

Observations on the Jurassic dinocyst genera *Energlynia* and *Wanaea*

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ABSTRACT. Topotype material of all known species of the Jurassic dinocyst genera *Energlynia* and *Wanaea* has been examined, and forms the basis of a brief review of the genera. Observations and interpretations of specific morphological features are presented. A new species *Wanaea thysanota* is described and the diagnosis of *Wanaea digitata* emended.

INTRODUCTION

The organic-walled dinocyst genus *Wanaea*, originally of unknown affinity, was recognised as a dinoflagellate by Evitt (1961). Subsequently, Evitt (1963) suggested that all fossil dinoflagellates represent the cyst phase in the life-cycle of the dinoflagellate individual. Confirmation of Evitt's theory came from observations on Recent dinoflagellates by Rossignol (1963), Evitt & Davidson (1964) and Wall & Dale (1968).

Wanaea was first described from Upper Jurassic deposits of Western Australia by Cookson & Eisenack (1958). They distinguished three species, *W. spectabilis* (the type species), *W. clathrata* and *W. digitata*. A fourth species *W. fimbriata* was described by Sarjeant in 1961 from the Oxford Clay of Yorkshire.

Morphologically, *Wanaea* consists of a large cone-shaped hypocyst with a short antapical horn and a single prominent, lace-like paracingular flange, which is interrupted at the parasulcus (Fig. 1). The archaeopyle is epicystal, the operculum consisting of the entire epicyst, which is only slightly apically convex, and is circular to ellipsoidal in polar view. The cyst surface is essentially smooth, and non-tabulate.

In 1975, *W. acollaris*, a species of Bathonian age, now known to range from the late Bajocian to late Callovian, was described from Bulgaria by Dodekova. *W. acollaris* lacked the prominent paracingular flange which characterised the other species of *Wanaea* and, in addition, exhibited a faint gonyaulacoid paratabulation, the cyst surface variably smooth to granulate. In the following year, Sarjeant (1976) described forms which were in all probability conspecific with *W. acollaris*. However, Sarjeant erected a new genus *Energlynia*, with its type species *E. kyrbasia* to accommodate these cysts, suggesting that forms without a prominent paracingular flange should not be included in *Wanaea*. *W. acollaris* was subsequently transferred to *Energlynia* by Sarjeant (1978), who commented on the possible synonymy of *E. kyrbasia* and *E. acollaris*. *Wanaea zoharensis* Conway 1978, and *Wanaea indotata* Drugg 1978 were later

described, both of which are referable to *Energlynia* on the basis of overall morphology.

A full study of both *Wanaea* and *Energlynia* was made by Fensome (1981), who formally synonymised *Energlynia acollaris*, *E. kyrbasia* and *Wanaea zoharensis*, and transferred *Wanaea indotata* to *Energlynia*, maintaining it as a separate species, but acknowledging that “*E. indotata* may well prove to fall within the range of variation of *E. acollaris*”. Fensome (*op. cit.*) also suggested a possible phylogenetic sequence from *Energlynia acollaris*/*E. indotata* through the various species of *Wanaea*, based on the relative ‘complexity’ of the paracingular flange, with *W. digitata* (s.s.) and *W. fimbriata* being linked by an intermediate form *Wanaea* sp. A, split off from *W. digitata* (s.l.). *Wanaea* sp. A is here given formal specific status as *Wanaea thysanota* sp. nov.

MATERIAL

In the study of dinocysts from Middle and Upper Jurassic strata from central England (Woollam 1980), the present author encountered numerous representatives of *Wanaea* and, to a lesser extent, *Energlynia*. Abundant specimens of other related dinocysts with epicystal archaeopyles, in particular *Ctenidodinium*, and also *Energlynia*, were subsequently observed while investigating the distribution of dinocysts in the Middle Jurassic rocks of southern England. The remarkable abundance of dinocysts with epicystal archaeopyles in certain strata, combined with their obvious stratigraphic importance, stimulated an extensive review of the group to be undertaken. The results presented here represent part of that investigation, relating to *Wanaea* and *Energlynia*.

Topotype material of *Wanaea spectabilis* and *W. clathrata*, held in the palynological collections of the Geology Department, University of Sheffield, and the type material of “*Wanaea zoharensis*”, also housed in Sheffield, were examined. Dr L. Dodekova kindly provided topotype material of *Energlynia acollaris*.

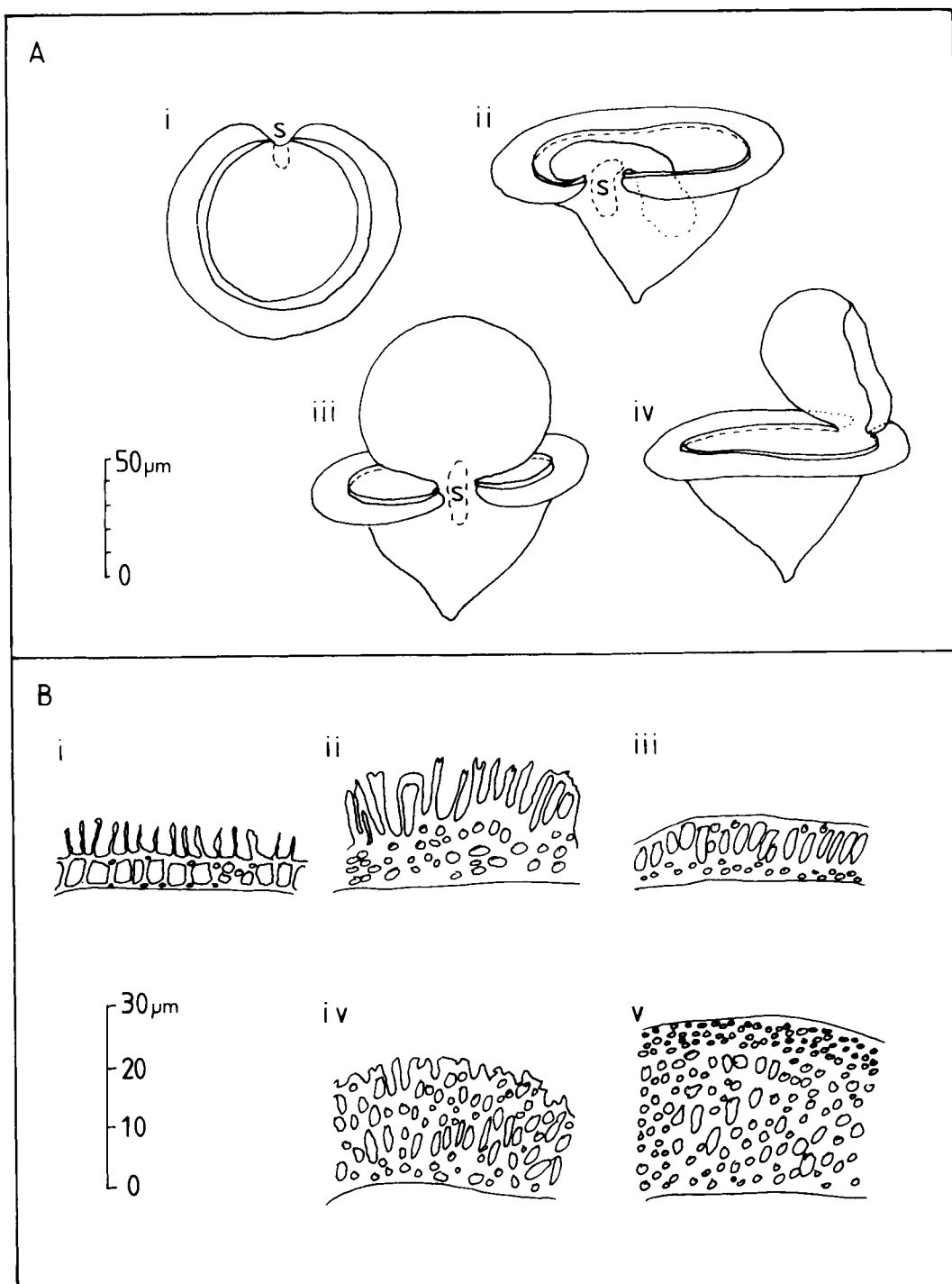


Fig. 1.

A General morphology and archaeopyle structure of *Wanaea* (schematic). s = parasulcus
 (i) Apical view; (ii) Ventral view, operculum 'flopped' inside hypocyst; (iii) Ventral view showing parasulcal "hinge", operculum hinged open; (iv) Right dorsal view, operculum hinged open.

B Paracingular flange morphology.
 (i) *Wanaea digitata*; (ii) *W. thysanota* sp. nov.; (iii) *W. spectabilis*; (iv) *W. fimbriata*; (v) *W. clathrata*.

Dr R. Helby and the National Museum of Victoria provided topotype material of *Wanaea digitata*. Topotype material containing *Wanaea fimbriata*, “*Energlynia kyrbasia*” and *Energlynia indotata* was collected from outcrop. Additional samples used in the study were also collected from outcrop. Well-preserved material of *Energlynia indotata* from Brora, Scotland was kindly provided by Dr R. Porter. Dr R. Morgan provided access to a number of colour transparencies of the Australian type specimens for examination.

The figured material is housed in the MPK collections of the Institute of Geological Sciences, Leeds.

MORPHOLOGY AND TAXONOMIC NOTES

The following remarks are brief comments on important aspects of the morphology and taxonomy of *Energlynia* and *Wanaea*.

Genus *Energlynia* Sargeant, 1976.

Description: cysts proximate, broadly biconical; hypocyst large, cone-shaped with a short antapical horn; epicyst relatively small, slightly apically convex, circular in polar view. Archaeopyle epicystal; operculum simple, compound, corresponding to all paraplates of the epicyst, attached ventrally. Paratabulation absent, or indistinct, gonyaulacoid, indicated by low parasutural or rows of spinelets; paracingulum may be more distinct, indicated by a low ridge or nebulous rim.

Remarks: No regularly occurring accessory archaeopyle sutures have been observed in the present study. This is in contrast to the observations of Sargeant (1976), Stover & Evitt (1978) and Fensome (1981). However, random splitting of the operculum occasionally occurs along parasutures and/or within paraplate areas, probably caused by damage during compression and flattening of the epicyst.

Under normal working conditions, the consistent recognition of species of *Energlynia* is difficult. The pronouncement of Fensome (1981), recognising only *E. acollaris* and *E. indotata* as separate species, is provisionally accepted here. However, examination of the topotype specimens of *E. acollaris* and its junior synonym “*E. kyrbasia*” illustrated in Pl. 1, figs. 1, 2, 4, 5, shows clear differences in size, details of shape and surface ornament, and paratabulation development between the two “species”. They may possibly be explained as ecophenotypic varieties. *E. indotata* (Pl. 1, figs. 3, 6, 7) is characterised by a relatively smooth cyst wall with a nebulous paracingular rim; Pl. 1, fig. 3 shows a faintly paratabulate, detached epicyst of *E. indotata*.

Genus *Wanaea* Cookson & Eisenack, 1958 emended Fensome, 1981.

Description: Cysts proximochorate (pterate), broadly biconical; hypocyst large, cone-shaped with a short antapical horn; epicyst relatively small, slightly apically convex, circular in polar view. Archaeopyle epicystal, operculum simple, compound corresponding to all paraplates of the epicyst, attached ventrally. Paratabulation generally absent except for a single prominent, lace-like, paracingular flange, interrupted at the parasulcus. The flange consists of radially arranged processes, variably inter-connected, and may form a perforate meshwork.

Remarks: Fensome (1981) emended the generic diagnosis of *Wanaea*, restricting the genus to forms generally lacking paratabulation, with the exception of a single paracingular flange (some specimens of *W. fimbriata* seen in this study show very faint parasutural lines on the epicyst—see Pl. 2, figs. 3, 5). This modified the generic synopsis of Stover & Evitt (1978) who mistakenly noted that forms with two paracingular flanges exist (which is clearly not the case), and who also followed Dodekova’s informal enlargement of the generic diagnosis to include forms with indications of paratabulation, other than a paracingular flange, now placed in *Energlynia*.

In both *Wanaea* and *Energlynia* the principal archaeopyle suture occurs along an equatorial line, interpreted as running above the anterior margin of the paracingulum. The archaeopyle suture divides the operculum, the complete epicyst, from the hypocyst. Suturing is not entire, the operculum remaining attached over a short length of the equatorial margin corresponding in position to the line of interruption of the paracingular flange. The area of attachment is interpreted as the parasulcus (Fig. 1A). Loss of the operculum which occasionally occurs is almost certainly due to secondary damage to the rather flimsy parasulcal “hinge”. No regularly occurring accessory archaeopyle sutures have been observed in the present study, although secondary splitting of the operculum was observed in a small proportion of specimens, probably due to compression and flattening of the epicyst.

Species recognition in *Wanaea* is based on the morphology of the paracingular flange (Fig. 1B). Four species have been delineated in this way: *W. spectabilis*, *W. clathrata*, *W. digitata* and *W. fimbriata*. In addition, Fensome (1981) split off a fifth species from *W. digitata*, informally designated *W. sp. A*. The latter species is found commonly in Europe in the late Callovian and early Oxfordian, and is quite different from *W. digitata* (s.s.), found only in Australia in the late Jurassic. *Wanaea sp. A*. of Fensome (*op. cit.*) is therefore given formal specific status herein, as *Wanaea thysanota* sp. nov., and *W. digitata* emended accordingly, being restricted to the Australian type material.

Wanaea thysanota sp. nov.
(Pl. 2, fig. 1)

- 1967 *Wanaea* sp. cf. *W. digitata* Cookson & Eisenack; Evitt: 80, pl. 10, figs. 4-6.
1968 *Wanaea digitata* (auct. non.) Cookson & Eisenack; Sarjeant: 233, pl. 1, fig. 2.
1972 *Wanaea digitata* (auct. non.) Cookson & Eisenack; Sarjeant: 46, pl. 7, fig. 5.
1978 *Wanaea digitata* (auct. non.) Cookson & Eisenack; Muir & Sarjeant: pl. 2, fig. 1.
1979 *Wanaea digitata* (auct. non.) Cookson & Eisenack; Fensome: 80, pl. 10, figs. 4-6.
1980 *Wanaea digitata* (auct. non.) Cookson & Eisenack; Woollam: 25, pl. 4, fig. 1.
1981 *Wanaea* sp. A Fensome: 56, fig. 1.

Derivation of name. Greek, *thysanotos*, fringed.

Holotype: No. MPK 3444. Middle Oxford Clay, 50cm below Lamberti Limestone, *lamberti* Zone, Upper Callovian, Woodham Brick Pit, near Aylesbury, England (Grid. Ref. SP 710170).

Diagnosis. Epicyst slightly apically convex, hypocyst broadly conical, with a short rounded antapical horn. Archaeopyle epicystal, an equatorial line of schism partially separating the simple compound operculum (the entire epicyst), from the hypocyst. Cyst wall smooth, paratabulation generally absent, except for a prominent lace-like (posterior paracingular) equatorial flange which is interrupted along a line corresponding to the area of attachment of the operculum (parasulcus). The equatorial flange consists of radially arranged processes, varying in length from 10 to 20 μ m, occasionally linked but generally free distally, simple, bifurcate or capitate, coalescing towards their bases to form a variably perforate crest.

Remarks. This species is erected to accommodate forms previously placed in *W. digitata*, but which do not accord with the type material of the latter.

Wanaea digitata Cookson & Eisenack, 1958 emended.

- 1958 *Wanaea digitata* Cookson & Eisenack: 58, pl. 9, figs. 2-5.

Holotype: Learmouth Formation, W.A., Wapet's Rough Range Well No. 1, 4376-79 ft P17298, Plate IX, fig. 2. (Paratype; Broome, W.A., Artesian Bore No. 3, 1405-27 ft, Plate IX, figs. 3-5).

Diagnosis. (emended). Hypocyst broadly conical with a short rounded antapical horn, epicyst flattened, only slightly apically convex, ellipsoidal in polar view. Archaeopyle epicystal, an equatorial line of schism partially separating the simple compound operculum (the entire epicyst) from the hypocyst. Cyst wall smooth, paratabulation absent, except for a lace-like (posterior paracingular) equatorial flange, which is interrupted along a line corresponding to the area of attachment of the operculum (parasulcus). The equatorial flange consists of radially arranged processes, generally no more than 10 μ m in length, usually thin, simple, bifurcate or capitate, consistently linked between one-third to half way along their length, but free distally.

Remarks. The diagnosis is emended to exclude those forms now placed in *W. thysanota* sp. nov., which do not accord with the type material of *W. digitata*.

OCCURRENCE

Published records of forms referable to *Energlynia* are from N. W. Europe and Israel, although they are present in Australian assemblages (R. Morgan, pers. comm.). *Energlynia* is clearly ancestral to *Wanaea* and ranges from the late Bajocian to late Callovian in Europe.

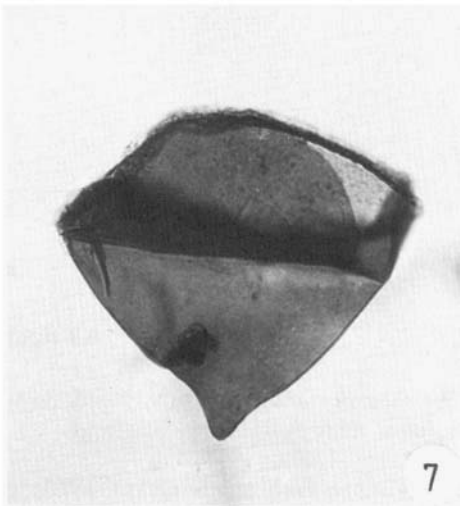
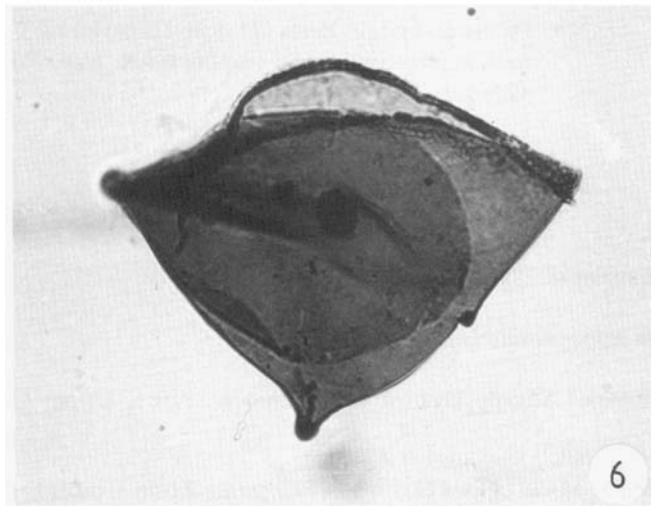
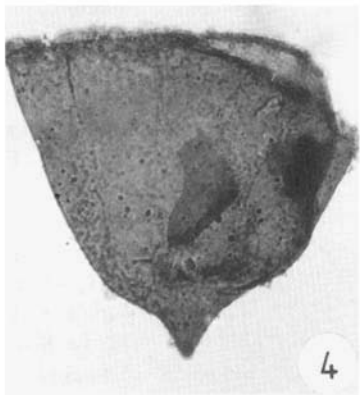
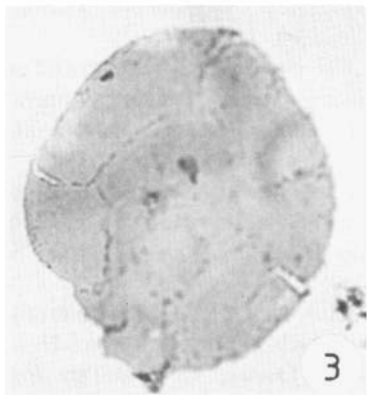
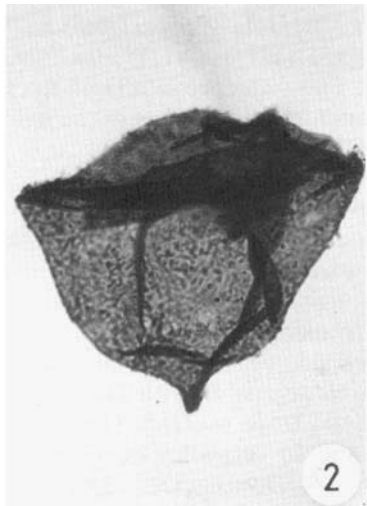
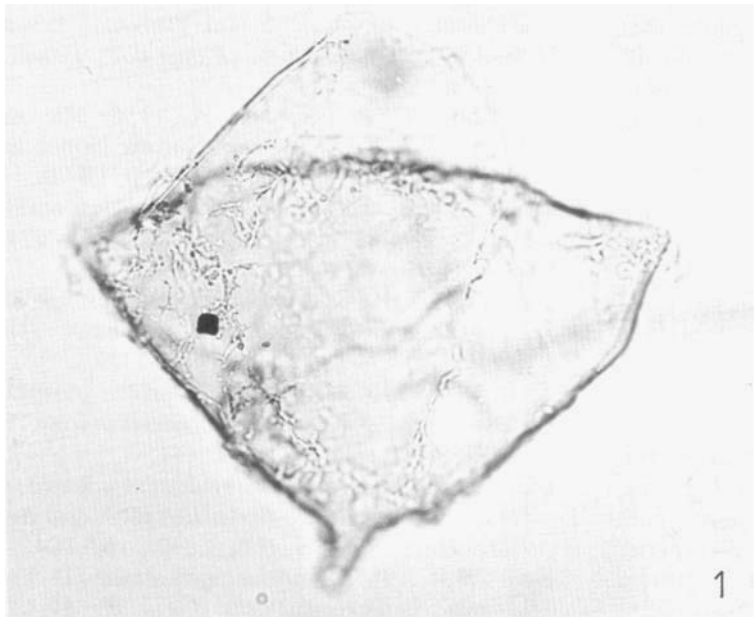
In Europe, Greenland and Canada only two species of *Wanaea* occur; *W. thysanota* (late Callovian to early Oxfordian), and *W. fimbriata* (early Oxfordian). *W. digitata*, as redefined herein, has not been recorded. Records of *W. clathrata* from these regions are probably misidentifications of *W. fimbriata*, both possessing similar paracingular flanges. Some variation in the character of the flange in *W. fimbriata* is shown in Pl. 2, figs. 2-5.

In Australia three species of *Wanaea* are known; *W. spectabilis*, *W. clathrata* and *W. digitata* (s.s.), all of which are of late Jurassic age. Current data suggest that these species are restricted to Australia.

Explanation of Plate 1

All figures are approximately x700.

- Fig. 1. *Energlynia acollaris* (Dodekova, 1975) Sarjeant, 1978, MPK 3437. Borehole C-32, Dolina. 745.5m. Upper Bathonian. Bulgaria.
Figs. 2, 4, 5. "*Energlynia kyrbasia*" Sarjeant, 1976, MPK 3430, MPK 3429, MPK 3427. Blisworth Limestone, hodsoni Zone Upper Bathonian, Ketton Grange Quarry, England.
Figs. 3, 6, 7. *Energlynia indotata* Drugg, 1978, MPK 341 (operculum), MPK 3433, MPK 3432. Brora Roof Bed, calloviense Zone, Lower Callovian, Brora, Scotland.



Fensome (1981) has postulated a phylogenetic sequence based on increasing complexity of the paracingular crest, from *W. spectabilis* to *W. digitata*, then *W. thysanota* (*W. sp. A*), *W. fimbriata* and finally *W. clathrata*. This sequence is difficult to envisage given the spatial/temporal distribution of the individual species as outlined above.

ACKNOWLEDGEMENTS

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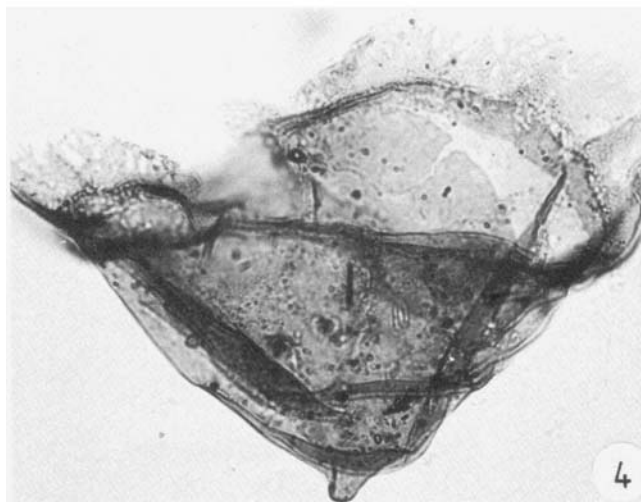
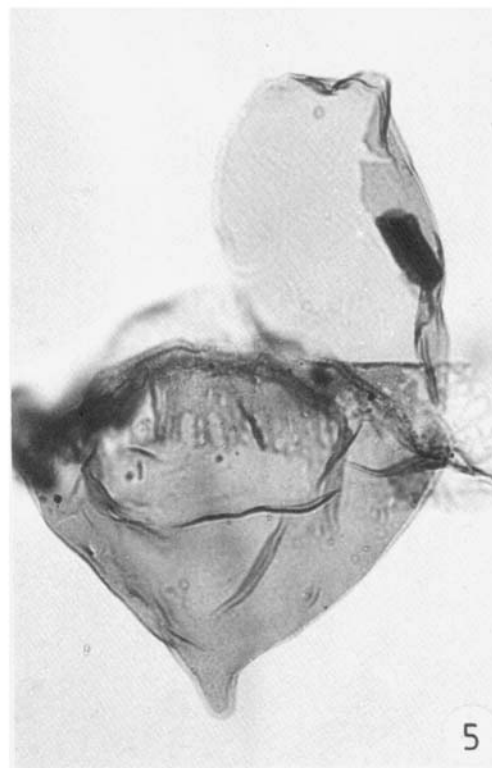
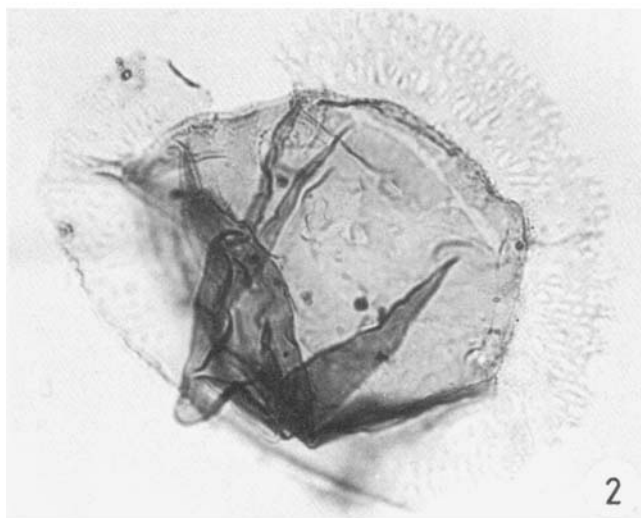
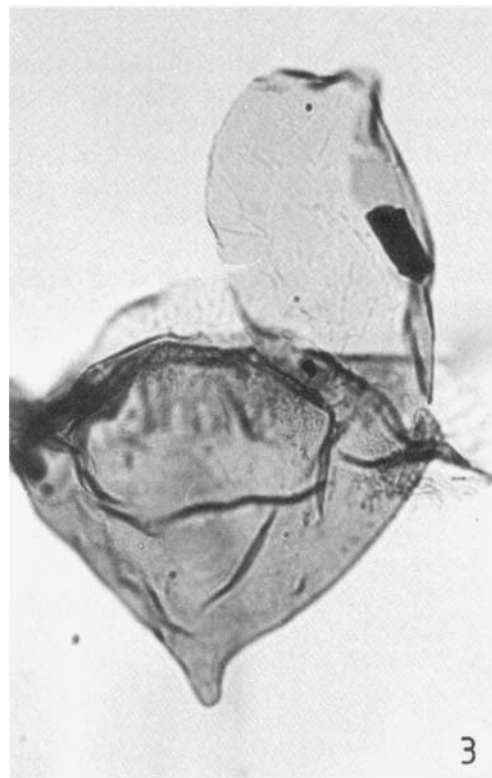
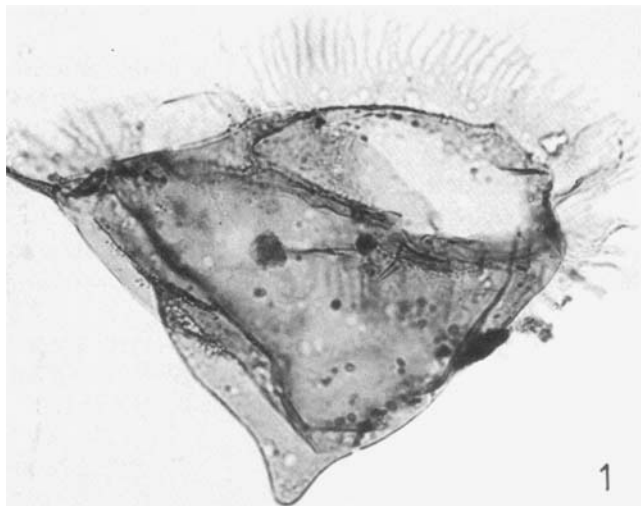
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Explanation of Plate 2

All figures are approximately x700.

Fig. 1. *Wanaea thysanota* sp. nov. MPK 3444 (holotype) Middle Oxford Clay, *lamberti* Zone, Upper Callovian, Woodham, near Aylesbury, England.

Figs. 2-5. *Wanaea fimbriata* Sarjeant, 1961: fig. 2. MPK 3442. Upper Oxford Clay, *mariae* Zone, Lower Oxfordian. Stewartby, near Bedford, England; figs. 3, 5, MPK 3443, as 2; fig. 4, MPK 3445. Upper Oxford Clay, *mariae* Zone, Lower Oxfordian. Woodham, near Aylesbury, England.



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