELS 1948); Paleocene of Australia (COOKSON & EISENACK 1967); Danian of Germany (W. WETZEL 1952); Maastrichtian of Poland (GÓRKA 1963) and of the United States (ZAITZEFF & CROSS 1970); Senonian of France (DEFLANDRE 1937; CONRAD 1941; VALENSI 1955); Coniacian of France (FOUCHER 1971); Cenomanian of England and France (DAVEY & WILLIAMS in DAVEY 1969); Albian of Roumania (BALTES 1963) and of France (DAVEY & VERDIER 1971); Lower Hauterivian of Germany (GOCHT 1959).

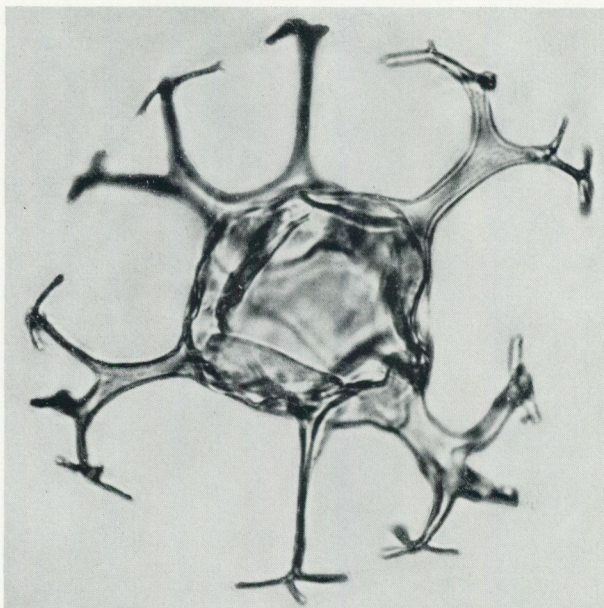


Fig. 2. *Achomosphaera ramulifera* (DEFLANDRE, 1937) EVITT, 1963. X 700. Slide: 540.

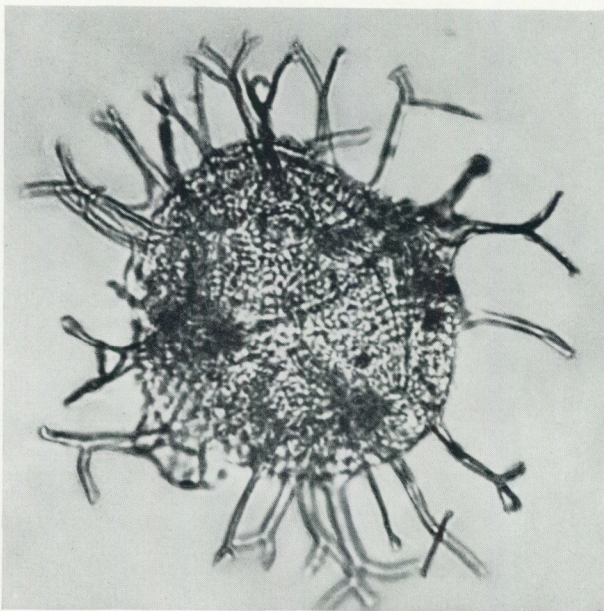


Fig. 3. *Achomosphaera sagena* DAVEY & WILLIAMS, 1966. X 840. Slide: 475.

Achomosphaera sagena DAVEY & WILLIAMS, 1966

Fig. 3

- 1966 *Achomosphaera sagena*. – DAVEY & WILLIAMS in DAVEY et al.: p. 51, Pl. 2, fig. 1, 2.
 1967 *Achomosphaera reticulata*. – CLARKE & VERDIER: p. 41, Pl. 8, fig. 2, 3; text-fig. 16.
 1969 *Achomosphaera sagena*. – DAVEY: p. 175.

REMARKS. – *Achomosphaera sagena* occurs frequently in the Lower, Middle and Upper Maastrichtian of the Höllviken core. This species is here reported for the first time from the Maastrichtian. It was formerly known from the Turonian and Senonian of the Isle of Wight (CLARKE & VERDIER 1967) and from the Cenomanian of England (DAVEY & WILLIAMS in DAVEY et al. 1966) and of France (DAVEY 1969).

Genus *Areoligera* LEJEUNE-CARPENTIER, 1939*Areoligera senonensis* LEJEUNE-CARPENTIER, 1939

Fig. 4

- 1939 *Areoligera senonensis*. – LEJEUNE-CARPENTIER: p. 164, fig. 2.
 1966 *Areoligera* cf. *senonensis*. – WILLIAMS & DOWNIE in DAVEY et al.: p. 230, Pl. 25, fig. 6; text-fig. 64.
 1970 *Areoligera senonensis*. – ZAITZEFF & CROSS: Pl. 4, fig. 33.
 1971 *Areoligera senonensis*. – WILSON: Pl. 3, fig. 8, 9.

REMARKS. – *Areoligera senonensis* is found in the Middle and Upper Maastrichtian of the Höllviken core. This species was originally described from the Senonian of Belgium (LEJEUNE-CARPENTIER 1939) but it has also been recovered from the Maastrichtian of Denmark, Holland (WILSON 1971), the United States (ZAITZEFF & CROSS 1970) and from the Eocene of England (WILLIAMS & DOWNIE in DAVEY et al. 1966).

Genus *Callaiosphaeridium* DAVEY & WILLIAMS, 1966*Callaiosphaeridium asymmetricum* (DEFLANDRE & COURTEVILLE, 1939)

DAVEY & WILLIAMS, 1966

Fig. 5

- 1939 *Hystrichosphaeridium asymmetricum*. – DEFLANDRE & COURTEVILLE: p. 100, Pl. 4, fig. 1.

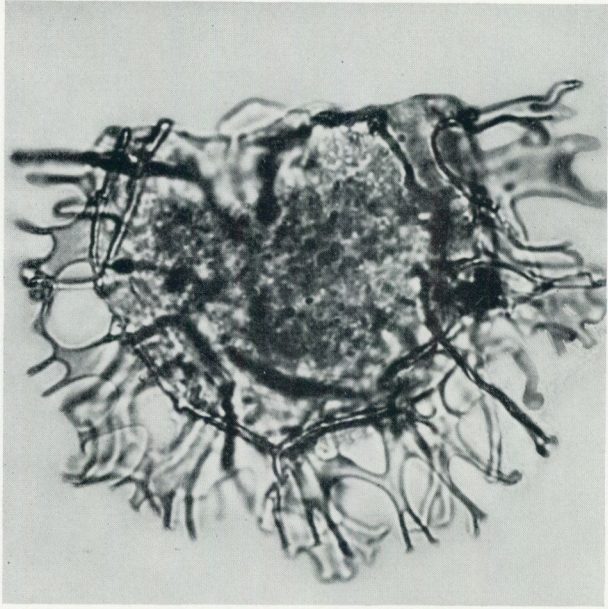


Fig. 4. *Areoligera senonensis* LEJEUNE-CARPENTIER, 1939. X 560. Slide: 297.

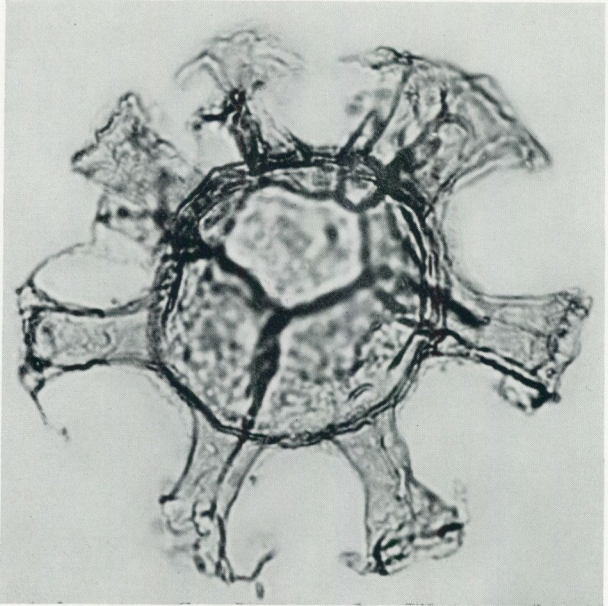


Fig. 5. *Calliosphaeridium asymmetricum* (DEFLANDRE & COURTEVILLE, 1939) DAVEY & WILLIAMS, 1966. X 700. Slide: 297.

- 1966 *Callaiosphaeridium asymmetricum*. – DAVEY & WILLIAMS in DAVEY et al.: p. 104, Pl. 8, fig. 9, 10; Pl. 9, fig. 2.
 1967 *Hexasphaera asymmetrica*. – CLARKE & VERDIER: p. 43, Pl. 7, fig. 1–3; text-fig. 17.
 1969 *Callaiosphaeridium asymmetricum*. – DAVEY: p. 152, Pl. 6, fig. 6.
 1970 *Callaiosphaeridium* cf. *asymmetricum*. – ZAITZEFF & CROSS: Pl. 2, fig. 20.
 1971 *Callaiosphaeridium asymmetricum*. – DAVEY & VERDIER: p. 12.
 1971 *Callaiosphaeridium asymmetricum*. – FOUCHER: p. 96, Pl. 4, fig. 3, 4.

REMARKS. – *Callaiosphaeridium asymmetricum* is encountered, though in small numbers, in the Middle and Upper Maastrichtian of the Höllviken material. It has also been reported from the Maastrichtian of the United States (ZAITZEFF & CROSS 1970), and it occurs in the Senonian (DEFLANDRE & COURTEVILLE 1939) and Coniacian (FOUCHER 1971) of France; Cenomanian – Santonian of the Isle of Wight (CLARKE & VERDIER 1967); Albian – Turonian of England and France (DAVEY 1969; DAVEY & WILLIAMS in DAVEY et al. 1966).

Genus *Canninginopsis* COOKSON & EISENACK, 1962
Canninginopsis denticulata COOKSON & EISENACK, 1962
 Fig. 6

- 1962 *Canninginopsis denticulata*. – COOKSON & EISENACK: p. 488, Pl. 1, fig. 16–19; text-fig. 2.

REMARKS. – *Canninginopsis denticulata* is an infrequent species in the Lower and Middle Maastrichtian of the Höllviken material. Its vertical range was previously restricted to Aptian – Cenomanian, as revealed from many boreholes in Australia (COOKSON & EISENACK 1962), but is now extended up to the Middle Maastrichtian.

Genus *Cannosphaeropsis* O. WETZEL, 1933
Cannosphaeropsis utinensis O. WETZEL, 1933
 Fig. 7

- 1933 *Cannosphaeropsis utinensis*. – O. WETZEL: p. 6, Pl. 3, fig. 9–17; text-fig. 12.
 1935 *Cannosphaeropsis utinensis*. – DEFLANDRE: p. 223, Pl. 4, fig. 1.
 1937 *Cannosphaeropsis utinensis*. – DEFLANDRE: p. 87, Pl. 16, fig. 12, 13.
 1943 *Cannosphaeropsis utinensis*. – DE WIT: p. 387, Fig. 15.
 1947 *Cannosphaeropsis utinensis*. – DEFLANDRE: p. 19, Fig. 5.
 1971 *Cannosphaeropsis utinensis*. – WILSON: Fig. 1.

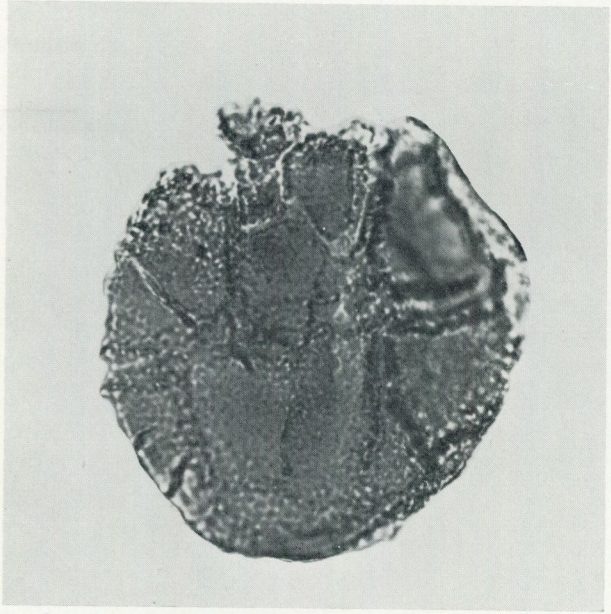


Fig. 6. *Canninginopsis denticulata* COOKSON & EISENACK, 1962. X 420. Slide: 475.

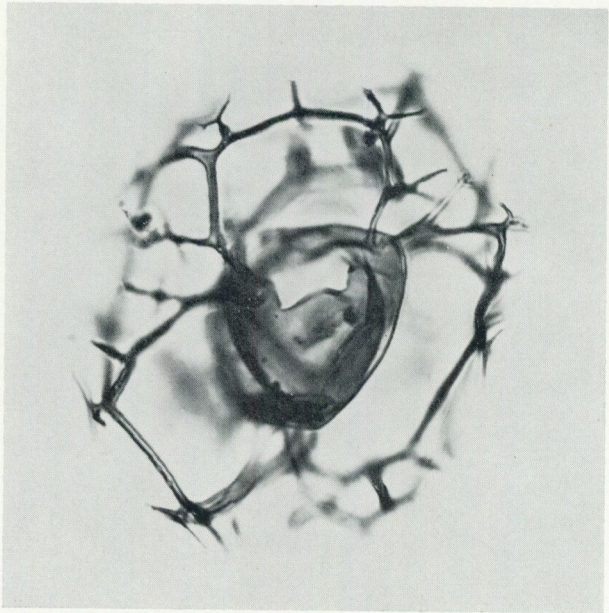


Fig. 7. *Cannosphaeropsis utinensis* O. WETZEL, 1933. X 460. Slide: 296.

REMARKS. – *Cannosphaeropsis utinensis* is extensively abundant in the Lower, Middle and Upper Maastrichtian of the Höllviken core. This species has previously been recovered from Miocene in Holland (DE WIT 1943); Lower Maastrichtian in Denmark (WILSON 1971); Senonian flint erratics from the Baltic area (O. WETZEL 1933) and from France (DEFLANDRE 1937, 1947).

Genus *Cordosphaeridium* DAVEY & WILLIAMS, 1966
Cordosphaeridium fibrospinosum DAVEY & WILLIAMS, 1966
 Fig. 8

- 1966 *Cordosphaeridium fibrospinosum*. – DAVEY & WILLIAMS in DAVEY et al.: p. 86, Pl. 5, fig. 5.
 1970 *Cordosphaeridium fibrospinosum*. – ZAITZEFF & CROSS: Pl. 2, fig. 22.

REMARKS. – *Cordosphaeridium fibrospinosum* is a rare species in the Lower, Middle and Upper Maastrichtian of the Höllviken material. This species, originally described from the Eocene of England (DAVEY & WILLIAMS in DAVEY et al. 1966), has also been recorded from the Maastrichtian of the United States (ZAITZEFF & CROSS 1970).

Genus *Crassosphaera* COOKSON & MANUM, 1960
Crassosphaera concinna COOKSON & MANUM, 1960
 Fig. 9

- 1960 *Crassosphaera concinna*. – COOKSON & MANUM: p. 6, Pl. 1, fig. 1–3, 7–10; text-fig. 1.
 1963 *Crassosphaera concinna*. – KRIVÁN-HUTTER: p. 75, Pl. 4, fig. 1–5.
 1963 *Pleurozonaria concinna*. – MÄDLER: p. 331.
 1966 *Crassosphaera concinna*. – SCHULZ & MAI: p. 41, 42.
 1966 *Crassosphaera concinna*. – PAČLTOVÁ: p. 14, Pl. I, fig. 1–3.
 1967 *Crassosphaera concinna*. – NAGY: p. 41, 43.

REMARKS. – *Crassosphaera concinna* is a very rare species in the Höllviken core and has only been found in one sample at 406.70 m. This species has been reported from the Tertiary of Vestspitsbergen (COOKSON & MANUM 1960); the Tertiary of Hungary (KRIVÁN-HUTTER 1963) and Czechoslovakia (PAČLTOVÁ 1966); Berriasian – Hauterivian of New Guinea (COOKSON & MANUM 1960); the Jurassic of Germany (MÄDLER 1963) and Northern Central Europe (SCHULZ & MAI 1966).

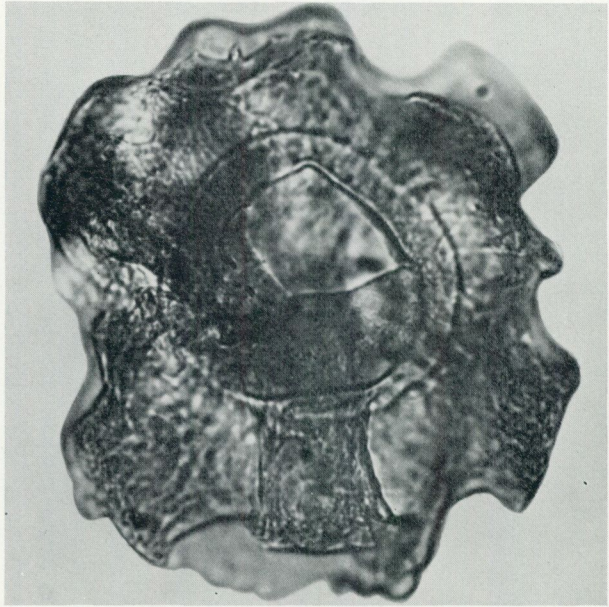


Fig. 8. *Cordosphaeridium fibrospinosum* DAVEY & WILLIAMS, 1966. X 460. Slide: 297.

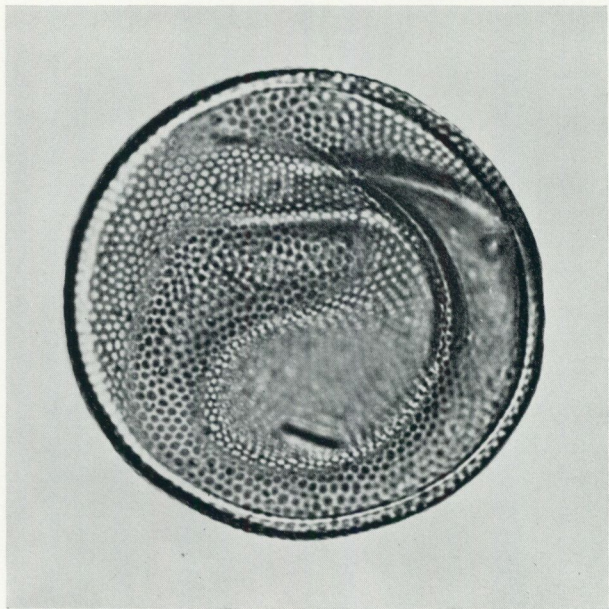


Fig. 9. *Crassosphaera concinna* COOKSON & MANUM, 1960. X 630. Slide: 406.

Genus *Deflandrea* EISENACK, 1938
Deflandrea bakeri DEFLANDRE & COOKSON, 1955
 Fig. 10

- 1955 *Deflandrea bakeri*. – DEFLANDRE & COOKSON: p. 251, Pl. 4, fig. 1, 2, 4.
 non 1959 *Deflandrea bakeri*. – MAIER: p. 292, Pl. 28, fig. 2.
 ? 1960 *Deflandrea bakeri*. – DOUGLAS: p. 19, Pl. 3, fig. 18a, b.

REMARKS. – *Deflandrea bakeri* occurs frequently in the Höllviken material. Formerly, this species was known from Tertiary strata of Australia (DEFLANDRE & COOKSON 1955; ? DOUGLAS 1960).

Deflandrea belfastensis COOKSON & EISENACK, 1961
 Fig. 11

- 1961 *Deflandrea belfastensis*. – COOKSON & EISENACK: p. 71, Pl. 11, fig. 4–6.

REMARKS. – *Deflandrea belfastensis* is a common species in the Lower, Middle and Upper Maastrichtian of the Höllviken core. Previous records are only known from the Senonian of Australia (COOKSON & EISENACK 1961).

Deflandrea cincta COOKSON & EISENACK, 1958
 Fig. 12

- 1958 *Deflandrea cincta*. – COOKSON & EISENACK: p. 26, Pl. 4, fig. 1–3.
 1959 *Deflandrea cincta*. – EISENACK: p. 49, Pl. 3, fig. 5.

REMARKS. – *Deflandrea cincta* appears abundantly in the Lower, Middle and Upper Maastrichtian of the Höllviken borehole. It is here reported for the first time from the Maastrichtian and was previously recorded from the Barremian – Aptian of Australia (COOKSON & EISENACK 1958; EISENACK 1959).

Deflandrea cooksoni ALBERTI, 1959
 Fig. 13

- 1959 *Deflandrea cooksoni*. – ALBERTI: p. 97, Pl. 9, fig. 1–6.
 1963 *Deflandrea* cf. *cooksoni*. – BROSIUS: p. 36, Pl. 7, fig. 6, 8.
 1964 *Deflandrea* cf. *cooksoni*. – MANUM & COOKSON: p. 8, Pl. 1, fig. 1, 3.
 1967 *Deflandrea* cf. *cooksoni*. – CLARKE & VERDIER: p. 25, Pl. 3, fig. 1–3.
 1970 *Deflandrea cooksoni*. – ZAITZEFF & CROSS: Pl. 5, fig. 50.

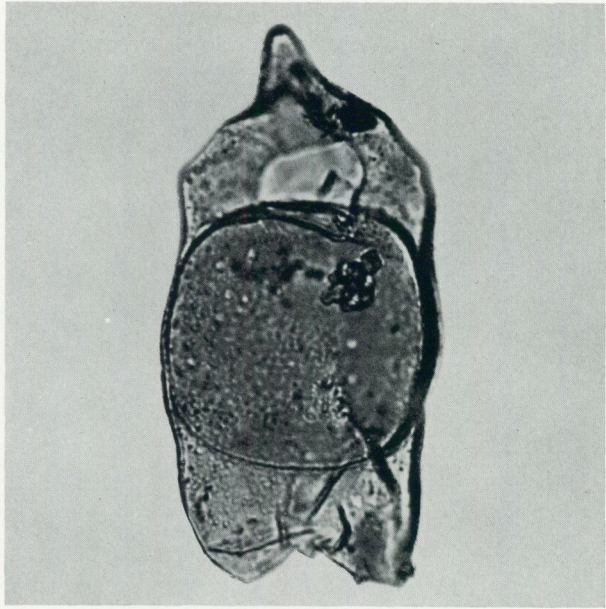


Fig. 10. *Deflandrea bakeri* DEFLANDRE & COOKSON, 1955.
X 615. Slide: 359.

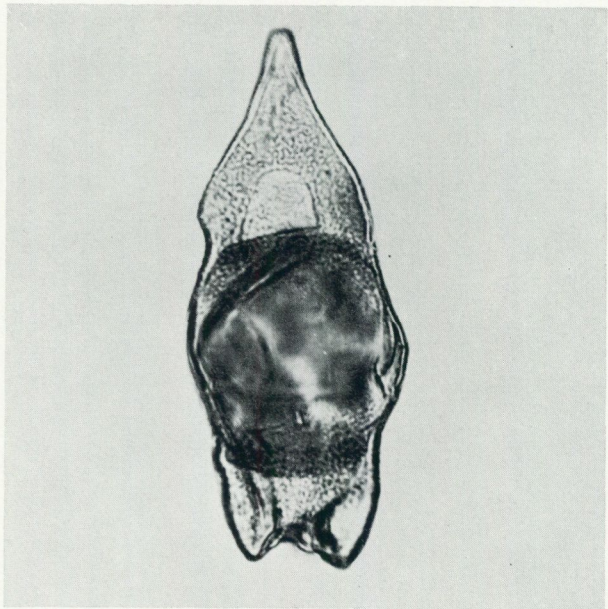


Fig. 11. *Deflandrea belfastensis* COOKSON & EISENACK, 1961.
X 500. Slide: 330.

REMARKS. — *Deflandrea cooksoni* is a frequent species in the Lower, Middle and Upper Maastrichtian of the Höllviken borehole. It has been encountered in the Maastrichtian of the United States (ZAITZEFF & CROSS 1970) and in the Senonian of Germany (ALBERTI 1959) and the Isle of Wight (CLARKE & VERDIER 1967). It has also been found in lower Upper Cretaceous strata of Arctic Canada (MANUM & COOKSON 1964) and has been described from the Tertiary of Germany (BROSIOUS 1963).

Deflandrea diebeli ALBERTI, 1959

Fig. 14

1959 *Deflandrea diebeli*. — ALBERTI: p. 99, Pl. 9, fig. 18–21.

1963 *Deflandrea diebeli*. — GÓRKA: p. 29, Pl. 4, fig. 6–8.

1967 *Deflandrea* cf. *D. diebeli*. — DRUGG: p. 16, Pl. 2, fig. 6.

1971 *Deflandrea diebeli*. — WILSON: Pl. 1, fig. 1.

REMARKS. — *Deflandrea diebeli* is an abundant species throughout the entire Maastrichtian of the Höllviken core. This species has also been reported from the Maastrichtian of Poland (GÓRKA 1963), Denmark (WILSON 1971) and the United States (DRUGG 1967), the latter contribution also deals with Danian records of this species. Originally, *D. diebeli* was described from the Santonian of Germany (ALBERTI 1959).

Deflandrea minor ALBERTI, 1959

Fig. 15

1959 *Deflandrea minor*. — ALBERTI: p. 98, Pl. 9, fig. 9–11.

1971 *Deflandrea* aff. *minor*. — WILSON: Pl. 1, fig. 2.

REMARKS. — *Deflandrea minor* is encountered in the Höllviken core in the Lower and Middle Maastrichtian. Other occurrences of Maastrichtian age have also been documented from Denmark (WILSON 1971). This species was formerly known to occur in the Senonian and was originally described from these strata in Germany (ALBERTI 1959).

Deflandrea rajiae n. sp.

Fig. 16.

DIAGNOSIS. — *Deflandrea* sp. with pentagonal, granular theca. Truncate apical horn and antapical horns. Psilate, pentagonal inner central capsule, the mar-

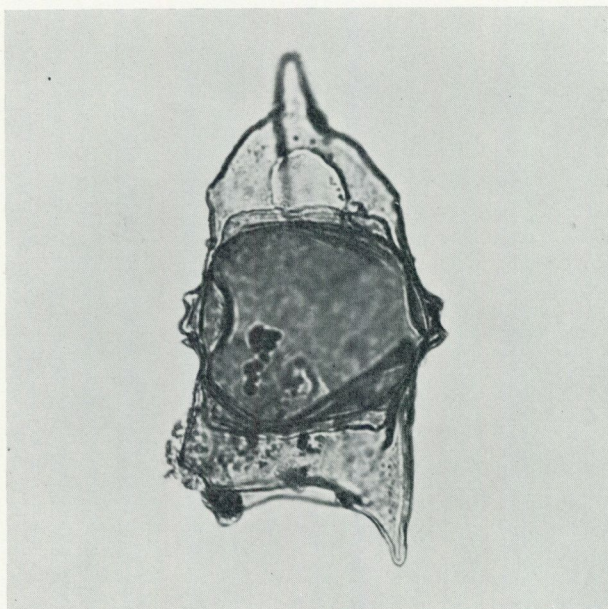


Fig. 12. *Deflandrea cincta* COOKSON & EISENACK, 1958.
X 500. Slide: 330.

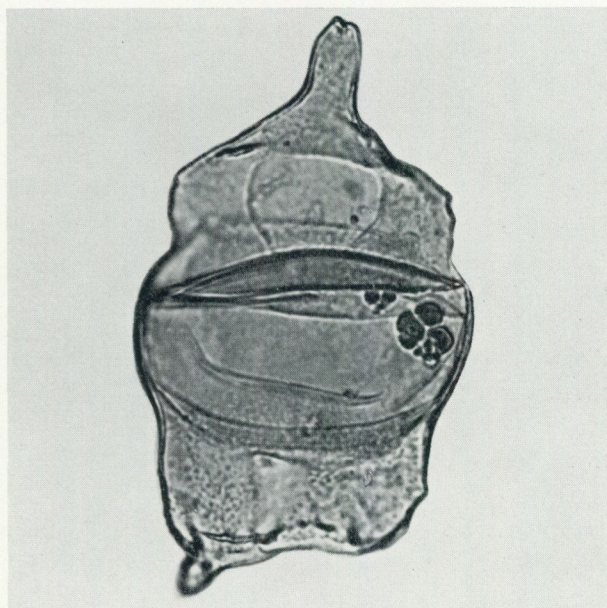


Fig. 13. *Deflandrea cooksoni* ALBERTI, 1959. X 615. Slide: 359.

gins of which extend to the central part of the theca. Well-defined cingulum with margins bulging outwards. Archaeopyle intercalary.

DIMENSIONS. – Length of theca: 70μ ; breadth of theca: 65μ .

HOLOTYPE. – SGU slide no. 330. Fig. 16.

TYPE LOCALITY AND TYPE STRATUM. – Höllviken Borehole No. 1, Scania, Sweden; Upper Cretaceous, Middle Maastrichtian, 330.00 m.

OCCURRENCE. – Middle and Upper Maastrichtian of the Höllviken core.

Deflandrea rectangularis COOKSON & EISENACK, 1962

Fig. 17

1962 *Deflandrea rectangularis*. – COOKSON & EISENACK: p. 486, Pl. 1, fig. 14–15.

REMARKS. – *Deflandrea rectangularis* occurs frequently in the Lower, Middle and Upper Maastrichtian of the Höllviken material. Hitherto this species was stratigraphically confined to the Upper Turonian – Middle Senonian of Australia (COOKSON & EISENACK 1962).

Deflandrea rectangularis var. *samuelsonii* n.

Fig. 18

DIAGNOSIS. – A variety of *Deflandrea rectangularis* with rectangular, granular theca. Spherical, psilate inner capsule extending to the lateral margins of the central part of the theca. Archaeopyle intercalary.

DIMENSIONS. – Length of theca: 140μ ; diameter of central capsule: 60μ .

REMARKS. – This variety differs from *D. rectangularis* by having a granular theca wall and a psilate central capsule.

HOLOTYPE. – SGU slide no. 330. Fig. 18.

TYPE LOCALITY AND TYPE STRATUM. – Höllviken Borehole No. 1, Scania, Sweden; Upper Cretaceous, Middle Maastrichtian, 330.00 m.

OCCURRENCE. – Lower, Middle and Upper Maastrichtian of the Höllviken core.

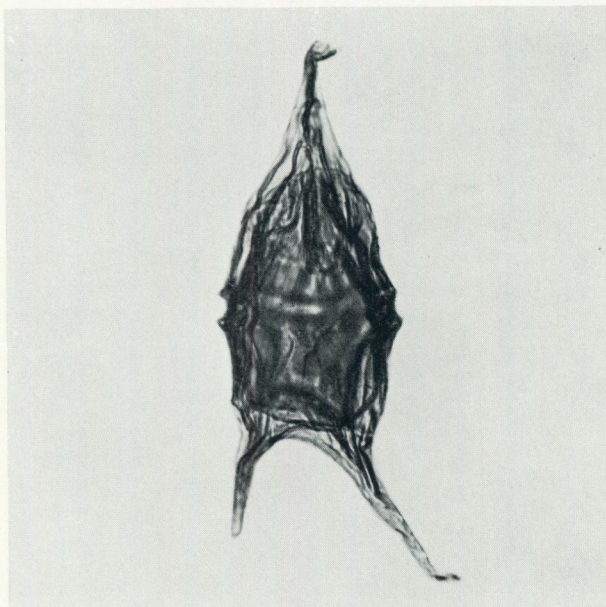


Fig. 14. *Deflandrea diebeli* ALBERTI, 1959. X 400. Slide: 455.

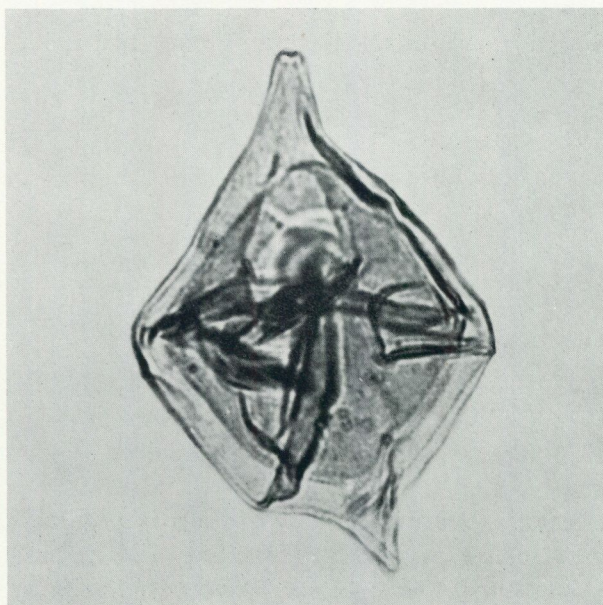


Fig. 15. *Deflandrea minor* ALBERTI, 1959. X 810. Slide: 330.

Deflandrea tripartita COOKSON & EISENACK, 1960

Fig. 19a, b

- 1960 *Deflandrea tripartita*. – COOKSON & EISENACK: p. 2, Pl. 1, fig. 10.
 1961 *Deflandrea tripartita*. – COOKSON & EISENACK: p. 70, text-fig. 1.
 1964 *Deflandrea tripartita*. – MANUM & COOKSON: p. 521, Pl. 76, fig. 1, 2.

REMARKS. – *Deflandrea tripartita* occurs infrequently in the Middle Maastrichtian of the Höllviken borehole. This species has previously been recorded from the Upper Turonian – Middle Senonian of Australia (COOKSON & EISENACK 1960, 1961; MANUM & COOKSON 1964).

Genus *Gonyaulacysta* DEFLANDRE, 1964*Gonyaulacysta wetzeli* LEJEUNE-CARPENTIER, 1939

Fig. 20

- 1939 *Gonyaulax Wetzeli*. – LEJEUNE-CARPENTIER: p. 526, fig. 1, 2.
 1946 *Gonyaulax Wetzeli*. – LEJEUNE-CARPENTIER: p. 189, fig. 1.
 1971 *Gonyaulacysta wetzeli*. – WILSON: Pl. 2, fig. 6.

REMARKS. – *Gonyaulacysta wetzeli* occurs abundantly in the Middle and Upper Maastrichtian of the core. The species has also been reported from the Maastrichtian of Denmark (WILSON 1971). Originally it was described from the Senonian of Holstein (LEJEUNE-CARPENTIER 1939, 1946).

Genus *Hexagonifera* COOKSON & EISENACK, 1961*Hexagonifera chlamydata* COOKSON & EISENACK, 1962

Fig. 21

- 1962 *Hexagonifera chlamydata*. – COOKSON & EISENACK: p. 496, Pl. 7, fig. 1–3, 5–8.
 1964 *Hexagonifera chlamydata*. – COOKSON & HUGHES: p. 53, Pl. 10, fig. 7–9.
 1967 *Hexagonifera chlamydata*. – CLARKE & VERDIER: p. 69, Pl. 11, fig. 6–8.
 1970 *Hexagonifera chlamydata*. – DAVEY: p. 349, Pl. 3, fig. 3, 9, 10.
 1971 *Hexagonifera chlamydata*. – WILSON: Pl. 4, fig. 6.

REMARKS. – *Hexagonifera chlamydata* is a rather frequent species occurring in the Middle Maastrichtian of the core. This species has been recovered from the Maastrichtian of Denmark (WILSON 1971), the Turonian – Senonian of England (CLARKE & VERDIER 1967), the Albian and Cenomanian of Australia

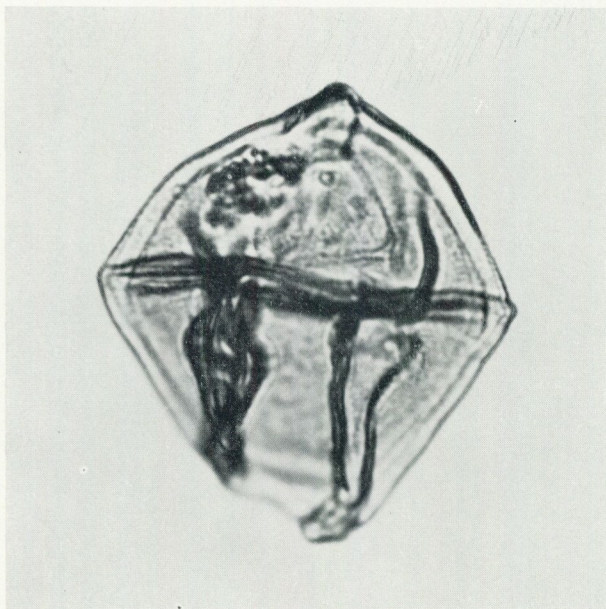


Fig. 16. *Deflandrea raijiae* n. sp., holotype. X 840. Slide: 330.

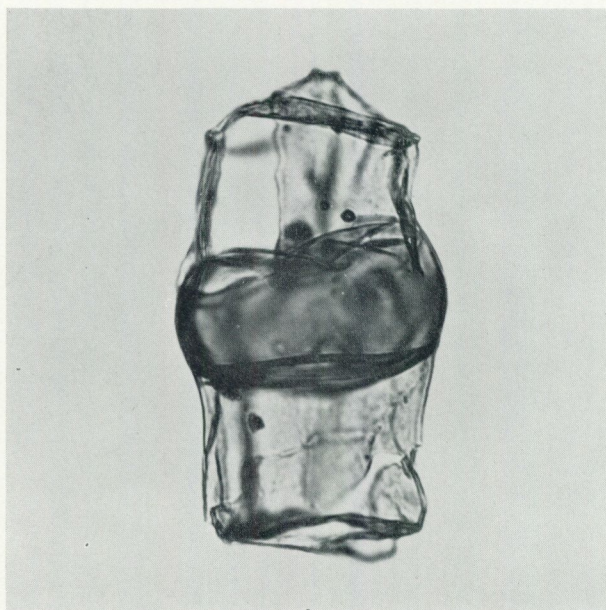


Fig. 17. *Deflandrea rectangularis* COOKSON & EISENACK, 1962.
X 420. Slide: 296.

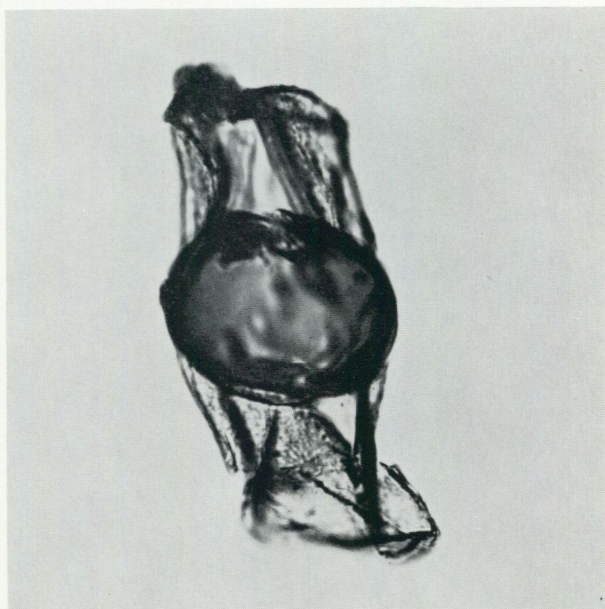


Fig. 18. *Deflandrea rectangularis* var. *samuelsonii* n., holotype. X 460. Slide: 330.

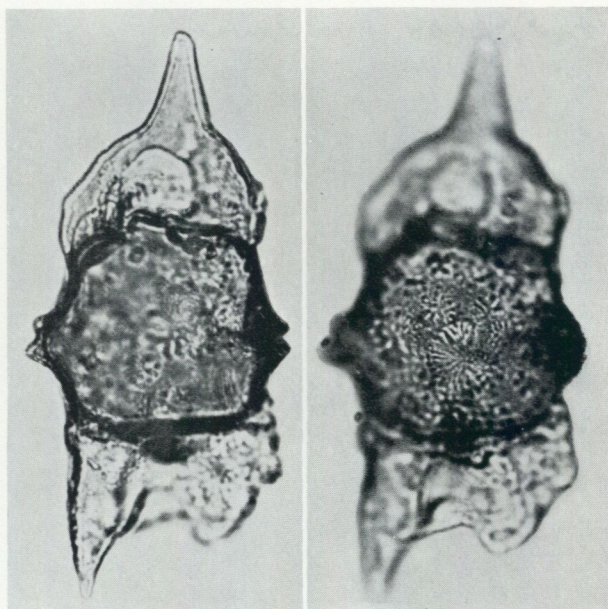


Fig. 19 a, b. *Deflandrea tripartita* COOKSON & EISENACK, 1960. X 460. Slide: 330.

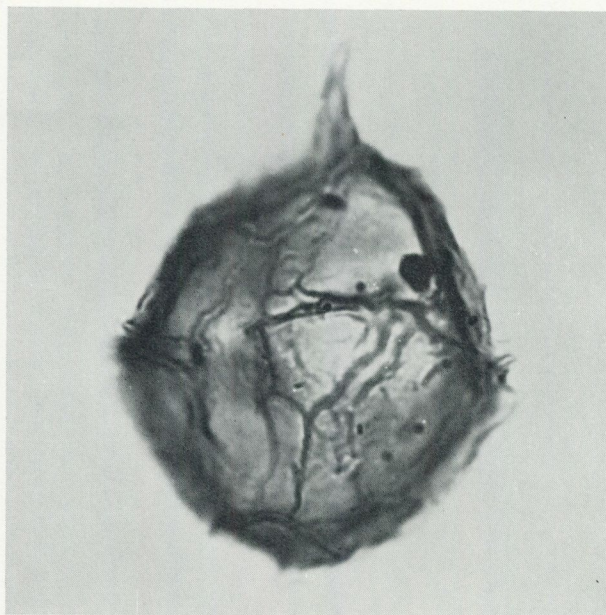


Fig. 20. *Gonyaulacysta wetzeli* LEJEUNE-CARPENTIER, 1939.
X 560. Slide: 296.

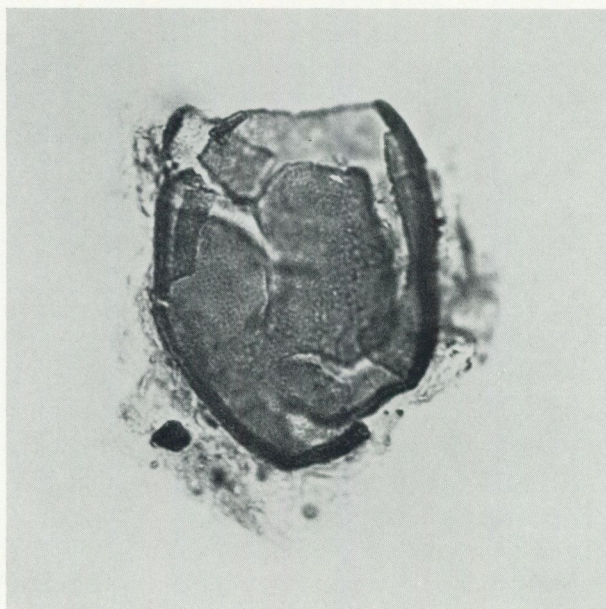


Fig. 21. *Hexagonifera chlamydata* COOKSON & EISENACK,
1962. X 560. Slide: 427.

(COOKSON & EISENACK 1962) and from the Cenomanian of England (COOKSON & HUGHES 1964; DAVEY 1970) and France (DAVEY 1970).

Hexagonifera glabra COOKSON & EISENACK, 1961

Fig. 22

1961 *Hexagonifera glabra*. – COOKSON & EISENACK: p. 34, Pl. 12, fig. 9–13.

REMARKS. – *Hexagonifera glabra* occurs frequently in the Lower and Middle Maastrichtian of the borehole. The species was previously only known from Senonian strata of Australia (COOKSON & EISENACK 1961).

Genus *Hystrichodinium* DEFLANDRE, 1935

Hystrichodinium pulchrum DEFLANDRE, 1935

Fig. 23

1846 *Xanthidium spinosum*. – WILKINSON: p. 89, Pl. 13, fig. 2.

1935 *Hystrichodinium pulchrum*. – DEFLANDRE: p. 230, Pl. 5, fig. 1; text-fig 9–11.

1936 *Hystrichodinium pulchrum*. – DEFLANDRE: p. 34, Pl. 8, fig. 3–9; text-fig 4.

1943 *Hystrichodinium pulchrum*. – DE WIT: p. 385.

1955 *Hystrichodinium pulchrum*. – VALENSI: p. 591, Pl. 3, fig. 11.

1959 *Hystrichodinium pulchrum*. – GOCHT: p. 58, Pl. 3, fig. 11 a, b; Pl. 5, fig. 7.

1961 *Hystrichodinium pulchrum*. – ALBERTI: p. 14, Pl. 8, fig. 6–10.

1963 *Hystrichodinium pulchrum*. – GÓRKA: p. 32, Pl. 5, fig. 5.

1964 *Hystrichodinium pulchrum*. – MANUM & COOKSON: p. 17, Pl. 2, fig. 11.

1964 *Hystrichodinium pulchrum*. – SERPAGLI: p. 96, Pl. 8, fig. 4.

1966 *Hystrichodinium pulchrum*. – SARJEANT in DAVEY et al.: p. 141, Pl. 16, fig. 7, 8.

1967 *Hystrichodinium pulchrum*. – MILLIoud: p. 164.

1971 *Hystrichodinium pulchrum*. – DAVEY & VERDIER: p. 22.

1971 *Hystrichodinium pulchrum*. – FOUCHER: p. 88, Pl. 2, fig. 1–3.

REMARKS. – *Hystrichodinium pulchrum* is frequently present in the Höllviken core in the Lower and Middle Maastrichtian. This species has a wide geographical distribution and has been reported from following stages: Senonian of France (DEFLANDRE 1935, 1936; VALENSI 1955), England (WILKINSON 1846) and Holland (DE WIT 1943); Campanian of Poland (GÓRKA 1963); Coniacian of France (FOUCHER 1971); Cenomanian – Turonian of Italy (SERPAGLI 1964); Cenomanian – Santonian of England (CLARKE & VERDIER 1967); Albian of

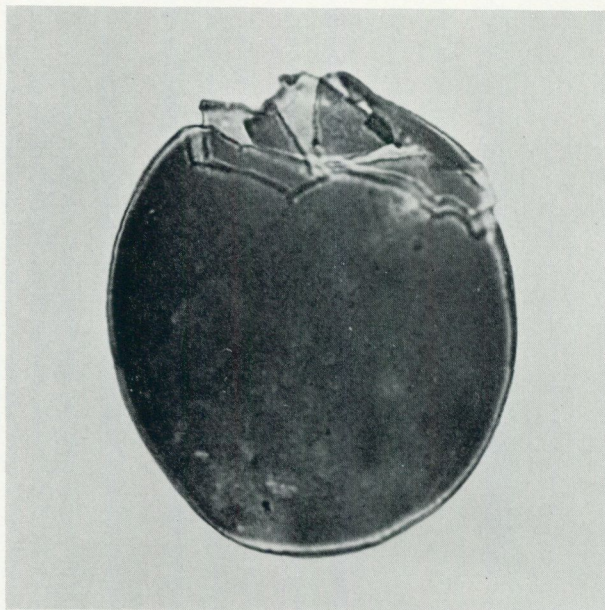


Fig. 22. *Hexagonifera glabra* COOKSON & EISENACK, 1961.
X 600. Slide: 550.

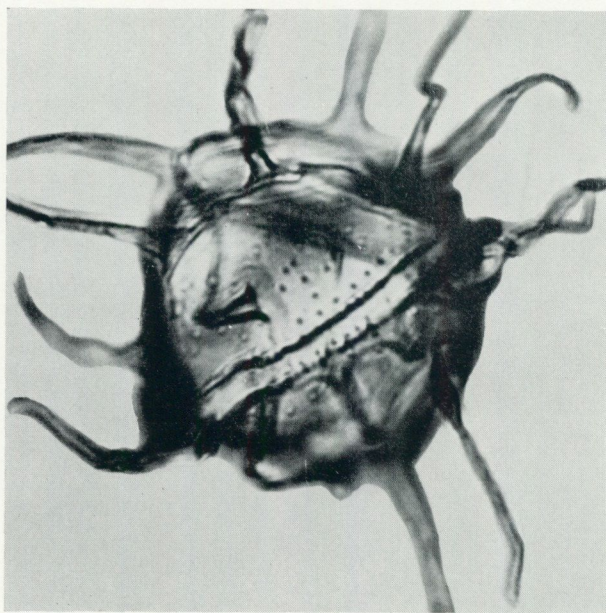


Fig. 23. *Hystrichodinium pulchrum* DEFLANDRE, 1935.
X 840. Slide: 525.

France (DAVEY & VERDIER 1971); Neocomian of Germany (GOCHT 1959); Hauterivian – Senonian of Germany (ALBERTI 1961); Hauterivian of Switzerland (ALBERTI 1961; MILLIoud 1967). It is also known from the Cretaceous of Arctic Canada (MANUM & COOKSON 1964) and of England (SARJEANT in DAVEY et al. 1966).

Genus *Hystrichosphaeridium* DEFLANDRE, 1937 emend.

EISENACK, 1958 emend. DAVEY & WILLIAMS, 1966

Hystrichosphaeridium recurvatum (WHITE) LEJEUNE-CARPENTIER, 1940
emend. DAVEY & WILLIAMS, 1966

Fig. 24

- 1839 *Xanthidium tubiferum*. – READE: p. 191, Pl. 9, fig. 6, 9.
 1842 *Xanthidium tubiferum palmatum*. – WHITE: p. 39, Pl. 4, fig. 16.
 1844 *Xanthidium tubiferum palmatum*. – WHITE: Pl. 8, fig. 11.
 1848 *Xanthidium palmatum*. – BRONN: p. 1375.
 1934 *Hystrichosphaera tubifera*. – DEFLANDRE: fig. 11.
 1935 *Hystrichosphaera tubifera*. – DEFLANDRE: p. 232, Pl. 7, fig. 10, 11.
 1937 *Hystrichosphaeridium tubiferum*. – DEFLANDRE: p. 69, Pl. 13, fig. 2, 4, 5.
 1940 *Hystrichosphaeridium recurvatum*. – LEJEUNE-CARPENTIER: p. 221, fig. 6.
 1955 *Hystrichosphaeridium recurvatum*. – DEFLANDRE & COOKSON: p. 269,
 Pl. 1, fig. 11, 12.
 1955 *Hystrichosphaeridium tubiferum*. – VALENSI: p. 592, Pl. 4, fig. 2; Pl. 5,
 fig. 8.
 1963 *Hystrichosphaeridium recurvatum*. – GÓRKA: p. 57, Pl. 8, fig. 8; text-fig
 6/5.
 1964 *Hystrichosphaeridium recurvatum*. – SARJEANT: p. 173–174.
 1966 *Hystrichosphaeridium recurvatum*. – DAVEY & WILLIAMS in DAVEY et al.:
 p. 67.
 1971 *Hystrichosphaeridium recurvatum*. – DAVEY & VERDIER: p. 23, Pl. 4, fig.
 7, 9.
 1971 *Hystrichosphaeridium recurvatum*. – FOUCHER: p. 100, Pl. 7, fig. 9, 10.

REMARKS. – *Hystrichosphaeridium recurvatum* is a very common species throughout the entire Maastrichtian of the Höllviken core. This species was formerly recorded from the Senonian, Coniacian and Albian of Europe (cf. synonym list bibliography).

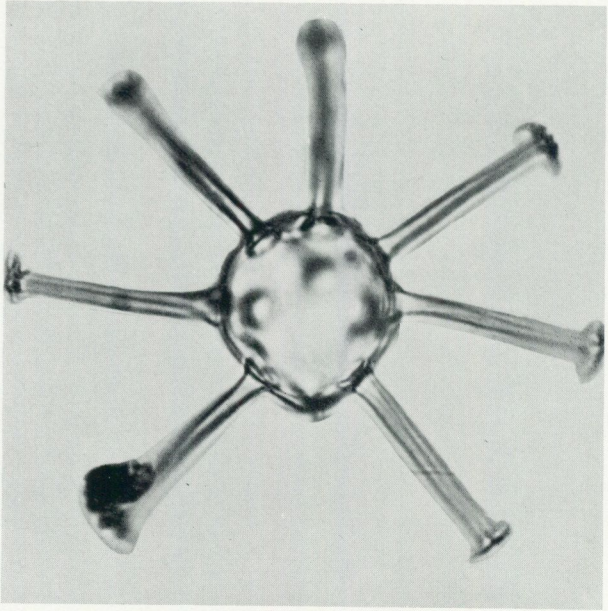


Fig. 24. *Hystrichosphaeridium recurvatum* (WHITE) LEJEUNE-CARPENTIER, 1940 emend. DAVEY & WILLIAMS, 1966. X 870. Slide: 330.

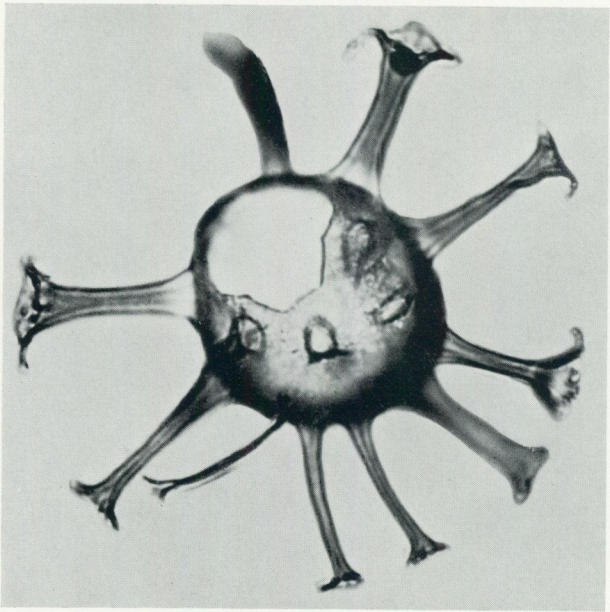


Fig. 25. *Hystrichosphaeridium tubiferum* (EHRENBERG, 1838). X 630. Slide: 296.

Hystrichosphaeridium tubiferum (EHRENBERG, 1838)

Fig. 25

- 1838 *Xanthidium tubiferum*. – EHRENBERG: Pl. 1, fig. 16.
 1854 *Xanthidium tubiferum*. – EHRENBERG: Pl. 7, fig. 48; Pl. 37, fig. 7, no. 11.
 1904 *Ovum hispidum*. – LOHMAN: p. 21.
 1933 *Hystrichosphaera tubifera*. – O. WETZEL: p. 40, Pl. 4, fig. 16.
 1937 *Hystrichosphaeridium tubiferum*. – DEFLANDRE: p. 69.
 1940 *Hystrichosphaeridium tubiferum*. – LEJEUNE-CARPENTIER: p. 218, fig. 1–5.
 1941 *Hystrichosphaeridium tubiferum*. – CONRAD: p. 2, Pl. 1, fig. F.
 1948 *Hystrichosphaeridium tubiferum*. – PASTIELS: p. 38, Pl. 3, fig. 1, 2.
 1952 *Hystrichosphaeridium tubiferum*. – GOCHT: p. 308, Pl. 1, fig. 4.
 1953 *Hystrichosphaeridium tubiferum*. – COOKSON: p. 120, Pl. 2, fig. 24.
 1958 *Hystrichosphaeridium tubiferum*. – EISENACK: p. 401, Pl. 25, fig. 16.
 1961 *Hystrichosphaeridium tubiferum*. – GERLACH: p. 184, Pl. 28, fig. 2.
 1963 *Hystrichosphaeridium tubiferum*. – GÓRKA: p. 55, Pl. 8, fig. 1, 2; text-fig. 6.
 1964 *Hystrichosphaeridium tubiferum*. – ROSSIGNOL: p. 88, fig. H.
 1965 *Hystrichosphaeridium tubiferum*. – DE CONINCK: p. 36, Pl. 10, fig. 24, 28, 29, 32–40.
 1966 *Hystrichosphaeridium tubiferum*. – DAVEY & WILLIAMS in DAVEY et al.: p. 56, Pl. 6, fig. 1, 2; Pl. 8, fig. 5; Pl. 10, fig. 2; text-fig. 13.
 1966 *Hystrichosphaeridium tubiferum*. – MORGENROTH: p. 31, Pl. 8, fig. 7–8.
 1968 *Hystrichosphaeridium tubiferum*. – WILSON: p. 58.
 1969 *Hystrichosphaeridium tubiferum*. – DAVEY: p. 143, Pl. 5, fig. 5, 8.
 1971 *Hystrichosphaeridium tubiferum*. – DAVEY & VERDIER: p. 24.
 1971 *Hystrichosphaeridium tubiferum*. – FOUCHER: p. 99, Pl. 7, fig. 5–8.
 1972 *Hystrichosphaeridium tubiferum*. – TRALAU: p. 568, fig. 1.

REMARKS. – *Hystrichosphaeridium tubiferum* occurs throughout the entire Maastrichtian of the core. The species has been recovered from a great many localities and is known to have an extensive stratigraphic range (Albian – Pleistocene, cf. synonym list bibliography).

Genus *Lejeunia* GERLACH, 1961 emend. KJELLSTRÖM, 1972

Lejeunia hyalina GERLACH, 1961 emend. KJELLSTRÖM, 1972

Fig. 26

- 1961 *Lejeunia hyalina*. – GERLACH: p. 169, Pl. 26, fig. 10, 11.
 ? 1967 *Lejeunia* sp. – VOZZHENNIKOVA: p. 105, Pl. 75, fig. 3.

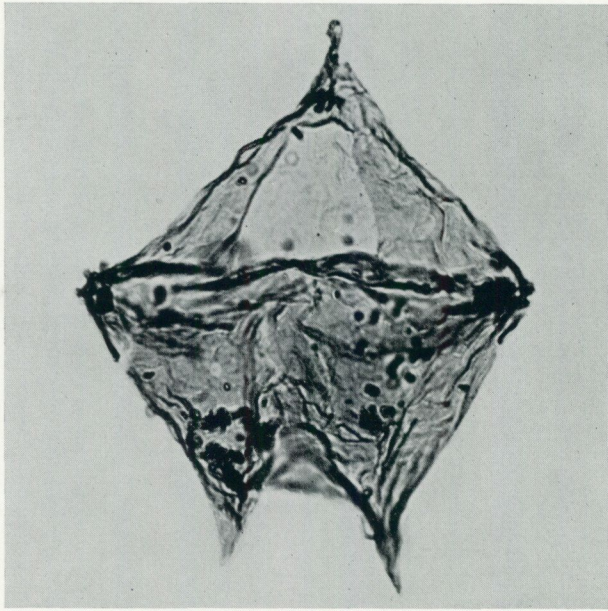


Fig. 26. *Lejeunia byalina* GERLACH, 1961 emend. KJELLSTRÖM, 1972. X 520. Slide: 330.

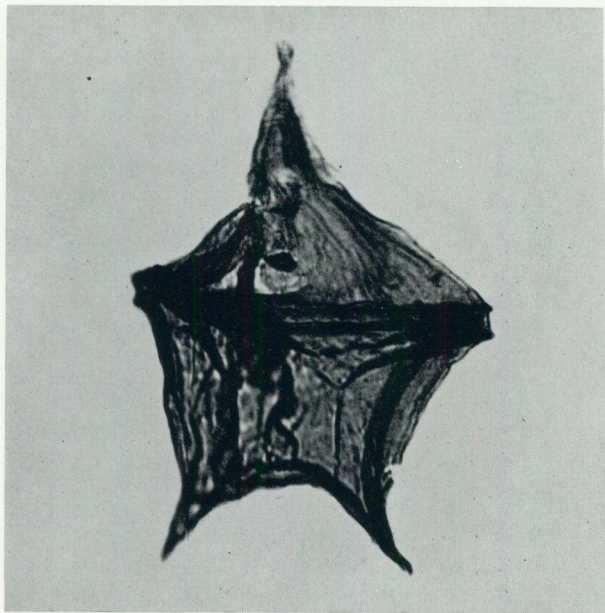


Fig. 27. *Lejeunia koslowskii* GÓRKA, 1963. X 450. Slide: 475.

1968 *Lejeunia hyalina*. – DE CONINCK: p. 19, Pl. 1, fig. 28, 29.

1972 *Lejeunia hyalina*. – KJELLSTRÖM: p. 469, fig. 1, 2.

REMARKS. – *Lejeunia hyalina* is encountered throughout the entire Maastrichtian of the Höllviken material. In certain samples, e.g. the sample at 296.00 m, this species comprises the bulk of the dinoflagellate assemblage. *L. hyalina* was formerly recorded only from Tertiary strata.

Lejeunia koslowskii GÓRKA, 1963

Fig. 27

1963 *Lejeunia koslowskii*. – GÓRKA: p. 41, Pl. 5, fig. 4.

REMARKS. – *Lejeunia koslowskii* is obtained from samples of Lower and Upper Maastrichtian age within the core. The species was originally described from the Upper Maastrichtian of Poland (GÓRKA 1963).

Genus *Membranilarnacia* EISENACK, 1963

Membranilarnacia leptoderma (COOKSON & EISENACK, 1958)

Fig. 28

1958 *Membranilarnax leptoderma*. – COOKSON & EISENACK: p. 50, Pl. 10, fig. 7, 9.

1963 *Membranilarnacia leptoderma*. – EISENACK: p. 99.

REMARKS. – *Membranilarnacia leptoderma* occurs abundantly in the Middle and Upper Maastrichtian of the Höllviken borehole. This species has, up to now, only been recovered from the Albian of Australia (COOKSON & EISENACK 1958).

Genus *Odontochitina* DEFLANDRE, 1935

Odontochitina operculata (O. WETZEL, 1933)

Fig. 29

1933 *Ceratium operculatum*. – O. WETZEL: p. 170, Pl. 2, fig. 21, 22; text-fig 3.

1935 *Odontochitina silicorum*. – DEFLANDRE: p. 234, Pl. 9, fig. 8–10.

1937 *Odontochitina silicorum*. – DEFLANDRE: p. 95, Pl. 15, fig. 8–13.

1952 *Odontochitina operculata*. – FIRTIION: p. 160, Pl. 9, fig. 9.

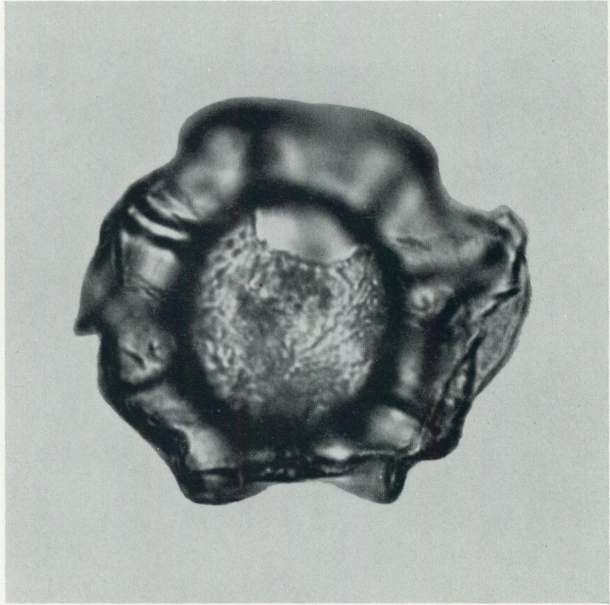


Fig. 28. *Membranilarnacia leptoderma* (COOKSON & EISENACK, 1958). X 700. Slide: 296.

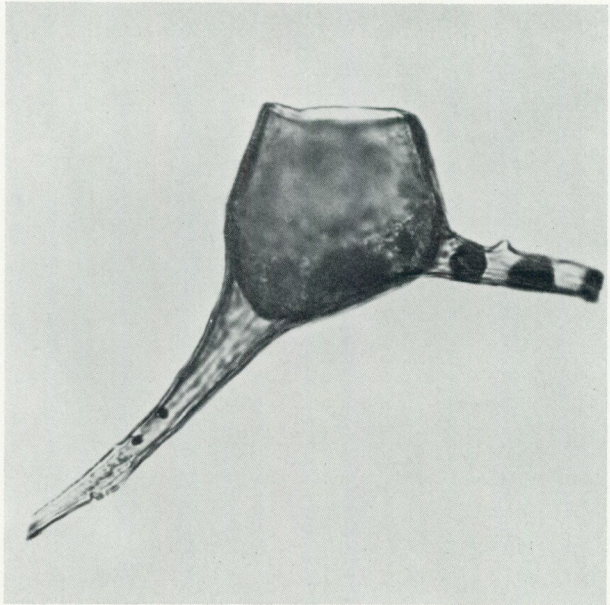


Fig. 29. *Odontochitina operculata* (O. WETZEL, 1933). X 380. Slide: 540.

- 1955 *Odontochitina operculata*. – DEFLANDRE & COOKSON: p. 291, Pl. 3, fig. 5, 6.
 1955 *Odontochitina operculata*. – VALENSI: p. 594, Pl. 4, fig. 7.
 1958 *Odontochitina operculata*. – EISENACK: p. 393, Pl. 27, fig. 7, 8.
 1959 *Odontochitina operculata*. – GOCHT: p. 64, Pl. 6, fig. 12.
 1961 *Odontochitina operculata*. – EISENACK: p. 308, Pl. 36, fig. 3.
 1961 *Odontochitina operculata*. – ALBERTI: p. 30, Pl. 6, fig. 6–9.
 1962 *Odontochitina silicorum*. – POCOCK: p. 78, Pl. 14, fig. 211, 212.
 1963 *Odontochitina operculata*. – GÓRKA: p. 35, Pl. 4, fig. 1–5.
 1963 *Odontochitina operculata*. – BALTES: p. 584, Pl. 5, fig. 1–4.
 1964 *Odontochitina operculata*. – SERPAGLI: p. 103, Pl. 19, fig. 4, 5.
 1966 *Odontochitina operculata*. – SARJEANT in DAVEY et al.: p. 208, Pl. 21, fig. 2.
 1967 *Odontochitina operculata*. – CLARKE & VERDIER: p. 59, Pl. 13, fig. 1, 7.
 1970 *Odontochitina operculata*. – DAVEY: p. 355, Pl. 4, fig. 8, 9; Pl. 5, fig. 3.
 1971 *Odontochitina operculata*. – FOUCHER: p. 110, Pl. 11, fig. 11, 12.
 1971 *Odontochitina operculata*. – DAVEY & VERDIER: p. 25.

REMARKS. – *Odontochitina operculata* is a moderately common species confined, in the Höllviken material, to the Lower Maastrichtian. This species is elsewhere known to have an extensive vertical range and has been documented from the following strata: Maastrichtian of Germany (ALBERTI 1961); Senonian of France (DEFLANDRE 1946; VALENSI 1955); Turonian of Poland (GÓRKA 1963) and Italy (SERPAGLI 1964); Coniacian of France (FOUCHER 1971); Cenomanian of France (FIRTION 1952) and Italy (SERPAGLI 1964); Cenomanian – Campanian of the Isle of Wight (CLARKE & VERDIER 1967); Albian of Roumania (BALTES 1963) and of France (DAVEY & VERDIER 1971); Aptian of Germany (EISENACK 1958, 1961); Hauterivian of Germany (GOCHT 1959; ALBERTI 1961); Upper Jurassic of Canada (POCOCK 1962).

Genus *Oligosphaeridium* DAVEY & WILLIAMS, 1966

Oligosphaeridium complex (WHITE, 1842) emend. DAVEY & WILLIAMS, 1966
 Fig. 30

- 1842 *Xanthidium tubiferum complex*. – WHITE: p. 83, Pl. 8, fig. 10.
 1848 *Xanthidium complexum*. – BRONN: p. 1375.
 1940 *Hystrichosphaeridium elegantulum*. – LEJEUNE-CARPENTIER: fig. 11, 12.
 1946 *Hystrichosphaeridium complex*. – DEFLANDRE: p. 1946.
 1952 *Hystrichosphaeridium complex*. – FIRTION: p. 156, Pl. 9, fig. 2, 4, 5; text-fig. 1 A–F.

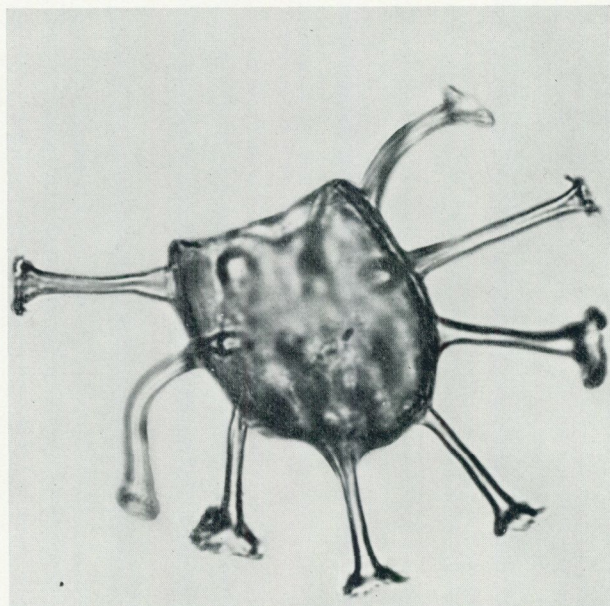


Fig. 30. *Oligosphaeridium complex* (WHITE, 1842) emend. DAVEY & WILLIAMS, 1966. X 700. Slide: 293.

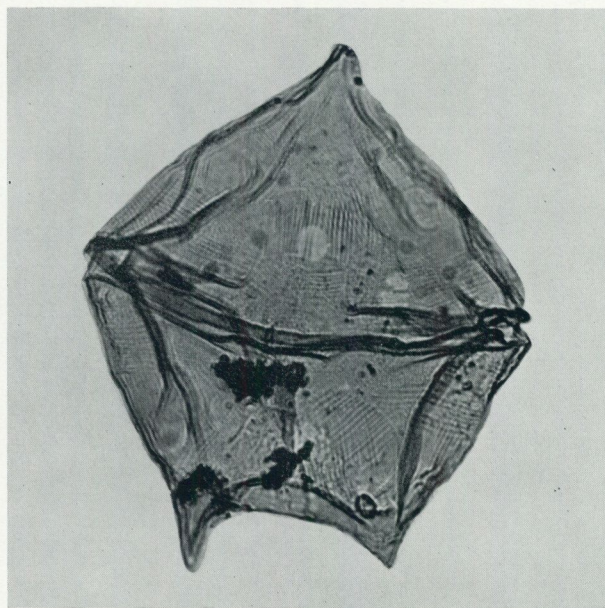


Fig. 31. *Palaeoperidinium pyrophorum* (EHRENBERG, 1838) DEFLANDRE, 1934. X 420. Slide: 525.

- 1955 *Hystrichosphaeridium complex*. – DEFLANDRE & COOKSON: p. 270, Pl. 1, fig. 9, 10.
- 1955 *Hystrichosphaeridium complex*. – VALENSI: p. 592, Pl. 4, fig. 3.
- 1958 *Hystrichosphaeridium complex*. – EISENACK: p. 400, Pl. 26, fig. 3–5.
- 1959 *Hystrichosphaeridium complex*. – GOCHT: p. 66, Pl. 3, fig. 2, 3; Pl. 7, fig. 5, 6.
- 1962 *Hystrichosphaeridium tubiferum*. – POCKOCK: p. 83, Pl. 15, fig. 230.
- 1963 *Hystrichosphaeridium tubiferum*. – BALTES: Pl. 2, fig. 1–3, 5, 6.
- 1964 *Hystrichosphaeridium complex*. – COOKSON & HUGHES: p. 46, Pl. 9, fig. 6.
- ?1964 *Hystrichosphaeridium complex*. – VARMA & DANGWAL: p. 65, Pl. 2, fig. 2, 3.
- 1966 *Oligosphaeridium complex*. – DAVEY & WILLIAMS in DAVEY et al.: p. 71, Pl. 7, fig. 1, 2; Pl. 10, fig. 3; text-fig. 14.
- 1967 *Hystrichosphaeridium complex*. – CLARKE & VERDIER: p. 53, Pl. 11, fig. 10, 11.
- 1969 *Oligosphaeridium complex*. – DAVEY: p. 146, Pl. 5, fig. 6, 7.
- 1971 *Oligosphaeridium complex*. – DAVEY & VERDIER: p. 26.
- 1971 *Oligosphaeridium complex*. – FOUCHER: p. 102, Pl. 8, fig. 8–10.

REMARKS. – *Oligosphaeridium complex* is recorded frequently throughout the entire Maastrichtian of the Höllviken material. This species has been reported from many localities and it exhibits an extensive vertical range from the Valanginian to the Tertiary (cf. synonym list bibliography).

Genus *Palaeoperidinium* DEFLANDRE, 1934

Palaeoperidinium pyrophorum (EHRENBERG, 1838) DEFLANDRE, 1934

Fig. 31

- 1838 *Peridinium pyrophorum*. – EHRENBERG: p. 110, Pl. 1, fig. 2, 4.
- 1854 *Peridinium pyrophorum*. – EHRENBERG: Pl. 37/7, fig. B. Fig. 1, 2.
- 1933 *Peridinium pyrophorum*. – O. WETZEL: p. 164, Pl. 2, fig. 3, 12, 13.
- 1934 *Palaeoperidinium pyrophorum*. – DEFLANDRE: p. 967, fig. 1.
- 1935 *Palaeoperidinium pyrophorum*. – DEFLANDRE: p. 227, Pl. 6, fig. 5–7.
- 1936 *Palaeoperidinium pyrophorum*. – DEFLANDRE: p. 175.
- 1938 *Palaeoperidinium pyrophorum*. – LEJEUNE-CARPENTIER: Fig. 1–8.
- 1971 *Palaeoperidinium pyrophorum*. – WILSON: Pl. 2, fig. 12.

REMARKS. – *Palaeoperidinium pyrophorum* occurs in the Lower, Middle and Upper Maastrichtian of the Höllviken core and is especially abundant in the upper part of the Middle Maastrichtian. This species has also been reported

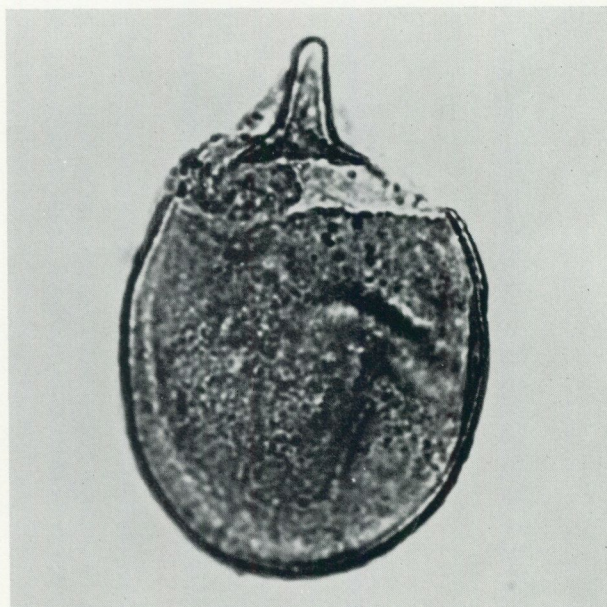


Fig. 32. *Pareodinia aphelia* COOKSON & EISENACK, 1958.
X 840. Slide: 406.

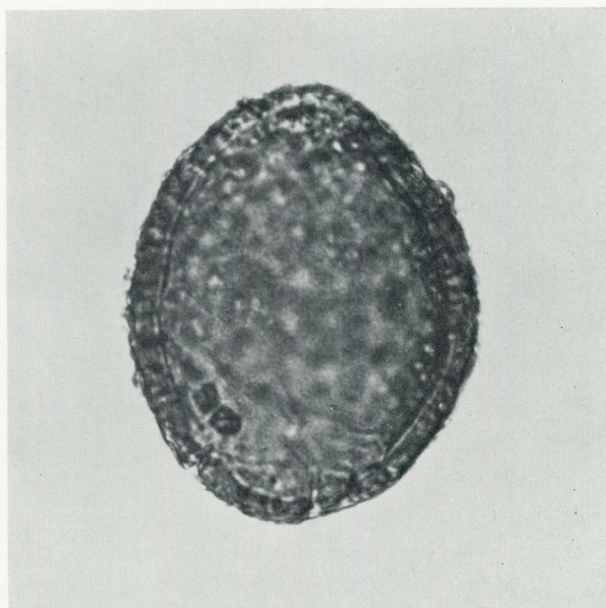


Fig. 33. *Pyxidiella scrobiculata* (DEFLANDRE & COOKSON,
1955) GERLACH, 1961. X 700. Slide: 293.

from the Maastrichtian of Denmark (WILSON 1971) and from the Senonian of Germany and France (cf. synonym list bibliography).

Genus *Pareodinia* DEFLANDRE, 1947
Pareodinia aphelia COOKSON & EISENACK, 1958
 Fig. 32

1958 *Pareodinia aphelia*. – COOKSON & EISENACK: p. 60, Pl. 12, fig. 3, 4, 9.

REMARKS. – *Pareodinia aphelia* has, in the Höllviken core, only been found in one sample at 406.70 m, i.e. from the Middle Maastrichtian. Originally, this species was described from the Middle Jurassic – Aptian of Australia (COOKSON & EISENACK 1958).

Genus *Pyxidiella* COOKSON & EISENACK, 1958
Pyxidiella scrobiculata (DEFLANDRE & COOKSON, 1955) GERLACH, 1961
 Fig. 33

1955 *Leiosphaera scrobiculata*. – DEFLANDRE & COOKSON: p. 291, Pl. 3, fig. 3; text-fig. 57.

1961 *Pyxidiella scrobiculata*. – GERLACH: p. 210, Pl. 29, fig. 11, 12.

REMARKS. – *Pyxidiella scrobiculata* is a fairly rare species occurring in the upper part of the Middle Maastrichtian and lower part of the Upper Maastrichtian of the core. This species is known from the Eocene, Oligocene and Miocene of Germany (GERLACH 1961) and from the Paleocene and Senonian of Australia (DEFLANDRE & COOKSON 1955).

Genus *Scriniodinium* KLEMENT, 1957 Subgenus *Scriniodinium* KLEMENT, 1960
 ? *Scriniodinium irisae* n. sp.
 Fig. 34

DIAGNOSIS. – ? *Scriniodinium* sp. with tripartite, granular theca. Central capsule granular, possessing two hemispherical segments. The bases of these two segments represent the well-defined equatorial cingulum. Archaeopyle precingular.

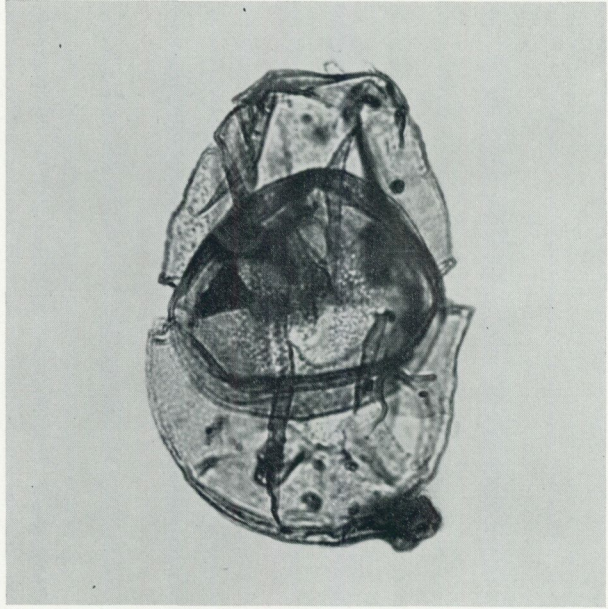


Fig. 34. ? *Scriniodinium irisae* n. sp., holotype.
X 520. Slide: 330.

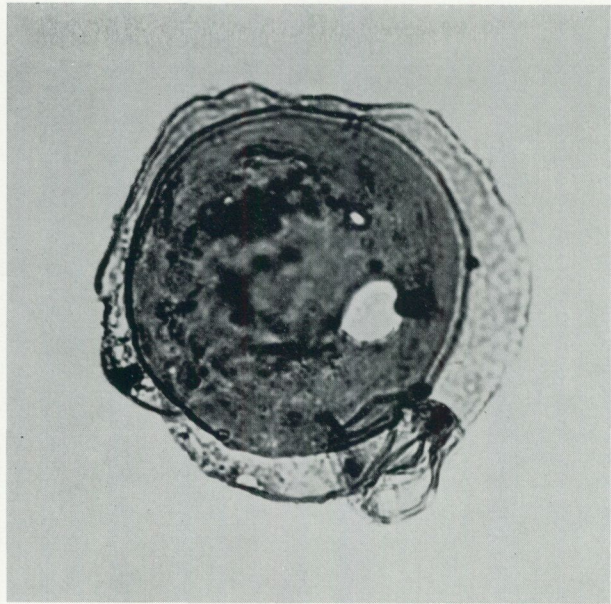


Fig. 35. ? *Scriniodinium nilsii* n. sp., holotype.
X 640. Slide: 330.

DIMENSIONS. – Length of theca: 120μ ; breadth of theca: 80μ . Diameter of central capsule: 70μ .

REMARKS. – This species is characterized by having a coarsely granular ornamentation of the theca and central capsule wall. This species is provisionally attributed to the genus *Scriniodinium* (cf. Eisenack's remarks on the genus *Scriniodinium* in EISENACK & KLEMENT 1964, p. 745 and on the genus *Triblastula* in EISENACK & KJELLSTRÖM 1971 b, p. 1071).

HOLOTYPE. – SGU slide no. 330. Fig. 34.

TYPE LOCALITY AND TYPE STRATUM. – Höllviken Borehole No. 1, Scania, Sweden; Upper Cretaceous, Middle Maastrichtian, 330.00 m.

OCCURRENCE. – This species occurs frequently in the upper part of the Middle Maastrichtian and in the lower part of the Upper Maastrichtian of the Höllviken borehole.

? *Scriniodinium nilsii* n. sp.

Fig. 35

DIAGNOSIS. – ? *Scriniodinium* sp. with ovoid, granular theca and spherical, psilate central capsule. No tabulation and no cingulum recorded. No archaeopyle formation recorded.

DIMENSIONS. – Diameter of theca: 85μ ; diameter of central capsule: 70μ .

HOLOTYPE. – SGU slide no. 330. Fig. 35.

TYPE LOCALITY AND TYPE STRATUM. – Höllviken Borehole No. 1, Scania, Sweden; Upper Cretaceous, Middle Maastrichtian, 330.00 m.

OCCURRENCE. – This species is found in the upper part of the Middle Maastrichtian and the lower part of the Upper Maastrichtian of the Höllviken core.

Genus *Spiniferites* MANTELL, 1850

Spiniferites pterotus (COOKSON & EISENACK, 1958)

Fig. 36

1958 *Cymatiosphaera pterota*. – COOKSON & EISENACK: p. 50, Pl. 11, fig. 7.

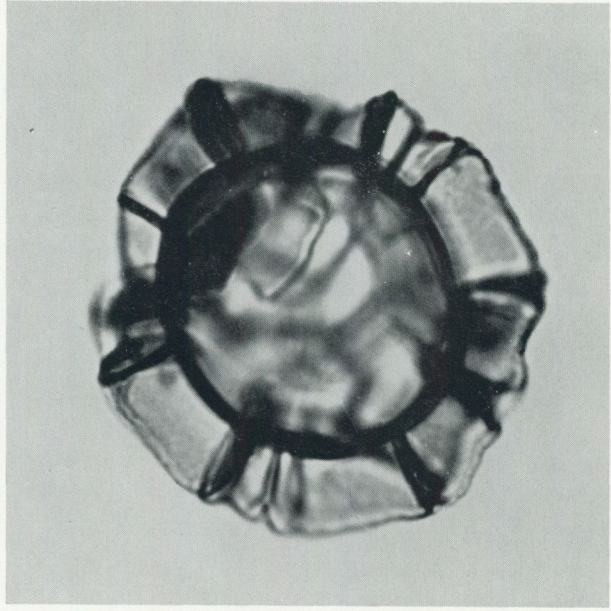


Fig. 36. *Spiniiferites pterotus* (COOKSON & EISENACK, 1958).
X 840. Slide: 296.

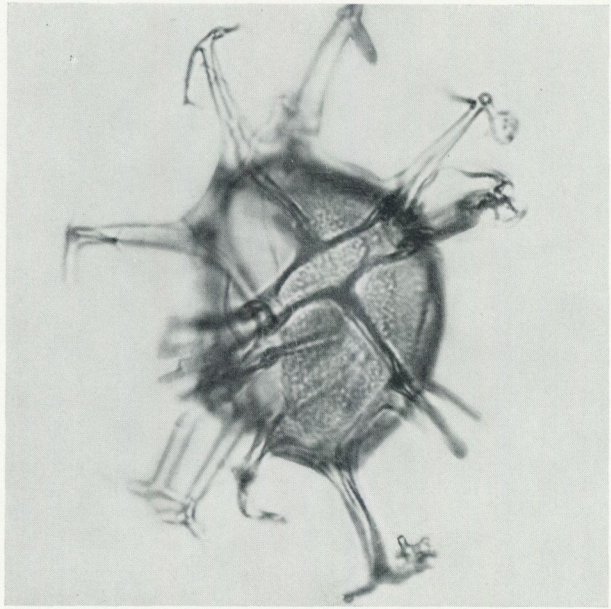


Fig. 37. *Spiniiferites ramosus* var. *granosus* DAVEY &
WILLIAMS, 1966. X 700. Slide: 296.

- 1966 *Hystrichosphaera crassimurata*. – DAVEY & WILLIAMS in DAVEY et al.: p. 39, Pl. 1, fig. 11.
 1967 *Hystrichosphaera cingulata* var. *polygonalis*. – CLARKE & VERDIER: p. 47, Pl. 8, fig. 7–8; text-fig. 20.

REMARKS. – *Spiniferites pterotus* is a very common species throughout the entire Maastrichtian of the Höllviken core. This species has also been reported from the lower Maastrichtian, Campanian, Turonian, Cenomanian and Albian of Australia (COOKSON & EISENACK 1958) and from the Cenomanian of England (DAVEY & WILLIAMS in DAVEY et al. 1966; CLARKE & VERDIER 1967).

Spiniferites ramosus var. *granosus* DAVEY & WILLIAMS, 1966
 Fig. 37

- 1966 *Hystrichosphaera ramosa* var. *granosa*. – DAVEY & WILLIAMS in DAVEY et al.: p. 35, Pl. 4, fig. 9.

REMARKS. – *Spiniferites ramosus* var. *granosus* occurs abundantly in the upper part of the Middle Maastrichtian and the lower part of the Upper Maastrichtian of the core. Previously it was described from the Eocene of England (DAVEY & WILLIAMS in DAVEY et al. 1966).

Spiniferites ramosus (EHRENBERG, 1838) var. *ramosus* DAVEY & WILLIAMS, 1966
 Fig. 38

- 1838 *Xanthidium ramosum*. – EHRENBERG: Pl. 1, fig. 1, 2, 5.
 1838 *Xanthidium furcatum*. – EHRENBERG: Pl. 1, fig. 12, 14.
 1854 *Xanthidium ramosum*. – EHRENBERG: Pl. 7, fig. 9, 10.
 1854 *Xanthidium furcatum*. – EHRENBERG: Pl. 7, fig. 7.
 1933 *Hystrichosphaera furcata*. – O. WETZEL: p. 34, Pl. 2, fig. 35.
 1933 *Hystrichosphaera ramosa*. – O. WETZEL: p. 34, Pl. 5, fig. 1, 9.
 1935 *Hystrichosphaera furcata*. – DEFLANDRE: p. 232, Pl. 5, fig. 9; Pl. 8, fig. 3.
 1936 *Hystrichosphaera furcata*. – DEFLANDRE: p. 62, fig. 108.
 1937 *Hystrichosphaera furcata*. – DEFLANDRE: p. 61, Pl. 11, fig. 5, 7.
 1937 *Hystrichosphaera ramosa*. – DEFLANDRE: p. 64, Pl. 11, fig. 1, 3, 4.
 1937 *Hystrichosphaera ramosa*. – LEJEUNE: p. 239, Pl. 1, fig. 2–4; Pl. 2, fig. 5–10.
 1941 *Hystrichosphaera furcata*. – CONRAD: p. 3, Pl. 1, fig. H, I.

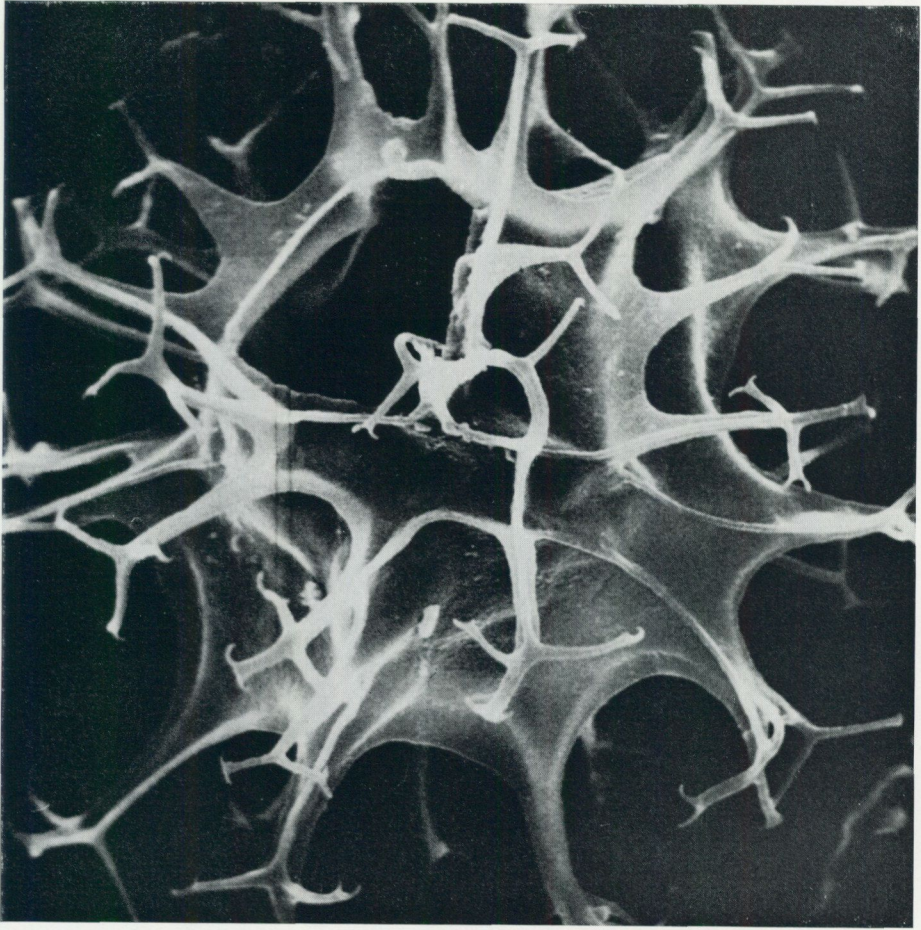


Fig. 38. *Spiniiferites ramosus* var. *ramosus* DAVEY & WILLIAMS, 1966. X 1500. Slide: SEM 296.

- 1955 *Hystrichosphaera furcata*. – DEFLANDRE & COOKSON: p. 263, Pl. 8, fig. 9.
 1955 *Hystrichosphaera ramosa*. – DEFLANDRE: p. 263, Pl. 6, fig. 1.
 1964 *Hystrichosphaera furcata*. – COOKSON & HUGHES: p. 45, Pl. 9, fig. 1, 2.
 1964 *Hystrichosphaera furcata*. – ROSSIGNOL: p. 85, Pl. 1, fig. 11; Pl. 3, fig. 9.
 1966 *Hystrichosphaera ramosa* var. *ramosa*. – DAVEY & WILLIAMS in DAVEY et al.: p. 33, Pl. 1, fig. 1, 6; Pl. 3, fig. 1; text-fig. 8.
 1967 *Hystrichosphaera furcata*. – WALL: p. 99, Pl. 14, fig. 1, 2; text-fig. 2 D–F.
 1969 *Hystrichosphaera ramosa* var. *ramosa*. – DAVEY: p. 172, Pl. 10, fig. 1, 2, 5.
 1971 *Spiniferites ramosus* var. *ramosus*. – DAVEY & VERDIER: p. 33, Pl. 4, fig. 1, 3; Pl. 7, fig. 5.
 1971 *Hystrichosphaera ramosa* var. *ramosa*. – FOUCHER: p. 89, Pl. 2, fig. 6, 7.

REMARKS. – *Spiniferites ramosus* var. *ramosus* is an extremely abundant species occurring throughout the entire Maastrichtian of the Höllviken borehole. This species has an extensive vertical range from the Oxfordian to the Pleistocene (cf. synonym list bibliography).

Spiniferites wetzeli (DEFLANDRE, 1937)

Fig. 39

- 1933 *Hystrichosphaera* cf. *furcata*. – O. WETZEL: Pl. 5, fig. 13.
 1935 *Hystrichosphaera wetzeli*. – DEFLANDRE: p. 232, Pl. 8, fig. 5.
 1936 *Hystrichosphaera wetzeli*. – DEFLANDRE: p. 63, fig. 109.
 1937 *Hystrichosphaera wetzeli*. – DEFLANDRE: p. 65, Pl. 8, fig. 6, 8.
 1955 *Hystrichosphaera wetzeli*. – DEFLANDRE & COOKSON: p. 267.

REMARKS. – *Spiniferites wetzeli* is a fairly abundant species in the core, stratigraphically confined here to the Lower Maastrichtian. This species was previously recorded from the Senonian of Baltic flint erratics (O. WETZEL 1933), France (DEFLANDRE 1935, 1936, 1937) and from the Albian of Australia (DEFLANDRE & COOKSON 1955).

Genus *Spongodinium* DEFLANDRE, 1936

Spongodinium delitiense (EHRENBERG, 1838) DEFLANDRE, 1936

Fig. 40 a, b

- 1838 *Peridinium delitiense*. – EHRENBERG: p. 110, Pl. 1, fig. 1, 6.
 1854 *Peridinium delitiense*. – EHRENBERG: Pl. 37, no. 7, fig. 1, 2.
 1933 *Peridinium delitiense*. – O. WETZEL: p. 160, Pl. 2, fig. 2, 3.
 1936 *Spongodinium delitiense*. – DEFLANDRE: p. 170, Pl. 4, fig. 1–3.

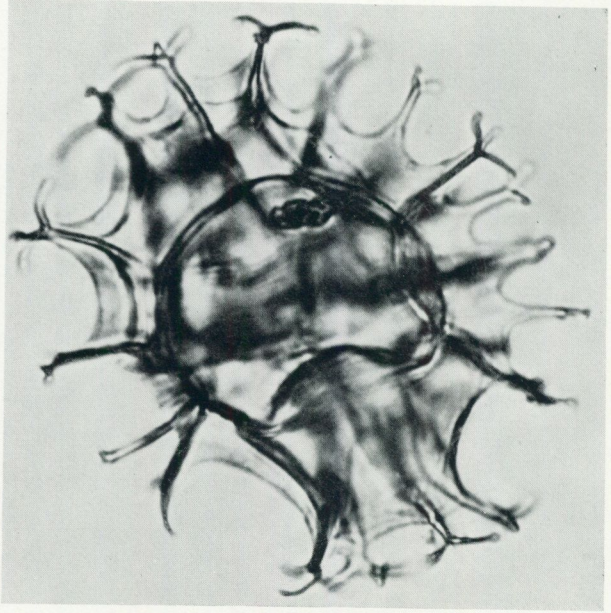


Fig. 39. *Spiniiferites wetzeli* (DEFLANDRE, 1937).
X 880. Slide: 540.

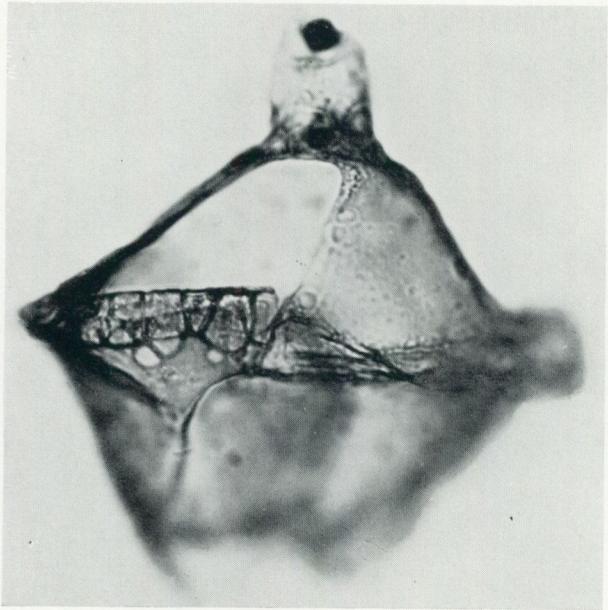


Fig. 40 a. *Spongodinium delitiense* (EHRENBERG, 1838)
DEFLANDRE, 1936. X 460. Slide: 540.

- 1952 *Spongodinium delitiense*. – O. WETZEL: p. 409, Pl. A, fig. 14.
 1968 *Spongodinium delitiense*. – MORGENROTH: p. 537, Pl. 42, fig. 2, 3.
 1971 *Spongodinium delitiense*. – WILSON: Pl. 2, fig. 7, 9.

REMARKS. – *Spongodinium delitiense* occurs in the Höllviken material only in the Lower Maastrichtian. Previous records of this species are from the Danian of Denmark (DEFLANDRE 1936; O. WETZEL 1933; MORGENROTH 1968; WILSON 1971), and Senonian flint erratics of the Baltic area (W. WETZEL 1952) and of Germany (EHRENBERG 1838, 1854).

Genus *Tanyosphaeridium* DAVEY & WILLIAMS, 1966
Tanyosphaeridium regulare DAVEY & WILLIAMS, 1966

Fig. 41

- 1966 *Tanyosphaeridium regulare*. – DAVEY & WILLIAMS in DAVEY et al.: p. 99, Pl. 3, fig. 4.

REMARKS. – *Tanyosphaeridium regulare* is, in the Höllviken core, locally restricted to the Lower Maastrichtian where it occurs abundantly in two samples at 540.00 m and 525.00 m. This species was originally described from the Lower Eocene of England (DAVEY & WILLIAMS in DAVEY et al. 1966).

Genus *Triblastula* O. WETZEL, 1933
Triblastula utinensis O. WETZEL, 1933

Fig. 42 a, b

- 1932 *Triblastula utinensis*. – O. WETZEL: p. 136, Pl. 2, fig. 11 (nom. nud.).
 1933 *Triblastula utinensis*. – O. WETZEL: p. 54, Pl. 6, fig. 5, 6.
 1961 *Triblastula utinensis*. – O. WETZEL: p. 339, Pl. 2, fig. 1; ?Pl. 2, fig. 5.
 1961 *Triblastula* cf. *utinensis*. – EVITT: p. 395, Pl. 6, fig. 6–8; Pl. 7, fig. 4–6.
 1971 *Triblastula utinensis*. – WILSON: Pl. 1, fig. 9.

REMARKS. – *Triblastula utinensis* is encountered in the Middle and Upper Maastrichtian of the Höllviken borehole. This species is also known to occur in the Maastrichtian of the United States (EVITT 1961) and Denmark (WILSON 1971). Apart from these Maastrichtian records it has so far only been reported from the Senonian of Germany.

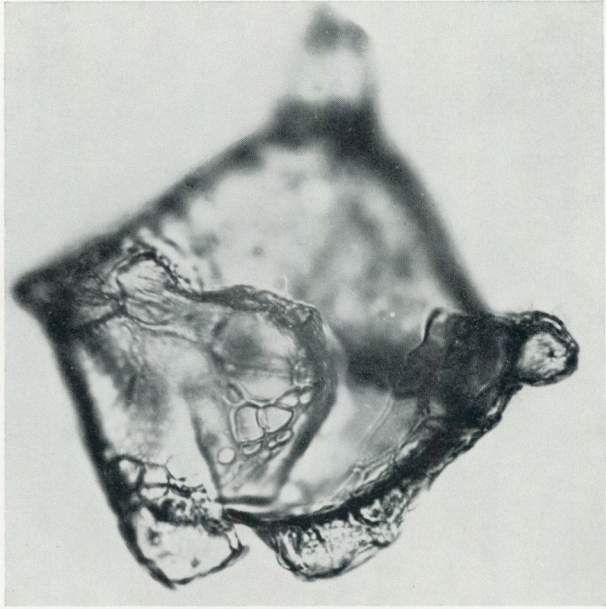


Fig. 40 b. *Spongodinium delitiense* (EHRENBERG, 1838)
DEFLANDRE, 1936. X 460. Slide: 540.

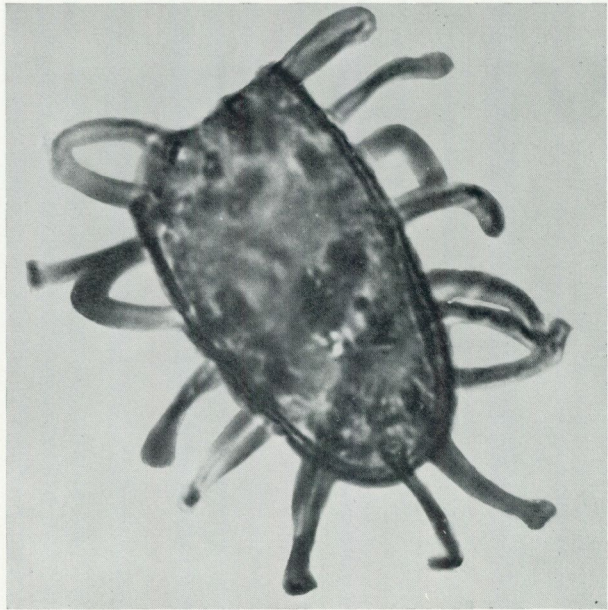


Fig. 41. *Tanyosphaeridium regulare* DAVEY & WILLIAMS,
1966. X 1100. Slide: 525.

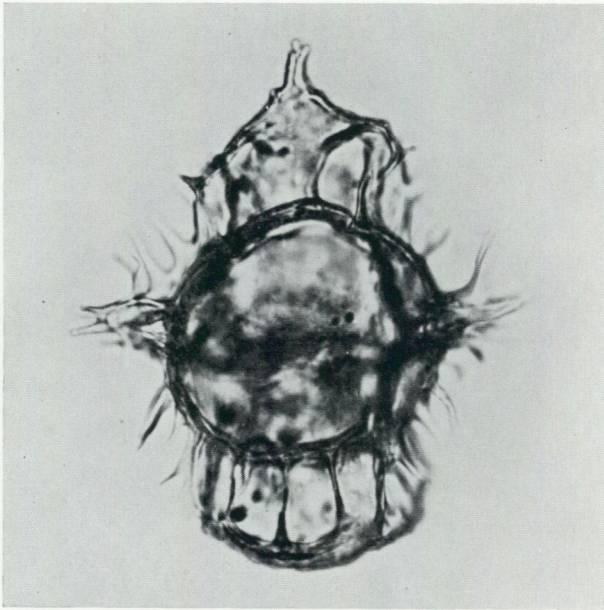


Fig. 42 a. *Triblastula utinensis* O. WETZEL, 1933.
X 570. Slide: 297.

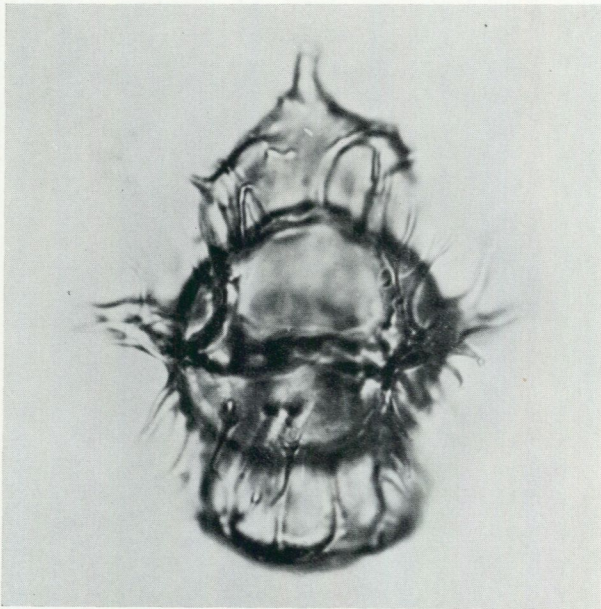


Fig. 42 b. *Triblastula utinensis* O. WETZEL, 1933.
X 570. Slide: 297.

CONCLUSIONS

In total forty-one species are encountered in the Maastrichtian of the Höllviken core (Fig. 43). Fifteen of these have been recorded elsewhere from the Maastrichtian. Of the remaining twenty-six species, reported here for the first time from the Maastrichtian, sixteen were previously considered to be stratigraphically confined to older or younger strata (Fig. 44). Consequently, a revised version of the total stratigraphic range is given, based upon the present material and on the records quoted in the synonym lists (Fig. 45).

In the Höllviken material the following species were recovered only from the Lower Maastrichtian, viz.: *Odontochitina operculata*, *Spiniferites wetzeli*, *Spongodinium delitiense* and *Tanyosphaeridium regulare*. With the exception of *Tanyosphaeridium regulare*, which has been described from the Eocene of England, the Lower Maastrichtian is the youngest stratigraphic level hitherto known for these species.

The following species are here locally confined to the Middle Maastrichtian: *Crassosphaera concinna*, *Hexagonifera chlamydata* and *Pareodinia aphelia*. At present the Middle Maastrichtian is the youngest stratigraphic level for the latter two; *Crassosphaera concinna* has been found elsewhere in younger and older strata.

MICROPLANKTON	PREVIOUS RECORDS
<i>Achomosphaera sagena</i>	Cenomanian – Campanian
<i>Canninginopsis denticulata</i>	Aptian – Cenomanian
<i>Deflandrea bakeri</i>	Paleocene – Oligocene
<i>Deflandrea belfastensis</i>	Senonian
<i>Deflandrea cincta</i>	Barremian – Aptian
<i>Deflandrea rectangularis</i>	Turonian – Senonian
<i>Deflandrea tripartita</i>	Turonian – Senonian
<i>Hexagonifera glabra</i>	Senonian
<i>Hystriochodium pulchrum</i>	Hauterivian – Senonian
<i>Hystriochosphaeridium recurvatum</i>	Senonian
<i>Lejeunia hyalina</i>	? Paleocene – Oligocene
<i>Membranilarnacia leptoderma</i>	Albian
<i>Pareodinia aphelia</i>	Jurassic – Aptian
<i>Spiniferites ramosus</i> var. <i>granosus</i>	Eocene
<i>Spiniferites wetzeli</i>	Albian – Senonian
<i>Tanyosphaeridium regulare</i>	Eocene

Fig. 44. Previous stratigraphic range of microplankton reported herein.

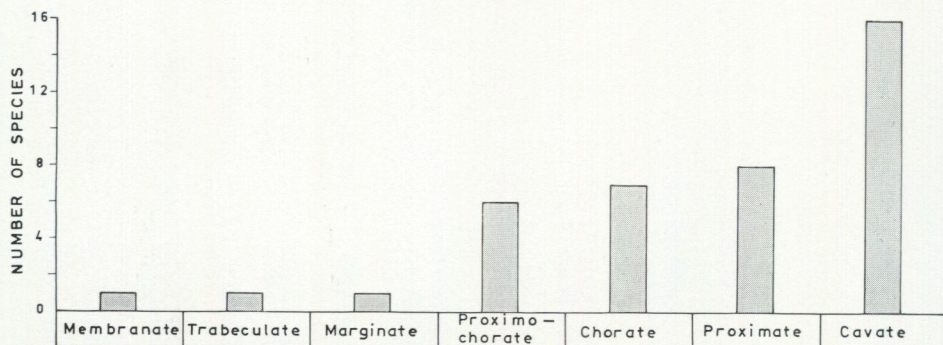


Fig. 46. Number of species of different types of dinoflagellate cysts from the Maastrichtian of the Höllviken core.

No species were encountered in the Upper Maastrichtian which could be locally restricted to this part of the stage, probably due to the lack of sufficient material.

As regards the different types of dinoflagellate cysts, i.e. all microplankton except *Crassosphaera concinna* (= ? Tasmanaceae), the cavate dinoflagellates are overwhelmingly predominant. Thus, they account for 40 % of the total assemblage (Fig. 46). The proximate cysts account for 20 % of the assemblage,

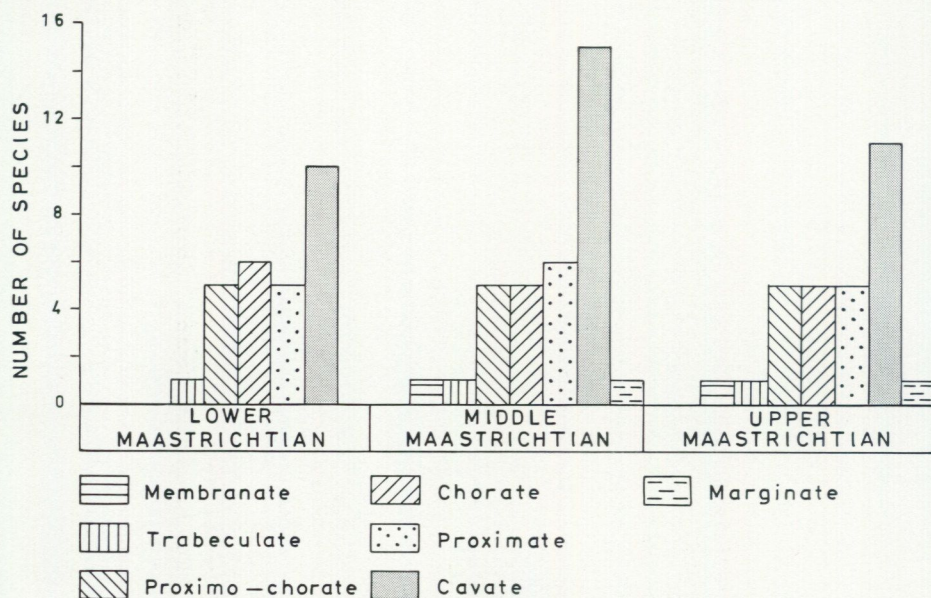


Fig. 47. Number of species of different types of dinoflagellate cysts from the Lower, Middle and Upper Maastrichtian of the Höllviken core.

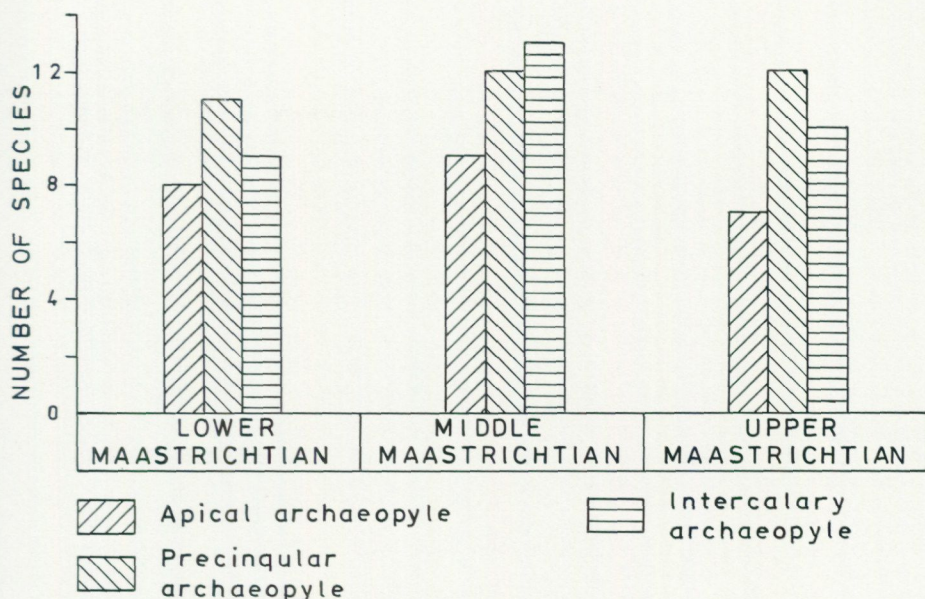


Fig. 48. Stratigraphic distribution of different archaeopyle types from the Maastrichtian of the Höllviken core.

the chorate dinoflagellates for 17.5 %, the proximo-chorate for 15 % and the trabeculate, marginate and membranate for 2.5 % each. The predominance of the cavate cysts is especially prominent in the Middle Maastrichtian (Fig. 47).

With respect to the stratigraphic distribution of different types of archaeopyles, the precingular type is dominant in the Lower and Upper Maastrichtian while the intercalary archaeopyle type is dominant in the Middle Maastrichtian (Fig. 48).

As a concluding remark to the above mentioned differentiation as regards the different types of cysts in the Lower, Middle and Upper Maastrichtian, the following statement made by Davey (1970) is worth attention: "... dinoflagellates inhabiting warm water produce cysts with relatively large surface area so as to retard the rate of sinking, for once the encysted organism enters the aphotic zone (approximately at 300 ft. depth) it has little chance of survival. Thus in warm sea water the cysts are predominantly chorate and as the temperature of the water decreases the proportion of the proximate and cavate cysts increases" (Davey 1970).

If this inference is correct, the predominance of the cavate cysts (in terms of number of species as well as number of specimens) in the Middle Maastrichtian of the present material might indicate a change in the palaeoenvironmental conditions, viz. a cooler sea water during the Middle Maastrichtian of the Höllviken area.

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