

When sufficiently well preserved to show it, this character proved present in every form of *Rhynchonella* which has been collected from the Secondary and Palæozoic rocks of New Zealand.

The recent forms *R. nigricans*, and *R. psittacea*, also show this character, and it has been detected in an English specimen from the lower greensand, at the base of the cretaceous system.

From the constancy of this character, I think there is sufficient grounds for regarding it as of generic value; as it has been found in all the species which afford the means of detecting it, and is seen in at least two of the living types of the genus.

I am not aware that hitherto attention has been called to the presence of this character as distinguishing the genus *Rhynchenella*.

From "Woodward's Manual of the Mollusca," p. 376, I take the following description of the genus:

"Shell trigonal, acutely beaked, usually plaited; dorsal valve elevated in front, depressed at the sides, ventral valve flattened, or hollowed along the centre, hinge-plate supporting two slender curved lamellæ, dental-plates diverging." and I add teeth crenulated or minutely denticulated.

ART. LVIII.—*On some Indications of Changes in the Level of the Coast Line in the Northern Part of the North Island.*

By S. PERCY SMITH.

[Read before the Auckland Institute, 15th November, 1880.]

INCIDENTAL reference to this matter is to be found in various works on New Zealand, more especially in "Hochstetter," the 12 vols. of "Transactions of the New Zealand Institute," and the annual reports of the Geological Survey; but nowhere, as far as I can learn, has the evidence ever been gathered into one point of view, or dealt with comprehensively. It has been thought therefore, if the information extant is put together, it will be more convenient for reference in the future, and will also perhaps interest the Members of this Institute. With this view I have, in the following notes, collated and summarised from different authorities all that can be found, and propose to supplement it by my own observations, extending over several years, as far as relates to this Northern part of the Island; though it will be necessary to adduce evidence bearing on the question as affecting the whole of the North Island. I have excluded from consideration the evidence relating to the South Island, although it is more voluminous and clear, the reason of which is in a great measure accounted for by the fact of

that island having glaciers, which this has not, or at least only to a very limited, and perhaps doubtful, extent on Ruapepu. The origin and period of greatest extent of such glaciers has given rise to more than one controversy in which this question of elevation or depression bears an important part. It is also premised that these notes will relate only to the latter or recent period, not to the vast geological ages that have passed, during which our hills and mountains rose out of the sea, and in using the term recent it should be understood that it is in its geological sense it is referred to, that is, to the period including the traditions, but extending backwards far beyond it, during which the present outline of the country remained not materially different to that we see at the present day.

In a question of this kind it is of importance that we should understand what kind of evidence we may expect to find, either of elevation or depression. Of the former, raised beaches, terraces, inland cliffs, or lines of sand-hills, are the principal and may be more easily read, whilst depression is to be looked for in the prolongation of the valleys under the sea, by finding land surfaces in sinking to depths now below the sea-level, and in some cases perhaps, by the character of the vegetation on the mountains in particular spots, by the plants and animals inhabiting the islands off the shore, by the depth of water along the coast line, and other indications, few of which are however so capable of direct demonstration as the facts of elevation. It requires, indeed, a practised eye to detect and interpret most of these hidden records of the past, but when once the attention has been drawn to them, it is marvellous how numerous they are, and the interest it gives to many an otherwise tedious journey, to follow them out, and recognize in each new feature some further evidence of the truth of the interpretation placed upon them. There are occasional difficulties, however, in separating the effects of sub-aerial denudation—which has been the active agent in carving out the greater part of our hills and valleys—from those due to the action of the sea; but setting these doubtful cases on one side, there is still a residuum of proof sufficient to demonstrate the facts of elevation or depression, though it can scarcely be expected that in the long ages to which such records have been subjected to the war of elements, that they should appear as fresh, or as easily deciphered as the result of forces in action at the present time. Therefore in speaking of raised beaches, it must not be supposed that these present a similar appearance to the beaches of our present coast line, or that the sands, shells, or rocks are to be seen as cleanly washed as by the daily tide. It is often a mere line, a fragment of a terrace, or isolated mound covered with vegetation, that indicates the coast line of the past. Whilst allowing fully for the immense, and almost inconceivable power required to elevate or depress the solid land, we could hardly

expect to find, in an extended coast line like that of this province, that each effort of the force should be simultaneous, or of a like nature over extended areas. It is more natural to suppose that the action would be partial, here an elevation, there a depression—and this is found to be so, though on the whole these notes will prove, that the tendency has been in its latest manifestation an upward one, and that of a very general nature.

The first extract to which attention is called is to be found in the proceedings of the Wellington Philosophical Society, under date July 28, 1868, when the chairman read a short paper "On indications of changes in level of the coast line of the southern portion of the North Island as deduced from the occurrence of drift pumice." Mr. Crawford remarked, "That pumice, having a small specific gravity, floats on the water, and in rivers flowing from the volcanic plateau in the interior of the island it may be seen descending in great quantities and at all hours towards the sea. When there, it is of course liable to be washed up at any part of the shore, and if there is no cause again to carry it away, it necessarily remains stranded. Pumice is found on the flats of the peninsula, near this city (Wellington) at a height of about eight or ten feet above the present high-water mark. He had not observed it on any of the coast terraces, consequently it is probable that the land had attained within 10 or 20 feet of its present level before the volcanic chain sent pumice to the sea; and this will give an age to the present coast line, or to one from 10 to 20 feet lower (supposing a steady rise of the land), enough to satisfy a very ardent lover of antiquity." He concluded by saying, "It may therefore be held that the probabilities are against any great oscillation of the present sea-level in this part of the North Island since the commencement of the vast period which must have elapsed since the central volcanic group of Tongariro and Ruapehu (and Mount Egmont inclusive) began to send down pumice to the sea."

Dr. Hector said, "That pumice was a mechanical variety of obsidian, the most perfectly fused product of volcanic eruptions, and did not indicate any particular era in volcanic eruption or elevation of a chain of mountains as Mr. Crawford seemed to require for his theory. * * * Mr. Crawford did not prove by his paper that the sea had not been relatively lower; or, in other words, that the land had not been undergoing submergence. The sea could never have been at a much higher level, or the pumice would have been drifted up, but there is every reason to believe that the country was much higher formerly, and in the interior contained larger lakes, by which the pumice would be drifted up at great heights above the sea."

In an essay on the geology of the North Island by the Hon. J. C. Crawford, printed in the appendix to the first volume of "*Transactions*," that gentleman, referring to terraces and raised beaches, says,—“These form a

characteristic feature in New Zealand geology. * * * Terraces are found in the south part of the island, as previously stated, at about 1,000, 400, and 250 to 300 feet, and decided raised beaches at about 15 and 4 to 9 feet. That these extend round the island at similar levels is probable, but more information is required to establish the fact. Between these principal terraces are many smaller ones. Although fossils are in general absent, it is likely that the terraces mark successive rests of the land during its rise. To account for them as lake terraces would require the supposed erection, or rather demolition of a vast number of barriers. At the height of about 15 feet above the present sea-level a very well-defined sea-beach is found all along the southern coast, worn into cavities and bored by pholadae. The latest raised beach is that which marks the rise of the land during the great earthquake of 1855. The upheaval appears to have been greatest at the Mukamuka rocks—nearly 9 feet, and is supposed to have sloped off to nothing at Manawatu.”

The same gentleman, in a paper “on the Geology of the Province of Wellington,” read 2nd October, 1869, says,—“A raised beach may be observed all along the coast, except at the foot of the Wairarapa Valley, where the sea encroaches on soft rocks.”

I would remark that these terraces are particularly distinct as seen from the steamers in passing Cape Palliser; they are referred to in Mr. McKay’s report on “the Southern part of the East Wairarapa District,” dated July, 1879, from which I extract the following:—“Returning to the coast line terrace formation, the loosely compacted gravels already mentioned form a level plain stretching round the head of Palliser Bay, which, at one time, appear to have stretched seaward much further than at present, the soft clay beds underneath the gravels yielding rapidly to the encroachment of the sea. At the north-east corner of the bay this terrace is now all but destroyed, and here the first terrace (about 200 feet above the sea) terminates. Along the east side of the bay, gravels cap the pareora beds unconformably, and form terraces at much greater heights than 200 feet. According to Mr. Crawford the higher inland terraces attain to a height of 1,000 feet above the sea; and it may be a questionable classification which thus places them as belonging to the same period as the lower-terraces. The reasons for their being so placed are that these terraces are evidently nothing more than ancient beaches, marking the different stages of the rising land; while at much lower levels (at the level of the sea at the outlet of the Lower Wairarapa Lake) we have deposits accumulated during the period of depression; so that if these high-level terraces are to be regarded as older than pleistocene, they must still be considered as younger than any of the fossiliferous pliocene rocks in this vicinity, and to have been deposited

after the land had begun again to emerge and recover itself from the depression which took place over a large part of the North Island in early pliocene times."

The above extracts show pretty clearly that as far as the southern part of this island is concerned, that elevation has been the latest phase of the forces, and if enquiry is pursued into the case as relating to the Southern Island it will be found to be the same. I would particularly refer to a most interesting paper by Captain Hutton, "On the last Glacier period of New Zealand,"* which, whilst dealing with a period prior to that under consideration, goes more fully into the question than any other, and contains also some references to the North Island during the later period; as for instance at page 386: "I will, therefore, in the first place give the reasons that have lead me to an opposite conclusion, namely, that during the whole of the pleistocene period, elevation has been more or less continuous over the greater part of New Zealand." He then enters fully into the question, but I must refer those interested to the paper itself, merely giving here two short quotations. On page 390 he says: "Raised beaches of pleistocene, or of almost recent age are found at Motunau in Canterbury, and on the north-west side of Cape Kidnapper, Hawke's Bay, but I do not know their altitude. On the north-west side of Hick's Bay, near the East Cape, there is a very distinctly marked line of inland cliffs; and the same thing is seen in Cook Strait, near Wellington." At page 392: "Indeed, there can be no doubt that the elevation has been very unequal in different districts. The central portion of the North Island appears to have risen most, and next to that the centre portion of the South Island, while the whole of the northern portion of the Auckland provincial district does not seem to have risen more than twenty to thirty feet, but we are almost without data at present to estimate these differences correctly." He adds: "I don't think, therefore, that the reasons brought forward by Dr. Hector by any means prove that subsidence has been going on during the pleistocene period; on the contrary, I believe that nearly the whole of the evidence is in favor of elevation."

One of the clearest cases of elevation, as shown by an inland coast line, which I have met with is that at Miranda, in the Gulf of Hauraki, opposite Grahamstown. Any one who has stood on the hills above the Thames river, and looked up its broad valley over the level swampy plain lying between that river and the Piako, would at once be struck by the fact that the dry land is a mere continuation of the bed of the gulf, and that the foot hills on either side are the remains of an old coast line once washed by the waves of the sea. The plain of Te Aroha is not more than 75 feet above

* "Trans. N. Z. Inst." Vol. V., p. 384.

the sea level, whilst Morrinsville is only 86 feet. Consequently a depression of 100 feet would again bring the sea up to those places, or within 20 miles of Hamilton, thus extending the gulf by an area of 250 square miles. Traces of the old coast line may be detected here and there far inland, but at Miranda it is more than usually distinct. Here we have a low flat, generally swampy, extending back from the coast line for a mile to the foot of the hills, which fall steeply to its level, where they form contours exactly like the sinuosities of an ocean beach, whilst at one spot, close to the foot of the hills, is found an isolated rock jutting out from the swamp, pinnacled with wave-beaten sides, through which is a cave or passage so clearly the result of water action as to cause surprise at the absence of the waves which made it. Near, too, lying along the foot of the hills, are to be seen large masses of clay slate rocks, just as one sees along a modern beach. The level of the flat here is about 15 feet above high-water mark, and therefore corresponds with the raised beach mentioned by Captain Hutton as existing on the opposite side of the gulf at Shortland. He says, after referring to a submergence which is proved by finding at a depth of 30 feet kauri gum, pieces of wood, and rotten raupo, and nearer Shortland an old Maori paddle.

“It would thus appear that when the alluvium full of boulders found on the top of the hills was forming, the land was 1,000 feet lower than at present, that it then gradually rose until it was at least 100 feet higher than now; and at that time the Thames ran further north than Shortland. The land then sunk to about 10 or 12 feet lower than now, and subsequently has again risen to its present level.”

I have been informed that in the great swamps lying between the Thames and Piako are to be found shell banks and sand banks, now several miles from the sea, which formerly marked the high water line at the level the land then stood at.

Following the coast northwards from Miranda, the same line of old beaches can be occasionally detected, and in some cases even the old shingle, as rolled by the tide, is visible, but now separated from the sea by long stretches of low-level land and swamps. At Umupuhia, near the mouth of the Wairoa, at about 15 feet above present high-water-mark, is a level plain extending through from Waiheke channel to the Wairoa River, which, before the elevation, separated the western head of that river from the mainland, forming an island. Approaching Auckland the line of old sea-level is seen here and there, as at Brown's Island, in Hobson's Bay, the north shore at the Victoria wharf, and at places up the harbour. It is probable that when the sea formed these old beaches there was another entrance to the harbour—namely, by the shallow arm running from Shoal Bay, behind the flag-

staff on Mount Victoria, which is only separated from the sea now by a low sandy neck, which has no doubt been formed as the land gradually rose. This channel now filled with mud and mangrove flats, and only navigable for small boats at high water, bears on its cliffs the evident impress of much larger waves than ever can arise there now. At Motutapu in several places, but particularly on the east side of Drunken Bay, is a well preserved raised beach, about the same general level as the others, which was formed when there was a deep water-channel between it and Rangitoto, and which owes its preservation to its sheltered position. The steep cliff on the right hand of the path leading down from the Supreme Court to Mechanics' Bay is the work of the sea when it stood at a higher level, and when the Bay extended up to near Fraser and Tinne's foundry.

If we continue our survey northwards from Auckland, the same evidence of elevation will be found. Time was when Whangaparaoa was not, as now, a peninsula, but an island, the old channel separating it from the main is still clearly visible, its floor being at about the same level of 15 feet above high water-mark. The flat north of Orewa, and that on which the Waiwera Hotel stands, are old sea beaches, whilst the small island off that place, the native name of which is Mahurangi (whence the name has been transferred by the settlers to the harbour to the north of it. The proper name of which is Waihe), has probably only become such by the action of the sea since this elevation. Native tradition speaks of this island as having been a large pa in comparatively modern times, though but a mere rock now. The flats between Waipu and Whangarei Heads, and extending up that harbour for some distance, are another illustration of a sea-bottom, now dry land. Here we learn of a probable depression going on in quite recent times. It is stated that within the last generation some of the mangrove flats in the harbour had dry flats on them, used by the Maoris as cultivations, but now washed by the spring tides. Further northwards again the same thing is seen. The flat on which the Town of Russell is built was at one time covered by the sea, which then separated the hill standing to the south-west of the town from the mainland, forming an island. At Whangaroa, at Mangonui, at Rangaounu Bay, the evidence is everywhere the same. At the latter place, the flats of the Awanui and Victoria River rise gradually up as a continuation of the sea-bottom, which a submergence of a very few feet would again convert into a channel running across to the West Coast, thus forming again, as it has done before, the northern termination of this island, and leaving the North Cape and Mount Carmel as separate islands.

The west coast shows the same line of elevation, with probably others more ancient than the 15 feet one. At Hokianga there are several well-marked beaches, notably the flats inside the heads at Pakia, whilst in

Kaipara they are more numerous and extensive still. The low-lying swampy flats on the Wairoa River, south of Tokatoka, elevated but little above tidal flow, are bounded to the east by a distinct old coast line, which, in its southerly extension towards Otamatea, shows signs of having been an ocean coast line before the barriers of consolidated sand-hills forming the north and south Kaipara heads were in existence. The origin of these, however, dates further back than since the 15 feet elevation.

Manukau has its raised beaches, as also its signs of local depression as demonstrated by the tree trunks standing in places now washed by the tide. Hockstetter, describing the long, low strip of sandy waste lying outside the north head of Manukau, says:—"Behind the sandy beach basins of fresh water are frequently found, and at the base of the rocks deep caves are seen washed out, in the back ground of which generally large masses of boulders are deposited. This would indicate a former period, when the surge washed the rocks themselves and piled up those masses." Captain Hutton, also speaking of the north head, says:—"On the inner or eastern side of Paretutai the cliff is being undermined or worn away at low water-mark, while at high water-mark, or at a little above it, another and older undermining of the sea can be observed forming a terrace, the difference of height between the two being about 10 feet, showing that the land has risen that distance since the higher one was formed. This closely corresponds to the height of the raised beach at the Thames, on which Shortland and Grahamstown are built. On the outer or western side of Paretutai a similar terracing exists." * * * I would add that this inner terrace now forms a most convenient natural wharf for shipping the timber from the Whatipu saw-mills.

To one standing on the bald hills near Mauku, and looking over the swampy tract lying between there and the Waikato heads, the steep hills abruptly terminating in the swamp, with their indented and sweeping contour line, present the appearance of a well-worn coast line from which the sea has receded, leaving the former bay to be filled with alluvium before the river cut its way down to its present level. Hockstetter says, in reference to the mouth of the Waikato:—"It is remarkable that at the mouth of the Waikato there is not an estuary similar to that at Manukau, Kaipara, and Hokianga in the north, or as at Whaingaroa, Aotea, and Kawhia in the south. With regard to this point, I have repeatedly heard the opinion expressed that the Waikato River had formerly emptied into the Manukau, and that its present mouth is comparatively of recent date; yet I cannot corroborate this opinion. I believe myself right in assuming that the river also had in former periods a similar estuary, and that the extensive swamps beginning two miles from the mouth and now partly

covered with bush, through which the Awaroa Creek meanders, are part of the former estuary, which the river has gradually almost filled up with masses of sand, mud, and pumice stone, which it always carries along," to which I add, aided by the gradual rising of the land.

This period was subsequent to the depression referred to in Mr. James Stewart's interesting paper "On the evidence of recent changes in the elevation of the Waikato district," and the old shingle beach therein referred to as having been found in sinking for the cylinders of Ngaruawahia bridge is probably of date coeval with, or prior to the grand elevation which took place when Tongariro and Ruapehu first exerted their powers. The evidence of changes in the physical geography of the Waikato and Thames valleys are so numerous and so interesting from the surface and geologists' point of view that a whole volume might be written on the subject, but as this paper only deals with coastal changes, I will merely quote from the "Transactions" and Hochstetter, two extracts, as bearing out the view that the Thames valley was recently occupied by the sea. The latter says, in referring to these two valleys,—“This whole basin was previous to the last elevation of the North Island, which was probably connected with the volcanic eruptions in the centre of the island, a bay of the sea, extending from Hauraki Gulf far into the interior. The steep margins of the surrounding ranges has continued to this day displaying the sea-shore of old, and the singular terrace formation on the declivities of the hills and the river-banks within this basin, is the result of a slow and periodical upheaving;” and again, at page 313, he says,—“These and similar strata seem to point to the fact that the whole of the Waikato basin was, but recently, a shallow bay of the sea, or a far extending estuary, at the bottom and on the margins of which these layers of shale were formed.” Mr. Kirk supports this opinion of the sea having recently occupied the Waikato basin by reference to the marine plants found there. Captain Hutton, however, in a paper “on the alluvial deposits of the Lower Waikato and the formation of islands by the river,” rather combats this idea, at all events as respects the Lower Waikato. He says,—“There appears therefore no geological evidence of the sea having been in the lower basin of the Waikato since the upheaval of the Waitemata series, that is, since it had any existence. I therefore think that the fact of the presence of several littoral plants in the Lower Waikato basin, brought forward last year by Mr. Kirk, may be best explained by supposing that they have spread down the river from the middle Waikato basin, after the formation of the Taupiri Gorge.”

Passing now to the southwards of Cape Colville in our coastal survey, we shall find the same evidence of elevation of about 15 feet, with, in addition, an older line of elevation, averaging from 80 to 100 feet. Those who

know Mercury Bay will recognise in the extensive flats to the west of the mouth of the river of that name, the work of elevation aided also by the formation of land by the sea itself, an operation which is the very reverse of its usual action. Here, along the Buffalo beach, we find a series of slightly raised parallel sandhills, divided from one another by lines of swamps, following closely the contour of the present coast. These are caused by the wind drifting the sand off the beach at low-water into low hillocks above high-water mark, which, after a time, become covered with vegetation, when others are formed in front of them, the intervening hollows being gradually filled with swamps. Another raised beach is to be found to the east of Shakespeare's cliff; indeed, in several places along the coast towards Katikati.

Tauranga Harbour presents some interesting changes due to elevation. Prior to the upheaving of the present coast-line the sea probably washed the southern shores of the harbour all the way from Katikati to Te Papa, leaving the higher parts of Matakana Island as low islands off the shore. On the elevation taking place, the sands have gradually accumulated sufficient to form Matakana Island some twenty miles long, to which is due the present harbour. At that time Mangonui mount was an island, as was also Matakapihi, which latter formed part of the sea-bottom prior to the older elevation referred to. From Tauranga to Maketu the old coast-line can be readily traced, where the steep hills sloping down from Otanewainuku end abruptly on the level and swampy foreshore. At Maketu the coast-line receded sufficiently far back to form a deep bay, in which that place stood as a flat island, which it also was before the ancient elevation took place, and at which time the flat surface of Motiti Island formed part of the floor of the ocean.

The evidence is everywhere the same as we follow along to and beyond Opotiki Cliffs, which have been worn by the sea, are now separated from it by low flats generally sandy and swampy, whilst at Matata there was a deep bay running inland, now filled with swamps and sands, due partly to river action, aided by elevation. The isolated slate-rock at Whakatane, close to the township, under the shade of which Te Kooti's men slept off the effects of their potations after the sack of that place, clearly demonstrates this elevation. No one, looking at the rock, can doubt the fact of the sea having separated it from the main, when the waves rose some 15 feet higher. The fertile flats of Opotiki are due to the alluvium brought down by the two rivers Otara and Waioeka, deposited in an estuary of the former sea. The so-called table-land of Opotiki is part of a much more ancient sea-beach or bottom, which can be traced from the East Cape to Katikati. It is everywhere on a much larger scale than the one hitherto described, and forms

extensive flats, cut up by streams. Nearly everywhere in the Bay of Plenty it is covered more or less with pumice, and is about 100 feet above the present sea-level. From a little east of Opotiki to the east Cape the coast is formed by the northern end of the main range of the island, or, I may say, by the continuation of the Southern Alps. They average in height near the coast from 1,500 to 3,000 feet, culminating in the interior in Mount Hikurangi, 5,606 feet high, the highest peak in this province. These ranges appear from the sea to end abruptly at the water's edge. Upon approaching the coast, however, a long level line of low cliffs is seen, from the top of which the land slopes gradually but slowly upwards to the base of the mountains, the slope being in general covered with native cultivations and villages, and the cliffs fringed with pohutu kawa trees. In the season when the yellow maize is ripe these flats form a pleasing contrast in colour to the sombre hue of the precipitous mountains rising behind them. This slope forms part of the more ancient sea-bottom alluded to. It is very distinctly seen in the steep cliffs a little to the north-west of Hick's Bay. Being out of the route of the coastal steamers, this part of the Bay of Plenty is rarely seen, and its beauties generally unknown, but the time will come when it will be visited on that account, and for its delightful climate.

As bearing on the question of elevation of this part of the coast, Dr. Hector says in his "Notes on the Geology of White Island,"* "I may here remark that I observed no signs of marine or beach drift within the crater wall, such as must have existed if the island had been undergoing a process of elevation. On the other hand, the evidence seemed to point to a steady submergence of the volcanic cone." In reference to this, I would observe, that the above extract, whilst setting forth a direct contrary opinion to that I have expressed with respect to the contiguous main land, refers to an active volcano, which might be more subject to alternations of level, within shorter periods, than the main land, and it is by no means improbable that submergence is going on there, whilst the shores of the Bay are rising.

From the East Cape southwards to Gisborne, I am not aware whether the same evidence of elevation is discernable, but I find Mr. A. M'Kay, of the Geological Survey states,† "On reaching the coast at McDonald's woolshed (a few miles north of Gisborne), one cannot help remarking the beautiful raised beach behind the present sand hills, as level and smooth as a carriage way, with its seaward slope just as the sea left it. The beach at the present high water has a very different appearance, the finer materials having been acted on by the winds, which have made sand hills. Here and there among these, and in the depression between them and the raised

* "Trans. N.Z. Inst.," Vol. VI., p. 281.

† "Geological Reports," 1873-4, p. 120.

beach, are relics of old Maori encampments. This raised beach continues as far as Makarori rocks, which are comparatively horizontal, and belong to the sandstone formation of the Leda marl series."

The extensive flats of Poverty Bay are no doubt due partly to elevation, the richness of the soil being accounted for by the deposition of alluvium in a former estuary.

Coming now to the southern boundary of this provincial district, we find that the thirty-ninth parallel of latitude strikes the sea at Te Mahanga, about four miles north of Te Mahia peninsula, on a low swampy and sandy flat, evidently an old sea beach, as the coast line may be traced running round some three miles inland, where the steep hills suddenly end on the flat. This plain which is of considerable extent, is generally not more than fifteen or twenty feet above high water mark, and were a depression to that amount to take place the Mahia would again become an island.

From what has been said, it is tolerably clear that the balance of evidence is in favour of elevation going on during the later geological ages, and that it has been pretty general all over this northern part of the Island; that there are two tolerably distinct lines of possibly sudden elevation, whilst others no doubt exist, and that the intermediate period between the two has probably been one of slow gradual rising, with perhaps some local oscillations of an opposite character. The more ancient level is most distinct in the Bay of Plenty, and was most likely coeval with the time when the sea occupied the valley of the Thames, and when the Waikato River emptied itself into that estuary instead of taking its present unnatural course right through two ranges of mountains, and then to the west coast as now. A somewhat similar sea-bottom (perhaps not so high above present high water-mark) can, I think, be traced even here near Auckland. At this period there was a channel through to Kaipara. It is obvious that owing to the length of time that has elapsed since this ancient coast line was in existence that the evidence of it must be much more obscure. During the ages that have passed, the power of running water has had time to exert its influence in cutting out deep gullies, or in planing the former level sea-bottom into slopes of different degrees, leaving only here and there some slight indications still to be found, but yet sufficient to warrant the probability of the supposition, more especially as the shape and contour of the ground in many places is explicable only on the theory of a plane of marine denudation.

As to whether the land is still rising, I would observe that the action of the elevatory forces is usually so exceedingly slow that the time we have been in occupation of the country has hardly been long enough to allow us to form an opinion. Lyell, in his classical work "*The Principles of Geology*," quotes the case of Norway as a country rapidly rising, and this is

at the rate of only 4 feet in the century. To show, however, that the question has engaged the attention of the colonists before, I will quote from a paper read before this Institute by our worthy President in 1868, entitled "Is the Land about Auckland Rising."* Dr. Purchas said:—"He might mention a very curious circumstance in reference to the rise that occurred in the land about Auckland. He thought it afforded positive proof that the land about Auckland was rising sufficiently to be quite measureable. Messrs. Thornton and Co. got a supply of water from the harbour. They had a pipe fixed at some distance down the wharf with a rose at the bottom. They have had to alter that rose three times at intervals of three years. Mr. Firth had told him of the circumstance, and he believed that special pains had been taken with the fixing of the pipe the last time, in order that the matter might be settled. He had been assured by a settler that the harbour of Mahurangi was 2 feet less in depth than it was two years ago. If the bottom of the harbour was rising, it was a matter of vital importance to the people in the neighbourhood of the city. He had no doubt about the accuracy of the information, as was shown by the fact that the rose had to be altered three times in order to get a supply at low-water. A discussion ensued, in which Mr. Weymouth, Captain Hutton, Mr. Wark, Mr. Buckland, and Mr. Stewart, took part. Most of the speakers seemed to be of the opinion that there was not sufficient evidence to show that the land was absolutely rising."

I also quote from the "New Zealand Herald" part of a report by Captain Burgess, dated 3rd January, 1878. After referring to the changes in the character of the weather and the alterations in the harbour due to the silting-up for the last thirty years, he says,—“With reference to the above remarks, I may mention that there is but 3 feet of water at the end of the Breakwater instead of 7 feet, as reported in 1868; also, that the rocks off St. George's Bay are evidently rising.” I think we may infer from the last remark, that Captain Burgess believes that the land is rising in addition to the harbour silting-up. If it is so, and that at anything like the rate that Norway is rising, the day is not so far distant when the commercial part of the city of Auckland will have to shift its quarters considerably to find depth of water for its shipping.

ART. LIX.—*Description of an Artesian Well sunk at Avonside.*

By T. A. MOLLET.

[Read before the Philosophical Institute of Canterbury, 30th December, 1880.]

THE information contained in this short paper, though of little or no importance to the ordinary observer, is of interest to the geologist, as helping

* "Trans. N.Z. Inst.," Vol. I., p. 38.