

PROCEEDINGS
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ON THE GEOLOGY OF THE BAHAMAS

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DISCOVERY OF *PHORMIDIUM* STROMATOLITES IN GRAHAMS HARBOUR, SAN SALVADOR, BAHAMAS

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ABSTRACT

Stromatolitic buttons of the cyanobacterium *Phormidium hendersonii* have been found in Grahams Harbour, San Salvador. The buttons were attached to subtidal beachrock and measured 15-40 mm in diameter. Sagittal sections revealed fine daily laminae of entrapped carbonate sand with an estimated daily growth rate of 0.18 mm; lateral growth exceeded vertical growth by a factor of 4. The buttons had a low carbonate content (12 vol %) and were apparently short-lived.

INTRODUCTION

During July, 1987, orange discoid buttons were collected from subtidal beachrock opposite the CCFL Field Station in Grahams Harbour. Microscopic examination revealed *Phormidium hendersonii* Howe, a widely-distributed stromatolite-forming cyanobacterium of shallow Caribbean and subtropical Atlantic waters. The buttons were almost circular in plan, of diameter 15-40 mm, and maximum thickness 8-11 mm, with a diameter:thickness ratio of 3.7:1 indicating more rapid lateral than vertical growth. Young specimens were, however, more hemispherical in shape. The gelatinous stromatolites were found in 0-100 cm water at low tide and some were exposed briefly to the air, but were not observed to dry out. They covered about 5% of the beachrock below the intertidal zone of *Rivularia bullata* and may well occur in deeper water.

Sagittal sections revealed white laminae consisting of entrapped carbonate sand (Fig. 1) with 34-93 laminae in 10 mm (mean 56). Within these laminae the *Phormidium* trichomes were prostrate, but they were vertically arranged in the broader hyaline laminae which alternated with the white laminae. The form-birefringence of this *Phormidium* is high and the arrangement of trichomes in the layers is exceptionally clear in the polarizing microscope. *Phormidium hendersonii* is

a motile, filamentous cyanobacterium with fine trichomes 1.0-1.7 μm wide (mean 1.26 μm , s.d. 0.3 μm , n=20). The cells are cylindrical and 2.7-11 μm in length (mean 6.06 μm , s.d. 2.7 μm) and match precisely the dimensions given for the species by Golubic & Focke (1978). However, samples taken from smaller, paler cushions were narrower with a mean diameter of 0.8 μm . A t-test indicated a highly significant difference ($p < 0.001$) between the two samples suggesting more than one species might be involved although internally, the buttons appeared identical in form.

Golubic & Focke (1978) found that the laminae of this *Phormidium* are formed daily. According to their hypothesis, carbonate accretion in the white laminae occurs at night when the filaments assume a prostrate form. During the day, the filaments assume an approximately vertical position and grow as a result of photosynthesis thus 'diluting out' the rain of carbonate sediment which is continuously trapped onto the sticky sheaths surrounding the trichomes. This diel rhythm is clear in the Grahams Harbour

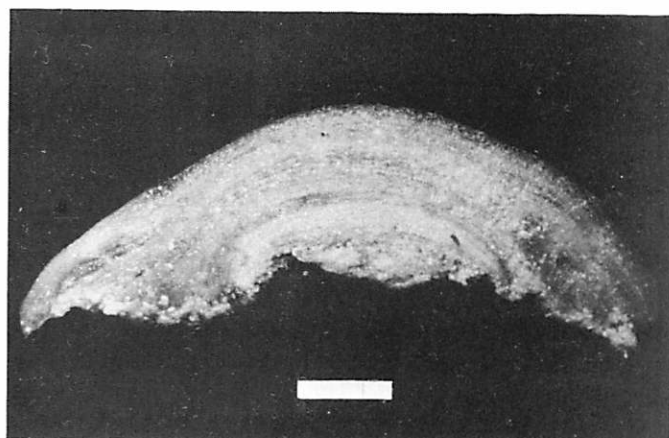


Fig. 1. Sagittal section across a *Phormidium* button from Grahams Harbour showing the calcareous and hyaline daily laminae. Bar 5 mm.

buttons although the lamina density is rather higher than the values previously reported. This higher density implies lower growth rates of around 180 μm per day, but the estimated age of mature buttons, averaging 46 days is comparable to the estimates made by Golubic & Focke (1978). The growth of the colonies is intriguing. Material collected in July, 1987, possessed very few living trichomes preventing identification, whilst samples collected in May appeared to be in a state of vigorous growth. Golubic & Focke (1978) noted that growth of colonies collected from Andros Island occurred between April and June whilst material from the Florida Keys grew from November to January. This apparently erratic seasonality has not been explained.

The trapped carbonate grains ranged from 10-100 (400) μm in diameter, but the buttons have never been reported lithified. With such rapid growth, the photosynthetic precipitation of carbonate within the colonies should be observable although it is not apparent from casual observation. The average calcium carbonate and organic matter content of the water-saturated colonies was 27 and 0.9wt% respectively. Small amounts of carbonate are also trapped and bound by *Rivularia bullata* and *Dichothrix seriata* further up shore, but daily laminae are absent in this material.

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