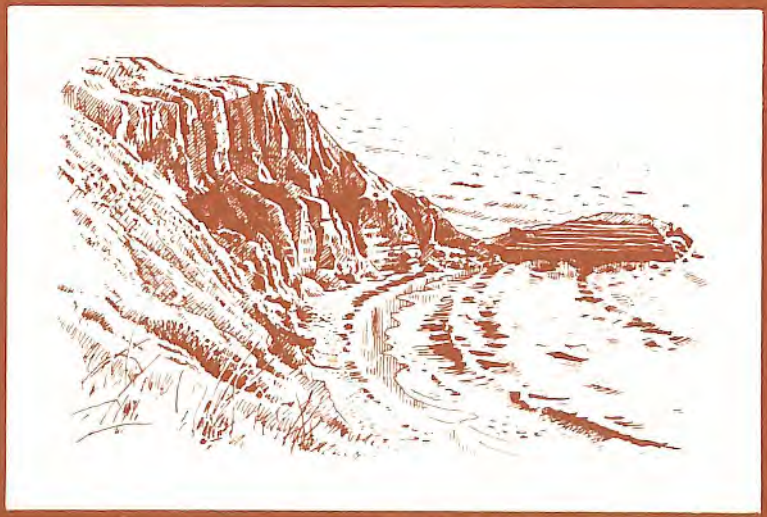
THE SANDRINGHAM ENVIRONMENT SERIES - No. 2

GEOLOGY AND LANDFORMS OF BEACH PARK:

An Excursion Guide



by ERIC BIRD

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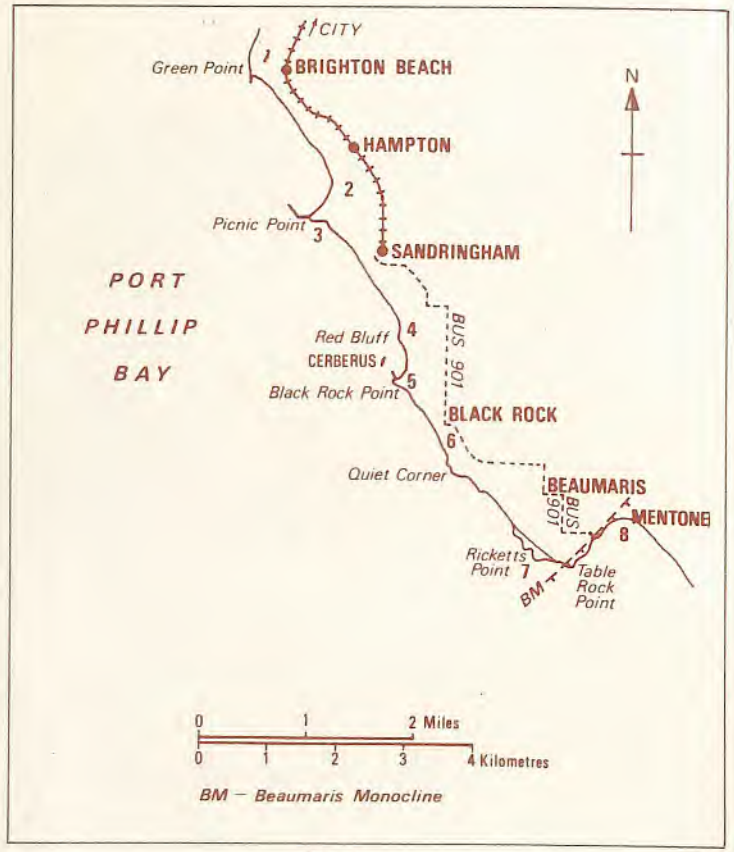

Fig. 1

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INTRODUCTION

This booklet describes and explains the geological and landform features seen in the course of a walk along the coast of Port Phillip Bay from Green Point, Brighton, to Mentone Corner, a distance of some 13 kilometres (about 8 miles). It includes the whole of the shoreline of Sandringham Municipality, from New Street on the Brighton boundary to Cromer Road, Beaumaris, a distance of 10.5 kilometres (6.6 miles).

The starting point is close to Brighton Beach station, a rail journey of about 25 minutes from the City. Allowing for pauses to admire the view and consult this booklet, and detours for refreshments, the walk takes about four hours. It is possible to catch Railway Bus No. 901 back from Beaumaris Hotel via Black Rock to Sandringham station, and return by train to Brighton Beach, or on to the City, a 30 minute journey. Alternatively, the walk can be done in two or three segments, using public transport to or from Sandringham station and Black Rock shops (Fig. 1).

Those who come by car or by coach can follow the itinerary by pausing at car parks close to each of the 8 stops listed in the text. It will be necessary to walk a little way along the shore to see some of the features mentioned.

It is advisable to make the walk during a period of low tide, when foreshore features are better exposed. Low tide occurs here a few minutes before it is recorded at Williamstown, and tidal predictions for Williamstown are given in the Melbourne morning and evening papers.

Stop 1 is in the car park at Green Point, just west of Brighton Beach station. The view southwards is along the shore of Hampton Bay to Picnic Point, where a large breakwater shelters Sandringham Harbour. In the distance, Arthur's Seat lies due south, and the You Yangs due west, across Port Phillip Bay. Geelong is over the horizon some 60 kilometres away to the west-south-west.

HAMPTON BEACH

In 1861, when Commander Cox drew his chart of this part of Port Phillip Bay, the coastline between Green Point and Picnic Point consisted of cliffs 5 to 10 metres high, bordered by a continuous sandy beach up to 30 metres wide (Fig. 2). Early photographs show that the cliffs were cut in soft clayey sandstone, gullied by rainwash and undercut by waves during storms.

This soft clayey sandstone extends along the coastline south to Beaumaris and is known as the *Red Bluff Sand*. It is underlain by a darker and harder ferruginous (i.e. iron-rich) sandstone, the *Black Rock Sandstone*, which here outcrops as a shore platform exposed in front of the sea wall at low tide.

In the 1880's, Brighton had become a popular seaside resort. Henry Burn's watercolour painting of the view south from Green Point in 1862 (La Trobe Library Collection) shows a train at the recently built Brighton Beach station, from which a tunnel led out to a pier. The crowded scene on Christmas Day 1864 was drawn by Chevalier (see Fig. 18 in Weston Bate's *History of Brighton*). People came by train to take boat trips from the pier, or to swim in Captain Kenny's Baths, a short distance to the south.

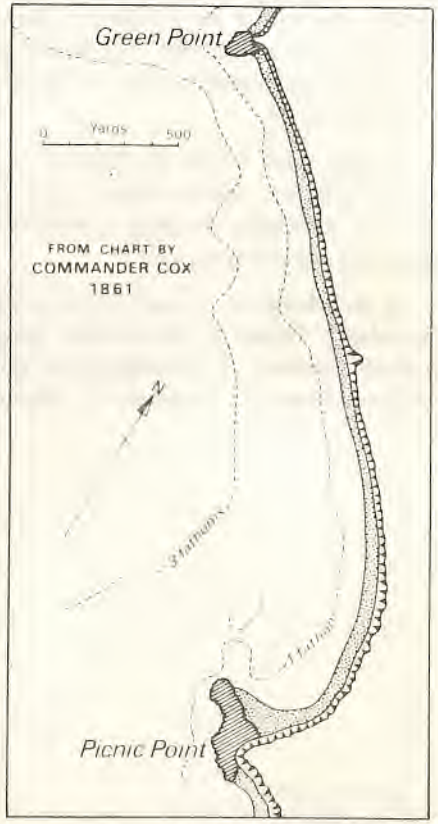

Fig. 2

The form of the cliffs and beach in 1864 are well shown on another engraving reproduced as Fig. 10 in Bate's book. A trackway, which has since become Beach Road, ran along the coast to Gipsy Village, in the tea tree behind Picnic Point. Gipsy Village is now part of Sandringham. Captain Kenny's Baths were destroyed by a storm in 1918, and replaced by the Brighton Beach Baths, dismantled in 1979: the pier shown in old pictures was removed in 1962.

The present sea wall was constructed in the late nineteen-thirties, and extended south as far as the Hampton Life Saving Club. The cliffs were re-shaped as an artificial coastal slope (20^{o} to 30^{o}) and planted with grasses and shrubs. When the wall was first built there was still a broad beach at Hampton, but in subsequent years it has almost disappeared.

The reduction of Hampton Beach is partly due to the fact that the eroding cliffs were the source of sand supply. Once they had been stabilised behind a sea wall this source of sand supply was cut off, and sand carried away from the beach by wave action could no longer be naturally replenished. Some beaches are nourished by sand carried down to the coast by rivers or washed up from the adjacent sea floor, but this is not the case here. The nearest river, the Yarra, is notoriously mud-yielding, rather than sand-yielding, and the sea floor off this coast is silty rather than sandy. Consequently, the persistence of Hampton Beach depended on continued erosion of the sandy cliffs.

In addition, these almost vertical sea walls reflect the waves, particularly during storms, and cause beach material to be swept away offshore. Some of it is returned by gentler waves in calmer weather, but with each major storm there has been further loss of beach material to the sea floor. Beach sand is also dispersed by longshore drifting, which occurs when the waves come in at an angle to the shoreline. The coast here faces south-west. Waves that arrive from this direction (i.e. with wave crests parallel to the shoreline) do not move beach material laterally, but waves arriving from the south drift sand towards Green Point, and those coming in from west or north-west carry it down towards Picnic Point. Thus the beach occupies a compartment separated by promontories from other similar beach compartments to the north and to the south.

At Hampton Beach, as in other beach compartments on the east coast of Port Phillip Bay, there are frequent alternations of longshore drifting as wave directions change. In summer (November to March) the predominant drifting is northward, because the waves include a more frequent southerly component than in winter, when

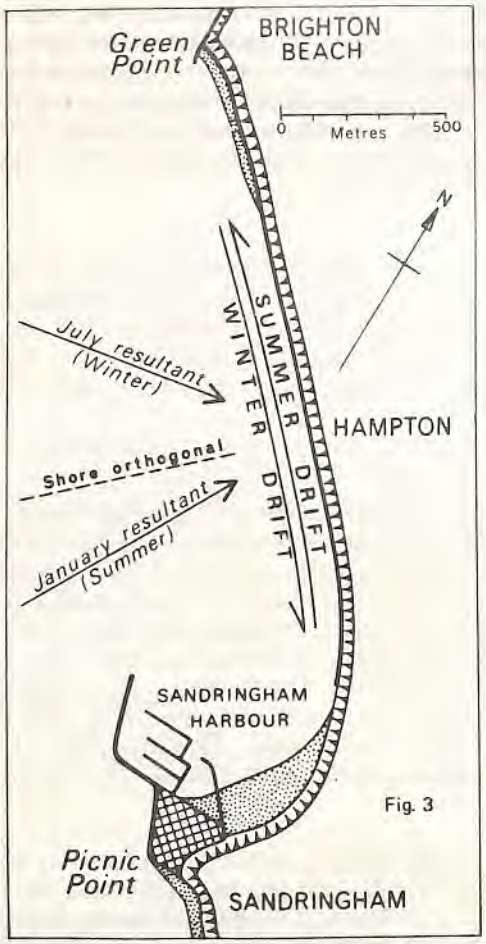

Fig. 3

the stronger westerly and north-westerly winds produce waves that drift the sand back to the south (Fig. 3).

It should be noted that this beach drifting results from wind generated wave action rather than from tidal currents, which are here too weak and impersistent to shift much sand along the shore. There is, however, a gradual southward movement of sediment over the sea floor in the zone up to a kilometre offshore in response to currents generated by the prevailing westerly winds, which flow down the coast in a south-easterly direction to Rickett's Point and beyond.

After the sea walls had been built, beach sand continued to drift to and fro each year, the beach widening towards Green Point in summer, and towards Picnic Point in winter. By 1950 there had been some reduction of beach material, but there was still a beach at Hampton, subject to this seasonal alternation. When the breakwater at Sandringham Harbour, extending out from Picnic Point, was completed in 1952

it began to act as a sand trap by excluding the southerly wave action that previously carried sand northwards from Picnic Point each summer. Subsequently, year by year, much of the sand that moved southwards in winter has become trapped on the shore behind the breakwater, within Sandringham Harbour.

Thus the primary reason for the depletion of Hampton Beach has been the trapping effect of Sandringham Harbour breakwater. Along with the halting of sand supply from the former cliffs and the addition of sea walls that cause reflection scour, this has resulted in exposure of the rocky shore platform that once lay beneath the sandy beach. The problems are thus due largely to man's interference with the coastal system. Yet if the sea wall had not been built the cliffs would by now have been cut back several metres more, and in places Beach Road would have been undermined.

The walk south along the undercliff to the Hampton Life Saving Club passes various kinds of groynes that have been put in to trap drifting sand and retain a beach. Most of the old timber groynes have disappeared, but in 1971 groynes of caged stones, up to 30 metres long and 50 to 80 metres apart, were added to the shore. A few patches of beach sand have been retained, but there is very little sand left to be trapped as it moves along this shore.

Artificial replacement of Hampton Beach would be difficult because any sand dumped here will be redistributed by wave action, drifting mainly southward to accumulate in Sandringham Harbour. One way of preventing this would be to construct artificial beach compartments consisting of groynes that ran out about 30 metres from the existing sea wall, linked along their outer limits by an underwater dam built up to low tide level. Beach material placed in these enclosed compartments would not be lost offshore or alongshore. Such 'boxed-in' beaches have been produced by Russian engineers on parts of the Soviet Black Sea coast that are comparable with the setting of Melbourne's bayside beaches, and the idea could be successful here at Hampton.

At the top of the bluff, opposite the railway crossing at the end of New Street, is the boundary between the Brighton and Sandringham municipalities. Sandringham Beach Park starts here, and extends southwards past Rickett's Point to Beaumaris. It varies in width from about 30 to over 300 metres, and is backed by Beach Road. Originally declared a Beach Reserve in 1852, it became known as Sandringham Beach Park in 1917, and has been intensively used for seaside recreation. Over the years the natural vegetation cover has been modified, and in places impoverished, but recently the local council has started to manage and restore the area with the aim of preserving landscape features as a setting for nature conservation as well as community use.

Near the Life Saving Club the Public Works Department has placed large basalt boulders in front of the sea wall. The aim was to create a structure that absorbed, rather than reflected, waves approaching the shore, in the hope of reducing scour, but there is still very little beach material here. The boulders have been criticised because they trap litter and seaweed, and provide a habitat for rats.

In front of the Life Saving Club an attempt was made in 1975 to restore the beach by pumping in sand from the floor of Sandringham Harbour. Unfortunately this sand is rather fine-grained, and has largely washed away. Beach nourishment is usually more successful if the material placed on the shore is at least as coarse in texture as the beach sand originally present.

Farther south, beyond the end of the wall, more boulders have been dumped in front of the last remaining section of cliff. Some exposures of the pale brown and yellow Red Bluff Sand may be seen on the coastal slope. An ascent may be made here to reach **Stop 2,** overlooking Sandringham Harbour.

SANDRINGHAM HARBOUR

The bluff here indicates the line of the cliffs that once curved out to Picnic Point. Early charts, maps and photographs show a sandy beach 25 to 50 metres wide (varying seasonally, as explained above) in front of gullied cliffs of Red Bluff Sand.

The pier was built in 1882. In 1900 a wooden wall was built at Picnic Point to stop cliff erosion, and in 1906-9 wooden breakwaters were added offshore to shelter a small boat anchorage. Stages in the elaboration of Sandringham Harbour are shown in Fig. 4. In 1935 the wooden breakwaters were lengthened, and in 1936 a submarine (S on Fig. 4) was sunk to fill a gap between them. In 1939 rock rubble was dumped to reinforce the breakwater. In 1949-50 the massive outer breakwater was built, at first with a gap at the southern end, through which it was hoped tidal currents would flow in such a way as to scour away sand. In fact, sand was washed in through this gap, and in 1954 it was sealed off. Meanwhile, Sandringham Yacht Club developed on reclaimed land at Picnic Point.

After 1954, sand accretion became rapid along the shore behind the breakwater, and by 1963 there was a broad sandy beach area in front of cliffs which were no longer reached by the waves (Plate 1). Rubble and soil were dumped to convert the abandoned cliffs into grassy bluffs. In the past ten years, dune scrub vegetation, including coast wattle *(Acacia longifolia, var. sophorae)*, some tea tree *(Leptospermum laevigatum)*, and the alien boneseed *(Chrysanthemoides)* has colonised

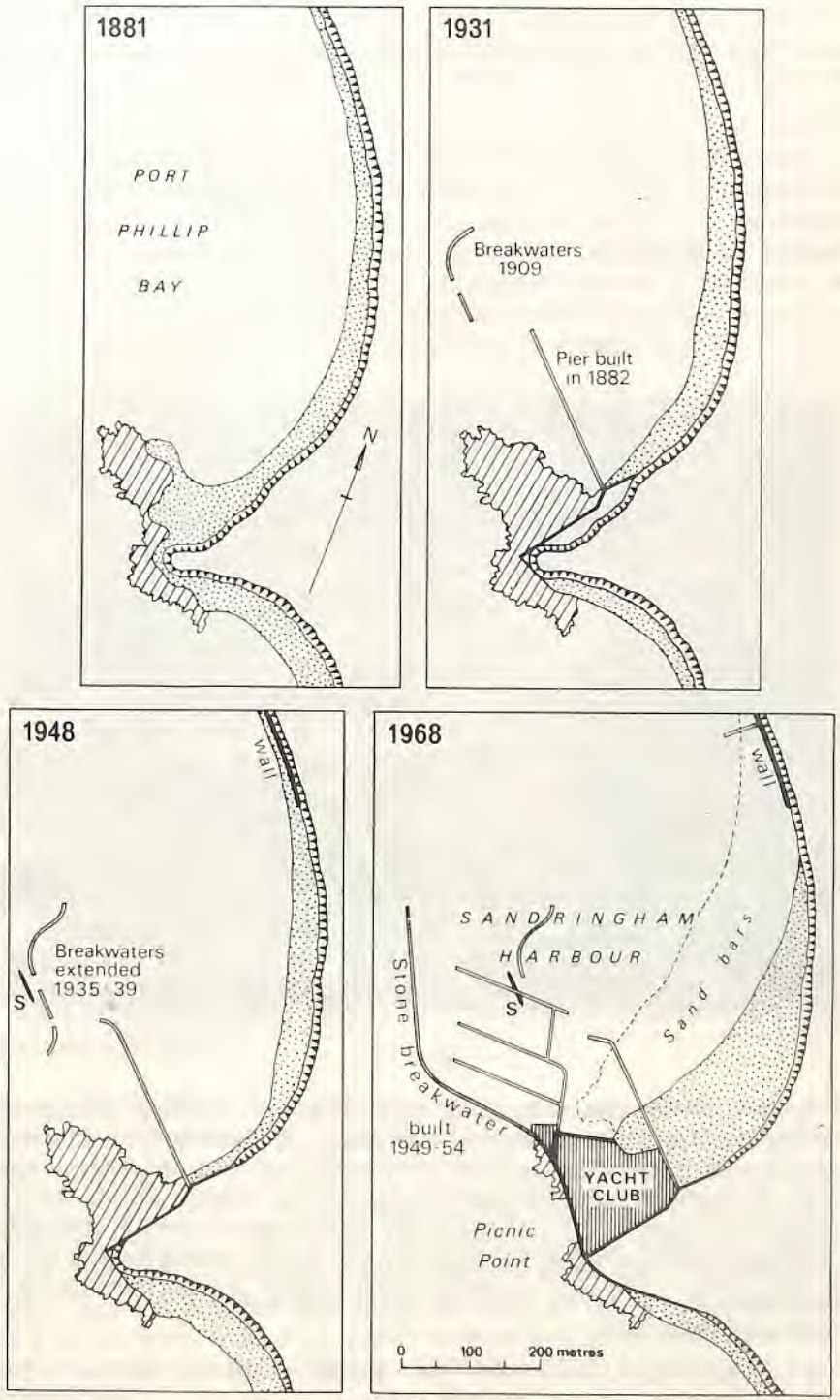

Fig. 4

this area, along with *Spinifex* grass and some rushes *(Scirpus nodosus)* in damper hollows. In its new location the sand which once formed Hampton Beach is now sustaining a developing shrubbery of dune plants.

Since 1962, attempts have been made to improve the harbour by dredging out sand and pumping it either northwards (as already mentioned) to Hampton Bay, or through the breakwater and south towards Sandringham. Among the suggestions for future action are the extremes of either dismantling Sandringham Harbour or building a chain of stone breakwaters north to Green Point to enclose the whole of Hampton Bay as a marina complex.

Plate 1.

A compromise would be the construction of a second breakwater, curving out from the vicinity of Hampton Life Saving Club towards a narrowed harbour entrance, and the removal of accumulated inwashed sand to restore the beaches northward to Green Point. Such a programme would lead eventually to accumulation of a broad beach along the northern flank of such a breakwater, and probably to the restoration of Hampton Beach as a seasonally alternating feature, as previously described.

A footpath leads along the top of the bluff south to the Yacht Club, and thence to **Stop 3,** the car park on Picnic Point.

PICNIC POINT

The view southward is along Sandringham beach to Red Bluff, with Half Moon Bay in the distance.

Picnic Point has been much modified by stabilisation and reclamation associated with the development of Sandringham Harbour. In 1950, E.D. Gill published an account of the geological features no longer visible here, including a shelly beach formed when the sea stood about 2 metres above its present level, and an aboriginal kitchen-midden, a cliff-top site where the aborigines cooked and feasted on shellfish, especially mussels and oysters, relics of which can still be seen mixed with charcoal in the bank alongside the ramp.

Picnic Point is one of several promontories related to foreshore outcrops of the Black Rock Sandstone. The junction between this relatively hard sandstone and the overlying softer Red Bluff Sand undulates as it is traced down the coast: where it rises above sea level there are headlands, and where it drops below sea level, bays have been cut out in the softer rock.

SANDRINGHAM BEACH

Sandringham Beach consists of coarse quartz sand, with minor amounts of shelly material and ironstone fragments. It has been little modified by sea walls, and it shows clearly the seasonal alternation of drifting mentioned previously: in summer it is wide near Picnic Point and narrow near Red Bluff, and in winter this is reversed. Just south of Picnic Point, where waves are refracted around both sides of a foreshore outcrop of Black Rock Sandstone the beach curves out to a cusp, or cuspate spit. At Sandringham a structural bench of Black Rock Sandstone outcrops at the base of the bluff, forming a low cliff fronted by a gently-shelving abrasion platform, cut in the sandstone by waves that move sand to and fro across the shore. Such a platform extends along much of this coastline, but is generally hidden by beach deposits. A wave-built sand bar is usually present a few metres offshore along Sandringham Beach.

Between Sandringham and Red Bluff the coastal slope and the reserve extending back to Beach Road are occupied by dune woodland, with coastal tea tree and associated shrubs. A footpath leads through to Red Bluff. Opposite Edward Street there is a broad dell, where spring-fed streams have carved out a hollow in the soft sands, and at several points gullies have been cut into the coastal slope by rainwater flowing down tracks formed where people scramble to and from the beach. Minor landslides have occurred here. In recent years the beach has been severely eroded by winter storms and only partly restored in calmer summer weather. Eventually artificial beach nourishment will be needed here.

RED BLUFF

Stop 4 is on top of Red Bluff (Plate 2), a conspicuous landmark on the north-east shore of Port Phillip Bay. It is also a site of scientific interest. Geologists identify and correlate the various rock formations in the earth's crust, naming each of them with reference to a selected example, called a *type-section*, usually in a cliff or quarry where the rock formation is particularly well exposed. Red Bluff is the geological type-section for the Tertiary rocks known as the Brighton Group, which consist of the Red Bluff Sand, red, yellow and grey in colour and gullied in the cliff face, overlying harder, darker Black Rock Sandstone which here runs out as a basal ledge. The rocks include coarse sand with some quartz pebbles, and finer, often clayey sand, and they are thought to have been deposited in an estuarine environment (perhaps ancestral to the Yarra River entering an earlier Port Phillip Bay) in late Miocene to early Pliocene times, 5 to 10 million years ago. The mottled colouring near the cliff crest and the paler zone below probably originated during a phase of deep weathering under humid tropical conditions in late Pliocene times, 2 to 3 million years ago.

Plate 2.

Gullying in the Red Bluff Sand is due partly to runoff after heavy rain, but has been much accentuated by people climbing and scrambling on the cliff face. There are chimneys, buttresses, and pinnacles reminiscent of desert landforms, as well as horizontal layers and ledges of slightly harder rock. Soon after the first World War, Red Bluff was used as the location for a film about the landings at Gallipoli. On the northern side the cliffs have been partly obscured by the dumping of rubble, broken paving, and derelict cars, a practice that was discontinued in 1964. Grassy and scrubby vegetation is gradually colonising this area.

HALF MOON BAY

The view southward is across Half Moon Bay, carved out by marine erosion in the softer Red Bluff Sand in a sector where the Black Rock Sandstone dips below sea level, to rise again off Black Rock Point. The bay is shaped by waves refracted into curves as they run in between the protruding sandstone promontories and reefs.

At the northern end of Half Moon Bay there are the rectangular aboriginal wells cut into Black Rock Sandstone at the base of the cliff. Kitchen middens are exposed at intervals along the back of the beach.

At the southern end of the bay the shore has been modified by the construction of a sea wall and a pier in front of the Life Saving Club and the Yacht Club, and by the placing of the *Cerberus*, an ironclad battleship of 1870 vintage, offshore to act as a breakwater in 1926. There is a possibility that the *Cerberus* could either be salvaged and removed to a nautical museum, or preserved where it is as an historical feature. If it were removed, there would be slight changes in the outline of the beach in Half Moon Bay, and it might be necessary to substitute another structure to shelter the existing boat harbour.

Plate 3.

BLACK ROCK POINT

Stop 5 is at Black Rock Point, where there are car parks on the cliff top and also at the bottom of a road which leads down to the shore. To the south is a sector of shore platform on Black Rock Sandstone backed by bluffs and gullied cliffs cut in the Red Bluff Sand, which are here pale grey in colour (Plate 3). The cliffs are undercut by storm waves occasionally at high tides, the rilling being mainly due to runoff after heavy rains, with some damage by scrambling people. Repeated surveys here since 1972 indicated only gradual changes, except during severe storms like that of 28-30 June 1980, when the cliff base was trimmed back and a natural arch cut through the buttress at A in Plate 3.

The cliff section is of geological importance, for it shows the contact between the Red Bluff Sand and the Black Rock Sandstone, near the base of the cliffs, as irregular, rising and falling across the almost horizontal bedding of the sands, grits, and clayey sands. A conspicuous layer of quartz grit and pebbles can be traced in the base of the cliff and out patchily across the shore platform. In places there is a mottled transition zone, due to a past phase of deep weathering under humid tropical conditions, possibly late in Pliocene times, some 3 million years ago. Similar pale rock overlies dark ferruginous rock in the cliffs at Nightcliff, near Darwin, where humid tropical weathering is still in progress.

At the top of the cliffs the Red Bluff Sand is overlain by grey dune sands, which form part of a series of Pleistocene dunes that extends south-eastwards across the hinterland to Cheltenham and Moorabbin. The dunes have been eroded at the cliff crest to expose an old soil horizon which, sloping seaward, acts as a watershed off which water pours down the cliff rills during heavy rain. Erosion could be reduced here by putting in a trap drain at the cliff top and restoring the vegetation cover to intercept the runoff.

An aboriginal kitchen midden is also exposed near the top of the dune capping. In places it is overlain by sand that has blown up from the eroded cliff crest.

The cliff is interrupted by a small embayment at the mouth of an incised valley with scrub-covered slopes. Immediately to the south the rilled cliffs are receding in such a way as to develop another incised valley, which will eventually be similar in form to the first one.

This is one of the wider sections of Sandringham Beach Park, with a zone of woodland and scrub extending 300 metres back to Beach Road. Cliff recession offers no immediate threat to Beach Road here, and Black Rock Point has been registered by the Town and Country Planning Board as a Site of Special Scientific Interest, the intention being that it should remain as a feature of geological importance, its continuing geomorphological evolution being worthy of study. Fig. 5 indicates the probable sequence of evolution here, an initial slope (ABC) having been cut back as a cliff (CF) in soft Red Bluff Sand, the underlying Black Rock Sandstone hardening on exposure to persist as a broad shore platform (EF) of dark brown rock. A study by Bird, Cullen and Rosengren (1973) forecasted the eventual development of natural bluffs here (DF), providing that the sea remains at its present level.

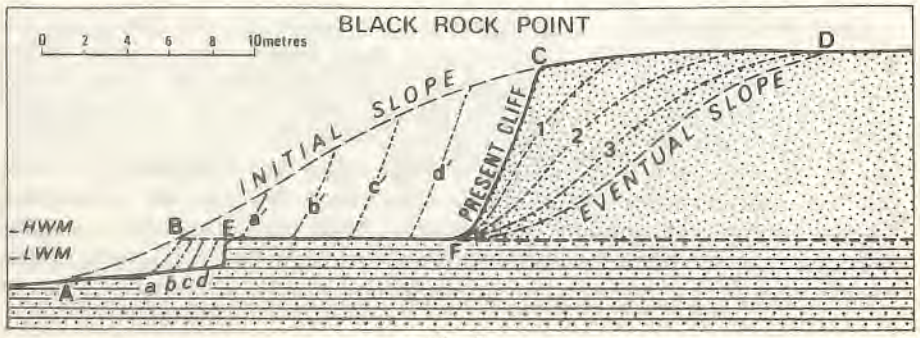

Fig. 5

BLACK ROCK BEACH

The southern end of the shore platform at Black Rock Point is also the northern limit of the next beach compartment, Black Rock Beach. As at Sandringham Beach, there is summer accretion at this end of the beach, when sand moves northward from Quiet Corner, the headland visible in the distance, and winter depletion when the sand moves back to the south.

Black Rock Beach is backed by scrub-covered bluffs and a woodland reserve through which a footpath runs south to the clock tower. At some earlier stage, when the sea level was slightly higher, these bluffs were retreating cliffs, but now they are subject only to local gullying down tracks worn by people scrambling to and from the beach.

Stop 6 is at the car park just south of the clock tower at Black Rock, where a ramp descends to the undercliff walk. South from Black Rock to Quiet Corner the coast originally consisted of eroding cliffs cut in sandstone, but during the late 1930s these were stabilised by building a sea wall. As at Hampton this led to a reduction in sand supply and an increase in scour by reflected waves, and the beach south of Black Rock is never as wide as it was before the wall was constructed. But as there is no trapping breakwater of the kind seen at Picnic Point, the beach sand still moves to and fro, and in the winter months the beach at and south of Black Rock may be up to 20 metres wide. It is estimated that there are now 40,000 to 50,000 cubic metres of sand in the Black Rock beach compartment. The quantity was increased in 1969, when about 10,000 cubic metres of sand were brought from inland quarries at Bentleigh and Moorabbin and then tipped on to the beach at Quiet Corner (1, 2 and 3, Fig. 6). It was quickly spread alongshore by wave action and incorporated in the seasonally alternating beach deposit.

The concrete drain which runs out below the car park gives a good indication of the most recent movement of beach material. If the sand has been built upward and outward on its northern side, the last movement was to the south, while accretion on its southern side indicates northward drifting. This is also a good place to judge the state of the tide. On calm days high tides reach the top of the drain pipe, and low tides fall just below the bottom, maximum tide range here being a little over 0.8 metres.

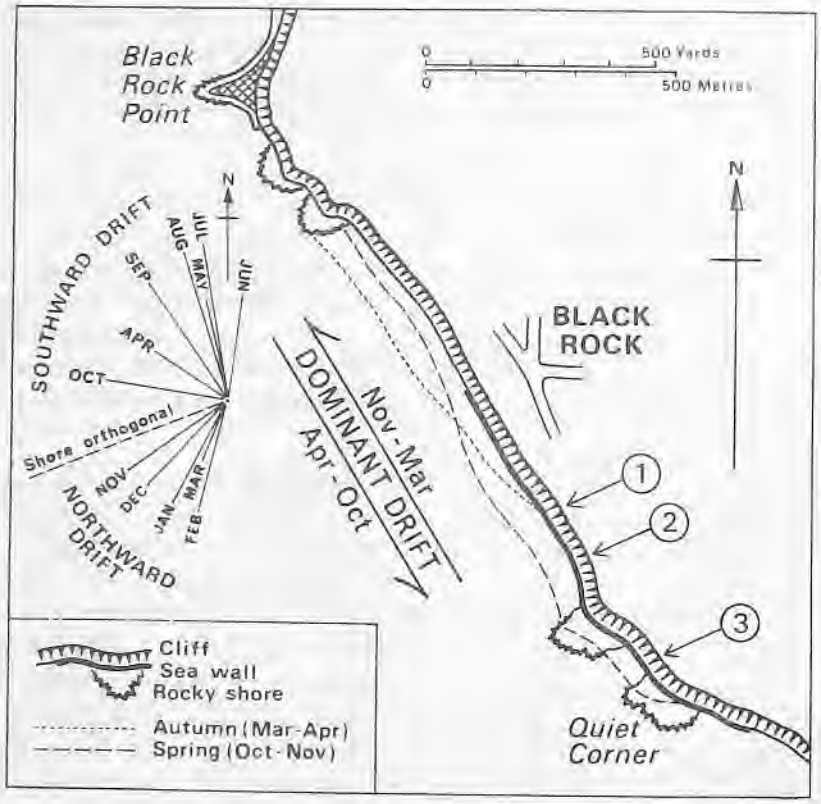

Fig. 6

Many of the basalt blocks used in building the sea wall were taken from the dismantled Old Melbourne jail. Some bear dates and other inscriptions. On the other hand, blocks of Black Rock Sandstone were quarried from the foreshore in the 1850s and used in the building of Black Rock House, which stands a short distance inland in Ebden Avenue. Now owned by Sandringham City Council, Black Rock House has been registered as part of the National Estate.

QUIET CORNER

At the southern end of Black Rock Beach, Quiet Corner is a site of particular interest because it showed very rapid natural changes in the nineteen-thirties (Fig. 7). It was then a long promontory with vertical, rapidly receding cliffs cut in soft Red Bluff Sand, and a basement of Black Rock Sandstone. The promontory became eroded into a series of stacks (rocky islets), which were gradually whittled down by wave attack. In 1935, severe storms cut the cliff back 6 metres here, and in 1936 the Foreshore Erosion Board decided that this part of the coast would have to be stabilised, or Beach Road would be undermined. A sea wall was then built, and the vertical cliffs trimmed back as the gentler slopes now seen, planted with *Stipa* grass and various shrubs (Plate 4).

Plate 4.

South of Quiet Corner, beyond the end of the sea wall, the beach has been reduced and storm waves occasionally undercut the grassy bluffs. Beach renourishment will soon be necessary here. Farther south there are broad shore platforms cut in Black Rock Sandstone, well exposed at low tide.

Locally, this platform shows outcrops of petrified wood, often in the shapes of tree trunks, branches and twigs, where driftwood deposited in the Pliocene estuary has been preserved by iron precipitates. There are also sheets of hardened ferruginous rock, which persist as miniature steep-sided plateaux (or mesas) on the dissected foreshore. Locally, banks of fine sediment have accumulated on the rocky platform beneath 'meadows' of eel grass *(Zostera spp.)*

The outlines of the shore platform influence the patterns of waves that run in to the shore at high tide, and this in turn shapes the outlines of the beaches to the rear. Banksia Point is a small cuspate foreland that has grown out in the lee of a high sector of shore plaftorm. As well as

quartz sand, the beach contains ferruginous gravel derived from the Black Rock Sandstone, and shelly material produced by organisms that inhabit the outer parts of the shore platform, particularly mussel shells (*Mytilus* spp.). On the point there is a small patch of salt marsh dominated by the wiry grass *Triglochin* and the beaded glasswort, *Salicornia.*

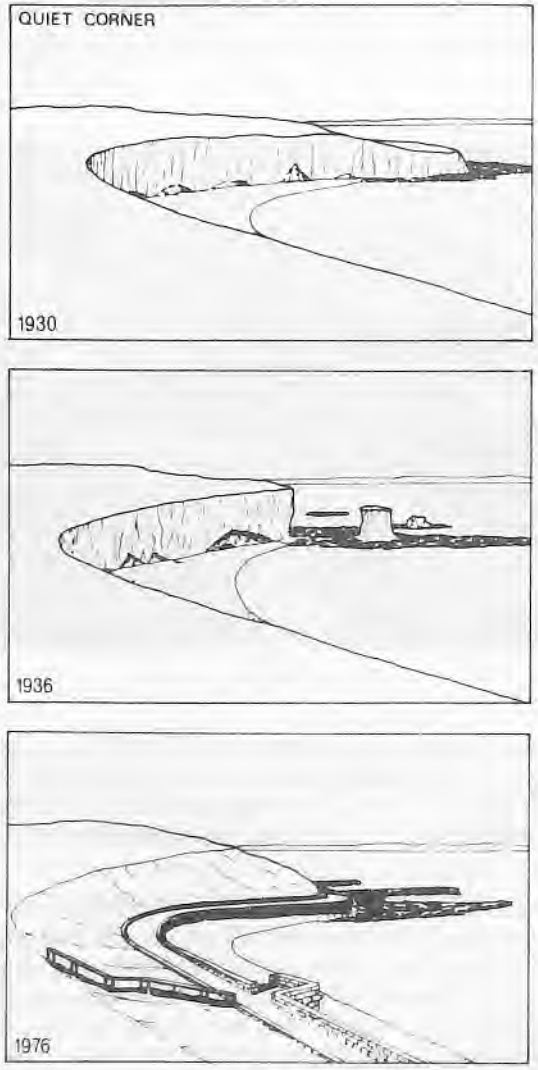

Fig. 7

Beyond Banksia Point the shore platform undulates gently in front of a shelly and gravelly beach, backed by a scrubby terrace with *Banksia integrifolia* trees and the bluff rising to the edge of Beach Road. Locally, there are outcrops of Red Bluff Sand.

RICKETT'S POINT

Stop 7 is at the car park on Rickett's Point (Plate 5). The land here has been built up by sand deposition in the lee of broad sections of rocky shore platform, the beach curving out to a series of cusps shaped by waves that sweep in on either side of the rock ledges. The sand deposited here includes some of the sediment lost from the beaches to the north and edged southwards to Rickett's Point and the sea floor south of Table Rock Point by currents in the offshore zone.

Plate 5.

To the rear, bluffs pass inland, behind Beach Road (this being a sector where Beach Park extends on the landward side of the road), marking a former line of cliffs cut when the sea stood at a higher level (Fig. 8). These cliffs may have been cut back in Pleistocene times, about 100,000 years ago. Alternatively, they may have been shaped in early Holocene times, about 5,000 years ago, after the world-wide rise of sea level had formed Port Phillip Bay as we now know it. For discussion of the origin of cliffs and bluffs see the article by Bird in 1977.

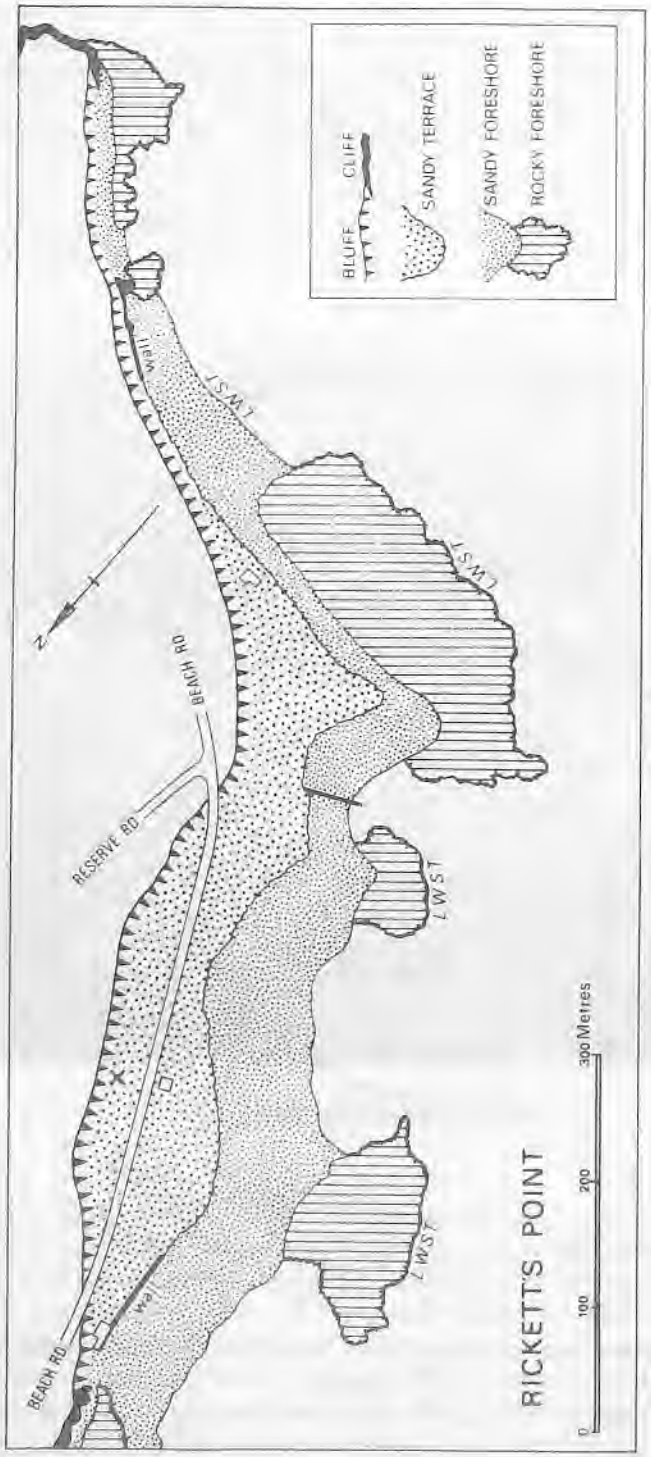

Fig. 8

BEAUMARIS CLIFFS

South of Rickett's Point the bluffs emerge as cliffs cut in sandstone at Table Rock Point (Plate 6). The influence of almost horizontal bedding-planes (between the rock strata) and intersecting vertical joints (planes of division between rock masses) is well exhibited in the outlines of Table Rock Point, both in profile and plan. Marine erosion, working along these planes of weakness, has dislodged blocks and cut out a steep-walled cleft in the headland. The alignment of the coast changes in relation to a transverse fold (The Beaumaris Monocline) running S.W. to N.E. in the Mio-Pliocene rocks (Fig. 9), and cliffs up to 12 metres high in Black Rock Sandstone run along the shoreline of Beaumaris Bay. A footpath through the woodland at the cliff crest gives a number of viewpoints, several of which show the strata curving downwards along the monoclinal fold, to outcrop as scarped ridges on the shore.

Near Keefer's Boatshed the lower part of the Black Rock Sandstone is exposed at the base of the cliffs and on the foreshore at low tide. The ferruginous sandstones are here underlain by fossil-bearing calcareous sandstones and sandy marls, with a basal layer of gravel containing nodules of phosphate and ironstone. The fossils include various molluscs, as well as bones of whales, sharks, rays, dolphins, birds, and marsupials, indicating the fauna present in this area about 6 million years ago. Palaeontologists take this outcrop as the type-section for the Cheltenhamian stage, extending from the late Miocene to the early Pliocene, and it is thought that the overlying sparsely fossiliferous sandstones have a fauna representing the succeeding Kalimnan stage, deposited in Pliocene times.

The cliffs continue past the clubhouse of the Beaumaris Motor Yacht Squadron, and across the boundary of Sandringham municipality at Cromer Road. The coastal reserve then continues into Mordialloc municipality, where the vegetation is being improved within fenced areas.

Plate 6.

MENTONE CORNER

Stop 8 is at Mentone Corner, at the head of Beaumaris Bay, where the coastal outline changes again. There is a cliff-top car park a short distance to the south. In this sector, the scrub-covered coastal slopes are artificial, having been shaped after eroding cliffs in Red Bluff Sand were stabilised by construction of the sea wall at their base in the 1930's. Again, this has led to beach depletion, but in 1977 beach restoration was attempted.

The Ports and Harbours branch of the Public Works Department first dredged a hole in the floor of Beaumaris Bay, within pumping distance of the Mentone shore, and filled it with shelly sand brought from the sea floor south-east of Table Rock Point by their vessel, the *Matthew Flinders*. Subsequently, a pump mounted on a raft anchored over the deposited sand piped it in to form a beach 30 metres wide in front of the sea wall (Plate 7, taken 25 May, 1977). Although some of the sand has since been washed away, a substantial beach remains here, and provides a setting for recreation. It is a safe beach for children, with shallow water and sand bars offshore.

The view extends south to Mordialloc, where a large breakwater at the mouth of the creek has trapped beach sand drifting southward, and then along the gently curving sandy shoreline past Chelsea and Seaford to Frankston, where the cliffed coast of Mount Eliza begins.

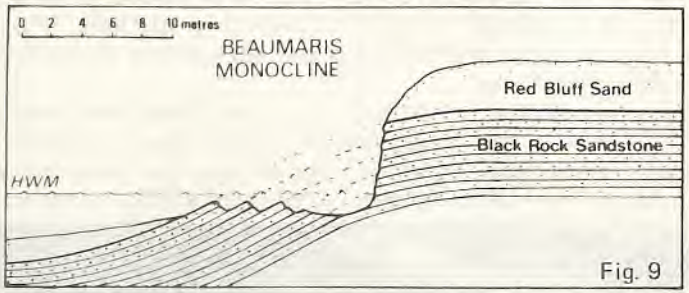

Fig. 9


Plate 7

FURTHER READING:

A more detailed account of coastal landforms is available in E.C.F. Bird's textbook, *Coasts*, published by the Australian National University Press in 1976. Additional information on the geology and landforms of the Sandringham coast is given in the articles listed below, which can be obtained in local libraries or in the La Trobe Library in Melbourne.

E.C.F. Bird 1970 Beach systems on the Melbourne coast, *Geography Teacher*, Vol. 10 Part 2, pp. 59-72

E.C.F. Bird 1977 Cliffs and bluffs on the Victorian coast, *Victorian Naturalist*, Vol. 94, Part 1, pp. 4-9

E.C.F. Bird, P.W. Cullen, N. Rosengren 1973 Conservation problems at Black Rock Point, *Victorian Naturalist*, Vol. 90, Part 9, pp. 240-247.

E.D. Gill 1950 Geology of Picnic Point, *Proceedings Royal Society Victoria*, Vol. 62, pp. 121-127

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Other Sandringham Environment Series

Sandringham Environment Series No. 1, *Common Birds* by Pauline Reilly (1977: 2nd edition 1980) and No. 3, *List of Local Native Plants* edited by Dr. J. H. Willis (1979).