CHAPTER 1

THE GEOLOGY AND BOTANY

Anguilla is the most northerly of the Leeward Islands in the West Indies. It lies one hundred and fifty miles east of Puerto Rico and eleven miles north of the Dutch/French island of St Maarten/St Martin. The island is narrow and low-lying. It is some fifteen miles long and two to three miles wide (see illus 1). The total area is thirty-six square miles. There are no mountains, rivers or forests.

It is an arid island, with little agricultural potential. The highest point at Crocus Hill is just over two hundred feet above sea level. The island runs from east to west. Its surface is tilted towards the south, so that most of the island slopes in that direction. At the foot of the slopes on the south, the limestone surface passes gently below sea level. At the higher end of the slope on the north, there are cliffs broken by the occasional beach.

1. Map of Anguilla

The greater part of the surface of the island has no topsoil. It consists of fissured slabs of limestone. A low, tough scrub covers most of it. What little weathered limestone soil exists is found in the hollows and valleys called 'bottoms' that dot the island.[1] This soil is frequently coloured a bright red, like clay, and can be quite fertile. The soil is not clay, but weathered limestone coloured by the

[1] One of the curiosities that never ceases to amuse the discerning person is that for such a flat island there is an exceptionally large number of places named Valley and Hill. Almost half of the place names on the island are named one or the other.

insoluble salts left behind when rainfall dissolved the white limestone.

The main crops for many years in the past were pigeon peas, corn or maize, and sweet potatoes. Pigeon peas were grown in the fissures in the solid limestone from which the scrub was previously cut down and burned. The pigeon pea shrub is nominally a biannual growing to a height of ten feet or more. Those of Anguilla bear fruit, but they seldom grow higher than waist level unless planted in good, deep soil. During periods of low rainfall, they almost never survive the first year's dry season to produce a second crop.

Geologically, Anguilla consists of a cap of upwards of two hundred feet of sedimentary limestone lying on an igneous base. In only two places, at Crocus Bay and Road Bay, is the volcanic basement of the island exposed to view. This volcanic basement is best visible at the northern end of the beach at Sandy Ground. There, a large dark boulder, black, brown or purple in colour, traversed by white veins of calcite, can be seen protruding from the cliff at sea level. It rises to a height of some 20 feet above the sea and is easy to find. Above it is the limestone cap that covers the entire island.

The second place to see evidence of the volcanic birth of Anguilla is at Crocus Bay to the south west of the beach, or to the left as you face the sea. There is a breccia

layer visible at the foot of the cliff about one hundred feet after the end of the beach. It must be reached by clambering over the rocks and stones that take the place of the beach. The layer of breccia is covered by several, almost indistinct layers of coloured clays. The breccia was laid down as volcanic ash from nearby eruptions during this geologically violent time. The clays were deposited in shallow water as the volcanic ash and rock were eroded by ancient rivers and flowed down to the sea as silt. There is a thin layer of lignite and small pellets of amber near the top of the layers of clay. The lignite and amber are fossilised traces of this ancient Carboniferous Era.

Some two hundred million years ago, at the start of the Jurassic period, what is now Anguilla was a small part of an old prehistoric continent known to geologists as Pangaea (see illus 2).[2] This ancient land mass was covered during the earlier Carboniferous period in swamps and forests, and animal life was then not yet significant.[3] During the Jurassic period, Pangaea began to break up. Parts of this pre-historic continent sank below the sea. Other parts began to draw away from one another to become the present-day continents, separated by the Atlantic and other Oceans. Europe and Africa lie to one

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[2] David Dineley, Earth's Voyage Through Time (1973).

[3] It is this primal vegetation that formed the coal that is mined today deep in the earth, and that, as Dr S B Jones recorded in his book Annals of Anguilla, is occasionally washed up on Anguilla's shores as fragments of lignite and fossil resin.

side of the Mid-Atlantic Ridge, and North and South America lie to the other. Running the length of the Mid-Atlantic Ridge, small amounts of magma ooze out of the earth onto the sea bottom. As the magma hardens it pushes Africa apart from South America at the rate of about 2.5 cm per year. The cooled magma to the west of the Mid-Atlantic Ridge forms the South American tectonic plate which as it advances westward pushes up against the lighter Caribbean plate causing volcanic activity and earthquakes from time to time. Anguilla and the other lesser Antilles were born on the lip of the Caribbean plate that rests uneasily on the heavier Atlantic plate that forms the ocean bottom to the east of the archipelago.

2. Pangaea 400 million years ago

Kenneth Earle writing long before plate tectonics was understood described the geology of Anguilla as follows,[4]

> *Geologically, the island of Anguilla forms one of the sedimentary group of islands constituting the eastern and south-eastern half of the Lesser Antillean chain . . . At only one spot on the island have I found this igneous basement exposed in the sea cliff, viz, immediately north of Road Village, where it rises in a short distance from sea level to about 25 feet and then suddenly drops again to sea level and disappears. This rock is dark, black, brown or purple in colour and is traversed by veins of calcite.*
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> *The rocks are immediately overlain by white or cream-coloured marly limestone with fossils . . .*
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> *In Crocus Bay a rather different state of affairs is seen. There is no true igneous basement, but at the base of the limestone series at Pelican Point is seen a series of clays, grits, volcanic breccias, etc . . . At the western side of Crocus Bay there are also blue, white, red and yellow clays at the base of the cliff - the blue clays crop out in the beach - but no volcanic grits. It is associated with these blue clays that the lignite and "amber" occur . . .*
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> *Limestone of Upper Oligocene age forms the whole of the surface rock of Anguilla . . .*
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> *The occurrence of lignite or brown coal on the shores of Crocus Bay has been known for a long time. This is to be picked up from the sea itself at certain times of the year (April - September), and some 50 lbs was collected in November 1921 from the surf . . . It is a soft,*

[4] Kenneth W Earle, The Geology of Anguilla (1922) quoted by Katherine J Burdon, A Handbook of St Kitts-Nevis, Chapter 28.

black, woody coal, showing distinct stratification with traces of pyritous material and plant remains on a bedding plane. It has a distinctly brown appearance when cut with a knife . . . At certain times of the year the sea is said to sweep the sand away and expose a clear bed of lignite, but no one seems to have ever been on the spot at the time to make critical investigations of its dip, thickness, etc. In my presence, a man went three or four paces into the sea at two distinct points, and, after removing boulders and sand from the sea floor, brought up fragments of the material, and I have seen lumps as big as a man's head collected on a previous occasion. The only record of the lignite in writing is that in 1871 indications of coal were found in a blue clay, 30 feet down, at Crocus Bay, while "much coal" was still being obtained in 1872 from the opening made. It was also reported to occur at Chalvilles, in the centre of the island.

Acting on these data, I had two excavations made in the beach just above water mark exactly at the spots where I saw the other pieces taken from the sea. The first excavation - made in a blue clay, cropping out in the beach - had to be abandoned owing to the influx of the sea. The second was carried down to a depth of eight and nine feet (beach sloping). Shortly below beach level, clay was encountered, in which was found a thin string, nowhere more than an inch thick, of the lignite. Associated with it were two or three nodules, the interior of which showed a transparent honey-coloured fossil resin allied to amber, which had also been reported by previous observers. Further excavation only revealed clay, black, white, yellow and deep red in colour, but no coal.

This layer of lignite dates to the Carboniferous Era, when coal and oil originate, not only does Anguilla have no coal, but there is no oil either. The crude oil and natural gas that other West Indian islands find around their shores, date back to this period. Nor would there be gold or silver in the rocks of Anguilla, as these valuable minerals were deposited billions of years ago in the ancient plates that form the continental land masses. Anguilla and other coral islands are much too young for this.

During long periods of time, as the South American plate collided with the Caribbean plate causing it sometimes to rise and sometimes to fall Anguilla was deep under water.[5] It was then that Anguilla's limestone cap was laid down. Thomas Wayland Vaughan described the limestone thus,[6]

> *This formation is uppermost Oligocene, if the Aquitanian of Europe is correctly referred to the Oligocene. In the opinion of some palaeontologists it would be classified as earliest Miocene. It is paleontologically characterised by certain foraminifera, described by JA Cushman in a report not yet published, by numerous species of corals,*

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[5] The nesting Green Turtles of Ascension Island spend long periods of time feeding off the coast of Brazil. During the Carboniferous Era, they got into the habit of swimming into a small stream to a nearby island to lay their eggs. Over a period of 300 million years, their descendants have continued to cross the same stream every 3 or 4 years to lay their eggs. Only, now the distance from the coast of Brazil to Ascension Island is 2,500 km, and the original stream has become the Atlantic Ocean. It takes the turtles 5 to 6 weeks to make the trip, but turtles notoriously return to the beach where they were born to lay their eggs.

[6] Thomas Wayland Vaughan, Correlation of the Tertiary Geological Formations of the South-Eastern United States, Central America and the West Indies in the Journal of the Washington Academy of Sciences, Vol VIII, No 9, May 4th 1918, cited by Katherine J Burdon.

among which are the general Stylophora, Stylocaenia, Antillia, Orbicella, Siderastrea and Goniopora, by echoids described by Guppy or by Cotteau; among which are Echinolampas Semiorbis Guppy, E. Lycopersicus Cotteau and Agasizzia Clevei Cotteau; and by a number of species of mollusca, described in a manuscript by CW Cooke. The mollusca include Amusium Lyonii Gabb and Orthaulax Pugnax (Heilprin). I obtained no specimens of Lepidocyclina in Anguilla. The type exposure is along the south-east and south shore of Crocus Bay. The material consists of calcareous clay, argillaceous limestone and more or less pure limestone. The formation unconformably overlies basic igneous rock.

System	Series	Stage	Age (Ma)
Neogene	Miocene	Aquitanian	younger
Paleogene	**Oligocene**	Chattian	23.03–28.4
		Rupelian	28.4–33.9
	Eocene	Priabonian	33.9–37.2
		Bartonian	37.2–40.4
		Lutetian	40.4–48.6
		Ypresian	48.6–55.8
	Paleocene	Thanetian	55.8–58.7
		Selandian	58.7–61.7
		Danian	61.7–65.5
Cretaceous	Upper	Maastrichtian	older

3. Subdivisions of the Paleogene period according to the IUGS, as of July 2009.

The name Oligocene (see illus 3) comes from the Greek ὀλίγος (*oligos*, few) and καινός (*kainos*, new). This refers to the sparsity of mammalian faunas found in this geologic epoch after a burst of evolution during the Eocene. The Oligocene epoch started about 33.9 million

years ago and lasted for some 10 million years, ending about 23 million years ago. Translated into ordinary English Dr Vaughan's quotation above means, therefore, that Anguilla's 200 foot limestone cap, which lies on top of the igneous rock and breccia that make up the basement of the island, was laid down between 30 and 20 million years ago, with the youngest fossil shells and corals lying at the surface and the oldest at the bottom of the cap.

Limestone consists of the remains of ancient life forms. Vast numbers of sea creatures died in the sea over eons of time. Their bones fell to the floor of the sea, joining conchs, corals and sea urchins. Gradually, layers of these remains were built up. The animal remains were changed by time and the pressure of the sea and their own accumulated weight into limestone.[7]

When Anguilla surfaced for the last time, during more recent geological times, it was capped with this layer of limestone.[8] To this day, one can walk about the island picking up the fossil shells, corals and sea urchins of this era. They are loosely embedded in the limestone that now forms the surface of the island and wash out in large numbers ready for collection.

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7 Helmut Blume, The Caribbean Islands (1974).

8 JS Beard, Natural Vegetation of the Windward and Leeward Islands (1949), p.18: "*The rock sequence in Anguilla indicates submergence from Eocene to Miocene, emergence in the Pliocene, a slight depression during the Pleistocene, and subsequent reemergence which still continues*."

Famous among the extinct mammals of Anguilla is *Amblyrhiza inundata* (see illus 4). This great rat was first described in 1868 by Professor Edward Drinker Cope.[9] Fragments of fossil bone were dug up in a phosphate mine on Anguilla. A shipment of it was sent to Professor Cope in the United States of America for analysis. He identified the bones he found in it as coming from this huge prehistoric rodent.

4. Amblyrhiza inundata (reconstruction)

The fossils were shipped to him accompanied by an Amerindian conch chisel. The sciences of geology and biology were not in Professor Cope's time as advanced as they are now. He entertained the possibility that the *Amblyrhiza* remains were associated with artefacts of early man. That was an error. It is now known that *Amblyrhiza*

[9] Professor Cope's report may be accessed online: https://books.google.com.ai/books?id=nJA4rYDQT-4C&pg=PA183&lpg=PA183&dq=&hl=en#v=onepage&q&f=false

pre-dated the entry of man into Anguilla by many thousands of years. The *Amblyrhiza* remains are 125,000 years old, long before humans entered the American Continent from Asia.

In a series of articles in the Anguilla Life magazine, botanist Mary Walker has described the source of Anguilla's plants. She says that the story begins some two million years ago in the late Pliocene time. Then, there was extensive land uplift due to continental plate shifting. During the Pleistocene glacial age that followed, much ocean water was tied up in the great continental ice sheets. Sea level was lowered by some two hundred feet. At that time, Anguilla and the Leeward Islands formed part of a larger land mass extending perhaps westward to Puerto Rico from Antigua in the east to Guadeloupe in the south. At low elevations the land constituted a dry zone. This was covered by a type of vegetation now called an evergreen bush land.

Some of Anguilla's common shrubs and trees date from this period. They are the bearded fig, fustic, cedar, masswood, cinnamint, alexanders, and loblolly. Anguilla shares them with Puerto Rico and the Lesser Antilles. Anguilla has about five hundred species of plants, as do the other limestone islands of the Lesser Antilles. More than two hundred of Anguilla's native plants are found on Puerto Rico too.

About sixty percent of Anguilla's plants are native or wild. That is, they become established and grow without any help from people. Some plants arrived by water and others by air. The Amerindians first introduced papaya, cassava, corn, cotton, tobacco, and the calabash tree whose dried fruit was used for making pots, pans and jugs.

About thirty five percent of Anguilla's plants are exotic or introduced. Most are cultivated as food plants or ornamentals. About forty of them are grasses and weeds which have naturalised, that is they grow on their own. A few, like pomegranates, tamarinds, acacias and pommesurettes have escaped from gardens and joined the wild vegetation.

In the year 1985, Dr Richard A Howard of Harvard University collected plants on Anguilla while doing field work for his six-volume Flora of the Lesser Antilles. He made a chance stop along the road in Chalvilles. One of the plants in the bush caught his eye. It was not like any other plant he saw before. From its flowers, he identified it as a member of the genus *Rondeletia.* Botanists call this a 'plastic' genus as its plants have evolved readily into many different species in order to adapt to the different habitats that were being created in the Pliocene and Pleistocene times. Five species are endemic to the Leeward Islands, meaning they grow only there. The plant

that Dr Howard discovered he named *Rondeletia anguillensis* (see illus 5).

5. Rondeletia Anguillensis (photo by the author)

It is Anguilla's one endemic plant we know of. It evolved to grow in the dissolved limestone pavement that covers the northern and eastern parts of the island. It is a low shrub reaching only to the knee in the specimens I have seen. It has the small tubular flowers typical of the Rubiaceae or coffee family to which it belongs. Other members of the family that are abundant on Anguilla are the fustic, coughbush, black torch, wild guava, and five-finger bush. At first glance Rondeletia looks much like a diminutive five-finger bush. On closer examination, its flowers are smaller, and pink rather than white. Its branches are sharp tipped like the five-finger, but the branching pattern is different. It has tinier leaves which minimise water loss and help conserve moisture in this dry

environment. The sharp tips and leathery leaves make it not attractive to goats, which should ensure its survival.[10]

[10] Articles by Mary M Walker "The Vegetation of Anguilla" in Anguilla Life magazine.