THREE NEW TETHYAN DASYCLADACEAE (CALCAREOUS ALGAE)

by GRAHAM F. ELLIOTT

ABSTRACT. *Epimastopora malaysiana* sp. nov., from the Malayan Permian, is described from a unique whole solid specimen: normally remains of any *Epimastopora* sp. are extremely fragmentary. Also described are *Harlanjohnsonella annulata* gen. et sp. nov., and *Suppiluliumaella polyreme* gen. et sp. nov., from the Yugoslav and Turkish Cretaceous respectively, and both considered related to *Dissocladella*.

1. *EPIMASTOPORA*

REMAINS of the genus *Epimastopora* are common at many levels in the Upper Carboniferous and Permian of southern Europe and North Africa, the Middle East, Malaya and Japan, and the south-western United States. They are almost always fragmentary, consisting of small pieces of thin calcareous wall penetrated by numerous close-set canals or pores, and usually seen in thin-sections of limestones. This fragmentation has led to much speculation as to the original form of the thallus (Pia 1923, 1937; Wood 1943; Kochansky and Herak 1960, etc.), and has not been without influence on the synonymy (ref. summary in E. Flügel 1966).

Thin-section remains of whole thalli are extremely rare, though figured by H. Flügel (1963) and Elliott (in press): both of these are of the closely related *Pseudoepimastopora* (Endo 1961).

It is therefore of interest to describe a solid, nearly complete, three-dimensional specimen of *Epimastopora*. This rarity was found in Malayan Permian material collected by Dr. D. J. Gobbett (University of Malaya) and sent by him to me, and I am very much indebted for his permission to describe it.

Family DASYCLADACEAE Kützing 1843 orth. mut Hauck 1884
Tribus CYCLOCRINEAE Pia 1920
Genus EPIMASTOPORA Pia 1923

Epimastopora malaysiana sp. nov.

Plate 93, figs. 3, 4

Diagnosis. Elongate cylindrical dasycladacean test with rounded distal termination: calcareous walls very thin and fragile, perforated by very numerous close-set fine cylindrical pores or canals which are themselves subparallel, each with constricted terminal openings to inner and outer wall-surfaces: horizontal (peripheral) rows of pores grouped into fascicules of about seven rows each by sinuous horizontal lines of interruption; these separate but do not space apart the fascicules.

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Holotype. The specimen figured in Plate 93, figs. 3, 4 from the Middle Permian, H.S. Lee Mine no. 8, Kampar, Perak, Malaya (Jones, Gobbett, and Kobayashi 1966, p. 324). Brit. Mus. (Nat. Hist.) Dept. Palaeont. V53442.

Other material. One fragmentary specimen, same locality and horizon.

Description. The thallus is hollow-cylindrical in form, with gently curved longitudinal axis, circular cross-section and a rounded sub-paraboloid distal termination; the observed length (incomplete) is 35 mm. and the diameter 7·0–7·5 mm. The thin, very fragile wall is from 0·26–0·31 mm. thick. It is perforated by very numerous close-set fine radial branches or canals, set at right-angles to the longitudinal axis. These canals are straight-sided, the diameter sometimes widening very slightly outwards, but they are rounded at both ends, constricting to open on inner and outer wall-surfaces as circular pores of lesser diameter than the main portion of the intra-mural canal. A thin-section in the very fine-grained powdery dolomite replacing the wall shows the form of the canals, somewhat indistinctly, and suggests that their diameter is probably 0·078 mm. with separating interstices of 0·039 mm.

The wall has broken away distally to reveal the inner core, also of fine dolomite: this shows an outer surface-pattern due to the impression of the inner wall-surface, with detail in reverse. This pattern is of tiny raised circular areas (casts of the inner canal pores), very uniform in size and close-set spacing, about 220 to a complete horizontal peripheral ring. Longitudinally (vertically) the horizontal rows are separated into fascicules of six or seven by sinuous horizontal peripheral lines. These have a characteristic irregular appearance due to the sinuosities being independent as between consecutive lines. The distance apart of any two successive lines varies from 0·68–0·78 mm., and this distance, accommodating six or seven rows of pores, is compatible with the inner canal and interstice dimensions inferred from the thin-section.

The outer wall-surface shows a comparable pattern, but the canal terminations show as minute pore-openings in gentle depressions separated by interpore convexities. On rubbed or worn portions the pores are much larger, since the abraded surface intercepts the inner, larger canal-diameters. For this reason, although the pores of the outer surface correspond each to a pore-cast of the inner core-surface, the outer surface has a much less uniform appearance. The sinuous horizontal lines occur, but are much fainter and less obvious. Where a broken edge of the calcareous wall terminates across a sinuous line on the core, the sinuous line of the outer surface, when visible, may be seen to correspond with that on the core.

Remarks. This unique specimen shows that in the living *Epimastopora* calcification was confined to a very thin peripheral zone. The thick core may have been a large non-calcified juicy stem-cell, with presumed endospore reproduction, in which case the

EXPLANATION OF PLATE 93

Figs. 1, 2. *Harlanjohnsonella annulata* gen. et sp. nov. Upper Cretaceous; Fetrebovo, Zlatibor, Serbia, Yugoslavia. 1. Near-transverse thin-section; 2. Tangential thin-section. Both ×30; syntypes. B.M. (N.H.), V53441.

Figs. 3, 4. *Epimastopora malaysiana* sp. nov. Middle Permian; H.S. Lee Mine no. 8, Kampar, Perak, Malaya. 3. Holotype, complete specimen, ×3. 4. Distal portion, enlarged to show detail, ×10. B.M. (N.H.), V53442.

existing wall-canals described above were minute crowded branches, and their sinuous-fasciculate arrangement may have been a transitional stage from aspondyl to euspondyl branch-arrangement. Alternatively, a thinner non-calcified stem-cell of unknown diameter, could have given rise to euspondyl whorls of non-calcified primaries, in which case the preserved wall-canals are to be interpreted as crowded secondaries or tertiaries in sinuous zones corresponding each to an inner whorl. The fascicules as now seen are to be interpreted not as six or seven adpressed horizontal rows, but as irregular horizontal zones six or seven branches wide. This interpretation is compatible with either of the two reconstructions suggested above.

Although traces of matrix were feebly effervescent with weak acid, both core and wall were completely replaced by fine-grained, friable dolomite. This was difficult to section, and the details of the wall were not distinct, although as stated, the inferred dimensions are compatible with external evidence. Since all other *Epimastopora* spp. are based on clearly sectioned wall-fragments with measurable canals and little else (see tables in Johnson 1963), the present specimen shows so much more that it is described as a new species.

This new evidence on the external form of *Epimastopora* invites comparison with *Koninckopora*, of somewhat similar morphology and also of Upper Palaeozoic age. This latter genus was described in detail by Wood (1943) from solid specimens and many thin-sections.

Both genera show a thin marginal calcification only, giving a thin sheath-like calcified thallus. In *Koninckopora* the infilled cavities representing the branch-terminations are proportionally large, very thin-walled, and adpressed to give a polygonal structure in cross-section. This appearance had led to its earlier interpretation as a coral and as a bryozoan, and only later was it recognized as algal (Wood 1943). In *Epimastopora* the corresponding structures, 'pores', are separate filled cavities within the calcified wall, and although often close-set, are proportionally better spaced and not adpressed. In *Koninckopora* the cells show evidence of sporangial structures in their outer parts, interpreted by Wood from the differential calcification of the infilling This phenomenon has never been seen by me in very many thin-sections of *Epimastopora*, nor in the related *Pseudoepimastopora*, although in this latter genus the pores have been suggested as sporangial from the swollen morphology.

Wood (op. cit., p. 209) suggested the close relationship and possible identity of *Koninckopora* and *Epimastopora*. In view of the very limited palaeontological evidence from the surviving calcified structures, I regard the two as valid separate genera, both referable to Pia's 'tribe' (or subfamily) Cyclocrineae.

2. *HARLANJOHNSONELLA*

In material examined by me for Dr. J.-P. Rampnoux (Université d'Orléans-Tours), certain thin-sections showed a profusion of dasyclad debris and fragments: most of this proves to be referable to a new genus. This sample is from transgressive basal Upper Cretaceous, possibly Cenomanian, in the Zlatibor area of SW. Serbia; associated microfossils are fragments of a small *Clypeina* sp. (Dasycladaceae), gastropod and other molluscan shell-debris, and rare crustacean fragments. I am much obliged to Dr. Rampnoux for his kind permission to study and describe the alga.

Tribus THYRSOPORELLEAE Pia 1927 emend. Pia 1936

Genus HARLANJOHNSONELLA gen. nov.

Diagnosis. Weakly calcified thin-walled tubular and annular dasyclad, with successive verticils showing numerous swollen primaries, the presumed secondaries not being calcified. Upper Cretaceous; type-species *H. annulata* sp. nov.

Harlanjohnsonella annulata sp. nov.

Plate 93, figs. 1, 2; Plate 94

Description. Thin-walled, weakly and irregularly calcified dasyclad, length (incomplete) up to 6 mm. seen, external diameter up to and commonly 2·0 mm., exceptionally 2·25 mm., full wall-thickness 0·26 mm., giving a d/D ratio of about 74%, but commonly the calcification is incomplete and hence the stem-cell cavity appears even wider. The dasyclad is annular in structure; these annuli or rings, about 0·19–0·25 mm. thick, readily came apart, and by reason both of their proportions and their weak calcification they fragmented easily, so that the species is largely represented by debris. Each complete annulus shows about 48–50 primary branch-cavities, somewhat crowded so that neighbouring branches are sometimes directed at slight angles greater or lesser than normal from the stem-cell axis. Because of this the alternation in position of branches in successive verticils may appear irregular in tangential section. The branches are pyriform or flask-shaped, communicating with the stem-cell by a narrow pore-neck of 0·013 mm. diameter, and widening rapidly within the wall-thickness to a globular or ovoid cavity of 0·13–0·14 mm. diameter. These cavities are usually open to the exterior by reason of the ragged incomplete calcification of the outer annulus-surface, though exceptional preservation seems to suggest that the swollen cavities divided externally into thinner secondaries.

Syntypes. The specimens figured in Plate 93, figs. 1, 2, Plate 94, fig. 1 from the transgressive basal Upper Cretaceous, possibly Cenomanian, of Fetrebovo, Dlaglica, SE. of the Zlatibor massif, SW. Serbia, Yugoslavia. Brit. Mus. (Nat. Hist.) Dept. Palaeont. V53441, 53443.

Other material. Five thin-sections, rock from same horizon and locality.

Remarks. Harlanjohnsonella, thin-walled, the annuli crowded with simple swollen branches, and fragmentary, brings to mind especially the Carboniferous *Coelosporella*, the Permian *Epimastopora* and *Pseudoepimastopora*, and certain forms referred to the Cretaceous *Neomeris cretacea* Steinmann. From the former three genera it differs in its markedly annular character, the Palaeozoic fragments being random pieces of the thin tubular or flask-shaped thalli. From such forms as the annular *Neomeris cretacea* Delmas and Deloffre non Steinmann, from the Cretaceous (Delmas and Deloffre 1962),

EXPLANATION OF PLATE 94

Figs. 1, 2. *Harlanjohnsonella annulata* gen. et sp. nov. Upper Cretaceous; Fetrebovo, Zlatibor, Serbia, Yugoslavia. 1. Syntype, Longitudinal thin-section, ×30. B.M. (N.H.), V53443. 2. Thin section of matrix with numerous broken and fragmentary *Harlanjohnsonella*, ×10. B.M. (N.H.), V53444.

it differs in the apparently more simple branch-structure, *Neomeris* spp. showing globular sporangia flanked by thinner sterile branches. A closer comparison can be made with *Dissocladella*, especially the Palaeocene *D. savitriae* (Pia 1936). This species shows annuli of similar size and proportions, each with a similar number of branches, but more strongly calcified. Within this calcification each branch is seen to communicate with the stem-cell cavity by a narrow pore and to swell distally to a spherical body: from this a bunch of four to six thin short secondaries communicates with the outer surface. *Dissocladella* is now known to be represented by species from older Mesozoic to Palaeocene (Ott 1965); it seems likely that the form now described was, in fact, a dasyclad of very similar plant morphology to *D. savitriae* but more weakly calcified, so that no certain evidence of the original secondary branches remains. Geological age and the observed nature of the calcification alike fit with this interpretation. Since there is no direct fossil evidence of the secondary branch-structure the species cannot correctly be referred to *Dissocladella*, all of whose species show calcified remains of the secondary branching. I have pleasure therefore in referring it to *Harlanjohnsonella* gen. nov., in tribute to the distinguished American palaeophycologist Professor J. Harlan Johnson.

3. *SUPPILULIUMAELLA*

This new and striking Lower Cretaceous genus occurred in Turkish material reported on by me for Professor Fuat Baykal of Ankara University, and I am much indebted to him for permission to describe it.

Genus SUPPILULIUMAELLA gen. nov.

Diagnosis. Strongly calcified thick-walled tubular dasyclad, showing verticils of long thin primaries with large conspicuous terminal swellings, each dividing into very short swollen secondaries. Lower Cretaceous: type-species *S. polyreme* sp. nov.

Suppiluliumaella polyreme sp. nov.

Plate 95, figs. 1–4

Description. Strongly calcified tubular dasyclad; length 6 mm. (incomplete), external diameter 1·82 mm., internal diameter 0·62 mm., with consequent d/D ratio of 34%. Numerous close-set verticils of branches, about five or six verticils per millimetre of tube-length. The calcification extends inwards adjacent to each primary, so that the stem-cell cavity in vertical section has a regularly notched outline, showing as annular bars in vertical section tangential to the stem-cell cavity wall. The primaries joined the stem-cell on the undersides of these annular bars.

Each verticil is estimated to contain about twenty-four primary branches. These branches are initially almost straight, about 0·065–0·078 mm. thick, circular in cross-section and set at an angle of 65–70° from the horizontal, with consequent long oblique courses in the wall thickness. At about the outer third of wall-thickness they turn to an angle of 45° from the horizontal, and form conspicuous swellings, of up to 0·18 mm. diameter. In vertical section the swellings are rounded triangular or shield-shaped, with

apices inwards: in transverse section they are rounded squares or pentagons. Finally, each divides into four or five short closely adjacent rounded-cylindrical secondaries of 0·065–0·078 mm. diameter, which extend to the outer surface.

Holotype. The specimen figured in Plate 95, fig. 1, from the Lower Cretaceous limestones exposed about 16 km. SSE. of Amasya, a Turkish town about 260 km. ENE. of Ankara. Brit. Mus. (Nat. Hist.), Dept. Palaeont. V53445.

Paratypes. The specimens figured in Plate 95, figs. 2–4, from the same thin-section as the holotype.

Remarks. This peculiar and distinctive dasyclad shows the basic branch-pattern or plan of a thyrsoporellid, and since it divides after the primary swelling into secondaries only, is closest to *Dissocladella*. However, the proportions of primary, swelling and secondary, and the steep angle at which they occur is quite different to that in any known species of *Dissocladella*, which have very short horizontally set branches. For this reason the Turkish species is made the type of a new genus. The generic name commemorates King Suppiluliuma of the ancient Hittites, whose territory lay in what is now Turkey, and the specific name refers to the numerous oar-like branches as seen in thin-section.

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EXPLANATION OF PLATE 95

Figs. 1–4. *Suppiluliumaella polyreme* gen. et sp. nov. Lower Cretaceous; 16 km. SSE. of Amasya, Turkey. Thin-sections, × 30. 1. Holotype: longitudinal section. 2. Paratype: outer tangential section to show swellings and secondary branchlets. 3. Paratype: oblique-transverse cut to show form of branches. 4. Paratype: inner tangential section to show annular structures around stem-cell cavity. B.M. (N.H.), V53445.

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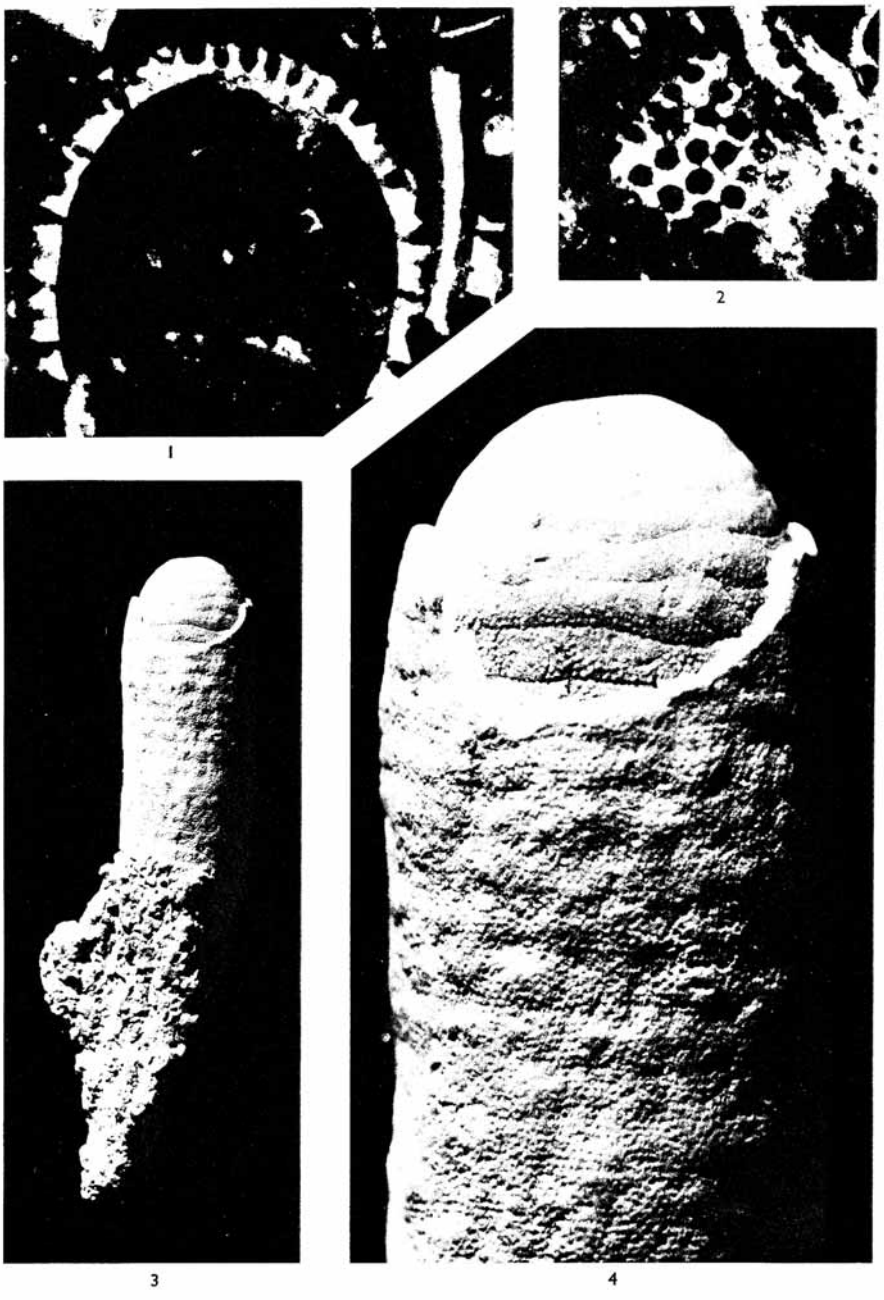

ELLIOTT, Tethyan Dasycladaceae

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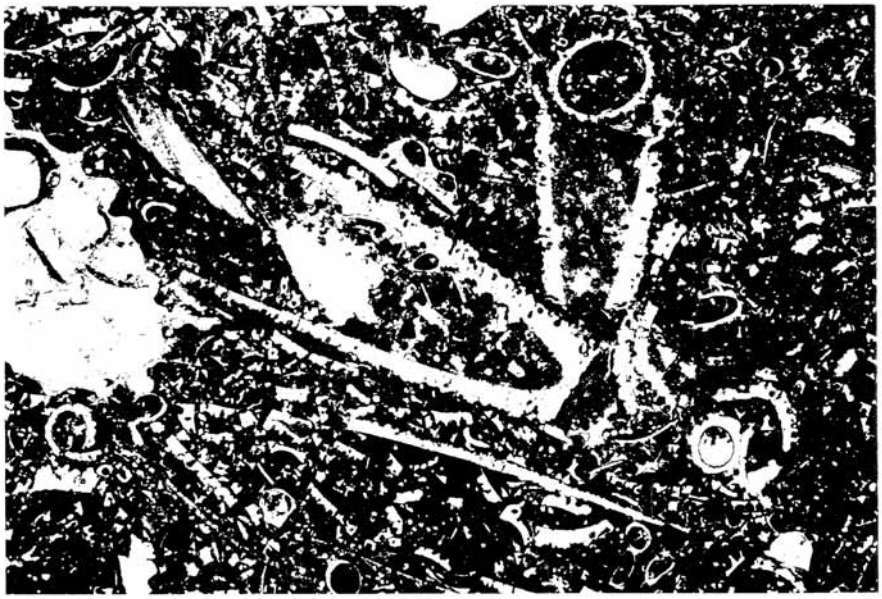

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ELLIOTT, Tethyan Dasycladaceae

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