

## Notes on the Geology and Geomorphology of the Coast Between Napier and Castlepoint.

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### INTRODUCTION.

AFTER the conclusion of some previous work on the coast from Castlepoint to Wellington the writer felt strongly impelled to examine the stretch of coastline from Napier to Castlepoint, expecting to find there raised terraces similar to those already examined south of Castlepoint and those recorded by other writers from north of Gisborne. Accordingly, in company with Mr W. K. McGavin, he made the trip in November-December, 1930. The coastline throughout most of the length examined proved most disappointing, only one high-level terrace of any magnitude being in evidence and most of the land facing the sea consisting of landslip. Thus only a series of notes on various portions of the coast (mainly with reference to the present shoreline) are here presented.\*

The thanks of both wayfarers are here gratefully tendered to the managers of the following stations for very welcome assistance or accommodation:—Haupouri, Te Apiti, Pourerere, Sir Percy Hunter's, and Aohanga.

#### CLIFTON TO CAPE KIDNAPPERS (5 miles).

From Clifton to Cape Kidnappers the coast cuts across the strike of the country so that, as the beds have a westerly dip, a descending sequence is observed on travelling towards the Cape (Pl. 17, Fig. 1). The rocks consist, in the upper part, of thick beds (20-60 feet) of coarse conglomerate alternating with beds of mudstone of about the same thickness. These conglomerates are composed of rounded, even-graded pebbles of greywacke some 3 or 4 inches in diameter with a ferruginous cement; while the mudstones contain much fragmentary carbonaceous material, embedded tree stumps, and small veins of gypsum. *Chione Stutchburyi*, often a brackish

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\* No notes relative to the coast from Napier to Clifton are included here, as it is intended to deal fully with this portion at a later date.

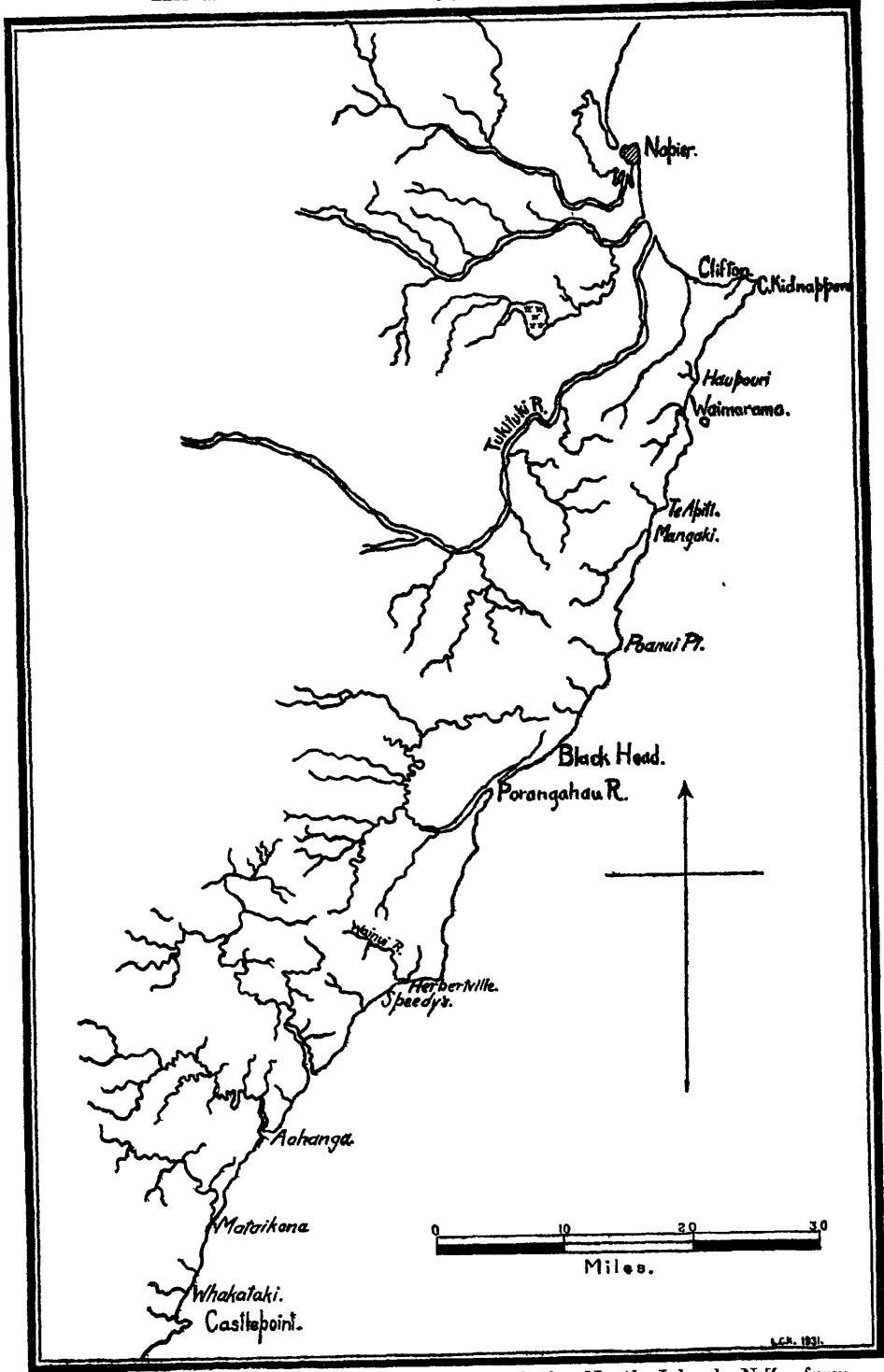


FIG. 1.—Sketch map of the East Coast of the North Island, N.Z., from Napier to Castle Point.

water fossil, also occurs in the mudstones at some horizons. The whole facies therefore presents the appearance of having been laid down in a partially enclosed sheet of water at some time during the Upper Pliocene or Pleistocene (vide McKay, 1887, p. 192). This area of deposition may be regarded as an ancestral, more extensive Heretaunga basin, in many respects akin to the infilled area known to-day as the Heretaunga Plain.

To the east, below these shallow-water-beds, succeed yellow sandy strata which appear to have been laid down under normal marine conditions preceding the formation of the basin. Several small faults in these beds may be observed in the coastal section. Half a mile west of Black Reef is an erosion-break between the upper, yellow sandy beds and well consolidated, dark grey sandy beds of Pliocene age, containing *Pecten triphooki* and *Glycymeris mahiana*. The unfossiliferous yellow sands near the contact often contain fragments of the lower beds with their characteristic fossils. Cape Kidnappers is cut from Tertiary mudstones, which frequently contain elongated, cylindrical concretionary bodies, usually with a hollow tube down the centre (Pl. 18, Fig. 1).

Thus normal marine deposition continued in this region till about the close of the Pliocene, when movements due to the Kairoua Orogeny instituted a local basin of deposition in which shallow water deposits were laid. Part of this depressed area now forms the Heretaunga Plain.

From Clifton to Black Reef the coast is backed by splendid cliffs 300 feet to 400 feet high, occasionally broken by gorges with vertical walls, where small streams emerge from the country in rear. At the foot of the cliffs is a small shingle beach seaward of which the shore zone consists of clean coarse sand. In moderately rough weather the sea still reaches the base of the cliffs, and the shore is for the most part kept clear of slip material. Beyond Black Reef a wide, firm, sandy beach extends halfway to Cape Kidnappers, to be succeeded by a rock bench, 2 or 3 feet above high water mark, cut in mudstone to a width of 6 yards, at the foot of the mudstone cliffs. This is, no doubt, a storm-wave platform similar to those described by Bartrum (1924, p. 493) from West Auckland.

Between Clifton and Cape Kidnappers an arched, high-level terrace, now deeply dissected by numerous streams, forms the most prominent feature of the landscape. This platform, some six miles long and with an average width of one mile, is of particular interest, for it is the only remnant of a raised coastal terrace at any considerable height above sea-level throughout the whole of the coast described in this paper. Owing to the arching to which it has been subjected, the height along the old strandline at the rear varies from a maximum of about 600 feet at a point two miles south-east of Clifton to some 350 feet at the Cape Kidnappers end. It also descends westward a little towards Clifton. To the west, the nature of the gravel cover is largely masked by the greywacke conglomerate of the basement beds; but towards the eastern end deposits of marine gravel covering the cut platform show that it has been carved by

the sea. This conclusion is strengthened by a detailed examination of its inner edge and a consideration of its extent, neither of which supports a hypothesis of river origin.

The terrace is not found south of Cape Kidnappers, and the most probable explanation of its presence in this locality is that it has been protected by its position along the side of Hawke's Bay from the erosive action of the sea, which has obliterated all traces of it on the coast south of the Cape.

#### CAPE KIDNAPPERS TO WAIMARAMA (16 miles).

Southward of Cape Kidnappers the rocks are typical Tertiary mudstones, marls, and sandstones, forming cliffs up to 400 feet high facing the sea. Near Cape Kidnappers a beach of boulders (up to 15 inches diameter) at present protects the cliffs from erosion by the sea, but two miles farther south a sand beach is in evidence, and continues almost unbroken to Waimarama. At three places, however, the remnants of former headlands, which existed before the bights or shallow bays between them were filled in with waste, break the continuity of the beach.

In many localities no true cliffs can be said to exist behind the sand beach, as immense landslides have taken place, leaving arcuate scarps above and piling up mounds of debris, mostly soft mudstone, on the rear portions of the beach, sometimes beyond, sometimes within reach of the waves. These landslides form a prominent feature of the coast from Cape Kidnappers as far almost as Castlepoint, and in some districts render the coastal route wellnigh impassable. This portion of the coast has recently undergone an uplift of 20 feet, and the waves no longer reach to the base of the cliffs which they had formerly cut, so that these immense slips cannot be attributed to normal marine undercutting. It seems most probable that they are the result of very recent earthquakes.

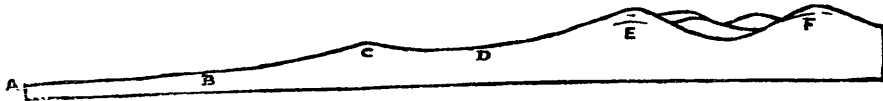


FIG 2.—Diagrammatic section across beach north of Haupouri.

- A. Sea level.
- B. Present beach.
- C. Beach ridge of sand.
- D. Depression or swale behind beach ridge.
- E. and F. Lines of dunes.

In two localities north of Haupouri and at Waimarama the coast has prograded a short distance, and appears at present to be appreciably advancing seaward. The beach profile is composite (Fig. 2) as though another stage in the general seaward advance of the shoreline was nearly complete, the beach ridge being almost sufficiently high to form the base for another line of dunes when enough waste is available. The lower hinder portion of the beach will, if this occurs, form a marshy swale behind the youngest line

of dunes. Just south of Haupouri small " 'tween tide " platforms cut in mudstone, similar to those described from the coast north of Castlepoint (King, 1930, p. 516; Pl. 80, Fig. 2) are present.

A little south of Cape Kidnappers remnants of a 20 feet marine bench have been recorded (Waghorn, 1927, p. 26). These are cut in rock 10 feet above high water mark, and are covered by 10 feet of poorly assorted gravel which has been only partly modified by marine agencies. Three-quarters of a mile south of Haupouri is a small terrace level at 10 feet, five feet of which consists of soft sandy cover; and two miles north of Waimarama the 20 feet terrace again shows, 12 feet being the thickness of the gravel cover at the seaward edge. All these terrace remnants may have been, and probably were, cut at the same time, slight differential uplift accounting for the observed differences in height.

A small local terrace attributable to stream-cutting alone is present at 250 feet behind Haupouri, and a somewhat similar terrace a mile to the south is probably of the same origin. Their accordance of level may imply a period of standstill, though no further evidence of such was obtained, unless these remnants be correlated with the Clifton to Cape Kidnappers marine bench.

#### WAIMARAMA TO BLACK HEAD (33 miles).

The axis of an anticline trending somewhat north of east passes through the country about two miles south of Waimarama. The rocks, chiefly sandstones, with a little mudstone and greensand, are of Cretaceous age and contain *Inoceramus*, *Pecten* sp., and a *Belemnite*. The sandstones frequently exhibit cone-in-cone and " cannon-ball " concretionary bodies. Southward, Lower Tertiary rocks flank the coast, the most prominent member being a coarse, impure, shelly limestone which, when struck with a hammer, smells slightly of oil. This thick limestone forms the bold escarpment, 900 feet high, which faces the sea from a point south of Waimarama to Mangaki, where its height has decreased to 500 feet. The rocks towards Poanui Point are mostly younger, though a small anticline just north of the point discloses a concretionary band similar to that overlying the limestone at Te Apiti. This may be the locality where Ongley collected an ammonite specimen (Marshall 1926, p. 132). From Poanui Point to Black Head the grain of the country runs parallel to the coast, so that the only rocks observed outcropping on the coastal section were mudstones of probable Tertiary age.

From Waimarama to Te Apiti the coastal route is impassable, though short lengths may be traversed. At the Te Apiti end, blocks of limestone from 8 feet to 10 feet across lie strewn at the foot of the cliffs (here 600 feet high) from which they have fallen, and form a surface over which travelling is very slow. The sea, however, still attacks the base of the cliffs at high water in some localities. Between Te Apiti and Mangaki the escarpment has in part collapsed, producing enormous landslides, the debris from which the sea is now actively engaged in removing.



FIG. 1.—The coastal section west of Black Reef, Cape Kidnappers.

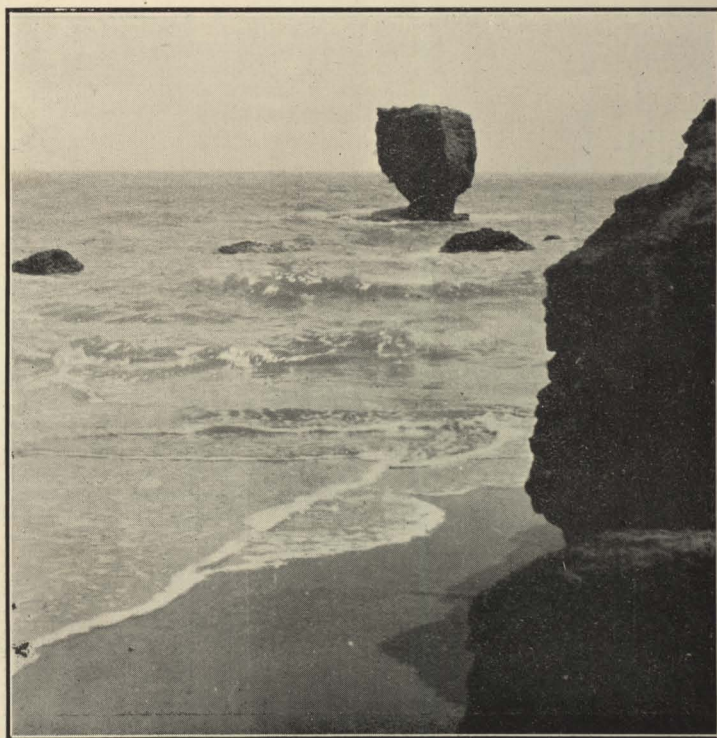


FIG. 2.—Stack undercut at high water mark, Black Reef, Cape Kidnappers.  
*Face p. 76.]*



FIG. 1.—Concretionary body with transverse cracks, giving a resemblance to a vertebral column, Cape Kidnappers.



FIG. 2.—“Tween tide” mudstone platforms, Poanui Point. Photograph taken at half tide.

Southward of Mangaki, stretches of beach are alternately sandy or bouldery, and about one mile north of Poanui Point spherical concretions up to four feet in diameter are strewn about the beach, being derived evidently from the rocks previously described. As at Te Apiti Station, these concretions frequently exhibit stratification planes passing through them, and are probably epigenetic in origin. A fine sand beach extends from this point to Poanui Point, where, seaward of the sand, extensive flat " 'tween tide " platforms of mudstone are well developed (Pl. 18, Fig 2). These platforms, which reach a width at Poanui Point of over 100 yards, are in every respect akin to those previously studied and described from Whakataki (King, 1930, p. 516). Owing to their almost horizontal surface the sea retreats and advances across them at a surprising speed just before and after low water. These platforms, which occur so noticeably in many of the localities described herein, appear to be a function of the rock in which they are cut. The same features have been noted at Cape Campbell, South Island, by Jobberns (1928, p. 515), who records that they can be traced along the coast for several miles. A feature of these soft Tertiary marls and mudstones is that, when damp, they prove very coherent, but upon drying they become friable and crumble away. Thus those portions which are below low water mark, or just sufficiently far above not to be dried by the sun and wind before the returning tide covers them again, remain solid, whereas those parts which are alternately wetted by the water and dried by the action of the sun and wind crumble, and are easily removed by the sea. They are thus largely analogous to the rock platforms described from the Bay of Islands by Bartrum (1916, p. 132).

From Poanui Point to within three miles of Black Head the shore consists of firm sand beach with a regular profile backed, near the headlands, by cliffs rising to a height of 400 feet. Seaward of the beach occur the " 'tween tide " platforms of mudstone, especially well developed on the headlands and diminishing or disappearing at the heads of small bays. A stretch of two miles north of Black Head has a coarse boulder beach instead of sand above the cut platform of mudstone.

#### BLACK HEAD TO PORANGAHAU (8 miles).

From Black Head to Porangahau the coastline is locally a coast of submergence which has been modified chiefly by the accumulation of waste under the influence of marine and alluvial agencies. After the drowning movement and the dismembering of the mature valley system in the lower reaches of the Porangahau River it seems that, under the influence of longshore currents, a spit grew across almost the whole of the open side of the depression, to enclose a large area of open water. At this stage it is likely that the gap in the spit through which the Porangahau River entered the sea was near the north end, towards Black Head. Smaller bays were then filled from their heads by streams flowing into them, and gradually almost all of the space behind the long spit was filled in.



Later, as the infilling at the north end of the lagoon progressed, the Porangahau River broached the spit at a point much farther south.

That the spit was flung across the shallow bay formed by the submergence at a very early stage, and that the sand beach is not merely the result of normal progradation is shown by the following features:—

(1) The boundaries of the depressed landscape show no signs of marine cliffing, and must have been early protected from wave-attack.

(2) Just landward of the beach is a marshy area extending parallel to the shore. This represents a partly infilled portion of the former lagoon, and in some parts probably marks the former extension of the Porangahau River.

(3) Along the first line of dunes behind the sea beach occur extensive Maori middens showing that, within very recent times at least, there has been no active progradation of the shore.

Much of the material of this area drifts in the form of dunes under the influence of winds, and has so modified the surface that it is somewhat difficult to obtain evidence of definite stages in the growth of the spit and the infilling of the lagoon. It certainly appears, however, that the spit (now broached near the centre by the Porangahau River) was built by marine action at approximately the present position of the shoreline, subsequent infilling by streams taking place behind this barrier; rather than that there was, at any time, an advance seaward of a completely filled-in feature.

#### PORANGAHAU TO CASTLEPOINT (53 miles).

The shore route was not followed from Porangahau to Herbertville, but from observations made at various points somewhat inland the coast appears to be very similar to that immediately north of Black Head (q.v.).

Raised terraces up to 50 feet near Herbertville have been recorded by Henderson (1915, p. 103; 1924, p. 584), but the writer was unable to locate any terrace higher than 10 feet above high tide mark. Between Herbertville and Speedy's a terrace form is present at about this height, but no evidence was obtained that it was of marine origin. The fact that the Wainui River turns east and flows along the rear portion of the beach to Tautane before breaking through to the sea may also suggest the formation of an offshore bar on a slightly emergent coast, turning the stream aside and later forming a beach, though normal longshore drift, similar to that at Porangahau, is also capable of forming such a feature.

From Herbertville to Aohanga the coast is very similar to that between Cape Kidnappers and Black Head, and need not be described in detail. Between Aohanga and Mataikona extensive low-angle fans of streamwash gravel extend from the base of the cliffs

across a broad, almost plane, area to the sea. These are very similar to the outwash fans south of the Muka Muka, West Palliser Bay. South of these fans, sandy beach backed by high cliffs is present most of the way to Castlepoint.

#### CONCLUSION.

For the most part the coast herein described may be regarded as emergent coast which has attained to the mature stage. The only locality where subsidence has occurred is at Porangahau, where later accumulations of sand have since considerably simplified the shoreline. A most surprising feature is the absence, south of Cape Kidnappers, of high-level marine terraces; especially as these have been recorded from the coast to the north (McKay, 1887, p. 198; Henderson and Ongley, 1920, p. 23) and to the south (King, 1930, pp. 511-517). Unfortunately, few soundings have been made along this portion of the coast, and without some knowledge of the form of the sea floor it would seem unsafe, as yet, to theorise upon the absence of terraces in this locality.

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