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EARLY VIEWS ON THE GEOLOGY OF THE BAHAMAS: 1837 - 1931

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ABSTRACT

The earliest writers about The Bahamas were not geologists, but keen observers in related professions. Nelson and Verrill were the most perceptive and also recognized the link with Bermuda. By the turn of the century The Bahamas was being visted by geologists who may be considered more as theorists than scientists, but they also contributed to our knowledge. Alexander and Louis Agassiz are the best known in this period. Vaughan, Drew and Field represent the final group and can be considered precursors to scientific study as we understand it today. From 1917 Andros was the location for much detailed fieldwork.

INTRODUCTION

Sixty years ago there were perhaps 20 papers published on the geology of The Bahamas, with about another 10 of direct relevance. The number of workers in that field, of whom only some were geologists by profession, was about half that. Despite this paucity of published knowledge these early workers had a fairly accurate idea of the nature of The Bahamas and the processes at work there. This is perhaps surprising when one reads some of the uninformed comment published in contemporary texts, notably in history and geography books which usually provide a geological background to their subject.

THE EARLY VIEWS

As is indeed true today, Bermuda provided some of the earliest evidence of what was going on in The Bahamas, and writers were quick to realise the similarities. The earliest record is by a Captain Nelson of the Royal Engineers. Nelson had been stationed in the Bermudas from 1830-3 and had published an account of that group in the British Geological Society of London's Proceedings (Nelson 1837). He later moved to The Bahamas and in 1853 his paper "On the Geology of The Bahamas" was read to the Society by Sir Charles Lyell. There seems little doubt that Nelson was highly regarded and he is acknowledged by both Dana (1874) and Darwin (1898) in their respective works on coral reefs.

Nelson, like quite a few amateurs after him, played the field, and had a view on almost every aspect of geology. He was most perceptive in some matters:

> (it is) "highly probable that the Bahamas were produced by the same causes as those to which the Bermudas owe their existence" (Nelson, 1853, p. 201).

In his Bermudan paper (1937) he had introduced the word 'Aeolian' to describe the surface processes, and did so again here, along with the observation that sediment formation was of a composite organic origin. He identified skeletal and spherical sand grains, and described the process by which:

> "fine calcareous sand is removed by the wind and deposited in irregularly laminated beds, which, being consolidated in various degrees, are converted into rock of different qualities" (Nelson 1853, p. 206).

Within the aeolian beds he recognized Cerions and other fossils, and correctly interpreted the many rhizomorphs or vegimorphs he saw.

On a broader scale he was adamant that:

> "there is no evidence of elevation having taken place within The Bahamas or Bermuda". (Nelson 1853, p. 212).

and also that there had been no subsidence:

> "Organic agency, direct or indirect, is quite competent to the task of raising the surface to the height required" (p. 213).

Subsequent workers disagreed with this, Northrop (1891) claiming that cave evidence in Andros and New Providence suggested that these islands had risen out of the sea, and Alexander Agassiz (1894) later requiring subsidence for at least 300 feet to account for the depth of Ocean Holes.

It is worth noting that Alexander's father, Louis Agassiz, apparently agreed with Nelson, for he was quite specific that:

> "The whole coral field of Florida furnishes connected evidence that neither upheaval nor subsidence of the ground on which the coral formations rest has taken place" (L. Agassiz, 1880, p. 35).

Shattuck (1905) in the well-known but disappointing study by the Baltimore Geographical Society later claimed there must have been a succession of elevations and depressions, with The Bahamas going up and down with some rapidity. It was left to Field in 1931 to reinstate Nelson's stability and identify eustatic sea level changes as the cause of cave formation above and below sea level. Field stated:

> "Various changes in sea level are apparent" (p. 780)

> "The emergence and submergence of the block naturally brings to mind the possibility of a connection with...Pleistocence glaciation" (p. 782).

Meanwhile Nelson had interpreted the nature of the limestone and the position of the water table. Percolating water passed through the rock:

> "to nearly sea-level. Here it meets with a body of salt water that permeates the lower portions of the rocky structure, and, from its lighter specific gravity, the fresh water floats upon this sea water, rising and falling with the tide" (Nelson, 1853, p. 205).

This is a perfect description of the nature of Bahamian fresh water lenses. At the same time he observed a deposit on the limestone which he said was 'coated or even arched over with a substalagmitic substance' (Nelson p. 203) and correctly identified storm berms.

Many of Nelson's successors did much worse. Nelson himself thought the red earth was organic because he took samples from a cave that were contaminated with bat guano or other deposits. Red cave earth is indeed oxidised guano, but the red soil is a lateritic deposit.

He was also responsible for the delta theory which attracted several followers and even proposed the term "Gulf Stream Delta" for The Bahamas. The concept was that The Bahamas was a northern extension of the eastern Caribbean mountain chain on which the Gulf Stream had dumped delta-like deposits. These built up a submarine aggregate on which the islands rested superficially.

Louis Agassiz (1880) also pursued this idea, and 25 years later Shattuck (1905) was still saying that The Bahamas Islands:

> "Are to be considered as the summits of a portion of the eastern ridge connecting South America with Florida",

and on which the 'dryland summits' are 'transitory and uncertain'.

It has proved very hard to remove this image of The Bahamas, as witness the following description in a CXC Geography text by the head of Geography at the University of the West Indies:

> "The Bahamas are really the coral-capped peaks of a submerged mountain range, stretching...from...Florida, as far as Haiti" and "The Gulf Stream... flows through the islands". (Wilma Bailey, 1983, p. 101).

On the latter point Field conducted experiments on the penetration of the Gulf Stream on to the banks and concluded there was absolutely:

> "No indication of Gulf Stream influence over the banks" (Field, 1931, p. 766).

Not all the early writers were as perceptive as Nelson and Louis Agassiz. Charles Maynard (1894) was way off the mark when he claimed that the Bahamas:

> "existence is also largely due to the coral polyp is quite obvious" (p. 182).

He considered the islands to be elevated atolls and the ridges coral reefs. New Providence was:

> "a series of atolls" and Watlings Island:
> "is an example of an existing atoll in which the reef has been

but slightly elevated, the whole interior being an unfilled lagoon" (p. 183).

On Andros the east coast was "evidently an old barrier reef, similar to the barrier reef which now exists" (p. 187). Richard Field, cited above, represents one of the earliest modern scientific geologists to work in The Bahamas. Others in this category included Vaughan and Drew. Thomas Wayland Vaughan studied coral growth rates in The Bahamas and Florida and did many experiments on Andros, which was a veritable field laboratory for Floridian and other U.S. geologists early in the century (Vaughan 1915).

Another Andros visitor was G.M. Drew who became preoccupied by the brilliantly white clayey deposit found on the West coast. This calcareous mud, subsequently called Drewite, was discussed by the tireless Nelson (Nelson 1853) as common in Bermuda and Andros, and he incorrectly thought it was a young chalk formation. Drew, Field, and any others made numerous visits to West Andros well into the 1930's in order to study it, and in recent years it has been studied by Ginsburg and his students (e.g. Ginsburg and Hardie 1975).

A related phenomenon, that of 'Whitings' or the cloudiness of the banks' water is also fully discussed by Field (1928), who found the cloudiness took 7 days to settle out of the water after a disturbance. Goldman (1926) foreshadowed the work of Illing (1954) and other sedimentologists with his study of reef sand from eastern Andros. All these sedimentologists recognized oolites, which were known from older beds in Britain and the U.S.A., but did not really understand them. Sorby (1879) had studied oolites from The Bahamas microscopically. Although he described them as 'true crystalline chemically deposited oolite grains' with a 'distinct concentric and radiate structure', around a nucleus, he could not determine the special conditions which led to their formation. For various reasons he said such an enquiry would lead him beyond the limits of his subject. Walter Bucher (1918) describes experiments by Drew (1914) producing small spherulites of calcium carbonate from sea water, and by Vaughan (1913) who collected shoal-water muds from The Bahamas. Vaughan strained the water through a cloth and allowed it to stand for over three months, after which he found he had produced numerous oolitic grains that could be strained out by the same cloth (Bucher 1918). Bucher concluded correctly that oolites grow in free suspension, and pointed out that other conclusions misinterpreted secondary deposition. Bucher also identified stromatoliths (first discovered by Kalkowsky in 1908) in association with oolites, and described their artifical reproduction as a massive layered crust in an experiment to produce spherites with an oolitic structure (Bucher 1918, p. 607-8).

At the beginning of this paper it was noted that Nelson had found much in common between Bermuda and The Bahamas. Another worker who contributed to our understanding in a similar way was A.E. Verrill (1900) who gave lectures with lantern slides at the Lowell Institute in Boston in the 1890's. His paper describes the nature of the aeolian ridges well and relates them to the beach sands and coral reefs, but his main contribution is to an understanding of geomorphological processes. In his discussion he clearly identifies the response to changing sea levels and estimates rates of erosion by studying old maps. He also distinguishes a base rock on which the present aeolian beds rest unconformably, and which is distinguished by a calcite crust. He recognises the crust as a response to sub-aerial processes and so is able to suggest a tentative history of emergence and submergence. In this respect he anticipates the definitive statements of Field who identified a distinctive palaeosol at Great Sturrup Cay and near Nicholls Town in North Andros (Field, 1931, p. 780-1).

Verrill, unlike Nelson, recognized the true [not considered "true" any longer (Foos, 1991, pers. comm.)] origin of the red soils:

> "as mainly the residue left after the destruction and solution of the limestones".

> "Its formation has been a very long and slow process, for the amount of impurities in the limestone is very small, probably less than 1%" (Verrill, 1900, p. 322).

He estimates a period of about 240,000 years to produce the present amount of red earth on Bermuda, and is also most perceptive in his statement that:

> "There is every reason for believing that the present conditions have continued for an immense period of time" (p. 330).

Verrill's study of process, erosion and deposition includes the earliest account of the

geological significance of hurricanes:

> "A single storm probably effects more in the way of eroding the high cliffs than a hundred years of ordinary weather would". (p. 334).

Verrill's, and all the more detailed early papers, are valuable also for the description they give us of the landscape a century or more ago. Verrill is full of detailed descriptions of natural and man-made landmarks which he used to estimate erosion, and could be still used today, 90 years later. Similarly Nelson describes Lyford Cay as an island in 1775 with 9 feet of water in its channel, which was filled up by 1804, and by 1850 had a 10 feet high isthmus. (Nelson 1853, p. 209). Much of the work by Field and his colleagues in Andros could be replicated.

CONCLUSION

Despite some careless assumptions and the absence of deep coring, the early geologists gave a good account of the Bahamas. Much of their work has relevance today and their contributions, far from being archival curiosities, have both a value and validity in their own right that could be well-noted by newcomers to the field.

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