2. GEOMORPHOLOGY OF DIEGO GARCIA ATOLL

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Diego Garcia Atoll (Fig. 2), Chagos Archipelago, has a total area of 170 sq km, of which the lagoon occupies 124 sq km and the peripheral reef (including the land rim) 47 sq km. Diego Garcia has one of the most continuous land rims of all coral atolls, and the land itself covers 30 sq km, or rather more than one-sixth of the total atoll area.

A. Structure and regional relationships

The atoll (Fig. 3) lies 55 km south of the Great Chagos Bank, a largely submerged platform of drowned atoll form, approximately 13,500 sq km in area. with maximum depths of 70-80 m and a broad rim at 7-17 m. The Bank is separated from the Maldives and Laccadives plateaux by a channel 500 km wide and 2200-3300 m deep. Both the Great Chagos Bank and the Maldives-Laccadives plateau are outlined bathymetrically by the 2000 m isobath, and together they form a major topographic lineament extending in a north-south direction across the Indian Ocean for 3000 km. The Chagos Bank lies adjacent to the Mid-Ocean Ridge close to its ENE-WSW intersection by the Vema Trench. The Mid-Ocean Ridge is a complex structure in this area, and is adjoined to the west by the Mascarene Plateau, the part granitic, part basaltic coral-capped arc extending from the Seychelles to the Mascarenes (Fisher, Johnson and Heezen 1967, 1261). Unlike the Maldive-Chagos plateaux, the Mascarene Plateau is apparently interrupted by ENE-WSW displacements.

In contrast to the extensive geophysical work in the northwest Indian Ocean, the structure of the Maldives and Chagos has been relatively neglected, and little is known in detail of the relationship between these features, the Indian sub-continent and the Mid-Ocean Ridge. Geophysical work on the Seychelles Bank and Cargados Carajos indicates a granitic basement covered with coral limestone (Matthews and Davies 1966), and on Saya de Malha a basaltic basement, also covered with coral (Shor and Pollard 1963); the inferred thicknesses of the coral in these cases range from 0.5 to 1.5 km. Seismic refraction profiles in the Maldives indicate a volcanic layer 4-5 km thick, capped with coral (Francis and Shor 1966, 431); Glennie (1936) observed large negative gravity anomalies throughout the Maldives, and large magnetic anomalies have also been reported. A seismic refraction profile is described by Francis and Shor (1966) near the Great Chagos Bank south of Peros Banhos and Salomon Atolls. This shows a layer 0.6-1.7 km thick with velocity 3.01 km/sec, interpreted as coral, over-

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lying 3.6-5 km of volcanic rock (velocity 4.76 km/sec) and basic crustal material (velocity 6.79 km/sec). Water depth in this area averaged about 1000 m. Presumably over the shallow Chagos Bank, and over Diego Garcia, the coral and possibly the volcanic layers are thicker.

The Maldives and Chagos plateaux lack the characteristic features of the deeper (c. 3 km) Mid-Ocean Ridge, i.e. high heat flow, seismicity and volcanicity. The plateaux are notably aseismic (Stover 1966). Francis and Shor (1966) suggest that, on the analogy with many Pacific linear volcanic belts, the Maldives-Chagos vulcanism began in the south and moved northwards, culminating in the outpouring of the Eocene Deccan Traps. This would imply that subsidence of reef foundations has been greatest and most prolonged in the south. It is possible that the Chagos and Maldives volcanic belt represents the track of drift of the Indian sub-continent to the north during the late Mesozoic and early Tertiary disruption of Gondwanaland (Le Pichon and Heirtzler 1968, 2115), though this interpretation remains speculative.

Little is known of the ocean floor to the east of the Chagos, where depths are generally 3.5-4.5 km. A north-south trending trench, the Chagos Trench, with depths greater than 5 km, has been identified along the east side of the Chagos Plateau (Francis and Shor 1966, 428).

The relationship of Diego Garcia itself to the Great Chagos Bank remains unclear. There are soundings of 1-1.3 km between the two. Similar depths are found to the north, between the Bank and Peros Banhos and Salomon Atolls, where Francis and Shor (1966) shot their refraction profile. Depths of less than 1.8 km extend for 130 km southwest of Diego Garcia, but for only 30 km to the east. No geophysical work has been done on Diego Garcia itself, which from the regional situation can be inferred to be a typical mid-ocean atoll, with a reef limestone cap 1.5 km or more in thickness resting on a subsiding volcanic basement.

B. Geomorphology of the land rim

The geomorphology of Diego Garcia has been briefly described by Bourne (1888a, 1888b) and Gardiner and Cooper (1907). The atoll is unusual in the length and continuity of its land rim, which extends round 90 per cent of the atoll circumference. Because of the narrowness of the rim, however, land covers only 18 per cent of the total area of the atoll.

Because of its length and continuity, the land rim is difficult to describe. It varies in width, height and surface features from place to place, and some sectors are clearly older and more stable than others. The nature of both the lagoon and seaward coasts varies with differences in exposure and sediment supply. For convenience the continuous rim is divided into three main types: normal rim, barachois rim, and narrow rim (Fig. 2). The terminal ends of the rim represent a fourth type, and the lagoon-mouth islets a fifth.

1. Normal rim

The term "normal rim" is applied to those sectors with a mean width of about 0.5 km, possessing a prominent seaward ridge, a less pronounced lagoon ridge, and either a gentle slope between the two or an interior depression. This type of rim has been described from many other atolls.

Between Cust Point and East Point, a distance of 7 km, the rim is 0.4-0.6 km wide, reaching 1 km at East Point. Figure 4a shows a levelled section north of East Point. The seaward ridge is topped by a belt of low dunes 120 m wide, rising to 5 m above low water level (Plates 5-6). The lagoon ridge is less pronounced, rising to little more than 2 m above low water. Apart from a central depression most of the rim surface is horizontal or falls gently lagoonward, with an elevation of only 1-2 m. The central depression is close to or slightly below the level of high water springs. The beaches and rim surface consist of fine to coarse sand, with organic debris forming a black deposit in the depression. After heavy rain the depression holds standing water several decimeters deep for some days.

The rim northwest of Pointe Marianne is very similar, being 8 km long and 0.4-0.75 km wide. The seaward ridge (Plate 8) is higher here than on the east rim, and the levelled transect at Pointe Marianne (Fig. 4b) reaches almost 7 m above low water springs in the seaward dunes. Inland from the dunes there is a horizontal surface at 3 m, formed by a gravel spread on which the dunes stand. The lagoon ridge here is low and insignificant.

Part of the southeast rim also falls into this category. From some 4 km northeast of Barachois Sylvain the rim has a width of 0.4-0.9 km. A transect on this coast (Fig. 4c) shows a rather lower seaward ridge (3-4 m above low water springs), with a gentle slope from the seaward beach crest to the lagoon. This sector is entirely built of sand.

Rims of this type have presumably formed by the gradual accretion of sand on the face of seaward beaches, with occasional washovers of sand and gravel raising the rim surface inland during storms. Lower beach ridges on the lagoon coast also grow by accretion. Where the rim is wide or sediment supply deficient, the two ridges may be separated by a depression, but generally there is a continuous gentle surface slope over bedded sands and gravels, part wind-blown and part washover. The width of these sectors implies formation over a considerable period of time, and they probably represent the oldest and most stable portions of the land rim. Two of the sectors described trend NNE-SSW, and the other at right-angles, NW-SE.

2. Barachois rim

In places the lagoon shore of the land rim is highly crenulate, with deep indentations enclosing areas of intertidal sands and gravels. These indentations are surrounded by the normal sandy island surface, and the seaward shore is formed by a normal beach ridge, in places topped by dunes. These indentations are known as barachois (Plate 12). The two main barachois systems are those at the South Point (Barachois Sylvain, 2 km long and 1.5 km wide) and at Horsburgh Point (Barachois Maurice, 4 km long, 0.9-1.4 km wide). In the case of Barachois Sylvain the seaward beach ridge is low and narrow, but at Maurice it has its usual high and wide development. In each case the lagoon beach ridge is weakly developed and is actively retreating, exposing a low cliff of consolidated cay sandstone at its foot. This sandstone is massive and lacks the strong seaward dip of true beachrock. It is not only exposed along the lagoon shore near the mouths of barachois, but also within the mouths and round the margins of the indentations.

Gardiner and Cooper (1907, 47) give a useful description of the barachois:

> "Their entrances are all relatively small, but inside they open out with horns branching off in every direction; the whole is fringed with tall coco-palms. At high water all parts are covered, but at low tide they form vast expanses of glaring white sand or mud, with perhaps shallow streams in their centres. They are evidently growing, dead and falling coconuts fringing their sides, soon to be buried by the Cardisoma crabs, whose immense holes and heaps of soil give a rough appearance to the ground. On the flats, too, which are regularly covered by the tide, any coral-mass or stone is as quickly buried by Uca."

The main features of barachois may be seen in the maps compiled from air photographs in Figures 5 and 6. Figure 7 gives a series of sections surveyed across one arm of Barachois Maurice, and shows the vertical separation of the Cardisoma and Uca zones. In the former the surface is formed of algal-blackened coral sticks and gravel, overlying sandy and silty deposits. Segregation of the coarse sediments is clearly caused by crab activity. The burrowing crabs bring unblackened sediments to the surface to form white conical mounds up to 0.3 m high; these are very conspicuous against the grey surface. Much of the surface is underlain by burrows, and collapses when walked over (Plate 13). This zone is probably only infrequently flooded. Toward the centre of the barachois it often passes into a pavement of cemented sandstone, and may be separated from the lower Uca zone by a low sandstone cliff which marks the upper limit of ordinary high tides (Plate 29). The Uca zone consists of sandy and silty deposits penetrated by large numbers of Uca burrows. Slightly more elevated areas are vegetated with a sward of a sterile grass similar to Paspalum, which may be regarded as the first stage in salt-marsh development (Plate 14). At lower levels the Uca zone is intersected by meandering creeks, in which deeper pools and abandoned arms contain very fine silty sediments. Uca is absent from these lower levels (Plate 15).

Gardiner interpreted the barachois as largely erosional, and the evidence of undercut sandstone cliffs round their margins and of dying coconuts standing in brackish water supports his argument. Bourne (1888b, 457) considered that the lagoon could be raised to abnormally high levels by northwesterly winds, and high salinity of the flood waters killing land vegetation, and scouring and deepening of the barachois occurring as soon as a channel is opened through the lagoon beach ridge. Not all barachois are growing, however. Air photographs show several small barachois on the coast between Sylvain and Maurice which are now dry and being colonised by vegetation. Between Maurice and Carcasse, another such barachois is being filled by fans of storm gravels washed over the lagoon beach ridge, and this too is being vegetated.

Barachois may thus represent an early stage in land rim formation, rather than, as Gardiner (1936, 418) thought, a late stage in land rim destruction. The main barachois occur on a lagoon coast where the dominant winds are from the south, i.e. offshore. Sediment movement on both the east and west sides of the lagoon is clearly northward, and the south side lies in an area of sediment deficit, with no sediment source except for material from the seaward reef carried over the seaward beach ridge, and lagoon floor sediment transported onshore during storms. Such supplies are necessarily limited: material from the seaward side will decrease in quantity as the rim becomes higher and wider, and living reefs are not well represented in the southern lagoon. In this interpretation, spits and projections on the inner margins of the barachois are probably original depositional features, probably washover deposits, stabilised by subsurface cementation and slightly modified by subsequent marginal erosion. Spits and recurves at the mouths of barachois are formed by small-scale longshore sand movement on the lagoon coast after the lagoon beach ridge has been breached; these features, like the original beach ridge, are subject to subsurface cementation and erosional modification.

It is difficult to estimate long-term trends in the barachois. It is possible that they are in approximate equilibrium, with the deposition of fine sediments and of new biogenic material, mainly crustacean and molluscan, balancing any loss by tidal flushing. The fact that no conspicuous changes have occurred since the first maps of the atoll were made in 1824 probably is the result of the absence of a mangrove swamp or salt marsh flora: mangroves or even a cover of Sesuvium or Arthrocnemum would certainly promote sedimentation and transition to a dry land vegetation at the higher levels. Colonisation by such vegetation is at present certainly prevented by the extreme environmental conditions, particularly of salinity and insolation, experienced on the flats, and by continuous reworking of the sediments by crabs.

The more remote arms of several barachois, especially Maurice, stand at a high level and are occupied by brackish standing water, as noted by Gardiner and Cooper (1907, 48). Gardiner considered these to be the advancing arms of enlarging barachois, with the rising water level killing the coconuts. There is no doubt that coconuts are being killed in these situations today, and their trunks stand or lie in brackish water. At Barachois Maurice the water surface in one such arm was shown by levelling to stand at the same elevation as the main *Cardisoma* flat and well above the *Uca* zone and the active creek system. It is possible that waterlogging has occurred as a result of the formation of a cemented horizon below the *Cardisoma* zone: this horizon outcrops in a cliff between the *Cardisoma* and *Uca* zones, and the perched pool is drained by a spillway over the edge of the cliff. Erosion in this spillway is not significant, and the marginal pool has clearly not been flooded as a result of backward erosion from the main barachois. These data suggest that Gardiner's explanation of the phenomenon may not be correct.

3. Narrow rim

Two distinct types of narrow rim are found. The first and most simple extends from Barton Point to Cust Point on the northeast side, a distance of 9 km. The width here varies from 45 to 250 m. The seaward ridge is low, generally less than 3 m. and lacks dunes; the lagoon ridge is in places higher and may be topped by low dunes (Plate 10). Along this sector the seaward beach is retreating and the lagoon beach stable or aggrading. The section surveyed at Cust Point (Fig. 8) represents a very narrow section; where the rim is broader incipient interior depressions are found. Because of the narrowness of the rim in this sector, breaches and washovers from sea to lagoon are not uncommon: Bourne found recent cuts in 1883 (1888b, 457-458). As both Bourne (1888b, 442) and Gardiner and Cooper (1907, 46) recognised, this sector of narrow rim is a recent and unstable link between the more permanent land areas at Observatory Point and south of Cust Point.

The second type of narrow rim is more complex. Between Pointe Marianne and Barachois Sylvain, a distance of 14 km, the rim varies in width from 100 to 500 m. The seaward beach ridge is similar to such ridges elsewhere round the atoll; it is lower in the south, where the beach is retreating, and higher in the north where dunes are building. At one point 4 km south of Pointe Marianne the sandy seaward beach-ridge is topped by a spread of gravel and cobbles, probably of storm origin. The lagoon shore is of diverse character. In the south it is lined by an intertidal rock platform up to 30 m wide (Plate 11), the inner 7-10 m being covered by wave-tossed loose blackened coral boulders. The beach is low and less than 1 m in thickness; it is usually only 5-10 m wide; and it is only intermittently attached to the main land area of the rim. The ridge thus effectively encloses small barachois at a higher level than the main southern barachois, lying mostly in the *Cardisoma* zone. Sediment transport is from south to north, and the lagoon beach thus forms a series of en echelon spits and headlands, each enclosing small barachois-like depressions. The headlands have been stabilised by intertidal cementation, and are made conspicuous by their tall clumps of Hernandia and Ficus. The low beach ridges south of each headland, enclosing the Barachois, are often breached, but the main entrance to each barachois is normally to the northwest of the headlands.

The largest of these barachois is at Mamzelle Adélie. Unfortunately this could not be visited, but air photographs show a well-developed creek system in a surface covered with what is probably a Paspalum turf. A larger indentation of a different type is found at Pointe Marianne itself, where the trend of the lagoon coast changes from N-S to NW-SE. Here the lagoon beach ridge encloses a large expanse of standing water (Plates 16-17), densely vegetated with the pondweed Bacopa monnieri. The inner margins of this pool are lined with dead and dying coconuts and Casuarina trees (Plates 18-19), and several islets also bear dead and decapitated coconuts. Gardiner and Cooper (1907, 417) reported a similar situation, and gave the maximum depth of water as 4-5 ft (1.2-1.5 m). It is similar in size to the large southern barachois, but does not dry at low water. The pool can only have been formed by the growth across a former arm of the lagoon of a sand spit where the coastline changes trend; it has remained open because of deficient sediment supply and because of its exceptional size, suggesting that here the reef itself was unusually wide. How coconuts formerly grew in now waterlogged conditions presents a major problem. Gardiner's account suggests little change during the last sixty years; it has already been shown in the discussion of the main barachois that Gardiner's views that "more barachois have formed" and "all have enlarged" since Moresby's 1837 survey (Gardiner 1931, 140) are not supported bv the 1824 charts, and that waterlogging in the southern barachois may have a different explanation.

4. Rim ends

At both its northeast and especially its northwest terminations, the land rim widens. Seaward and lagoon beaches diverge, without marked change of character, and the low-lying interior contains marshy areas with sedges and standing water. At the northwest point the area of standing water is large and surrounded by dense coconut thicket; unfortunately it was not possible to visit it in 1967. Both points have considerable dune fields, described in Section B.6, p. 15. At northeast point the dunes are being eroded, and there are vertical sand cliffs up to 3 m high at Observatory Point. Gardiner (1931, 139) observed these in 1905. At Barton Point, at the entrance to the lagoon, the reef flat is covered with boulders 0.5-1 m in diameter for a distance of several hundred meters (Plates 3-4). This is unusual on Diego Garcia reef flats, and may have resulted from the effects of a single major storm.

5. Lagoon-mouth islands

There are three small islets at the entrance to the atoll lagoon. West Island stands at the end of a spit-like reef extending 1.4 km from Eclipse Point; Middle Island stands at the northeastern point of an isolated reef 1.7 km long and 1.0-1.3 km broad; and East Island stands on a much smaller isolated reef only slightly larger than the island itself. West Island (Fig. 9) is a narrow strip of sand and cobbles 450 m long and 75 m wide standing on a rock platform which dries at low water springs; the area of the islet itself is 3.4 ha and of the islet and platform together 5.4 ha. Middle Island (Fig. 10) has a total area of about 6 ha, but a large area enclosed by a shingle rampart on the south side consists of standing water. East Island (Fig. 11) is the largest of the three, 800 m long and 200 m wide, and has an area of 11.75 ha.

Middle Island is the least interesting physiographically. It is built of cobbles and gravel at the windward edge of Spur Reef, and has maximum dimensions of 340 x 230 m. An intertidal tail of rubble more than 0.5 km long, with occasional sandbores, extends southwards from the cay across the reef surface. Rubble forms a subtidal carpet round the island shores. The shingle rampart enclosing the pools is largely unvegetated: spread of sand and gravel in the pools show that the rampart is often overtopped or breached by storm waves.

West and East Islands, though very different in size, are similar morphologically and of considerable interest. In each case bedded cemented sands outcrop to form horizontal or slightly dipping platforms along the north and east shores of the islands ("promenades"). At East Island (Plates 31-34) these bedded calcarenites rise at the east point to 3 m above the surrounding reef flat, decreasing in height towards the southwest. The deposits show cross-bedding, with dominant dip away from the island. The platform formed by the calcarenite increases in width to nearly 90 m near the east point; it is surrounded by a platform with similar width at about the level of low water neaps. The junction between the two is formed by a cliff, generally 1-2 m high and slightly undercut. The surface of the calcarenite above is rough and pitted, and the cliff is retreating by fracturing and detachment of quadrangular blocks. The lower outer surface is smoother, coated with algae, and marked by deep round potholes and by trenches presumably eroded along vertical joints. Its outer edge is straight and steep, with a coating of encrusting calcareous algae. Stacks and residuals of calcarenite rise at intervals from the lower platform, demonstrating its erosional origin. Blocks detached from the calcarenite platform during storms, which may reach several meters in length, form a massively imbricated sediment overlying the platform at the east end of East Island, bringing the total height above low water springs to 5.6 m. The island beaches of gravel and cobbles are perched on the conglomerate platform; the island sediments are 2-3 m thick.

The calcarenites are considered further in section C. 4, and the vegetation of the islands is described in Chapter 11, p. 127.

6. Sand dunes on aggrading coasts

While most of the seaward and lagoonward coasts of Diego Garcia are slightly retreating, as shown by the presence of erosion ramps and cliffing, sectors totalling about 17 km possess coastal dune belts. The two main dune areas both face the southwesterlies and trend NW-SE: one, from Simpson Point to Pointe Marianne, is a seaward coast; the other, from Observatory Point to Cust Point, is a lagoon coast. Both lie to the north of slightly retreating sectors of coast, and the direction of sediment movement in each case is clearly from south to north. A third dune sector lies on the eastern seaward coast between East Point and Cust Point: again this lies to the north of a retreating sector, and the sediment supply is from the south.

In all of these sectors, dune accumulation takes the form of a single ridge of varying width rather than of discrete dunes. Vegetation cover is usually so dense that the dune ridge often only becomes apparent when the vegetation is cleared (Plate 10). At the northeast point the dune ridge widens and covers much of the end of the land rim, with a rolling but subdued topography. Generally the ridge is 40-150 m wide. According to Bourne the highest point on Diego Garcia is 30 ft (9 m) high (1888b, 441) and the dunes reach 25 ft (7.5 m) (1886, 385). Gardiner first stated that dunes at Northeast Point varied up to 30 or 40 ft (9-12 m) in height (Gardiner and Cooper, 1907, 46), but he later said that there was "no evidence that they ever reached more than 20 to 30 ft [6-9 m] above sea level" (1936, 417). In places the dunes are being eroded, as at Observatory Point (Dolotov, 1968), but generally they overlook a wide sand beach.

It is interesting that dunes are not developed on the southeast coast, facing prevailing winds. It is probable that, with little lateral sand movement on this coast, sand supply across the reef is inadequate for dune building, and that intermittent storm action is mainly destructive. The main dunes only form where alongshore sand movement from the south provides a supply. In the field it is noticeable that even slight changes in beach orientation can lead to changes in sand accumulation and dune formation on the berm.

7. Land sediments

Land sediment samples were collected at several stations round the atoll rim (Fig. 16): no attempt was made to secure uniformity of coverage, but the samples were chosen to illustrate the sedimentary characteristics of particular environments. Coarse sediments (cobbles and larger particles) were not sampled. Table 3 lists Folk and Ward parameters for mean size, sorting, skewness and kurtosis (M_Z, σ_I, SK_I,

Table 3. Characteristics of some beach, dune and barachois sediments at Diego Garcia (ϕ units)

Environment	Sample number	D_{50}	M_z	σ_I	Sk_I	K_G
Lagoon beach	DG 2	2.05	2.05	1.46	-0.34	2.79
	DG 3	1.78	1.80	0.45	-0.01	1.19
	DG 4	1.95	1.68	1.09	-0.46	0.80
	DG 5	1.43	1.48	0.25	+0.39	1.93
	DG10	0.54	0.41	1.09	-0.29	1.06
Seaward beach	DG 6	-0.16	-0.25	0.70	-0.22	1.51
	DG11	1.62	1.61	0.61	-0.07	1.02
	DG12	1.70	1.69	0.45	-0.05	1.00
	DG16	1.40	1.17	0.94	-0.46	1.48
	DG19	0.30	0.23	1.15	-0.33	1.65
Dune	DG14	2.01	2.03	0.42	+0.01	0.89
	DG15	2.40	2.40	0.33	0	1.29
	DG21	1.72	1.75	0.48	+0.03	1.01
Barachois	DG 9	1.30	1.46	1.66	+0.17	1.06
	DG13	-0.52	-0.54	0.96	+0.02	1.31
	DG17	1.52	1.50	1.33	+0.02	1.17
	DG22	0.80	1.09	1.67	+0.24	1.14
	DG24	0.94	0.94	1.13	+0.04	0.96

and K_G)* for samples from seaward beach, lagoon beach, dune and barachois environments, and cumulative frequency curves for these samples are given in Figure 17.

Beach samples are generally moderately well to well sorted, with negative skewness. Seaward beach samples are coarser than lagoon beach samples. Lagoon beach samples are either well sorted if homogeneous or less well sorted if more than one kind of sediment is represented, particularly in quiet water environments. The beach samples do not differ in any major way from those of other atolls, such as those of Addu Atoll previously reported (Stoddart, Davies and Keith, 1966), except that seaward beach sediments on Diego Garcia are generally of finer calibre than those of other, especially Trade Wind, atolls.

Dune sediments are well sorted and show no marked skewness. The mean grain size of about $+2\phi$ is smaller than that of seaward beach sediments, and would closely approach that of lagoon beach sediments were it not that the mean size of the latter is often increased by the inclusion of coarse material in the sample.

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* For definitions of these parameters, see R. L. Folk, Sedimentology 6: 73-93, 1966.

Barachois sediments show greatest diversity. Whereas both beach and dune sediments are formed by an active sorting process, either by waves or wind, in the barachois the sediments have complex origins. Partly they are transported and deposited by tidal currents, though this is probably of minor importance; partly they result from the *in situ* deposition and disintegration of organic skeletons. As a result the sediments are poorly sorted (σ_I equal to or greater than 1.0). Most have a fine fraction (smaller than $+3.4\phi$) of about 10 per cent, whereas such fine sediments are rare or non-existent in other land environments. Barachois sediments are subject to continuous post-depositional disturbance by the activities of *Cardisoma*, *Uca* and other organisms, which themselves add material in the form of skeletons and faeces to the sediments.

Diego Garcia terrestrial sediments are entirely composed of calcium carbonate, except for fragments of stranded pumice. These are fairly plentiful on the berms of aggrading beaches on seaward coasts, for example on the east coast between East Point and Minni Minni. Most of the fragments are less than 5 cm in diameter, a few reach 20 cm. Finsch (1887, 42) and Wilson (1889, 144) noted large amounts of pumice on the atoll, but their visits took place in 1884, the year following the great explosion of Krakatau. Earlier observations of pumice in the Chagos Archipelago had been made by Moresby (1844, 309). Pumice now forms a quantitatively insignificant proportion of the land sediments, though often local concentrations are formed by the practice of piling pumice fragments around newly planted coconuts. No other non-calcareous material was seen on the atoll.

C. Beach conglomerates and beach rocks

Most of the seaward beaches of the atoll are lined with some form of lithified reef-derived sediments; the total outcrop is greater than on any other Indian Ocean atoll visited by the writer. Rock outcrops are found more intermittently round the lagoon shores, and on the lagoon-mouth islets. The origin and relationship to sea level of these rocks is important in interpreting atoll history, particularly in view of the references made to sea-level change by Gardiner.

Categories of lithified sediments were first recognised at Diego Garcia by Bourne (1888b, 443), who distinguished four types:

1. reef rock, of compacted coral debris with horizontal stratification, formed under the sea or intertidally;
2. boulder rock, formed above high tide by salt spray, outcropping as a low rampart with seaward dip;
3. shingle rock, which is either (a) horizontally stratified but finer in calibre than reef rock, formed under the sea or intertidally, and including corals in the position of growth in sheltered parts of the lagoon; and (b) a seaward-dipping rock, similar in features and origin to boulder rock, but of finer calibre;

4. sand rock, formed from sediment accumulated above water level by wind action and cemented by spray, the outcrops possessing seaward dip.

These categories are not mutually exclusive, and Bourne's use of both morphologic and genetic criteria leads to confusion, but it is clear that considerable differences do exist in the form, composition and origin of the coastal rock.

1. Seaward coast erosion ramp and beach rock

Rocks on the seaward coast are of similar form round the whole atoll rim, though in general they are not well exposed on aggrading coasts with dune development (e.g. East Point to Cust Point; Pointe Marianne to Simpson Point). Typically the base of the beach is formed by an erosion ramp or low-angle surface bevelling a coral conglomerate (Plate 23). Where wave action is considerable the surface of the ramp may be highly polished, but it is generally smooth, with rounded erosion furrows oriented normal to the beach (Plate 28). The surface of the ramp clearly truncates corals embedded in the conglomerate. In many places (e.g. southeast of Barton Point, northwest of Horsburgh Point, northeast of South Point) the ramp surface passes smoothly, without visible break, into the bevelled horizontal surface of the inner reef flat, suggesting that the underlying rocks are continuous and that the difference in form results from erosion. Between East Point and Horsburgh Point, this is further suggested by the continuity of erosion furrows of the rock surface between reef flat and ramp. The ramp rock is often a conglomerate filled with corals, particularly *Pocillopora*, also suggesting that this may be an elevated reef rock much modified by erosion during the formation of the present reef flat surface.

Elsewhere round the atoll the erosion ramp outcrops only intermittently across the lower beach: the middle part of the beach consists of sand or cobbles, and on the upper beach there is a vertical or overhanging clifflet cut into the conglomerate rock (Plates 25-26). The rock surface above the cliff is horizontal or rises slightly inland, and is overlain with sand or humic soil. Where the cliff is cut in conglomerate similar to that of the planed *Pocillopora* ramp, the corals can be seen to be wave-tossed and not in the position of growth. This can also occasionally be seen lower on the beach when vertical sections are revealed on the ramp by spalling of slabs. Near East Point there is a section showing on the lower beach a cemented conglomerate of jumbled coral colonies, and on the upper beach a wave-eroded cliff in unconsolidated sediments consisting mainly of coral colonies of the same size and type as those in the conglomerate (Plates 20-22). The only apparent difference is that the unconsolidated deposits contain more rounded cobbles than the conglomerate. No case was seen anywhere on the seaward coast where corals in the position of growth in the conglomerate indicated emergence. In many places, of course, the rock is a calcarenite (e.g. in the upper beach clifflets near South Point) and corals are completely absent.

The relationship of the erosion ramp and upper beach clifflet to tidal levels is of interest. The erosion ramp lies between approximate low water springs and mean sea level. The highest parts of the ramp and of the upper beach clifflet may lie above the still-water level of high water spring tides, but are within the range of swash. Thus, if the cementation process is intertidal (Stoddart and Cann 1965), all the rocks on the seaward coasts could be formed at their present elevation by cementation of clastic deposits and subsequent erosional modification. The East Point section indicates that some of the ramp rocks closely resemble contemporary beach sediments in composition. This interpretation would suggest that the erosion ramp rocks are similar in origin to ordinary beach rocks. The absence of normal morphologic features of beach rock and the continuity of ramp and reef flat in many places, on the other hand, suggest that the comparison with normal beach rock is an over-simplification.

Special attention was given in the field to observing whether beach-foot rock exposure possessed any morphological features of beach-rock, such as seaward dip, land-facing scarp, and undercut along stratification lines, to determine whether the smooth erosion ramps could be degraded beach rock. The results were ambiguous. In some places smooth erosion ramp passes into true beach rock with characteristic seaward dip; the beachrock features then disappear further along the beach and the ramp again becomes continuous with the reef flat. Northeast of South Point "morphologic beach rock" of sandy composition overlies conglomeratic ramp rock, and slabs of the beach rock are being peeled from the underlying ramp (Plate 24). But laterally this clear distinction fades, and becomes difficult to make as the beach rock often contains much coral debris. Sandy beach rock is found near Simpson Point, but again its relationship to the erosion ramp elsewhere is not clear. No relict beach rock was seen on the reef flats seaward of the present beaches anywhere round the atoll.

Provisionally, all the rocks seen on the seaward coast are interpreted as formed at present sea-level by cementation of beach deposits, and subsequently much modified by erosion. There is no clear evidence of elevation or relative sea level movement in any of these rocks.

2. Lagoon coast beach rock

"Morphologic beach rock" with seaward dip, at low intertidal levels, following the trend of the beach, and of clearly recent origin, is uncommon on Diego Garcia beaches. The best exposure is found in the wide sandy bay between Barton Point and Observatory Point at the lagoon entrance. Elsewhere beach rock is generally found slightly offshore on slowly retreating sandy coasts: for example between Observatory and Cust Points (30-40 m offshore), between East Point and Carcasse, and between Eclipse Point and Pointe Marianne (up to 30 m offshore). In the southern half of the lagoon, beaches with plentiful sand supply are absent, and normal beach rock is not found on the slightly cliffed shores. All the beach rocks seen on the lagoon coast are clearly related to the present sea-level stand.

3. Barachois rock

The massive calcarenitic ledges at the mouths and round part of the margins of the large southern barachois (Plates 29-30) have already been described (Section B.2). Gardiner, who figured "overhanging cliffs" of rock in one of the barachois (1906, 459), believed that it indicated a relative change in sea level. The rock at the mouth of Barachois Maurice was "such as might have been formed in the elevation of an encircling reef" (Gardiner 1936, 419). South of East Point the rock "was sometimes of coral in its growth position bedded by sand, not algae; it must have been of lagoon formation and its present position can only have been due to a fall in the water level of the lagoon" (Gardiner 1936, 419).

No trace was seen in 1967, at Barachois Maurice or elsewhere, of corals in the position of growth in this barachois rock. The rocks are fine-grained calcarenites formed from clastic sediments, generally massive and without marked bedding, but in places with a slight lagoonward dip resulting in the formation on the upper surface of the rock of small-scale cuestas which are, however, distinct from those of normal beach rock. The cementation is firm but superficial, and at Barachois Maurice decreases inland away from the lagoon until it becomes only a thin superficial crust.

The origin of the barachois rock is clearly linked to that of the barachois. It must be stressed, however, that all the outcrops seen are intertidal: Gardiner's photograph of "overhanging cliffs" was clearly taken at low water spring tide, and at high water springs almost all the barachois rock is submerged, with the sea reaching beaches perched on the rock surface. No evidence was found to support Gardiner's hypothesis of recent emergence.

The cemented pavements of the smaller barachois on the narrow western rim lack the cliffed form of the southern outcrops, but their surfaces lie at high intertidal levels, and they probably have a similar origin.

These rocks most resemble the cay sandstones outcropping on retreating sandy shores of Caribbean atolls (Stoddart 1962, plate 1; 1963, 108-109) and ascribed to ground-water cementation. The barachois rocks may have similar origin.

4. Island "promenades"

The outcrops of bedded calcarenites on the windward sides of East and West Islands have been described in Section B.5. They extend to about 3 m above low water spring tide level, and thus are clearly higher than intertidal. Bourne (1888b, 446-447) described this rock from East Island, and argued that it indicated a slight elevation. He described well sections on the island, showing 2.5 ft (0.8 m) of thick horizontal "shingle rock" with some corals, over 1.5 ft (0.46 m) of loose sand, over 3 ft (0.9 m) of coral rock, over more sand, over a basement of solid reef rock. Bourne thought that the alternation of sand and rock represented an alternation of coral growth and sedimentation under lagoon floor conditions. The upper rock surface he estimated to be 4 ft (1.2 m) above high springs, thus giving a minimum estimate of the amount of elevation. Gardiner (1931, 35) also briefly mentioned stratified rock forming cliffs 10 ft (3 m) high on the islands.

It is difficult to see how these bedded sands could be formed at their present elevation under present conditions. They probably indicate emergence of a few metres, following accumulation on the lagoon floor under conditions of active water movement. Strongly bedded sands of very similar form, though with a large terrigenous element, have been found in the Gulf of Mannar, South India, and undoubtedly originated as nearshore bay-floor sediments subsequently elevated (Stoddart and Pillai, in preparation). The restriction of these rocks on Diego Garcia to the two lagoon-mouth islets presents a considerable problem if they do indicate emergence. They could indicate that some at least of the seaward coast ramp rocks were also formed by the same elevation movement. The island promenades thus form a crucial problem in the recent geomorphic history of the atoll, and merit further study.

D. Seaward reefs

The seaward reef flats of Diego Garcia are remarkably uniform around the atoll. They vary in width from a minimum of 50 m to a maximum of 250 m, but are usually about 150 m wide. They also vary slightly in height: most of the flats remain slightly submerged even at low water spring tides, though some sections (e.g. at the South Point) dry. These characteristics differ from those of Addu in the southern Maldives, where the seaward reef flat varies in width from 50 to 750 m (the total width is from 1 to 2 km) and much of the flat dries completely at low spring tides.

The surface of the flat is rocky, with thin patches of rippled sand, gravel and boulders. Corals are generally rare, and the main organisms are Cymodocea (=Thalassodendron), benthic algae, and a crust-forming bivalve Modiolus. Boulders are in many cases scattered over the whole flat and there is no well-marked boulder zone. Local exceptions are, however, found, for example at Barton Point, where the inner flat is covered with large boulders (Plate 3). Where bare rock is exposed it is often polished, especially near the shore where it passes either beneath the beach or into an erosion ramp. The surface is intersected by long straight cracks with variable orientation. Toward the seaward side it may be dissected by erosional channels normal to the reef edge. The seaward edge is intermittently marked by an algal ridge forming a slight topographic feature. This is best developed on the west coast near Pointe Marianne (Plates 1 and 2), where, however, it extends for only a few hundred metres.

Surge channels through the ridge are found here but were not seen well developed elsewhere; the reef edge on the southeast coast could not be properly inspected because of surf. In general the algal ridge is less well developed at Diego Garcia than at Addu Atoll in the Maldives. Small and scattered coral colonies are found in places on the reef flats, particularly species of Pocillopora, Platygyra and Porites, and of Acropora near the edge, but these contribute little to the morphology of a mainly erosional landform. There is no evidence at all that "the reef is growing seawards on all sides and the gain of the island to seaward exceeds its loss", as Gardiner (1936, 416) supposed.

We have no data, apart from aerial photography, on the seaward reef slopes around the atoll, except outside the lagoon entrances on the north side where H.M.S. Vidal carried the 1967 survey to depths of 300-400 m. Figure 12 shows 8 profiles in this area from the 1967 chart. The mean slope of the outer reef to a depth of 25 m is 6°30'; the slope then steepens to 17° down to 50 m and to 48° down to 230 m, before declining to 20° between 230 and 410 m. Aerial photographs suggest a similar low-angle shelf, 200-300 m wide, outside the breakers round much of the atoll. We have no information at all on reef communities on these outer slopes.

E. Lagoon

1. Topography

The lagoon of Diego Garcia is large, shallow, and almost completely enclosed by land. It has a total area of 124 sq km, and a maximum depth of 31 m. It was first charted by R. Moresby in 1837, and the northern half was charted in great detail by F. C. P. Vereker in 1885. A detailed survey of the whole lagoon was made by Capt C. R. K. Roe, H.M.S. Vidal, in 1967. Diego Garcia lagoon is thus topographically one of the best known atoll lagoons in the world. Sounding density in the 1967 survey ranged from 100 to 200 soundings per sq km, giving a total number of soundings on the 1:25,000 chart of about 18,000. This sounding density is rather less than those for Addu and Eniwetok, but substantially greater than that of any other atoll.

The main features of the lagoon floor are given in Figure 13, reduced from the 1967 chart, and in the profiles from the same source in Figure 14. The lagoon consists of three main basins: a large northern basin with its floor at 25-30 m depth; a central basin with its floor at 16-20 m depth; and a southern basin with more intricate topography, isolated by a ridge with depths of only 2-4 m extending entirely across the lagoon. For an atoll of this size the lagoon is unusually shallow. Most of the Maldive atolls have depths of 40-70 m, and the southernmost, Addu, has a maximum depth of 78.6 m. Peros Banhos in the Chagos has a maximum depth of 75 m, and though Salomon has the same maximum as Diego Garcia it is a much smaller atoll (overall 36 sq km).

Hypsometric curves have been drawn for the Chagos (Fig. 15) and Maldive atolls, and hypsometric integrals* calculated. Diego Garcia has the highest hypsometric integral of all of these atolls, 51.0, indicating the least-basined form, compared with 48.7 for Peros Banhos and 38.4 for Salomon. Most Maldive atolls have values ranging from 25-30, and a few from 38-44 (Stoddart, in preparation). Median depths of the Chagos atolls read from hypsometric curves are: Diego Garcia 17 m; Salomon 21 m; and Peros Banhos 40 m. The hypsometric curve for Diego Garcia was constructed from a subjectively-generalized contour map of the lagoon floor based on the 1967 chart: it thus excludes the many knolls and irregularities and represents gross topography only.

2. Knolls

The extremely detailed sounding in 1967 clearly demonstrated the irregularity of the lagoon floor and the presence of large numbers of knolls. It is however remarkable, as Gardiner (1936, 419-420) pointed out, that outside the 10 m line virtually none of these knolls reaches the surface: Diego Garcia must be almost unique among atolls in the absence of surface patch reefs in the lagoon.

In the main northern basin of the lagoon, with its floor at 25-30 m, large numbers of knolls rise to 15-18 m depth, but only five reach 2-5 m. Knolls are especially concentrated in the north, near the lagoon entrances, where the basin-like form of the lagoon floor is in places almost obscured. In the central basin, with its floor at 18-20 m, the knoll summits are shoaler, many reaching 5-8 m and some even 3 m depth. The small southern basin is so encumbered with winding ridges and knolls mostly reaching 7-9 m but some reaching 2-4 m depth, that the intervening floor at 16-20 m is almost obscured. The variation of lagoon and knoll characteristics from north to south forms a problem second only to that of the absence of surface reefs in the Diego Garcia lagoon.

Knolls in atoll lagoons may be either contemporary growth features or karst-eroded limestone hillocks formed during periods of low sea-level. The fact that most of the Diego Garcia knolls fail to reach the surface and are apparently not actively growing suggests the latter explanation. Conversely the great concentration of knolls near the lagoon entrances suggests that coral growth may be restricted to this area and inhibited elsewhere in the lagoon by low water circulation, resulting from encirclement by land. There are problems in this explanation, however, for the shoalest knolls, with actively growing corals,

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* This measure is defined and measurement procedures are described by A. N. Strahler, Bull. Geol. Soc. Am. 63: 1117-1142, 1963.

are in fact found in the southernmost part of the lagoon, where water circulation is probably minimal. The problem of knolls and lagoon reef growth forms one of the most intriguing problems for future research at Diego Garcia.

3. Entrances

The unusual degree of enclosure of the lagoon has already been mentioned. There are three gaps, all in the north, and all shallow. Main Pass, the westernmost, is 1.6 km wide and about 10 m deep. Middle Pass is 0.6 km wide and 6-7.5 m deep, except for a narrow steep-walled trough more than 30 m deep cutting back into it. Barton Pass is 1 km wide, and again only 6.5-7.5 m deep.

The volume of the Diego Garcia lagoon is of the order of 1900 x 10^6 cubic meters. With a comparatively small tidal range, such shallow passes, and no possibility of water entering or leaving across reef flats as is usual in other atolls, the residence-time of water in the lagoon must be considerable and exchange with the open ocean much inhibited. The effects of this on the physical and biological characteristics of the lagoon require study. The Diego Garcia lagoon contrasts with those of many other landlocked atolls, which have very shallow and often hypersaline lagoons.

4. Lagoon sediments

Fifty-one lagoon-floor sediment samples were taken in 1967: their location is shown in Figure 16. Folk and Ward characteristics for some of these samples are given in Table 4, and cumulative curves for certain samples in Figure 18. These sediments will be reported in greater detail elsewhere. They fall into two groups: first, sediments with size and sorting characteristics similar to those of lagoon beach sediments, with mean size about 2ϕ and moderate sorting. These sand-size sediments are clearly subject to wave-sorting processes; they are found in shallow nearshore areas and adjacent to some knolls. Second, there is a group of sediments with a wide range of mean sizes, poor sorting, and a high proportion (50-90%) finer than +3.5ϕ. These fine sand and silt size sediments with occasional coarse skeletal fragments are found in the deep northern basin, especially towards the east side, in depths of 15-30 m. A sample of this "coral mud" was collected by Gardiner and was described by Murray (1910, 390). Electron micrographs of this fine fraction show that the material is largely of detrital origin. Similar fine sediments in other lagoons are not often found in such shallow depths (at Addu they are restricted to the deepest part of the lagoon) and their occurrence at Diego Garcia probably results from the encirclement and restricted movement of lagoon waters.

Table 4. Characteristics of some lagoon sediments at Diego Garcia (ø units)

Environment	Sample number	D_{50}	M_z	σ_I	Sk_I	K_G
LAGOON FLOOR	B 8	1.10	1.28	0.94	+0.30	0.94
	B 9	1.72	1.91	1.02	+0.20	0.93
	B10	1.55	1.59	1.00	+0.04	1.18
	B20	1.67	1.71	0.89	+0.06	0.97
	B24	1.08	1.15	0.83	+0.11	0.96
	B25	2.21	2.17	0.60	-0.09	0.96
	B28	1.24	1.20	1.49	-0.16	1.00
	B36	1.80	1.71	1.01	-0.17	0.95
	B39	1.44	1.30	1.06	-0.28	1.23
	B51	1.76	1.74	0.91	+0.01	1.00
	B52	2.23	2.16	1.05	-0.07	0.85

5. Lagoon changes

The availability of hydrographic charts made in 1837 and 1885 suggested to Gardiner (1931, 139-141; 1936, 419-420) the possibility of demonstrating topographic changes resulting from either solution or infilling over this 48 year period. Comparison of the charts of the northern lagoon basin led him to conclude that the total area had increased from 19.31 to 21.75 sq miles, and of the basin below 5 fathoms from 16.5 to 17.42 sq miles. He concluded that the lagoon was expanding by solution at the same rate as the outer reef was growing outwards, so that there was no change in gross form of the atoll. The detail of the earlier charts, however, was not sufficient to show the complexity of the lagoon floor topography revealed by the 1967 survey. The bottom variability is such that no inferences concerning changes in depth can be made from the data on earlier charts. Gardiner's calculations were made at the time when Daly (e.g. 1934, 221) was even using the Diego Garcia lagoon as one of his examples of lagoons with smooth horizontal floors. These interpretations are clearly untenable with present knowledge.

F. Conclusion

The main problems raised by this outline of the geomorphology of Diego Garcia concern (a) the origin of the various lithified sediments and their relationships to sea-level change, and (b) the status and origins of knolls and other lagoon floor features, and their relationship to sea-level changes. We have, however, no data from Diego Garcia from which an absolute chronology of sea-level change could be established. Many of the features of the atoll must remain unexplained until such a chronology is available. Except in the case of the calcarenites at East and West Islands, the evidence of lithified sediments for recent sea level change is equivocal. On the other hand many features of the land rim might more easily be explained if recent sea-level change were admitted. These include the formation of barachois and the general occurrence of beach retreat. Documentary evidence of the form of the atoll, going back to 1824, suggests, however that changes since that time have been minor. Future geomorphological research at Diego Garcia might concentrate on the problem of sea-level change, since this probably forms a key to most of the outstanding problems of the atoll geomorphology.

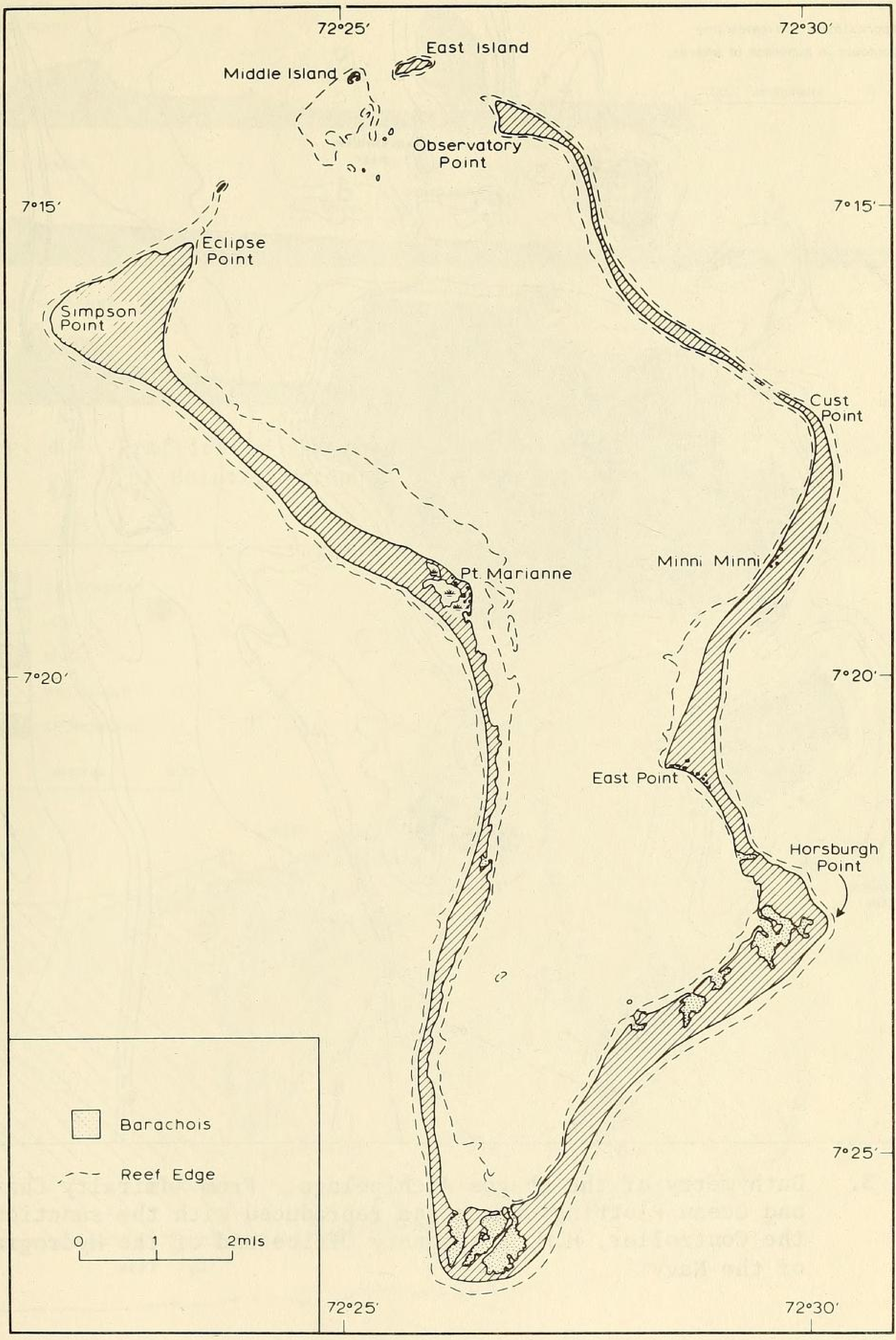


Fig. 2. Diego Garcia Atoll. From a survey by HMS Vidal 1967 and reproduced with the sanction of the Controller, Her Majesty's Stationery Office and of the Hydrographer of the Navy.

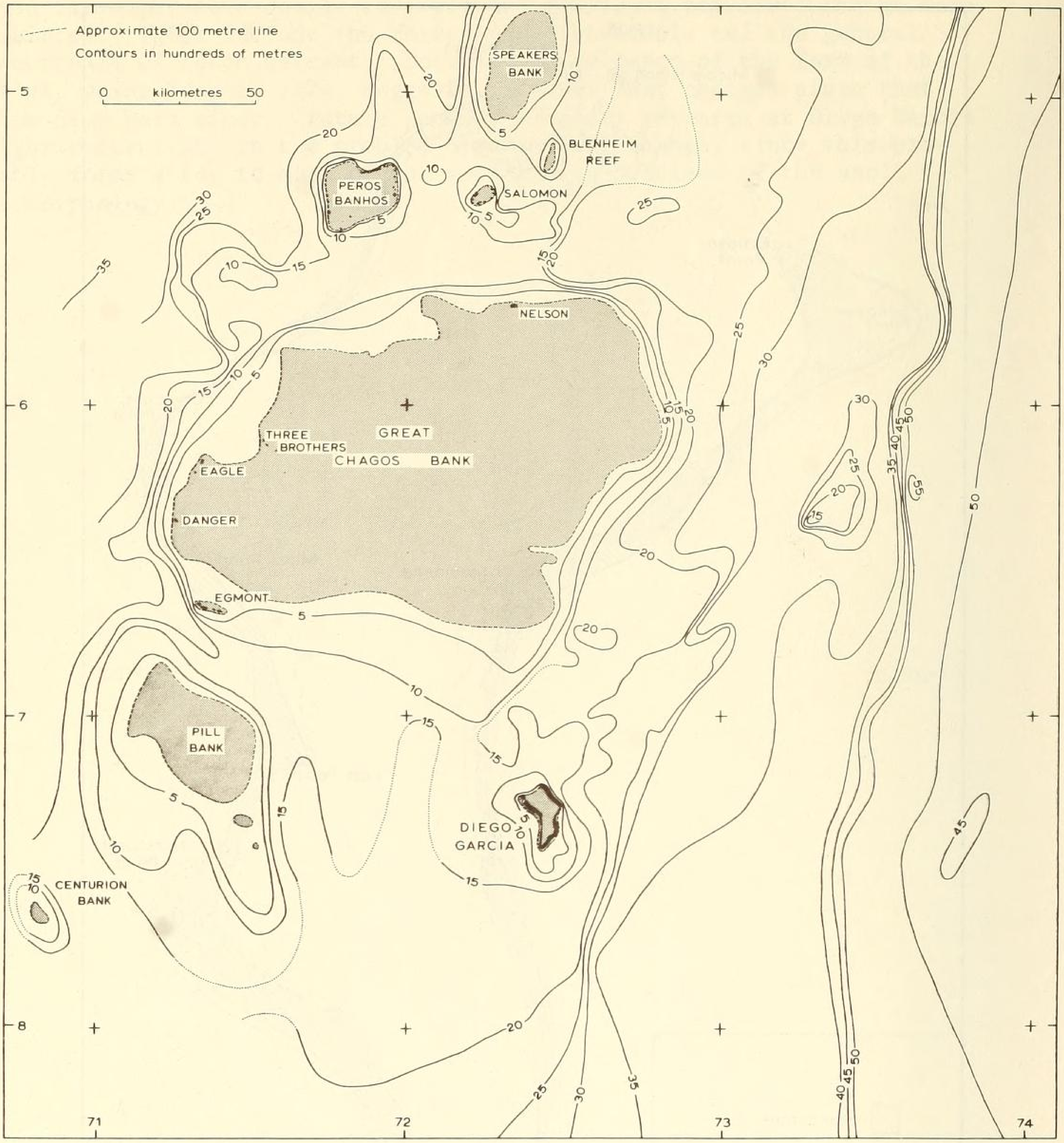


Fig. 3. Bathymetry of the Chagos Archipelago. From Admiralty Charts and Ocean Plotting Sheets and reproduced with the sanction of the Controller, H.M. Stationery Office and of the Hydrographer of the Navy.

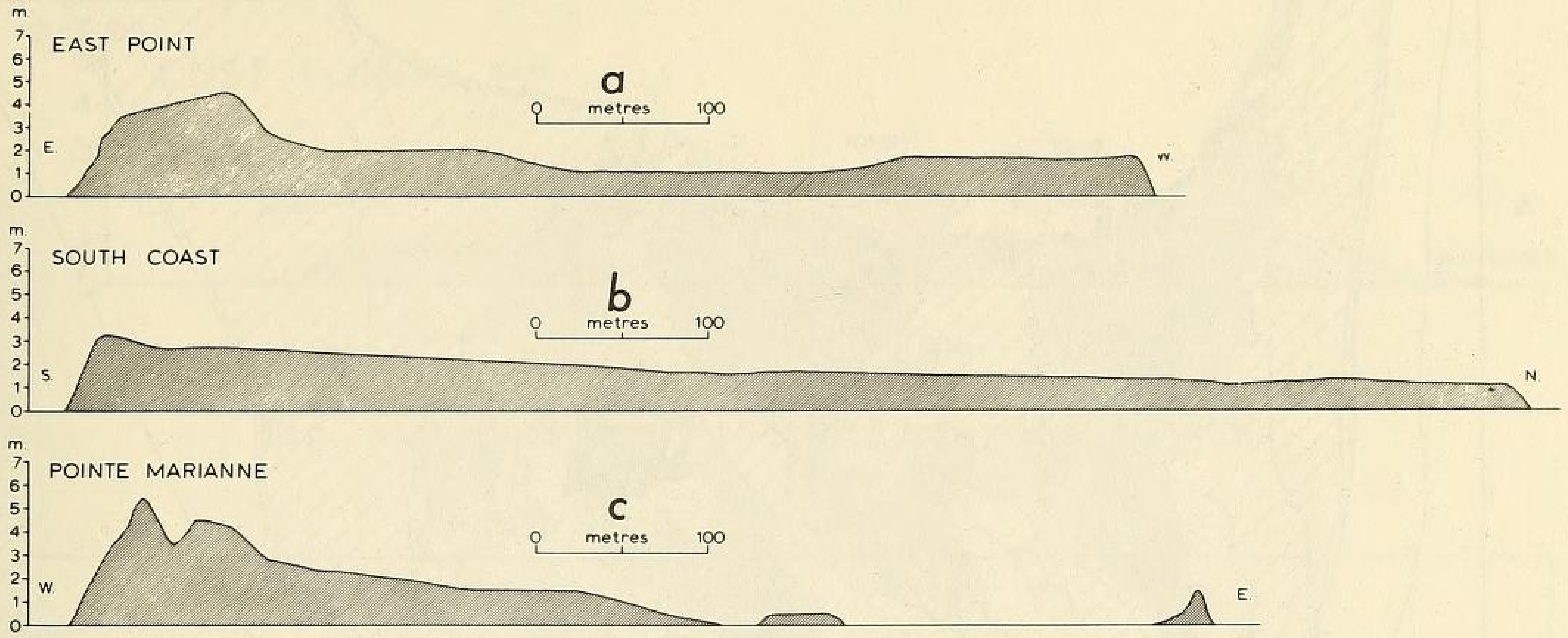


Fig. 4. Profiles of the land rim of Diego Garcia: (a) East Point, (b) Pointe Marianne and (c) South rim.

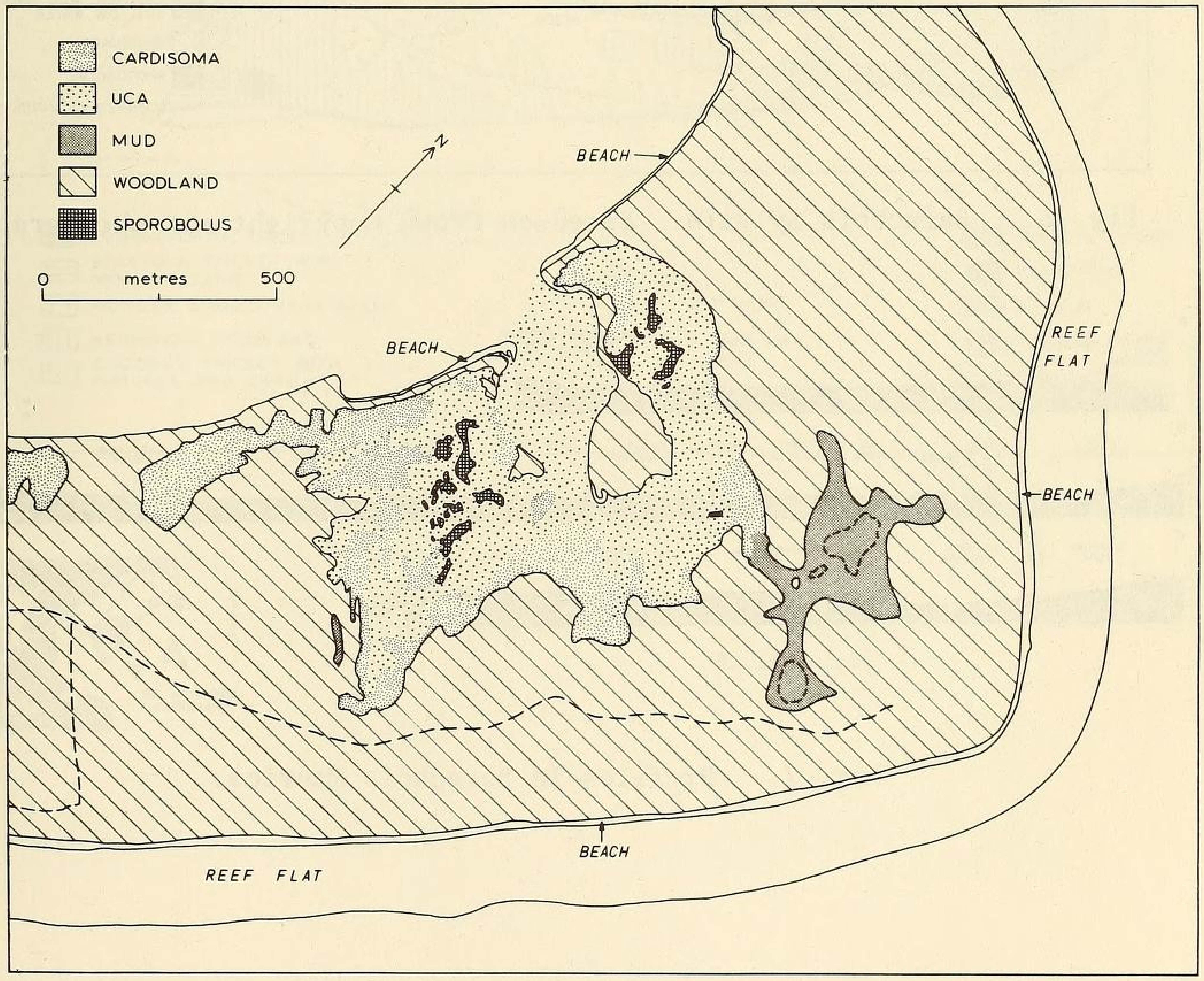


Fig. 5. Barachois Maurice. Based on Crown Copyright air photographs.

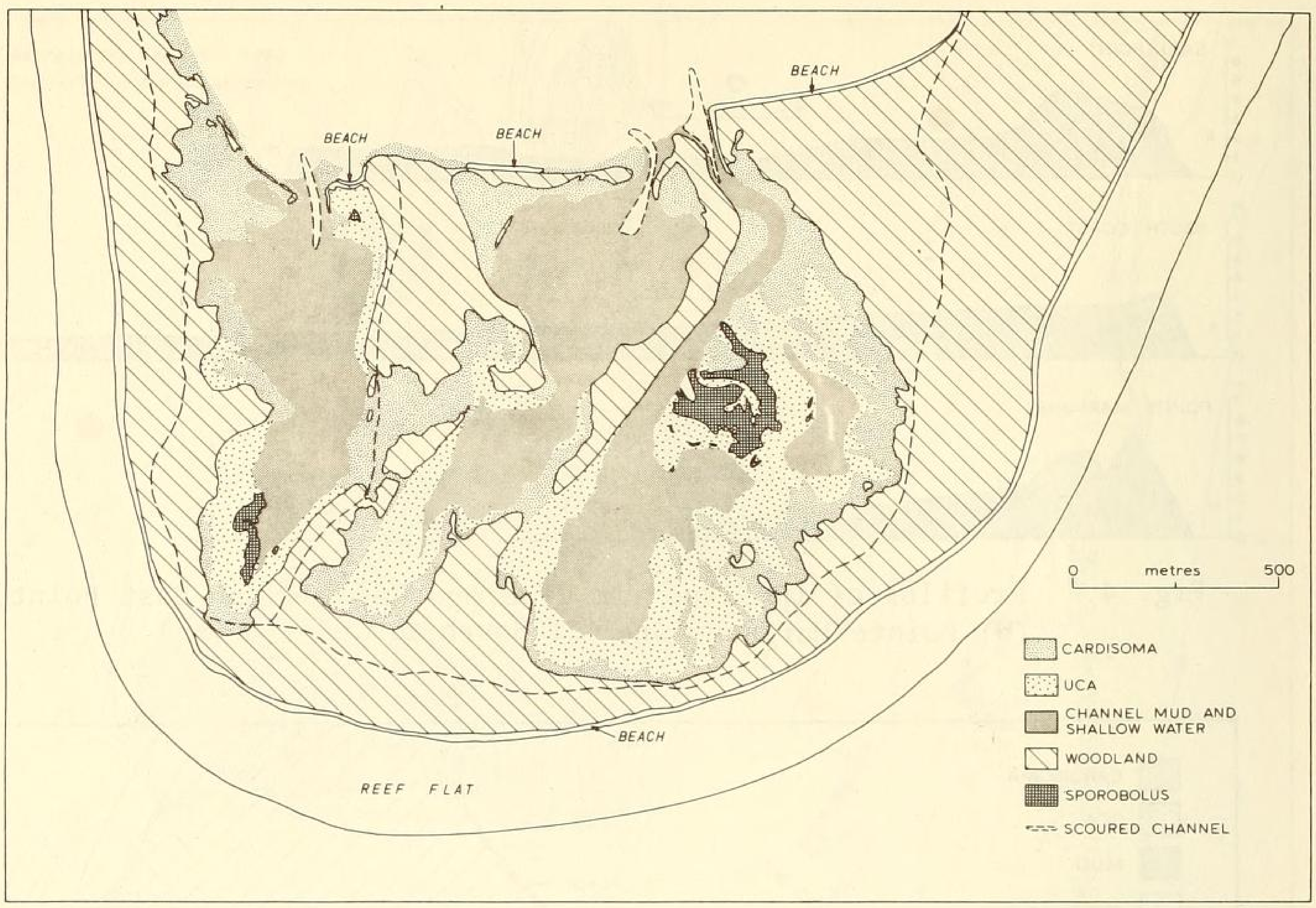


Fig. 6. Barachois Sylvain. Based on Crown Copyright air photographs.

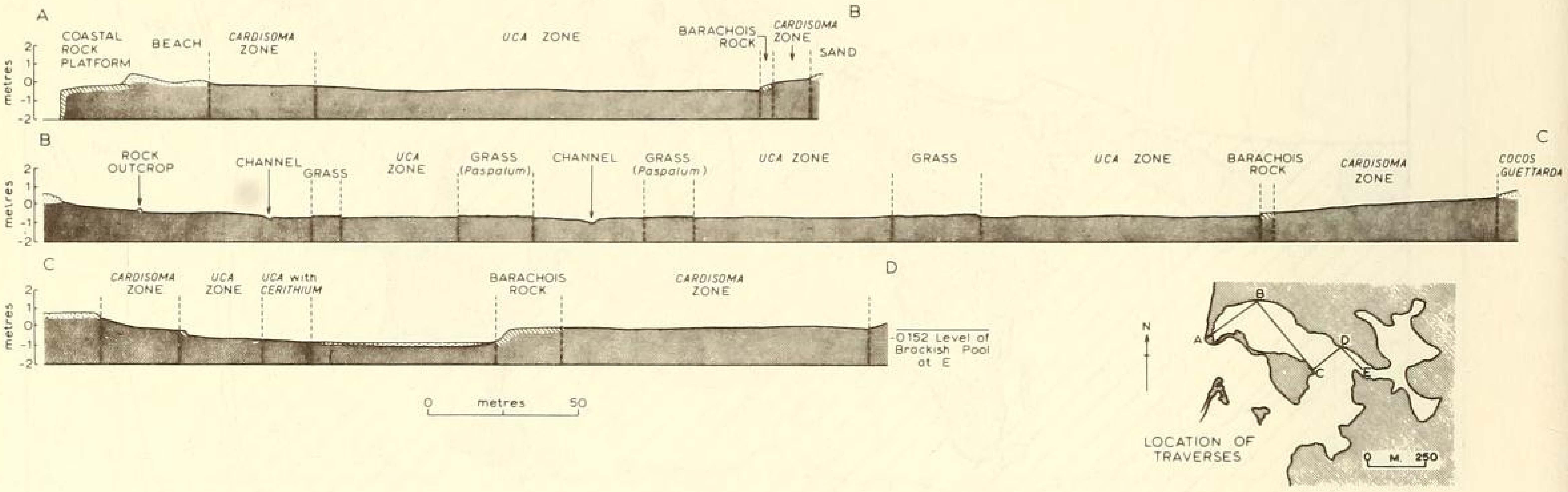


Fig. 7. Profiles in Barachois Maurice.

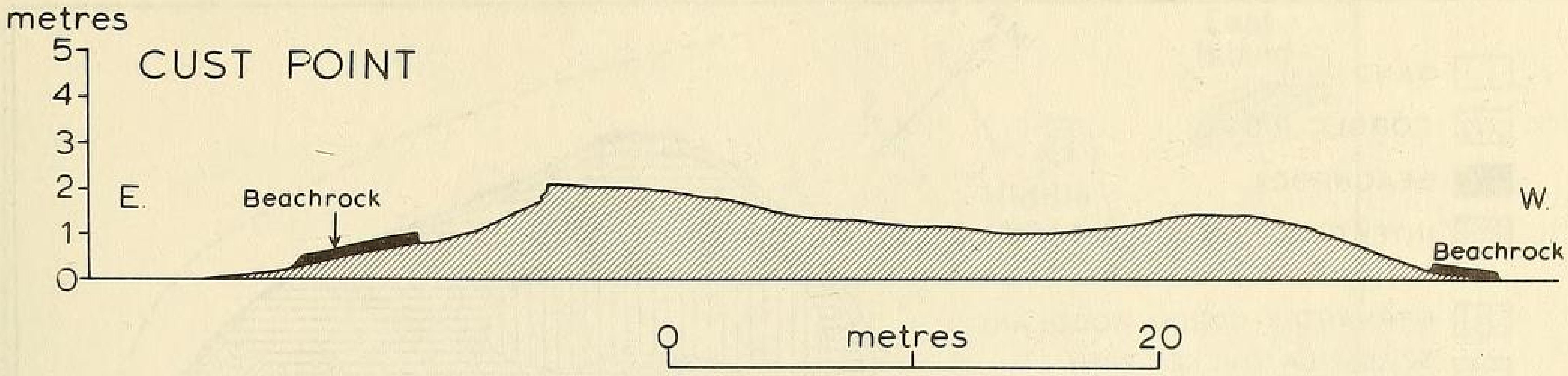


Fig. 8. Profile of the land rim at Cust Point.

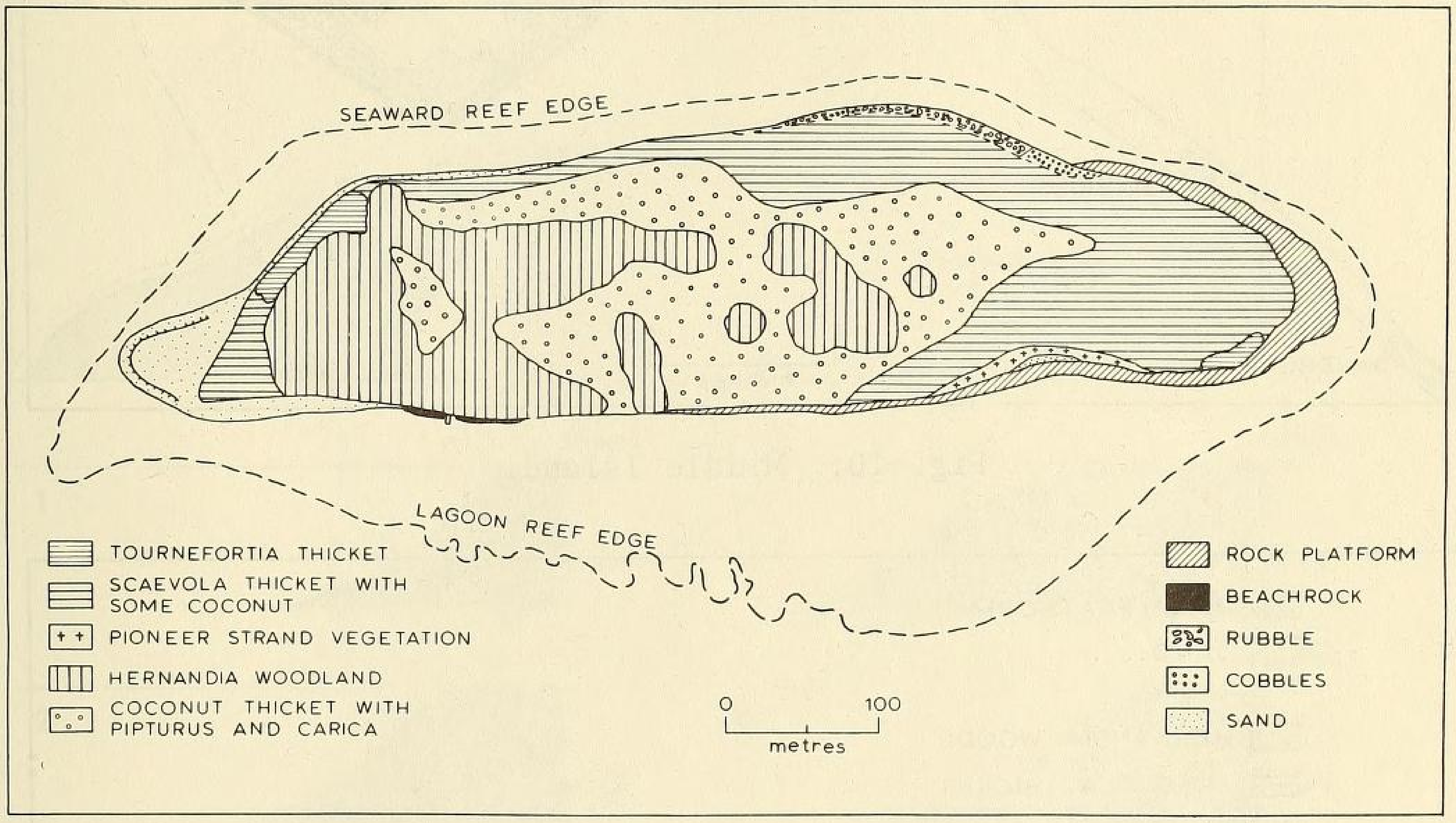


Fig. 9. West Island.

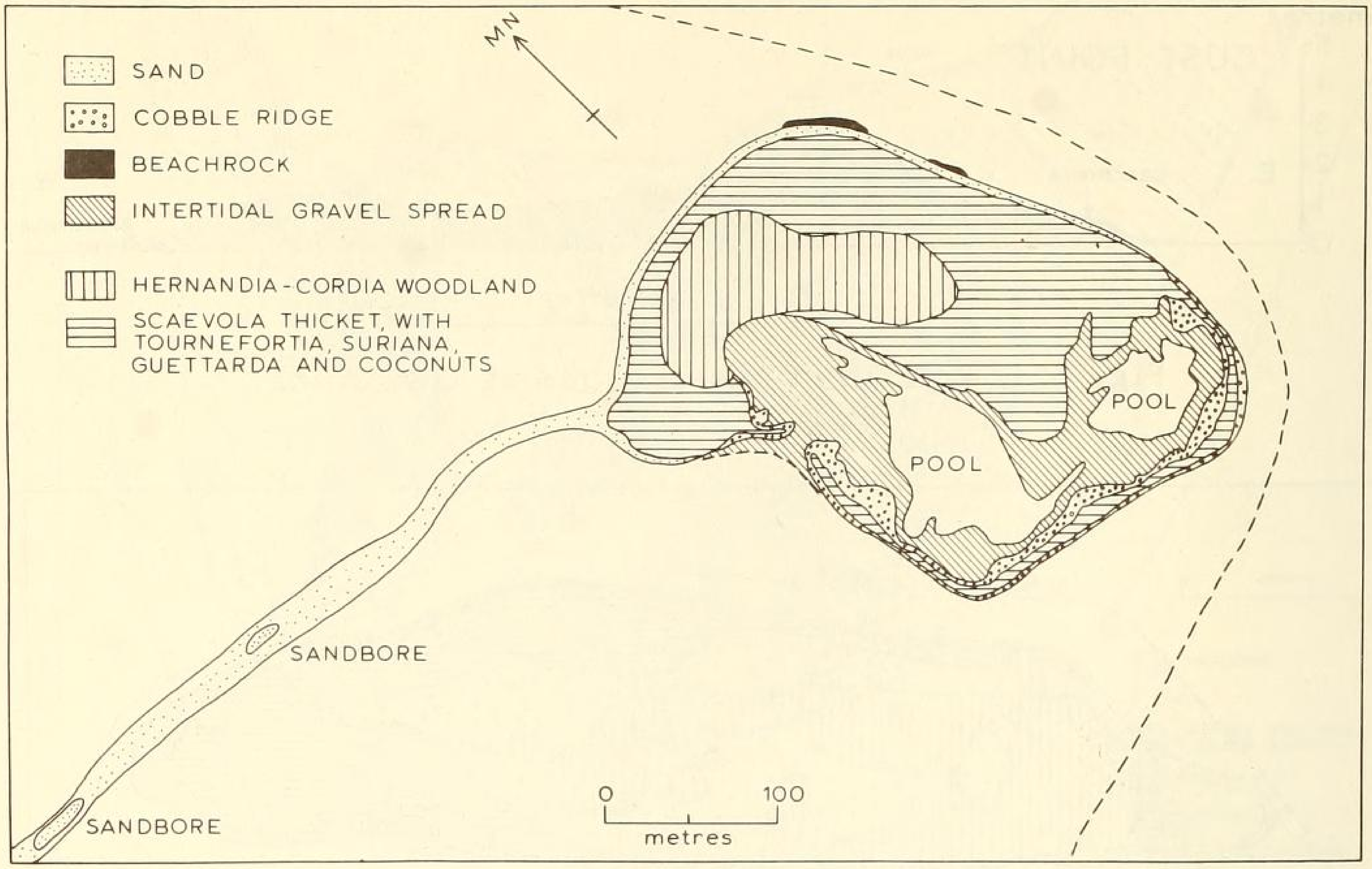


Fig. 10. Middle Island.

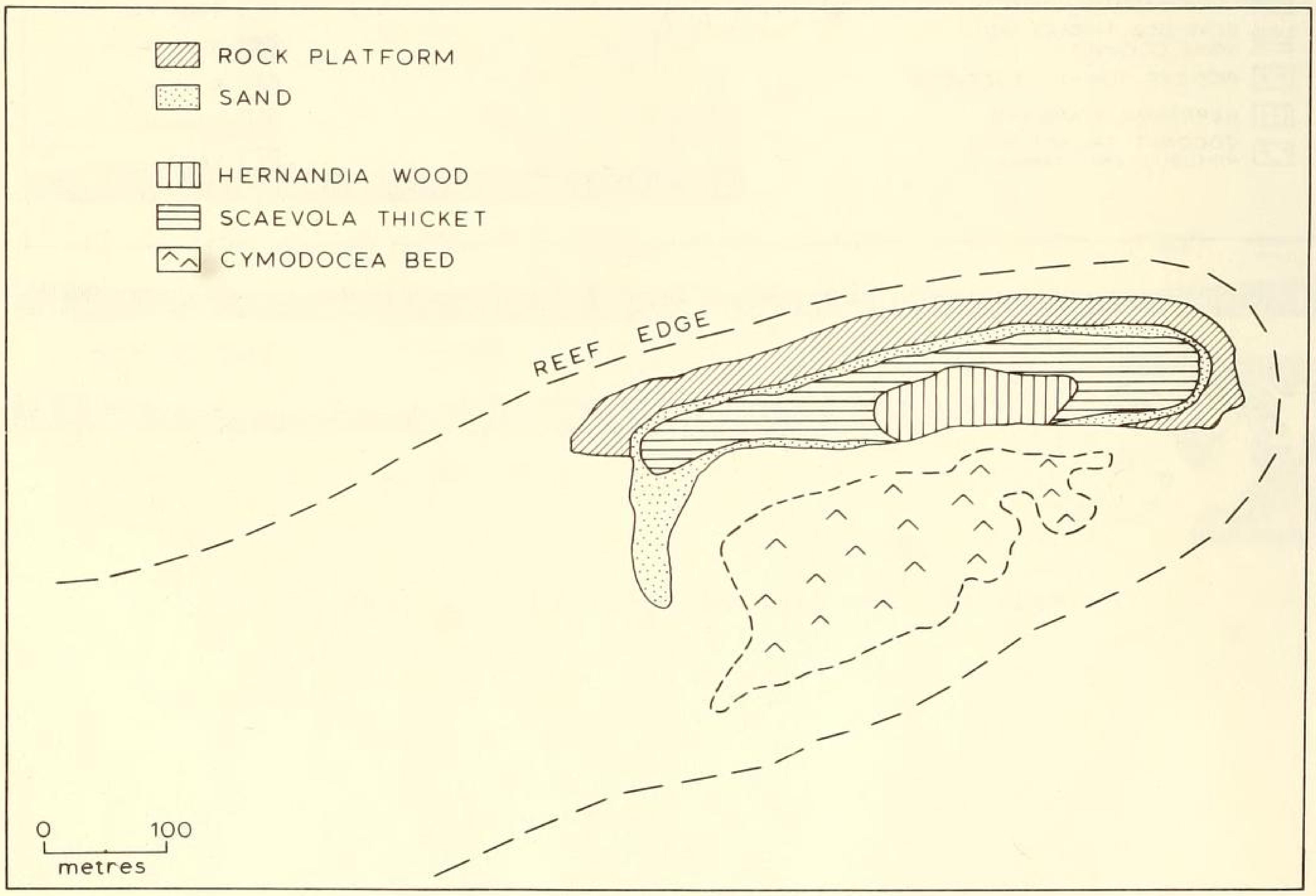


Fig. 11. East Island.

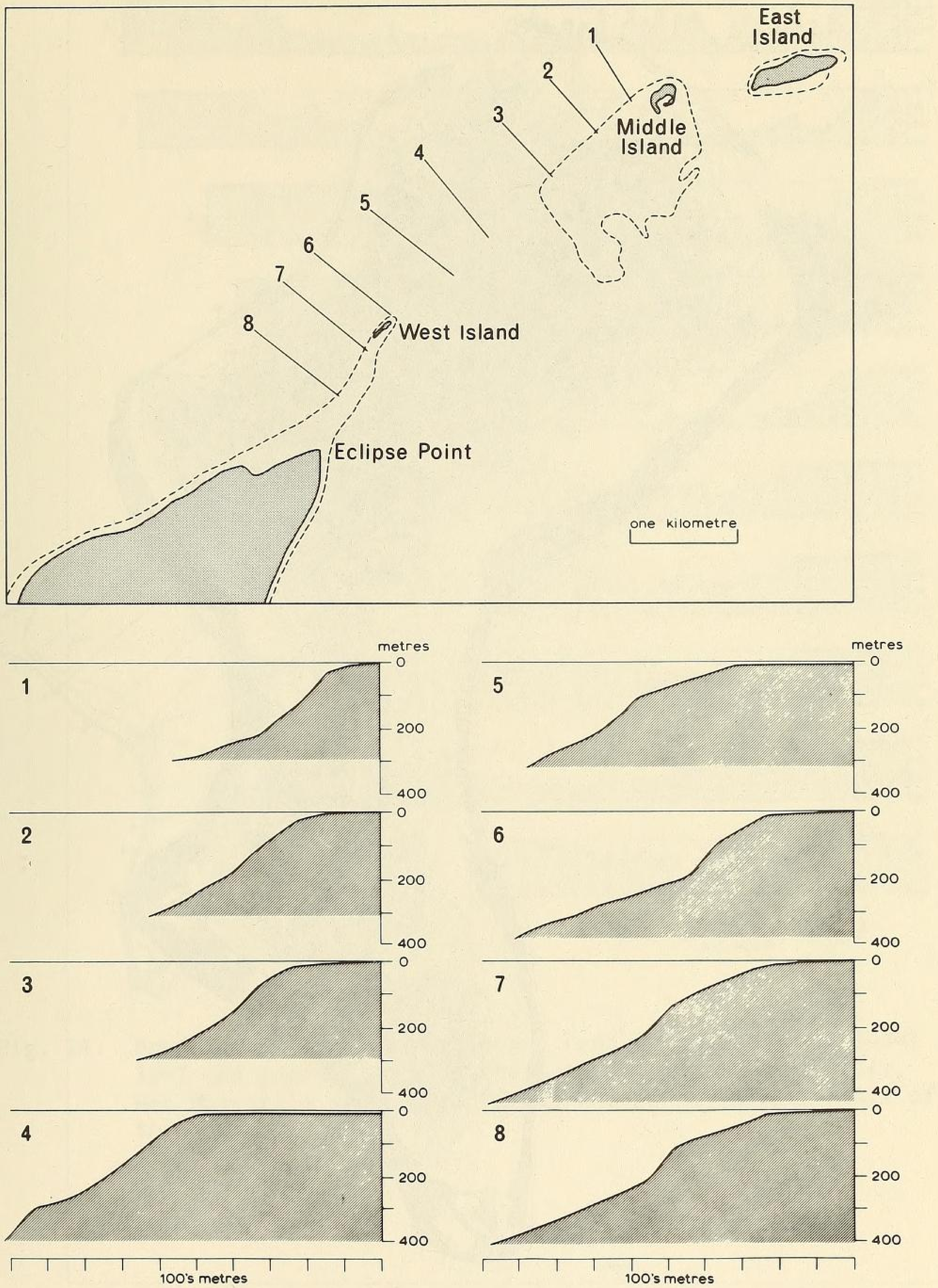


Fig. 12. Profiles of the seaward reef front, north side of the atoll. From a survey by HMS Vidal 1967 and reproduced with the sanction of the Controller, Her Majesty's Stationery Office and of the Hydrographer of the Navy.

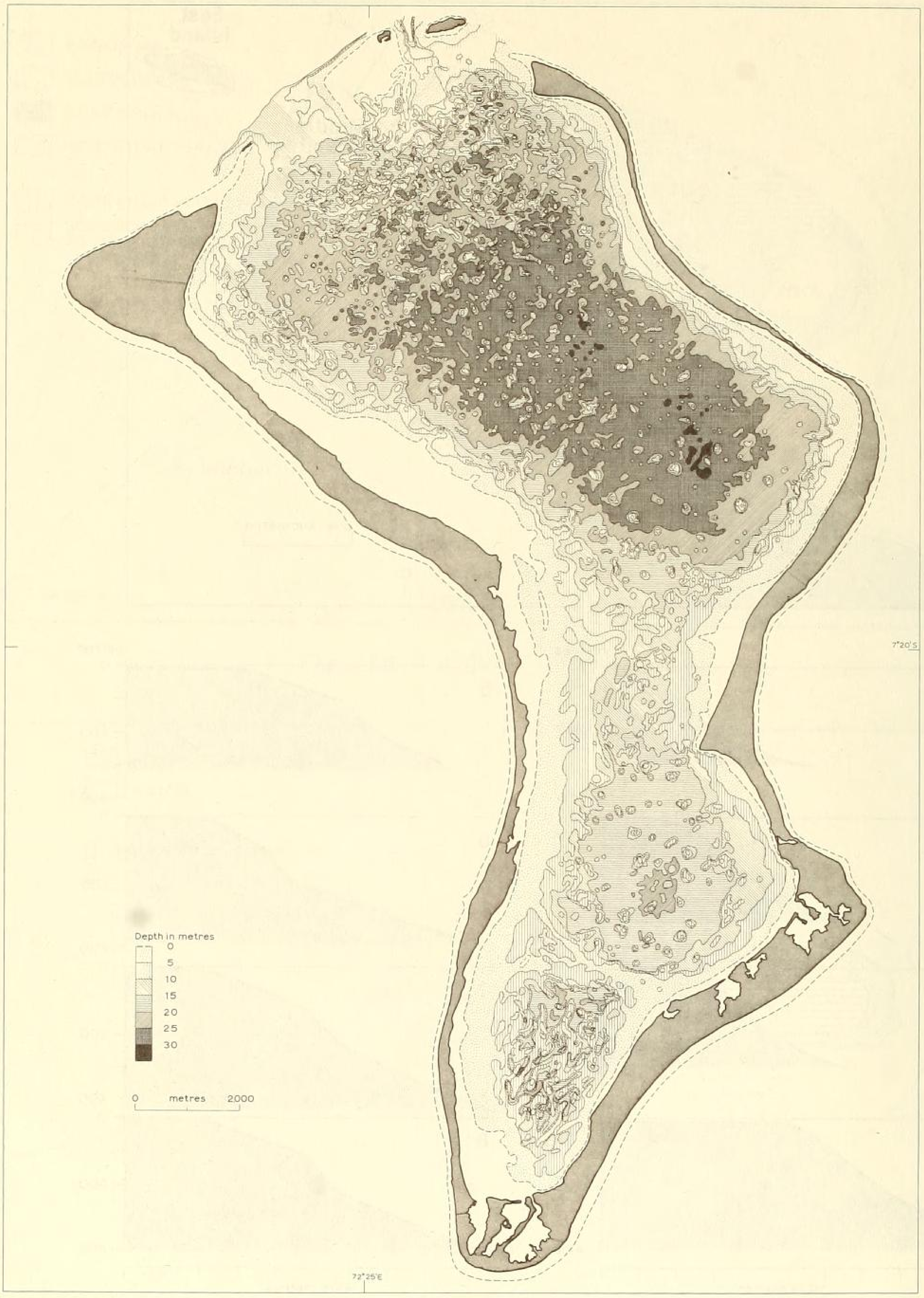


Fig. 13. Bathymetry of the lagoon floor. From a survey by Captain C.R.K. Roe, DSC, RN, HMS Vidal 1967 and reproduced with the sanction of the Controller, Her Majesty's Stationery Office and of the Hydrographer of the Navy.

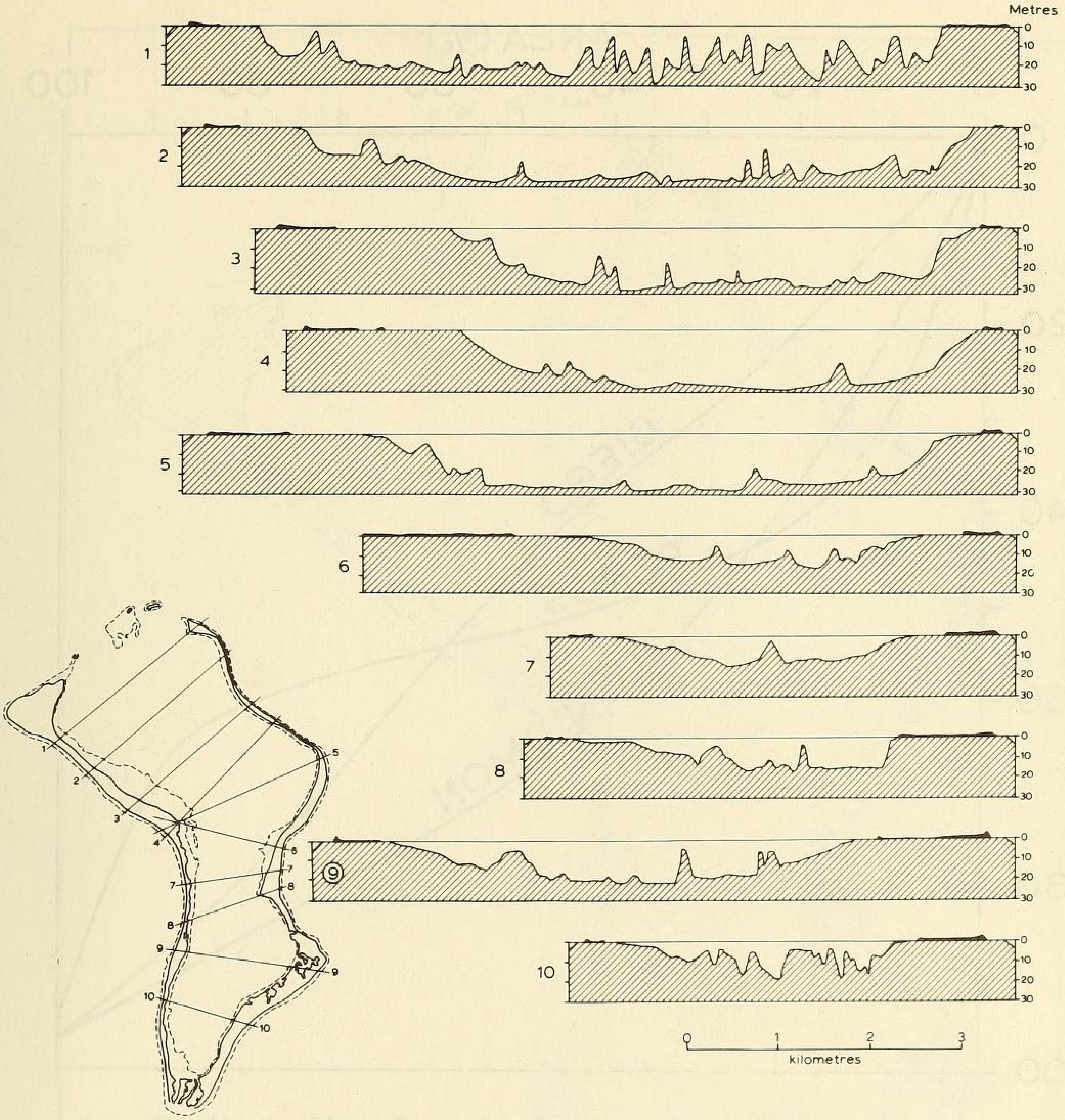


Fig. 14. Profiles of the lagoon floor. From a survey by HMS Vidal 1967 and reproduced with the sanction of the Controller, Her Majesty's Stationery Office and of the Hydrographer of the Navy.

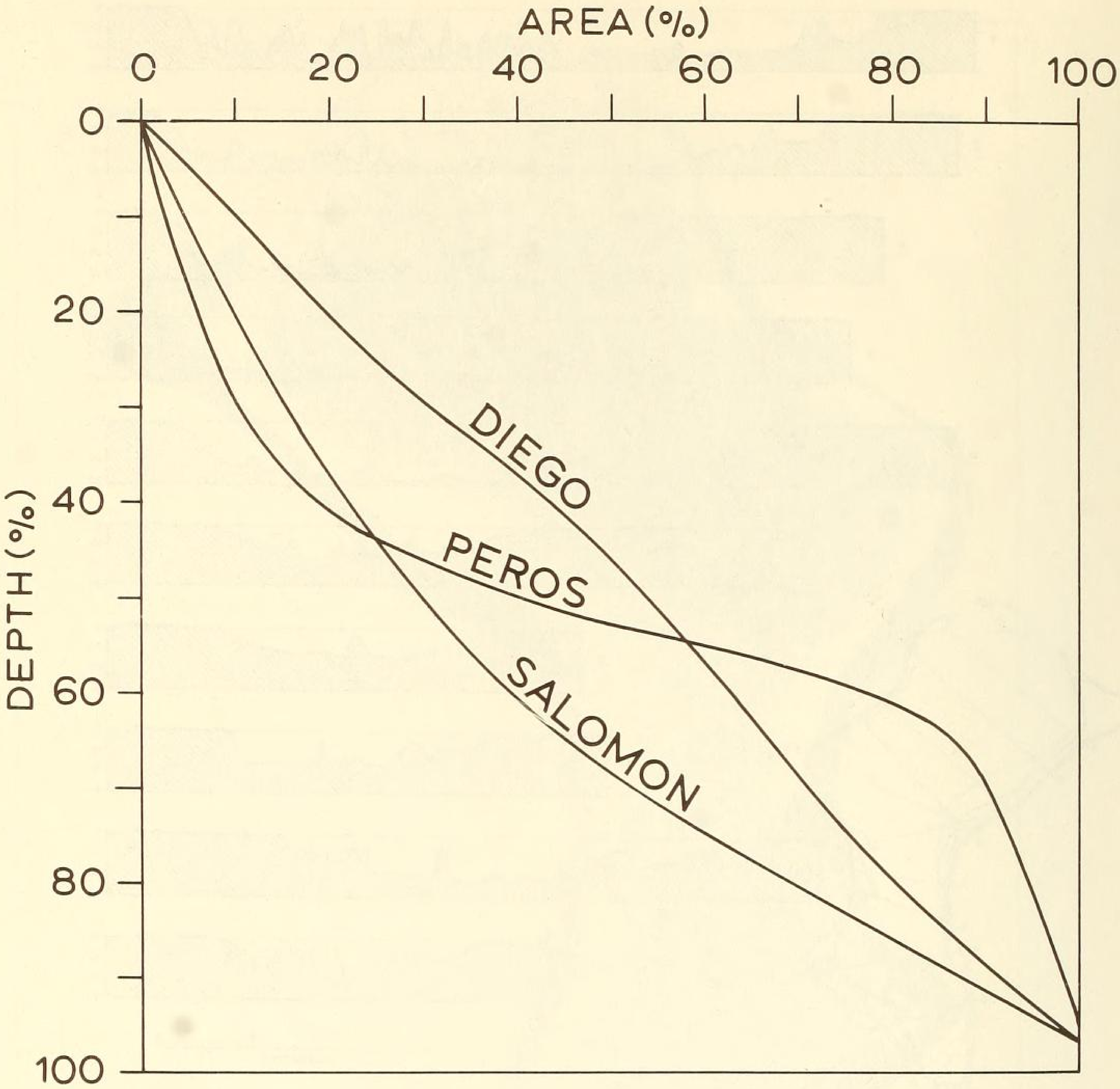


Fig. 15. Hypsometric curves for lagoons of atolls in the Chagos Archipelago.

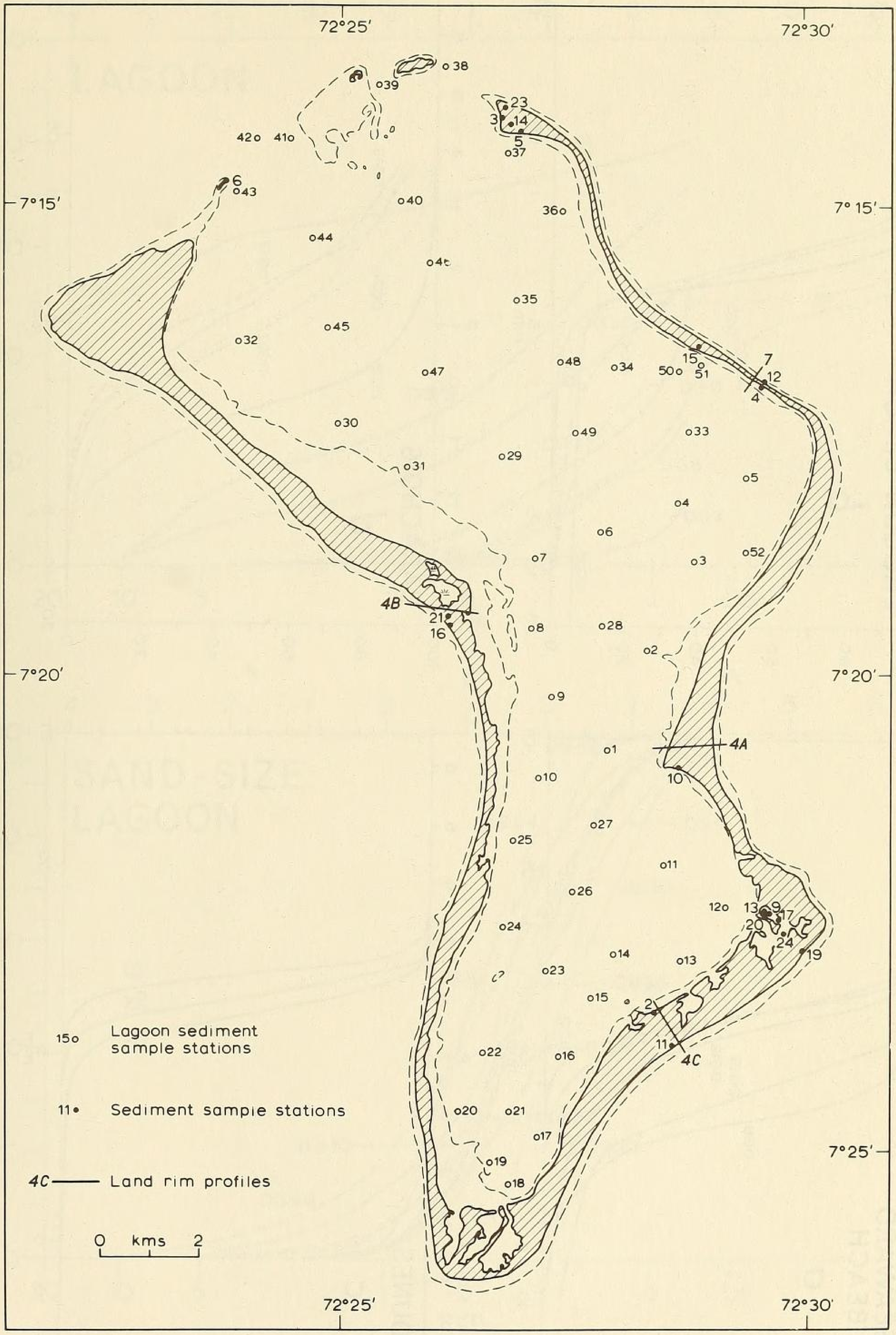


Fig. 16. Location of sediment samples. (a) Land rim and (b) Lagoon floor.

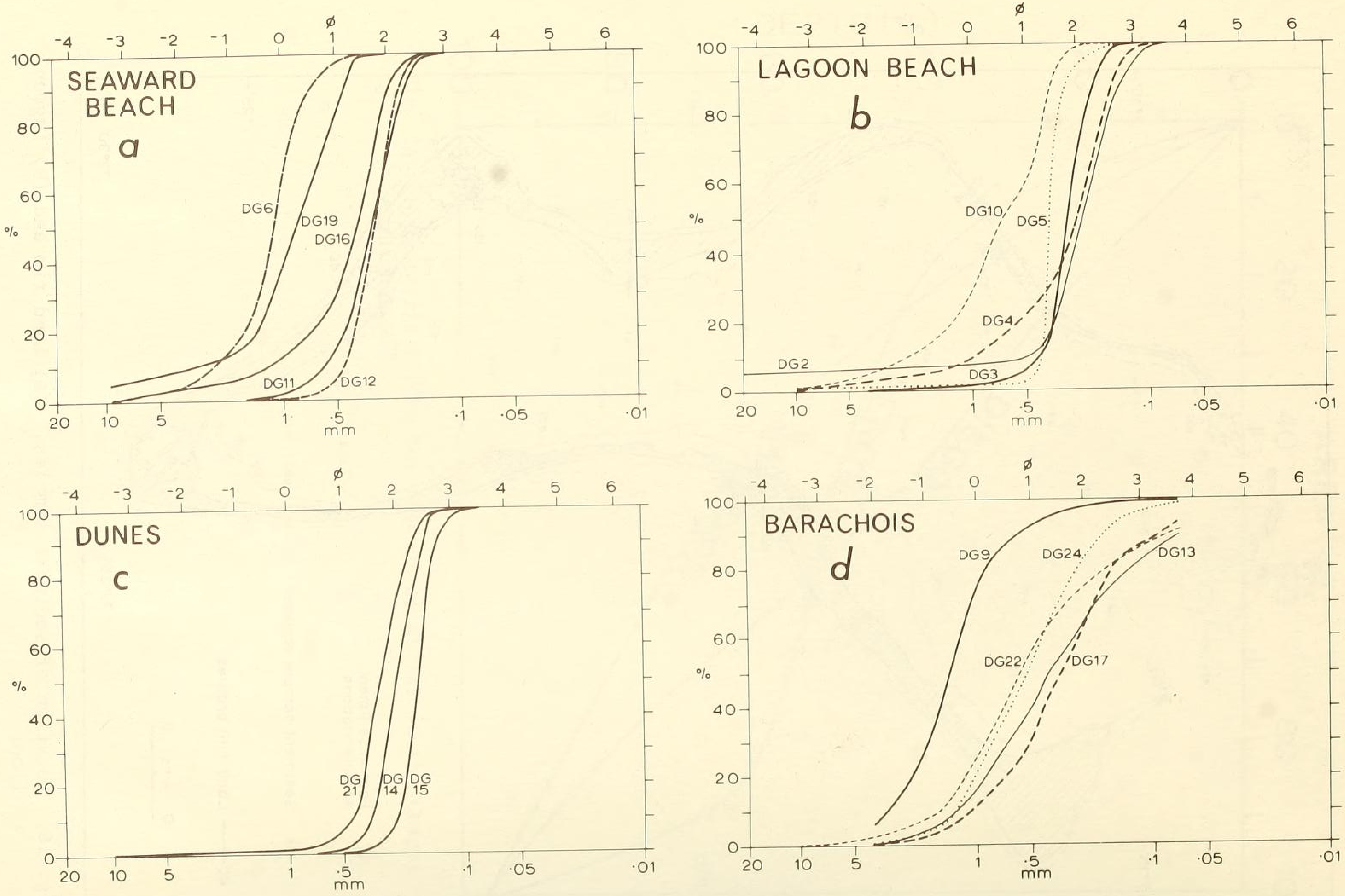


Fig. 17. Cumulative frequency curves for sediment samples from (a) seaward beach, (b) lagoon beach, (c) dunes, and (d) barachois environments.

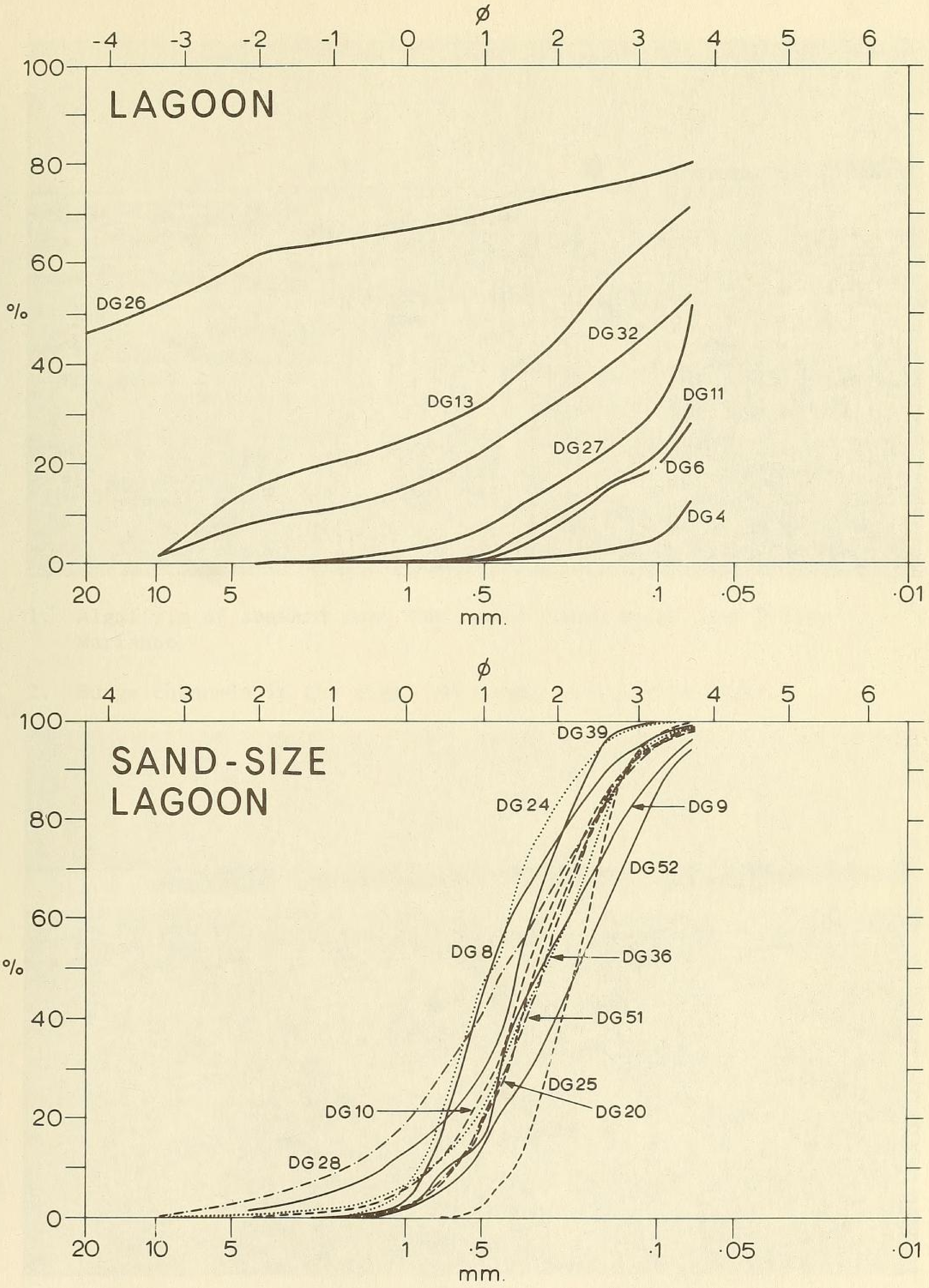
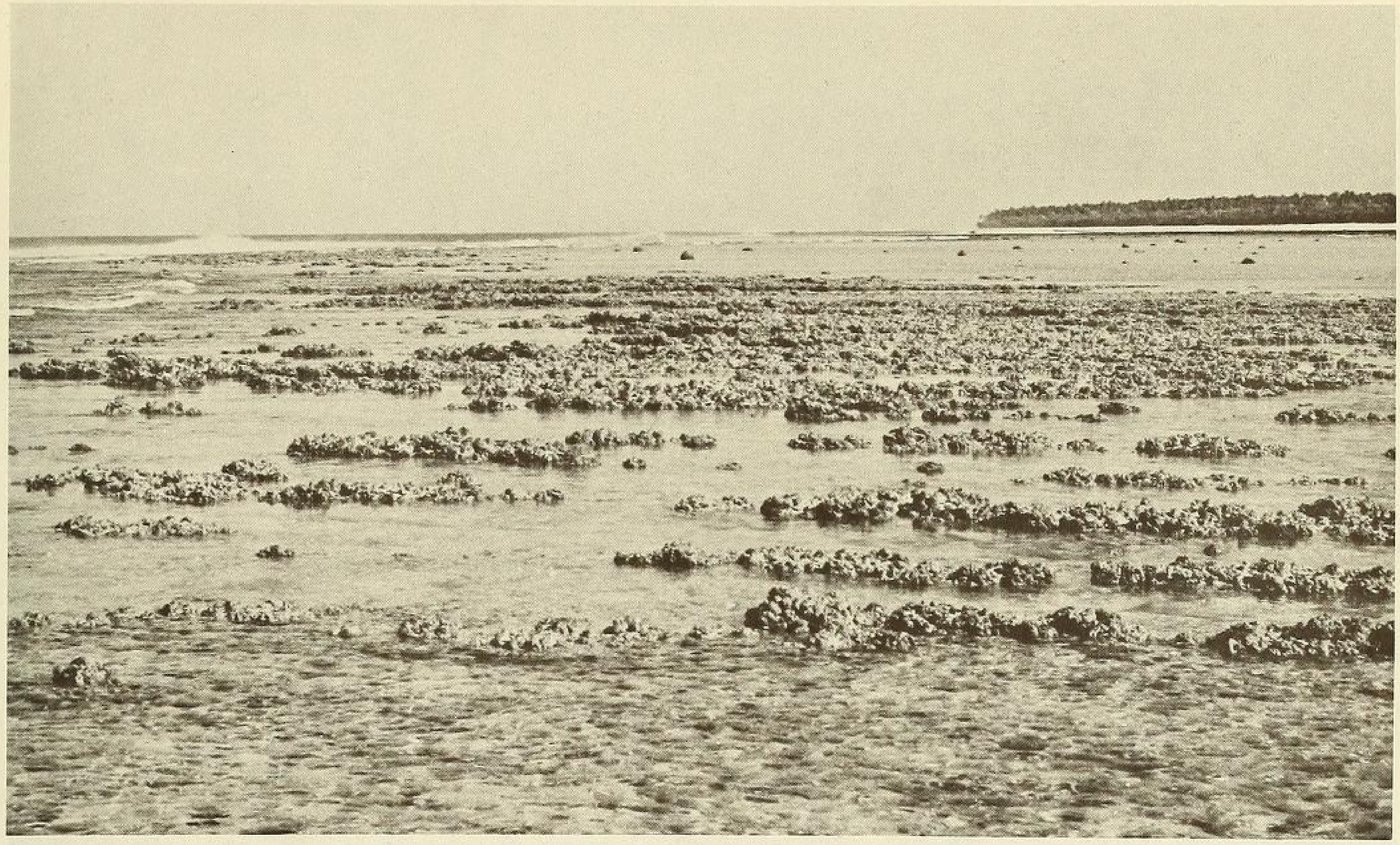
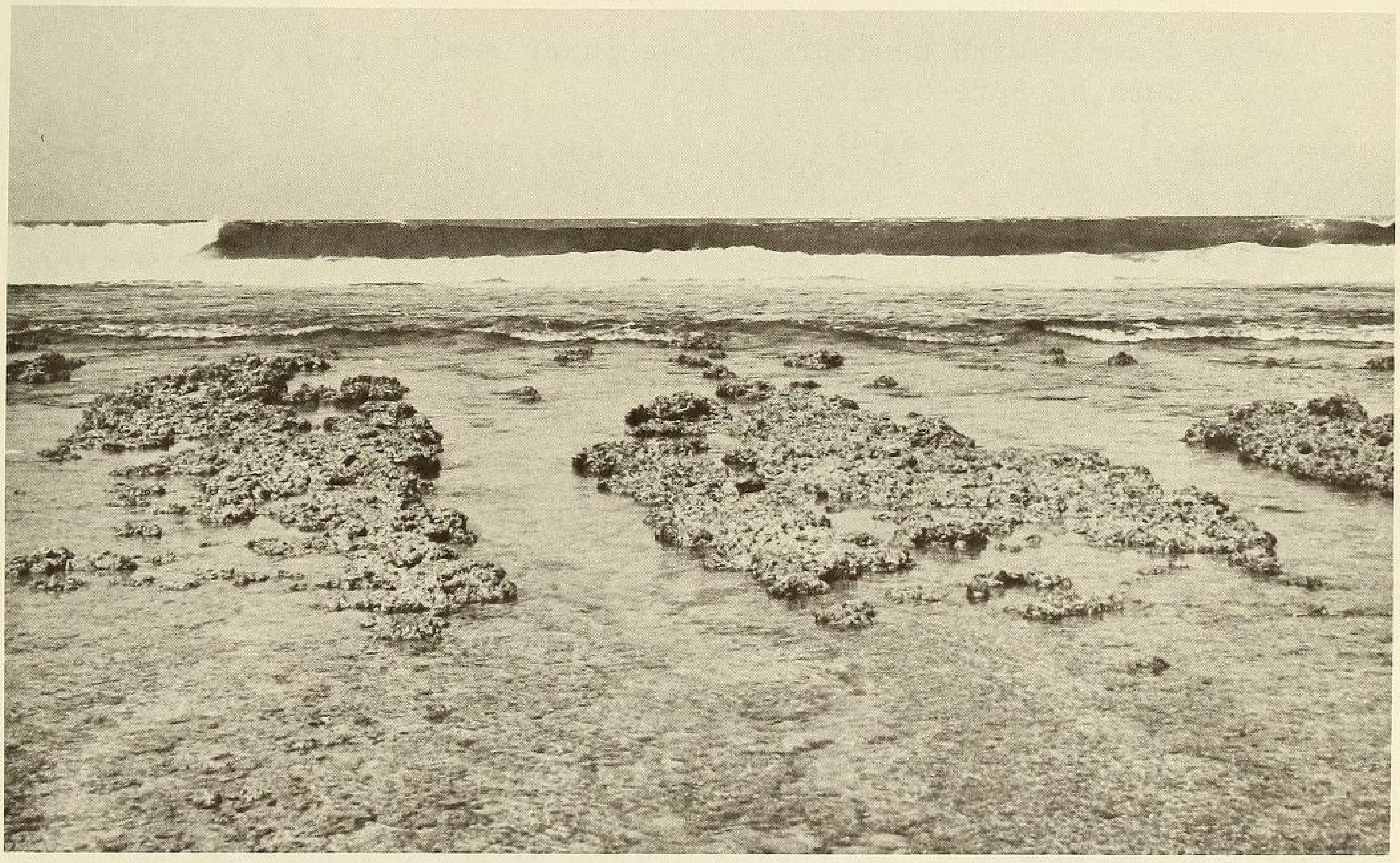


Fig. 18. Cumulative frequency curves for lagoon floor sediment samples.



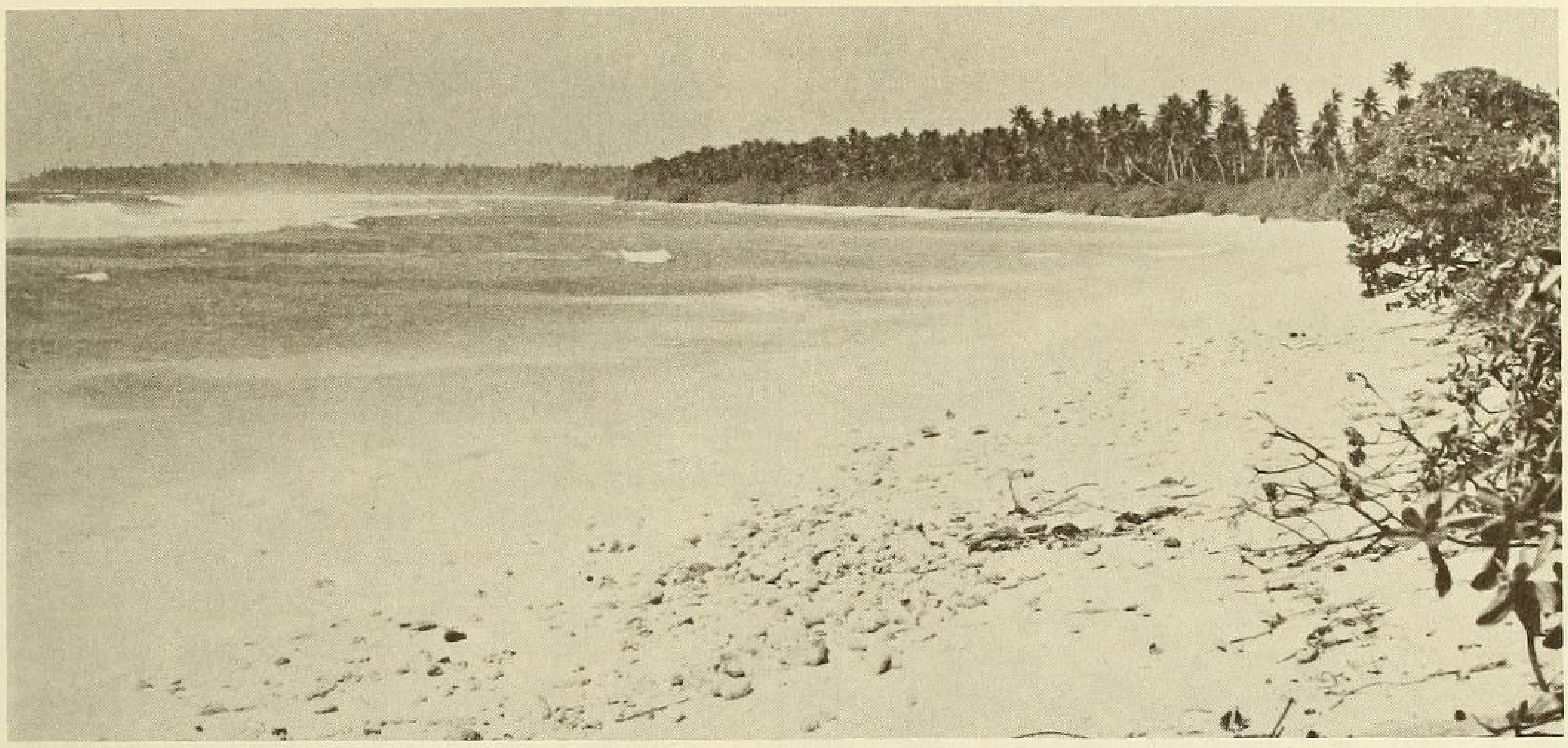
1. Algal rim of seaward reef flat, west coast reefs near Pointe Marianne

2. Surge channels in the algal rim; same locality as Plate 1



3. Boulder spread on the seaward reef flat at Barton Point

4. Low sand beach with boulders on the inner reef flat, seaward coast south of Barton Point

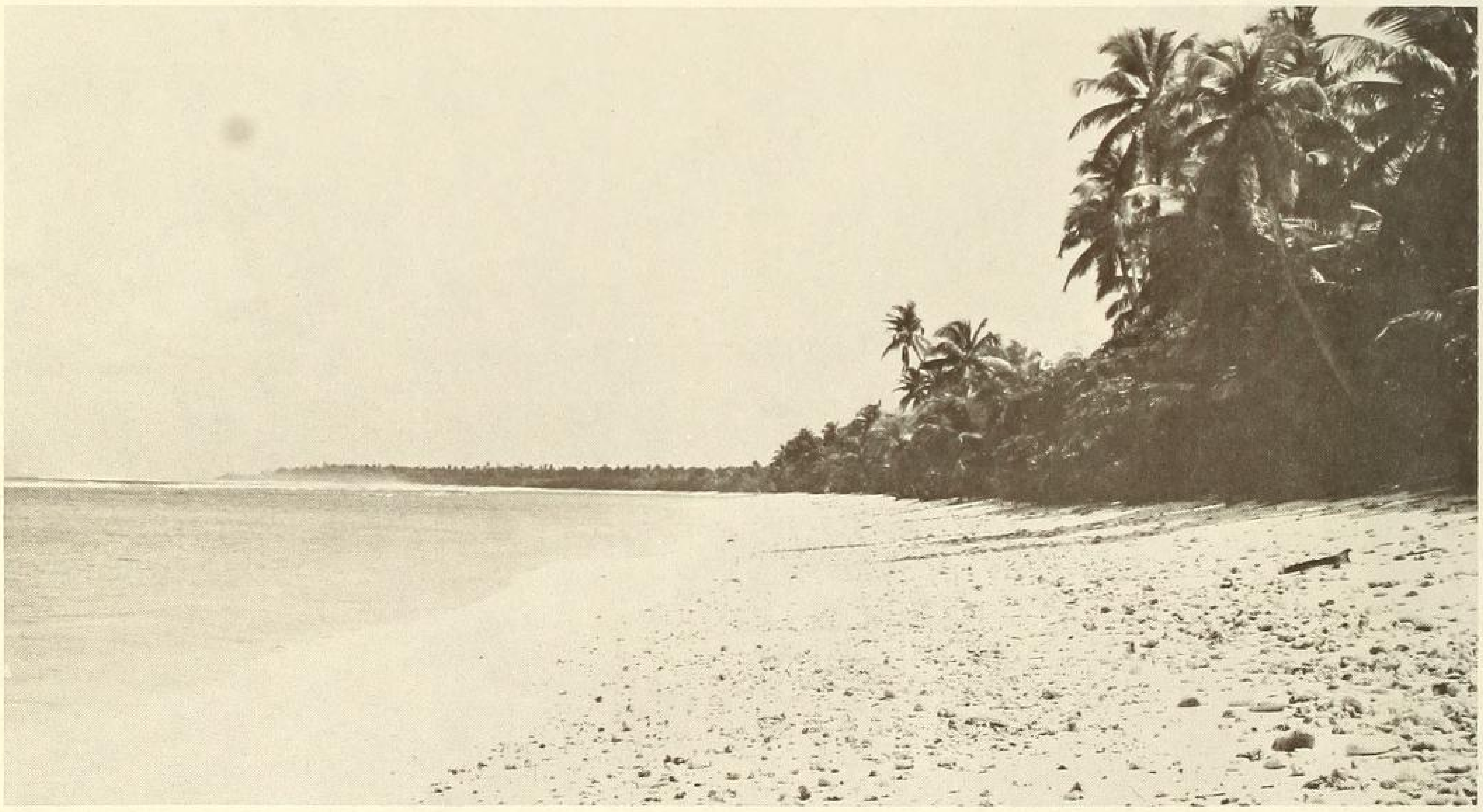


5. Wide sandy beach with Scaevola hedge and coconut woodland, seaward coast at East Point, looking south to Horsburgh Point

6. East coast sand and gravel beach at Horsburgh Point, looking north to Cust Point

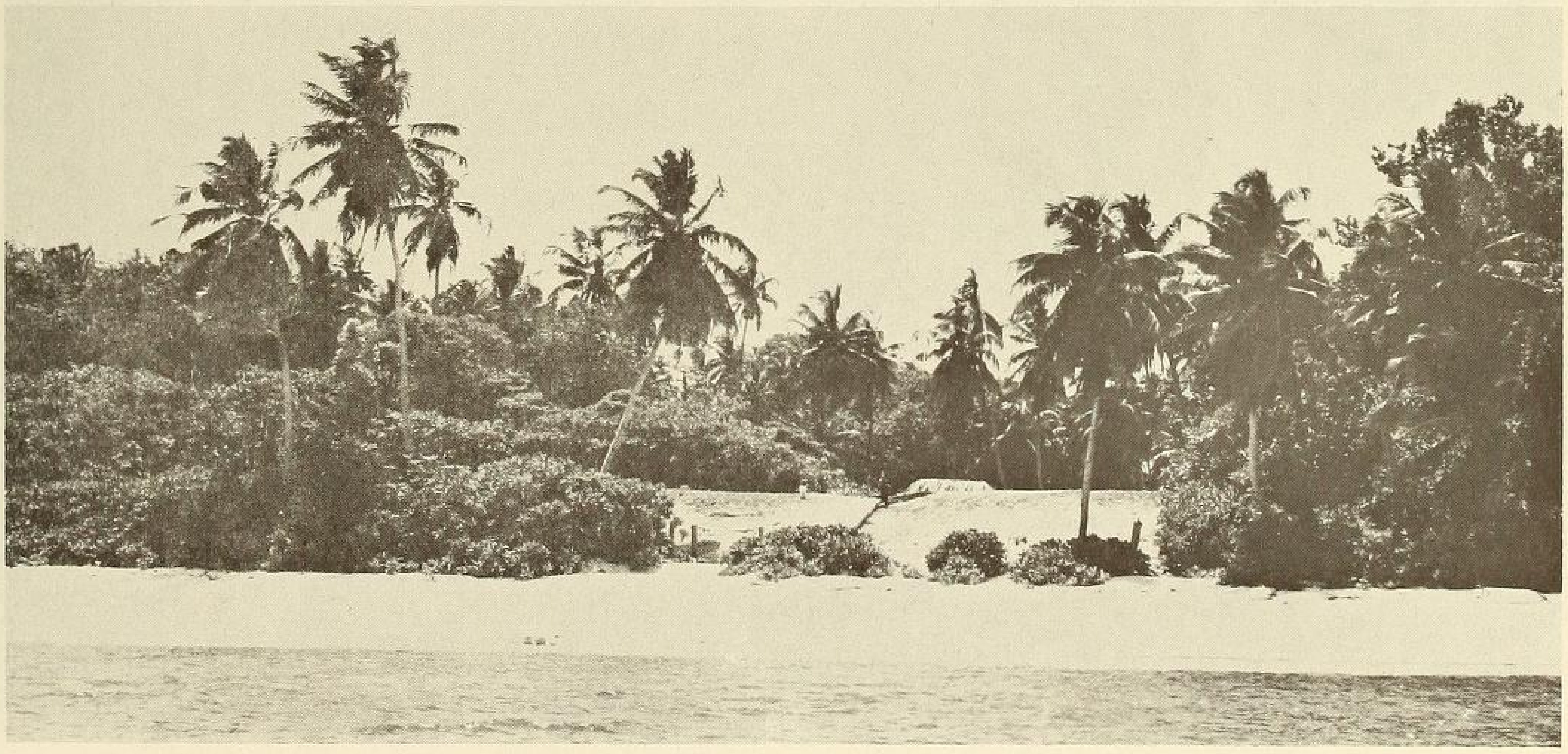
7. Cobble beach on exposed and retreating seaward coast, southeast coast 4 km northeast of Barachois Sylvain

8. Wide low-angle sandy beach, west coast, looking north from Pointe Marianne to Simpson Point



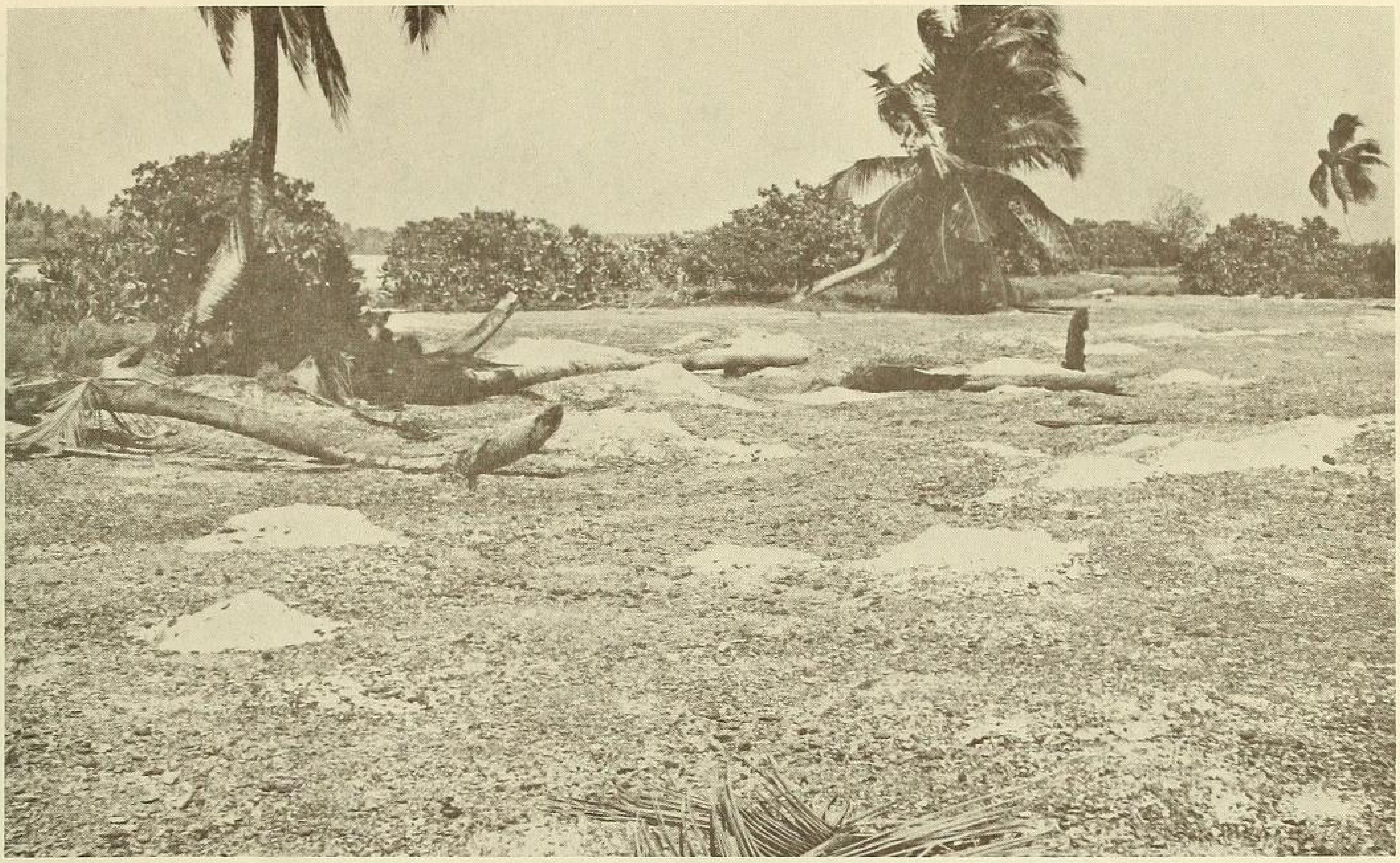
9. Retreating sandy beach with slightly cliffed dunes covered with Scaevola, seaward coast at Simpson Point

10. Lagoon coast, northeast rim between Cust Point and Observatory Point: most of this coast is lined with Scaevola, but at this point the vegetation has been cleared to reveal the lagoon dune ridge



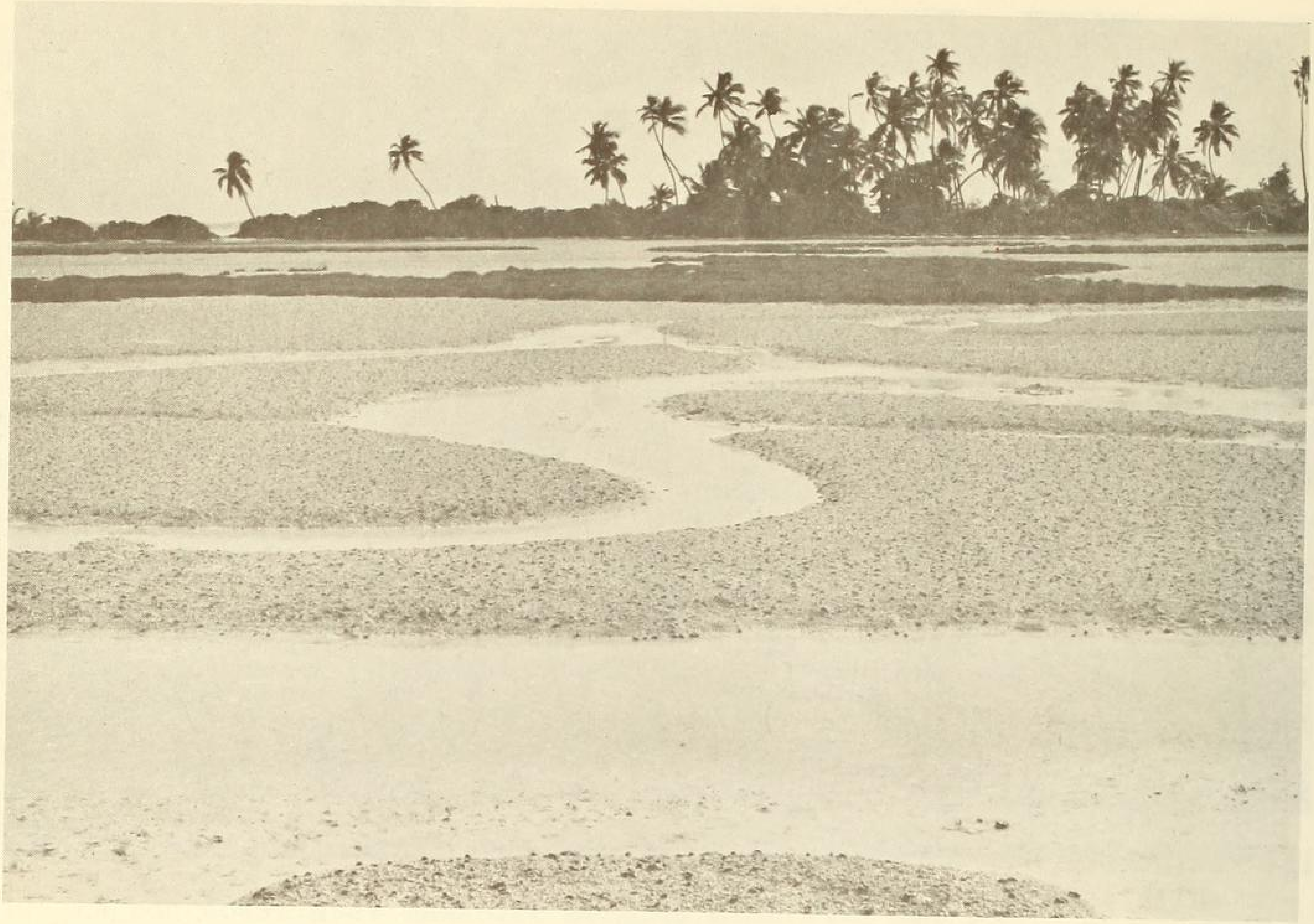
11. Lagoon coast near Mamzelle Adélie, west rim: the coast is formed by a low eroding rock platform and there is no beach

12. Small barachois at Carcasse, looking from the seaward beach ridge towards the lagoon entrance



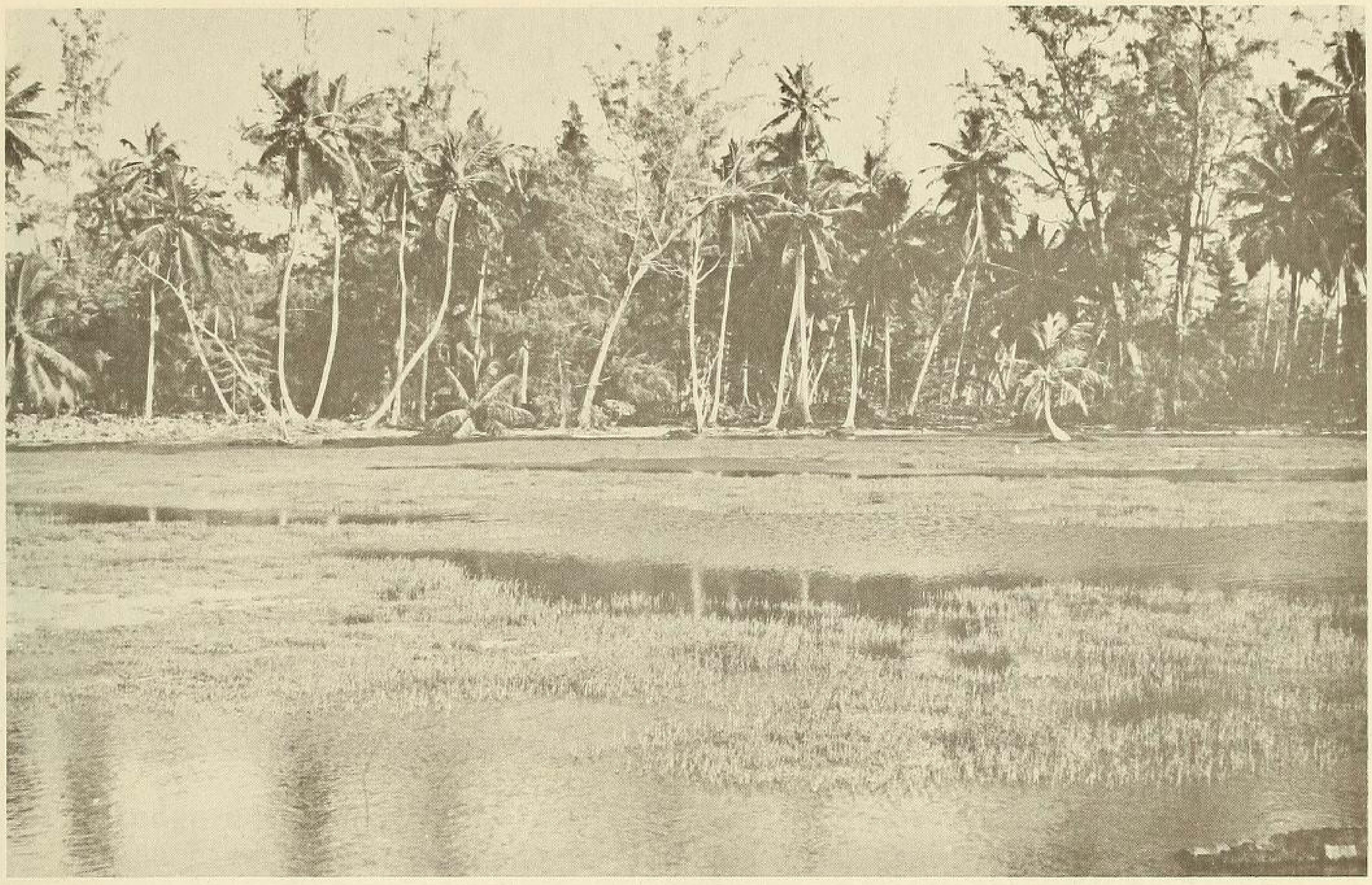
13. Barachois Maurice: blackened surface gravel with cones of white sand excavated by Cardisoma

14. Paspalum turf in the higher parts of Barachois Maurice; immediately below the turf is the Uca zone, and many of these crabs can be seen



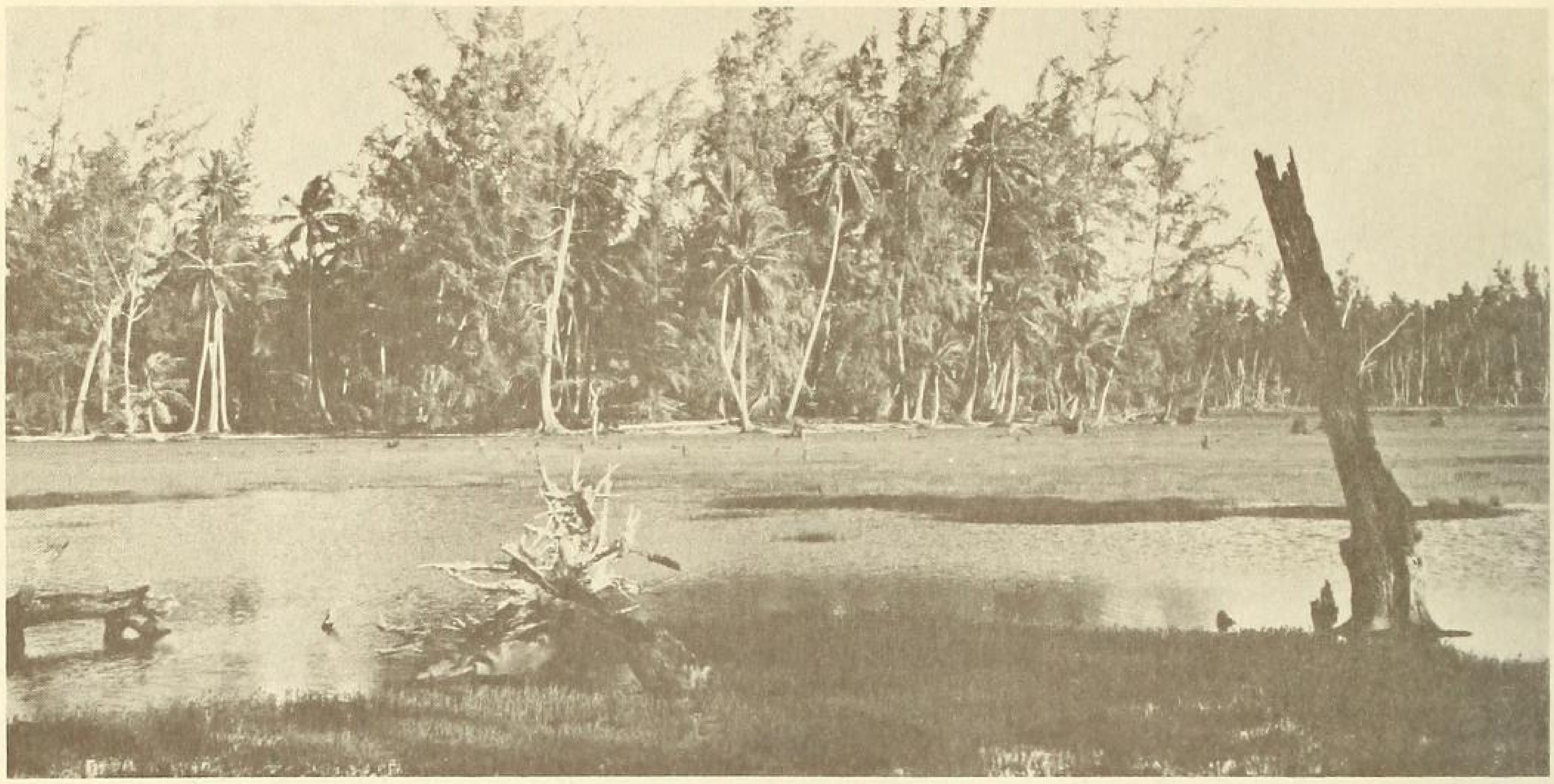
15. Meandering tidal channels, floored with calcilutite, and incised into the sandy Uca flats, Barachois Maurice

16. Large barachois at Pointe Marianne, surrounded by coconut woodland, and with Bacopa monnieri growing in the water



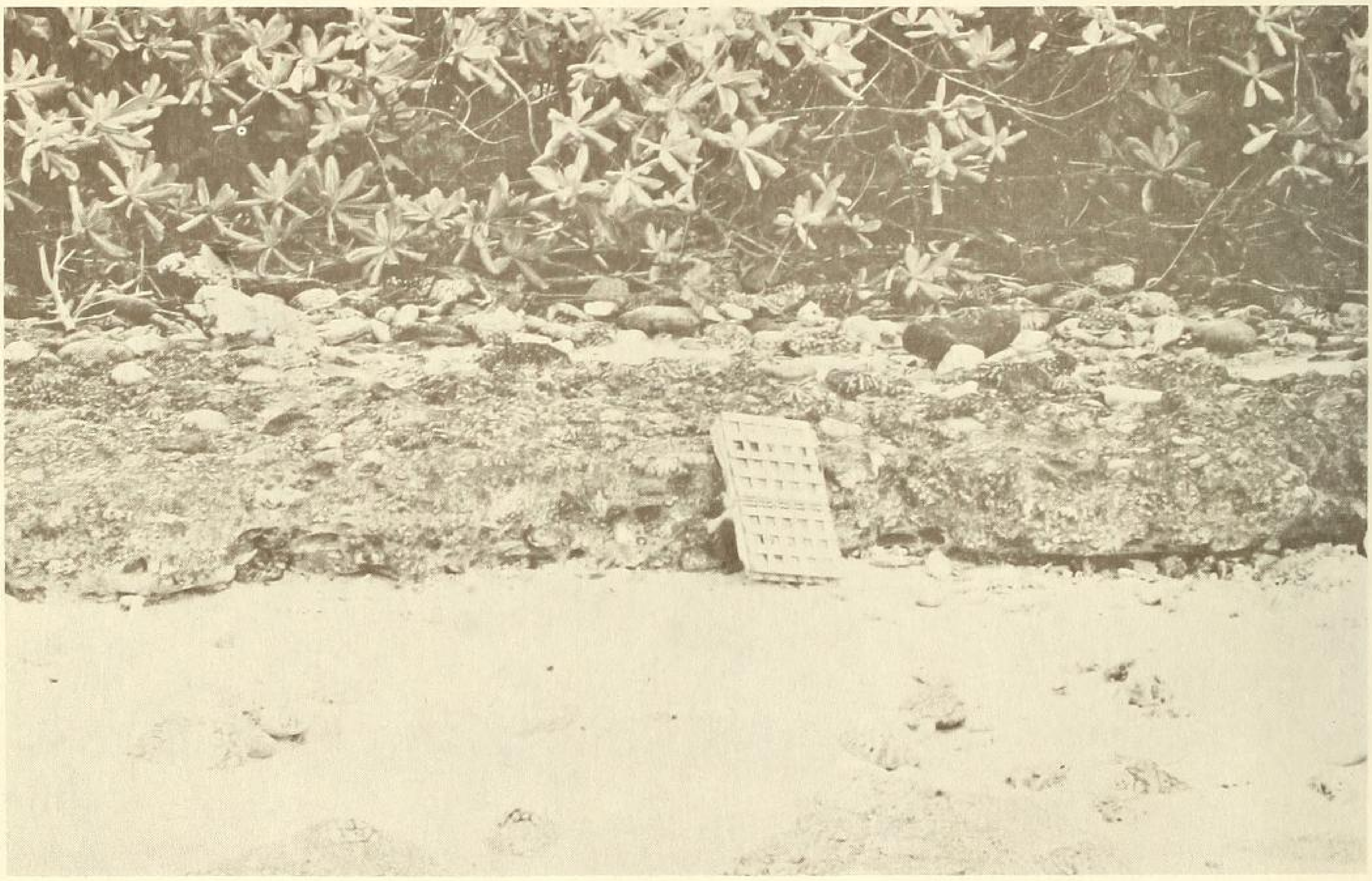
17. Large barachois at Pointe Marianne, surrounded by coconut woodland, and with Bacopa monnieri growing in the water

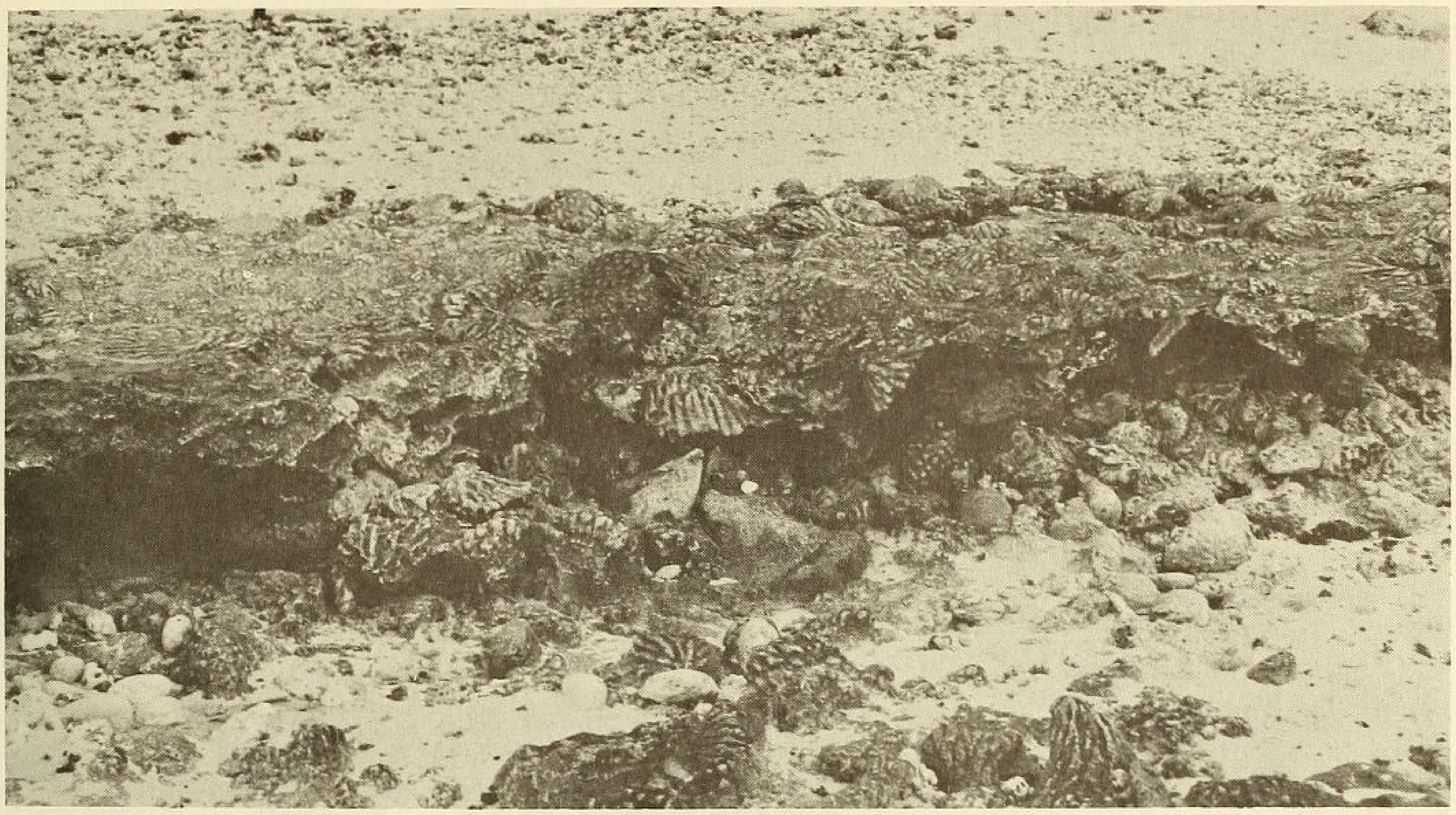
18. Dead coconut trees near the margins of the barachois at Pointe Marianne



19. Casuarina woodland on the margin of the Pointe Marianne barachois

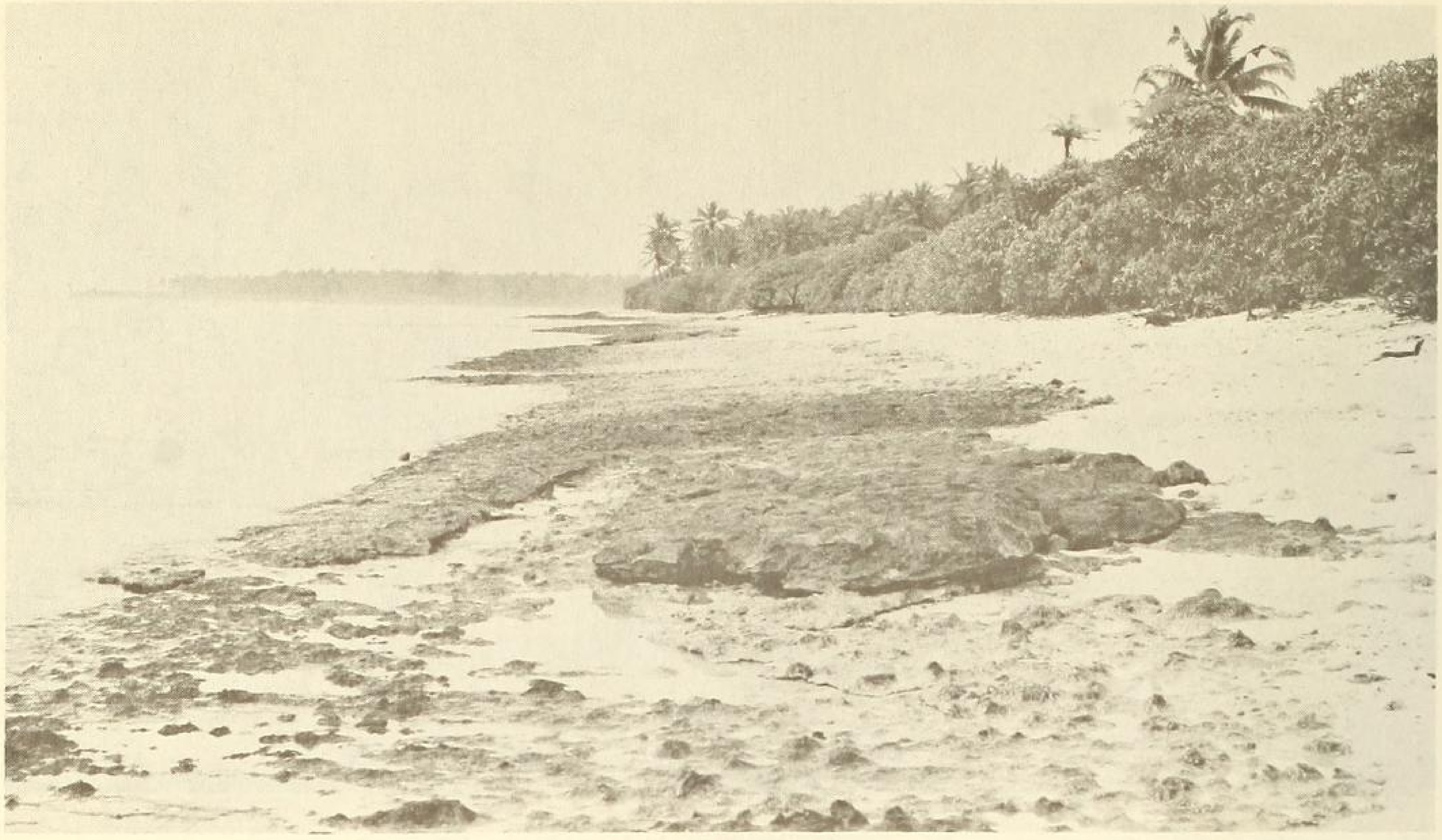
20. Ledge of conglomerate rock exposed in the mid and upper beach on the seaward coast at East Point: the rock contains many corals, mainly Acropora species, but not in the position of growth





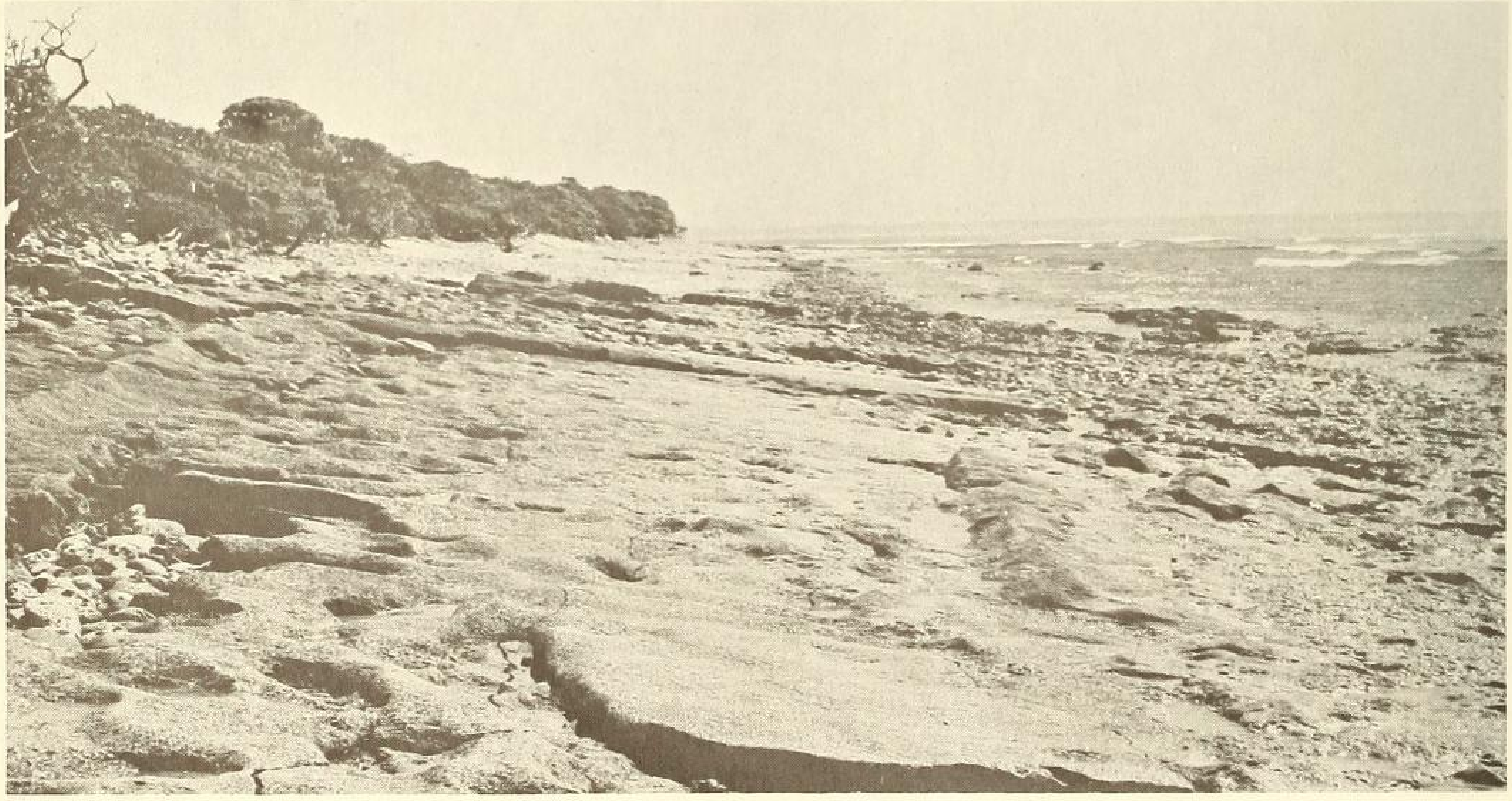
21. Ledge of conglomerate rock exposed in the mid and upper beach on the seaward coast at East Point: the rock contains many corals, mainly Acropora species, but not in the position of growth

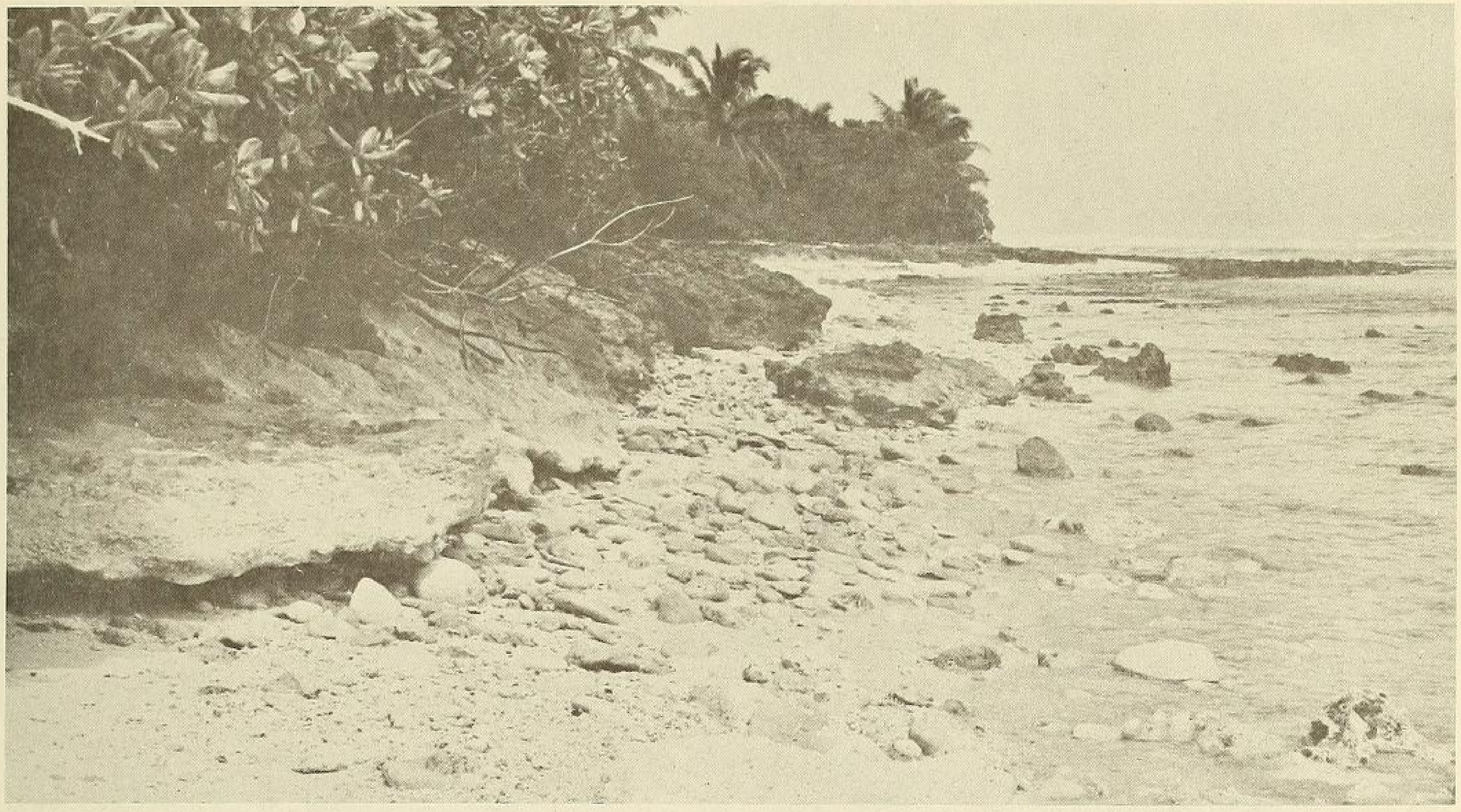
22. Eroded upper beach on the seaward coast at East Point, near to the rock exposure shown in Plates 20-21. The sediments are not cemented, but otherwise they closely resemble in calibre and composition the conglomerates exposed nearby



23. The conglomerate ledge of Plates 20-21, which shows no clear dip, passes laterally southwards into an eroded beach-foot platform which is in places surmounted by seaward-dipping calcarenites which resemble typical beach rock

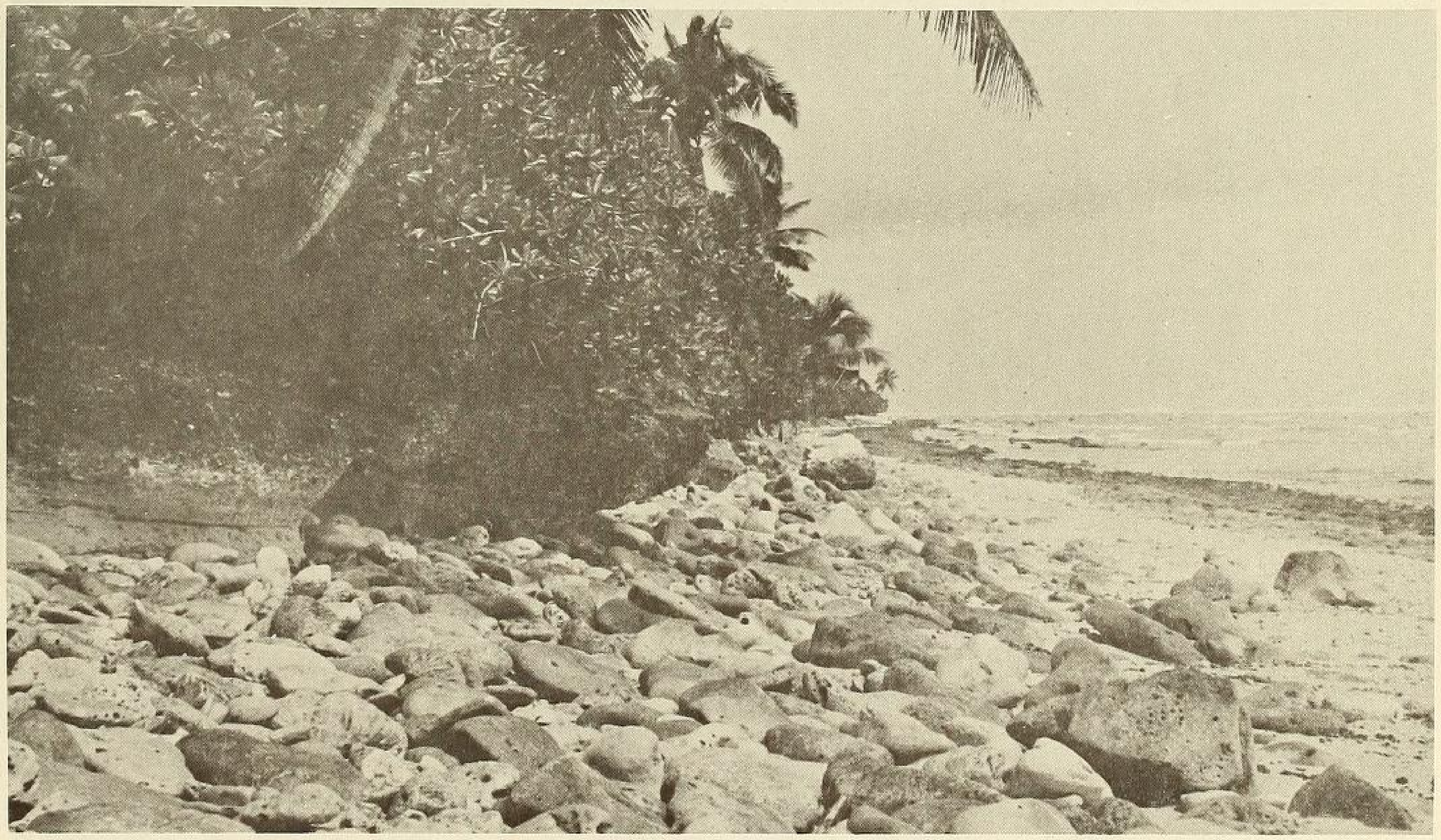
24. Well-developed flaggy beach rock on the southeast seaward coast, 6 km northeast of Barachois Sylvain





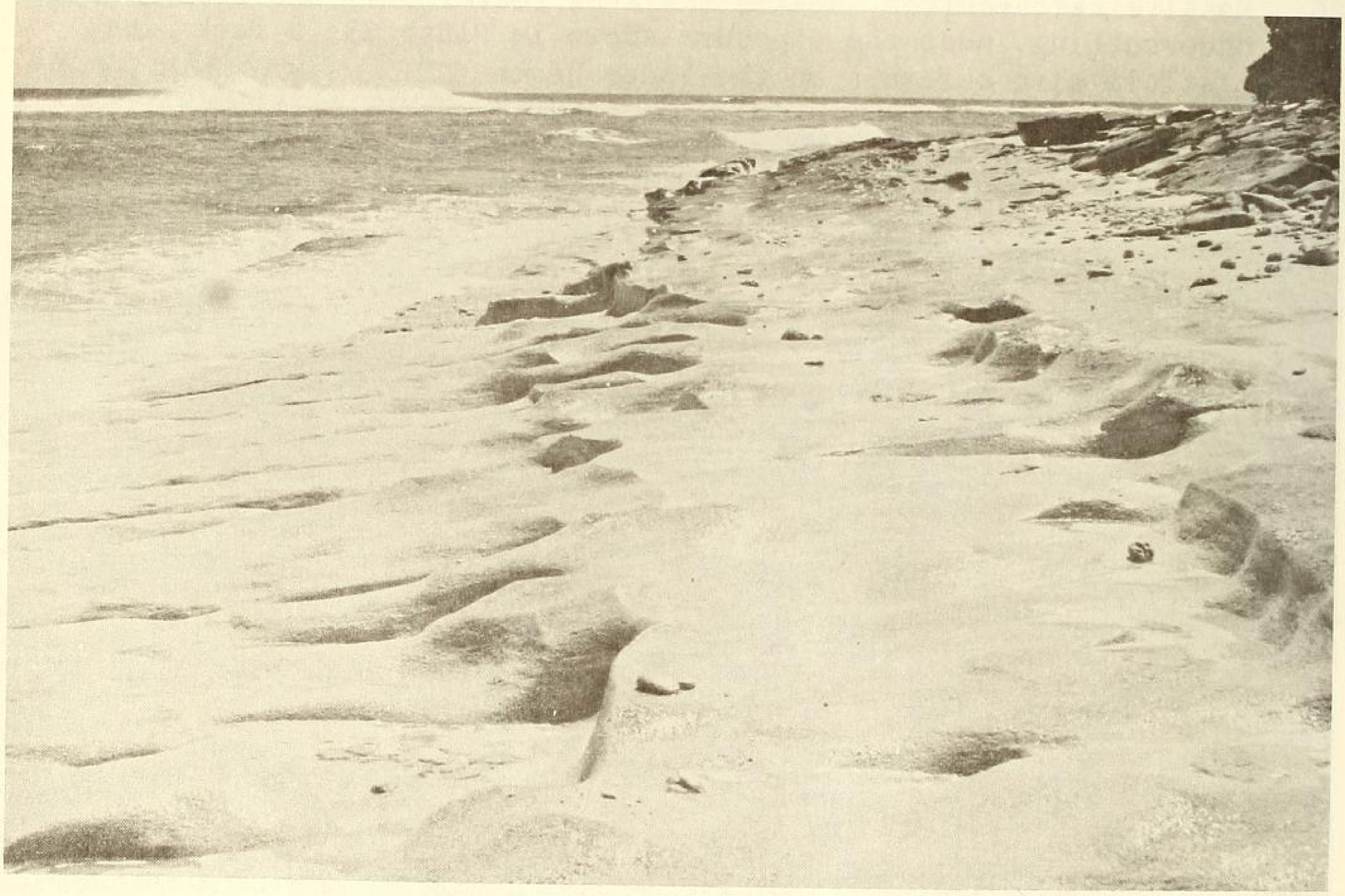
25. Massive fine-grained calcarenites forming an eroding ledge on the upper beach, western seaward coast north of the southern point

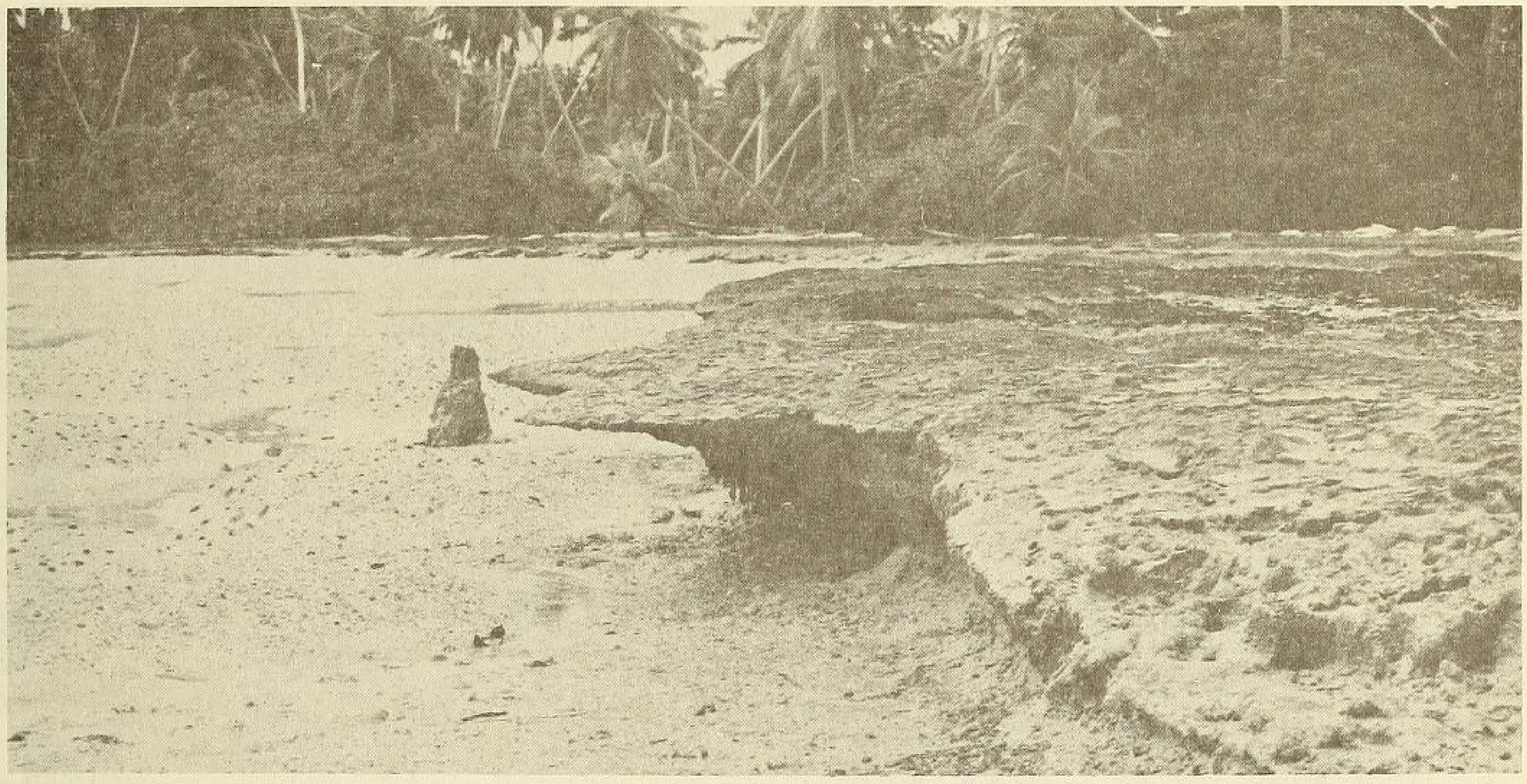
26. Massive calcarenites showing a slight seaward dip and also undercutting, near the exposure shown in Plate 25; a rock platform also outcrops on the lower beach



27. Smooth flaggy beach rock on a fine sand beach at Simpson Point

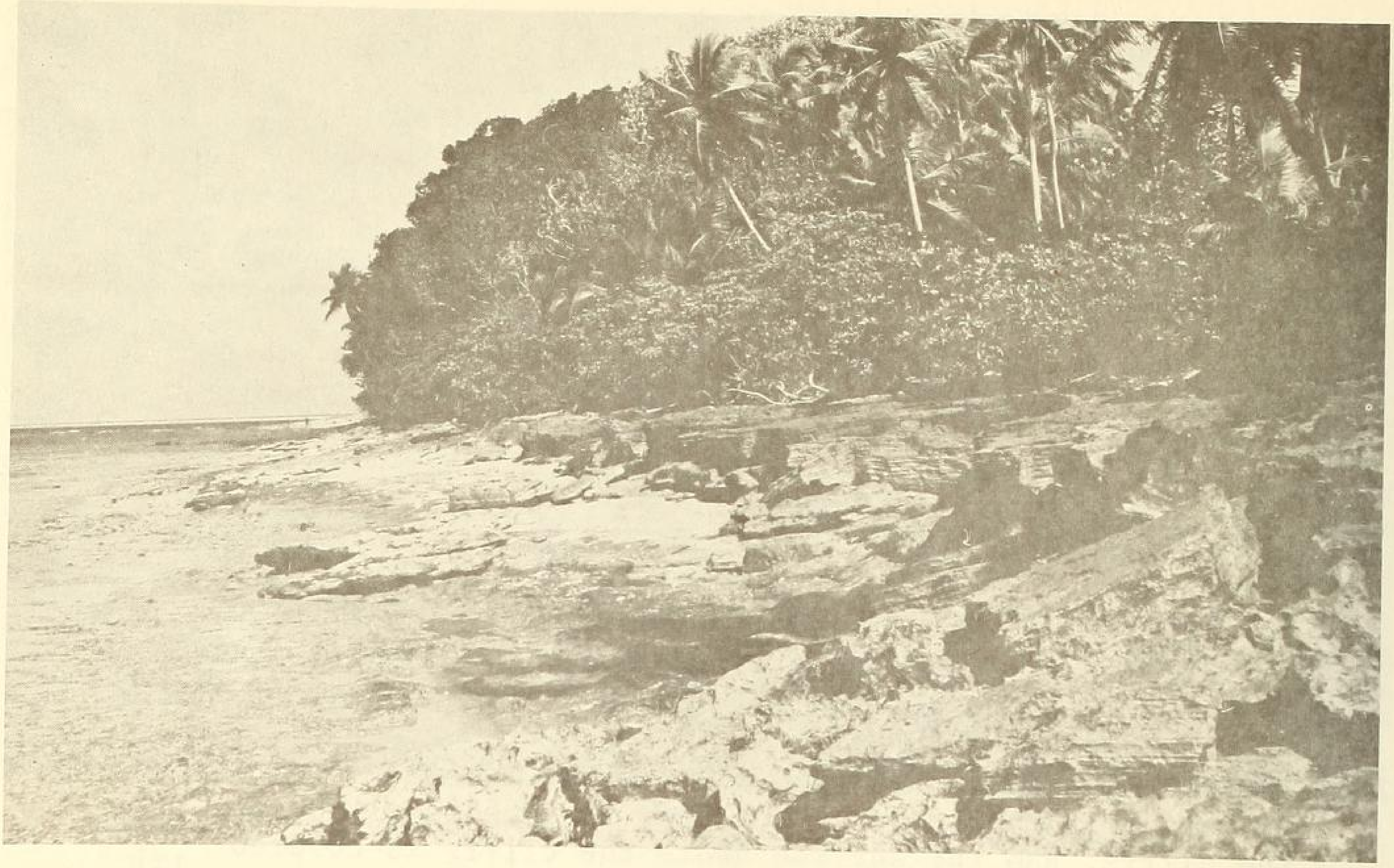
28. Grooved and fluted fine-sand beach rock at Simpson Point





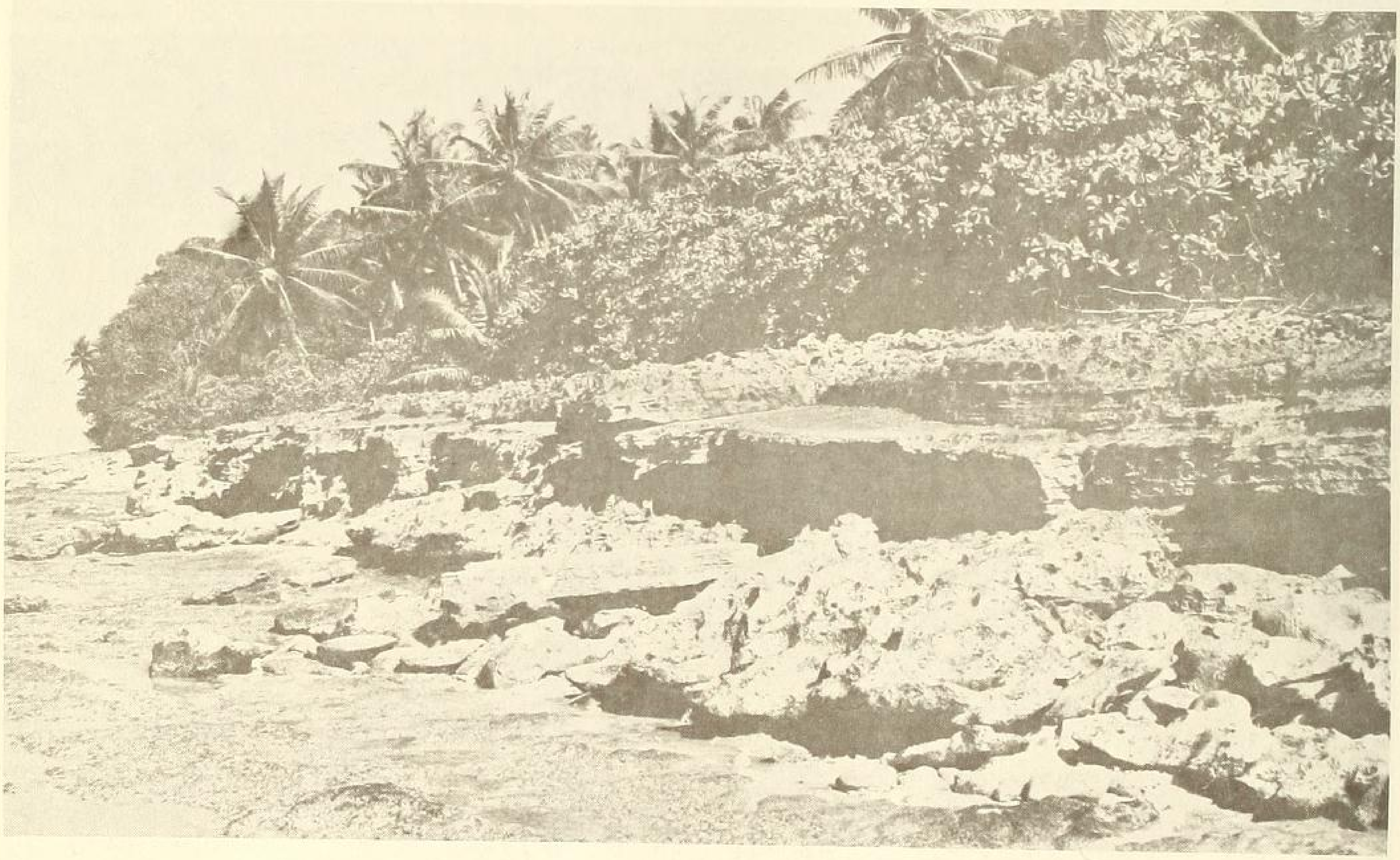
29. Undercut cliffs in cemented sands round the inner margins of Barachois Maurice: the <u>Uca</u> zone is immediately below the cliffs, and the surface above the cliffs is covered with an algal mat

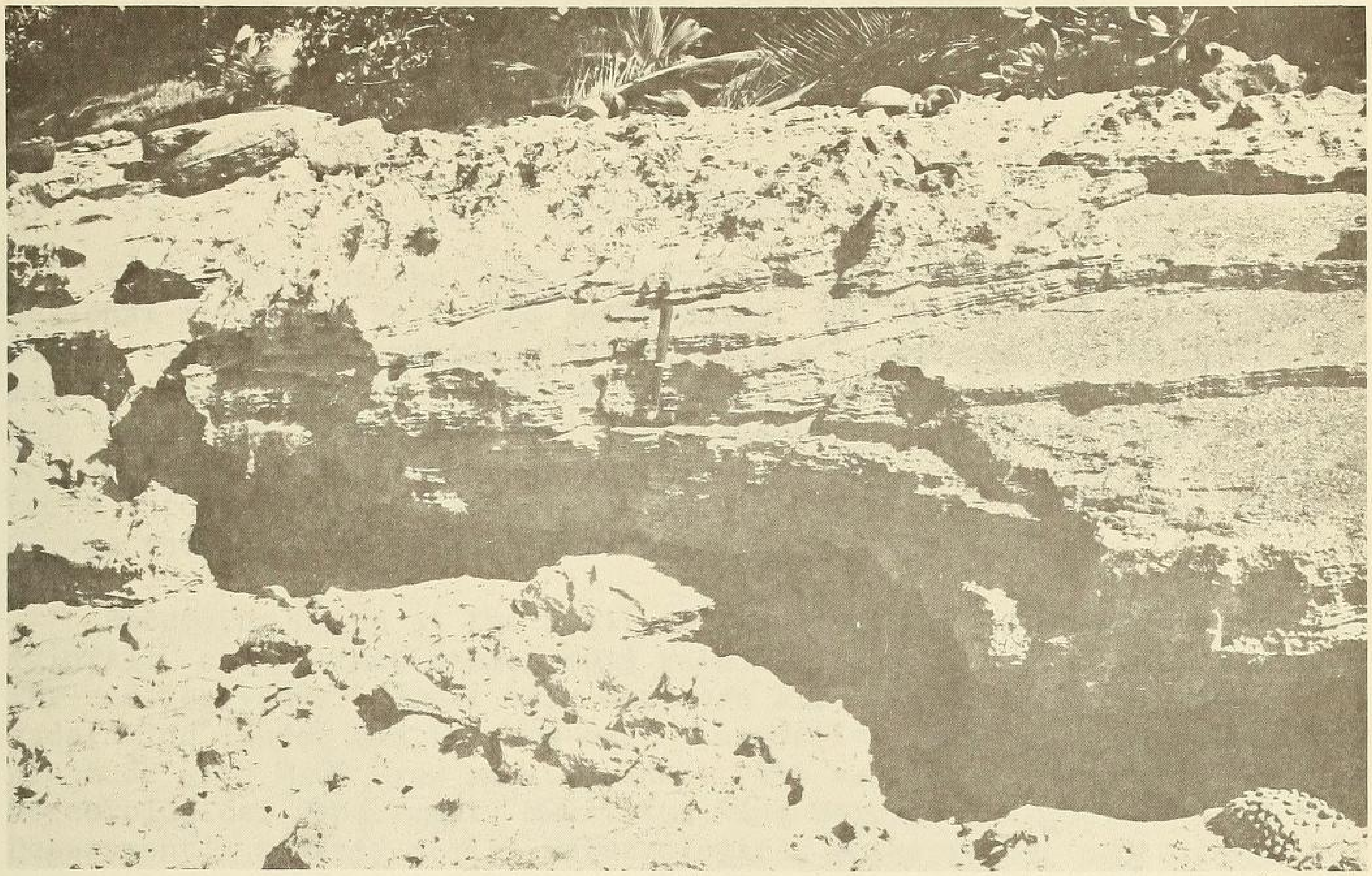
30. Isolated remnants of a formerly more extensive cemented surface, similar to that of the marginal cemented sands, are found within Barachois Maurice itself, surrounded by the <u>Uca</u> zone



31. Massive bedded calcarenites, dipping to the south, exposed on the southeast coast of East Island

32. Same as 31





33. Details of the East Island bedded calcarenites

34. Details of the East Island bedded calcarenites. Towards the eastern end of the island the calcarenites are much broken by wave erosion, forming large blocks