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Notes on some of the Seychelles Islands, Indian Ocean

by

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Introduction

The Seychelles are a group of islands in the western Indian Ocean (see map), under British Sovereignty. They are scattered over an area of about 150 thousand square miles but the actual land area is only about 100 square miles, 87 of which are accounted for by mountainous granitic islands at the administrative centre of the group, where is the capital, Victoria. Although these are beyond the scope of this paper the economic status of the 'Outer Islands' is dependant on the reservoir of labour and the facilities of exporting produce, which exist on the granitic islands.

The Seychelles Bank is, in effect, a fringing reef of the compact group of granitic islands but is unusually deep over most of this area. The rim is however relatively shallow and at a number of points near enough to the surface to become a danger to navigation. A slight drop in sea level would expose several islands which now only exist as shoals. In two places the bank rises above the surface, giving the islands of Denis and Bird, which are typical of sand cays normally found on atoll rims and are included in this discussion.

A second major bank in the Seychelles, the Amirantes, carries a number of reef islands and atolls, ten in all, with several shoals and submerged reefs. All the other Outer Islands are on separate bases.

Most of the common types of 'coral' island are represented in Seychelles and rough classification based on their morphology is:

Sand Cays (not on atolls, with no sign of recent uplift): Denis; Bird; Daros; Platte; Coetivy; African Banks; Etoile; Boudeuse.

Uplifted Sand Cays (not on atolls): Desnoeufs; Remire; Marie-Louise.

Atolls (with associated sand cays but not uplifted): Farquhar; Providence-Cerf; Alphonse; Bijoutier-St. Francois; Poivre; St. Joseph; Desroches.

Raised Reefs (no lagoon): St. Pierre; Assumption.

Raised Reefs on Raised Atolls (with lagoon): Aldabra; Cosmoledo; Astove.

Islands of the first three groups have an agricultural potential but those in the last two are of little value unless guano is present. Most are privately owned but a few remain as government property and are leased to suitable companies.

The past history of the islands is obscure, although it is known that the Amirantes were discovered by Vasco da Gama on his second voyage of exploration in 1502 and Farquhar was probably seen by Juan de Nova in 1503. Previous knowledge of the islands by Arab and Indian traders is not impossible. They were not charted accurately, however, until 1825 and it was not until the end of the 19th century that they began to have any economic importance. None of the islands have been permanently inhabited. In the early days of exploitation, fishing camps were established and it was probable that guano was discovered at the same time. Similarly, it would be noticed that some islands were suitable for cultivation.

It is proposed in this paper to discuss four typical islands in detail; Alphonse, St. Pierre, Astove and Desnoeufs with a final section dealing with variations to be found on the other islands. Firstly however it is necessary to give a brief reference to the meagre scientific work which has been carried out and to describe the guano and copra industries on which the economy of the islands depends. Not mentioned later is fishing which has, for many years, promised a great future but has never lived up to its promise. Large catches are obtainable near the islands and there is a small trade in salt fish, especially from Aldabra and Cosmoledo. Unfortunately, storage and marketing facilities have always been troublesome and, although a considerable variety of species can be caught and prepared, the export has been dropping and in 1960 only 82 tons were shipped. Without refrigeration and good transport facilities it is unlikely that a valuable market will be developed and it is somewhat galling that the Japanese find fishing in the waters between the islands quite profitable.

Previous Scientific Work

Although brief mentions of the islands had been made previously e.g. in Bojer's 'Hortus Mauritianus', in Coppinger's 'Cruise of the Alert' and in Linell's paper on insects (17), the first detailed study was carried out by the two 'Percy Sladen' Expeditions in 1905 and 1908, which have been reported on by Gardiner and Cooper (1 & 2) and by a series of papers up to 1936 in the Transactions of the Linnean Society, covering mainly the botanical and zoological features. Special mention must be made of two papers by Fryer (3,4) which show the results of detailed research rather than the recording, collecting and systematic work which characterized these expeditions.

Further information, mainly agricultural, has been given by Dupont (5,6) and recently by Piggott (7). Other recent papers of interest are Vesey-FitzGerald on ecology (8) and bird life (9,10) and Ridley and Percy on birds (11,12). Finally a valuable memoir on the geology and guano reserves of the islands is in preparation by Baker (13).

Climate

It is convenient to mention here the climate of the islands. This is dominated by the south-east monsoon of the Indian Ocean which blows strongly and steadily from about the end of April to November and, during

which, the rainfall is negligible. This period has hot almost cloudless days with an average shade temperature of about 83°F. The north-west monsoon is much weaker and its effect decreases westwards. At this time the islands experience variable winds and somewhat cloudy conditions. Rainfall is usually torrential but thunder-storms are rare. Although records are scarce it seems that islands eastward of the Amirantes have an annual fall of some 55 inches but this decreases sharply eastwards and on Aldabra it is probably only 15 inches. During the north-west monsoon temperatures are slightly higher, as is the humidity, and without wind the climate can become most trying. It is during this season that cyclonic disturbances occur to the south and the more southerly islands have occasionally suffered severely from their effects.

Guano

Many of the islands had workable guano deposits and, on several, guano formation was continuing when exploitation commenced. The total quantity which has been exported probably approaches half a million tons but relatively little remains now. Guano working started late in the 19th century, peak production being between 1906 and 1930, and still continues, on a reduced scale, on St. Pierre and Astove. The material was found on all types of island and was usually worked by very primitive methods which were, however, profitable. Human activity disturbed the enormous colonies of seabirds and they never returned in quantity and it is only on Desnoeufs and one or two minor atoll islands that guano formation continues. Another loss was the natural vegetation which had to be destroyed before the guano could be scraped up. Except on those islands where coconut planting was possible, the flora, after working ceased, was very limited and the species are now few and of little value.

Coconut Industry

Some coconut planting must have started in the 1870's or so, for it has been reported (1) that the plantation on Farquhar was destroyed by a cyclone in 1893 whilst a photograph in the same paper shows mature palms on Poivre in 1905. Now, all suitable land, and much unsuitable, is planted to coconuts under plantation conditions with little competition from other plants. In the early years yields were poor and not until about 1910 was it realized that special methods of planting and cultivation were necessary on these soils which are inherently infertile and have a low water holding capacity. Since then, yields have improved greatly and compare favourably with those obtained in other parts of the world. As an indication of these yields Alphonse gives annually 2,800 nuts per acre, with the Outer Island average being 1,861. On the granitic islands the yield is only 1,463 nuts per acre per year.

The agricultural technique necessary to produce these yields are (a) good spacing, (b) planting in holes dug to the water table and filled with organic debris, (c) keeping a free root passage to the water table by making holes, similar to the planting holes, close to the palm every 10 years or so, (d) utilizing all trash and husk as mulch, or organic manure and (e) slashing all weeds at least once every year.

The nuts mature on the palm; are collected after falling and converted to copra immediately. After initial rapid drying in locally designed hot air dryers, usually fired by shell and a few husks, the copra is finally sundried to a low moisture content. It is of high quality and stores well, as it must, for local schooners only call at the islands four times a year and there is often several months delay after this before final export.

Pests have been important on most islands especially the scale insects, and their biological control by coccinelids has been spectacular (14). Damage by Oryctes monoceros can be severe but many islands are free of this pest and stringent precautions are taken to prevent its entry. Finally, Poivre and Daros have recently suffered from an infestation by a long-tailed mealy bug, Pseudococcus adonidum, and attempts are being made at present to bring it under control by biological means.

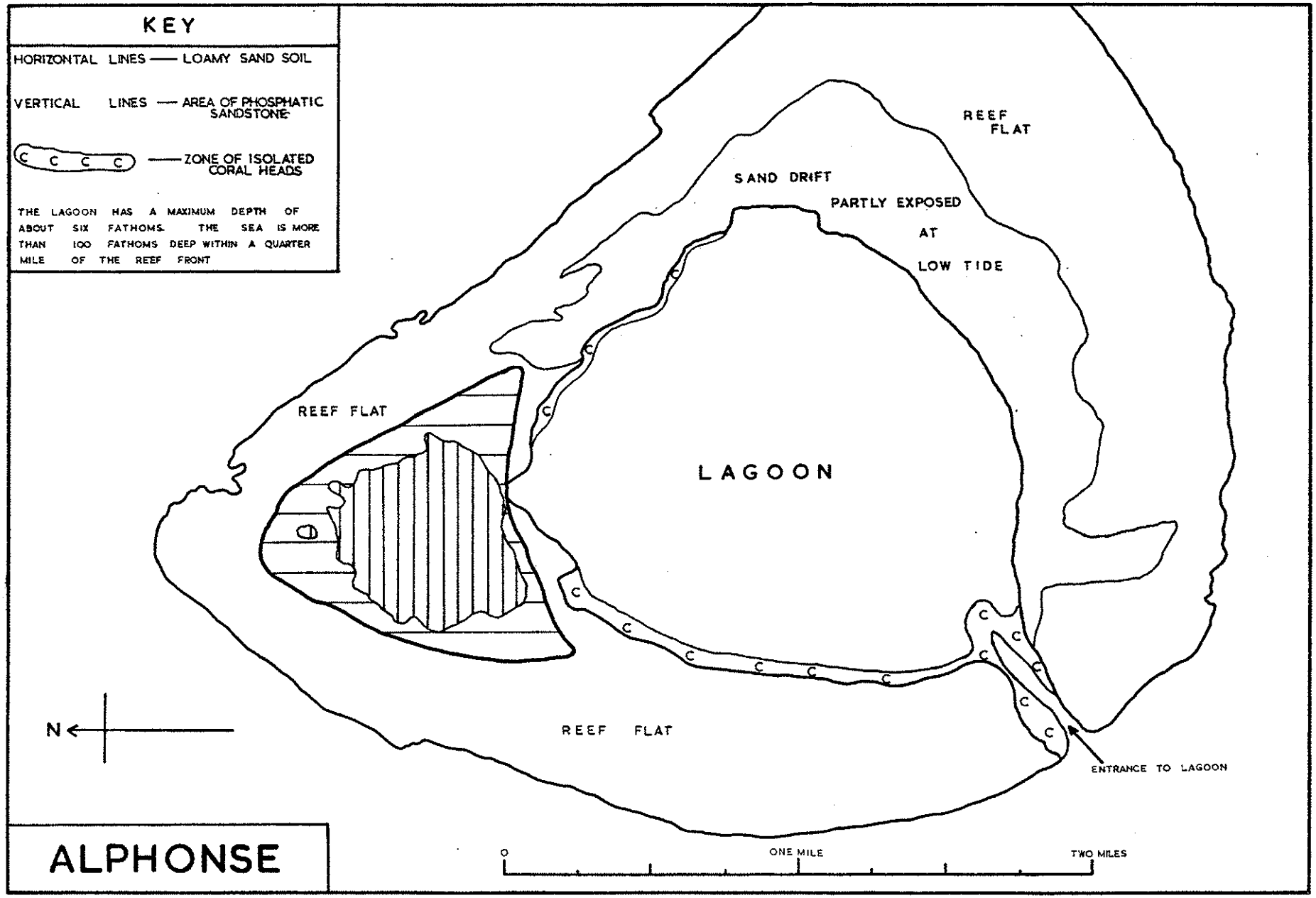
Representative Islands

ALPHONSE

This is a sand cay of some 450 acres, the only land on the rim of a small circular atoll some two miles in circumference (see map). There is a surf-boat passage into the lagoon, which is 15-20 feet deep in most places although there are considerable sand drifts near the reef which are exposed at low tide and emergence of more land is likely. The external reef slope is steep into deep water and the anchorage for schooners is not good, especially during the south-east monsoon.

The shape of the island, roughly an equilateral triangle, is somewhat unusual for an atoll cay but it does confer many advantages, not the least being a large fresh water storage capacity. As is common, the periphery of the island is somewhat higher than the centre but by no more than two or three feet. Beach sandstone is very uncommon with only a small patch near the middle of the lagoon shore. The centre of the island is, however, occupied by a massive layer of phosphatic sandstone which is, in places, over seven feet thick. Around this sandstone and, as far as it is possible to determine, below, the island is composed of uniform coarse sand with gravel only occuring at the points of the triangle.

The soil developed on the sand is a typical Shioya loamy sand (15) with Shioya sand near the coast. Owing to the agricultural development, undisturbed profiles are virtually nonexistant. It is probable that the sandstone in the centre of the island is part of a variant of Fosberg's Jemo Series (16) but with a much thicker than usual cemented layer. Guano, the surface horizon, has been exported but remnants show between 25% and 30% total P_2O_5 and its pH (colorimetric) varies between 5.7 and 7.0. The phosphate content of the rock slowly decreases downwards but the pH increases to about 8.0 within a fraction of an inch below the rock surface. The rock is pervious, and water can percolate down occasional cracks, but it forms an effective barrier to root penetration. There is no rock below the water table, which is at roughly the same level as in the sand.


KEY
HORIZONTAL LINES — LOAMY SAND SOIL
VERTICAL LINES — AREA OF PHOSPHATIC SANDSTONE
C C C C — ZONE OF ISOLATED CORAL HEADS
THE LAGOON HAS A MAXIMUM DEPTH OF ABOUT SIX FATHOMS. THE SEA IS MORE THAN 100 FATHOMS DEEP WITHIN A QUARTER MILE OF THE REEF FRONT
REEF FLAT
SAND DRIFT
PARTLY EXPOSED AT LOW TIDE
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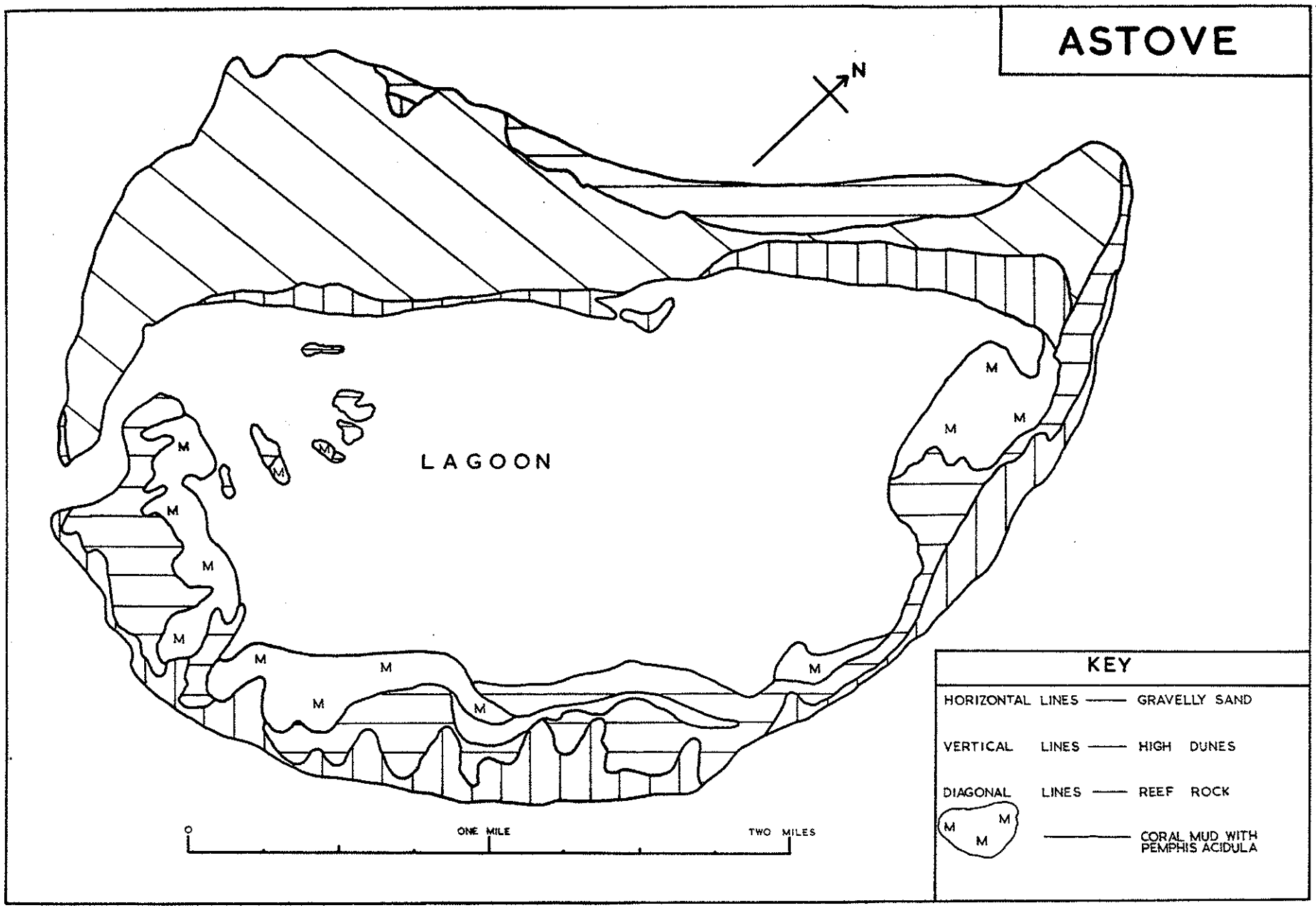
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KEY
HORIZONTAL LINES —— GRAVELLY SAND
VERTICAL LINES —— HIGH DUNES
DIAGONAL LINES —— REEF ROCK
CORAL MUD WITH PEMPHIS ACIDULA

As mentioned previously, it was inevitable that the natural vegetation should be destroyed during guano exploitation on the sandstone area whilst most was lost on the sand during coconut planting. There remains a much broken fringe of Scaevola sericea around the shore line and this is probably the only species left in its natural habitat. Occasional mature specimens of Hernandia sonora can be found but whether they formed part of the natural vegetation is difficult to determine. Other than coconut, the most noticeable tree is Casuarina equisetifolia which has certainly been introduced. This was planted over much of the island but has now been reduced to a pleasant avenue across the island and a wind break in the south-west. Alphonse is unusual in this respect for many coconut islands have an almost complete wind break of Casuarina. The only other tree which seems to thrive is Terminalia catappa. Exotic fruits such as the mango are absent, as is Pandanus.

Under the palms on the Shioya loamy sand, the vegetation is mainly low grass of several unidentified species although amongst them Stenotaphrum complanatum is common. On the sandstone a mixed population of low herbs is found, almost all introduced weed species, including Acalypha indica, Solanum nigrum, Commelina benghalensis, Tylophora asthmatica, Ricinus communis and Catharanthus roseus. Most characteristic, however, is Carica papaya which now grows wild and is an infallible indicator of the presence of phosphatic sandstone, even if this has been buried by sand.

In view of the negligible soil and poor water relations on the sandstone areas, palms do not thrive but, in selected places, annual crops can be grown with some success if the rainfall distribution is reasonable. Maize, pumpkin and sweet potatoes are carefully cultivated by the labourers and make a pleasant change in the otherwise monotonous diet. The high overall yields of coconuts given previously are confirmed by individual nut counts and an average over 165 random palms is 36 nuts per palm. Symptoms of potassium and iron deficiency are common whilst phosphorous is at a low level in the sandy soil so that, by careful manuring, it should be possible to increase even these good yields. Fertilizer trials are in progress with such an improvement beginning to show.

ST. PIERRE

This island, about 3/4 mile in diameter with an area of 417 acres, has been one of the most valuable of the group owing to its guano and high grade phosphatic rock. It is a raised reef and the surface consists of corals and calcareous algae in position of growth but much weathered. The uplift is greater than on any other island of this group and the surrounding cliffs are some 30 feet high although the centre of the island is more or less at sea level. These cliffs are undercut and fretted by wave action, for there is virtually no fringing reef, the swell breaking against them. Owing to the cavernous nature of the island there are many coastal caves and a number of these have 'blowholes' which have given rise to a characteristic feature of the island: coastal sand dunes, some ten feet high, behind each blowhole, built from the debris thrown out by the jet of water.

Although the wave action does not penetrate more than 30 yards inland, the inter-connecting caverns honeycomb the whole island and at the water table is, invariably, sea water. At one time the whole island was covered with guano and this has resulted in a considerable phosphatisation of both the coral rock and any drifts of sand which were present on uplift. At least 150,000 tons of high grade guano have been removed whilst in recent years the rock has been crushed and mixed with the guano giving a standard export grade of product with 22.5% P_2O_5 at a low moisture content. Small deposits of guano are still being found in caverns where it has been washed by rain.

Prior to guano exploitation the island had a mixed vegetation with a bank of Pemphis acidula along the coast and, behind, a scrub with Pisonia grandis, Cerbera odollam and Hibiscus spp. predominating (4). Now it is almost a desert. On the east coast a few scattered Pemphis bushes still exist whilst only two, extremely battered specimens of Pisonia have been left in the centre of the island. Of the herbs which survive on the remains of the soil, Stachytarpheta indica is the most common. A surprizing introduction which appears to be establishing itself is Gaillardia pulchella and this relieves the monotony of the colouring during the dry season. On the blowhole 'dunes' there is a thick mat of Sporobolus virginicus. Around the settlement several exotics have established themselves including Datura stramonium, Asystasia gangetica, sisal and a few pawpaws and bananas. Nearby, a partial windbreak of Casuarina equisetifolia has been planted and this, surprisingly, is thriving and spreading.

The island has, obviously, no agriculture potential and no food crops are grown. It can only be hoped that, when guano exploitation has finished, the birds will return or the Casuarina spread over the island. Otherwise it is likely to remain a desert.

ASTOVE

Astove (see map) has been classified as a raised atoll but it is not impossible that the shallow lagoon has been formed by solution for, as suggested by Fryer (4), it is rapidly widening and deepening. This lagoon, which is only about ten feet deep at the maximum, has an entrance, some 200 yards wide, only about two feet deep at low tide. The lagoon water has a high concentration of suspended calcium carbonate which is flushed out on a falling tide, and this gives the water an opacity similar to that of milk. Other than the single entrance, the lagoon is land locked. The atoll is surrounded by a fringing reef some 200 yards wide with an exceptionally steep outer slope, the water being over 100 fathoms within 100 yards of the reef front.

The maximum elevation of the reef rock is some 15 feet but, owing the rapidity of solution, the actual uplift must have been much greater. The reef rock is only exposed in quantity on the west limb of the island; the base of the remainder being somewhat lower and composed mainly of gravelly reef debris. On this debris has been developed a line of coastal sand dunes over fifty feet high and drift from these has given a shallow

cover to the gravel. Similar, but much lower, dunes have been formed on the leeward lagoon shore. All the dunes appear to be stable at the present time, although there is some superficial movement of sand grains during high winds, and they have a fairly good plant cover. The presence of dunes on the five southerly island groups only, indicates that the effects of cyclonic disturbances are important in their formation.

As on St. Pierre, the reef rock of Astove is cavernous and large quantities of the surface guano were washed into these and redistributed by the sea water. Although sporadic workings have taken place there probably remains an exportable weight of guano hidden in undiscovered caves. There remains little trace of the original vegetation in this rock area but trees of Pisonia grandis still occur, with occasional Sideroxylon inerme. More important is a herb 'mat', which thrives where there is any soil remaining, with Plumbago aphylla predominating and including Dactyloctenium pilosum and Stachytarpheta spp. Sisal and wild cotton also exist on the very thin soil.

On the western limb, both coastal sandy areas have been planted with coconuts which are, unfortunately, not thriving. Owing to the height of the ground surface above the water table the palms have difficulty in obtaining moisture during the dry season and they suffer badly from wind damage. Admittedly, there is no wind break and the palms are growing on exceedingly rocky land at the edge of the reef rock area and it is possible that these are tapping water supplies and nutrients from the caverns below. There is certainly no soil on the rocks.

The soil of the dunes approximates to the Shioya Sand (15) but should probably be in a 'series' of its own, as the grain size is remarkably uniform and the agricultural potential is low owing to the limited water retention. The gravel flats have a very gravelly variant of the Shioya Loamy Sand, there being a considerable variation in the textural profile with depth owing to an admixture of wind blown material. This soil is probably suitable for palms as it can retain a reasonable quantity of water but little planting has been attempted owing to the absence of a windbreak - the dunes themselves not being effective enough. Excellent crops of maize have been obtained occasionally however.

The natural vegetation of these dunes appears to be a mat of Sporobolus virginicus in the spray zone and above this desiccated wind-moulded shrubs of Suriana maritima. Where the exposure is less, Scaevola sericea and Tournefortia argentea come in with very occasional Pisonia grandis. Clumps of Fimbristylis form a scattered ground cover whilst Cassytha filiformis is common, climbing over all and sundry. On the gravel flats the predominant vegetation is a mixture of drought resistant grass species including Stenotaphrum complanatum. Near the lagoon Pemphis acidula occurs and there are occasional specimens of Avicenia marina; but these do not thrive in the milky water.

The potential of this island has never been exploited; the main interest in the past being guano which can now only be collected as a sideline. A little commercial fishing has hardly paid its way whilst interest in agriculture has only been sporadic. Coconut planting is possible, if suitable windbreaks are established first, on much of the sand

and gravel soil whilst annual crops such as maize will give good yields if properly looked after. The only real problem is the chance of a cyclone which could destroy all the work.

DESNOEUFS

This uplifted sand cay, of some 86 acres only, is the only example of a virtually untouched island in the group. It is nearly circular with a maximum height of about 18 feet but, as usual, is saucer shaped, the centre being 7 feet above high water. There is no lagoon, only a fringing reef, and the reef flat is narrow. On top of this are many irregular blocks of beach sandstone which have been broken away from the more continuous sheets on the island edge. The landing, even by surf boat, is extremely hazardous and this is one of the reasons why the island has not been exploited.

The geologic structure is complicated. From the air can be seen a series of white concentric rings which stand out against the brown and green of the soil and vegetation. Ground inspection shows these to be outcrops of apparently typical beach sandstone with an angle of dip approximating to 25°. Between them is sand. This sandstone is only formed by precipitation of calcium carbonate, when a saturated solution comes into contact with a saline groundwater and must indicate previous coastlines of the island. It is probable that each outcrop coincides with a different stage of uplift, the older one having lost much material by solution. The original stable sand cay was, therefore, about 100 yards in diameter. Outside the visible sandstone outcrops is a coastal sand-dune, formed from reef debris carried inland under storm conditions. Doubtless this covers further outcrops for similar intact sandstone is found exposed at the boulder zone. It is of interest that a similar structure is found on Marie Louise, only seven miles away, but there it is obscured by the luxuriant vegetation.

The vegetation on Desnoeufs is not luxuriant. It is depressed as the result of the presence of numerous sea birds. Ridley (11) estimated that a million and a quarter breeding pairs of terns congregate there in addition to numerous boobies and 'fouquets' (Procellaria pacifica hamiltoni). In the past an export of preserved egg yolk was permitted and in one season over 1,500 gallons were shipped. Nowadays the island is a bird sanctuary and egg collection is only allowed every alternate year, when over one and half million eggs are sent to the central island where they form a major item in the diet. Surprisingly, this has made little or no difference to the total population. There is a fairly thick layer of guano on the ground and its formation is continuing. At the same time the sand and the beach sandstone are becoming phosphatized.

As can be expected, only a few plant species can survive the steady rain of bird excreta during the dry season. Even the normal coastal scrub of Scaevola sericea is limited to half-a-dozen stunted bushes. An unidentified tufted grass exists on part of the coastal dune but the remainder of the vegetation is limited to either short lived annual species which can seed before the bird concentration becomes too great

or to very tolerant perenials. The commonest plant is Stachytarpheta but the total number of species is only about ten. There are certainly no trees, with the exception of a small clump of some twenty coconuts which are struggling to survive in the centre of the island.

Possibly a little of the guano has been exported as there is some evidence of workings but the quantity must have been very small. Again an attempt has been made to plant coconuts as sites of planting holes can be seen on the aerial photographs (but not on the ground). Whether these holes were once planted is impossible to determine but certainly only the palms mentioned above survive.

THE OTHER ISLANDS

The geological classification of the other islands has been given previously. Within each group the islands are superficially similar but differ greatly in detail. The larger sand cays are all used for coconut production as individual plantations and all but the most youthful have some remaining guano and phosphatic sandstone. Bird and Goelette on Farquhar atoll, are the only large cays with a significant sea bird population. The former was the site of a very large ternery fifty years ago but exploitation of guano and the beginning of agricultural development caused the disappearance of birds from all but a few acres on a very recent sand spit. The very small cays have not been exploited and are still nesting sites for some birds, and will be valuable if they increase in size by accretion of sand. The biggest sand cay is Coetivy with an area of over $3\frac{1}{2}$ square miles, the smallest cultivated one being Bijoutier which is only two acres. The atoll islands are similar to the sand cays but the adjacent lagoons vary considerably in depth. For example, it is only possible to enter St. Joseph lagoon by dragging a boat over the reef but the lagoon is deep and provides excellent fishing; Farquhar atoll has a deep water entrance and schooners can moor against a short pier on the main island in sheltered water but the lagoon is fairly shallow and abounds in coral 'heads'; whilst Desroches is on a submerged reef which can only be discovered by sounding, its lagoon having a maximum depth of 17 fathoms.

The raised atolls and reefs are scientifically more interesting but economically of little value. Aldabra, for example, is one of the two remaining island groups in the world inhabited by species of Giant Tortoises, (Testudo gigantea), the other being Galapagos, but, apart from mangrove poles and its use as a base for fishing and catching turtles, it has no immediate value although the land area is considerable. The same applies to Assumption and Cosmoledo, although guano was exported from them in quantity once. Certainly, where there is no soil there can be little agriculture.

Summary

The Seychelles Outer Islands show features common to many atoll groups of the tropics but the variations in relative uplift are large for such a small area. The natural fauna and flora have been modified by the guano exploitation and coconut plantations.

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