THE FINE STRUCTURE OF SOME LOWER TRIASSIC ACRITARCHS

by ALAN WILLIAM MEDD

ABSTRACT. Acritarchs from the Lower Triassic of Western Australia are examined with an electron microscope. As they are almost opaque to the electron beam, a modified replication technique is used to elucidate the fine structure of their tests. This examination is shown to be of taxonomic value, and a new variant is described.

THE electron microscope has proved a very useful tool in the study of foraminifera (Hyde and Krinsley 1964), pollen (Pettit and Chaloner 1964), and coccoliths (Black and Barnes 1961; Black 1963). The present paper describes its application to the acritarchs. Examination of their replicas shows the presence or absence of even the smallest structure on the surface of the acritarch test. Such an examination, together with one using an optical microscope, has led the writer to revise several species of Triassic acritarchs.

Material. This paper is based on a sample (No. 43305) of Lower Triassic (Scythian), prepared by Balme (1963), from the Kockatea Creek No. 19 Bore, over 300 miles north of Perth, Western Australia. The sample is rich in excellently preserved microfossils, particularly the acritarchs.

All the specimens and photographs described are now in the Archive Collection of the Department of Geology, University of Reading.

Methods. Some of the material was mounted in glycerin jelly on glass slides and then examined with an optical microscope.

A dilute suspension of this sample was dried on a Formvar membrane, which rested on a 200 mesh-to-the-inch copper grid. The sample was then examined with a Philips EM75C electron microscope. As the acritarchs are almost opaque to electrons, a satisfactory transmission-electron image of their surface detail can only be obtained when the condenser lens is set for maximum intensity. Unfortunately, the heat generated by the electron bombardment of the Formvar membrane at this intensity is such as to break the membrane. Therefore, a lower electron intensity must be used and this is seldom found to produce satisfactory micrographs because of the loss of most of the surface detail (Pl. 59, fig. 1).

Replica techniques overcome this problem as the carbon film, which has been deposited on the specimen, exactly reproduces the surface detail and is stable under electron bombardment. The method, adopted by Bradley and Williams (1957) for the study of spore morphology in the genus *Bacillus*, is followed here with some refinements of their technique. The carbon film may break when the specimen is dissolved, as there is a slight swelling of the specimen and also because the solvent slowly attacks both carbon and copper. Other replica techniques have been developed to overcome these problems (Bradley 1958; Takeoku and Stix 1963), but repeated attempts to use these techniques on the acritarchs failed to obtain more than a few satisfactory replicas of the commonest species in the assemblage.

If the specimen is coated with a single thickness of carbon of 250–400 Å, instead of 100–200 Å as recommended by Bradley, the extra thickness of film renders it more resilient to the later chemical processes. It should not be so thick, however, as to mask the finer surface detail. The solvent used is a freshly made 20% solution of potassium dichromate and potassium permanganate mixture in concentrated sulphuric acid, instead of the 10% solution as used by Bradley. The grid is slowly immersed in this solution and held there in a vertical position for only a few seconds. The grid is then removed and washed first in dilute sulphuric acid, and then in concentrated hydrochloric acid, 50% hydrochloric acid, 10% hydrochloric acid respectively, and finally twice in distilled water. After drying it is

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ready for shadowing with platinum/palladium metal. With this series of washings after the solvent treatment, there is usually a high percentage of the grid still covered by the film, and so every species in the assemblage can be examined with the electron microscope. Electron micrographs were taken on Ilford N60 plates and developed in Kodak D76.

SYSTEMATIC DESCRIPTIONS

Group Incertae sedis ACRITARCHA Evitt 1963
Sub-group SPHAEROMORPHITAE Downie, Evitt and Sarjeant 1963
Genus MICRHYSTRIDIUM Deflandre 1937 emend. Downie and Sarjeant 1963

Micrhystridium cf. *breve* Jansonius 1962

Plate 59, fig. 6

Remarks. Electron micrographs of the specimens referred to this species show that the thin-walled test possesses large, irregularly arranged granules; the processes are short (length about 2μ) and are easily broken, when they leave bosses (diameter $0{\cdot}5\mu$) on the surface of the test. Although the specimens examined have a smaller test diameter (about 11μ) than that considered to be typical by Jansonius, they are otherwise similar to one of his figured specimens: Imp. 3010–2–113·5×28·6.

Micrhystridium cf. *fragile* Deflandre 1947

Plate 59, figs. 1 and 2*a*, *b*

Remarks. The electron micrographs show that the test and processes are thin-walled and are covered by a regular arrangement of small granules (diameter about 500 Å). The long processes of this species are robust but flexible and occasionally develop from expanded bases on the surface of the test.

Wall and Downie (1963) suggest that the only valid criteria for distinguishing *M. fragile* Deflandre from *M. stellatum* Deflandre are that the former has delicate processes without expanded bases, and that the latter possesses relatively rigid processes whose bases are expanded. The Triassic specimens examined have some of the diagnostic elements of both species: they have a test diameter of about 13μ (about 25–29μ including processes), which is comparable to the range of measurements of *M. stellatum* as given by Wall and Downie. The occasional basal expansion of the processes is also characteristic of *M. stellatum*, whereas the dominantly spherical nature of the text and the flexible processes are diagnostic of *M. fragile*. Wall and Downie also stated that: 'Separation of the two species becomes artificial to some extent, especially in some

EXPLANATION OF PLATE 59

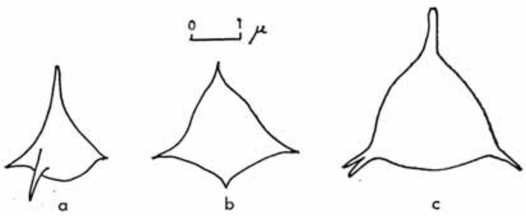
Figs. 1, 2*a*, *b*. *Micrhystridium* cf. *fragile* Deflandre. 1, E.M. 213, ×3500. 2*a*, E.M. 291, ×3000. 2*b*, E.M. 291, showing the granular test surface, ×10,000.

Figs. 3–5. *Veryhachium reductum* (Deunff) Jekhowsky. 3, Forma *breve*, E.M. 250, ×3300. 4, Forma *trispinoides*, E.M. 204, ×2500. 6, Form with a coarsely granular test, E.M. 777, ×3200.

Fig. 6. *Micrhystridium* cf. *breve* Jansonius, E.M. 260, ×5000.

Figs. 1 and 4 are electron micrographs of the specimens; figs. 2*a*, *b*, 3, 5, and 6 are carbon replicas. shadowed at 45° with platinum/palladium.

Jurassic strata, but on this basis the Permian forms must be regarded as belonging to *M. stellatum* since their spine bases are always expanded even if the spines are not always rigid.' Agreeing with these remarks, the writer by contrasted reasoning considers the Triassic specimens to belong to *M. fragile*; forms comparable with the holotype of *M. stellatum* are not found in this sample.



TEXT-FIG. 1. *Veryhachium reductum* Deunff, forms possessing a fourth process. *a*, S.A.M. 1–67 ×152. *b*, S.A.M. 2–54 ×119. *c*, S.A.M. 3–210 ×151.

Sub-group POLYGONOMORPHITAE Downie, Evitt and Sarjeant 1963
Genus VERYHACHIUM Deunff 1954, emend. Downie and Sarjeant 1963

Veryhachium reductum Deunff 1954

Plate 59, figs. 3–5; text-fig. 1

Remarks. All of the morphological variants described by Jekhowsky (1961) can be recognized in the sample, and there is no dominance of any of his types. Electron micrographs show the test to be thin-walled and to have a surface irregularly covered by fine granules. A further morphological variant which is occasionally found in the sample has a coarsely granular test with convex sides, together with three short processes. This is differentiated from *V. reductum* forma *breve* Jekhowsky by the more granulose nature of the test. Although this is suggested by the optical microscope investigation, it is clearly shown by the electron micrographs.

During an optical examination of several hundreds of specimens of this species, four were found to possess four processes instead of the typical three. One of the corner processes is bifid in two examples (text-fig. 1*c*), and they are probably similar to the type mentioned by Brosius and Bitterli (1961) for a specimen from the Trochitenkalk (Upper Muschelkalk). The other two have a fourth process on a separate part of the test, and all four processes are approximately of the same size.

Examination with an optical microscope of the tests of many specimens shows that their surface is often irregular. The electron micrographs indicate that there is some irregular folding of the test wall in about 40 per cent. of the specimens. This folding can occur anywhere on the test, perhaps with breakage of the test wall. Such folding and tearing occurs in other species in this sample, and could be interpreted as being collapse structures, caused by the compaction of the sediment.

Jansonius (1962) stated that: 'In Australian samples of Lower Triassic age forms assignable to *Wilsonastrum* occur abundantly; these have in part a modest but distinctive ornamentation, and show the tiny bristle very clearly. These include specimens of *W. colonicum* n. sp.' None of the specimens of this sample, examined with either the optical or the electron microscope, reveals the presence of this bristle, and so forms of the genus *Wilsonastrum* Jekhowsky are absent from this sample.

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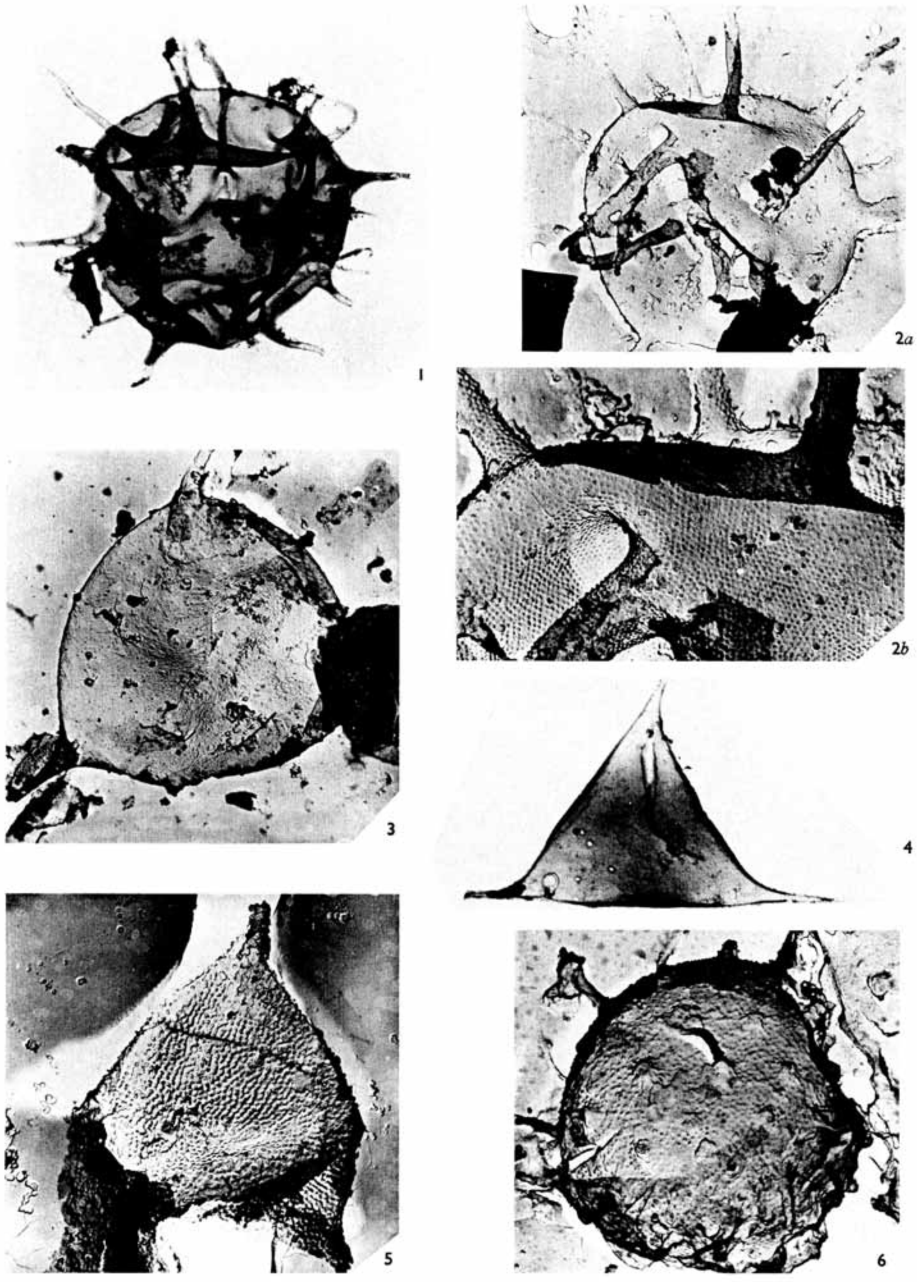

MEDD, Triassic acritarchs