TWO NEW PLIOCENE SPECIES OF *NEOMERIS* (CALCAREOUS ALGAE) FROM THE BOWDEN BEDS, JAMAICA

by LÁSZLÓ RÁCZ

ABSTRACT. *Neomeris bowdenensis* sp. nov. and *Neomeris* sp. nov. are described from the Lower Pliocene. The vegetative secondary rays and the reproductive cysts of these species are arranged according to a geometrical pattern on both the inside and outside of the calcareous wall. It is supposed that the *Neomeris* specimens, found together with a rich bryozoan, molluscan, foraminiferal, and coral assemblage, are derived from an extremely shallow, sheltered environment. The fragile nature of the algal structure suggests that they have not been transported very far.

Neomeris dasycladacean algae are common in the Cretaceous and Tertiary in southern Europe, North Africa, the Middle East, India, and the Caribbean region. In modern tropical seas they have been collected at several places within a geographical zone delimited by the marine surface isocrymes of 20 °C (Konishi and Epis 1962). Fragmentary fossil representatives of the genus are often found in carbonate rocks. Well-preserved calcareous tubes have occasionally been recognized, especially in some Tertiary deposits (Morellet and Morellet 1913; Weisbord 1966).

As far as I know no algal discoveries have as yet been reported from the Bowden Beds. The *Neomeris* fragments found in the Bowden Shell Bed cannot, to my knowledge, be considered as similar to any of the *Neomeris* species so far described.

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SYSTEMATIC DESCRIPTIONS

Phylum CHLOROPHYCOPHYTA
Family DASYCLADACEAE Kützing 1843, *orth. mut.* Stizenberger 1860.
Tribe NEOMEREAE Pia 1920.
Genus NEOMERIS Lamouroux 1816.

Neomeris bowdenensis sp. nov.

Plates 116 and 117, figs. 1, 2

Diagnosis. Elongate tubular *Neomeris* species, showing a relatively thick but delicate wall, perforated by numerous fine pores or canals; differs from the known Recent and Neogene species by having both a greater diameter and a thicker calcareous wall.

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Holotype. The specimen figured in Plate 116, figs. 1, 2; Plate 117, figs. 1, 2 from the Bowden Shell Bed, Jamaica. B.M. (N.H.) V.53924.

Paratypes. Three specimens, B.M. (N.H.) V.53925–V.53927, from the same locality as the holotype.

Other material. One thin section, B.M. (N.H.) V.53928, of a specimen from the same locality as the holotype.

Age. Lower Pliocene. Although the Bowden Beds were previously considered to be Upper Miocene in age (Lagaaij 1959), Dr. Lagaaij has, in a written communication, drawn the writer's attention to an article of Banner and Blow (1965, pp. 1164–1166) in which they state that the planktonic foraminiferal content of the beds is, in fact, of Lower Pliocene age.

Description. The thallus is tubular in form, straight or gently curved, consisting of a hollow central part and a relatively thick, delicate calcareous wall. The incomplete thallus varies between 3–5 mm long, and is a few mm wide. Regularly spaced nodular swellings, arranged in annular concentric rows on the exterior of the thallus, are the surface expressions of the gametangia (sporangial cases). Where the abrasion of the surface has reached an advanced state, the swellings have been removed and the gametangia are visible as deep cylindroid casts (Pl. 117, fig. 2). Fine pores, surrounding the gametangia according to a geometrical pattern, represent the distal ends of the radially arranged secondary rays. Numerous, very fine, irregularly spaced openings penetrate into the calcareous body. These usually show an inclination to the central longitudinal axis.

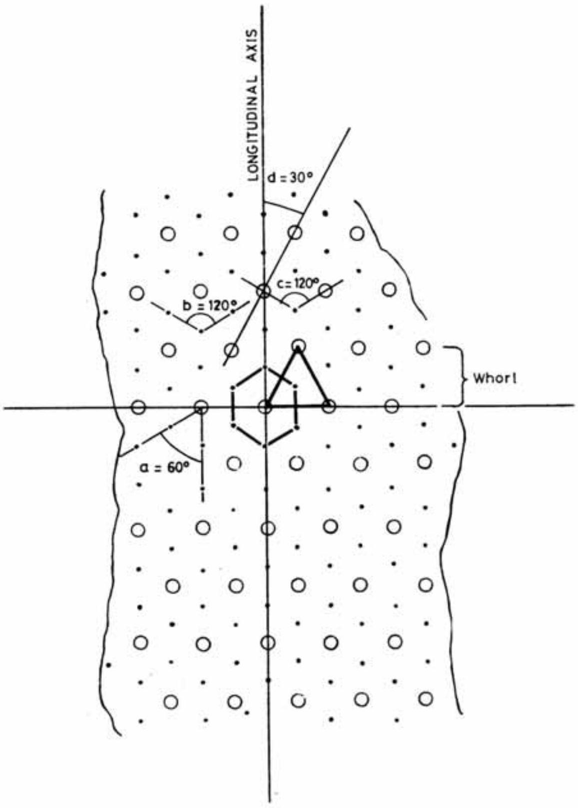
The interior surface of the thallus is annulated longitudinally by equally spaced, integrally calcified, sporangial rings. Each sporangial ring is itself divided by diagonally running rows of protuberances and furrows. Due to stronger calcification the protuberances may sometimes form a continuous 'ridge'. Abraded specimens and a transverse section have shown that the protuberances are bored by minute openings and that every opening leads into a gametangium (Pl. 116, figs. 3, 4). Slight depressions, which are to be considered as the inner terminations of the secondary rays, are arranged in an offset pattern in the furrows.

The biological and structural composition of the central stem is uncertain. The original non-calcified stem cell may have been composed of amorphous gelatinous material, which has disappeared and been replaced by poorly cemented post-mortem sediments.

The calcareous wall is perforated by minute pores or canals (secondary rays or branches) and oval-shaped gametangia. These are arranged radially in transverse section and perpendicular to the central axis. The distribution of the gametangia and the secondary rays seems to be regular in both transverse and longitudinal sections. The interpores are filled with calcite or aragonite cement produced by the reproductive organs and the vegetative secondary rays.

EXPLANATION OF PLATE 116

Figs. 1, 2, 3, 4. *Neomeris bowdenensis* sp. nov., Lower Pliocene, Jamaica. 1, 2 Holotype. 1, Exterior view of tubular fragment, ×20. 2, Transverse section of the same specimen, ×20; B.M. (N.H.) V.53924. 3, Longitudinal section, showing the wall and interior surface, ×20. 4, Thin section of another specimen showing the shape of the gametangia and their proximal and distal terminations, ×22; B.M. (N.H.) V.53928.



TEXT-FIG. 1. Diagrammatic representation of the external surface of a *Neomeris* thallus, showing the relative positions of the main features. ○ distal end of gametangium, ● distal end of secondary ray.

Since the primary rays are not preserved it is difficult to reconstruct their exact position and to trace their biological function. The secondary vegetative rays surrounding the sporangia are regularly arranged radially as well as longitudinally. They seem to be straight, cylindroid portions of the thallus, although a slight tapering towards the distal end has been observed. The gametangia are regularly arranged ovoid, shiny walled cases with a micro-aperture at both the proximal and distal ends (Pl. 116, fig. 4).

Geometry. On the exterior and interior surfaces the openings of the gametangia and the secondary rays are arranged according to a geometrical system (text-fig. 1). As is illustrated on the figure, six secondary rays surround one sporangial case, and three sporangial cases surround one secondary ray. In other words a pseudo-hexagonal honeycomb structure has been built up around a sporangial case and a pseudo-triangular structure has been built up around a secondary ray.

Because of the offset patterns present on both sides of the calcareous wall, an imaginary line connecting the secondary rays in two adjacent rows would bisect a similar line joining the gametangia of adjacent rows. This offset pattern has caused the oblique parallel columns of pores along the length of the thallus. This phenomenon can be clearly shown with the distal ends of the gametangia on an abraded surface where the columns form an angle of about 30° to the longitudinal axis of the thallus.

Relative positions of the main features (text-fig. 1)

(*a*)	Angle from a gametangium to two successive secondary rays	60°
(*b*)	„ of the connecting-line between secondary rays in two successive rows	120°
(*c*)	„ from a secondary ray to two gametangia of the same row	120°
(*d*)	„ of oblique columns of gametangia with longitudinal axis	30°

Measurements (in μm):

Tl	TD	Td	Wt	Psd	Rl	Rd	Rad	Rn	Pn
Up to 5000	2000–2700	110–1600	350–450 (500)	40–60	220–250	110–170	20–30	30–38	30–38

Explanation of symbols:

T = thallus	D = outer diameter
W = wall	d = inner diameter
P = pores, branches, rays	t = thickness
R = reproductive organs	l = length
a = aperture	s = secondary
	n = number

Rd: inner diameter of the ovoidal gametangia (sporangial case) at thickest part.

In comparing *N. bowdenensis* sp. nov. with other similar species from the Neogene of the Caribbean area it becomes apparent that the main differences are in the proportions of the thallus. The only two *Neomeris* species known to the author from tropical America are *N. venezuelensis* Weisbord, and *N.* (*Vaginopora*) sp. Morellet and Morellet (1939, p. 25, pl. 1, fig. 1). However, the measurements of both the diameter of the thallus and the thickness of the calcareous wall of *N. bowdenensis* are approximately double those of the species mentioned above.

Neomeris sp. nov.

Plate 117, fig. 3

One nearly complete, fairly well-preserved segment has been found. Although the calcification was very strong, the basic structural features, described in *N. bowdenensis* sp. nov., are also recognizable in this alga. However, the distinct differences in the size of the thallus, the calcareous wall, the secondary rays, and the reproductive organs, suggest that this is another species.

EXPLANATION OF PLATE 117

Figs. 1, 2. *Neomeris bowdenensis* sp. nov., Lower Pliocene, Jamaica. Holotype. 1, Details of wall structure showing the position of the reproductive organs and secondary rays, ×60. 2, A detailed view of the exterior surface, showing the distal ends of the reproductive organs and secondary rays, ×40; B.M. (N.H.) V.53924.

Fig. 3. *Neomeris* sp. nov., Lower Pliocene, Jamaica. General view of a slightly damaged specimen, ×20; B.M. (N.H.) V.53929.

Material. The specimen figured in Plate 117, fig. 3. B.M. (N.H.) V.53929 is from the Bowden Shell Bed, Jamaica.

Age. Lower Pliocene.

Measurements (in μm):

Tl	TD	Td	Wt	Psd	Rl	Rd	Rad	Rn	Pn
3500	1500	600–700	400–440	20	140	75	—	—	—

Depositional environment of the Bowden Beds

The algal species described form a minor part of an assemblage consisting of foraminifers, molluscs, bryozoans, and corals. Because of the variety of these fossil remains, the environment of deposition, especially the bathymetrical conditions, has attracted the attention of several workers.

Vaughan (1919) identified 17 coral species and on their evidence concluded 'that the depth probably was not so much as 20 fathoms'. Woodring (1928) stated that the molluscan fauna present is characteristic for neritic conditions (up to about 100 fathoms). Palmer (1945) studied the foraminiferal assemblage and reached the conclusion that 'the probable depth habitat . . . of 60 fathoms or slightly more' was very acceptable. Recent work by Brouwer (oral information given to the author) in the form of a computerized quantitative statistical study has produced rather different results. According to him the probable depth of water during deposition was confined to between 11 and 42 fathoms. The discrepancies in the latter two results may be due to the fact that Palmer attached too much significance to fossils which formed only a minor part of the assemblage. Lagaaij (1959) has described several bryozoan species which were new to Bowden. Recent representatives of some of these species are found at depths of between 0 and 71 fathoms. In order to determine the original bathymetrical conditions an extensive study of the whole bryozoan fauna was carried out by the same worker, who concluded that a water depth of between 24 and 35 fathoms during deposition was the most likely (Lagaaij, oral information).

Data concerning the bathymetrical position of recent representatives of *Neomeris* have shown that they appear to be present in very shallow, warm seas or lagoons. Their most frequent occurrence is in sheltered areas, but provided that the water energy is low, they may also occur in the littoral zone or very near to the low-tide level in the inner neritic (infra-littoral) zone, within a 0–10 m depth-range (Konishi and Epis 1962; Klement 1966). The few species of recent *Neomeris* which have been found in deeper water were probably transported from their usual habitat by current action (Klement 1966).

There are convincing arguments that suggest a shallow water environment for the Cretaceous *N. pfenderae* Konishi and Epis from the Mural Limestone in Arizona (Konishi and Epis 1962). The co-occurrence of *N. venezuelensis* Weisbord with other shallow water faunal and floral elements in a bioherm of the Pliocene Playe Grande Formation in N. Venezuela suggests the same ecological conditions (Weisbord 1966).

The presence of *Neomeris* fragments within the assemblage therefore suggests that the algal particles have been transported by current action from shallower areas of the sea into the deeper environment, prior to deposition. Because the relatively long, delicate algal fragments could not offer much resistance to current action, it is believed that they can have been transported only a short distance.

This theory of transportation and mixing of the fossil organisms has also been put forward, rather picturesquely, by Woodring (1965), who states that

> The Bowden fauna represents not a particular faunal facies, but a whole series of faunal facies, ranging from leaf litter on the forest floor (six species of land snails), through brackish-water courses of streams and mangrove swamps (*Neritina*, *Mytilopsis*, mangrove oysters), beach vegetation (*Tralia*, *Planaxis*), sand flats (*Olivella*, approximately 1,000 specimens of *Oliva*), inner and outer shelf (the bulk of the fauna), to a depth greater than 200 m, possibly as great as 500 m. It is as though these land, brackish-water (beach, shallow-water), and moderate-depth shells were swept together by a giant broom and dumped down a steep slope to be successfully buried and preserved in granule-gravel along with autochthonous deep-water and planktonic species.

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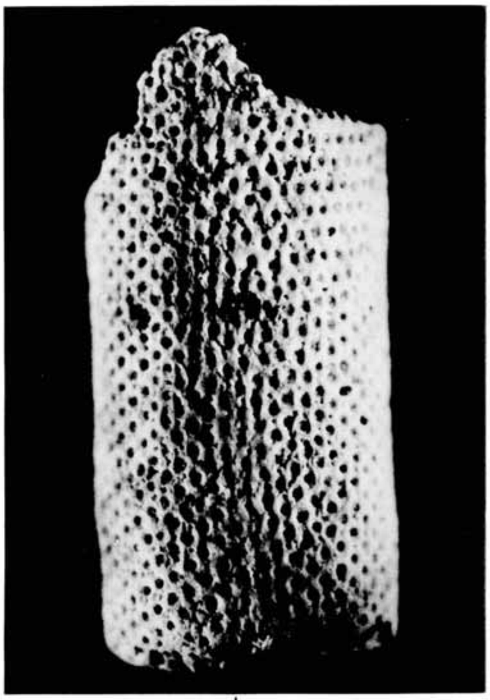

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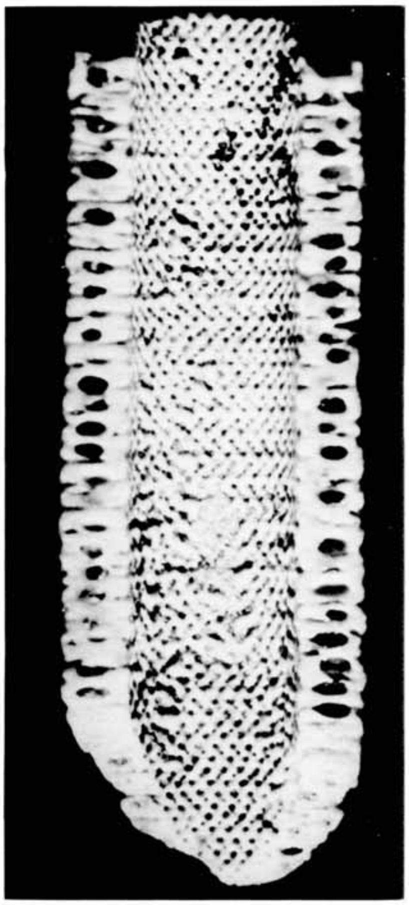

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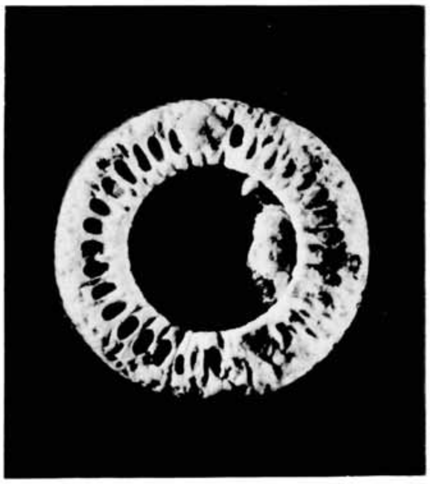

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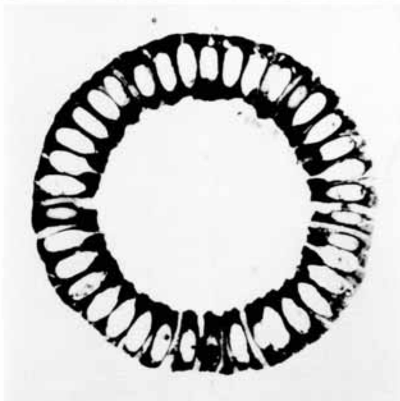

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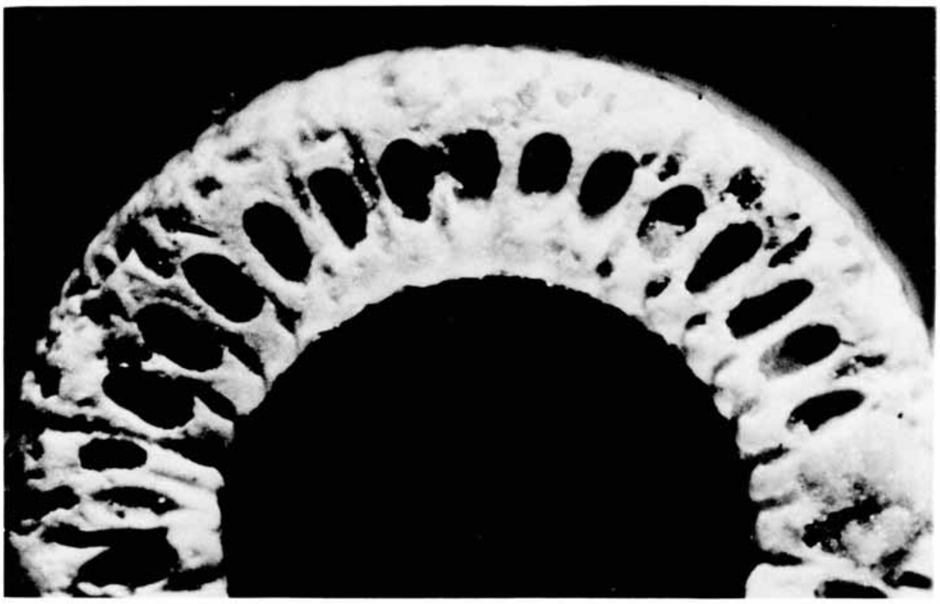

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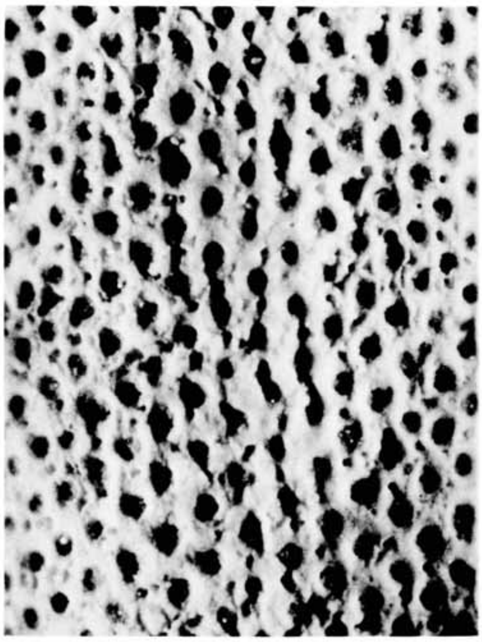

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RÁCZ, Pliocene alga