

ISOLATED ALGAL CYSTS IN THE PALAEOCENE-LOWER EOCENE OF KURDISTAN

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ABSTRACT. Individual spherical bodies from a richly algal deposit in the Palaeocene-Lower Eocene of Kurdistan are described in detail and interpreted as detached cysts from a dasycladalean alga believed to resemble *Halicoryne* (Cenozoic-Recent). The fossils are named *Sedalanella segonzacae* gen. et sp. nov.

THE Tethyan Palaeocene-Lower Eocene of Iraqi Kurdistan is locally richly algal, the microfloras showing a profusion of calcareous algae, both reds and greens. Amongst the latter the Dasycladales are represented by numerous species referable to fourteen genera (Elliott 1968, 1978; plus *Acroporella* sp., new record). The richest sample in my experience was that from near Sedalan, Sulaimaniya (details in Elliott 1978), a rock packed with fossils mostly algal, set in clear calcite. Amongst these are numerous examples of spherical bodies, described below, and now recognized as probably detached algal cysts.

MATERIAL

This consists of numerous examples seen in thin-section. The majority are uniformly near-circular, with thin outer wall of dark crystalline calcite, and infilling of clear calcite, or calcite and pyrite. These exclusively near-circular outlines, irrespective of diameter, indicate that these objects are near-spherical. There is, however, a minority of individuals in which the wall shows an irregular, 'crushed', outline.

Of the uncrushed circles, those of diameter from 0.15 mm up to about 0.36 mm mostly show an outer wall of blurred or fuzzy appearance, of which it is difficult to measure the thickness. They are interpreted as non-equatorial circles, with consequent oblique cuts of the wall structure. Those from 0.36 to 0.45 mm show clearly a wall of about 0.006 mm thickness, and are interpreted as full or near equatorial cuts. Some show a slight flattening of the circle on one side (text-fig. 1A). One showed an external coating of calcite on one hemisphere only, interpreted as a diagenetic feature. The infillings are usually of clear calcite, sometimes showing zones of different calcite growth, peripheral and central, and sometimes including small areas of pyrite, or in one instance, a pyritic core.

DISCUSSION

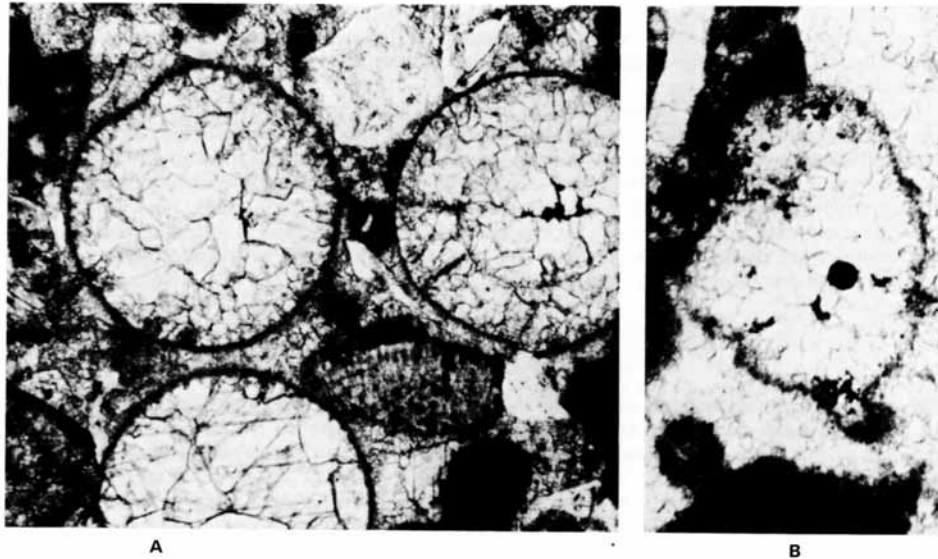
These objects are interpreted as single thin-walled dasycladalean reproductive cysts, freed from the plants of origin. In those living dasycladaleans which calcify, the cysts are formed in reproductive branches or chambers, and are usually indicated by individual cavities in a calcified body, occurring fossil as part of the main plant if this is heavily calcified; e.g. as in *Cymopolia*. Often, however, the calcified reproductive part, with its component cysts, is found separately, as in the familiar microfossil *Acicularia*. Groups of cysts with their individual calcifications fused may also occur. Adjacent cyst-formation in these groups may lead to crowding and deformation, with rounded-angular outlines and pyriform or tubular morphologies. None of the irregular Sedalan cysts (text-fig. 1B) show this: their outlines all appear due to pressure and crushing, and they are interpreted as uniformly *post-mortem* in origin. They appear to have been normal spheres, now showing *post-mortem* damage.

In the living *Halicoryne*, calcification is very light, except around the cysts. Valet (1969) has studied and figured these (along with the other living dasycladaleans) in great detail. In *H. spicata* (Kützing) Solms-Laubach the cysts are cemented in groups by their calcification, but in *H. wrightii* they are individually calcified, but separate within the uncalcified reproductive chamber. The flattened side of the Sedalan cysts probably indicates the operculum or mechanism by which the reproductive contents were eventually shed, as known to occur in these living species. Calcification is a feature of the adult growth-stages of dasycladaleans; it is especially characteristic of, and likely to originate around, their reproductive bodies, and may be confined to them in some genera.

Valet and Segonzac (1969) have studied the fossil record of *Halicoryne*; species are known from the Palaeocene-Lower Eocene of the south of France, and from the Czechoslovakian Miocene. Both are represented by aggregated cysts of the *H. spicata* type. In the French Palaeocene-Eocene species, the cysts are smaller in size and thicker-walled (cyst diameter 0.10 mm, wall-thickness 0.015-0.020 mm). The Miocene *H. moreletii* (Pokorny) Valet and Segonzac reaches the size of the Sedalan species, but is also thicker-walled (cyst diameter 0.20-0.40 mm, wall-thickness 0.030-0.035 mm).

Summarizing, the Sedalan spheres are interpreted as reproductive cysts from an extinct, largely uncalcified, dasycladalean alga. From living analogy, this could have been a *Halicoryne* sp. or a plant very similar. The cysts developed free in the reproductive chambers, and were probably the only structures of the plant to show calcification. A *Halicoryne* sp. is known from Tethyan rocks of the same age and similar facies in France, and the Miocene *H. moreletii* had cysts of a similar size. The wall-thickness of the Sedalan cysts is exceptionally thin, but does not otherwise conflict with what is known of the incidence of light calcification in dasycladaleans. The presumed operculum-site matches that known in the living *Halicoryne* spp. (Valet 1969).

It remains only to consider whether to name these spheres. Hollow calcareous-walled spheres



TEXT-FIG. 1A, B. *Sedalanella segonzacae* gen. et sp. nov. Thin-section examples from the Kolosh Formation (Palaeocene-Lower Eocene) of Sedalan, Sulaimaniya, north-east Iraq. BM (NH) V.41606, $\times 100$. 1A. Holotype, complete individual with portions of other individuals, one differently calcified. 1B. Crushed example.

occur at many stratigraphic levels from the Lower Palaeozoic onwards, and the term calcisphere is often used for this type of microfossil. It seems likely that they are of varied origins. However, Rupp (1966) drew attention to the similarity of recent acetabularian cysts to fossil calcispheres. Marszalek (1975), dealing with reproductive cysts of a species identified as the living *Acetabularia antillana* (Solms-Laubach) Egarod, studied the wall ultrastructure, and reviewed the environmental conditions and current taxonomy of these plants. Clearly some fossil calcispheres are probably of acetabularian algal origin. In view of the largely algal flora associated in the Kurdistan samples, and the occurrence elsewhere of *Halicoryne* at the same stratigraphic horizon, I think it desirable to name these objects. Whether this name will ever become a synonym of *Halicoryne* depends on future discoveries, if any, of cysts associated with plants.

SYSTEMATIC PALAEOONTOLOGY

Sedalanella gen. nov.

Type-species. *S. segonzacae* sp. nov.: Palaeocene–Lower Eocene of Iraqi Kurdistan.

Derivation of name. After the type-locality of Sedalan, Sulaimaniya, north-eastern Iraq.

Diagnosis. Calcareous, thin-walled, near-spherical hollow body, slightly flattened on one hemisphere.

Sedalanella segonzacae sp. nov.

Text-fig. 1

Derivation of name. In tribute to Mme G. Segonzac for her work on algae of the French Pyrenean Palaeocene–Lower Eocene.

Holotype. V.41606 (text-fig. 1A); British Museum (Natural History), Department of Palaeontology.

Horizon and locality. Palaeocene–Lower Eocene Kolosh Formation; 1.5 km south-west of Sedalan, 48 km north-west of Sulaimaniya, north-eastern Iraq.

Diagnosis. As for genus; diameter of hollow body 0.30–0.45 mm; wall-thickness 0.006 mm.

Other material. Numerous examples from the same horizon and locality, thin-sections V.32492, V.41606, V.51232.

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