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ORGANIC WALLED MICROFOSSILS FROM THE TYPE AREA OF THE PALEOCENE HEERS AND LANDEN FORMATIONS OF BELGIUM

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Key words - Belgium, Paleocene, organic walled microfossils, biozonation.

Sleutelwoorden - België, Paleoceen, mikrofossielen met organische wand, biozonatie.

Mots-clés - Belgique, Paléocène, microfossiles à paroi organique, biozonation.

SAMENVATTING

Onderzoek van het fossiel mikroplankton met organische wand in de Heers Formatie en de Landen Formatie (Paleoceen) in het oostelijk landsgedeelte laat ons toe een voorlopige informele biostratigrafische zonering te maken en deze te correleren met de dinoflagellatenzonering van het Paleoceen in de Zwitserse Alpen.

ABSTRACT

The investigation of the fossil organic walled microplankton in the Heers Formation and the Landen Formation (Paleocene) in the eastern part of the country allows us to introduce an informal zonation and to correlate it with the dinoflagellate zonation of the Paleocene of the Swiss Alps.

RESUME

L'étude des microfossiles à paroi organique dans la Formation de Heers et la Formation de Landen (Paléocène) dans la partie est du pays nous a permis d'établir une zonation biostratigraphique informèle et de la corréler avec une zonation à base de dinoflagellés du Paléocène dans les Alpes suisses.

INTRODUCTION

Fossil organic walled microplankton, mainly dinoflagellates cysts, have only occasionaly (De Coninck *et al.*, 1981) been studied in Belgian Paleocene deposits. I had the opportunity to analyse fourteen samples, three from the Heers Formation and eleven from the overlying Landen Formation. The samples were taken in the Linter boring, the KS-22 boring and the Overbroek and Wansin outcrops (Figs. 1-7).

The Linter Boring (Fig. 4)

Lambert coörd. : x = 194.160, Y = 168.000. The Linter boring n° 105W-345 (Geological Survey Belgium) is situated at Linter-Oplinter. In this boring 76 m of deposits have been cored. The upper 11 m are Quaternary sediments. Below them one encounters 38 m belonging to the Landen Formation (Paleocene). Deeper, from - 49 m to - 72.80 m, the deposits of the Heers Formation (Paleocene) are found with between - 49 m and - 68 m the Marls of Gelinden, and between - 68 m and - 72.80 m the Sands of Orp.

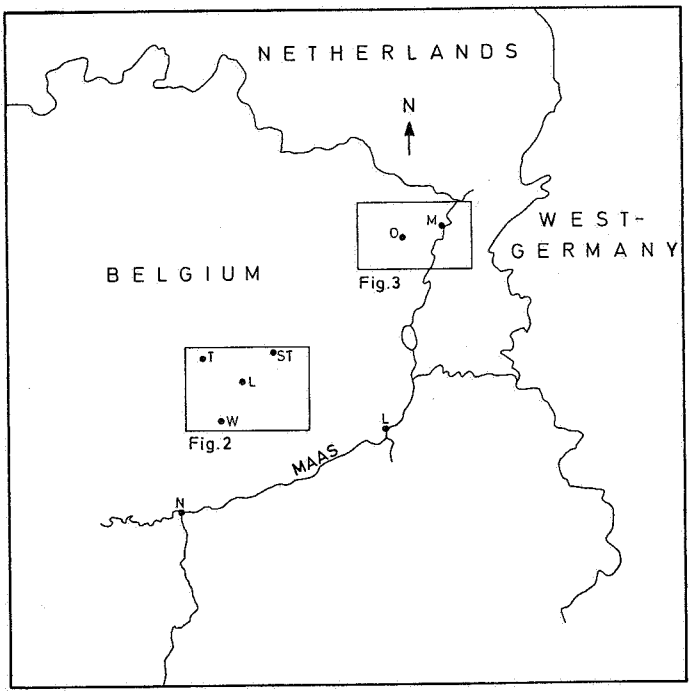

Fig. 1. Survey of the localities

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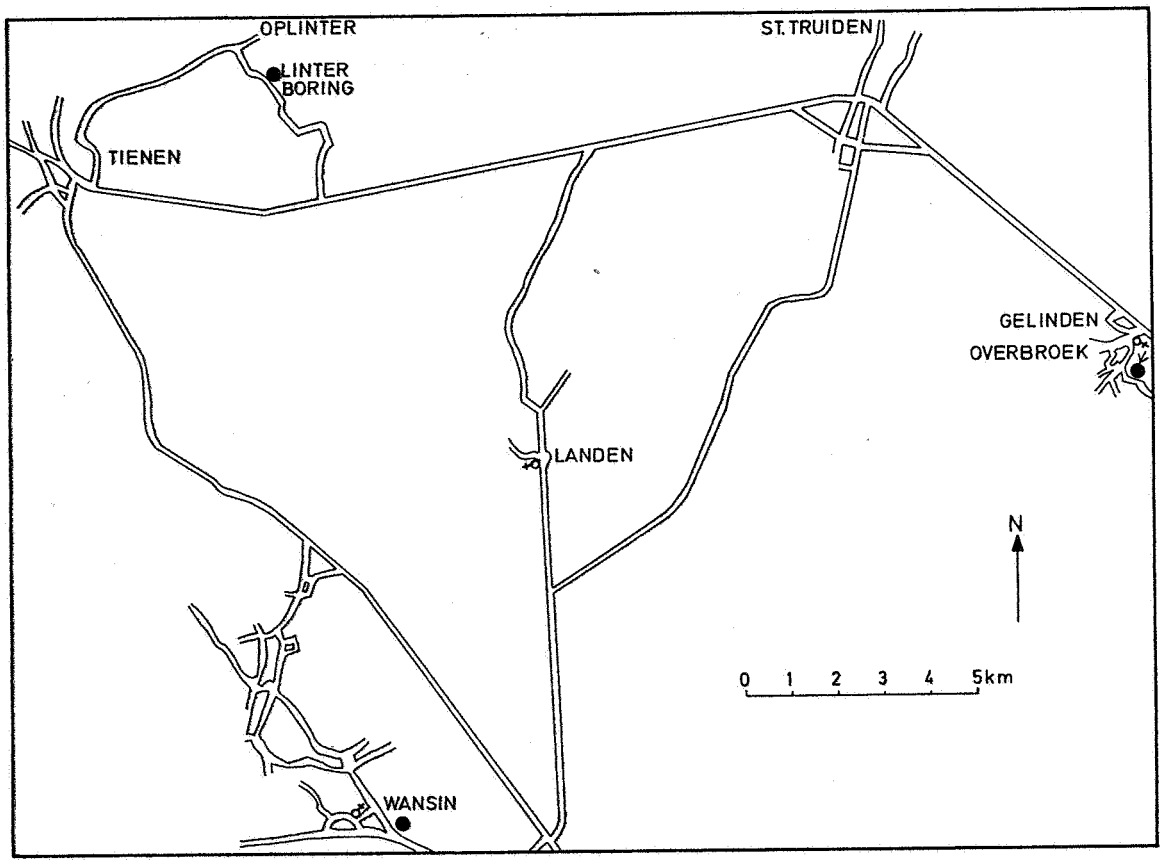


Figure 2. Map of samples in Landen area.

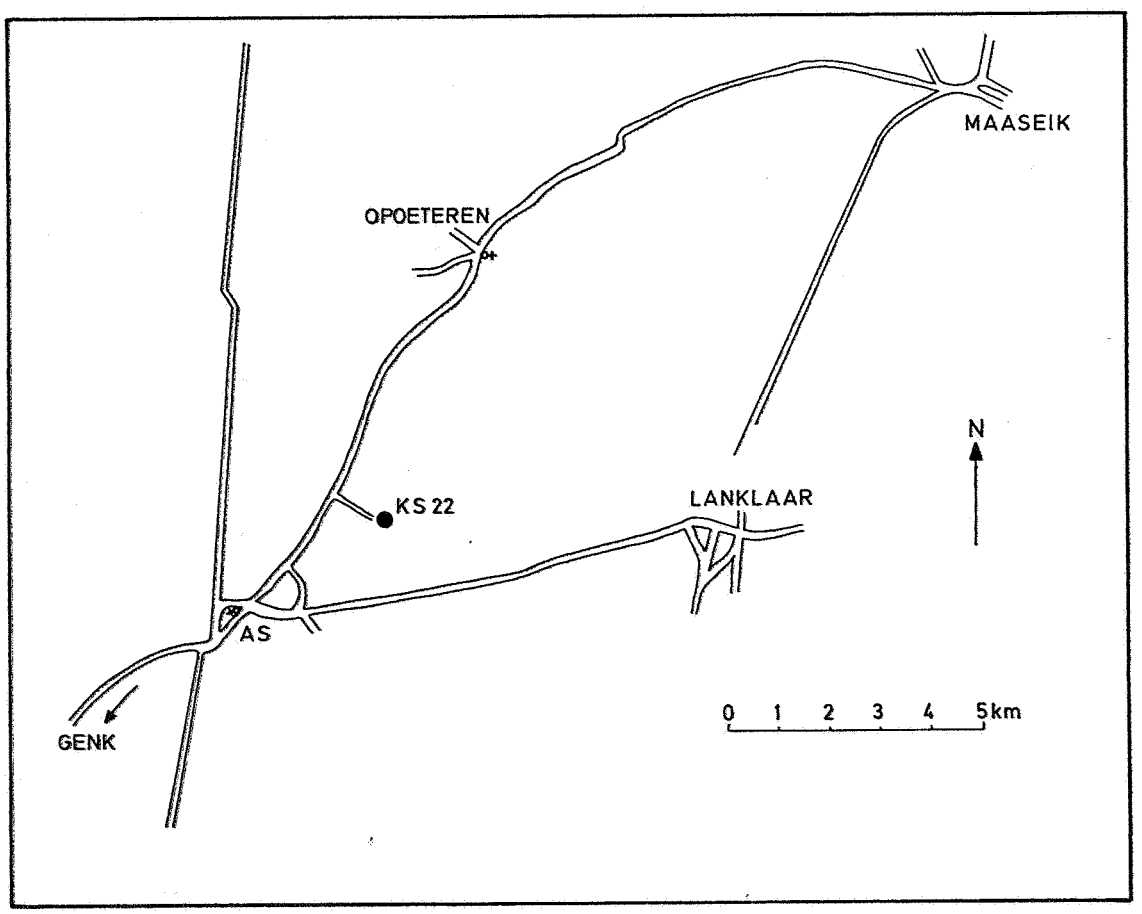


Figure 3. Map of samples in Maaseik area.

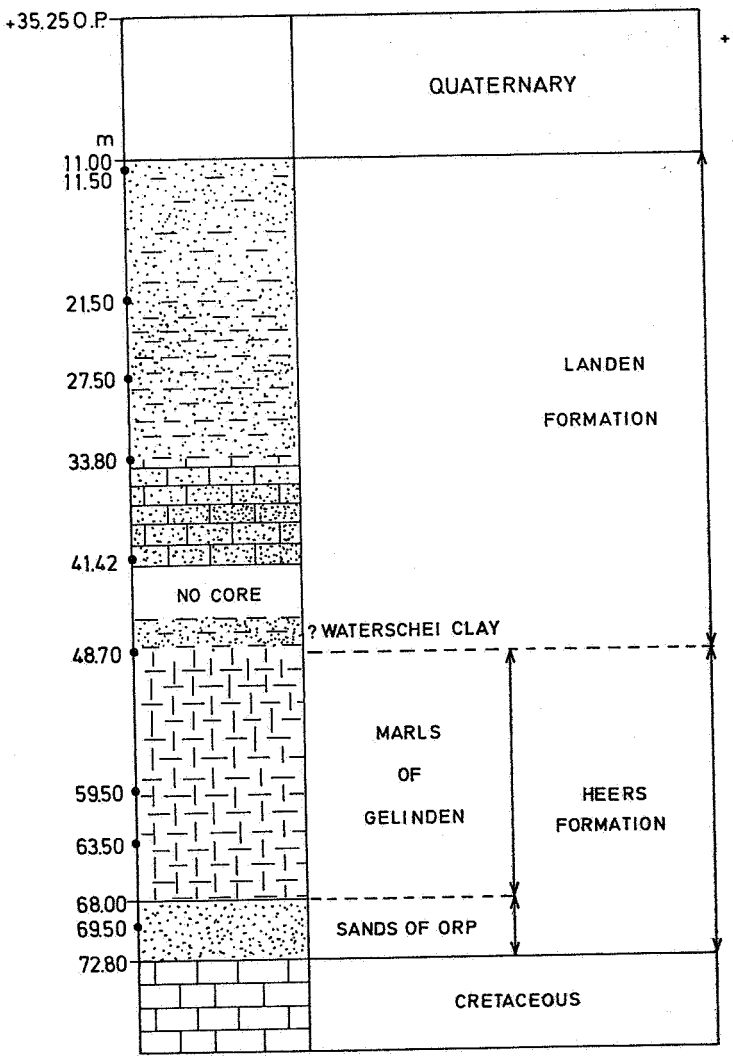


Figure 4. Linter boring.

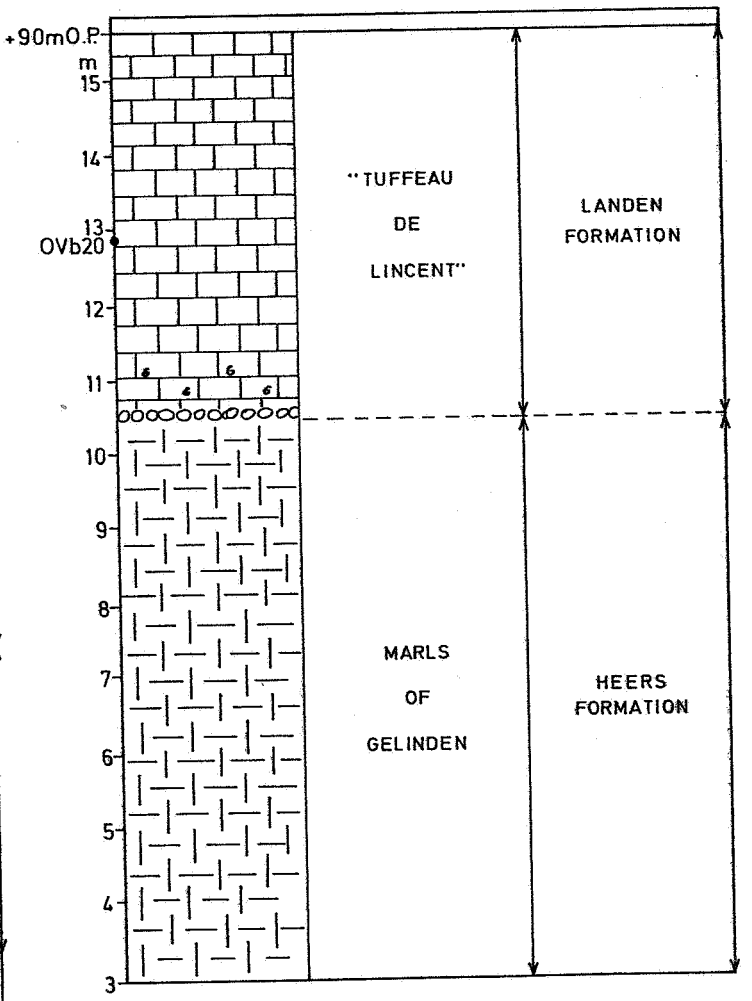


Figure 5. Gelinden, Quarry Thewis, at Overbroek (after Moorkens, T., 1982, fig. 11).

Below - 72.80 m a Cretaceous calcarenite is found.
We studied nine samples (- 11.50 m, - 21.20 m, - 27.50 m, - 33.80 m, - 41.42 m, - 48.70 m, - 59.50 m, - 63.50 m and - 69.50 m).

Gelinden, Quarry Thewis, at Overbroek (*Fig.* 5)

Lambert coörd. : x = 213.350, y = 161.025.
The abandoned quarry of Mr. Albert Thewis is situated in the hamlet of Overbroek, village of Gelinden, about three km north-west of the village of Heers.
In its lower part the quarry exposes the Marls of Gelinden, in their type section, which is also the stratotype of the Heersian Stage (Moorkens, 1982, p. 32).
In the upper part of the quarry, the Tuffeau de Lincent (Lower Landen Formation) crops out (from Moorkens, *ibid.*). We studied the sample OVb20 collected by Moorkens in 1969 about 2,5 m above the base of the Tuffeau de Lincent.

Wansin (*Fig.* 6)

Lambert coörd. : x = 196.155, y = 151.850.
As the Tuffeau de Lincent is not anymore exposed at the type locality, a new type section has been defined at Wansin by Moorkens, T. (1982, p. 34). The stratotype is situated on the valleyflank of the Wansin Brook and is easily accessible (De Geyter, 1981, p. 116-117). From this section we have

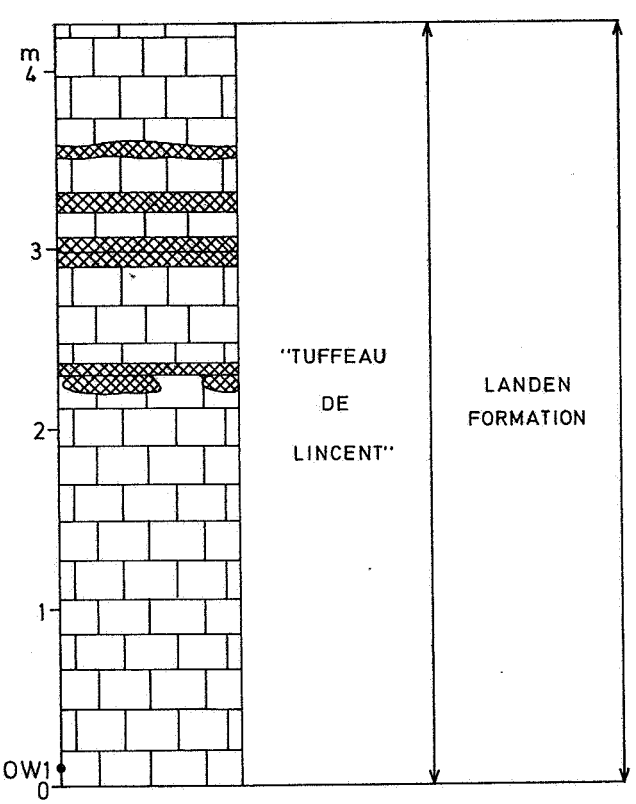


Figure 6. Wansin (after De Geyter, G., 1981, section 3) .

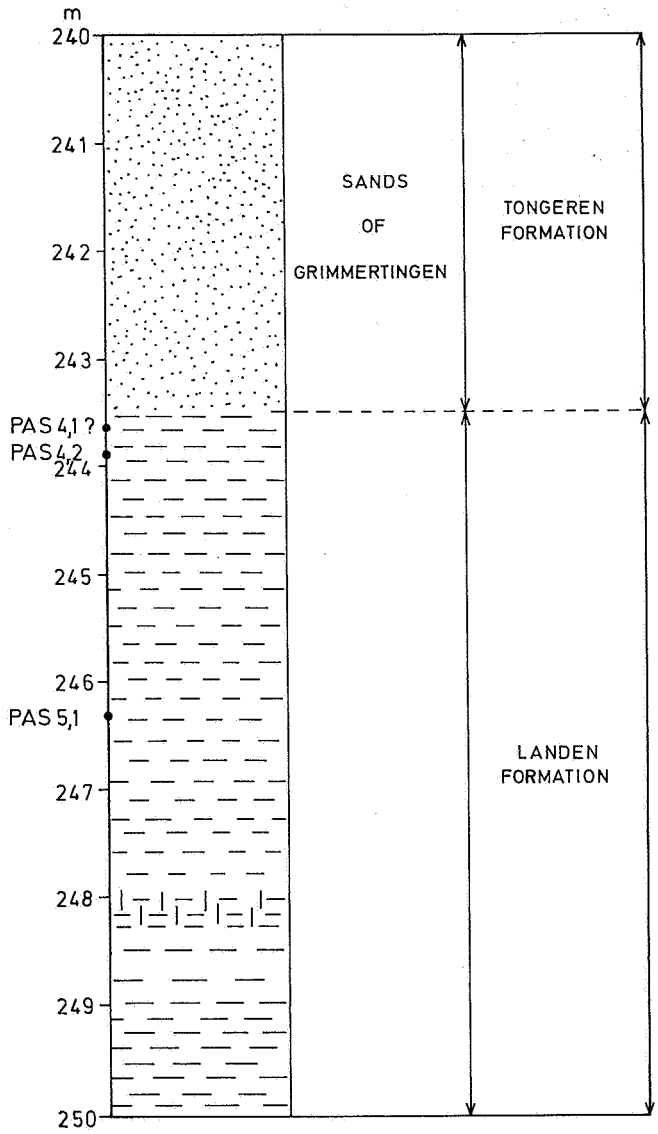


Figure 7. Boring KS 22

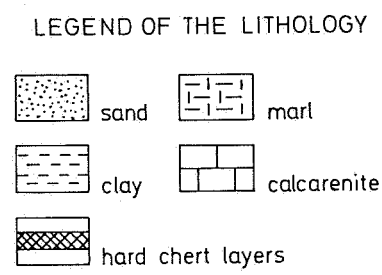
examined sample OW1, situated at the base of the section.

Boring KS 22 (Fig. 7)

Lambert coörd. : x = 238.787, y = 191.238. The KS 22 boring n° 63E-222 (Geological Survey Belgium) is situated at Opoeteren. In the boring a very heavy clay belonging to the Landen Formation is, according to the well logs, overlain at - 243.50 m by glauconitic, relatively coarse sands from the Tongeren Formation. The sedimentary gap between both formations corresponds to the almost entire Eocene period. The samples studied come from the Landen Formation. WA3/PAS4, 1 is situated near the contact between the Landen and Tongeren Formations near - 243.55 m ; WA3/PAS 4, 2 is situated about 0.30 m below the first sample. WA3/PAS 5 is situated at about - 246.35 m.

Biozonation at the Linter boring

The studied section of the Linter borehole contains well preserved dinoflagellate assemblages (Table 1). They allow us to introduce an informal zonation based on the first or last appearance of several species. When comparing the lithostratigraphic division of the Linter boring with these informal zones we see that zone 1 corresponds with the Sands of Orp (- 72.80 m - - 68.00 m), zone 2 with the Marls of Gelinden (- 68.00 m - - 49.00 m), and that zones 3, 4 and 5 are situated within the Landen Formation, from - 49.00 m up to - 11.00 m.



ZONE 1

(sample - 69.50 m)
Within this zone we note the presence of *Ceratiopsis* cf. *striata*, *Connexímura fimbriatum*, *Bosedinia laevigata*, *Deflandrea* aff. *D. denticulata*, *Elytrocysta* sp. *indet.* , *Palaeoperidinium pyrophorum*, *Senegalinium* cf. *obscurum* and? *Pervosphaeridium truncigerum*. This last species does not appear any more in a higher level.

ZONE 2

(samples - 63.50 m and - 59.50 m)
The lower boundary of this zone is defined by the first appearance of *Alisocysta margarita*, *Ceratiopsis speciosa*, *Cordosphaeridium fibrospinosum*, *C. inodes*, *Millioudodinium ?* spp. *indet.*, *Tanyosphaeridium* spp. *indet.*
The upper boundary corresponds with the last occurrence of *Ceratiopsis* cf. *striata*. Within this zone one notes the disappearance of *Palaeoperidinium pyrophorum* and the appearance of *Achomosphaera alcicornu*, *Operculodinium microtriaina* , *Palaeocystodinium golzowense* and *Thalassiphora delicata*.

ZONE 3

(samples - 48.70 m to - 33.80 m)
The first appearance of *Achomosphaera ramulifera*, *Areoligera senonensis*, *Caligodinium amiculum*, *Cribroperidinium wetzelii*, *Deflandrea denticulata* subsp. *minor*, *Fibrocysta axialis* and *Hystrichostrogylon membraniphorum* define the lower boundary. In the base we note the abundance of *Ophiobolus lapidaris*. *Hafniasphaera septata*, *Hystrichokolpoma unispinum*, *Kallosphaeridium brevibarbatum* and *Phthanoperidinium crenulatum* are observed for the first time within zone 3. In its upper part *Cladopyxidium saeptum* appears for the first time.

ZONE 4

(samples - 27.50 m and - 21.50 m)
Lower boundary defined by the first appearance of *Cordosphaeridium gracile*, *Deflandrea oebisfeldensis* and *Fibrocysta bipolaris*. *Caligodinium amiculum*, *Nematosphaeropsis reticulensis* and *Kallosphaeridium brevibarbatum* have their last appearance within this zone. *Cribroperidinium wetzelii*, *Millioudodinium* ? spp. *indet.*, and *Phthanoperidinium crenulatum* disappear at the top of this zone.

Table 1 : Distribution and frequency of species in the Linter boring.

Depth in metres below the surface	69.50	63.50	59.50	48.70	41.42	33.80	27.50	21.50	11.50
Frequencies in percentages									
CHLOROPHYCEAE KUTZING 1843									
Pediastrum sp.	1.0	-	-	-	-	-	-	-	-
Uvella nannae HANSEN 1980	-	-	-	<1	-	-	-	-	-
DINOPHYCEAE FRITSCH 1929									
?Achilleodinium biformoïdes (EISENACK 1954)	-	-	-	<1	-	-	-	-	-
Achomosphaera alcicornu (EISENACK 1954)	-	-	1.0	4.0	6.7	-	4.2	2.5	3.6
A. cf. alcicornu	<1	-	-	-	-	-	-	-	-
A. ramulifera (DEFLANDRE 1937)	-	-	-	<1	<1	-	<1	-	<1
A. sagena DAVEY & WILLIAMS 1966	2.6	1.8	1.0	3.0	<1	-	-	<1	-
A. aff. sagena	-	-	-	-	<1	-	-	-	-
A. cf. sagena	-	-	-	-	<1	-	-	-	-
A. spp. indet.	-	-	3	-	-	-	-	-	<1
Alisocysta margarita (HARLAND 1979)	-	1.8	4.0	3.7	5.1	7.4	<1	4.4	4
Amphorosphaeridium multispinosum (DAVEY & WILLIAMS 1966)	-	-	-	<1	-	-	-	-	-
A. cf. multispinosum	-	-	-	-	-	-	<1	-	-
Areoligera coronata (O. WETZEL 1933)	<1	-	-	-	-	-	-	-	-
A. cf. coronata	-	<1	-	-	-	-	-	-	-
A. senonensis LEJEUNE-CARPENTIER 1938	-	-	-	1.9	7.5	11.1	2.1	5.6	5.4
A. cf. senonensis	-	-	-	-	1.2	-	-	-	-
A. sp. A	-	-	-	-	<1	-	-	-	<1
A. spp. indet.	-	-	-	-	-	-	<1	-	-
Bitectatodinium? sp. A.	-	-	-	<1	-	-	-	-	-
Bosedinia laevigata (JIABO 1978)	<1	-	-	1.9	-	-	-	-	-
Caligodinium amiculum DRUGG 1970	-	-	-	<1	1.2	-	<1	-	-
Ceratiopsis speciosa (ALBERTI 1959)	-	<1	1.0	1.1	2.0	3.7	2.8	12.5	8.1
C. speciosa subsp. glabra (GOCHT 1969)	-	-	-	-	-	-	-	1.2	-
C. cf. striata (DRUGG 1967)	3.1	4.5	11.1	-	-	-	-	-	-
Cladopyxidium saeptum (MORGENROTH 1968)	-	-	-	-	-	3.7	3.5	-	-
Cometodinium cf. whitei	<1	-	-	2.6	<1	-	<1	<1	<1
Conneximura fimbriatum (MORGENROTH 1968)	2.6	2.7	-	1.9	1.2	-	<1	-	<1
Cordosphaeridium fibrospinosum DAVEY & WILLIAMS 1966	-	1.8	3.0	<1	2.8	-	2.8	3.8	2.3
C. gracile (EISENACK 1954)	-	-	-	-	-	-	<1	-	<1
C. inodes (KLUMPP 1953)	-	10.8	2.0	2.6	5.1	3.7	5.6	4.4	9.5
C. multispinosum à inodes	-	-	-	-	<1	-	-	<1	-
cf. C. minimum (MORGENROTH 1966)	-	-	-	-	-	-	<1	-	-
C. inodes à fibrospinosum	-	-	2.0	-	<1	-	2.1	-	-
Cribroperidinium wetzelii (LEJEUNE-CARPENTIER 1939)	-	-	-	4.8	12.6	-	6.3	5.0	-
Cyclopsiella cf. vieta DRUGG & LOEBLICH 1967	-	-	-	-	-	-	-	-	<1
Deflandrea denticulata ALBERTI 1959	<1	-	-	-	-	-	-	<1	3.4
D. aff. D. denticulata	3.6	-	-	1.0	-	-	-	-	-
D. denticulata subsp. minor (DE CONINCK 1969)	-	-	-	1.5	<1	3.7	<1	-	1.4
D. oebisfeldensis ALBERTI 1959	-	-	-	-	-	-	<1	1.3	-
Diacrocanthidium echinulatum (DEFLANDRE 1937)	-	-	-	-	-	-	-	-	<1
Dinogymnium spp. indet.	-	-	-	<1	-	-	-	-	-
Dinopterygium cf. cladoïdes DEFLANDRE 1935	-	-	-	-	<1	-	-	-	-
Diphyes colligerum (DEFLANDRE & COOKSON 1955)	3.6	3.6	11.1	2.2	<1	-	3.5	-	1.4
Exochosphaeridium phragmites DAVEY et al. 1966	-	-	1.0	-	-	-	-	-	-
Fibrocysta axialis (EISENACK 1965)	-	-	-	<1	3.9	-	3.5	1.9	1.4
F. bipolaris (COOKSON & EISENACK 1965)	-	-	-	-	-	-	<1	-	<1
Glaphyrocysta divaricata (WILLIAMS & DOWNIE 1966)	<1	9.9	-	-	<1	-	-	2.5	-
G. exuberans (DEFLANDRE & COOKSON 1955)	-	-	-	-	-	-	<1	-	<1
G. ordinata (WILLIAMS & DOWNIE 1966)	2.1	<1	-	-	-	-	-	-	-
G. cf. ordinata	2.1	2.7	-	-	-	-	-	-	-
G. pastielsi (DEFLANDRE & COOKSON 1955)	1.6	5.4	6.1	<1	-	-	-	1.3	-
G. reticulosa (GERLACH 1961)	-	-	1.0	-	-	-	-	-	-
Glyphanodinium facetum DRUGG 1964	-	-	-	<1	<1	-	-	-	-
Gonyaulacysta spp. indet.	-	-	-	-	-	-	-	-	<1
Hafniasphaera septata (COOKSON & EISENACK 1967)	-	-	-	-	4.1	1.6	2.8	<1	2.3
Horologinella incurvata COOKSON & EISENACK 1962	-	-	-	-	-	-	-	-	<1
H. aff. incurvata	-	-	-	-	<1	-	-	-	-
H. spp. indet.	-	-	-	-	-	-	-	<1	-

Depth metres below the surface	69.50	63.50	59.50	48.70	41.42	33.80	27.50	21.50	11.50
Hystrichokolpoma cinctum KLUMPP 1953	<1	-	-	-	-	-	-	-	-
H. unispinum WILLIAMS & DOWNIE 1966	-	-	-	-	<1	-	-	<1	<1
cf. Hystrichosphaeridium palmatum (WHITE 1842)	-	1.8	-	-	-	-	-	-	-
H. tubiferum (EHRENBERG 1838)	6.7	9.9	9.1	8.2	4.3	7.4	4.2	1.3	3.6
H. tubiferum subsp. brevispinosum (DAVEY & WILLIAMS 1966)	<1	-	-	-	-	-	-	-	-
Hystrichostrogylon membraniphorum AGELOPOULOS 1964	-	-	-	3.0	<1	-	<1	-	<1
Impagidinium cf. alectrolophum (SARJEANT 1966)	-	1.8	1.0	-	-	-	-	-	-
Isabelidinium cf. globosum (DAVEY 1970)	-	-	-	-	-	-	-	-	3.2
Kallosphaeridium brevibarbatum DE CONINCK 1969	-	-	-	-	<1	-	1.4	-	-
Melitasphaeridium pseudorecurvatum (MORGENROTH 1966)	2.1	<1	-	1.5	1.2	11.1	2.8	4.4	2.3
Membranosphaera sp. B zie D.C.	1.6	2.7	-	2.2	2.0	7.4	2.8	<1	<1
Microdinium ornatum COOKSON & EISENACK 1960	-	-	-	-	-	-	-	-	<1
M. reticulatum	-	-	-	<1	-	-	-	-	-
Millioudodinium? sp. indet.	-	<1	-	<1	1.6	-	1.4	1.3	-
Nematosphaeropsis reticulensis	1.6	-	-	<1	-	-	1.4	-	-
Oligosphaeridium complex (WHITE 1842)	-	-	-	<1	<1	-	1.4	-	<1
O. complex à perforatum	-	<1	-	-	-	-	-	-	-
Operculodinium centrocarpum (DEFLANDRE & COOKSON 1955)	-	-	-	<1	1.2	3.7	1.4	<1	2.3
O. microtriainum (KLUMPP 1953)	-	-	3.0	4.8	2.7	11.1	3.5	5.6	6.8
O.? sp. A	-	-	-	-	-	-	2.8	-	-
Palaeocystodinium golzowense ALBERTI 1961	-	-	1.0	<1	<1	-	<1	<1	<1
Palaeohystrichophora infusorioides DEFLANDRE 1935	<1	-	2.0	-	-	-	-	-	-
Palaeoperidinium pyrophorum (EHRENBERG 1838)	9.3	<1	-	-	-	-	-	-	-
Palaeotetradinium minusculum (ALBERTI 1961)	2.6	-	1.0	5.2	-	-	1.4	-	<1
Paralecaniella indentata (DEFLANDRE & COOKSON 1955)	5.7	<1	-	-	<1	-	-	<1	2.3
Pervosphaerid truncigerum (DEFLANDRE 1937)	7.7	-	-	-	-	-	-	-	-
Phthanoperidinium crenulatum	-	-	-	-	3.9	-	4.2	1.9	-
Polysphaeridium zoharyi (ROSSIGNOL 1962)	-	-	<1	-	-	-	-	-	-
Pterodinium cingulatum (O. WETZEL 1933)	-	-	-	<1	-	-	-	-	-
Senegalinium cf. obscura (DRUGG 1967)	11.9	-	-	3.3	-	-	-	1.3	<1
Spinidinium densispinatum STANLEY 1965	-	-	-	<1	-	-	-	-	-
S. cf. echinodea (COOKSON & EISENACK 1960)	-	-	-	<1	-	-	-	-	<1
S. macmurdoense (WILSON 1967)	-	-	-	<1	-	-	-	-	-
Spiniferites membranaceus (ROSSIGNOL 1964)	-	2.7	-	-	-	-	-	-	-
S. cf. pseudofurcatus (KLUMPP 1953)	-	<1	-	-	-	-	-	<1	-
S. ramosus (EHRENBERG 1838)	-	-	-	-	<1	-	-	-	<1
S. sp. 2	-	-	-	-	-	-	<1	-	-
S. aff. wetzelii (DEFLANDRE 1937)	<1	-	-	-	2.0	-	-	-	-
S. sp. B	-	-	-	2.2	<1	3.7	<1	-	<1
S. spp. indet.	9.3	10.8	20.2	10.4	9.1	11.1	9.7	6.9	8.6
Tanyosphaeridium cf. xanthiopyxides (O. WETZEL 1933)	-	-	1.0	-	-	-	-	-	-
T. sp. indet.	-	1.8	1.0	-	-	-	-	-	-
Thalassiphora delicata WILLIAMS & DOWNIE 1966	-	-	2.0	<1	<1	-	-	<1	-
T. spp. indet.	<1	-	-	-	-	-	-	-	-
Trichodinium castanea (DEFLANDRE 1935)	-	-	1.0	-	-	-	-	-	-
Trigonopyxidia ginella (COOKSON & EISENACK 1960)	<1	-	-	-	-	-	-	-	-
PRASINOPHYCEAE PARKE & RAYNS									
Crassosphaera aff. stellulata COOKSON & MANUM 1960	-	-	-	-	-	-	-	-	<1
C. sp. 1	-	-	-	-	<1	3.7	-	<1	<1
C. sp. 2 aff. concinna COOKSON & MANUM 1960	-	-	-	-	-	-	-	<1	<1
Cymatiosphaera cf. eupeplos (VALENSI 1948)	-	-	-	-	-	-	-	<1	-
Cymatiosphaera cf. nuda HAJOS 1966	-	-	-	-	-	-	<1	-	-
Cymatiosphaera aff. punctifera DEFLANDRE & COOKSON 1955	-	-	-	-	-	-	<1	<1	<1
Cymatiosphaera spp. indet.	-	<1	-	<1	-	-	-	-	-
Pterospermella ginginensis DEFLANDRE & COOKSON 1955	-	-	-	-	-	-	-	<1	-
Pterospermella aff. ginginensis	-	-	-	-	<1	-	-	-	-
P. spp. indet.	-	-	-	-	-	3.7	-	<1	<1
ACRITARCHA EVITT 1963									
Baltisphaeridium ligospinosum DE CONINCK 1969	1.0	3.6	4.0	2.6	<1	3.7	3.5	3.1	1.8
Comasphaeridium cometes (VALENSI 1948)	-	-	-	1.9	2.8	-	2.1	12.5	5.4
?Micrhystidium deflandrei VALENSI 1948	-	-	-	-	-	-	-	<1	-
M? oceaniae	-	2.7	1.0	<1	<1	-	1.4	1.3	2.7
M? spp. indet.	-	-	-	<1	<1	-	<1	-	-
INCERTAE SEDIS									
Ophiobolus lapidaris O. WETZEL 1933	-	1.8	2.0	8.0	-	-	<1	-	-
Incertae sedis 1 HEILMANN-CLAUSEN 1985	3.6	-	1.1	1.9	1.6	-	1.4	<1	-

ZONE 5

(sample - 11.50 m)
First appearance of *Isabelidinium* cf. *globosum* and *Microdinium ornatum*.

Comparison of the Linter boring with Overbroek, Wansin and boring KS 22.

To evaluate the regional biostratigraphic value of this informal zonation I have examined also two samples from the Tuffeau de Lincent : one from Overbroek and one from the type locality at Wansin (Table 2). Furthermore I have studied three samples of boring KS 22 at a depth between 246.38 m and 234.50 m in an interval corresponding with part of the Landen Formation and possibly an equivalent of the Tuffeau de Lincent (Table 3).

Tuffeau de Lincent at Overbroek-Gelinden and Wansin (Table 3).

The Tuffeau de Lincent is overlying the Marls of Gelinden. The dinoflagellate assemblages in the sample OVb20 from Overbroek and OW 1 from Wansin are comparable with the assemblages found in the base of the Landen Formation in the Linter boring (above - 49.00 m). *Areoligera senonensis, Gonyaulacysta wetzelii, Hystrichostrogylon membraniphorum* present in the base of zone 3, *Areoligera* sp. *A* and *Phthanoperidinium crenulatum* present at - 41.42 m, and also *Cladopyxidium saeptum* present in the upper part of zone 3, at - 33.80 m are common too in the samples of Wansin and Overbroek. The Tuffeau de Lincent in these localities can be biostratigraphically correlated with zone 3 in the Linter boring, situated in the lowermost part of the Landen Formation.

Boring KS 22 (Table 2).

In the assemblages of three samples of boring KS 22 situated between - 246.35 m and - 243.55 m we find *Achomosphaera ramulifera, Areoligera senonensis, Caligodinium amiculum, Cribroperidinium wetzelii, Hystrichostrogylon membraniphorum, Hafniasphaera septata, Phthanoperidinium crenulatum* and *Cladopyxidium saeptum*, species characterizing zone 3 in the Linter boring while *Deflandrea oebisfeldensis, Fibrocysta bipolaris, Operculodinium* sp. *A* and *Cordosphaeridium gracile*, species characterizing zone 4 in the Linter boring, are absent. This suggest a biostratigraphic correlation of the KS 22 samples with the lowermost part of the Landen Formation in the Linter boring between - 48.70 m and - 33.80 m (zone 3).

Comparison of the assemblages in the Linter boring with the dinoflagellate zonation of Paleocene deposits in the Alps of Switserland.

Jan du Chêne (1977) and Van Stuyvenberg & Jan du Chêne (1981) gave the following dinoflagellate zonation of Paleocene deposits which they have studied in the Alps of Switserland.

Ceratiopsis diebelii association

The base of the *C. diebelii* association is characterized by the absence of *Danea mutabilis* while the top is characterized by the last appearance of *C. diebelii*. This association is also defined by the abundance of Areoligeraceae. *Palaeoperidinium pyrophorum* is frequent within this association. (It was recorded as *P. basilium*, a junior synonym of *P. pyrophorum*).

Ceratiopsis striata association

In the base of this association *C. diebelii* has disappeared. *Palaeoperidinium pyrophorum* is a characteristic species of the *C. striata* association. In the upper part of the zone one notes the sporadical appearance of *Ceratiopsis speciosa* and/or *Deflandrea oebisfeldensis*.

Ceratiopsis speciosa association

The base of the *C. speciosa* association is marked by the absence of *P. pyrophorum* and the consistent occurrence of *Ceratiopsis speciosa* and/or *Deflandrea oebisfeldensis*. The transition to the following zone is marked by the sudden appearance of abundant Wetzeliellaceae.

Apectodinium homomorphum association

The base of this zone is defined by the abundance of *A. homomorphum, A. quinquelatum* and *A. hyperacanthum*.

Comparison with our informal zonation

In the informal zone 1 of Linter we encounter *Palaeoperidinium pyrophorum* (9.3 %). *Areoligera* spp. and *Ceratiopsis speciosa* (1 %) are not at all abundant while *Ceratiopsis diebelii* is absent in Linter. Therefore a correlation of the informal zone 1 with the *C. diebelii* zone is uncertain.

In the informal zone 2, *Ceratiopsis speciosa* becomes consistent and remains abundant in the rest of the sequence studied. *Palaeoperidinium pyrophorum* disappears (1 %) and *Ceratiopsis* cf. *striata* is abundant (4.5 % and 11.1 %). This indicates a possible correspondence between the *C. striata* association zone and the Linter zone-2.

The informal zones 3, 4 and 5 in the Linter boring correspond with the *C. speciosa* association zone. Indeed *C. speciosa* is abundant in the zones 3 to 5 while *P. pyrophorum* was recorded a last time in zone 2. We do not reach the *A. homomorphum* association zone because the Wetzeliellaceae do not yet appear in the samples of the Linter boring.

SYSTEMATICS

Class Dinophyceae FRITSCH 1929
Genus *Achilleodinium* EATON, 1976
? *Achilleodinium biformoides* (EISENACK, 1954)
Plate 1, Fig. 19
Hystrichosphaeridium biformoides EISENACK, 1954, p. 68, pl. 11, Fig. 16-20.
Although the position of the archeopyle is not clear in our specimens, they resemble remarkably *A. biformoides*. This species has however never been observed in Paleocene deposits. For these reasons we prefer to put a question mark before our determination.

Genus *Achomosphaera* EVITT ? 1963
Achomosphaera alcicornu (EISENACK, 1954)

Table 2 : Distribution and frequency of species in the KS 22 boring.

	PAS 5	PAS 4, 1	PAS 4, 2
CHLOROPHYCEAE KUTZING 1843			
Pediastrum sp.	-	-	<1
DINOPHYCEAE PASCHER 1931			
Achomosphaera alcicornu (EISENACK 1954)	-	-	2.3
A. ramulifera (DEFLANDRE 1937)	-	<1	<1
A. sagena DAVEY & WILLIAMS 1966	1.8	1.8	-
A. spp. indet.	-	<1	<1
Alisocysta margarita (HARLAND 1979)	1.8	5.6	6.5
Areoligera coronata (O. WETZEL 1933)	-	-	<1
A. senonensis LEJEUNE-CARPENTIER 1938	3.7	15.8	8.4
A. cf. senonensis	-	-	<1
A. sp. A	-	-	2.3
Bitectatodinium? sp. A	1.8	<1	1.7
Bosedinia laevigata (JIABO 1978)	1.8	-	-
Caligodinium amiculum DRUGG 1970	-	-	<1
Ceratiopsis diebeli (ALBERTI 1959)	-	<1	-
C. speciosa (ALBERTI 1959)	-	<1	1.5
Cladopyxidium saeptum (MORGENROTH 1968)	-	<1	-
Cometodinium cf. whitei (DEFLANDRE & COURTEVILLE 1939)	1.8	2.6	3.8
Connexímura fimbriatum (MORGENROTH 1968)	-	2.2	2.6
Cordosphaeridium fibrospinosum DAVEY & WILLIAMS 1966	-	<1	-
C. inodes (KLUMPP 1953)	1.8	1.9	4.3
Cribroperidinium wetzelii (LEJEUNE-CARPENTIER 1939)	1.8	2.2	7.5
?Cyclapoplysis monmouthensis BENSON 1976	-	-	<1
Deflandrea denticulata subsp. minor (DE CONINCK 1969)	-	1.1	<1
Deflandrea aff. D. denticulata ALBERTI 1959	-	-	<1
Deflandrea spp. indet.	-	-	<1
Diacrocanthidium echinulatum (DEFLANDRE 1937)	-	<1	<1
Diphyes colligerum (DEFLANDRE & COOKSON 1955)	1.8	3.4	2.0
Phthanoperidinium sp. A	-	-	<1
Glaphyrocysta exuberans (DEFLANDRE & COOKSON 1955)	-	-	<1
G. aff. ordinatum (WILLIAMS & DOWNIE 1966)	-	-	<1
Gonyaulacysta spp. indet.	5.3	-	1.2
Hafniasphaera septatum (COOKSON & EISENACK 1967)	1.8	1.1	3.5
?Horologinella apiculata COOKSON & EISENACK 1962	-	<1	-
Hystrichostrogylon membraniphorum AGELOUPELOS 1954	-	<1	<1
Hystrichosphaeridium tubiferum (EHRENBERG 1938)	3.5	3.7	4.6
Impagidinium sp. cf. I. patulum (WALL 1967)	-	-	<1
Isabelidinium cf. globosum (DAVEY 1970)	-	-	<1
?Kallosphaeridium yorrubayense	-	-	<1
?Lingulodinium machaerophorum (DEFLANDRE & COOKSON 1955)	-	<1	-
Melitasphaeridium pseudorecurvatum (MORGENROTH 1966)	-	1.1	3.5
M. cf. pseudorecurvatum	-	-	<1
Membranosphaera sp. B	5.3	2.2	1.7
Millioudodinium? spp. indet.	-	<1	<1
Nematosphaeropsis reticulensis (PASTIELS 1948)	-	<1	-
Oligosphaeridium complex (WHITE 1842)	-	3.0	1.5
O. sp. aff. O. complex WHITE 1842 - O. perforatum GOCHT 1959	-	-	1.5
Operculodinium centrocarpum (DEFLANDRE & COOKSON 1955)	1.8	1.1	1.5
O. sp. cf. O. centrocarpum	-	-	<1
O. microtriaina (KLUMPP 1953)	-	6.7	5.5
Palaeocystodinium golzowense ALBERTI 1961	-	2.2	1.2
Palaeohystrichophora infusiroIdes DEFLANDRE 1935	-	-	<1
Palaeotetradinium minusculum (ALBERTI 1961)	-	1.1	<1
Paralecaniella indentata (DEFLANDRE & COOKSON 1955)	1.8	-	-
Phthanoperidinium crenulatum (DE CONINCK 1969)	-	<1	<1
Phthanoperidinium sp. A	-	-	<1
Pterodinium cingulatum subsp. cingulatum (O. WETZEL 1933)	-	-	<1
Senegalinium cf. obscura (DRUGG 1967)	1.8	1.9	<1
Spinidinium echinoIdea (COOKSON & EISENACK 1960)	-	-	1.5
S. aff. echinoIdea	-	-	<1
Spiniferites sp. I	-	-	<1
S. sp. II	-	-	<1
S. sp. B DE CONINCK 1975	-	1.5	<1
S. spp. indet.	19.3	21.9	5.8
Thalassiphora delicata WILLIAMS & DOWNIE 1966	-	<1	2.9
T. inflata HEILMANN-CLAUSEN 1985	-	-	<1
Trigonopyxidia ginella (COOKSON & EISENACK 1960)	-	-	<1
PRASINOPHYCEAE PARKE & RAYNS			
Crassosphaera spp. indet.	-	-	<1
Cymatiosphaera aff. punctifera DEFLANDRE & COOKSON 1955	1.8	-	-
ACRITARCHA EVITT 1963			
Baltisphaeridium ligospinosum DE CONINCK 1969	-	<1	<1
Micrhystidium? oceaniae DE CONINCK 1969	-	<1	-
M? spp. indet.	-	<1	<1
INCERTAE SEDIS			
Ophiobolus lapidaris O. WETZEL 1933	14.0	7.4	4.3
Incertae sedis 1 HEILMANN-CLAUSEN 1985	1.8	<1	-

Table 3 : Distribution and frequency of species in WANSIN and OVERBROEK.

	WANSIN OW1	OVERBROEK OVb20
DINOPHYCEAE FRITSCH 1929		
?Achilleodinium biformoïdes (EISENACK 1959)	<1	-
Achomosphaera alcicornu (EISENACK 1954)	<1	<1
A. ramulifera (DEFLANDRE 1937)	<1	2.3
A. sagena DAVEY & WILLIAMS 1966	-	<1
A. cf. volata DRUGG 1967	<1	-
A. spp. indet.	1.5	-
Alisocysta margarita (HARLAND 1979)	2.3	4.2
Areoligera senonensis LEJEUNE-CARPENTIER 1938	17.3	60.3
A. cf. senonensis	<1	-
A. sp. A	<1	1.9
A. spp. indet.	<1	-
Ceratiopsis speciosa (ALBERTI 1959)	1.5	<1
Cladopyxidium saeptum (MORGENROTH 1968)	-	<1
Cometodinium cf. whitei (DEFLANDRE & COURTEVILLE 1939)	1.5	1
Conneximura fimbriatum (MORGENROTH 1968)	<1	1
Cordosphaeridium sp. cf. C. capillaceum SCHUMACKER-LAMBRY 1968	-	<1
C. gracile (EISENACK 1954)	-	<1
C. fibrospinosum DAVEY & WILLIAMS 1966	-	<1
C. inodes (KLUMPP 1953)	2.3	3.2
C. inodes à capillaceum	-	<1
Cribroperidinium wetzelii (LEJEUNE-CARPENTIER 1939)	-	<1
Danea mutabilis MORGENROTH 1968	1.5	-
Deflandrea spp. indet.	<1	-
Diphyes colligerum (DEFLANDRE & COOKSON 1955)	-	1.9
Elytrocysta spp. indet.	3.8	<1
Florentinia ferox (DEFLANDRE 1937)	-	<1
Glaphyrocysta divaricata (WILLIAMS & DOWNIE 1966)	-	<1
G. cf. divaricata	<1	-
G. exuberans (DEFLANDRE & COOKSON 1955)	-	<1
G. ordinata (WILLIAMS & DOWNIE 1966)	-	<1
G. cf. ordinata	-	<1
G. pastielsi (DEFLANDRE & COOKSON 1955)	-	<1
G. reticulosa (GERLACH 1961)	-	<1
Gonyaulacysta spp. indet.	<1	-
Hystrichosphaeridium tubiferum (EHRENBERG 1838)	<1	4.3
Hystrichostrogylon membraniphorum AGELOUPELOS 1954	-	<1
Millioudodinium? spp. indet.	-	<1
Nematosphaeropsis reticulensis (PASTIELS 1948)	<1	-
Oligosphaeridium complex (WHITE 1842)	3.0	3.7
O. sp. aff. O. complex WHITE 1842 - O. perforatum GOCHT 1959	-	<1
Operculodinium centrocarpum (DEFLANDRE & COOKSON 1955)	1.5	<1
O. microtriainum (KLUMPP 1953)	2.3	<1
O. uncinispinosum (DE CONINCK 1969)	<1	-
Palaeohystrichophora infusiroïdes DEFLANDRE 1935	<1	-
Palaeostomocystis reticulata DEFLANDRE 1937	<1	-
Paralecaniella indentata (DEFLANDRE & COOKSON 1955)	-	<1
Phthanoperidinium crenulatum (DE CONINCK 1975)	4.5	<1
Prolixosphaeridium xanthiopyxides (O. WETZEL 1933)	-	<1
Senegalinium cf. obscura (DRUGG 1967)	<1	-
Spiniferites membranaceus (ROSSIGNOL 1964)	3.0	-
S. ramosus (EHRENBERG 1838)	2.3	<1
S. ramosus subsp. gracilis (DAVEY & WILLIAMS 1966)	<1	-
Spiniferites sp. 2	-	<1
S. spp. indet.	25.6	5.2
Thalassiphora delicata WILLIAMS & DOWNIE 1966	-	<1
Triblastula aff. barussica (EISENACK 1954)	-	<1
ACRITARCHA EVITT 1963		
Comasphaeridium cometes (VALENSI 1948)	9.0	1.4
INCERTAE SEDIS		
Ophiobolus lapidaris O. WETZEL 1933	5.3	<1
Incertae sedis 1 HEILMANN-CLAUSEN 1985	5.3	<1

Hystrichosphaeridium alcicornu EISENACK, 1954, p. 65, pl. 10, figs. 1-2.
In general clearly defined plate boundaries are absent in the species ; this marks the difference with *S. buccina.*

Genus *Areoligera* LEJEUNE-CARPENTIER, 1938.
Areoligera sp. A
Plate 1, Figs. 7, 8.
Subspherical body ; short processes with enlarged base and a flat top arranged in solear or annular complexes.

Genus *Bitectatodinium* WILSON, 1973.
Bitectatodinium sp. A.
Plate 1, Fig. 16.
Test with circular outline. The wall is two layered. Outer layer with a lot of short hairlike processes, sometimes furcated. The specimens have a precingular archeopyle (2P).
Dimensions of the central body : 30 µm X 35 µm.
Length of the processes : 1 - 2 µm.

Genus *Ceratiopsis* VOZZHENNIKOVA, 1963.
Ceratiopsis cf. *striata* (DRUGG, 1967).
Plate 2, Figs. 7, 8.
Deflandrea striata DRUGG, 1967, p. 18, pl. 2, figs. 13-17.
C. cf. *striata* is smaller than the nominate species.
Dimensions : between 96 µm X 54 µm and 75 µm X 54 µm.

Genus *Cometodinium* DEFLANDRE & COURTEVILLE, 1939
Cometodinium cf. *whitei* (DEFLANDRE & COURTEVILLE, 1939)
Plate 1, Figs. 5, 6.
Hystrichosphaeridium whitei DEFLANDRE & COURTEVILLE, 1939
p. 103, pl. 3, figs. 5-6.
Subspherical body. Its wall is somewhat pleated at the margin. Hair-like processes with well marked implantation are densely distributed on the body. An archeopyle, possibly precingular, is visible. There are no other indications of a tabulation, nor of a cingulum. We can compare our specimen with *Impletosphaeridium whitei* in MORGENROTH 1966.
Dimensions of central body : ± 35 µm.

Genus *Cordosphaeridium* EISENACK, 1963.
Cordosphaeridium sp. cf. *C. capillaceum* SCHUMACKER-LAMBRY, 1978.
No figure.
Cordosphaeridium capillaceum SCHUMACKER-LAMBRY, 1978, p. 37-38, pl. 2, figs. 10-12.
Our specimens are much smaller than in the original description.

Genus *Cyclapophysis* BENSON, 1976.
? *Cyclapophysis monmouthensis* BENSON, 1976.
No figure.
BENSON, 1976, p. 183, pl. 1, figs. 9-12.
One specimen was encountered. No apical projection can be seen ; only the antapical projection is visible.

Genus *Deflandrea* EISENACK, 1938.
Deflandrea aff. *D. denticulata* ALBERTI, 1959.
Plate 1, Figs. 9-13.
Deflandrea denticulata ALBERTI, 1959, p. 102-103, fig. 1.
Periphragm with dark brownish surface, densely covered with short spines.
Short apical and antapical horns. The cingulum is accentuated by folds and ornamented with spines on its margin. A large intercalary archaeopyle is sometimes visible and also a subspherical inner body.

Genus *Elytrocysta* STOVER & EVITT, 1978.
Elytrocysta spp. *indet.*
Plate 1, Figs. 14-15, 17-18.
Our specimens have a subspherical body with very short, distally furcated processes densely distributed on its surface. Distally the processes give the impression to be connected. The specimens have an apical archeopyle with angular edge. Sometimes a little operculum is still attached. A cingulum is in one specimen visible as a slight depression.

Genus *Isabelidinium* LENTIN & WILLIAMS, 1977.
Isabelidinium cf. *globosum* (DAVEY, 1970).
Plate 2, Figs. 16, 17.
Deflandrea globosa DAVEY, 1970, p. 344, pl. 2, fig. 3.
The endocyst is not always visible. The horns are poorly developed. A I/3A archeopyle is visible. In most cases only endocyst-like specimens were found.
Dimensions of the body : min. 40 X 43 µm ; max. 54 X 54 µm.
6 measured specimens.

Genus *Kallosphaeridium* DE CONINCK, 1969.
? *Kallosphaeridium yorrubaense* JAN DU CHENE & ADEDIRAN, 1985.
No figure.
JAN DU CHENE & ADEDIRAN, 1985, p. 13, pl. 3, figs. 7, 14 ; pl. 5, figs. 1-12.
Folded autophragm with numerous short and slender projections. The specimen is not well preserved and the archeopyle nor operculum are visible. Nevertheless the form resembles *K. yorrubaense.*

Genus *Oligosphaeridium* DAVEY & WILLIAMS, 1966.
Oligosphaeridium sp. aff. *O. complex* (WHITE, 1842) - *O. perforatum* (GOCHT, 1959).
No figure.
Xanthidium tubiferum complex WHITE, 1842, p. 39, pl. 4, fig. 11.
Hystrichosphaeridium perforatum GOCHT, 1959, p. 68, pl. 3, fig. 7.
Some of the processes are simple or branched, open and expanded distally with aculeate or secate margin as in *O. complex.* Some other processes show distinct perforations in their distal end as in *O. perforatum.*

Genus *Operculodinium* WALL, 1967.
Operculodinium sp. A.
Plate 2, Figs. 4, 5.
Subspherical body with short subconical processes. Whether the archeopyle is precingular or not remains a question.
The length of the processes is about 4 µm.

Genus *Pervosphaeridium* YUN, 1981.
? *Pervosphaeridium truncigerum* (DEFLANDRE, 1937)
Plate 1, Fig. 1.
Hystrichosphaeridium truncigerum DEFLANDRE, 1937, p. 71-72, pl. 13, figs. 6-7.
The difference with *P. truncigerum* consists in the presence of a precingular archeopyle composed of only one plate instead of two.

Genus *Phthanoperdinium* DRUGG & LOEBICH, 1967.
Phthanoperidinium sp. A.
Plate 2, Fig. 6.
Endophragm pressed against periphragm. Intercalary archeopyle. Low apical and rounded antapical crests. The cingulum is moderately helicoïdal. The border of

the cingulum is strongly granulated. There is also a paratabulation visible, expressed by series of points.

Genus *Pterodinium* EISENACK, 1958.
Pterodinium cingulatum subst. *cingulatum* O. WETZEL, 1933.
No figure.
Cymatiosphaera cingulata O. WETZEL, 1933, p. 28, pl. 4, fig. 10.
The margin of the ridges is slightly denticulate. The ridges are well developed up to 8 µm, this is 1/5 of the diameter of the central body.

Genus *Senegalinium* JAIN & MILLEPIED, 1973.
Senegalinium cf. *obscurum* (DRUGG, 1967).
Plate 2, Figs. 10-13.
Deflandrea obscurum DRUGG, 1967, p. 17, pl. 2, figs. 8-9.
The periphragm is thin walled. Two short antapical horns are unequally developed. The apical horn has distally always a little pore. The intercalary, hexagonal archeopyle is sometimes visible. The pericoel is limited too. The cingulum is marked by low ridges.
Dimensions of body : min. 35 X 37 µm ;
max. 40 X 60 µm.

Genus *Spiniferites* MANTELL 1850.
Spiniferites sp. 1
Plate 2, Fig. 14.
The form is characterized by a short apical horn and by membranous ridges between the short processes especially in the antapical region. The apical horn is less well-developed than in *Triblastula borussica*.

Spiniferites sp. 2
Plate 2, Figs. 1-2.
The species is characterized by its membranous ledges from which protrude distally trifurcate processes.

Spiniferites sp. *in* DE CONINCK 1975, p. 332, fig. 3-E, I.
No figure.
Specimen characterized by its very long apical horn. Also noted as *Spiniferites* sp. *B* by DE CONINCK (1975) in Danian deposits at Limhamn.

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BIBLIOGRAPHY

ALBERTI, G. (1959) - Zur Kenntnis der Gattung Deflandrea EISENACK (Dinoflag.) in der Kreide und im Alttertiär Nord- und Mitteldeutschlands. *Mitt. Geol. Staatsinst. Hamburg, V. 28,* 93-105.

ALBERTI, G. (1961) - Zur Kenntnis mesozoischer und alttertiärer Dinoflagellaten und Hystrichosphaeriden von Nord- und Mitteldeutschlands. Sowie einigen anderen europäischen Gebieten. *Palaeontographica, B, 116,* 1-58.

COOKSON, I.C. & EISENACK, A. (1965) - Microplankton from the Browns Creek Clays, SW. Victoria. *Proc. Roy. Soc. Victoria, V. 79,* 119-131, pl. 11-15.

COOKSON, I.C. & EISENACK, A. (1965) - Microplankton from the Dartmoor Formation, SW. Victoria. *Proc. Roy. Soc. Victoria, V. 79,* 133-137, pl. 16-17.

COOKSON, I.C. & EISENACK, A. (1967) - Some early Tertiary microplankton and pollen grains from a deposit near Strahan, Western Tasmania. *Proc. Roy. Soc. Victoria, V. 80, part 1,* 131-140.

COOKSON, I.C. & EISENACK, A. (1967) - Some microplankton from the Paleocene rivernook bed, Victoria. *Proc. Roy. Soc. Victoria, V. 80, part 2,* 247-258.

COOKSON, I.C. & MANUM, S. (1960) - On Crassosphaera, a new genus of microfossils from Mesozoic and Tertiary deposits. *Nytt Mag. Bot., Norge, 8,* 5-9.

DE CONINCK, J. (1975) - Organic walled microfossils from the upper Danian and Middle Paleocene of Southern Sweden. *Geologiska föreningens I Stockholm förhandlingar, 97, 4,* n° 563.

DE CONINCK, J., DE DECKER, M., de HEINZELIN, J. & WILLEMS, W. (1981). L'âge des faunes d'Erquelinnes. *Bull. Soc. belge Géol., 90, 2,* 121-154.

DE CONINCK, J. & SMIT, J. (1982) - Marine organic-walled microfossils at the Cretaceous Tertiary boundary in the Barranco del Gredero (S.E. Spain). *Geol. Mijnbouw, 61,* 163-178.

DEFLANDRE, G. (1938) - Sur le microplancton des mers jurassiques, conservé à l'état de matière organique dans les marnes de Villers-sur-Mer. *C.R. Acad. Sc. Paris, 206,* 687-689.

DE GEYTER, F. (1981) - Contribution to the lithostratigraphy and the sedimentary petrology of the Landen Formation in Belgium. *Meded. K. Acad. Wet. Lett. Schone Kunsten Belg., Kl. Wet., 43,* 11-153.

DRUGG, W.S. (1967) - Palynology of the Upper Moreno Formation (Late Cretaceous-Paleocene) Escarpado Canyon, California. *Paleontographica, B, 120,* 1-71, pl. 1-9.

DRUGG, W.S. (1970) - Some new genera, species and combinations of phytoplankton form the Lower Tertiary of the Gulf Coast, U.S.A. *Proc. North. Am. Pal. Conv. Part. G,* 809-843.

GERLACH, E. (1961) - Mikrofossilien aus dem Oligozän und Miozän Nordwestdeutschlands, unter besonderer Berücksichtigung der Hystrichosphaeren und Dinoflagellaten. *Neues Jb. Geol. Paläntol., Abh., 112, 2,* 143-228.

HANSEN, J.M. (1977) - Dinoflagellate stratigraphy and echinoid distribution in Upper Maastrichtian and Danian deposits from Denmark. *Bull. geol. Soc. Denmark, 26,* 1-26.

HANSEN, J.M. (1979) - Dinoflagellate zonation around the boundary. *In :* Birkelund, T. & Bromley, R.G. (eds.) : Cretaceous-Tertiary boundary events. I. The Maastrichtian and Danian of Denmark. *University of Copenhargen,* 136-141.

HANSEN, J.M. (1979) - A new Dinoflagellate zone at the Maastrichtian/Danian boundary in Denmark. *Danm. Geol. Unders. Arbog 1978,* 131-140.

PLATE I

(Magnifications : X 500)

Figure 1 : ? Pervosphaeridium truncigerum (DEFLANDRE 1937) ;
Linter boring, 69.50 m, slide 1.

Figure 2 : ? Pervosphaeridium truncigerum (DEFLANDRE 1937) ;
Linter boring, 69.50 m, slide 1.

Figure 3 : *Connexímura fimbriatum* (MORGENROTH 1968) ;
Overbroek OVb20, slide 1.

Figure 4 : *Connexímura fimbriatum* (MORGENROTH 1968) ;
Linter boring, 63.50 m, slide 2.

Figure 5 : *Cometodinium* cf. *whitei* (DEFLANDRE & COURTEVILLE 1939) ;
Linter boring, 48.70 m, slide 1.

Figure 6 : *Cometodinium* cf. *whitei* (DEFLANDRE & COURTEVILLE 1939) ;
boring KS 22, PAS 4, 1, slide 1.

Figure 7 : *Areoligera* sp. *A.* ;
boring KS 22, PAS 4, 1, slide 1.

Figure 8 : *Areoligera* sp. *A.* ;
boring KS 22, PAS 4, 1, slide 1.

Figure 9 : *Deflandrea* aff. *D. denticulata* ALBERTI 1959 ;
Linter boring, 11.50 m, slide 1.

Figure 10 : *Delfandrea* aff. *D. denticulata* ALBERTI 1959 ;
Linter boring, 11.50 m, slide 3.

Figure 11 : *Deflandrea* aff. *D. denticulata* ALBERTI 1959 ;
Linter boring, 69.50 m, slide 1.

Figure 12 : *Deflandrea* aff. *D. denticulata* ALBERTI 1959 ;
boring KS 22, PAS 4, 1, slide 1.

Figure 13 : *Deflandrea* aff. *D. denticulata* ALBERTI 1959 ;
Linter boring, 48.70 m, slide 1.

Figure 14 : *Elytrocysta* spp. *indet.* ;
boring KS 22, PAS 4, 1, slide 1.

Figure 15 : *Elytrocysta* spp. *indet.* ;
boring KS 22, PAS 4, 1, slide 2.

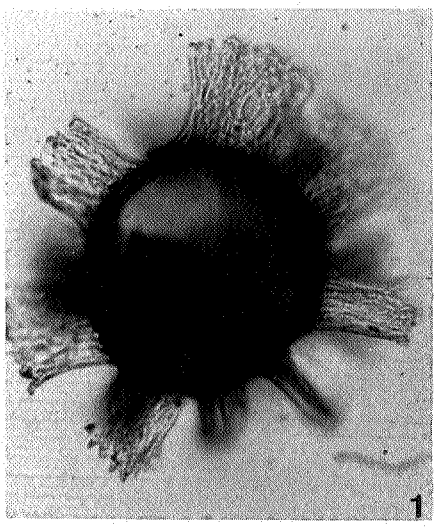
Figure 16 : *Bitectatodinium* sp. *A* ;
boring KS 22, PAS 4, 1, slide 1.

Figure 17 : *Elytrocysta* spp. *indet.* ;
Linter boring, 27.50 m, slide 1.

Figure 18 : *Elytrocysta* spp. *indet.* ;
Linter boring, 33.80 m, slide 2.

Figure 19 : ? *Achilleodinium biformoïdes* (EISENACK 1954) ;
Linter boring, 48.70 m, slide 1.

Plate 1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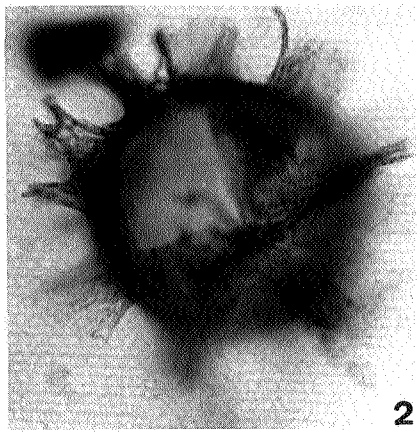
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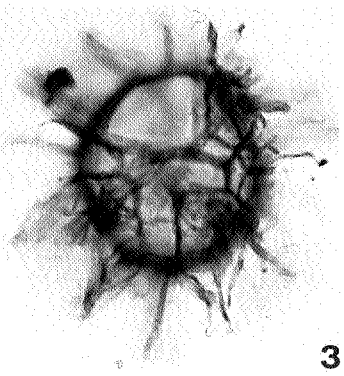
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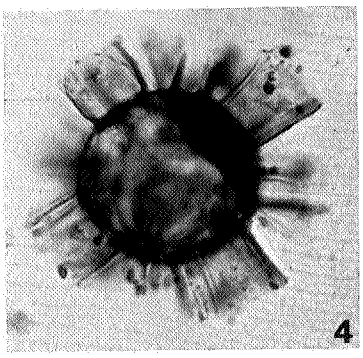
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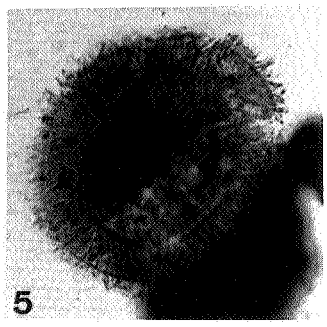
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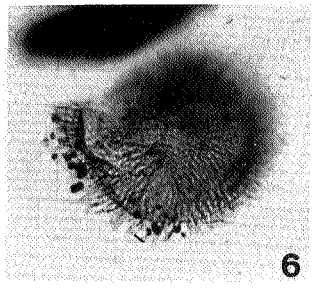
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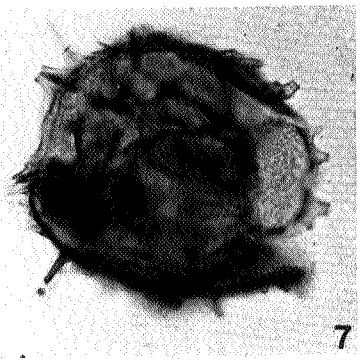
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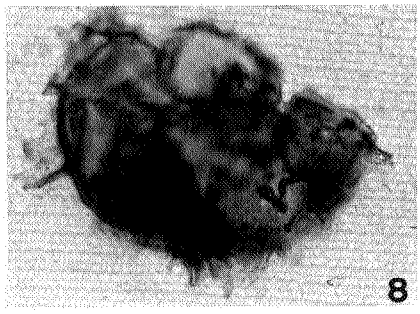
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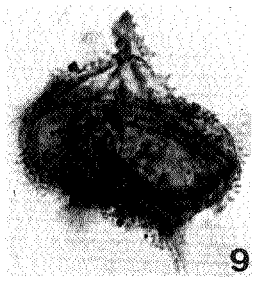
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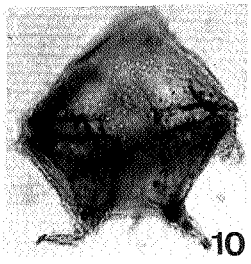
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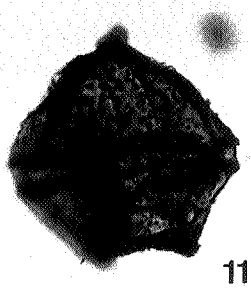
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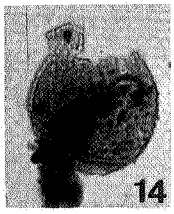
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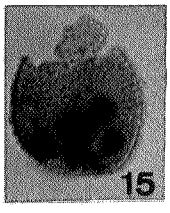
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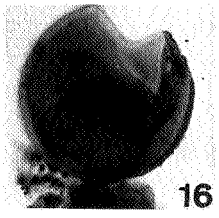
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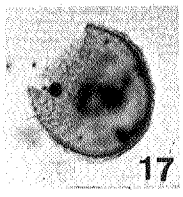
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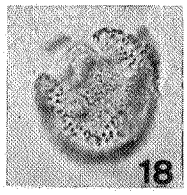
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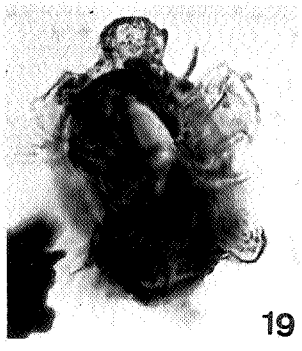
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PLATE 2

(Magnifications : X 500)

Figure 1 : *Spiniferites* sp. *2* ;
boring KS 22, PAS 4, 1, slide 2.

Figure 2 : *Spiniferites* sp. *2* ;
Overbroek OVb 20, slide 1.

Figure 3 : Incertae sedis 1 HEILMANN-CLAUSEN 1985 ;
Linter boring, 69.50 m, slide 1.

Figure 4 : *Operculodinium* ? sp. *A* ;
Linter boring, 27.50 m, slide 2.

Figure 5 : *Operculodinium* ? sp. *A* ;
Linter boring, 27.50 m, slide 2.

Figure 6 : *Phthanoperidinium* sp. *A* ;
boring KS 22, PAS 4, 1, slide 1.

Figure 7 : *Ceratiopsis* cf. *striata* (DRUGG 1967) ;
Linter boring, 63.50 m, slide 1.

Figure 8 : *Ceratiopsis* cf. *striata* (DRUGG 1967) ;
Linter boring, 63.50 m, slide 2.

Figure 9 : *Millioudodinium* ? spp. *indet.* ;
Overbroek OVb 20, slide 1.

Figure 10 : *Senegalinium* cf. *obscurum* (DRUGG 1967) ;
Linter boring, 63.50 m, slide 1.

Figure 11 : *Senegalinium* cf. *obscurum* (DRUGG 1967) ;
Linter boring, 48.70 m, slide 1.

Figure 12 : *Senegalinium* cf. *obscurum* (DRUGG 1967) ;
Linter boring, 48.70 m, slide 2.

Figure 13 : *Senegalinium* cf. *obscurum* (DRUGG 1967) ;
Linter boring, 69.50 m, slide 1.

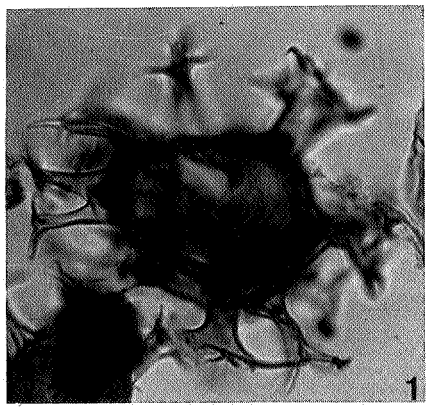
Figure 14 : *Spiniferites* sp. *1* ;
boring KS 22, PAS 4, 1, slide 1.

Figure 15 : *Ulvella nannae* HANSEN 1980 ;
Linter boring, 48.70 m, slide 1.

Figure 16 : *Isabelidinium* cf. *globosum* (DAVEY 1970) ;
Linter boring, 11.50 m, slide 1.

Figure 17 : *Isabelidinium* cf. *globosum* (DAVEY 1970) ;
Linter boring, 11.50 m, slide 2.

Plate 2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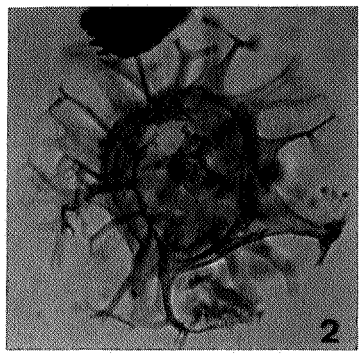
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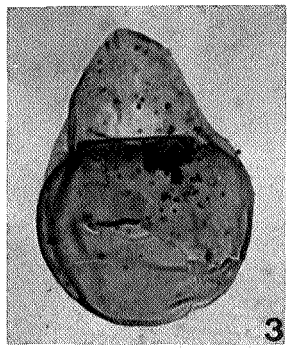
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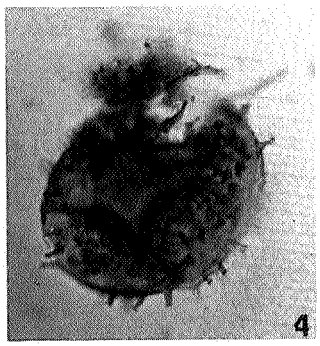
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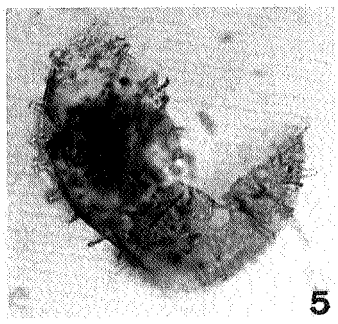
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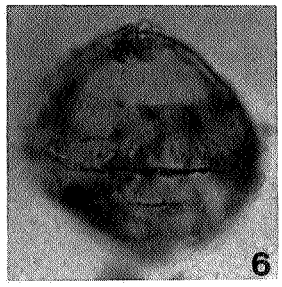
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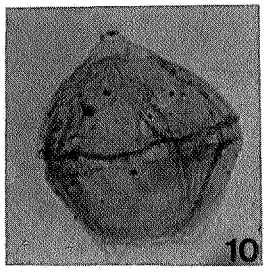
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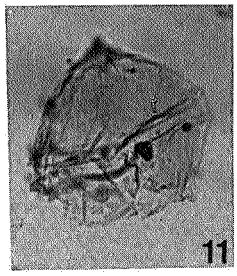
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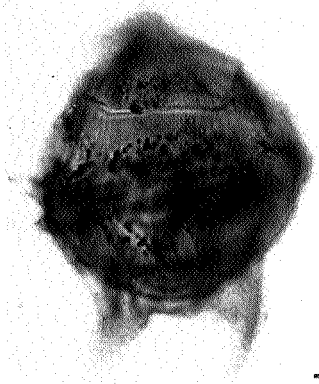
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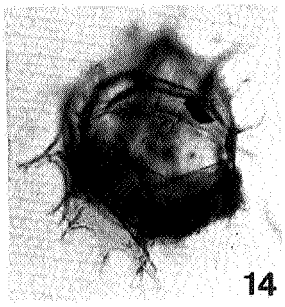
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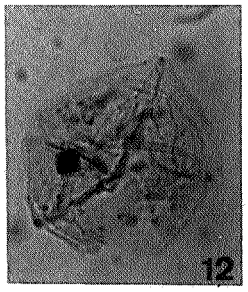
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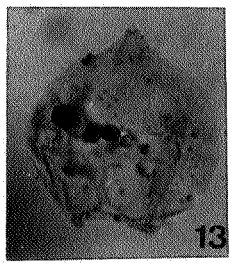
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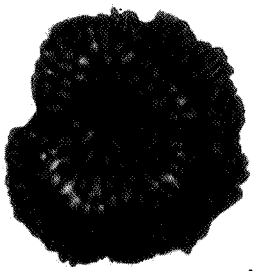
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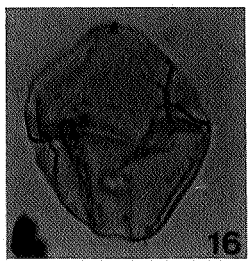
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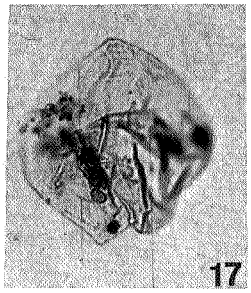
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HANSEN, J.M. (1980) - Morphological characterization of encrusting, palynomorph green algae from the Cretaceous-Tertiary of Central West Greenland and Denmark. *Grana, 19,* 67-77.

HARLAND, R. (1979) - Agerasphaera nov. gen., an 'Eisenackia"- like Dinoflagellate cyst from the Thanet sands (Paleocene) of Southeast England. *Review of Palaeobotany and Palynology, 28,* 27-35.

HARLAND, R. (1979) - The Wetzeliella (Apectodinium) homomorpha plexus from the Paleocene/earliest Eocene of Northwest Europe. *Proc. 4th Int. Palynol. Conf. Lucknow (76-77), 2,* 59-70.

HEILMANN-CLAUSEN, C. (1980) - Paleocene plastic clay from the Veyle Fjord area. *Bull. geol. Soc. Denmark, 29,* 47-52.

HEILMANN-CLAUSEN, C. (1983) - Dinoflagellate zonation and lithostratigraphy of Paleocene and Eocene sediments from Denmark. Lic. afhand., Arhus Universiteit, (not published).

HEILMANN-CLAUSEN, C. (1985) - Dinoflagellate stratigraphy of the uppermost Danian to Ypresian in the Viborg 1 borehole, central Jylland, Denmark. *Dan. Geol. undersogelse serie A, 7.*

HULTBERG, S.U. (1985) - Pithonella organica - a new calcareous dinoflagellate with an inner organic wall. *Grana 24,* 115-120.

JAN DU CHENE, R., STOVER, L. & DE CONINCK, J. (1984) - New observations on the Dinoflagellate cyst genus Kallosphaeridium DE CONINCK 1969. *Cahiers de micropaléontologie 4,* 1-18.

MOORKENS, T.L. (1982) - Foraminifera of the Montian stratotype. And of subjacent strata in the "Mons well 1969" with a review of the Belgian Paleocene Stratigraphy. *Toelicht. Verhand. Geolog. Kaart en Mijnkaart van België, II, 17,* 186 pp.

MORGENROTH, P. (1966) - Mikrofossilien und Konkretionen des nordwest-europaischen Untereozäns. *Palaeontographica, Abt. B, 49,* 1-53.

MORGENROTH, P. (1968) - Zur Kenntniss der Dinoflagellaten und Hystrichosphaeridien des Danien. *Geol. Jb., 86,* 533-578.

SCHUMACKER-LAMBRY, J. & CHATEAUNEUF, J.J. (1976) - Dinoflagellés et acritarches des marnes heersiennes de Gelinden (base du Landénien, Paléocène, Belgique). *Review of Palaeobotany and Palynology, 21 (1976),* 267-294.

SCHUMACKER-LAMBRY, J. (1978) - Palynology du Landénien inférieur (Paléocène) à Gelinden-Overbroek (Belgique). Relations entre les microfossiles et le sédiment. *Lab. Paléobot. Palynol. (éd.), Univ. Liège.*

STOVER, L.E. (1977) - Oligocene and early Miocene dinoflagellates from Atlantic corehole 5/5B, Blake Plateau. *Amer. Ass. Stratigr. Palyn., Contr. Ser. 5A,* 66-90.

THOMSON, E. & HEILMANN-CLAUSEN, C. (1985) - The Danian-Selandian boundary at Svejstrup with remarks on the biostratigraphy of the boundary in western Denmark. *Bull. geol. Soc. Denmark., 33,* 341-362, Copenhagen.

VOZZHENNIKOVA , T.F. (1967) - Introduction to the study of fossilized Peridinid Algae.

WILSON, G.J. (1967) - Some new species of lower Tertiary Dinoflagellates from the Mc Murdo sound, Antarctica. *New Zealand , Journal of Botany, 5, 1,* 57-83.