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AN INTRODUCTION TO THE BOWDEN SHELL BED, SOUTHEAST JAMAICA

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The Bowden shell bed of southeast Jamaica is one of the most fossiliferous deposits in the late Cenozoic of the Antillean region. It was discovered in 1859 by Lucas Barrett, who considered it to be Miocene in age. The Eocene Yellow Limestone was subsequently miscorrelated with the shell bed by Sawkins. The molluscan fauna of the Bowden shell bed was monographed by Woodring in the 1920s, whose interpretations of its palaeoecology are still valid, although he did not visit Bowden until 1952. Robinson divided the Bowden formation (or series, beds or marls) of earlier authors into three lithostratigraphic units; the Bowden Formation *sensu stricto* (Pliocene), the Old Pera beds (early Pleistocene) and the Port Morant Formation (late Pleistocene). The currently accepted Pliocene age of the Bowden shell bed was determined by reference to planktic microfossil zonations, particularly of foraminifers.

Key words — Bowden shell bed, Pliocene, Jamaica, history of geology.

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CONTENTS

INTRODUCTION

> 'No other American Tertiary locality has yielded 600 species of mollusks ... The outstanding feature of the Bowden fauna is that it seems to represent an unusual ecologic range especially as to depth' (Woodring, 1928a, pp. 22, 38).

> '... the Bowden [Shell] Beds ... [contain] probably the most remarkable Miocene fauna that has been found anywhere in the world' (Chubb, 1959, p. 270).

In the Antillean region, famous for highly fossiliferous deposits of late Cenozoic age, the Pliocene Bowden shell bed (Bowden Formation) of eastern Jamaica is one of the most fossiliferous and is possibly the most famous. Most geologists familiar with the shell bed know it for its magnificent fossil molluscs (Woodring, 1925, 1928a) and little else. However, this unit includes an abundant and disparate fossil biota. Although aspects of the microbiota of the Bowden Formation have been reviewed recently (papers in Wright & Robinson, 1993), the non-molluscan macrobiota of the Bowden shell bed has only been discussed in separate, scattered papers. The present volume aims to review the benthic foraminifers and the principal components of the macrobiota of the Bowden shell bed, including those groups that have received little attention such as vertebrates and echinoderms. It is anticipated that the volume will thus become a general reference for the Neogene of the Caribbean region.

The purpose of this short introduction is to indicate something of the importance of the Bowden shell bed, by reference to its palaeontological content and relevance to Caribbean geology. These points will be emphasised in summarising its history since discovery in 1859.

LUCAS BARRETT: THE DISCOVERY OF THE SHELL BED

The Bowden shell bed outcrops on the east side of Port Morant Harbour, in the parish of St Thomas, southeast Jamaica (Fig. 1).

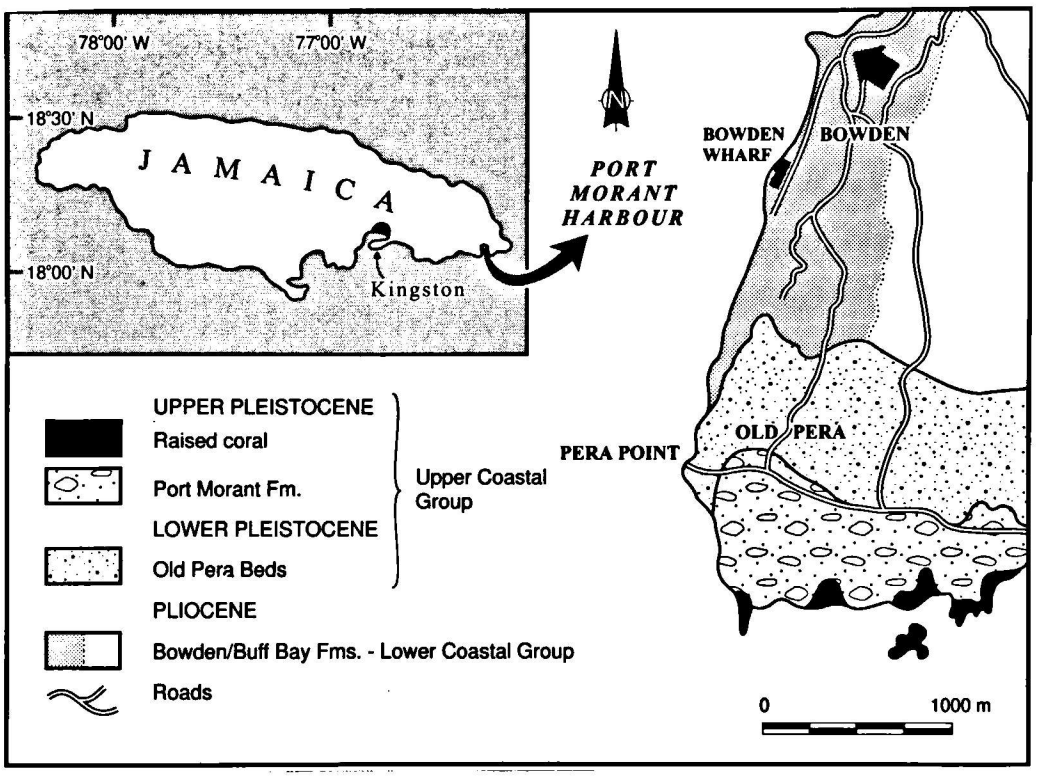

Fig. 1. Simplified geological map of the eastern side of Port Morant Harbour, southeast coastal Jamaica (after Pickerill *et al.*, 1996, fig. 1). The type section of the Bowden shell bed is arrowed. The type section of the Bowden Formation, including the shell bed, is exposed along the coast between this point and the contact with the Old Pera beds. The entire Plio-Pleistocene succession of this map was included within the Bowden Series of Sawkins (1869).

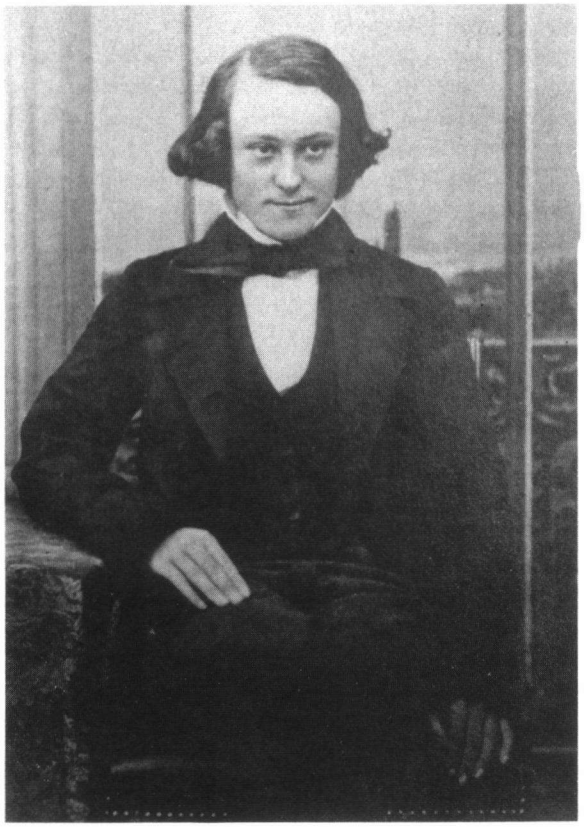

Fig. 2. Lucas Barrett (1837-1862) (after Wood, 1997, fig. 1).

It was discovered by a major figure in 19th century Jamaican geology, the Englishman Lucas Barrett (1837-1862) (Fig. 2). Barrett was appointed Director of the first Geological Survey of Jamaica in 1859 (Chubb, 1962; Donovan, in press). The survey of Jamaica, undertaken in association with his assistant, Mr J.G. Sawkins, commenced in the eastern parishes of the island. Amongst his notable contributions to Jamaican geology, Barrett used fossil molluscs to date the Jamaican Cretaceous (Barrett, 1860; Wood, 1997), which had been incorrectly identified as Palaeozoic over 30 years previously by De la Beche (1827; see also Donovan, 1996). Barrett attempted to date the Bowden shell bed and other late Cenozoic deposits of eastern Jamaica using Lyellian statistics (Rudwick, 1978), by comparing their included fossil molluscs with the island's extant fauna. It was his determination to investigate fully these Recent molluscs, as a necessary database for this method of dating, that led to his untimely death.

Barrett purchased a diving dress for exploration of those areas, principally around reefs, that were unsuitable for dredging. On 17th December, 1862, he successfully descended by diving dress for 30 minutes in shallow water, apparently amongst the Port Royal Cays to the south of Kingston Harbour. On the 19th Barrett made a longer

descent in deeper water. Unexpectedly, he floated to the surface at some distance from his boat and was dead by the time he was taken ashore. Most probably, Barrett purposely closed the principal valve of the diving dress, allowing it to inflate and float to the surface. This rapid ascent was presumably the cause of death due to a pulmonary air embolism (J.B.S. Haldane *in* Chubb, 1962, p. 25).

Following Barrett's tragic death, the responsibility of writing the *Reports on the Geology of Jamaica*, based on the work of the Survey, fell on the shoulders of the new Director, Sawkins (1869). Sawkins was not a biostratigrapher and his ignorance of this key subject led to one of the most gross miscorrelations in the history of Antillean geology.

> 'Both the Bowden Beds and the Yellow Limestone formation [= Eocene] include yellow-weathering limestones full of fossils, but the fact that the fossils in the two formations are entirely different escaped the notice of Sawkins and [fellow surveyor G.P.] Wall, who did not trouble to collect from either. They relied on Barrett's determination of the beds at Bowden as Miocene-Pliocene, and they attributed these ages to the Yellow Limestone. Thus, according to Sawkins, the White Limestone is not "Miocene" (i.e. Oligocene-Miocene), as Barrett believed [now dated as middle Eocene to middle or late Miocene; Robinson, 1994], but post-Pliocene ... This would make this 3,000 foot formation Pleistocene to Recent in age, a fantastic blunder' (Chubb, 1962, p. 29).

This error of correlation was corrected by Hill (1899), although over 20 years later Trechmann (1922, pp. 423, 424) still found it necessary to re-emphasise that the Bowden shell bed was much younger than the Eocene Yellow Limestone Group (see also Chubb, 1958).

WENDELL WOODRING: MOLLUSCS OF THE BOWDEN SHELL BED

The most common and diverse macrofossils in the Bowden shell bed are undoubtedly molluscs. It seems probable that Barrett intended to write his own account of these fossils. Taxonomic aspects of the Bowden molluscs have been discussed by many authors in the 140 years since the shell bed was discovered (reviewed by Woodring, 1925, pp. 9-12; Donovan *et al.*, 1998). The most comprehensive and important of these accounts was that of Wendell Phillips Woodring (1891-1983) (Fig. 3) of the United States Geological Survey (U.S.G.S.).

Woodring's monographs (1925, 1928a) were based in part on his Ph.D. research (Woodring, 1916) and list about 610 mollusc taxa (Woodring, 1928a, p. 22), 55% of which were endemic (Woodring, 1965).

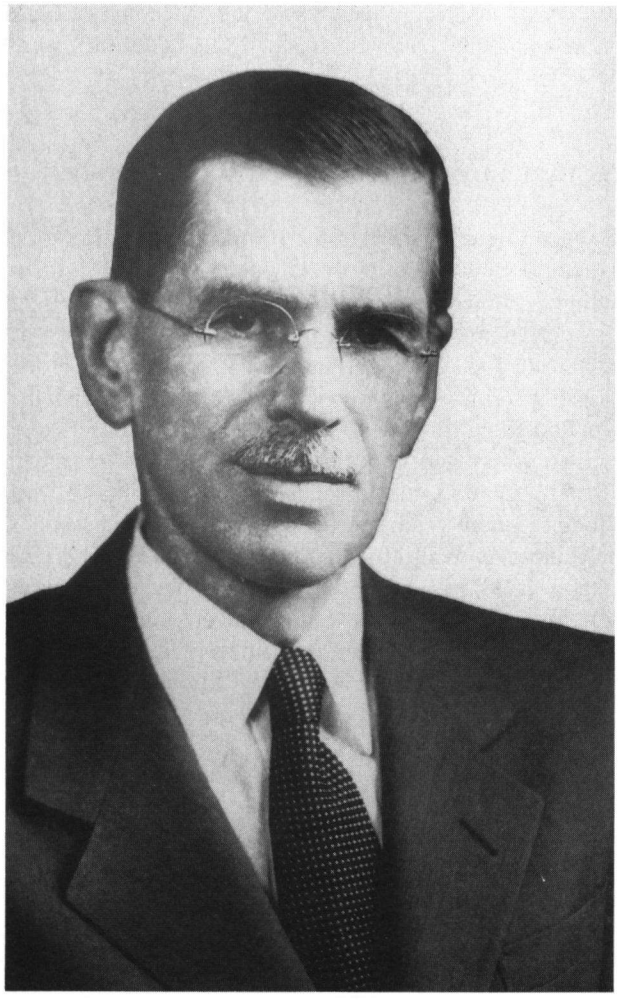

Fig. 3. Wendell P. Woodring (1891-1983).

His monographic studies were based on the collections of other workers, but still remain an important reference.

Woodring used the molluscan fauna of the Bowden shell bed in determinations of palaeoecology and palaeogeography (Woodring, 1928a, b, 1929, 1965), but, as he noted (Woodring, 1925, p. 7), his monographic study was undertaken without the benefit of a visit to Bowden. Woodring's Caribbean fieldwork did not commence until 1920 and then in Haiti, not Jamaica (Cloud, 1978; Moore, 1983, 1992). Thereafter, Woodring's principal field areas were California and the Republic of Panama. Indeed, Woodring did not visit Bowden until 1952, in the company of C. Bernard Lewis of the Institute of Jamaica (Caldwell, 1966, p. 339).

Woodring's (1928a, pp. 28-38) discussions and conclusions concerning the palaeoecology of the shell bed have a modern ring to them (compare with, for example, Pickerill *et al.*, 1998; Pickerill & Donovan, 1998). These are all the more notable for having been made without any personal observations of the Bowden Formation and without detailed, supporting sedimentological data. Woodring's interpretation of the synecology of the shell

bed, based on his deductions of the autecology of the included molluscs, are still fresh 70 years after they were published.

EDWARD ROBINSON AND THE COASTAL GROUP

The late Cenozoic rocks of the Bowden district were first called the Bowden series by Sawkins (1869, p. 44). Later authors referred to these rocks as the Bowden beds or Bowden marls (reviewed by Woodring, 1925, p. 7; Robinson, 1969a, p. 99). This succession was named the Bowden formation by Woodring (1925, p. 7), with the type locality at Bowden. However, the Bowden series or formation as understood by these authors encompassed all of the late Cenozoic rocks on the east side of Port Morant Harbour, as is indicated by the published sections of Duncan & Wall (1865, p. 6), Hill (1899, p. 12) and Chubb (1958, p. 27). Subsequently, this has led to confusion with notable fossils from the overlying Pleistocene succession being attributed the same age as the shell bed (see, e.g., Caldwell, 1966, whose 'Miocene' specimen came from the Pleistocene at Old Pera).

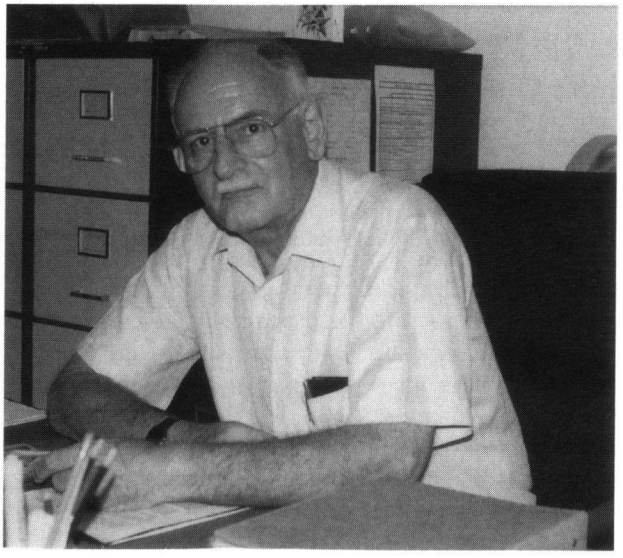

Fig. 4. Edward Robinson (1934-) (after Donovan, 1994, cover photograph).

Edward Robinson (1934-) (Fig. 4) recognised that the Pliocene sedimentary succession of the Bowden Formation is overlain disconformably or with a slight angular unconformity by a younger unit, which shows faunal and lithological dissimilarities to the Bowden Formation *sensu stricto* (Robinson, 1963, p. 45; 1969a, p. 104; 1969b, p. 15). The overlying unit comprises the Old Pera beds (of Robinson, 1969b), Manchioneal Formation, of early Pleistocene age (Fig. 1). Although lithologically dissimilar from the Manchioneal Formation *sensu stricto*, which is a sequence of limestones interpreted as having been deposited in a deeper water shelf, possibly fore-reef setting (Robinson, 1969b; Harper *et al.*, 1995), the siliciclastics of the Old Pera beds are coeval, as indicated by the similar included faunas of, for example, ostracods (van den Bold, 1971, p. 327). The Old Pera beds, in turn, are overlain by the late Pleistocene Port Morant Formation (Fig. 1). The Bowden Formation forms part of the Lower Coastal Group of Robinson (1967, 1968; = Coastal series of Hill, 1899); the Old Pera beds belong to the Upper Coastal Group.

The definitive Pliocene age of the Bowden shell bed was determined using evidence from planktic foraminifers. Earlier opinions, based on benthic molluscs (reviewed by Donovan *et al.*, 1998), postulated a Miocene or even Oligocene age for the shell bed. However, these Lyellian determinations gave an erroneously ancient date as a consequence of the influence of late Cenozoic molluscan extinctions in the tropical western Atlantic (Stanley & Campbell, 1981). The evidence of planktic foraminifers has suggested a Zone N19 (Banner & Blow, 1965), N20 (Robinson, 1967, 1969a, b) or N21 age (Kohl & Robinson, 1998) for the Bowden shell bed, that is, late early or early late Pliocene (Harland *et al.*, 1990, fig. 3.15). Other planktic taxa give similar results. For example, Aubry (1993) considered locality ER156 (about halfway through the type section of the Bowden Formation, between the shell bed and the base of the Old Pera beds; Robinson, 1969b, fig. 5), which is notable as the type locality for the N20 Zone, to be between Zones NN16 and NN18, that is, late Pliocene, in terms of the calcareous nannofossils. Janssen (1998) has suggested a late Pliocene age for the shell bed on the basis of holoplanktonic molluscs, in agreement with the determination of Kohl & Robinson (1998).

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