MARINE ORGANIC-WALLED MICROFOSSILS AT THE CRETACEOUS TERTIARY BOUNDARY IN THE BARRANCO DEL GREDERO (S.E. SPAIN)[1]

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ABSTRACT

De Coninck, J. & J. Smit 1982 Marine organic-walled microfossils at the Cretaceous-Tertiary boundary in the Barranco del Gredero (S.E. Spain) – Geol. Mijnbouw 61: 173-178.

Assemblages of marine organic-walled microfossils have been studied in four samples (SM 75 -502, -504, -505, and -506) that represent the Maastrichtian-Danian boundary layers in the Barranco del Gredero (S.E. Spain). No sharp changes can be seen in their composition and the marine organic-walled microfossils give no indication here at which level the Cretaceous-Paleocene boundary has to be placed.

INTRODUCTION

In the Barranco del Gredero near Cavaca in S.E. Spain there is a complete section in a pelagic facies across the Cretaceous-Tertiary boundary. The extinction of Cretaceous planktonic foraminifera and the renewal of the planktonic foraminiferal faunas by Globigerinids has been described by SMIT (1977, 1979). In this report the marine organic-walled microfossils in selected samples from this section are examined in order to see if a similar extinction event occurs here.

MATERIAL STUDIED (Plates 1 and 2)

Four samples were studied: sample Sm 75-502, which represents the top of the *Abathomphalus mayaroensis* Zone, and samples 75-504, -505 and -506, which were taken in the boundary marl, representing the period when the main mass of Cretaceous planktonic foraminifera were already extinct, but the new *Globigerina eugubina* assemblage had not yet developed. Other samples from Upper Maastrictian and lowermost Paleocene yielded only very poorly preserved marine organic-walled microfossil assemblages.

These assemblages contain 56 species of Dinophyceae, 2 species of Prasinophyceae and 2 species of Incertae Sedis. No Acritarchae have been found. The distribution of the species is given in Table I.

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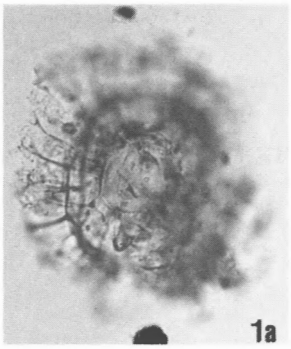
CHARACTERISTICS OF THE ASSEMBLAGES

The inspection of Table I shows that the samples Sm 75-502 and -504 are not as rich as Sm 75-505 and -506. All four samples yield some stratigraphically significant dinoflagellate cysts or some species related to significant cysts (Table II). One species, *Adnatosphaeridium appenninicum,* is so far only recorded in Upper Cretaceous sediments. Our *A.* aff. *appenninicum* is very similar to the species described by CORRADINI (1972, p. 163) and has been found in the two upper samples in the Barranco del Gredero section: Sm 75-505 and -506. Two species which until now seemed restricted to the Paleocene have also been found in Sm 75-506: *Danea mutabilis* (one specimen) and some specimens closely related to *Renidinium vitilare.* From the (known) biostratigraphic zonation on planktonic foraminifera (SMIT 1977, figure 4) it appears that sample Sm 75-506 is situated in the 'intermediate' zone between the *A. mayaroensis* zone and the *G. eugubina* zone. The assemblage of marine organic walled microfossils in this sample, in which *A.* aff. *appenninicum* may represent an 'Upper Cretaceous' species and *D. mutabilis* and *R. vitilare?* two 'Paleocene' species, shows intermediate characteristics between Upper Cretaceous and Lower Paleocene assemblages.

The assemblages in samples Sm 75-502, -504 and -505 are also neither of typical Upper Cretaceous nor of typical Paleocene composition. Indeed, significant species (Table II) encountered in these samples have been found in Upper Cretaceous as well as in the Paleocene, except perhaps for *Cribroperidinium* aff. *pyra,* whose biostratigraphic value has not yet been fully evaluated. DRUGG (1967, p. 15) described this species from the Maastrichtian-Danian transition beds and Danian deposits of California.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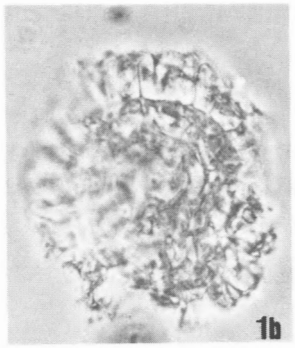
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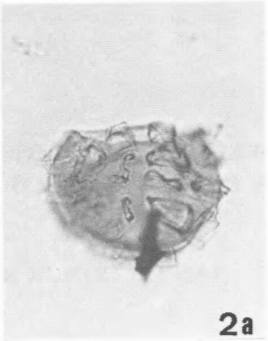
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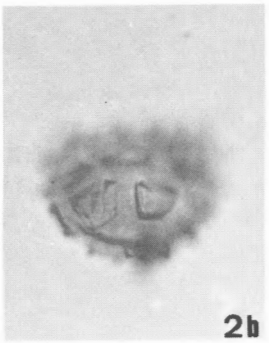
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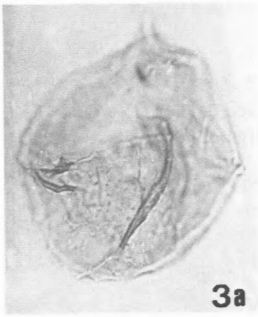
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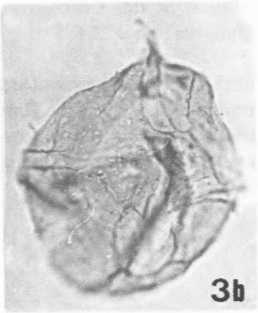
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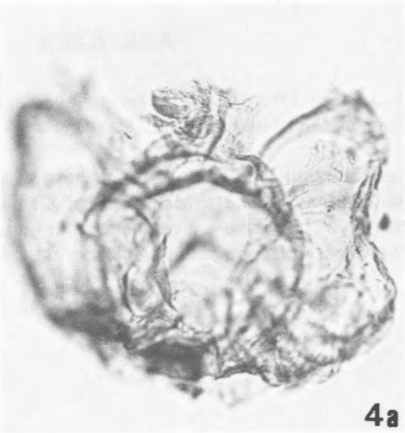
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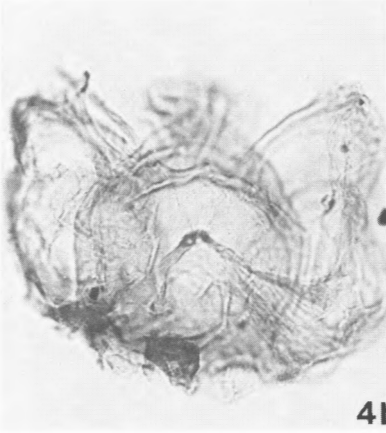
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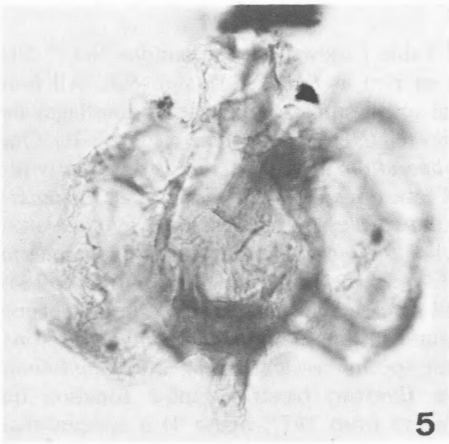
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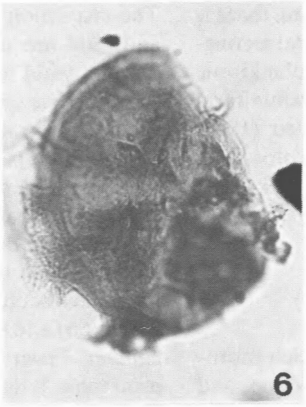
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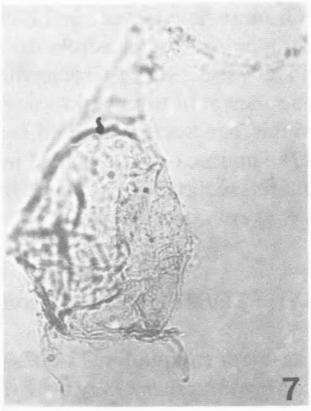
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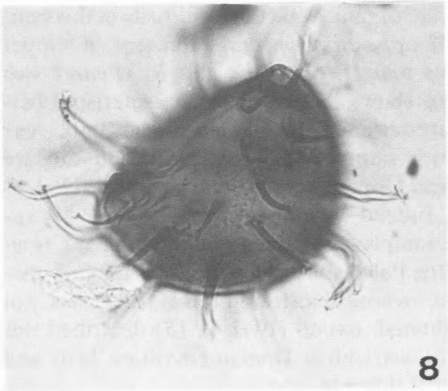
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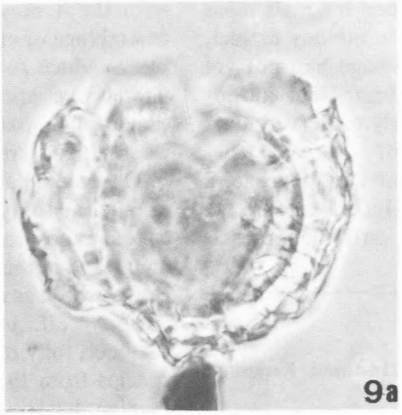
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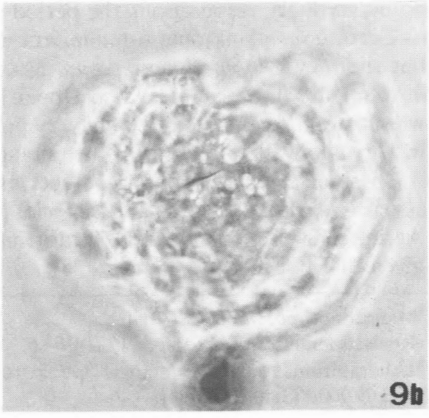
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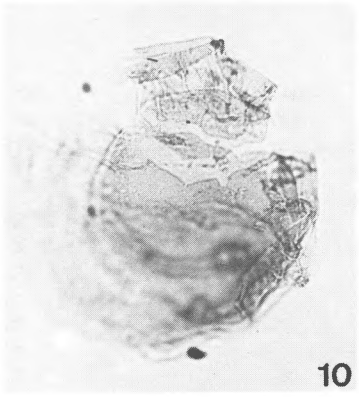
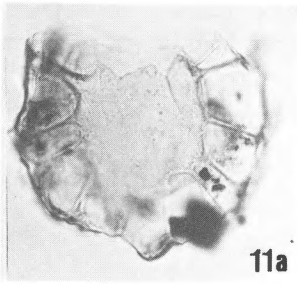
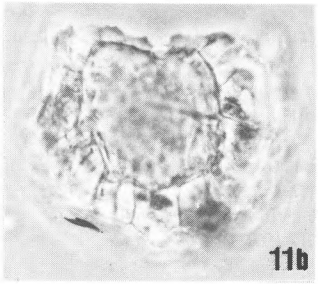
TABLE I
BARRANCO DEL GREDERO

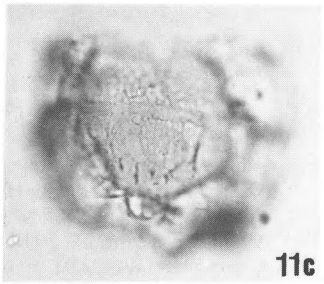
Samples SM 75	-502	-504	-505	-506
Number of species	17	17	27	44
Dinophyceae				
Achomosphaera regiensis CORRADINI 1972	X	X	X	X
A. spp. indet	X	X	X	X
Adnatosphaeridium aff. apenninicum CORRADINI 1972			X	X
Alisocysta circumtabulata (DRUGG 1967)			X	
Apteodinium ? sp. EISENACK 1958				X
Areoligera ? cassicula ? DRUGG 1970				X
A. coronata (WETZEL 1933)		X		X
A. senonensis LEJEUNE-CARPENTIER 1938				?
A. tenuicapilata (WETZEL 1933)	?	X		
Cordosphaeridium fibrospinosum DAVEY & WILLIAMS 1966	X			X
C. inodes (KLUMPP 1953)			X	X
'C.' microtriaina (KLUMPP 1953)	X	X	X	X
cf. 'C.' microtriaina subsp. centrocarum (DEFLANDRE & COOKSON 1955)	X			X
'C.' sp. cf. C. major in CORRADINI 1972			X	
Criboperidinium exilicristatum ? (DAVEY 1969)		X		X
C. aff. pyra (DRUGG 1967)	X	X	X	X
C. sp. indet.				X
Cyclapophysis lemniscata (CORRADINI 1972)		X	X	X
Danea mutabilis MORGENROTH 1968				X
Deflandrea alberti CORRADINI 1972	X			
D. diebelii ALBERTI 1959			X	X
D. aff. speciosa ALBERTI 1959	X		X	
D. warrenii SCHUMACKER-LAMBRY 1978			X	
D. sp. A in BENSON 1976				X
Diphyes colligerum (DEFLANDRE & COOKSON 1955)	?		X	X
Exosphaeridium scitulum SINGH 1971				X
Fibrocysta bipolaris (COOKSON & EISENACK 1965)			?	?
F. klumppiae ? (CORRADINI 1972)			X	X
Florentinia sp. DAVEY & VERDIER 1973		X		
Glaphyrocysta divaricata (WILLIAMS & DOWNIE 1966)			X	X
G. sp. cf. Cyclonephelium castelcasiense CORRADINI 1972	X	X	X	X
Hystrichodinium aff. furcatum ALBERTI 1961			X	
Hystrichosphaeridium tubiferum (EHRENBERG 1838)	X	X	X	X
H. tubiferum brevispinum DAVEY & WILLIAMS 1966			X	
H. tubiferum bulbosa (EHRENBERG 1838)			?	?
H. tubiferum mantellii DAVEY & WILLIAMS 1966				X
H. aff. tubiferum (EHRENBERG 1838)				X
H. sp. cf. Oligosphaeridium anthophorum (COOKSON & EISENACK 1958)			X	
Hystrichostrogylon sp. A.			X	X
Impagidinium cf. paradoxum (WALL 1967)		X		
I. ? sp. 1	X			
I. ? sp. 2	X			X
Odontochitinopsis ? sp. A in DE CONINCK 1976				X
Palaeocystodinium australinum (COOKSON 1965)	X		X	X
Palynodinium grallator GOCHT 1970				X
Pareodinia ? sp. DEFLANDRE 1947				X
Phelodinium pentagonalis ? (CORRADINI 1972)				X
P. tricuspis (WETZEL 1933)				X

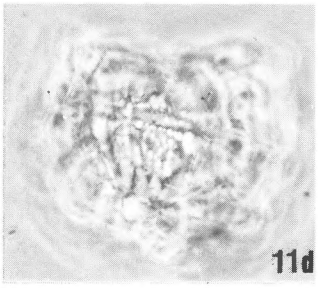
Plate 1 (facing page)
1a-b: Adnatosphaeridium aff. apenninicum CORRADINI 1972 (X 500). SM 75-505
2a-b: Alisocysta circumtabulata (DRUGG 1967) (X 500). SM 75-505
3a-b: Criboperidinium aff. pyra (DRUGG 1967) (X 500). SM 75-505
4a-b: Cyclapophysis lemniscata (CORRADINI 1972) (X 500). SM 75-506
5: Cyclapophysis lemniscata (CORRADINI 1972) (X 500). SM 75-506
6: Danea mutabilis MORGENROTH 1968 (X 500). SM 75-506
7: Deflandrea warrenii SCHUMACKER-LAMBRY 1978 (X 500). SM 75-505
8: Fibrocysta klumppiae ? (CORRADINI 1972) (X 500). SM 75-505
9a-b: Glaphyrocysta sp. cf. Cyclonephelium castelcasiense CORRADINI 1972 (X 500). SM 75-506

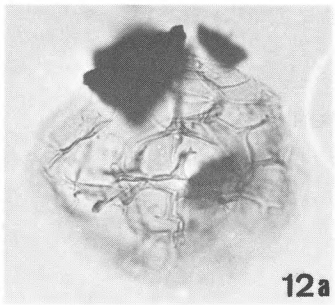


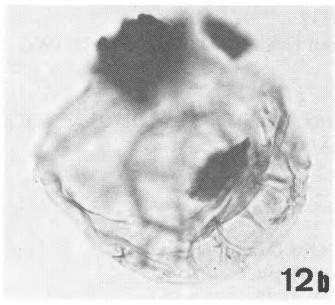


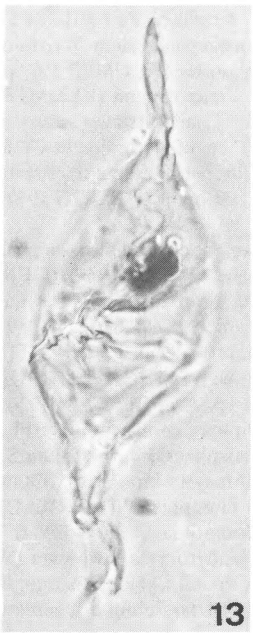


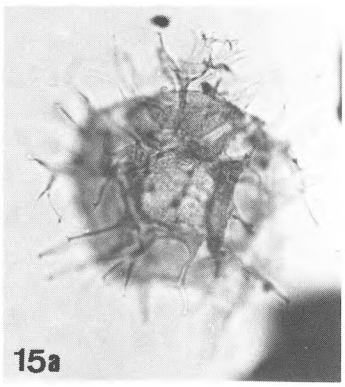


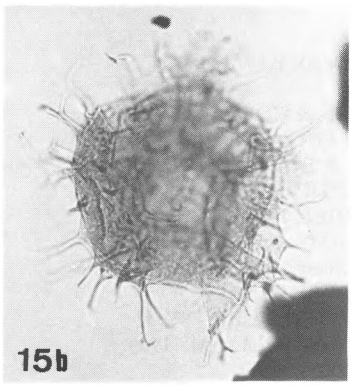


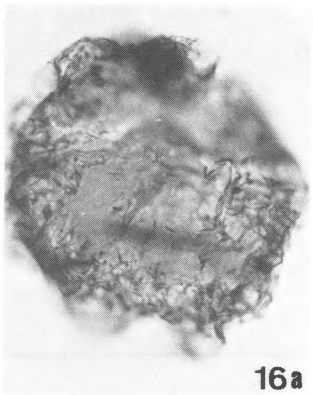












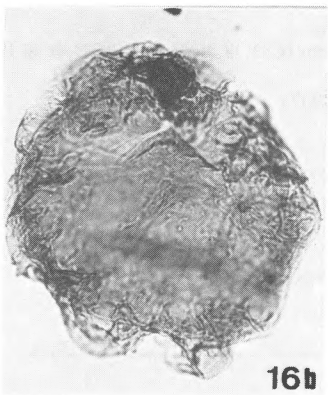


Plate 2

10: Glaphyrocysta sp. cf. Cyclonephelium castelcasiense CORRADINI 1972 (X 500). SM 75-506
11a-d: Glaphyrocysta sp. cf. Cyclonephelium castelcasiense CORRADINI 1972 (X 500). SM 75-506
12a-b: Hystrichostrogylon sp. A. (X 500). SM 75-505
13: Palaeocystodinium australinum (COOKSON 1965) (X 500). SM 75-505
14: Palaeocystodinium australinum (COOKSON 1965) (X 500). SM 75-506
15a-b: Palynodinium grallator GOCHT 1970 (X 500). SM 75-506
16a-b: Renidinium vitilare ? (COOKSON 1965) (X 500). SM 75-506

TABLE I (continued)
BARRANCO DEL GREDERO

	Samples SM 75	-502	-504	-505	-506
	Number of species	17	17	27	44
Dinophyceae					
Renidinium vitilare ? (COOKSON 1965)					X
Senoniasphaera inornata (DRUGG 1970)			X		
Silicisphaera ferox (DEFLANDRE 1937)			X		X
Spiniferites ? cingulatus (WETZEL 1933)		X	X		
S. spp. indet		X	X	X	X
Tanyosphaeridium xanthiopyxides (WETZEL 1933)				X	X
? Thalassiphora delicata WILLIAMS & DOWNIE 1966				X	
Trithyrodinium sp. DRUGG 1967			X		
Prasinophyceae					
Cymatiosphaera aff. asarota DAVEY 1970					X
Tasmanites ? sp. NEWTON 1875					X
Incertae Sedis					
Epicephalopyxis indentata DEFLANDRE & COOKSON 1955					X
Genus and species indet.					X

TABLE II

Significant species and their stratigraphic distribution around the Cretaceous / Paleocene boundary.

	Senonian	Maastrichtian	Danian	Landenian	
Adnatosphaeridium aff. apenninicum	X	X	–	–	Fig. 1a-b.
Alisocysta circumtabulata	–	X	X	X	Fig. 2a-b.
Criboperidinium aff. pyra	–	?	X	–	Fig. 3a-b.
Cyclapophysis lemniscata	–	X	X	–	Figs. 4a-b, 5.
Danea mutabilis	–	–	X	–	Fig. 6.
Deflandrei diebelii	–	X	X	X	no. fig.
Deflandrea warrenii	–	X	X	X	Fig. 7
Deflandrea sp. A	–	X	–	X	no fig.
Fibrocysta klumppiae	–	?-X-?		–	Fig. 8
Glaphyrocysta sp. cf. Cyclonephelium castelcasiense	–	?	X	?	Figs. 9a-b, 10, 11a-d.
Hystrichostrogylon sp. A	–	X	X	–	Fig. 12a-b.
Palaeocystodinium australinum	–	X	X	X	Figs. 13, 14.
Palynodinium grallator	X	?-X-?		–	Fig. 15a-b.
Renidinium vitilare ?	–	–	–	X	Fig. 16a-b.
Senoniasphaera inornata	–	X	X	?	no fig.

CONCLUSION

Samples SM 75-504, -505 and -506 are from the boundary marl. Their assemblages become richer from level -504 to -506 but are markedly different from that in sample SM 75-502. Although rather poor assemblages of marine organic walled microfossils in the uppermost Maastrichtian and lowermost Paleocene marls prevent any firm conclusion, it may tentatively be concluded that the marine organic walled microfossils do not show a terminal Cretaceous mass-extinction compatible with the one observed in planktonic foraminifera. Studies by MC LEAN (1980) and HANSEN (1979) also showed that dinoflagellate cyst assemblages do not change markedly across the Cretaceous-Tertiary boundary.

Investigations by SMIT & HERTOGEN (1980), ALVAREZ ET AL. (1980), EMILIANI (1980) and GANAPATHY (1980) on the Cretaceous-Tertiary boundary event present some data which lead these authors to the assumption that there might have been an impact on Earth of a large meteorite. This may have diminished the intensity of sunlight for a couple of years (ALVAREZ ET AL. 1980), or may have caused a sudden 'heat flash' (EMILIANI 1980), HSU (1980) favours a comet impact and assumes that comet ice will include chemicals toxic to phytoplankton. But whatever the cause of the extinction of planktonic foraminifera, it apparently did not affect the dinoflagellates.

REFERENCES

Alberti, G. 1959 Zur Kenntniss der Gattung *Deflandrea* Eisenack (Dinoflag.) in der Kreide und im Alttertiär Nord- und Mitteldeutschlands – Mitteulungen Geol. Staatsinst. Hamburg 28: 93-105.

—— 1961 Zur Kenntnis mesozoischer und alttertiärer Dinoflagellaten und Hystrichosphaerideen von Nord- und Mitteldeutschlands sowie einige anderen europaischen Gebieten – Palaeontographica 116A: 58 pp.

Alvarez, L. W., W. Alvarez, F. Asaro & Michel 1980 Extraterrestrial cause for the Cretaceous-Tertiary extinction – Science 208: 1095-1108.

Benson, D. G. jr. 1976 Dinoflagellate taxonomy and biostratigraphy at the Cretaceous-Tertiary boundary, Round Bay, Maryland – Tulane Stud. Geol. Paleont. 12: 169-233.

Cookson, I. C. 1965 Microplankton from the Paleocene Pebble Point Formation, South-Western Victoria – Proc. Roy. Soc. Vict. N.S. 78: 137-141.

Cookson, I. & A. Eisenack 1958 Mikroplankton from Australian and New Guinea Upper-Mesozoic sediments – Proc. Roy. Soc. Vict. N.S. 70: 19-79.

—— 1965 Microplankton from the Dartmoor Formation, SW. Victoria – Proc. Roy. Soc. Vict. N.S. 79: 133-137.

Corradini, D. 1972 Non-calcareous microplankton from the Upper Cretaceous of the Northern Appennines – Bull. Soc. Paleont. Ital. 11: 119-197.

Davey, R. 1969 Non calcareous microplankton from the Cenomanian of England, Northern France and North America – Bull. Br. Mus. Nat. Hist. Geol. 17: 107-180.

—— 1970 Non calcareous microplankton from the Cenomanian of England, Northern France and North America – Bull. Br. Mus. Nat. Hist. Geol. 18: 333-397.

Davey, R. & G. L. Williams 1966 The genus *Hystrichosphaeridium* and its allies. In: R. Davey, C. Downie, W. A. S. Sarjeant & G. L. Williams (eds): Studies on Mesozoic and Cainozoic dinoflagellate cysts – Bull. Br. Mus. Nat. Hist. Geol. Suppl. 3: 28-52.

Davey, R. & J. P. Verdier 1973 An investigation of microplankton assemblages from latest Albian (Vraconian) sediments – Rev. Esp. Micropal. 5: 173-212.

De Coninck, J. 1975 Organic walled microfossils from the Upper Danian and Middle Paleocene of southern Sweden – G. F. F. 97: 326-337.

—— 1976 Microfossiles à paroi organique de l'Yprésien du Bassin Belge – Serv. Geol. Belg. Prof. Paper 12 (1975): 151 p.

Deflandre, G. 1937 Microfossiles des silex crétacés. Deuxième partie. Flagellés incertae sedis Hystrichosphaeridés-Sarcodinés Organismes divers – Annal. Paleont 26: 51-103.

—— 1947 Sur quelques microorganismes planctoniques des silex Jurassiques – Bull. Inst. Océan. Monaco 921: 1-10.

Deflandre, G. & I. Cookson 1955 Fossil microplankton from Australian Late Mesozoic and Tertiary sediments – Austr. J. Mar. Freshw. Res. 6: 242-313.

Drugg, W. S. 1967 Palynology of the Upper Moreno Formation (Late Cretaceous-Paleocene). Escarpado Canyon, California – Palaeontogr. 120 B: 1-71.

—— 1970 Some new genera, species and combinations of phytoplankton from the Lower Tertiary of the Gulf Coast, U.S.A. – Proc. North Amer. Paleont. Conv. Chicago Part G: 809-843.

Eisenack, A. 1958 Mikroplankton aus dem norddeutschen Apt – N. Jb. Geol. Pal. Abh. 106: 383-422.

Emiliani, C. 1980 Death and renovation at the end of the Mesozoic – EOS 61: 505-506.

Ganapathy, R. A. 1980 A major meteorite impact on the Earth 65 million years ago; evidence from the Cretaceous-Tertiary boundary clay – Science 209: 921-923.

Gocht, H. 1970 Dinoflagellaten-Zysten aus einem Geschiebe Feuerstein und ihr Erhaltungszustand – N. Jb. Geol. Palaeont. Monatsh. 3: 129-140.

Hansen, J. M. 1979 Dinoflagellate zonation around the boundary. In: Birkelund & Bromley (eds): Cretaceous-Tertiary boundary events (Symposium) Proc. I. The Maastrichtian and Danian of Denmark – Univ. Copenhagen: 136-143.

Hsü, K. J. 1980 Terrestrial catastrophe caused by cometary impact at the end of the Cretaceous – Nature 285: 201-203.

Klumpp, B. 1953 Beitrag zur Kenntnis der Mikrofossilien des mittleren und oberen Eozän – Palaeontogr. 103 A: 377-406.

Lejeune-Carpentier, M. 1938 L'étude microscopique des silex. *Aeroligera:* nouveau genre d'Hystrichosphaeridée (Sixième note) – Ann. Soc. Géol. Belg. 62: B163-B174.

McLean, D. 1980 Terminal Cretaceous catastrophe – Nature 287: 760.

Morgenroth, P. 1968 Zur Kenntniss der Dinoflagellaten und Hystrichosphaeridien des Danien – Geol. Jb. 86: 533-578.

Newton, E. T. 1875 On 'Tasmanite' and Australian 'White Coal' – Geol. Mag. Ser. 2: 337-342.

Schumacker-Lambry, J. 1978 Palynologie du Landenien inférieur (Paléocène) à Gelinden-Overbroek/Belgique. Relations entre les microfossiles et le sediment – Lab. Paléobot. Univ. Liège: 8-157.

Singh, C. 1971 Lower Cretaceous microfloras of the Peace River area, north-western Alberta – Bull. Res. Council Alb. 28: 301-542.

Smit, J. 1977 Discovery of a planktonic foraminiferal association between the *Abathomphalus mayaroensis* zone and the *'Globigerina' eugubina* zone at the Cretaceous/Tertiary boundary in the Barranco del Gredero (Caravaca, S.E. Spain); a preliminary report I – Proc. Kon. Ned. Akad. Wet. Amsterdam, B 80: 280-301.

—— 1979 The Cretaceous-Tertiary transition in the Barranco del Gredero, Spain. In: Birkelund & Bromley (eds): Cretaceous-Tertiary Boundary Events (Symposium) Proc. – Univ. Copenhagen: 156-163.

Smit, J. & J. Hertogen 1980 An extraterrestrial event at the Cretaceous-Tertiary boundary – Nature 285: 198-200.

Wall, D. 1967 Fossil microplankton in deep-sea cores from the Caribbean Sea – Palaeontol. 10: 95-123.

Wetzel, O. 1933 Die in organischer Substanz erhaltenen Mikrofossilien des baltischen Kreidefeuersteines – Palaeontogr. 77 and 78 A: 110 pp.

Williams, G. L. & C. Downie 1966 Further dinoflagellate cysts from the London Clay. In: R. Davey, C. Downie, W. A. S. Sarjeant, G. L. Williams (eds): Studies on Mesozoic and Cainozoic dinoflagellate cysts – Bull. Br. Mus. Nat. Hist. Geol. Suppl. 3: 215-235