PROBLEMATICAL MICROFOSSILS FROM THE CRETACEOUS AND PALAEOCENE OF THE MIDDLE EAST

by GRAHAM F. ELLIOTT

ABSTRACT. During studies of the non-foraminiferal microfossils, especially the algae, of the Middle East over the last decade a considerable number of problematical organisms have been noted. These include some whose allocation is doubtful, at varying taxonomic levels, or whose position has only recently been established, as well as new or unusual examples of known families and genera. A selection of these, Cretaceous and Palaeocene in age, is now placed on record as a further contribution to Tethyan micropalaeontology.

1. *Calcareous Algae*

Pseudolithothamnium was described by Pfender (1937) as an organism apparently similar in growth-form and appearance in reflected light to the melobesioid algae (of which *Lithothamnium* and *Lithophyllum* are common examples), but differing in the transparent appearance of the tissues in thin section, in which condition the melobesioids appear more or less uniformly dark. This distinction was ascribed to differences in the calcification during life. Pfender saw no close resemblance in the cell-structures of *Pseudolithothamnium* to those of the melobesioids, and although she described apparent sporangial structures she did not regard the fossil as close to this algal family, and only doubtfully referred it to the Rhodophyta (red algae). She recorded it from rocks ranging from Lower Cretaceous to Oligocene in age, over a very wide area of central and southern Europe, the Mediterranean Basin, the Middle East, and Madagascar.

Pseudolithothamnium was figured from the Upper Cretaceous of the Carpathians by Andrusov (1939), and recorded from both Upper Cretaceous and Palaeocene of northern Iraq by Elliott (1955, 1960). These records, following Pfender, were all referred to the single described species *P. album*.

More recently a convincing case has been put forward by Massieux and Denizot (1962) for the identity of the fossil *Pseudolithothamnium* with the Recent *Ethelia*. This is an encrusting lamellar red alga (family Squamariaceae), with a central mesothallus margined by upper and lower perithalli; the reproductive structures are temporary deciduous outgrowths from the upper surface. The internal structures are not normally easy to prepare in orientated section owing to the contorted and twisted nature of the thallus. Fossil records of *Pseudolithothamnium* are all based on random cuts in thin-section or fractured surfaces, and it is not surprising that the detailed structure of *Ethelia* has not been seen in them before. The somewhat doubtful alleged reproductive structures in the fossils are discounted and ascribed to mineralization and fracture.

Ethelia is a calcified warm-water genus; the calcium carbonate is in the form of aragonite, unlike the melobesioids, which are calcitic. This initial difference is considered the probable cause of the different appearance of the fossils in thin-section. It may be added that similar exceptions are known in largely aragonitic groups, e.g. *Pseudovermiporella* (calcitic) in the Dasycladaceae (largely aragonitic).

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Massieux and Denizot show similar structure in Recent Atlantic *Ethelia fosliei* and French Eocene *Pseudolithothamnium album* Pfender, but wisely do not attempt to equate the long-range fossil *Pseudolithothamnium album* with any of the modern botanical species of *Ethelia*, and therefore propose the combination *Ethelia alba* (Pfender 1937).

The Iraqi material now figured from the Palaeocene of Kurdistan, a richly algal level, comes from the Kolosh Formation at Rowanduz and the Sinjar Limestone at Sarmord. The Rowanduz slide (Pl. 47, fig. 1) shows a tangle of thalles of *Ethelia* intergrown with those of the melobesioid *Archaeolithothamnium* (and also with other algae, not shown). *Ethelia* is transparent, *Archaeolithothamnium* dark, except for the chains of sporangial cavities. Although the section shows a considerable area of *Ethelia*, only at one spot (Pl. 47, fig. 2) was it possible to discern a vertical cut of the thin thallus showing the central mesothallus and upper and lower perithalli. The thickness of this thallus-section (0·26 mm.) is comparable with that of the Recent *Ethelia* (0·23 mm.) given by Massieux and Denizot (1962, fig. 2). Much of the section shows as highly oblique cuts through successive laminae about 0·10–0·12 mm. thick; this is even better shown on the Sarmord specimen (Pl. 47, fig. 3), where the varying laminae range up to 0·24 mm. in thickness as seen, traversed by a curved-radial cell arrangement, and the section is presumably very highly oblique through a gently curved flat growth. This may not be the same species, but Pfender (1937, fig. 2) shows a somewhat similar section of Turkish Palaeocene material, with similar transparent tissues, and she refers to the curved-radial 'jet d'eau' cell-arrangement. In the Recent *Ethelia* the species *biradiata* and *fosliei* show considerable differences in section (Weber-Van Bosse 1921).

Ethelia alba is easily distinguished from the associated solenoporoid *Parachaetetes asvapatii*, a much more massive species in which the curved-radial structure is much coarser, and which is normally yellowish or buff in thin-section appearance. It is also different from those melobesioids in which diagenesis has altered the dark calcite to a translucent appearance with partial obliteration of cell-structure, a condition seen not uncommonly in various Tertiary limestones.

2. Bačinella

Bačinella was diagnosed by Radoičić (1959), from the Lower Cretaceous of Jugoslavia, as nodular and encrusting algae whose interior is constructed of irregular cells of different size and form, filled with crystalline calcite, whereas the intercellular mass is cryptocrystalline; the dermal structure is differentiated. In her description she states that, when exceptionally preserved, *B. irregularis* may show a subdermal structure like that of *Lithocodium aggregatum* Elliott.

Elliott (1956) described *L. aggregatum*, also Lower Cretaceous in age, as irregular nodular growths largely formed of thin superimposed thalles: within the outer zone of definite *Lithocodium* structure there occurs in some, but not all, cases a very coarse irregular inner mesh or spongy mass, described originally as 'a larger mass of irregular tubules, never radial and presumably of *Lithocodium* itself'. This inner structure is the same as in *Bačinella*.

There is thus often a close association between these two doubtfully algal growths; in spite of frequent recrystallization, they have been seen to occur both separately and together in favourable thin-sections of Middle Eastern material. Moreover, *Lithocodium* is itself often intimately intergrown with the lamellar stromatoporoid *Burgundia*.

It seems likely that *Lithocodium* and *Bačinella* may be constructed by the same organism, but, pending a full investigation on favourable material, it seems best to use both names, for the appropriate structures. Both are typically Lower Cretaceous, but Radoičić (1959) states that she has seen structures like *Bačinella* in both the Upper Jurassic and Upper Cretaceous. Upper Jurassic species of *Lithocodium* have been described by Endo (1961) from Japan. The example now figured (Pl. 48, fig. 3) is from the Qamchuqa Limestone, Albian level, of Zewiya, Pir-i-Mugrun, Sulaimania, north-east Iraq.

3. Microcalamoides

As described by Bonet (1956) from the Lower Cretaceous (Barremian to Lower Albian) of Mexico, this is a problematic microfossil in the form of a thin-walled cylinder, fluted or grooved with about thirty longitudinal sulci, and ranging from about 0·2 to nearly 1·0 mm. in diameter; the fossils are all fragmentary or incomplete. Bonet discusses the pelagic associations, filamental and perhaps ramifying structure, and possible algal nature of this organism, which he describes as *M. diversus*, with varieties A, B, and C.

It is now recorded from the Lower Cretaceous Yamama Formation (Valanginian–Hauterivian) of Iraq (Pl. 47, fig. 4). The example shown is larger (diameter 1·69 mm.) and approximates most closely to Bonet's type C; fragments of type B have been seen also. It is associated with debris of *Permocalculus*, dasyclads, and *Bačinella*; all are shallow-water algae, but fragmented and washed out to a deeper zone, and it could be a pelagic addition to this debris from the littoral zone.

As well as the Mexican and Iraqi records, *Microcalamoides* has been seen by the writer from the Lower Cretaceous of Borneo, and so it has a very wide distribution.

4. Calymenospongia

Studies of calcareous algae from the Middle East (bibliography in Elliott 1960; 1961) were largely carried out on thin-sections, owing to the nature of the material collected, though weathered or loose specimens were examined whenever available. A sample from the Palaeocene of Bekhme, Erbil Liwa, northern Iraq, consisted of a loose detrital serpentine sand rich in dissociated calcareous algae. Some of these, such as *Cymopolia* and *Halimeda*, were instantly recognizable; some, e.g. *Pagodaporella* (Elliott 1956), proved on dissection to be already well known in thin-section, and the solid fossil permitted description of the genus. The earlier reconstruction from sections of the external appearance of *Dissocladella* by Pia (Rama Rao and Pia 1936) was proved correct from specimens in this sample. Among these little algae was a fossil which, similar in size-range and general appearance to the others, was revealed on sectioning to be, not an alga, but a small calcisponge.

Genus CALYMENOSPONGIA gen. nov.

Small calcisponge of uniserial consecutive near-spherical hollow growths, fused at junctions, and communicating internally by large, single apertures; a few scattered, irregularly placed pores penetrating outer surface of growths. Palaeocene, Iraq.

Type species. C. kurdistanensis sp. nov.

Calymenospongia kurdistanensis sp. nov.

Plate 46, figs. 1, 2, 3

Description. This sponge is about 2·3 mm. long (incomplete), with a maximum diameter of 0·72 mm. It consists of a simple, straight or gently curved, single series of consecutive swellings delimited by constrictions, like a row of fused spheres. These are circular in transverse section: in the measured example quoted above there are six (one incomplete), the others having a height of 0·42 mm. A few scattered coarse pores are to be seen on each swollen surface. Internally, a longitudinal section reveals that each swelling or unit is hollow and thin-walled, with a wall-thickness of 0·03 mm. measured at the maximum diameter of the unit. Top and bottom, inside from the external constrictions, the walls continue inwards to fuse with those of the next unit in a swollen thickening; this is perforated in the centre by a large intercommunicatory pore. The vertical thickness of the swollen fused internal walls, and the horizontal diameter of the intercommunicatory pores which they encircle, are about the same, 0·15 mm. The scattered pores of the external surfaces are filled with calcite, but are believed to have originally perforated the wall: the diameter of one seen in section is 0·026 mm. The wall-structure throughout shows as mottled grey calcite interpreted as fused spicules; thin-sections of material from the famous Lower Cretaceous calcisponge locality of Faringdon, England, show a similar appearance.

Holotype. BM S8335 (Pl. 46, fig. 1), Kolosh Formation (Palaeocene), Bekhme, Erbil Liwa, northern Iraq.

Paratypes. BM S8336, S8337 (Pl. 46, figs. 2, 3), same locality and horizon.

Remarks. This sponge is closest to *Sollasia* (Steinmann 1882) from the Carboniferous of Spain, resembling it in size and general simplicity of structure, but differing in having a wall showing one layer only, unlike the two of *Sollasia*, and in showing a more complete fusion internally at the junctions of the walls of the consecutive units. This latter feature is probably only a consequence of the different wall-structure. The group of sponges to which *Sollasia* belongs has recently been carefully revised in great detail by Seilacher (1962), on the occasion of the description of new and exceptionally well-preserved material. He places *Sollasia* in the family Celyphiidae de Laubenfels, superfamily Aporata Seilacher, suborder Sphinctozoa Steinmann, order Pharetronida Zittel. Like *Sollasia*, *Calymenospongia* is catenulate and cryptosiphonate. Seilacher interprets the wall-structure

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EXPLANATION OF PLATE 46

Fig. 1. *Calymenospongia kurdistanensis* gen. et sp. nov. Holotype, BM S8335, × 50. Kolosh Formation, Palaeocene; Bekhme, Erbil Liwa, northern Iraq.

Figs. 2, 3. *C. kurdistanensis*, paratypes, BM S8336, S8337, vertical and transverse thin-sections, × 50; same locality and horizon.

Fig. 4. *Coptocampylodon lineolatus* gen. et sp. nov. Holotype, BM Z988, × 56. Sarmord Formation, Hauterivian, Lower Cretaceous; Surdash, Sulaimania Liwa, north-east Iraq.

Figs. 5, 6. *C. lineolatus*, lateral and terminal views of two examples, same locality and horizon, × 56.

Fig. 7. *Favreina prusensis* Paréjas. BM Z996, thin-section, × 56. Chia Gara Formation, bottom Cretaceous (Berriasian); Ser Amadia, Mosul Liwa, northern Iraq.

Fig. 8. *Coptocampylodon lineolatus*. Paratype, BM Z993, thin-section, × 56; Garagu Formation, subsurface Lower Cretaceous, Fallujah Well, Dulaim Liwa, Iraq.

of the Palaeozoic genus as spicules embedded in an original calcareous sclerosome, giving a rigid wall in life and hence occasioning intermittent segment growth. The hollow segments seen in this fossil are considered to have contained soft sponge tissue originally. These interpretations are applicable to *Calymenospongia* also.

Calymenospongia is the first member of the Sphinctozoa to be described from post-Cretaceous strata. It is easily distinguished from the somewhat similar *Sphaerocoelia* (Upper Jurassic–Cretaceous), which has a markedly perforate wall.

Simple sponges of this kind, of microfossil dimensions, may be of much more common occurrence than has been realized hitherto.

5. Coptocampylodon

Grooved spicules of Lower Cretaceous age have been familiar to micropalaeontologists handling Middle Eastern material for many years, and have usually been referred to as *Acicularia sp. Acicularia* s.s. (Tertiary and Recent) is a genus of dasyclad algae with a terminal calcified sporangial disc which eventually falls apart into radial petal-like calcareous spicules each containing numerous, tiny, spherical, sporangial cavities. More or less similar algal structures of varying form occur from the Jurassic onwards, usually as small dissociated bodies, and have been described as species of *Acicularia* s.l. At least three are known from the Lower Cretaceous: a small, spherical, sporangial body '*Terquemella*' *sp.*, the ovoid *A. antiqua* Pia, and the long, irregular *A. elongata* Carozzi. Transverse cuts of the Middle East spicule referred to above are not unlike similar sections of worn examples of the acicularians, but numerous longitudinal and oblique cuts reveal that it is different. It is now described and its possible biological nature discussed.

Genus COPTOCAMPYLODON gen. nov.

Small solid cylindrical calcareous bodies, longer axis gently curved or irregular, circular in cross-section but deeply incised by longitudinal grooves, ends irregularly rounded. Lower Cretaceous; Middle East and Borneo.

Type species. C. lineolatus sp. nov.

Coptocampylodon lineolatus sp. nov.

Plate 46, figs. 4, 5, 6, 8; Plate 48, fig. 2

Description. Solid short cylindrical calcareous bodies (units), up to 3·0 mm. in length (incomplete) and varying from about 0·25 to 1·0 mm. in diameter. The longer axis of the unit is gently curved or slightly irregular: the ends, when not obviously broken, are irregularly rounded. The outer surface, itself usually smooth, but in some examples showing a feeble transverse lamination, is deeply incised by parallel equidistant longitudinal grooves, from five to eight in number. In transverse section these grooves are seen to widen inwards and often to be near-circular in cross-section, with an internal diameter of 0·04–0·05 mm. The circular transverse section of the whole unit is notched by the grooves and has the appearance of a coarse sparsely spoked cog-wheel or of a stellate structure with truncated rays. Longitudinal sections show the parallel, matrix-filled grooves, either curved or passing out of the plane of the section owing to their irregularity.

Holotype. BM Z988 (Pl. 46, fig. 4); Sarmord Formation (Hauterivian level), Lower Cretaceous; Surdash, Sulaimania Liwa, north-east Iraq. *Paratypes*. BM Z993) (Pl. 46, fig. 8), subsurface Garagu Formation, Lower Cretaceous; Fallujah Well, Dulaim Liwa, Iraq.

Other material. Numerous examples, solid and thin-section, from the Lower Cretaceous of Iraq. Seen in thin-section from the Lower Cretaceous of Borneo.

Remarks. As stated above, transverse sections of *Coptocampylodon* have previously been interpreted as acicularian, but the longitudinal sections disprove this, since all known acicularian spicules, long or short, have near-spherical sporangial cavities giving circular cross-sections at all angles of cut.

Nothing similar to the units of *Coptocampylodon* is known amongst the algae or the spicular elements of calcareous sponges. The mineral structure is not that of echinoderm skeletal elements, and the form is quite different from that of 'alcyonarian spicules'. These latter are the minute embedded calcareous elements of the horny corals or subclass Octocorallia. In the octocoral family Isididae Lamouroux there occur genera showing an alternation of horny nodes and calcareous internodes; the latter are known fossil, notably in the genus *Moltkia* (Upper Cretaceous). Typically these isolated calcareous bodies are larger than those of *Coptocampylodon*, and show conspicuous calicular pits; they are also associated with the larger, dichotomously branching structures characteristic of the genus. However, comparison of the varied series of skeletal remains of *Moltkia* figured by Voigt (1958) shows that some of the smaller dissociated elements are very similar to the Iraqi fossil (cf. Voigt 1958, pl. 3, figs. 9, 10; *Moltkia isis* Steenstrup). A comparison may also be made with the elements of the decorticated axis of *Isis* (Recent). It is therefore suggested that *Coptocampylodon* comprises the skeletal remains of a small octocoral in which horny and calcareous joints alternated. *Coptocampylodon* is earlier (Lower Cretaceous) than these genera; most pre-Upper Cretaceous records of fossils referred to the octocorals seem doubtful (Bayer 1956; Voigt 1958; Häntzschel 1958), but this allocation seems the most likely.

EXPLANATION OF PLATE 47

Fig. 1. Transparent *Ethelia* (*Pseudolithothamnium*), contrasted with dark *Archaeolithothamnium* showing chains of conceptacles. BM V44845, thin-section, ×40. Kolosh Formation, Palaeocene; Rowanduz, Erbil Liwa, northern Iraq.

Fig. 2. *Ethelia alba* (Pfender). BM V44845, thin-section, ×100. Vertical cut of single growth showing central mesothallus with upper and lower perithalli. Kolosh Formation, Palaeocene; Rowanduz, Erbil Liwa, northern Iraq.

Fig. 3. *Ethelia alba* (Pfender). BM V44844, thin-section, ×30. Sinjar Limestone, Palaeocene; Sarmord, Sulaimania Liwa, north-east Iraq.

Fig. 4. *Microcalamoides diversus* Bonet, cf. type C. BM Z992, thin-section, ×28. Subsurface Yamama Formation, Valanginian–Hauterivian; Makhul no. 1 well, Mosul Liwa, northern Iraq.

EXPLANATION OF PLATE 48

Fig. 1. *Favreina montana* sp. nov. Syntypes, BM Z997, thin-section, ×56. Qamchuqa Formation, Cretaceous (Albian); Gund-i-Shikavt, Erbil Liwa, northern Iraq.

Fig. 2. *Coptocampylodon lineolatus* gen. et sp. nov. BM Z994, random cuts in thin-section, ×56. Yamama Formation, subsurface Lower Cretaceous (Valanginian–Hauterivian); Makhul no. 1 well, Mosul Liwa, northern Iraq.

Fig. 3. *Bačinella irregularis* Radoičić. BM Z995, thin-section, ×28. Qamchuqa Formation, Cretaceous (Albian); Zewiya, Pir-i-Mugrun, Sulaimania Liwa, north-east Iraq.

6. Favreina

The peculiar microfossils named *Favreina* by Bronnimann (1955) are short, solid, cylindrical pellets perforated by varying numbers of fine longitudinal canals in arrangements showing as characteristic patterns in cross-section. They were first figured from the Swiss Jurassic (Joukowsky and Favre 1913), but we owe to Paréjas (1935, 1948) the recognition of these as the faecal pellets of certain crustaceans, the Anomura, in which the fleshy structure of the stomach initiates perforations in the gut-content of largely inorganic ingested material. Since different genera and species of living Anomura show distinctively different pellet-patterns (Moore 1932), numerous species of *Favreina* have been described on the morphology of the fossils; two recent review studies are those of Bronnimann and Norton (1961) and Elliott (1962). Two new records can now be added to the Middle East species listed and described in the latter study.

Favreina prusensis Paréjas

Plate 46, fig. 7

Remarks. This distinctive species (Paréjas 1948) from the Upper Jurassic (Portlandian) of Turkey, shows from 66 to 136 canals, set in a complicated pattern of zigzag lines as seen in transverse section. No doubt this pattern increased in complexity with the growth of the individual originating the pellets. Listed for comparison by Elliott (1962) on the strength of Paréjas's described material, it is now recorded from the Upper Chia Gara Formation, Berriasian, of Ser Amadia, Mosul Liwa, northern Iraq. This example, 0·57 mm. in diameter, shows over 100 canals: the arrangement may be interpreted as similar to that in the type material.

Favreina montana sp. nov.

Plate 48, fig. 1

Description. Pellet of up to 1·3 mm. in length and 0·6 mm. diameter, cylindrical, with circular or near-circular cross-section. Canals very fine, circular to comma-shaped in section, about sixty in number, seen in some examples to be paired by very fine lines. Pattern of canals in transverse-section not definite, but obscurely spiral.

Syntypes. BM Z997 (Pl. 48, fig. 1); Qamchuqa Formation (Albian level), Cretaceous; Gund-i-Shikavt, Erbil Liwa, northern Iraq.
Other material. Numerous random cuts in thin-section, same locality and horizon.

Remarks. F. montana resembles the Lower Cretaceous *F. cuvillieri* Bronnimann in size and arrangement of paired canals, but possesses double the number of canals. It is easily distinguished from the third Cretaceous species occurring in the Middle East, *F. kurdistanensis* Elliott, which shows eight large canals thinly crescentic in section.

Specimens in the Department of Palaeontology, British Museum (Natural History), which are referred to in the text, have the prefix BM.

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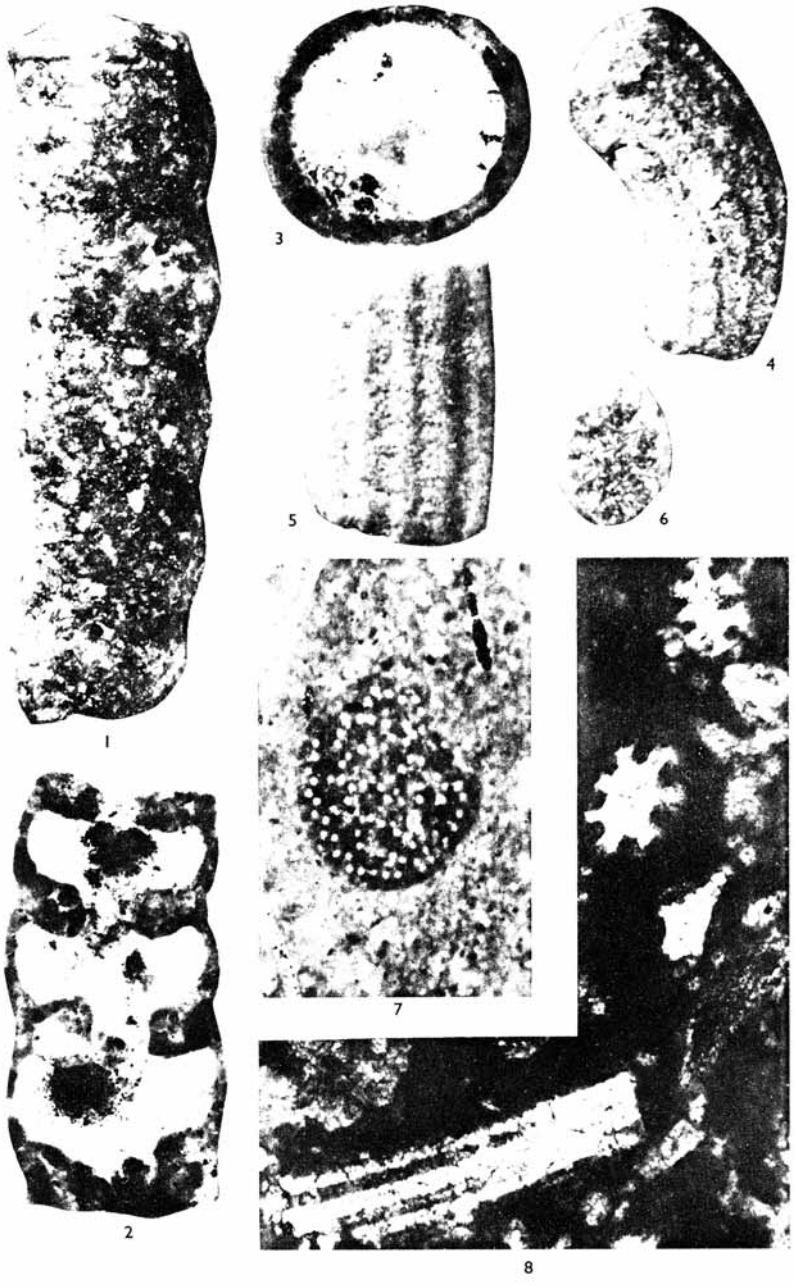

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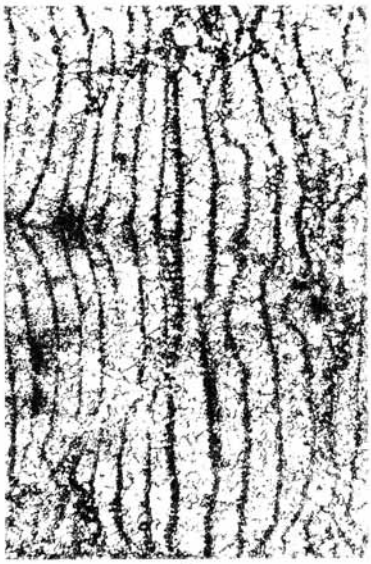

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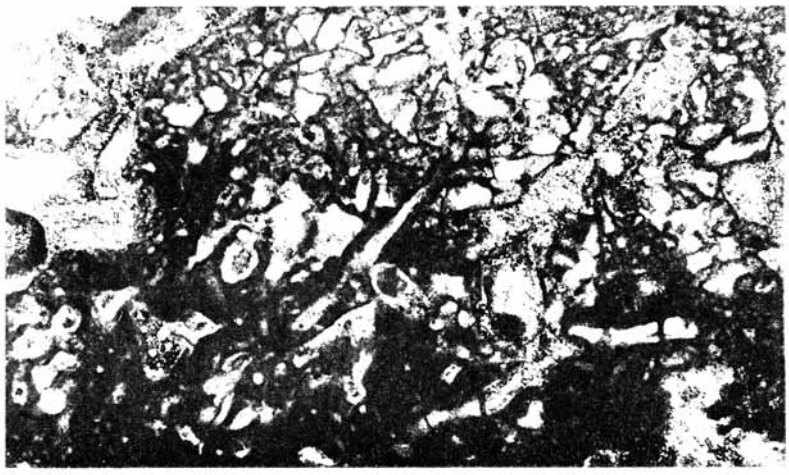

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