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Robinsoniella jamaicaensis Schlagintweit, gen. et sp. nov., Orbitolinidae (Foraminifera): middle Eocene – early Oligocene of the Caribbean Faunal Province

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ABSTRACT. A new representative of the family Orbitolinidae is described as *Robinsoniella jamaicaensis* Schlagintweit n. gen., n. sp. from the middle Eocene to early Oligocene of the Caribbean Faunal Province (Jamaica and Mexico). The type-level is placed into the Claremont Formation that belongs to the White Limestone Group of Jamaica. The high-conical test of *Robinsoniella jamaicaensis* displays vertical main partitions aligned from one chamber to the next, an exception among the Paleogene Orbitolinidae when leaving apart the genus *Verseyella* Robinson that is only tentatively included within family Orbitolinidae. All Paleogene Orbitolinidae and Coskinolinidae too are characterized by alternating skeletal elements (exo- and/or endoskeleton). The exoskeleton shows a moderate complex network of one rafter and one intercalary beam. *Robinsoniella jamaicaensis* represents the second Paleogene taxon assigned herein with some reservation to the subfamily Dictyorbitolininae Schroeder. With reported occurrences in Jamaica and Mexico (Yucatán Peninsula), the new taxon can be considered a component of the Caribbean Province as defined with larger benthic foraminifera. Besides *Fallotella cookei* (Moberg), *Robinsoniella jamaicaensis* is the second member of the family Orbitolinidae reported from the lower Oligocene of the Caribbean realm that "escaped" the Eocene-Oligocene extinction event (e.g., orthophragminids; Orbitolinidae in the Tethyan realm). The recorded stratigraphic range of *R. jamaicaensis* is from the mid Lutetian to the Rupelian.

Keywords: foraminifera, Orbitolinidae, taxonomy, Paleogene, Caribbean faunal province.

Zoobank nomenclature entries
Publication – LSID: http://zoobank.org/References/18e15059-b4c3-47ac-b1b9-7c4ff5d7096a

***Robinsoniella* Schlagintweit 2022**
http://zoobank.org/NomenclaturalActs/9F28F54E-2C5C-4F03-93A8-182CC4E2D36F

***Robinsoniella jamaicaensis* Schlagintweit 2022**
http://zoobank.org/NomenclaturalActs/20F362A4-B10A-4776-803F-00CE8BF5A66B

1. INTRODUCTION

The Orbitolinidae includes large-sized complex agglutinated conical foraminifers, which are widespread in Paleogene shallow-water carbonates of the Caribbean region (West Indies, Cuba, Jamaica), the Gulf coast of the United States (Florida) and Mexico (e.g., **Cushman, 1919**; **Cushman and Jarvis, 1931**; **Butterlin and Moullade, 1968**; **Cole, 1942**, **1956**; **Cole and Applin, 1964**; **Robinson, 1993**; **Robinson and Wright, 1993**). Specimens of a conspicuous high-conical form have been illustrated and assigned to either *Fallotella cookei* (Moberg) or *Fallotella floridana* (Cole) from the Yellow Limestone and White Limestone groups of Central Jamaica (**Robinson and Wright, 1993**; **Robinson et al., 2018**). This taxon is described herein as *Robinsoniella jamaicaensis* n. gen., n. sp.

2. MATERIAL AND METHODS

The present study is based on illustrations from the literature that have been selected, rearranged and partly modified, existing thin sections, and newly collected material. For all re-illustrated specimens, the original reference (author, year, plate and figure number) is indicated together with the sample numbers used in the respective studies. They come from the middle Eocene–lower Oligocene of Jamaica, where the type-locality of the new taxon is situated, and the Eocene (?middle–upper) of Mexico. Most thin-sections from Jamaica are deposited in the Collection of the University of the West Indies Geology Museum (UWI) with the prefixes ER., EJ., J., and EVC. (although, some thin sections are missing).

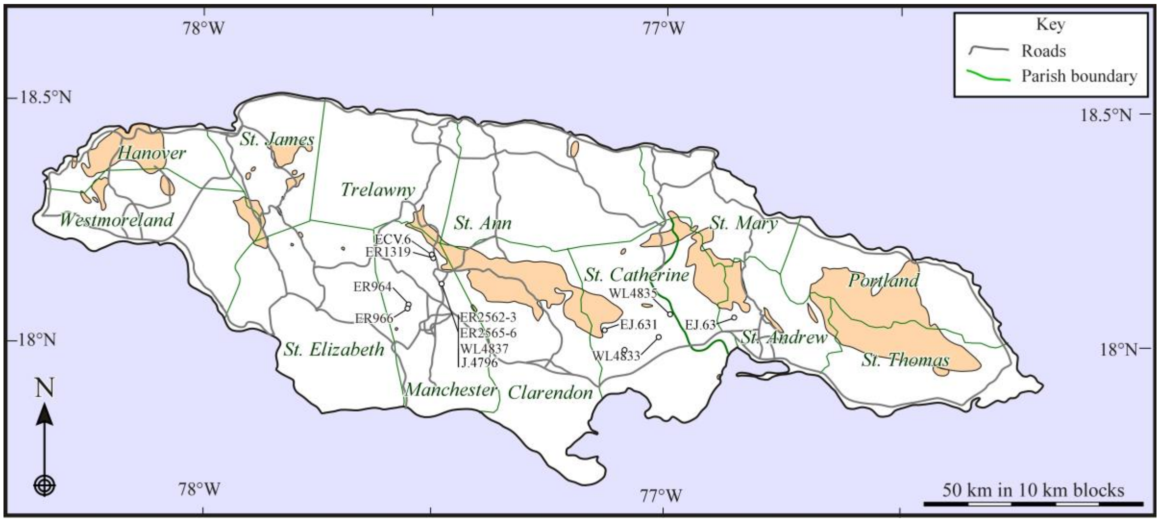


Figure 1. Map showing the locations of thin sections containing *Robinsoniella jamaicensis* n. gen., n. sp. in the parishes of Manchester, St. Catherine and St. Andrew, central Jamaica. ECV.6, ER1319, Coleyville; ER964, ER966, Somerset; ER2562, ER2565, J.4796, WL4837, Walderston; EJ.631, Bartons; WL.4833, Kitson Town; EJ.63, Coopers Hill. See Appendix 1 for latitude and longitude of samples.

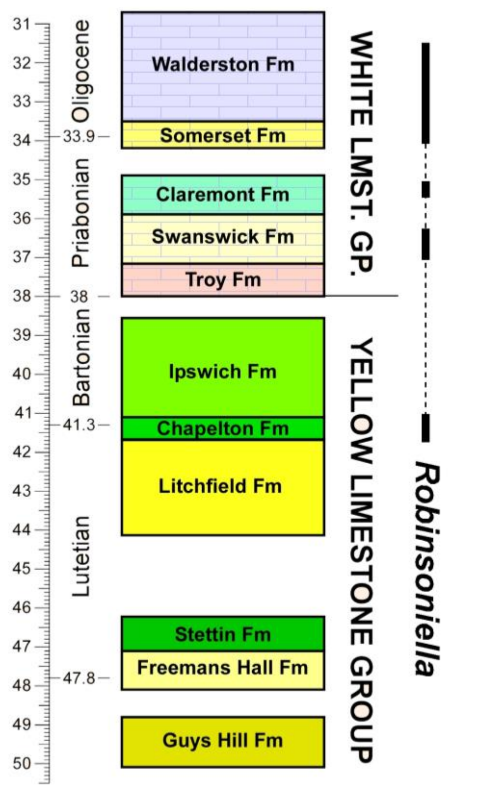


Figure 2. Lithostratigraphy of the occurrences of *Robinsoniella jamaicaensis* in Jamaica, modified after Mitchell (2016).

2.1. Jamaica

The four sample localities are situated in central Jamaica, namely in the parishes of Manchester and St. Catherine (**Figure 1**). For details on the geological setting together with the precise postions of the locations of provenance of the specimens, reference is made to **Robinson and Wright** (**1993**), **Robinson and Mitchell** (**1999**) and **Robinson et al.** (**2018**). *Robinsoniella jamaicensis* n. gen., n. sp. has been recovered from the middle Eocene Chapelton Formation (Yellow Limestone Group), the upper Eocene Swanswick, Claremont and Somerset formations and the lower Oligocene Walderston Formation (all White Limestone Group: see **Robinson, 2004** and **Mitchell, 2013**, for details) (**Figure 2**).

2.2. Mexico

The illustrated specimens from Mexico are from the studies of **Bonet** (**1959**) and **Butterlin and Moullade** (**1968**), which focused on the middle Eocene of the Chichèn Itzà zone of the Yucatan Peninsula.

3. Systematic Micropalaeontology
(by Felix Schlagintweit)

The classification used here is adopted from **Kaminski** (**2014**).

Class Foraminifera d'Orbigny, 1826

Subclass Globothalamea Pawlowski et al., 2013

Order Loftusiida Kaminski and Mikhalevich in Kaminski, 2004

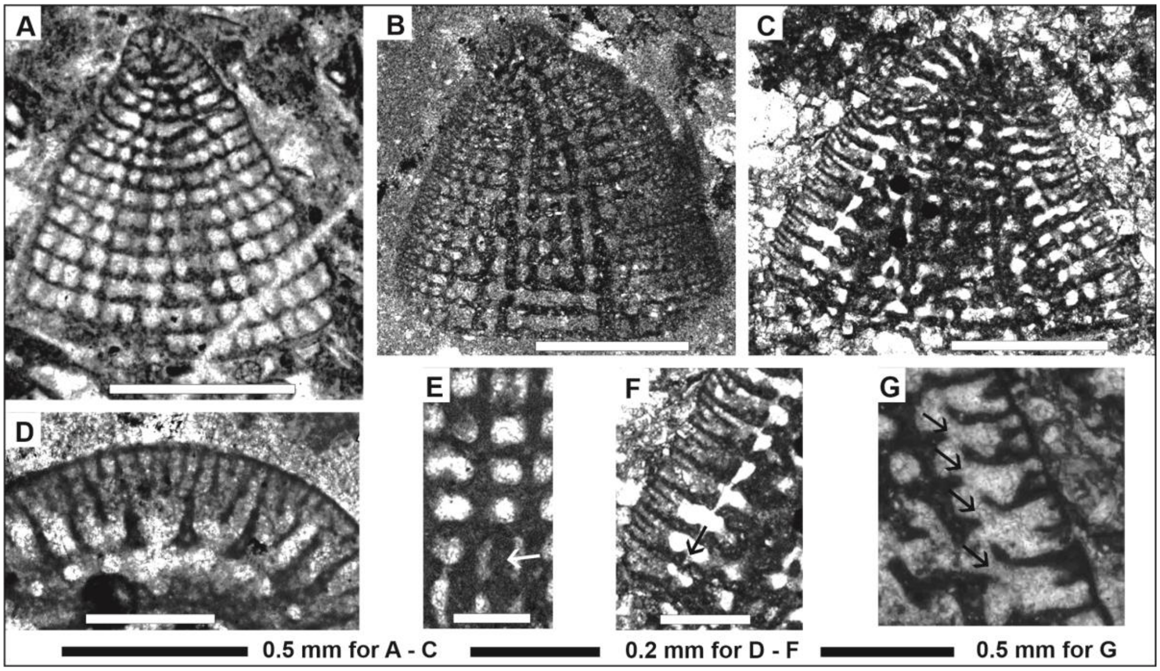


Figure 3. Examples of Dictyorbitolininae Schroeder (A-F) and Dictyoconinae (G). 3A, Axial section of *Paracoskinolina sunnilandensis* (Maync), lower Albian of Mexico showing vertically aligned pillars in the central zone (see Schlagintweit and Scott, 2015). 3B-D, F, *Gusicella minima* (Henson), upper Maastrichtian of Iran (see Schlagintweit and Rashidi, 2021). Tangential section showing vertically aligned main partitions (beams) and subepidermal network of the marginal zone (left and right) (3B). Axial section showing alternating pillars in the central zone and "ouvertures marginales" *sensu* Schroeder in Schroeder et al. (1990) aligned and arranged perpendicularly to the septa (3C). Part of transverse section showing circle of "marginal foramina" at the outer part of the central zone (compare with 3F) (3D). 3E, *Schroedericonus turriculus* (Drobne and Hottinger), tangential section showing aligned vertical partitions, Upper Paleocene of Iran. Note the installation of a new vertical element (arrow). 3G, Marginal apertures (arrows) *sensu* Hottinger and Drobne (1980) in *Dictyoconus* Blanckenhorn, Eocene of Iran. Note the different apertural axes (arrows) in 3F and 3G.

Suborder ORBITOLININA Kaminski, 2004

Superfamily ORBITOLINOIDEA Martin, 1890 *nomen translatum* Loeblich and Tappan, 1982 [Orbitolinacea] *nomen correctum* Kaminski, 2014

Family ORBITOLINIDAE Martin, 1890

?Subfamily DICTYORBITOLININAE Schroeder in Schroeder et al., 1990

Remarks. The subfamily Dictyorbitolininae includes Orbitolinidae displaying foramina arranged in a ring at the outer margin of the central zone, with an alignment paralleling the vertical main partitions (beams) (**Schroeder in Schroeder et al., 1990**, p. 196) (**Figure 3D**). The aligned beams are usually well constrained in tangential sections (**Figures 3B, 3E**), whereas the peculiar arrangement of the foramina ("ouvertures marginales") is often less clear, requiring well-oriented sections. They are arranged perpendicular to the septum ("verticaux par rapport au plancher"), in continuity paralleling the cone mantel line (**Figure 3F**). They differ from the marginal apertures of the Paleogene taxa where the marginal apertures are arranged obliquely to the septum (i.e. "about 45° with the mantel line of the cone"; **Figure 3G**). While the "marginal apertures" of the Dictyorbitolininae are in vertical continuity from chamber to chamber (**Figure 3F**), they "alternate regularly from one chamber to the next one" in the Paleogene forms (**Hottinger and Drobne, 1980**). They are laterally displaced to each other, not in linear continuity (**Figure 3G**), but they also form a "single circular row" as discerned in transverse sections (**Hottinger and Drobne, 1980**, p. 211). On the one hand, the Dictyorbitolininae include taxa where all vertical structural elements of the exo- and endoskeleton (main partitions and pillars) are aligned. This case is exemplified by the Lower Cretaceous genus *Paracoskinolina* **Moullade, 1965** (**Figure 3A**). On the other hand, it includes taxa where only the main partitions are aligned and the pillars of the central zone are alternating as in the Lower Cretaceous *Praedictyorbitolina* **Schroeder** (**in Schroeder et al., 1990**) or *Dictyorbitolina* **Cherchi and Schroeder, 1976** and *Gusicella minima* (**Henson, 1948**) of the Upper Cretaceous (see **Schlagintweit and Rashidi, 2021**; **Figures 3B-F**). Due to its aligned main partitions, *Robinsoniella* n. gen. is included herein tentatively in the Dictyorbitolininae, therefore becoming the possible second representative of this subfamily recognized in the Paleogene together with *Schroedericonus* **Schlagintweit, 2020**. Among the representatives of this subfamily, *Robinsoniella* belongs to the group where only the main vertical partitions (beams) are aligned, whereas the pillars of the central zone are alternating in position from one chamber to the next. Moreover, it is to be mentioned that dictyorbitolinids are typically high- to cylindroconical (e.g. *Paracoskinolina*, *Robinsoniella*) or medium-conical (e.g. *Dictyorbitolina*, Gusicella).

Genus *Robinsoniella* Schlagintweit

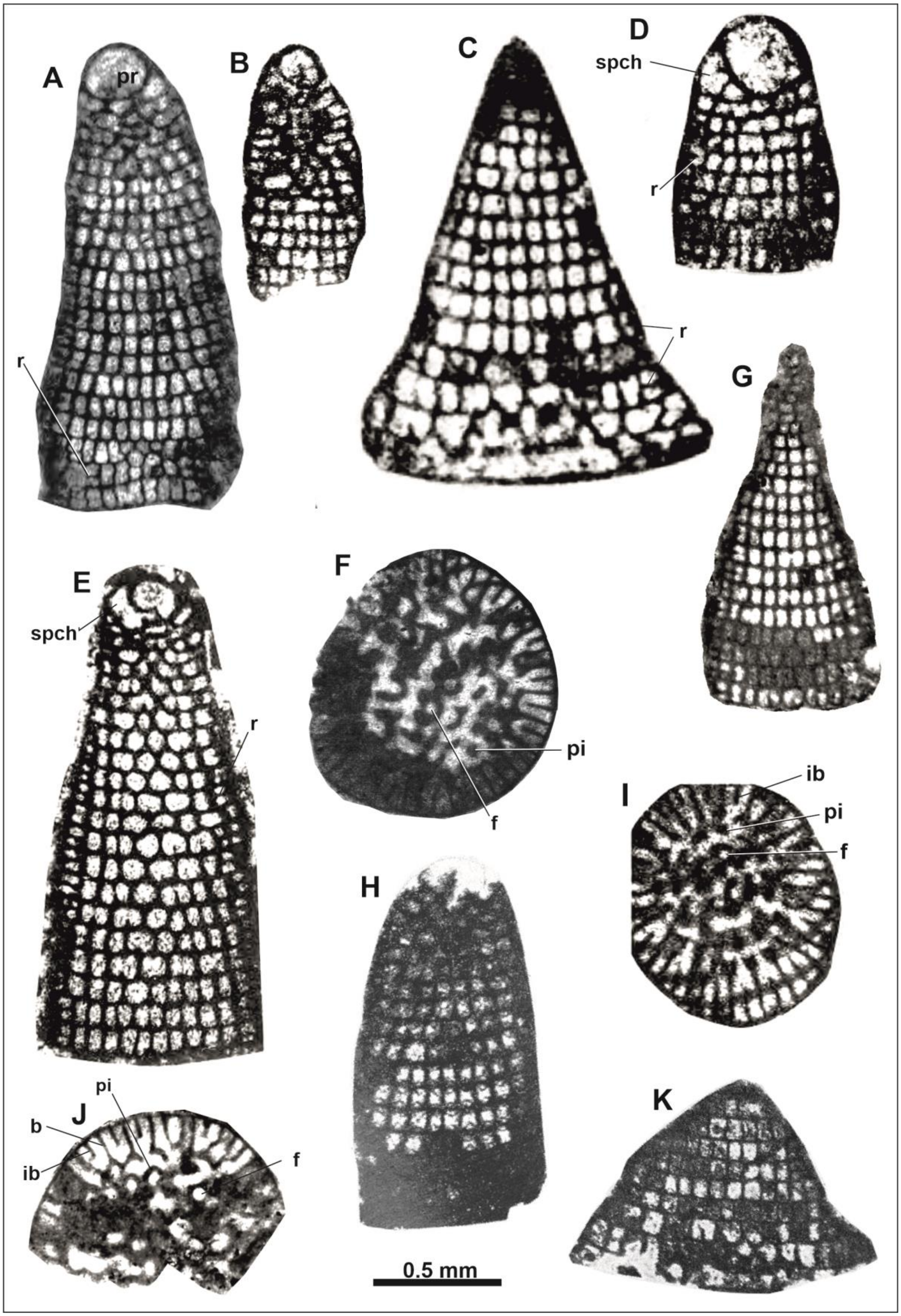
Type-species. *Robinsoniella jamaicaensis* Schlagintweit from the mid Eocene to Oligocene of Jamaica.

Description. High conical test with a slightly convex base in megalospheric forms. The megalospheric embryo is simple, in a centric to slightly eccentric position, and is followed by a few spiral chambers. The main test consists of numerous uniserial chambers. Exoskeleton moderately complex comprising one generation of horizontal (rafter) and one generation of vertical intercalary beams. The main vertical partitions (beams) are thin, about twice as long as the intercalary (secondary) beams and display a bifurcated distal end. In tangential sections, the main partitions form a regular pattern of almost rectangular thin-walled compartments, which are slightly higher than wide. Endoskeleton consists of pillars with subcircular (top) to lunular (base) outline, partly encircling the foramina, and arranged discontinuously between subsequent chambers. Foramina present a cribrate distribution in the central zone. Marginal apertures (or foramina) with oblique axes (~45°) and forming a circle. The test wall is thin, finely agglutinated. Microspheric forms are inadequately known probably presenting a wider cone angle, greater test diameter, and a more convex base.

Remarks. Due to the available sections, some details such as the embryo structure of *Robinsoniella* n. gen. require further clarification.

Comparisons. The available specimens comprise mostly tangential sections in cemented limestones and show clearly the aligned vertical partitions that form a regular pattern of rectangular compartments. This feature is incompatible with assignment to the genus *Fallotella* **Mangin, 1954**, *Dictyoconus* **Blanckenhorn, 1900** or *Cushmania* **Silvestri, 1925**, where all structural elements (e.g., partitions, pillars) alternate between subsequent chambers (e.g., **Davies, 1930**; **Mangin, 1954**; **Hottinger and Drobne, 1980**). The position of the vertical partitions in continuity from one chamber to the next is generally not observable in wide-angled conical tests such as those of the genus *Cushmania*; instead, if present, they appear confined to high-conical taxa such as *Robinsoniella*.

Figure 4. (facing) *Robinsoniella jamaicensis* n. gen., n. sp. from the middle Eocene-lower Oligocene of Jamaica (A-B, E-G, I-J) and Mexico (C-D, H, K). All specimens (except F) are from the original publications and partly modified. 4A-B, tangential sections of a megalospheric specimens from Robinson and Wright (1993, fig. 9.7 as *Fallotella cookei* ? and fig. 10.2 as *Fallotella floridana*), samples J4796, Walderston Formation and ER1319, upper Chapelton Formation respectively. 4C-D, tangential section of a possible microspheric specimen and megalospheric specimen from Butterlin and Moullade (1968, pl. 3, fig. 10, pl. 3, fig. 3 as *Coskinolina floridanus* and *Heterodictyoconus cookei*), samples YUCA 326 and YUCA 4, middle Eocene of Yucatan Peninsula, Mexico. 4E, subaxial section of a megalospheric specimen showing rafters and alternating pillars in the central part from Robinson and Wright (1993, fig. 10.4 as *Fallotella cookei*), sample ER964 Somerset Formation. 4F, transverse section, slightly oblique, sample ER2566, Walderston Formation. 4I, oblique transverse section from Robinson and Wright (1993, fig. 10.1 as *Fallotella floridana*), sample ER1319, upper Chapelton Formation. 4G, J, tangential and fragmentary transverse sections from Robinson et al., 2018, fig. 7.3 as *Fallotella cookei*), sample ER2566, Walderston Formation. 4H, K, tangential sections of megalospheric and possible microspheric specimens from Bonet (1959, pl. 2, figs. 5-6), ?middle- ?upper Eocene of Yucatán Peninsula, Mexico. Abbreviations: b = beam, f = foramen, pi = pillar, pr = proloculus, ib = intercalary beam, r = rafter, spch = spiral chambers.


A
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The monospecific high-conical *Schroedericonus* **Schlagintweit 2020** from the Thanetian of Iran (*Dictyoconus turriculus* of **Hottinger and Drobne, 1980**) displays aligned vertical partitions (**Figure 3E**), but has a more complex exoskeleton with numerous orders of rafters and intercalary beams, as well as a much less voluminous embryo situated eccentrically below the apex. *Verseyella* **Robinson, 1977** from the Eocene of Jamaica also has vertical partitions (beams or septules?) that are aligned between the chambers. In contrast to *Robinsoniella*, they reach inwards from the periphery to the unclearly delimited central part (raised shield) that does not have pillars or other structural elements, but a few circular arranged foramina (see also the new images in **Mitchell et al., 2020**). Also, the initial biserial part of *Veryesella* (emended diagnosis in **Robinson, 1993**) is completely different from *Robinsoniella*. As noted by **Robinson and Wright** (**1993**, p. 295), *Verseyella* is only provisionally retained in the Orbitolinidae, but should "probably be accommodated in a new family". Its belonging to the Eggerelloidea **Cushman, 1937** is put up here for discussion. Another form with aligned skeletal elements (pillars, and partly the main partitions) is *Barattolites* **Vecchio and Hottinger, 2017**, from the lower Eocene of Italy. *Barattolites* has a megalosphere situated at the beginning of a rather voluminous trochospire that can be distinctly inclined with respect to the test axis and lacks horizontal partitions (rafters). In addition, the alignment of the skeletal elements is considerably less evident, lacks a regular rectangular pattern, and cannot be traced over numerous chambers as in *Robinsoniella*.

Robinsoniella jamaicaensis **Schlagintweit**
Figures 4-5

1959 *Coskinolina floridana*; Bonet, pl. 1, fig. 5, pl. 2, fig. 5-6.
1968 *Heterodictyoconus cookei* (Moberg), *Dictyoconus floridanus* (Cole); Butterlin and Moullade, pl. 3, fig. 3, 10.
1993 *Fallotella cookei*?, *Fallotella floridana*, *Fallotella cookei*; Robinson and Wright, figs. 9.7, 10.1-10.2, 10.4.
2018 *Fallotella cookei* (Moberg); Robinson et al., fig. 7.3-7.4.

Etymology. The genus honors Professor Edward Robinson as acknowledgment of his scientific research on larger benthic foraminifera of the Greater Caribbean region, including Jamaica, the Nicaragua Rise, Florida and Alabama.

Type specimens. *Holotype*: subaxial section of the megalospheric specimen illustrated in **Figure 5H** herein (sample EJ.63-05, Claremont Formation, White Limestone Group, Coopers Hill, St Andrew, Jamaica). The diameter of the holotype specimen is 1.1 mm, and the height is 1.63 mm. *Paratypes*: EJ.631 (Fig. 5G), ECV.6 (Fig. 5I), EJ.631 (Fig. 5J), Chapelton Formation; WL4833 (Fig. 5A), WL4833 (Fig. 5E), Swanswick Formation; EJ.63 (Fig. 5H), Claremont Formation; ER2566 (Fig. 4F), ER2566 (Fig. 5B), WL4847 (Fig. 5D), ER2566 (Fig. 5F), Walderston Formation. The location of thin-sections containg the material illustrated in this paper is indicated in **Table 1**.

Description. Medium-sized, high-conical test build up of up to ~25 uniserial chambers in the adult part. Megalospheric simple embryo rather voluminous situated almost at the apex followed by a few spiral chambers. Main vertical partitions (beams) aligned between subsequent chambers forming rectangular chamberlets, higher than wide in axial sections. Exoskeleton moderately complex with one rafter and one intercalary beam. Main vertical partitions about twice as long as the intercalary beams and with a forked ending inwards. There are 30 (36) vertical main partitions (beams), when the cone diameter reaches ~0.95 mm (1.1 mm). Central zone with pillars alternating in position between subsequent chambers. At a cone diameter of about 1.0 mm, axial section passes 8-9 pillars. Microspheric specimens probably with wider apical angle resulting in larger test diameters.

Figure 5. (facing) *Robinsoniella jamaicensis* n. gen., n. sp. from the middle Eocene-lower Oligocene of Jamaica. Abbreviations: b = beam, f = foramen, ma = marginal aperture, pi = pillar, ib = intercalary beam, r = rafter. 5A, Tangential section, sample WL4833, early Priabonian, Swanswick Fm. 5B, oblique section, sample Er2566, Walderston Fm. 5C, almost centered axial section, from Robinson et al. (2018, Fig. 7.4, sample ER3128, Walderston Formation). 5D Subaxial-tangential section, sample WL4847, Walderston Fm. 5E, tangential section, detail from Fig. 5A showing aligned vertical partitions (beams) forming a regular pattern of rectangular compartments, sample WL4833, early Priabonian, Swanswick Fm. 5F, transverse section, detail from Fig. 4F showing exoskeleton (beams, intercalary beams), sample ER 2566, Walderston Formation. Fig. 5G Subaxial section, sample EJ.631-5, late Lutetian-early Bartonian, Chapelton Formation. Fig. 5H Subaxial section, holotype specimen, sample EJ.63-05, Priabonian, Claremont Formation. Fig. 5I Tangential section, sample ECV.6, late Lutetian-early Bartonian, Chapelton Formation. Fig. 5J Tangential section, sample EJ.631-4, late Lutetian-early Bartonian, Chapelton Formation.

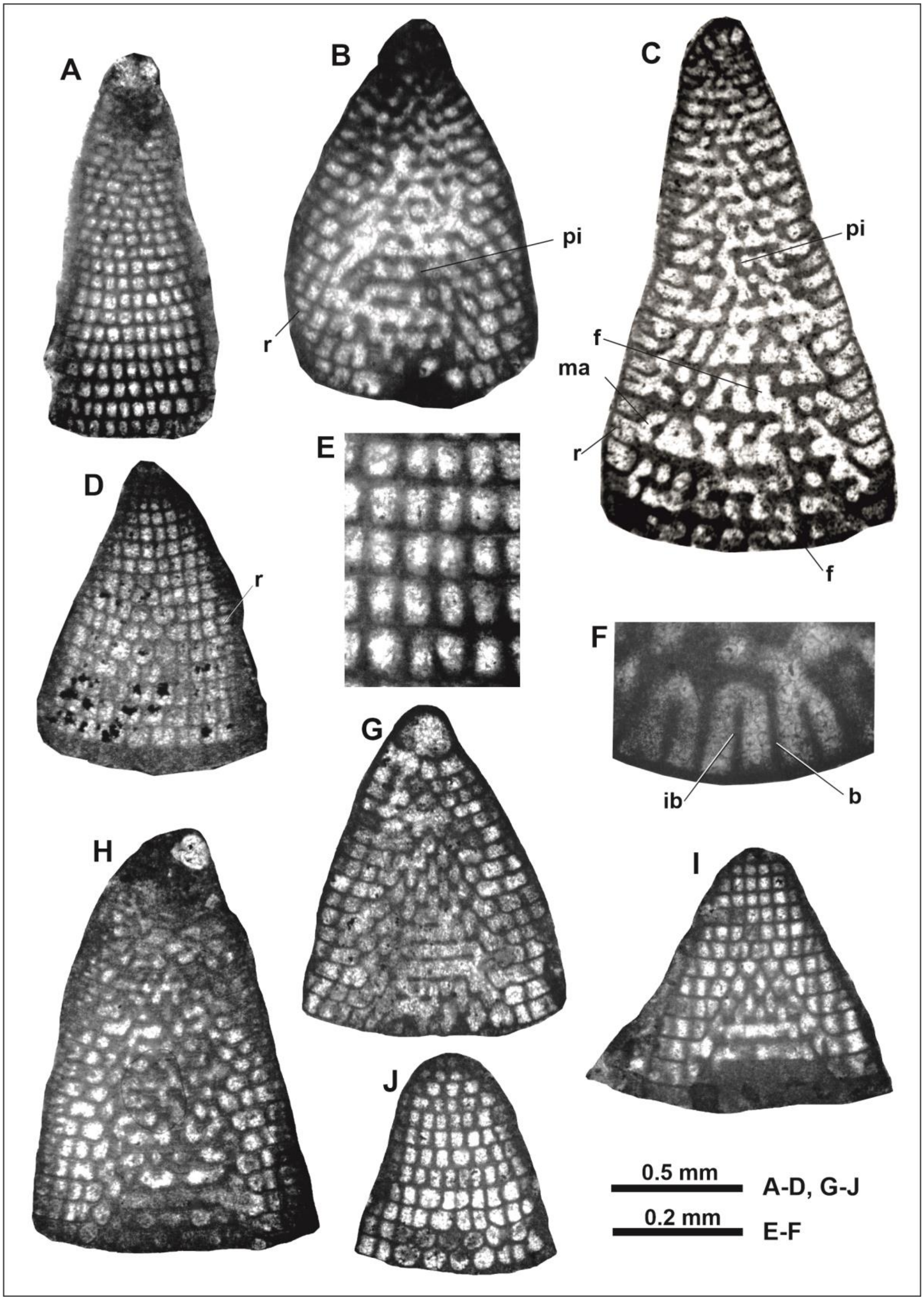
A
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Table 1. Specimens and repository of slides containing *Robinsoniella jamaicaensis* from Jamaica

Fig	Source	Formation	Slide	Location
Fig. 4A-B	Robinson & Wright, 1993, fig. 9.7	Walderston	J.4796	Missing
Fig. 4E	Robinson & Wright, 1993, fig. 10.4	Somerset	ER.964	Missing
Fig. 4F	Herein (Paratype)	Walderston	ER2566	UWIGM
Fig. 4I	Robinson and Wright, 1993, fig. 10.1	Chapelton	ER1319	Missing
Fig. 4G, J	Robinson et al., 2018, fig. 7.3	Walderson	ER2566	Missing
Fig. 5A	Herein (Paratype)	Swanswick	WL4833	UWIGM
Fig. 5B,	Herein (Paratype)	Walderston	ER2566	UWIGM
Fig. 5C	Robinson et al., 2018, Fig. 7.4	Walderston	ER3128	Missing
Fig. 5D	Herein (Paratype)	Walderston	WL4847	UWIGM
Fig. 5E	Herein (Paratype)	Swanswick	WL4833	UWIGM
Fig. 5F	Herein (Paratype)	Walderston	ER2566	UWIGM
Fig. 5G	Herein (Paratype)	Chapelton	EJ.631	UWIGM
Fig. 5H	Herein (Holotype)	Claremont	EJ.63	UWIGM
Fig. 5I	Herein (Paratype)	Chapelton	ECV.6	UWIGM
Fig. 5J	Herein (Paratype)	Chapelton	EJ.631	UWIGM

Dimensions.
Test height (h): up to 2.0 mm
Test diameter (d): up to 1.1 mm (up to 1.5 mm in probably microspheric specimens)
h/d (A-forms): 1.8-2.2
Diameter of embryo: 0.18 to 0.3 mm.
Number of chambers per l millimeter axial length of adult specimens: 10-14 (rarely up to 18).

4. Concluding remarks

With the reported occurrences in Mexico and Jamaica, *Robinsoniella jamaicaensis* seemingly was restricted to the Caribbean Faunal (or biogeographic) Province (CFP) of larger benthic foraminifers during Paleogene times (e.g., **Hottinger and Drobne, 1980**; **Goldbeck and Langer, 2009**; **Schlagintweit and Consorti, 2020**). *Robinsoniella* is probably the second Paleogene representative of the subfamily Dictyorbitolininae Schroeder described so far and the first one reported from the CFP. Besides *Fallotella cookei* (Moberg), *Robinsoniella jamaicaensis* is the second species of the Orbitolinidae reported from lower Oligocene (Rupelian) strata of the CFP (e.g., **Robinson, 2004**; **Molina et al., 2016**), whereas in the Neotethyan Faunal Province the available data indicate that the extinction happened in late Eocene times, or at the Eocene-Oligocene boundary (EOB) (e.g., orthophragminids; **Cotton and Pearson, 2011**). For reasons that are not precisely known at the present state of knowledge and in which the significant climatic influence (global cooling?) can be presumed (e.g., **Hutchinson et al., 2020**), the Caribbean realm may have served as a last refuge where some taxa of the Orbitolinidae survived the EOB event before the family finally became extinct.

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Authors Contributions. FS devised the project, wrote the draft, provided the taxonomy prepared figures and edited the document. SFM collected additional material, photographed specimens, drew figures, worked on the stratigraphy and edited the paper.

Data availability statement. All thin sections that are available are stored in the UWIGM collections and can be consulted via application.

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Appendix 1: List of latitude and longitude of samples from Jamaica

ECV.6	Chapelton Formation, Coleyville (Manchester)	18° 12.187' N 077° 30.935' W
EJ.361	Chapelton Formation, Bartons (St Catherine)	18° 00.856' N 077° 08.102' W
WL4833	Swanswick Formation, Kitson Town (St Catherine)	18° 01.019' N 077° 00.543' W
EJ.61	Claremont Formation, Coopers Hill (St Andrew)	18° 04.298' N 076° 51.463' W
ER964	Somerset Formation, Somerset (Manchester)	18° 05.050' N 077° 33.093' W
ER966	Somerset Formation, Somerset (Manchester)	18° 04.464' N 077° 33.194' W
J4796	Walderston Formation, Walderston (Manchester)	18° 08.000' N 077° 29.100' W
ER2562	Walderston Formation, Walderston (Manchester)	18° 07.963' N 077° 29.105' W
ER2563	Walderston Formation, Walderston (Manchester)	18° 07.937' N 077° 29.122' W
ER2565	Walderston Formation, Walderston (Manchester)	18° 07.838' N 077° 29.210' W
ER2566	Walderston Formation, Walderston (Manchester)	18° 07.963' N 077° 29.210' W
WL4835	Walderston Formation, Walderston (Manchester)	18° 03.979' N 076° 59.033' W
WL4847	Walderston Formation, Walderston (Manchester)	18° 07.825' N 076° 29.203' W

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