A Late Cretaceous terebratulid brachiopod from Jamaica, and its significance for Mesozoic brachiopod palaeobiogeography and evolution

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SANDY, M. R., HARPER, D. A. T., DONOVAN, S. K. & MILLER, D. J. 1997. A Late Cretaceous terebratulid brachiopod from Jamaica and its significance for Mesozoic brachiopod palaeobiogeography and evolution. *Proceedings of the Geologists' Association*, **108**, 201–207. Recent fieldwork has accumulated collections of terebratulid brachiopods from Late Cretaceous strata on Jamaica referable to the genus *Dyscritothyris* Cooper. This is confirmed by the preparation of serial sections of the internal structures of one well-preserved specimen. The only other record of this genus is from the Late Cretaceous rocks of Cuba. The specimens from Jamaica and Cuba are considered to belong to the same species, confirming oceanographic links between these islands during the Late Cretaceous, already apparent from similarities between their rudist bivalve and echinoid faunas. The small-sized *Dyscritothyris* is considered to be a Late Cretaceous derivative of the Cretaceous terebratulid *Capillithyris* which has been described primarily from Europe. Such a relationship would support models for the dispersal and evolution of brachiopods during the continued opening of the Central Atlantic Ocean during the Cretaceous.

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1. INTRODUCTION

Fossil brachiopods are rare in the Mesozoic rocks of the Antillean region. This paper represents the first detailed investigation of Cretaceous terebratulid brachiopods from Jamaica. Records of Cretaceous brachiopods from Jamaica are uncommon (Trechmann, 1927; Harper & Donovan, 1990; Harper, 1993) and they are certainly not abundant, *Dyscritothyris* being recorded from only one locality to date (Harper & Donovan, 1990) in the Central Inlier (Fig. 1). This, however, represents an important record of a Cretaceous terebratulid from the Caribbean region.

Cooper’s original description of *Dyscritothyris* from Cuba (1979) appears to be the only other record of the genus. There are, however, a reasonable number of confirmed records of other terebratulid brachiopods from the Cretaceous of North America (for example, Roemer, 1852; Stanton, 1895; Warren, 1937; Stephenson, 1941; Cooper, 1955; Ager, Underwood & DeFord, 1963; Owen, 1976, 1981; and other references in Sandy, Murphy & Rodda, 1995). Records from the South American Cretaceous are, by comparison, rare (e.g. Sandy, 1991). Most of these records are Early Cretaceous in age, not Late Cretaceous, making the material from Jamaica all the more noteworthy. Cooper (1979), however, recorded a few additional Late Cretaceous terebratulid genera from Cuba; *Cruralina, Orthothyris, Rugia* and *Terebratulina*.

In an effort to clarify the affinities of the Jamaican material, transverse serial sections have been prepared of

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Fig. 1. Outline map of the area around Frankfield, parish of Clarendon, central Jamaica, showing the position of the locality (+) discussed in the text (redrawn after Donovan et al., 1995, fig. 14). Key: thick lines = principal roads; thin line = Rio Minho (note that there are numerous streams that feed this river, but which are not shown for clarity). The inset map shows the position of the Central Inlier (stippled) and the Frankfield region (F) within Jamaica.
one well-preserved specimen. The techniques and equipment used are the same as those described by Sandy (1989). The serial-sectioning programme confirms assignment to *Discritothyris* and moreover, suggests the small-sized genus is a Late Cretaceous derivative of the Cretaceous terebratulid *Capillithyris* which has been described mainly from Europe. Specimens documented in the present paper are deposited in the James Mitchell Museum, University College Galway (JMM) and the Natural History Museum, London (NHM).

2. GEOLOGICAL SETTING

The Central Inlier, in the centre of the Clarendon Block (Fig. 1), has the second largest outcrop area of Cretaceous rocks in Jamaica, after the Blue Mountain Inlier to the east. The stratigraphic succession of the Central Inlier has most recently been reviewed by Robinson (1988, 1994). The Guinea Corn Formation is a sequence of grey, rubbly limestones and carbonate mudrocks interbedded with reworked volcanioclastic and some thin limestones. The siliciclastics are generally unfossiliferous, but the limestones have yielded a diverse marine fauna. This fauna is best known for its diverse assemblage of rudist bivalves (Chubb, 1971), but it also includes other benthic molluscs, corals, echinoids, foraminiferans and ostracodes, with rare brachiopods, barnacles and brachyuran crabs. Calcareous nanofossils indicate the age of this formation to be late Campanian to early Maastrichtian (Jiang & Robinson 1987a, b).

The *D. cubensis* horizon is in the bank of the Rio Minho, adjacent to the B3 road west of Frankfield, parish of Clarendon. This is Stop 3 of Donovan, Jackson, Dixon & Doyle (1995, p. 38–39), about 1 km west of Frankfield (1:50 000 topographic new series sheet 11 ‘Mandeville’, NGR 999 670; Fig. 1). The Guinea Corn Formation is exposed as steeply-dipping beds on the opposite side of the river to the road. Monospecific, autochthonous horizons of the small, gregarious rudist *Biradiolites* are a distinctive feature of this sequence and one has been taken as the top of the measured section; the base is a fault (Fig. 2). The section is essentially a series of alternating nodular to massive limestone beds interbedded with mudstones. The limestones may be at least partly secondary in origin, as indicated by lateral gradations from nodular to massive limestones and the interstitial sediment between nodules, which may be similar to that of the mudrocks. However, unlike the mudrocks, the limestones are rich in fossils, particularly benthic molluscs (mainly rudists and mouldic gastropods) and echinoid spines, and are commonly microporous to sparry with bands of bioclastic debris. Mudrocks are either grey, blocky, sticky muds or orange-brown, thinly (20–50 mm) bedded, mudrocks that are generally poorly fossiliferous, but which include some thin bioclastic horizons. This succession agrees well with the migrating carbonate bank sequences (Skelton, Donovan & Dixon, 1994: 27) noted from localities 4 and 5 of Donovan et al. (1995), although *Titanosarcolites giganteus* (Whitfield) is not commonly seen in the admitted more limited exposure at the *D.***

![KEY Diagram](image)

**Fig. 2.** Strip log of measured section through part of the Upper Cretaceous Guinea Corn Formation at NGR 099 670, 1 km west of Frankfield, parish of Clarendon, Jamaica. The *Discritothyris cubensis* horizon is the base of the muddy lens at the top of unit 8. The section is measured from a prominent, but thin, unit in situ *Biradiolites* (horizon 1), while the base is faulted (with a prominent shell of *Titanosarcolites giganteus* (Whitfield) in the overhang above the fault). Key: M=mudstone; S=siltstone; f, m, c SST=fine-, medium-, coarse-grained sandstone; P=pebble conglomerate; C=cobble conglomerate.
cubensis" locality. The presence of a 2 cm thick lignite bed in horizon 5 is indicative of "...occasional hyposalinity and nutrient flux" (Skelton et al., 1994). *D. cubensis* has only been found at the top of the muddy lens towards the base of horizon 2. Specimens are very rare and those documented herein have been collected since 1986, when the first specimen was found by C. R. C. Paul.

3. BRACHIOPOD PALAEOECOLOGY

*Discratothyris* is a small, biconvex pedunculate species suggested by the presence of an open pedicle foramen. To date no other brachiopods have been reported from the Rio Minho locality despite intensive searches over a number of years. The brachiopods occur near the base of horizon 2, within a muddy lens, associated with nodular limestones. The majority of brachiopod pedicles found in extant brachiopods are either short stout plenipedunculate stalks or longer thread-like rhizopedunculate structures. Although there is no direct evidence, *Discratothyris* may have been attached by a short stout plenipedunculate structure, providing a strong bond with the substrate in the relatively high energy conditions associated with migrating shell banks of rudists and other molluscs. *Discratothyris* is less than 1 cm in length, comparable to the taxa Surlky (1972) associated with small substrates such as shell fragments in carbonate banks. Habitats within the interstices between living and skeletal molluscan material may have supported a cryptoic life mode for *Discratothyris*. Elsewhere, small shells of the brachiopod *Pseudorhaoaetina* have been reported from interstices between the individual corallites of colonial corals from Triassic strata in Sonora, Mexico (Stanley, Gonzalez-Leon, Sandy, Senowbardi-Daryan, Doyle, Tamura & Erwin, 1994). To date, however, *Podichnus*, the trace fossil associated with pedicle etchings on shell substrates (Bromley & Surlky, 1973) has not been reported from the rudists at Rio Minho.

4. PALAEOBIOGEOGRAPHIC AND EVOLUTIONARY SIGNIFICANCE

*Discratothyris* was originally recorded from two Late Cretaceous localities in Cuba by Cooper (1979). The material described herein from Jamaica is considered to be referable to the Cuban species, namely *Discratothyris cubensis*. This certainly agrees with the close proximity of these islands during the Late Cretaceous (Draper, Jackson & Donovan, 1994). It is also possible, however, for terebratulid brachiopods to disperse over considerable distances; therefore, they should not be taken as reliable indicators of geographic proximity on their own. The sum of geological evidence, such as stratigraphy and sedimentology, as well as incorporation of palaeomagnetic data, all help in palaeo-geographic reconstructions in which palaeontology may play an important role. Other palaeontologic ties between the Late Cretaceous of Jamaica and Cuba include the similarities between the spectacular rudist bivalve faunas of the two islands (Chubb, 1971) and certain of the Campanian–Maastrichtian echinoids (Donovan, 1993), amongst others.

The small-sized *Discratothyris* is considered to be a Late Cretaceous derivative of the terebratulid genus *Capillithyris* Katz, 1974 which ranges from the Early to Late Cretaceous. *Capillithyris* was originally described from the Cretaceous of England by Middlemiss (1959), under the generic name *Platythyris* (see discussion by Middlemiss, 1991: 232–234). The similarity in the form of the brachidium (lophophore support) in both *Discratothyris* and *Capillithyris* suggests that they may be closely related. In fact, *Discratothyris* may be derived from *Capillithyris*; possibly by paedomorphosis (suggested by the small size of *Discratothyris*). Alternatively, but less likely, *Discratothyris* may simply be a small-sized species with an origin elsewhere.

Based on current distributional information, it would appear likely that the west Atlantic species, *Discratothyris cubensis*, was derived from European forms that migrated across the opening Atlantic Ocean. This dispersal route has been suggested for other brachiopods during the Cretaceous (Sandy, 1991; Sandy, Murphy & Rodda, 1995). The dispersal and diversification of terebratulid brachiopods would therefore appear to be linked to a major tectonic event, that is, the continued opening of the central Atlantic Ocean during the Cretaceous.

5. SYSTEMATIC DESCRIPTION

Order: TEREBRATULIDA Waagen, 1883
Suborder: TEREBRATULIDINA Waagen, 1883
Family: Uncertain
Subfamily: CAPILLITHYRIDINAE? Cooper, 1983
Genus: DISCRATO ThyRIS Cooper, 1979

Type species

*Discratothyris cubensis* Cooper, 1979, p. 16, fig. 1, from the Upper Cretaceous of Cuba. The only species known.

*Discratothyris cubensis* Cooper, 1979
Figs 3–4

1979 *Discratothyris cubensis* Cooper: 16, fig. 1;
*Discratothyris cubensis* Cooper (sic), Pl. 7, figs 3–8.

1983 *Discratothyris cubensis* Cooper; Cooper: 188, Pl. 61, figs 10–13.


1993 *Discratothyris* sp. cf. *D. cubensis* Cooper; Harper, p. 110, figs 3.20–23.

Revised diagnosis

Small, subcircular to rounded *Discratothyris* species of subpentagonal outline; sides well rounded. Valves nearly equal in convexity. Anterior commissure uniplicate in adult specimens. Shell surface generally smooth, may bear fine
capillation and fine concentric growth lines. Ventral valve interior lacks dental plates.

**Material and occurrence**

Cooper (1979) recorded the species from the Upper Cretaceous, Habana Province, Cuba, from conglomeratic sand beds under Eocene–Oligocene chalk, 7.3 (?) km E–SE of Madruga, 2.4 km S of Grua Esperanza and at a second locality 150 m N of Grua Esperanza, 6 km E of Madruga.

The Jamaican material, which is considered conspecific, is from the Central Inlier, Guinea Corn Formation, Upper Campanian–Lower Maastrichtian, Upper Cretaceous:
rubby limestone horizon at GR 419 455, in the Rio Minho west of Guinea Corn, on the B4 Frankfield to Spaldings Road (the exposure is on the opposite side of the river from the road), parish of Clarendon, Jamaica. The brachiopods are rare. The fauna is dominated by rudists (Chubb, 1971; Kauffman & Sohl, 1974) and other molluscs, corals, echinoids, foraminifers and ostracods. About 30 conjoined pairs of valves are known from the Rio Minho locality.

**Description**

(Adapted from Cooper, 1979, p. 16 and Harper, 1993, p. 110.) Small, subcircular to rounded subpentagonal in outline with maximum width at about midvalve; hinge width about three-fifths maximum width; sides well rounded; anterior margin broadly to somewhat narrowly rounded depending on age, subsutural in old age. Valves nearly equal in depth. Anterior commissure rectimarginate in young growth stages, uniplicate in adult specimens; beak small and low, pedicle foramen moderately large, submesothyrid. Deltidial plates disjunct (Cooper recorded as conjunct). Shell surface generally smooth but fine capillation (Figs 3a,e) and fine concentric growth lines may be present.

Ventral (pedicle) valve about nine-tenths as wide as long, gently and evenly convex in lateral profile with maximum convexity near midvalve; anterior profile broadly domed; median region somewhat narrowed, sides sloping moderately. Umbonal region broadly convex, rising to midvalve that is swollen; anterior somewhat flattened to form shallow sulcus and short rounded tongue. Valve interior lacks dental plates, but has moderately strong teeth.

Dorsal (brachial) valve about nine-tenths as wide as long, moderately convex in lateral profile, convexity slightly less than that of opposite valve; anterior profile broadly and moderately rounded, not medially narrowed. Umbonal and posteromedian regions fairly strongly swollen; anterior half somewhat flattened and narrowed anteriorly to form low, poorly defined fold. Valve interior with strong socket ridges, flattened outer hinge plates and loop about one-third the length of the dorsal valve, median ridge low and obscure, transverse band of loop not seen.

**Discussion**

The first detailed description of the species by G. A. Cooper (1979) was based on material collected by R. H. Palmer from the late Cretaceous rocks of Cuba. Harper’s (1993) description of the Jamaican material was based on a few conjoined valves and lacked detailed data on the valve interiors. On the basis of the available information the Jamaican material was compared with Cooper’s species although a limited Principal Component Analysis revealed no external shape differences between the two samples; the Cuban form, however, was significantly larger (Harper, 1993).

Cooper (1979) attempted to excavate infilling matrix from the Cuban specimens of this species but was unsuccessful. He then serially sectioned two specimens (Cooper, 1979: 15, fig. 1). Like the specimen sectioned herein, he did

| Table 1. Measurements and statistics for a sample of Dyscritothyris cubensis Cooper, 1979 from the Guinea Corn Formation, Central Inlier, Jamaica |
|-----------------|----|---|----|----|-----|-----|
| slp | slbv | mwi | hwi | pmwi | dpv | dbv |
| slpv | slbv | mwi | hwi | pmwi | dpv | dbv |
| \( \text{NRM BC1000} \) | 5.2 | 4.5 | 4.8 | 3.5 | 3.0 | 1.4 | 1.0 |
| \( \text{NRM BC1019} \) | 6.7 | 5.9 | 5.8 | 3.0 | 4.0 | 1.8 | 1.5 |
| **Statistics (n=10)** | | | | | | |
| Vector means | 6.6 | 4.9 | 5.1 | 3.3 | 3.2 | | |
| Variance | 2.8 | 2.5 | 2.6 | 1.3 | 1.6 | | |
| Covariance | 2.3 | 2.4 | 1.3 | 1.5 | | | |
| Matrix | 2.7 | 1.4 | 1.6 | | | | |
| | 0.9 | 0.7 | | | | | |
| | | | | | | | | |
| **Abbreviations:** slp : sagittal length of pedicle valve; slbv : sagittal length of brachial valve; mwi : maximum width; hwi : hinge width; pmwi : position of maximum width measured anteriorly from posterior margins; dpv : depth of pedicle valve; dbv : depth of brachial valve; N : sample size. |

**Fig. 4.** Transverse serial sections through a specimen of *Dyscritothyris cubensis* Cooper, 1979. Initial section at 0.0 mm represents tip of the pedicle valve umbo. Cumulative distance from initial section given in mm. Features observed include: initial section through brachial valve umbo (0.7 mm); broad concave cardinal process (0.8); incipient hinge plates (1.4); brachidium traced to 2.5 mm. Magnification of sections: 0.0-0.5, ×3.3; 0.7-2.3, ×10; 2.3, 2.5, ×20. Specimen sectioned perpendicular to maximum length. JMM Br2044, Central Inlier, Jamaica, Guinea Corn Formation, Upper Cretaceous. Dimensions of specimen: length 8.0; width 7.1; thickness 3.9 mm.
not encounter the anterior transverse band of the brachidium. However, he indicated that the structure of the socket ridges and the horizontal tapering style of the hinge plates defined a unique brachiopod. Another terebratulid with horizontal tapering hinge plates, Platythyris Middlissmiss, 1959 (now referred to Capillithyris), was considered by Cooper to differ markedly in both external and internal characters. As Cooper pointed out (1983: 188), Dyscritothyris lacks the capillate external ornament of Capillithyris. Despite Cooper’s comments, the relationship between Capillithyris, which spans much of the Cretaceous (Hauterivian to Campanian, see Middlissmiss, 1984), and Dyscritothyris, requires closer examination. Internally both genera possess a flat cardinal process with a distinct ‘U’-shaped dorsal valve floor/socket ridge outline just anterior of this (compare Fig. 4 with Cooper, 1979, fig. 1, and the sections of Capillithyris cristobali in Middlissmiss, 1978, fig. 7). Attached crural bases are not obvious features in Dyscritothyris, but are present in some species of Capillithyris (see Middlissmiss, 1978). In fact, the development of cuneate hinge plates with attached crural bases was interpreted as a gerontic feature in Capillithyris diversa (Middlissmiss, 1978, fig. 4). The general form of the development of the crural processes, hinge plates and free crura are not markedly different between Capillithyris and Dyscritothyris. However, such similarity might be readily evident between forms that do not develop hinge plates immediately and have reduced crural bases. As stated previously, the transverse band has not been observed in Dyscritothyris. From both internal and external morphological considerations, it is possible that Dyscritothyris could be a micromorphic terebratulid derived, paedomorphically, from Capillithyris.

Capillate ornament is not an obvious feature of Dyscritothyris, but fine capillation can be discerned in some specimens (Fig. 3.a.e). It is a variable feature among species of Capillithyris in which the shell may be ‘capillate, or smooth with more or less obvious longitudinal striae’ (Dieni & Middlissmiss, in Dieni, Middlissmiss & Owen, 1975: 195).

The other terebratulid that Cooper discussed in relation to Dyscritothyris was Gryphus. In spite of the incompleteness of the specimens of Dyscritothyris the ensemble of structures suggest those seen in Gryphus’ (Cooper, 1979: 15). However, crural processes with attached crural bases have not been observed in the serial sections of Dyscritothyris (see Cooper, 1979, Pl. 1, fig. 35, and serial sections of the genus), obviating the possibility of a close relationship.

Despite its overall larger size the medium-sized terebratulid Pseudogibbithyris arabica Owen, 1995 has much in common with Dyscritothyris. Owen described Pseudogibbithyris from the Maastrichtian of the United Arab Emirates–Oman border region. The fold of the anterior commissure is more pronounced in Pseudogibbithyris than in Dyscritothyris but outline and profile are similar, although Pseudogibbithyris is more biconvex in profile. These differences could be related to the larger size of Pseudogibbithyris. The transverse serial sections of Pseudogibbithyris (Owen, 1995, fig. 2) have many close similarities to those of Dyscritothyris (Cooper, 1979, fig. 1; Fig. 4 herein). The hinge plates seen in Owen’s sections taper medially as they do in Cooper’s specimen B. A cardinal process and complete transverse band are present in Pseudogibbithyris but are not seen in any of the series of sections taken of Dyscritothyris. Their absence in sections of Dyscritothyris does not prove their absence in the genus. The series of sections of Pseudogibbithyris and Dyscritothyris are sufficiently close to suggest a very close relationship between the two genera; either a closely related ancestry, or that Pseudogibbithyris is a junior subjective synonym of Dyscritothyris. If the latter is the case, a broadly distributed low-latitude Tethyan distribution is suggested for this latest Cretaceous brachiopod.

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REFERENCES


— 1983. The Terebratulacea (Brachiopoda), Triassic to Recent:
a study of the brachidia (loops). Smithsonian Contributions to Paleobiology, 50, 1–445.


Stephenson, L. W. 1941. The larger invertebrate fossils of the Navarro Roper of Texas. University of Texas Publications, 4101.


