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A bibliography of the Red Hills Road Cave, Jamaica

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Abstract: The Red Hills Road Cave (also known as the Red Hills Road Fissure), discovered by students as recently as 1988, is the most significant terrestrial palaeontological site in the Pleistocene rocks of Jamaica. It preserves the largest diversity of fossil land snails known from a Jamaican cave. The island is a biodiversity hot spot for terrestrial gastropods, with over 500 extant, mainly endemic species, so even the 62 fossil species known from the cave is only a sample, albeit a significant one. Apart from the Miocene amber of the Dominican Republic, the cave is the only site in the Antilles to yield even a moderate diversity of soil arthropods. These are of limited diversity and consist of groups, such as millipedes, isopods and land crabs, with calcite – which aided preservation – in their exoskeleton. Terrestrial tetrapod remains from the site are still incompletely documented; invariably they are disarticulated. Some bones and teeth are distinctive and readily identifiable, but the vast majority are, at best, nondescript. It is these bones that must be determined in future studies.

Keywords: palaeontology; Late Pleistocene; land snails; bones; millipedes; isopods.

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Introduction

The most diverse cave fauna known from the rocks of Pleistocene age in the Caribbean island of Jamaica is that of the Red Hills Road Cave or Fissure (RHRC below) (Fig.1). A diverse cave fauna has been described in the less than 40 years since it was discovered. It was found during the summer of 1988 by two students, Ms Anita Godwin (now Dr Anita Warrington) of the University of Liverpool, and Ms Marlene Britton of the University of the West Indies, Mona ([**1**], p.51), who were on foot, collecting land snails. The discovery was a fine demonstration of the adage that geology is a field science; many motorists (including the author) must have driven past this site before 1988 without recognizing its worth. Unexpectedly, Anita does not appear to have mentioned the RHRC in her thesis (Godwin, 1987; Warrington, 1990).

Only a remnant of the original RHRC survived after road construction. What remains suggests that it was either a bottle-shaped cave [**4**] or a fissure [**10**], which acted as a trap for the accumulation of vertebrates, land snails and soil arthropods during the Late Pleistocene.

Though only a short terminal length of the cave remains, the site is exceptionally fossiliferous. It has yielded numerous terrestrial gastropods and bones of vertebrates, which are both also common components of other Jamaican cave faunas. Arthropods are rare, but include millipedes, isopods, claws of non-marine crabs and pupae of dipterans. The present account compiles a bibliography of publications to facilitate future research on the RHRC in particular, and Jamaican caves in general. The bibliography is presented in order of publication; entries are numbered to facilitate easy cross-reference with the text. Other references are listed at the end of the paper.

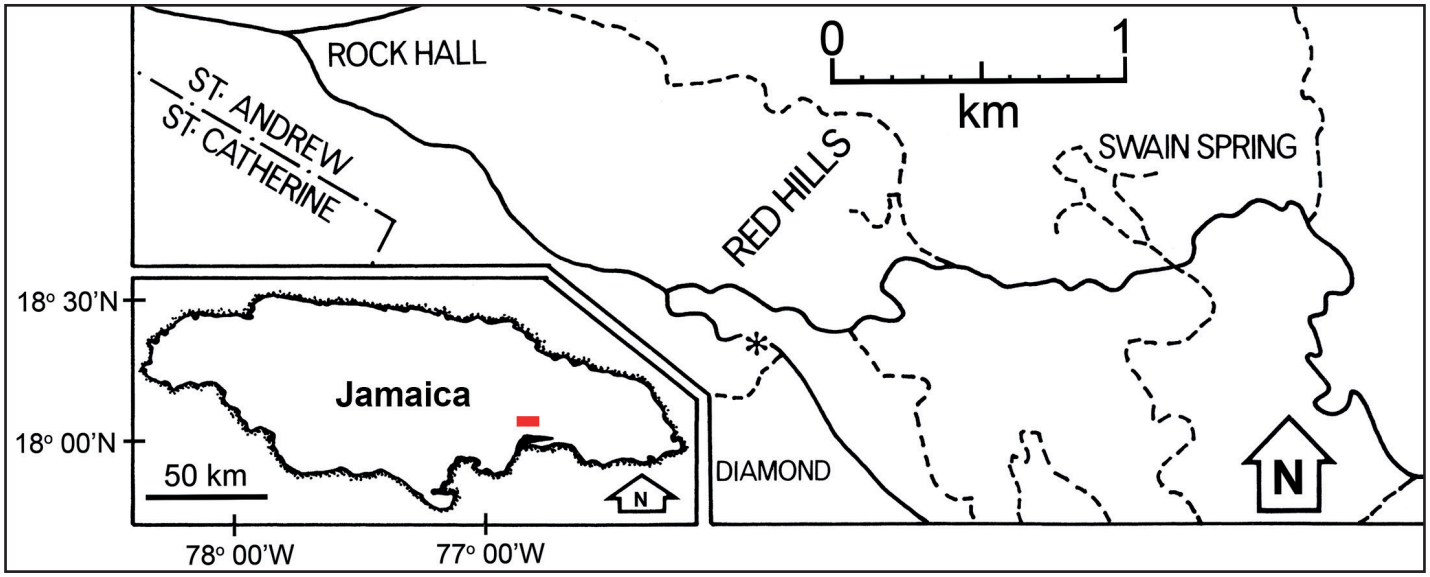

Figure 1*: Map showing the position of the Late Pleistocene Red Hills Road Cave (*∗*) on the south side of the Red Hills Road near Diamond, in the parish of St Andrew, Jamaica (based upon [**17**], fig.2). Main roads (continuous lines), minor roads (broken lines) and the boundary between the parishes of St Catherine and St Andrew, are shown. The inset map shows the approximate position (red rectangle) of the area covered by the main map within the island of Jamaica.*

The Red Hills Road Cave or Fissure

Geology and history

[Bibliography **1** / **6**–**8** / **14**.] Jamaica is one of the larger Antillean islands and has been exposed sub-aerially for about the last 10 million years (Robinson, 1994, p.122; [**6**]). The island's surface geological record is dominated by limestones, which account for more than two-thirds of the surface outcrop. Most widespread are the Eocene and younger limestones, namely the Yellow Limestone Group (Eocene), White Limestone Group (Eocene to Miocene) and limestone formations of the Coastal Group (Miocene to Pleistocene). These limestones are riddled with features typical of caves and karst in the humid tropics ([**8**]; Miller, 2004).

The RHRC is a truncated, unimpressive, but highly fossiliferous, karstic feature dissolved into rock of the mid-Tertiary White Limestone Group (Fig.1). Among the many truly spectacular caves in Jamaica [**8**], what remains of the cave is insignificant, but its value is palaeontological, not speleological, because it acted as a trap for the accumulation of vertebrates, land snails and soil arthropods during the Late Pleistocene [**14**]. The site was first brought to the attention of a wider audience by a field excursion of the Geological Society of Jamaica in 1989 [**1**]. A bulk sample from the cave has been deposited in the Geology Museum of the University of the West Indies, Mona, to facilitate future research [**7**].

Taphonomy

[Bibliography **4** / **5** / **13** / **23**–**25** / **27**.] The most significant question regarding the fossils of the RHRC is why are some soil arthropod taxa preserved more or less complete, such as millipedes and isopods ([**16**], figs 4–6; [**26**], fig.1C), whereas tetrapods are invariably disarticulated and other soil arthropods, such as insects and spiders, are absent? The original restoration of Donovan and Veltkamp ([**4**], fig.7) provided the answer, although a detailed understanding only came later [**23**–**25**, **27**]. Millipedes and isopods were likely washed into the RHRC during tropical storms. They drowned, but their exoskeleton included a small amount of calcium carbonate, which formed a substrate for precipitation of calcite. This stabilized the exoskeleton before it had a chance to disarticulate, and specimens may be particularly complete [**16**]. The only other Antillean site from which terrestrial arthropods are common is the Miocene amber of the Dominican Republic, a significantly different preservational system (Wu, 1996).

Tetrapods were probably washed into the RHRC as whole carcasses. Their bones and teeth were not exposed until the soft tissues had rotted, after the waters supplied by the tropical storm had drained away. Skeletons disarticulated and only became available for calcite precipitation during later storms. Exoskeletons of insects, spiders and scorpions lack significant quantities of calcite, so they would not provide a favourable substrate for precipitation of calcium carbonate. In consequence, they simply rotted away.

Fossil gastropods

[Bibliography **11** / **14** / **15** / **17** / **21**.] White snails and white bones are the most obvious fossil components of the red sediment filling the RHRC (e.g., [**14**], fig.3C). Jamaica is a biodiversity hot spot for land snails with more than 500 species, most of which are endemic. They are similarly common in Pleistocene cave fills, but nowhere more so than in the RHRC, from which 62 species of fossil gastropods have been identified. Of these, only 30 are common both to fossil and to Recent faunas of the area. This divergence between the known Pleistocene-age and Recent snail faunas of this area results both from local extinction of Pleistocene species and migration into the area by a significant proportion of the Recent fauna. This is in marked contrast with other cave faunas of land snails from the island, which have suggested that local endemic species have had more static distributions over the same period. The monograph of the RHRC gastropods [**11**] is available free on-line at:

www.city.mizunami.lg.jp/_res/projects/default_project/_page_/001/002/296/2014092922933_pauldonovan.pdf

A further feature of the snail fauna fossils is their occurrence cemented in dripstone at the margins of the cave, extending to close to the top/mouth of the fissure ([**17**], fig.3D). The obvious inference is that, before the road was driven through the Red Hills, sediment that was rich in fossils extended to near the top of the cave. What palaeontological treasures were lost downslope during excavation of the road can only be an object of speculation.

Fossil arthropods

[Bibliography **4** / **5** / **12** / **15**–**18** / **21** / **23**–**27** / **29**.] Undoubtedly, the jewel in the crown of the RHRC is the small diversity of soil arthropods, which represents part of the fauna otherwise unknown from the Pleistocene deposits of Jamaica or more widely among the Antillean islands. The only arthropod remains with a wider distribution are the claws of land crabs ([**12**, **16**]; Donovan and Dixon, 1998), but these may also be found in marine deposits (Collins and Donovan, 1998).

Typical soil arthropods are millipedes (four species [**4**, **5**, **15**–**18**, **21**, **23**–**27**, **29**]) and isopods (four species [**15**–**18**, **21**, **23**, **24**, **27**]) with only rare and robust parts of insects, including three taxa of fly puparia and possible beetle elytra ([**16**]). Isopods and millipedes are particularly well preserved; although the coating of calcite is sugary, details of many fine structures, such as legs, antennae, male gonopods, anal valves, and eyes are retained.

Fossil vertebrates

[Bibliography **2** / **3** / **9** / **10** /**15** / **17** / **19**–**25** / **27** / **28** / **30**.] Bones are a common component of the sediment of the RHRC. Forcing a hand into the unlithified sediment at the cave and making a fist, collectors will find bones protruding from between their fingers. But this wealth of specimens does not translate into a detailed knowledge of the tetrapods, because all specimens are disarticulated and most of the bones are indeterminate.

Some taxa are distinctive, such as the cranial skeleton and teeth of the rodent, *Geocapromys brownii* (Fischer) – the Jamaican hutia – ([**9**, **10**, **30**]), and the large limb bones of the extinct, flightless, ibis, *Xenicibis xympithecus* Olson and Steadman [**19**, **22**, **30**]. Four species of bats have been identified from their jaws [**20**, **28**, **30**], but these present an enigma; in part they represent taxa extirpated from the modern fauna, which includes about 21 species [**30**].

A preliminary survey of bird remains by Arjan Boot identified at least eight further bird species, which is certainly an incomplete record, with more than 300 species of modern bird recognized from the island. Lizard jaws and eggs (Recent or fossil?) are common but have not yet excited interest from any palaeoherpetologist. In short, the identified fossil tetrapods of the RHRC must represent only a sample of the true diversity. There is considerable potential for future research.

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