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NEW ZEALAND.

REPORT ON THE GEOLOGY OF THE CAPE COLVILLE PENINSULA, AUCKLAND.

BY
ALEXANDER McKAY, F.G.S., HON. M., N.Z. INST., GOVERNMENT GEOLOGIST.

Presented to both Houses of the General Assembly by Command of His Excellency.

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ERRATA.—Page 37, fourth paragraph, third-last line, *for* "scalanohendrons," *read* "scalenhedrons." Page 41, third paragraph from bottom, first line, *for* "Thames, Port Charles," *read* "Thames for Port Charles."

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INTRODUCTION.

THE revival in mining, which within the past two years has taken place at the older established centres of gold-mining on the Cape Colville Peninsula, and the impetus thus given to prospecting, has led to the discovery of gold at many places at which formerly its presence had been but suspected. Further prospecting has also proved the presence of gold at many places not before known to be gold-bearing, or where hitherto the prospects were considered too poor to pay, further and more exhaustive search is being made.

The phenomenal proceeds from a number of mines in the north and south parts of the Peninsula has aided the introduction of foreign capital, which, whether applied to the development of known mines, or to the discovery of new, has led to a general search being made from Cape Colville in the north to Te Aroha in the south, and in many cases has brought the prospector and miner face to face with a variety of conditions with which they were comparatively unacquainted, the nature of the country and the character of the auriferous material not always according with their former experiences.

There has thus been aroused a considerable interest as to the exact nature, position, and extent of the different rock-formations of the Peninsula in which gold-bearing lodes have been or may be found, and at the same time a desire that these should be so studied as to enable the production of a map showing the extent and limits of the different formations, and thus aid the prospector in his work, and be also of value to those engaged in other branches of mining. Aware of these facts, and alive to the importance of such a work, the Hon. the Minister of Mines directed the commencement of a geological survey of the Peninsula, which was accordingly begun in September of the present year (1896–97). Up till the present time (May), the work has been carried on continuously, either on the Great Barrier Island, or on the mainland within the area lying between Cape Colville, the northern extremity of the Peninsula, and the county road between Te Aroha and Katikati, on the shore of Tauranga Harbour, was so far examined that the general sequence of the rock-formations has been determined, and their extent and boundaries ascertained with a fair degree of accuracy. Yet, while this much can be claimed, it has to be admitted that further and most careful work will have to be carried on to determine many things respecting which there is still a doubt.

Hitherto, but small areas of the Peninsula have been geologically explored. At Cabbage Bay, Coromandel, on the Hauraki and Ohinemuri goldfields, and at Te Aroha, partial surveys have been made; but the north and south parts of the east coast, except at Kuaotunu, and the central region south of Coromandel, up to the present time have remained practically unexplored. The sequence of the different rock-formations has till now been unknown, most of the published reports dealing only with restricted areas in the vicinity of where gold was being mined.

Within the past two years, the prospector has penetrated to almost every part of the Peninsula, finding gold more or less at all places. My first duty, therefore, was a hasty survey of the whole of the Peninsula, to determine the sequence of the rock-formations, and, as far as might be, their boundaries. Survey in detail was in no instance undertaken.

PHYSICAL GEOGRAPHY.

Peninsular Auckland, or that part of the provincial district which lies to the northward of a line drawn from Kawhia, on the western coast, to Tauranga on the Bay of Plenty, has extension in

a north-west and south-east direction, and gives evidence—contrary to what now is—of a former linear extension of New Zealand along such line far beyond the limits of the present land. This obtained during early Cretaceous times, and long prior to the appearance of the Southern Alps, or of the mountains of the main chain extending from Cook Strait to the Bay of Plenty in the North Island.

From the east side of the south part of peninsular Auckland springs the Cape Colville Peninsula. This is bounded on the east side by the ocean, and on the west side by the Hauraki Gulf and the Frith of Thames. Strictly speaking, the Peninsula may be considered as terminated along a line drawn between the mouths of the Thames and Tairua Rivers. Doubtless this is true, but it must be apparent to every one having knowledge of the district that the tract of broad low swampy plain across which the Thames and Piako Rivers find their way to the sea is of extremely modern date. This extensive plain is for many miles to the south but a few feet above the level of the sea, and is unquestionably due to the action of the Waikato River filling-in and reclaiming the southern portion of the Hauraki Gulf.

There is thus reason to believe that once, and (geologically speaking) at no distant date, the southern continuation of the mountains of the Cape Colville Range were peninsular to and beyond Mount Te Aroha, or, in other words, to where the range ceases and the high sloping plateau to the south and south-east begins. Hence the whole region may properly be treated of as included in and forming the Cape Colville Peninsula.

The surface of the Peninsula is generally broken, in some parts extremely rugged, and along the main axis the mountains rise to an elevation of 2,000 ft. to 3,000 ft. The culminating points are in the extreme north and south parts, Moehau and Te Aroha being mountains of about equal height. Te Aroha does not stand on the main axis or water-divide, but somewhat to the westward, and is built up of rocks belonging to the first and second periods of volcanic activity, as displayed on Cape Colville Peninsula. Moehau, on the other hand, of nearly equal height, terminates towards the north the main range, and is itself a mountain formed of Palæozoic or older Mesozoic strata, hence for it may be claimed the chief place among the mountains of the Peninsula. South of Moehau the mountains lessen in height, till on the road between Cabbage Bay and Port Charles the heights do not exceed 800 ft. to 1,000 ft., and the road crosses the range at an elevation of 500 ft. Further south the water-divide attains to 1,500 ft. above the sea, till the range is again broken a little south of the track from Cabbage Bay to Kennedy Bay. This may be called the Cabbage Bay Range.

South of the Cabbage Bay Range and the saddle mentioned the water-divide shifts a little to the westward, and suddenly attaining a height of 1,700 ft. is continued in a straight line along the Austral and Tokatea Ranges to the Tokatea Saddle (1,200 ft.). Along the Success Range the same line of elevation is continued to the saddle by which the Coromandel–Kuaotunu Road crosses the ranges, and further to the south in the same line the main line of height is continued along the Tiki and Castle Rock Ranges to the saddle at the source of the Waiau by which the Tiki–Mercury Bay Road crosses the range here, also at a height of 1,200 ft. above the sea.

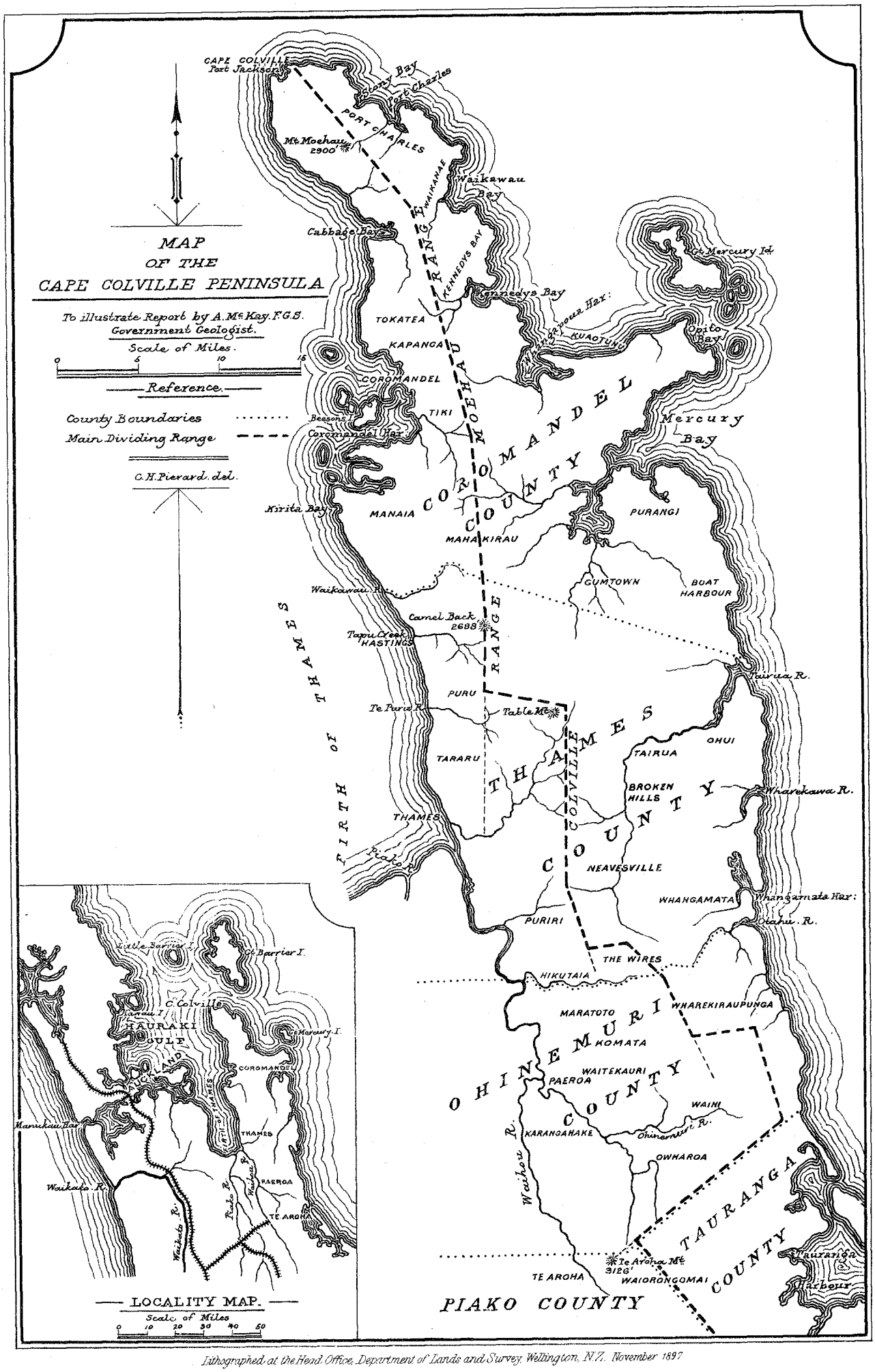
Yet farther south the range is continued in a direct line to the source of the Waiwawa, flowing north-east into Mercury Bay, and of Tapu and Puru Creeks, draining into Hauraki Gulf. Opposite the source of the Puru Creek the water-divide turns sharply to the eastward, and runs in this direction a distance of six miles across Table Mountain to the source of the Kauaeranga River. South of the source of the Puru the main range of the northern part of the Peninsula is continued as a spur range between the middle and lower parts of the Kauaeranga Valley and the east shore of the Hauraki Gulf to the Kauaeranga River.

In Table Mountain a new line of water-divide is established, which at first trends a little to the west of south, and divides the waters flowing eastward into the Tairua River from those flowing west along the Kauaeranga, Kerikeri, and Puriri Streams to the sea or the Thames River. This is a range distinct from that extending from Moehau to the Thames, and appears to be of younger date, denudation having barely sufficed to reduce and break into peaks and saddles what in the first instance was a high table-land, on which are yet represented, in its northern parts, the youngest of the volcanic rocks of the Peninsula. Beyond the source of the Puriri the water-parting trends slightly to the south-east, to the divide between the Hikutaia Stream and the source of the Tairua River, and thence in the same direction between the waters falling to the eastward and the Waitekauri, a tributary of the Ohinemuri River, on the west. The range of mountains beginning with Table Mountain terminates on the north side of the Hikutaia Valley, from which point the water-parting again departs to the east, and again takes up the south-east line, terminating at Waihi as already described.

Between the Hikutaia and Ohinemuri Rivers and west of the Marototo and the Waitekauri Streams, the southern continuation of the second main range commencing in Table Mountain is broken up into a series of high hills having no definite arrangement. The Komata Stream cuts deeply into the heart of these, while other lesser streams falling into the Hikutaia and Ohinemuri Rivers also break into and interrupt the continuity of these hills, so that they do not form a range, but a cluster of separate and distinct mountains. The Ohinemuri River, in its middle course, breaks through between these hills and Karangahake Mountain, and its upper valley opens out into the wide basin of the Waihi Plain, the actual water-parting receding nearly to the East Coast.

From the south side of the Waihi Plain the water-parting goes south-west to Mount Te Aroha, and includes between this and the crest of the Karangahake Range the watershed of the Whaitawheta, the principal southern tributary of the Ohinemuri River. The Karangahake–Te Aroha Range thus lies on the western verge of the mountainous district, and is separated altogether from the water-parting between the East Coast and the valley of the Thames or Waihou River.

At the source of the Whaitawheta and the Waiorongomai a high saddle connects Te Aroha with the mountain range to the east, which, as the main range, once more constitutes the true water-



Lithographed at the Head Office, Department of Lands and Survey, Wellington, N.Z. November 1897

divide between the East Coast and the valley of the Waihou River. This range continues in a direct line to the south boundary of the district examined.

From Cabbage Bay to Coromandel the principal range is flanked by different groups of hills divided from each other by the valleys of the different creeks draining towards the Hauraki Gulf. Between Kevin's Point and the foot of the Tokatea Hill, the last of the series, a group of four or five, constitutes an irregular spur range running north-east and south-west. To the south of Coromandel Harbour, like clusters of hills, often rising into mountains, flank the main range, and form a bold coast-line as far south as Tapu Creek, beyond which, to the Thames, the descending spurs of the main range reach the shore-line.

Cut through by the Kerikeri, between the Kauaeranga and the Puriri, a block of mountains flanks the main range, and between Omaha and Hikutaia a spur range runs west to the main road from the Thames to the southern goldfields. Also between Paeroa and Te Aroha a range of hills strikes westward into the plain, and is divided from the principal range, by the saddle by which the coach-road crosses from Paeroa to the southern side. On the east side of the Peninsula a spur range runs from Castle Rock Range to Kuaotunu, and south of Mercury Bay there commences a coastward series of mountains and ranges, that more or less divided from the different parts of the main range or water-divide, and broken through by various rivers and tidal inlets, reaches to and terminates at the upper or Katikati portion of Tauranga Harbour.

The sketch on the opposite page shows the position and trend of the principal water-divides and different sections of the main range.

North of Cabbage Bay the bulk of the country is formed of slate and sandstone of Carboniferous age, but on the east slopes of Moehau, and between the foot of the main peak and the sea, there is a considerable development of volcanic rock. Slate rocks, however, appear in the valleys on this side of the mountain down to 140 ft. above sea-level. Abreast of Cabbage Bay the slates are confined to the western slope of the range, but more to the south they appear on both the east and west flanks of the range, the volcanic rocks merely capping them and forming the higher part of the range. Slates appear as a small outcrop at the head of Cabbage Bay, on its south side, and on the coast-line from Torihine to Paparoa, but are not again seen on the shore-line till reaching the south side of Coromandel Harbour.

The presence of slate under the volcanic rocks of the Tokatea Range has been proved in various mine-workings, which show that the slates rise to a height of 1,020 ft. above sea-level. On the western middle slope of the Success Range the slates are exposed at the surface, and on this side of the main water-divide they continue to the southward to abreast of the middle part of the Castle Rock Range, where in connection with the main range for a time they terminate. A little to the north of this termination slates appear further to the west, on the shore of Coromandel Harbour, and this area of slate for a time, flanked to the west by volcanic rocks, in its south extension, reaches the shore of the gulf at Kirita Inlet, south of Manaia Harbour. There is between the shore of the gulf at this point and the eastern limit of the slate a breadth of four miles, which, next to the Moehau area, is the greatest width of slates on the Peninsula. Gradually the width of the slate belt lessens in a south direction to its termination in the gorge of Tapu Creek. Further south, at Waiohanga or Rocky Point, near the Thames, there is a small exposure of slate beyond which no slate is known in the southern part of the Peninsula. Slates appear isolated and away from the main range in the Kuaotunu Peninsula.

These rocks are thus mainly confined to the western slope of the main range north of the Thames, and to both slopes of Moehau in the northern part of the Peninsula. Near Cabbage Bay there is a development of the coal-bearing series of Cretaceous or old Tertiary date, but this, though once a widespread formation, has for the most part been denuded away, and is now of but little consequence as affecting the physical features of the district, being to a large extent covered up by younger volcanic rocks.

Volcanic rocks of different ages overlie the slates, and each division, with the exception of the youngest, the acidic rocks or rhyolite formation, are at one or other place found resting on the slate formation. The general arrangement, however, is as a succession of strata and groups of volcanic rocks that strike in a north-east direction, and dip to the south-east, and this is true of the whole of the Peninsula, though local deviations from the rule are not infrequent.

After all the important formations of the Peninsula had been deposited, movements still were continued, the commencement of which was of the date of the Kapanga group, whereby the rocks to the west and north were elevated and those to the south and east were depressed. And thus as time went on and denudation proceeded, the slates—the oldest rocks—appeared along the west coast, and in the northern part, and in accordance with and as a result of the same causes the rhyolite formation has its greatest development in the south and east, and is altogether absent from the northern part of the Peninsula.

The slates and the older volcanic rock thus form the main range in the north part of the Peninsula, and it is along the western slope of this range that the principal reefing localities at and north of the Hauraki Goldfield are situated. At the Thames and at Coromandel, as a rule, the gold-bearing reefs occur in the volcanic rocks, but also at no great distance from an outcrop of slate, or from where the presence of slate has been ascertained in mine-workings. This western range terminates at the Kauaeranga, near its mouth; but eleven miles to the north the water-divide between the east and west coasts, at the source of the Puru Creek, turns sharply to the west, and runs between the Kauaeranga and the upper part of the Waiwawa to Table Mountain, and west of Table Mountain to the divide between the Upper Kauaeranga and the waters flowing into Mercury Bay on the one hand, and into the Tairua River on the other. In Table Mountain and the range immediately to the north begins the second group of mountains, that, standing more to the east, forms the main water-divide south to where the range terminates on the north side of the Hikutaia Valley. This is composed of a variety of rocks

variously affected by mineralising agents, so as to produce physical features that resemble or differ from each other, but which for the most part are not represented in the western range. In Table Mountain and the range to the north the whole upper part is formed of prismatic columns of grey andesite that in the mountain itself forms vertical walls 300 ft. to 600 ft. in height, while the top of the range for a breadth of some two miles is perfectly flat. Hence the name. To the north these intrusive rocks die out before reaching the Waiwawa. To the south the line of intrusive rocks trends with a diminished width of exposure across various tributaries of the Kauaeranga, and, acquiring a more easterly direction, forms Mount Kaitarakihi, on the main range, at the source of the fourth branch of the Tairua River. This mountain is not table-topped; the thickness of the dyke of columnar rock being less than farther to the north; a rounded outline is the result. The Rhyolite formation forms the higher part of the range east and south-east of Table Mountain, and on this and on part of the adjoining and underlying andesic rocks of the Kapanga group, intense and long-continued thermal action has so saturated the rocks with silica, and built up mounds and terraces of siliceous sinter, that, supplemented by denudation carrying away the less resisting, less coherent rocks, extremely gorgey and rugged country, full of precipices and crowned by conical and fantastic peaks, is the result.

In the Neavesville part of the district, between the sources of the Puriri and the streams flowing into the fourth branch of the Tairua, the rocks are mostly volcanic ash and moderately fine-grained breccias belonging to the Kapanga group, and where not saturated with silica from thermal springs they weather and are denuded much after the fashion of the same rocks in the typical locality. On Pakirarahi, the mountain on the main water-divide west of the Neavesville mines, former thermal action is strongly manifested. The higher part of the mountain—2,000 ft. to 2,400 ft.—is formed of sinter, and the eastern slope is strewn with sinter fragments down nearly to the first crossing of the fourth branch of the Tairua. The London Rock, on the western fall of the range, forms one of a series that extend along the whole length of this range, and form small areas of indurated or more mineralised country, which denudation has been unable to remove as rapidly as the other parts, and thus, singly or in pairs, as in the case of the Marototo, four in a line, they rise as gigantic crags to heights from 400 ft. to 1,000 ft. above the general surface upon which they stand.

On the south side of the left branch of the Puriri Stream rhyolite again forms the higher part of the main range. Now, however, it takes on the outlines of tent-shaped mountains, with here and there a peak or dome-shaped projection above the general level. The western slope of the southern part of the range is very abrupt. On the eastern side the descent to the Tairua Valley is not so steep. In the Puriri Valley there is a small area of Thames–Tokatea rocks, the oldest group of the volcanic series; but the great bulk of this range is formed of rocks belonging to the Kapanga group and the Rhyolite formation. The range ends abruptly on the north side of the Hikutaia Valley. On the south side of that valley, between the Marototo Creek and the west border of the mountain region, there is in the line of the range of mountains just described an irregular cluster of hills and mountains that may be said to continue this range south to the Ohinemuri Gorge, yet, as their arrangement is not as members of a mountain range, and the rocks composing them are different, and the main water-parting lies considerably to the east of these, they have to be regarded as distinct, and as forming a group of mountains not directly connected with the range terminating on the north side of the Hikutaia Valley.

It has been said that the main water-divide leaves the first, or western, range eleven miles before that terminates on the north side of the Lower Kauaeranga. In like manner the water-divide leaves the second range before that is terminated on the north side of the Hikutaia Valley. The displacement to the eastward in the first case amounts to about six miles; in the second instance it is scarcely more than half that amount, and also the set-off is nearer the termination of the second range by more than half the distance between the Lower Kauaeranga and the source of the Puru. Yet, for all that, there is great similarity in the two cases as to the manner in which the western range terminates, and the recession of the water-parting to the east and the commencement of a distinct range forming the water-parting more to the east or south-east. The third, or Hikutaia Range, commences at the source of the right-hand branch of that stream, and trends more to the south-east than either the first or second range to its termination on the north side of the Upper Ohinemuri Plain, near Waihi. This range, in its northern part, is composed of rhyolitic tuff, and in some parts, of sedimentary beds composed of rhyolitic material. At the source of the left or main branch of the Hikutaia, intrusive rhyolites or quartz porphyries form the mountain mass of Ngapuketurua, between 2,000 ft. and 3,000 ft. in height. This mass of rhyolitic rock, forming a very bold and rocky mountain, extends westward across the valley of the left branch of the Hikutaia, and forms the most easterly of the Marototo peaks. The belt of acidic rocks is of no great width, and the section laid bare along the banks of the Hikutaia shows clearly the intrusive character of the rock. The southern end of the range is wholly composed of andesite, as solid flöes, or as ash and breccia beds, and constitutes the mining country of Waitekauri and the neighbourhood of Waihi. The features presented by the mountains of this part are a main ridge from which outrunning spurs proceed in various directions, all of them evidently due to the action of denudation on material of varying grain and hardness, deposited irregularly as *ejectamenta* from volcanic vents.

The northern source of the Ohinemuri lies on the east side of this range and some distance to the north of its southern end; so that here we have again repeated the same feature that marked the recession of the water-divide to the eastward before the second and third ranges began. In this case the water-parting lies between the Wharekeraupunga and the sources of the Ohinemuri, and goes east till the coast range is reached. The coast range, composed wholly of rhyolite to within a short distance of the mouth of the Waihi River, has had its eastern slopes carried away by the action of the sea, and a consequence of this is that the drainage flows east from within half a mile of the sea-cliffs of this part.

The Upper Ohinemuri or Waihi Plain, on the east, is bounded by low hills, and on the south side by a cluster of hills, the eastern part of which is cut through and drained by the Waiau Stream, falling into the upper part of the Tauranga Harbour. Among these hills the water-parting winds irregularly, but trends generally in a south-west direction to the commencement of another definite range, which, from the source of the Whaitawheta River, east of Mount Te Aroha, trends south to the limits of the district examined. This southern range, which is for the most part composed of moderately fine-grained volcanic breccia, is deeply cut into by gullies, and very abrupt on its western side. Its crest at frequent intervals is crowned by sharp or castellated crags, and stands in wonderful contrast to the smooth outlines of the last mountain to the south and the high sloping plateau plain that lies beyond in the direction of Tauranga and Rotorua.

A lesser range, mainly composed of rhyolitic rocks, follows the coast-line from Mercury Bay Heads to Waihi Beach. A portion of this, east of Waihi Township, is for a short distance the main water-divide. Between Cabbage Bay and Coromandel, hilly country, at places rising into mountains, stretches along the shore of the Hauraki Gulf, and generally is separate from the main range in that part. The same applies to the coast-line between Coromandel Harbour and Tapu Creek, and, with the exception of the foot-hills along the borders of the plain west of the mountains south of the Thames, the only feature of consequence is the range that from the Karangahake–Te Aroha Range runs out to the north-west some four miles on to the plain, and near its junction with the Karangahake–Te Aroha Range is crossed by the coach-road from Paeroa to Te Aroha.

The main water-divide of Cape Colville Peninsula, from the foregoing, it will be seen, is not one continuous range, but in reality consists of five sub-parallel ranges, the first four of which have depressions between them that lie nearly in a north-north-east and west-south-west line, and, assuming the ranges to have the same general direction (which is barely true of the third and fourth, but is of the first and second), they can be imagined as at a former period having extended beyond their present limits to the south-west. Some such extension of high land is necessary to account for peculiarities of the geological structure of these mountains, it being evident that extensive lakes at one time existed, of which the retaining barriers have long since been removed. The lacustrine strata referred to are found usually at considerable elevations, and forming in part the crests of the higher ranges.

This and other peculiarities that come to light in a study of the physical features of the district can only be explained by having regard to the geological history of the Peninsula from prior to the deposition of the coal-bearing series, or the commencement of the Cretaceous period, to the present time. Those who have made the geology of New Zealand a special study do in most part agree that, towards the close of the Jurassic and during the early part of the Cretaceous periods, the land over and outside what is now the New Zealand area was not only much more extensive than it now is, but was also in particular regions elevated and mountainous in character. Generally, however, it is thought that the direction of its principal mountain chains were as now—*i.e.*, in a north-east and south-west direction—and this in spite of the fact that it has been pointed out that the main lines of elevation in the Pacific Ocean are in the contrary direction, or as near as may be in a north-west and south-east direction. Hochstetter says, "The three islands of New Zealand constitute only parts of one and the same system of mountains, which, running from south-west to north-east, forms a distinctly marked line of elevation in the Pacific Ocean. This longitudinal line is crossed by a second, almost at right angles, which is indicated by the direction of Foveaux and Cook Straits, but still more so by the direction of the long-stretched north-west peninsula of the North Island. This north-west peninsula corresponds to the line striking N. 52° W., and designated by Dana as the axis of greatest depression in the Pacific Ocean."*

Geologically, the oldest rocks of the Auckland Provincial District are found along the eastern side of the long peninsula extending from south of Auckland City to North Cape, and which Hochstetter shows lies parallel to the line of greatest depression in the Pacific Ocean.† Dana, in "Corals and Coral Islands," shows that the submerged lands of the Pacific Ocean over the coral-bearing region have a general trend in a north-west and south-east direction, which is likewise the direction of the greatest depression in that ocean. On the south-west side of the great depression in the Pacific there is evidence also of a north-west trend of lines of elevation, and of depressions parallel to these—to wit, the Auckland peninsula, and its extension to the south-east, and the depression of Cook and Foveaux Straits. It is not difficult to imagine that the land of which the Auckland peninsula is a remnant was at one time prolonged to the north-west as far as Norfolk Island, and to the south-east as far as Bounty Island, the Chatham Islands lying in the line of this south-east extension. The broad expanse of deepest Pacific having always been ocean (Dana), and the lines of structural elevation to the north-east and south-west of this having the same direction, these, whether appearing above the waters as lines of low coral islands to the north-east, or as higher yet depressed lands to the south-west, must be regarded as the oldest and most permanent features of the physical geography of this division of the earth's surface.

On the other hand, we have in the mountain structure of New Zealand and the islands themselves an axial direction from north-east to south-west, or at right-angles to that of the Pacific depression and its bordering lands. Which of these two are the oldest need scarcely be made the subject of discussion. Geological investigation within New Zealand has made it clear to me that the Alps of the South Island and the mountains of the main chain in the North Island appeared at a comparatively modern date, and that the north-west and south-east axis, as illustrated by the North Auckland Peninsula, is of far older date. As part of this, the Cape Colville Peninsula trends nearly north and south, and is raised towards the north and north-west, and gives clear evidence of depression along its eastern side and southern end, where it abuts upon the mainland. The

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* "New Zealand," by Hochstetter (English edition), p. 36.

† "New Zealand," by Hochstetter, p. 37.

younger rocks present lie along the east side of the principal water-parting, but attain their greatest elevations towards the western or south-western border of the different areas.

The different mountain ranges of the Peninsula trend sub-parallel to each other and to the south-west, and it must have indeed been that they were continued in that direction considerably beyond their present limits, as otherwise it would be impossible to account for the presence of lake deposits on the tops of some of the higher mountains between the Kauaeranga and Ohinemuri watersheds. The mere erosion of the western end of these different ranges, though sufficient to remove the lake barriers in that direction, does not account for the tilted and disturbed state of the strata of lacustrine origin. Elevation of the western side of the Peninsula has to afford reasons for this.

The movements whereby the western side of the Peninsula has been raised and the eastern lowered have been in operation for a considerable time, and are still going on. The evidences of elevation within quite modern times are seen at the Thames, and on the coast-line north of Tapu Creek as far as the Orunui Stream, sea-beach gravels in this part being found at levels 200 ft. above the sea. North of this, direct evidence, as exemplified by the presence of old sea-beaches on the coast-line, is not abundant, nor very apparent; but at Torihine, three miles south of Cabbage Bay, old beach shingle reach to a height of 80 ft. above the present tide-mark. All the streams on the west side are tidal but for a short distance from where they enter the gulf, or the different harbours along its eastern shore, and none of them are tidal at low water. The deeper-seated rocks of the Peninsula appear also on this to a greater extent than on the eastern side of the Peninsula. On Moehau they rise to 2,500 ft.; at Cabbage Bay, on the Tokatea and Success Ranges, and thence to the Tiki, the height to which the slates attain on the west side of the range is from 800 ft. to 1,000 ft. Further south they reach to lesser heights, till they disappear beneath the volcanic rocks of Tapu Creek, at a moderate height above sea-level. In Rocky Point, near the Thames, they are last seen on the west side of the principal water-divide, and as an isolated outcrop reach to from 200 ft. to 300 ft. above the level of the sea.

On the east side of the Peninsula the slates appear at various places between Cape Colville and Mercury Bay. On this side they are last seen in Kuaotunu Peninsula, in which they reach a height of from 500 ft. to 600 ft. Here, however, they are in an axis of elevation different from that of the main range from Moehau to the Thames. Nevertheless, if a line be drawn from Kuaotunu to the Thames, this will be at right-angles to the greatest dip or plunge of the slates and the younger succeeding formations to the south-east. The Tokatea rocks, though not confined to the west side of the main range, have likewise this general plunge to the south-east; and the Kapanga group, though having its typical locality on the west side of the range, and largely developed between Coromandel and Cabbage Bay, has still the larger area of its development on the east side of the main water-parting. The rocks of the Beeson's Island group are developed largely on both sides of the main range, and form the whole of the mountain range beyond Te Aroha, in the southern part of the district. The acidic rocks, generally spoken of as rhyolites, are mainly confined to the eastern slopes of the main water-parting, but reach into the western fall in the Kauaeranga, Puriri, Omaha, and Hikutaia Valleys, and in the Omaha and Ohinemuri Valleys reach nearly to the level of the plain. In the Omaha the rhyolites are intrusive, as they are in the upper valley of the Hikutaia. In the Rahu, a small tributary of the Ohinemuri, and in the valley of the Ohinemuri itself, below Mackaytown, the rhyolitic material is of a more tufaceous character, and it is possibly of younger date than the great bulk of the acidic rocks.

From the disposition of the different groups of volcanic rocks, and their unconformable relation to each other, it is evident that the elevatory movement to the north and north-west began before the close of volcanic energy concerned in the outpouring and building-up of the younger rhyolitic rocks, and, as would appear, even before the deposit of the rocks of the Kapanga group.

Previous Geological Explorations.

Professor Von Hochstetter was the first geologist of note who made an examination of any part of Cape Colville Peninsula. He arrived in New Zealand in December, 1858,* and in June, 1859, made an examination of the district surrounding Coromandel Harbour, firstly and more particularly with reference to the occurrence of gold in that part of the Auckland District, and more generally with reference to the peculiar character of the rocks, as gold-producing, and the geological structure of Cape Colville Peninsula. The early history of the Coromandel Goldfield may fittingly here be given in Hochstetter's own words. He says:—

"People began to prospect for gold here, and already in October, 1852, a Reward Committee was formed which promised a reward of £500 to the discoverer of a valuable goldfield in the northern district of New Zealand. Within less than a week the reward was claimed by Mr. Charles Ring, a settler recently returned from California, who asserted that he had discovered gold upon Cape Colville Peninsula, forty miles east of Auckland, in the vicinity of Coromandel Harbour. The specimens produced by Mr. Ring were pieces of auriferous quartz, and some minute particles of gold-dust, which he had found on the Kapanga, a creek flowing into the harbour. The Commissioners sent out to investigate the matter also confirmed the existence of gold, leaving it, however, doubtful whether there was a goldfield extensive and rich enough to pay for the working.

"This was the first discovery of gold upon New Zealand. There was a general rejoicing in Auckland over the lucky event; the people indulged in the most sanguine hopes, and at once arrangements were made for working the goldfield. As the land upon which the gold was found

* "In 1854 and 1855, Mr. Heaphy, of Auckland, published geological notes on the Coromandel district, near Auckland, and in the gold-diggings in Coromandel Harbour. The trachytic rocks found there were mistaken for granite."—"New Zealand," by Hochstetter (English edition), p. 49.

belonged to the Natives, an agreement with the latter on the part of the Government had first to be brought about. The Maoris agreed for a certain payment to cede the acquisition of gold upon their own lands to Europeans; and already, in November, 1852, a treaty was made with the Coromandel chiefs for the term of three years, in which the Government pledged itself to pay the Natives for each square mile of land upon which gold was being dug £1 sterling annually, and for each gold-digger 2s. per month. In consequence of this the Government was, of course, obliged to lay a tax upon the gold-diggers. Granting an exemption for the first two months, it afterwards exacted from each digger £1 10s. per month for a digging license.

"About three thousand diggers set to work. On the Kapanga River towards north the Coolahan Diggings promised favourable results, and likewise the Waiau Diggings, a short distance from the former, on the Matawai Creek, a tributary of the Waiau River, which flows southwards into the Coromandel Harbour. The ore produced was sold in Auckland by public auction. But when the taxes were to be paid there were only about fifty diggers who took licenses. These also, however, were not able to subsist under the heavy taxes demanded; and as, moreover, nothing at all was heard of any encouraging results on a grand scale, and more and more difficulties arose on the part of the Natives, the whole enterprise died out after about six months. The simple verdict was that the gold-mines were too poor, and the promised reward was withheld from the discoverer. The whole produce upon the first New Zealand goldfield up to the time when the enterprise was given up was computed at £1,200 in gold-value, and the largest nugget found was a spheroidal piece of quartz of the size of an egg, which contained gold equivalent to about £10.

"Despite various trials and movements in later years, and although the Natives brought from time to time small quantities of gold to Auckland for sale, no serious trial was ever afterwards made upon the Coromandel Goldfield; and the Natives at last denied the Europeans even the right to make experiments.

"Such was the state of affairs when in June, 1859, I visited the goldfield in company of Mr. Charles Heaphy, the late Gold Commissioner. What the traveller observes on entering Coromandel Harbour and examining its shores does in no way correspond with what a geologist expects of a gold region. The Coromandel Peninsula consists mainly of a mountain ridge, running nearly north and south, the mountains having a bold serrated outline, and varying in height from 1,000 ft. to 1,600 ft. The most noteworthy point is Castle Hill (1,610 ft. high), a rocky peak resembling the ruin of a castle. The valleys between the spurs given off laterally by this main or dividing range are of the character of ravines or gorges, occupied by mere mountain streams; the flats or alluvial tracts at their mouths and on the coast are inconsiderable. The coast consists of nothing but trachytic breccia and tuff, in the most varying colours, and in the most different state of decomposition, from the hardest rock to a soft clayish mass, and in various places broken through by doleritic and basaltic dykes. Siliceous secretions in the shape of chalcedony, carnelion, agate, jasper, and the like, are a very frequent occurrence in these tuffs and conglomerates, likewise large blocks of wood silicified and changed to wood-opal. By local geologists those trachytic rocks were erroneously taken for granite and porphyry, and, by a gross mistake, the most sanguine hopes were based upon the notion that these siliceous secretions might be auriferous quartz veins.

"The Coromandel gold originates from quartz reefs of crystalline structure, belonging to a Palæozoic clay-slate formation,* of which under the cover of trachytic tuff and conglomerate the mountain range of Cape Colville Peninsula consists.† The mountains are so densely wooded that it is only here and there in the gorges of the streams that sections of these slates may be examined. In these sections the clay-slates are frequently found to resemble Lydian stone; they are arranged more or less vertically, their irregular upturned edges affording the most convenient and abundant pockets for the detention and storage of the alluvial gold washed from the higher grounds. The most gold was found in the narrow valleys, where, after digging to a depth of 4 ft. to 5 ft. through boulders and shingle, the bed-rock is struck. Where the valleys extended into broader alluvial plains, there was always but little and very light gold found.

"At a small branch of the Kapanga in the vicinity of Coolahan's Diggings, not far from Mr. Ring's mill, at a place pointed out to me by Mr. Heaphy as especially rich, I went to work myself to make an experiment in washing. We dug, partly from the bed of the small creek, partly from the banks, several shovelfulls of quartz-gravel intermixed with earth and clay, which, after removing the larger pieces, we washed in round tin dishes. The result of the very first trial was a considerable number of extremely fine scales of a light yellowish-green gold, which glistened among the black magnetic ironsand that had remained after the washing process, and some small pieces of ochrey quartz, in which fine scales were seen imbedded. Each successive trial yielded the same result, nor was there a single dishful of 'dirt' that did not show the 'colour,' so that I had to acknowledge to myself that if those deposits of detritus should extend over a larger area, and could be worked on a large scale with the necessary machinery, the result must doubtless be a very remunerative one. But in regard to the former point I had no opportunity to convince myself; and, as to the latter, the Natives would not have consented at that time. The pieces of quartz, among which there were many violet-coloured or amethystine, all being angular fragments, could

* It is now a well-known fact that while gold is not absent from the slate-formation, the great bulk of gold production of the Cape Colville Peninsula has been obtained from the two older groups of the volcanic series, the Thames–Tokatea and Kapanga groups; and it is also the general opinion, reasonably held, that the gold is mainly a product of the volcanic rocks, and merely by a process of segregation, as it were, descends into the slate-formation a certain and variable distance. However, at Kuaotunu, on the east side of the Peninsula, the auriferous reefs in the slate country appear to have been formed in the presence of thermal waters, and the gold may have been brought from far beneath any volcanic rock resting on the slate formation.—A. McK.

† "The same clay slate formation constitutes the Hunua Range, in the brown-coal district, south of Auckland, near Drury and Papakura, and continues towards south and north to a great distance. It is but very recently (May, 1862) that traces of gold are also said to have been discovered in the Hunua district."

not have been brought from any considerable distance, although in the creek itself we found nowhere a quartz vein *in situ*. On the slope of the hills I saw large blocks of quartz lying, which from all appearances originated from 'reefs' or veins, that—according to the statement of Mr. Heaphy—protrude on the top of the dividing-ridge in various places like walls, 8 ft. to 10 ft. high and 10 ft. to 20 ft. thick. I much regretted the inclemency of the weather at the time, which frustrated our intention to examine these quartz reefs more closely. It is worth mentioning that gold was also found on the creeks flowing from the east side of the Cape Colville Range on Mercury Bay into the sea; on the Arataonga, Waitekauri, Cook's River, and others. The traces of gold, therefore, seem to extend over a larger district, and the Coromandel goldfields—such was my opinion in 1859—bid fair to grow into importance in future years, when the country, as yet covered with dense woods, shall have become more accessible, when the auriferous-quartz reefs themselves shall have been discovered, and the difficulties which the Natives have hitherto opposed to every undertaking on a more extensive scale have ceased."*

The volcanic rocks of the Cape Colville Peninsula were regarded by Hochstetter as forming part of the older series of volcanic formations, as given at page 66 of his work on "New Zealand" above referred to. The rocks of Beeson's Island and the shores of Coromandel Harbour he mentions as being formed of trachytic rocks: "The coast consists of nothing but trachytic breccia and tuff, in the most varying colours, and in the most different state of decomposition"; and, referring to the more interior parts of the Coromandel district, he says, "The Coromandel gold originates from quartz reefs of crystalline structure, belonging to a Palæzoic clay-slate formation, of which, under the cover of trachytic, tuff, and conglomerate, the mountain-range of Cape Colville consists."

When Hochstetter visited Coromandel, gold-mining was at a standstill, and the state of the weather at the time prevented the making of any examination of the interior parts of the country.

Mining in the Coromandel district languished for some years, but in October, 1861, Coromandel again became the scene of mining operations, and a fresh impetus was thus given to prospecting and mining, which speedily made itself felt in the northern part of the Peninsula, and the district was proclaimed a goldfield in June, 1862. In the meantime the district had been visited by Sir James Hector, who in his report "On the Geology of the Cape Colville District," 1870, says:—

"My first visit to Coromandel was in June, 1864, at which date the mining operations were being conducted with considerable activity, but confined to a very limited area. The following notes, made at the time, indicate the state of our knowledge of this mining district at that date, and before additional experience of the manner in which the mineral lodes in other parts of the Colville Peninsula had been obtained.

"On entering the harbour, the rocks on each side are seen to be stratified, and dipping to the westward from the land, but rising again to the north and south, and, on landing at Beeson's, on Wanganui Island, were found to consist of trachyte, tufa, and conglomerate. The included fragments of trachyte, often of large size, are porphyritic with crystals of hornblende. In some places beds of compact trachyte occur, but this is probably only a variety of the tufa which has been more consolidated, or composed originally of finer-grained material. These tufas decompose freely to a ferruginous earth, which is sometimes bleached white, and frequently traversed by veins of quartz.

"Where excavations had been made in this formation in search of auriferous reefs, the rock appeared to be a mottled purple trachyte porphyry, traversed by bands of felspathic clay—probably decomposed dykes, which contain masses and veins of crystallized quartz—also, a soft vein in the same description of rock, 8 in. to 10 in. in width, containing masses of horny quartz. These veins underlay to the east, and strike north-north-east. No gold has been found in any of these veins.

"At Keevin's Point, a spur of the hills terminates in a bold ridge composed of light-grey tufaceous porphyry, containing iron-pyrites. The hill has been prospected in all directions by the miners, and the existence of two distinct reefs established. These consist of a banded quartz of a blue colour, with cavities lined with crystals. The rock appears to be originally a clay-stone porphyry, in which veins of segregation have been formed. The rock contiguous to these veins has been converted into a mottled pipeclay, stained with oxides and carbonate of iron. No gold has been found in these veins, which strike north 35° east, and dip eastward at 40°.†

"The chief diggings are up Driving Creek, two miles from Keevin's Point, in a north-east direction towards the highest point of the range. [Kapanga Mine?] Only one mine was in active operation (in 1864), having a five-stamp battery at work crushing a blue sub-crystalline quartz. The main reef is 6 in. to 8 in. thick, strikes north-by-west, and dips to the west at 45°. Since the new batteries began work they had crushed 40 tons, with a yield of 1,120 oz. Three shafts were sunk the depth of 150 ft., and one main level put in on the reef for 200 ft. Two other 'leaders' occur parallel with the main reef, with 30 ft. and 40 ft. of white rotten rock between. The lower or east side of the main reef is a very hard fine-grained breccia, charged with pyrites. Each leader consists of a band of bluish mullock, containing strings and nodules of quartz, generally quite detached, and frequently very auriferous. From practical trials by Mr. Ninnis, the pyrites obtained as tailings from the mill contains gold in the proportion of 7 dwt. to the pound. It is not established, however, that the pyrites from the rock contains this large proportion, or only that which is derived from the vein-stuff put through the mill. As much of the quartz is evidenty rich to the eye, these portions are selected and crushed separately as specimens. A crushing of 1,706 lb. of such specimens gave 2,198 oz. of gold. The rest of the ore from which the above specimens were picked weighed 100 tons, and yielded in the proportion of 4 oz. per ton.

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* "New Zealand," by Hochstetter (English edition), pp. 94–98.

† Keevin's Point and the adjacent hills, now the scene of active mining operations, are in this report regarded as formed of volcanic ash and fine-grained breccias of an andesic type, and as belonging to the Kapanga group of volcanic rocks, extending north along the coast-line to Paparoa, south to Preece's Point, and inland to the lower slopes of the Tokatea and Success Ranges.—A. McK.

The total produce, therefore, taking the gold at £2 15s. per ounce, was £7,143, representing the return of work executed from July, 1863, to May, 1864.

"The yield for the vein-stuff is, therefore, about 26 oz. per ton. No calls had up to this time been required to be made on the shareholders in this claim, as the first ground worked was the richest.

"From the shaft nearest Driving Creek the main reef had been worked out to 'day' in the bed of the stream, the vein being very rich as the surface was approached. It was from the outcrop of this reef that the rich specimens found in the creek must have been derived, which first attracted attention to this goldfield. The stream winds about among the outcrops of the various reefs that have been discovered, but, owing to the nature of the rock, has not formed any proper water-worn gravel or 'wash.' The rock is decomposed very freely to a red soil, which is washed down as a coating of clay on the surface. The reefs can be traced as blue bands through the red rotten rock. They are rarely more than 10 in. in width, and, as a rule, lie parallel to a mass of breccia which forms barren ground cutting off the gold to the east, for, although superficial quartz veins have been found in this breccia, they have never proved worth working.

"In the main or lowest reef are waterworn quartz pebbles, mixed with the same mullock or dark clay, in which are embedded the masses of crystallized auriferous quartz. The breccia consists of angular fragments of trachyte porphyry, and other rocks, but no quartz. Embedded in the surface soil, and lying in the bed of the creek, are masses of dolerite, and a dyke of the same rock appears north of Keevin's Point, but no proper volcanic rocks have ever been met with in the underground workings when they have proved auriferous.

"On the occasion of a second visit, in February, 1866, I found many more claims occupied, but still only in the vicinity of Driving Creek, and from their being chiefly among the old workings which had been abandoned for many years, no additional information was obtained.

"In April, 1868, after the discovery of the richer field at Shortland, the mining operations were again restricted to the Kapanga Mine. This mine had then reached a depth of 300 ft., or nearly to the sea-level. I found that the lode at this depth had the appearance of a fissure, with a well-defined hanging or west wall, but no regular vein-stone. The quartz occurred in larger concretions than in the higher parts of the mine, and these concretions contained, in addition to the gold and iron pyrites, native arsenic and crystals of calcite. Some of the specimens from this depth were exceedingly beautiful, but the main lead ceased to be practically remunerative, owing to the scarcity of auriferous ore at this depth.

"On the spurs extending from the high range [the Tokatea Range] at the head of Driving Creek, there were, in 1864, several drives and shafts on small leaders of quartz in the decomposed porphyry, which passes into what the miners term sandstone, a few fathoms below the surface. The quartz then changes from the friable crystalline texture into a compact blue variety containing a large admixture of iron-pyrites. On the surface of the spur leading to Tokatea Peak large blocks of crystalline quartz are strewn in a zigzag line, having a general north-east direction. The principal claims were Murphy's,* in which there is a drive and shaft; the Coromandel, where there is a shaft 120 ft. deep sunk in the bottom of the gully; and the Royal, in which claim a drive has been put into the spur for 150 ft., to meet a shaft sunk in the crest of the ridge. All these are excavated in the porphyritic tufa, in the hope that small leaders which cropped out on the surface would change to reefs as they increased in depth, but they did not prove successful ventures in any case.

"As all these works have been abandoned for many years, and are now inaccessible, I have stated the above facts as observed at the time, and will now proceed to the general consideration of the structure of the district from the result of a recent examination, in the course of which I crossed the range to Kennedy Bay, and returned by a different route, from Whangapoua. I also re-examined the valley of the Matawai Creek, following it up to the Tiki Diggings, which had been discovered since my previous visit to the district.

"In crossing to Kennedy Bay from the old diggings at Driving Creek, I found the difficult path by which I scrambled to the top of the Tokatea Range, in 1864, now superseded by a well-cut bridle-track, the cuttings along which afforded the additional advantage of clean sections of the rocks. The general direction in which the claims have been taken up towards the top of the range is in a north-north-east line, continued from Keevin's Point through Driving Creek and on to the Tokatea Reef. This great 'blow' of quartz, as the miners term it, strikes to the north-west, and therefore crosses the auriferous belt nearly at right-angles.†

"The shafts and drives on the Tokatea Hill, and also a few of the road-cuttings which penetrate the hard rock, show it to be the same grey tufaceous sandstone, full of mundic, as at Keevin's Point and Kapanga, thus proving this rock to extend in a narrow belt from the sea-level to 1,600 ft. altitude. On the surface it is everywhere so decomposed as to be scarcely recognisable from the patches of alluvial slope deposit. The auriferous reefs are generally in the decomposed rock, and, as at Shortland, have a general direction parallel with the boundaries of the formation, or north 40° east.

"The eastern descent of the range, to Kennedy Bay, is at first very steep, and, so far as could be judged from the superficial appearance of the rock, the first slope is composed of green decomposing sandstones and breccia, like the barren rocks on the east side of Driving Creek. These are

*Murphy's Hill is on the left bank of Driving Creek, at the foot of the northern part of the Success Range. The rocks belong to the Kapanga group, but in the bed of the creek to the south slates appear.—A. McK.

† From Keevin's Point to Scotty's Hill and the foot of the Tokatea Range a belt of auriferous country strikes north-east, which if prolonged would be continued to the lower grounds at the head of Kennedy Bay; but during the progress of the work of the present year I came to the conclusion that this line does not cross the main range, and that the reefs on the Tokatea and Success Ranges, and the main range as far south as the Tiki, are in a belt of country running parallel to the main range, and consequently nearly at right-angles to that ending at Keevin's Point or at Preece's Point.—A. McK.

succeeded by what might be taken for crystalline dykes, but which are probably only highly metamorphosed beds of sandstone [sandstone of the miners], containing mundic in cubic crystals.

"The low spurs along the eastern base of the range are formed of blue and yellow felspathic slate; while the hills along the coast, both north and south of Kennedy Bay, are formed of the volcanic agglomerates, presenting the same broken, but distinctly stratified, character as on the west side of the range. *

"The country occupied by the volcanic rocks has a very distinct appearance from the central portion of this part of the range, which is composed of the tufaceous and porphyritic sandstones, and felspathic slates. The eastern limit of these rocks is marked by a bold scarp, which is seen . . . from Kennedy Bay, looking south-west. . . ."

The boundary here indicated in the bold scarp seen looking south-west from Kennedy Bay is identical with the boundary between the Tokatea group and the Beeson's Island rocks to the east. In the opposite direction, for some distance from the shore of Kennedy's Bay, the Beeson's Island rocks rest upon coarse sandstones with abundance of minute fragments of slate, finer-grained sandstones, and slaty shales or mudstones.

"In passing round the coast, from Kennedy Bay to Whangapoua, fine sections were exhibited in the cliffs of this volcanic formation . . . and from the frequent alternation of agglomerates and tufas, intersected by dykes in various directions, the formation has all the character of a superficial or submarine volcanic accumulation. At Whangapoua Harbour this formation is confined to the hills near the coast, as it was not met with in ascending the Waitikooti Stream in recrossing the range towards Coromandel. The first rock met with in this section was the green indurated sandstone, interstratified with siliceous slates containing mundic.†

"The final ascent to the summit of the range is very steep, and passes over several alternations of rock, the changes being generally indicated by knobs on the spurs. The rocks are chiefly siliceous and clay-slates, weathering to various shades of white, pink, and red. The crest of the ridge is of vertical beds of sandstone, and descending the western slope a succession of slaty beds and indurated clay-stones is met with. To the north of the part of the range crossed by the track is a low dip, near which the abandoned Whangapoua Diggings are situated. The rock is the usually grey porphyry tufa, but the reef was remarkable from its consisting chiefly of a black ferruginous substance, entangling the gold in finely-divided leaves and filaments.‡ . . .

"The above may be considered as the northern district of Coromandel, and in the south district may be included the abandoned diggings on the Patawau, the alluvial diggings on the Matawai, and the recently-discovered reefing district on the top of the range behind the Tiki. The first-mentioned of these is about three miles south of the Wynyard Township, where in 1862 about two hundred pounds' worth of gold was obtained, of better quality than is usually obtained on this goldfield. It appears to have been confined to one small tributary of the creek from the north-east, which flows through decomposed argillaceous slates traversed by irregular quartz veins. A spur consisting of these slates had been cut through by a drive 300 ft. long, communicating with the surface by a shaft, but no auriferous leader was discovered.

"The Matawai is the next stream to the south from the Patawau, and the spur which divides leads back to that part of the main range where the Tiki reefs have been discovered.§ The section afforded by the valley of the Matawai is very interesting. The junction of the volcanic agglomerate, which forms the peninsula separating Coromandel from Manaia Harbour, with the older rocks is well exhibited below the old mill, where the Matawai and Waiau Streams meet. Following up the Matawai Valley, the stream is seen to flow over vertical ledges of green and blue slates, sandstones, and porphyritic breccias, containing small quantities of pyrites, and having a general north-west strike. On the steep spurs above the creek the same rocks are very much decomposed and altered in appearance. The creek is skirted by patches of coarse red gravel containing coarse gold. These deposits were supposed, when I examined the creek in 1864, to have been worked out; but I lately found several parties of diggers systematically turning the river, and obtaining a fair return of gold, generally in the form of nuggets, one or two having been obtained which weighed over an ounce. The quality of the gold obtained is the same as at Driving Creek and at the Tiki Diggings in the back range, and not like that on the Patawau side of the spur. The gold has been traced in these gravels for about two miles, to where a branch creek joins the stream from the north. No trace of gold has been found in the other or south branch, which rises near Castle Hill, which is a mass of trachytic agglomerate.‖

"Ascending the hill, at 800 ft. above the creek, on the north side is the Golden Crown Claim, which is the furthest south of forty claims that have been taken up along the ridge constituting the Tiki Diggings. Several drives and shafts enabled me to examine the formation, which is the same decomposed blue slaty sandstone as at Patawau Creek. Two distinct leaders of quartz had been found, the one running due north with a westerly underlay, and the other north 28° east, with an easterly underlay, the thickest being 16 in. The only gold which has been obtained is not from these veins, however, but from thin irregular leaders in the rotten rock near the surface.

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* On Beeson's Island and on the coast-line to and south of Manaia Harbour. These are the trachytes of Hochstetter, Beeson's Island group, of this report, and different from the Thames-Tokatea and Kapanga groups.—A. McK.

† No slates were observed by me on the east side of the range on the road from Whangapoua to Coromandel.—A. McK.

‡ The route followed was not what is now the road from Whangapoua to Coromandel, but from the saddle north to opposite the Success Mine, and thence by the spurs descending west to the low grounds.—A. McK.

§ Gold has, however, since then been discovered in the slates at the Tiki, and during the past summer prospecting in the slates near the saddle between Tiki spur and the main range was being carried on.—A. McK.

‖ Castle Rock is a massive dyke of grey rock, containing more or less abundantly crystals of hornblende.—A. McK.

"The absence of trachytic rocks up the Matawai Creek is rendered very obvious by comparing it with the Waiau, which flows direct from the trachytic district, of which Castle Rock forms part. The gravel in the Waiau is chiefly composed of a porphyry, consisting of grey felspathic base, with large crystals of hornblende. Half a mile up the river from its junction with the Matawai, it flows over solid ledges of this trachyte porphyry, and, although the valley has been well prospected, no gold has ever been obtained. From this circumstance, I think it probable that the trachyte will be found to cut off the auriferous rocks to the south, just as the volcanic agglomerates bound them on the east and west. The reefing district will therefore be limited at Coromandel to the range of hills that extends from the Matawai on the south to some little distance beyond the Tokatea Peak. Two bands of the auriferous formation appear to cross this range obliquely, as shown in the accompanying map [illustrating Dr. Hector's report]. The first of these extends from Preece's Point (which consists of the decomposed greenstone tufa), through Keevin's Point, Driving Creek, Tokatea, and on to Waikawau Bay, where traces of gold are reported to have been discovered. The second extends from the Tiki Diggings, by the old Whangapoua Diggings, to the Haratuhunga Creek, which flows to Kennedy Bay from the south.

"At a low estimate, this district must be held to include an area of not less than five square miles, but in which gold has only been obtained in notable quantity at the Kapanga."*

In the first part of this report Sir James Hector makes an extract from Hochstetter's "New Zealand," pointing out what were the determinations made by that geologist, and the opinions he had arrived at, and then goes on to say:—

"Professor Hochstetter thus clearly expresses his opinion that the more recent volcanic rocks of the district, to which he alone refers in the above passage, would not prove to be auriferous, a view which I think is fully borne out by our extended knowledge of the field. The gold is not, however, as he supposed, derived only from quartz veins in clay slates, for, as Captain Hutton very justly points out in his report on this district, the area of these exposed at the surface is very limited. On the other hand, Captain Hutton, in the same report, does not distinguish between the comparative modern breccias and agglomerates, which he describes as containing blocks of variously-coloured scoriæ and lavas, and the more ancient formation of green tufaceous sandstone and porphyry in which most of the auriferous lodes occur."†

Sir James Hector visited Coromandel in 1864, and the report from which the above extracts have been made was written in 1870, and, as in the meantime great discoveries were made in the district farther south (at the Thames, Tapu Creek, &c.), the opinion formed in 1864 may be considered expressed in his writings prior to 1870, and subsequent to the discovery of gold at the Thames.

Introductory to Captain Hutton's first report on the Thames Goldfield, at page 2 of the report as printed, is an extract from Dr. Hector's instructions to Captain Hutton, in which, evidently referring to the visit made to Coromandel in 1864, or to a subsequent examination of other parts of the Peninsula, he says:—

"The range which separates the Thames Valley from the Bay of Plenty I found to consist of a nucleus of aphanite slates, interbedded with green brecciated and greywacke slates, being part of the Upper Palæozoic series. Flanking and capping this nucleus is a great development of the following members of the Tertiary series: (*a.*) Brown-coal formation, very local. (*b.*) Quartzose gravels cemented, so that they break away in large blocks. (*c.*) Waitemata series (Pliocene). (*d.*) Trachytic tuff. (*e.*) Trachytic breccia.

"The Palæozoic rocks are cut by dykes of trachyte (granite of the miners), which is charged with auriferous and cupreous iron-pyrites. They, moreover, contain quartz veins, which are also pyritiferous and auriferous. The older rocks decompose very freely to laterite, and the fissures then contain secondary deposits of silica, manganese, &c., especially when near the supposed trachyte dykes, alongside of which in some cases there would seem to have been fissures that were only gradually filled up by deposits from thermal waters, giving rise to the banded, irregular, and crystalline structure of the lodes, which is so characteristic of Coromandel.

"The composition of the several reefs in the vicinity of the lodes at Coromandel shows this singular character, arising, I suspect, from all the soluble matter of what was once a basic rock having been removed and replaced by silica, and partly by iron-pyrites containing gold. That this mineral is the main source of the gold is shown by a section of the lode ground I made in 1864, when I found that the so-called quartz reefs were contained between two varieties of pyritous rock, the sulphurets having been removed from the overlying rock, but still remaining in the lower, the reef itself being a band of mullock containing kernels and geodes of quartz and carbonate of lime, and evidently formed by infiltration. A third manner in which quartz occurs in the district is in the trachytic tufas, but it is then more chalcedonic and crystalline, and associated with jasper and chert, and is non-auriferous, as proved by the numerous trials at Keeven's Point, Coromandel.

"The older rocks present too limited an area in the Coromandel district to form the source of much gold by direct denudation, as in the south of New Zealand; still, where they have been decomposed to form the red clay or laterite and secondary minerals thereby formed, gold may be among these. The gold in the case of Patawai Creek, Coromandel, must have had a different source from the gold got in Driving Creek, as its value was £3 17s. 6d. per ounce; but such deposits seem to be very small and patchy, as only two hundred pounds' worth was got, I believe, by Mr. Turner in 1862. I would not, therefore, recommend as a guide in forming an opinion as to the prospect of gold the mere presence or absence of Palæozoic rocks, without at the same time taking into consideration their peculiar association with the pyritous rocks above referred to. The same Palæozoic rocks occupy a large area in Otago, without a trace of gold; but on the west coast of Nelson, where they are associated with pyritous felstones and porphyries, they are then auriferous."

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* Geological Reports, 1870–71, pp. 88–95. † Geological Reports, 1870–71, p. 89.

In a covering letter, dated the 23rd September, 1867, with which was forwarded to the Under Colonial Secretary Captain Hutton's Report on the Thames Goldfield, are the following remarks:—

"The associations of gold with volcanic rocks belonging to the Tertiary period, near the point where they have been erupted through the older Palæozoic slates, has a very important bearing on the question of the occurrence of gold in the interior of the North Island, as there is a probability that many other localities besides the Cape Colville Peninsula will prove auriferous to a similar extent. I see no reason, however, to expect any extensive alluvial diggings in the Karaka district, or that it will afford a field for the employment of a large mining population."

From Captain Hutton's Report (his first on the Thames Goldfield), above referred to, is taken the following:—

"The whole country [the district east of the Thames] is much broken, rising, except at the mouths of four of the streams, into hills of from 600 ft. to 800 ft. close to the sea, and increasing in height towards the eastern boundary of the block to more than 1,000 ft. The country is for the most part covered with dense bush (except where close to the sea), and the streams are all mountain torrents, with large boulders occupying their beds.

"*Geological Structure.*—The geological structure of the country is very simple, being almost entirely composed of a huge mass of trachytic tufa, resting on Palæozoic rocks, which are cut by numerous dykes mostly of diorite, but occasionally of trachyte. This tufa appears generally as a softish grey coarse-grained rock, weathering white, and sometimes much stained with peroxide of iron. Where cut by dykes it is hardened for considerable distances, and much altered in appearance. As might be expected, however, from its origin, it varies a good deal in character, often containing rounded blocks of diorite 1 ft. or 2 ft. in diameter; indeed, in three or four places it passes into a true conglomerate, while occasionally small angular stones are seen in it, forming a breccia. These latter, however, are very local.

"Near Hongikori the rounded blocks of diorite are encased with a coating of red jasper. The rock is also traversed by numerous veins of quartz, carbonate of lime, or both these minerals mixed together, in which case it is seen that the carbonate of lime is a subsequent introduction, as it is found incrusting well-formed crystals of quartz. The whole of the rock, including some of the dykes, is much impregnated with iron-pyrites, generally in the form of minute cubes, but decomposed to a grey powder near the auriferous veins. . . .

The "tufa is probably of Tertiary age, and not older than the Waitemata beds.

In structure "there are no marks of bedding nor stratification to be seen, but from the extent of country that it covers, and the general vertical direction of the dykes, I think that it is not far from horizontal, dipping, probably, slightly to the west or north-west. The absence of slate boulders in the streams and on the coast seems to show that this tufa extends over much more ground than that visited by me, and I can see no reason why auriferous veins should not be found in any part of it. These veins, being thin and variable, must always render gold-mining in this district highly speculative, and if, as I believe, the stratification is nearly horizontal, deep sinking will be useless, and, in order to enable a company to make a profit, it will require more ground than is usually allotted to a gold claim.

"In one locality only, between Tararu and the Waiohanga Creeks, are Palæozoic rocks seen in the district. They here consist of blue aranaceous slates, covered by a fine-grained felsite tufa, the whole dipping 35° south-west.

"Lying on the tops of the old tufaceous hills, between Shortland and Tararu, a deposit of fine red-and-white trachytic tufa is seen, of a much later date than the old one on which it rests. This does not cover much extent of country, and is probably of Pleistocene age, and formed by the former eruptions of Aroha Mountain."*

Thus, according to the above report, the mass of the country is composed of trachytic tufa, cut by numerous dykes of diorite and trachyte. The tufa varies a good deal, and contains frequent boulders of diorite; is sometimes a conglomerate, shading off into a finer-grained breccia. Quartz veins are numerous, but not large, and carbonate of lime is often associated with the quartz. The trachytic tufa is of Tertiary age, and not older than the Waitemata beds. Palæozoic rocks are seen only on the coast-line between Tararu and Waiohanga Creeks, and a yet younger trachytic tufa of Tertiary date rests on the older, which is probably a product of Te Aroha, this mountain evidently being regarded as centre of eruption.

The following extract is from the "Second Report on the Thames Goldfields," by Captain Hutton, Wellington, 1869. The extract begins with a description of the country dealt with in the report, which is as follows:—

"*Description of the Country.*—The district included in this report is a narrow strip of land on the right or east bank of the River Thames, and on the eastern side of that part of the Hauraki Gulf known as the Firth of Thames. It is some twenty-five miles long, by two to four broad, the direction of the longer axis being about north 18° west. Shortland, the principal town, is distant from Auckland about forty-three miles by sea. At Puriri, the southern end of the district, the alluvial plain on this bank of the Thames is about three miles broad, and it gradually narrows until it comes to an apex at the Kuranui Creek, north of Grahamstown. The remainder of the country is hilly, the hills having generally very steep slopes, and rising to about 2,300 ft. near the head of the Karaka. The sides of the hills are generally covered with slipped ground and vegetable soil; very few precipitous places occur, and with the exception of the beds of the streams or creeks, and occasional landslips, are the only natural sections to be found. The most important of the creeks beginning from the south are the Puriri, the Kauaeranga, the Tararu, the Puru, the Waionau, the Pohue, the Tapu, and the Mata. The first two run for the last few miles of their course through alluvial flats; but all the others are mountain torrents almost to their mouths, their beds consisting

* "Geological Reports on Thames Goldfields," 1867: first report, by Captain Hutton.

of the solid rock of the country, generally filled up with more or less rounded boulders. Near the sea the hills are covered with fern, but in the valleys, and further inland, by dense forest, which, however, is rapidly disappearing in many localities before the axe of the miner.

"*Historical Account.*—Gold had been known to exist at Coromandel, a little north of this district, in 1852, and it had been regularly worked there since 1862. Rumours had also long existed that gold was plentiful in the Thames Valley, and several Maoris and Europeans had brought specimens to Auckland at various times from 1865. In July, 1867, a Native chief named Taipari, stimulated by the offer of the Provincial Government of a reward of £5,000 for any one who should discover a payable goldfield, employed several men, both Europeans and Natives, to prospect his land; and gold was obtained by sluicing in the Karaka and Hape Creeks. This was taken to Auckland and shown to the Deputy-Superintendent and the Native Commissioner, and at the same time Taipari offered to throw open his lands as a goldfield. Satisfactory arrangements having been made with him, the result was that a block of land from the Hape to the Pukehinau Creeks, known as the Karaka Block, was proclaimed a goldfield on the 1st August, 1867, and a town was laid out at the mouth of the Kauaeranga, and named Shortland. Parties at once set to work sluicing on the Karaka, Waiotahi, and Moanataiari, but with indifferent results; when, on the 17th August, four men discovered the gold *in situ* in the Kuranui, on the face of a waterfall, on the spot now so well known as 'Hunt's Reef.' This led to further exploration for quartz veins, and in a month's time gold had been found in about a dozen places. Further discoveries quickly followed. Sluicing was abandoned, and quartz-mining recognised as the true industry of the field. So satisfactorily did this turn out that at the end of December, 1868, or seventeen months after the first proclamation of the field, not only had two other distinct districts—Tapu and Puriri—been started, but about twelve hundred claims had been taken up near Shortland, between eight hundred and eight hundred and fifty of which were then actually working, and probably six hundred of the number had seen gold in greater or less quantities. Twenty-seven crushing-machines were on the ground, and thirteen others were going up. The yield of gold had exceeded 83,000 oz., valued at more than £200,000; and the population numbered about 18,000 souls. Gold is now being worked at Puriri, in the district between Shortland and the Tararu, and at Tapu. It has also been found in one or two places between Tararu and Tapu; and, as the same geological structure extends over the whole district, there is every probability of it existing much more extensively than has yet been discovered.

"*Geological Structure—Slates.*—The oldest rocks found in the district are a series of dark-blue, more or less arenaceous, sub-metamorphosed slaty rocks of a fine grain, rather closely jointed, but not cleaved. At Tapu they strike east 10° south, and are nearly vertical, their dip oscillating to about 80°, in some places to the north, and in others to the south. They here consist of blue, rather friable slates, interbedded with soft brown arenaceous slates, that weather white, and hard green slates traversed by innumerable minute veins of compact white quartz. Near Shortland a small patch of blue and reddish-yellow ribboned slates is seen on the beach, a little north of Tararu, and again up the Waiohanga Creek. On the beach the dip of the beds is 35° south-west. These two are the only localities in the district in which this formation is found. No fossils have as yet been found in these slates, and their age is therefore uncertain. Judging, however, from the lithological characters, they appear to belong to the Maitai series of the South Island (as described by Hochstetter). A few miles north of Hastings, on the coast between the Mata and Waikowhau Rivers, these rocks are cut by several dykes, running within a few points east or west of north, or about at right-angles to the strike of the beds. These dykes are composed of a coarsely-crystallized diorite, generally of a dark-green colour, but occasionally red, with white crystals of felspar (orthoclase?), sometimes more than $\frac{1}{10}$in. long. They also contain as accessories small quantities of magnetic iron and iron-pyrites. These dykes would be called syenites by many geologists, although they contain no free quartz. The patch of slates on the beach north of Tararu dips towards a mass of fine-grained yellowish-white felstone, containing pyrites, which forms the first point north of the Tararu Creek. This felstone is not seen up the Waiohanga Creek, and probably, therefore, it is an intrusive mass.

"In the Tapu district gold is found in lodes traversing these slates. Pyrites also is abundant in some places, but it is not generally distributed through these rocks. Quartz veins also are by no means so common as in the formation to be next described.

"*Trachytic Tufas.*—Lying unconformably on the denuded and waterworn surface of the slates, and covering by far the greater part of the district, is a mass of trachytic breccia, agglomerate, and tufa, in places at least 3,000 ft. thick. This rock, in its normal condition, is a hard, grey, granular rock, with more or less rounded grains of white potash felspar (orthoclase). It passes in places into gravelly tufa, breccia, and agglomerate, the included fragments being pieces of the tufa itself, of dolerite, trachy-dolerite, trachyte, and occasional small pieces of obsidian. Near the older rocks it also contains pieces of slate, and the igneous rocks penetrating them. The junctions of the two formations that are seen on the coast between the Mata and the Waikowhau is very interesting. The tufa here passes into a coarse conglomerate, by far the largest portion of the enclosed fragments being more or less rounded pieces of the slates, while the surface of the slates rises from a very waterworn base into a nearly perpendicular cliff. It appears to have been an old sea-beach when the tufa was accumulating, and, if this be the case, the tufa must have been deposited during subsidence, as the upper portions of the formation are evidently sub-aqueous.

"North of Tararu, where the tufa lays upon the slates, the lower part of the formation is a breccia, containing fragments of tufa, slate, and felstone. This passes upwards, through gravelly tufa, into the ordinary granular blue tufa, at a height of about 30 ft. above the sea. The upper portion of the tufa is decomposed by the action of the atmosphere into a white, or yellowish-white, soft rock, stained red in places by peroxide of iron, which is derived from the decomposition of the iron-pyrites, with which the blue tufa is highly charged. The action of water further

decomposes it into a stiff clay. The lower part of the formation has generally been metamorphosed to a variable height above the sea into a hard, green, pink, or purple felspar porphyry, or more rarely into hornblende porphyry; and this action is also distinctly traceable in the neighbourhood of the various igneous dykes which traverse it. The tufa, whether in its normal or metamorphosed condition, never contains mica in this district.

"I can see no reason for supposing that the lower part, or porphyry, is distinct in age from the upper part, or decidedly trachytic tufa. When decomposed they are both alike. There is no appearance of any line of separation between the two rocks, but the one passes gradually into the other; and there are no signs of any suspension of the volcanic energy for so long a time as to divide it into two geological periods. No doubt the fact of the tufa often containing angular blocks of the hardened tufa itself (not necessarily metamorphosed into porphyry), as well as the great thickness of the formation, prove that the volcanic action lasted so long that the lower part of the tufa was consolidated, broken through, and ejected by volcanoes while the upper part was forming. Although evidently of sub-aqueous origin, no fossils have as yet been discovered in it, and its age can only be inferred from other considerations. No scoriæ or other signs of the proximity of volcanic centres of eruption are seen at the Thames; but on the Great Barrier Island a trachytic tufa, similar in most respects to that at Shortland, is largely charged with scoriæ, and is seen to be connected with subaërial volcanic cones, whose craters can still be distinctly traced. The same trachytic formation extends across the Hauraki Gulf to Manaia, at Whangarei, where it rests upon Tertiary sandstones and limestones; and at the North Head of the Manakau a formation, essentially the same, but differing in the composition of the dykes which cut through it, forms the upper part of the Waitemata series, which is known to be of late Tertiary, probably of Upper Miocene date. On the whole, then, it is probable that this trachytic tufa, breccia, and felspar-porphyry is of Upper Miocene age, but more information must be obtained before the question can be considered as settled.

"Gold is found both in the porphyry and in the softer blue tufa, but more abundantly in the latter. This may, perhaps, be owing to the greater hardness of the porphyry, and to the more perfect crystallization of the pyrites contained in it, which prevent the water percolating freely through the rock and decomposing the pyrites, and so liberating the gold contained in it.

"The tufa formation is traversed by many dykes of igneous rocks, generally more or less magnetic, some of which seem not to have reached the surface. These dykes may be divided into two classes—viz., I., *Dolerites;* and II., *Greenstones*. The first class are composed of dark-gray dolerites, showing crystals of augite in a compact dark felspathic base. One is seen in the Star of Karaka Claim, on the left bank of the Karaka Creek, a little above the Hokianga machine. Another runs along the top of the ridge between the Karaka and the Waiotahi, and traverses the Galway, Fair Maid of Perth, and the upper part of the Monster (Karaka Gold-mining Company) claims. In the Waiotahi Creek, on the Lovers' Walk Road, in the upper part of the Freeman's Bay Claim, another dolerite dyke appears, probably the same as the one in Star of the Karaka. This throws off a branch which runs through the Duchess of Kent Claim. Another dolerite dyke occurs in the Cosmopolitan Claim, at the junction of Madman's Gully with the Moanataiari; and this is again seen lower down, on the right hand side of the creek, in the Pheasant Claim, about 200 yards below the Launceston (Carter's) battery.

"The second class of dykes is much more numerous, and can be again divided into two groups, which are, however, connected by many intermediate varieties. These groups are: (*a.*) *Metaphires:* Dark bluish-green, weathering red, generally fine-grained, with only occasional distinct crystals of hornblende or augite. Examples: Fiery Cross Claim, on Ponga Flat; Tararu Creek; Waiohanga Creek; Tinker's Gully; Moanataiari Creek, below the Point Russell Claim; and also near the junctions of the Lucky Hit and Alabama Creeks with the Karaka. (*b.*) *Timazites:* Paler green, weathering red, with well-developed crystals of hornblende. These rocks appear to be the same as G. Rose's *dioritic-trachyte*, or the *greenstone trachyte* of Van Richthofen; but Breithaupt's name of *Timazite* is the more euphonious. Examples: Pukihinau Creek; Heart and Hand Claim, in Wiseman's Gully; and in the Ballymore Claim, Waiotahi.

"Besides these dykes, there are several masses of what appear to be highly metamorphosed tufa traversing the field. One of these extends from the Waiotahi, a little above the Waiotahi Gold-mining Company's machine, to the Otago Claim, in the Moanataiari, and strikes the Shellback above Bleazard's machine. These masses are just similar to the tufa when in proximity to a dyke, and I therefore suppose that they are the tops, or caps, of dykes that have not penetrated as far as the present surface of the land. As there is no evidence of the tufa ever having been covered up by younger formations, it is evident that we might expect that few if any of the dykes had reached the surface, for if they had done so they would probably have formed volcanoes, and traces of them would have been left by pieces of vesicular scoriæ becoming embedded in the tufa. It is highly probable that these dykes influence considerably the direction of the quartz veins; but it would be premature at present to form an opinion as to what effect, if any, they may have on the distribution of the gold, as neither the position of all the dykes, nor the richest parts of the field, are as yet perfectly known.

"Besides the *gold*, which is always combined with more or less *silver*, the following metals have been found in the tufa, but not in sufficient quantity to be worked. [*Mercury, zinc, lead, antimony, copper, arsenic*, and *iron*.] . . ."

"*Alluvial Deposits*.—These are of four kinds. The oldest is a loose, red, and more or less sandy clay, containing rounded boulders of dolerite. It occurs in many places on the top of the spurs that divide the creeks from one another. On the ridge between Karaka and Waiotohi, above the Hauraki Gold-mining Company's Claim, it reaches an elevation of 1,550 ft. above the sea-level. It also, at Tapu, fills up some of the gullies on the flanks of the spurs, as seen in the Hit-or-Miss and Marquis of Hastings claims. It here contains many rolled agates and carnelians from the

tufa, and gold, which latter curiously enough, is very little worn. The boulder formation on the top of the hills must have been formed when the land was still under water; but the alluvium in the gullies may have another and more recent origin. Next in age come the deposits of pumice sand that underlie the Town of Shortland. A shaft sunk just behind the town, after passing through a marine formation of sand with broken shells, about 10 ft. thick, traversed about 68 ft. of gravel composed of stones of tufa, dolerite, trachyte, quartz, and occasionally rhyolite and obsidian. It then got into pumice sand, after penetrating which for 10 ft. it was abandoned. These two last beds are evidently an old river-deposit, and must have been brought down the valley of the Thames when the land was at least 100 ft. higher than at present.

"The bed of sand with broken shells belongs to the third kind of alluvial deposits. Up the bed of the Kauaeranga it is seen to pass into two beds, the lower of which is a stiff blue clay full of shells of *Turbo* (recent species), *Venus intermedias*, *Tellina alba*, and a species of *Mactra*, which, although very abundant in this deposit, is now either extinct or very rare in the neighbouring seas. Upon this rests a bed, 3 ft. thick, of brown clay, only the lower part of which contains shells.

"The fourth kind of alluvium is formed by landslips from the adjacent hills, but between the Hape and Waiotahi it assumes much more important dimensions than landslips usually do. It consists of tufa more or less decomposed into yellow, white, or pale-blue clays, containing boulders of tufa, dolerite, and quartz, which latter are sometimes auriferous. Below the Royal Standard Claim, on the Karaka Hill, at a depth of 30 ft., kauri-gum, pieces of wood, and rotten raupo (*Typha*) have been found; and near Shortland, at about the same depth, an old Maori padddle was dug out in sinking a shaft. It would thus appear that when the alluvium full of boulders found on the tops of the hills was forming, the land was 1,600 ft. lower than at present; that it then gradually rose until it was at least 100 ft. higher than now; and at that time the Thames ran further north than Shortland. The land then sunk to about 10 ft. or 12 ft. lower than now, and subsequently has again risen to its present level."—(Second Report on Thames Goldfield, by Captain Hutton, pp. 3–11.)

In this second report by Captain Hutton, the slates at Tapu Creek and on the coast-line to the north (over and above those at Tararu or Rocky Point) are described, and the dykes of diorite cutting through the slates on the coast-line between the Mata and Waikowhau Rivers, and the presence of gold in lodes, traversing the slates at Tapu Creek, is noted. The trachytic tufa formation is more fully described than in the first report by the author, and as giving evidence of having been deposited in the sea and in places altered to a felspar porphyry more rarely to a hornblende porphyry, the lower altered parts of the tufa formation are not necessarily older or of a different age than the upper unaltered part that still shows as a trachytic tufa. Though the tufa formation is believed to be of sub-aqueous origin, the absence of fossils is noted, and its age can only be inferred from other considerations, the conclusion being that the tufa is of Upper Miocene age. The absence of scoriæ and other signs of the proximity of volcanic centres is noted. The many dykes in the tufa formations are divided into two groups: I., *Dolerites;* II., *Greenstones;* the latter being divided into (*a*) *Melaphyres* and (*b*) *Timazites*. Other hard rocks in the field are considered probably metamorphosed tufa, as in the immediate neighbourhood of the Thames.

"*Veins and Lodes.*—The tufa formation is traversed by a large number of quartz veins of all sizes, and running in all directions—one in the Portuguese Claim, on the Karaka Hill, being quite horizontal. Although there is no point of the compass to which veins may not be found running, still there is a most decided tendency to a more or less north-east and south-west direction. Out of nearly two hundred veins observed in different parts of the field, the bearings of 90 per cent. were in the quadrant between north and east, while only 10 per cent. were in the quadrant from east to south; north-east, north-north-east, and north being the most favoured directions, and south-east by south, south-east, and east by south the least favoured. The fact that the three least-favoured directions are almost at right-angles to the three most favoured ones is sufficiently remarkable. The direction of the veins does not appear to have any influence on the abundance or scarcity of the gold. They vary in thickness from a $\frac{1}{4}$ in. to 14 ft., and, as a general rule, the smaller they are the more irregular is their bearing and dip. The thicker veins are not so rich as the thinner ones. The larger veins are often laminated or divided into different layers of quartz by thin bands of clay, or 'flucans.' The quartz is generally crystallized, the points of the crystals meeting in the centre, but it is also often compact, cavernous, or geodic. The veins often contain chert, red and green jasper, and (more particularly at Tapu) carnelian, chalcedony, and agate. Opal has not yet been found, but may be expected to occur. The jasper is sometimes highly charged with pyrites. Carbonate of lime, both as calcite and aragonite, and carbonate of iron are also found in some of the veins. In the Lady Bowen Claim at Tapu, a reef of pure white calcite, about 2 ft. thick, occurs. Gold is found in the clayey casing of this reef, but not in the reef itself. These carbonates have generally been introduced after the quartz.

"Gold is found in every description of quartz, from the most tough and flinty varieties to quite crystalline; and I have been informed that it has been found in red jasper, but I have not seen the specimen. It has not, I believe, been seen actually enclosed in a quartz crystal, as many other metals have been found.

"Besides the veins, lodes or reefs of three different characters are found in the district. The first occur only in the slates at Tapu, and consist of a mass of soft stiff blue clay generally from 1 ft. to 2 ft. thick, charged with small nodules of quartz. A good example may be seen in the Little Jessie Claim, at Tapu. The second kind is found in the tufa. These lodes consist of a tufaceous gangue, thoroughly infiltrated with silica, which also forms nodules and small veins and strings of quartz through it. The walls of these lodes are not easy to recognise, and the amount of quartz contained in them varies very much. Examples are found in the Golden Crown, Hunt's, and Middle Star reefs. The third kind also occurs in the tufa. These are fissures filled up with fragments of rock fallen into them, and cemented together by a silicous matrix. Such are Dixon's No. 1, and the Dawn of Hope reefs.

"With the exception of iron pyrites, which is abundant, the auriferous veins and lodes are, as a rule, remarkably free from the ores of other metals, small quantities of stibnite, blende, arsenical pyrites, and copper pyrites being the only ores found; and even of these the copper pyrites and blende are comparatively rare, and, as well as the stibnite, appear to have been introduced subsequently to the gold. The gold is nearly always found in or associated with quartz, although probably it also occurs in places in the bed-rock, but encased in iron pyrites. A series of analyses are necessary to determine this point. The gold in the quartz may be conveniently arranged under two typical forms, which may be regarded as the extremes of a series connected together by many intermediate varieties. Often, however, the two forms may be combined in one specimen.

"The first form is when the gold is finely peppered, generally in small grains, but sometimes in flakes, through amorphous quartz. In this case it is so intimately mixed up with the quartz that it is impossible to doubt that the two were deposited simultaneously, and from the same menstrum. In well crystallized veins this kind of gold is often seen to be plentiful in the amorphous, or semi-crystalline quartz at the base of the crystals; as soon as the crystals of quartz begins to be regularly formed the gold ceases. This is the commonest form in which gold is seen at Shortland, and it is found in all the best claims, both in the quartz veins, and in the irregular nodules that occur so plentifully in the mullock reefs or lodes. The nodules in these mullock lodes often show no trace of gold on the outside, but when broken are seen to be thoroughly impregnated with it. The second form is where the gold lies in fine threads or scales on the surface of the quartz without penetrating it. This is seen only in the smaller veins, generally where the points of the two sets of quartz crystals, starting from either side of the vein, approach so near as almost to touch each other. Here, entangled, as it were, between the points of the crystals, most beautiful specimens of leaf and filiform gold are found, while the quartz on either side is often quite barren. In these cases it is evident that the gold must have been introduced after the deposition of quartz had ceased; and, as the veins in which it is found are almost always not far from the surface, and the quartz is generally stained red by the oxide of iron, there can be little doubt but that the gold is a secondary deposit and derived from the decomposition of auriferous iron pyrites. Many claims in which most magnificent specimens of this form of gold have been found have not paid for working, all the gold contained in the vein being apparently visible to the naked eye; while, when the gold is of the form first mentioned, exceedingly good results are often obtained from stone in which little or nothing can be seen.

"It may be taken as a general rule applicable to the whole field, that all the veins and lodes show more gold, and crush better, when taken from the red iron-stained upper portions, and that as they descend into the blue undecomposed parts the yield is less satisfactory, not that they contain a less quantity of gold, but because that the undecomposed pyrites contains a large percentage of it that cannot be got out by the ordinary processes at present in use; and also on account of the injurious effect of the pyrites itself on the mercury, preventing it amalgamating with some of the gold that is in a free state, and that would readily be attracted by clean mercury. The pyrites also cause the mercury, when used in the battery-boxes, to break up into very fine globules, which float over the tables and cannot be caught, but which probably carry away with them more or less gold.

"The quality of the gold differs considerably in different parts of the field, and even from the same claim it often varies a good deal. Out of twenty-eight assays from various parts of the Shortland district, kindly furnished to me by the assayer of the Union Bank of Australia, the highest gave 19·5 and the lowest 9·625 carats fine, both being from the Waiotahi Creek; while from the Lord Derby Claim, also on the Waiotahi, some stone yielded nearly pure silver, being only 2·75 carats fine, and worth only 9s. 8d. an ounce. The average of the twenty-eight assays is 15 carats fine. . . .

"The gold is very widely distributed through the district, although certain parts appear at present to contain it in more considerable quantities than others; but the mines have not yet been long enough worked to pronounce with much certainty on this point. The fact before mentioned, that probably six hundred out of twelve hundred claims had seen gold, shows well how widely it is distributed through the country, for it must be borne in mind that, unlike most quartz-mining districts, the reefs here are not continuous for far, and that the greater part are but thin irregular veins, so that the country was not taken up along lines of leads only, but, *en masse*, nearly the whole of the country between Hape and Tararu being pegged off. . . ."

"*Tapu District—Description.*—The Tapu Creek is situated about twelve miles north of Shortland, and in size about equals the Tararu. At its mouth it forms a small harbour, available for coasters and small steamers. On this harbour the Township of Hastings is situated. Rather more than one hundred claims have been taken up in the district, and it has at present a population of about five hundred. The north side of the stream is for the most part covered with bush, and rises to a height of 950 ft. above the sea. The south side is almost entirely fern, and does not attain to quite so great an elevation as the other, the highest point in the Golden Horn claim being 880 ft. The north side is chiefly composed of the blue slates, nearly vertical, and with a strike of east 10° south. They attain an elevation at the Southern Cross and Diggers' Rest Claims of about 810 ft., and are capped by a horizontal layer of white decomposed tufa, stained red in places. These slates cross to the south side of the creek, but are quickly cut off by two faults, one of which runs north-east and south-west, and the other north-west and south-east. The rest of the district is composed of trachytic tufa and breccia. I have only seen one dyke in the district, which is situated on the beach on the north side of the harbour, just where the alluvial sands joins the rock. It runs north-west and south-east, and is about 10 ft. thick, and is composed of pale-green, nearly compact, greenstone, with occasional small crystals of hornblende. Until recently only one machine (Buckland and Gibbon's) was at work in this district, and consequently but few claims as yet have had any considerable crushings. . . .

"One of the most remarkable features of this district is the occurrence of considerable quantities of gold in the decomposed soil on the slopes of the hills. This gold is usually flaky and free from quartz, but sometimes attached to small portions of matrix. It is not at all water-worn. It probably is due to the action of rain, which has slowly washed away the rock and reefs contained in it, as they decomposed, leaving the gold behind, almost on the spot where it originally occurred. . . .

"The gold varies much in quality, both from the slates and from the tufa, and the best samples from the latter are purer than the worst from the former, but on the whole the gold from the slates appears to be the most valuable. . . .

"*Puriri District.*—The Puriri Stream falls into the Thames about eight miles above Shortland. It is navigable at high water for cutters for nearly a mile, the tide rising about 6 ft. Above this, large boulders in the stream form rapids, and prevent boats and canoes from going any higher. The stream flows for its last three miles through an alluvial plain composed of reddish-yellow and green clays, containing many trunks of trees, but with little or no pumice. At about two miles from the Thames the valley of the Puriri is about a mile wide, bounded by low, fern-covered hills composed of trachytic tufa. These hills are about 500 ft. high, and continue at about the same altitude for a mile, when they become covered with bush, and rise abruptly to a height of 2,000 ft. It is in these steeper hills that the gold has been found. They, too, are composed of trachytic tufa, containing large rounded boulders of dolerite and greenstone. Behind, again, the ranges are still higher, and probably composed of blue and pink slates, for boulders of these rocks are seen in the streams." *

In the report, dated April, 1870 (Geological Reports, 1870–71), at page 98, where describing the Tapu Creek district, Sir James Hector remarks :—

"This is the next locality south of Coromandel where gold has been found in quantity. Very little progress has been made in this mining district since the date of Captain Hutton's report in 1869. Mr. Davis, who has recently examined it, is of opinion that it has been to some extent sacrificed to the superior attractions of the Shortland field. The number of diggers had fallen from five hundred to fifty, but those that remained were well satisfied with their returns.

"The structure of the district bears a strong resemblance to that of the Matawai Valley, Tapu Creek flowing over green and blue slates, sandstones, and breccias, which rise on the north side of the river to form an isolated mass of hill, about 1,000 ft. high, in the decomposed surface-rock of which most of the remunerative reefs are situated. No well-defined lodes have been established, the reefs being in the decomposed slates and bands of greenstone porphyry which intersect them with a prevalent north-east strike. In the slope-deposits on this hill rich patches of alluvial gold were obtained when the field was first discovered, some of the nuggets weighing over an ounce.

"On the south side of the creek are hills of trachytic agglomerate, which have been thoroughly tested, but, except in a few claims near the junction of the two formations, they were not remunerative. In the same manner the eastern extension of the gold is cut off by trachytic rocks. In this district, therefore, we have the auriferous reefs confined to the surface of the older slate and greenstone rocks, which have been laid bare by the denudation of the trachytic breccias.

"On this subject Mr. Davis furnishes me with the following notes: 'Tapu Creek district furnishes very conclusive evidence of the existence of two distinct and two widely separated volcanic formations. Section I. shows this clearly. It is from the south head of the bay in which Hastings is situated to the top of the hill above the Tapu Gold-mining Company's claims. The dotted line shows a supposed plane of marine denudation, subsequent to the deposition of the older trachyte breccia which lies against the slates, and prior to that of the recent tufas which rest nearly horizontally on the top of all. It would appear as if the stream originally ran more to the north than at present, and that it has gradually cut away the tufas, leaving the slate until it reached the dyke, which has for a time arrested its progress in a southerly direction, and compelled it to cut a channel in the slate itself; the blank space in the section cannot be filled in, as I do not know what formation exists there; at the same time I see no reason for supposing that the slate is cut off by the dyke. The slate and volcanic formations are quite unconformable, the one running north and south, the other east and west. The more recent tufas are nearly horizontal.'"

Sir James, as will be seen from the above, considers that in the Tapu district there is an older (greenstone) and a younger (trachyte breccia) formation, and that the gold is confined to the first or older of these, and in confirmation of this he quotes from notes made by Mr. Davis, who had recently made a more detailed examination of the district. Mr. Davis's remarks are given immediately above. Sir James Hector then goes on to say of the—

"*Ohinemuri* [*District*].—Deferring for the present the discussion of the Shortland district (including the Puriri), which has recently been reported on by Captain Hutton and Mr. Davis, I pass [to] the most southern locality in the Colville Peninsula, which has been prospected for gold. The Ohinemuri River is the largest tributary which the Waihou or Thames receives from the eastward, the two rivers joining about eighteen miles in a straight line south of Shortland, but about thirty miles by the windings of the stream, which is navigable as far as the Junction. The mountain-range, which forms the backbone of the Colville Peninsula, is at this point reduced to a single narrow ridge, broken through by the gorge of the Ohinemuri River. This river drains the eastern watershed of the Peninsula by three principal feeders: one, the Whatakura, rising in the ranges to the north, apparently near the sources of the Kahurangi; a middle branch, which rises close to the sea-coast, taking the drainage of a large extent of open level country extending eastward to the edge of a steep cliff that rises abruptly from the

* Probably rhyolite, of which the higher part of the main range is composed, and of which boulders somewhat answering the description of them as above given are found in the bed of the Puriri Stream. In Omaha Peak the rhyolite forms nearly the whole mass down to 500 ft. above the sea, or even lower.—A. McK.

sea-shore on that side of the Peninsula. The third and largest branch, the Oraki, is fed from the eastern slope of Te Aroha, and the ranges which flank it on that side. These branches join to form the main stream of the Ohinemuri at the gorge, after passing which the stream has a short course of five miles through the alluvial deposits of the Thames Valley, receiving only a few insignificent streamlets from the western side of the range. I may remark that this exceptional physical conformation affords a practically level route through the range at this point, the gorge being short and not precipitous, and the greatest elevation in this line, at the source of the middle branch, within three miles of Waihi, on the east coast, being only 370 ft. above the sea, with very favourable ground for grading down to Tauranga Harbour.

"I recently explored the district (19th to 26th April, 1870) crossing the range north of the gorge to the head-waters of the northern branches. In crossing the alluvial flat between the Thames River and the base of the hills several outlines of dolerite were observed, being the remains of what were once continuous sheets that occupied this part of the valley at a low level. The outer range proved to be formed of dark-coloured trachyte tufa, beyond which is a basaltic range, the summit of which is 1,100 ft. above the river. This range has broad, massive ridges, which continue for six miles, when the formation changes, at a marked dip in the ground, beyond which the ridges become narrow and the gullies steep. The formation is here a yellowish-white, smooth-grained, or gritty felspathic rock, intersected by quartz veins, which frequently mark the summits of the ridges. Several of these reefs have been opened at the surface, and consist of sub-crystalline quartz, not unlike that which occurs at the top of the Tokatea Hill, at Coromandel. From the highest point of these hills (1,210 ft.), at what is called the Bare Patch, a magnificent view is obtained, especially to the south and east, in which direction the country is quite free from timber, except in the valleys leading from Te Aroha. An abrupt descent of 500 ft. leads to the valley of the Whatakura, with several principal branches, in some of which a good deal of prospecting had been done along the base of the terraces. The most extensive of these workings, which were all abandoned at the time of my visit, consisted of two tunnels, driven for about 130 ft. in a north direction. They both passed through a soft porphyritic rock, decomposed to a white mottled clay, with obscure crystals interspersed. A few small leaders of compact sub-crystalline ferruginous quartz had been cut, but no decided reef found. I was led to understand by one of my party, who had been digging there, that no gold had been obtained from these drives, but that some small specimens found in the adjacent creeks had led to the underground exploration. Small quantities of gold are reported to have been found in several places on the west or right-hand side of the Whatakura, but never in any of the creeks on the opposite side. The main stream, which is 30 ft. wide, flows in a bed cut in this soft porphyritic rock, but is filled by rolled bolders of trachyte and dolerite derived from the surrounding hill-tops. On following down the river for five miles, to its junction with the Ohinemuri in the low-level land seen from the top of the mountains, the trachytic lavas are met with, forming widespread floes, over which the river runs in a broken, rocky bed—falls, 30 ft. to 40 ft. in height, being frequent. The plains are about four miles in width, and expand towards the eastward, the soil being everywhere extremely poor, owing to the trachyte being near the surface. The vegetation is chiefly short wiry manuka, rushes, and straggling ferns. In one part of the plain, a little below the junction of the Whatakura, and almost directly south of the Bare Patch Hill, there is a good deal of quartz, in fragments, strewn on the surface, which I failed to trace to its source, but which appears as if derived from veins in the neighbourhood. Along with these are fragments of quartz, porphyry and nodules, with large well-developed crystals of quartz. It is, no doubt, the occurrence of these fragments on the surface, and the wide expanse of terraced plain, recalling, as it does, the surface features of the southern goldfields, that has led to the general belief that alluvial gold will be found in this district. Following up the valley of the middle branch of the Ohinemuri to the eastward, the only rock exposed at the surface is a compact trachyte, sometimes porphryritic, until a low range of hills, 360 ft. above the general level of the country, but presenting broken rocky cliffs 500 ft. in height to the sea, is reached. The coast is, on the whole, very bold, and in the cliffs between Matuara and Waihi, of true trachyte agglomerate, intersected by dykes of trachyte, that give rise to remarkable promontories enclosing a few sheltered bays, in some of which are small Maori settlements. The upper part of these hills is formed of true rhyolite, or quartzose trachyte, apparently similar to those at Rotorua, in the Lake District, and which, by their disintegration, give rise to extensive beds of felspathic and quartz sands. The only exception observed to the above formation is on the south headland of the first sandy bay north of Waihi, the Maori settlement at the commencement of the long sandy beach that extends to Tauranga. The north headland of this bay is composed of the ordinary agglomerate, containing masses of scoria and basalt in a tufacious matrix; but the rock at the south headland contains large angular blocks of primary slate and sandstone, and masses of green breccia, so that probably the junction of the agglomerate with the older rocks of the district is not far distant. On the face of the spur above this point a small quartz reef crops out at the surface, and in the gully beyond a soft blue rock is exposed, covered by a wash of rolled fragments of green sandstones and diorite, thus indicating a nearer approach to the character of the formations in the auriferous parts of the Peninsula than I had observed in other parts of the district. The deficiency of pyrites, however, [it is] which argues against the probability of gold being found in any quantity in any of the places where the ground has been tried. Returning down the river to the westward, through the gorge, heavy deposits of alluvium are found at a considerable elevation above the stream, indicating the higher levels of the former river channels as it cut its way gradually through the barrier of trachyte rock. These drifts contain well-rounded boulders of large size, chiefly fragments of trachyte and chert, intermixed with ferruginous sand, and it has been ascertained that a little gold is irregularly interspersed. . . . There is a similarity in the character of the formation [on the] . . . summit ranges . . . to that of the 'country-rock' at Shortland."*

* Geological Reports, 1870–71, pp. 98–102.

In November, 1880, Mr. Cox, in a report on the North Auckland district, has the following notes on the Thames and Coromandel districts :—

"My special object in examining these districts was to trace the relations between the coal series, auriferous greenstone trachyte, and the Tertiary trachyte series of Beeson's Island. I, however, also visited several of the mines both at the Thames and Coromandel. . . . At the Thames the relation between the two trachyte series are not quite so clear as at Coromandel, and again at Ohinemuri, but, all things taken together, I do not think there can be any doubt that the trachyte breccias, &c., are unconformably younger than the auriferous greenstone trachytes which occur throughout the district. The breccias are, moreover, younger than the coal series at Cabbage Bay resting upon them, but whether conformably or otherwise could not be determined here. Our knowledge of these breccia beds, however, in other localities, I think, warrants me in stating that they are unconformably younger than the coals. . . .

[In the Ohinemuri district] "between Mackaytown and Owharoa the road goes over some hills, which I consider belong to the tufaceous beds of the Tertiary age, and which are frequently breccias. As we descend the other side of the hill, however, a somewhat interesting section is seen, exposing black marls at places interstratified with tufaceous beds, and at others included as large blocks in decomposed tufaceous rocks. The black marls yield no sign of fossils, as far as I could make out, but they decompose to a light-brown marly clay, which occupies a good bit of country here. At Owharoa, the Radical is the only mine at present working, and the gold is being got out of thin leaders traversing a sort of decomposed trachyte-looking rock. The strike of these reefs is the same as the prevailing strike at the Thames—namely, north-east and south-west—and some very good gold is got here in patches, but the place appears to be almost abandoned now [1880].

"Between here and Waitekauri nothing of interest is to be seen, beyond what is described by Dr. Hector (Geological Reports, 1870–71, p. 100); but at Waitekauri a large reef, 25 ft. wide, that at the date of Dr. Hector's visit had not been discovered, only leaders being then known, has since been found and worked, and is now abandoned by the original company. It is said to contain a few pennyweights of gold throughout the stone, but not sufficient to pay for crushing, and only the richer parts of the reef have been worked. This really means that it was worked as long as moderately rich quartz was to be got out easily, and then abandoned. It is at present worked to a small extent by tributers, but what is being done is of but little value in proving the reef. Coming back to Paeroa we took the track which had been specially made to the Waitekauri Diggings, and, as the low country is reached, most unmistakable instances of the Tertiary trachyte breccias lying unconformably on the auriferous diabase series are seen.

"At Coromandel a somewhat greater variety of rocks occur, the basement rocks of the series consisting of slates, which in many cases resemble in character those of the Te Anau series, but, so far as I have seen, do not appear to be interstratified with breccias as they are farther south. These slates occur at the Tiki, forming what is known as the Golden Belt. A battery has been erected on these slates, just below a waterfall, and a tramway and fluming brought in, a good deal of gold, I am informed, having been obtained in patches from this locality from time to time. At present this locality is entirely deserted, and I can only quote what I was told by miners concerning the former workings.

"After ascending the hill over the Golden Belt, and passing to the westward, decomposed tufaceous rocks come in, and in these numerous short tunnels have been entered; but, as they do not appear to have been carried far, I do not imagine any very good results have been obtained. This belt of tufaceous rocks probably extends to the Tokatea, and the same series extends to the Union Beach and Kapanga claims. The run of the auriferous country from the Union Beach to the Tokatea appears to be north and south, and the strike of the main reef, which is a very large one, is also north and south to north-east, with an underlie to the westward. Parallel to this, and in the direction of Kennedy Bay, a felsite dyke occurs, which also strikes north and south, but underlies to the east. The belt is very thick, very hard, and contains a large quantity of lime as calcite, and is also itself impregnated with lime. It is between these two—the reef and the dyke—that the greater quantity of the auriferous stone has been found, as small leaders that drop into the main reef.

"The main reef occurs in what the miners call a sandstone country, but which is really a decomposed volcanic rock; it has never as yet proved to be remunerative, but is reported to carry a few pennyweights of gold per ton. In this district, as at the Thames, it is in the more decomposed rocks that the payable gold appears to occur, and the only reason which suggests itself to me for this is that decomposition in rocks is very often due to the presence of iron-pyrites, which is liable to change; and Mr. Skey has shown that decomposing pyrites has the power of precipitating gold from solution. . . .

"Round the flanks of these slates and older volcanic rocks the Tertiary breccias of Beeson's Island flank, resting quite unconformably upon them, and indiscriminately upon each. They exactly correspond in character with the breccia beds of the Manukau Heads, being composed of a coarse volcanic agglomerate traversed by at least one dyke on Beeson's Island, a dolerite dyke also occurring close to the Union Beach Claim, and probably running through these beds.

"In the direction of Cabbage Bay these breccias rest on the coal formation, which in turn rests unconformably upon the slates." *

The above extracts from the first report by Cox convey his impressions and conclusions at the time, but are not to be taken as final. The time devoted to an examination of the district was short, and the district examined is confessedly one of the most difficult and puzzling in New Zealand. In 1882, Mr. Cox made an extended and more complete examination of the different goldfields of

* Geological Reports, 1881, pp. 36–41.

the Cape Colville Peninsula, and from this I have extracted such parts as describe the physical features and geology of the parts examined. Beginning with an account of the general geological structure, this he describes as follows :—

"The Cape Colville Peninsula consists of a belt of slates which stretch from Tapu Creek to the Matawai at Coromandel, being overlaid at places by one or other of the formations which have yet to be described. They crop out again in the lower parts of the gullies cut by the creeks which fall into Cabbage Bay, and are seen as a small patch near Tararu Point, at the Thames. They are also mentioned by Dr. Hector* as cropping out of the shores of the Bay of Plenty, near Waihi. It thus appears that these slates form the basement rock of the district under consideration, and they will doubtless be found at many points in the interior of the Peninsula, occupying the low ground cut by the creeks, when these areas have been further opened up. It is of great importance in studying the various goldfields throughout the district to bear in mind the foregoing fact, and more especially is it essential for us to remember that, although at places—*e.g.*, Thames, Te Aroha, Waitekauri, and Owharoa—the auriferous reefs are in a country which does not appear to have any direct connection with the slate formation, yet at no very great depths these rocks are certain to occur, and the question of whether the auriferous reefs will ever be found payable in them is one on which the eventual prosperity of the goldfields will largely depend.

"The slates are of a green, blue, or brown colour, and fine-grained; they are in many cases very hard, as at Tapu and Matawai; and they are interstratified with sandstones. At Tapu the main strike of the slates, as seen at the back of Mr. Pepper's battery, is north and south, with an easterly dip of 60°. They can be traced up the creek from just above the bridge to Number Five Gully, and extend through the range between the Tapu and Matu Creeks, in which latter they occur for some distance along the lower part of its course, and then strike across to the coast, which I understand they follow for the greater part of the way to Coromandel. In the Matawai the strike appears to be about north 15° west, with a westerly dip at high angles; and at Waiohanga, near Tararu Creek, the strike is north-west, and the dip south-west at an angle of 35°; a bed of felsite which overlies them there having the same strike and dip. . . .

"What absolute relation these felsites have to the slates I am not prepared to say, for, although I was constantly on the look-out for information, I found no opportunity of placing the matter beyond doubt. Captain Hutton† mentions the occurrence of a felsite at Waiohanga, alongside the slates on the beach, but states that it does not appear further up the creek where the slates are again seen, and argues from this that the felsite is an intrusive mass. The statements he makes I can quite bear out, but, as the strike of the rocks north-west would carry the felsite away in the direction of the Thames, and not up the creek, it is probably obscured by the overlying unconformable formation of which the surrounding country is composed, and may thus be a stratified rock, the slates cropping out higher up the Waiohanga Creek being a parallel belt. . . .

"At Tapu Creek, up Number Two Gully, a very similar rock is met with, close to which a little gold has lately been obtained; and here again it is in close juxtaposition to the slates. It may seem a matter of small importance whether this particular bed is or is not associated with the slates; but this is not the case, for, when we come to visit Coromandel, we find that in the Tokatea drive this same rock has been met with and passed through, striking north 15° west, and dipping to the westward at an angle of about 50°, thus corresponding in strike and dip with the slates of the Matawai Creek. It is moreover in this locality interstratified with rocks which in the drive where they are undecomposed very closely resemble the slates, while on surface it is very difficult to recognise them, owing to the occurrence of decomposed volcanic rocks which belong to the auriferous series of the Thames, and partially obscure them. The rocks in which the gold occurs in the Tokatea tunnel are of a more earthy character, and softer than the slates, which are exposed at the surface in the localities mentioned.

"Notwithstanding the difficulty of correlating the surface-rocks of the Tokatea Range with those which are met with in the tunnel, it appears equally unreasonable to consider them as the equivalents of the auriferous series of the Thames, which I shall presently describe; neither do they resemble any auriferous rocks which I have seen elsewhere throughout the Peninsula. On the upper part of the Tokatea Range, however, where the Bismarck Claim is situated, and between there and the Union Beach Mine at Coromandel, rocks occur which are distinctly volcanic in character, and which do not appear to have their counterparts in the low-level tunnel which I have mentioned. This leads me to suppose that the lower workings at least of the Tokatea Mine are in a different formation from what the whole of the Thames workings are in, my view of the matter being borne out by the different character of the rocks, the dip of the country, and the fact that the felsite is associated with the gold-bearing rocks, which do not materially differ from it except in their degree of hardness, being softer and more readily worked. Whether the rocks of the Tokatea Mine are allied to the slates I am not prepared authoritatively to state, but think that such is the case; and I believe the points which have been observed will tend to confirm this view of the matter.

"*Auriferous Rocks of Thames.*—(Age?)—The next series of rocks, in ascending order, which are met with in the Cape Colville Peninsula, are those which carry the gold-bearing reefs of the Thames and other goldfields of the district; and I devoted some time to the study of these rocks at the Thames, where the large amount of work done affords opportunities, not elsewhere obtainable, of testing whether or no one is correct in any views which may be formed. This series consist of alternations of various kinds of volcanic rock, the lowest visible ones of which are the Hape Creek breccias, which consist of angular fragments of a purple and green colour, coarse or fine-grained at different points, the whole being cemented in a tufaceous matrix. These beds have evidently undergone a considerable amount of decomposition, the felspars which form a large part

* Geological Reports, 1870–71, p. 102. † Geological Reports, 1868–69, p. 18.

of the rock being all changed; but this decomposition has not been due to surface weathering, as is evidenced by the presence of large quantities of pyrites in a perfectly undecomposed state, and also by the fact that at the bottom of the Queen of Beauty shaft, 540 ft. from the surface, the same rock is met with, not differing in any way from that at Hape and Karaka Creeks. The same remarks about decomposition apply equally well to each of the numerous beds which overlie the breccias, and which are all more or less charged with pyrites, notably in the vicinity of the reefs. These breccias are overlaid by a fine-grained felspathic pyritous rock, the sandstone of the miners, which occupies the whole thickness to the surface in the Queen of Beauty Mine; and above this, I am informed, alternations of different classes of country occurred through the Crown Princess and Prince Imperial Claims, which, as the mines were abandoned, I have not had opportunity of examining. The next bed met with in ascending order, which we can carefully examine at present, is a hard green felspathic rock found at the bottom of the Waiotahi main shaft, 300 ft. from the surface: this rock has a dioritic appearance, but seems to be mechanically formed. Above this is a belt of so-called 'kindly sandstone,' and then a band of what is known as 'jointy' or 'shingly' country occurs, and consists of a fine-grained light-brown rock, which is much shattered and traversed by joints in every direction. Over this again, another belt of the 'good sandstone country,' similar to that described in the Queen of Beauty Mine, occurs, and through this numerous thin black veins (which are probably protosulphide of iron) may be seen traversing the rock in all directions, especially in the vicinity of the reefs.

"In the Cure Mine, towards the Waiotahi boundary, another belt of hard green rock, similar in character to [that found at the other place], comes in, and in its neighbourhood very varying classes of country are met with. At some places it is the 'good kindly sandstone country,' at others 'shingly ground,' and at others again the rock could not be distinguished in hand specimens from the best class of rock, but is more jointy, and for some reason or other does not appear to have been kindly for gold. This belt of hard green rock comes to the surface on the Waiotahi Lease, and dips through the Manukau and Cure Claims, passing from these through the lower levels of the Golden Crown; the rock met with at the bottom of the shaft, 170 ft. from the surface, being the same, but slightly decomposed, and more of a grey than a green colour; it is met with again in the Caledonian Claim at the 350 ft. level, and from there passes into the lower levels of Tookey's Claim, it being the upper part of this belt which cut off the gold in the Caledonian reef when it reached the boundaries of Tookey's Claim. Above this again the rich belt of sandstone country in which the Caledonian reef was worked occurs, and passes through the upper levels of the Manukau to the 170 ft. level of the Golden Crown, and the 350 ft. level in the Caledonian; from which point leaving the reef, in consequence of the dip of the country being at a less angle than the underlie of the reefs, it passes through Tookey's Mine above the 400 ft. level, and from there dips into the Kuranui Hill and Moanataiari Leases, where, owing to all the workings having been shallow, it has not been proved. A barren belt comes in above this, and cuts off the gold in the Moanataiari Mine at the 70 ft. level on the south-east side of the main tunnel, it being close to this level that the last rich patch was obtained; and from this point in ascending order through the Kuranui Hill Mine the country has frequently changed its character, and the reefs have been correspondingly patchy, no *shoots* of gold having occurred to the north-west of the tunnel, and the horizontal extensions of the patches having only varied from 30 ft. to 40 ft. or 60 ft. in length, and these have only been traced to a depth of 30 ft. below the tunnel level. . . .

"The section of country which I have thus described is that in which the most important lodes hitherto worked on the Thames Goldfield occur, and it is to be observed that, although there are hard belts of country in this area (which is bounded on the north by a large slide or fault, following more or less an east-and-west course), no rocks are met with which could be considered as dykes. To the northward of this slide, which is marked on the surface by a depression crossing all the spurs, and the outcrop of which in the Moanataiari Creek is only at an altitude of 200 ft. above sea-level, a very different-looking class of country is met with, which has chiefly to be studied on the surface, in the Alburnia and New Devon Mines, and in the Moanataiari long tunnel, as but few claims are at present working elsewhere. This difference in character is, however, only due to the greater hardness of the rock, and to the fact that those agencies which have shattered and subsequently decomposed the beds lying to the southward of the main slide have not exerted their influence to the same extent on the northern side; and this is the more remarkable since those to the southward are lying at a lower elevation, and are indeed principally developed below the level of the sea. The bearing of this fact will be particularly evident when I come to discuss the question of the reefs. The approximate strike of the rocks to the southward of the slide is north-north-east, and they are dipping west-north-west at an angle of about 1 in 2, as nearly as I can determine by the observations it is possible to make. The rocks to the north of the slide do not appear to differ from these either in strike or dip.

"Several hard dioritic belts of rock may be traced on the surface in this area, and have been cut again in the workings to which I have alluded. One of these can be traced from the edge of the main slide, close to where the Moanataiari winding-engine is situated, up the Moanataiari Creek, which it crosses at the upper end of the Dauntless Claim, and from there passes through the spur to the Luck's-All Claim, and thence to the upper part of the Waiotahi Creek; another closely follows the ridge between the Moanataiari and Shellback Creeks, passing to the south-east of the trig. station on the New North Devon Lease, and both of these belts have been cut in the Alburnia Mine. A third belt, lying to the south-east of these two, is met with in the eastern cross-cut from the Moanataiari tunnel, and crops out at the surface in the Waiotahi Creek, where it forms the walls of the big reef for some distance, and, crossing the creek, rises the spur on the south-east side. Yet another belt can be traced at the Tararu Creek end, where it is seen occurring as disconnected patches on the tops of the spurs on each side of Tinker's Gully, looking on the surface like parallel

dykes; but the creek itself having cut through a somewhat softer class of country, in which some remunerative workings have been situated, proves that these are not the outcrops of dykes, but parts of a belt which is lying parallel to the bedding of the country. Interstratified with these hard bands are belts of more kindly country, in which the auriferous workings have been carried forward, and have at places, as in the Alburnia, proved highly remunerative.

"The dip of the beds between the Tararu and Waiotahi Creeks is constant to the west-north-west, at an approximate angle of 1 in 2, flattening somewhat as Tararu Creek is reached, which would give a thickness of over 2,000 ft. of strata in this section above the belt of hard rock in the Moanataiari cross-cut. On the north-west side of Tararu Creek, near its mouth, a coarse breccia similar in character to that at Hape Creek occurs, and this can be traced for a long distance up the creek, which it crosses at places, it being in the same formation that the Little Agnes Claim, up the Ohio Creek, is situated. The late E. H. Davis, in his report on the Thames Goldfield (Geological Reports, 1870–71, page 56), has very carefully described the characters of this rock as seen in Tararu Creek, and he estimates its thickness at 150 ft. (*l.c.*, page 58), but I should consider the total thickness to be a great deal more. The dip of the rock interstratified with it in Tararu Creek is south 60° east, at an angle of 15°, and the breccia turns up against the outcrop of slates and felsite at Waiohanga Point. This bed does not appear to be represented in the section between the Moanataiari and Tararu Creeks, and the evidence of the section on the southern side of the Moanataiari main slide is to place it at the base of the auriferous series so far as at present proved, a position which it must occupy here, since it rests upon the basement-rock of the district. Under these circumstances, the only way of accounting for its occurrence at Tararu Creek is by a fault traversing the country in a north-east direction from the mouth of the creek, which would bound these breccias accurately as far as Little Agnes Claim, beyond which point I am not acquainted with the country. I have accordingly shown this fault, which would have a throw of not less than 2,000 ft. . . . It is sufficiently remarkable that this line of fault is parallel to the lines of fracture of the principal auriferous reefs, with which it is probably contemporaneous.

"To the north of Waiohanga Point, until reaching Tapu Creek, the strike of the beds varies from east-north-east to north-east, and the dip from south-south-east to south-east, all at low angles, the strata consisting of alternations of hard and soft bands of rock until Waiomo is reached. At this point, where some workings have lately been started, the country, which is of a sandy nature, is banded, and strikes east-north-east, dipping south-south-east at flat angles, but waving slightly; overlying which, and preserving the same strike and dip, another of these hard bands is met with, differing in no degree from those of the Alburnia and Moanataiari. It occurs capping the spur on the northern side of the creek, and descends to the creek-level on the southern side, while in the direction of the Thames it is overlaid by a light-grey decomposed felsitic-looking rock. Between Waiomo and Tapu Creek very little change takes place in the character of the rocks, which consists chiefly of a jointy, decomposing, tufaceous formation, with (at a point near Tapu) a thin band of lignite of very inferior character interstratified with them. Up to the present time no gold has been obtained from these rocks, and it appears probable that the series belong to a younger formation, which lies on the western side of a belt of slate at this point, and corresponds with certain rocks which I shall have to mention further on.

"At Tapu, on the north side of the creek, there is a belt of auriferous country overlying the slates on the western side of Number One Gully, and this belt extends into Number Two Gully, it being partly in this formation that the Great Republic Claim was worked, and also that the present patch of gold has been obtained by Bowden and party. There is, however, a belt of felsitic rock represented in this district which very closely resembles that found at the Waiohanga Point, and which I am inclined to regard as related to the slate formation. The slates are met with in the Great Republic Claim, and I am informed that the reefs were traced down into these, and also that they carried gold; but the reefs were pinched, and the country was so hard that the workings were very soon abandoned. These slates can be traced up the creek from just above the bridge to Number Five Gully, where they are overlaid uncomformably by a belt of hard rock and breccia, which in places resembles the Hape Creek breccias, and at others are far more like those belonging to the Miocene formation, to which, however, they cannot belong. Overlying these beds, in which, by the way, reefs occur, but have never yet proved highly auriferous, a belt of softer country is met with, and in this the principal auriferous workings have been carried on. The dip of these beds is south-east at low angles, and they are capped again by a harder belt of rock. The auriferous belt may be traced across the country from Tapu Creek to Mata Creek, in which it it is found as high up as Gentle Annie Creek; but above this point no gold has yet been found, and the younger Miocene breccias come in with thin seams of coal.

"Passing again to the southward of the Thames we find the auriferous series of rocks retreating from the western side of the range, which they occupy at that place; when Tairua is reached they form the body of the main range, with the Puriri rocks flanking them to the westward. The country between Tairua and Waitekauri is practically unknown, but it is probable that the same belt of rocks is continuous throughout, although it may be capped at places by the Younger series. When we arrive at Waitekauri we find a similar class of country to that represented at the Thames, although somewhat coarser-grained rocks appear to have been the matrix of the gold here. The strike and dip of the beds both at Waitekauri and Owharoa have changed, but they are still lying at flat angles, and information is more readily obtainable here concerning them than at the Thames, or possibly, having, before visiting this locality, gained some insight into the stratification elsewhere, it appeared simpler to me.

"At Owharoa the Smile of Fortune and Radical Claims are being worked in the same belt of what the miners call 'good' sandstone country, and these have hitherto proved the most remunerative mines in the district. This country is rather coarser-grained and more gritty than the auriferous country of the Thames, and is traversed by 'flinties' (small veins of cherty quartz)

instead of the black veins I have previously alluded to, and they appear to affect the auriferous reefs in the same way. This belt of country runs through the Battalion ground to the westward, and through the Golden Hill and Bank of New Zealand ground to the east. It is overlaid unconformably by a belt of pumiceous clay, which has been taken for a slide, but which I shall refer to again when treating of a younger formation. The auriferous series again crops out close to the southern side of the Ohinemuri River, being overlaid there by a hard belt of porphyry, which passes into dolerite at places.

"Below the auriferous belt of the Smile of Fortune and Radical Claims a hard belt of country comes in which has recently been struck in a drive put in by the proprietors of the Lucky Hit Claim, and it is also met with in the Radical ground, a similar rock occurring up to an elevation of about 500 ft. at Waitekauri, from which points it dips towards Owharoa, forming the basement of what has yet proved auriferous country. It will doubtless be found, if this rock be sunk through, that another belt of auriferous country underlies it.

"Between Owharoa and Waihi a belt of hard green rock crops out, in which decomposition has frequently set in concentrically. Over part of the road the rock is not visible, but a red-coloured soil points to the fact that it is underlying. It is probable that this hard belt of rock is to be found at no great depth all along this line, and that the pumice sands and clays, which overlie it unconformably, lie away to the southward on the plain. This belt of hard rock may be traced from the road-line, or just on the other side of the creek, up to the Waitekauri, where, as previously mentioned, it crops out at an altitude of 500 ft., and underlies the auriferous belt which can be traced from Waitekauri to Owharoa, and occurs as isolated patches along the strike of the beds between there and Waihi, but at Waihi the country is of a softer nature, although still fair standing-ground. The strike of the rocks at Owharoa and Waitekauri is about east and west, with a southerly dip; while at Waihi the strike is more nearly east-north-east, and the beds syncline as shown on the plan.

"At Te Aroha, again, the geological structure of the country is of great interest, more especially because, on Dr. Hochstetter's authority, the mountain was originally considered to be an extinct trachytic cone. As a matter of fact, it is nothing of the sort, but consists of a series of regularly stratified volcanic rocks, which are continuous through the mountain itself and the adjoining ranges, not differing in any way from those which have proved auriferous at the Thames and elsewhere. On the south-west side of Te Aroha Range, near where the Waiorongomai River debouches on to the plain, a belt of soft country occurs, in which a little gold was formerly got. Above this, a belt of hard greenish rock, perhaps 100 ft. thick, is seen dipping to the north-east at angle of about 20°; and above this a belt of banded country, some hard and some soft, crops out, in part of which the old Shotover workings were situated. This belt would sweep round the hill to near the Te Aroha Township, a belt of hard brown rock, partially decomposed, overlying it; and in this belt the original prospectors' claim was opened. Above this belt, again, comes a bed of purple and green breccia, which closely resembles the Hape Creek stone, and this is passed over on the mountain-track. It is in this breccia that the galena and blende lode, the property of Mr. Allen, occurs; and it will be remembered that it was the same class of rock which formed the matrix of the mineral lode of the Little Agnes Claim, up Tararu Creek. The belts of country which overlie this are those which are met with in the new diggings; and the first of these is a soft belt, which does not show well on the western side of the range, but crops out above the first rise on the mountain-track, and, passing through the mountain as a flat syncline, dips away again to the north-east at an angle of perhaps 20° on the eastern side, passing through the lower part of the Arizona Claim and into the middle spur. Above this, a belt of hard blue rock occurs, which has not a very great thickness, but may still be seen at several points, notably in the gully between the Young Colonial and New Find Claims. Above this comes the belt of country in which the New Find, Eureka, Golden Crown, and Young Colonial, as well as several other claims, have got or expect to get their gold, and this belt consists of a rather hard, partially decomposed, felspathic rock, in which a good deal of pyrites is present at times. It is a harder class of country than is generally considered favourable for gold at the Thames and elsewhere, but is, I think, the same rock, in which the filling of the reefs has not been attended by so much decomposition. A belt of hard blue rock (anamesite?) overlies this, and caps the range about Peter Ferguson's Victoria Claim, runs through the mountain at an elevation of about 2,000 ft., and caps the far ranges, dipping away towards the Waitawheta Valley; and on the summit of Te Aroha Mountain it is overlaid again by a softer class of country. . . .

"I should mention that at Coromandel, in addition to those auriferous rocks which are met with in the Tokatea, there is also a patch of rocks at the Tiki, which undoubtedly belong to the formation I am at present describing, and that these beds are lying comparatively flat, and resting unconformably upon the slates which crop out in the Matawai Creek. They are identical in character with the auriferous rocks of the Owharoa and Waitekauri Goldfields. As the distribution of these beds is of the greatest interest and importance, I attach a small map showing their approximate boundaries, as well as the other formations which are developed on the Cape Colville Peninsula, together with the strike and dip of the beds where I have observed them.*

"*Lower Miocene Beds.*—The next series of beds which is met with in ascending order are the Lower Miocene breccia-beds, which are the same as those described in a previous report as occurring at the Manukau Heads (Geological Reports, 1879–80, p. 16). These are developed at various places throughout the Cape Colville Peninsula, but are more or less confined to the eastern side of it, coming down, however, to the western side at Beeson's Island, Coromandel. Their relations to the auriferous beds last described are somewhat difficult to make out, for where they are in direct contact with them the flat dip of both series renders it a hard matter to decide whether or

* See original of report, by Cox, page 16.

no an unconformity exists. In the Tapu district, I mentioned before, these beds come in on Mata Creek, just above Gentle Annie Creek, above which no gold has been found up to the present time. About a mile and a half above Gentle Annie Creek a branch creek comes in from the southern side, and up this coal has been discovered. I visited this locality, and found that the coal obtained there was of the same character as the Mahurangi coal (Geological Reports, 1880–81, p. 24), occurring in small pockets in a sort of shale, which was interstratified with tufaceous clays and trachydolerite breccias, and was distinctly overlying the auriferous rocks, but whether conformably or not I was unable to determine at this point. The thickest bit of coal which I saw there was about 2 in. thick, but there were several feet of strata in vertical section in which these patches of coal could be obtained. I was informed that in the next creek higher up a seam about 5 in. thick had been found, but, as it was doubtless in the same formation, I did not visit this locality. I find on inquiry that it is from this last place that the reported seam of coal occurs which I was instructed to report on, and of which samples were forwarded by the Hon. Mr. Whitaker; but I could hear of nothing in the district which corresponded with the 12 ft. seam, and on further inquiry in Auckland the thickness was allowed to fall from 12 ft. to 2 ft. by the discoverer, so I should not be disposed to attach a great deal of importance to the discovery. The section which is exhibited is the same as that depicted on page 14 [of Cox's report], but the unconformity which is shown is not very apparent in this locality, and it is on account of my observations elsewhere that I have shown it.

"At Coromandel these beds, as breccias, form the whole of Beeson's Island, skirt the coast on either side of Coromandel Harbour, and stretch along the northern coast in the direction of Cabbage Bay, and also rise up into the ranges in that direction. They flank up against the auriferous rocks at the Union Beach Mine, a dyke of dolerite occurring at their junction, which is seen at the surface, and was again met with below ground, where it bounded the auriferous formation. I was unable to see this at the time of my visit, as the mine was not at work, and the shaft was filled with water.

"In Beeson's Island again these rocks are traversed by at least one dyke of dolerite, and they exactly correspond in character with the breccias of the Manukau Heads. On the Kennedy's Bay side of the Tokatea Range they again occur, and here also overlie the auriferous rocks unconformably; and the formation is traversed by a very large dyke of trachyte-porphyry which forms the whole of Castle Rock, and strikes east-south-east through the country. It is several hundred feet thick, and a similar rock has been met with in Kikowhakarere Bay on the line of strike, where it has been mistaken for granite by some people who are interested in working it for a building-stone. The section from Kennedy's Bay to Beeson's Island shows the relations of these beds well.

"On the range, from the Tokatea to Cabbage Bay, the auriferous rocks can be traced on the surface until the turn-off to Kikowhakarere Bay is passed, beyond which the rocks do not show well on the surface for some little distance, and then angular pieces of trachyte rock make their appearance. These fragments, I conclude, are derived from the Miocene breccias, as these rocks can be seen cropping out at places along the road, although in a very decomposed state. No very good sections are to be obtained, but belts of tufaceous sandstone, very much decomposed, are seen, and again beds of these breccias also in a highly decomposed state. At one point a belt of rock which would appear to belong to the auriferous series is seen cropping out on the surface, but it occupies only a very limited area, and is speedily covered again by the younger formations, which, however, can only be very thin here. As we descend towards Cabbage Bay, these younger beds occupy a much greater area of country, and are of considerable thickness, occurring right down to the flat. They vary in their dip, but are generally lying at angles of not more than 20°, and are frequently much flatter. The coal occurs in these beds at an altitude of about 800 ft. above the level of the sea, with a tufaceous clay on which rests a tufaceous sandstone overlaid by the breccias in a very decomposed state; and from the coal to the level of the flat the beds consist of alternations of tufaceous sandstone, breccia, and clay. The outcrop of coal is 5 ft. thick, but, as shown by the analysis last year, is very impure, and, on a close examination, appears to consist of numerous thin veins of shale which contain a good deal of carbonaceous matter, with which are seams of really good coal, but so thin as to be of no practical value. It would correspond with the coal of Mata Creek and Mahurangi in this particular, only the shale has more the appearance of coal here than at the other localities. These younger beds lap round the auriferous series at the northern end . . . and the auriferous beds have been found close to the coal at Cabbage Bay. . . .

"Another patch of these beds occurs in the Ohinemuri district, about two miles from Paeroa, on the road to Waitekauri; and coal is reported to have been found up a creek which crosses the track at this point. I went to see this seam with Mr. Hennelly, who has interested himself largely in it; but he was unable to find the outcrop. The measures occupy a hill lying to the westward of the auriferous belt at this place; they are dipping westward at low angles, and two seams are reported as having been found.

"Between Mackaytown and Te Aroha a belt of the same country occurs, forming the western spur of the main range, but consisting here of doleritic lava-flöes, which have weathered over considerable areas into a boulder-clay, with large dolerite masses yet left as undecomposed kernels. In the Thames district these rocks occupy the high country to the eastward of the Alburnia and Nolan's Candlelight Claims, form the Lookout Rocks, and occupy the high country stretching round by Table Mountain. They also descend the spur between the Moanataiari and Waiotahi Creeks, and are again met with up Hape Creek, where they are resting unconformably upon the auriferous rocks. These beds frequently exhibit a marked concretionary structure in their decomposed parts, and in places, as up Karaka Creek, they contain heavy boulders of anamesite, sometimes many feet in diameter, forming a boulder-clay very like some of the Otago rocks. The same class of country was driven through on the spur between the Waiotahi and Karaka Creeks; and in the central part it proved to consist of a dark-green tufaceous deposit, which closely resembles the

rocks of the North Auckland district; and I am informed that not a single reef was met with in this drive.

"When we come to examine the country on the surface, no doubt remains that these beds are distinct from the auriferous series, for this reason: We find that the deposits of brown tufaceous rock (due to the surface-weathering of the green rock cut in the drive) do not follow a definite level, but are sometimes at a very great elevation—1,500 ft. or more—and at other times they are met with on spurs which are comparatively low-lying; not more than 300 ft. above the level of the sea. When we seek a cause for this, it is at once apparent that the auriferous rocks had been deposited, upheaved, fractured, and partially denuded—indeed, so much so that the conformation of the country corresponded more or less with that which at present exists—before these Younger rocks were deposited upon them. These beds are traversed at places by dykes of basalt, anamesite, and dolerite, through which reefs have never been known to pass, and which do not appear in any way to affect the auriferous characters of the country, being younger than the reefs.

"*Rhylotic Formation (Pliocene).*—A yet younger volcanic formation occurs in this district, occupying a part of the Ohinemuri Valley, and I have casually alluded to this before when speaking of the Smile of Fortune and Radical Claims, at Owharoa. These beds consist of pumiceous clay, which has been cut through in two of the Radical levels and taken for a slide. It is, however, nothing of the sort, but fills an old gully which had been formed in the auriferous rocks prior to the deposition of these beds. It is met with again on the slopes of the spur at the foot of which the Annie Claim is situated, and, passing through the saddle above Farmerville to the west, is seen again cropping out on the road-line in that direction, making its course about east and west. On the opposite side of the river to which the Owharoa Township is situated the same class of country has been cut in a drive, after passing through a narrow belt of auriferous rocks, and here the beds are associated with a belt of porphyry (which is considerably decomposed) at their base, and this has sometimes weathered in the concentric manner I have before described. The pumiceous clays rise to the top of this range, it being through them that the water-race which supplies the battery has been cut, and they extend for some distance in the direction of Waitawheta. . . . In following the road from Owharoa to Waihi, the clay band which crops out on the Annie spur may be traced for some distance, as shown on the plan, rising up on to the hill, which is passed over before the turn-off to Waitekauri is reached. From this point the road follows undulating ground for a long way, and at places the clay band appears lying indiscriminately upon the auriferous rocks and the hard belt which I have described at their base, where the auriferous rocks have been deunded. This clay band has to a large extent determined the course of the Ohinemuri River near Owharoa, and also, no doubt, has been instrumental in forming the falls in Waterfall Creek, which are situated just above the township. At the battery-site on the Waihi Plains an outcrop of rhyolitic lava consisting of a mixture of pumice and obsidian occurs, associated with these pumiceous clays, and a similar rock occurs on the Waitawheta track, very near to the Ohinemuri River. The whole of the Waihi Plains, on the southern side of the Waihi track, may be looked upon as belonging to this youngest volcanic formation of the district, and one which corresponds with the rhyolitic beds of the interior, near Taupo. It appears probable that the sinters, &c., of Puriri also belong to this formation; but very little is to be seen of these, since they occupy low-lying fern-covered grounds, in which sections can only be obtained with great difficulty. . . .

"The tufaceous rocks of the Thames rest unconformably on the slates, as shown by the section between the Waiohanga Creek and the head of Moanataiari Creek, and the section through the Tokatea Range from Beeson's Island to Kennedy's Bay further support this. At Tapu the breccia-beds rest unconformably upon the slates, and are a more or less local formation, since, in some cases, the tufaceous sandstones themselves rest on the slates into which auriferous rocks have been traced; but the rock is very hard, and the reefs pinched. . . . Gold has been obtained in the beds at the Thames to an altitude of 1,500 ft. in Nolan's Candlelight Claim; but the tops of the spurs further back appear to be composed of a different class of rock, more approaching a dolerite in character; and this rock, in a decomposed state, and very closely resembling some of the Lower Miocene tufaceous sandstones of the North Auckland district, may be traced down the spur between the Moanataiari and Waiotahi Creeks to comparatively low levels, where they are resting unconformably upon the auriferous rocks. There is a further proof of this superposition of the Miocene beds up Mata Creek near Tapu, and again at Coromandel, so no doubt can exist that the auriferous rocks belong to an older series, which is well developed at the Thames, stretches from there to Tapu, may be found at several places between the Thames and Ohinemuri, and crops out again at Te Aroha. A yet younger rhyolitic formation is met with in the Ohinemuri Valley and towards Waitawheta.

"As regards the relations of the superficial to the deep-seated workings at the Thames no difference is to be detected. The deep-seated workings are all situated to the south of a large east-and-west fault or slide, and consist of a moderately hard, white, tufaceous sandstone (the most favourable country for gold), with hard green dioritic belts and beds of jointy or shingly ground, the lowest beds seen being the breccias of Karaka and Hape Creeks, which are again met with at the bottom of the Queen of Beauty shaft. These beds are all dipping, as near as I have been able to determine, west-north-west at an angle of 1 in 2, and the rocks on the northern side of the slide have approximately the same dip. The breccias are again represented at Tararu Creek, as shown in section.

"It will be at once evident that the diamond-drill will form a valuable agent for proving the country at the Thames, for the flat-lying character of the beds offers great facilities for its use, and when it is considered that the reefs are generally auriferous in certain classes of ground and non-auriferous in others, it will be seen what a vast amount of information can thus be obtained. In using this drill, I should recommend that, first of all, three bore-holes be put down on the flat in a

triangle, at points sufficiently wide apart to afford a sound basis for determining the exact lie of the strata. After this had been done an accurate map of the district could readily be prepared, showing the position the different beds of rock occupy in existing mines, and predicting, within very narrow limits, where they would occur in country which has not yet been worked; but it would entail a very considerable amount of work in the mines, which could be carried on simultaneously with the boring. Beyond this, the diamond-drill cannot, it appears to me, be used to advantage, unless locally in the mines, where horizontal boring-machines may give very valuable information; but their use should be directed by a careful compilation of all the information which can be obtained in the mines at present at work, on a map and sections showing the strike and dip of all the reefs, the positions of the various belts of country, and the slides which have been met with in the workings, together with the throw of each and the angle of its underlie. This would entail about two years' work, to be done at all thoroughly, and unless done in a perfect manner would be of no value whatever, as it would give very little more information than I have already been able to compile. The country to the northern side of the slide could be mapped in a similar manner without the aid of the diamond-drill, since the outcrops on the surface could be traced, and the workings in the Alburnia and other mines utilised for obtaining accurate dips. The horizontal boring-machine could be employed at the end of the Moanataiari long drive. To prove the auriferous character of the reefs the diamond-drill would be of little value.

"The Te Aroha Range does not consist of an andesitic or trachytic mass flanked on the east by a belt of auriferous country, but, as shown in section, is composed of a series of stratified tufaceous rocks, which correspond with those at the Thames, and which are continuous through the mountain and on to the ranges on the opposite side of the Waiorongomai River. . . .

"The seams of bituminous coal mentioned are those which occur in a branch of the Mata Creek, near Tapu, and, so far as yet proved, are not of any very great value. They occur in the Lower Miocene formation, interstratified with tufaceous sandstone, marl, and breccia, similar to the Mahurangi deposits. The greatest thickness reported is 2 ft., and the greatest I have observed is 2 in. . . .

"I have thus brought together in as condensed a form as was possible the notes which I have been able to gather in examining the goldfields of the Cape Colville Peninsula. I have carefully avoided any assumptions throughout, and have only recorded those points which have been established by close observations of the managers, and indicated the channels in which I consider these observations would be most advantageously directed in the future. In concluding my report, I may be allowed to express the opinion that nothing I have seen tends in any way to limit the occurrence of gold in depth, but rather should I expect that quite as rich deposits as have yet been found will again occur in the deeper workings. Moreover, the evidence I have been able to gather leads me to suppose that the occurrence of auriferous reefs in depth will not be limited by the boundary of what is now known as the auriferous formation, but they will be traced down into the slates at places where the physical characters of these rocks are favourable for the formation of reefs, and for the occurrence of gold. The difference between the gold-bearing and non-gold-bearing beds of the slate series can be well studied at the Tokatea Mine and Tapu."*

In 1883 I reported on the geology of Cabbage Bay district, Cape Colville, and pointed out the distinction between the rocks of Beeson's Island and the older volcanic rocks of that part of the Peninsula. I also for the first time described the sequence of the coal-bearing series, as seen on the coast-line at Torihine, and collected the fossils from the calcareous rocks forming the higher members of the series. The report, chiefly descriptive of the beds dealt with, will be incorporated in another part of this. In 1883 my explorations did not extend south along the coast-line beyond Tawhetirangi, and consequently I was unaware of the fact that the slates are present in that direction almost to Paparoa. The main area of the slates also do not extend to and beyond the source of the central branch of the Umangawha River, otherwise the sketch-map accompanying the report of 1883 is a fair representation of the surface areas of the different formations present in the district. The classification adopted by me, in so far as the naming of the rocks are concerned, is in accordance with the then state of knowledge and the terms in use at the time; even now, as regards a correct knowledge of the nature of the volcanic rocks and their nomenclature, we are not in a greatly better position than at that time.

"The following notes on the geological formation of the Kuaotunu mining district are by James Park, Esq., F.G.S., at that time Director of the Thames School of Mines:—†

'It has often been asserted that the Hauraki Peninsula is a goldfield from one end to the other, and the numerous discoveries of the last few years would certainly seem to justify this conclusion. The wide gaps which at one time existed between the older-established goldfields are being gradually filled up, while the boundaries of all the fields are being continually extended.

'Perhaps the most important find of late years was the discovery of payable gold at Kuaotunu, a little over three years ago. Since that date a large amount of money has been expended in the preliminary work of prospecting and opening the mines, erection of batteries, and other necessary works; and as a result this field has now taken its place as a steady gold-producer.

'Kuaotunu is situated on the east-coast side of the Peninsula, on the neck of the short peninsula lying between Mercury Bay and Whangapoua Harbour. It is connected with Coromandel by a bridle-track, and there is regular communication with Auckland by a steamer service twice a week. The port suffers the disadvantage of being an open roadstead, and this is a difficulty which it will be very costly to remedy. The waterway has, nevertheless, been an inestimable boon to the place, and it is doubtful if without this it would have been able to survive the troubles which beset the early stages of its existence.

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* Geological Reports, 1882, pp. 4–51. † Mines Reports, 1893, pp. 93–97.

'*General Geological Features.*—The geological features of this field differ but little from those of the other goldfields scattered throughout the Peninsula. Excluding the recent deposits, the rocks are found to belong to two distinct geological formations, both of which are gold-bearing, although differing greatly in age and physical characters. The younger formation consists of highly decomposed andesitic tuffs, which extend northwards from Mercury Bay till within a mile of the sea at Kuaotunu roadstead. Within the drainage area of the Kuaotunu River and its branches these tuffs form a high ridge, which seems to stand in an ancient valley in the older Palæozoic rocks. This tuff ridge ends abruptly at the place locally called the Junction. It is bounded on both sides by ridges composed of Palæozoic sandstones and greywackes. The western ridge lies on the west side of the river, and forms low descending scrub and fern-covered spurs which reach the sea at the rocky point at the end of the sandhills. The eastern ridge is rugged and forest-clad. It reaches a height of 800 ft. in some places, and descends to the sea on the eastern and northern sides of the Peninsula, of which it occupies the greater portion. On the coast-line it forms high, precipitous, and inaccessible cliffs.

'*Classifications of Formations.*—The general formations may be classified as follows: 1. *Recent:* Sand-dunes, alluvial flats, and swamps. 2. *Lower Tertiary:* Andesite tuffs. 3. *Palæozoic:* Sandstones, slaty shales, and breccias.

'*Recent.*—The sand-dunes extend along the coast from Maori Point to the mouth of the Kuaotunu River, a distance of about half a mile. On their inland side they are bounded by a wide extent of low-lying flat and swamp land, which follows the course of the river for over a mile and a quarter, and in places possesses a width of over 25 chains.

'*Lower Tertiary Tuffs.*—These are first seen in ascending the valley, near the junction of the Kuaotunu and its right-hand branch, where they rise as a conspicuous, bare, abruptly-ending spur or ridge, on the lower slopes of which are built the new schoolhouse and schoolmaster's residence. This ridge extends southwards to the head-waters of the Kuaotunu and its branches, where it spreads out into a number of long spurs which descend in the direction of Mercury Bay. These tuffs are highly decomposed at every point where I examined them, but in composition and in general physical characters they are undoubtedly closely related to the gold-bearing tuffs at Coromandel and the Thames. Their finely stratified appearance in places would tend to the belief that they were of pyroclastic origin, the materials of which they are composed having probably been derived from great submarine or maritime volcanic eruptions.

'This district affords no evidence as to their age. They rest unconformably on a highly denuded surface of the Palæozoic sandstones, while no clastic rocks of younger date are found overlying them. The scarcity of evidence relating to the age of these tuffs is a noticeable feature of the geology of the Hauraki Peninsula, and this circumstance is solely due to the almost entire absence of members of the numerous fossiliferous formations, which in other parts of New Zealand render the geological structure so varied, and very frequently so involved and complicated. The only evidence bearing directly on the age of these rocks, so far as known at present, is found at Waitete, situate on the coast-line a few miles south of Cabbage Bay. Two years ago, when making a reconnaissance geological survey of that part of the coast, I discovered a small patch of the New Zealand brown-coal measures, occupying an area not many square miles in extent.* They consist of the following strata, reading the section downwards:—

'(1.) Hard shelly limestone;
'(2.) Calcareous and marly sandstones;
'(3.) Ferruginous conglomerates.

'The conglomerates were about 200 ft. thick, and rested directly on the basement rocks, which at this point consisted of blue and red-banded slaty shales. The shelly limestone, which was the highest and closing member of the series, dipped away to the north-east, and a few chains back from the beach disappeared below a great accumulation of volcanic tuffs, breccias, and solid lava-floes of an andesitic character. These rocks, so far as could be judged from physical characters and general appearance, were in every respect similar to the gold-bearing tuffs and associated rocks in other parts of the Peninsula.

'On a subsequent occasion I traced these tuffs and breccias, without a break, as far as Paparoa and Paul's Creek, and then southward to the Tokatea Range, near Coromandel. Another circumstance which tends to prove their identity with the tuffs of the Thames and Coromandel is the discovery in them of gold-bearing veins of quartz in the neighbourhood of the limestone deposit. The Palæozoic rocks on which the coal-measures rest are, in several places in the vicinity of Waitete, intruded by massive dykes of igneous rock. It is a noteworthy fact that I was unable to find, after a most careful examination, a single fragment of igneous rock included among the materials composing the conglomerates. This negative evidence is of great value, as tending to prove that these igneous intrusions took place after the deposition of the Cretaceo-tertiary coal-beds. The whole of the stratigraphical evidence obtainable at Waitete points to the Post-eocene age of these Kuaotunu tuffs, which can be traced almost continuously to Coromandel on the west and Tapu on the south. In connection with their economic importance, it is interesting to note that they are the youngest gold-bearing rocks in the Southern Hemisphere, being younger than the gold-bearing rocks of Otago, Reefton, and the different goldfields of Australia by the whole of the secondary epoch and the upper part of the vast Palæozoic. Even in composition and origin they stand unique, and their homologues are found only in two countries in the Northern Hemisphere—namely, Transylvania, in Hungary, and the Pacific States of America; and in these countries the similarity extends also to their gold and silver contents, which are frequently as refractory and difficult to treat as ours, while

* This, as stated by Mr. Park in 1891, is misleading. In 1883 I described the same beds in a report printed with and issued as part of the "Reports of the New Zealand Geological Survey," for the year 1885.—A.McK.

their free-milling bullion is alloyed with silver to the extent of about 30 per cent., as it is throughout the Hauraki Peninsula.

'*Palæozoic Rocks.*—These form the basement or floor of this district, and, indeed, of the whole Peninsula. They consist principally of hard siliceous, greenish, and grey-coloured sandstones, interbedded with slaty breccias, and occasionally with slaty shales. The siliceous sandstones or greywackes are the prevailing rock here. They are very much shattered and jointed, and often streaked with thread-like veins of quartz or hæmatite. On the spurs behind the township, and in most places near the point of contact with the overlying tuffs, they are decomposed into reddish-coloured clays to a great depth, as if they had been subjected at some period to the long-continued action of thermal waters. The gold-bearing reefs of this formation are found in the more decomposed portions of these sandstones, and the quartz is often of a brecciated, flinty, or chalcedonic character, which is an evidence of hydro-thermal origin. These rocks have yielded no fossil remains, and their exact age is therefore still undetermined; but in the Waikato they have been found underlying rocks which contain *Halobia monotis*, and other Triassic forms, and hence have been placed in the Palæozoic Period.

'*Gold-bearing Reefs.*—I have already pointed out that there are two distinct reef-systems at Kuaotunu, one belonging to the tuff formation, and the other to the Palæozoic formation. The major lode of the field is the Try Fluke Reef, found in the former. It possesses well-defined walls, and varies in width from 2 ft. to 20 ft. Its average width is probably about 6 ft. Its course is north-north-east, south-south-west, and its dip easterly, at angles seldom under 60 degrees, more often over 65 degrees. It has been traced through the leases of the Kaipai, Try Fluke, Carbine, Red Mercury, Great Mercury, and Irene. It has been proved to continue downwards in the deepest workings so far undertaken upon it. All the workings on this reef have, so far, been confined to the brown oxidized tuffs above water-level. The nature of the quartz varies in different parts of the lode. In places it is hard, cavernous, and stained black with manganese oxides; in others it is mullocky, and more friable or crumbling, and is stained rusty-brown with peroxide of iron. The gold is alloyed with about 30 per cent. of silver, and it exists principally in an extremely finely divided state. The patches of rich stone, which are so characteristic of the Thames reefs, are not known in this reef, or, indeed, in any other reef in this field. The reefs in the Palæozoic sandstones have received a large amount of attention, and most encouraging results have been obtained from the Black Jack and many others.

'There are no known laws regulating the distribution of gold, although some geological conditions are known from experience to favour the occurrence of gold more than others. It is therefore impossible for any one to predict with any degree of certainty where gold may or may not be found in paying quantities. At Tapu and Coromandel it is found that when the reefs descend from the tuffs to the Palæozoic rocks they run out, or become non-gold-bearing. At these places the old rock consists of black jointed slaty shales. At Kuaotunu they consist of siliceous sandstones, and the prospects of the permanency of the reefs in them are altogether more favourable. At the same time, it would be wrong to neglect the experience of other places; and in the case of Kuaotunu, it would, I think, be prudent to thoroughly prospect the reefs before undertaking the erection of batteries and other expensive works. Up to the present time the Try Fluke reef has proved the chief gold-producer on this field, and, so far as can be judged from the existing conditions, it seems likely to hold this position for a number of years to come; but to effect this, low levels will have to be driven in most of the mines on its course. With the advent of a cheaper motive-power many reefs that at present would not pay to develop could be worked with profitable results, and there would then exist a fresh incentive to undertake systematic prospecting in new directions, which would no doubt result in other discoveries of a valuable nature.'" *

In the first volume of the "Transactions of the Australian Association for the Advancement of Science" (Sydney meeting, 1887) is a paper by Professor Hutton, "On the Rocks of the Hauraki Goldfields." Such parts of this as deal with the general geology of the Peninsula or particular parts of it are here transcribed, giving the writer's latest views on the subject. Professor Hutton introduces his subject as follows:—

"The Hauraki gold-mining district, Auckland, New Zealand, extends from Cape Colville on the north to Te Aroha on the south, a distance of about one hundred miles, and includes the subdistricts of Coromandel, Tapu, Thames, Ohinemuri, and Te Aroha. In geological structure it consists of a sedimentary formation of slates and sandstones, not younger than Triassic, overlain quite unconformably by a Younger formation chiefly of volcanic origin, which is not older than Cretaceous, and in which all the gold-mines are situated. To this statement all geologists are now agreed, but opinions differ as to whether any long interval of time separates the volcanic rocks into two distinct series, the older of which is alone auriferous, or whether all should be considered as parts of one. This point will not be decided until the country in the neighbourhood of Cabbage Bay is satisfactorily made out. In this district the limestones of Oligocene age containing *Hemipatagus tuberculatus*, *Pentacrinus stellatus*, *Ostrea wullerstorfii* (?), as well as *Fusus*, *Turritella*, *Cucullæa*, and other genera, are found in close proximity to the auriferous volcanic series; but the officers of the Geological Survey who have reported on the district hold diametrically opposite opinions as to its structure. If Mr. S. H. Cox is right in supposing that these limestones, &c., rest unconformably on the auriferous series (Reports, Geological Explorations, 1882, page 19), then that series will probably be Cretaceous, and the volcanic rocks of Coromandel and Kennedy's Bay may be much younger. If, however, Mr. A. McKay should be right in saying that the auriferous volcanic series lies unconformably on the sedimentary series (Reports, Geographical Explorations, 1885, page 98, &c.), then the whole volcanic formation must be considered as not older than Miocene.

* Mines Reports, 1893, pp. 93, 94.

"*Pre-Jurassic Rocks.*

"These consist chiefly of dark-coloured sandstones, greywackes and slates, in which no fossils have as yet been found. The only rock belonging to this formation that I wish to notice is the so-called felsite at Waiohanga Point, north of Grahamstown. This rock was described by me in 1867 as a felsite tuff. Afterwards I called it a felstone, meaning thereby an altered eruptive rock. By Mr. E. H. Davis it was considered as a claystone 'cut through by a band of pyritous quartz sandstone.' Mr. S. H. Cox calls it a felsite, but is uncertain whether it is intrusive in or interbedded with the slate rocks. When I first visited the locality in 1867–69 the junction between the felsite and the blue slates was hidden by sand, but last year I found the sand washed away and the junction exposed. It could then be seen distinctly that the felsite was interbedded with the slates. Above the slates comes a bed of felsite 5 ft. thick, then 4 ft. of pale slates, and then the main body of the felsite which forms the Point. Both the blue slates and the white felsite are largely impregnated with pyrites in places, in other places they are free from it. The felsite is creamy white, with an earthy fracture and a hardness of about 3. It is irregularly jointed in three directions, and the joints are so numerous that it is difficult to get good specimens showing a fresh fracture. To the naked eye it is distinctly vesicular, the vesicles being minute and irregularly scattered. It is not laminated, but occasionally there are bands of a coarser material in it. Where it is vesicular there is no pyrites, and the vesicles are probably due to the removal of the latter. Under the microscope with an inch objective and ordinary light it is seen to be very finely granular, with minute specks of an opaque white mineral like leucoxene. In places there are rather sharply-defined clouds of lighter and darker, but no distinctly crystalline forms. Occasionally narrow pale bands run through it, in which larger masses of the opaque white mineral are collected. The vesicles are either rounded or angular, and are no doubt due to the decomposition of pyrites. With polarised light and crossed nicols the general tint is dark-grey, with bright specks; a few microlites can be seen, and more abundant anisotropic angular grains without polarisation colours. With an eighth objective it appears as a water-clear glass with minute rods and specks, and occasional layers of larger, irregularly-shaped, dark fragments. The quartz-sandstone of Mr. Davis has a microscopic structure similar to that of the felsite, but has, in addition, quartz grains scattered through it as well as abundant pyrites. The specific gravity of the felsite without pyrites is between 2·494 and 2·505, and Mr. W. Skey has made the following partial analysis of it: Silica, 73·46; alumina, 22·11; lime, 0·77; magnesia, 1·34; alkalies, 1·56; water, 0·76: total, 100·00. Mr. Cox has observed a similar rock interstratified with the slates of Coromandel (*loc. cit.*, p. 7), and I am now convinced that this felsite is of clastic origin. It resembles a felstone in appearance, but is much softer and has an earthy fracture, while the small quantity of water contained in it forbids it being considered a slate or clay-stone. Perhaps it will be better to return to the name felsite-tuff which I originally gave it.

"*Post-Jurassic Rocks.*

"These cover the greater part of the Peninsula, and are almost entirely volcanic. At Coromandel and at Kennedy's Bay distinctly stratified scoræaceous agglomerates are found which are the youngest rocks of the formation; but elsewhere, so far as my observations go, there are no traces of stratification, no vesicular rocks, and different lava streams can rarely be distinguished; volcanic breccias frequently occur, but they usually pass imperceptibly into unbrecciated rock. Hard dark rocks are comparatively rare; usually they are light coloured—grey or greenish—and with a trachytic habitus, but soft. At Coromandel they were called trachytes by Dr. Von Hochstetter, and this has apparently been confirmed by Mr. W. Skey, who found the alkali in them to be potash. ('Report on Geology of Thames Goldfields,' 1867, pp. 5, 6.) However, both at the Thames and Coromandel I have always found the felspars to be plagioclase, probably labradorite, or a still more basic variety.

"When I first examined the district, twenty years ago, I was much puzzled with these volcanic rocks, for they were unlike anything I had seen before—indeed, their equivalents are found in Hungary, Transylvania, and North-west America. Seeing breccias and no vesicular lava-streams, I supposed that the whole series was an enormous mass of tuffs dipping slightly to the west or north-west, and traversed by dykes of timazite, melaphyre and dolerite, which looked very different from the surrounding rocks. As much of this supposed tuff was porphyritic, with glassy feldspar crystals, I supposed that these portions had been altered by heat. Five or six years later, having had more experience in acidic volcanic districts, I changed my views and considered these 'tuffs' to be submarine lava-flows of viscous trachyte. ('Geology of the Thames Goldfields,' Trans. N.Z. Inst., 1878, Vol. vi.) Professor G. H. F. Ulrich, in a letter, informs me that many years ago he determined the hard black rocks occurring in patches among the light-coloured ones in the goldfields, as well as in the range just beyond its limits, as varieties of augite andesite, the former frequently containing hypersthene. Last year I made a collection of rocks from this formation, and selected out of it a series of twenty-eight, from which I made sixty-seven thin slices for microscopic examination.

"*Sedimentary Rocks.*—The lowest beds of the auriferous series at the Thames are seen on the south side of Waiohanga Point, between the point and Waiohanga Creek. Here the high bluff of the point is formed by the felsite tuff already mentioned, and has a steep slope on the southern side. On it rests a white felsitic clastic rock with small round pebbles of the felsite tuff. Then comes a breccia of fragments of blue sandy slate in a sandstone matrix, which is composed chiefly of felsite grains, but also contains some quartz and a little chlorite. Upon this is a bed of sandstone, composed of the same materials as the last; and then follows another slate breccia which passes upwards into the andesite and andesitic breccias which compose the auriferous series. The exposure is not sufficiently clear to measure the thickness of these basement beds. A much better junction of the two formations is seen on the coast a few miles north of Tapu, between the Mata and

Waikowhau Rivers ('Second Report on Thames Goldfields,' 1868–69, p. 6, and section 3), but I did not visit this again last year.

"*Volcanic Rocks.*—None of these are holocrystalline, but all have a trachytoid texture. They show considerable variety, but nearly all are propylites—that is, andesites, in which the bisilicates have been altered into hydrated magnesian unisilicates. Different opinions are held among geologists as to whether the name 'propylite' should be retained. This rock bears the same relation to andesite that diabase does to dolorite, and if one is retained, so also should be the other. I am inclined to think that the change indicated by the terms propylite, diabase, melaphyre, and serpentine is worthy of being recorded in the name of the rock, perhaps by the adjective chloretic, but as there is no unanimity of opinion I will use them here.

"*Structure of the District.*

"If we omit the tuffs of Coromandel, Kennedy's Bay, &c., then, so far as my observations go, the only clastic rocks belonging to the auriferous formation are those at Mata and Waiohanga, already described as forming the basement of the series; but Mr. Davis states that fragments of slate occur in some of the breccias in Karaka Creek (Reports, Geological Explorations, 1870–71, p. 65). These breccias are composed of angular fragments of andesite in an andesite matrix, which is in general so much decomposed that I was unable, except in one case, to obtain a specimen fit for microscopic examination. The single exception was the breccia exposed on the beach north of Tararu Creek, just below the cemetery. Here it is a pale greyish-white rock, with an earthy fracture, and largely impregnated with pyrites. The microscope shows an abundant divitrefied ground-mass with secondary quartz and leucoxene, in which lie crystals of felspar decomposed into calcite, and isotropic chlorites, probably pseudomorphs after augite, but much decomposed. I have no hesitation in calling the rock a decomposed lava-stream. In other places the matrix of the breccia passes insensibly into evidently eruptive rocks. Probably all are brecciated lavas, or perhaps some of them may be the friction-breccias of dykes. Mr. Davis mentions a block in a breccia in Tinker's Gully as being itself part of an older breccia (*loc. cit.*, p. 56), and this may perhaps be due to a dyke breaking through an older breccia.

"These breccias are by no means limited to the base of the series, but occur at many horizons and in many different places beside the Hape, Karaka, and Tararu Creeks. They are all, I think, local, and of small superficial extent. Mr. S. H. Cox identifies the breccias of Hape Creek with that found at the bottom of the shaft of the Queen of Beauty Mine (Reports, Geological Explorations, 1882, p. 10). This may be correct, but similar breccias are also found in the upper part of the shaft of the same mine, and others in the Waiotahi and Moanataiari Creeks. Another was passed through in an early drive in the Moanataiari Mine (Reports, Geological Explorations, 1868–69, p. 31, fig. 1), and another occurs at the point north of the mouth of the Kuranui Creek. I see no reason for identifying the breccia at the bottom of the Queen of Beauty shaft with any one of these more than another; but if Mr. Cox's view of the structure of the district should turn out to be correct, four or five additional bands of breccia at least will have to be introduced into his section.

"A microscopic study of the other rocks of the series shows that they are mostly lava-streams in which fluxion structure is rare, so that they must generally have consolidated after movement had ceased. Only two among my specimens show fluxion structure. One is a hornblende andesite, probably a dyke from the north side of Coromandel Harbour, and the other is an augite andesite, certainly a lava from high up Mount Te Aroha. The total absence of vesicular texture in all the lavas over so wide an area is difficult to explain, but it is no doubt connected with the absence of fragmental volcanic rocks, and both point to a viscia anhydrous condition of the lavas on first extrusion.

"Surface decomposition has penetrated downwards in a very irregular manner, and has left in places isolated masses of dark, undecomposed rock, surrounded on all sides by the paler products of decomposed. A very good example was seen in a shaft in the Caledonian Mine, which was sunk vertically for 40 ft. alongside a hard mass of decomposed rock (Davis: Reports, Geological Explorations, 1870–71, p. 63, and section 6). Also, at the 350 ft. level of the same mine, a hard patch was met with which was supposed to be isolated. Mr. Cox gives another explanation of the position of this last mass (Reports, Geological Explorations, 1882, p. 30, and fig.), but he seems to have overlooked Mr. Davis's section. One of the early drives in the Moanataiari Mine passed under a large isolated block of hard rock (Reports, Geological Explorations, 1868–69, p. 31, fig. 1), and in the Puriri district many large spherical masses of undecomposed andesites occur in the decomposed portions (Reports, Geological Explorations, 1868–69, p. 35).

"This irregular decomposition may account for some of the hard masses which still appear at the surface, but nevertheless I think that many of them are dykes. This was my opinion in 1868; but, with the exception of Mr. Davis, the Government Geologists who have reported on the Thames since 1870 have treated the whole series as a volcanic formation of great thickness without any contemporaneous dykes, but possibly with some belonging to a later and quite different period. Indeed, Mr. Cox seems to think that the hard portions are regularly bedded with the softer portions, and dip to the west-north-west at an angle of about 26° with all the regularity of a sedimentary formation, and as quite unbroken by dykes. The microscopic examination of these rocks has, however, tended to confirm the idea that some of the hard masses are true dykes. I base this opinion on the absence of magnetite dust in the base, and its collection into large grains, on the grouping of the pyroxene crystals, and on the ophictic structure; for all these things prove that the cooling process was slow, and that during the whole time the mass of rock was at rest. . . .

"Although I collected every variety of rock that I could find at the Thames, including specimens of the Miocene dolorites of the Geological Survey, I have failed to find any sharp line of division. If two widely separated volcanic formations are present at the Thames they cannot be recognised by

mineralogical characters. The absence or presence of pyrites would quite fail as a test, and no one has supposed this to constitute a difference. Chlorite offers a better chance, because if this mineral was only formed at depths it would not occur in a newer and superficial formation, but, under these conditions, neither would it occur in the upper part of the auriferous series, so that, although its presence might indicate the older series, its absence from a rock would be no proof that the rock belonged to a newer series, unless it could be shown that the whole of the upper beds of the older series had been removed by denudation. Of this I have seen no stratigraphical evidence, and can find nothing under this head in the published reports that appears to me to have any importance. If there were two widely separated series, as supposed, we should expect to find that all, or nearly all, the bisilicates of the older series had been altered into chlorite, &c., while in the newer series only the ordinary series of changes would have taken place, and there would be no chlorite. But if there was only one series, we should then expect to trace a gradual change in the rocks from those most altered to those in which the alteration of bisilicates into chlorite had only just commenced; and this is precisely what we do find.

"Mr. Cox says that the younger volcanic series is undoubtedly distinct from the auriferous series because it is found at very different levels—sometimes at 1,500 ft. or more, at other times on spurs which are comparatively low-lying, not more than 300 ft. above the level of the sea (*loc. cit.*, p. 20), and from this he infers that the auriferous rocks had been deposited, upheaved, fractured, and partially denuded—indeed, so much so that the conformation of the country corresponded more or less with that which at present exists—before the younger rocks were deposited upon them. I am sorry that I cannot agree with Mr. Cox here. Granting, for the sake of argument, that he has been able to distinguish two series, and to identify them accurately, still, it seems to me that the older series, being composed of viscous lava-flows, would have consolidated at steep angles, and that the latter products of eruption would have flowed down these steep slopes, and would now be found at all elevations. Viscous lava is known to have consolidated at angles up to 80°, while, as the places indicated by Mr. Cox in his map are a mile and a half apart, a slope of 10° would be sufficient to account for the difference in level. Some, also, of the supposed newer dolerites are certainly nearly vertical dykes. Also, Mr. Cox allows that this younger series at the Thames occupies the spurs and higher ground only, so that the valleys of the present creeks and rivers must have been entirely cut since these latter lava-flows took place.

"*Source of the Gold.*

"To discuss with anything like completeness the question of the sources of the gold requires a knowledge of chemistry far beyond what I possess, but I think that a geologist may be of assistance to the chemist by pointing out to him the lines on which chemical investigation might probably lead to successful results; and this is all I hope to do here.

"*Origin of the Gold Veins.*—There can, I think, be no reasonable doubt that the gold came out of the volcanic rocks, and was not brought into them from below. Five different lines of reasoning tend equally to this result.

"The first is that after thirty-six years of prospecting we find the gold-veins to be confined to the volcanic series, or to the slates in immediate contact with the volcanic series, and not found in the older formation. At Tapu Creek the auriferous veins penetrated a short distance down into the slates, but the lodes in the slates always consisted of soft, stiff, blue clay (mullock), charged with small nodules of quartz (Reports, Geological Explorations, 1868-69, p. 24), and were evidently infiltration lodes from above. Mr. Cox informs us that they soon pinched out in the slates, and that the mines were abandoned. (Reports, Geological Explorations, 1882, p. 40.) There is, I believe, no mine at present working in the slates, although some were tried at Tiki, near Coromandel. This is a district that I have not examined personally. As the volcanic series is a superficial one, overlying the slates, it follows that the gold must have originated in that superficial series, for, if not, the lodes would have penetrated the older as well as the newer rocks, and would have been found equally in both.

"The second argument is founded on the nature of the gold-veins. These are often small, irregular, branching veins, sometimes only a $\frac{1}{4}$ in. in thickness, traversing the rock in all directions and rapidly dying out. The idea that these small branching veins were leaders from large and well-defined lodes has been disproved in many cases, but there is evidence to show that occasionally they lead into large veins of nearly barren quartz called 'buck reefs.' (Cox: Reports, Geological Explorations, 1882, p. 25.) Of this I shall speak again. At present I merely wish to point out that in a large majority of cases these so-called leaders have led to nothing. In the Thames district gold is very widely distributed. On the first opening of the fields the ground was taken up *en masse*, as in an alluvial field, and not upon supposed lines of reef only. This is apparent in the map which accompanies my report of 1868–69, in which I say that of twelve hundred claims thus taken up at hazard about one-half had found gold. Most of these claims have turned out too poor to pay for working; but the fact remains that gold was found in them. Some of the larger lodes are merely country-rock infiltrated with silica, and have no defined walls. Such were the Golden Crown, the Shotover (Hunt's), and the Middle Star. (Reports, Geological Explorations, 1868–69, p. 24.) In 1871 the country-rock on the south side of the Shotover was crushed for a distance of 60 ft. from the lode, and yielded from 5 dwt. to 8 dwt. of gold to the ton. The Golden Crown Company has also crushed part of the spur belonging to them with fair results. These cases might be explained by supposing an outward infiltration from the lode, but it is very doubtful if these lodes are of such a character as to allow us to suppose that they were part of extensive fissures filled from below.

"The third argument in favour of the origin of the gold-veins by lateral segregation is that, speaking roughly, the amount of gold in the veins varies with the state of decomposition of the country-rock, the veins in decomposed rock being richer than those in undecomposed rock, as I shall presently bring evidence to prove. At Puriri the gold was in small irregular veins in decomposed

rock, and they stopped altogether when they approached the boulder-like undecomposing cores. (Reports, Geological Explorations, 1868–69, p. 35.) If the gold had come up from below we can see no reason why it should specially affect the decomposed rocks.

"The fourth argument is taken from the very recent origin of some of the gold-veins. This might be inferred from those cases like Puriri, just mentioned, where the decomposition is evidently due to surface weathering, and the gold-veins appear to have been formed *pari passu* with the decomposition. But stronger evidence was found in the old Star of the South No. 2 Claim, which was situated on the spur facing Shortland, between the Karaka and Hape Creeks. Here irregular veins of quartz occurred at the junction of the face of the rock with slipped ground, due evidently to a landslip, and these veins contained gold. (Reports, Geological Explorations, 1868–69, p. 26, fig. 2.) We can hardly suppose that the thermal springs have brought up gold so near to the surface and at so recent a period, and yet have left no other evidence of their existence.

"The fifth argument is founded on the quality of the gold itself, which is an electrum similar to that found in similar volcanic rocks in Hungary and Nevada, but different from that usually found in older formations.

"I think, therefore, that we must look to the volcanic rocks themselves for the source of the gold, and with the gold the quartz also; and that we may dismiss all idea of either of them having been brought up by thermal springs. If the quartz of the buck-reefs, which are either barren or do not contain more than 10 dwt. of gold per ton, is also due to lateral segregation, as appears probable, then we may suppose that in these cases the greater part of the gold was deposited from solution in the feeders before reaching the main fissure. It is more probable that the bulk of the gold should have been deposited in the fissures which were feeding the buck-reef than that the whole of the gold should have come from the buck-reef, and the bulk of it should have passed out into the small fissures. The process I have suggested seems to have taken place at Coromandel and at Te Aroha; but Mr. Cox has pointed out that in the Moanataiari Mine an auriferous vein, with clearly defined walls, crossed a buck-reef obliquely. (Reports, Geological Explorations, 1882, p. 25.) In this case undoubtedly the buck-reef is the older of the two, but this single fact is not sufficient to form the basis of an induction that all buck-reefs are older than the auriferous veins. Sir James Hector is of opinion that the quartz which forms the veins and infiltrates the auriferous gangue must have been introduced into these rocks subsequent to their original formation, but not derived from their partial decomposition, as the rocks themselves are deficient in silica, considering the felspathic nature. (Reports, Geological Explorations, 1868–69, p. 27.) But my microscopic examination of the rocks has shown that large quantities of silica have been removed from the bisilicates and from the felspars, only small portions having remained as secondary quartz, and this silica must have gone somewhere. That the rocks are now deficient in silica goes far to disprove the opinion which Sir James Hector would found upon it.

"*Indications of Favourable Country-rock.*—Mr. Cox says that 'the white, fairly-hard stone is the best country'; that 'reefs in good ground are remunerative, but in hard ground do not pay'; that 'hard green dioritic belts and jointy or shingly ground are not good for gold'; that 'moderately hard country traversed by small veins and of a pyritous nature near the reefs is the best'; and that 'it is universally admitted throughout the field that a moderately hard tufaceous sandstone country is the class of rock most favourable for gold, and that where this is pyritous and carries small black veins—(of proto-sulphide of iron (?))—which run into the reefs, rich deposits almost always occur.' (Reports, Geological Explorations, 1882, pp. 23–44.) Sir James Hector also says, 'All varieties of these rocks are auriferous only in proportion to the amount of sulphides they contain.' (Reports, Geological Explorations, 1868–69, p. 27.) From this we may infer that the most favourable country is where the rocks have gone through the first and second stages of decomposition already described, having been changed into what the miners call 'kindly sandstone,' and especially where these rocks are abundantly charged with pyrites. However, we must remember that numerous auriferous veins occur in the hard rocks also, and that the greater expense of working them here may account for some of them having been failures. Also, I much doubt if Sir James Hector's induction is founded on a sufficiently wide basis of fact; but I shall have to return to this subject again.

"*Facts connected with the Lodes.*—Gold occurs in the veins in four ways: (*a*) In auriferous pyrites; (*b*) scattered in small grains through massive quartz; (*c*) in threads or scales, some of which are pseudomorphs, after botryogen or copiapite (Campbell, Trans. N.Z. Inst., xiv., p. 457), between the points or quartz crystals in comby veins, the quartz at the base of the crystals being often stained red; and (*d*) in calcite, at the Success Mine, Coromandel. It is never found enclosed in a quartz crystal. Mr. W. Skey (Reports, Geological Explorations, 1870–71, p. 84) says that he was not able to observe any other matrix than quartz or highly quartzose rock, where the gold at least was in paying quantity.

"In some of the claims in the upper and middle portions of Tararu Creek manganese oxides occur along with the gold to the almost exclusion of iron compounds. (Reports, Geological Explorations, 1870–71, p. 85.) The auriferous veins usually contain abundance of pyrites, but other sulphides—stibnite, blende, arsenical pyrites, copper-pyrites—are in small quantity only, and these have been introduced subsequently to the gold. (Reports, Geological Explorations, 1868–69, p. 24; and *ibid.*, 1882, p. 44.) Carbonates of lime and of iron have been introduced into the veins after the quartz. (Reports, Geological Explorations, 1867, p. 8, and *ibid.*, 1868–69, p. 23.)

"According to Mr. Davis, the occurrence of 'pyrites in the matrix of the lodes is a *sine quâ non*,' that 'the hanging-wall of roof need not of necessity carry pyrites, but rather the richness of the reef is increased by the diminution of pyrites in the roof, provided that the foot-wall is rich in them,' and that 'leaders joining the reef on the hanging-wall probably increase the yield of the gold for a time, but leaders from the foot-wall seldom.' (Reports, Geological Explorations, 1870–71,

p. 68.) On this I must remark that I have often seen small veins carrying rich gold without any pyrites at all, but in the larger reefs pyrites generally occurs.

"*Theories.*—Sir James Hector, who has had excellent opportunities for studying the subject, finds the source of the gold in the pyrites of the country rock. In his printed instructions to me in 1867 he says, 'The composition of the several rocks in the vicinity of the lodes at Coromandel shows their singular character, arising, as I suspect, from all the soluble matters of what was once a basic rock having been removed and replaced by silica, and partly by iron-pyrites containing gold. That this mineral is the main source of the gold is shown by a section of the lode-ground I made in 1864, when I found that the so-called quartz reefs were contained between two varieties of pyritous rocks, the sulphurets having been removed from the overlying rock, but still remaining in the lower, the reef itself being a band of mullock, containing kernels and geodes of quartz and carbonate of lime, and evidently formed by infiltration.' The attached analyses* show that the hanging wall contained neither gold nor pyrites, while the foot-wall contained about 11·68 per cent. of pyrites; but it is not stated that this pyrites contained gold. In 1869 Dr. Hector says, 'Whatever may be the age of the impregnation of these rocks with sulphides, the gold they contain seems first to have appeared in them at the same time.' (Reports, Geological Explorations, 1868–69, p. 39.) He then says that the quartz was brought up from below, as I have already mentioned, and he adopts the generally accepted opinion that thermal waters and acid vapours were the agents that produced the changes.

"Mr. Davis, I suppose, agreed with Sir James Hector, as their conclusions are identical. I also held the same opinion in 1869. In 1882 Mr. Cox pointed out that the pyrites in the decomposed rocks is not itself decomposed, and could not therefore be the source of the gold. The pyrites, he thought, was formed contemporaneously with the gold in the veins, the mineral waters which deposited the gold and the quartz in the reefs having found their way through numerous small joints in the rocks, decomposed their felspathic constituents, and deposited from solution the crystals of crystalline grains of pyrites. (Reports, Geological Explorations, 1882, p. 44.) Mr. Cox thus accounts for the presence of pyrites in the surrounding rock being a favourable indication of gold, although it is not decomposed. He looks upon these pyrites as the overspill from the reef of materials brought up in fissures.

"Undoubtedly, under ordinary circumstances, much of the pyrites remains in the rock unaltered, and can be washed out of it, even when the rock has decomposed to clay. It is one of the last minerals to decompose, but that it does dissolve slowly is proved by the presence of iron sulphate in all the old drives. Mr. Cox's theory, however, implies that all the gold and most of the gangues came up from below, and I cannot accept it for the reasons already given. Sir James Hector's theory seems to me to be more probable, provided that the quartz be supposed to come from the bed-rock equally with the gold; but it does not satisfy me altogether, because (1) I cannot see how during any stage of alteration of the rocks auriferous pyrites could be removed from the rock, and, in the absence of organic matter, be redeposited as auriferous pyrites in a fissure in the neighbourhood; (2) pyrites is not confined to the volcanic series, but occurs also in the slate formation, but gold does not accompany it there; and (3) I rather doubt the statement of the intimate relation between pyrites and gold.

"It is certainly by no means the case that gold occurs wherever pyrites is abundant, or where it has once been abundant. The rocks contain quite as much pyrites in the Karaka and Tararu Creeks as they do in the Moanataiari and Waiotahi Creeks, but the gold is much less in quantity in the former localities than in the latter; indeed, the two rocks described in this paper from the Prince Imperial and Waiotahi Mines contain very little pyrites, although one of them encloses a very rich vein, and there is no evidence to show that they ever contained more than they do now. The rocks of Te Aroha and of Keevin's Point at Coromandel also have much pyrites, but not much gold, while the slates and felsite tuff at Waiohanga Point are largely impregnated with pyrites, and yet there is no gold, although in places the pyrites has been completely decomposed. On the other hand, the rocks of the lower part of the Shellback Creek contain little or no pyrites, and little or no gold. Again, I am not convinced that the pyrites of the country rock is so uniformly auriferous as is generally supposed. That the pyrites from the lodes is auriferous I allow, but the evidence that the pyrites of the country rock is also auriferous is but slight. In 1868 Dr. Hector exhibited, at a meeting of the Auckland Institute, pyritous vein rock from the Golden Crown, which was highly auriferous, and a portion of the bed-rock which also contained gold; but it is not stated that in the latter case the gold was in pyrites.

"In 1869 Dr. Hector, speaking of pyritiferous rocks from the Kapanga Mine, Coromandel, says, 'It was from this rock that the iron-pyrites formerly examined for gold was obtained, which yielded at the rate of 4 oz. to the ton.' But on turning to these analyses I find that the pyrites is said to have been brought from an auriferous leader, and from the Kapanga Mine; it is not said to have come from the country rock. Mr. W. Skey says that in two cases at the Thames pyrites was roughly separated from a quantity of rocks free from all appearance of quartz-veins, and these, when separately assayed, gave no positive indication of gold; but some pyrites from the Long Drive Claim, selected with the greatest care so as to avoid anything like a quartz vein, gave distinct traces of gold. (Reports, Geological Explorations, 1870–71, pp. 84, 85.) This is the only analysis that I can find which gave positive results, and it is of great importance; but numerous assays of pyrites taken at different distances from reefs are required before this point can be considered as settled.

"A piece of carbonised wood, about 1 in. in diameter, highly charged with pyrites, was found in the Maid of England Claim, Waiotahi Creek; the pyrites here being probably due to the organic matter having reduced the iron sulphate which circulates through the rock. This pyrites was examined by Mr. W. Skey, who reported that it contained no gold. (Laboratory Reports, No. 4, 1869, p. 17, No. 465.) Sir James Hector, however, says that 'the specimen was not sufficiently

* See original report.

large to give a reliable indication of the presence or absence of gold' (Reports, Geological Observations, 1868–69, p. 32), so that the evidence is not conclusive; but as far as it goes, it is against the idea of iron sulphate containing gold in solution. I am not aware of the iron sulphate found in the old drives having been tested for gold.

"If it should turn out that pyrites in the country rock is an indication of gold in the neighbouring veins, but that the pyrites is not decomposed and is non-auriferous, then I would suggest that, as part at least of the pyrites has been formed from magnetite, the gold may have been originally in the magnetite, and have been released during the formation of the pyrites. I do not think that this has been the case, but it is a point worthy of investigation by the chemist. The pyrites is no doubt a secondary mineral formed in the rock after consolidation, and, if it should turn out to be generally auriferous, we must suppose either that the gold came from below with the sulphur, or that its source is the titaniferous magnetite, which is one of the original constituents of the rocks.

"But there are other secondary minerals constantly associated with the gold-veins which must not be overlooked. They are chlorite and bastite. As chloritic-andesites, or propylites, are also found in Nevada and in Hungary, as well as at the Thames, and as in all three places they contain gold and silver in remarkably similar proportions, it would seem *a priori* that the chlorite might be connected with the occurrence of the precious metals in veins. Now, Professor F. Sandberger has proved that the mica of the gneiss of the Black Forest contains small quantities of several metals, including silver; and other observers have shown that a large number of metals are present in the micas, the augite, the hornblende, and the olivine of the crystalline rocks. (Green's "Physical Geology," ed. 1882, p. 560.) Mr. Becker has also found gold and silver in the diabases that bound the Comstock Lode, most of it in the augites. This gold and silver is in much the same relative proportions as the Comstock bullion; and he further found that the decomposed diabases contained only about half as much of the precious metals as the fresh rocks (United States Geological Survey, 1880–81, p. 309). That is to say, one-half of the gold and silver has passed out of the decomposed rocks, and has, no doubt, been deposited elsewhere. If, therefore, we assume that the pyroxenes of our volcanic rocks contain gold and silver, that the conditions necessary for dissolving them rarely obtain, but that one of the exceptions has been in the Hauraki Goldfields, we have a hypothesis which will, I think, explain most of the facts.

"The first change that took place in these rocks was, as I have shown, the conversion of the pyroxenes into chlorite and bastite with the liberation of silica, lime, and some iron. If gold and silver were partly removed with these substances we can conceive that while the lime was altogether removed the silica and iron might have been deposited with the precious metals in fissures, and the iron converted into pyrites by hydrogen sulphide. During the second series of changes the whole of the chlorite with the remaining gold would be removed, and auriferous quartz would be deposited in the veins. If the decomposition of the felspars took longer than that of the chlorites, which is very probable, pure crystallised quartz might be deposited on the auriferous quartz. In the third series of changes the carbonates which had been formed during the second series of changes were dissolved, and part may have been deposited occasionally on the quartz. This, it will be seen, gives a fair explanation of the principal facts connected with the reefs, and also explains why the white rock, from which the chlorite has been removed, is more favourable for gold than the harder dark-green rocks in which the chlorite still remains. But no reason is apparent why the sulphides of antimony, zinc, arsenic, and copper should have been formed subsequently to the iron-sulphide. Absence of gold in the well-crystallised quartz shows that silica continued to be removed after all the gold had gone; and we might account for the fine threads and scales of gold between the points of quartz-crystals by supposing that during the second or third series of changes the auriferous pyrites in the veins was in some places dissolved, and that the gold was redeposited, while the sulphur and most of the iron were removed in solution, nothing but red stains being left behind. If this hypothesis is the true one, I should expect that, as the whole of the gold in the veins in the hard dark rocks is due to the first set of changes, it would exist chiefly as auriferous pyrites, while in the softer kindly sandstone more gold would be added in auriferous quartz without pyrites. These are, however, surmises, which I am not in a position to test, and are intended merely to direct the steps of other investigators. I must, however, add that if my views are correct it will be useless to follow the reefs far down into the slates. This conclusion is, I am aware, opposed to the opinions of Sir James Hector and Mr. Cox (Reports, Geological Explorations, 1882, pages 15 and 45), and I can only say that I hope time may prove me to be wrong."

In the second volume of the "Transactions of the Australian Association for the Advancement of Science," Melbourne meeting, 1890, is a paper by James Park, F.G.S., at that time director of the Thames School of Mines, "On the Geological Structure and Future Prospects of the Thames Goldfield," from which the following extracts have been made. Mr. Park says:—

"Although over twenty-two years have elapsed since gold was first discovered at the Thames, the geology of this goldfield has always been a subject of much discussion among New Zealand geologists, and even at the present time the most opposite and divergent views are held by different authorities, both as to the structure and true character of the rocks themselves. The mining operations of this field have so far been confined to an area a little more than a square mile in extent, and, as the more accessible and readily obtainable gold is being rapidly worked out, the question of deep-sinking and going further afield must sooner or later claim the attention and serious consideration of mining men and those dependent upon the production of gold. . . .

"*General Structure.*—The rocks of this goldfield, as disclosed by the above line of section,* which supplies the key of their structure, divide themselves into three distinct formations, as follows:—

* Section from Bonemill to Hape Creek.

" (1.) Slaty shales and siliceous mud-stones.
" (2.) Felspathic and tufaceous sandstones passing into breccias with gold-bearing veins.
" (3.) Coarse volcanic breccias and tuffs, with coal and coaly shales at their base.

" The slaty shales and associated rocks form the old floor of the district upon which rest unconformably the two succeeding formations, between which no marked break or unconformity exists. Between Shellback and Hape Creeks these younger formations are arranged as an anticline, the dome of which, formed by the coarse volcanic breccias and tuffs, has been largely denuded, thus exposing the gold-bearing series below. Near the core of the anticline which is situated between the Saxon Mine and the old Queen of Beauty shaft, the strata are inclined at high angles, being much disturbed, but towards the sides of the anticline they are lying flatter, the dip varying from thirty to fifty degrees. . . .

" The auriferous series consists of grey and yellowish-grey and sometimes ferruginous sandstones, which alternate with wide belts of hard greyish-blue, coarser-grained sandstone, often of a felspathic nature. The former are of moderate hardness, are generally highly decomposed, and at the surface look as if at one time they had been permeated in every direction by thermal waters. The gold-bearing veins are almost exclusively confined to the softer decomposed sandstones. In places the harder sandstones pass imperceptibly into angular breccias, which weather on the surface into bright coloured clays, being very subject to decomposition by atmospheric agencies. . . .

" Tabulating them [the rocks of the Thames Goldfield] according to their probable age, they are as follows:—

" (1.) Upper Eocene—volcanic breccias and tuffs—Mount Brown series.
" (2.) Lower Eocene—auriferous series—Grey marl series.
" (3.) Palæozoic—slaty shales, &c.—Te Anau series.

" 1. *Upper Eocene.*—This formation covers by far the greater part of the peninsula. It consists of a great succession of trachyte tuffs, andesite breccias, and fine-grained, tufaceous sandstones, passing into dirty greenish-coloured grit beds. Its thickness varies considerably, but is generally between 1,200 ft. and 1,500 ft. It is frequently intruded by dykes of hornblende-andesite, augite-andesite, and trachyte. A fine example of the former may be seen on the coast, three miles past Tararu, and of the latter, in the valley of the Kauaeranga, opposite the Orphanage. Viens of jasperoid, chalcedonic, and opaline quartz, calcite, and ironstone are not uncommon in the breccias and finer-grained tufas, but no gold-bearing quartz, so far as I can ascertain, has up to the present time been found in this formation.

" In a bed of blue tufaceous clay exposed in a road-cutting on the beach, about two miles north of Tararu, there occurs a quantity of selenite, as well-developed crystals and radiating fibrous masses. Near their junction with the underlying auriferous series the breccias often contain large quantities of silicified wood, as at Hape Creek and Kauaeranga, and thin seams of brown-coal and coaly shales, as at Paeroa and Owharoa. The presence of the latter would indicate an approach to land conditions at the close of the Lower Eocene formation, but, as has already been stated, there is no stratigraphical break to mark an unconformity. At Waiohanga they overlap an isolated rocky ride of the Palæozoic rock; elsewhere they rest upon the auriferous series. Between Cape Colville and Te Aroha this formation is arranged as a succession of synclinal and anticlinal folds, the axes of which have a general north-east trend. The underlying auriferous series at the Thames, Tapu, Puriri, Hikutaia, Karangahake, Waitekauri, Te Aroha, and all the other goldfields on the peninsula, are exposed in the denuded cores of the anticlinal folds.

" It may be interesting to note that the Waitakerei Range, extending between the Kaipara and Manukau Harbours, and the Great Pirongia Range, lying between the Waipa and the west coast, are composed of similar rocks. It is evident that, during the period of their formation, the Province of Auckland must have been the scene of the most violent and intense volcanic activity. From stratigraphical reasons I am inclined to think that this great series is probably of Upper Eocene age, and contemporary with the great volcanic outbursts which took place around Oamaru during the deposition of the Mount Brown or Hutchinson quarry-beds.

" 2. *Lower Eocene, Auriferous Series.*—This formation, as we have seen, consists principally of fine-grained sandstones, generally pyritous and highly decomposed, alternating with subordinate bands of harder and coarser sandstone, which sometimes pass imperceptibly into breccia beds. It is exposed in the denuded core of an anticline, both sides of which are overlain by the great volcanic breccia and tuff series just described.

" In his report on the Thames Goldfield in 1882, Mr. S. H. Cox, F.G.S., late Assistant-Geologist, makes the dip of the auriferous series north-west along the whole line of exposure from Kuranui Creek to Hape Creek (Geological Reports, 1882, pp. 10–12). The effect of this is to place the coarse breccias and tuffs as the lowest members of the auriferous series. At the Tararu end of the section these breccias are formed overlying the auriferous rocks, but Mr. Cox gets rid of this difficulty by calling in the aid of a hypothetical fault, the throw of which he says would not be less than 2,000 ft. (*l.c.*, p. 12), but it is evident that 5,000 ft. would be nearer the amount, as the two outcrops are separated by over a mile and a half. The hard sandstone and breccia band forming the apex of the anticline, which follows the trend of Waiotahi Hill, is shown by Mr. Cox on his map and section as lying on the highly denuded edges of the auriferous series. An important result of my survey of this line of section has been to place these rocks in their natural position.

" It is usual among most writers to speak of the reefs at the Thames as occurring in volcanic rocks. This, however is not the case. The gold-bearing rocks are closely hemmed on both sides of the field by coarse volcanic breccias, tuffs, and agglomerates, frequently intruded and interbedded with solid dykes and lavas, and this has probably led to the error. The whole of the auriferous series is of undoubted sub-aqueous origin. No doubt much of the material composing some of the

members of this series has been derived from the destruction of volcanic rocks, more especially the coarser breccia bands, which, however, are distinctly stratified, and sometimes contain large fragments of partially-carbonised wood, showing that the conditions of deposition were probably estuarine.

"In his paper 'On the Rocks of the Hauraki Goldfields,' read before the Geological Section of this Association at last year's meeting at Sydney, Professor Hutton describes a number of igneous rocks which are said to come from Waiotahi Creek, Karaka Creek, and other places on this goldfield. He mentions hornblende and enstatite-dacites, hornblende-andesite, augite-andesite, and enstatite-andesite. This is a subject to which I have devoted some study, and I regret that I am unable to confirm this author's conclusions. As a result of the closest investigation, I have been unable to find any of the above rocks *in situ* within the boundaries of the goldfield. Rounded boulders of hornblende and augite-andesites are common enough in the beds of the Waiotahi and Karaka Streams, but they are obviously derived from the overlying breccia and tuff formation, which, as I have pointed out, is often intruded by igneous dykes, and in places contains huge angular masses of solid lava many feet in diameter. I have also examined many of the so-called dykes, both in the mines and on the surface, and have no hesitation whatever in stating that they are all of clastic origin. The rocks composing these hard bands are generally extremely hard, and of a dark bluish-grey or green colour when obtained in the solid. They are highly felspathic, and hence very subject to decomposition near the surface, and usually contain disseminated nests and grains of iron pyrites, and, not uncommonly, well-developed prisms of hornblende. They are in fact, indurated tufas of fine texture, the true character of which can only be determined by a close study of their disposition and arrangement in the field. . . .

"*3. Palæozoic—Te Anau Series.*—This formation forms the floor or basement rock of the peninsula, but it does not reach the surface within the limits of the Thames Goldfield proper, nor has it been reached in any of the mines. It crops out on the shores of the firth, about a mile north of Tararu Stream, forming Rocky Point, whence it extends eastward to the upper part of Waiohanga Creek. It consists of blue and grey banded slaty shales, which are followed by yellowish grey siliceous mudstones, which seldom show distinct stratification, but are jointed in all directions, the joints being often stained or filled with yellow ocherous clays. Professor Hutton in 1869, and Mr. Cox in 1882, spoke of this mudstone as a felsite. In 1887 the former re-examined this point, and in his paper on the 'Rocks of the Hauraki Goldfields' states that he is now convinced of its clastic origin, a conclusion which I can fully indorse.

"These shales and mudstones are of uncertain age, as no fossils have yet been found in them, but they most probably belong to the Palæozoic period. At any rate, they bear a strong resemblance to the rocks forming the Taupiri Range, on whose flanks occur fossiliferous rocks of undoubted Triassic age.

"At the Thames, the gold-bearing veins occur in the felspathic and tufaceous sandstones of Eocene age; at Tapu and Coromandel goldfields they occur both in the tufaceous sandstones and in the underlying slaty shales and mudstones. At Coromandel, for instance, we have the celebrated Kapanga Mine in the tufaceous sandstone, and the Tokatea and Bismarck Mines in the slaty shales, near their junction with the overlying tufaceous sandstones. On the coast between Waikawau and Tapu the slaty shales are intruded by eight dyke-like masses of hornblende-andesite, which are well exposed in the road-cuttings.

"*Future Prospects of the Thames Goldfield.*—Up to the present time the mining operations on this field have been almost exclusively confined to a small area on the foreshore, embracing altogether little more than a square mile of country. I have already pointed out that the auriferous series, with its gold-bearing veins, possess a general north-north-east or north-east strike, and a reference to the accompanying map will show that it passes as a narrow belt, about a mile and a quarter wide, north-eastward to the upper parts of Tararu and Otonui Streams, and thence onward in the direction of Mercury Bay. I am fully convinced that the prospects of finding payable gold in the forest country just indicated are sufficiently encouraging to warrant the thorough exploration of that portion of the field. The country is broken and heavily timbered, but these obstacles could easily be overcome by a judicious expenditure in making pack or even blaze-tracks in the more inaccessible parts."

In the volume of papers and reports relating to minerals and mines for 1894, published by the Mines Department, New Zealand, Mr. Park has a further paper "On the Geology, Resources, and Future Prospects of the Thames Goldfield," from which, as his latest views on the questions treated of, the following extracts have been taken. In this Mr. Park says:—

"*Rocky Point to Kauaeranga River.*—The basement rock of the district is exposed as a small patch on the beach between high- and low-water mark, in the first small indentation to the north of the fishing-rocks at Rocky Point. Here it consists of blue and yellowish-grey slaty shales, but on the coast-road north of Waikawau these are found to be associated with slaty breccias and greywackes. The blue shales are somewhat broken and disturbed, the dip varying from south-south-west to west-south-west at flat angles varying from 26° to 30°. In former years the outcrop was over a chain square in extent, but at the present time it is only a few square yards, having become covered up by recent accumulations of beach-sands and gravels. Another small outcrop of the blue slaty shales is exposed in the bed of Waiohanga Creek, about half a mile distant on the line of strike, and at an elevation of about 400 ft. above the sea.

"A few chains north of Rocky Point the slaty shales are followed, apparently quite conformably, by a great thickness of pale-yellow or grey-coloured siliceous shales or mudstones, which rise into steep rocky cliffs and form Rocky Point itself, as well as the outlying fishing-rocks and islets. These mudstones are much jointed and broken, and show evidences of having been at one time much disturbed and crushed. They exhibit no distinct lines of bedding or stratification, but in a few places the lines of different coloured materials would indicate a dip to the south-south-west, or

the same as that of the underlying blue shales. About 3 chains south of the Point—that is, on the side facing Tararu—they are curved, bent, and tilted up at high angles, and terminate very abruptly and steeply against the overlying volcanic breccias. At their base they possess a bluish-grey colour when seen in the solid, but they weather for a great depth to a yellowish-grey colour. They are highly pyritous, and occasionally interlaminated with thin layers of grit, consisting of small rounded particles of hard mudstone, mostly of uniform size. The blue shales also contain similar grit-bands, as well as nests and veins of pyrites.

"The age of these old mudstones and slaty shales is still a matter of much doubt. Up to the present time they have yielded no distinct fossils, and the only remains that could be considered of organic origin are some small dark-blue tube-like markings in the lower blue shales, which may be referred to annelid or worm trails. These markings are, however, too obscure to fix the age of these rocks; and, until more satisfactory evidence is obtained, they may be regarded of Lower Secondary or Upper Palæozoic age, most probably the latter.

"Passing southward towards Tararu, at the point where the yellowish mudstones abruptly terminate, they are followed by a hard blue or bluish-green andesitic tuff or ash-rock, which abuts against and overrides them, resting both on the mudstones and shales. Where it rests on the blue slaty shales it contains small fragments of shale and masses of jasperoid quartz; but, on the Tararu side, for the first 30 ft. from the mudstones, it is almost free from foreign matter. At the old quarry face, a few yards beyond this, it becomes quite brecciated with numerous angular fragments of blue shale, varying from ¼ in. to ½ in. in length, but in some layers the fragments are over 3 in. in diameter, and so abundant as to form a slaty breccia.

"When solid and free from slaty particles, this tuff possesses a dark greyish-blue colour, and shows a finely crystalline structure, and might readily be mistaken for a solid lava. It decomposes rapidly when exposed to the influence of rain and other atmospheric agencies. It first assumes a greyish-green or purple colour, and soon become speckled with small, white, rounded particles, which apparently owe their origin to the decomposition and kaolinising of its felspars. It then passes into a fairly even or uniform yellowish-brown rock of moderate hardness, which in its turn gradually assumes a pale-grey or yellowish-grey colour, due to the abstraction of its iron oxides. In the latter state it is a very striking and instructive rock, and, to outward appearance, is similar to the 'kindly' gold-bearing rocks to be described hereafter. When it contains slaty particles, these stand out, black and undecomposed, in very marked contrast to the bleached and weathered tuff matrix. This slaty brecciated tuff, in all its different stages of decomposition, is well exposed in the quarry face a few chains north of Rocky Point.

"On the beach near the mouth of Waiohanga Creek, on the smooth water-worn ledges at high-water mark, the tuffs, now free from slaty inclusions, are intersected by a number of small parallel mineral veins, many of which are filled with a greenish-grey material resembling the matrix of the enclosing rocks. The strike of these veins is north-east to south-west, and they are generally standing vertical. They vary from a mere thread to 6 in. in thickness, are often branching and faulted, and in many ways afford an excellent object-lesson in the structure and behaviour of lodes. A few chains further along the beach the tuffs are again similarly intersected by another system of parallel veins of pyritous quartz, while large veins and segregated masses of calcite are plentiful. The calcite veins often possess a comb structure, and in the centre the opposite and corresponding layers terminate in beautiful scalanohendrons. In some of these veins I have found bunches of galena and blende, associated with iron- and copper-pyrites. The assays of the galenas proved that they were poor in both gold and silver.

"Between this point and Tararu Creek the tuffs pass imperceptibly into coarse breccias, consisting of irregular-shaped masses of greenish-grey andesite or tuff, enclosed in an andesitic matrix. In some places they contain large angular fragments of slaty shale, but these become rare as Tararu Creek is approached. From Rocky Point to Tararu the tuffs and breccias exhibit no distinct lines of stratification, and the southerly dip which they seem to possess is only indicated by the direction of the layers of the different materials.

"Just before Tararu is reached, the coarse breccias are followed by a narrow belt of a greenish-grey compact tuff, or partially decomposed andesitic lava, containing a number of gold-bearing quartz-reefs, which pursue a general north-east course and traverse the City of Dunedin, Norfolk, and Sylvia mining leases in Tararu Valley. This is the lowest horizon of payable metalliferous veins in the Thames district. The metallic sulphides which accompany the gold are galena (often richly argentiferous), blende, copper, and iron-pyrites, while the principal oxides are those of manganese, which are often very abundant in the City of Dunedin and Norfolk Mines, especially in the shallower workings.

"From Tararu to Kuranui Creek the rocks consist of greenish-grey and dark-green or purple breccias and tuffs, which up to the present time have not been found to contain a single payable reef. The same or similar breccias form the ranges on the south side of the Hape Creek, and in places they contain large masses of silicified wood, which would point to the existence of solfatara action during their formation. In the Kauaeranga Valley they are overlain by an enormous accumulation of trachytic tuffs and agglomerates, which are in many places intruded by dykes of trachyte and augite andesite. In the higher part of the river-valley the latter are well exposed in the narrow deep gorges, where they exhibit a beautiful columnar structure of huge hexagonal prisms. In all parts of the valley the tuffs contain veins and segregations of jasper, agate, chalcedony, as well as blocks of wood converted into wood-opal. At the foot of Table Mountain they contain intercalated beds of black and yellow coloured shales, and seams of impure brown coal. The presence of the latter proves the existence of a land surface in this area during the period of eruption of the trachytic tuffs and lavas.

"*Gold-bearing Formation.*—At the Kuranui or Shotover Stream we pass on to the gold-bearing formation of the Thames Goldfield, which extends without a break as far as Hape Creek on the south, and stretches in a north-easterly direction into the upper valleys of the Tararu, Puru,

and Waiomo Streams, whence it extends northwards towards Mercury Bay. It is a noteworthy fact that wherever it is found it contains large well-defined payable reefs. It consists of alternations of soft or moderately-hard decomposed andesites and bands of solid hornblende and augite andesite lavas, which pass imperceptibly into indurated tuffs and breccias. The decomposed andesites generally possess a characteristic yellowish-brown or grey colour, and form the 'kindly country' of the local miners; while the solid andesites and tuffs possess a greenish or dark-blue or purple colour, and are generally known as 'hard country.' These alternating bands of soft and hard rock follow a general north-east course, and, from the Kuranui Hill to the Waiokaraka Gully, possess a north-west dip, at angles varying from 40° to 70°. From the Queen of Beauty shaft southwards the hard lavas assume an almost vertical position. The main reefs or lodes occur in the soft decomposed andesites, and follow their course and underlie. Of course it must be clearly understood that the decomposed andesites show no stratification whatever, and the apparent strike and dip which they exhibit are imparted by the narrow hard bands of undecomposed cores, whose line of outcrop follows a north-east course. The reefs in most cases run parallel to the hard bars, and where these are steep, as in Kuranui Hill and between the Waiotahi and Karaka Streams, the reefs are steep, and where they are flat, as between the Moanataiari and Waiotahi Streams, the reefs are correspondingly flat or low lying.

"From the Thames foreshore the country rises to the north-east by a number of long, ascending spurs or ridges, which gradually converge and culminate at the Look-out Rocks, situated on the watershed lying between the Karaka and Ohio Streams. The ridges and spurs appear in most cases to be formed by cores of the hard country, while the creeks have excavated their courses and valleys in the softer bands. The streams which diverge from the culminating point just spoken of are the Hape, Karaka, Waiotahi, Moanataiari, Kuranui, Shellback, Tinker's, Ohio, and Otanui.

"Excepting in the Karaka area, the hard bars or belts of rock are always subordinate to the soft 'kindly country' both in width and extent. On the seaward side of the Moanataiari Fault, and in the upper basins of the Moanataiari and Waiotahi, where extensive mining operations have been conducted for a great number of years, the alternating character of the soft and hard country is very marked and distinct. . . .

"*Origin of the Gold-bearing Rocks.*—Judging from the character of the breccias at Tararu beach, and the more or less rudely stratified structure of the tuff in many parts of the peninsula, I am inclined to think that the volcanic eruptions which originated the rocks of the Thames Goldfield were submarine, and most probably took place in shallow seas studded with rock-girt islets. The occasional presence of masses of silicificed wood in the Hape Creek breccias clearly indicates the proximity of dry land. But while sub-aqueous eruptions were active in one case, sub-aërial volcanoes were pouring out vast deposits of fragmentary ejecta, accompanied by streams of lava in others. On the western slopes of the main range lying between Coromandel and Cabbage Bay the great volcanic breccias contain intercalated shales and thin seams of fine bituminous coal, composed of a terrestrial vegetation, thus proving that the eruption in that area took place on dry land. The same conditions are also indicated near Paeroa, where a thick deposit of black coaly shale, containing irregular layers of brown coal several inches thick, is intercalated among coarse volcanic breccias.

"There is an entire absence of visible volcanic vents in this district; but the prominent masses of andesitic lavas and breccias in the high country at the source of the Karaka may mark the sites of ancient points of eruption. The widespread character of the volcanic ejections, extending throughout the whole length of the peninsula, would lead to the conclusion that the eruptions took place along a great fissure rent, possessing many points or *foci* of intense activity, a feature so strikingly illustrated during the volcanic eruption in June, 1886.

"*Age of the Gold-bearing Rocks.*—In the Thames district the gold-bearing rocks are found resting directly on a highly denuded surface of the Palæozoic slaty shales; and, since they contain no distinct fossils themselves, their age cannot be determined here, although the presence of decotyledinous leaf-impressions in the coaly shales embedded in the breccias at Paeroa and Tapu affords unmistakable evidence of their Tertiary age. But the only direct and satisfactory evidence of their age is to be found on the coast-line between Coromandel and Cabbage Bay. There, at Waitete Bay, a small isolated patch of fossiliferous strata of Cretaceo-tertiary age is found resting on a denuded surface of Palæozoic slaty shales and greywackes. The younger series consists of a thick stratum of coarse sandstone conglomerate resting on the slaty rocks. This is followed by marly greensands, in turn overlaid by a hard impure shelly limestone, which closes the series. A few chains back from the beach the whole series is overlaid by the gold-bearing series, consisting there of coarse breccias, with coaly shales, indurated tuffs, solid andesites, and propylites containing gold-bearing quartz-veins. The volcanic rocks are therefore younger than the shelly limestone of Lower Eocene age, and, judging from the presence of the ash-beds in the Waitemata series on the shores of the Waitemata Harbour, I am of the opinion that the eruptions began in Upper Eocene times and continued down to the Middle Eocene period. It is interesting to note that the North American andesites are considered of Lower Miocene age, as also are the andesites and propylites of Hungary and Transylvania.

"*High-level Terraces.*—On the north side of the Kauaeranga River, in the direction of Tot ra Point, there is a high, broad river-terrace, composed of well-worn water gravels, and white quartz sands. The materials forming this terrace were transported by the river when it flowed at a higher level than at the present time.

"The flat on which Irishtown is built, and the undulating and sloping ground in the area known as Block 27, are occupied by the remains of the old high-level terrace formed by the joint action of the Karaka and Hape Creeks. The original level of this old terrace is best seen at Irishtown, at the lower end of which it terminates abruptly, at a point overlooking the Queen of Beauty shaft. Its height is about 175 ft., and an examination of its face shows that it consists of numerous alternating horizontal layers of clay, sand, and gravel, with occasional bands containing

large rounded boulders of decomposing andesite. On the south side of the Karaka the original level of the old terrace can only be traced in a few places, the small streams which descend from Una Hill having excavated it into broad undulating spurs, which are now largely built upon. A portion of the old Hape Creek terrace is well preserved at Mount Pleasant, and in the road-cuttings in that neighbourhood the bedded character of the materials is very clearly been. Both in the Karaka and Hape Creek areas the terrace-clays often contain numerous large subangular masses of solid andesite.

"A small patch of the Waiotahi old high-level terrace is still preserved opposite the Cambria battery, at the point where the stream issues from its valley.

"The Moanataiari Fault forms the north-east boundary of the terrace-materials along the foot of Una Hill, but no evidence can be obtained to show whether the Great Fault is older or younger than this Pleistocene gravel and boulder-formation, but at present I favour the opinion that it is of somewhat older date.

"*The Alluvial Flat, and Floor of the Harbour.*—The alluvial deposits on the foreshore have been exposed by different shafts and borings to a depth of 90ft. from the surface; and by levels driven from the New Prince Imperial and Piako shafts to a depth of 300ft., or 400ft. A shaft sunk in Shortland, in 1868, passed through 2ft. of surface soil, 10ft. of shelly sand, 68ft. of blue and yellow clay, mixed with boulders of andesite, and 10ft. of pumice-sand. The actual depth of pumice-sand was never determined. The information disclosed by the seaward levels shows that the floor of the old harbour is occupied by a great boulder formation, composed of materials similar to those forming the high-level terrace behind Shortland. For a number of years no mining operations have been carried on from the shafts on the foreshore in the direction of the harbour, so that the data relating to the existence of the supposed beach slide or fault is of a very meagre kind. In consequence of this, it is impossible to definitely decide whether the boulder and clay formation met with on the floor of the harbour is really a faulted portion of the Shortland terraces, or merely the accumulated waste of the back country. . . .

"*Geological History of the Hauraki Peninsula.*—During the whole of the Secondary epoch this area was occupied by a deep still sea, devoid of islands or islets. With no dry land to waste, no sediments were formed during this long period of time. New Zealand throughout the Secondary epoch—like Great Britain—seems to have been singularly free from volcanic activity and all great earth-movements. But at the close of the Cretaceous period the land in this area began to gradually emerge from the sea, and an island of large size appeared to the north-east of the present site of Coromandel. The ever active agencies of denudation at once began to wear away the dry land, and the spoil was carried to the sea by numerous streams and rivers. After a period of rest, the land began to sink, and the peaty deposits which had accumulated on the low-lying marshy shores of the island were soon submerged, and in their turn became covered with coarse gravels, sands, and clays carried seaward by the streams which descended to the coast-line. The land still continued to sink, and, as the sea encroached, true marine deposits were formed above the fluviatile materials, and, as shelly limestones, closed the sequence of the coal-measures, and marked the complete submergence of the dry land. But with this disappearance the quietude which New Zealand had so long enjoyed was rudely broken. Submarine volcanic eruptions of the most violent and widespread nature now took place. Great fissure rents opened in the floor of the ocean, and poured out vast quantities of ashes and floods of fiery lavas which soon became piled up, until many of the volcanoes reared their heads above the water. This stupendous outburst took place in Upper Eocene times, and is marked by a characteristic fossiliferous ash-bed in the Waitemata series, whose sediments were accumulating at this time in the quieter seas in the Western Hauraki region. This bed, well known as the 'Parnell grit,' consists of sea-borne ashes and mud, and occasionally angular fragments of solid hornblende and augite-andesite lavas, often several inches in diameter.

"After the pent-up forces had spent themselves in the first great paroxysm there was a period of rest from volcanic activity, during which vegetation established itself on the mud and ashes washed into the low grounds by the streams draining the slopes of the newly-formed volcanoes. But the land was in a continual state of tremor, and the oscillations too frequent to permit the continued growth and accumulation of sufficient vegetation to form workable seams of coal. The cessation of volcanic activity was of short duration. The plutonic forces burst out with renewed energy. The forests were devastated and utterly destroyed, and covered by hundreds of feet of ashes and solid lavas, first of a semi-basic and then a trachytic character. The embedded trees in many cases were converted into wood-opal by the petrifying action of the thermal springs, which appeared when the volcanic forces had become once more dormant. The land along the line of eruption now began to emerge from the sea, but the process was accompanied by violent earthquakes and convulsions of the land. The enormous strain following the consolidation and cooling of the vast accumulation of volcanic ejections, no doubt aided by the settling of the crust, due to the great excavations made below, originated numerous deep-seated parallel fissures running in a north or north-east direction. The expiring volcanic forces still manifested themselves in solfatara action of an intense kind along these fissures, which probably coincided approximately to the general trend of the original line of fissure-rent.

"The thermal waters, steam, sulphuretted hydrogen, and other acid vapours, soon began an energetic attack upon the amphiboles, pyroxenes, feldspars, and other complex silicates forming the matrix of the semi-basic lavas. The silica became separated from its bases, and soluble alkaline silicates were formed as well as soluble salts of the metallic bases. After the leaching had thus proceeded for a long time, and the solfatara action had become feeble, the alkalies found new combinations, and the liberated silica, in the form of quartz, became segregated in the cracks and fissures, and distributed in fine grains throughout the mass of the leached lavas. While the changes which caused the liberation of the quartz were in operation, the fissures, now charged with alkalies as alkaline sulphide, became great voltaic cells, and the theatre of electro-chemical action. The

basic solutions were decomposed and their metallic contents electro-deposited, the base metals and a portion of the silver as sulphides, and the gold, together with the greater portion of the silver, as a metallic alloy. The formation of the quartz and the deposition of the metals was thus carried on simultaneously in the fissures by reactions, which were the complements of each other. During this period of solfatara action, and for a long time after, the dry land was ever subject to the denuding and degrading agencies of rain and running water. The present valleys were then being excavated, and the waste transported to the sea, where it was spread out on the floor by the sorting action of the water.

"Since the second great outburst recorded above, which culminated in the formation of the massive trachytic mountains which occupy the higher and more inland portions of the Peninsula, as well as the outlying islands in Coromandel Harbour, this area has enjoyed complete repose from all volcanic manifestations. But not so in other parts of this island. In Newer Pliocene times the central portion of this island became the scene of the most widespread and devastating eruptions that have ever taken place in New Zealand. The region from Ruapehu to Tauranga was occupied by a chain of great crater-lakes filled with molten magmas, from which liquid streams of fiery acid lavas were projected over the country for hundred of square miles. At this time were formed Ruapehu, Tongariro, Pihanga, Tauhara, Horohoro, and the solfatara scarred mountains of the Tarawera region. The light frothy ash or pumice of the acid eruptions, either wind- or water-borne, was spread as a continuous sheet over half of the island. At Shortland the pumice deposit is only 10 ft. thick; but in the Upper Thames Valley, and in the Upper Waikato, it is often found hundreds of feet deep, especially near the centres of eruption. The solid rhyolites, often much brecciated, reached as far north as Paeroa, Awaroa, and Waihi, filling in and levelling the old valleys excavated in the older volcanic rocks. Thus, at Waihi we find the well-known Martha Hill and its productive lode surrounded by a great thickness of grey rhyolitic breccias and lavas, which appear to have originated in the direction of Tauranga.

"It was probably during these Pliocene eruptions that the great earth-movements took place which resulted in the formation of the faults which traverse the Thames Goldfield. These faults cross the lines of the reef systems transversely, and their courses approximate to the direction of the initial line of eruption, which no doubt followed the line of least resistance." *

Description of the Different Formations occurring on the Cape Colville Peninsula.

Considering the extent of the area examined and the rugged character of the Peninsula, and having regard also to the fact that much of its area has been till now geologically unexplored, it will be readily understood that nothing like a minute and exhaustive examination could be undertaken. All that was aimed at during the past season was a knowledge of the sequence of the different sedimentary formations and groups of volcanic rocks, and approximately to ascertain the areas over which each of these appear at the surface; to determine if possible the conditions under which the volcanic series had been accumulated, whether as the products of submarine or terrestrial volcanoes, and in which of them reefs or lodes carrying gold and silver in payable quantities occurred. This work has been so far effected as to enable the drawing up of the Table of Formations appearing on this page and the descriptions which follow.

The scheme of classification includes divisions of the volcanic series not hitherto recognised by other writers on the geology of the Peninsula, and may in some cases be considered unnecessary; but I am fully convinced that in the field the distinctions made can in most cases be readily followed; besides which in every case there is a chronological reason for the separation of the different groups, this being the unconformable relations that subsist between them. It is not denied but that some modifications of the mapping of the different boundaries may be necessary; this is to be expected, but on the whole the sequence of the different groups, and approximately, the areas assigned to them will be found fairly correct. Despite the difficulties in the way of this first attempt to describe the geology of the whole of the Peninsula, it is hoped that a body of facts has been brought together such as will serve the purpose for which the work was undertaken, and afford valuable insight to the structure of the Peninsula as a whole, and also be of value as regards particular localities.

Table of Formations.

Probable Age.	Name of Formation or Group.	Characteristic Rocks.
8. Carboniferous ..	Maitai Series	Slaty breccias, grits, sandstones, siliceous and argillaceous mudstones, often calcareous, carbonised plants, and thin seams of impure coal.
7. Cretaceo-tertiary	Coal formation	Conglomerates, sands, clays, and limestones with coal.
6. ?	Thames-Tokatea Group ..	Volcanic ejectamenta, mainly andesic, solid fragmental or tufaceous, with traces of coal.
5. Older Tertiary ..	Kapanga Group	Volcanic ejectamenta, mainly andesic, solid fragmental or tufaceous, with traces of coal.
4. Miocene ..	Beeson's Island Group ..	Volcanic ejectamenta, mainly andesic, in places trachytic, solid fragmental or tufaceous, with sedimentary deposits and seams of coal.
3. Older Pliocene ..	Acidic Group	Volcanic ejectamenta; trachytes, rhyolites, porlite, spherulite, obsidian, &c., solid or tufaceous, with sedimentary beds and traces of coal.
2. Newer Pliocene or Pleistocene ..	Kauaeranga beds	Grey sandy beds and ferruginous clays.
1. Recent	Recent deposits	Various kinds of deposit, from coarse beach or river shingle to pumice sand and clays.
Dyke intrusions and thermal-spring deposits.		

* Mines Reports, 1894: Report by James Park, pp. 52 to 68.

LOWER CARBONIFEROUS.

Maitai Series.—These are the oldest rocks found or likely to be found on the Cape Colville Peninsula. Of them, Hochstetter says they form the nucleus of the mountain ranges of the Peninsula, and other succeeding writers have expressed the opinion that these rocks are to be or may be found from Cape Colville as far south as the Puriri River or Waihi Beach. During the investigations conducted for the purposes of this report the last traces of this formation were met with along a line drawn from the northern headland of Mercury Bay to Rocky Point near the Thames.

The chief developments of this series are in the northern part, and along the western side of the Peninsula to the points stated. In the northern part, the slates and associated rocks form the headland of Cape Colville and the opposing headland on the west side of Port Jackson, they also rise into and form the mass of Moehau, the highest mountain in the northern part of the Peninsula. Thence they extend south along the west side to Cabbage Bay, and along the coast-line to the south of Cabbage Bay as far as Paparoa; are seen at Kennedy Bay, in the Tokatea Range and at Kuaotunu. Between the Tokatea Saddle and Castle Rock they form the lower western flanks of the main range. South of Coromandel Harbour they are largely developed a little inland of the coast, or on the coast-line, as far as Tapu Creek, and finally are seen at Rocky Point, a little north of Tararu Creek at the Thames.

At Cape Colville, and thence to Stony Bay, the rocks of this series are mainly of a slaty character, dark-coloured and thin bedded. This also is their general character on the western headland of Port Jackson, although varied by bands of sandstone and grit beds. These rocks on the sea-coast are so rapidly denuded by the action of the tide that the effects of oxidation and decomposition are but little apparent, and thus they present a different aspect to what shows on ranges inland or some distance away from the coast-line, as in such latter positions they are prone to decomposition, and usually assume a buff- or pale stone-colour, except where recently and to some depth exposed by slips, or along the beds and banks of streams. Slates, mudstones, sandstones, &c., form the great mass of Moehau; but on the lower slopes of the mountain, towards the western head of Port Jackson, and on the east side of the Peninsula as far south as Sandy Bay and Port Charles, volcanic rocks form the outlying spurs, the slates descending to the shore-line of the Hauraki Gulf and to the sea, north of Port Charles. Owing to the presence of volcanic rocks on the flanks and lower slopes of the mountain, and of dykes cutting through the slates at various elevations, one large dyke forming the peak of the mountain itself, false ideas have been entertained regarding the real structure of Moehau. This uncertainty necessitated making an ascent of the mountain, but this through the pressure of other work was deferred till the end of the season, and then, owing to bad weather, had to be undertaken under very adverse circumstances. Meantime an ascent of the mountain from the Port Charles side was made by Mr. S. A. R. Mair. At my request he brought samples of rock from different heights on its slopes, and from the top of Moehau, and supplied me with the following notes respecting these and the ascent of the mountain. They are as follows:—

"On Easter Sunday I made an excursion to the top of Moehau. For several days previous the peak had been cloud-clad; nevertheless, as the morning looked promising, we made a start at seven o'clock a.m. Nine o'clock saw us up the ridge to a height of 1,150 ft., where we left the andesite and entered on the decomposed slate. On top of the first shoulder, from where we could gaze on the coast on either side, and at a height of 2,050 ft. above the sea, I still found this yellow decomposed slate. Our course then led us along the ridge due north for about three miles.

"At one spot along the ridge I came upon a 'shed' of small pieces of quartz mixed with slate, evidently being the outcrop of a leader. This was the only signs of reef matter encountered during the trip.

"However, 2,350 ft. above the sea-level was the last place in which I was able to obtain slate of any description, but I would not say it did not go higher, as the great depth of peaty matter and thickness of undergrowth prevented me from making as complete observations as I should have wished to. At this stage of the journey huge basaltic boulders were frequently encountered, and nothing of geological interest was seen till the cone was reached. This is exactly what it appears to be, a basaltic deposit on the older formation."

At a latter date my assistant, Mr. W. A. McKay, made the ascent, following upwards nearly the same route as that taken by Mr. Mair. The results of the two expeditions are confirmatory of each other, and prove beyond all question that Moehau is essentially a mountain formed of sedimentary rocks belonging to the formation under description.

The Assistant Geologist has supplied me with the following notes of the ascent made on the 17th May, 1897:—

"As directed, on the 11th May I left the Thames, Port Charles, for the purpose of making an ascent of Moehau from that side of the mountain. Owing to a variety of circumstances, mainly owing to bad weather, I found it impossible to make the attempt before the 17th of the month, but on that date, in spite of unfavourable weather, a start was made, and finally, after encountering many difficulties, the purpose of the expedition was accomplished.

"The mountain which was the object of the examination occupies that portion of the Cape Colville or Coromandel Peninsula lying to the north and north-east of a line drawn from Port Charles to Cabbage Bay, and forms a considerable portion of the northern part of the Peninsula.

"The mountain sends out long descending spurs, which have a moderately uniform slope to sea-level, and none of them rise into subsidiary peaks surrounding or flanking the main mountain mass. Lesser flanking ridges there are that on the east side lie between the mountain and the sea, but, despite of these, Moehau, as seen from north or south, or from each side of the Peninsula, stands alone and constitutes a mountain simply, and not the culminating and principal peak of a mountain-range. The northernmost spur or divide terminates at the western point of Port Jackson; while the

southern one splits up into several, one trending to Port Charles, and another in the direction of Cabbage Bay. From the low angle which they present the whole mountain is given a bulky and massive appearance, relieved only by their terminating in a sharp rugged peak, destitute of forest vegetation, forming a prominent feature in the landscape, the rest of the mountain being otherwise densely bush-clad.

"As leading to the summit of the mountain I had choice of three different routes—viz., one from Stony Bay, one from Port Charles, and a third from the western side by means of Spencer's survey track from Waiaro, on the Hauraki Gulf. Electing to take the second route mentioned, by which to make the ascent, I decided also, should circumstances permit, to descend by Spencer's track to the shore of the gulf, at the mouth of the Waiaro, and thus make a complete traverse of this part of the Peninsula.

"Having so decided, and made the necessary arrangements, with a guide I left Port Charles at daybreak on Monday, the 17th May, and commenced the ascent to the southern central spur that forms the water-divide between Port Charles and the gulf immediately north of Cabbage Bay. The good qualities of the track might easily be called in question, and a dense undergrowth of bush, grass, and scrub made progress difficult and slow. The rocks travelled over showed frequent exposures at the surface, and at other places loose stones indicated that we were still on the same class of country that shows in the low grounds and around the shores of Port Charles and the neighbouring bays. I had no means of determining heights with exactitude, the pocket aneroid I had with me clearly being in error, and therefore the heights given are but a rough approximation; but as the heights where the Waiaro track reaches the top of the southern spur and the top of the mountain are known, the estimates given cannot be greatly in error. Determined in this way, I consider that from Port Charles the volcanic rock, andesic breccias, &c., stretch from the shore-line up the eastern side of the southern spur to a height of 1,500 ft. above the sea, at which point the slates forming the crest and western slopes of the ridge appear from beneath the volcanic rocks.

"Following the principal ridge northward towards the main peak the presence of the slates on this was evidenced by outcrops of solid rock, and also by boulders, &c., derived from the same. The slates were mostly decomposed to a buff or stone-coloured rock, very different in appearance to the same rocks as seen on the coast-line and within or below tide-mark, but not differing from what may be seen on the first few miles of road on the way from Cabbage Bay to Port Charles, or on the road from Coromandel to Kuaotunu, or on the hilly country south of Coromandel Harbour, and thence to the Manaia Valley.

"The slates by such means were traced to a point under the highest peak of Moehau, which I estimate at about 350 ft. from the top. Where last seen in the solid the slates were of fine grain and much weathered or decomposed, yet easily distinguished from the nearly adjacent igneous rocks forming the highest part of the mountain. As the height to which the slates reach is a matter of importance, I may once again state on what grounds I estimated the remaining height from the last outcrop of the slates to the top of the mountain. From the disappearance of the slates upwards travelling was over steep ground, clad with a dense scrub 4 ft. to 5 ft. in height; there being no track, progress over this part was necessarily slow. To overcome this might have taken ten or twelve minutes, when boggy ground not so steep was entered upon. Finally, to reach the peak, a precipitous cliff, 50 ft. or 60 ft. in height, had to be scaled, and the entire journey from the last seen of the slates to the top occupied about twenty minutes. As the height of the mountain is 2,900 ft., by the above means I estimate that the slates reach a height of 2,650 ft.

"On leaving the sedimentary rocks behind, the contours of the higher part of Moehau completely alter, the long spurs come together, crowned by abrupt escarpments, to form the final peak, which thus stands up separate and very distinguishable from the bulkier mass of the mountain below. This tooth-like projection forming the top of Moehau is composed of a moderately fine-grained but completely crystalized rock, andesite or diorite, as the case may be. In its arrangement the mass seems to dip to the north at a low angle. Unfortunately, the higher part, from 1,500 ft. above the sea, had to be ascended during the prevalence of a dense fog, so that when the top of the mountain was reached no observations of anything more than a few yards could be made; but, as my instructions principally directed the determination of the height to which the slates attained, I did not consider the tracing of the volcanic rock a matter of prime importance; indeed, under the circumstances, to attempt such was to essay the impossible, as during a short winter day the ascent and descent by another route was more than enough for the time at our disposal.

"Commencing the descent of the Spencer survey-track, which, however, went over a portion of the Port Charles route, and after passing the junction, nothing but slates showed, and continued completely down to the water's edge at Waiaro, no volcanic *débris* being seen in the creeks or elsewhere, thus defining the present boundary of the volcanic rocks forming the lower slopes of the mountain towards Port Charles. The slates on the lower ground are quite undecomposed, and extremely hard, resembling (except that they are not brecciated) those immediately north of Tapu, between Coromandel and the Thames. The Spencer track downwards leaves the spur on to a small alluvial deposit, stretching forward for three-quarters of a mile to the coast-line at Waiaro.

"On the beach the indurated character of the slates is still retained, the dip and strike being shown very plainly. The strike is in a northerly direction, with a general dip to the eastward at an angle of about 45°, thus in strike conforming with the main body of the slates in other parts of the Peninsula."

Around the shores of Cabbage Bay the slates are fine-grained, and thin-bedded mudstones with thicker-bedded strata of more calcareous rock. Sometimes the calcareous matter so abounds that the rock may be regarded as an impure limestone. Mostly, however, it is aggregated in patches, scarcely ever in concretionary masses.

On the lower slopes of the main divide along the valley of the Umangawha River the slates are generally fine-grained and moderately thin-bedded, but sandstones in thicker beds are not uncommon, and at places predominate. Along the east side of the valley thick reefs of flinty quartz resembling hornstone show in the banks of several of the tributary streams or main branches of the river. On the coast-line between Torihine and Paparoa, and in the mountains south-east and east to within a mile of the track from Coromandel to Cabbage Bay, the rocks vary from fine-grained slaty breccia and sandstones with small fragments of slate to the mudstones and more calcareous rocks already mentioned. The strike of these rocks in the Cabbage Bay district varies between N.N.E. and N.N.W., and the prevailing dip is towards the west at angles from 45° to vertical.

Towards the head of Cabbage Bay these rocks rise to between 400 ft. and 500 ft. above the sea before they are overlain and obscured by rocks of the volcanic series, but as the range is followed to the south they attain a higher elevation, and reach their maximum of 850 ft. between the end of the Tokatea Range and the old track from Cabbage Bay to Tokatea and Coromandel. On the opposite, north-western side of the valley they show mainly on the shore of the bay, and in an isolated hill opposite Mr. Evans's homestead, and never on this side reach more than 400 ft. above the sea.

In the Kennedy Bay district coarse gritty sandstones, slaty breccias, and finer-grained sediments, stratified in thin or thicker beds, strike northerly and dip to the westward at moderate or high angles. The outcrop of these rocks is generally in the low grounds along the valleys of the different creeks coming from the north and north-west. At the head of the bay, immediately beyond the flat lands, the slates form a range of hills flanking the lower slopes of the Tokatea Range, and the same line is continued northward along the lower slopes of the main range to the foot of the spur by which the track from Kennedy Bay to Cabbage Bay ascends the range. This approaches the water-divide by way of the valley of the Mataiterangi Stream, on the east side of which the slates appear also, and form the terminal spur of the range between that and the Whareroa Valley further to the east. There is at the base of the hills on the south side of the valley leading from Kennedy Bay to Tokatea a small isolated outcrop of slate rock, which is exposed in a cutting of a tram-line. This is opposite and in continuation of the southern end of the flanking slate range of hills that lie at the eastern foot of the Tokatea Range, but half a mile of alluvial flat lies between this last and the main outcrop of the slate rocks. There is nothing peculiar to note respecting these rocks in the Kennedy Bay district, except it may be their coarse, gritty, and brecciated character, as seen on the north side of the bay, a condition of deposit that is almost if not quite paralleled near Paparoa on the west side of the Peninsula.

Elsewhere on the East Coast I know of no rocks belonging to this formation till the Kuaotunu Peninsula is reached, nor on the west shore of the Peninsula till reaching the southern side of Coromandel Harbour.* No slates, except those on the low grounds at the head of Kennedy Bay, are met with at the surface on the east slopes of the Tokatea, Success, or Tiki Ranges. Rocks of the Maitai series are, however, met with in various mine workings and adits driven from the east side under the eastern slope and crest of the Tokatea Hill; but all such openings have had to be made through a variable thickness of volcanic rock to reach the slates forming the core of this part of the range. In the lower or No. 7 level of the Tokatea Mine some 300 ft. of volcanic rock had first to be passed through, and in the higher levels, Nos. 6 and 5, considerable distances had to be driven before reaching the slaty rocks. The No. 7 level of this mine has been driven for fully 2,000 ft. till it reaches forward to and into the Big Reef showing on the western slope, and the rocks passed through illustrate the finer-grained of the different strata belonging to this formation. Owing to the state of the drive and the decomposition which has taken place before and since the driving of the lower tunnel, it is not easy to say exactly where the volcanic rocks end and those of the Maitai series begin, but on passing this debatable land the identity of the sedimentary rocks is easily made out. The rocks excavated from and seen in the tunnel closely resemble the so-called felsite of Rocky Point, near the Thames, and with these are associated darker-coloured sandy muds in which the lines parting the different kinds of sediment are abundantly apparent. Towards the inner end of the tunnel the rocks are drossy greasy shales, evidently considerably altered, owing to their near vicinity to the Big Reef. Similar rocks, as dark mud-stones, occur not so far forward in the tunnel, but these have not been crushed nor slickensided so as to produce the glossy appearance of those met with further in.

Lime is common in these rocks, and, as calcite, occurs in strings and veins throughout the tunnel where the slates are present. For the greater part of the distance driven the course has been along the line of the Tokatea Reef; and in this, at all levels up to the 4th, calcite is abundant in the lode fissure, often in greater bulk than the quartz itself. The so-called felsite or felsite-tuff is calcareous, as also are the darker-coloured rocks, hence the amount of carbonate of lime found within the walls of the lode. The felsite-tuff, the name now decided on by Professor Hutton for this particular rock, so closely resembles that of Rocky Point that its identity cannot be doubted, and any further remarks may properly be deferred until dealing with these rocks in that locality.

In the different levels on the east side of Tokatea Hill the slates are met with up to about 1,000 ft. above sea-level. In the No. 3 and higher levels only volcanic rocks are found. Though stratification is evident, the rocks are much bent and contorted, and the direction of strike can only be stated as being in a northerly and southerly direction, with a varying dip to the westward. Therefore the dark drossy beds that lie furthest to the west are above the felsite-tuff and do not correspond to those seen on the beach at Rocky Point, near the Thames.

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* "I have failed to identify the rocks described as green indurated sandstone, interstratified with siliceous slates, containing mundic, which Sir James Hector points out as the first rock met with in ascending the Watikooti Stream on the east side of the range on the way from Whangapaoua to Coromandel." (Geological Reports, 1870–71, p. 93.)

On the opposite side of the range, and a little to the south-west of the Tokatea Saddle, the slates are next met with in the low-level tunnel of the Peveril Mine. They are here cut into after passing 300 ft. of volcanic rock, and their exposure in section extends only 150 ft. along the drive. They cannot, therefore, rise to a great height above this level which is 1,020 ft. above the sea. The rocks thus exposed or cut through are dark-coloured mudstones, sometimes with an indistinct slaty structure. These being overlain by the volcanic rocks, no slates show at the surface till reaching down to the low grounds of Driving Creek. Nor in Driving Creek itself are any slate rocks seen; although it was reported to me that such are found on the Kapanga Hill, and along the bed of the creek downwards in the direction of the upper township. I made careful investigation, but failed to find the least indication of slate, or of rocks belonging to the Maitai series. The slates, however, show a little to the east of the road, between the western foot of Murphy's Hill and the upper township. They are exposed in the bed of a small creek draining from the Success Range, and form slaty strata of a dark colour dipping to the eastward. This is the commencement of an area of Maitai rock exposed at the surface along the whole length of the Success and Tiki Ranges to nearly abreast of Castle Rock, at the source of the Matawai branch of the Waiau. At first the breadth over which the slate rock is seen is not more than 40 or 50 yds., but, as the rocks are followed to the south, the width of their exposure gradually increases till, on the new road leading to the Success Mine, the exposure is at least a quarter of a mile across and attains a height of 600 ft. above the sea. Where they form the channel and show in the immediate banks of the creeks they are of a dark-grey colour, often veined with calcite, but on the sides of the spurs and in many of the road-cuttings they are, through decomposition, of a pale yellow or buff colour. The dip is generally to the eastward, and at angles as a rule 45° and over. On the Success Road, the last and highest rock seen is a reddish shale, but whether the colour is native to the rock or induced by decomposition of contained pyrites may be uncertain.

Volcanic rocks stretch some distance up the spur at the back of Bridson's Store, along the road to the Success Mine which leaves the main road to Kapanga and the Tokatea at Bridson's Store; but following the range south these again descend to the level of the Kapanga Flat, and the slates show in the bed of the creek where the Coromandel–Kuaotunu Road leaves the flat and begins to ascend the range, forming the main water-divide between the east and west coasts of the Peninsula. At first the rocks are alternating beds of sandstone and shale, dipping at a considerable angle to the east, and these, light-grey or buff-coloured, continue for a considerable distance along the road; but on the track gaining the crest of the ridge by which the main range is approached, a craggy mass of coarse, indurated sandstone is met with, round the northern side of which the road, to avoid a heavy grade, has been carried. Beyond, or south-east of this, is a saddle on the ridge, and here again the rocks are softer, finer in grain, and slaty in character. The slate rocks terminate somewhat obscurely by being overlain by volcanic rocks at a height of 650 ft. above the sea, fully half a mile before reaching the saddle by which the road crosses the range.

Within the watershed of Pukemaukuku Creek the slates rise to about an equal height, and are of the same character as on the Coromandel–Kuaotunu Road. Sandstones are perhaps more abundant; the heavy bed of coarse sandstone forming the bluff on the road-line being here of greater thickness or lying at a flatter angle. Dyke rocks also disturb the slates and sandstones in the lower part of the spur by which the ascent is made to Aicken's freehold and the neighbouring claims.

More to the south the lower western slopes of the outer flanking range shows the presence of volcanic rocks belonging to the Kapanga group, but these again descend to the low ground at the foot of the Tiki Spur. The Tiki Creek, in its lower part, but above where it enters the hills, is cut deeply into alternations of slate and sandstone till reaching forward to the heavy bed of gritty sandstone, the presence of which farther north has already been noticed. Beyond this, towards the upper part and source of the creek, there are several massive dykes of grey crystalline rock, and heavy bands, perhaps intrusive, of more brecciated and much decomposed rock.

On the road leading up to the Tiki Diggings the rocks are again, through weathering at the surface, of a light-grey or buff-colour, but near the saddle they change to reddish and purple shales. These latter lie beyond or east of the hard sandstone bar. Further on, beyond the saddle near the Tiki Diggings, these purple rocks continue to be exposed in the cuttings of the track till they disappear beneath the rocks of the Thames–Tokatea group, forming the higher part of the main range. The height to which the slates attain on the Tiki Spur is about 800 ft., beyond which to the south they gradually are found at lower levels, till, in the first creek beyond the Matawai that comes from the Castle Rock Range, they disappear under volcanic rocks.

Within the area occupied by the rocks of the Maitai series which begins on the south side of Coromandel Harbour, and thence, uninterruptedly extends along the western side of the Peninsula to Tapu Creek, the rocks are various, but not generally different to those which as belonging to this formation have already been described. Thin contorted strata consisting of harder and softer bands appear at the water's edge on Lynch's farm; but beyond the bridge where the road to the Thames commences to ascend the hilly country between Coromandel and Manaia Harbours, the rocks are those common to the middle part of the series as seen in other parts of the district—viz., moderately fine-grained sandstones and distinctly bedded argillaceous shales, standing at moderate or high angles, and dipping variously but usually to the eastward. In the middle part of the Manaia Valley this also is the character and disposition of the rocks, although sandstones may be more abundant. In the lower end of the gorge of the Manaia Stream the slates have intruded into them massive dykes of igneous rocks, similar to those that appear on the coast-line between Waikawau and Mata Creeks, but, as all the dykes affecting this formation have appeared apparently during or after the deposit of the Kapanga group, they need not be particularly described in this place.

Between Kirita Bay and where the road descends to the shore-line the rocks at places are dark-blue splintery shales, which near the surface have weathered to light-yellow or buff-coloured rock, characteristic of other parts. On the coast-line the rocks are often more gritty; sometimes thin-bedded and drossy. The sandstones and shales alike abound in veins and nests of calcite. The dip of the different strata is various, but generally easterly or away from the coast-line. Between Waikawau and Mata Creeks a succession of massive dykes of diorite or andesite appears on the coast running sub-parallel thereto, as they cannot be traced far inland, and hence they may not prove so numerous as they appear to be. Between the Mata and the mouth of the Waitapukahu River, better known as Tapu Creek, volcanic rocks appear on the coast-line, and the slates lie a little inland, first appearing at the bridge in the lower part of the gorge of Tapu Creek, less than a mile from the beach. Sandstones predominate, but shales are not absent, and immediately on the south side of the gorge these disappear under heavy beds of coarse volcanic breccia on the inland or east side of their exposure, and rocks of finer grain on the seaward side. The eastern boundary of this area of the Maitai series has not been exactly ascertained, but as determined by four or five traverses from the coast-line to the eastern boundary, it is approximately as shown on the map accompanying this report.

The only other outcrops of slate rock met with on the western side of the Peninsula appear at Rocky Point, north of Tararu Creek, near the Thames, and in the middle part of Waihoanga Creek. This has been often described, and shortly, as seen on the beach and in Rocky Point, the lowest rock is a dark-blue slate, stratified, and dipping to the south-west at moderate angles, followed by a light-grey felsite-tuff, of which sufficient and ample description has been given in the various extracts made from the writings of previous workers on this field. The rock is to the best of my knowledge of a sedimentary character, but the reasons put forth by Professor Hutton weigh with me, and I agree to speak of it as a felsite-tuff.

The only other area of Maitai rocks met with on the Peninsula is that exposed on the Kuaotunu Peninsula. This lies separate and apart from the nearest outcrop of the same formation at the Tiki, a distance of between ten and eleven miles, and in the intervening space there is such massive and thick developments of volcanic rocks that there is little likelihood of rocks of the older sedimentary series being found in this intervening space. At Kuaotunu these rocks are well exposed on the beach and along the north shore-line of the Peninsula, from fully a mile west of the township to the eastern end of the high cliffs that terminate the northern slopes and out-running spurs of Black Jack on the Waitaia Range.

Black Jack is a rugged peak rising immediately at the back of Kuaotunu Township, and is formed of rocks belonging to the Maitai series, saturated with siliceous deposits, the result of thermal action. This constitutes the northern peak of the Waitaia Range, which runs north-north-west and south-south-east across the Peninsula, near its eastern or landward end. Essentially, this range is composed of slates and sandstone belonging to the Maitai series, but towards its southern end volcanic ejectamenta cover up the sedimentary rocks, these and these only are seen at the surface from the trig. station to the shores of Mercury Bay. The eastern boundary of the slates runs from the shore of Kuaotunu Bay south-east to near Brown's camp, on the road from Kuaotunu to Mercury Bay, and thus the area of slates and sandstones is approximately about three miles in length east and west, and somewhat better than two miles broad in a north and south direction. The rocks on the coast-line consist of hard grey sandstones, often with small angular inclusions of slate and bands of sandstone or shale interbedded. At some places, the strike is nearly east and west, but as a rule it is in a northerly direction, and the dip is variable but mostly to the eastward. On the shore-line, though towards the east the rocks in the sea-cliffs are much decomposed, there is no difficulty in recognising these rocks, nor should there be in any part of the area covered by them. Yet where decomposed at the surface they have been mistaken for and described as volcanic rocks. (*Vide* p. 27.) South of the middle part of the Waitaia Range a line of auriferous quartz occurs in the Waitaia Mine, trending north-north-east, and others are present in a spur of slate and sandstone country that lies between the two main branches of Kuaotunu Creek. On the principal line of reef are situated the more important mines of the the Kuaotunu district and goldfield. The field was examined in 1893 by Mr. James Park, late Director of the Thames School of Mines. Mr. Park describes the rocks forming the spur between the two branches of the Kuaotunu as being of volcanic origin; but deeper mining and road-cuttings, &c., have shown the true nature of the rock. These slates are surrounded on the east, south, and west by volcanic rocks, and rise to a height of 600 ft., and are generally arranged as a syncline. They show the presence of the middle and lower parts of the series as developed in the Cape Colville Peninsula.

The Maitai series of the Geological Survey classification has its typical development in the Maitai Valley, near Nelson, and thence rocks belonging to the series extend along the western slopes of Dun Mountain Range to near Top House in the Wairau Valley. In Nelson, the formation consists of sandstones, red and green and dark-blue slaty beds, with a massive development of grey or bluish-grey limestone at the base of the series. Characteristic fossils are found in the lime-stones, leaving no doubt as to the Carboniferous age of the beds.

In the rocks of the Cape Colville Peninsula, referred to the same period, fossils might be expected, but after careful search none have been discovered by me. Mr. Park, however, informs me that he found fossils in these beds at Cabbage Bay, and again at Stony Bay, on the east of the Peninsula, north of Port Charles. Whether these will serve to determine the age of the beds may be considered doubtful, as I could not learn to what genera they belonged. Thin and impure seams of coaly matter or graphite occurs at Kuaotunu, at the eastern end of the sea-cliffs forming the northern slopes of Black Jack, and in the adjacent sandstones scattered fragments of carbonised plants are to be found, but these give no hint of the presence of a well-preserved flora in the neighbouring rocks; and from this paucity of fossil remains, by such evidence, the question of the age of these older sedimentary rocks on the Peninsula is likely to remain undetermined. Nevertheless,

from their lithological character and condition, there is little doubt that the rocks belong to the Carboniferous period and the Maitai series of the Geological Survey classification, any possible doubt in the matter being whether they may not be of Permian or Triassic age. Permian deposits not being known in the Auckland District of the North Island, and the rocks thus to be co-related not resembling the Permian deposits of Nelson or Southland, this theory may be disregarded. As to their being of Triassic age, the evidence is of the same kind, but stronger. There are in them no granity or porphyritic conglomerates which are elsewhere met with in connection with Triassic strata, and the remarkable scarcity of fossils in the older sediments of the Peninsula agrees with the general character of the Maitai series, and is strongly opposed to the idea that they are of Permian or Triassic date, these formations being almost everywhere, even to their coarse sandstones and grits, abundantly fossiliferous. Sometimes these breccia slates have been referred to the Te Anau series of the Geological Survey—a series of rocks which immediately underlies the Maitai rocks—but there is no close resemblance between the two, and on the whole it is as near the truth as may be; and the error cannot be great in placing these older rocks of the Cape Colville Peninsula as representing the Maitai series, and of being of Carboniferous age.

Metalliferous Depcsits of the Slate Formations.—The massive cherty or hornstone reefs of the Cabbage Bay district yield traces of gold, but not in quantities sufficient to pay the cost of working the reefs, and in a consideration of the mineral wealth of the formation these may be disregarded. At places where the yet overlying volcanic rocks are not distant, outcrops of massive or crystallized quartz are found, and these contain gold that sometimes would pay for working, providing the containing reefs were thicker than they are. Prospecting has been carried on in Dutchman's Gully in the Upper Valley of the Umangawha, and in the slate hills on the west side of the valley opposite Mr. Evans's farm, and some test samples have been taken from the massive hornstone reefs that skirt the lower slopes of the range on the east side of the Umangawha Valley, but the results generally have been unsatisfactory. So that for the present it may be said that in the district of Cabbage Bay and the northern part of the Peninsula gold-mining in the slate formation has not been nor is it likely to prove successful; yet discoveries may be made revealing the presence of paying deposits.

A vein of copper-ore is known to occur on the western slope of Moehau. This was prospected many years ago, but has not received any attention during the recent revival in mining. The locality was not visited by me, and Mr. Park tells me that the copper-ore occurs in connection with volcanic rocks, which, on this part of the coast-line, appear mostly as intrusive masses flanking and rising into the mass of the mountain.

In the Kennedy Bay district no reefs were observed in connection with the slates, and nothing could be learned from miners and prospectors leading to the supposition that such did occur. However, as the slates appear not distant from where reefs are being worked or prospected within the volconic country, it is not improbable that the reefs found, or others to be found, may be traced into the slates underlying or horizontally not far distant; and were it not that, with the exception of the Kuaotunu field, all mining in the slate country has proved of an unremunerative character, the vicinity of the slates would be regarded as a favourable indication. Mining in the slates in the Tokatea, Success, and Tiki Ranges has been carried on, on and off, for a great number of years, and during the past summer was vigorously prosecuted in the Tokatea Mine, and prospecting was carried on in slates at the Tiki and in the Matawai, but, so far as I could learn, with no very encouraging results.

On the Tokatea Hill the Tokatea Reef has been followed down through the overlying volcanic rocks into the slates and felsite tuffs that underlie, and in the slate country has been worked and prospected to a further depth of nearly 500 ft. The reef has continued to the lowest level reached, and can hardly be said to have lessened in thickness; neither has gold been absent, but on the whole it does not appear that these lower workings in slate have been successfully carried on.

At the Tiki, gold-mining has also been carried on in the slate country in the Golden Belt and other claims, for a time hopefully, though eventually without sufficient remuneration. Even now prospecting is being carried on in other parts of the slate country in that neighbourhood, but there are no reports to hand that this is being done with a sufficiency of reward. A little further to the north, on and near Aitken's freehold, gold-mining is being prosecuted in the lowest beds of the Thames-Tokatea group with fair prospects of success, but there any workings lower than those of a shallow and prospecting character must be carried on in slate country, and there is consequent uncertainty of results and as to the productive character of the lodes when they are followed downwards into the slates.

In the Manaia Valley several mining ventures have been carried on during the past two years, all of them in slates, and all of them with some doubt as to their ultimate success. In the case of the Golden Hill and some adjacent claims, situated in the valley of a western tributary of the Manaia, these appear to be in a narrow belt of volcanic country, probably a huge dyke decomposed to the condition of the sandstone of the miner, but the adjacent claims to the north, the Golden Hill Extended and others, are again in slate country, and not in a very flourishing condition.

At Tapu Creek the Little Jessie seems to be the only mine working in slate, the hope being still entertained that the gold-bearing reefs found in the volcanic rocks, or in the slates near the junction of these with the volcanic rocks, will continue in depth, and prove remunerative.

On the west side of the Peninsula gold-mining in the slate country, it has to be confessed, has not been successfully carried on. And now mining-men are beginning to regard the slate as a kind of Farewell rock, and to avoid it accordingly. Theoretically there is no reason why it should be so regarded, and practically in the experience of the past, and over other mining districts even within New Zealand, the slates of the Carboniferous period prove their capacity to carry numerous and rich reefs of auriferous quartz. In this respect the rocks of the same age seem to fail on the west side of the Cape Colville Peninsula; but it would be wrong to arrive at a hasty and premature conclusion in that respect, since in but few instances have the slates been proved to any great depth from the surface or their contact with the overlying volcanic rock.

Opinion has been and still is to some extent divided on the question of deep mining in the slate country, and various different theories as to the whence of the gold in the reefs of the Thames-Tokatea and Kapanga groups are responsible for this. Those who maintain that the gold is by thermal agencies derived from deep-seated rocks, and with its associated silica now forms ore bodies traversing formations diverse in character, as are the slates and superimposed volcanic rocks, find no difficulty in postulating the existence of rich metallic and auriferous deposits in the slate country. On the other hand, there are those who maintain that the gold from its primary source has been brought to the surface or near to the surface by being included in and as forming part of the volcanic ejectamenta that covers and forms so large a part of the Cape Colville Peninsula. These theorists cite in support of their views the usual presence of small quantities of gold and silver in the volcanic rocks themselves; the numerous strings and small leaders of quartz, often auriferous, that from the superior rocks feed into and supply as it were the main lode itself; the fact also that special volcanic rocks are the principal repositories of the gold; and, finally, that the gold-bearing veins in the slates are almost exclusively but the continuation downwards of auriferous lodes that are present in the overlying volcanic rocks, or have been, where these and the upper part of the lodes have been removed by denudation. As is usual in such cases there may be truth on both sides, and amid a conflict of evidence it were unwise to attempt a solution of the problem before the whole of the facts have been placed in review.

One important locality in connection with mining in the slates has yet to be considered. This is the slate area forming part of the Kuaotunu Peninsula. Within this, the evident influences that have been the main agent in the deposit of the principal quartz reefs are thermal waters, the source of which, though not distant from the scene of volcanic action, is not directly from volcanic rocks. There can be no doubt whatever that the vast accumulations of siliceous sinter that form such a prominent feature on the higher part and eastern slope of the Waitaia Range have been derived from the slate country that underlies and forms the bulk of that range, or from unknown rocks of a more siliceous type underlying these. Neither need it be doubted that the principal reefs of the Kuaotunu field have been deposited by thermal agencies bringing their burden of silica and more valuable products from below, and not from any volcanic rocks at or near the surface. In view of these considerations it may therefore be prudent to defer judgment on a matter on which so much may be advanced on both sides, and simply acknowledge in this place the fact that gold-mining in the slates has not hitherto, on the west side of the Peninsula, been a successful venture; while, on the other hand, the bulk of the gold obtained from the Kuaotunu field has been taken from reefs in slate country, the material and contents of which could not have been supplied from adjacent or overlying volcanic rocks.

The principal line of reef at Kuaotunu appears to have had one main shoot of gold declining at a low angle from north to south, the direction of the lode. And this having been passed through, although the quartz as a thick reef continues, the amount of gold present is not sufficient to pay the cost of raising and treatment of the stone, and at the same time yield a profit to the shareholders. This being so, there next arises the question of the probability of other shoots of gold lying at lower levels in the reef, and the warranty there may be in justification of any venture in search of gold at lower levels, either by boring or shaft-sinking. The success of any such venture, it will be readily seen, depends on which of the two theories of the immediate source of the gold to the reef proves to be the correct one. The facts at Kuaotunu appear to be in favour of the supposition that other shoots of gold may be found at levels below those yet reached in the Try Fluke and Kapai-Vermont Claims, and other claims along the same line of reef.

Remarks.—The Carboniferous rocks of the Cape Colville Peninsula are vastly older than any of the superincumbent formations that rest upon them. Whether rocks of the Older or Middle Secondary systems were ever present within the area of the Peninsula cannot now be determined. If such ever were present, it is certain that over the areas where slates now appear at the surface these had been denuded away, prior to the deposit of any part of the Cretaceo-tertiary or coal-bearing series that, as regards those of this Peninsula, are usually considered the next oldest rocks in succession to those of the Maitai series. As seen in the neighbourhood of Cabbage Bay, the outlines of the old land, the surface on which the coal-measures repose, indicates the existence of a hilly if not a mountainous country, and the lowest deposits of the coal-bearing series is confirmatory of this view. Also, it is a well-known fact that between the deposit of the Mataura or Putataka series of Jurassic age and the earliest deposits of the Cretaceous period, as these are preserved to us in New Zealand, a great gap in the geological record intervenes, and it was during this period that the land within the New Zealand and neighbouring areas had its main line of extension, and the axes of its mountain-chains in a north-west and south-east direction, as indicated in a former part of this report. Cape Colville Peninsula was therefore at that time probably a flanking range on the west side of the great mountain axis of the old land. It is of great importance to determine whether the coal-bearing series *was* the first deposit of post-Jurassic date, and this is a matter that, in the present state of our knowledge, cannot be determined. It is possible that the volcanic rocks of the Thames-Tokatea group antedate the sedimentary rocks of the Cretaceo-tertiary period, and in that case the former must be regarded as appearing about the middle or beginning of the Cretaceous period. Until further evidence makes this manifest, it is preferred to adhere to what is generally the conclusion respecting this matter, and to treat of the Cretaceo-tertiary coal-bearing series as being the second in age of the rock formations of the Peninsula.

Cretaceo-tertiary or Coal-bearing Formation.

Rocks belonging to this series, as forming a distinct formation among the various groups present in the Cape Colville Peninsula, were first described by Mr. Cox, late Assistant Geologist, who, during the latter part of 1880, examined the Thames and Coromandel district, and at the same time paid a

visit to Cabbage Bay, and examined the coal-seam then recently discovered in that district. In his report he says his object was "to trace the relations between the coal series, auriferous greenstone trachyte, and the Tertiary trachyte series of Beeson's Island." Of the Beeson's Island rocks, he says, "In the direction of Cabbage Bay these breccias rest on the coal formation, which in turn rests unconformably on the slates."* The description which follows states that a seam of coal 5 ft. in thickness had been found on the slope of a hill descending to the low grounds at the head of Cabbage Bay; but among other particulars he gives at this time no description of the associated rocks other than what has been stated above. In his principal report dealing with the rocks of the Cape Colville Peninsula, dated the 10th June, 1882, which has already been largely quoted from, he again describes the coal-beds at Cabbage Bay, and he seems to have associated the coal found near the track from Tokatea Hill to Cabbage Bay with the trachytic rocks of Beeson's Island, and to have confounded with these the slates of Carboniferous date also. At all events, we have no better description of the rocks than in the preceding report; and the section shown at page 19 of the report does not very clearly represent what is to be seen in the vicinity of the coal outcrop. No rocks are described that give the least hint of the presence of Cretaceo-tertiary coal-measures, to which the coal-seam at this place undoubtedly belongs.

During the latter part of 1883 I was directed to make an examination of the coal-bearing beds in the neighbourhood of Cabbage Bay, and reported on the same on the 30th of December of that year. Near the outcrop of coal on the descent from the Tokatea Range to the low grounds of the Umangawha Valley, the rocks associated with and of the same series were at best indefinite, and the section generally immediately above and below somewhat of a puzzling character. Apparently the coal-seam dipped so as to pass under the volcanic rocks lying higher on the range, and there could be no mistake about their resting on slates, that are well exposed on the slopes of the hills, right down to the bed of the Umangawha River. Some sandy shales and a bed of the same mixed with small well-rounded quartz pebbles here and there, forming a grit or pebble-bed, are associated with the coal at this place, and, such being insufficient to determine the age of the coal-beds, it was necessary to examine other parts of the district in the hope of finding other outcrops of coal and a more complete section of the rocks of the same age with which these might be associated.

With this object in view the west branch of the Umangawha was examined, where marly shales and traces of coal were found to be overlain by fossiliferous limestones resembling those of Abbey Rocks at Whangarei, and overlying the coal-measures at Kawakawa. But the sections here exposed are fragmentary, and the coal-bearing series obscured by overlying volcanic rocks belonging to the Beeson's Island group, and further explorations had to be made to make clear the sequence and general relations of the different members of the sedimentary series. For this purpose the coast-line at Torihine was examined, and here a section was found displaying the coal-bearing series more completely than any other yet discovered in the district.

The younger series is there seen resting on Palæozoic rocks. Towards the west the lowest rocks seen consist of conglomerates, formed almost wholly of well-rounded sandstone material, and show no trace of the presence of volcanic rocks such as are to be met with in the hills adjacent. The conglomerate belt has a thickness of from 20 ft. to 25 ft. or more; it dips in a N.N.E. direction, and in its upper part shows traces of coaly matter in beds of finer grain. Dark sandy shales succeed the conglomerates; but these were, when the place was last visited, covered over with beach-sand and could not be examined. This is the horizon in which the coal should occur, but in this section neither on the beach nor inland along the strike of the beds could an outcrop of coal be detected; yet, a little more to the south-west, an outlier of the same beds, tilted to a considerable angle, and in near contact with a massive dyke of intrusive rock, showed the presence of a thin seam of coal. The associated rocks were grey sandy beds that sufficiently corresponded with the beds interposed between the conglomerates and the limestones on the other or west side of the bluff. Dipping at a moderately low angle, these beds, after an exposure on the beach of from 2 chains to 3 chains, pass under calcareous sandstone or limestone rock, and near the contact with these become more marly in character, and contain concretions of a calcareous character. The limestone dips to the north-east, and its lower beds contain fossils. The lower part of the limestone forms a brownish-grey calcareous sandstone, while in the upper part it is coralline and foraminiferous. Towards the north-east end of the section a thick band of fossil oysters are seen on the beach, and a little way inland soft brown sandstones are met with in the lower spurs of the hills. These may possibly be the same beds that appear from beneath the limestone towards the opposite end of the section. Whether or not this merely affects the arrangement of beds belonging to the same series, or indicates the occurrence of another argillaceous band above the limestone, similar to what lies below: in either case all these beds, from the conglomerates at the base of the section to the highest in the same sequence, belong to one series of rocks, and are stratigraphically connected with the coal-bearing beds. The fossils collected from these beds on the coast-line include *Pentacrinus stellatus*, *Hemipatagus tuberculatus*, *Ostrea wullerstorphi*, *Turritella*, *Fusus*, *Cucullæa*, and other mollusca, while from the limestones on the coast and within the west branch of the Umangawha may be obtained numerous *Foraminifera* and small corals.

The beds from the coast-line at Torihine extend east and south-east, under volcanic rocks, till they again appear in the west branch of the Umangawha, and are doubtless continuous between the two places; and more to the south they appear in the upper part of both branches of Tawhetarangi Stream. This latter locality was examined during the past summer, good coal having been reported as occurring in the upper part of the main branch of the creek. Only a thin streak of impure coal was found, resting on some 10 ft. or 12 ft. of sandy carbonaceous beds that in turn reposed on the slates. The conglomerates of the coast-line were absent, and upwards in the section, after passing a moderate thickness of sandy and marly clays, earthy argillaceous limestones

* Geological Reports, 1881, pp. 36 and 41.

showed to the junction of the two main branches of the stream. Below this to the beach the channel of the creek has been excavated in slates. In the right-hand branch of the creek it is said limestones and beds or concretions full of large oysters occur, but this was not explored. A black oyster of lesser size than that seen on the coast-line was met with between the limestone and the coal in the left branch.

The coal-seam on the track between Coromandel and Cabbage Bay is an outcrop of beds similar to those forming the lower part of the section on the coast at Torihine. In the tunnel on the north-east side of the spur on which the outcrop of coal is situated, the shales and sandy beds covering the coal have been driven on till the conglomerates were reached, but without passing through more than 1 in. or 2 in. of coal.

The inclined shaft in the south-west side of the spur was full of water, and partly had fallen in when the place was examined in 1883; yet, where the outcrop was first laid bare was to be seen enough to show that but a few feet of the rocks really belong to the coal-bearing series, and that lower down the spur the rocks are decidedly unconformable, they being slate belonging to the Maitai series, while those forming the plateau top and the higher part of the range are, without doubt, unconformable also.

Last year I was shown some fossils, collected by Mr. Jamison, of Cabbage Bay, from the sandy beds overlying the coal at this place, strictly from material excavated in exploring for coal. Among these were a coral, *Flabelluna*, and a small shell resembling *Cardium*, which shows clearly that the cover of the coal here, as at Torihine and in Tawhetarangi Creek, consists, at no distance overlying the coal, of marine beds.

The conglomerates, coal, and immediately overlying beds belonging to this series, as developed in the Cabbage Bay district, might very well be of local origin, and the deposits of a restricted area. This also might be said of some parts of the limestones, but the foraminiferal limestones clearly indicate ocean conditions, and a wide-spread deposit similar to that which characterizes the Amuri and Cobden limestones in the South Island and over larger parts of the North Island. It must therefore be assumed that these limestones covered the whole area of what is now Cape Colville Peninsula, and that by denudation they and the associated beds have been removed from every part accessible to examination prior to the deposit of the next succeeding rocks, whether sedimentary or volcanic. Thus, as a result of long continued errosion, the physical features of the peninsular district must have been remodelled, and, assuming that the beginning of the display of volcanic energy, which has left such abundant evidences of its action, was subsequent and not prior to the deposit of the coal-bearing Cretaceo-tertiary series, it can be made apparent that the configuration of the country was hilly in the main and sometimes mountainous. This is not inferred from the heights to which the older rocks rise at the present time, for the country has been unequally elevated and depressed during Tertiary times, but from the irregularities of the surface viewed as a sloping plain, dipping towards the east or south-east. Sections taken from Cabbage Bay, east or south-east, will show this. Also, the same will be apparent in any line of section taken from the vicinity of Coromandel towards Kennedy Bay or Whangapoua, or from Manaia to Kuaotunu. Nor would the evidence be less decisive on any traverse from the coast-line south of Manaia to the main range south of the Tiki and Castle Rock Ranges.

Whether, then, it be assumed that the Cretaceo-tertiary beds are older or younger than the Thames-Tokatea group of volcanic rocks, it is certain that the products of volcanic action were at the first on an irregular hilly or sub-mountainous surface.

The probabilities are great—nay, it is almost a certainty—that the coal-bearing series is older than the first formed of the volcanic rocks, and, assuming the correctness of this conclusion, it follows that the Thames-Tokatea volcanic rocks must be considerably younger than the youngest of the Cretaceo-tertiary series. These considerations will scarcely admit of the coal-bearing series being regarded as younger than of the Cretaceous period.

Volcanic Formations.

The great feature of the Cape Colville Peninsula at the present time is a vast accumulation of volcanic matter, that, from the northern extremity to where the land ceases to be peninsular, gives to the entire district its peculiar character. This is piled up in mountain masses, and gives to the greater part of the Peninsula the rugged character that distinguishes it. The physical features of the present day are, however, the result of sub-aërial denudation after the last of the four great groups of volcanic rocks had been errupted. There were periods of denudation and of sedimentary deposit between each of the great divisions of volcanic rocks; and before the commencement of each succeeding display of volcanic energy the surface of the older deposits had been greatly modified. Unconformities are therefore to be traced, some of which are well marked locally. In other cases decisive evidence is not to be obtained, but the general arrangement of the rocks if considered carefully in detail, points to the fact that the older group had to a large extent been denuded before the commencement of the succeeding outburst. Previous writers on the geology of the Cape Colville Peninsula have generally considered that the volcanic rocks of the district belonged to two, and in some cases three, distinct periods of time. As, for instance, the rocks of the Thames and Coromandel Goldfields, and the younger series known as the trachytic breccias of Beeson's Island. The rhyolitic rocks of the south-eastern part of the district are mentioned both by Hector and Cox, and latterly by Park, but no one clearly defines the position of these in relation to the other rocks of the Cape Colville Peninsula. Sometimes these latter are regarded as the equivalents and an extension northward of the trachytic and rhyolitic rocks of Rotorua and the interior central parts of the North Island, but no one has investigated their relations to the rocks of the Beeson's Island group.

Thames-Tokatea Group.

The rocks of this group are in the main fine-grained tufas, ash, or breccia beds consolidated to form the "sandstone" of the gold miner. At many places there are interstratified floes and intrusive

dykes of crystalline volcanic rocks, decomposed, or but little altered. The colours of the fragmental rocks vary from whitish through light-grey to dark or greenish grey and not unfrequently in surface exposures are of a brownish tint. When solid and crystalline the rocks are of various shades of grey to almost black, according as the different minerals felspar, hornblende, or augite prevail or predominate. Numerous samples of these rocks were collected from the Coromandel district illustrative of their characteristics, but these have yet to be critically examined. And, for reasons given in the report dealing with the silver-bearing lodes of the Great Barrier Island, they shall be here spoken of as light- and dark-grey andesites, with accompanying breccia ash and tufa beds of the same character; and this will apply to the rocks not only of the Thames-Tokatea group, but to those of the Kapanga and Beeson's Island groups as well.

Thames to Coromandel Area.—In the northern part of the Peninsula the group of rocks under description begins on the eastern side of the Tokatea Range, between the slate hills inland of the upper part of Kennedy Bay and the Tokatea Range north of the Triumph Mine. At first they are confined to the lower slopes on this side of the range, but gradually they rise higher on to the range, till at the Triumph Mine they have passed the crest, and appear on the western side of the ridge. From the Triumph Mine the western boundary trends south along the west slope of the range to a little below the Pigmy Mine, in the valley of Mountain Hotel Creek, towards the northern end of the Success Range. From this point the west boundary is along the slopes of the Success Range to the point where the slates disappear, and a thin seam of coal shows at 580 ft. above sea-level. From this point the west boundary trends more to the south-east, and crossing a deep gully is again met with on the west side of the Tiki Range at a height of 650 ft. Thence the boundary is continued nearly in a straight line across the intervening valleys to the saddle on the Tiki Spur, where the lowest beds of the group are seen resting on rocks belonging to the Maitai series at about 800 ft. above the sea. From this point the west boundary of the Thames-Tokatea rocks trends more to the south and south-south-west, and reaches into the lower grounds along the east side of the Waiau Valley where they are overlain by rocks of the Kapanga series, the slates being no longer visible. At the point where the road turns to the eastward to lead on to the saddle by which the road to Mercury Bay crosses to the east side of the range, the rocks belong to the Kapanga group, but shortly the rocks of the group under description appear in the road-cuttings, and thence are continuous for several miles in an east and south-east direction. From this point the line of the eastern limit of these rocks, where it crosses the different source branches of the Manaia River, has not been exactly determined. This was due to the exceedingly rugged nature of the country in that part; but approximately the boundary is as shown on the map accompanying this report, till reaching into the Waikawau watershed, where the boundary is again determinable, and, further south, is seen in the Mata Valley at a point less than two miles inland from the sea. From the Mata Valley the boundary runs across the intervening hills to the Tapu Gorge, and thence returns to the north as far as the mouth of the Mata, leaving a narrow strip of these rocks between the slate hills and the shore of the gulf. From Mata Creek to Rocky Point, near the Thames, the shore of the Gulf and Frith of Thames forms the visible boundary of these rocks. The Shortland Flat and the high-level deposits of Irishtown and Mount Pleasant, at the western base of Una Hill, do but obscure these rocks, which at deep levels extend to beyond Hape Creek and probably reach as far as the bridge on the main road crossing the Kauaeranga River.

The eastern boundary of this, by far the greater area of the Thames-Tokatea rocks, from their northern extremity west of Kennedy Bay, runs south-east across the Haratuunga Valley to the high conical hill noted by Sir James Hector, and described (*vide* page 10) as seen looking south-west from Kennedy Bay. From this hill to the northern shore of Whangapoua Harbour the boundary has not been determined with exactitude. South of the Waitekauri River, and south of Opitonui Stream, the rocks of this series are at first towards the east limited by the alluvial flats surrounding the inner part of Whangapoua Harbour and extending along the valleys of the streams named. To the south-east of the latter, the Thames-Tokatea rocks extend east from Castle Rock a distance of about four miles, and are then succeeded by a series of rocks of different aspect, and it is on such distinction that the eastern boundary in this part has been determined. More to the south the boundary recedes to the westward, and within the Mahakirau watershed has been determined with tolerable accuracy. South across the Ounuora Valley the boundary of this group of rocks lies within a tract of rugged, hilly, or sub-mountainous country densely clothed with forest, so that within this and thence into the valley of the Waiwawa the boundary is again an approximation. In the Waiwawa Valley younger rocks are met with till passing westward of the northern spur of Table Mountain Range, and it is even not clear but that the east boundary of the Thames-Tokatea rocks should be placed yet further west than shown on the map herewith. From the western source of the south branch of the Waiwawa, the boundary runs along the middle slopes of the northern side of the Kauaeranga Valley to the source of Hape Creek, the south-east side of the valley of which is formed of younger rocks. These rocks within the Thames and Coromandel districts cover an area of 150 square miles, forming the high backbone of the country, but, except from Mata Creek to the Kauaeranga in the southern part, they do not reach on to the coast-line on either side of the Peninsula.

Their relation to the slates below, and the other groups of volcanic rocks overlying, may be seen in the section from Kennedy Bay west to the shore of Hauraki Gulf, which shows the arrangement of the different rocks from a little south of the mouth of Tawhetarangi Creek to the low grounds at the head of Kennedy Bay, in which slates and sandstones belonging to the Maitai series are seen at four different parts of the section line. Those in the vicinity of the coast at each end of the section are exposed at the surface along the line, while the other two, more inland, can be seen a little to the north of the line of section. The Cretaceo-tertiary series is also shown in this section. The rocks of the Thames-Tokatea group; of the Kapanga group; the Beeson's Island group; and the alluvial deposits at the head of Kennedy Bay are also shown.

In the present connection it is the Thames-Tokatea rocks to which special reference has to be made. They are here represented as resting on the slates towards the east, and so shown as to appear unconformable to the overlying group, the Kapanga group, while at the same time they rest as the lowest of the volcanic series on the slates to the westward. The evidences leading to these conclusions, it may be, are not to be clearly seen along the line of section; but that they are, is supported by what may be seen a little further south in the sections in the lines passing the Triumph and Tokatea Claims, in which it will be seen that, along this, the position and relations of the Thames-Tokatea rocks cannot well be other than as represented.

Another section, taken from Kikowhakarere Bay east across the Tokatea Range to Kennedy Bay and the coast-line a little north of the Bay, shows the increased importance of the Thames-Tokatea rocks as they are followed to the southward. In this section is represented the slates of the Maitai series, which as seen at the surface are confined to the eastern side of the range. The probability is that they are present under the crest of the range at and above sea-level, but as yet no workings have shown their presence, and they accordingly are not represented. To the north, on the slope towards Cabbage Bay, the slates show to a height of fully 800 ft. above the sea, and southward on the range in Tokatea Hill they reach to 1,000 ft.; so that, allowing for an old valley or saddle in the slate ridge, slates should still be above the sea datum in the line of section above indicated. In this the rocks of the Thames-Tokatea group are represented: these in this line form the crest of the range and extend down the western slope a short distance. In the lower and second levels of the Triumph Mine, rocks of the Kapanga group are first met with, at the base of which beds of tufaceous shaly clay with impure lignite are met with, beyond which the so-called sandstones of the Thames-Tokatea group are entered upon. The contact of the two groups is represented as proving the unconformity of the two, and, though this is undoubedly their relation ship, it may be that the anticlinal arrangement of the older group is not so evident. This is to some extent inferred from what may be seen on Tokatea Saddle and Hill. The rocks of the group in this line of section are solid and compact, but otherwise represent well the normal characters of the grey sandstone of the miners.

In the next section to the south, which in the west commences on the neck of land between Coromandel Harbour and Kikowhakarere Bay, and is thence continued eastward across Dacre's Hill through the Kapanga Claim and across Scotty's Hill to the Tokatea Range, and on the east side of the range to the south side of Kennedy Bay, the Thames-Tokatea rocks form all the higher part of the range, as rocks visible at the surface; but the slates are met with in all the mine-workings that at levels below 1,000 ft. reach forward any considerable distance westward from the east side of the range. The inner workings connected with the lower levels, Nos. 7, 6, and 5, of the Tokatea and Royal Oak Mines, are all in slate, though slate does not show at the surface on any part of Tokatea Hill. The character of the rock met with in these different workings has already been indicated as being more or less sandy calcareous shales and mudstones, with which are associated thick deposits of the rock called by Professor Hutton felsite tuff. These beds dip at high angles, and the felsite tuff, dipping west, is apparently followed by the calcareous mudstones and shales as overlying beds, thus reversing the order of sequence seen on the shore of the Firth of Thames near Rocky Point. Reefs of gold-bearing quartz from the overlying volcanic group descend into these rocks, and the great "blow" or "buck-reef" of the Tokatea is found in the slates at the western end of the lower or No. 7 adit.

The Thames-Tokatea rocks rest on the slates on the east of the main ridge of the range at all levels, and appear down the west slope of the range for at least half the distance from the saddle to the low grounds of Driving Creek. In this section it is difficult to determine which is the lowest rock belonging to the group; but on the west side of the range, on Harbour View and the Peveril claims, it appears to be a coarse ash, or fine-grained breccia. These ash or breccia beds appear not far from the level to which the slates reach in the heart of the range, and the rocks at higher levels in the No. 3 level of the Royal Oak are thick banded tufaceous sandstones, lying nearly flat, or dipping slightly to the north-east. On the east side of the range, these and the associated rocks gradually acquire a higher dip, and with the other succeeding rocks cover up the slates to a depth of 400 ft. or 500 ft., and at the surface continue to the low grounds of the valley leading to the upper end of Kennedy Bay. The line of section crossing this, before it opens out on the broader flats, rises again into a mountain of considerable height, the peak and eastern slope of which show the presence of a younger and unconformable group of volcanic rocks (the Beeson's Island group), that occupies, with the exception of a small outcrop of slate, the country east to the sea.

Generally the rocks at the surface, and for the most part the rocky spoil from the mines, are so far decomposed that the original and crystalline character of the rocks has been defaced or effaced altogether, but on the eastern slope there are several outcrops showing in road-cuttings, whence specimens of crystalline rocks in fairly good condition may be collected. On the road-side, near the house occupied by the manager of the Tokatea Mine, there is a massive outcrop of light-grey rock, full of cavities once occupied by minerals that have now disappeared, and only the ground mass of the rock remains. This appears to have been a dyke. It is not traceable to the north-east of the section line, but in the opposite direction it continues to and crosses the mountain road to the Upper Waikoromiko and seems to continue into the higher part of the Success Range, but owing to dense bush, and the rugged nature of the country, it has not been further traced in that direction.

On the west side of the range, as stated, the rocks of the Thames-Tokatea group descend some distance below the outcrop of the "big reef," and gradually, as the range is followed southwards, to lower levels. On the road from Driving Creek to the Tokatea Saddle the boundary between these and the Kapanga rocks is across the upper part of the Britannia Claim. Beyond this to the westward the rocks change in character, the Kapanga rocks being coarse greenish breccias and floes of solid andesite, dark or light-grey in colour, the breccias becoming grey in the vicinity of lines of reef quartz. Higher up the range than the outcrop of the "big reef" slates appear in the Peveril Mine. On these rest the ash or fine-grained breccia beds that are here described as the

lowest of the Thames-Tokatea group. Following down the Mountain Hotel Creek till passing the Pigmy Mine, rocks of the older series are met with, till suddenly, standing at high angles and dipping westward the lowest beds of the Kapanga group are met with. These run through and constitute Murphy's Hill, opposite the Kapanga Mine; and on the southern side of this, at quite low levels in the valley, the slates appear, and from this onwards to the south the Kapanga rocks rise but an inconsiderable height on to the range.

In the section next succeeding to the south, which is taken from the west side of Kevin's Point near Coromandel Wharf, east across the intervening hills to Kapanga Flat, and follows generally the line of the new road to the Success Mine, and is thence continued east into the mountainous country on the east side of the range, the Thames-Tokatea rocks occupy the whole of the Success Range above the 580 ft. level. Below that height, as shown in the section, are represented slates and sandstones belonging to the Maitai series exposed in the road-cuttings from the 400 ft. to the 580 ft. level. Below the 400 ft. level the slates are overlain by rocks of the Kapanga group. At the upper level the slates are succeeded by gritty soft sandstones and shaly clays, with which are associated a thin seam of coal. This lies at the base of the Thames-Tokatea group, and is the lowest of a great series of fragmental rocks that dipping to the eastward occupies the middle slope of the range to 900 ft. above the sea. These rocks, as lying at the base of the Thames-Tokatea group, have but a limited development farther to the north, and in the Tokatea Section are represented by the ash and fine-grained breccia beds that have been mentioned as showing within the bounds of Harbour View Claim and below the lower level of the Peveril Mine.

The coal and associated beds in the section seen on the road to the Success Mine lie uncomformably on the slates, but the material forming the lowest beds is not volcanic, but derived from the waste of the older sedimentary series. The coal is of good quality, but the seam at the outcrop is thin, and there is little hope of its being found of workable thickness. As the section is followed upwards into higher beds volcanic material makes its appearance, and is very pronounced towards the end of the long side-cutting of the road above the coal outcrop. Beyond this, in the sharp bend of the road before reaching the saddle overlooking the Success battery, sedimentary lacustrine beds again appear, above which lie the characteristic rocks of the group, as seen in the higher part of the range, and farther to the north. Veins of quartz now begin to appear in the grey sandstone rock of the miner, but the principal developments of these lie further to the east, and higher on the range at and in the vicinity of the Success Mine. Bands of grey or dark-coloured rock begin to be abundant, and these continue to the crest of the range, and constitute on the eastern side of the range the broken, hilly, or submountainous country that lies round the sources of the Waikoromiko and Waitekauri Streams. More to the east, bands of ash and breccia beds appear, that resemble the rocks of the younger Kapanga group, to which they may possibly belong; but it has not been possible to dintinguish these so as to separate them from the elder group, and more to the south it is seen that similar rocks undoubtedly belong to the Thames-Tokatea group.

The general dip of the Thames-Tokatea group in this line of section is to the eastward, and its total thickness must approach 2,000 ft., or considerably greater than in the line of section carried across the Tokatea Hill.

With respect to the lower beds, carrying coal, these cannot be compared with the coal-bearing series in the neighbourhood of Cabbage Bay. The shales overlying the coal on the Success Road yield fragments of two species of ferns, and a number of jointed stems of a reed-like plant, but it was in vain that search was made for plant-remains of a higher order. No trace of dicotyledons was found.

In the next section, which towards the west begins in Preece's Point peninsula, and thence is carried east-north-east to the main water-divide of the Peninsula, the Thames-Tokatea rocks have a development similar to that seen along the preceding section, the principal difference being that the slates rise to a higher level on the west slope of the range, and the lower beds (coal beds, and succeeding sandstones and breccias) of the Thames-Tokatea group are absent, or but feebly represented. The more typical rocks of the group begin at about the same level in each of the sections (this, and the last), and it appears as though the lower beds of the group on the Success Hill had accumulated in a basin-like area, of which the northern limit was near where now is Tokatea Hill and the southern not far from this line of section.

Being parallel to and not distant from the line of section next to the north, no particular description of the Thames-Tokatea rocks on this line need be given. Mining is being carried on near the junction of the Thames-Tokatea group with the slates on Aitken's freehold, and in that neighbourhood. Although the outcrop of the reefs appear in the the volcanic rocks, it seems evident that all deep mining must be carried on in the slates, which lower down the spur have intruded into them broad dykes of igneous rock that should be referred to the period of the Beeson's Island group.

Proceeding south, the next section is taken from the mouth of the Waiau River, falling into Coromandel Harbour, north-east, to the north-west side of Whangapoua Harbour, and in this the rocks of the Thames-Tokatea group appear on the higher part of the Tiki Spur, and forms the whole of the country eastward to the sea. Slates form the Tiki Spur from the low grounds of the creek to the Golden Belt, about 800 ft. above the sea, beyond which the lowest beds of the volcanic series appears as stratified ash and tufa beds, associated with moderately coarse breccias, followed by a considerable thickness of the grey or brownish-grey tufaceous sandstone of the miner, all the beds dipping at moderately low angles to the eastward. Traces of coal appear in the lower beds in near contact with the slates, and it is evident that here we have to deal with deposits similar to those described as the lowest beds of the group in the Success Section, an extension of which as a similar or independent area lies to the south of it. Masses of solid andesite are met with on the higher part of the range, but generally along the track that from the Tiki crosses to the east side of the range the rocks are tufaceous sandstones, or, if originally lava streams, they have decomposed to

the condition of the "sandstone" of the miner. On the eastern side of the range the exact nature of the rocks on this line of section are to be inferred from what can be seen on the line of travel from Coromandel to Kuaotunu, on which it is evident that the rocks are much less decomposed and are at places intensely dark augitic andesites. Quartz-reefs appear towards the eastern end of the section, and towards the west are numerous near the contact of the volcanic rocks with the slates and in the slates themselves. The dip of the rocks is generally to the eastward, at low or moderate angles.

The next section, from the north-west side of Preece's Point, is taken along a line running east-south-east across the Waiau Flat, the narrow strip of the Kapanga rocks at the foot of the Tiki Spur, and the slate country within the Maitawai Valley, to the middle slope of Castle Rock Range, where it enters a country formed of rocks belonging to the group being described.

On the eastern slope of the range the rocks are similar to those occurring along the line of section last described, but on the crest of the range the great dyke constituting Castle Rock crosses the line, and on the eastern slope, in very broken and rugged country, the rocks change to a darker tint and are largely ash-beds, part of which are solidly compacted beds that can be well studied on the road that from the Waiau Saddle, by way of the Waitakatanga Valley, and that by which the Mahakirau River leads to Mercury Bay.

On the east side of the range the rocks sometimes resemble those of the Kapanga group, and the opinion might be hazarded that at places these rocks are present; but such doubtful rocks are every here and there seen to be associated with the typical rocks of this group, which latter as the section is followed to the eastward becomes more and more pronounced, and, finally, for the last two miles of their exposure, there can be no doubt as to which group of rocks they should be referred. Finally, the Thames-Tokatea rocks are overlain unconformably by strata containing coal or lignite, and volcanic rocks belonging to the Beeson's Island group. Mining in the neighbourhood of this line of section is carried on within the Maitawai watershed, on the east slope of the Castle Rock Range, and for the most part in the lower part of the Thames-Tokatea group.

The Manaia Section, which from its western extremity on the Peninsula between Coromandel and Manaia Harbours is continued east-south-east across Cape Colville Peninsula, shows the presence of the Thames-Tokatea group within the Manaia watershed. Near Hooker's Store, in the Mahakirau Valley, and thence following the valley of that river upwards for some miles, the rocks are seen to be distinctly such as are here regarded as typical of the group to which they belong. In the Manaia watershed nothing is known as to the lower part of these Thames-Tokatea rocks, but they cannot be greatly different to what appears in the Castle Rock Range, and the range immediately south of the Mercury Bay Road. The greater part of this line of section shows the presence of rocks other than those of the Thames-Tokatea group. Contiguous to the line, there is in the Mahakirau Valley one very large reef, and several of lesser size, on which mining was being carried on during the past summer. To the southward the next section runs generally along the line of the southern boundary of Coromandel County. Along this the rocks of the Thames-Tokatea group have expanded so as to cover a greater breadth of country than they do at any point to the north or to the south within the Thames-Coromandel area. In Camelback Mountain it attains its highest elevation above the sea, and constitutes exceeding rugged country on both slopes of the range. On the higher part of the range the rudely stratified volcanic material seems to have a nearly horizontal arrangement.

In the Waikawau Valley the section was followed east as far as the slates extend, but not further, and thus the exact nature of the rocks forming the higher part of the main range was not determined. In the Waiwawa Valley the north-west branches of the river drain the country along this line of section. As on passing the coarse breccias of the Beeson's Island group, seen in the Waiwawa Valley, the next rocks to the westward resemble those of the Thames-Tokatea group, and are continued south along the main range to the sources of the Puru and Tararu Creeks, there can be little doubt that the rocks of the main water-divide and the spur-range to the south belong to the division of the volcanic series.

In the valleys of the Mata River and Tapu Creek, the lowest beds of the Thames-Tokatea group are rather coarse breccias, followed by the grey tufaceous sandstone of the miners, which mantle over the slate and appear both on the coast-line and inland sides of the range. In the south-west tributaries of the Waiwawa the higher part of the range shows heavy floes of dark andesite, underlain by fine-grained breccias beds; and on the lower slopes of the range, descending into the deep valley of the southern branch of the Waiwawa, grey tufaceous sandstone, often charged with mineral sulphides, and nests and small leaders of quartz, form the rocks on the west side of the Waiwawa watershed.

In the section which, from the shore of the Firth of Thames, follows the general trend of Tararu Creek into the south-east sources of the Puru, crosses the main range between the principal sources of that stream into the upper Waiwawa Valley, and thence is continued across Table Mountain Range to Boat Harbour on the east coast of the Peninsula, to the westward the first rocks met with are the Tararu breccias, lying at the base of the Thames-Tokatea group and resting on the felsite tuff of Rocky Point. This is the position of the breccias as seen in the section from Rocky Point south along the shore-line, and that which the similar or identical rocks occupy at Tapu Creek and in the Mata Valley. They are traceable but for a short distance up Tararu Creek, being followed and overlain by the auriferous rocks of the Thames Goldfield. In following up Tararu Creek to the saddle overlooking the head-waters of the Puru Stream alternations of tufaceous sandstones, undecomposed crystalline rocks, and breccias of finer grain than the Tararu breccias are frequent, three distinct bands of breccia rock being passed over before reaching the main ridge. The whole system as exposed along this line dips to the eastward, and therefore, generally, the lower down the spurs in the direction of the shore of the gulf the deeper-seated are the rocks met with.

Round the sources of the Puru other breccias again occur, and forming the peaks of the range are heavy floes of augitic andesite. On the slope of the deep valley between the main range and

Table Mountain grey moderately-fine-grained breccias again are seen, but these may represent some of the bands seen farther to the west, the slope of the range being at a greater angle than the dip of the rocks.

Finally, within the watershed of the Waiwawa and Waiwawa Creek, falling into the Kauaeranga, the Thames-Tokatea rocks are overlain by rocks belonging to the Beeson's Island group, and the further continuation of the section to the north-east does not again show the presence of the Thames-Tokatea rocks.

In the section taken from the shore of the Frith of Thames across the Thames Goldfield, east-north-east into the Kauaeranga Valley, and thence along the valley of Hihi Stream, a tributary of the Kauaeranga, and across the main range to Broken Hills, whence the line continued reaches to the sea at Ohui (Motuhana). In this section the rocks of the Thames-Tokatea group are little more than three miles across. This is due to the gradual approach westward of the Beeson's Island Group, which has a very large development in the Kauaeranga Valley. For this part a nearly parallel section is described by Mr. Park, illustrating his report on the Thames Goldfield, published in the Mines Reports for 1894, from which extracts descriptive of the geology of the district were made at page 36 of this report. Mr. Park shows the belts of hard and soft or "kindly" country, but not the sequence of these as higher or lower beds; and, in view of two lines of fault crossing the section-line, no doubt there is difficulty in doing so.

The different belts of country with the numerous reefs in this field, according to some authors, dip and hade towards the westward, and this would be a reversal of the general inclination of the group farther to the north. This, however, can only apply to the country as far as the Look-out Rocks; and, while admitting that the dip is in parts and may generally be to the westward, the theory of the general succession of the different groups of the volcanic series is not thereby affected. About two miles before reaching the Kauaeranga River the Thames-Tokatea rocks give place to those of the Beeson's Island group, and are not again met with on this line of section.

Puriri Area.—The Thames-Coromandel area of the Thames-Tokatea group of volcanic rocks is terminated on the north side of the Kauaeranga River, to the south of which the Beeson's Island group and strata of pleistocene and recent date form the mountains west of the main water-parting and the downs and lower grounds to the westward.

South of the Kerikeri Valley rocks belonging to this group begin on the lower spurs of the mountainous district, at first with a limited breadth of exposure in an east-and-west direction, but in the Puriri Valley this increases to at least two miles, and in the southern branch this breadth is exceeded, owing to the valley being scooped out in superincumbent rocks at higher levels, but cut into the lower group in the deeper parts of the valley. To the south, towards Omaha Valley, the breadth over which these rocks are found lessens rapidly, and they are not seen on the south side of that valley.

Their most interesting development is between the two branches of the Puriri River and along a line of characteristic hills flanking the higher range between the south branch and Omaha Peak, on the north side of the valley of that name. On the north side of the Puriri Valley the country formed of these rocks presents hills of rounded outline, with here and there a craggy protuberance standing above the general level.

Between the two branches of the Puriri a mountain of pyramidal form rises from the level of the plain, and to the eastward is connected as an offshoot of the main range by a ridge dividing the headwaters of the north and south branches. The belt of Thames-Tokatea country on the south side of the watershed forms a series, in line, of conical hills quite distinct from the lower hills and rolling downs that interpose between and blend with the eastern margin of the plain, and are equally distinct from ranges formed of rhyolite that rising to greater heights lie to the eastward.

The section along the Puriri Valley shows the position of these rocks in relation to those of the Beeson's Island group that occupy the hills of smoother outline and low grounds to the west, and the rhyolite rocks that form the mountains to the eastward. Along this line to the westward no junction between the Thames-Tokatea rocks and the younger group can be made out, but from the point where the south branch leaves the hills and enters on the alluvial plain, upwards, the valley and adjacent hills show the presence of greenish or grey sandstones and breccias formed of volcanic matter that closely resembles the class of country which, at the Thames, is regarded as the most favourable for the occurrence of gold. Higher up the valley and higher in the sequence of the rocks, towards the east and passing under the Rhyolite formation the rocks are lava floes or consolidated tufas of a crystalline texture and dark colour, as fine-grained or coarser andesites. In this direction the Thames-Tokatea rocks are followed by a coarse volcanic breccia that indicates the presence of the Beeson's Island group interposed between them and the rhyolites.

Gold-mining has been carried on in the Puriri Valley since shortly after the opening of the Thames Goldfields, and prospecting is still being carried on on two or three lines of reef, some claims on which appear to have good prospects. Southwards, towards Omaha, prospecting is also being carried on, but in this direction none of the works were visited.

Karangahake Area.—This begins on the north side of the Ohinemuri Gorge, half a mile to the north of where the old road to the Upper Ohinemuri and Waihi crosses the saddle to descend again to the level of the river; and from Mackaytown through the Ohinemuri Gorge the Thames-Tokatea rocks are well displayed to the point where the deeper part of the gorge ceases, a little before reaching the point where the old road joins the new. The western boundary crosses the spur outrunning from Karangahake Mountain, and to the southward runs along the lower slope of the range to where the coach-road begins to ascend the outstanding range projected north-west into the plain, this being formed of Beeson's Island rocks, as shown on the geological map accompanying. The same rocks have extension south-east on to and across the range between Karangahake and Te Aroha Mountains into, across, and beyond the Waitawheta watershed, and thus separate the Karangahake from the Te Aroha area of the Thames-Tokatea group.

The rocks in the Ohinemuri Gorge, from the Crown battery to a mile above the Township of Karangahake, stand out distinct from all those of the surrounding district. Between the pool opposite the Crown battery and the township is an outcrop of columnar andesite, forming dark-coloured—almost black—rocks on both banks of the river, which is remarkable on account of the small size of the prisms of which this rock is formed. This rock strikes south, and appears to be a dyke of very considerable width. Above the junction of the Waitawheta the rocks are characteristically those of the Thames Goldfield—grey tufaceous sandstone predominating, which on the whole appears more indurated than in the northern locality, but this appearance may be due to the rapidity with which the gorge has been cut down. In the Waitawheta Gorge and in the mountain between this and the Ohinemuri Gorge this indurated character of the tufaceous sandstones also is noticeable, and is a characteristic of Karangahake Mountain itself, as it is of the whole extent of this area of the Thames-Tokatea rocks. The rocks generally appear to be tilted so as to stand at high angles, and the strike is necessarily southward in the direction of Te Aroha. Quartz lodes are plentiful in these rocks, and a number of mines, important as dividend-paying ventures, are being worked in them. One very massive reef traverses the length of the area, and this is of such large proportions that properly it should be considered in dealing with the rocks of the group as developed in this part. On the north side of the Ohinemuri Gorge, and thence north to where the rocks of this group disappear under those of the Beeson's Island group, the central higher part of the range shows quartz in what appears to be mountain masses, and beyond the Rahau Saddle there are two isolated hills of quartz rock set in a cup-like depression under the slope of the higher range to the north-east. Towards the east these rocks suddenly disappear under andesic rocks of younger date, or at high levels on the south side of the gorge are overlain by rocks belonging to the Acidic group, rhyolites, &c. To the westward the dip of the contact line is not so high, but the junction is generally more obscure than on the eastern side of this development of the Thames-Tokatea rocks.

Te Aroha Area.—This includes Mount Te Aroha and areas of the same rocks that, with a gradually lessening width of exposure, extend some distance both to the north and the south. To the north from Te Aroha Mountain they extend about four miles to the upper part of the Waitoki Stream, and in this direction form a line of lower hills flanking to the west the principal range. Beyond this the Beeson's Island rocks interpose between the rocks of this and the Karangahake area of the Thames-Tokatea group. South of Te Aroha and the Waiorongomai Stream in like manner the same rocks are continued as a range of flanking hills along the base of the higher mountains to within about a mile of where the county road from Te Aroha to Katikati begins to ascend the west side of the principal range. North-east of Te Aroha it would appear that, as a belt of some width, the same rocks extend into the upper part of the Waitawheta watershed, or that within that watershed there is a separate and distinct area of the same rocks containing lodes of quartz that were being prospected during the past summer.

The rocks of this area differ considerably from those of the Ohinemuri Gorge and Mount Karangahake, and, on the whole, resemble more those of the Kapanga than the rocks of the Thames-Tokatea group generally; in some respects they resemble the rocks of the Beeson's Island group. They consist of coarse- or fine-grained breccias, grey or green in colour, with bands and floes of solid andesite, varying from dark-grey to greenish or light-grey. The breccias often present an appearance of stratification that is scarcely if at all seen within the Karangahake area. A large reef traverses these rocks from north to south, and this is perhaps the feature and circumstance that has mainly led to the correlation of these rocks with those of the Karangahake area and at the Thames.

I follow here Mr. Cox and others in placing these rocks with the Thames-Tokatea group, but wish it to be understood that further examination will probably compel their being classified as belonging to the Waitekauri division of the Kapanga group, with which in their general aspect they better agree than with the rocks of the Ohinemuri Gorge and Karangahake.

It will thus be seen that for the most part the Thames-Tokatea group of rocks is confined to the first or north-west of the series of subparallel ranges that trend across the peninsula from north-east to south-west, and that on this range alone do these rocks appear on the east slopes of any range in which they may be present. In the case of the Ohinemuri Gorge and in Mount Karangahake it may be contended that this peculiarity appears, but this is hardly the case, and the Thames-Tokatea group merely appears in the axis of the mountain-range, the lower flanks on each side being formed of much younger rocks. Hitherto this has proved the principal gold-bearing formation on the peninsula, and there is every probability that it will maintain a prominent position, though it might be rash to say the first, among the different groups of rocks that carry gold-bearing reefs.

Principal centres of mining are situated within its area on the Tokatea and Success Ranges, at the Tiki, Tapu Creek, Puru, and at the Thames, at Puriri, Karangahake, and at Te Aroha. During the past two years prospecting has been carried on at many other places, principally between the Thames and Tapu Creek and within Coromandel County, and finds that promise to be of great importance have been made on the west slope of the range between the Success Range and Castle Rock, and on the east side of the main divide within the Coromandel district many reefs are being prospected hopefully.

The Kapanga Group.

This has typical developments in three different districts of the Peninsula: First, in the northern part, in which it is present from Stony Bay, near Cape Colville, on both sides of the Peninsula, to a little south of Cabbage Bay, and thence along the west side through the Kapanga and Coromandel districts to the water-parting between the Waiau and Manaia Rivers. Second, from Table Mountain it forms the deeper-seated rocks along the mountain-range that forms the water-divide between the east and west drainage areas of that part as far to the south as the sources of the left-hand branch of the Puriri. This area includes Broken Hills on the east side of the Lower

Tairua. Third, the extensive and important area of auriferous country that from the northern inner part of the Whangamata Harbour extends south and south-west to Waihi and Waitekauri. The area of andesic rocks on the east coast, between Boat Harbour and the neck of sandhills between the estuary of the Tairua and the sea, though separate and apart from it, may be regarded as part of the second area into which, for purposes of description, the group is here divided.

The northern area, which includes the typical name-giving locality, exhibits a series of rocks that consist mainly of volcanic ejectamenta that in greater part consist of fine or coarser breccias associated with ash and tufa beds that give evidence of having, within limited areas, been laid down under water, in marshes, lagoons, or lakes of limited extent; and sometimes, but very rarely, conglomerates, consisting of volcanic material, have been formed.

Coromandel Area.—The first or Coromandel area of the Kapanga group commences in the north at Stony Bay, and, like the Thames-Tokatea group, has at the northern extremity but a limited breadth of exposure, and like that is at first confined to the lower slopes of the eastern side of the main range. Gradually, as they are followed southward, the breadth of their exposure increases, and they rise towards the west on to the main range, till abreast of the head of Cabbage Bay these rocks cover up the slates and form the highest peaks of the main water-divide. In this part they also reach to the sea in Waikawau Bay, and are exposed over a width east and west of about three miles and a half. The slate area lying to the north-west of the head of Kennedy Bay causes a sudden restriction of the breadth of exposure on the east side, and the presence of rocks belonging to the Beeson's Island group, south of Cabbage Bay and east of the Umangawha River, reduces for a time the breadth over which the Kapanga rocks are exposed to about two miles, but within this narrower exposure they occupy the higher part of the main range. They continue along the higher part of the range south to the Triumph Mine, and for the first time reach the western shore line at Paparoa. Gradually descending the western slope of the Tokatea Range along the boundary-line already indicated as separating them from the rocks of the Thames-Tokatea group, the east boundary of the Kapanga group runs along the lower slopes of the Success Range, and for a short distance along the margin of the Kapanga Flat, south of which it is again continued along the lower slopes of the ridge of hills that to the westward flanks the Tiki Range, and finally follows the course of the Waiau River to the saddle leading into the Manaia watershed.

From Paparoa to the peninsula between Kikowhakarere Bay and Coromandel Harbour these rocks reach to and continue on the coast-line uninterruptedly till overlain in the eastern end of the peninsula indicated by rocks belonging to the Beeson's Island group, which, however, is but for a short distance.

On the shore of Coromandel Harbour these rocks appear wherever this is not backed by alluvial flats, which to a considerable extent is the case in the low grounds of Kapanga Flat and the alluvial stretch inland of the mouth of the Waiau River. The Kapanga rocks, however, underlie the alluvial deposits of the low grounds from Kevin's Point to Preece's Point, and beyond this to the Coromandel–Thames Road, at the eastern border of the slate area commencing on the south side of Coromandel Harbour. Thence the boundary runs south-south-east into the upper part of the Manaia watershed, beyond which these rocks have not been traced, and where they, as shown on the map, end somewhat abruptly, their extension in this direction not having been carefully defined. Everywhere these rocks form broken hilly country, more particularly between the main range and the sea coast from Paparoa to Coromandel.

Solid crystalline rocks are met with in the Cabbage Bay district towards the western margin of the area, and between Kikowhakarere Bay and the next to the north, and at the western base of Dacre's Hill; in Scotty's Hill, within the Kapanga Claim, and in the hills between the Kapanga Mine and Kikowhakarere Bay; in Preece's Point Peninsula and at the foot of the Tiki spur. These are mostly dark-grey augite andesites, but light-grey rocks of a more felspathic type are found in the Kathleen Crown Claim. These latter, however, appear to be dyke-rocks, and should be regarded as belonging to the period of the Beeson's Island group. On the eastern slope of the Cabbage Bay Range, in the low level of the Bay View Mine, are thick bands of crystalised felspar rock that have been mistaken for limestone, while on the opposite western slope of the range dark augitic andesites are met with close down to the junction of these rocks with the slates.

While such rocks are not of infrequent occurrence, the great bulk and characteristic rocks of the group consist of coarser material than is usually met with in the Thames-Tokatea group. This may be light-grey or greenish in colour; sometimes it is dark-green and contains large boulders of augite andesite, as, for instance, on the road from Cabbage Bay to Port Charles. The breccia beds are usually of moderately fine grain and grey in colour on the Cabbage Bay Range, as is also the case on the northern end of the Tokatea Range. On the coast-line at Paparoa the breccias showing in the sea-cliffs are of a coarse description, blocks more than 2 ft. in diameter being of common occurrence. On the southern headland of the next bay to the south they are of a finer description, and over a considerable breadth may be described as a stratified tufaceous sandstone. On both sides of Kikowhakarere Bay moderately coarse breccias are seen, and in Dacre's Hill the material of the breccias increases in size till it is nearly as coarse as at Paparoa. These coarse breccias extend through the Blagrove Claim to the hill-slopes descending to the Kapanga near the Upper Township. Moderately fine-grained breccias and ash beds are, however, the prevailing rock from Preece's Point northwards, and this it is that is usually considered the most favourable for the occurrence of quartz reefs carrying gold. South of the mouth of the Waiau River the rocks are of a varying grain, often coarse breccias of dark colour, and do not very closely resemble the rocks of the typical locality. Tufaceous sedimentary beds and traces of coal occur at several localities.

In the Waiau Valley thin streaks of coal occur with tufaceous clays associated with conglomerates formed of rolled fragments of volcanic rock, the whole resting on slate. These might be regarded as the oldest and lowest beds belonging to the group, but this is doubtful, as other rocks of a different type are also found resting on the Thames-Tokatea rocks, or the slates farther

to the north. Breccias and shaly clays with coal are found in the two lower levels of the Triumph Mine, and dipping west form an unconformable junction between the rocks of the Thames-Tokatea and the Kapanga groups. Lacustrine deposits containing plant-remains are found on the northern end of the Tokatea Range; similar deposits are found at places along the road from the Kapanga Mine to Cabbage Bay, and in the shaft of the Kathleen Mine at Coromandel.

In the section taken from the eastern slopes of Moehau to the sea in Big Sandy Bay, Port Charles, the lowest beds are hard compact volcanic sandstones and breccias that, resting on slates showing in the valley at 140ft. above the sea, are to the east followed by rocks of a softer character, in which occur the nests and veins of quartz in the Jay Gould Mine. The volcanic rocks to the north and south of the valley rise into hills of considerable altitude, that, as sub-ranges, flank Moehau on the east side. Towards the sea the section across these rocks is obscure, and it is not certain at what distance from the sea the Kapanga rocks are overlain by the coarse breccias of the Beeson's Island group, which are finely displayed on the shore-line on both sides of Big Sandy Bay.

In the section from Cabbage Bay to Port Charles the height of land is reached before the slate ceases and the rocks of the Kapanga group are entered upon. In the lower beds coarse blocks of dark augitic andesite are often met with, and it is in the ridge between Waikawau Creek and the fall into Port Charles that the light-grey tufaceous sandstone regarded as "kindly country" is met with. These in the road-cuttings descending to Port Charles are well exposed, and in the rocks of this part quartz reefs are present, some of which carry a considerable percentage of silver. Samples of stone taken from a lode 3ft. to 4ft. thick have been analysed, both at the Thames School of Mines and at the Colonial Laboratory, Wellington, the yield in both cases being from 105 oz. to 110 oz. of silver, and from a trace to 17 dwt. of gold to the ton.

The sections across the northern and southern part of the Cabbage Bay Range, across the Cuvier Light, Shotover, and other claims in the north part, or over the White Star block of country in the southern part, show the same general character and sequence of the rocks, which for the most part consist of light-grey moderately-fine-grained breccias, with subordinate bands of dark augitic andesite, that have a general dip to the eastward. In this part of the district there are numerous lodes of quartz that for the most part yield prospects of gold. The prospects from the small reefs would be sufficient were there a greater body of stone, while in the large reefs the prospect is barely enough to make the stone pay for working. Almost all the reefs yet found yield gold, more or less, and this general distribution of gold in the reefs of this and the northern part of the Tokatea Range gives hopes that the district will yet afford mines of a payable character.

In Austral Hill, forming the northern part of the Tokatea Range, the rocks of the Kapanga group are well and characteristically displayed as grey sandstones and breccias of moderately fine grain. Between the slate lower part and the top of the hill they display a thickness of between 800 ft. and 1,000 ft., and toward the lower part show the presence of stratified rocks consisting of tufaceous sandstones and fine-grained tufa indurated or altered to a species of chert. In these beds coaly matter and plant-remains are plentiful, the latter in the fine-grained beds that underlie the sandstones. The material is such that plant-remains of whatever kind should be perfectly preserved in it, and such as are present are so, but it was in vain that these beds were searched for remains of dicotyledonous plants. The most abundant form indicated a jointed reed-like plant, and a few species of ferns were also collected. Subsequent to my examination Mr. Park visited the locality, and afterwards informed me that remains of dicotyledons were found by him, but he did not inform me what their affinities were, or the genera to which they belonged. Possibly Mr. Park was mistaken with respect to the character of the plant-remains collected by him, and further search will have to be made in these beds in order to verify the alleged fact.

Along the line of section from Kikowhakarere Bay to the north side of Kennedy Bay contact of these rocks with those of the Thames-Tokatea group can be first conveniently studied in the different workings of the Triumph Mine. In these, as seen in the two lower adits driven into the range, the lowest beds of the Kapanga group are breccias and tufaceous clays with traces of coal. At a lower level on the range similar beds containing bands of iron-sulphide appear in the road-cuttings, but these probably belong to a higher horizon. Between the Triumph and the group of claims on the Austral Hill there appears to be a portion of the main ridge in which quartz lodes are comparatively rare, and this also may be said of the country in the same vicinity extending to the shore of the gulf between Kikowhakarere Bay and Paparoa. In the first bay north of Kikowhakarere thin veins of quartz show in the south headland, and are there associated with a "kindly" class of country consisting of tufaceous sandstone, in which lines of stratification can be distinctly traced. This belt of country extends to the south-east in the direction of Kapanga Hill, and its presence is evidenced by a depression and the lower heights of the hills in that direction.

Dykes and solid floes of andesite, much or but little decomposed, appear on the shore-line on the north side of Kikowhakarere Bay, and with these are bands of breccia of varying thickness, which increase in importance towards the south and south-east. On the south side of the bay the breccias predominate, and the size of the material of which they are composed increases as they are followed into and on to the higher part of Dacre's Hill. In the direction of the Kapanga Mine an isolated hill to the north-east of the road-line shows the presence of a thick floe of grey andesite, which, though present in the middle higher part of Dacre's Hill, has been denuded away from the area of the Kapanga Claim. Scotty's Hill, interposed between the Kapanga Claim and the west slopes of the Tokatea Range, shows the presence of two or more thick bands of dark augite andesite that evidently rapidly thin out towards the west. These are underlain in the Britannia Mine, and in the Kapanga Mine are underlain and overlain by grey and greenish moderately-fine-grained breccias that gradually tend to become coarser as they are followed to the westward. The same rocks are of a coarse description in the Blagrove Mine and in Dacre's Hill. Further to the westward the size of the breccias decrease until they again are normal, 3in. or 4in. through being the

average of the fragments, with larger or smaller, as the case may be. Breccias continue to the shore of Coromandel Harbour in the line of the Hauraki and Bunker Hill Claims, with, however, dykes or included masses of dark augitic rock.

In Kevin's Point, in the sections exposed on the roadside from the wharf to where the road passes on to the alluvial flat of Kapanga Creek, decomposition has reduced breccias and other rocks alike to the condition of a tufaceous sandstone, and their true condition is to be seen only in the material brought to the surface by the various mines of the surrounding district.

From the Britannia Mine the eastern boundary of the Kapanga group rapidly declines to lower levels, and south of Kapanga Creek, except in Preece's Point and at the base of the hills east of Preece's Point Peninsula, no prospecting has been carried on in the southern part of this area of the Kapanga group.

Preece's Point Peninsula shows the presence of the characteristic rocks of the Kapanga group, and forms part of the belt of more auriferous country that from Coromandel Wharf trends north-east to the western slopes of Tokatea Hill. This belt is proven by the location of the various claims in which auriferous lodes have been found or are being worked. It may be regarded as being from one to two miles in width. The strike of the lodes is across it, and it might be expected that these would extend into the country to the north and north-west of the line that limits it in these directions. As a matter of fact, whether the reefs do extend or not, failure to discover these or to prove them remuneratively gold-bearing has defined apparently the limits of the auriferous belt along a remarkably straight line on the north-western side of the belt. There seems, so far as the rocks indicate, no reason why the reefs and gold should not continue to the northward, but the fact has to be accepted that the district to the north, and for no lack of prospecting, has not proved productive.

The southern limits of the belt are not at the surface so well defined as the northern. This is owing to the rocks being covered up by the alluvial deposits of the Kapanga Flat and the middle course of the stream to the Upper Township. Also, it may be constricted in breadth owing to the presence of the slate on the lower slopes of the Success Range. Between Preece's Point and the northern limit north of Bunker Hill and the Hauraki North Mines its full width appears. This line, belt, or channel of auriferous country—for it is known by these different terms—abuts against that running along the main range on the west slope of Tokatea Hill and the northern part of Success Range, but does not pass through the range to the Kennedy Bay side.

Neavesville Area of the Kapanga Rocks.—The rocks of the Kapanga group as develope in this area, with which are included those of the Upper Whenuakite and Boat Harbour, that stretch along the coast-line to near the mouth of the Tairua River, so closely resemble those of the neighbourhood of Coromandel that there need be no difficulty in recognising them. On the west side of the Peninsula they begin in the Kauaeranga Valley, south-east of Table Mountain, and east of the Billygoat Falls they form a narrow outcrop between the great intrusive mass of Table Mountain and the rhyolite rocks that form the higher part of the water-divide between the Upper Kauaeranga and the Tairua Valleys. Underlying the rhyolites they form the deeper-seated rocks of the range, and at low levels are probably continuous through to the Tairua Valley, but on the west side flanked by younger rocks of an andesic character, and to the east, overlain as they are by the rhyolites, they are exposed chiefly by being deeply cut into by the Hihi and other small rivers, tributaries of the Kauaeranga, and on the spurs appear along the middle slope of the range. Opposite the northern sources of the Fourth Branch of the Tairua the boundary sweeps to the south-west and crosses the upper valley of the Kerikeri, two to three miles from the source of that stream. Thence the eastern boundary turns to the south and crosses the upper valleys of both branches of the Puriri, and from the southern sources of the last-named stream the south-east boundary trends north-east to the Tairua River, about two miles above the junction of the Fourth Branch. Rhyolite rocks appear for a short distance up the Fourth Branch of the Tairua, and thence the junction between the Kapanga rocks and acidic rocks in a north direction follows an irregular line, due to the fact that along the Tairua Valley the rhyolites are either intrusive or have been exceedingly disturbed. The contact-line between the two rocks being at places vertical in the low grounds, while at the same time the projection from the north of rhyolite rock in a more horizontal position on the higher part of the main range, and possible outlines of this on the different spurs descending to the Tairua Valley, render difficult the tracing of the boundary on this side, and the difficulty in this respect is greatly enhanced by the exceedingly rugged nature of the country, which towards the north, round the sources of the Hikuwai and Second Branch, is little short of impenetrable and impassable.

The area within which mining is carried on at Broken Hills is surrounded on the east, south, and west by rhyolite rock, and is connected with the larger area of these rocks, which, to the east, north, and west is surrounded by rhyolite, the andesic breccias of the Kapanga group reaching to the north a little farther than the east and west line from their first appearance on the west side of the range. Thermal action has been rampant throughout this area, and, besides building up vast piles of siliceous sinter, has charged the rocks with threads, strings, veins, and masses of chalcedonic, flinty, and crystalline quartz, that where these more particularly abound mounds, pinnacles, and peaks remain, while the softer surrounding rock has been removed by denudation. These tower above the general level of the country, yet every stream of any consequence has cut deep, narrow gorges that twist and wind through and among these harder cores, the centres of thermal action, so that the northern part of this area on the east side of the range constitutes one of the most remarkable sights to be met with in the northern, or, indeed, any part, of New Zealand.

In the southern part of the area the outlines, though rugged, are not so intensely so as in the northern part. Here thermal action is displayed on a gigantic scale in the vicinity of Neavesville, and the top of the mountain west of Neavesville is formed of sinter, which, however—what remains of it—is but a fragment of what once was: the whole slope to the north-east into the valley

of the Fourth Branch being strewed or deeply covered with fragments or blocks of sinter from this or other thermal vents.

The brecciated character of the Kapanga group over this Neavesville area is that which is most prominent, but other rocks of a solid and crystalline type are not wanting.

The best section easily accessible is that along the new road following the north branch of the Puriri from the junction of the two branches to Neavesville, and thence the track from Neavesville by way of the Fourth Branch to the Tairua River. Along this line the lowest rock seen resting on the Thames-Tokatea group is a tufaceous sandstone, in which apparent lines of bedding can be seen. Higher in the section is the London Rock, a castellated mass of great height springing from the side of the higher range, but free and apart from it, rising to many hundred feet above the base on which it rests or from which it springs.

Overlying these beds, and constituting the higher part of the range forming the water-divide between the Puriri and the Fourth Branch of the Tairua, is a great series of moderately fine-grained breccias, the general tint of which is grey or greenish-grey. At Neavesville these are saturated with siliceous impregnations that are generally more or less auriferous; the quartz thus formed constitutes a cement, binding the breccias more firmly together, or occurs as nests and pipes, or ramifies in every direction as veins and small reefs. Lower on the range, on the descent into the valley of the Fourth Branch, the rocks *in situ* are for a time obscured by sinter *débris*, but it is evident that the higher beds have been cut through, and that in the deep valley to the north-east lower beds are exposed along the bed of the Fourth Branch. Finally, columnar andesites are encountered, which are probably an extension into this part of the range of the intrusive rocks of Table Mountain.

The section from the Kauaeranga River across the range at the source of the Hihi to Broken Hills, were the rhyolites removed, would show at the surface similar rocks to those which are met with in the Puriri-Neavesville section.

The area surrounding the sources of the Whenuakite, and on the coast-line from Boat Harbour to the estuary of the Tairua River, consists of broken hilly country, descending abruptly to the sea-coast, five miles in length and three to four miles in width. The rocks towards the north-west in near contact with the rhyolites are dark augite andesites, and in the hilly country of the middle part mainly fine-grained ash and breccia beds, and on the coast-line grey andesites, felspar predominating. Quartz lodes are present on the coast-line, and inland on the high land between the sources of the Whenuakite, Stony Creek, and Graham's Creek. Towards the south, within the watershed of Graham's Creek, hot springs have appeared, and sinter mounds and terraces are plentiful along the valley of Graham's Creek. The same rocks appear near the lower landing of Tairua River, form a small island in the estuary, and a limited area on the south side of the river.

Southern Area of the Kapanga Group: Whangamata to Waihi and Waitekauri.—This important area of these rocks commences on the east side of the upper part of Whangamata Harbour and thence extends south-west, forming a rugged mountain country which continues into the watershed of the Ohinemuri River, a distance of seventeen miles in length, with an average width of from four to five miles. From the commencement of these rocks in the north of the area the western boundary goes south-west seven to eight miles to the Upper Hikutaia, and thence generally this boundary runs south to within less than a mile of the Ohinemuri River at Owharoa. The eastern boundary is generally in a south direction to Waihi, east of which is a lesser area of these rocks, surrounded by rhyolite, that extends from the trig. Ngatiko north-east through Waihi Monument, a distance about four miles, with a breadth of about one mile. Martha Hill, included in the celebrated Waihi Claim, is the southern part of a small peninsular area extending south from the east side of the main area.

Towards the north-east these rocks are bounded on all sides by rhyolite, the alluvial flats of the Whangamata basin not being considered. From the source of the Hikutaia to the Ohinemuri at Owharoa the rocks west of the boundary-line belong to the Beeson's Island group. Outside the east and southern boundaries the rocks adjacent are everywhere rhyolitic. The rocks vary in different parts, but in their breccias and ash-beds it is sufficiently obvious that they belong to the Kapanga group, and they do not compare closely or at all with the nearest development of the Thames-Tokatea rocks in the Ohinemuri and Karangahake Gorges. Dark augitic and grey felsitic andesites, ash and breccia beds characterize the country to the north-east. Round the south-east side of the upper sources of the Tairua solid dark porphyritic andesite is abundant, often banded and exhibiting a coarse fluction structure, while at the same time fully crystalline. In the neighbourhood of Waihi the breccias are moderately fine, often calcareous, while in the Waitekauri they are of a green colour. In the Waitekauri and in the ranges between the Waitekauri and the Wharekeraupunga the solid andesites are often strongly porphyritic with crystals of felspar. Of the area including the Waihi Monument the south-west extremity is formed by an intrusive mass having a columnar structure, and this is a grey-coloured rock, having a large proportion of augite or hornblende, crystals that are often crossed and in close contact with each other. Quartz reefs are abundant in these rocks, many of them of large size, and all of them give evidence of having been formed under the influence of hot water.

The Kapanga Group considered in relation to the Thames-Tokatea Group of the Volcanic Series.—Hitherto these rocks have been considered identical, and by other writers whenever unconformity between different parts of the volcanic series has been referred to, it is evident that it was the rocks of the Beeson's Island group that formed the overlying uncomformable division. Though the lower and older divisions have been described as highly indurated in comparison with rocks at higher levels or higher in the series, in most previous reports the idea conveyed is that the whole belongs to one period of volcanic activity and deposit.

The rocks forming the two groups, it must be admitted, are typically the same in character, but it is easy to observe that generally the Thames-Tokatea rocks have been subjected to greater change, removal, and alteration of their constituent minerals, and as a rule, in spite of decomposition at and near the surface, that they have been solid and compacted to a degree far greater than

characterizes the general bulk of the Kapanga rocks. Along lines of strong mineralisation the spoil from the mines may in cases be very similar, but this does not affect the rocks as a whole.

Whatever may be the value of the evidence which the condition of the rocks affords, the manner of their distribution and arrangement of the rocks in section gives evidence that is sufficiently decisive. Within the Thames-Coromandel area the thickness of the Thames-Tokatea group is very considerable, ranging from 1000 ft. to 2000 ft., and at places even more. In the section from where the slates disappear on the road to the Success Mine, across the Success Range to the Four-in-Hand Mine, the greater thickness mentioned must be exceeded, as it must be from the source of the Manaia to Hooker's Store, on the road to Mercury Bay, and farther south in the section from the shore of Hauraki Gulf to the source of Waiwawa Creek, a little west of Table Mountain. The nature of the material is such that it is largely the result of paroxysmal explosions from probably a number of volcanic vents—whether submarine or terrestrial, as far as the present concern, is of little consequence. It is certain that it could not have been piled up along the higher part of a mountain-range, as it appears in the Coromandel district from the Tokatea to the southern boundary of the county, leaving the slates to the westward uncovered and bare for the reception of deposits of the Kapanga period. These latter rest on the slates laid bare towards the west, reach on to the range, and overlap the rocks of the Thames-Tokatea group north of the Triumph Mine; and in the same vicinity show that if the older series are of marine origin, land must have appeared and vegetation sprung up in the interval between the first and second periods of eruption. Considerable denudation is further proved by the rolled and water-worn volcanic material at the base of the Kapanga group, on the west side of the Waiau Valley, opposite Castle Rock. Consequently, the contrasting condition of the rocks, the evidence of a land-surface, and, much more, the proofs of the great and long-continued denudation of the Thames-Tokatea rocks prior to the deposit of those of the Kapanga group, are proofs of their distinctness, and warranty for the distinction which has been made.

In the Neavesville area it is only in the Puriri Valley where the rocks of the two groups come in contact, yet there the rocks are distinct from each other, and, although proofs of their unconformity to each other have not been carefully sought for, there is little doubt that such will be forthcoming. In the southern area, from Whangamata to Waihi and Waitekauri, the Kapanga group nowhere come in contact with those of the older group, and, as a consequence, it is only the condition of the rocks that can be put in evidence and relied on in support of the distinction which has been made.

Upper Miocene.

Beeson's Island Group.—These rocks were first described by Hochstetter as "trachytic breccia and tuff," forming the islands and coast-line in the vicinity of Coromandel Harbour. Regardless of whether they should be called trachytes or andesites, the same rocks, besides forming Beeson's Island, some of the other outlying islands, and the peninsula on the north side of the harbour, are present on the south side of the harbour, and form between Coromandel and Manaia Harbours west of the Coromandel–Thames Road, the country to the sea. South of Manaia Harbour the same rocks form the country south and west of Manaia Harbour and the alluvial flat along the lower course of the Manaia River to Kirita Bay, where along an east and west line they are suddenly terminated. This is the typical and most characteristic locality of these rocks.

Sometimes, as may be gathered from the extracts made from former writers on the geology of the district, the coast to the north of Coromandel Harbour is considered as being formed of trachytic tufa the same as met with in Beeson's Island, and even the mainland north of the lower part of Kapanga Creek has been described as such, and this apart from the fact that the two older groups —the Thames-Tokatea and Kapanga groups—are often described as being formed of rocks of a trachytic character.

These rocks from Beeson's Island to Kirita Bay are generally coarse breccias of a light-grey colour, but rocks dark as normal augite andesite are met with at many places. Thick beds or elliptic masses of clayey tufa of various colours—blue, purple, red, or white—are of frequent occurrence, alternating with the coarser breccias. Sometimes beds of intermediate grade form tufaceous sandstones that show bedding planes and stratification with some degree of regularity for considerable distances, as, for instance, in the peninsula between Coromandel and Manaia Harbours. At other places soils have been formed in the intervals between periods of activity of the volcanic vents, and in or on these quantities of fossilised wood are to be found.

On the peninsula opposite Beeson's Island the breccias are often of a coarse description, and, the finer material between the larger blocks weathering out the cliffs and precipices, present the appearance of being formed of an aggregate of angular blocks.

Between Manaia and Kirita the coarse breccia accumulations form mountains of considerable altitude that show material of a darker colour than on the coast line.

In the Cabbage Bay district these rocks are developed on the coast-line to the south of the bay for a distance of three miles, and inland of the coast-line for half a mile further. In the section on the south side of Cabbage Bay the lowest rocks belonging to this group seen resting on slates are breccias and light-grey sandy beds, followed by more argillaceous tufas. These rocks contain quantities of fossil wood, and nests and veins of chalcedony, grey or red; and to the north-west are followed by darker and more compacted breccias. Towards the South Head finer-grained beds again appear, and in this part the beach is strewn with great quantities of silicified wood derived from the breccia, ash, and tufa beds of this part. Two or three old land surfaces are traceable in this part of the section, and from the old soils exposed on the hill-slopes and on the shore of the bay most of the fossil wood comes. Many of the trees have been of considerable size—up to 2 ft. in diameter—and the stumps and roots of these can still be traced in their natural position, the roots in the soil, or under clay, the trunks broken off a short distance above the ground, the parts above the old soil being surrounded by coarse or finer-grained breccia beds, the product of eruption from an adjacent sub-aërial volcano. The higher deposits in this line of section are met with at the

south headland of Cabbage Bay, and on the coast for a short distance to the south, and consist of a coarse breccia of loosely-cemented material, usually of a light-grey colour, coarsely crystalline, the felspars predominating.

South of Cabbage Bay solid floes of grey porphyritic andesite, having a sub-columnar structure, appear on the coast-line, and darker augitic rocks appear in the south-east part of the area immediately overlying the coal-bearing beds of Torihine and Tawhetarangi Creek, and separates these from outcrops of the same rock in the west branch of the Umangawha River. In the report of December, 1883, I divided these rocks into three divisions, the lower of which I seem to have regarded the equivalents of the Kapanga group, as this is seen in the ranges on the east side of the Umangawha Valley. Furtherresearch has shown that the rocks on the two sides of the valley are not the same. In the southern part of this area the boundary between these and the rocks of the Kapanga group is not easily determined. As in the southern source of the west branch of the Umangawha, the rocks of the coast-line north of Torehine appear as dyke-like masses, and apparently extend south through the range intervening to the new road from Coromandel to Cabbage Bay, and the boundary may be more to the south and east of where it appears to be on the map accompanying. This, however, is a matter of secondary importance at the present time. None of these rocks within this area are auriferous, and they are highly unconformable to those of the Kapanga group, as developed on the east side of the Umangawha Valley.

It is the evident unconformity of the Beeson's Island rocks at Cabbage Bay to those of the Kapanga group in the northern part of the Tokatea Range, and in the Cabbage Bay Range east of the Umangawha Valley, that makes them of importance. It might be difficult to prove unconformity between the two in the district around Coromandel Harbour or further south, or on the East Coast from Stony Bay to Mercury Bay, but fortunately at Cabbage Bay the unconformable relations of the two are quite apparent.

As the Kapanga group consists mainly of fragmental ejectamenta accumulated on Austral Hill and the Cabbage Bay Range to the depth of 1,000 ft. or more, and forms a very abrupt slope on the east side of the valley down to 800 ft. and 600 ft. above the level of the sea, below which level into the low grounds of the valley slates are met with, it is clear from the nature of the material and the mode of their deposition that the rocks of the Kapanga group must have been spread over the district to the west, and might be expected to occur interposed between the Beeson's Island rocks and the coal-measures or the slates. They are absent, and are absent due to their having been removed by denudation prior to the deposit of any of the rocks forming the Beeson's Island group. The slates and coal-measures were thus laid bare, and, subsequently, from a volcanic centre lying to the west of the coast-line the rocks of the Beeson's Island group were discharged, and built up the superimposed lava-streams, breccia, and ash-beds by which the group is here represented. Without question, the Beeson's Island rocks were at one time in contact with those of the Kapanga group throughout the Umangawha Valley; but except in the south these rocks have been carried away, and along the middle and lower course of the river they are now confined to the west side of the valley, reaching to sea-level. On the opposite, the east side of the valley, from above the slates, spring nearly vertical cliffs of Kapanga rocks, directly opposite where the younger series reaches furthest into the low grounds, and for a short distance on to the east side of the valley. The relations of the two groups, and the evidences of the unconformity between them, is shown in the section from Torehine to Kennedy Bay section.

On the north-west slopes of Moehau these beds were not particularly examined, but according to Mr. Park, who during the past summer examined the coast-line of this part, the rocks are for the most part hard grey porphyritic andesites of an intrusive character that extend to the north, to the west side of Port Jackson. South of Port Jackson, over the eastern part of this area, the rocks are of a less intrusive character.

From Stony Bay to Port Charles the rocks belonging to the Beeson's Island group are, in the main, coarse breccias, the larger blocks in which are usually dark augitic andesites, and, where of finer material, greenish or grey, nests and veins of calcspar being not uncommon. On the east side of Port Charles these breccias are of a very coarse description, blocks 6 ft. or 8 ft. in diameter being not uncommon. Further south along the coast-line finer-grained breccia and ash-beds are plentiful, but in the hills more to the east enormously coarse breccias are met with. In this part lava-streams having a more or less perfect columnar structure cap the finer-grained breccia and ash-beds, and at places curiously display in the same lava-stream vertical and inclined columnar structure. The coast-line of this part is high and precipitous, and inland the hills are high, and form rugged broken country. The boundary between these and the Kapanga rocks is fairly well marked in the valley of the creek falling into Big Sandy Bay, and in that of the main stream falling into the upper part of Port Charles, but over the broken country to the mouth of Waikawau Creek it has not been followed.

On the opposite (south) side of the bay, into which Waikawau Creek discharges, the boundary between these and the Kapanga rocks is well marked, and to the south the Beeson's Island rocks continue along the coast-line and inland to the slate country extending north from the inner part of Kennedy Bay. East of the slates, and forming the north head of Kennedy Bay and the neighbouring hills, the rocks of this group resemble closely those of the typical locality, Beeson's Island, and the south shores of Coromandel Harbour. The lower part of the group on the north side of Kennedy Bay consists of solid floes of grey rock resembling trachyte. The upper part is a very coarse breccia of light-grey colour; that on the shore-line has weathered into a variety of fantastic shapes. On the hill-slopes the breccias are of large size, and full of fissures and caves that in times past have been used as places of sepulture by the Maoris. The same beds occupy the whole of the south side of the bay. The solid rocks forming the lower part of the group appear at the head of the bay, and here occurs a remarkable stratum, the lower part of a lava-stream, having a structure that closely resembles that of mica-schist. The formation extends inland towards the Tokatea Range for about a mile from the head of the bay, and forms the crest of a high conical hill on the south side of the valley leading forward to the foot of Tokatea Hill.

Through the mountainous and rugged country that lies inland of the coast-line between Kennedy Bay and Whangapoua Harbour, there have been no means of determining the boundary between these and the rocks of the Thames-Tokatea group of rocks; but as the latter reaches to the head of Whangapoua Harbour, and the Beeson's Island rocks are met with beyond the alluvial flats of Opitonui Stream on the road to Kuaotunu, the junction between the two groups should reach the north shore of Whangapoua Harbour somewhere in the near vicinity of where it is represented on the geological sketch-map herewith.

The west boundary of these rocks was next determined in the valley of the Mahakirau River, and the boundary as traced on the map, from Whangapoua Harbour to within less than a mile east of Hooker's Store in the Mahakirau, is, approximately, between these two points of the boundary-line as traced on the map. In the ranges outrunning from Castle Rock Range towards Kuaotunu Peninsula, over a large area of country which it has not been possible to examine closely, the rocks have been determined as belonging to this group, they, where examined, corresponding with those of the typical locality. Over the Kuaotunu Peninsula also the volcanic rocks present seem to belong to the Beeson's Island group. This is seen in the block of country between the Opitonui and Owera Streams. In the hills on each side of the road, and on the coast-line at Materangi, almost every variety of rock described as characteristic of the Beeson's Island group is to be met with. There is especial illustration of this on the coast-line between the most eastern reach of Whangapoua Harbour and Kuaotunu, where dark andesic and grey trachytic lava-floes, breccias, tufa, and fine-grained ash-beds are met with in succession or alternate with one another. The ash and tufa beds and finer grained breccias have all the variety of colours that have been described as distinguishing the Beeson's Island group in other parts of the Peninsula. In the Materangi Hills are rocks resembling the grey tufaceous sandstone of the mineralised parts of the Kapanga and Thames-Tokatea groups, and quartz lodes occurring in these, it is generally believed that here is a development of the auriferous rocks of the Thames and Coromandel districts. This, however, is very doubtful, and a study of the adjacent hills and coast-line where the true character of the rocks can be seen should lead to the conclusion that these rocks are different.

Nearer Kuaotunu, east of the last saddle, before the road reaches the beach, there is a high conical hill formed of andesites, breccias, and tufas of various hues, the highest top of which is formed of volcanic agglomerate, and this in the south-east side of the hill, which has been greatly denuded by the cutting down of the valley, shows this volcanic agglomerate filling the neck or vent of a former volcano; the agglomerate can be traced 300 ft. to 400 ft. under the top of the hill, and is laid bare on one side only. This is the most decisive instance of the location of a volcano that has yet been discovered on the Cape Colville Peninsula.

On the other side of the valley from this volcanic cone the slates begin, and extend east to beyond Kuaotunu, but to the west, south, and east the area of these is bounded by rocks of volcanic origin that are here referred to the Beeson's Island group. To the south, rocks of this class extend to the shores of Mercury Bay, and east of the Waitaia Range; the outer part of Kuaotunu Peninsula is formed of these rocks. On the road from Kuaotunu to Mercury Bay the rocks are for the most part dark andesites, the further south and higher in the sequence, closely resembling those of the head of Kennedy Bay on the south side. Towards the outer end of Kuaotunu Peninsula, to the north, massive grey porphyritic andesites prevail, but in the middle and southern parts tufaceous beds of various colours for the most part abound. Generally speaking, these rocks are not regarded as favourable for the occurrence of auriferous reefs, but on the northern and southern ends of the Waitaia Range and at Matarangi mining in them is being carried on. As a rule, where the parti-coloured tufa and clays are present the country is considered specially unfavourable for the occurrence of gold-bearing reefs.

In the Mahakirau Valley, the lowest rocks of the group are partly sedimentary beds of shale and soft sandstone, and fine or coarse-grained breccias, occurring in association with dark andesites, that in some cases approach basalt in character. Further to the east grey porphyritic andesites, having the aspect of trachyte, form ranges of hills trending north-east and south-west. These rocks are solid or brecciated, and sometimes form thick-bedded masses that at a distance resemble calcareous sandstones, or the rhyolitic ash and tufa beds of the district south of Mercury Bay. Between the Mahakirau and Waiwawa Valleys the breadth east and west, over which these rocks are exposed, is narrowed considerably, mainly owing to the appearance of the rhyolites to the eastward in the district south of Mercury Bay. The section along the Waiwawa Valley runs at an angle across the narrowed exposure of these rocks, and thus, in following the river from Gumtown to its source, they appear to have a much greater development than in reality they have. The most striking, if not the most characteristic, rock of the group in this part is a moderately coarse breccia of dark augite andesite, solidly compacted without finer material as an ash matrix. This is well seen in the middle and deeper part of the Waiwawa Gorge. In other parts a grey porphyritic andesite abounds, in which the felspars often appear as imperfect crystals, twinned, and as blebs. These rocks run along the valley of the south branch of the Waiwawa to abreast of Table Mountain, and thence pass into the upper valley of the Kauaeranga River, within which the breadth of their exposure is suddenly increased. Stretching up the valley of the Hihi, they form the flanks of the main range south of Table Mountain on the one hand, and the eastern slopes of the range between the Kauaeranga middle and lower valleys and the upper part of the Hauraki Gulf.

Like the Waiwawa, the Kauaeranga cuts obliquely across the linear extension of these rocks, so that along the lower hill-slopes of the bottom of the valley scarcely any other rocks are met with from near the sea to abreast of the Billy-Goat Falls and Table Mountain. All the ranges on the southern side of the valley are formed of these rocks, and in that direction they extend into, across, and beyond the Kirikiri into the Puriri watershed.

On the north-western side of the Lower Kauaeranga Valley these Beeson's Island rocks pass across the bounding range into the upper part of Hape Creek, and thence they form the higher hills forming the last part of the Spur Range terminating at the Kauaeranga. In the Kirikiri Valley

these rocks have still a great breadth of exposure, but in that of the Puriri it is much less, owing to the appearance here of an area of the Thames-Tokatea rocks. In the upper valleys of both branches of the Puriri the Beeson's Island group occurs, apparently resting on and overlapping the junction of the Thames-Tokatea rocks and Neavesville division of the Kapanga group; but in the rugged mountain country of this part neither the position of the rocks nor the manner of contact has been definitely ascertained. The low downs and lesser hills bounding on its south side the lower part of the Puriri Valley probably belong to these rocks, and from this point southwards to the Ohinemuri River they form the outer flanking hills of the mountains, and cross the valleys of the Omaha, Hikutaia, and Komata, while between the Waihou Plain and the eastern boundary of these rocks the breadth of their exposure varies considerably. In the Omaha Valley the breadth of their exposure to the foot of Omaha Peak, formed of rhyolite, is little more than two miles. In the Hikutaia Valley they extend to almost the source of the north branch, and in the middle or main branch to the foot of the most easterly of the Maratoto Peaks.

Between the Omaha and the main source of the Hikutaia River the Beeson's Island rocks are overlain by rhyolites, or lacustrine sedimentary rocks mainly composed of rhyolitic material. From the manner in which these latter rest on the underlying rocks, the eastern boundary of the Beeson's Island group is very irregular, and from the "Steps" on the track from Hikutaia to Whangamata an embayment extends to the north-east, the limits of which have not been ascertained. The highest of the Maratoto Peaks and the two adjacent to the eastward are formed of rocks belonging to this group, but immediately to the east of these the boundary separating these from the Kapanga rocks trends south-west across the mountains into the Komata Valley, and thence into the Ohinemuri watershed, where the area of the group is again as two separate exposures, having between these the northern extremity of the Karangahake rocks—the Thames-Tokatea group—as an inlier, and a limited development of rhyolitic rock as an outlier. Coarse breccias distinguish the group from the Omaha to the Ohinemuri, but other rocks are not wanting. Massive flöes or dyke intrusions are met with at many places, while sedimentary beds, shaly clays, and indications of coal occur in the southern part. In the upper Hikutaia the rocks are notably coarse breccias, and where they are in near contact with the rhyolite of that part the angular agglomerate without ashy matrix described as occurring in the Waiwawa is the most prevailing rock. In the hills at the back of the racecourse at Paeroa shales and traces of coal are met with, and coal is also reported somewhere in the vicinity of the mountain-track from Paeroa to Waitekauri; but, as was the experience formerly of Mr. Cox, the outcrop could not be discovered during the examinations of the past season. In the Ohinemuri Gorge, one mile below Owharoa, these rocks in the lower part of their development show the presence of massive clays and shaly beds underlying breccias. This seemingly corresponds to the beds of shale and coaly matter that appear in the hills to the east of Paeroa Racecourse. At Paeroa, rocks lower in position than the shales and coaly beds form the lower slopes of the hills, and a number of isolated lesser hills outstanding on the plain lie to the north and north-west of Paeroa Township.

Opposite Mackaytown the rocks of the Beeson's Island group cross to the south side of the Ohinemuri Valley, and are continued as a narrow belt along the western lower slopes of Karangahake to the range outrunning on to the plain four miles south of Paeroa, which is wholly composed of these rocks. Abreast of this outrunning range the main range from Karangahake to Te Aroha also shows the presence of the Beeson's Island group, which, crossing the range and the valleys of the southern branches of the Ohinemuri River, spreads over the country to the south and east of the Waihi or Upper Ohinemuri Plain, and occupies, with the exception of Hikurangi, composed of rhyolite, all the mountainous country east of Te Aroha to the sea at Waihi Beach, and south to the Pleistocene and Recent deposits of the lower region west of Tauranga Harbour. East of the Waiorongomai the main range is formed of these rocks, and, with the exception of a narrow strip of flanking hills between Waiorongomai and the Te Aroha–Katikati Road, all the country other than what is occupied by Pleistocene and Recent deposits is formed of these Beeson's Island rocks.

The character of the rock south of the Ohinemuri is for the most part moderately fine-grained breccias. Often, however, they are coarse, and not unfrequently are of a red or purple colour. At all places they are sufficiently characteristic to be distinguished from the rocks of the Thames-Tokatea group, as this is displayed in the Ohinemuri Gorge and on Karangahake Mountain, but in the case of Te Aroha the distinction is not so easily made out, and there is a possibility that some parts are formed of these or of rocks belonging to the Kapanga group. The relation of these to the other rocks of the volcanic series is marked by unconformity at almost all places. At Cabbage Bay this unconformity to the rocks of the Kapanga group is most marked. The rocks of the latter group had been removed from the middle and lower valley of the Umangawha and the slates laid bare before the commencement of the igneous outbursts as a result of which the Beeson's Island rocks were deposited. The evidence in proof of this is the same in kind as that adduced to prove the uncomformity of the Kapanga group to the rocks of the Thames-Tokatea group along the western lower slopes of the Success, Tiki, and Castle-Rock Ranges. The younger rocks are piled up to form the mass of the lower range on the coast-line between Cabbage Bay and Torehine, and their disposition is so that generally they slope inland to the lower grounds along the river-valley, where they stop short, not crossing to the east side of the valley. Slates appear in the low grounds on both sides, but mainly on the east side of the valley, and after rising to various heights on the east side these are overlain by the rocks of the Kapanga group, rising abruptly, and in cases nearly vertically, to heights two or three times that attained by the rocks of the Beeson's Island group; and it is difficult to apprehend how the thick and widespread Kapanga group should not be represented over this area, or the Beeson's Island group be present resting on the slates, without coming to the conclusion that the former had been removed by denudation so as to lay bare the area over which the Beeson's Island rocks are found resting on the slates or the Cretaceo-tertiary rocks.

At Port Charles the evidence of unconformity has not been so clearly made out, but this is probably because the rocks have been less studied in that part of the northern district. At Kennedy Bay the Beeson's Island group rest upon the slates on the north side of the bay, and more inland, on the south side, on the rocks of the Thames-Tokatea group. Thence southward their relation to the Thames-Tokatea rocks is more obscure till reaching into the valley of the Mahakirau, where again unconformity is sufficiently apparent. In the valley of the Kauaeranga River these rocks to the east rest on rocks belonging to the Kapanga group, and on the north-west side of the valley on rocks belonging to the Thames-Tokatea group. Between the Thames and Coromandel, on the west side of the Peninsula, they are usually found resting on the slates, and it is only in the peninsula outrunning from the mainland towards Beeson's Island that they come in contact with rocks belonging to the Kapanga group, and here their relation to the elder group is not clearly displayed.

In the Puriri Valley they are unconformable alike to the Thames-Tokatea, Kapanga, and Acidic groups, to the Kapanga group and the rhyolites in the Hikutaia Valley, and to the Thames-Tokatea group in the Ohinemuri Gorge. Less plainly are they seen to be unconformable to the Kapanga group in the Komata and Waitekauri Valleys, or to the doubtful Thames-Tokatea rocks of Te Aroha. South of Waihi Plain, in the great eruptive centre of Hikurangi, many hundred feet of rhyolite is piled on top of or errupted through rocks of the Beeson's Island group, and the relation of the two in that mountain is that of evident unconformity.

Reefs occur in these rocks at Port Charles, perhaps at Kennedy Bay, at Matarangi and Kuaotunu, in the ranges behind Mercury Bay, and at Waihi Beach, probably also in the Katikati district beyond the limits of the area examined; but it is only in the Kuaotunu district where any of these have been worked to any extent. Possibly Golden Hill Mine, Manaia Valley, and some others in that vicinity may be in these rocks or in decomposed dykes of this period. Generally, however, on the mainland this is not a group of rocks productive of many reefs or of much gold. On the Great Barrier Island the silver-mining district in the vicinity of Blind Bay is in these rocks.

The age of these rocks has by most previous writers been regarded Miocene, and to that period they are here referred. There is no distinctive proofs of their age anywhere to be found, fossil plants and freshwater mollusca (*Unio*) not being regarded satisfactory evidence. Even this, as seen in the vicinity of Table Mountain, has to be considered as having come from the rhyolitic formation.

Older Pliocene.

Acidic Group.—Within the mountainous and hilly parts of the Peninsula these rocks are for the most part confined to the eastern watershed and the district south of Mercury Bay. With respect to the pumiceous deposits of the plain west of the mountains and south of the Thames, these, consisting mainly of sands and gravel of recent date, have to be treated elsewhere in this report.

The group as developed in the mountains and on the east side of the Peninsula consists of a variety of rocks, some of which are, chemically, doubtfully to be considered under this head, but which are stratigraphically or otherwise connected with it. Near the southern source of the Waiwawa River there is a development of soft sandstones and shales with coal seams, followed by a conglomerate mainly consisting of andesic rocks that interpose between the rocks of Beeson's Island group and the rhyolite formation of that part, but these are associated with rhyolitic tuffs following them without apparent break in the sequence, and are unconformable to the rocks upon which they rest, and, consequently, have either to be treated of apart from the former or as part of this group, and, as other similar deposits occur in higher horizons, and in other localities, they cannot well be dealt with other than as here proposed. Sometimes, also, deposits that are mainly rhyolitic, as in the cliffs along the south shore of Mercury Bay and the east side of Whitianga Harbour, contain a proportion of andesic rocks as inclusions, and also in the same vicinity there are limited areas of devitrified rocks of an andesic type: these have not to be considered as affecting generally the character of the rocks within that region. Also, in the district round the sources of the Rangihua, frequent masses of andesite are met with, the source of which cannot be clearly stated, but, as the bulk of the country is decidedly formed of rhyolite, they, in a general description such as this is, may, apart from the mention of them, be disregarded. The like also occurs in some parts of the valley of Stony Creek, and on the higher parts of the main range; and again on the western slope of this there massive outcrops of andesic rocks in a district of which the great bulk of the rocks undoubtedly belong to the Acidic group. Andesites are also reported as occurring in the mountains on the north side of the entrance to the Tairua River, but whether this be so or no the great bulk of the mountain is formed of spherulitic rhyolite. In the Ohinemuri Valley, near Owharoa, rocks of a highly felspatic character occur in association with rhyolites, and these it might be claimed do not belong to the group, but none the less they occur in association with and gradually pass into the adjacent rhyolites. Sedimentary beds mainly but not wholly of rhyolitic material occur at many places within the area mapped as covered by rocks belonging to this group, yet these, however denominated, cannot be conveniently dealt with separate and apart from the bulk of the great Acidic group of rocks now to be described.

Fragmental or solid, the bulk of the formation consists of rhyolite, which may be completely devitrified, as round the headwaters of the Hikutaia River, spherulitic or perlitic, but generally as a more or less devitrified rock exhibiting in a marked degree fluxion-structure, and may be massive, porous, or brecciated.

At the old mill opposite Mercury Bay Township the beds showing along the east side of Whitianga Harbour are massive accumulations of rhyolitic ash that to a remarkable degree resemble cliffs of Oamaru limestone, and the calcareous sandstones of the Cretaceo-tertiary period in the South Island and many parts of the North Island. On the surface these rocks have often the appearance of being formed of fragments of pumice, but this arises from the partial decomposition

and weathering of the rock. Frequently this rock contains fragments of dark andesite, which when cut and polished is seen to be holocrystalline. These rocks extend eastward to Cook's Bay on the south side of Mercury Bay, and on the west side of that form Shakespeare Cliff. They weather into fantastic shapes, some remarkable cliffs of this kind appearing opposite Mercury Bay Township. These rocks are followed by solid grey rhyolites that form the hills to the south and east as far as the waterfall on the road from Mercury Bay to the lower Tairua. In the valleys of the creeks draining into the swamp at the head of Cook's Bay fragmental rocks again appear, and before reaching the saddle by which the road passes into the valley of the Purangi Stream considerable quantities of obsidian are met with in the higher beds. At one place a somewhat greater than ordinary quantity of obsidian appears as loose fragments alongside the track, and at first sight it seemed as though this had been collected by the Maoris for the purpose of obtaining cutting-flakes and other instruments; but as on closer examination it was seen that this had not been the case, it became important to trace the loose fragments on the surface to the beds from whence they had been derived. After some search the source of these was found to immediately underlie a thick bed or floe of coarse, spongy, or highly vesicular rhyolite that forms the higher part of the hill west of the saddle, and descends from this into the valley of the Purangi. This particular stratum containing much obsidian stretches westward through the hills to the shores of Whitianga Harbour, and is seen to have a low dip to the south-east.

On the east side of Cook Bay there are considerable deposits of light-stone-coloured or yellowish-brown rocks, some parts of which consist wholly of spherulite, from which many rock-slides have been prepared by Mr. Bradshaw, of Mercury Bay. Mr. Cheeseman, of the Auckland Museum, informs me that perlite also has been obtained from this locality, but no sample of this rock is in the collections made by me from the neighbourhood of Mercury Bay.

Round the sources of the Purangi the spongy coarse vesicular rhyolite forms a prominent band dipping through the hills to the south-east in the direction of the coast at Whigmore's. To the westward, overlying beds of decomposed rhyolite or rhyolitic tuff of various colours, forms the hills for a considerable distance in the direction of Whenuakite; and to the south-east of the broad swampy plain that lies to the left of the road to the Whenuakite the hills towards the coast-line are composed of like materials. Towards the south-east from the Whenuakite Station the more coherent tuff rhyolites again make their appearance, and there appears to be a rude synclinal arrangement of the beds between a point to the north of Boat Harbour and the mouth of the Whitianga River, at Mercury Bay. The lowest beds seen in this area are solid, somewhat splintery, brown and green rhyolites, that form the range between the middle part of Stony Creek and the upper part of the Whenuakite. These rocks rest on augite andesites developed to the south-east, and constitute the limit of the rhyolite formation in this direction within the area north of the lower Tairua River.

From the upper Whenuakite the eastern boundary of the rhyolite trends to the south-west outside a tongue-like projection of andesites and ash-beds belonging to the Kapanga group, which passed it again runs south-east to the north head of the Tairua River. Over this area of the rhyolites no special examination of the rhyolite has been made, except in the mountain forming the north head of the entrance to the Tairua River. Here the most beautiful examples of fluxion rhyolite and supherulite may be obtained. On the north side of the mountain, where exposed to the full force of the open sea, very fine sections of the beds are displayed, and here the structure of the rock is seen to the best advantage. Fluxion-structure is exhibited on a gigantic and also in the most minute scale; and at the same time the rock is often spherulitic, a peculiar modification of spherulitic subcrystallization being here common. This consists of a solid nucleus of spherulitic substance from which spring radiating spikes of the same material, the lateral margins and terminations of which are often encrusted with crystals of quartz. Through the kindness of Mr. Bradshaw, of Mercury Bay, microscopic slides of this echinal spherulite were prepared from specimens collected by me, and these constitute objects of the most wonderful beauty and scientific interest. Later in the season were forwarded to me specimens collected by H. D. M. Haszard, Government surveyor at the Thames, which shows this structure in specimens of large size, but apparently without the attaching quartz crystals.

On the shore of the tidal estuary of the Tairua River rhyolites appear at the mill and township, but a little beyond this andesites appear on the left bank of the river, and, by way of a small island in the channel, these cross to the south-eastern side of the valley. Higher up the river, to a point between the Upper Landing and Broken Hills, the rhyolites are on both banks of the river, and the rhyolite area to the north and west is thus connected with an extensive development of the same rocks to the east, south of the Tairua.

Returning for the time being to the district around Mercury Bay, the rhyolites are found on each shore of the different arms of Whitianga Harbour, and along the valley of the Rangihau to Gumtown. The boundary between the Acidic group and the rocks of the Beeson's Island group reaches a short distance up the Rangahau River from where it is joined by the Waiwawa, and thence the boundary runs along the south-east slopes of the range between the two rivers to Dirty Camp, lying to the east of the upper valley of the Rangihau. To the south and east the whole country between the sources of Stony Creek and the waters running south-east into the Tairua River is formed of rhyolite and its allied rocks, and on the height of land between the Rangihau and the sources of the Kauaeranga Rivers the rocks of this group attain an elevation of fully 2,500 ft. above the sea. They are well displayed along the banks of the Rangihau and in the "Big Slip" at the source of one of its lesser branches.

On Bull's Run the rocks are partly sedimentary, partly andesic, but mainly rhyolite. From the sedimentary beds of this part were collected a number of well-preserved plant-remains, which, however, owing to their not having been critically examined by a competent authority and determined specifically, cannot be made use of in fixing the age of the deposit in which they were found, or of this group generally. Fluxion-structure is the chief characteristic of the rhyolites in this part of the district.

Towards the source of the Rangihau the rhyolites reach to the foot of Table Mountain, and more to the north of Table Mountain Range, at heights of 1,600 ft. to 1,800 ft. above the sea; but from the north-west side of the valley at Dirty Camp a narrow strip of acidic rocks, consisting of rhyolites and rhyolitic breccia, passes the north-eastern end of the Table Mountain Range, and, turning to the south-west, runs along the western slope of Table Mountain to the water-divide between the Waiwawa and Waiwawa Creek, falling into the Kauaeranga River. This area of acidic rocks within the Kauaeranga watershed comes in contact with the columnar intrusive rocks of Table Mountain, and, in all seeming probability, has been separated from the main area of the rhyolites east of Table Mountain by the appearance through them of the more basic rock. How this western tongue of the rhyolites is terminated in the upper valley of the Kauaeranga has not been definitely ascertained; but, owing to the continuance to the south-east of the columnar intrusive rocks of Table Mountain, it is probable they do not rejoin the south continuations of the main area east of Table Mountain.

On the saddle forming the parting between the Upper Waiwawa and Waiwawa Creek the rhyolite and rhyolitic tuff is exposed. Near the source of the Waiwawa Creek these are underlain by conglomerates composed mainly of volcanic rocks derived from the older groups, and these again by soft brown sandstones passing into or alternating with sandy shales and carbonaceous shales with thin seams of coal. In some places the finer of these beds resemble oil-shale; the whole resting on rocks of the Beeson's Island group, constitute a series of considerable thickness, estimated at from 200 ft. to 300 ft. *Unio aucklandicus* is very abundant in some of these beds, where they are also crowded with plant-remains, and are generally of a dark colour owing to the presence of carbonaceous matter. The plants are similar to those collected from the sedimentary deposits in connection with the rhyolites on the east side of the Table Mountain Range. In the Waiwawa Creek the beds dip east at angles varying from 15° to 20°. This shows that considerable movements have taken place since they were deposited, and that they are of older date than the high-level deposits of the low grounds on the west side of the Peninsula, which are scarcely, if at all, disturbed.

The rocks forming the area of the Acidic group on the east side of Table Mountain, and thence stretching south along the water-divide between the Kauaeranga and Tairua Valleys, are confined on its western side to the higher part of the mountain-range. Round the sources of the Hikuwai and the Second Branch of the Tairua the eastern boundary of the rhyolite, &c., is very irregular, owing to the manner in which these have been cut through, and the underlying rocks of the Kapanga group exposed along the bottom and sides of the many deep gorges and narrow valleys that intersect this part of the range. The acidic rocks are, however, continuous along the higher part of the range to the first peak north of the source of the Fourth Branch, and descend the range on the east side to within a mile of the Tairua River. Spherulite and dark pitchstone rocks having a perlitic structure are rocks of common occurrence on this part of the range.

At the point where the Fourth Branch leaves the mountains the rhyolites appear in the low grounds of the Tairua Valley, and along the east bank to the Broken Hills gold-workings. On the west bank of the river the underlying rock is often exposed, as has already been described, and an irregular boundary is thus formed with the outcrops of the younger rocks adjacent. Along the lower slope of the range the acidic rocks are often deeply involved along lines of contact with the Neavesville breccias, which constitute the auriferous rocks at Broken Hills. On the west side of Broken Hills the contact is as near as may be vertical.

East and south-east of Broken Hills the rocks of the Acidic group occupy a large extent of country between the Tairua Valley and the coast-line, and this, to some extent separated from the northern area, beginning at Mercury Bay, may be treated of separately.

In the angle formed by the Hikuwai Stream and the Tairua River, below the junction of the two on Marsh's farm, there is an outcrop of glassy fluxion rhyolite in which common opal and opals of high quality are found. Excellent specimens of fire-opal are here obtained, and some of the stones of better quality are of considerable size. A quarry has been opened for the purpose of working the gem-bearing stone, but the methods in vogue at the time the place was visited last March were not such as should be practised with the aim of preserving the stones unbroken and entire. Many of the opal stones are without question valuable, but care will have to be exercised in obtaining the rough block, and skilful means employed in the extraction of the gems from these.

From the upper to near the lower landing on the Tairua River, a distance of from five to six miles, the acidic rocks appear on both banks of the river, and, with the exception of a small area in the foothills opposite the island above the lower landing, and the possible presence of andesic rock in the sea-cliffs of the coast-range between the mouth of the Tairua River and the entrance to the Wharekawa River, and a small area of hard dark andesic rocks on the north bank of the Wharekawa, the whole country between the Tairua River, the coast-line to the south, and the Wharekawa River, is formed of rocks belonging to this group.

Some distance below the line of travel, from Whangamata across the Tairua Valley, and the main range between the Omaha Puriri Streams in the Tairua Valley, the acidic rocks cross from the east to the west side, and thence reach on to the crest of the main water-divide at the source of the southern branch of the Puriri. Rhyolite is sparingly met with in the northern branch of the Puriri, and within the valley of this stream it has not been detected *in situ*. Rhyolite tuffs, glassy and earthy rhyolites, and great masses of grey earthy rocks of the same type, are met with between the upper part of the Wharekawa and the upper third of the mountain by which the track crosses the main range from the Tairua to the low grounds of the Omaha Stream. The higher part of the range is formed of solid dark andesite, but, after making for some distance descent on the western side, rhyolite tuff again makes its appearance at a lower level, to be again followed by andesic rocks, and these again by solid rhyolite, forming Omaha Peak and extending south across the main valley of the stream into the Hikutaia watershed. In quite the low grounds of the Omaha Valley the rhyolites come in contact with the breccias of the Beeson's Island group.

In the upper valley of the south branch of the Puriri magnificent specimens of spherulite and perlite combined may be collected, besides other varieties of rock belonging to this group, the higher part of the mountain-range bounding the valley to the south-east being formed of acidic rocks. Dark perlitic pitchstone occurs here and in the Omaha Valley, passing into a variety of rock resembling the opal-bearing stone of the lower Tairua Valley.

In the ranges between the upper Omaha and the Hikutaia rhyolite prevails at levels above 800 ft. or 1000 ft.—as solid, brecciated, or as tufaceous deposits of rhyolitic material. Where the main range from Table Mountain is terminated, overlooking the middle part of the Hikutaia Valley, much fragmental rhyolitic material has apparently been stratified under water, but this is not so clearly displayed here as is the case in the upper basin of the Tairua, at the Wires, on the road from Hikutaia to the landing on Whangamata Harbour. This being at a considerable elevation, the erosion of the Hikutaia Valley has laid bare in the lower grounds the rocks of the Beeson's Island group that unconformably underlie the younger group, and these appear along the different side valleys, causing the western boundary of the Acidic group to be somewhat sinuous, and, in the case of the valley of the left branch of the Hikutaia, to recede as a deep embayment to the north-east.

In a tract of country lying on the west side of the upper Tairua Valley, between the Omaha and Wires tracks, andesic rocks belonging to the Beeson's Island group, or to the Kapanga group as represented between the upper part of Whangamata Harbour and Waihi and Waitekauri, may be present, but the district, being inaccessible, was not examined. The probability is the larger part of the area shows the presence of the rocks of the Acidic group, although prospectors state that quartz reefs of large size are met with in this part of the district.

In a line from Neavesville to Whangamata, between the Tairua and Wharekawa Rivers, stand a number of high peaks formed of rhyolite, which constitute a prominent and remarkable feature in the landscape; and it is these as seen from Neavesville that more than anything else simulate the physical features of the mountains of the main range of the South Island. More to the south, a little north of the Wires Store, a bold craggy hill, and a ridge of lesser height to the north-east and east, bound the depression at the Wires through which the source-stream of the Tairua River makes its way to the middle and lower valley. This basin to the south-east and south is also bounded by mountains, but to the west has been broken into by the cutting-down of the valley of the north branch of the Hikutaia. To the north-west it extends to the mountains outstanding from the main range in that direction, and which constitute the connecting line of water-divide between the main range from Table Mountain to the Hikutaia and that commencing at the source of the Hikutaia, and thence running to the north side of the Upper Ohinemuri or Waihi Plain at Waihi. To the north the Wires basin is open along the valley of the Tairua River. The basin thus bounded has been in comparatively recent times the site of a lake, and is now filled with sedimentary material mainly of a rhyolitic character. It is sometimes called "the Crater," but although volcanic vents from which the solid rhyolites of the neighbourhood were poured out may be traced, this in itself gives no evidence of being such.

The chief mountain in this neighbourhood, Waipahaki, stands between the source of the Tairua and the upper main stream of the Hikutaia, and is formed of massive rhyolite, in which mica is often abundantly developed, and which not infrequently resembles granite. These rocks extend to the south-west and west across the valley of the upper Hikutaia to the most easterly of the Maratoto Peaks. The contact between these rocks and those of the Beeson's Island group is vertical, and the change from the one to the other very sudden. From the same locality great quantities of spongy vesicular and spherulitic rhyolite is carried into the Hikutaia River-bed, and from this almost every variety of acidic rock occurring on the Peninsula may be collected.

South of the outlet of the Wharekawa River, the coastal range thence to the north head of the entrance to Whangamata Harbour is formed of rocks chiefly belonging to the Acidic group, and south of Whangamata the same rocks continue as a distinct range along the coast-line to near Waihi beach. In the northern part the rocks of this range have not been closely examined, but between the northern sources of the Ohinemuri River and the coast-line they consist very largely of spherulite and spherulitic rhyolite. Towards the south, on the west lower slopes of the coastal range, these rocks reach down into the low grounds and blend with the rhyolites of the lower grounds around Waihi and over the Upper Ohinemuri Plain. From the mouth of the Tairua River to the source of the Puriri, and thence south and south-east, a line so drawn may be regarded as the boundary of the second considerable area over which rocks of the Acidic group are found.

The third area of acidic rocks covers most of the low grounds of the upper Ohinemuri basin, and stretches up the lower parts of the valleys, running into the mountains on the north side of the plain to the Waihi Monument and to the westward are found in the main valleys west of the andesite ridge, on the road from Waihi to Whangamata, on each side of Martha Hill, and for a short distance above the road-line up the Waitekauri Valley. Such prolongations of the rhyolites do not occur on the south side of the plain, the southern prolongation of which, between the Waihi–Tauranga Road and the hills to the westward, shows andesite.

An earthy compact rhyolite forms the principal rock of the group around Waihi; but a remarkable brecciated form is found near the Waihi-Silverton battery, and tufaceous rhyolite is seen included between andesites in one of the main adit workings of the Waihi Mine. Martha Hill, containing the celebrated Martha or Waihi lode, has been described as being surrounded by rhyolite. This, however, is not the case; the ridge running north and connecting with the higher mountains in that direction being composed of andesites or other rocks belonging to the Kapanga group.

At the crossing of the Waitekauri River, on the road from Waihi to Karangahake, the remarkable brecciated form of rhyolite found at the quarry near the Waihi-Silverton battery is again seen. It a third time occurs in the hills immediately at the back of the Waihi Company's new battery at Waikino, and further down the Ohinemuri at the infall of Waterfall Creek, being exposed in the road-cuttings at the waterfall. South from above the waterfall on the creek of that name begins a line of cliffs that run in the direction indicated to the margin of the bush-clad

mountain-ranges, beyond the south-western edge of the Upper Ohinemuri Plain. This at places limits the extension of the rhyolites in a westerly direction: but at places beds of rhyolite underlying the rocks forming the line of cliffs extend yet more to the westward to and at places across the Whaitawheta River. On the north side of the Ohinemuri River the earthy compact rhyolite of Waihi appears at several places along the road to Karangahake, and is last seen near Owharoa in the bend of the river below the junction of Waterfall Creek, and forms the spurs immediately east of where the mines are situated at Owharoa. Downwards, this passes into a rock almost wholly composed of felspar crystals, but which at places exhibits a spherulitic structure. A little lower down the river the character of the rock changes, and dark andesites belonging to the Beeson's Island group make their appearance.

Opposite Owharoa the rhyolites continue at high levels along the ridge between the Ohinemuri and the Whangawheta, above the Karangahake Gorge, and in this exhibits a variety of forms, the felspar rock mentioned as occurring at Owharoa appearing on the southern slope of the ridge within the Ruapehu and adjacent mining leases. In one of the trial adits of the Ruapehu Claim this rock carries opals of a blue colour, and also fire-opals of very fair quality. Opals have also been detected in the brecciated rhyolites of Waihi.

A little beyond Mackaytown, on the road to Paeroa, an outcrop of rhyolitic tuff or of decomposed rhyolite appears on the roadside, and this extends north along the lower slopes of the hills into the valley next to the north, along which goes the mountain-road from Paeroa to Waitekauri. This was seen at two places on the Paeroa–Waitekauri Road, and at both places appeared more like a rhyolitic tuff than a solid rhyolite decomposed.

The last important area of the Acidic group occurring on the Peninsula forms Hikurangi Mountain, to the west of Waiau Gorge, on the road from Waihi to Katikati and Tauranga. The low grounds along the Waiau Gorge are formed of andesites and andesic breccias belonging to the Beeson's Island group, but the upper part of the mountain and the spurs running south-east and east to Captain Stuart's homestead are formed of rocks belonging to this group. The mountain presents all the appearance of having been a crater of eruption, but many of the rocks remind one strongly of what is to be met with in the upper Hikutaia. Great masses of magnificent spherulite are found fallen from the spurs running south and east from the mountain, and the granitoid rhyolite of the upper Hikutaia is also to be met with. The area covered by the acidic rocks of Hikurangi is not great, is triangular in shape, and about three miles in length on each side. This area is isolated, and apart from that of Waihi and the Upper Ohinemuri Plain, and south of this from the sea to the western slopes of the main range there is not a trace of these rocks; and, with the possible exception of this and some light-coloured rocks high on the hills overlooking the Waihi beach, the rocks from the sea at the mouth of the Waihi River to Te Aroha, and thence south to the boundary of the district examined and mapped over all the hilly country shows no rhyolite, but is composed of material classed as belonging to the Beeson's Island group.

The Acidic group rests at different places on the Beeson's Island and Kapanga groups, and in the Ohinemuri Gorge, on rocks belonging to Thames-Tokatea group, and, as will thus appear, is uncomformable to the youngest as well as the oldest of the three preceding groups of the volcanic series. Physically, its rocks are generally easily distinguishable from those of either of the preceding groups, although in certain cases some confusion has arisen, and, it seems, may yet arise, with respect to the more brecciated forms of these and the Kapanga rocks. When at Neavesville certain areas were described to me as corresponding in the character of the rocks present to those elsewhere that undoubtedly belong to the Acidic group, whereas the Neavesville rocks referred to belong to the Kapanga group. The same also has to be said of the lower part of the rhyolitic rocks at Owharoa, where they rest on rocks belonging to the Beeson's Island group.

As to the age of these rocks, they are admittedly unconformably younger than those of the Beeson's Island group, which are usually considered Miocene, and almost of necessity of Upper Miocene age. The Acidic group, as developed on the Cape Colville Peninsula, must therefore be regarded as belonging to the Pliocene period. Next, having regard to their connection or otherwise with the acidic group of rocks developed in the central region of the North Island around Rotorua and thence extending to Tongariro and Ruapehu, those of the Cape Colville Peninsula cannot be regarded other than as older and unconformably older than the pumiceous deposits of the upper Waitoa plain, and the extension of the same rocks to the southward. This is plainly and distinctly shown by a comparison of the positions which the Acidic rocks of the Peninsula occupy in relation to those of the plain, and the circumstances that have brought them to occupy the one set the mountain heights, and the other the low grounds of the district in positions not far separated from each other, under such conditions that they cannot well be other than unconformable.

Again, the broad characteristics of the two are different. Pumice as an original product is strictly absent from the rocks of the Peninsula: pumice is the great characteristic of the southern area of acidic rocks.

It has already been stated that the rocks of the Acidic group, and sedimentary beds associated therewith, form the tops of the mountains overlooking the western plain, from the source of the Puriri to that of the Hikutaia River, and that the barriers confining the lake or lakes once existing have on the western side been carried away. Therefore, as lacustrine strata is found at high elevations within from two to two and a half miles of the main road along the plain from Thames to Te Aroha, denudation subsequent to the deposit of the lacustrine beds on the mountains must have removed high land once existent over part of the area now low ground, and subsequent to the removal of this the pumiceous rocks of the younger acidic group were deposited. This is so evident that, without inquiring what the age of the younger series may be, the question may be dismissed in the full assurance that this is not of the age of the acidic rocks on the mountains and the east coast of the Peninsula, nor in any way connected with them.

The acidic rocks of the Peninsula are not generally gold-bearing, but reefs of gold-bearing quartz are not absent, and may yet prove to be more abundant and productive than at the present

time is thought to be the case. As a rule, the quartz is evidently deposits from thermal waters in fissures and pipes, or as deposits at the surface. Such deposits will be more particularly described under another heading of this report, and in the meantime it will be sufficient to state that gold in connection with quartz or sinter deposits has been found in Pumpkin Hill, on the east side of the lower part of Whitianga Harbour, Mercury Bay; at Whigmore's, on the east coast, about five miles south of Mercury Bay; in Stony Creek, at Ohui, and at Owharoa. The importance of the finds at the two latter places is considerable; at the first-mentioned places paying prospects—except, it may be, in the case of Whigmore's—have not been found. In the vicinity of Waihi, on the Waihi Monument Claim, the workings are on the very junction between the rhyolite and the rocks of the Kapanga group in the same neighbourhood, and, for the time being, it cannot be said into which group of rocks the auriferous ore is likely to be followed. In truth, the gold on this claim has been obtained from the consolidated sinter-deposits of a thermal spring, in connection with which there is a great body of iron-pyrites that are auriferous to such an extent that their further prospecting and the results of it may prove of considerable importance.

Chalcedony, agate, and jasper occur in all the groups of the volcanic series. Opaline stone also may occur in the different groups, but it is only in connection with the Acidic group that opals of value have been found. The more important find at Marsh's farm, near the Upper Landing on the Tairua River, has already been referred to. Opals are found also at other places, and there is a probability that, when sought for, this gem will be found at many places over the area covered by the rocks of this group. Little or no prospecting has been done having this object in view. Opaline quartz occurs abundantly in connection with deposits from hot springs; but at Marsh's, at Waihi, and at Owharoa the opals occur away from such influences, and appear as secretions in cavities of the rock in which they occur. Frequently these cavities are not filled, and when exposed by fracture of the rock the lower part is found filled with opal in various degrees of consolidation, uniform in colour or ribboned like jasper, while the upper part of the cavity is more or less completely filled with a white milky siliceous fluid secreted from the body of the surrounding rock. This occurs in the glassy fluxion rhyolites of Marsh's, and also in the more devitrified rocks of the Ohinemuri Valley, near Owharoa.

At many places building-stones of good quality might be obtained from the rocks of this group, and often in situations where they could be utilised—quarried and placed in the market at a minimum of cost. Prominent among these is the rhyolitic tuff of Mercury Bay. This rock, where free from inclusions of more devitrified or andesic rocks, in appearance resembles roughly a calcareous sandstone. Locally it has been used as a building-stone, and during a quarter of a century has proved its worth and durability. It withstands well the action of a moderate heat, and where used in that connection is well spoken of. Although the cliffs formed of this rock along the shores of Whitianga Harbour under the influence of the weather have assumed the most fantastic and grotesque shapes, the rock, after all, weathers and abrades but slowly, the tool-marks in the excavations for and the blocks in the masonry of the old mill at the ferry landing on the east bank of the river being yet almost as keen as when first the rock was cut into or dressed. This rock is found abundantly from Shakespeare Cliff to some three miles south of Gumtown, and for the most part in positions accessible by water.

The earthy rhyolite of the neighbourhood of Waihi is very suitable for building purposes, and when carefully selected is likely to prove a durable stone. Is has been used by the Waihi Gold-mining Company in various work in which strength and durability is an essential, and the same rock might be utilised in buildings in which other properties besides strength and durability are required. The same rock, or one similar and akin to it, is found at several places along the road between Waihi and Owharoa, and is similarly utilised in connection with the new battery being erected at Waikino by the Waihi Company.

Spherulite often occurs solid, and in such mass as makes it available as a building-stone. This rock is abundant in many parts. It is more accessible at Purangi, on the east side of Cook Bay; on the north side of the entrance to the Tairua River; and in Hikurangi Mountain, than at most other places. Some varieties of this rock are prone to decomposition, but that of Hikurangi seems to be a durable rock, and is of a good colour. In some places the component spherulites are very visible, and sometimes of large size, and in such cases this rock is of an ornamental character, and could be utilised as marbles, some of which are very beautiful, more especially where the spherulites are spiked or spiny. The spherulite occurs in a variety of colours, from light-grey through various shades of flesh and reddish colour to purple and black. In the latter case it is extremely hard.

Spherulite, both simple and echinate, abounds on the main water-divide between the Hihi branch of the Kauaeranga and the Tairua River valley, opposite Broken Hills, but it is in the mountain forming the north head at the entrance to the Tairua River where the latter form of this rock may be obtained with the greatest facility. The samples sent me by Mr. Haszard from the range between the Tairua and Kauaeranga Valleys, being surface-stone, were partly decomposed, and of a brown colour; also, the material was hard. The same rock at the mouth of the Tairua River is of a light-grey or buff colour, easily cut and susceptible of taking a high polish, and could easily be cut into veneers of moderate thickness. This structure occurs in the fluxion rhyolite on the sea-face of the north side of the hill, and it is here that the echinal projections are feathered and armed with crystals of quartz. Here, however, the spherulites are small.

Perlite is found mainly in the streams flowing west from the main divide between Table Mountain and the source of the Hikutaia River. In the Puriri River are found masses of beautiful pale flesh-coloured perlite in which are independent spheres of darker-coloured spherulite. Dark-coloured pitchstone having a perlitic structure is plentiful in the gravels and boulder-beds of the Kauaeranga River, in the Omaha, and in the Hikutaia, and doubtless at many other places within the limits covered by rocks belonging to the Acidic group.

The brecciated rhyolites of Waihi and of the Ohinemuri Valley, near Owharoa, are of a grey colour, and under the influence of the weather are prone to discoloration and decomposition. The rock is, however, remarkable for its solid yet brecciated character, and the fragments being of different tints of light- and dark-grey, this rock might be of use for interior work, slabs, panels, &c. Opals are occasionally met with in this rock, and, as it is often under the influence of the weather reduced to an incoherent mass, should in such cases the opal be of size and value they could be separated by a process of sluicing.

Newer Pliocene or Pleistocene.

Kauaeranga Beds.— These beds, which are of Newer Pliocene or Pleistocene age, are developed at the Thames, on the east side of the Shortland Flat, and thence extend along the foot of the hills to the Kauaeranga River. At the Thames they consist of grey sandy beds and red or purple-coloured clays. In the downs between the Kauaeranga and the lower Kerikeri they are pumiceous or coarse bouldery beds derived from the volcanic rocks of the Peninsula. Further south along the margin of the plain the superficial deposits seen are of like character.

North of the Thames the beds of this age are for the most part or wholly beach-gravels, and are unimportant, other than as proving an elevation of the west side of the Peninsula since the date of their deposit. It has already been mentioned that such beds occur at Torehine, Cabbage Bay, up to some 80 ft. above sea-level. Between Hastings and Kirita Bay the same deposits reach to 200 ft.

In the Katikati district the lower downs between the mountains and the shore of Tauranga Harbour are formed of these beds. The material of which they are formed in this part is in part pumiceous and partly waste from the andesic rocks of the main range to the westward. The andesic breccias of the Beeson's Island group stretch out from the mountains, and, underlying the more modern deposits, show in the deep-cut channels of different streams flowing east to Tauranga Harbour. Along the east side of the Peninsula, from Waihi Beach to Port Charles, there is scarcely any evidence of the presence of these rocks, the various river-flats and alluvial flats lying round the upper parts of the tidal inlets being of recent date.

Recent.

The Waihou or Waitoa Plain, extending along the western side of the Peninsula from the southern boundary of the district examined to the Frith of Thames, has to be regarded as coming under this head. Away from the foot of the mountains and the stronger carrying-power of the streams coming from these, the plain is formed of pumice, drift, loam, or peaty deposit, according as circumstances have determined. Along the margin of the mountain region the detritus from these covers up more pumiceous deposits. The pumiceous material exists in the form of gravel and sand, or beds of yet finer grain. In the various exposures of these rocks there is no evidence of the presence of solid pumice or other rocks belonging to the same group, and between Te Aroha and the Thames all pumice-deposits have to be regarded as due to the action of a river of considerable volume, probably the Waikato, which formerly discharged into the Frith of Thames. Elsewhere the recent alluvial deposits require no special description. The position of the larger areas are shown on the map accompanying.

Dyke-intrusions.

It is beyond question that, considering the Peninsula has been the theatre of intense volcanic action, during long intervals, in different geological ages, dyke-intrusions, or the evidences of them now remaining, are far from abundant. Whether present or not—and their absence would be so remarkable that we must naturally assume their presence in some degree over the Thames and Coromandel Goldfields—some writers on the geology of the Peninsula, Cox for example, never so much as makes mention of a dyke in connection with the auriferous rocks of the Thames Goldfield; and, as showing their comparative rarity, Professor Hutton makes special mention of the fact that some specimens collected by him give in their microscopic characters undoubted evidence of being dyke-rocks.

Between the Mata and Waikawau Rivers, dykes, described by Hutton as composed of diorite, appear on the shore of the gulf. There are some eight or ten exposures of these, but from their strike, and the sinuosity of the coast-line, in number there may not be more than three or four. A massive dyke in slate is seen crossing the Manaia River near the junction of the first branch from the north-east. This strikes to the south-west, and in a decomposed form probably forms the gold-bearing igneous rocks of the Golden Hill Claim.

In Castle Rock, on the range between the sources of the Matawai and the upper Waiau, Coromandel, there is unmistakable evidence of the presence of a very large dyke. This forms the castellated crag that crowns the higher part of the range; and to the south-east, on one of the out-running ranges towards Mercury Bay and Kuaotunu Peninsula, the same rock appears as a tooth-like projection rising to a very considerable height above the general surrounding level of the range. Traced in the opposite direction, the same, or independent dykes of a like character, appear in the gorge of the Tiki Stream, now, however, breaking through slate rock, and the same rocks appear in Cadman's Creek more to the north. The working-shaft of the Kathleen Crown Mine at Coromandel is being sunk in a grey porphyritic andesite, possibly a trachyte, that appears to be a continuation of the dyke or dykes seen in Cadman's and the Tiki Creeks, and the same rock appears on the coast-line in Kikowhakarere Bay, where, however, it is associated with a finer-grained and much darker andesic rock, also apparently a dyke.

Two very large dykes appear on the coast-line at Torehine, south of Cabbage Bay, and in the mass of Moehau, and thence to Port Jackson. It would appear that the great mass of the igneous rocks met with along the west side of the mountain are dyke-rocks.

At Materangi and on Kuaotunu Peninsula there are a number of outcrops of solid massive igneous rocks that probably are intrusive, but which were not examined carefully enough to determine the point.

In Table Mountain a vast development of grey columnar porphyritic rock appears to be and undoubtedly is of an intrusive character. This extends from the north end of Table Mountain Range through Table Mountain, across the source of the Kauaeranga by way of the Billygoat Falls to the Hihi Valley, and thence to the main range at the northern source of the Fourth Branch of the Tairua River. A probable extension of this is seen in the Fourth Branch one to two miles above its junction with the main stream. The Black Hill at Waihi, and the columnar rocks on the banks of the Ohinemuri at the Crown battery, are probably rocks to be classed under this head.

For the most part these dykes, &c., appear to belong to the period of the Beeson's Island group, and if this assumption be correct it still remains a matter for surprise that no very evident proofs of the occurrence of dykes, as belonging to the older groups, are to be met with. Further investigation may show clearly that these are not wanting.

Thermal Springs and Sinter Deposits.

These chiefly affect the junction-line between the Acidic group and whatever other formation the rocks of that may come in contact with. Thermal deposits as surface-accumulations are remarkably absent from the west side of the Peninsula from the Thames or Puriri northwards, and it is only at Manaia, along the junction between the slates and rocks of the Beeson's Island group, where traces of this action remains. Although chalcedony, agate, and jasper occur plentifully amongst the Miocene rocks of Cabbage Bay, such usually occur as small strings and nests in the joints and crevices of the rocks, and nothing in the shape of a sinter terrace appears anywhere at the surface. Nor do such deposits appear to be present in the district of Moehau, forming the northern part of the Peninsula. It is hardly to be supposed that the volcanic activity, as a result of which the Thames-Tokatea and Kapanga groups were deposited exhausted itself without a display of thermal action, and the only reasonable explanation of the absence of the evidences of this as usually met with at the surface is that such deposits have long since been removed by denudation. This is the more reasonable, seeing that there is evidence that a great part of the two older groups have been so removed, owing to the elevation of the Peninsula in the north and along its western side.

There is some evidence of thermal action among the rocks of the Beeson's Island group at Kennedy Bay, but in following down the east coast it is not till Kuaotunu is reached that the products of thermal activity is displayed on an important scale.

The Waitaia Range, east of the Kuaotunu River, runs north and south across the middle or nearer the western end of the Peninsula. The fundamental rock of this is Maitai slate, but volcanic rocks appear to the east and over the southern and higher part of the range. From the northern extremity for fully three miles to the south the higher part and eastern slope of the range is covered with frequent massive developments of siliceous sinter, that at many places, and generally, resemble quartz rock that might at first sight be taken for outcrops of an enormous "buck reef." A little observation shows that the quartz is for the most part at the surface, and does not descend into the slate formation after the manner of a reef. It caps alike the slates and the volcanic rocks, and is disposed along the higher part of the range sometimes as flat table terraces or jutting crags of quartz without leaner arrangement, and towards the south preserving in a marked degree the mound terrace outline of a hot spring. Most of the spurs descending to the eastward are covered by clusters of gigantic blocks of quartz, indicating the position of thermal springs, around which this quartz accumulated as siliceous sinter. Some of these are found quite down to the low grounds near to sea-level. Vast quantities of sinter blocks or whole terraces wrecked are found in the gorge of the creek draining the eastern side of the range. These may have fallen or rolled from the higher part of the range, or may be due to thermal springs, the locality of which was near to where the blocks now are. The sinter quartz is often subcrystalline, and has often a glassy appearance on the surface, clearly an effect of weathering and exposure to a saline atmosphere, being at furthest not more than from two miles to two miles and a half from the sea. On the northern fall of the range towards Mercury Bay, massive bodies of similar quartz occur in the volcanic rocks as reefs, but the deposits that are more particularly being described are clearly and unmistakably a surface deposit.

In the Lincoln Mine, near to the best-preserved terrace forming the higher part of the range, the volcanic rocks driven through have been completely reduced by the action of hot water to a puggy clay, and to all appearances the prosecution of the drive would lead into grounds immediately affected by the near vicinity of the thermal pipe, if not into the very pipe itself.

At the northern end of the range there are also terrace-mounds produced by thermal action, and in "Black Jack," the higher peak on this part of the range, the slates are fissured in all directions, the fissures being filled with siliceous deposits, which also form massive deposits in, or clinging to, the sides of the mountain. Gold is found sparingly in these deposits, and in a band of such rock cut in the Lincoln Claim, by the report of the manager, Mr. Ritchie, this yielded gold and silver at the rate of £5 per ton. Most, if not all, of the reefs on the Kuaotunu field show quartz of a character that leads to the belief that these have been deposited by the agency of hot water. They lie to the westward of the Waitaia Range, and strike nearly parallel thereto, or in a north-north-east direction.

Three miles from Mercury Bay, in Pumpkin or Pannikin Hill, there are heavy deposits of siliceous sinter, the deposits of hot springs, partly in the valley of a small stream flowing into an arm of Whitianga Harbour, and partly on the sides and top of Pumpkin Hill and the next adjacent to the south. Weathered this rock is of a grey colour, but broken into it is dark and flinty in appearance. The area covered by these deposits extends over fully half a mile square. The underlying rock is rhyolitic tuff and coarse spongy rhyolite. Many years ago a little alluvial gold was found in the bed and banks of the upper part of the creek, lodged among the finer material between blocks of

sinter rock. Recently prospecting has again been carried on at this place, and the ground has again been pegged off afresh. On visiting the place the former workings could still be traced, consisting of two or three large holes or small paddocks sunk near the bank of the creek, and an open cut or trench 5 ft. or 6 ft. deep, which followed a rib of dark sinter rock trending north-east towards Pumpkin Hill. The amount of gold obtained from this place was not great, but it sufficed to show that gold occurs in the rhyolite rocks in connection with thermal springs and their sinter deposits.

On the saddle by which the road from Mercury Bay leads into the upper tidal part of Purangi Creek there is a round hill capped by deposits of sinter, and a massive lode-like outcrop of the same material proceeds from this east across the road to Porangi Creek. The sinter in this is grey and opaline in character. The reef-like extension towards the eastward sheds blocks of large size, and towards Purangi Creek appearances indicate an independent centre of thermal action. The containing rocks are rhyolitic tuff containing obsidian capped by a thick bed of coarse spungy rhyolite. No gold has been found at this place.

At Hot-water Beach, six miles south of Mercury Bay, the beach is backed by cliffs fully 100 ft. high, the material of which is strongly impregnated with the deposits of siliceous waters as a cementing medium. Fossil wood occurs abundantly in these cliffs. A mile or so to the north of this is Whigmore's, where some prospecting for gold has been carried on in a brecciated deposit of siliceous sinter occurring after the manner of a reef, as on the saddle leading into the Purangi Valley above described. The adjacent hill-slopes are covered with blocks of sinter clustered together at particular places, indicative of terraces at one time existent, but now, as such, destroyed. The bed-rock here is rhyolite. Gold has been found at Whigmore's in the vein-like bodies of sinter, which, indeed, may be followed into the ground as true reefs. Prospects were said to be obtained such as might lead to the belief that the lode would pay to work, but for some time past no prospecting has been carried on at this place.

Sinter deposits forming conical hills occur at several places south of Gumtown and east of Table Mountain Range, over the area covered by the rhyolite formation within the Rangihau Valley. The sinter of such deposits is usually compact, dark, and flinty. Veins and strings of chalcedonic quartz, evidently due to hot water, are met with in the hills bounding the lower part of Stony Creek, and from these evidently the little gold found on the hill-slope beneath has been derived.

Along the east side of the valley of Graham's Creek, the last creek that from the north falls into the estuary of the Tairua River, there is abundant evidence of thermal action, which, whether as still-existing terrraces and mounds, or as vast blocks and masses of chalcedonic quartz cap the hills, strew the middle and lower slopes of the hills bounding the creek-valley, or choke the channels of the lesser streams flowing into the main creek.

At Broken Hills the evidence of the action of hot water is patent and abundant in the masses of chalcedonic quartz that outcrop or lie strewn over the surface of the area regarded as auriferous.

Round the sources of the Hikuwai, the second and third branches of the Tairua River, and thence to the source of the Kauaeranga, and north along the higher part of the range, the evidence of thermal action is practically everywhere, and is testified to by every one who has penetrated into that part of the district. Much of the sinter from this part is of an earthy tufaceous character, implying a comparatively modern period during which the springs were active. Deeper-seated or older impregnations form a line of mineralised country extending from abreast of Broken Hills along the east slope of the main range as far as Neavesville. This segregation of quartz by thermal action along this part of the district affects chiefly the rocks of the Kapanga group, in which are thus formed innumerable nests and veins of chalcedonic or more crystalline quartz, that, occurring indiscriminately or ramifying through the rock in all directions at Broken Hills and at Neavesville, form stockworks the richer parts of which are being exploited.

The higher part of Pakirarahi west of Neavesville yet retains a vast body of siliceous sinter, the remains of a gigantic terrace, the eastern edge of which reached forward towards the Tairua Valley so as to cover the line of auriferous breccias that constitute the Neavesville gold-workings.

In the district of Wharekawa at Ohui there is abundant evidence of the action of hot water forming deposits at the surface and as veins in the rhyolite formation, and the gold-bearing veins worked in this neighbourhood must be regarded as due to thermal action within a region that at the surface is formed of rhyolite, whatever the nature of the rock in the further mine-workings may prove to be.

Throughout the district from the upper part of Whangamata and the Luck at Last Mine to Golden Hill and the Wires, the reefs all give evidence of having been formed by the agency of hot water, but great bodies of sinter forming mounds and terraces at the surfaces have not been noted, mainly through the rugged and inaccessible character of the country. Thermal action is evidenced in the valley of the Hikutaia River, mainly by the presence of blocks of sinter in the gravels of the river-bed. These, of an earthy character, are thus probably from deposits comparatively modern. Behind Mackaytown, in the Ohinemuri Valley, there is a massive development of sinter. On the Ascot Claim there is a very thick deposit of dark curly flinty quartz rock, which, forming a flat terrace, that on two sides—the west and north sides—shows vertical cliffs about 100 ft. high. This is evidently an old hot spring developed and built up on and over the junction between the Thames-Tokatea rocks and those of the Beeson's Island group.

In the Silverton Hills, at Waihi, hot-spring quartz is abundant as surface deposits, and as veins and reef-like masses descending into the rocks of the Kapanga group. The Martha Lode itself is of this character. The furthest south manifestation of this kind on the Silverton Hills is seen in the El Dorado Claim, in which the rock mined is dark flinty sinter, very similar to that found in the northern part of the district, on the rhyolite formation.

On the Waihi Monument Claim, three to four miles north-east of Waihi, close to or on the very junction of the Kapanga group and the rhyolite formation, a thermal spring, now extinct, had built up a terrace of chalcedonic and opaline quartz, of which now only a fragment remains. This constitutes a little rocky hill in the low grounds of the valley, and on being prospected gave traces

of gold. The quartz rock at the surface was driven into in one or two places, but these different trial drifts were abandoned, and a shaft was then put down on the east side of the mound or little hill. This, within a yard or two of the outcrop of the quartz rock, on being sunk some distance, entered on a deposit of dark, fine-grained, feebly-coherent iron-sulphide or pyrites, which continued for 40ft., and at the time the mine was visited this deposit in the shaft had not been passed through. These iron-pyrites contain gold, free or combined, and a sample taken from the deepest part of the shaft, on being exposed to the atmosphere till, on partial decomposition, it was reduced to an incoherent heap of crystals, was then panned off, and gold was collected in this way amounting to 3 dwt. 16 gr. per ton. The total of the gold contained in these pyrites amounts to but a trace or little more per ton.

Thermal springs are still present in different parts of the Peninsula—at Hot-water Beach, at Puriri, Te Aroha, and at Katikati. They are notable for their volume and curative properties, chiefly at Te Aroha and at Katikati. The springs at Te Aroha have been long and well known. Those on the opposite side of the mountains are now also coming into prominence on account of their value in application to special diseases.

Faults.

Faults of large displacement have not been traced at many places. The Moanataiari fault at the Thames has a course in approximately a north-north-west and south-south-east direction, and a downthrow to the westward which may be variously estimated as from 700 ft. to 1,000 ft. The Collarbone and Beach Slides at the same place have not been so well established or proved in the different mine-workings.

At Waihi the Martha Lode appears to be crossed by faults on both the east and west sides of the hill, thereby causing considerable difficulty in tracing the lode beyond the bounds of the Waihi Company's claim in each of these directions. The reef east of Martha Hill is clearly displaced to the north, and search should accordingly be made in that direction, and on the west side in the opposite direction.

Gold.

It is doubtful whether the flinty hornstone reefs found in the slates of Cabbage Bay and the northern part of the Peninsula are gold-bearing. They probably originated prior to the commencement of the volcanic activity that deposited the Thames-Tokatea and younger groups of volcanic rock, and therefore they may be left out of consideration.

Two main lines or belts of auriferous country are traceable, the first along the west side of the Peninsula from Puriri to Cabbage Bay, to which also the gold of Karangahake and Te Aroha may be referred; the second lies along the east side of the Peninsula from Kuaotunu Peninsula to Waihi and Waitekauri. Of the first, this is chiefly confined to the rocks of the Thames-Tokatea and Kapanga groups, but also at several places is found in slate country.

Whether there may have been two periods of gold-impregnation is a question which may not admit of determination at the present time; and whether on the one side of the Peninsula the quartz has been deposited by other than thermal agencies of an intense degree, and on the other in the presence of such intense thermal agency, may be also left for future decision. Apparently, however, the reefs in the older groups of volcanic rocks along the west side of the Peninsula are of much deeper-seated origin than those on the east side, and this may be a reason sufficient to account for the difference that obtains between the quartz on the two sides of the Peninsula. While chalcedonic, ribboned, and jasperoid quartz is not absent from the western slope of the Peninsula, massive sparry and crystallized quartz are the characteristic forms on this side. Calcite, perhaps as a secondary introduction into the reefs, is also much more common on the west than on the east side. The gold itself differs, not so much in mineral composition as an alloy of gold and silver as in the manner in which it is aggregated in the substance of the reefs or in connection therewith. On the west side it occurs visible and massive as very rich "pockets," or distributed as "blobs" and "dabs" throughout the stone or towards the walls of the reef or leader; often also entangled between the points of the crystals in drusy cavities—conditions that are not often exemplified on the east side of the Peninsula. All this may have arisen from the fact that we have now to deal with a formation the higher part of which is either non-auriferous or has been removed by denudation, a truth which seems to be demonstrated by the fact that the productive areas on the west side of the Peninsula, from the Thames to Cabbage Bay, are never far removed from the underlying slates. This has resulted obviously from the gold finding a resting-place near or being deposited in the lower part of the formation, whether of the Kapanga or the Thames-Tokatea group, and now being exposed or brought within reach of the miner by the tilting of the north end and west side of the Peninsula, and the denudation that followed, by means of which, as a necessary consequence, the slates and deeper-seated volcanic rocks were exposed.

As regards the continuance of the gold-bearing reefs into the slate formation that underlies the volcanic series, there are many well-established instances of this, and yet mining in slate on the west side of the Peninsula has not been established on a sound basis.

On the east side of the Peninsula the gold is fine, and for the most part evenly distributed through the reefs. Pockets of gold and specimen stone are not common, and—perhaps due to the more superficial character of the workings—refractory minerals are less common, and the ore is in comparison eminently fit for the application of the cyanide process as a means of gold extraction. On the whole, therefore, it would appear that in the one case we are dealing with the roots, in the other case with the branches, of the tree, and in the latter case it must be left to inference where the bole and trunk of the tree is to be sought for.

The most northerly area constituting a promising field is the Cabbage Bay district. Over this during the past two years a considerable amount of prospecting has been done, with hopeful but not decided results. This lies within the Kapanga group of rocks.

The next to the south is Tokatea Hill and the Success Range, an old-established field within which there are possibilities of future and encouraging developments.

To the west of the Tokatea area lies that of Kapanga and Coromandel, within which gold was first discovered on the Peninsula. After many ups and downs this field startled the mining world by the unwonted developments within the Hauraki Mine, from which within a very limited area of ground two hundred thousand pounds' worth of ore has been produced since the commencement of the present "boom" in mining on the Peninsula. Less important, yet highly promising, are the discoveries being made between the end of the Success Range, along the main watershed to Castle Rock. Although the development of mining at the Tiki proper has been slow, on other parts of the range hopeful progress has been made during the past two seasons. More recently active prospecting has been carried on on the east side of the Castle Rock and Tiki Ranges, it is said with good prospects of success. In the Manaia Valley, mining is chiefly carried on in slate country, and, although of late considerable prospecting has been carried on, the value of the field has yet to be proven.

At Tapu Creek, and thence to the Thames, there is along the west slope of the range considerable activity, and generally miners are hopeful, although no very startling results have lately been obtained. The proximity of the slates to the auriferous rocks of Tapu Creek, and the fact that gold-bearing reefs have there been traced into the slate formation, gives to this locality a peculiar interest, and the progress of developments in this connection are anxiously awaited.

At the Thames much preparation is being made with a view to further developments in the hills east of the Moanataiari fault and over the low grounds of Shortland Flat. Without question the expenditure of money on this field means an increase in the gold returns, on completion of the preparatory works. The field has yielded largely in the past, and, while the glories of bygone days may never return, it is not to be thought of but that a greatly increased output of gold will be the result of the works in progress.

The Puriri field seems to have been neglected and, of late, forgotten. It is worthy of better things. Next to the south are the Maratoto and Komata, but these belong to the Waitekauri area, and as a system of reefs to the east side of the range. The Karangahake Goldfield is perhaps the most flourishing in the southern part of the Peninsula, and certainly is the most so of those that lie on the main geological axis of the Peninsula. The Te Aroha field is in a less flourishing condition.

On the east side of the Peninsula, commencing at the northern extremity of the eastern belt of gold-bearing country, lies the Kuaotunu Peninsula. This, at first slow of development, afterwards yielded from a few claims a large quantity of gold, but during the past few years the gold yield has declined, owing to the main shoot of gold in the Kapai-Vermont and Try Fluke Mines having been passed through and its richer parts worked out. Southward of these, at lower levels, in the claims next adjoining and succeeding, a continuation of payable auriferous quartz may be expected, and claims located on other lines of reef are hopeful as likely to afford paying returns in the near future. As in this field the bulk of the gold product has been obtained from reefs in the slate and sandstone country of the Carboniferous formation, and as the reefs in the lower levels of the more important mines have not pinched out or materially lessened in thickness at lower levels, there is warranty for the prosecution of deep sinking in the hope of reaching underlying shoots of gold, which it is reasonable to suppose do exist. How far warrantable and how likely of success prospecting for gold in the quartz and sinter deposits of the Waitai Range is a matter which future enterprise must determine. By analogy there is hope; so far as tried the results seem not to have been of the most satisfactory kind. Gold-mining at Matarangi and outside the slate area on the Kuaotunu Peninsula is for the most part in the prospecting stage.

In the Mercury Bay district the reefs being prospected in the Mahakirau Valley and the adjacent valleys to the south in character belong to those on the west side of the range. Excellent prospects are from time to time reported, but the inconstant character of these, or the difficulties attending the development of the reefs, places them in a somewhat backward position.

South of Mercury Bay, at Pumpkin Hill, at Whigmore's, and at Stony Creek, gold has been got in small quantities only, and although this field is interesting on account of rhyolite being the containing rock, at the present time at least, it cannot be regarded as of great importance.

The Boat Harbour field, extending to the upper part of Stony Creek and south to the Tairua River, has been prospected to a considerable extent during the past season, without, however, yielding any marked results.

At Broken Hills and on the adjacent slopes of the main range there is a promising field, and one that is held in high estimation by those engaged in its development. There is every evidence of faith in the field, but, as milling plants have yet to be or are but being erected, the real value of the field cannot be determined at the present time.

On the Neavesville field matters are in a backward state, partly from the inaccessibility of the position and partly from difficulties with respect to the right to mine for gold over these lands; but some prospecting being done at the Brothers, on the south slope of Pakirarahi, was said, during March last, to be productive of highly encouraging results.

Ohui lies on the coast-line between the mouth of the Tairua and Wharekawa Rivers, nearer the latter. The country is rhyolite and the character of the quartz thermal. Gold has been got in several claims, and a considerable amount of prospecting is being carried on. Here results more encouraging than from the rhyolite formation elsewhere are being obtained.

Over the Whangamata field, extending from the Wharekawa River to the Wires, there are many reefs, and a good deal of prospecting is being done. The most important mine on this field, the Luck at Last or Whangamata Proprietary Claim, lies in the northern part, close to the junction of the andesic breccias with the rhyolite formation. In the Wharekeraupunga district a number of claims are being vigorously developed, and there is an almost certainty that this will prove an important gold-producing centre on the completion of works now in progress. At Waihi prospecting is being vigorously prosecuted in the hope of finding the east and west continuations of

the different lodes in Martha Hill, while the lodes worked by the Waihi Company show no signs of being exhausted for many years to come. Over the Silverton Hills mining is being also vigorously prosecuted. Over the Waitekauri field, including the Komata and Maratoto divisions of the same, vigorous work is being prosecuted in all directions, and within these a large mining population is located.

CONCLUDING REMARKS.

The foregoing report embodies the results of the past year's work within the boundaries of the Cape Colville Peninsula. Necessarily, over so extensive an area, difficult of exploration, and of which the geology was not only difficult but practically over the greater part unknown, not much of close and detailed geology was to be expected. Nor under the circumstances was this attempted. In such a case the collection of rock-specimens necessary to illustrate the rocks of different formations and special localities would have proved such an impediment that but a small part of the whole could have been examined during the past season. The collecting of evidence from mines had also in a great measure to be abandoned, other than so far as this was necessary to a knowledge of the formation within which these might chance to lie.

The broader questions relating to the age, character, and limits of the older sedimentary formations and the volcanic rocks of the Peninsula, the relations of these to each other, and the modification of the surface due to the greater movements of the Peninsula, &c., though seemingly not directly connected with an investigation of which mining and the advancement of mining was the principal object, yet proved of such essential consequence that without this knowledge the main object could not be effected.

REPORT ON THE SILVER-BEARING LODES OF THE NEIGHBOURHOOD OF BLIND BAY, GREAT BARRIER ISLAND, AUCKLAND, BY ALEXANDER McKAY, F.R.G.S., GOVERNMENT GEOLOGIST.

Mr. A. McKAY to the UNDER-SECRETARY for MINES.

SIR,— 15th June, 1897.

In accordance with your instructions, under date of January 19th, 1897, I left Auckland for the Great Barrier Island on the 24th February, where till the end of the month I was engaged in making the examination required to enable me to report on the silver-mining now being carried on in the neighbourhood of Blind Bay, on which I have the honour to submit the following report:—

GENERAL SKETCH OF THE GEOLOGY OF THE GREAT BARRIER ISLAND.

My examinations were confined to the immediate neighbourhood of where the silver-mining lodes are found, and, except as given by Professor Hutton, who in January, 1868, reported on the geology of the island, there is no other description of the whole of the Great Barrier Island on record. I therefore extract from Professor Hutton's report his remarks on the general geological structure of the island. He says,—

"*General Geological Structure.* — The greater part of the island is composed of volcanic (Trachytic) rocks resting on and partly enveloping sub-metamorphic slates and sandstones of Upper Palæozoic age. These Palæozoic rocks come to the surface only in the northern and central parts of the island, and form steep mountain-ranges, for the most part thickly covered with bush.

Over the greater portion of the island the older rocks have been worn down to or below the present sea-level, and here they are covered by thick masses of trachytic tufa and agglomerate of late Tertiary age. Speaking generally, this land, except the bottoms of the valleys, is poor, and bears more fern and manuka scrub than bush. The trachytic tufa seems to be too purely siliceous to form a good soil, and when charged with oxide of iron decomposes into a pink or brick-red 'laterite,' which is exceedingly barren. Where, however, it mixed with streams of lava of trachyte, or, still better, the dark-coloured trachy-dolerites, they add to the soil, on decomposition, the alkalies and alkaline earths that are wanting in the fine-grained tufa, and so improve it. The same thing happens when blocks of lava are collected together in the tufa to form an agglomerate; and, as these lavas and agglomerates are considerably harder than the fine-grained tufa, they resist the action of the rain and atmosphere much better, and so generally form the summits of the hills. This is the reason why here, as in many volcanic countries, the soil at the tops of the hills is often more fertile than that of the slopes or valleys.

"*Palæozoic Rocks.*—The whole of the north part of the island, from the Needles to a line drawn from Maori Bay to Waikaro, is composed of dark-blue siliceous slates and diorite sandstone, the slates often containing rounded stones of a fine-grained dark-grey sandstone. These rocks, especially at Mine Bay, are cut by numerous dykes of quartz-porphyry, felstone, and diorite (granite of the miners), and the dip is very obscure. I am, however, inclined to think that a synclinal axis runs from Mine Bay to Rangiwhakea, rising towards the east, as the dip in Needles Bay is 70° S.S.W., and at Waikaro 45° N.W. To the southward the continuity of the strata is interrupted by a mass of tufa, but a little north of Harataonga, Palæozoic rocks apparently similar to those in the north part of the island, are again seen; and in Harataonga Bay they appear to rest on dark-grey thin-bedded sandstones interstratified with laminated and indurated shales, dipping 20° N.

"An anticlinal axis probably passes a little south of Hirakimata, for Mount Young (1,260 ft.) is composed of pink-and-white siliceous slates, with small veins and nodules of chert, dipping 70° S. I was not able to ascertain the relation that these slates bear to the other Palæozoic rocks further north. The strike of the whole of the Palæozoic strata is nearly east and west over the whole of the north and central parts of the island."

"*Tertiary Trachytic Tufa.*—The whole of the south-west parts of the island, and a broad belt stretching from Maori Bay and Port Fitzroy on the west to Whangapoua Bay on the east coast, are composed of trachytic tufa and agglomerate, attaining, on the ridge between Kairara and Whangapoua, an altitude of 1,550 ft. This tufa is generally stratified, and is evidently a submarine deposit. At Onewhero, in Maori Bay, the base is seen to consist of coarse, soft, tufaceous sandstone, with seams of black laminated shale, which latter has given rise to the report of coal having been found on the island. I found no fossils."

. . . "Ahumata is" [a mountain] "1,500 ft. high, and is composed of trachytic tuffs and pumiceous ash or 'ceneri' traversed by siliceous veins. At the top a crater about a mile in diameter can still be distinctly traced, the south-east side being broken down."*

As the steamer called only at Port Abercrombie, Blind Bay, and Tryphena, in the south-west, I had no opportunity of examining and studying the older stratified rocks of the island; but from the description given of them by Professor Hutton, and quoted above, there can be no doubt that they are identical with the similar rocks seen on the mainland on Cape Colville Peninsula, stretching along the coast from Cape Colville to Stony Bay, rising into the mass of Moehau, the highest mountain in the northern part, and developed in various other places in the northern part of the peninsula.

In the middle part of the Great Barrier Island the slates lie towards the east, and nowhere south of Port Fitzroy do they appear on the west coast. The west coast of the middle part and the whole of the southern part of the island are composed of volcanic rocks belonging to the "Beeson's Island group," which are probably of Miocene age. The rocks of Beeson's Island were named trachytes by Hochstetter, and those of a similar description covering the greater part of the Barrier Island are recognised by Professor Hutton as trachytic rocks also. During the past season I have examined these rocks, both on the Barrier Island and on the mainland from Cape Colville to Katikati, and conclude that, while trachytic, they may be, in part, the great bulk of the formation so closely resembles the elder series of volcanic rocks on the mainland—the Kapanga and Tokatea groups—which are now generally spoken of as andesites—that, for the sake of consistency, it is necessary to speak of the Beeson's Island rocks on the Great Barrier Island as andesic in character, even though they turn out to be different. So often and so differently have the volcanic rocks of Cape Colville Peninsula been named that, until they have been examined and determined by a Petrologist of standing and repute, all renaming of them should be avoided, and the common names at present in use should be adhered to. As regards the mountain Te Ahamuta, this and parts of the adjoining area to the north and north-west are largely composed of siliceous sinter, the product of hot springs, which have had a gigantic development along the west coast of the middle part of the island. Professor Hutton describes this mountain as being built up of trachytic and pumiceous material, and as even now showing indications of a crater a mile in diameter, of which the south-east side has been broken down. I confess I could not interpret this mountain as being composed of such materials, nor trace on it any crater whatever. It is difficult even to locate the position of the latest thermal action on the mountain. The volcanic rocks of the island are, as has been said, identical with those which, on the mainland, within the bounds of the Cape Colville Peninsula, are characteristically developed on Beeson's Island, on both sides of Manaia Harbour, and at Cabbage Bay on the west side of the peninsula, and on the east coast from Port Charles to Mercury Bay.

On the Great Barrier Island the different typical and characteristic rocks of the Beeson's Island group are to be met with: the coarse breccias on the shores of Man-of-war Passage, Port Abercrombie, in the north, and on the southern shore of Blind Bay, in the middle part of the island; whilst decomposed and highly-ferruginous rocks, alternating with thick bands of white or grey rock, are met with south-east of Te Ahamuta.

The sub-columnar grey andesites of Torehine are present, interbedded with breccias, on the south side of Blind Bay, and, in like relationship, form the mass and flanking lesser heights of Hirakimata and its surroundings. The decomposed rocks flanking the Te Ahumata Range, and found over the greater part of the silver-bearing area, find their parallel on the southern end of the Waitai Range, at Kuaotunu and at Matarangi. The latter rocks in the localities cited have been decomposed and leached of their more soluble minerals; they now constitute the "Sandstone" of the gold-miner, and by some geologists to these rocks the term "Propylite" is applied, and this irrespective of the different original condition of the rocks or the periods to which they belong.

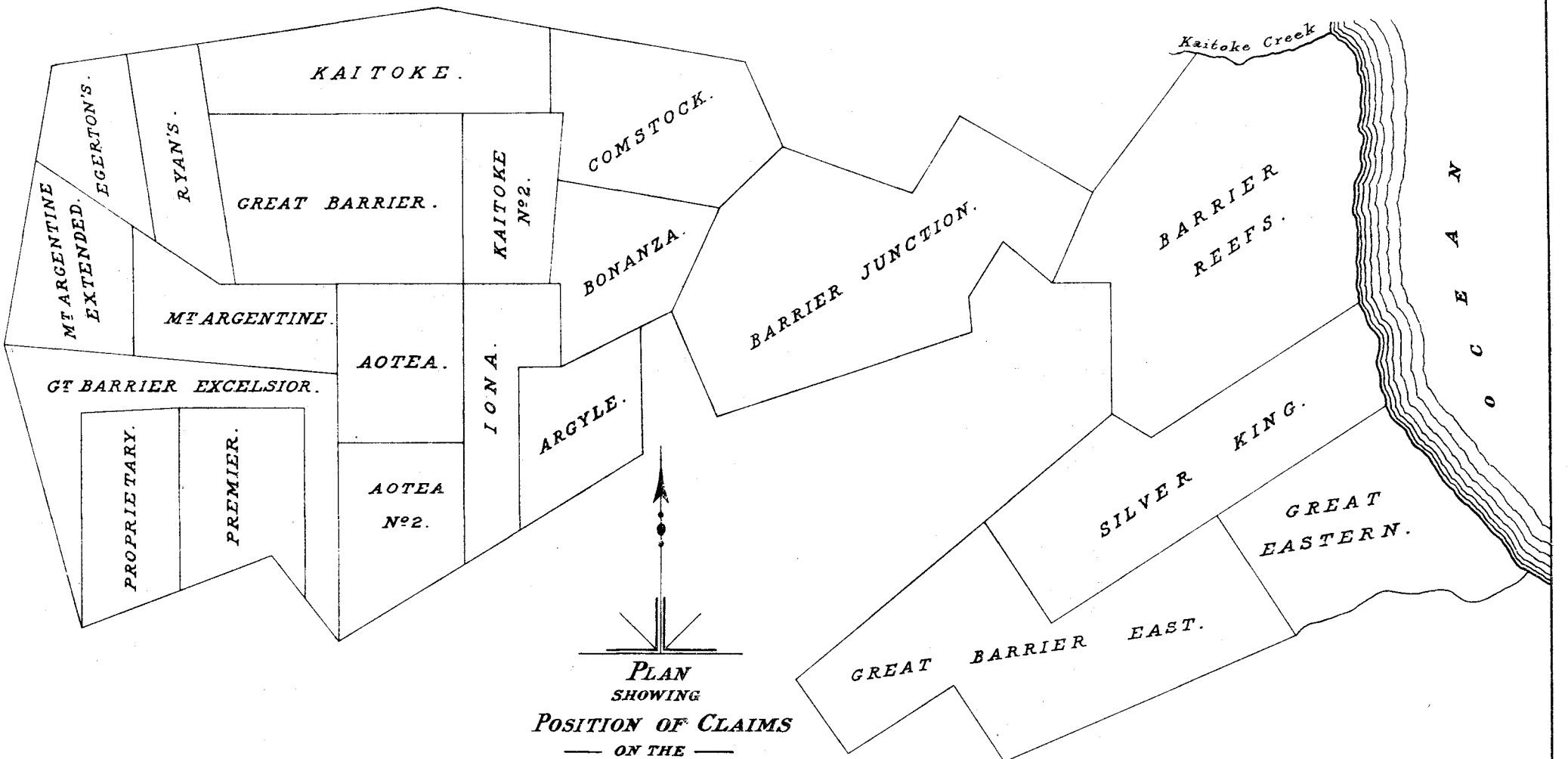
On the Te Ahumata Range, two miles to the north of the inner part of Blind Bay, there are vast accumulations of siliceous sinter that give evidence of great and long-continued hydrothermal action. The deposits from this cause, spread over an area of at least two square miles, vary from 300 ft. to 500 ft. in thickness.

Nests and strings of chalcedony and agate are met with in the lava floes on the south part of the island, and in the breccia deposits and finer-grained ash-beds of the same district, fossil wood silicified is frequently met with. Coal is reported as occurring near Cape Barrier. Antimony occurs in the eastern central district, and Copper in the northern part was worked for a time, but the mine has not been worked for many years past. Silver and Gold is found in reefs of quartz on the flanks and middle slopes of Te Ahumata Range.

Area specially examined.

Parts of Blocks II., III., VI., and VII., of the Great Barrier Island Survey District, were examined with special reference to the occurrence in them of silver-bearing reefs, more especially those parts that form the higher part and middle and lower slopes of Te Ahumata Range, and thence the country to the south and west to the shores of Blind Bay.

* Geological Reports, 1868–69, pp. 1–6.



PLAN
SHOWING
POSITION OF CLAIMS
— ON THE —
GREAT BARRIER SILVER FIELD.

To illustrate Report by A. McKay F.G.S. Mining Geologist.

Scale of Chains.
20 10 0 20 40 60 80.

On its south side, and east of the upper part of Blind Bay, the rocks are coarse breccias and solid floes of grey andesite belonging to the Beeson's Island group of Miocene volcanic rocks, as developed at many places on the Cape Colville Peninsula. On the northern side of the bay the rocks are mainly andesic lava floes that, due probably to hydrothermal action in or near them, have been much decomposed and leached of their soluble contents, till they now present the general appearance of the older series of volcanic rocks on the Cape Colville Peninsula. Andesic rocks much or but little decomposed appear on the south-east and north-east slopes of the mountain Te Ahumata and towards its northern end, under a lesser thickness of superincumbent sinter deposit than appears on the middle and higher part of the range. The same rocks appear on the south-west and southern slopes of the mountain, up to heights varying from 500 ft. to 700 ft. above the sea, and form the hills towards the coast-line west and north-west of Sanderson's Creek. Sanderson's Creek rises on the higher grounds of the northern part of the range, and flows south-west and south to the point where it falls into Blind Bay.

On the ridge between the upper part of Sanderson's Creek and the waters falling into the Whangaparapara Harbour andesitic rocks reach to a height of fully 700 ft. above the sea, but above that and even lesser heights the north-eastern end of this spur range is formed of siliceous sinter that, solid or in huge slips, covers to a low level the slope towards Whangaparapara Harbour. The sinter deposits of Te Ahumata cross the valley of Sanderson's Creek at the gorge above the Proprietary Mine, and are there seen at a lower level than elsewhere where the rocks occur *in sitù*.

On all sides except the northern, the middle and lower slopes of Te Ahumata are encumbered, and the andesite rocks often obscured, by enormous slips of sinter material that have broken away from the higher part of the mountain. One of these slides reaches the sea at the head of Blind Bay, and another, a little further to the west, reaches the shore-line in the valley of Sanderson's Creek.

Mount Te Ahumata, as seen from Blind Bay, lies to the north of the upper part of the bay, and on the south side the line of cliffs forming its higher part stretch nearly east and west. All the higher part of the mountain is formed of light-grey or white siliceous sinter, which outwards form vertical cliffs devoid of vegetation, and vary from 300 ft. to 500 ft. in height. It thus appears as though Te Ahumata had been suddenly and recently transplanted from the heart of the Southern Alps, in the South Island, and, still retaining a thick covering of snow and *névé* field, has till now succeeded in resisting at the same time the stronger sunbeam and milder climate of the Great Barrier Island. The great slips of sinter rock that in broad streams cover the southern sides of the mountain strongly resemble some of the less rock-encumbered glaciers of the South, and tend, if not to complete the illusion, at least to perfect the comparison that has been here made. On the north-east side of the mountain from the south and south-east sides the line of cliffs is continuous, without alteration of direction, to the culminating point at the trig. station 1,292 ft. above sea-level. From the trig. station the line of high cliffs trends more to the westward, and lowers considerably. The northern part of the range does not exceed 1,000 ft. in height. The andesic rocks are found at higher levels up to 900 ft. over this part, but sinter deposits still form the water-divide and two somewhat prominent heights at the northern extremity of the range. As seen from the outer part of Blind Bay the top of the mountain seems to be a narrow ridge, but from the south-east it is seen to be a sloping uneven tableland which in the line of north-west and south-east extension is slightly lower towards the south.

The mountain and immediately adjacent areas have been in past times the scene of intense and long-continued hydrothermal action, which has deposited at the surface the immense beds of siliceous sinter that have already been mentioned. But, extensive and thick as these deposits now are, they are much less than formerly they have been. What the former limits of the deposit were might be hard to determine, but it seems probable that it extended over the whole area within which silver-mining is at the present time being carried on, and it is likely that the quartz lodes bearing silver have been formed since the commencement of hydrothermal action; and there are examples of quartz reefs clearly subsequent to the formation of the lower part of the sinter deposit. The andesite rocks on which the sinter deposits rest are probably of Miocene date, and therefore to Younger Miocene or Older Pliocene times must be referred the period of hydrothermal action, and not to latter times, as there is some evidence that it must have taken place and closed before the period of rhyolitic outburst which made such display of volcanic action along the east side of the Cape Colville Peninsula.

The lowest and first-formed deposits of sinter consist of fine-grained flinty or evenly-bedded strata that betray no evidence of the presence of vegetable matter, but in the middle and higher parts the sinter deposit is one vast repository of broken plant-remains so thickly crowded together as seemingly to constitute its whole mass. Chiefly these remains belong to plants of no great size, but fragments apparently of small trees are sometimes to be met with. It would thus seem that a continuous growth over the same area was contemporaneous with the accumulation of by far the greater part of the sinter deposit, and that it thus was not of very rapid accumulation.

The slow accumulation of the sinter deposits, their great thickness and vast extent, their loss in thickness, and the circumscription of their area due to denudation indicate the lapse of a long period of time since hydrothermal action began and since it ceased. There are now no hot springs in or about any part of the mountain, though further to the east, in the low grounds of the Kaitoke Valley, thermal waters are still escaping at the surface.

On the higher part of the mountain considerable quantities of obsidian are met with, and at times it occurs in considerable masses, varying from 12 in. to 15 in. in diameter. The whence of this is not easily determinable. It is not to be met with on the hills formed of andesic rocks, solid or brecciated, away from the mountain, and it never occurs on surfaces where sinter forms hills overlooking the hollows and shallow valleys of the mountain-top, and is never included in the

sinter itself. As known on the mainland, obsidian is confined to the Rhyolite formation south of Mercury Bay, in which it occurs as part of the breccias between different floes of solid rhyolite rock. On Te Ahumata it is met with in the peaty soils of the hollows of the mountain-top, and in the upper part of Sanderson's Creek it occurs mixed with sinter rubble, and may therefore have been derived from the higher part of the mountain, as assuredly has been the case with reference to its occurrence on the south and south-eastern slopes of the mountain.

There are several funnel-shaped holes on the top of the mountain from which it is supposed this erratic obsidian may have been erupted, but an examination of these determined such a theory—the origin of the obsidian—as untenable.

The Reefs.

Lodes carrying silver-ores, and in some cases a considerable percentage of gold, occur on both the west and north-east sides of the mountain Te Ahumata, but as yet their known occurrence is never at a great distance from where are or have been sinter deposits, and there is thus some evident connection between the massive sinter deposits at the surface and the lodes of quartz that occur in the andesic rocks.

Proprietary and Premier Claims.—Silver was first found by the brothers Sanderson in the lower part of the valley of Sanderson's Creek, samples from small reefs in that part yielding silver on analysis. This led to the tracing of silver-bearing stone along the course of the stream upwards till in the end the Prospectors or Proprietary lode was discovered outcropping in the face of a slip. This in the outcrop and upper level yielded comparatively rich ore, and a quantity of ore was treated, yielding what was considered a satisfactory return, with the result that a company was formed which acquired the rights of the original prospectors, from whom, again, the Anglo-Continental Company acquired the option of purchase, and proceeded to prospect the lode at a lower level. In the works carried on by the Anglo-Continental Company the lode was cut, showing a good body of stone, and this was driven on to the right and left a distance of 30 ft. from the intersection of the lode, but apparently without satisfactory results, since on the expiry of the option period the Anglo-Continental Company did not purchase the property.

The lode strikes east and west, and has a high dip to the north, and should therefore extend west across the valley of Sanderson's Creek into the ridge covered with sinter deposit that lies between Sanderson's Creek and the upper part of Whangaparapara Harbour. In this direction a leader or small reef rich in silver has been discovered, but so far as could be ascertained the main body of stone has not been traced any considerable distance in that direction. To the east the lode should run through the Premier Claim, held by the same company, but to what extent prospecting has been carried on over this portion of the property was not ascertained. The quartz of the lode in the upper levels, and where richest in silver, was chalcedonic in character, often showing the structure of agate, and extremely complicated in the direction, twisting, and winding of the various laminæ of which it was built up. The presence of quartz of this character was considered favourable for the occurrence of ore. In the lower level driven by the Anglo-Continental Company the quartz is mostly of that peculiar platy character that distinguishes the Try Fluke and Kapai-Vermont lode at Kuaotuna, and which may either have the separate plates sub-parallel to each other or set at various angles so as to include triangular spaces very variable in size. The best of the ore had been removed from the paddock at the mouth of the mine, and what remained did not give a very favourable impression of the lode. Yet the mine has yielded rich ore, and may again do so, and it cannot be said that the lode in the lowest level has been very fully explored. The present company are preparing to drive an adit so as to cut the lode at a yet lower level, which may possibly lead to the discovery of rich ores, it being quite evident that this lode is somewhat variable as regards the richness and value of its ore-deposits.

Aotea No. 2.—This claim within its area includes part of the higher plateau level and southern slope of Te Ahumata, and, if continued so far, the reef in the Proprietary Claim should, in its east extension, pass through the southern part of the claim. With a view to proving this surmise, surveys have been made, indicating the position which the lode should occupy at the surface, and an adit has been driven a short distance into the andesic rocks of the south slope of the mountain.

The surveys did not lead to the discovery of the lode at the surface, and the prospecting adit failed to cut it. One or two small stringers of highly-pyritous quartz were met with, but these did not appear to be continuous, either horizontally or in depth, and for the present, after having been driven a distance of 60 ft., work in this adit has been suspended. In the eastern extension of the line of strike of the Proprietary lode quartz of the same character appears on the south-east angle of the mountain, at a height of between 650 ft. and 700 ft., but this lies within the boundary of the Iona Claim.

Iona Claim.—The area of this occupies the south-eastern and north-eastern higher parts of the mountain and the middle slopes to some distance below where the andesite rocks appear at the surface. On the north-east side of the mountain a massive reef extends along the base of the sinter cliffs, and of this the hanging-wall is within, and formed of, sinter deposit. This is clearly seen in the line of the adit now being driven to cut through and prove the thickness of the lode. To the north-west for some distance the lode is evidently in contact with the sinter deposit, and this is probably the case as far as the Iona Claim extends towards the north-west. In the opposite direction the lode must also be close to, if it be not everywhere on the hanging-wall side, in actual contact with, the sinter deposit. This, however, can only be the case at levels 650 ft. above the sea, which is the elevation at which sinter begins, and above which it forms the higher part of the mountain. At lower levels than 650 ft. it is very probable that both walls of the lode are "sandstone" or decomposed andesite.

At the surface above where the present adit is being driven the Iona reef shows a thick outcrop of quartz, and many large boulders strew the slope from the outcrop downwards, but these fail to convey an idea of the great size of the reef, as this is seen underground. As yet prospecting has been carried on by a single adit, which, cutting the lode 30 ft. to 40 ft. under the surface, shows the foot-wall to be decomposed andesite, the hade of contact with the reef being to the south-west at an angle of about 45°. The reef itself has, at right angles to its strike, been driven into a distance of 42 ft., at which distance the hanging-wall was not met with, and it is therefore as yet uncertain what the actual thickness of the lode may be. The general body of the lode consists of flinty or curly agate-looking quartz with bands and ribs of granular and crystalline quartz. In driving across the reef from the foot-wall the first 25 ft. of quartz was considered not "likely-looking" stone, but for the last 15 ft. or 16 ft. there have been indications of both gold and silver in the reef, indeed, small nests of very rich ore were found. One such small sample, on analysis made in Auckland, yielded gold and silver to a value of £263 per ton, the gold and silver values being about equal. But this excessively high return gives no indication of the actual value of the lode. It is difficult to take from the ore in the paddock samples that appear much better than the general run of the stone. The samples taken, and of which the returns are here given, were selected in the manner above indicated, and therefore represent fairly the better class of ore, while yet they are in no sense specimen samples.* This lode strikes to the north-west, and eventually must pass into the Aotea No. 1 and the Great Barrier Claims. Quartz is found along the course here indicated, but no prospecting laying the reef bare has been done. From the foot of the high cliff under the trig. station the direction the Iona lode takes has yet to be proved, other massive lodes appearing in this part; but, as far as the Iona Claim extends, there can be no doubt as to the identity of the lode stretching along the foot of the sinter cliff.

Kaitokai Claim (Kaitokai Nos. 1 and 2).—A drive is being carried south in this claim, commencing 300 to 400 yards to the north-east of the line of cliff. This will cut a small leader of quartz showing on the surface, but will have to be considerably extended towards the mountain to cut the Iona reef, which must occur beyond the south boundary of this claim. The adit is therefore driven in the hope that a silver-bearing reef will be cut before reaching the south boundary of the claim.

Great Barrier Claim.—This claim is well situated with respect to the probable continuation into its area of the Iona reef, and, at the same time, the occurrence of several other reefs within its boundaries. Of the Iona reef within this claim nothing is known, but its presence is suspected by the occurrence of huge blocks of quartz along and near the southern boundary of the claim. Such quartz does, indeed, betray the presence of at least one massive lode, and one such, *in situ*, is seen crossing Ryan's Creek, on the boundary of the Great Barrier ground and Ryan's Freehold. But this reef has not a thickness of more than 5 ft., and other and even larger reefs must exist higher on the hill to the south. At the present time it does not appear as a matter of much moment whether the Iona reef runs through the property or not, the attention of the directors of the Great Barrier Company being chiefly devoted to the development of a small but exceedingly rich lode occurring a little to the north-east of the line of the larger reef crossing Ryan's Creek. This lode ranges from less than 1 ft. to 2 ft. or a little better between the walls, but generally, over the distance it has been driven on, it may be considered as averaging 15 in. in thickness. The strike of the lode is east and west, and the dip south, but usually at a very high angle. The lode occurs in hard dark-grey andesic rock, over which Ryan's Creek is precipitated as a cascade some 30 ft. in height. From the creek valley below the fall a low-level adit is being driven to cut the lode 60 ft. or 70 ft. below the present level, driven east along the lode. The lode yields silver to an amount considered very payable; one ton treated gave a value of £15 per ton, and since the above result was known a considerably larger parcel (10 tons) of ore has been shipped for treatment at Swansea.

Ryan's Freehold.—This is the area contiguous to the Great Barrier, on its western boundary, the reef from which passes into Ryan's Freehold at the waterfall, in the bed of the creek. In this the reef has been explored west a distance of 60 ft. The ore-band is continuous, and at the upper level shows a thickness varying from 12 in. to 15 in. or 18 in.; 15 in. may be considered the full average thickness of the lode in this part of its course. The ore is richer here than in the Great Barrier Claim, and magnificent samples might have been collected from the heap when the mine was visited. At that time a winze was being sunk to cut the lode at a further depth of 25 ft. to 30 ft. This has now been done, and it is reported that in the winze the lode shows 30 in. in width, carrying ore quite as rich as may be had from the upper level. A low-level adit is contemplated, which may be made to cut the lode 70 ft. to 80 ft. below the present workings, and at which it is hoped the thickness of the lode will be further increased. Many tests on small samples of the ore have been made, leading to the conclusion that the value of the ore is not less than £36 per ton, and from the character of the ore coming from the mine at the time of my visit the above seems to be a very moderate estimate of what the average yield will be should the ore continue of the same grade. A sample analysed at the Thames School of Mines yielded at the rate of 500 oz. silver to the ton. The country on the foot-wall of the lode within Ryan's Freehold is fairly well decomposed to a kindly-looking "sandstone," but this will probably not continue to any great depth, the foot-wall in the winze being very hard andesite; so that anticipations of the presence of soft country along the western part of the lode are of doubtful realisation. There is ample warrant for the energetic prospecting of this lode in both claims in which it has been traced, and the ore is rich enough to pay for transit to Europe for treatment. Its richness, therefore, to some extent

* The analyses referred to are as yet uncompleted, but they show that, while none of the stone is very rich, all rts of the reef contain s ome silver, the poorest parts yielding about 5 oz. of silver per ton, and of gold but a trace.

compensates for the smallness of the lode, and in this particular has to be looked at favourably in comparison with the greater mass and poorer ore of the Iona lode.

Egerton's Claim.—This lies next to and adjoins the western boundary of Ryan's Freehold. The lode, rich in silver, may pass from Ryan's Freehold into this claim, and efforts are being made to cut an extension of it further west. As yet only small leaders carrying a little silver have been found, and it seems likely that the southern boundary of the claim may be reached without cutting the rich lode that shows further to the east.

Mount Argentine and Mount Argentine Extended.—Prospecting has been carried on at various places within these claims, but so far no very rich ore has been found. The manager reported that in one adit a reef 12 ft. in thickness had been cut, and that this was silver-bearing, but at date of the claim being visited the drive had fallen in, and could not be examined, while the new adit at a lower level has yet to be driven some distance before reaching forward to the line of reef. In this lower adit-level three or four small leaders had been cut, in which but a trace of silver could be found. Over the area of Mount Argentine a great deal of loose quartz escaping from a very large reef was scattered on the surface of the ground. These are mostly composed of platy quartz, and are white and hard and barren-looking.

The Great Barrier Excelsior.—This surrounds on three sides the Proprietary and Premier Claims, as shown on plan, and was not specially examined.

The *Argyle, Bonanza, Comstock, Barrier Junction, Barrier Reefs, Great Barrier East, Silver King* and *Great Eastern Claims* cover a considerable part of the area east and south-east of Te Ahumata, but it is doubtful whether they all lie within the silver-bearing area. The Argyle may be considered as occupying the best position, as it adjoins the Iona on its east side.

ALEXANDER McKAY.

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Geological Sketch Map of the CAPE COLVILLE PENINSULA.

BY

Alexander McKay. F.G.S.
Government Geologist.

To illustrate Report dated May 1897.

REFERENCE.

1.	REGENT TO YOUNGER PLIOCENE.		
2.	PLIOCENE.	Acidic Group Rhyolite Forms	Gold-bearing, with few paying mines.
3.	MIOCENE.	Beeson's Id Group.	Gold-bearing in S part of District. Few paying mines.
4.	EOCENE.	Kapanga Group.	Principal Gold-bearing Groups.
5.	? ?	Thames-Tokatea Group.	
	CRETACEO-TERTIARY.	Coal Formation.	
7.	CARBONIFEROUS.	Maitai Series	Gold-bearing generally; Payable at Kuaotunu.
8.	& ⊕ Ancient Sinter Deposits.		

Hot Springs (Active).

Scale of Miles.

0 5 10

C.H. Pierard. del.