Chapter 2

GEOGRAPHY AND ECOLOGY OF ALDABRA ATOLL

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1. LOCATION AND REGIONAL SETTING

Aldabra Atoll (latitude 9°24'S., longitude 46°20'E.) lies 260 miles northwest of Madagascar and 400 miles from the East African mainland. With the adjacent islands of Assumption and Cosmoledo, it rises as an isolated mountain in a basin 2000-2500 fathoms deep, bounded to the west by the African coast, to the south by Madagascar and the Comoros, and to the east by the Farquhar and Amirantes Banks and the Seychelles-Mascarene Ridge. Farther north, this basin has been shown to contain thick sequences of sedimentary rocks and to have a normal crustal structure (Francis and others 1966). The Seychelles-Mascarene Ridge, clearly defined by the 2000 fathom isobath (Figure 1), appears to be of complex structure. The Seychelles Bank itself is underlain by Pre-Cambrian granite, which emerges to form the main islands (Baker and Miller 1963; Matthews and Davies 1966). Matthews believes, from geophysical evidence, that similar rocks, with later basic dykes, are found between the Seychelles Bank and the Saya de Malha Bank, and again underlying Cargados Carajos Shoals near the southern end of the Ridge. Conversely, the Amirantes ridge, southwest of Seychelles, is

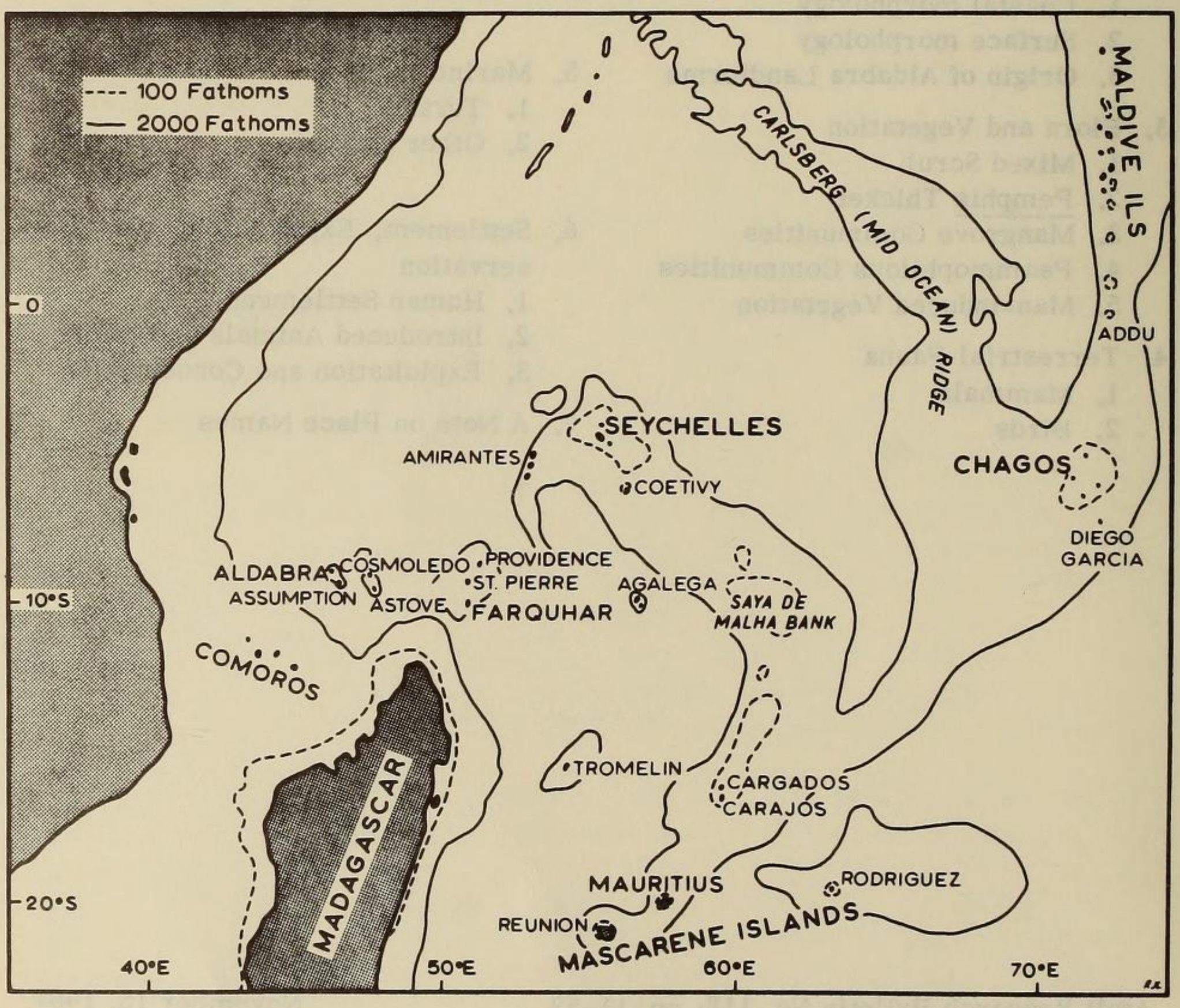

Figure 1.--Location of Aldabra

thought to consist of a coral capping, less than 1 km thick, overlying a basaltic volcanic arc (Matthews and Davies 1966). The Saya de Malha Bank itself, near the middle of the mid-ocean ridge, is also thought to consist of volcanic rocks capped with coral (Shor and Pollard 1963), and the islands of Mauritius and Réunion are themselves volcanic. South of Aldabra the Comoro group consists of a series of volcanoes of different ages (Guilcher and others 1965), and large areas of the Madagascar granites are covered with volcanics.

Little is know of the crustal structure north of the Comoros, or between Aldabra and Farquhar and Madagascar and the Amirantes. The conclusions of earlier biologists, concerned with problems of distribution, calling for isthmian links and drifting continents, are no longer tenable. Although geophysical evidence is lacking, the isolated nature and considerable relief of the mounts of the Aldabra group, rising steeply from uniform depths of c. 2200 fathoms, together with the proximity of recent volcanoes in the Comoros, suggests a volcanic basement at undetermined depth beneath the islands. This interpretation is supported by the presence of fragmental basalts, similar to rocks from Madagascar, associated with foraminifera of Eocene-Oligocene age, from the slopes of Providence, 300 miles east of Aldabra, at a depth of 744 fathoms (Wiseman 1936), and by the similar trends of both the Aldabra and Comoro ridges. This may imply the former existence of high volcanic islands, similar to the Comoros, perhaps in the early Tertiary, at Aldabra, Assumption and Cosmoledo, and also at Farquhar, Providence and St Pierre, and their transformation into atolls by Darwinian subsidence.

Apart, therefore, from the Comoros, the volcanic Mascarene Islands, and the granitic Seychelles, the islands of this western sector of the Indian Ocean are of reef origin. They include either sand cays of reef debris on sea-level reefs, as in the Amirantes, Cargados Carajos, and the Chagos Archipelago, or islands formed of uplifted reef limestones, as at Aldabra, Astove, Assumption, St Pierre, Providence, Cosmoledo and Farquhar. Baker (1963) has described the geology of many of these smaller islands, and their distribution is shown in Figure 2.

The date of uplift of the raised reef islands, including Aldabra, is unknown. Contrary to earlier ideas, based on Daly's hypothesis of Holocene high stands of sea-level, it has now been shown that many elevated reefs, formerly thought to be of post-glacial age, are in fact Last Interglacial. Veeh (1965, 1966), using uranium-series radiometric dating techniques, has shown that elevated fringing reefs at Mahé and Praslin in the Seychelles and at Gabriel Island, Mauritius, at 9, 6 and 2 metres respectively above present sea-level, have ages of 140, 140 and 160 thousand years. Dates of low elevated reefs from Hawaii, the Tuamotus, the Cook Islands, and western Australia (all reported by Veeh 1965), and from Florida and the Bahamas (Osmond and others 1965; Broecker and Thurber 1965), are all greater than 80,000 years, and cluster round 130,000-150,000 years B.P. This suggests that many elevated reefs were formed during the Last Interglacial and have emerged subsequently, perhaps eustatically. This simple picture must be complicated locally by earth movement, but it provides a tentative time-framework into which the elevated Aldabra group of islands may fit. The freshness of the raised reefs at Aldabra itself suggests that the time-scale may be too long, and material has been collected for radiometric dating. There is

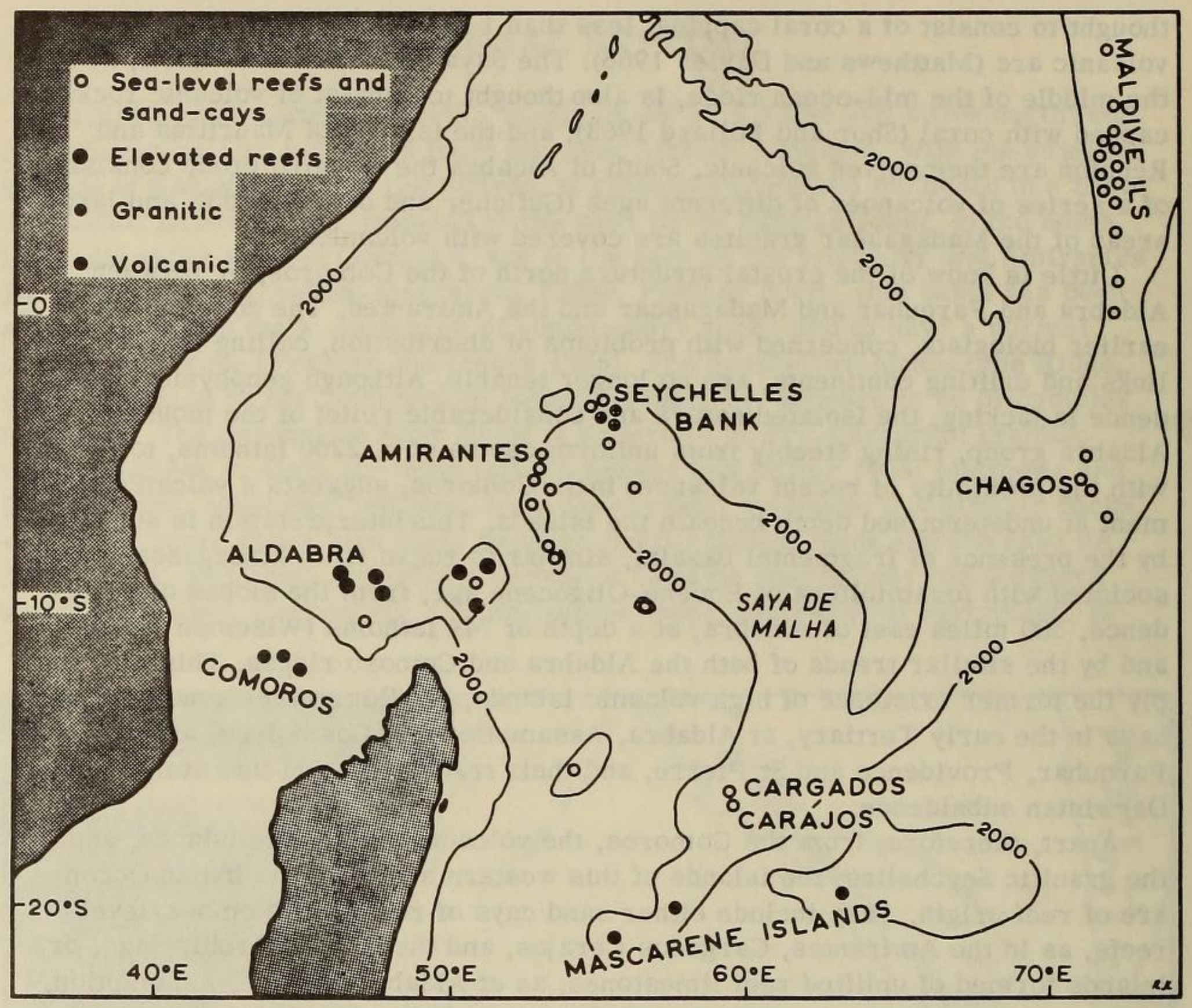

Figure 2.--Geology of Indian Ocean Islands

certainly no basis for Travis's statement (1959, 170) that the age of Aldabra is less than 3,500 years.

No climatic records are available for Aldabra, though a wartime station was established at Agalega, 450 miles to the east (Newnham 1945), and another has been established at Tromelin. The period May-November is that of the South-east Trades, and is dry; December-April, during the north-west monsoon, is a period of calms, oppressive weather, and rains. Estimates of total rainfall vary from 15 inches per annum (Vesey-FitzGerald 1942, 1) to 90 inches. Dupont in 1906-7 recorded 34 inches between October and January, with 25 inches during 17 days in January alone, when the wet season had just begun (Dupont 1907, 18). The mean annual total may thus be of the order of 50-60 inches. Mid-day temperatures are generally 85-90°F., and night temperatures may fall to 70°F. Aldabra lies to the northwest of the Indian Ocean belt of tropical cyclones, but it is occasionally affected. Perhaps the closest on record is that of February 1898, which passed over the atoll. Spurs (1892) mentions the defoliation and killing of vegetation during cyclones, and Fryer (1908-9) describes mangroves defoliated in 1907, but these must be rare events. Other cyclones have passed close by the atoll in recent years, but their effects have not been recorded.

2. GEOMORPHOLOGY AND GEOLOGY

Aldabra Atoll (Figure 3) is an elevated atoll, elongated east-west, with a maximum length of 21 miles and a maximum width of 9 miles. Its total area, bounded by the edge of the peripheral reef flat, is 141 square miles, and of this, land occupies 60 square miles. The land rim consists of four main islands (for a discussion of place names on Aldabra, see Section 7 of this paper: the asterisk attached to names in this paragraph indicates the name used in this report): South Island*, also known as Main Island and Grande Terre (42.5 sq. miles), Middle* or Malabar Island (10.2 sq. miles), Polymnie* (0.7 sq. miles), and West Island* or Ile Picard (3.6 sq. miles).

West Island and Polymnie are separated by Main Channel*, 1000 yards wide and carrying 10-12 fathoms at its entrance, and Middle and South Islands by the narrower East Channel* or Passe Houareau. Both of these channels are made dangerous for navigation by rapid tidal currents, and East Channel in particular is short and narrow. Main Channel branches dendritically lagoonward, and its branches maintain depths of up to 3-5 fathoms for 4 miles from its mouth. Johnny Channel*, between Polymnie and Middle Islands, unlike Main and East Channels, is a gap in the land rim rather than in the peripheral reef platform, which has been subsequently scoured out by tidal rips to a depth of 4 fathoms. West Channels* (Passe Lanier), between West and South Islands, are shallow gaps of recent origin eroded through a narrow sector of the land rim; they do not transect the reef platform. Of the West Channels, several of the individual passes between the small residual islands are named (Passes Femme*, Dubois*, Magnan*, Grabeau*); Passe Dubois is the deepest and is navigable by small craft and pirogues at high water.

In addition to the main rim islands, there are numbers of smaller islands within the lagoon, mostly close to the land rim and often connected to it at low water. These lagoon islands are concentrated along the south shore of Middle Island and along the eastern lagoon shore of South Island. Within the lagoon itself there are only two large islands: Ile Esprit* or Euphrates Island (0.13 sq. miles), with its tiny adjacent Ile Sylvestre* in the west, and Ile Michel* or Coconut Island, 0.16 sq. miles, in the east. The lagoon itself is shallow, and navigability depends entirely on the state of the tide. This has a maximum range of approximately 11 feet and is semi-diurnal: at low water springs, much of the eastern part of the lagoon, together with a fringe along its southern side, dries out, exposing mud flats and sandbanks; over the rest, Admiralty Chart 718 plots soundings of not more than 1 fathom in the inter-distributary areas of inner Main Channel. Because of the large area of the lagoon and the small and restricted entrances, there is a considerable lag in tidal behaviour within the lagoon compared with outside it: at springs the tide is still flooding in the Bras Takamaka* when it has begun to ebb outside.

1. Coastal Morphology

(a) Seaward side

The land rim is surrounded on its seaward side by an intertidal or slightly subtidal platform, which is narrowest (down to 100 yards) on the east or windward side, averages 200-300 yards in width along the north and south coasts,

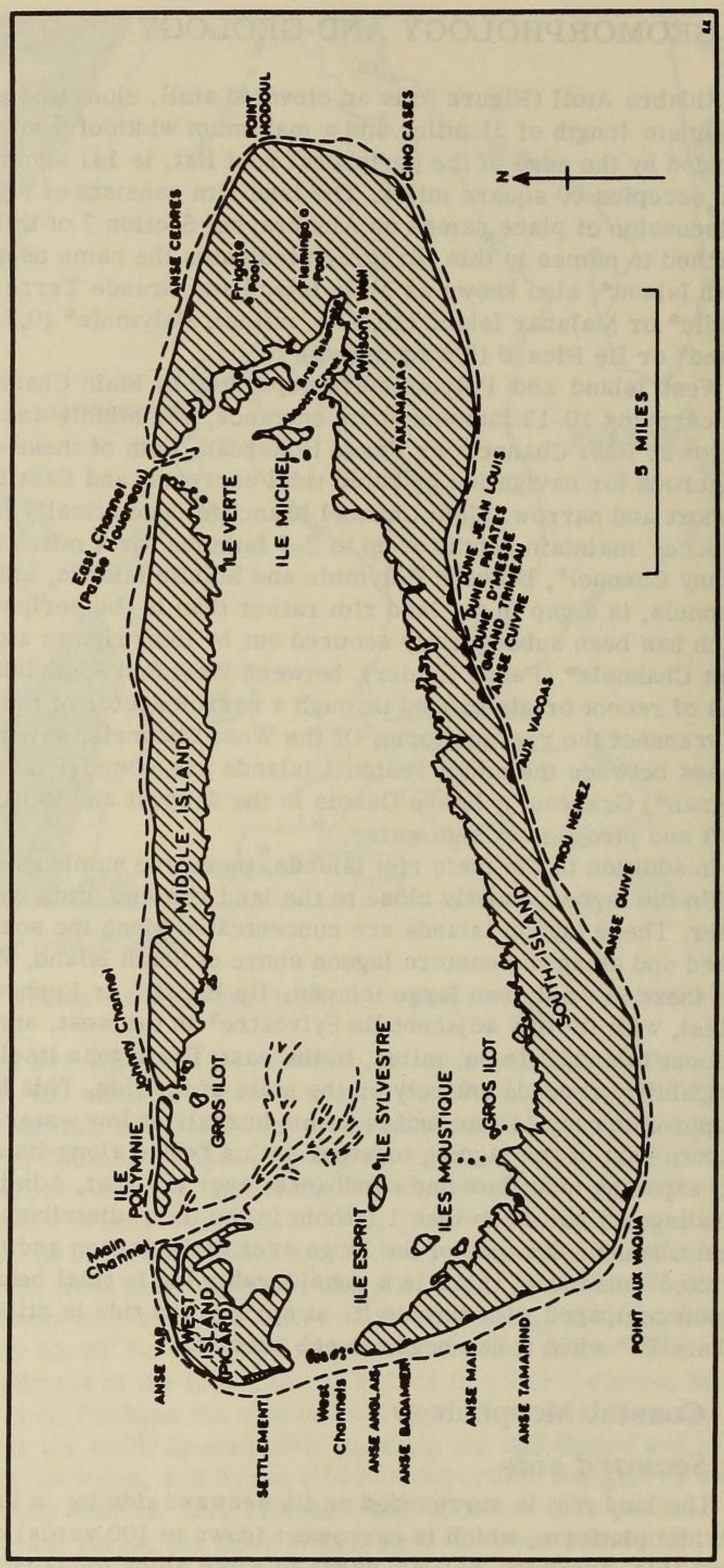

Figure 3.--Aldabra Atoll

and reaches 500 yards on the sheltered west coast. According to Travis (1959, 163), the reef front falls gently from the edge of this platform to a depth of 70 feet, before falling steeply to great depths, and this upper slope is marked by furrows 2 feet wide and 1 foot deep. The upper seaward slope may thus be equivalent to the 10 fathom terrace identified on many other atolls. Depths greater than 100 fathoms are generally found within half a mile of the edge of the intertidal platform, except at the east end, off Point Hodoul, where a shelf of bare limestone and algae extends seawards for two or three miles with depths of 20-25 fathoms (Travis 1959, 163).

The intertidal platform itself is an erosional feature formed of planed reef-rock with a thin, discontinuous sand cover and mats of Cymodocea, and is not a primary reef flat formed by contemporary reef growth. The seaward edge is marked by an intermittent boulder zone on the windward side (Plate 3), but there is no algal ridge, in contrast to the reefs of the central Indian Ocean (Stoddart 1966, 17). Baker (1963, 110) has argued that the platform is a growth feature, since if it were erosional it would be widest in more exposed locations. This misconceives the erosional process, however, which is mainly solutional and biological, rather than abrasional, and hence not so directly dependent on wave energy. His second point, that it must be a growth feature because it continues into the channel entrances, does not follow. The planed-rock surface cannot be a simple growth feature, nor could it form by reef growth at its present level, which dries at low water springs. No living corals were seen on the flat between East Channel and Anse Cèdres, nor at the seaward side of West Island. Fryer (1911, 413-414) suggested an erosional origin, and this is supported here. There is no information on reef growth on the seaward slope, though reef-blocks and cobbles suggest that Heliopora is important.

The inner margin of the intertidal flat or platform is generally formed by low retreating limestone cliffs in which corals are exposed. The cliffs rise to 15 feet above the platform in the east of the atoll, and to slightly lower in the west. Two distinct cliff morphologies may be recognised, the exposed type and the medium-energy type:

(i) Exposed Type

Locality: seaward coast from Takamaka to Point Hodoul. Here the cliff form is indistinct and ramp-like, rising at a high angle from a narrow basal intertidal platform with rimmed pools (Plate 1). The main peripheral reef platform appears to be at a lower level here than elsewhere, and surge breaks over the rimmed-pool platform, which is less than 3 yards wide and is coloured reddish-brown with algae. The upper part of the cliff-ramp is deeply and intricately dissected by salt-spray solution holes. There are no beaches. This type is homologous with several exposed shore profiles under study on elevated reefs of the southwest Pacific.

(ii) Medium-energy Type

Locality: Point Hodoul to East Channel, and the north coast of Middle Island. Here sea conditions are less extreme, and the dominant process is solutional: the cliff is vertical, deeply undercut by an intertidal solution notch, and the intertidal rimmed-pool platform is absent (Plate 2). The

notch has an amplitude at its mouth of not less than six feet; and the deepest notches extend back under the cliff for up to 30 feet. Small sand and cobble beaches may form within these deep notches, and are characteristically blue-coloured from their Heliopora content. Water constantly drips from the notch roof, where deposition may be taking place. Above the notch the cliff face rises vertically for 6-9 feet, and at the curve-over to the land surface it is intricately dissected by salt-spray solution cups. Occasional blowholes connect the land surface with the deeper notches. While the notch-forming process is clearly chemical and biological rather than mechanical, and analogous to that described from the Red Sea by Macfadyen (1930) and Guilcher (1955), the undercutting frequently leads to failure and collapse of sections of the cliff face. In plan, the recession process forms micro-headlands and bays, but the outline is surprisingly regular and outliers and residuals are rare. Immediately at the base of the cliff, between the notch and the intertidal platform, there is often a linear depression which may be up to 2 feet lower than the platform itself. This is probably partly excavated by mechanical action, and partly by increased solution associated with turbulence, at times of high water; at low water springs the notch is completely exposed, and at high water springs the sea reaches its upper lip.

Beaches are rare. In places, uneven cliff-retreat has formed small coves with "pocket beaches" (Plate 4), locally known as anses (the "lances" of Fryer 1911, 402). At Anse Cèdres (Plate 5) the beach is less than 100 yards long, with a 10^{o} slope, and a low-water width of 50 yards. Half the beach is lined with beachrock outcropping at high water level. Similar pocket beaches are reported on the south coast of Aux Vacoas, Trou Nenez and Anse Quive, but have not been visited: it is possible that at some of these locations the sand is so extensive that locally it covers the cliffs and joins the beach to the dunes above. At the east end of South Island, small perched beaches up to 3 feet in thickness are found on the cliff-top 15-20 yards inland from the edge (Plate 4). These are clearly storm deposits with much Halimeda. On the leeward side of the atoll, beaches are more extensive, as at Anse Mais, Anse Badamier, and Anse Anglais; and along the southernmost mile of the seaward coast of West Island beach deposits almost completely blanket the underlying raised reefrock (Plate 38). At the settlement itself the beach rises to a height of 15 feet above the intertidal platform, and has basal beachrock several hundred yards long and several yards wide.

Dunes are developed along much of the south coast of South Island, from Point Hodoul westwards. Between Point Hodoul and Takamaka the dunes are narrow and low, only locally exceeding 6 feet in thickness (Plates 6-8); further west, at Grand Trimeau, Dune d'Messe, Dune Patates and Dune Jean Louis, isolated dunes rise to heights of 50 feet above sea level, and are visible from the lagoon. Small dunes up to 13 feet high are also found at the south end of West Island (Plate 9).

(b) Lagoon side

The lagoon shores are formed either of undercut reef limestone or by mangrove communities; the latter are discussed in Section 3(3). The undercut cliffs

of the lagoon shore differ from seaward medium-energy cliffs mainly in their lower total height. The vertical amplitude of the solution notch is approximately the same (6-8 feet), but the vertical cliff above is rarely more than 1.5 feet and in many cases it is so low that it is overtopped by the sea at highest high water. The deep undercutting of the cliffs is striking (Plate 10). The width of the basal erosion platform formed by cliff recession is variable, but may reach 50 yards; it is generally a bare rock platform, with solution grooves normal to the shore, occasional residuals (which because of the calmer waters, especially at the east end of the lagoon, may be of most delicate form), and small patchy beaches at its landward margin. Active recession has isolated many stacks (Plate 11), of which the larger ones are vegetated. Several of these have surface dimensions several times as large as the pillar on which they rest, and it is to these that the term "champignon" (mushroom rock) originally referred. Undercut islands are well seen in both Main and East Channels, along the north shore of South Island, and particularly in West Channels, where the land rim has fragmented to form a series of small islands. Though both Wharton (1878) and Fryer (1911) argued that much of the lagoon cliff recession was caused by the mechanical and chemical action of mangrove roots, it is more likely that the undercuts are formed by a combination of physicochemical and biogenic (algal and molluscan) activities. Fryer, however, is clearly correct when he states that the lagoon is actively enlarging at the expense of the land.

Much of the lagoon floor is covered with a thin layer of calcium carbonate mud, overlying an irregular rock floor. Shoals of calcium carbonate sand are exposed during low tides. Living corals are confined to the neighbourhood of West and East Channels, but are scarce elsewhere. Air photographs indicate a watershed between the Main and East Channels, as shown by bottom sediment patterns, 4-5 miles west of the latter.

2. Surface Morphology

(a) General features

The main features of the surface geomorphology of Aldabra have been described by Fryer (1911, 401-405), when the local terms "champignon" and "platin" entered the reef literature. The distinction between the two tends to oversimplify the morphological variations. It is clear that two distinct sets of factors, lithology and process, have influenced the development of the present landforms. Champignon is used for deeply pitted and irregular solution-fretted reefrock, and platin for smooth surfaced, pavement-like cemented limestones. Champignon (Figure 4) occupies the greater part of West, Polymnie and Middle Islands, together with most of South Island from West Channels to 1.5 miles east of Dune Jean Louis. It forms a zone several hundred yards wide round the eastern end of South Island, and near East Channel occupies the whole width of the island. Platin, apart from small areas near the settlement on West Island, occupies the greater part of the eastern end of South Island, from Takamaka towards East Channel. It covers a total area of 14 square miles, 28 per cent of the dry land area (excluding mangrove), or one quarter of the total land area. Champignon forms the higher parts of the atoll rim, generally rising to 10-15 feet above

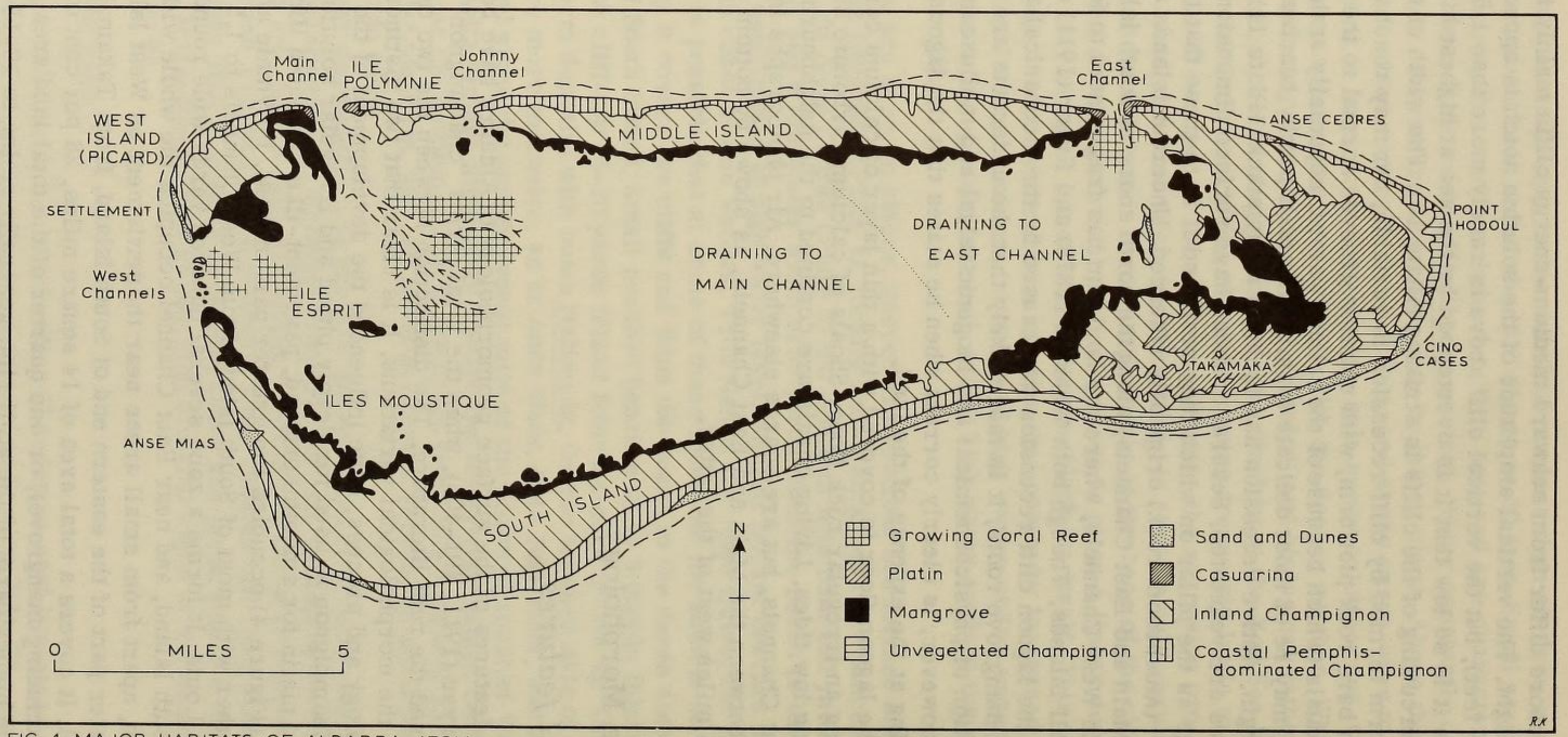

FIG. 4 MAJOR HABITATS OF ALDABRA ATOLL

Figure 4.--Major Habitats of Aldabra Atoll

mean sea level; the platin is lower, and ranges from approximately 3-10 feet above mean sea level.

(b) Surface solution features

The nature of champignon dissection varies considerably in scale and origin, though no descriptive terminology exists for the resulting forms. The largest erosional features are tidal solution holes excavated to intertidal levels, tens or occasionally hundreds of yards in extent, and which are clearly expanding by solutional recession and undercutting of the marginal cliffs, exactly as on protected lagoon shores. These holes may dry completely at low water, but flood rapidly on the rising tide. They are normally close to the sea or the lagoon, but we have no information on tidal lag. The mollusc fauna is marine, and the floors of the holes are covered with soft sediment. Good examples were seen south-east of the West Island settlement at Basin Cabris, and west of Point Hodoul. In the latter (Plate 21), several small residuals have been isolated in the middle of the hole by the rapid recession of the margins.

Normal champignon sinkholes are on a smaller scale. They are vertical clefts, often in the centre of wider surface depressions, and in many cases become wider with depth. Their mouths are usually less than 15 feet wide, and their depth appears to be a function of the height of the land surface above sea level. The deepest seen on South Island, in areas of high champignon perhaps 15 feet above sea level, were 12-15 feet deep. Though it was the dry season, most had standing water, with a brackish-water molluscan fauna. The dry sinkholes have a bottom full of yellow-brown silt and clayey sediment. There is no evidence of the solutional undercutting characteristic of marine tidal solution, but the walls are vertically furrowed by freshwater solution.

The third level of dissection in champignon is that of pinnacle and pothole[1] formation on the surface, which gives champignon its distinctiveness. The most extreme and intricate pinnacle formation is found in the salt-spray zone on top of seaward cliffs, where holes and pinnacles are angled slightly seawards. The bottoms of the holes are round in plan, and flat, and at lower levels contain salt water. They are similar to salt-spray solution features described, for example, from Puerto Rico by Kaye (1959), and seen on many of the Solomon Islands, particularly on New Georgia. Away from the salt-spray zone, in areas where surface solution is by fresh water, the dissection is less extreme. In the most dissected salt-spray champignon the holes and pinnacles may have a vertical amplitude of more than 1 foot, with comparable diameters; in the freshwater zone this is infrequent, and the surface dissection grades towards a broken scoriaceous or honeycomb character. Champignon is generally devoid of surface soil, except for thin sandy deposits on the floors of some potholes (Plate 13).

Solutional processes on platin operate on two levels. Though gradients are gentle, the platin has a local relief of up to 6 feet, and the surface consists of many local surface-drainage basins centred on solution pans. Many of these

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[1] The term 'pothole' is usually used for mechanically-scoured features formed by fluvial action (Baulig 1956, 106); the term as used here is synonymous with 'solution cup' and is used descriptively (Baulig 1956, 61-62).

dry out during the dry season (Plate 27), and even the largest are considerably reduced in size (Plate 24). Flamingo Pool, the largest, has a dry season diameter of about 200 yards. All are freshwater, as shown by their molluscan and crustacean microfauna; and it is clear that during the wet season these pools expand, some perhaps coalesce, and large areas of platin are covered by up to 2 feet of water. This is demonstrated by the solutional undercutting of limestone residuals between the pools, and by the distribution of shells of the freshwater mollusc Bulinus, found 1.5-2 feet above the general platin surface, lodged on limestone residuals. The gross topography of surface dimpling associated with these pools is probably solutional, though solution may be a discontinuous process. Several pools, during the dry season, are surrounded by ramps of mammillate limestone, samples of which show depositional layering. Clearly solution during the rains is followed by marginal deposition as pools dry out. Most of the surface drainage is local and unintegrated; only near Cinq Cases is there any sign of a short, semi-permanent drainage line leading to a central sink (Plate 23), though such features may be more widespread during the wet season.

The second platin solution process is small-scale and local. In areas of flat surface, lacking drainage systems, rainwater may stand for days after falling. By processes not yet studied, these rainwater pools are able to etch the limestone surface by solution, and gradually become incised, and bounded by cliffets showing pronounced basal solution-notching (Plate 16). Most of these incised pools are not more than 6 inches deep, though the deepest was more than 1 foot, and most are a few yards in maximum dimension. The floors are absolutely smooth, thinly-coated with a film of cream-coloured sediment, and strongly contrasting with the rougher grey surface of the interpool areas. The striking flatness of the platin results partly from the final smoothing by this process of the dimpled surface formed by the main solution pans (Plate 15).

3. Origin of Aldabra Landforms

Fryer (1911, 405-407) distinguished three main rock-types at Aldabra: the peripheral elevated reef, exposed in the sea cliffs; the champignon rock, which he termed a metamorphosed limestone; and the platin, which he considered a detrital limestone. He noted the abundance of reef corals in the position of growth in the sea cliffs, and deduced that these constituted an uplifted atoll reef. He drew attention to the freshness of many of the corals: on the surface near the cliffs there are many beautifully preserved Tridacna shells in the position of growth, with open valves, which, with the corals, suggests a relatively recent date for the emergence. The platin rock he considered to be a back-reef deposit, mainly of clastic sediments with molluscs and foraminifera, formed as a reef-flat deposit in the lee of the eastern reef and subsequently uplifted with it. The distinction between the elevated reefrock and the champignon rock was less clear, and Fryer considered the champignon rock to be a phosphatised reefrock. In Fryer's view, the morphology of Aldabra is the result of relatively minor solutional modification of a reef topography formed before the elevation of the atoll, and this interpretation superseded Voeltzkow's (1902a) thesis, influenced by Murray's theory of atoll formation, which laid stress on the uplift of a bank of deeper-water foraminifera coated by corals.

Fryer's interpretation neglects several geomorphic features which indicate a more complex history, as Fryer himself realised in his account of Ile Esprit (1911, 407-408). The platin surface of South Island is not simply a slightly modified depositional surface, but has undergone considerable vertical erosion. Following uplift of both platin and champignon, vertical solution holes are formed, and fine brown residual sediment is washed into them and ultimately lithifies. This brown pipe-limestone is much more resistant to solutional erosion than the surrounding white limestone, especially in the platin, and it weathers out to form stacks or pillars on retreating cliffy coasts, where it is morphologically identical with similar pipe-limestones studied in the British Solomon Islands. The pipe-limestones are also exposed by vertical erosion, and the flat surface of the platin is interrupted by massive irregular blocks of brown pipe-limestone 3-6 feet high, and in some cases 6-9 feet in diameter (Plates 18 and 19). The surfaces of the residuals are furrowed by solution lapies, and near the freshwater pools they may be solutionally undercut. With the open vegetation, the resemblance of the pillars to termite mounds gives the platin landscape a distinctly African savanna landscape appearance.

The residuals show that in spite of the flatness of the platin surface, the main platin surface is erosional, and the original surface must have been at least 6 feet higher and probably more. Over much of the platin, this would bring it closer to the level of theperipheral champignon. The residuals themselves must be distinguished from isolated patches of champignon within the platin area: these may stand up to 5 feet above the general platin surface, and have a typically scoriaceous surface. They are interpreted as patch reefs on the former reef flat, and demonstrate the original topography was itself irregular. Since the solution of these isolated champignon patches is purely by fresh water, their dissection is less extreme than on the coastal champignon.

The character of the platin surface is highly variable, with facies changes in the back-reef deposits. Generally the surface is strongly lithified, and weathering is taking place by spalling or exfoliation of large but thin slabs of rock, which ring musically when walked over (Plates 15 and 17). This process, which is more characteristic of igneous rocks, has also been observed at Rangiroa Atoll, Tuamotu Archipelago (Stoddart, in press), and in the northern Marshall Islands (F. R. Fosberg, personal communication), but the processes causing it are not fully understood. At another location on the platin, where the superficial deposits contained marine mollusca, it was found that these were weathering out of a loosely cemented coquina. It should ultimately be possible to map these facies zones in the back-reef area.

If the hypothesis of at least six feet of vertical downwearing is accepted, certain difficulties remain. The flatness of the platin surface and its level above mean sea-level are problems. It is also implied that in the past solutional downwearing has proceeded rapidly on platin, though at present these processes are slow, and in places deposition is taking place; whereas on the champignon, which is the area of deepest and most intricate dissection, it is argued that least downwearing has occurred. Complete explanation of these anomalies is not yet possible. In the case of the platin, we need to know the relationship between its near-equilibrium surface and tidal levels. In the case of the champignon, it is known that fresh rock exposures are less resistant than older ones, and it may be suggested that the most intricate dissection of champignon takes place

rapidly after exposure, and that case-hardening then decreases the rate of solution and protects the surface.

Fryer himself emphasised the anomalous character of Ile Esprit, in the lagoon. Here a complex topography of pinnacles and depressions with a vertical relief of up to 18 feet resembles in miniature a tropical Kegelkarst (Plate 14). The central part of the island is formed by a relatively undissected ridge rising to more than 30 feet. The island is composed of shelly limestone overlain by cemented limesands, with vitreous brown cavity fills. Fryer interpreted the whole as a lithified homologue of the soft sediments in the large tidal solution basin on West Island, the implication being that the reefrock surrounding these pan sediments, to a height equal to at least that of the highest part of the island (30 feet), has been eroded away. Comparison of the shell limestone and limesands, with the vitreous cavity fill, which Baker (1963, 109) found to have a phosphate content of 35-40 per cent, and the normal pipe-limestone of other parts of the atoll does not convince that they have a similar origin. The height of the Esprit ridge, approximately 15 feet higher than any other solid rock on the atoll, requires explanation. It is possible that the original uplift of the atoll was not less than 30 feet, and that Esprit is the last remnant of a widespread lagoon fill; but in this case the horizontal bevelling of the marginal cliff tops at about 15 feet presents an additional problem.

While in detail the morphology of the raised reefs is complex, therefore, and their history incompletely known, the two major controls are seen to be lithology and type of solution. The elevated coral limestones, with their coarse honeycombed structure and high permeability, lend themselves to deep and intricate dissection and the formation of sinkholes which may coalesce to form larger features. The fact that champignon dissection is most extreme near the sea indicates that salt spray is a powerful agent of solution. In the finer-grained, less permeable, back-reef deposits forming the platin, the original honeycomb structure is absent, and the solutional depressions formed by fresh water are broad, shallow features. Where patch reefs formerly existed on the platin, however, a modified form of champignon surface is formed, with freshwater solution giving a scoriaceous surface rather than deep honeycombing.

The land area is actively decreasing, by retreat of both the seaward and lagoon cliffs, forming wider seaward intertidal platforms and a larger lagoon. By measuring the rate of solution retreat of the cliffs, it should be possible to calculate the rate of formation of the seaward intertidal platform. Assuming (a) a mean width of 200 yards for the platform, and (b) a period of 5,000 years since sea-level reached its present level in the Holocene, suggests a rate of seaward cliff retreat of 1 yard in 25 years, if the platform is formed by cliff retreat wholly in the Post-glacial. This rate is probably excessive in view of the measured rates of notch formation, averaging 1 mm per annum, in other parts of the world: Aldabra would form an excellent location for field studies of limestone solution rates.

3. FLORA AND VEGETATION

The first botanical collecting at Aldabra was that of Abbott in 1892 (Baker 1894). Voeltzkow's collections made in 1895 were studied by Schinz (1897; also Voeltzkow 1902b). Further collections were made and reported by Dupont

(1907, 34-41, and later), by which time at least 100 species of flowering plants had been recorded. Fryer's account (1911, 414-416) includes the first detailed ecological notes, and his collections, together with those of W. Fox, who visited Aldabra in 1916, were worked up, with all the earlier material, in W. B. Hemsley's "Flora of Aldabra" (1919; also Hemsley 1916, 1917), which remains the standard reference. Christensen (1912) noted a single pteridophyte; and Vesey-FitzGerald (1942) added useful ecological notes on the vegetation. A further collection of 55 numbers, including 45 species, was made in 1966 and has been identified at Kew.

The flora is thus relatively well known. Hemsley's flora contains 173 species of flowering plants recorded from Aldabra, together with a number of common atoll species recorded from nearby islands, which might also be expected to occur at Aldabra, but which had not then been collected there; a few additional records were obtained in 1966. Of this total he considered 68 to be indigenous, in the sense of not being artificially introduced by man; and this compares with figures for the indigenous floras of the Chagos Archipelago of 49 species and the Maldive Islands of 87 species. Of the 68 species, Hemsely considered 18 to be endemic to Aldabra itself (forming about 10 per cent of the total flora), and 13 to be confined to the Aldabra group (Assumption, Cosmoledo, Astove, St Pierre, Gloriosa). Of the rest, 18 species are Madagascan, and 11 are East African; and the flora is thus clearly related to that of the nearby continental areas. Table 2 lists the strict endemics and Table 3 the group endemics recorded by Hemsely (1919); no attempt has been made to revise nomenclature.

Table 2. Endemic species in the Aldabra flora

Capparidaceae
Maerua dupontii Hemsl.

Tiliaceae
Grewia aldabrensis Baker
Grewia salicifolia Schinz

Erythroxylaceae
Erythroxylon acranthum Hemsl.

Ochnaceae
Ochna fryeri Hemsl.

Leguminosae - Papilionatae
Tephrosia aldabrensis J. R. Drum. and Hemsl.

Leguminosae - Caesalpinioideae
Cassia aldabrensis Hemsl.

Leguminosae - Mimosoideae
Pithecelobium ambiguum Hemsl.

Rubiaceae
Oldenlandia sp. n. ? Hemsl.
Tricalysia cuneifolia Baker
Pavetta supra-axillaris Hemsl.

Compositae
Vernonia aldabrensis Hemsl.

Plumbaginaceae
Plumbago parvifolia Hemsl.

Oleaceae
Jasminum aldabrense Hemsl.

Amarantaceae
Apterantha oligomeroides C. H. Wright

Loranthaceae
Loranthus aldabrensis Turrill

Euphorbiaceae
Phyllanthus cheloniphorbe Hutch.
Acalypha fryeri Hutch.

Table 3. Group endemics in the Aldabra flora

Capparidaceae
Cleome strigosa Oliv.

Icacinaceae
Apodytes mauritiana Planch.

Plumbaginaceae
Plumbago aphylla Bojer

Asclepiadaceae
Secamone fryeri Hemsl.

Solanaceae
Solanum aldabrense C. H. Wright

Acanthaceae
Hypoestes aldabrensis Baker

Verbenaceae
Nesogenes dupontii Hemsl.
Clerodendron minutiflorum Baker

Euphorbiaceae
Euphorbia abbottii Baker
Acalypha claoxyloides Hutch.

Moraceae
Ficus aldabrensis Baker

Dioscoreaceae
Dioscorea nesiotis Hemsl.

Liliaceae
Asparagus umbellulatus Sieber

Less is known, however, of the distribution and ecology of the vegetation, apart from the broad outlines sketched by Fryer (1911), followed by Hemsley (1919), and amplified by Vesey-FitzGerald (1942). Vesey-FitzGerald distinguishes four vegetation types:

1. Mixed scrub (Fryer's open bush);
2. Pemphis thicket (Fryer's Pemphis bush);
3. Mangrove communities; and
4. Psammophilous associations (Fryer's shore zone);

to which a further category may be added,

5. Man-induced vegetation.

These vegetation types are closely associated with the morphological zones defined in Section 2(2). Mixed Scrub is found on platin, Pemphis thicket on champignon, psammophilous associations on beaches, dunes and coastal cliffs, and the mangrove communities on the lagoon margins. The species-composition of each type is known only imperfectly, however, and there is little information on internal variation within the types. Analysis is made more difficult by the lack of activity during the dry season, when many trees in the Mixed Scrub lose their leaves, and few plants are in flower anywhere on the atoll. This was the situation during the 1966 expedition. By contrast, flowering is reported to be rapid and widespread at the onset of the rainy season, in January, when more collecting needs to be done.

1. Mixed Scrub

The Mixed Scrub is especially variable, both in floristic composition and in density. At the east end of South Island, the scrub is most dense on isolated patches of scoriaceous champignon, and more open on the platin, particularly near the freshwater pools (Plates 15-18). A number of species, including Euphorbia abbottii and Thespesia populnea, appear to vary in frequency in different areas, but the most conspicuous segregation is that of the screwpine, Pandanus vandermeeschii, at pool margins (Plate 24). Though most of the trees in the Mixed Scrub are slender and shrublike, and less than 15 feet tall, the denser scrub is very difficult to penetrate and is devoid of directional indicators: when it is possible to climb a low tree, the pandans are excellent indicators of the location of freshwater pools. In terms of normal atoll floras, it is the Mixed Scrub which has the most unusual and African aspect, and many expected atoll species are absent, or, as in the case of the leafless vine Cassytha filiformis, rare. Taller trees are found only occasionally, and the massive Ficus and Calophyllum at the Takamaka pool are best known (Plate 22). On the more open platin the orange-tinged sedge Fimbristylis spathacea forms an irregular tortoise-cropped turf (Plate 16), with small brittle rosettes of Eragrostis sp. on bare rock in between. In addition to the sedges, the tortoises also crop the lower leaves of shrubs up to a maximum height of about 4 feet. Other grasses and sedges growing beneath the trees include Eragrostis riparia, Cyperus obtusiflorus, Kyllinga nemoralis, and Fimbristylis ferruginea.

Floristically the area of Mixed Scrub on West Island is similar to that on South Island, though probably with more introductions from the settlement. Plumbago aphylla and the vine Abrus precatorius, with its distinctive black and red seeds, were collected here in 1966, and leafless Euphorbia abbottii trees were common.

Acrostichum aureum, the only recorded fern, is widespread in the deeper clefts and sinkholes on South Island (Plate 23), both in the Mixed Scrub and in Pemphis thicket.

It is likely that when the Mixed Scrub is better known it will be considerably subdivided, and differentiated in terms of substrate and location.

2. Pemphis Thicket

Pemphis Thicket is named after its dominant, Pemphis acidula, a species widespread on uplifted reefs in the Indo-Pacific, but here extraordinarily luxuriant (though absent in the Seychelles). The thicket has a maximum height of about 15 feet, and though the trunks and branches of the Pemphis are slender they are extremely tough and grow in such profusion that penetration is difficult. Because of its association with the soil-less champignon, Pemphis Thicket occurs to seaward of the Mixed Scrub on South Island, and to a lesser extent along the lagoon shore. It covers most of the exposed rock areas of the other main islands, except for an area of Mixed Scrub at the south end of West Island, and clumps of Pemphis are found even on minute reefrock islets in the lagoon. On the northern side of the atoll, Pemphis is normally the first shrub met with at the cliff-top (Plate 2), and largely replaces the Scaevola-Tournefortia zone normally found in sandier habitats. Inland its dominance is reduced,

and Pemphis is found with many of the Mixed Scrub species, forming a thicket that is much denser than the Mixed Scrub itself, and in places a woodland in which Pemphis itself is rare. Mystroxylon aethiopicum and Ficus sp. are common in such areas on South Island, and Dracaena reflexa was collected in dense mixed Pemphis thicket on West Island near Main Channel. In these transitional areas, Pemphis is most dense round the margins of the larger sinkholes, where it may be almost impenetrable, except with extreme labour. Smaller flowering plants in potholes include the thorny Capparis galatea, with a conspicuous white flower, and wisps of Oldenlandia sp. Most of the rock surface beneath the shrubs is bare, with sparse and scattered clumps of Mariscus ligularis and Eragrostis riparia.

The flatness of the ground combines with the uniform height (10-15 feet) of the vegetation to make travelling except with a compass very difficult; and Wharton (1883, 77) gives a graphic account of the difficulty of traversing Pemphis-covered champignon when he states that "a walk in Aldabra is the most aggravating and slowest piece of locomotion I have ever engaged in: and nothing short of the patience, perseverance, and general disregard of time of the tortoise tribe can make it an agreeable residence. Some of my Negro sailors were sent into the bush to hunt for tortoises, and after three days' search brought back one . . .; but they returned nearly as guiltless of artificial clothing as their captive."

3. Mangrove Communities

The mangrove communities have been discussed by Fryer and Vesey-FitzGerald. Both agree on the zonation of the genera: Bruguiera and Ceriops at the head of creeks; Rhizophora (R. mucronata) on deeper mud in the creeks themselves; Avicennia (A. marina) on open lagoon flats subject to tidal flooding; and Lumnitzera in isolated inland depressions. It has been argued (Wharton 1883; Fryer 1911, 403, 409) that the lagoon mangroves are instrumental in eroding the lagoon margins, both by the mechanical effects of root growth in crevices, and by the chemical activity of mangrove mud. It can, however, be seen that the undercut lagoon margins and creek systems are morphologically similar whether mangroves are present or absent. Wherever mangroves were seen growing in intimate association with eroding cliff forms, there was no evidence of mechanical activity; rather the trees appeared to be growing in pre-existing holes. Fine carbonate sediment is certainly being formed, however, and the processes need examination. The main mangrove area surrounds the Bras Takamaka, at the southeast end of the lagoon, where it totals more than 3 sq. miles. Large areas also exist on West Island (0.6 sq. miles), and at the west end of South Island, opposite Iles Moustique (1 sq. mile). Many of the small lagoon islands have areas of mangrove. The mangroves seen in Bras Takamaka are low and open. Taller trees, up to 40 feet high, were seen on the lagoon side of Middle Island, where the mangroves perch precariously on the edges of limestone islands intersected by deep tidal channels. Tall mature mangroves were described on West Island by Dupont (1907), but there was no opportunity to see these in 1966. Half a century of exploitation for timber and bark must have severely modified the mangroves of West and nearby South Island, but no investigation could be made of this in 1966. Further damage is caused from time

to time by cyclones, and defoliation is described by Fryer (1908-9). The mangroves play an important part in the ecology of sea and shore birds at Aldabra.

4. Psammophilous Communities

Fryer's Shore Zone Vegetation, in which most of the plants are common pantropical or Indo-Pacific strand species, may be further subdivided in terms of habitat. Vesey-FitzGerald (1942) distinguishes a spray-zone community, dune scrub, and a herb-mat community. The spray-zone community itself varies with aspect. On the windward side of the atoll, from Takamaka to Point Hodoul, a narrow belt of blown sand at the cliff top is succeeded inland by a zone several hundred yards wide of bare rugged champignon. At the seaward edge of the Mixed Scrub community, most of the larger shrubs and trees are gnarled and dead, leaning away from the wind (Plate 20), and even Acrostichum, the leather fern, nestling in crevices, is shrivelled and brown. The living vegetation in this maximum exposure area consists of dwarf flowering plants (Sida parviflora, Portulaca quadrifida, Evolvulus alsinoides, Hypoestes sp., Lagrezia madagascariensis, Oldenlandia sieberi) and sedges and grasses (Eragrostis sp., Dactyloctenium pilosum) sheltered from the wind in potholes and crevices, with thorn bushes such as Solanum aldabrense and Capparis galatea in the larger holes. Many of the common strand species, such as Tournefortia, Scaevola, Suriana and Ipomoea are absent from this habitat.

In more protected conditions, from Point Hodoul towards Anse Cedres, the Mixed Scrub and Pemphis communities approach within 30 yards of the cliff-top, and form a hedge of Pandanus with occasional clumps of Scaevola sericea (Plate 1). The zone between the Pandanus and the cliff edge, intermittently carpeted with sand, is colonised by a sparse community of coarse tussock grass (Sclerodactylon microstachyum) with scattered low Scaevola and occasional Tournefortia. From Anse Cèdres westwards, the vegetation approaches within a few feet of the cliff edge and is dominated by Pemphis, with occasional Guettarda speciosa, Scaevola sericea and Tournefortia argentea; a distinct spray-zone community can hardly be said to exist.

No observations have been made on the south and west coasts of South Island. Most of the coast is presumably covered with dune scrub, with tall Sclerodactylon macrostachyum, low carpets of a Paspalum-like grass, and Scaevola and dwarf Guettarda, according to Vesey-FitzGerald (1942). A modified dune scrub is also found at the south end of West Island (Plate 9), where it is interesting that some of the dwarf flowering plants, such as Sida parviflora, are the same as those inhabiting potholes in the most exposed spray zone of the windward coast. Tall shrubs on these dunes include Azima tetracantha and Acalypha claoxyloides, together with the grasses Dactyloctenium pilosum, D. aegyptium, and Eragrostis riparia, the attractive blue-flowered Cleome strigosa, and Scaevola. Low fresh sand spits below the dunes are being colonised by the sedge Cyperus maritimus and seedlings of Scaevola and Tournefortia (Plate 12). The low dunes between Takamaka and Point Hodoul are occupied only by a turf formed by a Paspalum-like grass, and bunch-grasses (Plates 6, 7 and 8).

Vesey-FitzGerald adds a third community, the herb-mat community, found in the western Indian Ocean islands particularly beneath dense bird colonies, but this does not seem to have an Aldabra counterpart.

5. Man-induced Vegetation

To the vegetation types distinguished by Fryer and Vesey-FitzGerald is added the category of man-induced vegetation. In addition to the 173 species listed in his flora, Hemsley (1919) refers to a number of introduced economic species reported from Aldabra, including

Amaranthus tristis
Amaranthus gangeticus
Brassica nigra
Carica papaya
Gossypium barbadense
Ocimum canum
Ricinus communis
Lochnera rosea
Cocos nucifera.

Further species were added to this list in 1966.

Man-induced vegetation is of three main types: coconut plantation, Casuarina thicket and woodland, and village vegetation. Coconuts are only found in small clumps at the settlement on West Island (Plates 38 and 39); intermingled with other species to form a coconut thicket on Ile Michel; and reportedly also at some of the pocket beaches at the west end of South Island (e.g. Anse Mais). Clumps of tall Casuarina are found at Anse Cèdres (Plate 37), on both sides of East Channel, at Ile Michel, and on both sides of Main Channel, as well as at the settlement on West Island (Plate 40). They vary from open woodland with no undergrowth to dense thickets of broken trunks and saplings, though much of this damage observed in 1966 had resulted from a recent cyclone. Needles carpet the ground, obscuring the irregularities of the champignon and in places making walking dangerous, and apart from rare Scaevola and Tournefortia seedlings there is no ground vegetation. At the landward margin there is some invasion by tall spindly Scaevola and other plants, and the red flowers of the aloe-like Lomatophyllum borbonicum are in places conspicuous.

The introduction of coconuts and the spread of Casuarina date from the end of the nineteenth century. H.M.S. Fawn planted fifty coconuts at Ile Michel in 1878, together with Casuarina (Findlay 1882, 550). Active planting of coconuts by lessees began about 1880, and for some time was made a condition of the lease. Dupont in 1906 found about 1000 coconuts at the West Island settlement up to 25 years old, and the small pocket beaches at the west end of South Island were also planted at this time (Dupont 1907, 21). It is likely that the main Casuarina groves, however, already existed at the time of the Fawn survey. It is said that James Spurs, when lessee, went so far as to dynamite holes in the champignon in which to plant nuts, in his efforts to establish thriving coconut plantations (Anon. 1920).

Village vegetation includes cultivated plants, such as cotton and sisal, and cultivated trees, together with common pantropic weeds and cultivated decorative plants. Agave and Gossypium grow in the settlement itself, with thickets of Caesalpinia bonduc and taller trees of Moringa pterygosperma. Fruitbats were

seen in 1966 apparently feeding on the flower buds of Agave during the day time. There are also early reports of the cultivation of maize and tobacco. The common weed Stachytarpheta indica is found only at the West Island settlement, and near the abandoned fishing hut on the west side of East Channel. The most common decorative flowering plant, planted round most of the houses in the settlement, is Catharanthus rosea, in both white and pink varieties. Clearly human settlements are acting as foci for the introduction of alien species, though these have not yet made much progress against the native vegetation and are still sharply circumscribed.

The role of man and animals in controlling native vegetation needs study. Man has harvested mangrove for timber and bark since the 1880s (Dupont 1907, 23-24), but on a small scale. Tortoises and goats crop the lower vegetation, including grasses, sedges, and the lower leaves of trees and shrubs, particularly in the more open Mixed Scrub. Birds must have a considerable direct effect on leaves and branches, and an indirect effect on soils and the phosphorus cycle, particularly in the large Middle Island breeding colonies, and this too needs further study.

4. TERRESTRIAL FAUNA

In common with most island faunas, that of Aldabra is notably disharmonic, with many groups unrepresented, and with a degree of probable endemism in those which are; and it is notable for the survival there of forms unsuited to competition with introduced species, in which class the land tortoise is the outstanding example. It is difficult to discuss the biogeography of the land fauna at the present time: in many groups the taxonomy itself has been inadequately worked out; many groups at Aldabra have been collected only casually or not at all; and for those which are better known, particularly the insects and the land birds, so little work has been done in neighbouring areas that the biogeographic relationships and degree of endemism are uncertain.

1. Mammals

Mammals are represented in the native land fauna only by fruit-eating and insectivorous bats, which are also found in both the Seychelles and the Mascarene Islands. The fruit bat was collected by Abbott in 1892, and was described as an endemic species, Pteropus aldabrensis, by True (1893). This beautiful animal was seen during the day in 1966 on the branches of large Ficus trees at Takamaka Pool, though Fryer (1911, 416) states that "it never forms large gatherings on a tree during the daytime." The insectivorous bats are more widely distributed. Fryer names them as Taphozous mauritianus and Triaenops furcula, and Miller (1902) names one as Nyctinomus pusillus. The insectivorous bats are seen at dusk at the West Island settlement, and in the Casuarina groves at East Channel, where a specimen taken in 1966 has been identified as Tadarida pumila (= Nyctinomus pusillus).

2. Birds

The land birds, of which there are sixteen known resident species, are most numerous in the Mixed Scrub on the platin, and in Casuarina and coconut groves.

Benson (1967) considers that only one, the Drongo Dicrurus aldabranus, is a full species endemic to Aldabra, but at the same time only two of the native Aldabra land birds cannot be distinguished from other members of the same species in nearby areas (the Grey Heron Ardea cinerea cinerea and the Barn Owl Tyto alba affinis). Endemic subspecies are the Sacred Ibis Threskiornis aethiopica abbotti, the rail Dryolimnas cuvieri aldabranus, the nightjar Caprimulgus madagascariensis aldabrensis, and the fody Foudia eminentissima aldabrana, the last of which commonly occurs at the West Island settlement and in Casuarina woodland elsewhere. Good subspecies found on Aldabra and also on nearby reef islands are the little Green Heron Butorides striatus crawfordi, the Madagascar Turtledove Streptopelia picturata coppingeri, and the Souimanga Sunbird Nectarinia sovimanga aldabrensis. Aldabra also has less distinct forms of the kestrel Falco newtoni aldabranus, the Comoro Blue Pigeon Alectroenas sganzini minor, the Madagascar Coucal Centropus toulou insularis, the Madagascar Bulbul Hypsipetes madagascariensis rostratus, and the Madagascar White-eye Zosterops maderaspatana aldabrensis. Benson finds the land avifauna to be mainly of Madagascan origin, and suggests colonisation either via the Comoros or via Gloriosa and the islands to the east of Aldabra. For detailed consideration of the native land birds, and also of recent arrivals such as the Pied Crow Corvus albus, see the accompanying papers by Benson (1967) and Gaymer (1967): three species only are considered further here, on account of their susceptibility to human interference.

The White-throated Rail Dryolimnas cuvieri aldabranus (Gunther 1879) is almost flightless. Rails, many of them flightless, are found on islands throughout the world, though many of the insular populations have recently become extinct following the introduction of predators and increased human activity. Thus the rails of Laysan and Wake Island in the Pacific have both recently become extinct. Fryer (1911, 418) reported that the Aldabra rail "is generally distributed over the atoll, though it is scarce on Picard (West Island), and has generally been exterminated in the neighbourhood of Takamaka by the cats". Abbott (1893, 762) feared that the rail would soon be exterminated, "as their arch enemy, the cat, has already exterminated them from Grande Terre (South Island), and must sooner or later reach the other small islands of the group, where the rails as yet abound in great numbers". Voeltzkow (1897, 63) had found them plentiful and extremely tame. They have been recorded from Ile Esprit by Fryer (1911, 418) and from Ile Michel (Anon. 1920, Ch. 8, 9; Vesey-FitzGerald 1940, 487). Rails now exist on Middle Island, where they were seen in 1966, and on Polymnie (Bourne 1966), but they have disappeared from West Island. Abbott (in Ridgway 1895, 528-529) gives an account of their behaviour. Related birds formerly existed on Assumption, Cosmoledo and Astove, but have all become extinct in this century, and the flightless rail of Aldabra is now the last of the flightless birds of the Indian Ocean islands, a series which once included the dodo and the solitaire (Lorenz 1908, Hutchinson 1953).

The Sacred Ibis Threskiornis aethiopica abbotti, is conspicuous on South Island, particularly round the major freshwater pools, each of which has one or two birds (Plates 28 and 32, and illustrations in Nicoll 1908). At Takamaka it is still extremely inquisitive and has to be kept away from baggage, as described by Nicoll (1908, 121), but elsewhere it is less approachable. It is rare at the west end of the atoll, and was absent from West Island near the

settlement fifty years ago (Nicoll 1908, 119). Fryer (1911, 417) reported it on Ile Michel, and also described the destruction of eggs by the birds in a nesting colony on South Island (1911, 417-418). Gaymer found the sacred Ibis nesting at Takamaka (Plate 33). Because of its inquisitiveness it would undoubtedly suffer if the human population of Aldabra increased.

Another species in considerable danger is the flamingo, Phoenicopterus ruber roseus, which is not yet definitely known to breed, and which Benson (1967) does not consider to be distinct. Abbott in 1892 found a population of 500-1000 birds, in flocks of 20-60 individuals, on the south and east shores of the lagoon (Ridgway 1895, 529). Dupont (1907, 21, 23) reported numerous flocks of several hundred birds along the south side of the atoll, and he and Fryer (1911, 419) describe their flight and cries. More recently, Travis (1959, 202) noted "several small flocks" on the north side of the atoll, but the Bristol Seychelles Expedition suggested that there may be only 50 left, and that the survivors breed in the Bras Takamaka (Plate 36). It was not seen in 1966. Fryer collected the bird louse Esthiopterum subsignatum from this species in 1908-9 (Scott 1914).

Sea and other shore birds are numerous (Vesey-FitzGerald 1941; Benson 1967), and include both breeding and migrant species. Frigate birds (Fregata minor aldabrensis and F. ariel iredalei) and Red-footed Boobies (Sula sula rubripes) nest in great numbers in the mangroves of Middle Island, where the former are concentrated towards East Channel and the latter near Johnny Channel, though the nests of both species are intermingled. Fryer (1911, 419) reported a nesting colony of frigates on West Island which has now disappeared. As is usual with this species the frigates parasitise the boobies, spending the day soaring on air currents to heights of a few thousand feet over the windward end of the atoll, awaiting the return of the boobies with food. Though no adequate observations could be made of these vast colonies in 1966, it appeared that the number of frigates greatly exceed that of boobies. Several of the large freshwater pools on South Island are frequented by frigates, which dive continuously to drink, scooping up water from the surface in their beaks while still on the wing (Plate 29). Similar diving behaviour of frigates (in this case F. minor palmerstoni) has been reported from a freshwater pool on Canton atoll in the Phoenix Islands (Degener and Gillaspy 1955, 6). It is thought that the Aldabra frigate colonies serve as the major breeding ground for the frigates of the western Indian Ocean, and that a considerable non-breeding population may be scattered over this area (W. R. P. Bourne, personal communication). If an airfield were to be built at Aldabra, the frigates would clearly represent a major aviation hazard, similar to that of the albatrosses at Midway Atoll in the Pacific (Fisher 1966), and any control measures would have to take account of the fact that birds may continue to return to Aldabra to breed for several years.

Red and White-tailed Tropicbirds (Phaethon rubricauda rubricauda, P. lepturus lepturus) were seen nesting on the ground on lagoon islets near East Channel in 1966. Other very common sea birds include the Noddy Anous stolidus pileatus, breeding on lagoon islets (Ridgway 1895, 527), and fairy terns (Gygis alba monte).

Shore and wading birds are especially numerous, particularly in the lagoon at low water. Dimorphic egrets Egretta garzetta dimorpha, in both white and dark phases, are perhaps most striking; together with the Crab Plover Dromas

ardeola, the Turnstone Arenaria interpres interpres, the Sanderling Crocethia alba, the Grey Heron Ardea cinerea cinerea, and the Little Green Heron Butorides striatus crawfordi. For other records, see Benson (1967). The feeding behaviour of the shore birds on the lagoon flats and their dependence on the unstudied invertebrate fauna would repay detailed investigation.

3. Land Reptiles

The land tortoises of Aldabra form, with those of the Galapagos Islands, the only surviving native populations of this giant form. Most of the study of these reptiles has been made on museum specimens, often of doubtful origin, and until recently no work had been carried out on the Aldabra species in the field. On the basis of museum identifications, two species in the Linnean genus Testudo have been segregated for the Aldabra tortoises: Testudo daudinii Dum. and Bibr., on South Island, and T. elephantina Dum. and Bibr., on Middle Island (Rothschild 1915; see also Siebenrock 1904). Günther (1877) distinguished 4 species in the Aldabra group (i.e. Madagascar, Seychelles, and small islands in between) of giant land tortoises, 5 in the Mascarene group, and 6 in the Galapagos Islands; Rothschild (1915) found 7 (plus a possible 2), 8 (plus a possible 2), and 13 (plus a possible 2) in each group respectively. Williams in 1952 placed the Aldabra tortoises in one species, in the genus Testudo, subgenus Asterochelys, species Testudo gigantea Schweigger; with the Galapagos tortoises in the single species Testudo elephantopus (Williams 1952). In their revision of the Order Testudinata, however, Loveridge and Williams (1957, 225) place both the Aldabra and Galapagos tortoises in the genus Geochelone Fitzinger (Family Testudinidae, Subfamily Testudininae). They erect a new subgenus Aldabrachelys Lov. and Will. for the Aldabra tortoise, with the single species gigantea Schweigger (Plate 26). The specific name elephantopus is retained for the Galapagos tortoise, genus Geochelone, subgenus Chelonoidis (Williams 1952). Comparative field studies of South and Middle Island tortoises by the Bristol Seychelles Expedition at Aldabra failed to establish any differences between the supposed species (R. Gaymer, personal communication). Geochelone (Aldabrachelys) gigantea of Aldabra has close relatives in the Pleistocene and Recent of Madagascar and the Indian Ocean islands, and in the Eocene of the Fayum depression, Egypt (Williams 1952; see also Wermuth and Mertens 1961).

Figure 5, based on data in Rothschild (1915), maps the distribution of the Indian Ocean giant tortoises in the early eighteenth century, when, according to Rothschild, they extended from Madagascar to the Seychelles, the Mascarenes, and even to the Chagos Archipelago. In the early eighteenth century, tortoises were abundant on Mauritius, Réunion, and Rodriguez; but during the period 1750-1800 they became extremely rare, and had disappared before 1840. In the eighteenth century they were abundant in the Seychelles and some of the smaller islands of the south-west Indian Ocean; but they had disappared on the main islands and on most of the lesser ones by 1840, surviving only as semi-domestic animals in a few places. We have found confirmatory records in the literature of the former existence of giant tortoises on the small islands of Assumption, Astove, and Cosmoledo, as well as Aldabra; but not for Gloriosa, Farquhar, St Pierre, and Providence, which Rothschild also cites, though

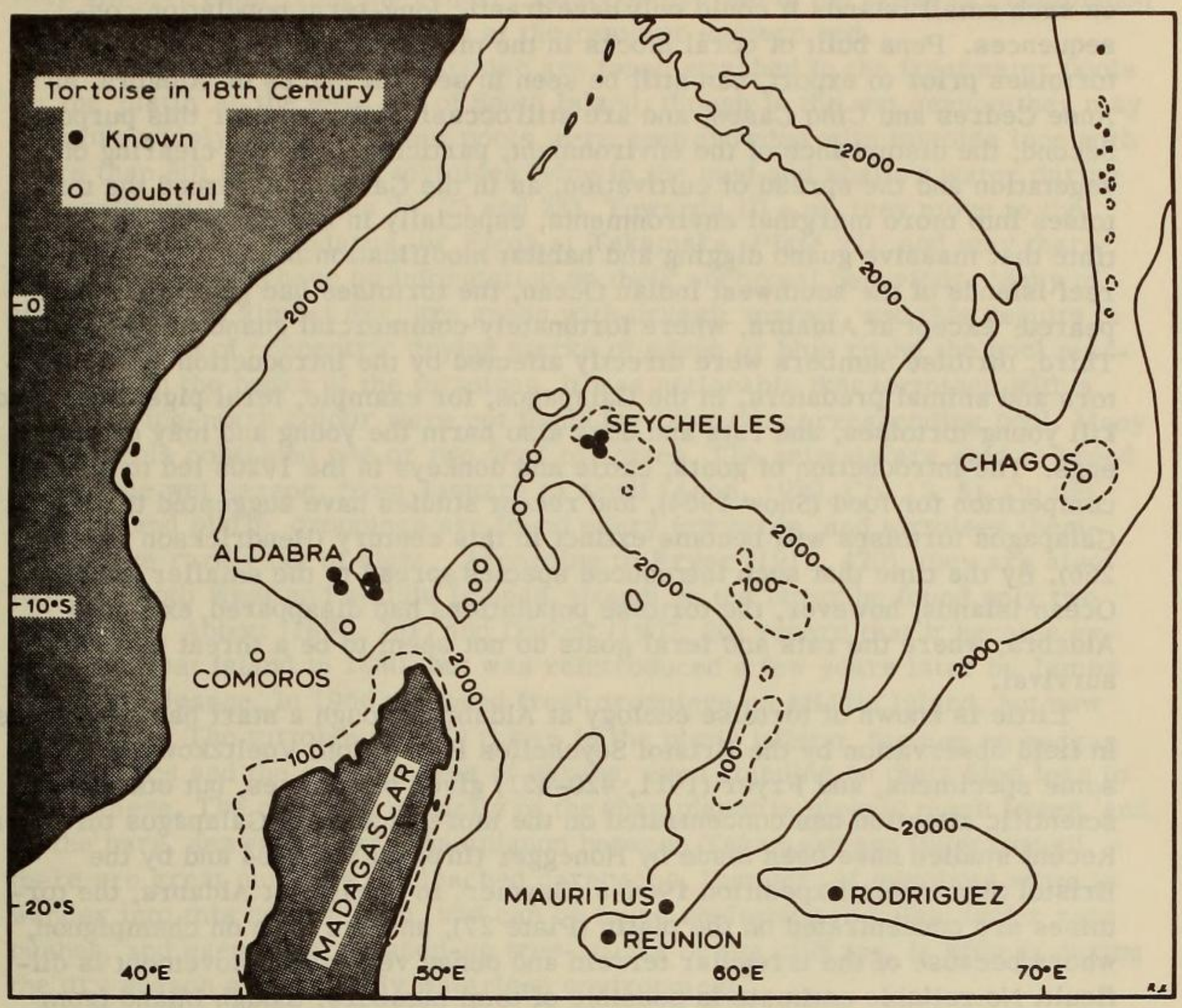

Figure 5.--Distribution of giant land tortoise in the eighteenth century in the Indian Ocean, after Rothschild (1915)

Coppinger in 1882 found seven giant tortoises imported from Aldabra roaming in the woodland on Providence (Coppinger 1883, 234). Nor can we find any record of wild populations in the Chagos Archipelago. These records are therefore marked as doubtful in Figure 5. The case of Providence is an example of the manner in which, as described by Rothschild, domestic herds were recruited from many different islands, and how transfer of wild tortoise took place from one island to another, thus making any detailed study of original variation impossible. Some of the Seychelles domestic tortoises, of unknown provenance, were released, for example, on the north and west islands of Aldabra (Rothschild 1915, 433).

The massive decline in tortoise numbers in the Malagasy Region seems to have resulted from many factors. Direct predation by man for food seems to have been considerable. Sauzier (1893) records exports from the Seychelles and Mauritius of more than 3000 tortoises in 1826, for example, and in 1847 two ships took 1200 tortoises from Aldabra alone (Rothschild 1915, 424; Voeltzkow 1897, 59; Parsons 1962 wrongly states that the animals were turtles). This trade was probably episodic; but with such a long-lived animal

on such small islands it could only have drastic long-term population consequences. Pens built of coral blocks in the nineteenth century, for confining tortoises prior to export, can still be seen in several places on Aldabra, as at Anse Cèdres and Cinq Cases, and are still occasionally used for this purpose. Second, the disturbance of the environment, particularly by the clearing of vegetation and the spread of cultivation, as in the Galapagos, forced the tortoises into more marginal environments, especially in the high islands. By the time that massive guano digging and habitat modification began in the smaller reef islands of the southwest Indian Ocean, the tortoises had generally disappeared: except at Aldabra, where fortunately commercial guano was absent. Third, tortoise numbers were directly affected by the introduction of competitors and animal predators. In the Galapagos, for example, feral pigs attack and kill young tortoises, and rats and dogs also harm the young and may destroy eggs. The introduction of goats, cattle and donkeys in the 1920s led to direct competition for food (Snow 1964), and recent studies have suggested that the Galapagos tortoises will become extinct in this century (Hendrickson 1966, 256). By the time that such introduced species spread to the smaller Indian Ocean islands, however, the tortoise populations had disappared, except at Aldabra, where the rats and feral goats do not seem to be a threat to tortoise survival.

Little is known of tortoise ecology at Aldabra, though a start has been made in field observation by the Bristol Seychelles Expedition. Voeltzkow collected some specimens, and Fryer (1911, 420-421) gives brief notes, but otherwise scientific attention has concentrated on the more accessible Galapagos tortoises. Recent studies have been made by Honegger (in press) in 1964 and by the Bristol Seychelles Expedition 1964-5 (Gaymer, in press). At Aldabra, the tortoises are concentrated on the platin (Plate 27), and are rare on champignon, where because of the irregular terrain and dense vegetation movement is difficult. No reliable estimate is possible of total numbers, though inland from Anse Cèdres, 57 were seen in a traverse of 1 hour in 1966, and 200 in less than 2 hours in a traverse between the lagoon and Takamaka Pool. Prosperi (1957, 201) suggested a total of 80,000 in 1953, and the Bristol Seychelles Expedition, from sample counts in three areas of South Island (at Anse Mais, with 360 tortoise in 3 sq. miles; at Takamaka, with 176 tortoise in 4.5 acres; and in another area of platin, with 8 tortoise in 19,200 sq. yards), and extrapolation on the basis of areas of platin and champignon shown on published maps, suggest totals of 30,000 tortoise on South Island, 3,370 on Middle Island, and perhaps several hundred on West Island (Gaymer, personal communication). From our observations in 1966, we would place the total at more than 10,000, but we would also stress the variability in habitat on South Island, and the need for caution in extrapolating sample counts, especially from lines of rapid traverse, which are likely to be the most open and hence most favourable locations. This order of magnitude contrasts strongly with the total of 1,000 estimated by James Spurs (Griffith, in Fairfield and others 1893, 153), and the general fear of imminent extinction and declining number in the second half of the nineteenth century. Wharton's sailors spent three days finding one tortoise in 1878 (Wharton 1883, 77). Fryer (1910, 258) comments that "it would be possible to live for years on Aldabra and never see a specimen." These reports may either indicate a spectacular increase in numbers in the last one hundred years, or

may simply result from the general rarity of tortoise in the areas of champignon and their concentration on platin at the remoter eastern end.

The greatest numbers of tortoise are found attached to the freshwater pools on the platin at the east end of South Island, though in the wet season they may be more widely-ranging. A few pools were seen crowded with tortoise (one with more than 80) in 1966, the tortoises lying in the mud and shallow water during the early morning (Plates 24, 25 and 28). Towards 10 a.m. they move to the shade of adjacent Pandanus, or Ficus at Takamaka (Plate 22), and stay there until sundown. We have no information on their nocturnal behaviour. Many of the pools, when almost dry, are green with organic matter, and this results in the formation of concentric drying marks of green or blue round the pool margins and on the backs of the tortoises. It was noticeable that tortoises with a given drying-mark colour were not found far from the corresponding pool. Many of the pools contained one or two dead tortoises. The animals are said to breed during the wet season, from January to April (Anon. 1920, Ch. 12, 8). On the South Island platin, droppings are found every few yards, and tortoises themselves are rarely out of sight. According to Fryer (1911, 420), they are also found on both West and Middle Islands, though on the latter he found only two specimens. Abbott (1893, 761) and Dupont (1907, 20) record that it became extinct on West Island in 1880, but was reintroduced a few years later by James Spurs, the lessee. In 1966 we found fresh droppings on Middle Island, but saw no tortoise. The tortoise clearly thrive in the platin habitat, feeding on sedges and grasses and the lower leaves of shrubs, even standing on their hind legs to reach these. The carrying capacity of the champignon is clearly much lower, and on the bare, seaward-coast champignon between Takamaka and Point Hodoul there are great numbers of bleached carapaces. Numbers of tortoises seem to wander into this barren area, and can be found sheltering in holes, under rare bushes, and even under washed-up tree-trunks on the cliff top, in what is during the dry season a completely waterless environment.

The conservation of the tortoises is discussed in Section 6(3)(a).

Aldabra has no snakes and no amphibians, and apart from the tortoises the land reptiles are represented by only two geckos and a skink. The geckos are Hemidactylis mercatorius (the H. gardineri of Boulenger 1911) and Phelsuma abbotti abbotti (the P. madagascariensis abbotti of Boulenger 1911 and Stejneger 1893). Hemidactylis is also found on Astove, Assumption and Cosmoledo (Honegger 1966b); Stejneger (1893) recorded H. mabouia from Aldabra, but Boulenger (1911) considered this to be identical with his H. gardineri. Phelsuma abbotti abbotti is also found on Assumption, and forms part of a series of species and subspecies of this genus in the southwest Indian Ocean, with P. abbotti menaiensis and a possible undescribed subspecies on Cosmoledo and P. astriata astovei on Astove (Mertens 1962, Honegger 1966b; also Boettger 1913). In 1966 we observed Phelsuma in symbiosis with the tortoises on South Island, running on the carapace and feeding on the Aedes mosquitoes which congregate round the soft neck and underparts of the tortoise; and a similar observation has been made by Honegger (1966b, 31). The skink Ablepharus boutonii peronii (Boulenger 1911) is of a species also found on Astove, Cosmoledo and Assumption.

4. Insects

By contrast the fauna is particularly rich in insects, especially by comparison with other Indian Ocean islands. While the Seychelles have more than two thousand species of insects recorded, none of the coral islands of the western Indian Ocean has more than one hundred, with the exception of Aldabra, which has more than 360 (Scott 1933, Legrand 1965). While this partly reflects the intensity of collecting by Abbott, Voeltzkow, Dupont, and especially by Fryer, himself an entomologist, it is also the result of the larger size and habitat diversity of Aldabra compared with the other coral islands, and also of its proximity to Madagascar.

The largest group represented is the Order Lepidoptera. After the Percy Sladen Expeditions there were 66 species recorded, with 7 endemics. Legrand's (1965) recent monograph, including the results of his own collecting together with that of the Italian Zoological Expedition of 1953, adds many new records of Microlepidoptera and increases the total to 127 species, 35 of which are endemic (about 28 per cent), and of which 12 are represented by endemic subspecies. The Order Coleoptera is represented by 93 species, of which 16 are thought to be endemic (about 25 per cent): three of these endemic species belong to endemic genera (Keeta, with two species, and Bikasha, with one: Maulik 1931). Other well-represented orders include the Diptera, Hymenoptera and Orthoptera. Scott (1933) gives biogeographical comments on each order, and Table 4 keys the entomological literature of Aldabra. Apart from cosmopolitan species, the insect affinities are dominantly Madagascan or East African, with few Oriental or Mascarene forms. Most of the possible endemic species are close to Madagascan forms, though so little is known of insect faunas in the Indian Ocean that Scott himself prefers the term "potential endemic" for species so far recorded nowhere else. The Aldabra insect fauna thus contrasts strongly with that of the Seychelles, which is dominantly Oriental in character (Scott 1933).

Apart from the species lists there is almost no information on the ecology and distribution of the insects of Aldabra, and the differences between the faunas of the champignon, platin and mangrove habitats. Information is also required on the insects associated with the large bird colonies.

Particular interest attaches to the mosquitoes of Aldabra because of the potential danger of malaria, which in fact occurred at Aldabra in 1908 and in 1930. Fryer collected Aedes aegypti (A. fasciata) at West Island, and Aedes albocephalus (Reedomyia seychellensis) and Aedes fryeri (Culicelsa fryeri) at Takamaka (Theobald 1912), the latter also taken by Dupont. Mattinly and Brown (1955) also record Culex sitiens Wied., collected by Dupont in 1907. Anopheles gambiae has been collected only once, in 1930 (Hermitte 1931), at the time of the malaria outbreak. This mosquito was then breeding only in small rainwater pools in West Island, and does not seem to have survived. In 1966 we took only A. fryeri.

Two species of horseflies taken in 1966 have been identified as Aegophagamyia remota and Neavella albipectus.

Table 4. Key to the Literature on the Insects of Aldabra

THYSANURA and COLLEMBOLA
- Carpenter 1916

ORTHOPTERA
- Bolivar 1912
- De Saussure 1897
- Linell 1893

DERMAPTERA
- Burr 1910

ISOPTERA
- Holmgren 1910
- Wasmann 1897

EMBIOPTERA
- Enderlein 1910

ANOPLURA
- Scott 1914

ODONATA
- Calvert 1898
- Campion 1913
- Linell 1893

HEMIPTERA
- Bergroth in Voeltzkow 1920b
- Distant 1913, 1917
- Green 1907
- Linell 1893
- Mamet 1943

NEUROPTERA
- Needham 1913

LEPIDOPTERA
- Aurivillius 1909
- Berio 1956, 1959, 1962
- Bourgogne 1963
- Fletcher 1910a, 1910b
- Fryer 1912
- Hampson 1908
- Herbulot 1962
- Holland 1895
- Karsch 1900
- Legrand 1965
- Meyrick 1911
- Viette 1958

COLEOPTERA
- Aurivillius 1922
- Bernhauer 1922
- Champion 1914
- Fairmaire 1896
- Gebien 1922
- Grouvelle 1913
- Kerremans 1914
- Kolbe 1902
- Linell 1897
- Maulik 1913
- Régimbart 1900
- Schenkling 1922
- Scott 1912, 1913, 1922b, 1926
- Sicard 1912

HYMENOPTERA
- Cockerell 1912
- Forel 1897, 1912
- Friese 1902
- Meade-Waldo 1912
- Turner 1911

DIPTERA
- Eaton 1913
- Edwards 1912
- Hermitte 1913
- Kertész 1912
- Lamb 1914, 1922
- Linell 1893
- Mattinly and Brown 1955
- Scott 1914
- Stein 1910
- Theobald 1912

5. Other groups

Little can be added on the other terrestrial groups to the results of collecting by Abbott, Voeltzkow, Dupont and Thomasset, and Fryer. The land crustacea have been reported by Rathbun (1894), Lenz (1905), and Borradaile (1910), who listed 17 species in 10 genera. The brachyuran decapod crustacea have recently been revised by Guinot (1964), using the collections made by Cherbonnier in 1954. She lists 33 species in 21 genera, including one new to science (Xanthias cherbonnieri). The land crustacean fauna is remarkable chiefly for the presence of the robber crab, Birgus latro, which is also reported from the Chagos Archipelago but is absent from the Maldives: clearly on Aldabra it cannot feed on coconuts. Cardisoma carnifex is common round the freshwater pools of the platin. There is a single earthworm (Ehlers 1897); a common scorpion (Isometrus maculatus, Hirst 1913); and several spiders (Hirst 1911), one of which, Nephila madagascariensis, is particularly prominent in the Mixed Scrub of the South Island platin, forming a large and strong web.

There is an inadequately known land molluscan fauna, which includes one endemic species, Rhachistia aldabrae (Von Martens, in Von Martens and Wiegmann 1898, 28, as Buliminus (Rhachis) aldabra), collected by a Mr Wilson in 1895. Other records listed by Connolly (1925) are Gulella (Molarella) gwendolinae, Gastrocopta tripuncta, Succinea mascarenensis, Isodora forkali, Assiminea punctum, A. parvula, and Truncatella valida. The microfauna is particularly poorly studied. In 1966, for example, we found a rich freshwater microfauna in the drying platin pools, including crustaceans (fairy shrimps Streptocephalus sp., conchostracans Bulimnadia sp., and ostracods Heterocypris sp.) and molluscs, including a species of Bulinus. We also obtained a semi-freshwater fish of the widespread gobiid genus Tamanka from the freshwater well at Cinq Cases: this was the first record of a freshwater fish from the atoll.

5. MARINE BIOTA

1. Turtles

The marine biota of the Aldabra group of islands is best known for its turtles: Aldabra, Cosmoledo and Assumption support "the greatest concentration of breeding turtles in the Indian Ocean in modern times, and perhaps in antiquity" (Parsons 1962, 47). It is, therefore, extraordinary that no field study of these turtles has ever been carried out, and that the available information is largely based on local reports and hearsay set down by infrequent visitors.

The green turtle, Chelonia mydas L. (Loveridge and Williams 1957, 472-484; Parsons 1962), is by far the most important on Aldabra, though it is now rare as a breeding species on Cosmoledo and may have vanished from Assumption. The hawksbill, Eretmochelys imbricata L., taken for its shell, is found in much smaller numbers, and at Aldabra has a distinctively lighter shell than elsewhere in the Seychelles, as a result, according to Fryer, of the muddiness of the lagoon. The loggerhead, Caretta caretta L., is also thought to occur, but does not seem to have been positively identified. Hornell (1927) draws attention to the fact that not only is the distribution of the hawksbill and the green turtle reversed (the former being abundant in the Seychelles and rare at Aldabra, and

vice versa), but also that their breeding seasons alternate. The hawksbill breeds from September to November, and comes up the beaches during the day; whereas the green, a nocturnal egg layer, lays from February through to September. Hornell believes that the green turtle appear from their feeding grounds, presumably in the Mozambique Channel, from December onwards, and begin to lay in February, perhaps in two groups of different origins (the main group in February-March, and a subsidiary group in May-September). However, there is no month in which turtles are not coming up the beaches to lay (Hornell 1927, 31). The numbers of turtles were declining rapidly by the end of the last century (Spurs 1892), and Hornell forecast ultimate extinction if exploitation continued under the lessee system without any attempt at conservation. Considerable losses of newly hatched green turtles were also said to have been caused by predation by herons and frigatebirds (Hornell 1927). Voeltzkow (in Boettger 1913) suggested that 3000 a year were lost in this way. Later surveys in 1948-49 (Wheeler 1953b) and more recently (Veevers-Carter 1962; Newman 1965; Gaymer 1966c) have shown that the decline in numbers has continued, though this is not precisely documented. Conservation measures and their results are considered in greater detail in Section 6(3)(b). Field studies to establish the status of the marine turtles at Aldabra and nearby islands are urgently required.

2. Other groups

Apart from the turtles, little is known of the marine biota, which does not appear to be rich. Voeltzkow made a small collection of marine fishes (Jatzow and Lenz 1899), echinoderms (Ludwig 1899), corals (Doederlein 1901), and marine mollusca (Thiele 1902, 244-246), but only the latter were at all thoroughly collected, and the fauna was typically Indo-Pacific. Travis (1959, 159-166, 182-188) draws attention to the abundance of Turbo on the forereef slopes on the east and south sides of the atoll, and this species is also found on the reef-flat boulder zone. The coral fauna appears curiously poor, by comparison with the period when the reef limestones were formed; so much so that Gardiner (1936, 426) drew a distinction between the decadent and eroding reefs of the Mascarene region, including Aldabra, and the flourishing, growing reefs of the Maldives and the Chagos. This conclusion is supported by Stoddart's own observations at Aldabra and in the Maldives. Apart from the forereef slopes, reef corals are only actively growing on the margins of the two main channels into the lagoon, and these are mostly massive slow-growing species: a few are listed by Matthai (1914, 1928). Fryer's small collection of marine algae was named by Madame Weber-van Bosse (1914). The commercial fishery potential of Aldabra was investigated by the Mauritius-Seychelles Fisheries Survey in 1948-49, and found to be disappointing (Wheeler and Ommanney 1953; Wheeler 1953a). The invertebrate fauna of the lagoon, which is almost entirely unstudied, must be considerable to support the large numbers of shore birds.

6. SETTLEMENT, EXPLOITATION, AND CONSERVATION

1. Human Settlement

The early history of human settlement at Aldabra is obscure. Voeltzkow (1897) summarises early knowledge, mainly from the charts in A. Grandidier's Atlas der Karten von Madagascar, from the sixteenth century onwards. Aldabra did not become well known until the middle of the eighteenth century, when Lacaze Picault and Jean Grossen called there in the Charles and the Elizabeth in 1742 (Findlay 1882; Keller 1901). According to Horsburgh (1852, 174-176), Aldabra was visited in August 1756 by a "Mr Morphey" (Nicolaus de Morphy), in November 1766 by the ship Asia, and in December 1815 by the Lord Castlereagh. Commander R. Moresby passed close by in August 1822, but did not land. Aldabra was visited in 1841 by Captain Jehenne in the ship La Prévoyante (Voeltzkow 1897, 41). The ship Euphrates, out of London for Karachi, anchored in the lagoon in 1862. At a much later date the German cruiser Königsberg hid in Main Channel for two months in 1915, before being destroyed by English warships on the African coast.

The atoll was apparently uninhabited in 1878, when H.M.S. Fawn, Commander Wharton, carried out the first hydrographic survey. In 1879, however, an attempt was made to settle by a party of 27 adults and 13 children, all Norwegians from Bergen, who arrived via Nossi-Bé to found a fishing station on communistic principles (Anonymous 1879; Reclus 1889, 155). The fate of this scheme is unknown. Shortly afterwards it was decided by the Government of Mauritius to exploit the atoll by leasing it commercially for a small annual rent. The first lease was allotted to Jules Cauvin of Mahé in 1888. Cauvin established a settlement at Ile Magnan in West Channels, where he planted coconuts while exploiting timber. In 1890 the lease passed to James Spurs, at a rent of Rs. 500 per annum, and he held it for ten years, moving the settlement to Ile Picard or West Island, its present site. Spurs had worked for many years as a manager at Diego Garcia in the Chagos Archipelago (Scott 1961, 165-169). The Administrator of the Seychelles considered that "the Government are fortunate in having secured Mr Spurs for a tenant; for it will be gathered from his report . . . that he is an observant man and a lover of Nature, nor do I think he is likely, to use an old and homely phrase, to kill the goose that lays the golden eggs by exhibiting that rapaciousness which has characterised the actions of others who have been there before him" (Griffiths, in Spurs 1892, 45). Nevertheless, Spurs proposed to take up to 12,000 green turtle a year from Aldabra, for what was then a "trifling" rent. He did, however, attempt to repopulate West Island with tortoises, warned of the disappearance of the hawksbill and of the consequences of taking many more female than male green turtles, and even brought Chinese to Aldabra from Mahé to make trepang. By the time of Voeltzkow's visit in 1895, there was a settlement at West Island of 20 Seychellois labourers in ten houses, growing maize and vegetables, and taking turtles and tortoises (Keller 1901; and also Fryer 1910 for an illustration). The earlier settlement site at Ile Magnan, and the site at Ile Michel, recommended after H.M.S. Fawn's survey as "the only suitable place for building a house" (Findlay 1882, 550), had both been abandoned.

The lease passed in 1900 to Messrs Baty, Bergne and Co., at a rent of Rs. 3000 per annum, and the company concentrated on fishing rather than on timber; and also planted many coconuts (cf. Baty 1896). In 1904 M. D'Emmerez de Charmoy became the lessee, with James Spurs as his manager; and his administration became notorious for its wasteful and inefficient exploitation of the turtle industry (Hornell 1927). D'Emmerez was still lessee at the time of Fryer's visit in 1908-9; and the atoll was leased in this way until 1945, when commercial exploitation lapsed temporarily. The lease was renewed ten years later, when in 1955 M. Harry Savy of Mahé obtained a 30 year lease, with an option on a further 20 years. His company employs up to 100 labourers to work the atoll, under contract from the Seychelles for periods of up to three years. They live in well-built wood and cement houses on West Island, and are supplied by schooner from Mahé. Rainwater is supplied from three large tanks (Plates 39 and 40). The company salts and dries fish for export, cuts mangrove for timber, collects a limited number of giant tortoises for export, and also takes the green turtle, maintaining a large turtle pen on the northernmost island in West Channels. Aldabra is leased jointly with Cosmoledo and Assumption.

No guano or phosphate ever seems to have been exported from Aldabra. Fryer (1911, 407) drew attention to the presence of phosphate, and Baker (1963, 107-110) estimated reserves at about 1000 tons, being uneconomic to work. He found no evidence of rich guano previously reported in the Cinq Cases area. One of the Western Channels, Passes Lanier, may, however, be named after one of the leading Seychelles guano companies.

The further prospects for economic development at Aldabra seem unpromising. The areas of sandy soil suitable for coconuts are very limited, and there is no possibility of extending the coconut industry. The Mauritius-Seychelles Fisheries Survey gave a disappointing picture of Aldabra's fish potential (Wheeler 1953a). It was estimated that eight men could produce 70 tons, at first, of fresh fish a year from the lagoon, falling to a steady figure of 12-16 tons per annum; and that eighty men could produce 460 tons per annum outside the atoll. The possibility of exporting orchella as an organic dyestuff (Dupont 1907, 28-29) collapsed with the development of synthetic dyes.

2. Introduced Animals and Plants

In 1966 the introduced mammals of Aldabra included goats, dogs, cats, rats and mice. Voeltzkow recorded the presence of a feral cat, though his narrative does not make clear where it was seen (Voeltzkow 1897, 66), and also rats and mice, in 1895 (Lorenz-Liburnau 1899). Abbott (1893, 762) and Fryer (1911, 417) considered the feral cats to be confined to South Island, and though an unidentified observer in 1906 considered they were "everywhere" he only saw them on South Island (Anon. 1920, Ch. 9, 5-7). The cats are said (Anon. 1920, Ch. 9, 7) to have been introduced by James Spurs to control rats, and that Spurs rejected the suggestion that only one sex should be introduced. Both Abbott and Fryer stated that the feral cats had exterminated the flightless rail, at least in the Takamaka area. Two were seen near Frigate Pool, at the east end of South Island, in 1966. Feral dogs were heard barking on South Island in 1966, but were not seen; they are reported to number only two, and to be of the same sex.

Goats were introduced by James Spurs when lessee in 1890. Griffith (in Fairfield and others 1893, 154) states that they were brought from Cosmoledo, but we have found no other reference to goats on that atoll. According to Dupont (1907, 13, 22) they were brought from Assumption, where they had been introduced by a whaler in c. 1887, possibly from Europa Island in the Mozambique Channel (Abbott 1893, 763). According to Dupont, they were soon exterminated on West Island (Dupont 1907, 22), though they were again reported there in 1905 (Anon. 1920, Ch. 9, 2). They became feral on South Island. Travis (1959, 178-181) describes considerable herds on the southern dunes, but in 1966 only one small group of four individuals was seen on two occasions at the east end of South Island. Prosperi (1957, 198) records goats at the east end of Middle Island, but this must be an error, as they are not otherwise recorded there. The feral goats at Aldabra do not seem to have reached the status of major pests that they have become on other islands, and do not appear to represent a major threat to tortoise food supplies.

Rats are thought to be more active predators; they probably feed on frigate and booby eggs and young, and possibly also on tortoise eggs and young, though not to a serious extent. Domestic fowl are also kept at West Island, and have become feral.

Introduced plants include such cultivated species as maize, cotton, sisal, and probably coconuts, together with common weeds such as Stachytarpheta, but these are all limited to the neighbourhood of the settlement and cultivated areas.

Because of their poverty in genera and species, island ecosystems normally have low ecological inertia and are specially liable to catastrophic invasion by animals and plants (Elton 1958). It is therefore remarkable that the effects of introduced species at Aldabra have so far been so limited; though the possible effects of the spread of the major predators and competitors already present on South Island to other parts of the atoll must not be ignored. It is fortunate that the introduction of rabbits, hares, and cattle--all potential herbivore competitors for the tortoises--which was proposed by Dupont (1907, 32) to augment food supplies, never took place.

3. Exploitation and Conservation

The scientific importance of Aldabra was not realised until the latter part of the nineteenth century, after the disappearance of tortoises and rare land birds from the Mascarene Islands. When the Government of Mauritius first proposed to lease the islands for woodcutting, there was a considerable outcry, and several species are now protected by legislation. "Legislation is one thing," however, "and the enforcement of laws against fishermen on the open sea or in uninhabited places is another" (Griffith, in Spurs 1892, 44).

(a) Tortoises

Active conservation of the tortoises was begun by the letter sent to the Governor of Mauritius in 1874 by a group of naturalists which included Charles Darwin, Joseph Hooker and Richard Owen (Günther 1877, 20-21), when it was first proposed to establish a woodcutting colony on the atoll. Particular concern

was expressed over the "imminent extermination of the Gigantic Land-Tortoises of the Mascarenes". Even at that time it could be stated that "Aldabra is now the only locality where the last remains of this animal form are known to exist in a state of nature", and it was argued that

> "The rescue and protection of these animals is, however, recommended . . . less on account of their utility . . . than on account of the great scientific interest attached to them. With the exception of a similar tortoise in the Galapagos Islands (now also fast disappearing), that of the Mascarenes is the only surviving link reminding us of those still more gigantic forms which once inhabited the continent of India in a past geological age. . . . It flourished with the Dodo and Solitaire; and whilst it is a matter of lasting regret that not even a few individuals of these curious birds should have had a chance of surviving the lawless and disturbed conditions of past centuries, it is confidently hoped that the present Government and people . . . will find a means of saving the last examples of a contemporary of the Dodo and Solitaire" (quoted in Günther 1877, 20-21).

Leasing of exploitation rights on the islands proceeded, however, without legislation to protect the tortoises. For a number of years they were conserved by the private philanthropy of the Hon. Walter (later Lord) Rothschild, who entered into an agreement by which he paid one half of the lessee's annual rent (Rs. 1500 per annum of a total rent of Rs. 3000) on condition that the tortoises were rigidly protected. This agreement was first made with Messrs Baty, Borgne and Co., the lessees in 1900-04, and was later transferred to their successors (Dupont 1907, 15-16).

No protective legislation covering the tortoises was passed until recently (Lane 1953a, 1953b), although the species could have been scheduled (but was not) under the Wild Birds and Animals (Protection) Ordinance of 1906. Action was eventually taken (Proclamation 4 of 1961) under the Customs Management Ordinance, to prohibit the export of the giant tortoise from the Seychelles without the written authorisation of the Colonial Secretary (Statutory Instrument 7, 1961: Seychelles Gazette, Supplement, 13 February 1961, p. 40). There is apparently no legislation concerning the taking of tortoises from Aldabra, or the killing of tortoise on the atoll. The Governor of the Seychelles has powers, however, to "make regulations for the protection of wild animals" under the revised Ordinance to provide for the Protection of Wild Animals and Birds, No. 37 of 1961 (Seychelles Gazette, Supplement, 26 December 1961, pp. 163-165). Under the terms of the 1955 commercial lease (see Section 6(3)(d)), the lessee is required to protect the tortoises and not to interfere with them. The West Island settlers kill tortoise occasionally for food, and though the total annual loss may be quite high, it is by no means catastrophic. If any future development of Aldabra were to exclude tortoises from the platin, however, there would certainly be a considerable fall in numbers, and further protective legislation would be necessary.

(b) Turtles

Commercial exploitation of the turtles, mostly the green, began about 1906, though they had been taken less systematically for several years before this.

Fryer (1910, 260) regretted their "wasteful slaughter", which even then (1908-09) was resulting in a considerable decline in numbers (Fryer 1911, 421-423). In particular the practice of turning females on the beaches when they came ashore to lay had greater long-term effects on the population than that of harpooning males at sea, particularly when carried out early in the season. Hornell, commissioned to enquire into the state of the Seychelles turtle industry, reported that at Aldabra "the policy of the lessees cannot but lead to an early extinction of the trade" (Hornell 1927, 37). At this time the total number of green turtle taken from the islands of Aldabra, Assumption and Cosmoledo was of the order of 3000-4000 per annum. Hornell made specific recommendations for conservation and for the revision of original conservation legislation which dated from the beginning of the century (Ordinances 16 of 1901 and 2 of 1904). The new legislation (Ordinances 5 of 1925 and 5 of 1929) specified minimum sizes for both green and hawksbill turtles taken, prohibited the taking of buried eggs, barred the use of torches at night and the taking of turtle within 1000 metres of the high water line, and laid down control procedures (Lane 1953a, 114-120; 1953b, 195-200). The major recommendation which was not adopted was that for a close season from December 1 to the last day of February, during which no turtle might be taken. Hornell also proposed the control, at Aldabra, of frigate birds, herons, and the ibis, all of which (but especially the frigate) were said to kill large numbers of newly hatched turtle. Dupont (1907, 29) had previously proposed the extermination of frigates and herons by shooting and poisoning, for the same purpose, but neither proposal was fortunately accepted.

In spite of the legislation of 1925 and 1929, the numbers of green turtles continued to decline, and by the time of the Mauritius-Seychelles Fisheries Survey the number taken annually was less than 1500. Following this survey, Wheeler (1953b) again put forward Hornell's close-season recommendations, and these were adopted in Government Notice 452 of 1948. Under this, the close season, during which no green turtle might be taken at Aldabra or Cosmoledo, was defined from December 1 to the last day of February; and it was further made illegal to turn turtle on the beaches between March 1 and May 31 (Lane 1953a, 200-201). This last provision was designed to protect females during the earlier of their repeated egg-laying visits. Minor changes in this legislation were made by Ordinance 22 of 1957 (Seychelles Gazette, Supplement, 23 December 1957, pp. 64-66).

There has been no detailed work on the Aldabra turtles since the Fisheries Survey, but numbers of the green turtle continue to decline, and those of the hawksbill are now very low. A further revision of the Turtles Ordinance was made by the Female Turtles Protection Regulations, 1962 (Seychelles Gazette, Supplement, 23 July 1962, p. 44), in which the close season, during which it is made illegal to catch, kill, harpoon or otherwise take female turtles, is extended from December 1 to March 31. This originally applied to both the green turtle and the hawksbill on Aldabra, Cosmoledo, Farquhar, Providence and other islands; but the hawksbill was deleted in revised regulations later the same year (Female Turtles Protection (no. 2) Regulations, 1962: Seychelles Gazette, Supplement, 1 October 1962, p. 68). Subsequently, the use of underwater guns or other underwater equipment for taking the hawksbill was prohibited (The Hawksbill Turtle Protection Regulations 1963: Seychelles Gazette,

Supplement, 3 June 1963, p. 48); and this provision specific to the hawksbill was later revoked and added as an amendment to the Turtles Ordinance, prohibiting the use of underwater equipment for either the green turtle or the hawksbill (Ordinance 1 of 1964: Seychelles Gazette, Supplement, 9 March 1964, pp. 9-11).

Under the terms of the 1955 commercial lease, not more than 500 green turtles per annum may be taken on or within three miles of Aldabra, and none at all at Cosmoledo and Assumption, without written permission from the Seychelles Government, and no turtle eggs may be taken on any of the islands (Article 9(a)).

(c) Birds

Birds have long been protected in the Seychelles under the Wild Birds and Animals (Protection) Ordinance of 8 December 1906 and the Plumage Birds (Exportation) Ordinance of 21 February 1914. The former gave the Governor of the Seychelles powers to prohibit the killing or taking of any scheduled bird, or the taking of its eggs, with exceptions permitted for scientific or natural history purposes (Lane 1953a, 124-125). The schedule of birds thus protected (Wild Birds and Animals Protection Ordinance of 21 June 1941) included the following species at Aldabra (nomenclature revised; original nomenclature given in brackets):

Phoenicopterus ruber roseus	(Phoeniconaias minor)
Threskiornis aethiopica abbotti	(Ibis abbotti)
Phaethon lepturus lepturus	(Phaethon lepturus)
Alectroenas sganzini minor	(Alectroenas minor)
Dryolimnas cuvieri aldabrana	(Dryolimnas aldabranus)

(Lane 1953b, 204-205). The schedule of birds protected under the Plumage Birds (Exportation) Ordinance includes (by Proclamations 5 of 1914 and 1 of 1947), for Aldabra, all the above except Phaethon lepturus lepturus, together with:

Phaethon rubricauda rubricauda	(Phaethon rubricauda)
Streptopelia picturata aldabrana	(Turtur aldabrana)
Dicrurus aldabranus	(Buchanga aldabrana)
Zosterops maderaspatana aldabrensis	(Zosterops aldabrensis)
Caprimulgus madagascariensis aldabrensis	(Caprimulgus aldabrensis)
Centropus toulou insularis	(Centropus insularis)
Foudia eminentissima aldabrana	(Foudia aldabrana)
Nectarinia sovimanga aldabrensis	(Cinnyris aldabrensis)

(Lane 1953b, 193). All these protected birds are land birds except for the tropicbirds, the sacred ibis, and the flamingo. The Bird's Egg Ordinance of 1933, designed to protect the Sooty Tern in the Seychelles, and subsequently extended and many times revised (chiefly by the Collection of Birds' Eggs Regulations, 1957, and the Collection of Birds' Eggs Regulations, 1962: Seychelles Gazette, Supplement, 17 May 1957, pp. 25-26, and 4 June 1962, pp. 32-34), has never extended to Aldabra.

In 1961 the Wild Birds and Animals (Protection) Ordinance and the Plumage Birds (Exportation) Ordinance, under which all the above birds were protected, were both revoked, and replaced by a single Ordinance to provide for the Protection of Wild Animals and Birds (Ordinance 37 of 1961: Seychelles Gazette, Supplement, 26 December 1961, pp. 163-165). This Ordinance gives the Governor in Council power to "make regulations for the protection of wild animals and birds". In addition to the two earlier ordinances, all the proclamations under them were also revoked; so that presumably new schedules of animals and birds protected must be issued.*

Under the terms of the 1955 commercial lease, no birds' eggs may be commercially exploited, and the only birds which can be taken are crows and poultry.

(d) Conservation Prospects

Following the Darwin-Hooker appeal over the tortoises, and the gradual development of protective legislation for tortoises, turtles and birds, commercial exploitation of Aldabra on a small scale became accepted. The next major issue was in the early 1950s, when it was proposed to settle 1200 Seychellois, discharged from the Army Pioneer Corps in the Middle East, on the atoll, the last commercial lease having lapsed in 1945 and not having been renewed. Fosberg (1954) prepared a memorandum on the scientific importance of Aldabra, and the inadvisability of this step, and the proposal was dropped, probably as much on account of the inhospitable environment as for scientific reasons.

Following the visit of the Calypso to Aldabra in 1954, Commander J.-Y. Cousteau became interested in the conservation of the atoll, at a time when the commercial lease was about to be renewed. Cousteau's proposal to lease the atoll "as a wildlife sanctuary and . . . tropical research centre on an island almost uncontaminated by man" (Cousteau 1963, 149) was rejected, but his publicity in London (Cousteau 1963, and also Cousteau 1959) led to important conservation clauses in the commercial lease concluded between the Seychelles Government and Mr H. Savy, of Mahé, on 2 and 5 February 1955. Proposals for turning Aldabra into a commercial breeding ground for Chinese ducks were also rejected. The lease is for 30 years, with an option on a further period of 20 years. Article 5 of the lease states:

> "That the lessee shall respect South Island in the atoll of Aldabra as a nature reserve. Without prejudice to the generality of the implications of this condition the lessee hereby covenants:--
> (a) That there shall be no settlement on South Island.
> (b) That he shall protect all animal life on South Island.
> (c) That he shall not introduce any new animal or plant on South Island.

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*"The Commissioner, British Indian Ocean Territory, states that although the Protection of Wild Birds and Animals Ordinance was published in 1961, it did not come into force in the Seychelles until 1966, i.e., after the formation of the British Indian Ocean Territory on 8 November 1965. Hence it does not apply to Aldabra, where the Wild Birds and Animals (Protection) Ordinance (Cap. 24) and the Plumage Birds (Exportation) Ordinance (Cap. 19) together with the Regulations made under these Ordinances are still in force. The schedules of protected birds listed in Chapter 2 consequently still apply to Aldabra."

(d) That he shall not exploit any of the resources of the said South Island except mangrove which he shall have the right to cut and remove."

Article 6 allows "unrestricted exploitation" of coconuts, mangroves, seaweed, shell fish, sea slugs, fish, goats, crows and poultry. Quarrying of stone (Article 9(b)) and clearing of woodland (Article 10) are restricted; clearing by fire is prohibited without permission (Article 11). The total resident population is not to exceed 200 persons without permission (Article 17).

Articles 12, 13 and 14 add further conservation measures:

"12. That the lessee shall be the guardian and protector of all wild life and all the resources of the Islands and of the surrounding seas. The lessee shall ensure to the best of his ability that, save as provided in this lease, no wild birds, tortoises or other animals are molested, deprived of their proper sustenance, disturbed, taken or killed by any person not holding the express permission in writing of the lessor.

13. That apart from the restricted and unrestricted exploitation detailed above the lessee shall in no way exploit or permit the exploitation of the animal and mineral resources of the Islands or surrounding seas without the express permission in writing of the lessor.

14. That the lessee shall not exploit for export or otherwise birds' eggs without the express permission in writing of the lessor."

An important clause, Article 16, gave the Government of the Seychelles powers to establish a research station on the atoll:

"16. That the lessor reserves the right for the Government of Seychelles or for any person, body of persons corporate or incorporate, sponsored by the Government of Seychelles, to establish on any of the Islands, scientific research stations for the purposes of zoological, oceanographic and other scientific researches. The lessee shall be bound to grant, free of any charge, all the reasonable facilities on the Islands for the establishment of the said research stations and shall do everything in his power to promote and facilitate any researches that may be carried out."

Finally, Article 21 gives the Government of Seychelles power to resume possession of the islands at any time for a "public purpose", defined to include "the building of lighthouses, Police Stations, or other public buildings and all Admiralty and War Department requirements".

In 1964 it became known that the Ministry of Defence was considering the establishment of defence facilities, including an airfield, at Aldabra. This proposal, following discussions between the Ministry of Defence and the Royal Society, led to scientific participation in the joint B.B.C.-Ministry of Defence expedition in 1966, the formulation of preliminary conservation policies (Stoddart 1966b), and to the planning of a programme of further scientific work on the atoll, beginning with the Royal Society Expedition to Aldabra 1967-68.

The Ministry of Defence interest also led to a change in the status of Aldabra and certain other islands. Since 1903, when the Seychelles administration became independent of that of Mauritius, Aldabra has been administered from the

Seychelles as part of that colony, and in fact had been so administered informally since the 1880s. By the British Indian Ocean Territory Order in Council, 1965, however, Aldabra was detached from the Colony of Seychelles to form, with Farquhar, Desroches, and the islands of the Chagos Archipelago, a new Territory. Under the British Indian Ocean Territory Order 1965 and the British Indian Ocean Territory Royal Instructions 1965 (Seychelles Gazette, Supplement, 13 December 1965, pp. 184-193), the Territory is to be governed by a Commissioner, with powers of legislation, and laws in force in the individual islands at the time of the formation of the Territory are to continue to be valid. The first Commissioner of the B.I.O.T. is the Governor of the Seychelles; and the laws of the Seychelles will continue to apply and to be enforced in the Territory, including Aldabra (Ordinance to provide for the exercise of powers and duties in Seychelles in respect of the British Indian Ocean Territory, for the enforcement of process and the execution of judgment in Seychelles issued or given by Courts in the exercise of their jurisdiction in respect of the British Indian Ocean Territory, Ordinance 27 of 1965: Seychelles Gazette, Supplement, 20 December 1965, pp. 131-132). All the conservation measures so far discussed remain in force, therefore, in spite of the change in the status of Aldabra. A further measure which also remains in force is the designation of West Island (Picard) as a port for the purposes of Customs laws, under Proclamation 11 of 1956 (Seychelles Gazette, Supplement, 8 October 1956).

7. A NOTE ON PLACE NAMES

Place-name usage on Aldabra is complicated by the fact that the atoll is a British possession, but most of the place names were given by French-speaking people, and the local inhabitants speak a French patois. English names have been given to some of the larger islands, and are to some extent used locally, but most of the smaller topographic features only have French names. In at least one case (Johnny Channel) a topographic feature has an English but no French name. It is not therefore possible to adhere to a toponymy either completely English or completely French. A further complication is added by the fact that some features have been named by passing vessels or occasional visitors, the name has had brief usage and has appeared in the literature, but is no longer used locally and may be considered dead.

A basis for accepted toponymy is given by the two Department of Overseas Surveys 1:25,000 map sheets of Aldabra, which where possible give precedence to English names adding the French in brackets, and otherwise using French names where no English name is available. This usage is generally followed in these papers, with a few exceptions mentioned below. Where a choice of names exists, regard should be given to established usage, and as a further principle, new names should not be unnecessarily introduced.

1. Main islands

Polymnie

No alternative name is known. The name is presumably of French origin, and the correct version is thus Ile Polymnie, though the D.O.S. uses Polymnie Island.

Middle Island

This name is used on the 1878 Admiralty chart, by Fryer (1911), and on the D.O.S. map, all with the subsidiary form Ile Malabar or Malabar Island. Abbott (1893) uses "North or Middle Island" and "Ile Nord". The usage of of North Island has come into the zoological literature through Rothschild (1915). Middle Island is accepted.

South Island

This name is used on the 1878 Admiralty chart and by Fryer (1911) (who uses "Main or South Island"), and also on the D.O.S. map. Abbott (1893) uses Grande Terre. South Island is accepted.

West Island

This name is used on the 1878 Admiralty chart, by Fryer (1911), and on the D.O.S. map. The 1878 chart and Fryer quote as a subsidiary name Ile Picard, and the D.O.S. map uses the hybrid Picard Island. These names predate the existence of the settlement, and hence there is no case for using the name Settlement Island. West Island is accepted.

2. Lagoon islands

Ile Esprit

Ile Esprit appears on the 1878 Admiralty chart, in Fryer (1911), and on the D.O.S. map as subsidiary to "Euphrates Island". Esprit has priority and is used locally: the name Euphrates derives, according to Findlay (1882), from the visit of the ship Euphrates en route from London to Karachi in 1862. This does not seem a sufficient basis to establish the name. Abbott (1893) uses Ile Sepoy, which must be a misunderstanding or misprint. Ile Sylvestre is used for the small adjacent island on the 1878 chart, by Fryer (1911), and on the D.O.S. map, and has no English alternative name. Esprit and Sylvestre are accepted here.

Ile Michel

Ile Michel appears on the 1878 Admiralty chart, in Fryer (1911), and on the D.O.S. map as subsidiary to "Cocoanut Island". Cocoanut Island was introduced by Wharton during the Fawn survey, when coconut trees were planted there; and Michel has precedence and is used locally. Abbott (1893) also uses Michel. Michel is used here.

Other islands

The D.O.S. map gives French names to a number of other lagoon islands, all of which are acceptable and are used here. The name Ile Magnan should be used for the largest island in West channels, and appears on the 1878 chart.

3. Channels

The names Main Channel, East Channel, and West or Western Channels are used on the D.O.S. map and the 1878 chart, with the subsidiary names of Grande Passe, Passe Houareau, and (in the 1878 chart) Passes Lanier, respectively. This usage is followed here. The D.O.S. map gives French names to the minor channels of West Channels (Passe Femme, Passe du Bois, Passe Mannian, Passe Grabeau), and these are also accepted apart from Mannian, which is properly Magnan. Johnny Channel has no French equivalent.

4. Land names

The D.O.S. map gives a number of French names for dunes, beaches and headlands, and all are accepted. On South Island it is useful to add Takamaka (1878 chart), Wilson's Well (Dupont 1907),and Abbott's Creek (1878 chart and Fryer 1911). Bras Takamaka of the D.O.S. map is preferred to the East Bay of Fryer (1911). The names Camp Frigate, Ile Verte, and Couroupa are used by Fryer (1911) and may be usefully retained. Couroupa is also used by Dupont (1907), and is apparently the same as the D.O.S. feature named Anse Tamarind, though this is in a different location from Fryer's (1911) Tamarind Point: this should be resolved in the field. Fryer's (1911) location named Camp Frigate is named "Opark" on the D.O.S. map of Middle Island.

Two further names are proposed here for pools on the platin of South Island: Frigate Pool, a large pool used by diving frigate birds, and Flamingo Pool, the largest freshwater pool on the island, a name in local usage though we have not been able to discover any evidence of flamingoes using it. These names are located in Figure 3.