The Guadeloupe Skeleton: Further Evidence

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The following paper adds further commentary to the Guadeloupe skeleton controversy (see references 26–36). The purpose of this paper is threefold. Firstly, I would like to answer critiques by Bill Cooper[35] and Malcolm Bowden[36] directed against both an earlier paper of my own[34] and others by David Tyler.[32,33] Secondly, I have found more information which bears directly on this issue which I would like to report. Thirdly, I would like to introduce a preliminary report on beachrock formation. Hopefully the latter will be expanded for publication at a later date.

Cooper and Bowden each accused Tyler and myself of starting with erroneous premises. We each used the conventional methods of relative and/or absolute geologic dating. In order to arrive at a Miocene age for the British Museum skeleton Bill Cooper would have had to use at least some of these techniques whether he did so consciously or not. All objects are given epoch or period designations only in this manner. He admits that he used "conventional geologic dating" [27] and "conventional time scales"[26] to go from a relative age of Miocene to the absolute age of 25 million years. How is it that Mr Cooper can use conventional dating to support his contention that this specimen was deposited in Noah's Flood, but we are not allowed to use the same techniques to show that it could not have been? In this paper I will use conventional geologic dating methods and will not apologize for it. I hope to show that if you assume these methods, you can arrive at a conclusion about this specimen which is consistent with more of the evidence than is Cooper's theory.

Cooper, and to a limited extent Bowden as well, seems to accuse Tyler and myself of intentionally selecting only the facts which support our claims. They each seem to intimate that we are attempting to deceive our readers. I hope this accusation is not intentional on either Cooper or Bowden's part, because I am not guilty of this and I do not think Tyler is either. I had hoped in my paper to reveal all that I knew to bear on this specimen. That was the purpose of the extended bibliography and the space-consuming tables. Cooper and Bowden, on the other hand, do accuse a number of other people of outright deceit — namely Spencer,[36:44;35:42] Reynal de Saint-Michel,[36:49–50; 35:42] the British Museum,[26] and Lyell.[36:48] In some cases this may be warranted. Mr Bowden, for example, is not alone in questioning the literary tactics of Sir Charles Lyell. If any sort of accusation is going to be made, however, I believe one needs much more evidence than Cooper and Bowden bring against Spencer, Reynal de Saint-Michel, and the British Museum. I make it a practice to assume that all authors, whether they be creationist, evolutionist, or otherwise, are correct when they make first-hand observations. I will make this assumption in the following paper. I will attempt to show that all these observations are not only consistent, but collectively create a reasonable picture of the geological environment of the so-called "Galibis" formation.

THE GEOLOGIC SETTING

Cooper[26,27,29,35,36] has proposed a geologic reconstruction of the area from which the skeletons have been taken. He believes that the skeleton layer is a fully lithified, thinly bedded limestone deposited sub-aqueously under catastrophic conditions. He believes the raised Quaternary reefs overlie the skeleton layer, while unfossiliferous clays possibly underlie the layer (see Figure 1 in Bowden's article[36]). I hope to show that this model is inconsistent with first-hand observations of a number of investigators.

The first recorded on-site observer of this formation was General Jean Augustan Ernouf. As governor of the island, Ernouf had access to the area from at least 1804 to the English takeover in 1810. Dauxion-Lavaysse[2] described Ernouf as a "well-enlightened, intelligent, zealous friend of science".

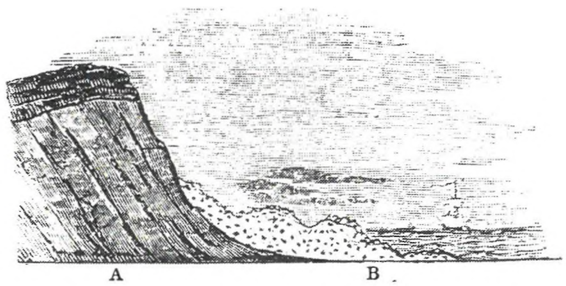
This seems to be verified in Ernouf's 1804 letter to Faujas-Saint-Fond at the Paris Musuem.[1] He relates in this letter that he hired an individual and crew to excavate some human skeletons found in the intertidal range of a beach near Moule. The choicest specimen Ernouf intended to send to the French museum. Ernouf also relates three local Indian traditions for the origin of the skeletons: an inter-island battle which took place on the beach, the sinking of a canoe fleet in a storm, and an Indian cemetery being invaded by the sea. Since three such disparate traditions existed in Ernouf's time, the skeletons almost certainly were interred at a time previous to any living islander's memory. Near the end of 1804, Dauxion-Lavaysse claims that Ernouf sent for a naturalist Monsieur Gerard, from Brussels, to properly excavate and study the specimens.[2] In April of 1806 a detailed report of the excavations was sent to General Ernouf, perhaps by M. Gerard.[5] The reporter proposed a theory for the rock's lithification which is virtually identical to most modern theories of beachrock formation. In addition to the human bones, the reporter also listed a number of taxa (all living species) and artifacts (all then used by island natives) found in the rock *(Cyprea pediculus, C. stercoraria, C. exanthema, Buccinum* cornuiam, B. *perdix, B. dolium, Voluta oliva*, Murex ramosus, *Bulla ampulla, B. gibbosa, Nerita versicolor, N. peloranta, Strombus Iambis, Turbo pica, Trochus nilotica, Patella* spp., terrestrial gastropods, pottery and rock axes). Most interestingly, the reporter related some of the local Indian traditions, especially one told by a man whose father had claimed to have observed the events himself. According to this man's father, there were two Indian tribes living peaceably in the area of Moule. The "Galibis" were a robust, tall, olive-brown-skinned people, whereas the 'Caraibes' were more slender, shorter, and had a much darker brown skin. Peaceful coexistence ended about 1710 or 1711 when a war broke out. The Galibis were defeated and dispersed. The bodies encased in stone were supposedly those remaining from this battle.

Ernouf's reporter doubted the story because: (1) Other traditions existed — though none were so believable to him as this one; (2) He found it hard to believe that such an event could have escaped observation by Europeans; and (3) No record existed verifying the existence of two cultures in the area. A further complication is added by the fact that "Galibis" and "Caraibes" are local language variations of the same word, from which we get our word "Carib". It's a fascinating story, but Ernouf's reporter had every reason to be cautious about that part which was related in at least a second-hand manner. It appears, however, that Ernouf accepted the theory, or at least was credited with its conception.[11] Southall[15] and Reader[25] present similar scenarios, so they may have directly or indirectly based their conclusions on Ernouf's reporter. Petrie[16] and von Fange[23,24] clearly based their conclusions on Southall, so perhaps they too have indirectly relied on this man's report. Ernouf's reporter seemed to lean in opinion toward the idea that these skeletons were from graves from the Indian culture then inhabiting the island. This is because the skeletons were lying in positions similar to those used by the island Indians when they buried their dead. One last interesting point is that this letter tells us that the British Museum specimen was excavated in the summer of 1806, from a beach east of Moule.

J.J. Dauxion-Lavaysse visited the islands and made geological observations sometime between 1804 and 1813.[2] He described the formation enclosing the skeletons as lying along the shoreline near Moule and being about one kilometre in length. He added that the enclosed bodies were oriented east-west and associated with human implements (see Table 2 in Wise[34]).

Not having visited the site himself, Konig[3] based his conclusions about the site's geology on Ernouf's 1804 letter and Dauxion-Lavaysse's brief description (the 1806 letter to Ernouf was not available to Konig). Konig's conclusions about the skeleton's place of origin must be considered sceptically in the light of the small amount of information about the site that he had available to him.

Alexandre Moreau de Jonnes visited the West Indies sometime between 1804 and 1814. He subsequently began to write a two volume description of their geology. A brief mention of the Moule site is given in volume one, but a complete description was intended for volume two.[7] Unfortunately only the first volume of Moreau de Jonnes' work was ever published. This only leaves us with his own intentionally incomplete account and an account related by Cuvier as being due to Moreau de Jonnes.[6] It is worth noting that all of Cuvier's conclusions were based on Moreau de Jonnes' observations. Neither Cuvier nor Lyell made any on-site observations. Sir Charles Lyell, in turn, based his contributions[8] on Cuvier. Moreau de Jonnes describes the skeleton-containing unit as a slope of carbonate debris resting at the base of a steep island bank on the shoreline near Moule. He claims that the sand was in his day being accumulated daily as a result of the erosion of shell and coral debris from the island's rocks. Moreau de Jonnes observed that the rate of accumulation increased with the violence of the sea. In areas most frequently dry he observed that the mass "coheres very firmly". Presumably then, according to Moreau de Jonnes, the formation's



PLAN OF THE CLIFFS AT GUADALOUPE.
A, Ancient rocks; B, recent limestone, in which human skeletons are found imbedded.

Figure 1.

accumulation is due to erosion of both the older island rocks and the reefs located offshore. The formation's lithification occurred in the intertidal or wave-splash areas of the beach.

Gideon Algernon Mantell, a famous early nineteenth century surgeon and geologist has something to say about this site as well.[11,12] It is not at all clear, however, whether Mantell ever actually visited the site. It's possible that he got all his information from Ernouf or from Moreau de Jonnes' unpublished notes. It is not at all clear how much faith we can put in Mantell's conclusions. In any case, Mantell adds some very interesting information not given by any other author that I've located to date. Mantell claims that a caiman tooth and a wooden ornament with a mask carved on one side and the figure of a frog on the other, were found associated with the skeletons. Mantell also includes a diagram of the beach area from which the specimens presumably were taken (Figure 1).[12] Mantell's diagram seems to show sand, not an accumulation of flagstones at the base of the cliff. Bowden's cross section[36] does not seem compatible with Mantell's section. More interesting than even the artifacts and the diagram are Mantell's description of two specimens **other** than the one described by Konig[3] and the one figured by Cuvier.[6] "An entire skeleton was also discovered in the usual position of burial; another, which was in softer sandstone was in a sitting posture".[11] Presumably Mantell is describing one specimen prone on its back, as in the case of the British Museum specimen. The second specimen, described in the same manner as Mantell described Cuvier's figured specimen, is probably in the prone foetal position. The "softer" sandstone enclosing the second specimen seems to indicate that different parts of this formation have been indurated to varying degrees.

Pierre Duchassaing, who lived in the Antilles, investigated the geology of Guadeloupe sometime around the 1840's and reported on it in 1847 and 1855.[13,14] Duchassaing does **not** call both the raised reefs and the Galibis formation "Anthropolite" as Bowden[36:46] claims. Duchassaing calls the raised reefs the "formation madreporique" and the "recifs circulaires". The formation in which the skeletons were found he calls the rocks or travertine in which are enclosed the "Galibis" or "Anthropolithes" **(a la** Desmarest, 1816[4]). In his 1847 paper Duchassaing concludes that the Galibis sands and the raised reefs are of similar age.[13] After restudying the area, though, Duchassaing concludes in his 1855 paper that the Galibis sands are **younger** than the raised reefs.[14] He indicates that the sands in which the skeletons are found were deposited in a topographic depression between the raised reefs and the ancient shoreline. He felt the raised reefs once ringed the island, separated from the shore by a marine lagoon, much as a lagoon separates Moule from an offshore reef today. When volcanic activity raised the shoreline, the tops of these 4 to 5 metre high reefs were elevated 2 to 3 metres above sea level. Duchassaing thought that the former lagoon was then filled with carbonate sand. This explains how the raised reefs can be 2 to 3 metres above sea level, and yet **not** be stratigraphically above the Galibis sands which lie in the intertidal zone. Bowden's cross-section is inconsistent with Duchassaing's observations. Duchassaing claims that the sands **postdate** both the formation of the madrepore reefs **and** their uplift. I think it's very possible that the raised reefs have been eroded away at the location where the skeletons have been excavated, exposing the sands behind to the action of the sea. In addition to these observations, Duchassaing indicates that the site of skeleton excavation is near Moule on the lands of MM. Morelle. I do not think it's mere coincidence that on Reynal de Saint-Michel's map, less than 1.5 km **east** of Moule is the place name of "Morel", less than 300 metres from the ocean (see Figure 2). Just north of Morel, along the shore is a 2.6 kilometre long outcrop of carbonate beach sand which Reynal de Saint-Michel claims is "subject to a very active phenomenon of consolidation".[16] Duchassaing also claims that the Galibis formation was, in his day, growing in size **and** being actively consolidated. Lastly, Duchassaing lists a number of organisms and artifacts found in the same sands as the skeletons (see Table 2 of Wise[34]).

Robert T. Hill visited the area sometime before 1899 and concluded that Duchassaing's observations were correct.[17] He clearly claims that the human remains are found in a "land wash" which **overlies** the Miocene deposits, and are **not** overlain by the elevated reef rocks. Schuchert[19] based all his Guadeloupe geological notes upon Hill.

Joseph W.W. Spencer visited the islands

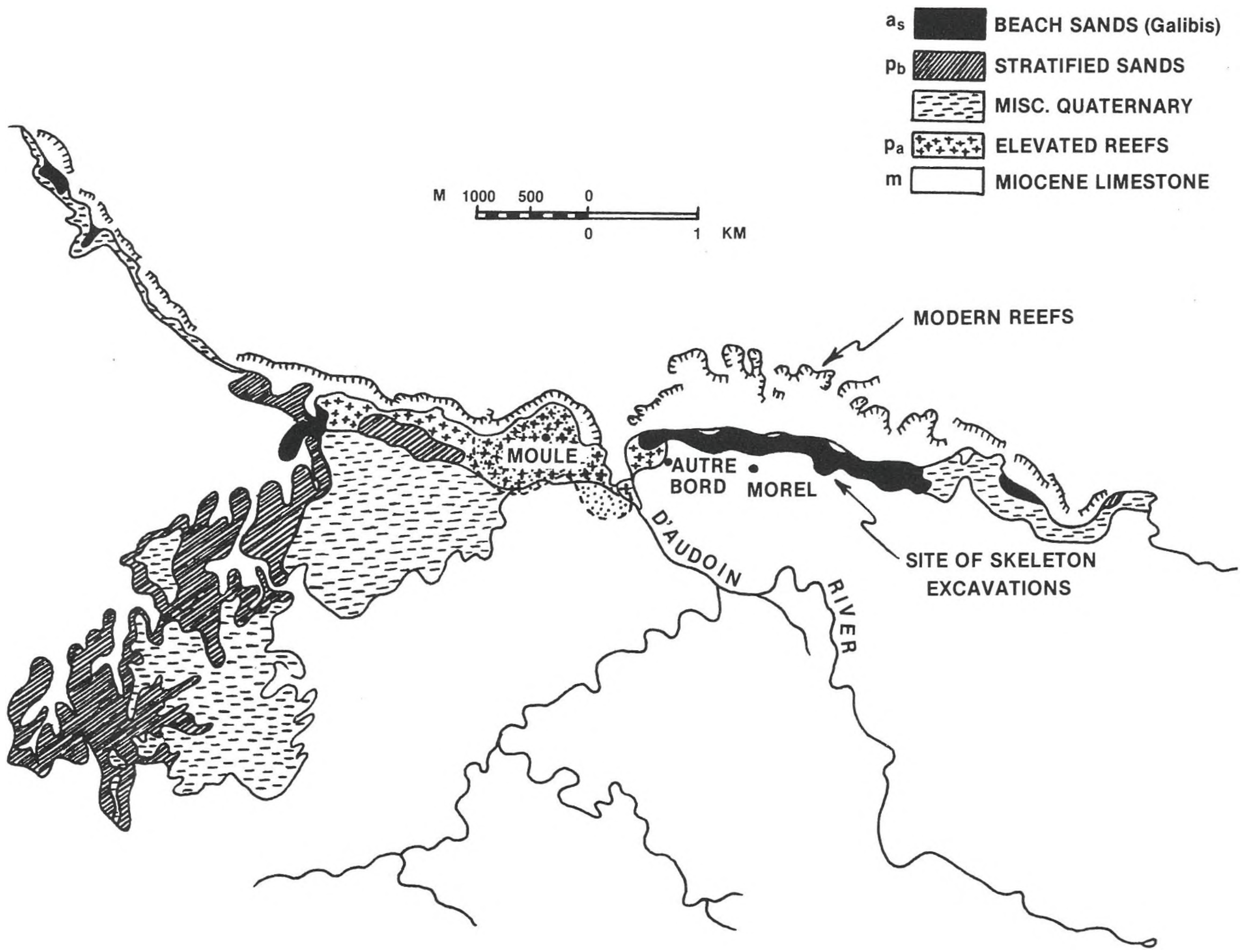


***Figure** 2. Geology of the Moule area, Guadeloupe (after Reynal de Saint-Michel[20]).*

sometime before 1901, and described their geology in a 1901 publication.[18] He did visit the site of the skeletons' excavations, contrary to the claim made by both Cooper and Bowden. Bowden quotes Spencer as follows: "It was in this district that the human remains were found. . .Neither these nor the thin fossiliferous clays beneath were studied by me at Grande-Terre". This quote is incorrectly taken out of context. A paragraph division separates the first sentence from the second in Spencer's paper. Spencer devotes just two paragraphs to the "Late Deposits and Coral-Reefs in Grande-Terre". This diminutive amount of space is appropriate when one is dealing with all the geology of such a large area in one paper. These formations collectively make up a very small percentage of the island's entire rock record. There is certainly no reason to believe that Spencer is contriving a conspiracy as Cooper and Bowden intimate. In any case, Spencer mentions the raised madrepore reefs and the Galibis formation in the first of his two paragraphs on Guadeloupe's recent formations. In the second paragraph he speaks of the alluvial sediments and the unfossiliferous clays that underlie the **alluvium** (not the Galibis sands and raised madrepore reefs). Apparently ignoring Duchassaing's 1855 paper[14] which rejects the similar ages of the Galibis sands and the raised reefs, Spencer follows the outline of Duchassaing's 1847 paper.[13] In this paper Duchassaing deals with the raised madrepore reefs, the Galibis formation, and finally the alluvium and underlying clays under three separate headings. According to Duchassaing "under the **alluvium** is a clay bed without fossils and of minor thickness" (emphasis added). Bowden's quote is thus clearly out of context, and his cross-section is incorrect in including unfossiliferous clays beneath both the Galibis formation and the raised reefs, while **both**

Cooper and Bowden are incorrect in claiming that Spencer never investigated the Galibis formation. Spencer never visited the alluvium and underlying clays, but he did visit the Galibis. Spencer claims that it was on the coast near Moule where the skeletons were found.

Alain de Reynal de Saint-Michel visited the island of Grande-Terre sometime before 1961 to study its geology.[20] I am baffled by Cooper's claim that "Saint-Michel makes absolutely no attempt to even describe the site's precise location, other than saying that it lies somewhere 'east of the town of Moule'. So indeed does Africa."[35:42] Cooper then implies that Reynal de Saint-Michel is taking part in a large conspiracy to keep the truth from us. First of all, Africa is not part of Guadeloupe, and Reynal de Saint-Michel is describing the geology of Grande-Terre, Guadeloupe. There is only 10 kilometres of beach east of Moule! Secondly, I cannot find anywhere in Reynal de Saint-Michel's monograph where he located the site in any such manner as Cooper claims ("east of the town of Moule"). Reynal de Saint-Michel entitles the formation labelled "a_s" on his map as "sands of the beaches".[20:16] "a_s" occurs many times on his map including a 2.5 kilometre long patch east of Moule and a smaller patch to the west of the town (see Figure 2). He describes these beach sands as being essentially calcareous, generally coarse, and made up of animal shell debris with small amounts of magnetite and ilmenite. He claims the sands are subject to a "very active phenomenon of consolidation". Reynal de Saint-Michel claims that often encased in these sands are relics of pre-Columbian Indians. He says this is true "principally to the east and west of Moule". He then relates excavations done in these sediments by Edgar Clerc (see below). Reynal de Saint-Michel seems to indicate that the burial of items of human manufacture is not only common around Moule but also all around the island. It is not as great a mystery as Cooper and Bowden think, that geologists are not too concerned about this formation. As Tyler[33:32] indicated, the site has much more archaeological interest than geological import.

Edgar Clerc made a number of excavations on Grande-Terre in the 1960's and 1970's.[21,22] Perhaps he is even now engaged in excavations there. His principle area of excavation is at Morel, mentioned above as lying east of Moule. I believe the evidence is very convincing that Clerc is excavating in the same deposits from which Gerard, Dauxion-Lavaysse, and Donzelot extracted their specimens.

Clerc has uncovered four distinct levels of habitation at Morel, all of which are considered as having been the people of the Arawak language group. The Arawaks are thought to have invaded the Antilles from South America about the time of Christ according to ^{14}C dating. They were exterminated from the Antilles around the time of Columbus by the Carib Indians, also originally from South America. The Arawaks relied on agriculture and fishing — preferring to fish in lagoons behind offshore reefs on the windward side of islands, and planting in the fertile alluvial deposits of rivers. The Morel/Moule area is an ideal locality. Two rivers, one on the east, the other on the west of Moule empty into the lagoon behind the offshore reefs.

Clerc's lowest level, Morel I, is located 15cm above sea level, and is 10-15 cm thick. Two ^{14}C dates have been obtained from this level, namely 220 ± 70 A.D. and 245 ± 100 A.D. This level, like the others, has characteristic artifacts. In this level are also found graves from the people of Morel II. Clerc claims that these graves occur in a sand composed of particles which in places are cemented together into a "compact form". The skeletons are found "in prone or semi-prone positions on the back or on the side, or in prone foetal positions. . .". Thus contrary to Cooper and Bowden's claim, the prone foetal position of the French museum specimen and the prone flat position of the British Museum specimen do **not** indicate different cultures. The Arawaks used a variety of burial postures at different times. Clerc also indicates that in this level he never found a skeleton in the sitting foetal position. Thus there is no "danger" of producing polystrate fossils as Cooper and Bowden claim. In addition, it is not at all traditional, as Cooper claims, for Arawaks to dislocate the hips of their dead in order to bury them in the foetal position. They very rarely, if ever, followed this practice on Guadeloupe. Associated with the skeletons buried into Morel I are found artifacts characteristic of Morel II.

Above Morel I Clerc claims that in most places there is a 1.5 to 2.4 metre thick layer of sand. In some places, however, there is a layer of sterile sand of a few centimetres thickness which is in turn overlain by Morel II. From 0.5 to 1.0 metres above sea level, this unit is 30 to 60 centimetres thick. There are two ^{14}C dates from Morel II, namely 550 ± 80 A.D. and 570 ± 100 A.D. From this level are ceramics of very fine workmanship, and other distinctive artifacts of human manufacture. Clerc claims that tombs of people from Morel III are found in this level but are few in number. No artifacts are found with the skeletons, and the humidity in the Morel II sediments have "rendered the skeletons irrecuperable".

Although in most places 0.4 to 1.8 metres of sand overlie Morel II, Morel III overlies it in a few locations. Morel III contains characteristic ceramics as well as tombs of the people of Morel IV. It is in these tombs that Clerc found skeletons in the sitting foetal position with inverted triconic vases over their heads. In addition the skulls show a distinct right tabular or right fronto-occipital deformation.

Morel IV is found mostly to the east of the other levels, overlying them in only a few places. Morel IV is between 30 and 40 cm thick, and is found around 2.1 to 2.3 metres above sea level. The lowest part of Morel IV has a ^{14}C date of 850 ± 80 A.D. This level contains pottery fragments and scattered, rarely articulated, human bones.

The evidence seems to indicate very strongly that the British Museum specimen was taken from Clerc's Level I, from a Morel II grave. It is only in this level that Clerc mentions consolidated sands; this is the only level which is entirely intertidal; only in this level has Clerc excavated complete skeletons which are oriented in the positions of those in the British and French museums.

A summary of all observations of the formation do not, I believe, leave as confused a picture as Cooper and Bowden seem to maintain. The formation is composed of carbonate sand broken up from offshore reefs and island cliffs. This sand fills a topographic depression created by the uplifting of offshore reefs and their associated lagoons. The Arawak Indians of the area probably found this sand unsuitable for agriculture, but perfect for burial. The sea later encroached on the cemetery, perhaps breaking down the protecting raised reefs in a storm, or series of storms. Deposition of $CaCO_3$ by waters supersaturated with respect to carbonate cemented these sands together, into a mass which in places was as hard as statuary marble.

Cooper's model, on the other hand, is inconsistent with all recorded observations of Guadeloupe's geology. The Galibis formation is **not** a fully lithified, thinly-bedded limestone — it is a carbonate sand lithified into a carbonate sandstone **in some places.** It is **not** overlain by raised carbonate reefs, but lies to their landward flanks, being younger than both their formation **and** their uplift. The Galibis formation is **not** lying atop the unfossiliferous clays mentioned by Duchassaing, but rather is in no way associated with them. These clays underlie alluvial material associated with the island's rivers and not these beach deposits.

BEACH ROCK

Beach rock is a grain-supported clastic sedimentary rock. The clasts are pieces of other rocks. The clasts vary in size from fine sand to boulders. Mineralogically, beachrock clasts can by anything[38] (e.g. basalt[40,42] or human garbage[55]).

Beachrock cement is always an evaporitic mineral. Rarely cemented by gypsum,[56] almost all beach rocks are cemented by carbonate, more specifically by aragonite or high-magnesium calcite.[3] Although low-magnesium calcite is occasionally found in beachrock matrix, it can always be attributed to diagenetic replacement. Under most diagenetic conditions, as a matter of fact, calcite will replace aragonite or high-magnesium calcite.[43] Rarely does an ancient rock retain aragonitic or high-magnesium calcite cement. Beachrock cement is found predominantly in three forms: (1) Long, thin crystals of aragonite or high-magnesium calcite growing perpendicular to the clast surfaces; (2) Crypto- to microcrystalline aragonite or high-magnesium calcite coating the clasts; and (3) Microcrystalline aragonite or high-magnesium calcite infilling the pore spaces.[38] The drusy crystals are almost always present and the microcrystalline coatings and fills may or may not be present.

Beach rock, however, was initially defined not by composition but according to where it was found. Beach rock is restricted to the intertidal and wave-splash zones of a beach.[38] The beachrock clasts are of the same composition as the beach sand.[45] With a seaward dip commonly between 5° and 15° (for example in Brazil,[37] Puerto Rico,[47] and Pacific Islands[39,41]), beach rocks strike parallel to the shore (e.g. in Florida[51]), unless erosion has changed the beach since the beach rock's formation. The stratification of beach rock has the same orientation as the beach's stratification (e.g. Puerto Rico[47] and Australia's Great Barrier Reef[50]). Beach rock usually forms incipiently, several feet below the sand's surface,[57] and is exposed only when the sand above is eroded off. Each beachrock layer is usually about four to eight inches (ten to twenty centimetres) thick.[48,55] When being actively formed beach rock characteristically is lithified in different amounts in different areas.[53] It varies from a slightly lithified sand easily crumbled in one's hand to a heavily indurated rock, solid enough for use in building. Along the beach, beach rock is discontinuous, usually not laterally continuous for more than 100 metres, but occasionally for a kilometre or so (e.g. in the Caribbean[47,55]). Beach rock is also restricted to tropical or semi-tropical shores between 35°N and 35°S latitude.[43,44,45]

Erosion usually leaves exposed beach rock with a very heavily pitted surface (e.g. in Hawaii,[42] Brazil,[37] and the Caribbean[55]). Storm activity often breaks up beachrock layers, turns them over, and redeposits them, creating a chaotic mass on many beaches. This debris is sometimes cemented onto the undisturbed beach rock below.

Though not formed overnight, beach rock is formed with remarkable rapidity. Onsite rates of lithification are unknown. Lyell, in 1840,[49] and Jukes, in 1847,[46] each report separate cases of beach rock preserving unhatched turtle eggs, thus demonstrating that reasonable lithification can occur in less than five months. **Solid** lithification can occur in less than a few years.[55]

The exact mode of lithification is the process that is still not fully understood. In the space of a few hours or days cementation of beach sand can be achieved in the laboratory, either with the aid of cyanobacteria or solely by inorganic precipitation. When finally and completely analysed there is probably a wide range of environmental conditions under which such cementation can occur. The problem is not so much why cementation occurs, but why cementation **doesn't** occur. Beach rock has a patchy distribution along a single beach, and what concerns scientists most is why it **doesn't** form in some areas but does in others. On a given island, beach rock is formed on only some beaches, and on a given beach it is formed in only certain areas. Various theories have been proposed. A freshwater influx was thought necessary, but not enough rain falls in some areas (e.g. in Qatar[58] and in the Canary Islands[59]), and no fresh water is possible on many sand cays, yet beach rock exists. Limestone bedrock was thought necessary landward of the beach,[47] but Maui has beach rock[40] and no limestone hinterland. Cyanophyte activity was thought necessary,[52,54] but how photosynthetic activity could thrive one to three metres below the beach's surface has not been explained. I think it may turn out to be complex interaction of these and other factors which allow for aragonite crystallization and subsequent cementation.

To identify beach rock one fortunately does not need to understand the exact mode of formation. The following are diagnostic characteristics of beach rock:

(1) coarse-grained clastic sedimentary rock;
(2) grain-supported;
(3) clasts have the same composition as the beach sand;
(4) cement is aragonite and/or high-magnesium calcite;
(5) cement is composed of long crystals oriented perpendicular to the surfaces of the clasts;
(6) crypto- or microcrystalline cement fills the pore spaces;
(7) formed in the intertidal zone of the beach;
(8) when undisturbed has a seaward dip of 5° to 15°, and a strike parallel to the beach;
(9) forms below the surface of the beach;
(10) has a patchy distribution — usually less than 100 metres along the beach, and never more than a few kilometres;
(11) has different degrees of lithification (friable to solid rock);
(12) individual beds are from 4 to 8 inches thick (10-20 centimetres);
(13) within 35°N and 35°S latitude; and
(14) rapid lithification (solidity may occur in hours, and certainly can be less than a few years).

In the case of the Guadeloupe specimen the enclosing rock:

(1) is a coarse sandstone to conglomerate;
(2) is grain-supported;[32,33]
(3) contains clasts of the same composition as the beach (unlike Konig,[3] all other authors intimate the rock is identical to the beach sand);
(4) has has an aragonitic cement;[32,33]
(5) long aragonitic crystals radiate from the clasts;[32,33]
(6) appears to have microcrystalline aragonite infilling the pore spaces;
(7) was found in the intertidal zone of a beach:[1]
(8) had an unknown original orientation and location;
(9) see (8);
(10) the unit was one kilometre in length in 1813[2] and possibly 2.6 kilometres long in 1961;[20]
(11) at least one specimen was found in a softer sandstone,[11] and the British Museum specimen was reported to have been in friable sandstone in about 1766,[5] but harder than statuary marble in 1814;[2]
(12) The British Museum specimen is in a slab which is about six inches (15 cm) thick;
(13) was found at 16° 20'N latitude; and
(14) lithification was possibly less than 40 years,[5] but definitely less than 1600 years by radiocarbon dates.[21,22]

Chris Stringer and David Tyler were both quite correct in identifying this deposit as beach rock.

Richard J. Russell, in 1959,[55] introduced another paper which I think is crucial to this discussion. Russell's purpose was not to report on skeletons found in rock on Guadeloupe, but rather on beach rocks in the Caribbean. In the summer of 1958 Russell visited 110 beaches on the islands of Puerto Rico, Antigua and Guadeloupe. Thirty-six of these beaches had beach rock, including several beaches on Grande-Terre, Guadeloupe. One of these beaches was the "plage de la Autre Bord near Moule". Autre Bord, on Reynal de Saint-Michel's map,[20] is located between Moule and Morel, a few hundred metres south of the "consolidated beach sand" unit ("a_s") of Reynal de Saint-Michel's map (see Figure 2). Russell not only mentions that beach rock occurs on this beach, but also includes several photographs in his article. He also states that 100 metres inland of the beach rock on the beach was incipient beach rock, exposed in the summer of 1958 but covered with a metre of beach sand six months later. Thus by the observations of Russell,[55] Reynal de Saint-Michel,[20] and Clerc[21,22] beach rock definitely exists north of Morel and Autre Bord, in the vicinity of Moule.

CONCLUSION

Ultimately complete resolution of this problem will come only with an on-site investigation of the Guadeloupe site. However, if Chris Stringer, David Tyler, and I are correct, along the coast to the east of Moule one should find beach rock which in places encases human bodies and artifacts of the Arawak Indian language group. A sample of this beach rock should find it of the same composition as both the beach sand in the same area and of the rock encasing the British Museum specimen, the French museum specimen, and the specimen in the Charleston Museum in Charleston, South Carolina. This beach rock will have the microscopic and macroscopic characteristics of typical beach rock. In addition this unit will be found in the position and orientation that one would expect for beach rock. Furthermore, the enclosed Indian artifacts will be found to be those from the "Morel II" level of Edgar Clerc's excavations, dated about 550 A.D.

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