

A new assemblage of palynomorphs from the low-grade Upper Devonian metamorphic rocks of east Cornwall

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The deformation and low-grade metamorphism of the Variscan rocks of south-west England have caused difficulties in the use of standard palynological techniques. With rare exceptions, yields in the past have been low. The difficulties associated with the use of conventional oxidation techniques, necessary to enable transmitted light microscopy, have been overcome by the use of scanning electron microscopy which allows close analysis of the palynomorph surface structure and ornament. Taxonomically care must be taken in assigning a detailed nomenclature, as some palynomorphs are diagnosed by internal structures. The technique is being applied with considerable success in clastic sequences in a joint programme of research between the University of Exeter and the British Geological Survey. The sample described comes from the grey undivided Upper Devonian slates of east Cornwall, and has produced a well preserved and predominantly marine assemblage with an Upper Devonian age (Figs 1 and 2).

The sample was prepared using routine palynological procedures (Playford and Dring 1981), but omitting the intense oxidation techniques usually employed upon carbonised palynomorphs (Neves and Dale 1963). After acid-etching and centrifuging with zinc bromide, the resultant organic residue was strew-mounted and gold-coated, prior to analysis on a standard bench-top SEM. The SEM technique is detailed elsewhere (Dean 1989). As conventional palynological analysis is carried out on a transmitted light microscope, a programme of detailed comparison of the morphologies revealed by the two methods is in progress.

The palynomorph assemblage comes from a grey slate horizon identified near Landrake north of Plymouth; the locality lies east of the road to Skeltons Park Farm (SX 36956199). This study forms part of the detailed review of the regional structure and stratigraphy currently being undertaken by the British Geological Survey (North Cornwall and South Devon Project). The Upper Devonian age obtained is consistent with the ostracod-based determination made in the area by Gooday (1973) and the dominance of the acritarch phase confirms a predominantly marine origin for the grey slate sequence.

The complete faunal list is set out below, it should be noted that although significant spore diversity is represented, numerically spores are relatively infrequent. Long-ranging Devonian palynomorph species present here include *Micrhystridium stellatum*, *Veryhachium downiei*, *Veryhaehium trispinosum*, *Punctatisporites sp.* and *Leiotriletes sp.* The spore phase contains several typically, though not exclusively, Frasnian species, in particular *Punctatisporites ferquensis*, *Dictyotriletes perlotus*, *Leiotriletes cf. nigratus*, *Punctatisporites pullatus* and *Apiculiretispora granulata* which was first described from the Frasnian of Canada, though subsequent findings are rare.

The acritarch species not mentioned above are very similar to Upper Devonian assemblages described from North America and Australia (Playford and Dring 1981), and Cornwall (Turner *et al.* 1979). *Gorgonisphaeridium absitum*, *Gorgonisphaeridium ohioense* and *Unellium*

winslowae are typical Upper Devonian species, while *Micrhystridium cf. comatum* and *Micrhystridium cf. albertensis* are more typical of the Frasnian. *Gorgonisphaeridium evexispinosum* is restricted to the Famennian. *Multiplicisphaeridium sp.* differs only from the Upper Givetian species *M. procerum* in its very small size.

Unidentified chitinozoan fragments are found but are not illustrated. The assemblage is clearly marine, with a restricted terrestrial input.

Acritarch phase

<i>Dictyotidium cf. torosum</i>	Playford and Dring, 1981
<i>Gorgonisphaeridium absitum</i>	Wicander 1974
<i>Gorgonisphaeridium ohioense</i>	(Winslow) Wicander, 1974
<i>Gorgonisphaeridium evexispinosum</i>	Wicander, 1974
<i>Micrhystridium cf. albertensis</i>	Staplin, 1961
<i>Micrhystridium cf. comatum</i>	Stockmans and Williere, 1962
<i>Micrhystridium stellatum</i>	Deflandre, 1945
<i>Multiplicisphaeridium sp.</i>	
<i>Veryhachium downiei</i>	Stockmans and Williere, 1962
<i>Veryhachium trispinosum</i>	(Eisenack) Downie, 1959
<i>Unellium winslowae</i>	Rauscher, 1969

Spore phase

<i>Apiculiretispora granulata</i>	Owens, 1971
<i>Dictyotriletes perlotus</i>	(Naumova) Mortimer and Chaloner, 1967
<i>Leiotriletes cf. nigratus</i>	Naumova, 1953
<i>Leiotriletes sp.</i>	
<i>Punctatisporites ferquensis</i>	Taugourdeav-Lantz, 1960
<i>Punctatisporites (Leiotriletes) pullatus</i>	(Naumova) Taugourdeau-Lantz, 1960
<i>Punctatisporites sp.</i>	
<i>Verrucosisorites sp.</i>	

The concurrence of such diagnostic taxa as *Gorgonisphaeridium ohioense*, *Gorgonisphaeridium absitum*, *Unellium winslowae*, *Punctatisporites ferquensis* and *Apiculiretispora granulata* confirms an Upper Devonian date, the last two species more typically indicate the Frasnian. The occurrence of *G. evexispinosum* which characterises the Famennian of Ohio (Wicander 1974) indicates that the typically Frasnian species may be misleading, or that *G. evexispinosum* ranges down further in the geological column in Cornwall than Ohio. On present evidence a conclusion on this cannot be reached, but a time close to the Frasnian/Famennian boundary can be deduced. The preponderance of acritarch species is consistent with the basal marine environment of deposition which has been proposed for the Upper Devonian slates lying north of Plymouth (Ussher 1907), and contrasts strongly with the spore-dominated assemblage from the Meadfoot Formation (Dean 1989).

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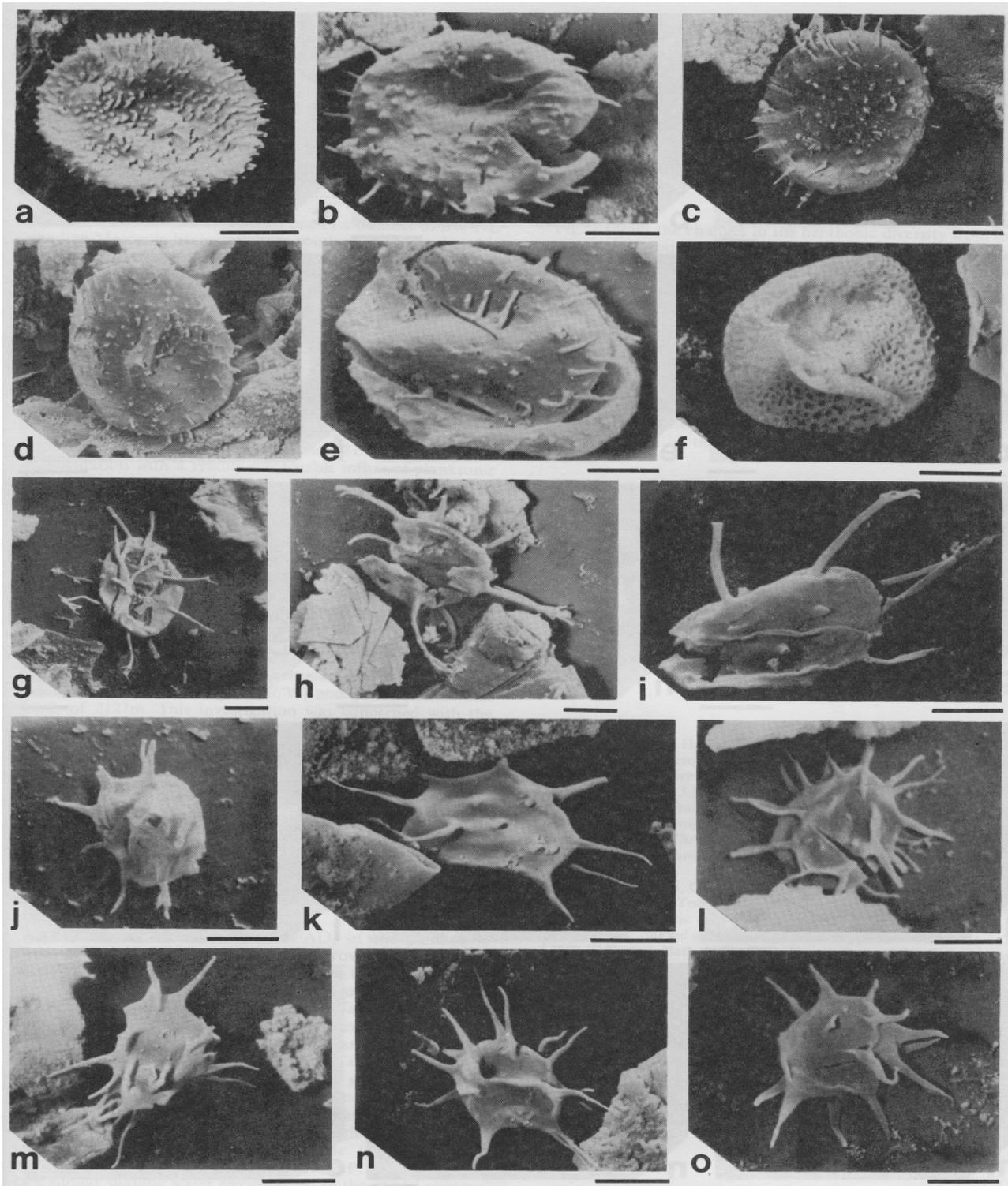


Figure 1. SEM photomicrographs of typical acritarchs. Scale bars equal 10µm.

a *Gorgonisphaeridium evexispinosum*, b, c, e *Gorgonisphaeridium ohioense*, d *Gorgonisphaeridium absitum*, f *Dictyotidium* cf. *torosum*, g, h, i *Multiplicisphaeridium* sp., j *Micrhystridium* cf. *comatum*, k, m *Micrhystridium stellatum*, l *Micrhystridium* cf. *albertensis*, n, o *Unellium winslowae*.

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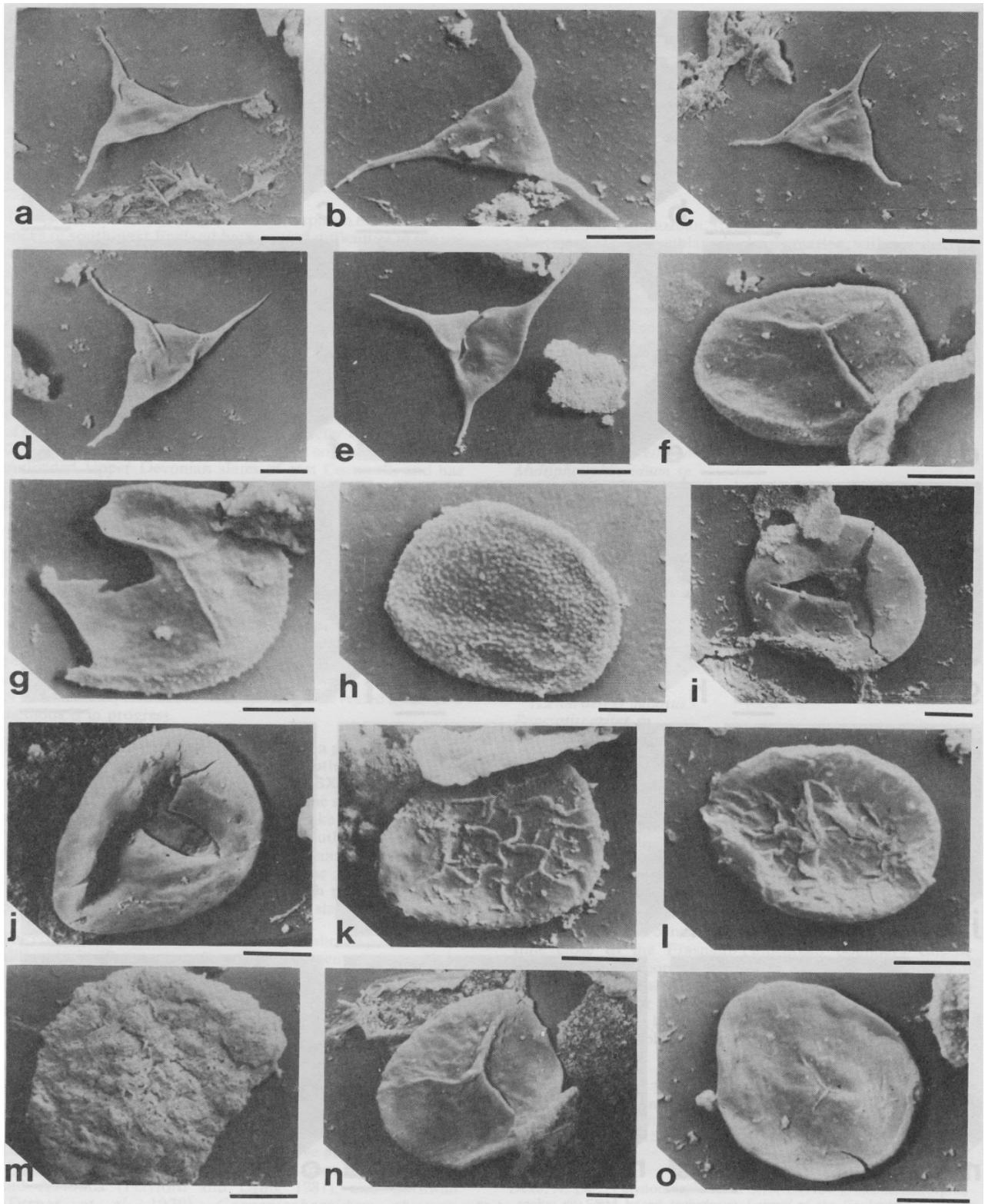


Figure 2. SEM photomicrographs of typical acritarchs and spores. Scale bars equal 10µm.

a, b, d *Veryhachium trispinosum*, c, e *Veryhachium downiei*, f, g, h *Apiculiretispora granulata*, i, m *Punctatisporites ferquensis*, j *Verrucosisorites* sp., k, l *Dicyotriletes perlotus*, n *Punctatisporites pullatus*, m *Leiotriletes* cf. *nigratus*.

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