MICROPLANKTON FROM THE AMPTHILL CLAY OF MELTON, SOUTH YORKSHIRE

by W. A. S. SARJEANT

ABSTRACT. Assemblages of organic-shelled microplankton from the Ampthill Clay (Upper Jurassic) of South Yorkshire are described. They comprise twenty-one species of dinoflagellates, of which two are new; twenty-seven species of hystrichospheres, of which three are new; and four species of presumed microplankton *incertae sedis*. From comparison with microplankton assemblages previously described, a stratigraphic position is tentatively assigned to the horizons studied.

THE assemblages of fossil microplankton to be described are from four horizons within the argillaceous facies of the Oxfordian ('Ampthill Clay') exposed in the clay pit of Messrs. G. and T. Earle, Ltd., at Melton, near Kingston-upon-Hull (grid reference S.E. 971268). A first visit was made to this pit during a meeting of the Yorkshire Geological Society on 13 February 1960, and a second visit in the following July, the pit having been considerably deepened between visits. At the time of the second visit, some 62 feet of grey clay were exposed below the unconformable capping of orange sands and Red Chalk (text-fig. 1). Four specimens collected were examined for microplankton, respectively from 61 ft. 7 in., 45 ft. approx., 25 ft., and 10 ft. below the overlying Cretaceous beds (henceforth referred to as the '62-foot', '45-foot', '25-foot', and '10-foot' horizons).

The samples consisted of light-grey clay with yellowish flecks. Each was crushed mechanically and treated successively with hydrochloric and hydrofluoric acids: the resultant organic residue was partially oxidized with Schulze solution and washed with potassium hydroxide solution, thus further concentrating the microfossil content. The product was mounted for study in glycerine jelly.

The proportion of microfossils present proved high at all horizons, their state of preservation being generally excellent. Spores and pollen are present in abundance: at the 62-foot horizon they comprise only 40 per cent., at the 25-foot and 10-foot horizons around 50 per cent., and at the 45-foot horizon fully 70 per cent. of the total microfossil assemblage. Microplankton (dinoflagellates, hystrichospheres, and genera of presumed microplankton) form the remainder of the assemblage, foraminiferal shell linings being also present but only in extremely low numbers.

DISCUSSION OF THE ASSEMBLAGES

The relative proportions of the major microplankton groups are shown in Table 1, and especially noteworthy are the abundance of micrhystridia at the 25-foot horizon and the abundance of leiospheres at this and at the 45-foot horizons. In the assemblages as a whole, dinoflagellates form 42·5 per cent., hystrichospheres 53·4 per cent., and genera *incertae sedis* 4·1 per cent.; the dinoflagellates are numerically dominant only in the uppermost (10-foot) horizon. Twenty-one species of dinoflagellates, twenty-seven species of hystrichospheres, and four species *incertae sedis* were recognized; several

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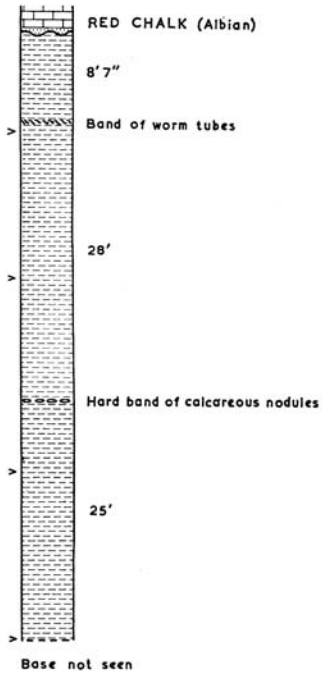


TEXT-FIG. 1. Section through the Ampthill Clay of Messrs. G. & T. Earle's clay pit at Melton, near Hull. The horizons from which assemblages were examined are indicated by arrows.

HORIZONS	% Dinoflagellates	% Hystrichospheres				Microplankton Incertae Sedis
		Larger Forms	Micrhystridia	Leiospheres	Total	
10 — Foot	53·0	25·4	16·2	1·4	43·0	4·0
25 — Foot	39·2	3·6	38·4	13·8	55·8	5·0
45 — Foot	40·8	19·6	10·0	25·6	55·2	4·0
62 — Foot	37·2	37·6	13·8	8·0	59·4	3·4

TABLE 1. The relative proportions of the groups of microplankton in the Melton assemblages.

other species of dinoflagellates are certainly present, each represented by a few poor specimens not suitable for full description. A list of species, with their numerical distribution by horizon, is given in Table 2.

In this section, only new species, or species about which additional information was forthcoming, are dealt with. All holotypes of species described are to be lodged in the Laboratory of Sedimentology, University of Reading.

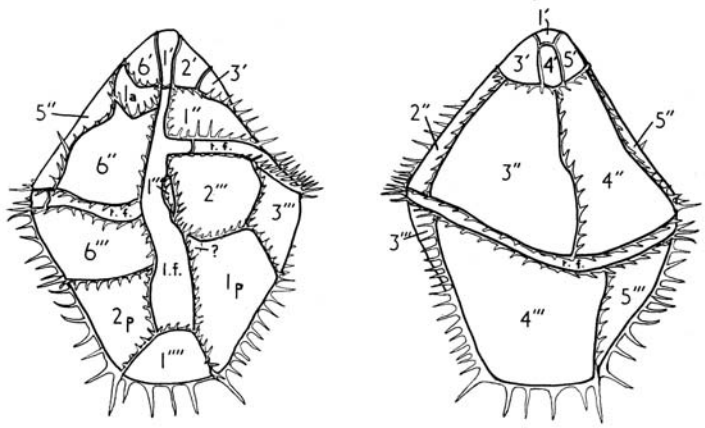
Class DINOPHYCEAE
Order PERIDINIALES
Family GONYAULACIDAE Lindemann
Genus GONYAULAX Diesing

Gonyaulax nealei sp. nov.

Plate 69, fig. 1; text-fig. 2

Holotype. M134/3/172, 62-foot horizon of Ampthill Clay, Melton. *Dimensions of Type.* Overall: length 69 μ, breadth 61 μ. Without spines: length 64 μ, breadth 50 μ. Spines up to 5 μ in length. Other specimens too damaged for satisfactory measurement.

Diagnosis. A species of fossil *Gonyaulax* with epitheca conical, rounded at the apex, and hypotheca in the form of a truncated cone. Tabulation 6′, la, 6″, 6‴, 2p, 1⁗: plate 1‴ reduced and elongate. Sutures in the form of low ridges generally bearing simple spines of varying length and quite wide separation: the apical sutures, however, lack spines.



TEXT-FIG. 2. *Gonyaulax nealei* sp. nov. Holotype (M134/3/172), ×900. Left: in ventral view. Right: in dorsal view. *t.f.*, transverse furrow. *l.f.*, longitudinal furrow.

Description. Theca pale yellowish in colour, thin walled and without granulation. There is no apical horn: the six apical plates differ from those of the rest of the theca in that

the sutures between them lack spines, whereas the sutures separating them from the other epithecal plates are spinose. One anterior intercalary plate and six pre-equatorial plates are present: plates 1″ and 6″ are somewhat reduced.

The transverse furrow is of moderate breadth and extends round the theca in a laevo-rotatory spiral such that its two ends differ in antero-posterior position by twice the width of the furrow. The longitudinal furrow is narrow in its epithecal portion but broadens as it approaches the antapex. Of the six post-equatorial plates, plate 1‴ is very reduced and not readily seen, and plates 2‴ and 6‴ are also somewhat reduced. Two large posterior intercalary plates are certainly present: a third (marked '?') may also be present in the angle formed by plate 1p against plate 2‴ and the longitudinal furrow, but this could not be confirmed. The antapical plate is large and polygonal in shape.

The species is named after Dr. J. W. Neale of the Geology Department, University of Hull.

Remarks. Of the six specimens seen, only the holotype is well enough preserved to be capable of full study. In shape, tabulation, and ornamentation of crests, *Gonyaulax nealei* differs from all described fossil species. Those most closely comparable are *Gonyaulax cornigera* Valensi 1953, from the Bathonian of France, and *G. serrata* Cookson and Eisenack 1958, from Upper Jurassic to ?Neocomian of Western Australia. In neither of these species is the tabulation fully known: the former is distinguished by its longer and sometimes bifurcate sutural spines, the latter by the possession of grouped bifurcate processes on the apex.

Gonyaulax paliuros Sarjeant 1962

Plate 69, fig. 2

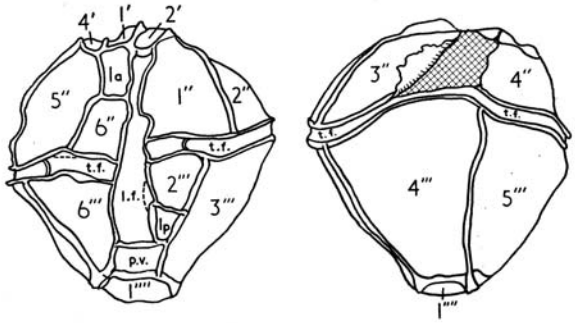
Remarks. This species, originally described from the Oxfordian (Corallian) (Sandsfoot Clay, *E. bimammatum* Zone) of Dorset, is abundant at all four horizons. The tabulation proved, as always, very difficult to determine, but observations made supported the earlier interpretation. This species has also now been found present in the assemblage from the Hambleton Oolite of Filey Brigg, Yorkshire, described earlier (Sarjeant 1960*b*).

Gonyaulax eumorpha Cookson and Eisenack 1960

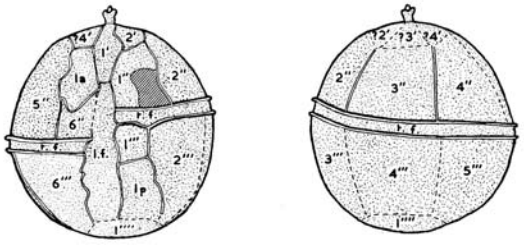
Plate 69, fig. 12; text-fig. 3

Remarks. This species, originally described from Oxfordian to Lower Kimmeridgian and probably Tithonian horizons of Western Australia, is recorded for the first time from Europe, representatives being present at three of the horizons studied.

The figured specimen (M132/8/61A) is the best preserved. Its tabulation corresponds in broad terms to that of the type; there are, however, several differences in detail. The boundary between plates 1a and 6″ is well defined and plate 6″ is clearly larger than plate 1a: in the type, the boundary is poorly defined and plate 1a considered larger. The transverse furrow shows a distinct subdivision by low sutures, a feature not observed in the type: and the posterior ventral plate (p.v.) is squarish and has a clearer relation to the antapical plate. Pre-equatorial plate 3″ is torn open and may well represent an archaeopyle.



TEXT-FIG. 3. *Gonyaulax eumorpha* Cookson and Eisenack. The specimen figured (M132/8/61a) differs from the type description in detail of tabulation. Left: in ventral view. Right: in dorsal view. ×600.



TEXT-FIG. 4. *Gonyaulax nuciformis* (Deflandre) comb. nov. Ventral tabulation (left) from specimen M134/1/37; dorsal tabulation (right) diagrammatic, reconstructed from several specimens studied. ×600.

Gonyaulax nuciformis (Deflandre) comb. nov.

Plate 69, fig. 6; text-fig. 4

1938 *Palaeoperidinium nuciforme* Deflandre, p. 180, pl. viii, figs. 4–6.

Diagnosis. A species of fossil *Gonyaulax* having a spheroidal to ovoidal theca, thick walled and very coarsely granular, the granules in some cases so large as to be better regarded as very short spines. Tabulation ?4′, 1a, 6″, 6‴, 1p, 1⁗: extremely difficult to determine, since the sutural crests are very low and masked by the surface ornament. The apical process is short and broad, bifurcating briefly distally and giving rise to a short terminal process.

Remarks. This species was originally attributed to the genus *Palaeoperidinium* in absence of knowledge of the tabulation. In course of a recent visit to the Laboratoire de Micropaléontologie in Paris, I was courteously allowed by Prof. Deflandre to examine the holotype, which gives indication of a tabulation but no more. The species is present in the Middle Callovian of Dorset (Sarjeant 1962) and it occurs at all four Melton

horizons: the majority of its representatives, like the type, show only traces of a tabulation, the thick walls, dark yellowish-brown colour and heavy granulation making study difficult. One specimen, however (M134/1/37), in which the dorsal surface is almost entirely lacking, allowed determination of details of the ventral tabulation, and indications on several other specimens enabled reconstruction of the dorsal tabulation. The species is clearly attributable to the genus *Gonyaulax* and resembles, in tabulation, the thickness and granular nature of its walls, and the possession of a short apical horn, the species *G. pachyderma* Deflandre of the French Lower Oxfordian (1938), differing from the latter in the shape of the apical horn, details of plate shape, and the presence of an anterior intercalary plate. A close systematic relationship between the two species is clearly indicated; *G. nuciformis* is known to occur earlier than *G. pachyderma* and might be visualized as giving rise to the latter species by loss of plate 1a, simplification of horn structure and emphasis of sutural crests. However, no intermediate forms are known to date. The range of dimensions exhibited (Melton specimens) is overall length 56–58 μ, breadth 50–64 μ: the specimens are more generally spheroidal than those whose dimensions are quoted by Deflandre (length 60–65 μ: breadth 47–53 μ).

Family HYSTRICHODINIDAE
Genus PALAEOHYSTRICHOPHORA Deflandre, 1934 (emend. Deflandre and Cookson, 1955)

Cf. *Palaeohystrichophora spinosissima* (Deflandre 1938)

Remarks. A single specimen from the 62-foot horizon accords well with forms described under this name from North Yorkshire (Sarjeant 1960). The tabulation again proved incapable of determination.

?Order GYMNODINIALES
Family uncertain
Genus PAREODINIA Deflandre

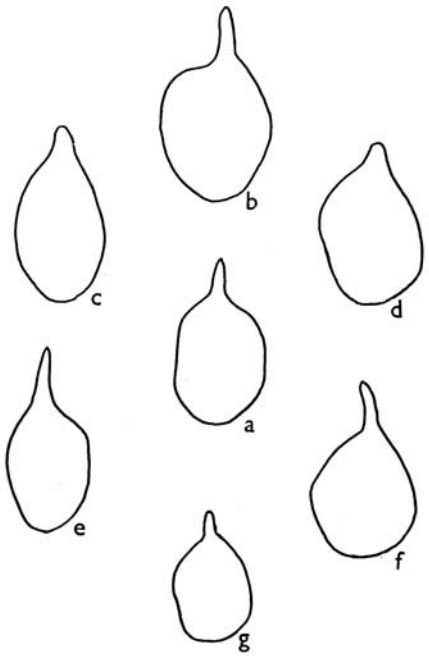
Pareodinia ceratophora Deflandre, 1947

Plate 69, fig. 8; text-fig. 5

Remarks. This species was originally described from the Callovian of the Baltic region and Bajocian of France (1947). It has subsequently been found represented, in its typical form, in British strata ranging in age from Middle Callovian to Upper Oxfordian (Lantz 1958, Sarjeant 1960, 1961, 1962) and a variety, *P. ceratophora* var. *pachyceras* Sarjeant, in the Lower Callovian and lowest Oxfordian (1959 and 1961).

This species is of extremely variable form, variation occurring in overall size, in granularity, in ratio of length to breadth, in shape of the apical horn, and in ratio of horn length to overall length. The variation in all characters save granularity is shown in text-fig. 5, where the outlines of individuals, drawn to a constant scale, are shown in pictogram form (variation in granularity proved independent of these dimensional variations). All intermediates between the figured extremes are known. Within the Melton assemblage, a very wide variation of form was observed, the variations typified by specimens in text-fig. 5 *b*, *c*, being especially frequent. The latter is indistinguishable in outline from the forms classed previously (1959) as var. *pachyceras*, differing only in

the less strongly coloured and more granular nature of the shell. *Pareodinia aphelia* Cookson and Eisenack 1958, from the Upper Jurassic and Lower Cretaceous of Western Australia, is known to vary in proportions in similar fashion to *P. ceratophora*, although the proportion of horn length to body length is generally smaller. It is probable



TEXT-FIG. 5. The range of variation exhibited by *Pareodinia ceratophora* Deflandre. Outlines of specimens from several horizons, drawn to a constant scale. *a*, CB81/6/4, from the Oxford Clay of Cayton Bay, Yorkshire. *b*, *c*, *f*. M134/1/92, M133/4/14, and M134/4/66, from the Ampthill Clay of Melton. *d*, *e*, WC90/14/5 and WC90/1/1, from the Oxford Clay of Chickerell, Dorset. *g*, O130/9/2, from the Osmington Oolite of Osmington Mills, Dorset. All ×375.

EXPLANATION OF PLATE 69

Microplankton from the Ampthill Clay of Melton, near Hull, Yorkshire. All figures ×c. 500.

1, *Gonyaulax nealei* sp. nov., M134/3/172, holotype, ventral view. 2, *G. paliuros* Sarjeant, M133/2/24, ventral view. 3, *G. eisenacki* Deflandre, M134/1/71, lateral view. 4, *Pluriarvalium osmingtonense* Sarjeant, M133/5/13, dorsal view. 5, *Scriniodinium subvallare* Sarjeant, M134/3/132, ventral view. 6, *G. nuciformis* (Deflandre) comb. nov., M134/1/37, ventral view (interior view of half-shell). 7, *S. luridum* (Deflandre), M134/2/131. 8, *Pareodinia ceratophora* Deflandre, M134/1/92. 9, 10, *Nannoceratopsis pellucida* Deflandre, M132/8/18A, M134/4/64. 11, *S. dictyotum* Cookson and Eisenack, M132/8/88A. 12, *G. eumorpha* Cookson and Eisenack, M132/8/61A. 13, 14, *S. oxfordianum* sp. nov. 13, M131/1/58. 14, holotype, FB122/11/34 Hambleton Oolite, Carr Naze, Filey Brigg, Yorks.

that both species are part of one continuous plexus and that the systematic distinction between them is wholly artificial.

Order Uncertain
Family DEFLANDREIDAE
Genus SCRINIODINIUM Klement
Subgenus ENDOSCRINIUM Klement 1960

Scriniodinium (?*Endoscrinium*) *oxfordianum* sp. nov.

Plate 69, figs. 13, 14

1960 Scriniodinium sp. A Sarjeant, p. 394, pl. 13, fig. 2.
1962 *Scriniodinium* (?*Endoscrinium*) sp. Sarjeant, p. 263, pl. 1, fig. 15.

Holotype. FB122/11/34, Hambleton Oolite (10 feet below top), Carr Naze, Filey Brigg. *Dimensions of type.* Cyst length 100 μ, breadth 82 μ. Theca length 82 μ, breadth 62 μ.

Diagnosis. A species of *Scriniodinium* having a cyst of broadly ellipsoidal shape, one face of whose hypothecal portion is somewhat flattened. Theca ellipsoidal, having a distinct tabulation, apparently 4′, 6″, 5‴, 0p, 0⁗; the sutures of the ventral surface are unornamented, but sutures elsewhere bear raised crests formed by short spines, quite widely separated, whose tips are linked by a trabecula following the course of the suture.

Description. The cyst is ellipsoidal, pale yellowish or yellowish-brown in colour, smooth or very faintly granular. In some specimens there is a distinct equatorial bulge, the shape thus becoming biconical rather than ellipsoidal; in others, the space between theca and cyst is larger at one pole than at the other. The theca is somewhat darker in colour and broadly ellipsoidal in shape. Its surface may be areolate in patches; these patches are quite irregular in position and their distribution varies between individuals, the areolation being in all cases most pronounced near to a suture and dying out toward the centre of the plate.

The characteristic features of this species are its distinctive sutural crests, composed of widely spaced spines linked in T-fashion by a trabecula. The sutures of the ventral surface lack such crests, being marked only by low ridges, extremely hard to see even under the most favourable conditions: orientation and the establishment of a tabulation are thus difficult. From the examination of all available specimens, the tabulation was considered to resemble that established by Klement for his subgenus *Endoscrinium*, with four apical plates definitely present. The transverse furrow is of moderate breadth and only feebly laevo-rotatory, the longitudinal furrow narrow in its epithecal portion but broadening as it approaches the antapex. All specimens examined show some degree of damage, but the presence in constant position of an archaeopyle cannot be affirmed.

Remarks. Following study of the Melton specimens of *Scriniodinium oxfordianum*, representatives of this genus in the Yorkshire Corallian horizons were re-examined and the earlier interpretation of the crests of *Scriniodinium* sp. A (1960) corrected: these are as here described, and not 'perforated and in part areolate', as stated earlier. Indeed, specimen FB122/11/34 shows the form of the crests more clearly than any other seen;

for this reason, it has been chosen as type despite its damaged condition. The specimens from the Ringstead Waxy Clay (*E. bimammatum* Zone) of Dorset, earlier attributed to an undescribed species of *Scriniodinium* (1962), fall clearly within the range of variation of this species. The Melton specimens are generally somewhat larger than the type; specimen M131/1/58 (figured) has cyst 124 μ × 107·5 μ and theca 98·5 μ × 75·5 μ.

Scriniodinium oxfordianum may represent an intermediate stage between species without a recognizable tabulation, such as the type species of the genus, *Scriniodinium* (*S.*) *crystallinum* (Deflandre) and clearly tabulate species, such as *S.* (*Endoscrinium*) *luridum*. In *S. oxfordianum*, the sutures of the ventral surface are poorly defined; in *S. crystallinum*, the transverse furrow cannot be traced across this surface and no longitudinal furrow is apparent. The flattening of one face of the hypothecal portion of the cyst of *S. oxfordianum* may be regarded as an approach to the projecting membraneous 'cross-arching' of *S. luridum:* and the tabulation of the two species appears similar. In some poorly preserved specimens from Melton, there appears to be incomplete development of crests on sutures near the apex; these specimens could not be definitely attributed either to *S. crystallinum* or to *S. oxfordianum* and may well represent an intermediate stage of progressive crest development, leading from the former to the latter species. A process of filling in of the crests and modification of general shape might lead from *S. oxfordianum* to *S. luridum*. The forms from the Upper Calcareous Grit of Yorkshire, described as *Scriniodinium* sp. B (1960*b*) are similar in general shape to *S. luridum* but have crests of the type of *S. oxfordianum:* however, they occur in an assemblage in which the typical forms of these species are not present. Apparent intermediates of this character are not known from earlier horizons, and this second line of possible evolutionary development remains hypothetical.

Order HYSTRICHOSPHAERIDIA
Family HYSTRICHOSPHAERIDAE
Genus HYSTRICHOSPHAERA O. Wetzel 1933
Hystrichosphaera furcata (Ehrenberg 1838) O. Wetzel 1933

Remarks. The occurrences of this species in the Upper Jurassic, of which the Melton record is the third, are of interest in relation to the controversy with regard to the definition of this species and of *H. ramosa* (Ehrenberg 1838) O. Wetzel 1933. In the Upper Cretaceous, the two species form a continuously varying plexus (Lejeune-Carpentier 1937*a*, *b*); *H. ramosa* has not to date been recorded earlier. It appears that *H. furcata* is, as would be expected, the ancestral type and that the trend of increase in complexity of the spines, leading to *H. ramosa*, did not begin to operate until well into the Cretaceous.

Genus BALTISPHAERIDIUM Eisenack 1958
Baltisphaeridium ehrenbergi (Deflandre 1947) Sarjeant 1961

Plate 70, fig. 1; text-fig. 6*a*

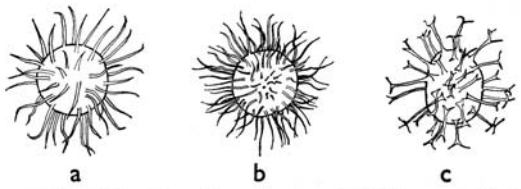
Remarks. This species, originally described from the Lower Oxfordian of Normandy, is present in three Melton assemblages. It has also now been noted from three horizons in the Yorkshire Oxford Clay (from the base, in the exposures in Scarborough Castle

Cliff: and from horizons respectively 25 feet and *c.* 100 feet above the base, in High Red Cliff, Cayton Bay; all within the *Q. mariae* Zone) and from the Hambleton Oolite of Filey Brigg, Yorkshire (*C. cordatum* Zone). These are the first British records of this species.

Baltisphaeridium polytrichum (Valensi 1947) Sarjeant 1960*a*

Plate 70, fig. 2; text-figs. 6*b*

Remarks. This species, originally described from the Bathonian of France, is present in the two lower Melton horizons and is also present in the Yorkshire Oxford Clay (lowest and 25-foot horizons: see above) and in the Osmington Oolite of Filey Brigg, Yorkshire (*P. plicatilis* Zone). These occurrences represent a considerable extension of the known range of this species within the Jurassic. A morphologically similar form from the Australian Upper Cretaceous has been placed in this species (Deflandre and Cookson 1955), but the stratigraphic separation remains immense. The forms from the Upper Kimmeridgian of Dorset, attributed to this species by Downie (1957), show clear morphological differences (Sarjeant 1960*a*).



TEXT-FIG. 6. Hystrichospheres from the Ampthill Clay. *a*, *Baltisphaeridium ehrenbergi* (Deflandre) (M134/4/60). *b*, *B. polytrichum* (Valensi) (M134/3/67). *c*, *B. tribuliferum* sp. nov. Holotype, M134/2/29. *All* ×900.

TEXT-FIG. 7. Variation in the form of spines of *Baltisphaeridium tribuliferum* sp. nov. Holotype, M134/2/29; ×*c.* 1,800.

Baltisphaeridium tribuliferum sp. nov.

Plate 70, fig. 4; text-figs. 6*c*, 7

Holotype. M134/2/29, 62-foot horizon of Ampthill Clay, Melton.

Dimensions of type. Overall: long diameter 59 μ, short diameter 54 μ. Shell: long diameter 33 μ, short diameter 25·5 μ. *Range of dimensions.* Overall: long diameters 53–62 μ, short diameters 48–58 μ.

Diagnosis. A species of *Baltisphaeridium* having an ovoid shell bearing widely spaced processes, attached proximally by root-like extensions on the shell surface and tapering somewhat distally, branching at a constant distance from the shell surface into bi-, tri-, or quadri-furcations of variable length and attitude.

Description. Shell smooth, without granulation or punctation, varying in hue from

yellowish to quite colourless. The spines are hollow but appear not to open directly into the shell's interior. They are of very variable form, never simple but having two to four branches of varying length: the branches appear flexible and may be directed outward from, or inward towards, the shell surface or may be roughly parallel to it (text-fig. 7). The branches are closed at their tips. The spines are widely spaced: the number present is between about forty-five and sixty; in length they exceed half the long diameter.

Remarks. Baltisphaeridium tribuliferum differs from all described species of this genus in its combination of form, and proportionate length, of processes with shell shape. The forms from the Lower Oxfordian of France, described by Deflandre as *Hystrichosphaeridium* cf. *intermedium* (1938), are probably attributable to this species, as also is the form from the Bathonian of France, described under this name by Valensi (1953).

This species is present in low numbers at three Melton horizons and has also been noted from all three horizons of the Yorkshire Oxford Clay (see above) and from the Lower Calcareous Grit and Hambleton Oolite of Filey Brigg, Yorkshire.

Baltisphaeridium parvispinum (Deflandre 1937) Cookson and Eisenack 1957

Text-fig. 9*d*

Remarks. This species, present at the 10-foot Melton horizon, is described for the first time from Britain and from the Jurassic: it has previously been recorded from the Lower Cretaceous (Aptian) of France (1937), Queensland, and Papua (Aptian: Cookson and Eisenack 1957) and the Upper Cretaceous of Belgium (Conrad 1941). In their dimensions, the Melton specimens fall between the range estimated by Cookson and Eisenack for the French specimens (shell 40 $\mu \times 20\ \mu$) and that quoted for the Australasian specimens (shell 73–76 $\mu \times 32$–$33\ \mu$); specimen M132/10/1 is typical—overall 63 $\mu \times 38\ \mu$, shell 57·5 $\mu \times 32{\cdot}5\ \mu$.

Baltisphaeridium stimuliferum (Deflandre 1938) Sarjeant 1961

Plate 70, figs. 5, 17; text-figs. 8?*c*, *e*, *g*

Remarks. The range of forms depicted in text-fig. 8, all from the lowest (62-foot) horizon at Melton, well illustrates the difficulty of establishing a satisfactory morpholo-

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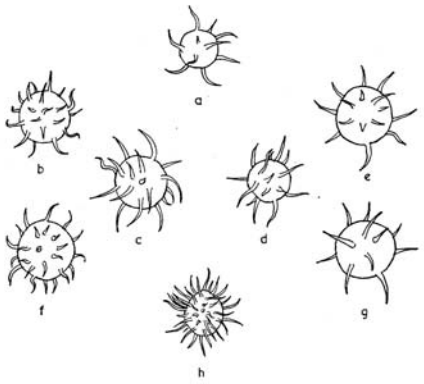
EXPLANATION OF PLATE 70

Microplankton from the Ampthill Clay of Melton, near Hull, Yorkshire. All figures (except fig. 12) $\times$c. 500; fig. 12, $\times$*c.* 750.

1, *Baltisphaeridium ehrenbergi* Deflandre, M134/4/60. 2, *B. polytrichum* (Valensi), M134/3/67. 3, *Cannosphaeropsis caulleryi* (Deflandre), M134/4/25. 4, *B. tribuliferum* sp. nov., Holotype, M134/2/29. 5, *B. stimuliferum* (Deflandre), M134/2/42. 6, *Micrhystridium fragile* Deflandre, M134/1/72. 7, *B. pilosum* (Ehrenberg) with *Stephanelytron redcliffense* Sarjeant, M132/8/105A and M132/8/105. 8, *B. sp.*, M134/3/73. 9, *Leiosphaeridia similis* Cookson and Eisenack, M133/7/48. 10, *B. pilosum* (*Ehrenberg*), M134/4/26. 11, *Stephanelytron scarburghense* Sarjeant, M134/2/104. 12, *S. redcliffense* Sarjeant, M134/4/16, in slightly oblique view, showing the matte of fibres within the corona. 13, *Leiosphaeridia chytroeides* sp. nov., holotype, M133/2/53. 14, *M. rhopalicum* sp. nov., holotype, M132/8/47. 15, *Pterospermopsis* cf. *helios* Sarjeant, M132/9/27. 16, *L. chytroeides* sp. nov., M134 2/80, showing organism emerging from cyst. 17, *B. stimuliferum* (Deflandre), M134/2/92. 18, *Netrelytron stegastum* Sarjeant, M132/5/2. 19, *Dictyopyxis areolata* Cookson and Eisenack, M134/4/16.

gical classification of those hystrichospheres with a spherical test and with simple spines present in moderate number. The size ranges of these forms overlap from above and below the artificial boundary ('size generally less than 20 μ') separating *Micrhystridium* from *Baltisphaeridium*; and considerable variation in spine number and length is exhibited. Specimens *e* and *g* (text-fig. 8), in size and in spine number and character, are attributable to *Baltisphaeridium stimuliferum*, which has a quoted range of shell diameters 20–26 μ and of spine lengths 10–23 μ (Deflandre 1938, Valensi 1953). Specimen *a* is clearly *Micrhystridium fragile*. Its author, Deflandre (1947), quotes for this species a range of overall diameters of 12–24 μ, and shell diameters of 8–10 μ. Valensi (1953) quotes ranges respectively of 15–40 μ and of 7–20 μ: a similar range was exhibited by an assemblage studied earlier from the Yorkshire Hambleton Oolite (Sarjeant 1960*b*). Specimens *b* and *f* fall within the species *Micrhystridium recurvatum* Valensi (1953), which, with its described varieties, exhibits a range of overall diameters of 17–35 μ and shell diameters of 10–21 μ. *Baltisphaeridium stimuliferum* typically has about 15 spines; *Micrhystridium fragile*, 9 to 26; and *M. recurvatum*, 20 to 30. In known chronologic range, these species again overlap. *B. stimuliferum* has been recorded from the Bajocian, Bathonian, and Lower Oxfordian of France (Valensi 1953, Deflandre 1938) and from the Lower Oxfordian of England (Sarjeant 1961); certain forms from the Upper Oxfordian of England have been classed as *B.* cf. *stimuliferum* (Sarjeant 1962). *M. fragile* has been recorded from the Bajocian and Bathonian of France (Deflandre 1947, Valensi 1953) and from the Lower and Middle Callovian and the Lower and Upper Oxfordian of England (Sarjeant 1959, 1960*b*, 1961, 1962). *M. recurvatum* and its varieties have been recorded from the Bajocian and Bathonian of France (Valensi 1953) and from the Lower Callovian and Lower and Upper Oxfordian of England (Sarjeant 1960*b*, 1961, 1962).



TEXT-FIG. 8. Hystrichospheres of closely comparable structure from the lowest (62-foot) Melton horizon. *a*, *Micrhystridium fragile* Deflandre (M134/1/72). *b*, *f*, *M. recurvatum* Valensi (M134/1/8 and M134/2/92). *c*, Cf. *Baltisphaeridium stimuliferum* (Deflandre) (M134/2/81). *d*, *M.* cf. *fragile* Deflandre. *e*, *g*, *Baltisphaeridium stimuliferum* (Deflandre) (M134/2/92 and M134/2/42). *h*, cf. *piveteaui* Deflandre (M134/3/17). $\times c.$ 750.

At many horizons, the hystrichospheres of this general morphological type (shell spherical, spines not exceeding thirty in number, spine lengths from about one-quarter of the shell diameter to slightly greater than the diameter, shell diameter between 8 μ and 40 μ) may be grouped without difficulty into one or more of the above species. Of the Melton assemblages, only that from the 62-foot horizon presented any difficulties: it is significant that hystrichospheres of the specified morphological type were commonest at this horizon. Specimen *d* is near the limit of spine number but may be classed as *M. fragile;* specimen *c* is morphologically most similar to *B. stimuliferum* but has too many spines.

Although the size boundary separating *Micrhystridium* and *Baltisphaeridium* is arbitrarily drawn, these genera appear nonetheless to express natural morphogenetic groupings and problems in allocation are rare. The mean and modal sizes of the three species here discussed fall clearly above or below the boundary; however, their very similar morphology suggests a relationship. *M. fragile* and *M. recurvatum* appear to be two parts of a single morphological plexus; and the degree of variation within the species *B. stimuliferum* is comparable.

Baltisphaeridium sp.

Plate 70, fig. 8; text-fig. 9*c*

Specimen. M134/3/73, 62-foot horizon of Ampthill Clay, Melton.

Dimensions. Overall: long diameter 62 μ, short diameter 60 μ. Shell: long diameter 32·5 μ, short diameter 25μ.

Description. Shell oval, bearing simple, hollow spines; these open directly into the shell interior and have closed tips. The length of the spines exceeds half the long diameter of the shell; they number around thirty.

Remarks. The single specimen differs in its morphology from all described species. In view of lack of knowledge of the range of variation, it was decided not to designate this as a new species.

Genus SYSTEMATOPHORA Klement 1960

Systematophora orbifera Klement 1960

Remarks. The two specimens from Melton, placed within this genus and species, are both severely obscured by adherent organic debris, so that their attribution here, made on the basis of what could be seen of the process clusters, is somewhat doubtful.

Genus MICRHYSTRIDIUM Deflandre 1937

Remarks. The validity of this genus, as at present defined, is discussed above (see under *Baltisphaeridium stimuliferum*).

Micrhystridium rhopalicum sp. nov.

Plate 70, fig. 14; text-fig. 9*f*

Holotype. M132/8/47, 10-foot horizon of Ampthill Clay, Melton.

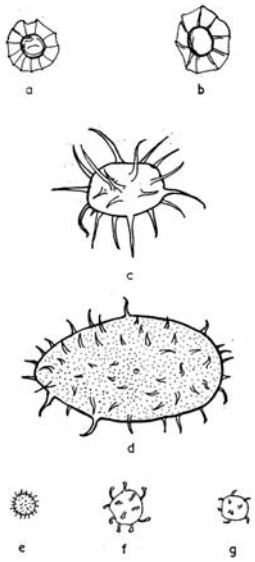
Dimensions of type. Overall diameter 21μ: diameter of shell 13·5μ: spines *c.* 4 μ in length.

Range of dimensions. Overall diameter 18–23μ: shell 10–15μ.

Diagnosis. A species of *Micrhystridium* having a spherical shell, without surface ornamentation. Spines relatively few in number, short (less than half the shell diameter), with knob-shaped or briefly bifurcate tips.

Description. Shell yellowish in colour and of moderate thickness. The spines number 15–20: they taper from the base, but swell out at the tip in club-like form or into a T-shape with very brief arms.

Remarks. This species, present probably at all four Melton horizons, is also represented in an assemblage from the Osmington Oolite of Filey Brigg and may well have a much wider distribution than is at present known. However, at the high magnifications necessary for study of the processes, it has frequently proved difficult to confirm that the spines having a knobbed appearance are not merely recurved simple spines; at several horizons, more information must be awaited before its presence can be confirmed.



TEXT-FIG. 9. Hystrichospheres from the Ampthill Clay. *a*, *Pterospermopsis helios* Sarjeant (M132/7/14). *b*, *P.* cf. *helios* Sarjeant (M132/9/27). *c*, *Baltisphaeridium* sp. (M134/3/73). *d*, *B. parvispinum* Deflandre (M132/10/1). *e*, *Micrhystridium deflandrei* Valensi (M133/3/23). *f*, *M. rhopalicum* sp. nov. (Holotype, M132/8/47). *g*, *M. rarispinum* Sarjeant (M133/2/25). × *c.* 750.

In the form and number of its processes, *Micrhystridium rhopalicum* differs from all described fossil species of this genus. The only comparable species is *M. bigoti*, from the Bajocian and Bathonian of France (Deflandre 1947); however, in this latter species the processes are clearly capitate and are much shorter and more numerous.

Micrhystridium cf. *piveteaui* Valensi 1953

Specimen. M134/3/17, 62-foot horizon of Ampthill Clay, Melton.

Dimensions. Overall: long diameter 36 μ, short diameter 27 μ. Shell: long diameter 21·5 μ, short diameter 16 μ. Spines *c.* 9 μ long.

Description. Shell ovoidal, yellowish, bearing a large number (50–60) of simple processes whose length is equal to about half the long diameter. The surface of the shell lacks other ornament.

Remarks. The single specimen here described differs in shell shape and process number from all described species. It finds its closest comparison in *Micrhystridium piveteaui*, which has, however, somewhat fewer processes (about 40). In general morphology, there is considerable similarity to the *B. stimuliferum—M. fragile—M. recurvatum* type; but specimens of intermediate character were not found.

Family PTEROSPERMOPSIDAE
Genus PTEROSPERMOPSIS W. Wetzel 1952
Pterospermopsis cf. *helios* Sarjeant 1959

Plate 70, fig. 15; text-fig. 9*b*

Specimen. M132/9/27, 10-foot horizons of Ampthill Clay, Melton.
Dimensions. Overall: long diameter 29 μ, short diameter 23 μ. Capsule: maximum diameter 9 μ.

Description. Capsule broadly oval, almost spherical, in outline: colour yellowish-brown. Wing oval in outline, thrown into nine radial folds; colour pale yellowish. Ratio of wing breadth to capsule radius: 2+ to 1.

Remarks. This species is closely comparable to forms present in the Hambleton Oolite of Filey Brigg, Yorkshire (Sarjeant 1960*b*). In wing outline and in ratio of wing breadth to capsule radius, it differs from the typical *P. helios*, specimens of which are present at three Melton horizons. (*P. helios* typically has a wing circular in outline and a ratio of 1·5 to 1.)

Family LEIOSPHAERIDIDAE Eisenack
Genus LEIOSPHAERIDIA Eisenack 1958
Subgenus LEIOSPHAERIDIA subgen. nov.

Type species. Leiosphaeridia (*L.*) *baltica* Eisenack 1958.

Diagnosis. A subgenus of *Leiosphaeridia* comprising species having a circular pylome or none at all.

Leiosphaeridia (*Leiosphaeridia*) cf. *similis* Cookson and Eisenack 1960

Plate 70, fig. 9; text-fig. 10

Remarks. Ten specimens in the two upper Melton horizons correspond in their morphology to this species, originally described from probably Tithonian and late Upper Jurassic horizons of Western Australia and Papua. They differ however in their much smaller size; the range of diameters is 38–45·5 μ, in comparison with a quoted range of 70–100 μ.

Subgenus CHYTROEISPHAERIDIA subgen. nov.

Type species. Leiosphaeridia (*Chytr.*) *chytroeides* sp. nov.

Diagnosis. A subgenus of *Leiosphaeridia* comprising species having a polygonal or

subpolygonal pylome, lateral or terminal in position. The pylome may not be present in all individuals of such species.

Remarks. Evitt (1961), discussing the significance of the pylome in fossil dinoflagellates and related organisms, proposed the term 'archaeopyle' for pylomes formed by the release of single plates or groups of plates. He lists *Leiosphaeridia* as a genus without definite dinoflagellate affinity, in which the pylome is most often absent or, where present, is of circular shape. The form of the pylome in *L. chytroeides* sp. nov. suggests an archaeopyle and thus also suggests dinoflagellate affinity; a taxonomic distinction from species having a circular pylome or no pylome is thus necessary. However, since a pylome is not constantly present, differentiation is not always possible. It is therefore considered best that all forms conforming in their morphology with Eisenack's generic diagnosis should remain in *Leiosphaeridia* and that distinction on pylome form should be made at subgeneric level only, the two subgenera being otherwise morphologically indistinguishable.

TEXT-FIG. 10. *Leiosphaeridia similis* Cookson and Eisenack. Specimens showing extremes of the size range exhibited in the Melton assemblages. *a*, M133/7/48 (45·5 μ). *b*, M133/8/26 (34 μ). $\times c.$ 750.

TEXT-FIG. 11. The range of variation exhibited by *Leiosphaeridia chytroeides*, sp. nov. *a*, M133/8/51. *b*, M131/2/19. *c*, M134/3/18. *d*, Holotype, M133/2/52. *e*, M131/1/79. $\times$375.

TEXT-FIG. 12. *Leiosphaeridia chytroeides* sp. nov. *a*, Specimen lacking a pylome (M133/1/6). *b*, Organism emerging from cyst (M134/2/80). $\times$375.

Leiosphaeridia (*Chytroeisphaeridia*) *chytroeides* sp. nov.

Plate 70, figs. 13, 16; text-figs. 11, 12

Holotype. M133/2/53, 25-foot horizon of Ampthill Clay, Melton.

Dimensions of type. Diameter (maximum) 50 μ. *Range of dimensions.* Maximum diameters 30–60 μ.

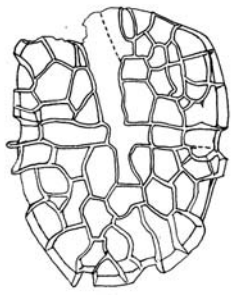
Diagnosis. A species of *Leiosphaeridia* having a smooth or faintly granular shell of

spherical to broadly ovoidal shape and variable thickness. A large pylome of polygonal outline, without a thickened rim, is characteristic.

Description. The shell is of pale to deep yellowish-brown colour. Its thickness is variable: the largest forms frequently have very thin walls, whereas the walls of smaller forms tend to be proportionately much thicker: however, thick-walled large forms are not uncommon. A pylome is frequently, though not uniformly, present; it is of approximately polygonal shape, the sides of the polygon curving inward. It varies in size with relation to shell diameter; the portion detached ranges from about one-third to just under two-thirds the longest radius. In ovoidal forms, the pylome is situated at one pole. In text-fig. 11, an arbitrary apical orientation has been given; the outline of the pylome suggests that of a plate, so that the term 'archaeopyle' may be preferable.

Some forms present in the Ampthill assemblage, for example that figured in text-fig. 12*a*, have no pylome: their correspondence in all other morphological characters with *L. chytroeides* suggests their identity with the pylomate forms. One specimen encountered appears to represent the preservation of an individual actually in the stage of emerging from its cyst (Plate 70, fig. 16; text-fig. 12*b*); this interpretation is suggested by the lines of folding traversing both shells and the partial contraction of the upper one, presumed to be the cyst. The taxonomic character of the lower, emergent body is not clear.

Remarks. Leiosphaeridia chytroeides sp. nov. is abundant in the Melton assemblages. It differs, in the character of its pylome, from all other described species of leiospheres.



TEXT-FIG. 13. *Dictyopyxis areolata* Cookson and Eisenack, showing the median and longitudinal bands which are suggestive of a dinoflagellate cyst, M134/4/16. × *c.* 600.

Family Uncertain

Genus DICTYOPYXIS Cookson and Eisenack 1960

Dictyopyxis areolata Cookson and Eisenack 1960

Plate 70, fig. 19; text-fig. 13

Remarks. This species, described originally from Oxfordian to Lower Kimmeridgian horizons of Western Australia, is recorded for the first time from Europe. It was regarded by its authors as *incertae sedis*: however, its possession of median and longitudinal bands, homologous with the furrows of a dinoflagellate albeit almost certainly functionless in this species, and the absence of one pole of the shell (text-fig. 13) in one specimen seen, suggesting a possible apical pylome, indicate that this may well be a dinoflagellate cyst. It is therefore here placed in the Order Hystrichosphaeridia, alongside other genera of presumed dinoflagellate cysts.

INCERTAE SEDIS

Genus NETRELYTRON Sarjeant 1961

Netrelytron stegastum Sarjeant 1961

Plate 70, fig. 18

Remarks. Two features noted in the original descriptions of this remarkable species are

confirmed from its Melton representatives; the oval perforation on one? dorsal flank, which is clearly a pylome: and the investment of each individual in a mass of formless organic material. The former feature was observed with certainty in eleven specimens, the state of preservation and/or the orientation of the others seen not permitting certainty; and all specimens seen showed the latter feature, the cloak of debris presumably affording protection during encystment.

Genus STEPHANELYTRON Sarjeant 1961

Stephanelytron scarburghense Sarjeant 1961

Plate 70, fig. 11

Remarks. The presence of this genus at all four horizons at Melton shows that the original limited vertical range postulated for it is incorrect. It was originally described from the lowest Yorkshire Oxford Clay and was not represented in assemblages from higher horizons. The extension of its known range suggests that it may well have given rise to *S. redcliffense*, by disappearance of processes within fields and slight increase in ratio of shell length to breadth (the shell of *S. scarburghense* is typically almost spherical).

Stephanelytron redcliffense Sarjeant 1961

Plate 70, figs. 7, 12

Remarks. The specimen described as Organism A, from the Hambleton Oolite of Yorkshire (Sarjeant 1960*b*), is attributable to this species, which thus has a known range from the top of the *Q. mariae* Zone through the *C. cordatum* Zone (middle–upper Lower Oxfordian).

CONCLUSIONS

The principal aim in studying the Ampthill Clay assemblages was to determine whether a stratigraphic position could be allotted to these beds on the basis of their microplankton content. The known distribution by horizon of microplankton in British Callovian and Oxfordian horizons is given in Table 3; the known distribution of these species in other described assemblages is also shown, together with their distribution in the Melton assemblages. For the British horizons, stage names and ammonite zones are given, where known: for the non-British assemblages, only stage names are given, since ammonite zones were not quoted. The Australasian assemblages, obtained from borehole material, are often very vaguely dated. From examination of Table 3, it is evident that the Melton assemblages are exceptionally rich in number of species. Their age is clearly Oxfordian. The absence of several species recorded only from the Lower Oxfordian (*Gonyaulax areolata*, *Baltisphaeridium* cf. *fimbriatum*, *Cannosphaeropsis aemula*, *Polystephanephorus calathus*, *Wanaea fimbriata*, *Stephanelytron caytonense*) and the presence of others known only from the Upper Oxfordian (*Gonyaulax paliuros*, *Pluriarvalium osmingtonense*, *Scriniodinium subvallare*, *Micrhystridium rarispinum*), together with the presence of species whose ranges overlap these horizons from above or below, indicate an uppermost Lower to Upper Oxfordian age. It would seem most probable, on the basis of these assemblages, that the age range of the Ampthill Clay succession examined is from uppermost *C. cordatum* to *P. plicatilis* Zone (approximately

equivalent to the Nothe Grit–Osmington Oolite range in the Dorset Corallian, or to the Hambleton Oolite–Osmington Oolite range in North Yorkshire). The Ampthill Clay is a facies equivalent of the Corallian: no ammonite zonation has to date been established for the Melton Clay Pit.

Seventeen species from Melton are also present in the assemblage described by Deflandre (1938) from the Lower Oxfordian (*C. cordatum* Zone) of Villers-sur-Mer, Calvados, France: and ten species in the Australasian assemblages described by Cookson and her associates. In contrast, only nine species occur in common with Klement's assemblages from the Malm of South-west Germany (1960); this degree of comparison is much smaller than was anticipated and may suggest some environmental barrier. None of the authors quoted here concerned themselves with the micrhystridia, a group of difficult systematics and doubtful stratigraphic value.

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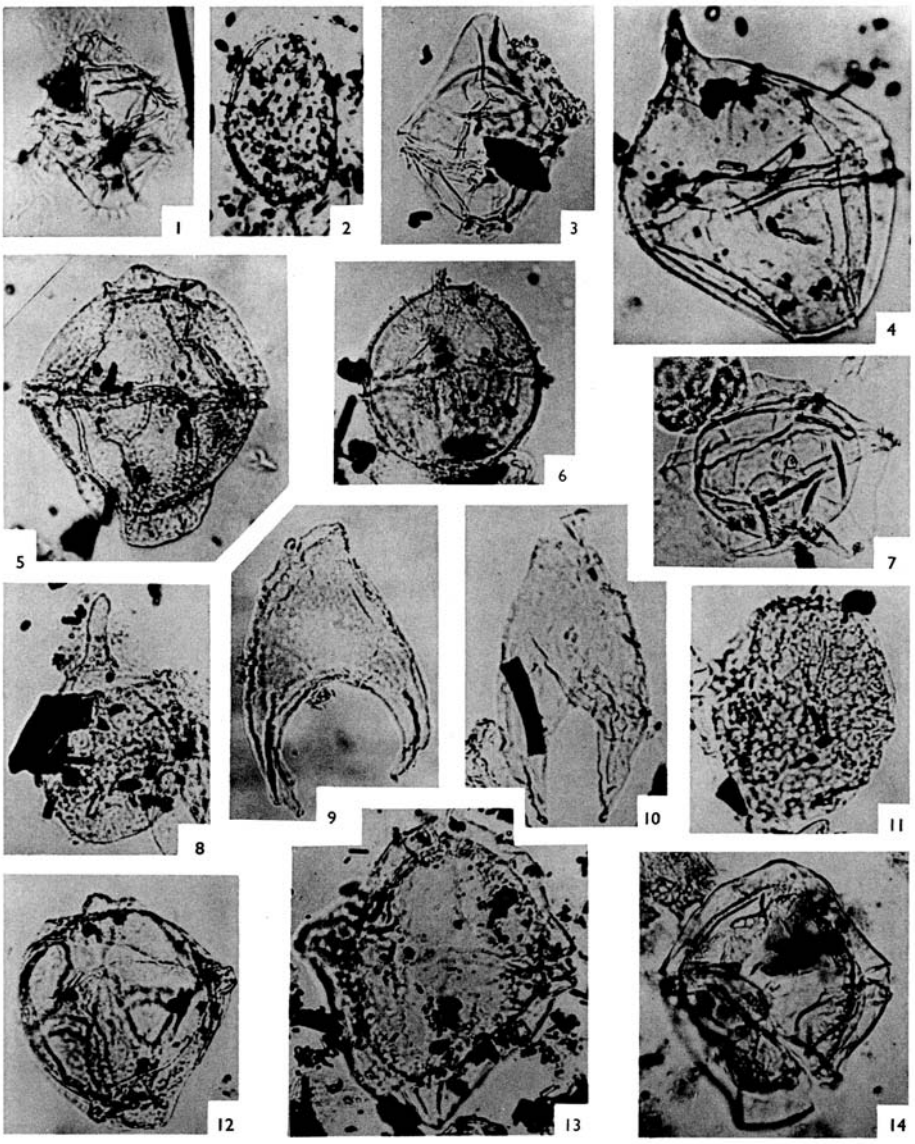
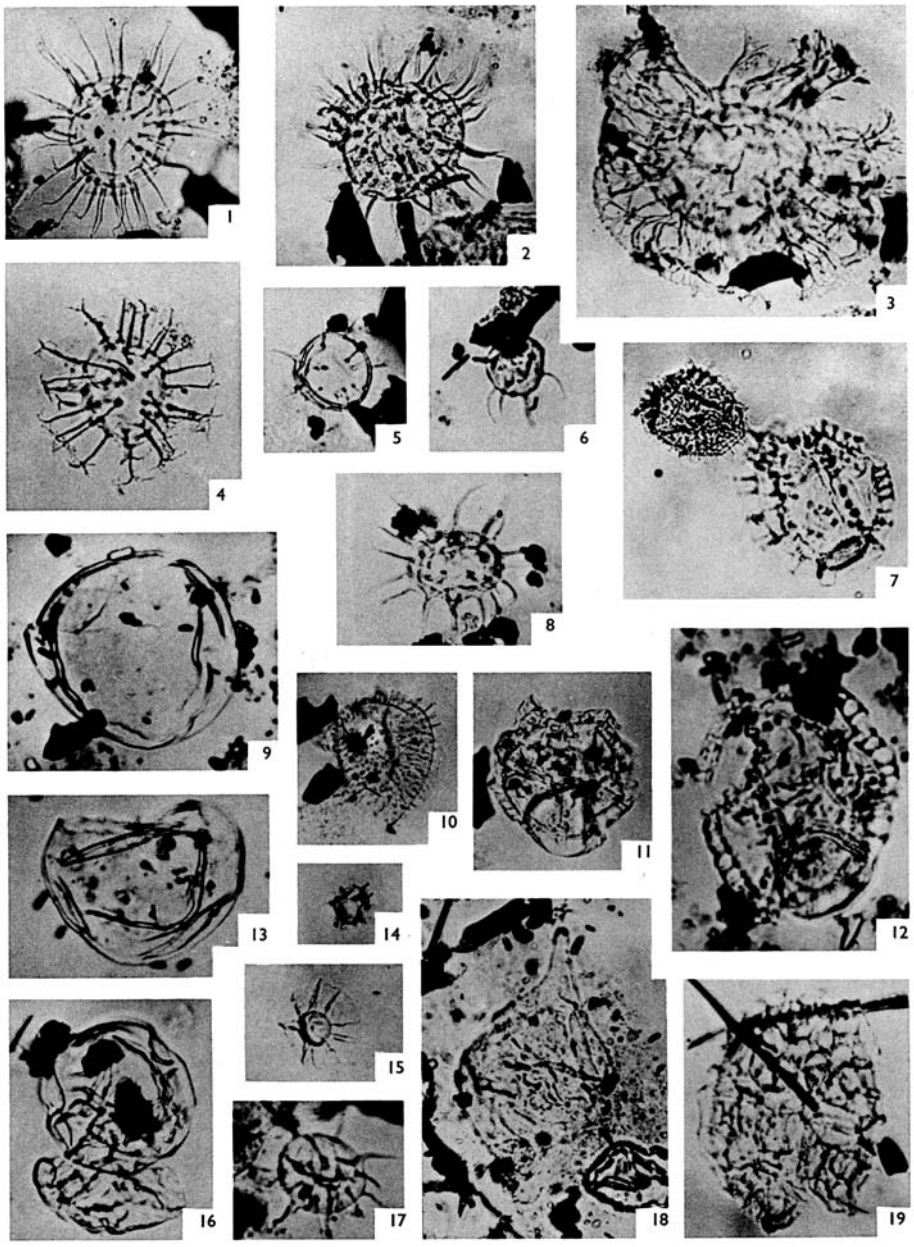


SARJEANT, Oxfordian microplankton



SARJEANT, Oxfordian microplankton

Species of microplankton \ Horizon within the Ampthill Clay of Melton	62 — foot M134	45 — foot M131	25 — foot M133	10 — foot M132
Gonyaulax jurassica Deflandre	31	17	16	49
G. cladophora Deflandre	3	13	17	49
G. eisenacki Deflandre	15	11	4	9
G. ambigua Deflandre	4	5	9	7
G. paliuros Sarjeant	19	9	29	12
G. acanthosphaera Sarjeant	9	—	11	14
G. eumorpha Cookson & Eisenack	4	3	—	3
G. nuciformis (Deflandre) comb. nov.	25	9	2	18
G. pachyderma Deflandre	2	—	—	—
G. negalei sp. nov.	1	5	—	—
Pluriarvalium osmingtonense Sarjeant	—	—	1	—
Ctenidodinium ornatum Deflandre	1	2	—	1
Cf. Palaeohystrichophora spinosissima (Defl.)	1	—	—	—
Pareodinia ceratophora Deflandre	12	21	12	9
Scriniodinium crystallinum (Deflandre)	12	14	35	75
S. luridum Deflandre	2	11	3	7
S. galeritum Deflandre	3	13	9	—
S. subvallare Sarjeant	3	7	—	—
S. oxfordianum sp. nov.	—	7	5	2
S. dictyotum Cookson & Eisenack	6	12	4	10
Nannoceratopsis pellucida Deflandre	3	18	—	1
Hystrichosphaera furcata (Ehrenberg)	—	2	—	—
Hystrichosphaeridium salpingophorum (Defl.)	2	7	—	—
Baltisphaeridium pilosum (Ehrenberg)	51	8	—	11
B. stimuliferum (Deflandre)	47	3	10	19
B. vestitum (Deflandre)	23	12	1	34
B. ehrenbergi (Deflandre)	19	15	—	11
B. tribuliferum sp. nov.	3	4	—	6
B. polytrichum (Valensi)	5	15	—	—
B. parvispinum (Deflandre)	—	—	—	4
Baltisphaeridium sp.	1	—	—	—
Cannosphaeropsis cauleryi Deflandre	22	3	1	14
Systematophora orbifera Klement	1	1	—	—
Dictyopyxis areolata Cookson & Eisenack	2	3	—	—
Chlamydophorella wallala Cookson & Eisenack	—	—	—	4
Cymatiosphaera parva Sarjeant	—	—	3	2

P. cf. helios Sarjeant	—	—	—	1
Micrhystridium inconspicuum (Deflandre)	17	30	114	62
M. fragile Deflandre	33	14	14	8
M. recurvatum Valensi	7	5	?	—
M. stellatum Deflandre	8	1	—	4
M. rhopalicum sp. nov.	2	?	6	9
M. rarispinum Sarjeant	—	2	19	—
M. sydus Valensi	—	—	10	—
M. cf piveteavi Valensi	1	—	—	—
M. deflandrei Valensi	—	—	3	—
Leiosphaeridia similis Cookson & Eisenack	—	—	6	4
L. chytroeides sp. nov.	40	128	32	3
L. sp.	—	—	25	—
Palaeostomocystis sinuosa Cook. & Eis.	—	—	2	—
Stephanelytron scarburghense Sarjeant	7	4	1	1
S. redcliffense Sarjeant	7	7	21	20
Netrelytron stegastum Sarjeant	6	10	—	3

TABLE 2. List of microplankton species present in the Melton assemblages, showing numerical distribution by horizon.

LOCATION / STAGE NAME (with ammonite zones) / SPECIES OF MICROPLANKTON	France	France	England (North Yorkshire and Dorset)										FRANCE		Malm S.W. Germany		Australasia			England	N.	England (Melton, S. Yorks)			
			CALLOVIAN				OXFORDIAN															Ampthill Clay			
							Q. mariae		C. cordatum																
	BAJOCIAN	BATHONIAN	M. macrocephalus	S. calloviense	K. jason	E. coronatum:P. athleta:K. lamberti (NOT YET OBTAINED)	LOWER	UPPER	LOWER	UPPER	P. plicatis	E. bimammatum	OXFORDIAN (C. cordatum)	LOWER KIMMERIDGIAN	OXFORDIAN	LOWER KIMMERIDGIAN	OXFORDIAN	L. KIMMERIDGIAN	M.-U. KIMMERIDGIAN	U. KIMMERIDGIAN	POST-KIMMERIDGIAN	62 foot	45 foot	25 foot	10 foot
Gonyaulax cladophora	X	X		X	X		X	X	X	X	X	X	X		X	X	X	?				X	X	X	X
G. jurassica		X		X	X		X	X	X	X	X	X	X		X	X	X	?				X	X	X	X
G. caytonense			X																						
G. cristulata			X																						
G. transparens			X																						
G. eisenacki					X						X		X		X							X	X	X	X
G. ambigua					X						X			X						X		X	X	X	X
G. nuciformis					X								X									X	X	X	X
G. areolata							X	X	X																
G. acanthosphaera							X		X		X											X	o	X	X
G. paliuros										X		X										X	X	X	X
G. pachyderma												X	X									X			
G. nealei																						X	X		
G. eumorpha																	X	X	?			X	X	o	X
Ctenidodinium ornatum									?	X			X		X							X	X	o	X
Pluriarvalium osmingtonense												X										·		X	
Palaeohystrichophora spinosissima									cf.	cf.			X									cf.			
Palaeoperidinium dictyophorum										X			X												
Pareodinia prolongata			X																						
P. ceratophora	X		var		X		var	X	X	X	X	X										X	X	X	X
Nannoceratopsis pellucida									X				X				X	X	?			X	X	o	X
Scriniodinium luridum					X		X	X	X	X	X		X	X	X		X	?				X	X	X	X
S. crystallinum							X	X	X	X	X		X		X	?	X					X	X	X	X
S. galeritum								X		X			X		X	?						X	X	X	
S. dictyotum												X					X	X				X	X	X	X
S. subvallare											X											X	X		
S. oxfordianum										X		X											X	X	X
Hystrichosphaera furcata												X	X								X		X		
Hystrichosphaeridium salpingophorum							X	X		X	X	X	X		X						X	X	X		
H. cribrotubiferum										X															
Cannosphaeropsis filamentosa			X												X		X								
C. caulleryi				X	X		X	X	X	X	X	X	X							X		X	X	X	X
C. aemula								X	X	X					X										
Systematophora orbifera															X								X		
S. valensii											X														

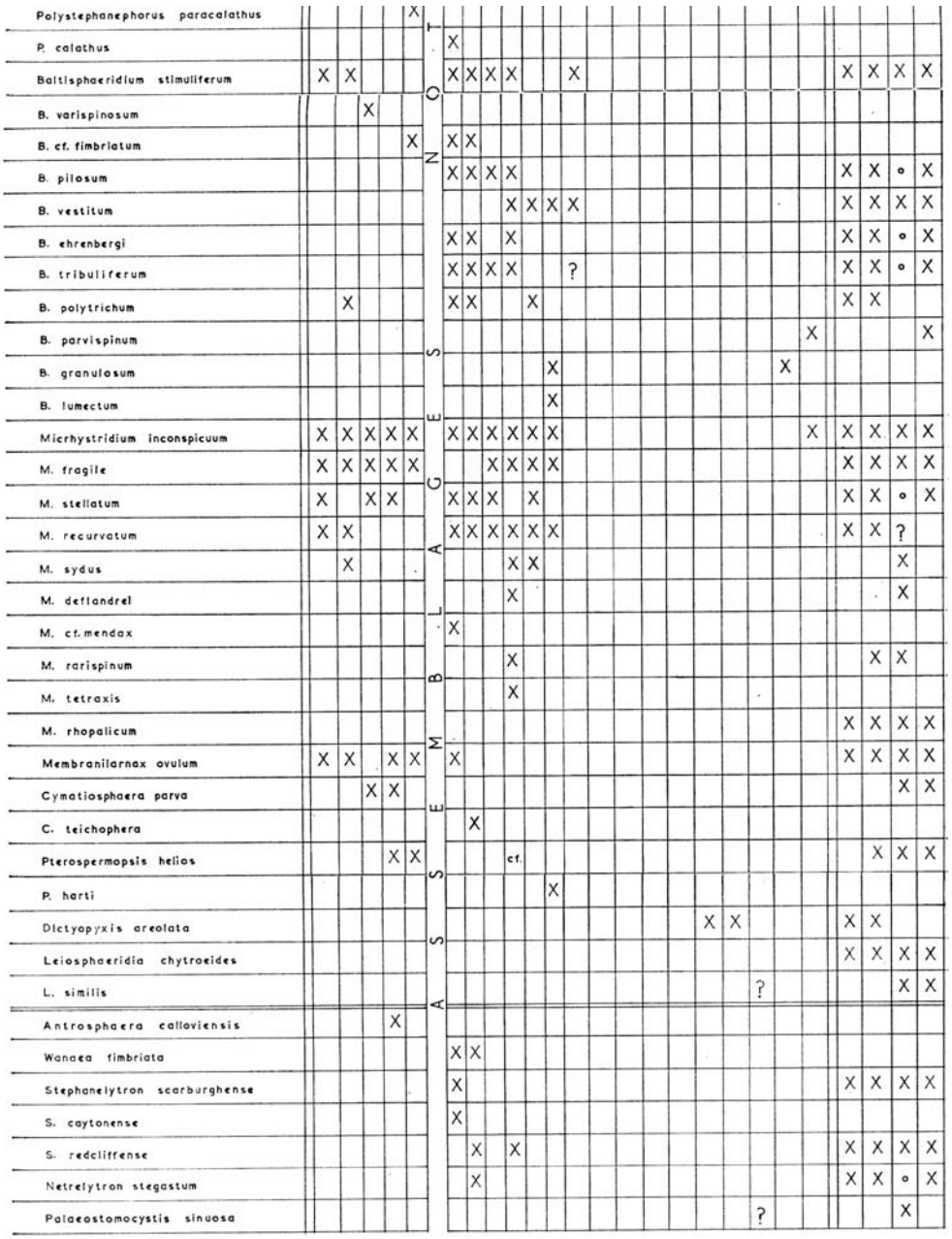


TABLE 3. Known distribution by horizon of microplankton species in British Callovian and Oxfordian assemblages described to date, compared with the known distribution of these species at other localities and horizons. (Distribution of species in the Bajocian and Bathonian of France based on Deflandre 1947, Valensi 1953; in the Oxfordian and L. Kimmeridgian of France, on Deflandre 1938, 1941; in the German Malm, on Klement 1960: in the Upper Jurassic of Australasia, on Cookson and Eisenack 1958, 1960: in the Upper Kimmeridgian of England, on Downie 1957: and in post-Kimmeridgian sediments, on Deflandre 1934, 1937, O. Wetzel 1933, &c.)