THE HISTORY OF CAVE STUDIES IN TRINIDAD, JAMAICA, THE BAHAMAS AND SOME OTHER CARIBBEAN ISLANDS

ZGODOVINA JAMSKIH RAZISKAV NA TRINIDADU, JAMAJKI, BAHAMIH IN NA NEKATERIH DRUGIH KARIBSKIH OTOKIH

TREVOR R. SHAW

Izvleček

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Shaw, Trevor R.: Zgodovina jamskih raziskav na Trinidadu, Jamajki, Bahamih in na nekaterih drugih Karibskih otokih

Prisotnost tolstičnika je zbudila zanimanje za jame na Trinidadu v začetku 19. stol. V nadaljevanju so preučevali netopirje, višek raziskav je bil povezan s preprečevanjem stekline v 30-tih letih 20. stol. Geološke raziskave so bile drugotnega pomena (Geological Survey Memoir 1860). Tudi potniki so opisovali predvsem jame s tolstičniki, dokler po 1940 niso pričeli s pravimi speleološkimi raziskavami. Potniki in domačini so opisovali jame na Jamajki od 1688 dalje. Zanesljive geološke raziskave so se pričele 1824. Zaradi preučevanja netopirjev je bilo veliko obiskov jam okoli 1860. Jame na Bahamih so bile objavljene 1725 in kasneje so jih preučevali geologi in ljudje, ki so se zanimali za izkoriščanje guana. Jamske slike na Arawaku so bile opisane 1889. Podmorske jame (Blue Holes) so bile objavljene okoli 1840, jame na manjših otokih pa 1749 (Antigua), 1773 (Caicos), 1813 (Barbuda) in 1878 (Grenadini). Najstarejše omembe so na pomorskih kartah, zemljevidih ali v navodilih za pomorščake.

Ključne besede: regionalna speleologija, zgodovina speleologije, netopirji, tolstičnik, guano, steklina, hystoplasmosis; Amerika, Zahodna Indija, Jamajka, Trinidad, Bahami.

Abstract

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Shaw, Trevor R.: The History of Cave Studies in Trinidad, Jamaica, the Bahamas and some other Caribbean Islands

Interest in Trinidad caves arose early in the 19th century because of the presence of the the guacharo. Continuing study was supplemented on bats, which culminated in research to control the rabies in 1930s. Geological aspects took second place (Geological Survey Memoir 1860). Travellers' accounts were limited to guacharo caves until speleological explorations commenced in the 1940s. Caves in Jamaica were described, from 1688, by residents and travellers. Geological investigations of generally high quality began in 1824. Bat studies resulted in a number of cave visits about 1860. Caves in the Bahamas were noted in 1725 and studied later geologists and those interested in the exploitation of guano. Arawak petroglyphs were described in 1889. The underwater caves, or Blue Holes, were recorded about 1840. Caves in other small islands were recorded in 1749 (Antigua), 1773 (Caicos), 1813 (Barbuda) and 1878 (The Grenadines). All the earliest references are on charts, maps, or instructions for mariners.

Key words: regional speleology, speleological research history, bats, guacharo, guano, rabies, hystoplasmosis; America, West Indies, Jamaica, Trinidad, Bahamas.

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PREFACE

Despite the Caribbean being a single region there has been no common thread in the exploration and study of its caves and karst regions. Work in one part generally had little or no influence elsewhere. Indeed the individual islands or groups of islands, although some of them are close together, mostly have quite different histories of investigation.

In part this may have been due to the influence of the colonizing powers - Spain, Great Britain, France, the Netherlands and USA - which caused different languages and customs in the regions they ruled. This does not, however, explain the differences between one island and another. More, it seems, this was dependent on the specific concerns of each one - water supply, guano, edible birds, fossils, floods, picturesque caves, etc. - and on the interests and contacts of individual people living in each island.

Since World War II, i.e. after the period covered by this paper, the former links with Europe remained, and easier travel resulted in many study visits and 'expeditions' specially to the karst regions. Some of these were from central European countries which had not previously been involved there, but each with a long tradition of karst study. Research by Panoš and Štelcl (1968) was particularly important, and Czechs, Hungarians, Poles, Romanians and others have all done significant work there.

Some caves in the Caribbean islands were described quite early in the 17th century, and in Mexico in the 16th. Caves in the Yucatan peninsular of Mexico had been used by the Mayan Indian people much earlier.

Not surprisingly, Valvasor (1689) already knew of several caves in the Caribbean and Central America. Although he never visited the area, his extensive knowledge of the literature world wide enabled him to describe:

- a cave, in the island of Hispaniola, in which is a great crashing and roaring. Valvasor named his source as Petrus Martyr, and examination of the fuller description there shows that the cave was almost certainly the Boca del Infierno (also known as Cueva Fun Fun) on the edge of Bahia de Samaná in the north-eastern part of the island.
- a cave with a river in it near San Augustin in the Verapaz region of Guatemala. This is undoubtedly the Cueva de Lanquin. Valvasor's source was evidently the book by Dapper (1673, 305) which he includes in his published list of sources, but Dapper's description in turn is clearly taken from Johannes de Laet (1633).
- a cave near 'Kuertlavaka' (probably Cuertlavaca near Oaxaca) in Mexico. Valvasor cites Dapper's book (1673, p.287) but this itself is evidently based on the then unpublished description of 1629 by Antonio Vazquez de Espinosa (1942, 182)

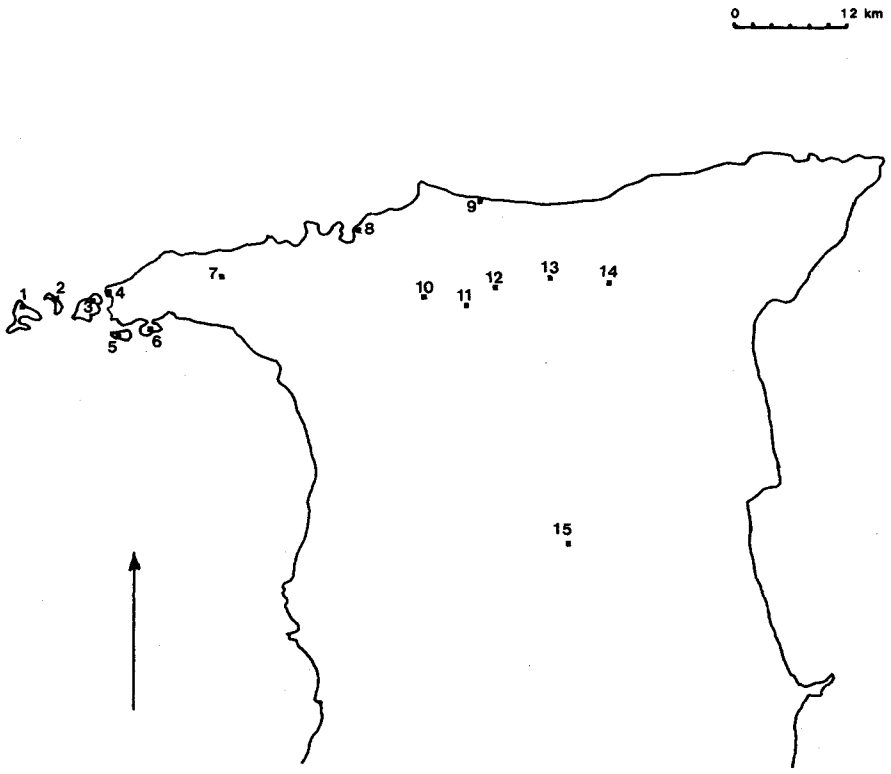

Fig. 1. Cave locations in northern and central Trinidad
Sl. 1. Lega jam na severnem in srednjem Trinidadu

1. Chacachacare Island
2. Huevos Island
3. Monos Island
4. Ance Paua
5. Gasparee Cave in Gaspar Grande
6. Point Gourde
7. Diego Martin
8. Las Cuevas
9. Blanchisseuse
10. Caura
11. Lopinot
12. Arima
13. Aripo
14. Oropuche
15. Mount Tamana

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TRINIDAD TO 1950

Abstract: Interest in Trinidad caves arose early in the 19th century because of the presence in them of the cave-dwelling bird, the guacharo. Continuing study of the bird and its haunts was supplemented from the 1890s by work on bats, which later culminated in research to control the rabies epidemic of the 1930s. Geological aspects of the caves tended to take second place despite the Geological Survey Memoir of 1860. Travellers' accounts were usually limited to guacharo caves until cave exploration for its own sake commenced in the 1940s.

The principal caves in Trinidad, including most of those investigated during the period covered by this chapter, are in the Jurassic limestone of the Northern Range of hills and in the islands forming its continuation off the north-west corner of Trinidad. There are also a few caves on the coast of the northern part of the island. Those of Mount Tamana in the central range apparently remained unrecorded until the 1940s. The locations of caves referred to are shown in Fig. 1.

To describe the history of cave studies in Trinidad either in a strictly chronological sequence or by rigid regional demarcations would be unhelpful. Instead, the main division here is by the subject of investigation, e.g. guacharos, bats, bugs, or exploration per se, with regional sub-division within each. There are exceptions to these arrangement in two places. Because tourist visits developed to see the guacharo caves of the more or less accessible islands, guide-books and tourism are treated immediately after the main accounts of the birds there. Secondly, the Geological Survey Memoir of 1860, though referring very little to caves, is of such significance that it is considered separately at an early stage in the chapter.

The main divisions, therefore, are:

- guacharos in the north-western islands and adjacent coastal caves;
- tourist visits and guide-books;

- the Geological Survey Memoir;
- the guacharo cave of Oropuche;
- guacharo and other caves at Aripo;
- guacharos in the gorge known as Dunstan Cave at Arima;
- cave bats;
- other cave fauna;
- cave exploration for its own sake.

Guacharos in the North-Western Islands and Adjacent Coastal Caves

The cave literature of Trinidad is enhanced by the interest taken in the cave-dwelling Guacharo or Oil Bird (Steatornis caripensis), as well as the more usual concerns with guano, bats, other fauna, geology and casual sight-seeing.

Indeed the earliest reference to caves in Trinidad is also, not surprisingly, the first account of the guacharo living there. Dr. John Latham (1823, 366-368) writes as follows:

> [The Trinidad Goatsucker] Inhabits the Island of Trinidad, and adjacent parts, has a plump body, and [is] excessively fat, particularly the abdominal region and rump. I owe the above account to the kindness of J.V. Thompson, Esq. who informed me, that he first became acquainted with this bird at the regimental mess in Trinidad, in 1803, when they were served up without the heads or feet, under the name of Dumpy Ducks, or Diablotins, and said to be considered as one of the greatest delicacies afforded by the Island; but as they did not seem to be much relished by unassimilated palates, and wishing first to know what description of bird it was, at that time did not taste of them; but considered them of the greater interest, as no person could be found capable of furnishing the requisite information: and it was not till 1809 that he again met with them, although annually brought to market, which the little that could be collected of their history will in some measure explain.
>
> They inhabit coves* of the Islands forming the Bocases, an entrance into the Gulf of Paria, accessible only at the very lowest ebb tides, and in moderate weather; and as they are never observed on the wing in the day time, most probably, like the rest of the Genus, seek their food in the absence of the sun; here they breed, during the early part of spring, and it is at the time of new and full moon, in April and May, that the people, who are acquainted with these coves*, resort thither; when finding the young ones not sufficiently fledged to be able to fly, they speedily fill their boats; not, however, despising the old ones, many of which are knocked down with sticks, and constitute a portion of their cargo: but as such as happen to be killed, in this horrible affray, amid the screetches of the whole, and the attacks of the old ones, will not, in many instances, keep a sufficient time to reach the market; these are most generally packed on the spot, in barrels, with bay salt, after being plucked, gutted, and divested of their heads and feet: and are sold from about a shilling to as far as eighteen-pence a piece sterling; and it is astonishing with what avidity this noisy cargo is bought up by all classes of the people, the moment it reaches the town wharf; so that a boat load of many hundreds entirely disappears in the course of an hour or after two.
>
> We believe that the above species is not already known to ornithologists, unless the

* see comment in text below

> following extract from Monsieur Depens, in his **History of South America**, may allude to it. He says, 'In the Mountain Turmeriquiri, situated in the interior of the Government of Cumana, there is a cavern called Guacharo: it is immense, and serves as a habitation for millions of nocturnal birds, (a new Species of the Caprimulgus of Linnaeus), whose fat yields the Oil of Guacharo.'

In view of this uncertainty of identification, Latham does not venture a Latin name for the bird. The guacharo of Trinidad is in fact the same Steatornis caripensis as occurs in Venezuela.

John Latham (b. 1740; d. 1837) was a British ornithologist and Fellow of the Royal Society, who is perhaps best known for his 11-volume **A General History of Birds** in which this account appears. The word 'coves' he uses for the places where the birds were taken does in fact mean caves. The **Oxford English Dictionary** shows that the word was in active use with this meaning at least until 1849, and it survives still in the names of a few caves, such as Cleaves Cove in Scotland. Besides, comparison with later descriptions of the guacharo cave in Huevos island in the Bocas make it clear that it is of this that Latham is writing.

Although the guacharo may well have been taken from caves as food for centuries before it was first recorded in 1799 by Humboldt and Bonpland (1814) in nearby Venezuela in 1799, consumption in Trinidad was always relatively local. Thus as a delicacy for commerce the guacharo did not approach the swiftlet (Collocalia sp.) of south-east Asia, the widespread trade in which was recorded as early as 1600 or before and which still continues today.

It is important to point out that the name Diablotin, or Devil Bird, is also applied in the Caribbean to a totally different species, the Blackcapped Petrel (Pterodroma hasitata) which roosts in small holes in the ground like a martin or a rabbit. Thus it was this petrel which was referred to by Du Tertre (1654) and which gave its name to the highest mountain in Dominica, Morne Diablotin, where it used to occur (Feilden 1890). The distinction was first pointed out by Hautessier (in Bory de Saint-Vincent 1838).

Most accounts refer to the presence of guacharos in the island of Huevos. They are also recorded on the nearby mainland coast in a cave Anse Paua. Although bats are present in the caves of Gaspar Grande and Chacachacare, guacharos have not been seen there.

The next writer to refer to guacharos in Trinidad is more precise in stating where they were found. Hautessier (in Bory de Saint-Vincent 1838) was the first to see the birds in their natural environment there. His account is concerned principally with the birds themselves so only those parts of it relating to the caves where they occur is printed here (in translation):

> One of the largest and most visited by hunters is on the northern side of Huevos Island ... Without any doubt the caves owe their existence to the dissolving and destructive action of the sea, for all their entrances are at the height at which the waves break. It is because of this that problems arise in hunting out of season, and especially in January, the month of my visit ...
>
> To capture the young Guacharos, the fine weather of April and May is usually chosen,

when the sea is as smooth as glass, so as to be able to reach the caves without fear of damaging the boats... Once the dangers of landing are past, there are many others to overcome: much strength is needed to crawl in the very narrow passages, to climb the high rocks, and finally to get into the roof fissures in which the birds nest. But as the collectors hang on in some well-chosen place they seize hundreds of Guacharos of all ages with their bare hands and throw them down to the floor of the cave which is soon littered with them. Only the fear of the sea getting up and closing the entrance is capable of stopping the hunters' frenzy of destruction. They fill their boats and take them straight to the markets of Port of Spain where the birds are greatly sought after by gourmets despite the great quantities of unpleasant fat they contain, and their strong smell.

A preserved specimen of a guacharo taken by Hautessier, together with a nest and eggs, was presented to the Acad,mie des Sciences in Paris in August 1838. The Huevos cave, 'swarming with guacharos', is referred to by De Verteuil (1858, 293) and the bird is described by L,otaud (1866, 65-69) in his standard work on the birds of Trinidad. L,otaud lived in Trinidad and he was the first to state that the guacharo occurs also in caves inland; the one at Oropuche (see later) was on the family land (Darlington, pers. comm.) and he probably knew of their presence there.

The novelist Charles Kingsley (1871, vol. 1, 203-205) set out early in January 1870 to visit the guacharo cave in Huevos but the sea was running so high that the boat was unable to enter. His graphic description of the conditions, however, makes it clear how the birds there avoid human interference for much of the year. Kingsley's boatman was the same Mr. Morrison who is said (Chapman 1894, 60) to have discovered the cave.

A rather more professional, and successful, visit to the Huevos cave was made about 1883 by William Hornaday of the National Museum of Natural History in Washington, D.C. His own account of this is printed in **The Standard Natural History** (J.S. Kingsley 1885, vol. 4, 386) and provides the earliest description of the cave:

Half an hour's pull along the precipitous side of Huevos Island brought us to a tiny bay hemmed in by the same high wall of rock. A turn to the left around some half-sunken rocks and we were at the entrance of the cave, a black, semicircular hole at the base of the cliff, six feet high and twelve wide, into which the swells of the sea dashed every moment.

The oarsmen held the boat carefully in position until a big wave came rolling in, when they sent the boat flying forward on its crest. We passed safely over the sunken rocks, and the next roller, which lifted the boat so high that we had to crouch down in order that our heads might escape the roof of the tunnel, brought us to terra firma. Scrambling out upon the pebbly beach we found rising before us a huge dome-like cave. The moment we entered there arose a perfect storm of rasping cries coming from the throats of about two hundred guacharo birds that circled about the top of the cave.

The walls of the cave were smooth bare rock, but at one side a huge mass of fallen rock formed a series of ledges from the floor up to a height of thirty feet. Climbing upon this we found numerous nests of the guacharos. The rocks were covered with guano to a depth of several inches. Whenever a smooth spot offered a safe resting place the nests were placed like so many cheeses, while others were built half swallow-like on the slopes.

> As nearly as we could estimate there were about seventy or eighty nests, nearly all of which we searched for eggs. In different nests we found the number to vary from one up to four, so that we are unable to say what is the usual number laid.

A vivid account of the same visit was later published in a popular book by the same author (Hornaday 1925, 140-145). The guide was not Mr. Morrison but a David Basanta who lived on Monos Island.

Ten years after Hornaday's visit, Frank Chapman (1894, 60) entered the Huevos Island cave on 5 May 1893 with its discoverer Mr. Morrison as guide, and estimated the total number of birds present as 200. He collected debris of the birds' food, largely seeds and fruit pips, which were identified by McAtee (1922).

Chapman also visited a cave

> on the main island of Trinidad in the first Boca. It contained apparently not more than fifty birds. There is no beach or floor in this cavern; the water reaches to its innermost parts, and as the walls are precipitous I was unable to explore it for nests.

This is the cave in the cliffs about 400 m to seaward of the small bay locally known as L'Ance Paua (Williams 1922, 168). Williams himself entered the cave on 12 May 1918:

> About halfway back in the cave I climbed out of the boat and found the water about two feet deep, getting shallower to the back of the cave. About a dozen or twenty birds were nesting on ledges high up on the walls but all were out of reach so I cannot say if laying was taking place or not.

The cave is not in limestone. Guacharos were still present in 1945 or 1946 (Pawson, c. 1948, 5) but are not there now.

It is possible that guacharos may formerly have occurred in a cave in Monos island also. Two specimens obtained between January 30 and February 2 1884 by naturalists from the U.S. Fish Commission steamer 'Albatross' were recorded by Ridgway (1884) as from Monos, though they could have been supplied by Monos inhabitants who exploited the nearby colony in Huevos. The only other mention of a Monos cave being a guacharo site is by Carricker (1931) who reported the birds to be present there in 1930. There is no first-hand account of their being seen there and Snow (1962) does not record the island either as an active or a former location for the birds. Komisarcik (1979) does refer to their presence there but it is evident that his party did not see them. There is however a small inland cave where bats occur (Darlington, pers. comm.).

Commercial harvesting of the guacharos on Huevos has long since ceased, though some casual collecting for food continued at least until recently.

Tourist Visits and Guide-Books

> We started one morning for a cave which exists on a neighbouring island. It was beautifully hung with glittering stalactites, which gave it the effect of being supported on white marble arches and columns. In one place these rose direct out of the azure depths, which lay as motionless as a mirror around them. The vaulted roof, fretted, Moorish fashion, was prettily reflected in its bright surface, and looking down into its recesses, the rocky floor could be plainly seen four fathoms below. I undressed for a dip, swimming in and out among the Gothic transepts and aisles. The water was tepid. A more romantic bath can scarcely be imagined, and the Greeks of old would at once have assigned it to the nymphs, or pointed it out as the grotto where Diana took her morning plunge. It was partly lighted from the entrance, and partly by a torch which we had brought with us (Stuart 1891, 86-87).

This 1858-1859 account of a tourist visit, evidently to the cave in Gaspar Grande or Gasparee Island, clearly owes nothing to scientific investigation and fitly opens a consideration of early cave tourism and the guide-books and services provided for it.

Fig. 2. Gasparee Cave about 1903 or before, on a postcard
Sl. 2. Razglednica Gasparee Cave okoli 1903 ali prej

Collens's **Guide to Trinidad** (Collens 1888, 225-226) mentions 'some curious limestone caves, containing singular petrifactions and swarming with ... bats, which may be explored at low water' in Gaspar Grande. To go beyond Monos 'you must engage a boat. I know of no better guide than Mr. Morrison if you can secure his services. He will pilot you to the celebrated cave at Huevos'.

By 1908 there were regular steamer services on four days a week to Gaspar Grande, Monos and Chacachacare (Ober 1908, 484-486) but a visit to the cave in Huevos still required a small boat to be hired specially. Houses were available for rent on Monos, Huevos and Chacachacare, though visitors had to take their own provisions with them (Aspinall 1907, 136; Ober 1908, 485).

It was about this time that tourist visits to Gasparee Cave on Gaspar Grande were promoted. A picture postcard (Fig. 2) was issued in the days when postal regulations allowed only the address to be written on the reverse side (i.e. before about 1903). A series of at least five photographic postcards, by 'HJB', were produced later; one of them has been seen with a postmark of December 30, 1921. Other postcards appeared towards 1930. Steps were built in the cave some time before 1936 to improve access and it is said (Pawson c.1948, 6) that the Trinidad Field Naturalists' Club held some of its meetings in the cave.

The attraction of the Gasparee Cave featured in the 1936 guide (Digby 1936, 182-184), and the same book (181) noted that 'boating excursions can be arranged and picnic parties made up for a visit to the Guacharo Caves at Huevos..., entrance being obtained at low tide'.

The Geological Survey Memoir

The Geological Survey Memoir on Trinidad (Wall and Sawkins 1860) is treated separately here, partly because of its intrinsic importance and partly because its point of view, unlike that of nearly all the other writers on Trinidad caves, is primarily geological.

The preface is dated December 1858 and the field work involved was no doubt spread over several years before that. Only a few pages (27-29) of the whole volume refer to caves, but in every case the information given is the earliest to be published on that cave.

First, and most prominent because it is accompanied by the engraving reproduced in Fig. 3, is a cave in the Diego Martin district. It 'has a considerable deposit of the latter substance ['crystallized spar'], and is resorted to by vast numbers of bats'. There are several caves at Diego Martin, but the only one listed by Goodwin and Greenhall (1961, 293) as containing bats is the La Fontaine Cave in Petit Valley, 2 km east of Diego Martin village. It is presumably 'the Diego Martin bat cave' visited in 1934 by Ditmars and Bridges (1935, 81) but it seems to have been destroyed since then (pers. comm. Greenhall to Darlington).

The part of the Memoir describing the Oropuche Cave is reprinted later, in the section dealing with that cave. Also, smaller 'cuevas de guacharos' are reported in the heights of Aripo and Arima'.

A guacharo cave 'at Acona [or Acono], is not in limestone at all, being produced by the

water having eroded a passage through very hard mica slates which arch over the stream'. Williams (1922, 171) 'made a close search of the Acono valley (a branch of the Maracas Valley)' and found, not a roofed cave, but a cave-like gorge 'exactly similar to the Arima Valley locality and apparently quite suitable for the guacharos, but none were present.'

The second cave illustrated in the Survey Memoir is labelled as 'Cavity in schist near Blanchisseuse' but is not referred to in the text. Blanchisseuse is on the north coast of Trinidad, and the picture appears to show a small natural bridge or tunnel open to daylight at both ends. Somewhat similar wave-cut caves at Las Cuevas, some 10 km west of Blanchisseuse, had earlier been mentioned by Dauxion Lavaysse (1813, vol. 1, 47).

The Guacharo Cave of Oropuche

Guacharos in Trinidad having been first recorded, first collected and first studied in the caves of Huevos and Monos islands, the history of those caves has been considered first and followed up until the 1940s.

Nevertheless it was as early as 1860 that another major cave site of the guacharo was recorded (Wall and Sawkins 1860, 27-29):

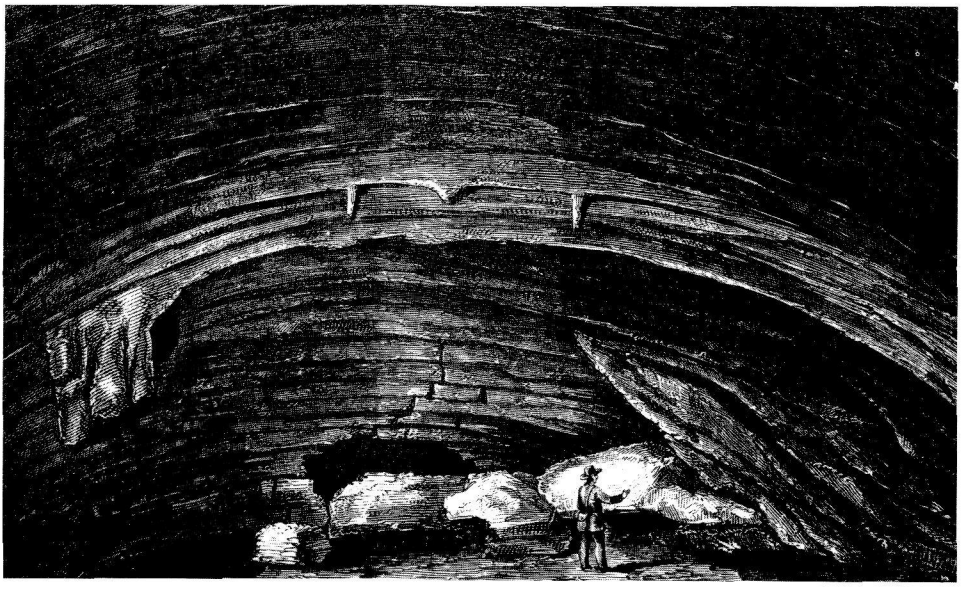

Fig. 3. A cave at Diego Martin, probably La Fontaine Cave, from an engraving in the Geological Survey Memoir (Wall & Sawkins 1860)

Sl. 3. Jama pri Diego Martin, verjetno La Fontaine Cave, na risbi v Geological Survey Memoir (Wall in Sawkins 1860)

> Perhaps the most remerkable cavern is situated at the base of the hill of Oropuche. This mountain rises to over 2,000 feet, and consists of calcareous rocks, which are extensively fissured. That circumstance facilitates the accumulation of a considerable body of water in the upper part of the cave, whence it flows in a constant and abundant stream, forming the origin of the river Oropuche. At the entrance the dimensions are about 30 feet high by 14 feet wide, and these are preserved for 100 feet; after which the area contracts. The cavern is distinguished as the habitation of the curious nocturnal bird termed guacharo...

As has been seen already, the cave was probably the source of L,otaud's statement (1866) that guacharos were to be found in inland caves as well as in those by the sea.

A visit to Oropuche cave on 2 March 1895 by F.W. Urich was described in detail in the **Journal of the Trinidad Naturalists' Field Club,** of which Urich was a prominent member.

> The Guacharo cave is pierced in the vertical side of the wall of crystalline limestone a hundred feet high, the entrance is about 25 feet in height and about 15 feet broad. Strewn about it are some huge boulders. The first thing to greet us was the smell of the birds and their deposits. They were of a decided "cockroachy" aroma. There are numerous rocky ledges and cavities in the sides. It is difficult for me to judge the distance I penetrated as progress was very slow but I should say that about 150 yards is not over estimated. In the bottom of the cave is a clear running stream in which we waded, reaching as a rule to above the ankle and sometimes above the knee. The bottom is composed of white quartz pebbles and sand; strewn about the bed are large boulders with jagged ends which make progress very slow. At the sides of the river, out of the current, there is a large accumulation of guano and seeds of, so far as I could judge, several kinds of palms. The roof of the cave slopes downwards and at the further end I could not stand erect, while the water was above my knees. Divesting ourselves of as much clothing as we could without running the risk of getting chilled, we each lighted a pavil and entered the cave. The scene which met our eyes and the noises we heard were of peculiar weirdness. Above our heads about a hundred birds fluttered, wheeled, darted, and screamed. The beating of their wings their shrill and piercing cries and croakings together with the rushing and murmuring of the stream created an impression which cannot be described but which was intensified by the vaulted rocks and repeated by the echoes in the depth of the cavern. Ped, by fixing a pavil at the end of a long rod bent at the end like a shepherd's crook, to which was attached a fish hook, showed me the nests of the birds some 25 feet above our heads. They were mostly in the holes and fissures of the rock, with which the sides of the cave are riddled. Feeling about the nest with the hook we managed to get two young ones, but they were very young and not yet fit for table. Most of the birds were still sitting on nests built of clay of a reddish colour. As we penetrated into the cave the noise increased, but when we got into the lower parts, no more guacharos were seen and we got into the region of the bats, which belonged to Chilonycteris rubiginosa species and were in numbers, treating us to a shrill concert which was answered by the plaintive cries of the guacharos in the distance. After securing a few specimens we retraced our steps and after various tumbles over the boulders emerged into daylight and seated ourselves at the entrance on the banks of the river and rested (Urich 1895).

The cave was visited by Urich again, in company with Freeman and Williams (1922, 168-169) on 23 April 1916. The birds were nesting at that time and there were some 30 or 40 nests on ledges from six feet above the river to the highest part of the walls.

It was the Oropuche cave that was visited by Theodore Roosevelt (1917), the former President of the United States, also with Urich and also in 1916. Roosevelt was a recognized naturalist of wide interests. He appears in the foreground of a photograph taken outside the cave by Urich and reproduced as Fig. 4. Roosevelt mentions the presence of bats in addition to the birds, and also noticed that seeds from the birds' food were germinating in the guano, though he mistook the growths for fungi.

Another quite detailed description of the cave resulted from a visit in June, probably of 1930, by M.A. Carricker (1931, 190-194).

Fig. 4. Theodore Roosevelt (front) and two companions outside the Oropuche cave in 1916 (photo by F.W. Urich, reproduced from Roosevelt 1917)

Sl. 4. Theodore Roosevelt (v ospredju) in dva tovariša pred Oropuche cave leta 1916 (foto F.W. Urich, reprodukcija iz Roosevelt 1917)

Guacharo and Other Caves at Aripo

A cave (or caves) at Aripo had been mentioned by Wall and Sawkins (1860, 29) as reputedly occupied by guacharos. Clearly the authors had not been there, so the earliest detailed report must date from 1922 (Williams) or possibly from 1911.

D.C. Plummer (1911) was an Agricultural Inspector in Trinidad who published in **The World Wide Magazine** how a neighbour of his, who remained anonymous, had fallen while trying to descend the entrance shaft of 'the Bottomless Pit' near the entrance of a famous guacharo cave some miles from Arima. His wife had fallen too, but they had landed on sponge-like moss which broke their fall. Eventually they reached another entrance above the coast near Blanchisseuse. The title page of the magazine describes it as 'an illustrated monthly of true narrative' but whatever in this story may be truth is so obscured that it is impossible to identify the cave concerned with certainty. However, Dr. Johanna Darlington (pers. comm.) suggests that it might be based partly on Soho Cave at Aripo.

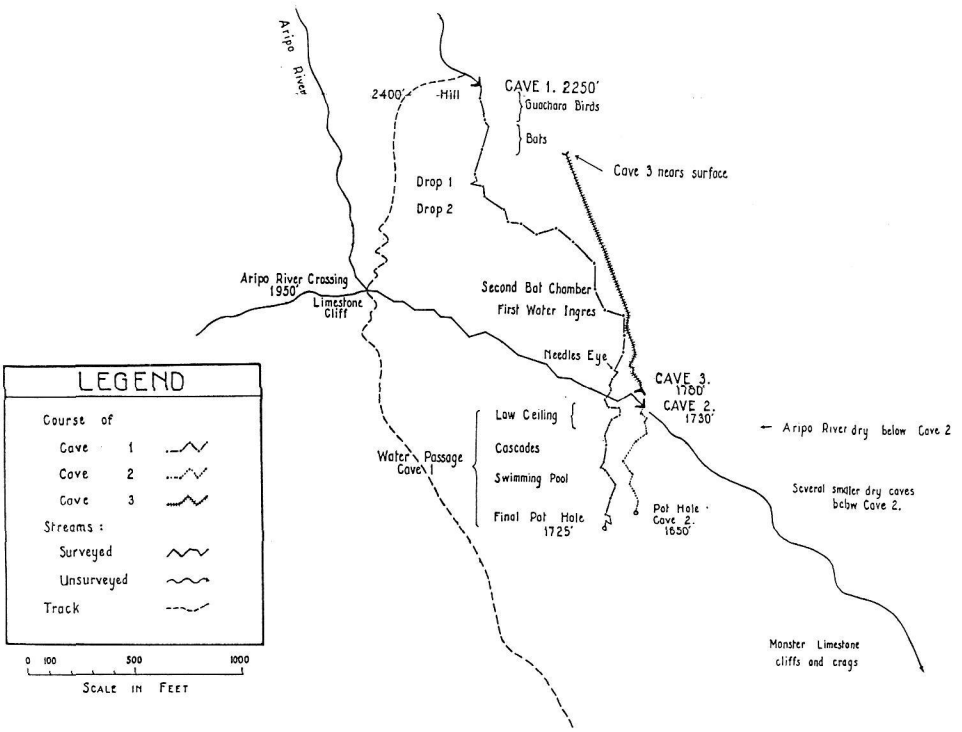

Fig. 5. A previously unpublished plan of Aripo Caves No. 1, 2 and 3, surveyed in 1940 by Gunther and Chenery (reproduced by courtesy of Trintoc)

Sl. 5. Neobjavljen načrt Aripo Caves No. 1, 2 in 3, meritev 1940, Gunther in Chenery (reproducirano z dovoljenjem Trintoca)

C.B. Williams (1922, 169), already cited so often, mentions a guacharo cave at Aripo very briefly. He had not visited it but had heard that it contained the largest guacharo colony in the island; this is certainly not so now. 'It has been visited on several occasions by Mr. E. Andre but so far as I am aware no account of it has ever been published.' Nor is anything known now of Mr. Andre.

In 1922 also a Major D.R. Latham, who had been in charge of the Government's survey, penetrated for 610 m in Aripo Cave No. 1 (Gunther 1940). The initials GLA were painted on the wall at this point. The exploration is apparently unpublished and, surprisingly, it has not been possible to trace any information about Major Latham.

It was probably in 1929 that M.A. Carricker (1931, 187-189) explored what he called the Shagramal Cave, now known as Aripo Cave No. 1. It is a stream cave containing both guacharos and bats. Nearby, Carricker (189-190) used a rope ladder to descend another cave in the same district, entered by an 18 m shaft - perhaps the original or inspiration of the **Wide World** cave. Two more caves were also noted, one of them with 6 m shaft near the entrance.

In 1937 the naturalist and popular writer Ivan Sanderson (1939, 35-77) was combining his honeymoon with a collecting expedition when he visited Aripo Cave No. 1, where he noted that the guacharo guano was 5 m deep, and also another cave which contained some vampire bats as well as other species.

The Aripo Caves No. 1, 2 and 3 were surveyed in 1940 by A.E. Gunther and Dr. E. Chenery. A detailed description, with a location map, was published in **The Trinidad Guardian** (Gunther 1940) and gave passage lengths of about 853 m, 152 m and 305 m respectively for the three caves. The survey of the caves referred to in the text was not printed with the article but an unpublished copy was traced in the files of the Trinidad and Tobago Oil Company by their archivist, who has provided the copy reproduced here (Fig. 5).

A rather more accessible description of Aripo Cave No. 1, written in 1948, has been publishe by Pawson (1974).

Guacharos at Arima

The Arima valley was the site of another of the guacharo caves heard of but not seen by Wall and Sawkins (1860, 29).

Williams (1922, 170-171) describes the place:

> ... on searching in company with Mr. Urich on June 2, 1918 we found that it was not a cave but a deep narrow canyon that had been chosen by the birds. The river has cut a deep ravine, forty to fifty feet deep and less than ten feet wide in the soft schist that forms so much of the northern range and in the semi-gloom near the bottom of this, and ten to fifteen feet above the level of the water seven nests were found.

This 'cave' is sometimes called Dunstan Cave (e.g. on the modern tourist maps), Asa Wright Cave or Spring Hill Cave. It was visited on 17 April 1926 by Gloria Hollister, in company with Urich, and she described it in a popular article (Hollister 1926).

Bats

The subject of cave bat research provides a convenient place to introduce the Trinidad Field Naturalists' Club, the president and other members of which studied bats and explored caves and whose journal published their findings.

The Club was founded in 1891 and its journal first published in 1892. Already the name of one of its members - F.W. Urich - has appeared often in these pages. The Society, though, like most scientific societies, was more than the sum of its members and its publications. It provided stimulation for work appropriate to its aims and, by meetings and publication, encouraged its progress,

Of the members one of the most prominent in cave work and over the longest period was Frederick William Urich (b. 1879, d. 1937) (Fig. 6), whose exploration of the Oropuche

Fig. 6. F.W. Urich, probably in the 1920s (from Howard 1930)
Sl. 6. F.W. Urich, verjetno okoli 1920 (iz Howard 1930)

Cave has already been noticed. He was appointed a government entomologist in 1909 (Wolcott 1938) and in 1934 he was put in charge of bat studies as a part of the government's anti-rabies programme. From 1926 to 1935 he was Assistant Professor of Zoology at the Imperial College of Tropical Agriculture in Trinidad.

Although his publications on cave matters were limited, Urich was repeatedly acknowledged as the catalyst who encouraged and made possible cave visits by others, including specialists from abroad. It was he who accompanied Williams and Freeman at the Oropuche Cave in 1916 and also Theodore Roosevelt in the same year, C.B. Williams at Arima in 1918, Gloria Hollister at Arima in 1926 and R.L. Ditmars and his colleagues in Caura Cave in 1934. A new species of blind cave fish was named after him in 1926.

Early in the 1890s, Henry Caracciolo, President of the Society and another entomologist, had many mammal specimens sent to the British Museum (Natural History) and the resulting report by Oldfield Thomas (1893) included three species of bat from caves. These had been collected in 1889 by Sir William Robinson, from the Point Gourde Caves and from a 'Cave in First Boca', which was probably the cave in Monos island.

In March and April 1893 Frank M. Chapman of the American Museum of Natural History collected specimens of Noctilio leporinus from the cave in Huevos, to which he was taken by the Mr. Morrison already mentioned. By this time the cave in Monos Island seems to have been deserted by the bats (Allen and Chapman 1893).

Caracciolo (1895) had watched these fish-eating bats in Januray 1892 and described how they caught their fish by swooping to the surface of the water with one foot lowered.

Specimens were taken in the Gasparee cave in 1934 by Raymond L. Ditmars (1935, 218), Curator of Mammals and Reptiles of New York Zoo. A shot gun was used to obtain them (Ditmars and Bridges 1935, 178)! In the same expedition Ditmars and Bridges (1935, 81) went to the Diego Martin bat cave (probably La Fontaine) and also made a more enterprising visit to the 'Jumbie Cave' at Caura (Caura No. 1 Cave), further east in the Northern Range, where they saw many bats but none of the vampires they were particularly seeking (Ditmars and Bridges, 1935, 78-103). Urich was with them but, now aged about 64, he did not go far into the cave.

It was in the 1930s that search for and research on bats was given impetus by an epidemic of paralytic rabies. The first incidence was in animals in 1925, with the first human case in 1929, and by 1935 eighty-nine humans had died of the disease which was spread by the vampire *Desmodus rufus* and other species of bat. Urich was appointed in January 1934 to investigate the relation of bats to the disease and to develop methods for their control. Much cave exploration and bat study resulted and the last human death from rabies was reported in 1937 (De Verteuil and Urich 1935; Goodwin and Greenhall 1961). Such work has continued since.

Other Cave Fauna

Although cave entomology has played such an important part in Trinidad cave studies since 1950, and though Urich was an entomologist, almost no one was working on invertebrate cave fauna in the period under review. Some occasional collecting took place, however.

Urich, together with C.B. Williams (the English entomologist trained in the United States whose cave work has been referred to several times) collected in the Oropuche Cave on 23 April 1916 (Williams 1922, 171). A new species of centipede, *Pselliophora cavincola*, was taken from the cave wall 'far in' (Chamberlin 1918, 168-169). Two new diptera (Edwards 1918) were *Trichobius caecus* from a bat and *Erioptera troglodyta* from the cave walls.

On March 1942 D.K. McE. Kevan found a new species of gryllid, *Aclodes cavicola*, in one of the Aripo caves (Chopard 1954). D.J. Billes collected two species of earwig from there in 1941 or 1942 (Kevan 1951).

The Oxford zoologist Dr. Peter C.J. Brunet (1921-1991) was in Trinidad in 1945 while serving as a Royal Navy officer. His collecting, in the caves of Aripo, Caura, Lopinot and Oropuche, included Opilionids and Pseudo-scorpions and he made a special study of the sub-order Schozonotidae (Brunet, pers. comm.)

A new species of blind catfish was obtained in 1924 by Urich and named *Caecorhamdia urichi* after him (Norman 1926). The location is given simply as 'a pool in the interior of the Guacharo Cave, Trinidad'. As, however, the pool 'becomes connected with a rivulet running out of the cave' in times of heavy rains, and the species is a fresh water one, the sea caves of the islands are precluded. Oropuche Cave, often referred to as 'the Guacharo Cave' in zoological literature, was well known to Urich and is almost certainly where the fish was found. It still occurs there and is not known anywhere else.

Cave Exploration for its Own Sake

With the increased number of foreigners working in Trinidad in the 1940s, both for oil companies and for the military, the circumstances that had led to cave exploring being a popular amateur occupation elsewhere in the world became applicable in Trinidad. People of varying backgrounds having no professional need to work in caves, but linked by their enjoyment of exploring the unknown, began to visit the caves and discover new ones. In some cases a professional approach led to surveying, but rarely were the results properly published.

Good work done by Gunther (1940) and Chenery at the Aripo Caves has been described earlier. It was in Aripo Cave No. 1 that an American airman, one of an exploring party of six, fell and broke his back on June 23, 1943 (Freitag 1943). The rescue involved a medical officer and seven others, all but one of whom subsequently suffered symptoms that are now recognizable as those of the lung infection histoplasmosis (Brown 1988).

The most comprehensive cave explorations known to have occurred before 1950 were those of Ken Pawson in 1945 and 1946 when he was in the Royal Air Force. A 61-page typed report was written, mainly in 1948. Of this, 56 pages, including three location maps, deal with Trinidad, the rest being about caves in Barbados. The typescript was never published, apart from the description of Aripo Cave No. 1 (Pawson 1974). The full report (Pawson, c.1948) has been cited from time to time as authority for statements earlier in this chapter. The full extent of Pawson's work can be seen by a list of the caves he explored: the main cave and others in Gaspar Grande, Biogowa [?Begorrats] Cave at Diego Martin, Caura No. 1 Cave, three caves in the Lopinot Valley, the Aripo Caves, Oropuche River Cave, and the caves on Mount Tamana in the Central Range (Pawson, c. 1948).

After 1950

Although this chapter covers only the period up to 1950, it is right to indicate the main directions in which cave work has developed since then, much of it driven by the need for more information on cave bats, guacharos and other cave fauna.

The anti-rabies programme of the 1930s, already mentioned, continued (Goodwin and Greenhall 1961) and led also to extensive work on bat ectoparasites and blood-sucking flies (Jobling 1949).

The recognition of the fungus *Histoplasma capsulatum* as the cause of histoplasmosis resulted in a widespread survey of guacharo and bat habitats, including caves (Ajello et al. 1962a, 1962b). Snow (1962) made a detailed study of the guacharo.

The ecology of bat guano was studied by Hill (1981) in the Tamana Caves, and Darlington (1970) worked on the cave-dwelling cockroaches in the same caves. New genera and species were named as a result.

In the 1970s the Government sponsored a survey of the Lopinot Caves with a view to developing them for tourism (Aquing 1974).

Cave explorers from USA reported on the main Trinidad caves while seeking new ones in 1978 (Komisarcik 1979),

Acknowledgements

Biographical information has been taken from the **Dictionary of National Biography** and the **Dictionary of American Biography** unless otherwise stated. Dr. Johanna Darlington, formerly of the University of the West Indies in Trinidad, drew my attention to several important references and I am particularly grateful for her helping me to tell which 'Guacharo Cave' was which in the 19th century literature. She also made helpful comments on the manuscript. Chris Howes, FRPS, copied the postcard used as Fig. 2 and has critically read this paper in manuscript. I am also grateful to the late Dr. Peter Brunet for information.

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JAMAICA TO 1940

Abstract: Caves in Jamaica were described, from 1688, by residents and travellers who were interested in anything unusual and were in effect cave tourists. Geological investigations of generally high quality began in 1824. Bat studies resulted in a number of cave visits about 1860.

Awareness of caves in Jamaica followed a very different pattern to that in Trinidad.

Firstly, caves and rivers flowing underground were noticed earlier, in descriptions of the island from the late 17th century onwards. Partly, no doubt, this is due to the fact that there are more of them in a larger island; partly because they are more prominent as so much of Jamaica is karst; partly, too, because several of the sinking rivers and caves are relatively accessible to people going about their normal business. Another factor affecting the notice taken of karst phenomena was the presence, in an island of considerable size and economic importance, of a high proportion of professional people - in government, as local residents, and as visitors. Some of these were geologists, attracted by the need to resolve the geology of an important island.

Secondly, there were no guacharos present, with all the attraction they presented to zoologists, collectors, curious visitors, and the catering industry. Nor, in Jamaica, has much research on bats been reported.

A study of the karst literature of Jamaica falls conveniently into the sections adopted in this chapter:

a) travels, 1688-1866
b) geologists
   (i) De la Beche, 1824;
   (ii)The Geological Survey Memoir of 1869;
   (iii) Hill and Daneš, 1899-1914;
c) popular and guide books 1877-1908;
d) prehistoric and quaternary remains;
e) bats and guano;
f) cave fish and other fauna.

The locations of the caves referred to are shown in Fig. 7.

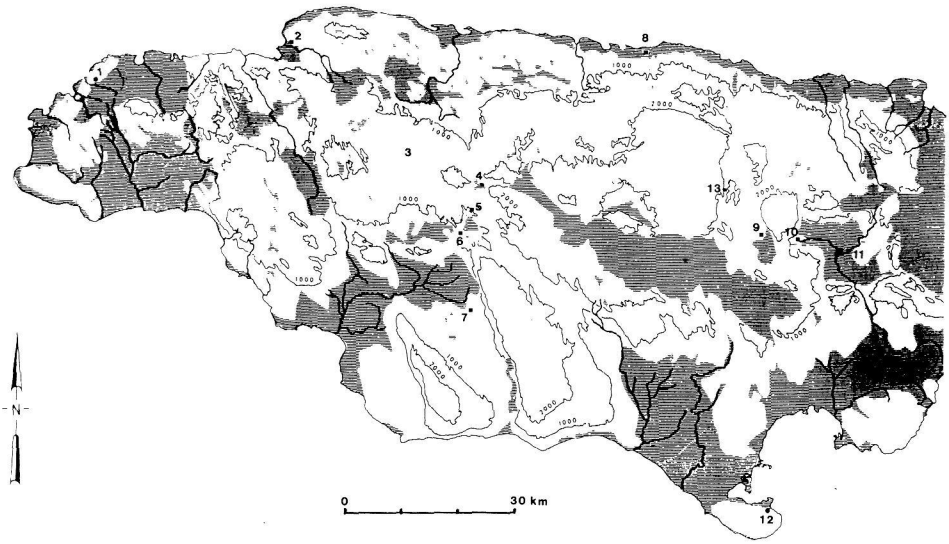
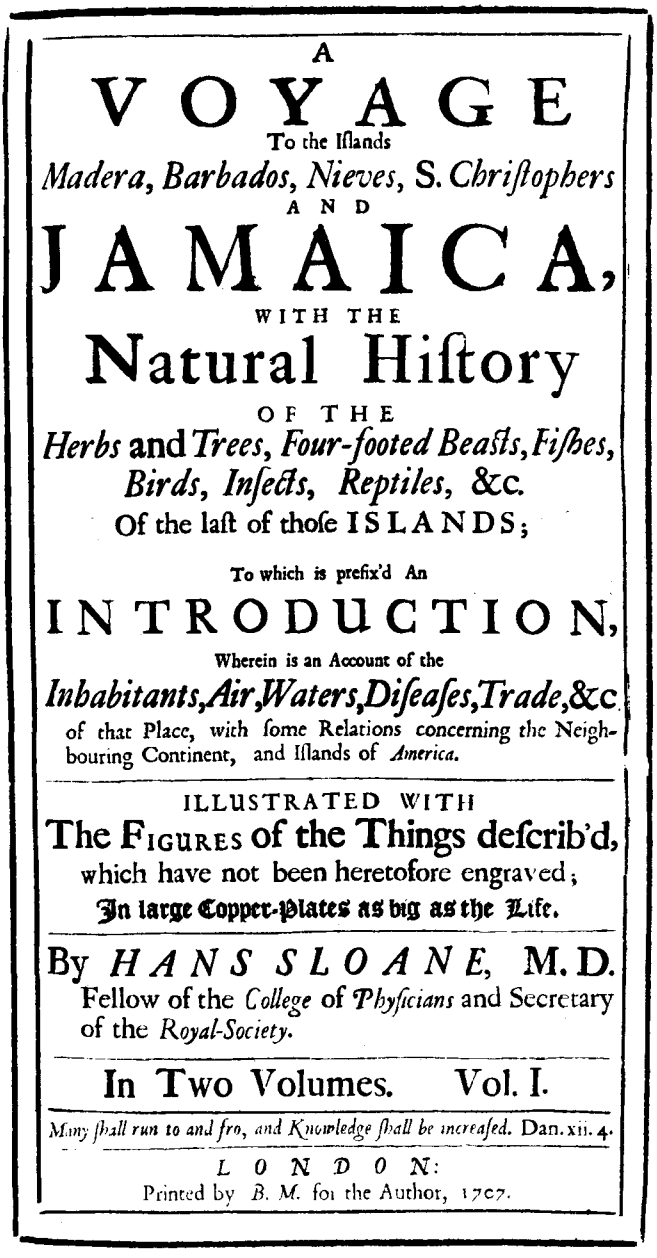


Fig. 7. Cave locations, etc. in Jamaica (adapted from the map in Peck, 1976)
Sl. 7. Lege jam itd. na Jamajki (prirejeno po karti v Peck, 1976)

1. Cousins Cove Cave No. 2	1. Cousins Cove Cave No. 2
2. cave at Montego Bay	2. jama pri Montego Bayu
3. Cockpit Country	3. Cockpit Country
4. Hector's River Sink	4. Hector's River Sink
5. Oxford Cave	5. Oxford Cave
6. Wallingford Caves	6. Wallingford Caves
7. Peru Cave	7. Peru Cave
8. Runaway Bay Caves	8. Runaway Bay Caves
9. Swansea Cave	9. Swansea Cave
10. Riverhead Cave	10. Riverhead Cave
11. junction of Rio Cobre and Rio Doro	11. sotočje Rio Cobre in Rio Doro
12. Portland Cave	12. Portland Cave
Dallas Castle Cave (off the map to the east, c. 7 km E. of Kingston)	Dallas Castle Cave (izven karte na vzhod, približno 7 km E of Kingstona)
Three-fingered Jack's Cave (off the map to the east, c. 10 km E. of Kingston)	Three-fingered Jack's Cave (izven karte na vzhod, približno 10 km E of Kingstona)



A

VOYAGE

To the Iſlands

Madera, Barbados, Nieves, S. *Chriſtophers*

AND

JAMAICA,

WITH THE

Natural Hiſtory

OF THE

Herbs and *Trees, Four-footed Beaſts, Fiſhes, Birds, Inſects, Reptiles,* &c.

Of the laſt of thoſe ISLANDS;

To which is prefix'd An

INTRODUCTION,

Wherein is an Account of the

Inhabitants, Air, Waters, Diſeaſes, Trade, &c.

of that Place, with ſome Relations concerning the Neighbouring Continent, and Iſlands of *America.*

ILLUSTRATED WITH

The FIGURES of the Things deſcrib'd,

which have not been heretofore engraved;

In large Copper-Plates as big as the Life.

By *HANS SLOANE,* M.D.

Fellow of the *College* of *Phyſicians* and Secretary of the *Royal-Society.*

In Two Volumes. Vol. I.

Many ſhall run to and fro, and Knowledge ſhall be increaſed. Dan. xii. 4.

LONDON:

Printed by *B. M.* for the Author, 1707.

Fig. 8. The title page of Sloane's book of 1707
Sl. 8. Naslovna stran v Sloanovi knjigi iz 1707

Travels 1688-1866

The classic first record of sinking streams in Jamaica was written by Hans Sloane (b. 1660; d. 1753) who spent fifteen months in Jamaica from December 1687 as physician to the Governor, the Duke of Albemarle. Sloane was later President of the Royal Society and his vast collection of books, manuscripts and natural history specimens went to found the British Museum. Sloane's book on his West Indian travels (Sloane 1707, 1725) (Fig. 8) is concerned mainly with plants and animals, but caves and underground rivers are referred to in the opening pages (vol. 1, ix-xii):

> Rivers here in the Mountains rise above and go under ground again in a great many places, as **Rio d'Oro** falls under, and rises above ground above **Sixteen Miles Walk,** three or four times, and so it is in many others.

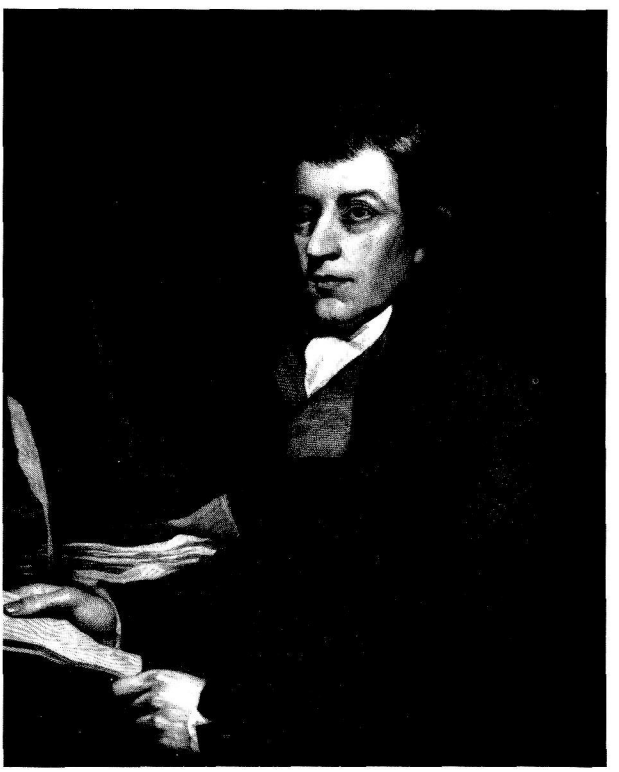


Fig. 9. Edward Long (1734-1813), engraved by W. Sharp after a painting by J. Opie (reproduced by courtesy of the trustees pf the British Museum)
Sl. 9. Edward Long (1734-1813), gravura W. Sharpa po sliki J. Opie (reproducirano z dovoljenjem pooblaščencev British Museum)

The Rio Doro flows from the north-east towards Bog Walk where it joins the Rio Cobre. Although the Rio Doro flows through some limestone country, and under a well-known natural bridge about 10 km from the junction, it does not constantly sink underground. It does sink in its lower reach, however, and it also twists and turns a lot, frequently in deep gullies, and this might lead to an impression of sinking and rising.

Unspecified caves are mentioned by Sloane in connection with saltpetre:

> What Saltpetre is to be had here, is from the Earth dug out of Caves where Indians were buried, or where Bats, and their Dung, are in great quantities. This I am certain of, because the Duke of Albemarle carried several people to Jamaica on purpose to try to make Saltpetre, having had a Patent for that Design.

He describes also the formation of tufa by the lime-bearing surface streams and refers to stalactites as the underground equivalent:

> Spring water is reckon'd preferable to other kinds: there are fine, large Springs here, many of them as well as Rivers, petrify their own Channels, by which they sometimes stop their own Courses, by a Sediment and Cement uniting the Gravel and Sand in their bottoms. When this petrifying water falls drop by drop, it makes the **Stalactites**. Several caves have their bottoms and tops united by this Stone, so that they appear Pillars.

There is no indication which caves he had seen these in. The most probable sites are those described later in the 18th century (though not Runaway Bay Caves, in view of Long's remarks on their discovery).

The next account of underground rivers, towards the middle of the 18th century, is by Charles Leslie of whom nothing is known except that he visited the island. He writes (Leslie 1740, 18-19):

> ... some [rivers] run for many Miles under Ground, particularly the **Rio Cobre,** in **St. Thomas's in the Vale** [which runs underground for nine miles] and the **Rio Pedro** in the same Precinct [which] runs about two Miles thro' a Mountain; it falls in with a mighty Noise, and rushes forth with no less. The **Negroes**, when they go a Fishing, stop the Inlet of the Water, and enter with Ease in the Cavity on the other Side, where they fish a little way with good Success.

More important, more lengthy, and more subterranean are the remarks of Edward Long (b. 1734; d. 1813) (Fig. 9). His father had lived in Jamaica and he himself went there from England in 1757 as a lawyer, and became a judge there. Ill health caused his return to England in 1769 and he spent the rest of his life writing, including his three-volume **History of Jamaica** (Long 1774), which contains descriptions of three caves.

The first of these is Riverhead Cave, in which the Rio Pedro rises:

> The cavern at River-head in the North-West part of the vale extends near a quarter of a

> mile under a mountain, or perhaps more, it being impossible to explore the whole length, on account of the river Cobre, which occupies the inmost part of it, and, running for a considerable way, suddenly shoots through a hole in the rock on one side, and continues its current under ground for a considerable distance from the cave. That this river draws its origin from some large stream in the mountains, far beyond the cave, seems evident, by its rising or falling in exact proportion as the rains are heavy or otherwise in the mountains. After very heavy rains, the river is so swelled, that, unable to vent itself at the hole, the superfluous water disembogues through the mouth of the cavern. An ingenious man attempted, a few years since, by fixing a flood-gate across the hole, to force the current of the river into a regular channel by the mouth of the cavern, and conduct it from thence to turn water-mills on the neighbouring estates. The undertaking had all the appearance of being practicable, but was laid aside after the death of the projector (Long 1774, vol. 2, 57).

The remains of a stone-built dam are still present about 400 m inside the cave. The stream is believed to come from the Worthy Park Sinks, more than a kilometre away, or perhaps from even further (Fincham 1977, 3, 124).

The whereabouts of the next cave is no longer known:

> In a rocky hill, on the Northern side of Old Woman's Savannah, is a cavern which runs a great depth under the earth. Upon examination, a few years since, it was found to contain a great many human bones, which were probably either Indians, or the relics of some of the wild or rebellious Negroes, who formerly infested this part of the country, and made it their place of concealment (Long 1774, vol. 2, 65).

After describing various tufa deposits and cascades in surface streams, Long (1774, vol. 2, 95-100) gives a detailed account of what is now known as Runaway Bay Caves, near Dry Harbour where Columbus landed. This description is printed here in its entirety, being the earliest detailed one of a visit to any Jamaican cave:

> The grotto in this parish, near Dry Harbour, and about fourteen miles West from St. Anne's Bay, is situated at the foot of a rocky hill, under which it runs for a considerable way, and then branches into several adits, some of which penetrate so far, that no person has yet ventured to discover their ending. The front is extremely Gothic in its appearance. It is the perpendicular face of a rock, having two arched entrances about twenty feet asunder, which look as if they had anciently been door-ways, but sunk by time or accident to within two or three feet of their lintels. In the centre of the rock, between these portals, is a natural niche, about four feet in height, and as many from the ground, which might well be supposed intended for the reception of a madona, especially as at the foot of it is a small excavation, or bason, projected a little beyond the face of the rock; which seems a very proper reservoir for holy water. Excited by the accounts I had heard of this celebrated curiosity, I made one among a party to visit it. After providing ourselves with several bundles of candlewood, split in small pieces, we crept on our hands and knees under the larger of the two apertures in the front of the rock, and immediately found ourselves in a circular vestibule, of about eighteen feet diameter, and fourteen in height. The cieling [sic!] (an irregular concave), as well as the sides, was covered with stalactic and sparry matter, interspersed with innumerable glistening

particles, which, reflecting the light of our torches from their polished surface, exhibited the most rich and splendid appearance imaginable.

This roof seemed to be supported by several columns of the same matter, concreted by length of time; whole chaptrels, and the angular arches above, appeared in the true Gothic taste. The pillars surrounded the vestibule; the open spaces between them led into avenues which diverged away into different parts of this subterraneous labyrinth. On one side we observed a rock, which by the continual dripping of water upon it from the cieling, was covered with an incrustation, and bore a very striking resemblance of some venerable old hermit, sitting in profound meditation, wrapped in a flowing robe, his arms folded, and a beard descending to his waist. The head appeared bald, and the forehead wrinkled with age. Nothing was wanted to complete the figure, except the addition of features, which we immediately supplied, in the theatric manner, with a piece of charcoal. The graceful, easy folds and plaits of the drapery, and the wavy flow of the beard, were remarkably well expressed. Roubilliac, the rival of nature, could not have executed them in a more finished and masterly style. After we had sufficiently contemplated this reverend personage, we pursued our route through one of the largest adits. We found the passage every where of good height, in general from twelve to fifteen feet; but so totally excluded from day-light, that the gloom, together with the hollow sound of our trampling, and dismal echo of our voices, recalled to our minds the well-imagined description of Aeneas's descent into the infernal regions...

That the comparison might have appeared more just, I ought to have premised, that the grotto is surrounded with a thick wood, and that at a small distance before the entrance is a large lagoon of stagnant water... The soil beneath our feet we perceived was deep, soft and yielding, and had a faint, cadaverous smell. Upon examination, we imagined it to be a congeries of bat's dung, accumulating perhaps for ages past; and were further confirmed in this opinion by the multitude of these creatures, which, upon the disturbances of our torch-light, and the unusual noise of so many visitors, flitted in numerous swarms over our heads. It is probable this soil is strongly impregnated with nitre; but we had not time to search for it. After walking a considerable way, we observed many new adits branching from the sides. Our guide informed us they led several miles under ground; and that one half of them had never been explored by any human being. Soon after, we came all on a sudden to a little precipice, of about four or five feet; and some of the party would have hurt themselves very severely, if it had not been for the soft stratum of bat's dung which lay below ready to receive them. Our guide, and two or three of the foremost, disappeared in an instant, having tumbled one over the other; but soon recovered from their surprize, when they found themselves unhurt. The rest, who followed at some little distance, being put on their guard, descended with somewhat less rapidity. We continued our walk without further interruption, till we hailed the day-light again, in an open area environed on all sides with steep rocks covered with trees. This area, as nearly as we could conjecture, lies about a quarter of a mile from the entrance of the grotto. We remarked several adits leading from different parts of this little court; but our guide was acquainted with one of them only, into which we walked, and came into a magnificent apartment, or rotunda, of about twenty-five feet diameter, and about eighteen to the dome, or vaulted cieling; from the centre of which descended a strait tap-root of some tree above, about the size of a cable, and pretty uniform in shape from top to bottom. This had made its way through a cleft in the rock, and penetrated downward quite into the floor of the apartment. On one side was a small chasm, opening like the door-way of a closet into a narrow passage; which our guide endeavoured to dissuade us from entering, on account of a deep well, which he informed us lay a few paces within. However, we ventured in

a little way with great caution, and found his account very true. The passage grew more and more contracted, till we met with a thin, upright ledge of rock, rising like a parapet-wall, almost breast-high, which seemed to decline gradually lower as we advanced. We therefore thought it prudent to halt, and soon discovered the ledge of rock separated us from a vast cavernous hollow or well. Having no line, we could not sound the depth of the water, nor how far it lay beneath us; but, by the fall of some stones we threw in, we judged the distance to the water about thirty or forty feet. The stones in their fall produced a most horrid, hoarse noise, as loud as hell's porter uttered from his triple jaws, primis in forcibus orci. Our guide informed us it was unfathomable, and communicated with the sea. The latter is probable, as the entrance of the grotto is very near the coast. We returned across the area by the way that we came, only peeping into a few of the other avenues as we proceeded, which we found very little different. They had the like rude cielings incrusted with stalactites, here and there interspersed with the radical fibres of trees and plants, and their walks strewed with various seeds and fruits, particularly the bread-nut in great abundance; and even some reptiles, all curiously covered over with incrustations, but still preserving their original shapes. The structure and furniture of these various cloysters and apartments, at the same time that they excite the utmost curiosity, baffle all description. In some we saw, or fancied we saw, sparkling icicles, and beautifully-variegated foliage, gemmy canopies, festoons, thrones, rostrums, busts, skulls, pillars, pilasters, basons, and a thousand other semblances of such objects as struck our different imaginations. Most of the arches and columns seemed to be composed internally of a greyish, sonorous marble, and were extravagantly wild and curious. Some are perfect, and sustain the massy superstructure; others half formed; and some in their very infant state. Several of the apartments are cellular; others, spacious and airy, having here and there an eyelet-hole to the world above. These aerial communications are of signal service; for, although not in general large enough to admit much light, yet they introduce sufficient fresh air to expel noxious vapors, and afford a convenient respiration, except in those parts which are most recluse. The exterior summit of the cave is a greyish rock, honey-combed all over, full of crannies, and thick-set with various species of trees, whose roots having penetrated wheresoever they could find an opening, they flourish without any visible soil, an appearance which is extremely common in this island. We were anxious to investigate further: but, upon examining our stock of torch-wood, we found scarcely sufficient left for conducting us back to the entrance, and we were obliged to use dispatch in regaining it, for fear of rambling into some one of the numerous passages opening to the right and left, where, puzzled with mazes and perplexed with errors, we might have rambled on without the probability of ever finding our way out again: and in such a distressful event we could not reasonably have expected any human assistance. The famous Cretan labyrinth did not, I am persuaded, contain half the turns and windings which branch through every part of this infernal wilderness; and which even Theseus, with the help of his clue, would have found difficult to unravel. Whoever may have the curiosity to examine these meanders with more attention, and to discover their extent and termination, ought to furnish himself with the implements necessary for striking fire, a portable mariner's compass, a proper quantity of wax tapers, and some provision for the stomach. Thus equipped, he may pervade them without fear of being lost, if he walks with due circumspection: the impression of his feet on the soft mould, which is thick-strewed in these passages, might enable him to re-trace his own tract almost without the assistance of a compass; though to avoid the possibility of being bewildered, it will be advisable to carry one.

> There are the most remarkable curiosities as yet discovered in this parish; but it may probably contain others, the grotto not having been found out, or at least generally known, till within these few years. We are uncertain whether it was known to the Spaniards; but it is supposed that run-away Negroes were not unacquainted with so convenient a hiding-place.

A curious little book, whose author is not known, appeared a few years later, in 1790, and contains a short account of the same cave, apparently by then the most visited cave:

> There is a very curious cave on the North side of the island, which I have been visiting with my friend Philanthropos, - the chambers are very lofty and spacious, but the passages are so intricate, that none have yet ventured to explore the extent of the grotto. - Trusting to our guides we wandered from chamber to chamber, till the decrease of our wooden torches, warned us to return in time to the Sun.
>
> The ground we walked upon was uneven, and our feet sunk half over our shoes into a kind of soft black dust like soot: we met vast numbers of bats.
>
> In some of the apartments there were small clefts that admitted day-light and after proceeding a considerable way, we got out into a curious large area, in which there were trees growing.
>
> Entering by another cell on the opposite side of the area, we were told by our guides to walk with caution, as we were approaching a deep well - at which we shortly arrived, and throwing down a large stone, heard it strike repeatedly against the sides, till at last it dashed into the water, after taking near a minute in its descent.
>
> As we returned we passed thro' one apartment, where we were struck with a number of extraordinary figures; some in the shape of tombs, others of various bodies and faces, but one image was so nearly perfect, that we could scarcely resolve upon its being a lusus naturae [sport of nature]. - It was the figure of an old man with a long beard, cloathed in a robe sitting on a stone, and reclining his head upon his hand, his elbow resting on his knee: - the folds of his robe fell over his feet, and above his head was (if I may so express myself) a large concave sheet of the rock, under which he sat as under a canopy - his posture was that of pensive melancoly, which furnished Philanthropos with the subject of the following ode (Anon. 1790, vol. 2, 126-129).

The author's friend 'Philanthropos' was Robert Charles Dallas (b. 1754; d. 1824) and his poem, of 15 verses, is called 'The Grotto: or melancholy. An ode'. Its author is known because the poem was reprinted in the **Miscellaneous Writings** of Dallas (1797, 59-66). He was born in Kingston but left the island as quite a young man, as the climate affected his wife's health. Fincham (1977, iv), who quotes one verse of the poem, states that he was still in Jamaica in 1778 so the date of the cave visit that inspired it, and his anonymous friend's description, may have been as early as that.

A few years later Dr. Thomas Coke (1808, 352) described the same cave but his account is merely adapted from Long's book, without acknowledgement, the parts that are not shortened being almost word for word copies of Long's text. In its turn, Coke's description was quoted by the Baptist missionary James M. Phillippo (1843, 43-44).

The naturalist Philip Gosse lived in Jamaica from 1844 to 1846 and visited two caves, neither of which can now be identified. They are 'Hallow-well' near Grand Vale,

Westmorland, and 'a singular little grotto close by the road side' at Mount Carey, St.James (Gosse 1851, 198-199, 253-254).

A remarkable exploration was made in 1895 when the Governor of Jamaica and a Mr Davis were lowered to the bottom of Hutchinson's Hole, a shaft now known to be 98 m deep (Fincham 1977, 85). Sir Henry Blake (b. 1840; d. 1918) was 55 years old at the time. The cave gets its name from a tradition that the highwayman Lewis Hutchinson used to throw his victims' bodies down the shaft.

Sir Henry's descent, on 19 or 20 July 1895, is described in some detail in one of the Jamaica's main newspapers (Anon. 1895).

> Telegraphing yesterday morning our correspondent says: Yesterday His Excellency the Governor and Lady Blake drove to the historical 'Hutchinson's Hole' on the property of Edinburgh Castle in the Pedro district[.] Preparations had previously been made by Mr. Davis, Superintendent of Public Works, for a descent into the hole into which he first went, after which His Excellency descended and remained for some time. No bones or other relics of Hutchinson's reported victims were found. The bottom of the cave opens into a rather large hall and appears to have been flooded at some not very remote period; this might possibly account for the absence of such relics. The depth of the hole as ascertained by actual measurement is 256 feet and not 6 or 8 hundred as previously supposed.

Geologists

De la Beche

Like several of the people already mentioned, Thomas Henry De la Beche (b. 1796; d. 1855) had some family connection with Jamaica, and it was to see the family estate that he visited the island in 1824. For most of his life, however, he was concerned with British geology, initiating the Geologiocal Survey of Great Britain and becoming its director.

Two main papers resulted from his Jamaica visit. The second of these is the more wide-ranging but the first (De la Beche 1825) includes a description of his visit to Portland Cave No. 1 which he called the 'most celebrated' one at that time. 'Portland Cave has been visited by hundreds of persons, most of whom have written their names on almost every accessible portion of it'. Imbued with the then fashionable writings of Buckland (1823) on the presence of mammal bones in cave earth beneath a stalagmite layer, he comments 'I did not observe any bones beneath it [the 'crust of stalagmite'], and am now sorry that proper search was not made, as the depth of the silty clay has not been ascertained, and as it might contain bones.' Indeed it might; in 1920 H.E. Anthony found bones there (Koopman & Williams 1951, 2) but his excavation has not been published.

Although the other paper (De la Beche 1827) is 52 pages long, it aims to cover the geology of the whole island so the underground rivers, while noted, are not given prominence. Indeed it is surprising to find a quite lengthy footnote describing the Swansea Cave:

> The entrance to this cavern is highly picturesque, and is concealed from a distant observer by dense tropical vegetation. The first part of the cave varies in height, and is, in some

places, lofty; this portion is covered with grotesque stalactites and stalagmites, and some of the columns are very beautiful. It terminates in a small open space surrounded by cliffs, where some negroes cultivate plantains and cocos. The lenght of the first cavern is about 76 paces allowing for all inequalities. After crossing the small open space above mentioned, (probably only a portion of the cave that has fallen in,) we entered a cavern forming a winding chamber, about 89 paces in length, the sides, roof, and floor of which are covered with stalactites and stalagmites. We then crept through a low communication about three paces long, and entered another chamber about 34 paces in length, containing grotesque stalactites and stalagmites. We then came to a small space, through which we crept upon our hands and knees, for about the distance of two paces; and this opened into a lofty cavern 54 paces in length, where bats were clustered in considerable numbers on a portion of the roof. This chamber was separated from another by a small division. The space now entered was tolerably lofty and about 21 paces long: at the end, the roof had fallen in, and admitted the light of day; and the rubbish formed a rough ascent and descent, occupying about 60 paces of the cavern's length. We then entered a chamber 14 paces long, which is succeeded by a low passage, where we could not stand upright, 21 paces in length. After passing this low place, we found ourselves in a chamber 14 paces long, and we then entered a low place where the bed of limestone that formed the roof gradually approached the clay floor and prevented further progress.

Near this cavern is another, from which the people on Swansea estate obtain their supply of water, which remains at a greater or less depth in it according to the seasons. Sometimes, when heavy rains have fallen in certain parts of the neighbourhood, with which it must have communication, it rushes out of the cavern with great noise and impetuosity into a gully, but is soon swallowed up among the sink-holes (De la Beche 1827, 185-186).

The cave referred to in the final paragraph is now called Sand Hole Gulley Cave.

The Geological Survey Memoir of 1869

The Gelogical Survey Memoir on Jamaica (Sawkins 1869) has 340 pages devoted to an island about 70% of which is limestone, so it cannot be expected that this section can give an adequate r,sum, of all there is in it relating to caves. It is not the intention to trace the development of geological interpretation of Jamaica karst from De la Beche, through Sawkins, Hill and Daneš. To do so would require a lengthy chapter to itself. The purpose here and in the next few paragraphs is to note the existence of such work and to show how it led to a greater knowledge of the caves themselves.

Most of the book consists of reports on individual regions, parish by parish, by five separate authors, some of them writing as early as 1863. There is thus a vast amount of detailed information, not only on the rocks but on the hydrology of the island, mentioning caves primarily in this connection. The value of the volume is in its comprehensiveness, including as it does the more remote areas. Thus the Cockpit Country is described for the first time in some detail (216-219, 242-243). By providing information on individual places, it allows the hydrology to be seen as a whole. The dolines or 'cockpits' of the Cockpit Country, as well as 'light-holes', are attributed to collapse (242-243). The Geological Sur-

vey Memoir made the karst of Jamaica known world-wide and was cited by Cviji- (1893, 244) and Martel (1894, 548; 1896, 40).

Hill and Daneš

Thirty years after the publication of the Geological Survvey Memoir a lengthy reassessement of the geology of Jamaica was produced by Hill (1899). There is little of descriptive interest on the karst, but the cockpits are explained as being products of solution, not of collapse (25-27).

Daneš (1914 and earlier) was aware of Hill's views and he also favoured solution for the formation of cockpits. His principal contribution to the study of karst was that he was able to add his observations of tropical karst in Jamaica and Java to the European investigations which had hitherto been the basis for karst theories. Sweeting (1972) has pointed out that it was mainly because of Daneš's work that Grund (1914) was able to put forward his scheme of evolution of karst areas, in which the doline karst of temperate regions evolved towards the type of tropical karst seen in Jamaica.

Popular and Guide Books

In a country where the caves had been as well researched and reported as they had in Jamaica. one would not expect the popular books to contain new information. Nor do they, but they are significant in that they show how the public would learn about the caves and to what extent they were regarded as tourist attractions. It will be seen that they were given much less prominence than those in, say, Trinidad.

Considered first, as the earliest, is a series of a large size photographic reproductions of scenes in the island by Dr. V.P. Parkhurst (1887), photographer and publisher, with a short accompanying text. Not popular in the sense of a large-scale production, it was nevertheless aimed at the lay public, not the scientist. It would have been a magnificent production had it been completed, measuring 35,5 cm by 27,5 cm, but the author died when only five parts had been issued. The very high quality photographs included ones of the river sinking at Luidas Vale and the rising at Riverhead Cave.

The guide-book by Bacon and Aaron (1890) mentions the main Hector's River Sink. Both Gardner (1893) and Stark (1898) refer in identical terms to Three-Fingered Jack's Cave on the Cane River and the latter book goes on to describe Runaway Bay Cave and the Cockpit Country. Ober (1908) has no more than 16 lines on caves but he does say that 'Peru Cave ... is noted for its fine stalagmites', the first written intimation that the public might go there, though names on its walls indicate that it had been visited for a long time already (Fincham 1977, 3).

Prehistoric and Quaternary Remains

Rock carvings made by aboriginal Indians in or near cave entrances are known at several sites, suggesting that some caves were sacred and perhaps used for burial. In 1895 the

small Dallas Castle Cave was discovered by removing the boulders that blocked the entrance and at least 24 human skeletons were found there, together with the remains of a canoe and of food animals (Duerden 1895).

In 1919 and 1920 H.E. Anthony investigated 18 caves, finding and collecting bones in 10 of them. He himself published only a popular article (Anthony 1920a) and one note on new genera of rodents from a cave at Wallingford (Anthony 1920b). The fossil bats he collected were subsequently studied by Koopman and Williams (1951) and the fossil monkeys by Williams and Koopman (1952). Anthony's work at Wallingford has been reviewed recently by McFarlane and Gledhill (1986). With these exceptions, his work in Jamaica remains unreported (A.P. Currant, pers. comm.).

Bats and Guano

Cave bats, among others, were studied from 1858 to 1860 by W. Osburn who died suddenly while working on them, leaving extensive manuscript notes. From these a paper was prepared for publication by the Secretary of the Zoological Society of London (Osburn 1865). The caves he visited included Mahogany Hall Cave and Sportsman's Hall Cave in 1858; and, in 1859, Oxford Cave (an 'immense cave, whose winding galleries cannot be less than a mile in length'), a 'magnificent' cave in Portland Ridge, Runaway Bay Caves, two caves on the Harmony Hall estate in Trelawny parish, and a 'picturesque little cave' close to the town of Montego Bay, perhaps Sewell Cave. The Portland Cave referred to may be the same one (No. 1) that De la Beche saw, or it may be the more 'magnificent' and longer cave (No. 2) which is more difficult to explore but nevertheless contains dates from the mid 18th century. The locations of Mahogany Hall Cave and Sportsman's Hall Cave are not known exactly, but they are not far from Oxford Cave and Balaclava (S.J. Walker, pers. comm.). In Mahogany Hall Cave 'The floor of the cave was strewn here and there with the kernels of bread-nut (Brosimum), which had sometimes germinated into young blanched trees on the thick deposit of dung'.

Bat guano was used locally as a fertilizer in the 19th century and analyses of 35 samples were published by Cousins (1903) when export to U.S.A. was being considered. The largest deposits occurred in what is now known as Cousins Cove Cave No. 2 (Fincham 1977, 214-215) and it was from there that at least some of his samples were obtained.

Cave Fish and other Fauna

Eigenmann (1909, 188) wrote that blind fishes related to the Stygicola and Lucifuga species found by Poey in Cuban caves in 1856 'are said to occur in Jamaica'. This statement may derive from a newspaper report (Anon. 1909) that an English researcher had found blind fish in Wallingford Cave (now known as Wallingford Sink).

Other fauna seem to have attracted little attention in the period under review. Chopard (1923) describes a Uraroviella, a new genus of gryllid, from specimens taken by Major A. C. Clarke in a cave in Trelawny parish, 'nearly a mile from daylight', in September 1921.

Acknowledgements

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THE BAHAMAS TO 1950

Abstract: Caves in the Bahamas were noted in 1725 and studied in the 19th and 20th centuries by geologists and those interested in the exploitation of guano. Arawak petroglyphs in a cave were described in 1889. The underwater caves, or Blue Holes, were recorded on charts about 1840 and attracted much attention in the 1890s.

The Bahamas are today perhaps better known for their underwater caverns or Blue Holes than for conventional caves. Both have been recorded over the years, together with numerous pits on land which the high water table cause to be water-filled. In the days before cave diving, observations on the underwater caves were limited to their surface appearance and depth.

Whilst it was the 'curious' nature of the water-filled holes that attracted attention to them, many of the caves were recorded because of the considerable trade in bat guano. The presence of aboriginal petroglyphs in one cave was also noted.

As many of the caves are small and have few distinguishing features, it is often difficult to determine their precise location from contemporary descriptions. For this reason the map accompanying this paper (Fig. 10) names the islands only, as well as some of the Blue Holes in the ocean.

The peculiarly porous nature of these low-lying islands is demonstrated by the presence of pits or dolines in which the water level rises and falls with the tide (though not in phase with it). These were the first karst phenomena to be noticed in the Bahamas and were seen in 1725 by the English naturalist Mark Catesby (b. 1679?; d. 1749). He was a friend of Hans Sloane, noticed in the chapter of Jamaica, and many of his plant specimens went to the latter's museum and thence to the British Museum. Catesby had travelled extensively in America from 1710 and in 1725 he visited the Bahamas, staying with the governor in [New] Providence and visiting several of the other islands.

> Many of the Islands, particularly **Providence**, abound with deep Caverns, containing salt Water at their Bottoms; these Pits being perpendicular from the Surface, their Mouths are so frequently choaked up, and obscured by the Fall of Trees and Rubbish, that great Caution is required to avoid falling into these unfathomable Pits (as the Inhabitants call them) and it is thought, that many Men, which never returned from Hunting [,] have perished in them: in **Providence**, and some other [i]slands, are extensive Tracts of low level Land, or rather spongy Rock, through which, at the coming in of the Tide, Water Ooses, by subterraneous Passages from the Sea, covering it some Feet deep with Salt Water, which at the Return of the Tide sinks in, and is no more seen, 'till the Return of Tide again, so that there is an alternate Appearance of a Lake and a Medow every 12 Hours; One of these Lakes being visible at a Distance of about four Miles from the Governor's House, surprised me at its appearing and disappearing several Days successively, 'till I was truly inform'd of the Cause. The Caverns before mentioned, I make no doubt of, are supplyed with Salt Water from the Sea, in like manner with these Lakes, but because of their Depth and Darkness, the rising and falling of the Water may not have been observed; ... (Catesby 1731, vol. 1, xl).

More than a hundred years later Captain Richard John Nelson made a detailed geological study of the islands (Nelson 1853). Captain Nelson (b. 1803; d. 1877) was in the Royal Engineers of the British Army and later became a major-general, studying the geology of many of the areas where he was stationed. Like Catesby, he noticed the dolines with their fluctuating levels of brackish water on the lower ground. It was he who first recognized that the fresh ground water formed a lens, floating on top of the salt water in the ground and

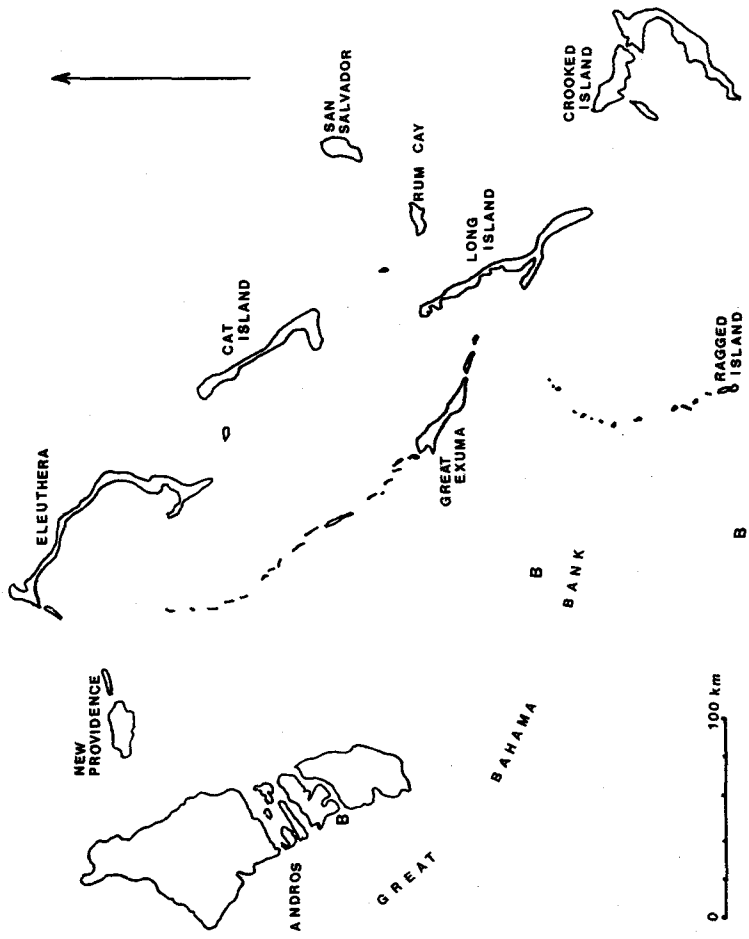

Fig. 10. Part of the Bahamas, showing places mentioned in the text. B: Blue Holes on Admiralty Charts surveyed 1836-1844

Sl. 10. Del otoka Bahamov, ki prikazuje kraje, omenjene v besedilu. B: Blue Holes na Admiralty Charts izmerjene 1836-1844

resupplied by rainfall. The practical importance of wells therefore being dug no deper than necessary did not escape him.

Blue Holes

One of the characteristics of the Bahamas is the presence of Blue Holes or deep underwater caves. Some of these have entrances on land but most of them open as shafts in the sea bed where the blue colour of their deep water, contrasting with the green of the shallow sea, gives rise to their name.

Blue Holes are of particular interest today, when they are being extensively explored by cave divers. Their history goes back more than a hundred years before the 1950s underwater explorations of George Benjamin, who is credited in a widely read reference book (Courbon et al. 1989, 43) as being the first to describe them.

Although they have probably been noticed for centuries, the earliest record of Blue Holes (as distinct from Catesby's tidal dolines), so far located, is their presence on the Admiralty Charts surveyed in 1843 and 1844 by Commander Edward Barnett and Lieutenant G.B. Lawrance, Royal Navy. One of these holes, at 2306'15" N, 76038'45" W, is marked as '38 fms [69.5 m] hole 10fms diameter. in c[o]r[a]l patch', with the surrounding sea bed about 9 m deep; another, at 2209'25" N, 76029'53" W, is labelled 'Blue Hole', and shown as 13 fathoms (23.75 m) in a surrounding 11 m; yet another, at 220 14'30" N, 76028'50" W, is 24 fathoms (44 m) deep. All these occur on the Great Bahama Bank; the first is some 150 km west of Long Island and 120 km south-east of Andros; the others lie about 80 km west of Ragged Island. Another, shown on an Admiralty Chart of 1844, is a 2.5 fathom (4.5 m) 'Deep Hole' in water otherwise only half a fathom (1 m) deep off the west end of South Bight in Andros; it was recorded during surveying between 1836 and 1842.

Nelson (1853) did not remark on Blue Holes but they received considerable attention in the 1890s from those who recorded their position, described their behaviour, and attempted to explain their origin.

The geologist Dr John I. Northrop (1890) spent a little over six months in the islands, two of them in new Providence and the rest in Andros. One hole he saw, on land but nevertheless 'known as the "Ocean-hole"', was near Nicholl's Town at the northern end of Andros. The pit 'was about one hundred feet in diameter and perhaps forty feet in depth, and contained a pool of brackish water... The name "ocean-hole" is also applied by the natives of Andros to deep holes **under** the water' and Northrop lists the following, all of which he saw himself;

- Mangrove Cay, close to the shore, 30 m diameter and said to be over 33 m deep.
- Andros, close to the northern bank of Fresh Creek, about 16 km from its mouth. 30 m diameter, and 5.5 m deep in water that is otherwise only 0.6 m deep.
- Andros. Near Grassy Creek, the shore forming one edge of the hole. About 50 m diameter and more than 37 m deep.

In addition, he was told of one over 55 m deep in the 'Pine Yard'.

Northrop uses the term 'Boiling-Hole' to distinguish those holes where the water could be seen moving with some velocity.

> The first of these I was shown on Andros in a small creek that runs into Conch Sound. The top of the hole was about a foot under water at low tide, and close to the mangroves that formed the side of the creek. It was about seven feet in length and about two or three wide. Below the diameter increased, forming an overhanging ledge. When the tide was low in the creek, but rising outside, the clear sea-water could be distinctly seen ascending, thus producing the same appearance at that presented by a mixture of sulphuric acid and water. Suspended particles could also be seen rising.
>
> While sailing past Rat Cay, near Mastic Point, another "boiling-hole" was seen that was apparently about ten feet in diameter, and from a distance we could see a perceptible "boil" on the surface that was undoubtedly caused by the rising water. Our captain said that when the tide was falling the water in the hole went "down and round" - which statement I believe, as the water was rising with some force, and probably ran out again with sufficient rapidity to cause a small whirlpool. In another boiling-hole near Mangrove Cay the water was seen ascending.
>
> These facts prove not only that an underground connection exists between these holes and the ocean, but that the connection is an open one, so that the water can flow freely through it, and thus the pressure resulting from the passing tidal wave is shown before the tide commences to rise on the shore. The ocean-holes, I believe, can be explained by supposing them to be old boiling-holes in which the connection has been stopped up, and their greater size caused by the falling-in of the ledge on the edge, which would aid in the stoppage. I regret that I have no fact to offer on the depth of the boiling-holes, for the only one I stopped to examine was at Conch Sound, and this one ran under the ledge, so that its depth could not be determined. The ocean-hole at Nicols Town, described above, is also, I believe, an old ocean-hole now elevated.

'Ocean-holes' were also examined by Alexander Agassiz (b. 1835; d. 1910), oceanographer and zoologist and son of the better-known Jean Louis Agassiz. He studied the Bahamas and the surrounding sea bed in the early part of 1893 and was interested in the evidence that the holes provided for subsidence of the land.

> May we not to a great extent measure the amount of subsidence which must have taken place at certain points of the Bahamas by the depth attained in some of the so called ocean-holes, as marked on the charts? Of course we assume that they were due in the aeolian strata to the same process which has on the shores of many islands formed potholes, boiling holes, banana holes [i.e. small solution holes], sea-holes, caverns, caves, sinks, cavities, blow-holes, and other openings in the aeolian rocks. They are all due more or less to the action of rain percolating through the aeolian rocks and becoming charged with carbonic acid, or rendered acid by the fermentation of decomposed vegetable or animal matter or by the action upon the limestone of sea water or spray under the most varying conditions of elevation and of exposure. None of them have their upper openings below low-water mark [i.e. none that he knew of], though some of them may reach many feet below low-water level. Ocean-holes were

> formed in a similar way at a time when that part of the bank where they exist was above high-water mark, and at a sufficient height above that point to include its deepest part. The subsidence of the bank has carried the level of the mouth and of the bottom of the hole below high-water mark.
>
> ...
>
> The principal ocean-holes, Blue Holes, are the following: one five to six miles from Hawk's Bill Rock; three, of eighteen, twenty-four, and thirteen fathoms [33, 44 and 23,75 m], a little east of north of Blue Hole Point, each about five miles apart on a northerly line; and two, of seventeen and thirty-eight fathoms, in the extension of the line of Blossom Channel leading from the Tongue of the Ocean upon the bank [This last is probably the one shown on the chart of 1844].
>
> ...
>
> At other places on the banks ocean-holes are said to exist. Among those not on the charts, I may mention a fifteen fathom [27 m] hole at High Point, Andros, and a twenty fathom [37 m] hole in the Middle Bight, between Gibson Cay and Big Wood Cay (Agassiz 1894, 41-42).

The 'fifteen fathom hole at High Point, Andros' might be Stargate, a hole near the highest point of Andros, and now known to be 80 m deep overall (Palmer 1986a; 1989), though the name High Point was applied in the 17th century to what is now called High Point Cay, further to the south on the sea coast.

Thus Agassiz considered that the underwater caves were formed originally by water action when they were at higher level. Northrop had stressed the flow of sea water through the passages, caused by the tide, though he does not explicitly link this with development of the caves. As will be seen, this was the contribution made by Maynard in 1894.

In order to see these 19th century statements in perspective, it is well to summarize the present-day explanation of the origin of Blue Holes (from Palmer 1986b). The caves in the islands originally formed just below sea level, at the interface of the lens-shaped mass of fresh water ground water with the salt water below. Corrosion is particularly great here in the chemically aggressive mixing zone of fresh and salt water, aided by bacteria living at the interface. Tidal movement as well as rainfall ensures movement of the water, removing corrosion products and restoring aggressivity. The caves formed some 100000 years ago when sea levels were not dissimilar to today's, and became dry during the ice ages, when speleothems formed in them, only to be submerged again since. The land levels of the time allowed the Ocean Holes far out on the Bahama Bank to form in the same way.

Charles Johnson Maynard (b. 1845; d. 1929) was a taxidermist and naturalist from U.S.A.. He made five collecting expeditions to the Bahamas and published on them in his **Contributions to Science,** one of the several books he published himself, setting the type and making his own woodcut illustrations.

Maynard was unconventional in many ways and his independence led him to conclusions about Blue Holes that in some ways closely approach the modern view. In a biographical note, Stone (1933) comments, 'while Maynard's observations were voluminous, often original, and covered a wide field, his lack of early scientific training was frequently evident in his publications and he fell short of the accomplishements that might have been his had had he had a thorough foundation in science. Nevertheless, as one of his biogra-

phers has said, "It is possible this would have spoiled his independence and originality, and made a narrow specialist of him".'

It was the reason for the flow of water in the submerged caves that particularly exercised Maynard's mind. He believed that the passages remained from spaces left when coral was forming into reefs and that they were kept open by the water flow or even enlarged by the 'dissolving away of the dead coral'. As will be seen, he invoked the movement of the Gulf Stream water, which is indeed largely channelled close to the Bahamas.

Because Maynard's (1894) account also gives locations and descriptions of some of the Blue Holes, and because copies of the original book are now excessively difficult to find, extracts are printed here at length:

> [A] coral reef, no matter how thick it is, is not a solid wall, but is honey-combed in all directions by passages which are either left through the irregular method of the formation of coral heads, branches etc., or from a dissolving away of the dead coral. With elevation of the reefs, many of these passages would remain much as they were, especially in that portion of the reef which still remained below sea level, for the water would still continue to flow through them.
>
> That such water ways do continue to remain, we have ample proof in many places in the Bahamas. On New Providence are three or four large lakes of salt water, which occur in old lagoon beds, and in which the water rises and falls with the tides of the ocean. The most distant of these bodies of water from the sea is Lake Cunningham, which lies south of Fort Charlotte and which is a little over a mile from the shore.
>
> But among the most remarkable of the remains of the ancient passages through the reefs are what are known as ocean holes. The first instance of this that I saw was at New Providence. About a mile south of the Government House, also in the lagoon bed, in a middle of a cleared portion of land, is a depression in the rock, which is occupied by a basin of water, somewhat circular in form and about ten feet in diameter. This basin is about six feet deep, but on the north-eastern portion opens into an apparently bottomless cavity, some four or five feet in diameter, in which the water, on account of its great depth, is as blue as indigo. Through this passage this ocean hole has direct communication with the sea, and the tide ebbs and flows regularly in the basin, rising and falling between two and three feet.
>
> There is a beautifully clear lake on the eastern side of Rum Key, the center of which is as blue as the water of the Gulf Stream, which is a huge ocean hole and which is said to be visited by turtles from the ocean.
>
> One day while my men were pushing my boat over the shallows of the great bank which lies south of Andros, on which the water is only a few inches deep, we suddenly glided over a large ocean hole in which the water was also blue, and gazing into its limpid depths. I could perceive no bottom. The current set into this hole with the ebb, and out of it with the flood, tides.
>
> On the south shore of Andros Island is a large ocean hole in the naked rock, about a half mile from the shore, which is some fifty yards in diameter, and which has a large spreading mangrove tree growing beside it.
>
> Further north on Andros, about opposite Green Key, is an ocean hole remarkable for its singular form. It occurs in the naked rock as a cleft which is about a hundred yards long, but which is nowhere over twenty feet wide. To all appearances the water is of great depth in this chasm, how deep, either in this or in others of the holes mentioned, I cannot say, as I had no

means of sounding them, but in this, as in others mentioned the tide rises and falls regularly with that of the neighbouring ocean.

These ocean holes, are, I think, of not unusual occurrence, throughout the Bahamas, and appear to connect, as seen, directly with the ocean, at perhaps no very great depth, but there is another class of subterranean water way which is even more remarkable than are the ocean holes, of which I know two only, one by actual observation and one by report. Both of these lie in Middle Bight, near the eastern opening, and from them both, as I can bear witness in one case, the water flows out constantly and with considerable force.

The one with which I am acquainted is situated on the side of a little islet known as Givens' Key that lies about a mile within the Bight towards the northern shore. The hole is quite near the island, about thirty yards from the beach, and being between tide-marks, the land about it is left dry by the falling water. This hole is somewhat circular in form and some ten feet in diameter, opening out of the solid rock, which it penetrates, without diminishing in diameter, for some twenty feet perpendicularly, then diminishing somewhat in size, passes obliquely under the rock to the eastward. From the mouth of this cavity the water flows with such force that it is difficult to stand upright in the stream which flows into the Bight on the north side at low tide, and it flows up to a considerable distance above the surface of the water at high tide. Just how much water is ejected by this singular orifice is difficult to calculate, but it must amount to several hundred gallons a minute.

The water is salt, and is evidently sea water, for gorgonias, especialy the Briarium arbestinium [a missprint for asbestinium], which is usually a deep water species, thrive well there, and several species of coral grow about the mouth of the cavity and in the stream that flows from it. None, however, grew far down in the cavity. I did, however, obtain the largest specimen of Briarium asbestinium that I ever saw, on the southern side of the cavity, from the top of a projecting shelf some two feet below the surface, and fine specimens of this gorgonia grew on all sides of the cavity as far as the water from the orifice flowed.

Before attempting to advance any hypothesis as to why the water constantly flows out of this singular cavity, I will explain its situation more fully by the aid of the accompanying diagram and also give a special idea of the formation of Andros Island.

In fig. 62 [reproduced here as Fig. 11] I have given a section of the mouth of this subterranean water way in which it will be seen just how and at what angle the passage bends to the eastward. By standing on the western shore one can see considerably further into the cavity than on the eastern side which I have marked with an E.

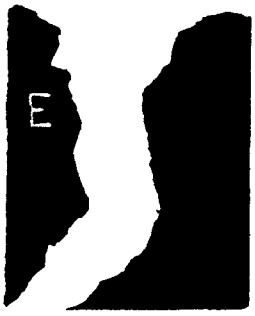

Fig. 11. 'Section of mouth of boiling hole'. The original Fig. 62 of Maynard's 1894 paper, showing a Blue Hole. E denotes east side

Sl. 11. 'Del ustja jame, ki "vre"'. Originalna slika 62 Maynardovega besedila iz 1894, prikazuje Blue Hole. E označuje vzhod.

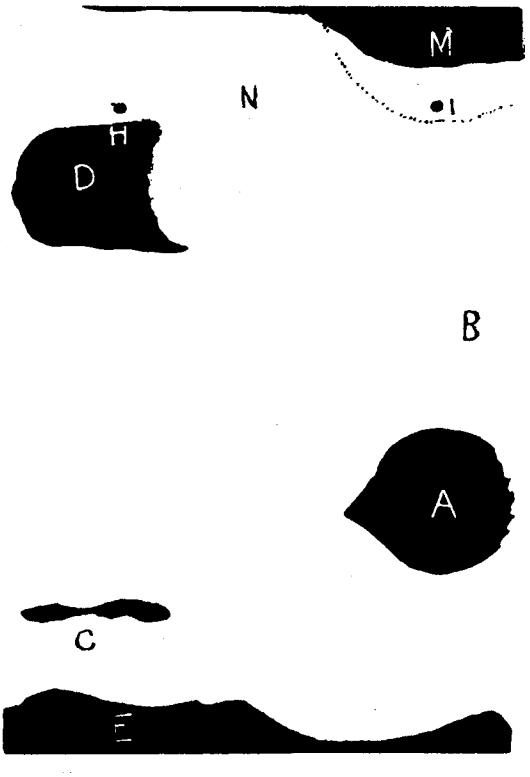

Fig. 12. The eastern entrance of Middle Bight, Andros, showing the position of two Blue Holes ('boiling holes'). The original Fig. 63 of Maynard's 1894 paper; the key is in the text

Sl. 12. Vzhodni vhod Middle Bight, Andros prikazuje lego dveh Blue Holes ('boiling holes'). Originalna slika 63 Maynardovega besedila iz 1894; razlaga v besedilu.

In the diagram, fig. 63 [Fig. 12], the white is water and the black land. B, is the entrance of the Bight; M, Mangrove Key on the north of the Bight;

A, Little Galden Key; C, Goat Key; D, Givens' Key; H, the cavity;

E, the south shore of the Bight; I, approximate position of the second boiling hole, and the dotted lines represent a shallow bank between it and the land. The scale of this diagrammatic chart is about two inches to the mile.

Andros Island, on the eastern shore of which these boiling holes are situated, is an island of somewhat peculiar formation as compared with the rest of the Bahamas. Along the eastern shore the land is quite high, often rising into cliffs. This line of cliffs is evidently an old barrier reef, similar to the barrier reef which now exists all along the eastern shore of the island, but of course the old reef has been elevated with the other of the Bahamas. West of this old line of reef, the land is low, that in the interior being rocky and covered by

pine woods, but west of this it gradually merges into marl flats that by degrees, through a network of creeks and lagoons, merge into the waters to the westward.

Between this low coast and the Gulf Stream, distant about seventy miles, are comparatively shallow banks which terminate quite abruptly on the borders of the Gulf Stream, but without the intervention, as yet, of any well-defined reefs. From this gradual lowering of the land from the eastward it is easy to understand that Andros has been formed by an accumulation from the western side, and that its greatest increase has been in that direction; in fact, it is highly probable that it is only a matter of time when all the bank between what is now the west coast of Andros and the Gulf Stream will become land. This is readily comprehended by one who has visited the southern coast of the island and seen the extremely shallow water there with little mangrove keys gradually forming and filling-in the watery area.

Now in regard to the constantly flowing water from the two boiling holes, this can be accounted for in two ways only. As shown, it is pure sea water, therefore cannot come from extreme depths, as does the sulphur water of Florida, which flows from the earth in a similar manner, as at Blue Springs, near the St. John's, and in other places. The Tongue of Ocean which lies only a little over a mile to the eastward is quite deep, and water under the pressure of considerable depths might, by being forced into a narrow passage, boil upward in that manner, but it would almost seem that the counteracting air pressure on the mouth of the passage would prevent any outward flow, and even if it came from a considerable depth would act exactly as we find it acting in the ocean holes, namely, rise and fall with the tide without any constant outward flow.

Then again, water from a great depth in the ocean would be cooler than surface water, which was not the case, or at least in any perceptible degree, and as seen it could not have been colder or corals would not have thriven in it.

After giving the matter much thought I can account for these boiling holes in one way only and that is by supposing that when the old reef was formed these passages were in it just as we find passages through the old reef which borders the everglades of Florida on its southern side, through which subterranean streams find their way into the ocean.

The elevation of the island does not appear to have broken the connection of these ocean holes with the sea and it did not break the connection which this boiling holes had with the ocean. We have seen that in case of the ocean holes their connection was with the neighboring ocean, to the eastward of the old reef, in an extreme case, not over three miles distant, but in order to account for the boiling holes we must consider that they were connected with the waters on the westward of the reef, which was, then as now, the Gulf Stream. Before the elevation of the land this stream had practically gradually receded to what is now the western border of the island, for it is clear that the whole western portion of the key is nothing but an elevated mud bank. In its retreat it carried the sea entrance and the passage to the boiling hole with it, until it not only reached the present western border of the island, but backward to the present border of the Stream a hundred miles from the mouth of the boiling hole.

Now it can be readily understood that the northward flowing current of the Gulf Stream, moving as it does with considerable velocity between the Bahama Bank and Florida reef, would cause the water to run into a narrow passage with such force as to cause it to emerge from the opposite opening especially if this were smaller than the entrance in the sea. To account for the two boiling holes we have only to suppose that they are both entrances to one passage, which would seem plausible, as they are not over a quarter of a mile apart.

Another class of subterranean water ways is a system of smaller passages, through which the water finds its way underneath all the land of the Bahamas, but always at sea level and

below it. The evidence that the sea water does so penetrate beneath the land may be found in the fact that the water of the wells, no matter where situated, as far as I have examined them, rises and falls with the tide. To be sure this water is fresh, or but slightly brackish, but it is a well known fact that fresh water will float on salt, as it is lighter. The rain water falling upon the surface of the land finds its way slowly through the more or less porous lime stone until it reaches the level of the underlying sea water, after which it can go no further. Hence all wells excepting those of which I have spoken, as being Indian wells and rock holes, in which the surface water is retained for a time, must be sunk to sea level. Thus we find that the well at Fort Charlotte, which stands on the top of a hill, is over ninety feet deep, but other wells, situated in the old lagoon bed, are much shallower, while in the pine woods, where the land is quite low, water occurs within about three feet of the surface.

It is scarcely probable that the sea water thus penetrates to all parts of the underlying strata of the keys by simply percolating through the aeolian lime stone, even though this is softer at considerable depths than on the surface, for the water rises and falls in the wells nearly or quite uniformly with the tides, as regards time, and at extreme low water the wells are dry. This fact renders it probable that there are larger channels through which the water ebbs and flows and that such channels occasionally break out into the light of day in the form of the ocean holes, of which I have spoken.

A few years later Shattuck (1905), although he added no new information of significance, made the subject of Blue Holes more widely known, for his work was reported also in the French journal **La Nature** (Anon., 1906), one of whose editors-in-chief was Martel, and was later cited by Martel (1921) himself.

Caves

Turning now from submarine caves to more readily accessible ones, the earliest description appears to be by Daniel McKinnen (1804, 161-163), of a cave containing bat guano in Crooked Island:

> ... you are obliged to enter it by descending from an aperture in the rock above. Within this cave the devastation of the water, evident in various places throughout the island, has left more remarkable traces. In some spots, the top appears as if completely demolished, in others it is worn and fretted into regular cavities and shapes, giving it an air of Gothic ceiling, and the stalactites and incrustations on the side walls (if they may be so called) have a damp and mouldy appearance, tinged with occasional hues of green and light blue. In various parts the wild fig-trees, which are particularly fond of moisture, have penetrated into the recesses, and shot their bearded roots like clusters of columns on the sides or through the holes in the roof, which admit the light and in some places the sun's rays. It extends in a variety of capricious and romantic figures to a distance which has never been yet traced; and the imagination, prone to the marvellous, has led some persons to believe that it runs nearly across the island. The bottom was covered with a concretion, many feet deep, of some elastic substance resembling mould, but which is not possessed of any vegetative power. A philosophic gentleman conceived it was an accumulation for many ages of the dung of the bats which swarm in the dark recesses of this singular cave.

Captain Nelson (1853), already mentioned, explored a cave near Delaport (New Providence) in 1849 and found guano there. Some of it still contained recognizable insect remains but the rest was so decomposed that it was only by the presence of ammonia that it was identified. He also noted that,

> There are large caverns* in Long Cay and Rum Cay; and probably caverns are as numerous in the Bahama Islands as in the Bermudas; but so few extensive excavations have been made, that they cannot be positively affirmed.

The petroglyphs in the Rum Cay cave are discussed later. Caves in Long Island, probably those referred to by Nelson, were described more fully in 1891 in a guide-book (Stark, 1891, p. 236):

> Fine specimens of stalagmite are to be found at the Long Island caves. These caves are the finest in the Bahamas; they extend almost across the island. At the entrance is the Cathedral, seemingly prepared by nature for the officiating priest. A broad stalagmite makes a good pulpit, and near it the font, three feet high, with a hollow basin at the top always overflowing with water, then a number of pillars reaching to a roof with many arches. A test applied to one of the stalagmites used by geologists gave it an age of 90000 years.

It has not been possible to trace the source of this information on stalagmite dating. The Challenger expedition did not call at the Bahamas and Agassiz's investigations on the island were after 1891. The age given is different to that calculated for the Admiral's Cave stalagmite in Bermuda, thus precluding possibility that the two were confused.

Moseley (1926, 83-84) describes what is almost certainly the same cave, adding that 'A skeleton of a very large man, thought to be a Lucayan, was found some years ago in this cave'. Lucayans (Arawaks) were the now extinct inhabitants of the islands before Europeans arrived, and their remains have been found in several caves, including Hartford Cave discussed later.

A cave in New Providence Island, known unimaginatively as 'The Caves', is in a former sea cliff near the coast to the north of Lake Killarney. Though modified by the action of the sea it is basically a karst cave (Shattuck 1905, 18). Charles Ives (1880, 46) mentions bats there and writes:

> In quite a number of instances the ceilings of the rocky chambers had partially fallen in, and, through the openings, the roots of wild fig trees had made their way, dropped from ten to twenty feet to the bottom, where, entwined among and running over the rocks, they seemed in the dim light like huge anacondas, whose repose it might be dangerous to disturb.

It was in this cave that Maynard, on 2 June 1884, discovered for the first time the bat *Phyllonycteris plainfrons* which is known only from the Bahamas (Shattuck, 1905, 382). In describing the bats of the islands, Shattuck (1905, 380-383) refers to specimens from

* Some of these are remarkable for the rude Indian pictures drawn on their walls.

Hamilton Cave and a cave 2,5 km from Clarence Harbour (both in Long Island), a cave at Sandy Point (San Salvador), a 'large cave' about 6,5 km south of Georgetown ('Eleuthera', but perhaps Great Exuma was intended), and The Caves in New Providence. Caves known in 1935, and from which bats were collected for the Field Museum of Natural History in Chicago, were Hamilton's, McKinnon's and Miller's Caves, in Long Island, and James Cystern Cave and Sheep Hill Cave, in Cat Island (Allen & Sanborn 1937).

The trade in bat guano was extensive in the 19th century. An anonymous (1876) report states that an estimated 400000 tons of guano existed in the Bahamas at that time. It is not named as bat guano, but that is the only sort referred to in the literature. Ives (1880, 47) notes exports of bat guano, principally to the United States, of about 20000 USD per year at around 15 USD per ton, and Voelcker (1878) says that 'Most of the Bats' guano which is actually imported into England as an article of commerce is derived from numerous caves frequented by bats on Guanahani Island (St. Salvador) and on other islands belonging to the group of Bahamas'. He gives the composition of nine samples of such guano.

The existence of petroglyphs in Hartford Cave (Rum Cay) has been mentioned already. A detailed description of these, together with the illustrations reproduced here as Fig. 13, is provided by Maynard (1889). According to the Department of Archives in Nassau (Dr Gail Saunders, pers. comm.), 'Maynard's 1889 work, although dated, remains the seminal printed source for the Hartford Hill assemblage.'

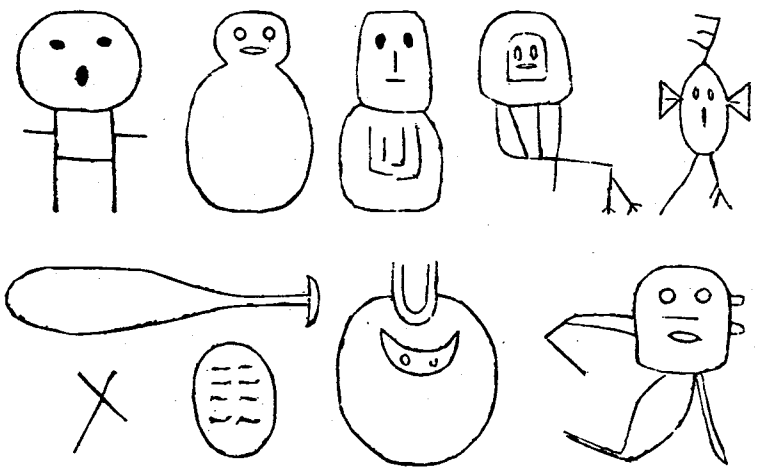

Fig. 13. The petroglyphs of Hartford Cave, Rum Cay, as drawn by Maynard in his 1889 paper

Sl. 13. Petroglifi v Hartford Cave, Rum Cay, kot jih je narisal Maynard leta 1889

Maynard visited the cave on January 20, 1888.

> ... we took a creole as a guide and he conducted us along interior road, to the north shore to what is known as Hartford Hill, one of the highest elevations on the key. ... At the foot of the hill we dismounted and made our way across the elevation, being somewhat retarded by the thick growth of shrubbery that everywhere covers the ground. Reaching the shore, here a rugged mass of rocks, we turned to the westward, proceeding till we came to a narrow sand beach, midway on which is the opening of the cave, in a limestone cliff which is some fifty feet high.
>
> The entrance to this ancient domicile was a low arch not over twelve feet high, but some fifty feet in long diameter. Just as we entered, the sun was nearing the water in the western horizon, and by reflection shone directly into the interior, illuminating it much more thoroughly than it would have done even at noon day. I found a rounded chamber about fifty feet in diameter, with smooth, evidently water worn walls, rising some fifteen feet nearly perpendicularly from the white sandy floor to the arched roof. There were a few gray stalactites, evidently forming slowly in wet weather and crumbling in dry, so that the rate of decrease was nearly equal to that of increase.
>
> The walls were of lime rocks, grayish in color, and covered with distinct, though rude figures of human beings and other objects, formed by lines cut in the stone to the depth of half an inch. As the sinking sun gave me comparatively little time for observations I hastily sketched ten of the principal figures, which I have given in the accompanying cuts.

He interprets the petroglyphs as representing white men and their equipment and concludes that they 'were placed there in commemoration of the landing of Columbus, on either this, or a neighbouring island'. Alternatively, he says, the figures may represent natives of some other island who recorded their visit in this way.

Acknowledgements

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ANTIGUA, BARBUDA, CAICOS ISLANDS, CAYMAN ISLANDS AND THE GRENADINES TO 1950

Abstract: Caves in these small islands were recorded in 1749 (Antigua), 1773 (Caicos), 1813 (Barbuda) and 1878 (The Grenadines), but apparently not until the 20th century in the Caymans. All the earliest references are on charts, maps, or instructions for mariners.

ANTIGUA

Bat's Cave or Bat Cave, in the south of the island of Antigua (Fig. 14), has a history of respectable antiquity. The first definite record of it is in the map surveyed by Robert Baker (1749) in 1746 to 1748, where it is named Balls Hole (Fig. 15). Gurnee (1961) refers to its presence on 'charts made in 1710', but no details are given and his notes have been destroyed by fire so this cannot now be confirmed (Gurnee, pers. comm.). The cave is not shown on Thornton's map made in 1701 and nothing earlier than the 1749 map is known in Antigua. The name Balls Hole was repeated on maps into the next century, for it appears on those Thomson (1814) and Philip (1856).

Early in the 19th century the cave was mentioned briefly, without naming it, in a book by a Methodist bishop, Dr Thomas Coke (1810, 417):

> In the vicinity of the Ridge, in a wild sterile spot, overgrown with false Acacia, Cactus, and dwarfy Psidium, intermixed with innumerable huge masses of spar, there is a curious cavern, in which an immense quantity of beautiful petrifactions are found, besides **Stalactites**;

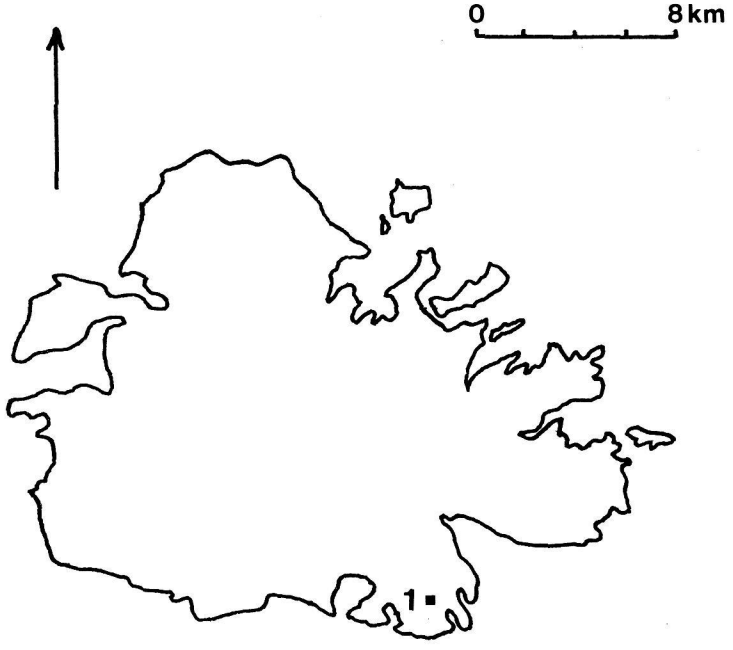

Fig. 14 - Antigua, showing Bat's Cave
Sl. 14. Antigua, prikaz Bat's Cave

Fig. 15 - The cave now known as Bat's Cave, on the map surveyed in 1746-48 by Robert Baker. The inlet of the sea at bottom left is English Harbour, with Indian Creek to the right. In the scale at the top each small division, 5 mm on the original map, represents one tenth of a mile. (reproduced by courtesy of the trustees of the British Library)

Sl. 15. Jama, znana kot Bat's Cave, karta, ki jo je izmeril Robert Baker 1746-48. Zaliv v spodnjem levem kotu je English Harbour, Indian Creek na desni. Po merilu na vrhu vsak delček predstavlja 5 mm na osnovni karti kar je desetina milje (reproducirano z dovoljenjem pooblaščencev British Library)

He says also of such petrifactions that 'in many other parts of the island they are met with, detached in forms infinitely varied'. Where they came from is not stated.

Some thirty years later a Mrs Lanaghan (1844, vol. 1, 281-282) provided a detailed description of the cave. She walked to it from the naval dockyard at English Harbour.

> After leaving the Ridge, we turned down a slight declivity, by the victualling offices, on our way to Bat's Cave, and the Savannah.
>
> ...
>
> Scrambling, as best we could, over a huge bed of prickly pear, (one of the cactus family), we

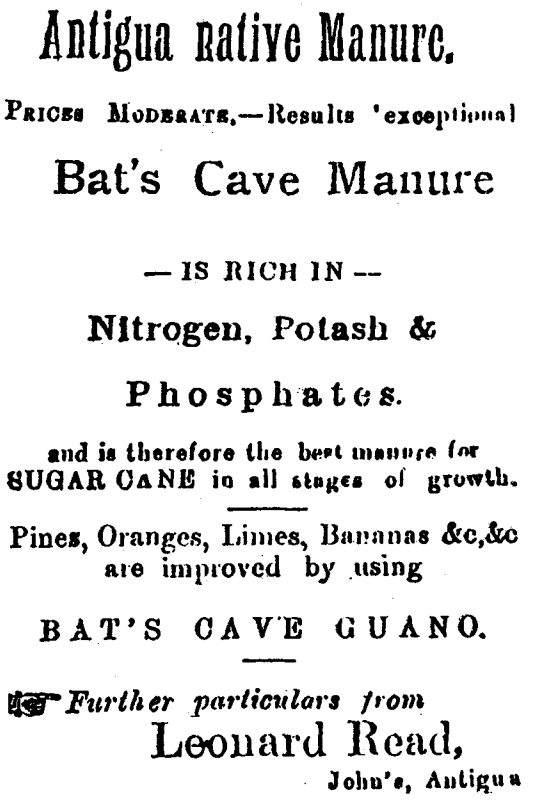

Fig. 16 - An advertisement for guano from Bat's Cave, which appeared in The Antigua Observer from 19 August 1897 until 17 March 1898. Height of original 10 cm.

Sl. 16. Oglas za guano iz Bat's Cave, objavljan v The Antigua Observer 19 augusta 1897 do 17 marca 1898. Višina originala je 10 cm.

> gained an opening in the copse, and stood before the mouth of the cave. Two large trees, which grew on each side, extended their gnarled roots (from which the earth had been washed) across the opening, forming natural steps, by which we descended, and stood within the cave.
>
> Huge masses of the rock which forms the cavern have fallen in, and in great measure blocked it up, so that it now only presents an arena of about 50 feet in circumference, although in time past it was of considerable extent. From the main cavern, two passages branch off in opposite directions. They are perfectly dark, the only means of exploring them being by the use of flambeaux; but to what length they extend has never been discovered. Mr. M. Lane, a late resident of English Harbour, (now of Canada,) has made several attempts to that purpose, all of which proved fruitless; the greatest distance he ever proceeded was to the extent of two sea-lines [i. e. sounding lines], about 120 yards. The only known occupants are bats, which breed there in immense numbers, and often attain the size of a common pigeon. A dark unhealthy vapour is emitted from these openings, proceeding, no doubt, from the carbonic acid gas they contain. This vapour soon extinguishes the light of a torch, which is one reason this cavern has never been further explored. [It is supposed that these passages extend to the sea-shore, a distance of about a quarter of a mile.] A streak of dank green runs down one side of the cave, which was pointed out to me as indicating the existence of copper; but upon examining a portion of the rock I brought away with me, I found that the colour was occasioned only by a vegetable substance adhering to the stones.
>
> In former times, Bat's Cave was a great place of concealment for the tribes of erratic Caribs, when visiting Antigua on their predatory excursions; and tradition still points it out as the scene of a barbarous carousal among that wild and savage race, in one of their attacks upon this island.

At the end of the century an attempt was made to sell bat guano from the cave as a fertilizer. An advertisement (Fig. 16) in **The Antigua Observer** of 19 August 1897 was accompanied by an article (Anon. 1897) encouraging planters to use this inexpensive local fertilizer instead of chemical ones from abroad which were said to be less effective. An analysis by the Government Analyst gave 12,3% of phosphates in the guano. The advertisement appeared weekly for exactly seven months, until 17 March 1898, but whether its cessation indicated failure is not known.

A location map is provided by Gurnee (1961), together with a modern cave plan which agrees quite closely with the description of nearly 120 years earlier. The cave is in a small patch of dark Seaforth Limestone resting on the igneous rocks which form most of the southern part of the island (Reed 1949, 259).

BARBUDA

Two caves are marked on the 1814 Admiralty Chart of this island, the result of a survey made in the previous year by Captain Deckar. Both are in The Highlands (see Figs. 17 and 18), the more northerly one being named as Darby's Cave. A third cave in The Highlands is shown on an undated manuscript chart which appears to be of slightly later date (C 284 in the archives of the Hydrographer of the Royal Navy at Taunton, England). Darby's Cave is a flat-bottomed doline about 100 m long (Wagenaar Hummelinck 1979, 170-171) and the

unnamed caves may well be the ones now known as Dark Cave and Bryant's Cave, both of which contain pools of water. It would be these, or others like them, that Ober (1908, 350) referred to as the 'rude cisterns' from which the inhabitants collected their water when he was there between 1876 and 1880.

Ober also states that 'there are several caves, one of which is large enough to serve as a shelter for a band of lawless men, and was probably used by the wreckers when they plied here their nefarious calling'. This is likely to be Bat Hole, a cave some 25 m long and about 10 m above sea level at Gunshop Cliff on the east coast (Brasier and Donahue 1985).

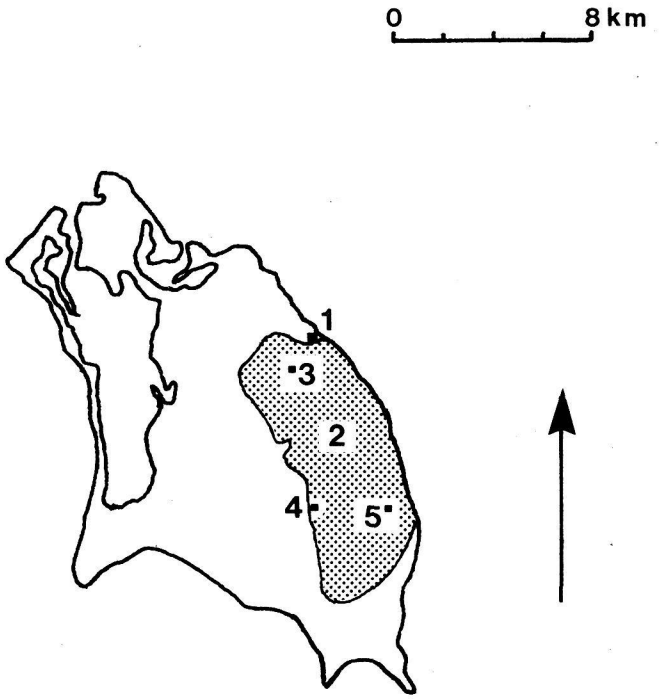

Fig. 17 - Barbuda
1. Bat Hole
2. The Highlands
3. Darby's Cave
4. other cave in 1813 survey
5. cave in later 19th century map

Sl. 17. Barbuda
1. Bat Hole
2. The Highlands
3. Darby's Cave
4. druge jame na načrtu iz 1813
5. jame na kasnejši karti iz 19. stoletja

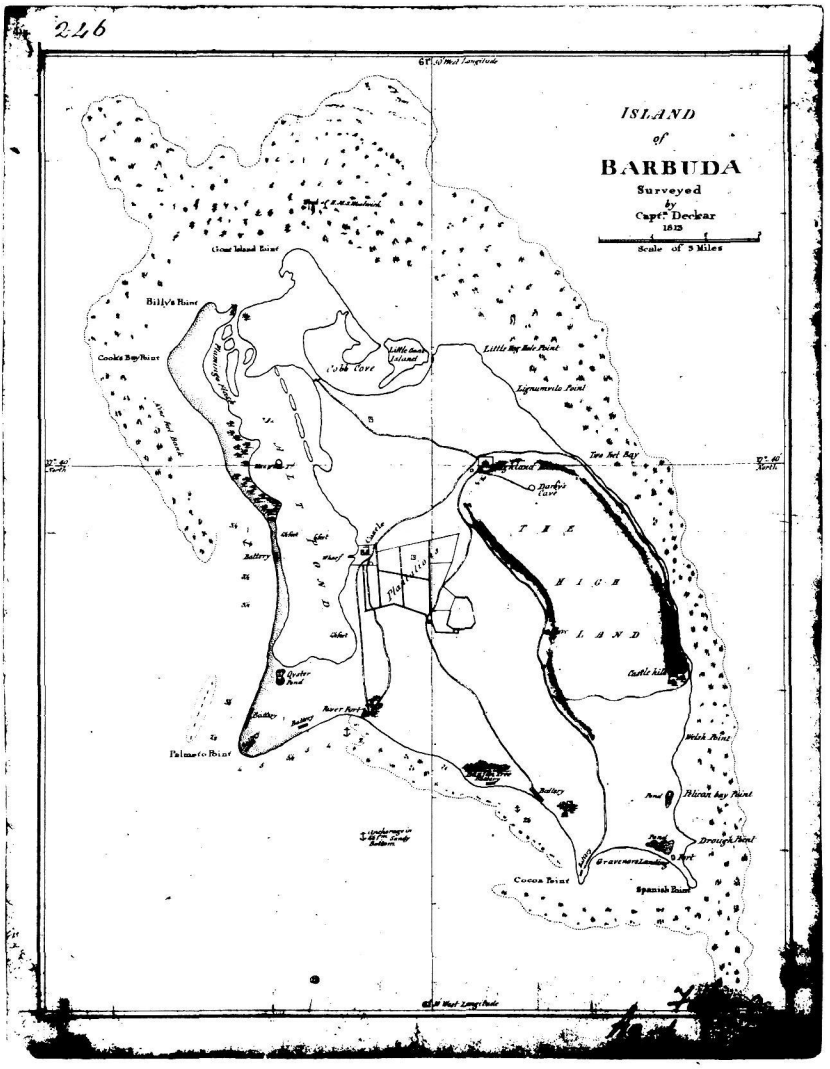

Fig. 18 - The original 1813 survey of Barbuda by Captain Deckar, Royal Navy, showing Darby's Cave and one other cave. (reproduced by courtesy of the Hydrographic Office, Royal Navy)

Sl. 18. Originalni načrt Barbude iz 1813 avtorja Captain Deckar, Royal Navy, prikazuje Darby's Cave in še eno jamo (reproducirano z dovoljenjem Hydrographic Office, Royal Navy)

CAICOS ISLANDS

Limestone caves exist in many of the Caicos Islands. Although the one best known to visitors today (Conch Bar Cave) is in Grand, or Middle, Caicos, it was those in the western and eastern islands that were noticed in earlier times. Their location is not known, so no map is provided.

First in date is the statement by J. N. Bellin (1773, 57), referring to the west coast of West Caicos:

> There are some caves, and good anchorage occurs opposite these pools and caves a quarter of a league [1 km] from Pointe de Nord Ouest.

Bellin's map confirms that the Pointe de Nord Ouest is indeed in the northwest corner of the island but it does not mark the caves. They are likely to be sea caves, either raised or still at sea level.

Even less precise is the remark of Daniel McKinnen (1804, 133):

> In a cave some sculls, I was informed, had been recently taken up, which on being touched, immediately mouldered to dust.

He does not say in which island the cave is, but it might be the one that Sharples later described as containing aboriginal drawings.

S. P. Sharples (1884) visited the guano caves of South Caicos about 1882 and his report is still cited in the standard publication on guano (Hutchinson, 1950). He writes:

> The main object of our visit, was not to see the Grand Turk, but an island to the west of it which is called Cape Comet, on the charts, but which is known locally as Breezy Point. This island lies about twenty miles to the west of the Grand Turk.
>
> ...
>
> The guano caves, which it was our special object to visit, are situated at the western end of the island on a beautiful bay, which is large enough to afford anchorage for vessels drawing nine or ten feet of water. The caves are in a low range of hills which form the principal elevation on the island. These hills are never very high: the principal one being about 150 feet in height, and is called by the negroes "Filamingo Hill", otherwise Flamingo, from a pond at its base where this bird is frequently seen. The hills in which the main deposits of guano have been found do not exceed fifty feet in height. These hills have been most thoroughly honey-combed by the action of the waves at a date that must be comparatively remote, since many of the caves are now half a mile or more inland. ... That they are true erosion caves, formed by the waves and not like the caves in our limestone stone valleys formed by under ground streams, is shown by their general character, and their great resemblance to the caves that are now being formed wherever the sea has access to a limestone bluff. ... In one of the largest of the caves the water still ebbs and flows, although it is at least a quarter of a mile from the shore. The caves are remarkable for the almost entire absence of stalactites and stalagmites although they may occasionally be seen. This is accounted for by the compactness of the roof and its thinness, for it rarely exceeds a few feet in thickness. Access to these caves as a general rule is obtained through openings in the roof, where the

thin roof has broken away. Many of these openings are not over a foot in diameter, and seem in many instances to have been caused by the growth of roots through crevices of the rocks.

At the largest entrance, where we made our first descent the opening is about ten feet across and is partially blocked up by the rocks from the roof;

...

The opening in the first cave led into a large, roughly circular chamber which in former times had evidently been a place of considerable resort, as the walls were blackened in many places by smoke and the fireplaces and ashes were plainly to be seen. On the walls of this chamber are a number of rude drawings, which in most cases are evident attempts to imitate the human figure. In one of the branches of this cave the first explorers found two bowls and a chair. They were evidently of aboriginal manufacture, being similar to those described by the early visitors to this region as in use by the inhabitants, and they must have been in the cave upwards of three hundred years, since it is about that time since the Spaniards took the Indians to the happy hunting grounds and depopulated the islands.

The cave contained what Sharples regarded as fossil guano, without smell and almost free of recognizable remains:

The entrance to the second cave that we visited was in a hillside. At this place we descended over broken rocks to the water level where we found distinct evidence of the ebb and flow of the tide, though the cave is at least half a mile from the shore. We entered a boat and were rowed into the cave for about a hundred yards, through a channel from fifteen to twenty feet wide. By burning magnesium wire from time to time we could get some idea of the size of the cave and could see passages opening off from it on either side. Near the end the cave made an abrupt turn and opened into a large vaulted chamber, about forty feet in height, and fifty feet in diameter; at the apex of the vault there was an opening which admitted the light, so that it was well illuminated. The entire floor of the chamber was covered to the depth of twenty-five feet above water level with guano. It was estimated that there were at least one thousand tons in this one heap. ... The enormous extent of these caves may be imagined from the fact that it is estimated that there is at least three hundred thousand tons of guano in them.

CAYMAN ISLANDS

Caves exist in all three of the Cayman Islands - Grand Cayman, Little Cayman and Cayman Brac. No mention of them has been traced before 1900 and even those in the first half of the 20th century are vague as to location. These references are reprinted here and are followed by discussion of the probable cave locations.

There are a few caves [in Cayman Brac], but not large, and though stalactites and stalagmites are to be found they show to no advantage (Rutty, 1907, 67).

All around the [Cayman] islands are vast fishing-grounds, and natural caves of great extent extend from the land under the sea. These were once the abodes of pirates and buccaneers... (Ober 1908, 195).

The flat plateau [of Cayman Brac] is a waterless karst country in a rather advanced stage of development. Its rough rocky surface is corroded into fingerlike pinnacles and is cut up

> everywhere by hollows, cracks, and fissures. Sink-holes abound, some of them having the form of deep circular or elliptical well-like pits with vertical sides. Many caves must be hidden in the mass of the plateau, and I saw one on the surface which contained a fine assemblage of stalactites and columns. Although the plateau supports a dense growth of forest or 'bush', it is almost bereft of soil, as the insoluble residue of dissolved limestone and the decomposed vegetable matter are rapidly washed away into the fissures and sink-holes; (Mattley 1926, 359-360)

H. W. Rutty was a magistrate and Collector of Customs resident in the Cayman Islands so he had probably seen some of the caves. Although Frederick Ober had spent several years further south in the Caribbean, he was writing this part of his guide without personal knowledge. Dr Charles Mattley, on the other hand, devoted four days to geological field work in Cayman Brac in January 1924.

Rutty's sentence is about Cayman Brac, on which the 1979 1:50 000 Ordnance Survey map marks seven caves. Both Rutty and Mattley refer to stalactites and they may well have visited the same caves. Local knowledge of which caves are the most prominent or easy of access, or which show signs of much visiting, might suggest where these two authors had been.

Ober's pirate caves under the sea are unlikely to exist as such but there may be some real caves to which the undersea extension has been attributed (like cave routes supposed to be taken by hairless dogs in other lands). Ober does not indicate which island the caves are in but Aspinall (1954, 296) says 'Among the natural curiosities at Boddentown are a cave which extends for some hundreds of yards under the sea...' Boddentown is on the south coast of Grand Cayman but too far (6 km) from Bats Cave for the two caves to be confused. Both Ober and Aspinall may have heard the undersea story of the same cave.

THE GRENADINES

Caves not in limestone are rare in the Caribbean, and even less common is any mention of them before 1900. One such cave, a fissure cave, occurs in Battowia Island, one of the most northerly of the Grenadines and lying 16 km south of St. Vincent (Fig. 19).

Frederick Ober (b. 1849; d. 1913) was collecting birds in the Lesser Antilles for the Smithsonian Institution from 1876 to 1878 and it was probably in February of 1878 that he visited Battowia. His own account (Ober 1880, 220-222, 224), shorn of details of the party's breakfast and journey, is as follows:

> In the eastern cliffs was the cave which some of the Indians had occupied, and which we desired to explore. ...
>
> After a light lunch, we scattered down the cliffs in search of the cave. A whoop from one of our attendants drew us half-way down the precipice, where we were introduced to a deep fissure-like hole in the rock, hidden by trees. Crawling carefully over the loose rock, three hundred feet above the surf beating at the base of the cliff, we entered the cave and prepared to explore it. A glance showed that it was not large nor deep, and we soon found that it led in

only a hundred feet before the crevice grew so narrow that it could not be followed; but we were satisfied that it led down to the sea as we could distinctly hear the booming of the waves.

Along each side of the cavern were hollows, evidently artificial, begrimed with smoke, as though they had been used as fireplaces. We found no living things but bats and tarantulas; the former flew about in great numbers. While my companions were engaged in the farther end of the cave, I groped among the loose fragments of stone near the mouth, where, one of the men told me, an Indian chair had been found some fifteen years before. Carefully displacing the stone chippings, I at last found what seemed to be an image of stone; but scraping with a knife revealed that it was of wood. It was a tortoise, four inches long and two and one-half broad, curiously carved. Two holes, a quarter of an inch in diameter, are bored through back and breast; the back, upper part of the head, and the throat, are covered with incised figures, and the eyes carefully carved hollows, as if for the reception of some foreign substance.There is little doubt that this image once belonged to an Indian living many years

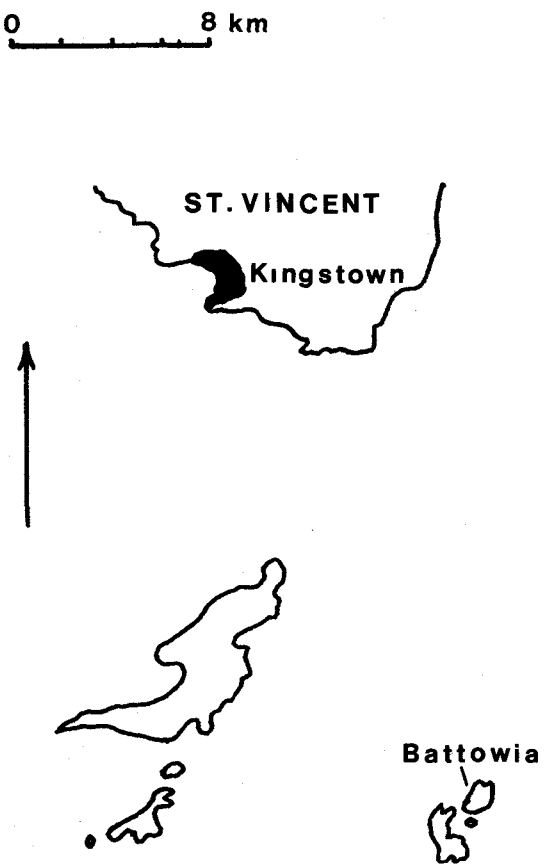

Fig. 19 - The northern Grenadines, showing Battowia in relation to St. Vincent
Sl. 19. Severni Grenadini, ki prikazujejo Battowio glede na St. Vincent

ago. Beneath the cave, a hundred feet farther down the cliff, was a grotto sparkling with lime crystals.

The exact location of the cave is not known but Ober's statements that it is in the eastern cliffs of an island only 1 km from north to south, accessible from the top of the cliffs and more than 30 m above the sea, narrows the area to be examined.

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ZGODOVINA JAMSKIH RAZISKAV NA TRINIDADU, JAMAJKI, BAHAMIH IN NA NEKATERIH DRUGIH KARIBSKIH OTOKIH

Povzetek

Večina jam na Trinidadu je v "Northern Range" (jurski apnenci) in v SZ delu otoka. Avtor je pregled raziskav razdelil po predmetu raziskav. Za speleološko literaturo Trinidada je najpomembnejši jamski ptič tolstičnik (guacharo, Steatornis caripensis) in tako je tudi najstarejša omemba jame na Trinidadu v vezana nanj (Latham 1823). Vsa najstarejša lieratura omenja jamo Huevos, iz katere je Hautessier prinesel tudi primerek živali, gnezda in jajca Akademiji v Parizu 1838. Ker so tolstičniki taka posebnost, so jame, v katerih živijo, omenjane tudi v prvih turističnih vodičih po otoku (Collens 1888). Eno izmed jam je obiskal tudi ameriški predsednik T. Roosevelt 1917. Razen za jamo Huevos, je obsežnejša starejša literatura še za jame Oropuche, jame v Aripu in v Arimi. V vseh živijo oziroma so živeli tolstičniki. Temeljno geološko delo o otoku, Geological Survey Memoir on Trinidad (Wall in Sawkins 1860) omenja tudi jame. Tako že slika 3 v tem delu prikazuje jamo iz okrožja Diego Martin. 1891 je bil ustanovljen Trinidad Field Naturalists' Club, katerega člani so se ukvarjali tudi z raziskavami netopirjev. Te raziskave so bile 1934 vključene v vladni program za zatiranje stekline. 1935 je zaradi nje umrlo 89 ljudi. V literaturi so tako omenjane številne jame, v katerih so preučevali oziroma lovili netopirje. Čeprav so bili člani omenjenega kluba tudi entomologi in drugi naravoslovci, so bila preučevanja ostale jamske favne pred letom 1950 zelo redka. Raziskovanje kraških jam na Trinidadu zaradi raziskovanja samega se je pričelo šele v 40-tih letih tega stoletja, ko je prišlo na otok večje število tujcev, pripadnikov naftnih družb in vojske. Ker je kras na Jamajki bolj opazen, kot na manjših otokih, in ima tudi reke ponikalnice, je bil tudi v literaturi omenjan bolj zgodaj. Najbolj znan je prvi opis izpod peresa H. Sloaneja (1707), ki je bil na otoku 15 mesecev kot guvernerjev zdravnik. Poleg ponikalnic omenja Sloane turi kraške izvire, stalaktite in soliter, ki so ga v jamah kopali Indijanci. Več potopisov in opisov iz 18. in 19. stol. omenja jame. Morda je najpomembnejši opisani dogodek spust samega guvernerja v 98 m globoko Hutchinson's Hole leta 1895. Tudi na Jamajki so prvi opisi jam vključeni v geološke okvire (De la Beche 1825; Geological Survey Memoir 1869). Zaradi tega so postale po vsem

svetu znane posebnosti krasa z Jamajke: "cockpits" in "light-holes", ki jih omenja tudi Cvijić (1893). Tudi v turističnih vodnikih s konca prejšnjega stoletja se pojavijo opisi kraških jam. Na Jamajki je prvi preučeval jamske netopirje Osburn 1858-1860, posebno pozornost pa je vzbujalo guano. Na prelomu stoletja so opravili 35 analiz, kot osnovo za izvoz guana v ZDA. Bahamsko otočje je s kraškega vidika znano predvsem po t.im. "blue-holes" - kraških breznih pod oziroma v nivoju morske gladine. Prve so omenjene v delu M. Catesbyja 1725, podrobneje opisane in locirane pa ob izdelavi Admiralitetnih pomorskih kart 1843 in 1844. Oblike in delovanje "modrih lukenj" je bolje pojasnjeno šele v novejšem času, ko so jih pričeli raziskovati potapljači z avtonomno potapljaško opremo. Kot na ostalih zahodnoindijskih otokih so tudi na Bahamih običajne kraške jame, ki so jih raziskovali predvsem v zvezi z netopirji in njihovim guanom. Tako naj bi že pred 1880 izvažali guano v ZDA za 20.000 USD letno. Tudi na manjših zahodnoindijskih otokih je razvit kras, ki je bil opisan v literaturi razmeroma zgodaj: na otoku Antigua 1749, na Caicosu 1773, na Barbudi 1813, na Grenadinih 1878 in na Caymanskih otokih v začetku 20. stol. Vendar v primeru teh otokov ne gre za krasoslovne ali podobne raziskave (guano), ampak za pojave in oblike, zarisane ali omenjane na pomorskih kartah, na zemljevidih ali v navodilih za pomorščake, čeprav je tudi na teh otokih kasneje postal pomemben vir dohodkov ravno guano jamskih netopirjev.