

## Re-interpretation of the archaeopyle type in the dinoflagellate cyst *Leberidocysta? scabrata* (Jain & Taugourdeau-Lantz, 1973) Stover & Evitt, 1978 and its taxonomic reallocation

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**ABSTRACT** – The holotype and some additional specimens from the type material of the dinoflagellate cyst species *Leberidocysta? scabrata* (Jain & Taugourdeau-Lantz, 1973) Stover & Evitt, 1978, described from the Grey Shale Member (Lower Albian), Dalmiapuram Formation, Cauvery Basin, southern India are re-investigated. The diagnosis is emended and the species is reallocated to the genus *Ovoidinium* Davey, 1970, emend. Lentin & Williams, 1976. *J. Micropalaeontol.* 23(1): 11–14, May 2004.

### INTRODUCTION

Jain & Taugourdeau-Lantz (1973) and Jain (1977) described the dinoflagellate cysts, including several new taxa, from the Grey Shale Member, Dalmiapuram Formation (Upper Aptian–Middle Albian), Cauvery Basin, southern India. The present paper reports on a morphological re-investigation and taxonomic reallocation of one of the new species, viz. *Hexagonifera scabrata* Jain & Taugourdeau-Lantz (1973, p. 64, pl. 4, figs 11–12).

### STRATIGRAPHIC STATUS AND AGE OF THE GREY SHALE MEMBER

A thick, highly fossiliferous marine Cretaceous succession is exposed in the Cauvery Basin along the southernmost part of the eastern margin of India. The succession, ranging in age from ?Barremian/Aptian to Maastrichtian, is best exposed in the Ariyalur area. Subsequent to the three-fold subdivision of these rocks by Blanford (1862) – Uttatur, Trichinopoly and Ariyalur Groups in ascending order – modifications in the lithostratigraphy have been proposed by several workers (Ramanathan, 1968; Banerji, 1973; Sundaram & Rao, 1979, 1986; Ramasamy & Banerji, 1991; Tewari *et al.*, 1996; Sundaram *et al.*, 2001). Subbaraman (1968) first reported the occurrence of grey shale below the ‘reefal’ limestone in the lowermost part of the Uttatur Group from a quarry near Dalmiapuram. Bhatia & Jain (1969) named this grey shale unit as the Dalmiapuram Formation. Banerji (1972, 1973) extended the scope of the Dalmiapuram Formation by including the overlying ‘reefal’ limestone and proposed two members: a lower Shale Member and an upper Limestone Member. The Shale Member was later renamed as the Grey Shale Member (Banerji, 1982; Ramasamy & Banerji, 1991). Jain (1977), however, inadvertently first used the term Grey Shale Member, attributing it to Banerji (1972). Tewari *et al.* (1996) redefined the so-called ‘Grey Shale Member’ as the Grey Siltstone Member considering siltstone to be the main lithology of the unit.

The grey shale unit contains rich assemblages of terrestrial palynomorphs and dinoflagellate cysts (Jain & Subbaraman, 1969; Rao & Venkatachala, 1971; Jain & Taugourdeau-Lantz, 1973; Jain, 1977; Venkatachala & Kumar, 1980), nannofossils (Jafar & Rai, 1989; Kale & Phansalkar, 1992) besides smaller benthic foraminifera (Banerji, 1972; Venkatachalapathy & Ragothaman, 1995), ostracods (Bhatia & Jain, 1969) and few ammonites, bivalves and ichnofossils (Chiplonkar & Tapaswi,

1975; Phansalkar & Kumar, 1983). A probable Late Aptian–Early Albian age is suggested on palynomorphic (Jain, 1977) and foraminiferal evidence (Venkatachalapathy & Ragothaman, 1995), while nannofossils indicated a younger Early–Middle Albian age (Jafar & Rai, 1989; Kale & Phansalkar, 1992). Thus, the palaeontological evidence suggests an Early Albian age for the Grey Shale Member.

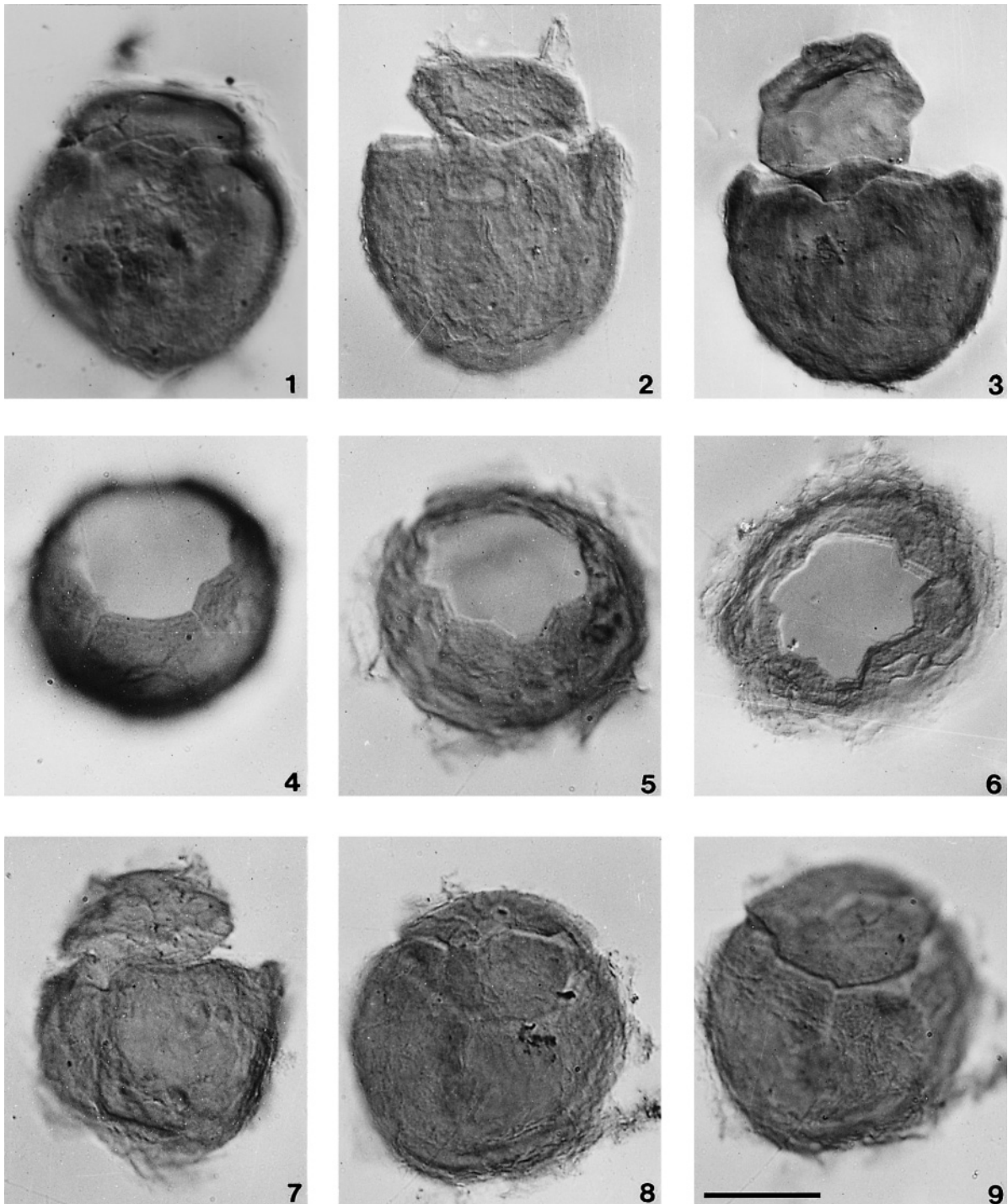
### TAXONOMIC COMMENTS

Jain & Taugourdeau-Lantz (1973) described *Hexagonifera scabrata* from the Grey Shale Member exposed in the Kallakudi quarry II, near Dalmiapuram. The species was characterized as:

Shell globular, 50–80 µm diameter, without any horn or appendages, enclosed in a spongy, fiber-like covering extending 4–6 µm beyond shell. Shell wall 4–5 µm thick, inner surface scabrate. Archaeopyle apical, apical operculum distinct, line of separation six sided, notches deep, 6 in number.

Stover & Evitt (1978, p. 60) tentatively transferred *Hexagonifera scabrata* Jain & Taugourdeau-Lantz, 1973 to *Leberidocysta*, though adding a note that ‘Configuration of archaeopyle uncertain’. Mehrotra & Sarjeant (1984, p. 50) decided to return *Leberidocysta? scabrata* (Jain & Taugourdeau-Lantz) Stover & Evitt, 1978 to the genus *Hexagonifera*, but this was subsequently rejected by Lentin & Williams (1985, p. 215).

The current re-investigation of the holotype of *Leberidocysta? scabrata* (Jain & Taugourdeau-Lantz, 1973, pl. 4, fig. 11; slide no. 3938–40) Stover & Evitt, 1978, as well as of several other well preserved specimens present in the assemblages (Pl. 1, figs 1–9), clearly indicates the presence of a combination type of archaeopyle formed by the removal of four apical and three anterior intercalary paraplates (**4A3I**). Therefore, the species *Leberidocysta? scabrata* (Jain & Taugourdeau-Lantz, 1973) Stover & Evitt, 1978 neither comes under the generic circumscription of *Hexagonifera* nor of *Leberidocysta* (since the archaeopyle in *Hexagonifera* is intercalary, standard hexa 2a, whereas it is apical, type **1A** in *Leberidocysta*). The nature of the cyst and combination type of archaeopyle (**4A3I**), indicate affinities with the genera *Ovoidinium* Davey, 1970 and *Ascodinium* Cookson & Eisenack, 1960. Both these genera have been the subject of discussion for a long time, especially with regard to their wall relationships and the type of archaeopyle. For publications



**Explanation of Plate 1.** Dinoflagellate cysts from the Grey Shale Member, Kallakudi Quarry II, near Dalmiapuram, Cauvery Basin, India. All photographs on BH2 Olympus microscope in DIC. Scale bar 20  $\mu\text{m}$ . **fig. 1.** *Ovoidinium scabratum* (Jain & Taugourdeau-Lantz) emend. *comb. nov.*, holotype (*Hexagonifera scabrata* Jain & Taugourdeau-Lantz, 1973, pl. 4, fig. 11; sl. no. 3938-40) re-photographed (E.F. no: X 40), showing archaeopyle sutures. **figs 2-9.** Other specimens of *Ovoidinium scabratum* (Jain & Taugourdeau-Lantz) emend. *comb. nov.*: **2**, specimen in ventro-lateral position with attached operculum (sl. no. 5053, E.F. no: K67); **3**, specimen in ventral view showing combination archaeopyle (**4A3I**) with operculum attached along the archaeopyle suture 1'-as (sl. no. 5063, E.F. no: M 33/4); **4**, specimen showing archaeopyle margins and precingular parasutural thinning between paraplates 3?-4? and 4?-5?, in dorsal view (sl. no. 5063, E.F. no: M 40/3); **5**, specimen showing archaeopyle sutures in ventral view (sl. no. 5056, E.F. no: D 42); **6**, specimen showing combination archaeopyle (**4A3I**) with archaeopyle margins: 1'-as, 1?-1', 1?-2', 2?-2', 2?-1a, 3?-1a, 3?-2a, 4?-2a, 5?-2a, 5?-3a, 6?-3a, 6?-4', 7?-4' and 7?-1', anticlockwise in apical view (sl. no. 5053, E.F. no: T 67/4); **7**, specimen in dorso-lateral view with attached operculum (sl. no. 5056, E.F. no: O 40/2); **8-9**, specimen in ventral and dorsal views respectively, showing archaeopyle sutures and precingular parasutural thinning (sl. no. 5054, E.F. no: O 51).

referring to the definition and the subsequent modifications of the morphological concepts of these two genera, the reader is referred to Cookson & Eisenack (1960, p. 5), Cookson & Hughes (1964, p. 40), Evitt (1967, p. 50), Davey (1970, pp. 351–352), Singh (1971, p. 336), Lentin & Williams (1976, pp. 101, 103), Norvick & Burger (1976, p. 87), Stover & Evitt (1978, pp. 201, 216–217), Davey (1979, p. 558) and Wilson & Clowes (1980, p. 17).

Helenes (1983) discussed the morphological features of *Ascodinium* and *Ovoidinium* and demonstrated that the two genera are similar with respect to the nature of the cyst (i.e. proximate, two layered), the relative thickness of the walls (i.e. thin periphragm and thicker endophragm), the shape of the endophragm (subspherical to ovoid) and the type of archaeopyle [combination (*tAtI*)]. They are, however, differentiated by wall relationships (bicavate vs. circumcavate) and the degree of angularity of the archaeopyle margins. He concluded (Helenes, 1983, p. 257) that ‘the morphologic characteristics common to *Ascodinium* and *Ovoidinium* are more numerous – perhaps more basic morphologically and less likely to be influenced by differences in the state of preservation – than those characteristics used to separate them’. Helenes (1983, p. 257) proposed to ‘redefine *Ascodinium*, modifying slightly Cookson & Eisenack’s (1960) original description of this genus to include the species formerly assigned to *Ovoidinium*’ and made *Ascodinium* Cookson & Eisenack, 1960 emend. Helenes, 1983, a senior synonym of *Ovoidinium* Davey, 1970.

Bujak & Davies (1983, pp. 62–63) described the archaeopyle in the genus *Ovoidinium* as being **4A3Ia**. At the same time they stated that

some species that have been attributed to *Ascodinium* had the typical Ovoidinioidean archeopyle (Stover & Evitt, 1978), *Ascodinium serratum* and *A. acrophorum* had an **A1a** archeopyle in which plate 3’ and 2a comprised the anteriorly attached operculum, as demonstrated by Lentin & Williams (1976).

Lentin & Williams (1985, p. 27) initially accepted the reasoning of Helenes (1983, p. 258), that *Ovoidinium* is a junior synonym of *Ascodinium*. Later, Lentin & Williams (1989, p. 28) followed Bujak & Davies (1983, pp. 62–63), retaining *Ovoidinium* as a separate genus (based on its distinctive archaeopyle), transferring species attributed to *Ascodinium* having an **4A3Ia** archaeopyle to *Ovoidinium*, and restricting *Ascodinium* to include only the species *A. acrophorum*, *A. parvum* and *A. serratum*.

This paper follows Lentin & Williams (1989) in retaining *Ascodinium* and *Ovoidinium* as two separate genera. Davey (1970, pp. 351–352) defined the genus *Ovoidinium* initially as being bicavate possessing one or two antapical horns and typically one apical horn. Later, he described a new species, *Ovoidinium diversum*, as

subspherical in shape with thin periphragm occasionally adhering so closely to the thick endophragm that no pericoel is formed or sometimes thin wrinkled, hyaline periphragm appears to form a loose enveloping cover around endocyst and the pericoel may be irregularly developed (Davey, 1979, p. 558).

He modified the original concept of the genus *Ovoidinium* to accommodate *O. scabratum*, referring to the shape of the cyst and wall relationship but placing more emphasis on the unique **4A3Ia** archaeopyle type. Restudy of the specimens described by Jain & Taugourdeau-Lantz (1973) from the Grey Shale Member of the Dalmiapuram Formation, Cauvery Basin, southern India clearly indicates the presence of combination type of archaeopyle formed by the total removal of the apical paraplates (4) and all the three anterior intercalary paraplates (**4A3Ia**) and, hence, needs assignment to the genus *Ovoidinium*. Therefore, the reattribution of *Hexagonifera scabrata* Jain & Taugourdeau-Lantz, 1973 to the genus *Leberidocysta* by Stover & Evitt (1978, p. 60) is rejected. *Hexagonifera scabrata* Jain & Taugourdeau-Lantz, 1973 is emended herein and a new combination is proposed below.

### SYSTEMATIC PALAEOONTOLOGY

Figured specimens described in this paper are from the type slides of Jain & Taugourdeau-Lantz (1973) and Jain (1977), based on the material collected from the Grey Shale Member, exposed in Kallakudi Quarry II, near Dalmiapuram, Cauvery Basin, southern India. The type slides are stored in the museum – Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow, India. Specimen location refers to the England Finder position on the respective slides.

### SYSTEMATIC DESCRIPTION

Division **Pyrrophyta** Pascher, 1914

Class **Dinophyceae**, 1929

Subclass **Peridiniphycidae** Fensome *et al.*, 1993

Order **Peridinales** Haeckel, 1894

Suborder **Peridiniineae** Fott, 1959 emend. Bujak & Davies, 1983

Family **Peridiniaceae** Ehrenberg, 1831

Subfamily **Ovoidinioideae** (Norris, 1978) Bujak & Davies, 1983

Genus *Ovoidinium* Davey, 1970, emend. Lentin & Williams, 1976

*Ovoidinium scabratum* (Jain & Taugourdeau-Lantz, 1973)

emend. *comb. nov.*

(Pl. 1, figs 1–9)

1973 *Hexagonifera scabrata* Jain & Taugourdeau-Lantz: 64, pl. 4, figs 11–12

1977 *H. scabrata* Jain & Taugourdeau-Lantz in Jain: 179, pl. 4, fig. 46

1978 *Leberidocysta? scabrata* (Jain & Taugourdeau-Lantz) Stover & Evitt: 60

**Type species.** *Ovoidinium verrucosum* (Cookson & Hughes, 1964) Davey, 1970.

**Emended diagnosis.** Cyst spherical to sub-spherical, without apical or antapical horns; proximate, two layered; periphragm spongy, fibre-like covering extending 4–6 µm beyond shell, variably developed; endophragm thick, about 4–5 µm, scabrate; endophragm and periphragm appressed, sometimes periphragm covers endophragm loosely, leaving irregularly developed pericoels; paratabulation indicated by archaeopyle alone and occasionally by parasutural thinning; archaeopyle combination

type, *4A3I*, with hexa 2a, operculum simple, free or attached along the archaeopyle suture 1'-as; cyst size range 50–80 µm.

**Holotype.** *Hexagonifera scabrata* Jain & Taugourdeau-Lantz (1973, pl. 4, fig. 11).

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