

who, as a rule, concentrate their attention on gold. The establishment of the School of Mines at the Thames affords every facility for acquiring a thorough acquaintance with the mineralogy of the goldfields. It is to be regretted that recent failures, and still more dishonest transactions, have brought discredit on such a rich and extensive goldfield as Ohinemuri, which must necessarily become some day one of the first gold-producing districts of the world.

EXPLANATION OF PLATES XXXIII., XXXIV.

PLATE XXXIII.

- Figs. 1, 2. Granular gold.
 Figs. 3-15. Gold in quartz-veins.
 Figs. 16, 17. Incrustation on hæmatite.

PLATE XXXIV.

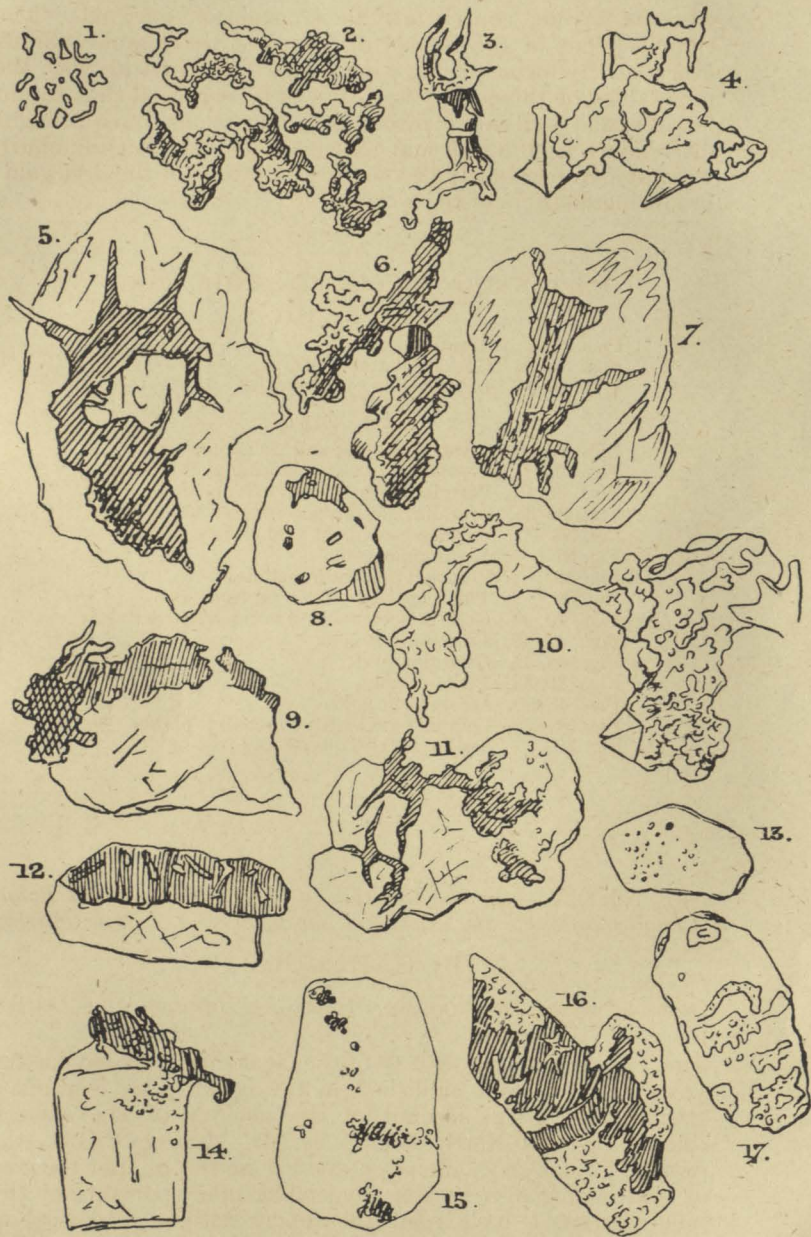
- Figs. 18-28. Crystals of gold, and pseudomorphs.
 Fig. 29. Crystal of quartz enclosing gold (Owharoa).
 Figs. 30, 31. Vermicular gold in ironstone (iron-oxides).
 Figs. 32-35. Granular gold in decomposed iron-pyrites.
 Fig. 36. Surface-coating of gold on iron-nodule.
 Fig. 37. Vermicular gold.
 Fig. 38. Compact gold in ironstone.
 Fig. 39. Thick coating of gold on ironstone.
 Figs. 40, 41. Gold in decomposing iron-pyrites nodules.
 Figs. 42, 43. Filamentous gold.
 Figs. 44, 45. Granular gold.
 Figs. 46, 47. Filiform gold.
 Figs. 48-50. Arborescent gold.
 Fig. 51. Compact gold with octahedral planes.
 Fig. 52. Stellar gold on quartz and iron-oxide.

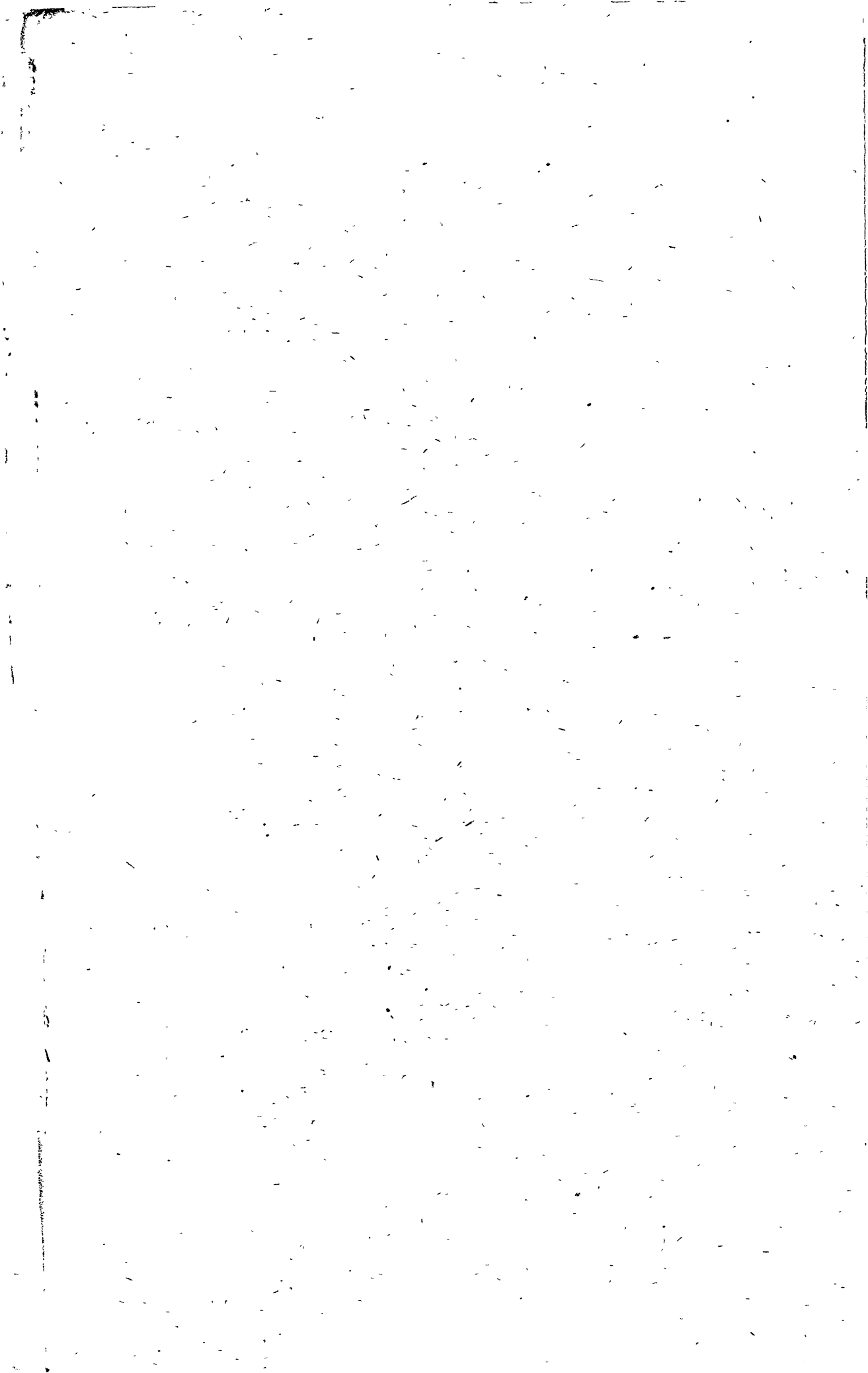
ART. XXXIV.—*On the Relation of the Kidnapper and Pohui Conglomerates to the Napier Limestones and Petane Marls.*

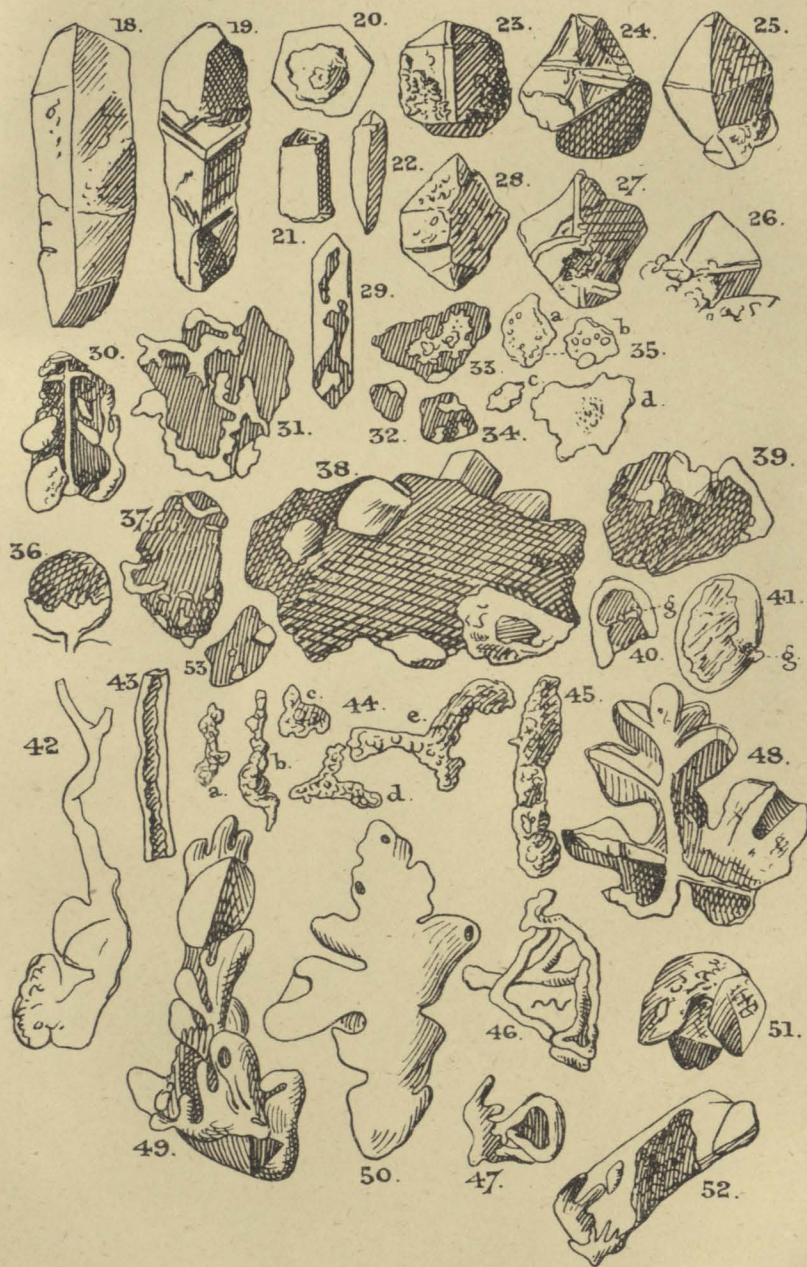
By H. HILL, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 13th October, 1890.*]

THE Progress Report No. 18 of the Geological Survey, for the years 1886-87, and published in the latter year, contains a special descriptive account of the geology of the eastern counties of the North Island, by Mr. McKay, F.G.S., the Assistant Geologist. Being interested in the district referred to, and having also written somewhat upon portions of the same district, I have read the report with a good deal of pleasure, and I may also say profit. To those acquainted









with the topographical features of the district the report is well worth perusal, although at the outset I must confess my inability to assent to some of Mr. McKay's conclusions, more especially with respect to his classification of the rocks extending from Cape Kidnappers to Pohui, midway between Napier and Tarawera, including the Napier limestones and what Mr. McKay terms the "Petane clays."

I am naturally loth to dissent from any of the conclusions arrived at by officers connected with the Geological Survey, as their much wider experience in field geology gives them an advantage that far outweighs any special knowledge I may possess of the topography and otherwise of this immediate district. In the present instance, however, the wide divergence of opinion held by officers who have been connected with the Survey from time to time as to the stratigraphical relation to one another of the rocks in question causes me to think that the more light that can be thrown on the subject the sooner will it be possible to harmonize the varying and opposite conclusions of the different observers. Hence the main object of this paper will be to describe and correlate as well as I am able the surface-rocks of a district within a specified radius from Napier, with the view of showing that Mr. McKay's classification, as stated in his report, is untenable. And in order to do this I propose to work back inductively from the present plane of denudation, with its mountains, hills, plains, and valleys, to the plane of denudation immediately preceding it, so as to show the stratigraphical sequence of certain rocks that are now classed much older than I think can be warranted by the evidence available, whether stratigraphical or palæontological.

The district to which the paper will be limited for descriptive purposes is the area embraced within the Hawke's Bay river-system, and which extends curiously from the 39th to the 40th degree of south latitude—that is, from a little to the north of the Mahia Peninsula to a little beyond Bare Island, south of the Kidnappers. These boundary-lines include the whole of Hawke's Bay County, a large part of Wairoa County, and small portions of Waipawa and Patangata Counties.

Along the western boundary of this district the rocks generally are of Palæozoic or Mesozoic age, the Ruahine mountain-range being composed, in its highest parts, of a compact, fairly coarse, and indurated sandstone, and having a strong likeness to the New Red Sandstone to be found in some of the midland counties of England. Compact gritstone and pudding-stone are also met with in some places on the range; but these rocks are comparatively rare, being seen in the upper streams of the Manawatu and Waipawa Rivers,

but nowhere else, as far as my own observations have gone. Flanking these sandstones, and in places found in connection with them, are quartzite rocks with traces of copper, iron, and other metals; whilst fine bluish compact sandstones and slates—the latter showing true cleavage-planes—make up what may be termed the supplementary range that runs parallel to the main axial range from the Manawatu Gorge to the Whakareare Mountains. The slates and sandstones continue to the north as far as the 39th parallel, but I have not seen the sandstones characteristic of the Ruahine Range beyond Kereru in a northerly direction.

If we now follow the Tukituki River—which is the most southerly river in the district under notice—from its source to the sea—that is, from west to east—the following rocks will be met with by the way: 1, Compact sandstones (Ruahine); 2, slates; 3, limestones; 4, blue fossiliferous clay-marls; 5, shingle- and pumice-deposits corresponding with the Kidnapper beds; 6, limestone; 7, Ruataniwha river-gravels; 8, Te Aute limestones; 9, chalk-marls; 10, blue clay-marls (Patangata); 11, Kidnapper pumice- and conglomerate-beds.

Along the northern boundary of the district, beginning in the west—say, at Tarawera, on the Napier-Taupo Road—the following rocks are crossed: 1, Pumice-deposits overlying slates; 2, slates (Maitai); 3, limestones and fossiliferous brown clays; 4, grits and blue clay-marls; 5, limestone; 6, sands and conglomerates (Pohui beds); 7, limestones; 8, blue clay-marls; 9, limestone (outliers); 10, coarse sandstone, with thin bands of blue clay interbedded.

Along the eastern boundary—that is, by way of the coast—the exposures are clear and distinct, and the rocks are as follows: 1, Blue clay-marls with pumice-band; 2, Te Aute limestone (black reef); 3, Kidnapper shingle-, pumice-, and conglomerate-beds; 4, alluvial plain, with shingle-beach, to Napier; 5, Napier limestones, separated by clay-marls; 6, shingle-beach to Tongio, with isolated limestone outliers covered with shingle- and pumice-clays; 7, limestones and marls, Tongio to Moeangiangi; 8, blue clay-marls, with pumice-band; 9, limestone outliers (Nuhaka); 10, coarse sandstones, as in 10 above.

And this distribution of the rocks, the oldest by the western boundary of the district, and the youngest towards the east, well represents the general slope of the country, or true plane of denudation, at the present time, seeing that all the rivers run eastward and pour their drainage-waters into Hawke's Bay.

From what has already been stated with regard to the existence of sandstones and of slates with two cleavage-planes, along the western watershed, it will be easily inferred that the

rivers are mostly great shingle-carriers, especially in times of flood, and that the vast deposits of shingle to be met with in the limits of the bay between the Kidnappers and Te Mahia represent some of the products of that carriage within a comparatively recent period.

The Tukituki, Mohaka, and Esk Rivers are perhaps the greatest shingle-carriers, and within the basin of each of these rivers large deposits of shingle are to be met with. Of the Esk River it may be remarked that its carriage of shingle is not from the mountains, as in the case of the others, but from immense deposits of shingle-conglomerate between the Kaiwaka and Maungaharuru Mountains, and to which reference will shortly be made.

The present river-valleys represent fluvial deposits that have accumulated since the time when the river-system of Hawke's Bay was, in the main, similar to what it now is—that is, since its slope or drainage-area was generally eastward. But this slope for drainage purposes was not always in this direction, for it can be proved by the most complete evidence derived from the rocks in this same district that the plane of denudation which immediately preceded the present one, certainly between the parallels of 39° and 40° , extended from north-east to south-west. And, curiously, the evidence to prove this statement is derived from the distribution of shingle-, sand-, and pumice-deposits that are traceable in a great measure in the vicinity of the river-basins already named.

And now for the proofs:—

Flanking the slates that form the lower ranges along the western portion of the district there is the remnant of an old limestone deposit. In most places, as I have elsewhere remarked, this limestone has been washed away, in some cases with portions of the underlying blue clay-marls. But wherever this is the case the area has been reoccupied by shingle, pumice, clays, and allied deposits.

These beds are clearly exposed in the Makaretu, Tukituki, Waipawa, and Manganuku Rivers, that flow over the Ruataniwha Plain. No doubt this plain was at one time entirely filled in with these same beds from east to west. Similar beds are traceable to the north-east through Kereru, and thence onward to Pohui. At the Waipukurau, Waipawa, and Maraekakaho gorges remnants of the linking of these beds with the present river-beds are to be found; and the terrace-gravels of the Geological Department, as seen at Waipawa, Waipukurau, Pata-ngata, and other places, are simply the remnants of a transitional period, when the drainage to the south-west, across the Ruataniwha Plains, was dammed back at Norsewood by deposits from a rising area to the westward, and breaches were

made in the limestones in the places named above, and the drainage from the west and north-west began to flow as at present, though at a much higher level.

But the shingle-conglomerate and other deposits of this old plane of denudation are not merely found flanking the Ruahine and Kaiwaka Mountains: similar deposits are very largely developed near Pohui, on the Napier-Taupo Road, and are found flanking the Maungaharuru limestones and occupying a large valley in that district as far as the 39th parallel. These conglomerates and allied deposits spread over a great extent of country, and they occupy the entire valley from Wairoa, *via* Pohui, to the Seventy-mile Bush.

For a long time it had been a great puzzle to me to account for the existence of extensive deposits of a somewhat indurated sandstone, pumice, and conglomerates, especially about Pohui and to the north-east of that place. There are no slates or fine sandstone rocks to the east or north-east of Pohui in the direction of the Mohaka River. At Taurangakuma, fifteen miles or so further to the west, and overlooking Tarawera, the Maitai slates, belonging to the Carboniferous system, are met with for the first time when proceeding from Napier; but between the two places there intervene the Maungaharuru limestone range, the Mohaka River valley, certainly 900ft. in depth, and the Te Hauroto limestones, clays, and grits. That there has been a break in the Maungaharuru Range the Te Waka scarp is a sufficient proof. There is, however, no trace of shingle, that I am aware of, on the range at a greater height than 350ft. above the present bed of the Mohaka River.

But the great conglomerate area in the vicinity of Pohui must be accounted for, and that from a source of origin corresponding to the products. Now, the only possible district from which the deposits could have been derived lies still farther to the westward than the districts named; and I am of the opinion that the filling-up of the Pohui valley and surrounding country was brought about by the same processes that are now at work bringing their loads of *débris*—shingle, pumice, &c.—from the west to the east. Those who are acquainted with the Ruahine and Kaiwaka Mountains are aware there are great breaks in them, through which pass the Mohaka, Ngaururora, and Tutaekuri Rivers. These breaks correspond to the present system of drainage.

From the mountains named there formerly extended a vast area of limestone country: in fact, limestone, towards the close of the Tertiary period, seems to have been the only rock exposed in the whole of the district, with the single exception, perhaps, of the chalk-marls in the hills known as the Alps, at Kaikora. At the time to which reference is now being made,

the Kaiwaka and Ruahine Mountains, as separate ranges, or as ranges at all, did not exist. The watershed of the south-east portion of the country, known as the Taupo volcanic zone, was primarily to the east; but when the rivers—or river, in preference—reached the more indurated and less broken and denuded limestones towards the east, it was diverted to the south-west and south-east, in the direction of an area of depression caused by the progressive elevation of the mountain-ranges named above. This was the period of extreme volcanic activity, and it was the period likewise of great denudation. Great floods appear to have been a special characteristic of the period, by which means vast quantities of the same kind of products were moved scores of miles from their place of origin, and deposited in the most extensive beds, and in perfect conformity with other beds of entirely different material.

This difference of material in the composition of the bedding implies either a change in the direction of the drainage-area, or greater floods at special periods, because the shingle-deposits, although they are interbedded with beds of pumice as pure as the pumice on the Taupo plain, or with greyish-blue clays and lignite-beds, are not structurally of igneous origin, although they might have been thrown from volcanic orifices, just as shingle and blue clays were thrown out during the Tarawera eruption. As pointed out above, these deposits cover a wide extent of country; but, wherever found, they simply occupy the place of limestones and clay-marls, as may be easily demonstrated by reference to the surrounding rocks in cases where the pumice and conglomerates are traceable.

With the exceptions of the Kidnapper beds on a large scale, and a few minor deposits at the mouths of the Esk, Mohaka, and Wairoa Rivers, all the shingle- and pumice-deposits are found at a comparatively high level. For example, between the Kaiwaka Hill and Pohui, on the Napier-Taupo Road, where these conglomerates, sands, pumice, and other beds are largely developed, they are met with at an average height of from 600ft. to 800ft.

Between Pohui and Maraekakaho the country, except where the limestones and marls remain, presents one vast accumulation of these deposits, and they continue past Hampden and throughout the entire length and breadth of the Ruataniwha Plain, and onward into the district known as the Seventy-mile Bush. As already pointed out, the latter plain is simply a remnant of the old valley-plain of denudation, when the whole surrounding country was filled—absolutely filled—with enormous deposits of shingle, blue volcanic clays (?), and pumice, brought down by the rivers that ran in this direction towards the close of the Tertiary and the commencement of the Post-tertiary period.

The River Manganuku, that runs along the east of the Ruataniwha Plain, and joins the Waipawa River just below the Waipawa-Hampden Bridge, rises in the pumice and conglomerate hills between Maraekakaho, Kereru, and the Guavas Station. Along the left bank of that stream there is a range of hills, running north-east and south-west, ten miles or more in length, composed of nothing but the Kidnapper pumice- and conglomerate-beds; and, in order to test the stratigraphical position of these beds, I have been over within the last month the entire country between Kaikora and Hampden, and there is no doubt whatever as to the position the beds occupy in relation to the limestones and clay-marls.

These pumice and conglomerate hills, I believe, are classed as limestones by the Geological Survey, but I shall have occasion to say more upon this point presently, when dealing with Mr. McKay's classification. In some places hereabout the pumice is a salmon-colour, as at the Kidnappers in certain beds, and is exactly similar to the vast accumulation one sees at Tauranga-Taupo, and other places on the eastern side of Lake Taupo. Now, if a line were taken from the top of the pumice and conglomerates forming the hills on the Hampden-Maraekakaho Road to similar deposits that flank the mountains along the western watershed of the district, it would link together the old area in this direction once occupied by deposits corresponding in every particular with those at Kereru, Dartmoor, Okawa, Pohui, Wairoa, Redcliffe, Kidnappers, and a dozen other places. Further, all those beds would be in the same general plane, except, perhaps, the Kidnappers, which I have shown in a former paper read before this society* to be connected with a subsiding area that has taken place at a comparatively recent date.

And now, before referring to the points in Mr. McKay's classification of the rocks in this district to which exception is taken, it will be well to summarise what has already been stated by me:—

1. The present watershed of the district under notice is to the west, and the slope or present plane of denudation to the east.

2. This plane of denudation is of recent date, as is shown by the gullet-like valleys through which the rivers run, combined with the absence of alluvial plains in connection with the several river-basins.

3. Except towards the west, all the rocks across which the present rivers flow are younger Tertiaries or Post-tertiaries.

4. The so-called high-level gravels of the Geological De-

* Trans., vol. xxii., pp. 436-7.

partment, as seen at Waipukurau, Waipawa, Kaikora, Patangata, are simply the remnants of the transitional period linking the present plane of denudation with the one immediately preceding it.

5. The river-system that preceded the present one was towards the south-west and south-east; the watershed was yet further to the west and north-west than the Ruahine Mountains.

6. The accumulation of shingle-deposits at Norsewood from the westward, consequent on the elevation of the Ruahine and supplementary ranges, threw a barrier across the drainage-area to the south-west, and the limestones to the eastward of what is now the Ruataniwha Plain were broken through.

7. Remnants of the old river-beds, as they broke through the limestones, are to be found in the terrace-gravels or transitional gravels, as explained in No. 4.

Hence it will be observed that all the shingle, conglomerates, pumice, lignite, and attendant clays found throughout the district are classed by me as belonging to two distinct periods only—viz., a recent one, still incomplete, with its transitional deposits of high-level gravels; and one corresponding to the Kidnapper pumice and conglomerate deposits, and which I ventured some time ago to place as the youngest of the Pliocene deposits, and as closing the Tertiary period.

Now, in order to show clearly and fully the wide divergence between Mr. McKay's classification and my own, and between his present classification and a former one, I shall make extracts from his reports, and then summarize those extracts, as representing the classified arrangement of the rocks in this district by the Geological Department.

1. On page 192 of the Geological Reports, 1886–87, appears the following, respecting the Kidnapper beds: "From Cape Kidnappers westward along the south shore of Hawke's Bay Tertiary beds . . . continue to the first point inside the cape, and are there overlain by Te Aute limestone. . . . Superimposed on these, but *unconformable* to the limestones, a great thickness of conglomerates, sands, and clays succeeds. . . . As these beds follow the Te Aute limestone . . . I had formerly supposed them to *succeed these limestones conformably, and to be the same as the Esk and Rangimapa conglomerates and pumice-sands which underlie the Petane clays*: but the past year's work has shown that similar gravels on the north bank of the Tutaekuri River, near Taradale, rest on a denuded surface of the Petane beds, and I therefore consider them to be of Pleistocene date."

2. Page 193, Scinde Island: "Notwithstanding this change of the name, I refer all the beds in Scinde Island to the Wai-

patiki beds, which clearly *overlie the Petane clays and sands.*" Here the Napier limestones are placed above the Petane clays, as seen in the inner harbour; but, although this classification has been made, Mr. McKay is clearly doubtful on the point, for he says a little further on, "Whatever the ultimate conclusion arrived at may be, there seems no likelihood that the lower limestone in Scinde Island will be referred to the Pareora system of Hutton."

3. Page 200, younger Pliocene, Petane series: "This series includes—(a) Mahia beds, consisting of pumice-sands, sands, and clays, overlying the limestones on the west side of the Mahia Peninsula; (b) the Waipatiki beds, including an upper and a lower shelly limestone, parted by a series of sandy clays and pumice-sands; (c) the Kaiwaka beds, which comprise the typical Petane clays and sands, and the pumice-sands, conglomerates, and brown sands of the Esk Valley and Kaiwaka Creek."

4. Page 205, older Pliocene, Pohui series: "This includes the triple sandstone conglomerate and other beds of Rangimapapa Hill, and the Pohui grey and brown sands, . . . also the shelly limestones of Te Whaka and the Maungaharuru Range, and, as a consequence, to this should be referred the Te Aute limestone in the southern part of the district."

5. Pages 206–7, Rangimapapa beds: "These beds have not been proved fossiliferous in the district south of the Mohaka [River (?), 39th parallel]. On the north bank fossils have been obtained from what should be the same beds. The collection . . . consisted mostly of recent shells."

6. Page 202, Petane clays: "These are best known . . . along the north and western shores of Napier Harbour. . . . To the south-west they extend across the Tutae-kuri into the Ngaruroro Valley, in which they form characteristic strata underlying the Petane limestones. . . . Farther to the south-west the clays overlying the Te Aute limestones along the eastern side of the Ruataniwha Plain *may belong to these beds*; but in this case the lower members of the *Kaiwaka beds would have to be considered absent, as also would the Rangimapapa and the Pohui beds.*"

(The italics in the quotations are my own.)

From the foregoing extracts the sequence of the younger and older Pliocene rocks of this district is as follows, according to the Geological Survey authorities:—

OLDER PLIOCENE.

I. Pohui series.

1. Te Aute limestones.
2. Pohui grey- and brown-sand beds.
3. Rangimapapa triple conglomerates.

YOUNGER PLIOCENE.

II. Kaiwaka series.

4. Sandy clays, brown sands, and conglomerates, underlying and alternating pumiceous sands, shales, and conglomerates.
5. Pumice and sandstone conglomerates of Esk Valley below Kaiwaka Creek.
6. Petane clay-marls and brown sands.

III. Waipatiki series.

7. Lower Petane limestones.
8. Pumice-sands and sandy clays.
9. Petane upper limestone.

IV. Mahia series.

10. } Mahia pumices and blue sandy-clay beds.
11. }

PLEISTOCENE.

12. Kidnapper conglomerates and pumice.

It will be seen from this summarized classification how very widely separated are the two readings of the Kidnapper conglomerates to which Mr. McKay refers on page 192 of his report. The conglomerates were classed as conformable to the Te Aute limestones in the first instance, and, simply because similar beds are met with at Redcliffe, near Taradale, resting, as Mr. McKay rightly interprets, on the Petane clays, they are at once separated from the limestones by the other beds, and they are further transferred from older Pliocene, or Upper Miocene, to Pleistocene, and this for no other reason than that they are found at Redcliffe on the top of rocks representing the Petane clays. In the Kidnapper beds the fossils can be shovelled up from several bands that intervene between the limestones and the pumice; but all the shells are recent, and correspond more closely with those found in the artesian beds underneath the Heretaunga Plain, and which were described in my second paper on artesian wells, a year ago, than with the fossils in the limestones below them.

Before the present classification was made by Mr. McKay I had directed attention to the then classification adopted by the Geological Survey authorities, in which the Kidnapper pumice- and conglomerate-beds were made to pass underneath the Scinde Island limestones. The recent classification, as pointed out above, has separated the Kidnapper pumice- and conglomerate-beds from the limestones on which they rest by a very great gap indeed; but it seems to me that the difficulties in the way of harmonizing the stratigraphical arrangement of the rocks in this district have been increased very much thereby.

Let it be remembered that the Te Aute limestones, so Mr. McKay says, are at the Black Reef within eight miles of Napier, and that between the Scinde Island limestones and those at the Black Reef, on which the Kidnapper beds

rest, there intervene, or ought to intervene according to the amended classification of the Geological Department, no less than eight beds, corresponding to the Pohui and the Kaiwaka series.

At Taradale, four miles from Napier, the Petane beds occur, and the Petane limestones overtop them where the conglomerates are absent. There is certainly not a trace of any intervening beds between the Napier or Scinde Island limestones and the Te Aute limestones, or between the latter limestones and the Petane clays, and exactly the same difficulty arises here which Mr. McKay saw would follow his squeezing process, where, in the sixth extract I have made from his report, he says that "the clays overlying the Te Aute limestones along the eastern side of the Ruataniwha Plain may belong to these beds; but in this case the *lower members* of the Kaiwaka beds would have to be considered absent, as also would the Rangimapapa and the Pohui beds." Now, if Mr. McKay is willing to recognize the clays on the eastern side of the Ruataniwha Plain, and which overlie the Te Aute limestones, as belonging to the Petane clays, why may he not consider the same as being possible in the case of the Petane clays at Redcliffe? But, whether he does so or not, the fact remains that in order to make his classification work it is necessary to consider all members of the Pohui and Kaiwaka beds as absent in this district as in the Ruataniwha district.

The limestones at the Black Reef dip underneath the Heretaunga Plain in the direction of Redcliffe, and it is certain that up the creek near the Black Reef, where the conglomerates, &c., are absent, the Petane clays are largely developed. The same thing occurs over the entire district. If the denudation has been very great the clays have gone, and the lower limestones have the pumice and conglomerates resting on them, whilst if the denudation has not been excessive the conglomerates, &c., rest upon the blue clays; but in the latter instance some of the former beds are absent. At Napier the upper limestones have been worn away in places by the denudation resulting from beds corresponding to the Kidnapper conglomerates. At Petane the same thing has occurred; and, in fact, the rule holds good over the whole of the district.

With regard to the Petane clays, I would point out, with all due deference to Mr. McKay, that these clays have their equivalents—identical as to material and identical as to fossils—on Scinde Island, and that these clays are found with the marls separating the upper and lower limestones, just as they are met with in the Waipatiki Creek, but without a trace of pumice, as stated in the official report. I have lately

passed over the entire country between Tongoio and the Waipatiki Creek, and between the latter place and Moaeangiangi, and at the end of November last year I had the opportunity of going in a steamer from Mohaka to Moaeangiangi and Arapawanui, thence to Waipatiki and Tongoio, keeping close in shore the whole way. As far as I could judge after most careful observation, there appears to be no unconformability between any of the beds belonging to the series, and I agree entirely with Mr. Cox in this matter. The blue marls and clays which form the entire cliffs from Mohaka to Moaeangiangi are the lowest beds of the series. They are seen to underlie the limestones at Moaeangiangi, and they disappear a little to the south of Arapawanui. These are overlain by bluish-brown sands, followed by limestones corresponding to the lowest of the Napier limestones. At the Waipatiki Creek blue and brown clay-marls rest on the limestones, and these are followed by limestones, the arrangement being exactly similar to that seen between Sturm's Gully and Breakwater Point on Scinde Island.

For myself, I cannot see any distinction between the limestones at the Black Reef, Scinde Island (lower), Lower Waipatiki, and Te Whakā near Pohui, and the evidence in favour of contemporaneity appears to me as overwhelming. They all rest upon bluish-brown sands, which run into the underlying blue clay-marls, just as they are seen at the Kidnappers proper, at Moaeangiangi, at Maungaharuru, at Patangata, and in the district between Hampden and Maraekakaho. These blue clay-marls all trough in the direction of Hawke's Bay, as I have elsewhere indicated, and as Sir James Hector pointed out years ago. The entire series of limestones and interbedded clays are succeeded or were succeeded by the series belonging to the Kidnapper pumice and conglomerates which have been here described.

And that this arrangement as to the stratigraphy of the rocks in this district is the correct one, we have, in further proof, the facts gathered from the numerous sinkings for artesian water that have been made on the Heretaunga Plain, as also at Napier, Petane, and Puketapu. To the north and north-west of the Napier Hills, sinkings have been put down to a depth of 400ft., and the lower Napier limestones were struck at that depth a little beyond the Petane end of the Ahuriri bridge. This is exactly what might have been expected from the dip of the limestones in this direction. A well put down in May of the present year at Mr. Torr's, Petane Valley, to a depth of 100ft., simply passed through the shingle- and sand-beds full of brackish water which are met with along the sea-beach from Awatoto to Napier at a similar depth. The Napier marls or Petane clays are on either side

of this valley, whilst the limestones are seen topping the hills in every direction. At Greenmeadows, near Taradale, Mr. Gilbert put down for Mr. Tiffen, so recently as March of the present year, a tube-bore to a depth of 600ft. I had pointed out on two different occasions, in papers read before this society, that the place chosen was outside the artesian water-bearing area; yet the sinking was proceeded with, and, though no water was reached, it proved to be of great scientific value, as it connected the lower beds in the well with the blue clays at the Kidnappers, which undoubtedly pass underneath the limestones at the Black Reef. In this sinking no traces of conglomerates or sands other than pumice-sands were met with, blue papa or blue clays being the only rock passed through during the sinking below the first 150ft. Now, this sinking is within a mile and a quarter of the Redcliffe conglomerates, and it is within half a mile of the upper pumice-deposits belonging to the Redcliffe bed. There were no signs of the Pohui conglomerates—triple conglomerates—and brown-sand beds, or even of the Kaiwaka beds that are held by the Survey to underlie the Petane clay-marls and brown sands, and which come between the latter and the Te Aute limestones in the official report of the Geological Department.

Let it be kept clearly in mind that the limestones at the Black Reef, inside of the Kidnappers, are recognized in the report as belonging to the Te Aute, or, which is the same thing, the Te Whaka limestones. The blue sands and blue clay-marls of the Kidnappers proper are seen to pass underneath these limestones, and are certainly met with in the 600ft. sinking at the Greenmeadows, near Taradale, to which reference was made above. Near the latter place the Survey recognizes the existence of Petane clays, with the Redcliffe conglomerates atop of them. Corresponding conglomerates also rest upon the Petane clays behind the Kidnappers, half a mile or so to the south-east of the Black Reef, just as they rest on the limestones at the latter place:

But the question arises as to the whereabouts of the intervening beds—the Pohui and Kaiwaka sands and conglomerates of the Geological Survey. There is no trace of them in the vicinity of the Kidnappers, just as there is no trace of them on the east-side of the Ruataniwha Plain and surrounding district. They cannot be traced by means of deep sinkings—either at Napier, Petane, Taradale, or Puketapu. Neither in the depths below nor in the exposed rocks above are any traces of the Pohui and Kaiwaka beds found, other than as represented in the Kidnapper, Redcliffe, Maraetaha (inner harbour), and Petane conglomerates, sands, and pumice-deposits. Are we to suppose that these Pohui and Kaiwaka beds which are structurally similar to the Kidnapper and Redcliffe beds, and

are found resting on similar limestones and clays, were deposited, the former at the commencement of the Pliocene period, the latter at the commencement of the Pleistocene, as stated by the Geological Survey? Such a classification is contrary to every geological fact in this district, and it opens up difficulties which cannot be harmonized either by the aid of stratigraphical or palæontological evidence. Mr. McKay, by a single stroke of his pen, removed the Kidnapper conglomerates from resting conformably upon rocks classed as Upper Miocene, and as passing underneath the Scinde Island limestones, to an unconformability, as of Pleistocene age, and, of course, much younger than the Napier limestones. Had a similar course been adopted with regard to the Kaiwaka and Pohui conglomerates and sands, which, curiously, Mr. McKay first classed with the Kidnapper conglomerates, the alteration would have enabled the rocks of this district to be read without difficulty. As remarked at the outset, the official report of the Geological Department is full of interest, and had the Kidnapper conglomerates, together with the Kaiwaka and Pohui beds, been simply removed from Upper Miocene to Lower Pleistocene, this paper would not have been written.*

ART. XXXV.—*Note on the Eruptive Rocks of the Bluff Peninsula, Southland.*

By Professor F. W. HUTTON.

[*Read before the Philosophical Institute of Canterbury, 7th August, 1890.*]

THE structure of the Bluff Peninsula has been lately described by Mr. James Park in a report to the Director of the Geological Survey of New Zealand.† It is composed partly of sedimentary sandstones and slates, which are referred by Mr. Park to the Te Anau series, from lithological characters, and partly of eruptive rocks which have usually been called syenites.‡ There are also diabasic-ash breccias, which, as Mr. Park points out, prove that volcanic activity was exhibited during the period of deposition of the sandstones. In fact, Bluff Hill is the stump of an old volcano.

* See map of the district, *Trans.*, vol. xx., pl. xviii.

† "Reports of Geological Explorations," 1887-88, p. 72, with map and sections.

‡ Dr. C. Forbes, *Quar. Jour. Geol. Soc.*, vol. ii., 1855, p. 522; Hector, in *Otago Provincial Gov. Gazette*, 5th November, 1863; Hutton, *Reports Geol. Expl.*, 1871-72, p. 102; *Geology of Otago, Dunedin*, 1875, p. 41; Hamilton, *Trans. N.Z. Inst.*, vol. xix., p. 452.