NEW ZEALAND

GOVERNMENT GAZETTE,

(PROVINCE OF WELLINGTON.)

Published by Authority.

☞ *All Public Notifications which appear in this Gazette, with any Official Signatures thereunto annexed, are to be considered as Official Communications made to those Persons to whom they relate, and are to be obeyed accordingly.*

J. WOODWARD,
Acting Provincial Secretary.

VOL. X.] MONDAY, MARCH 2, 1863. [No. 12

GEOLOGICAL REPORTS,

BY THE

HON. J. C. CRAWFORD, GOVERNMENT GEOLOGIST.

I. ON THE WAIRARAPA AND EAST COAST.

II. ON MR. R. BROUGH SMYTH'S "NOTES ON THE SPECIMENS OF ROCKS COLLECTED IN THE PROVINCE OF WELLINGTON."

I.

Report on the Wairarapa and East Coast.

Wellington, February 11, 1863.

To His Honor
J. E. Featherston,
Superintendent of the Province of Wellington.

Sir,—

After returning from the exploration of the Valleys of the Akatarawa and the Waikanae rivers, I started from Wellington on the 15th of January, with the view of gaining an insight into the geology of the N.E. part of the Province, more particularly in the direction of the Puketoe range, and the country generally, lying between the Tararua range and the East Coast.

Leaving the drift gravel of the Wairarapa behind me at Masterton, I found on rising the hills towards the Tauera station, that I had entered upon the upper tertiary sandstone. This rock I found extending over the whole of the interior of the North-Eastern district, resting upon the blue clay except where some drift gravel intervened between the two, but the gravel is by no means largely developed in this district. Towards the East Coast I found a change of rock, but of this more hereafter.

This upper sandstone consists of a series of soft fine-grained sandstones, fossiliferous and alternated with fossil beds almost approaching limestone, and is sometimes of great thickness in this district, seldom less than 500 feet, and in some places I think it must measure 1000 feet.

Some of its fossils are turritella, venus, dentalium, pecten, struthiolaria, I have no doubt that it is of the same age and character as the upper sandstone of the Whanganui river.

This formation, where found undisturbed, seems to lie very horizontal; but numerous hill sides have slipped into the valleys, there giving the strata the appearance, to the casual observer, of dipping in various directions and at high angles.

From the vertical nature of the sections in which this series is found exposed, it has been impossible for me to make any but a partial investigation of its different beds, and the same difficulty, you may have perceived in the cliffs of the Whanganui and other Western rivers.

The blue clay throughout this district does not show much of its thickness above the river levels.

Crossing the Manuka range, 906 feet above the sea level, the road drops down to the Valley of the Taueru, and thence on to the Taueru station.

Here I visited a very beautiful waterfall, formed by the waters of the Mangarei, a tributary of the Taueru. The stream falls over a ledge of the upper sandstone to a depth of about fifty feet, into a large circular pool. Hard fossiliferous beds of the upper sandstone form the rocks at the fall, the softer overlying beds, which are found in an adjacent cliff, having been denuded.

I may here state that there is a remarkable parallelism between the effects produced in this district and in that of the country inland on the Whanganui and Rangitikei rivers, inclusive. In both districts are the upper sandstones largely developed, and in both have these nearly horizontal strata been broken up by denudation, into very rugged surfaces.

Many of the beds of the upper sandstone are extremely soft, and therefore liable to be rapidly worn away; some of them, indeed, on being struck by a hammer, instead of breaking into fragments, crumble and run down into pure sand; and water poured upon them passes through as in a sieve.

At the Taueru pieces of marine fossils were shewn to me as quartz; and I found that generally throughout the district calc spar, white limestone, or, as I have said, even fragments of fossil shells, were supposed to be quartz.

Some very perfect "pecten," from the top of the Maunga Pakeha range, were presented to me by Mr. Varnham, for the museum in Wellington.

On the 19th January, I left the Taueru station and proceeded up the valley of that river, the Forty Mile Bush lying about three or four miles on my left and here covering a very broken country.

The road leads past Mr. Nicholl's, crosses the Taueru, and ascends the ridge on the Eastern side of that river. My estimate of the height of the Taueru station above the sea is 427 feet. The ridge just mentioned rises to 1100 feet, and the Manawa hill next to it, above a run which rejoices in the euphonious name of Boggley Wallah, to 1179 feet. Here one looks down upon Messrs. Jeffs and Riach's head station, and on the valley of the Whareama, with its level flats and swamps, while to the Northward may be seen the country drained by the Matai kuna, the Oahanga, perhaps also the Akiteo and here I could see plainly enough that all within view was of tertiary age, except the blue ridges of Tararua in the far distance.

At the Manawa hill, I was lucky in meeting Messrs. Spinks and Langdon, proceeding in the direction in which I wanted to go, viz, to Mr. Spinks' out station, Mount Pleasant, or Waitawiti. Our road passed over the highest ridge which I traversed in the district, viz Ngatakitura, which, by a mean of two observations, I make 1210 feet above the sea. From this ridge we descended to Mount Pleasant which is probably the highest inhabited European house in this island, being also by a mean of two observations, 985 feet above the sea level. Notwithstanding the height, it is a very cheerful looking place and it commands an extensive view.

Leaving Mount Pleasant on the 20th January in the direction of Knight's station, we soon crossed the sources of the Taueru, passing therefore again to the Westward of that river, crossed a ridge and came upon the flats of the Waitawiti a tributary of the Tiraumea. As the latter river is a large branch of the Manawatu, we were now therefore, on Western waters.

We crossed another ridge and descended to the Tiraumea, at Knight's station, where the Waitawiti joins that stream. Our descent had been considerable, and Knight's house, by a mean of two observations, is only 414 feet above the level of the sea. Thus it appears that the gorge of the Manawatu must be considerably lower than that height.

The Tiraumea rises to the Eastward of the Puketoe range, runs to the Southward at first and turns to the Westward and Northward round the South end of that range, to join the Manawatu.

The country here is better and less abrupt than that lying further to the Eastward, but it is close to the forest of the forty mile bush.

When the forty mile bush road is made I should suppose it would be easy to open a branch line, by or near the Tiraumea to Knight's station, which would then form the easiest line to the Wairarapa for a good deal of the open country.

An open track of a few thousand acres, called Moroa, lies surrounded by forest, between the Tiraumea and the Taueru, about six miles below this.

The Tiraumea has at present very little water in it, but I am informed that in a fresh, canoes can ascend about three miles beyond Knight's.

In its bed I found a boulder with plant impressions.

I would now call your attention to the Puketoe range, which has been in sight for the last two days, and where we may be said to have arrived, for Knight's station is on its lower spurs. I believe a great deal has been expected from this range in a mineral point of view, perhaps because it is remote, and difficult of approach. My first view of its outline settled its character in my mind and a close approach confirms the first view.

It is clearly tertiary, of the same age and character as the country I had traversed, but attaining a somewhat greater elevation. The additional height and its scarped cliffs, lead me to suppose that it marks a line of fault, or slip. I need hardly add that metals cannot here be expected.

The ascent of the Puketoe from Knight's would be troublesome, although the distance is short. A succession of sharp wooded ridges intervene. It looks to be easier of access from the North East.

I do not suppose the height of this range to reach 2000 feet. Supposing it to be 500 feet higher than Ngatakitura, this would give an elevation of 1770 feet above the sea. There may be some open land on the top of the range, but the greater part is covered with bush.

At Knight's I found the blue clay, and on the ridges above, upper sandstone beds, with turritella, venus, struthiolaria &c., From Knight's it is impossible, at present, to get a horse through the bush to the gorge of the Manawatu, which, as the distance is short, might be easily rectified. The view this day extended over the sources of a number of rivers, the Tiraumea, the Taueru, the Whareama, the Mataikuna, the Oahanga, and perhaps the Akitio: open country to the Northward and Eastward, bush to the West, beyond which the Tararua is seen in the distance. On the Tiraumea there appears to be a good deal of totara.

From Knight's I returned to Mount Pleasant.

It had often puzzled me why the alluvium of the Wairarapa should be of such a different character to that of the Hutt, but I think I have now solved that problem. The Taueru from its source to its exit in the Ruamahunga, passes entirely through soft tertiary rocks, and I believe it to be from their degradation, that the peculiar character of the alluvium of the lower Rumahunga is derived.

On January 21st I left Mr. Spinks' hospitable mansion, and proceeded to the Eastward, again crossing Ngatakitura and Manawa ranges. From the latter the road drops down to the valley of the Whareama, near the junction of the Makirikiri with that stream.

Here I again found the usual upper sandstone fossils. About two miles further down I reached Ngapapatu, Messrs. Spinks and Langdon's head station, which I make only 143 feet above the sea level. I now began to perceive signs of a geological change. Still proceeding downwards I crossed the Whareama, passed over a hill and descended upon the Tinui station, situated upon the flats of that stream, a tributary of the Whareama.

Immediately above the station is one of those remarkable hills called Taipos, which I accordingly proceeded to examine. These hills have an extremely fantastic, picturesque and rugged outline, and at first give the impression of volcanic peaks, but on examination prove to be our old friend the upper tertiary sandstone, tilted at an angle of about 70°, and dipping to the Westward; the harder parts of the strata sticking out in peaks, while the softer parts have been worn away.

On the top of the Tinui taipo I obtained turritella, venus, dentalium &c., Its height is 975 feet. Here also I found the Matai kuna taipo bore N 50° E, Buxtons taipos S. 20° to 30° W, and what I supposed to be Moore's taipos S. 15° W. W. It will thus be seen that the several peaks are nearly, but not quite, in a straight line.

Proceeding on the 22nd towards the coast, the road passes for a short distance up the valley of the Tinui, where I think I found the blue clay. Crossing that stream I ascended a ridge 828 feet high, where a fresh geological series is found, consisting of white limestone and calcareous grits, and in their midst, a fine grained greenstone, looking like a Syenite, which is doubtless the intrusive rock that has tilted the strata. It appears to have brought up the calcareous rocks, dislocating and tilting the upper sandstone at the same time.

If you refer to my report of October 24th, 1861, you will perceive that I describe calcareous rocks, highly inclined on Messrs. Barton's and Riddiford's stations, White Rock and Teawaite. I had now clearly found the continuation of the same series, and more than that I had found "in situ," the dislocating and upheaving rock. The Hornblendic pebbles found in the bed of the Upoko Ngaruru must also have been derived from another variety of the intrusive rock of the same age, and from my previous traverse in that direction, to Messrs. Beetham's station, I have quite sufficient evidence to establish a line of dislocation and upheaval, extending about N.N.E. from the White Rock and Teawaite stations, the action along which line has exposed a series of calcareous rocks, thrown up the strata of the upper sandstone at an angle of 70°, and probably bent and folded a series of tertiary rocks which I was now approaching on the East Coast.

Descending from the calcareous ridge to the valley of the Whakatake the road follows that stream to the sea, and thence South to Castle Point. We now find a series of thin and soft beds of sandstones and mudstones, cropping out on the beach and in the vallies, sometimes nearly horizontal, and sometimes inclined at high angles. What relation these rocks have to the limestones and calcareous grits, I am at a loss to determine, for I could not here find a section which would throw light upon the subject. My impression is that they overlie the calcareous rocks and at the period of dislocation were rucked up on the back of the latter by the force of the upheaving power.

In these sandstones and mudstones I found small seams of coal and numerous impressions of vegetation, but none clear enough to be enabled to judge of their age, but as the coal-seams appear to be lignite, or brown coal, I have little doubt that we may put them down as of tertiary age. In fact I believe them to be of the same age and character, as the coal shales of the Whanganui River, mentioned in my letter of February 17th, 1862.

The history and age of the calcareous rocks will I believe be best obtained on the Teawaite station, where they approach the sea. They must not be confounded with the upper tertiary fossiliferous limestone of Tepurapura and elsewhere, which seems to be found in patches only.

On January 23rd I examined the reef at Castle Point. This reef is a peninsula forming the shelter to the anchorage. Both it and the rock called the Castle are composed of calcareous sandstone, resting unconformably on the sandstones and mudstones just mentioned. In it I found venus, pecten, terebratula, ostrea, turritella, struthiolaria, &c. The reef, which is a ridge perhaps fifty feet high, is penetrated by a cave, through which the tide passes and in which the roar of the wind and waves is very striking. Between the reef and the Castle Rock, the sea has another passage through the rocks into a basin. The Castle Rock is of similar formation to the reef.

In the mudstones and sandstones on the shore I found plant impressions, and in consequence proceeded in the afternoon up the bed of the stream behind Castle Point in the hopes of falling in with some seams of coal. I went on as far as I could penetrate, perhaps three miles, finding plenty of plant impressions, but no actual coal seams.

Mr. Guthrie informs me that some years ago, one of his shepherds, who has since returned to Australia, brought in a handkerchief full of coal, (stating that there was plenty more where he found it) which burnt well and seemed of good quality, and which must have been found within three miles of the Castle; but unfortunately he had neglected to ask him where he got it.

The coal question in the East Coast District may be put as follows.

My impression is that the mudstones and sandstones of the coast are of tertiary age and therefore if any workable coal seams are found in them, that the mineral will be of inferior quality, but there are the little known calcareous rocks to be considered.

Now, at the Kowhai coal fields in Canterbury, there are calcareous rocks in the vicinity similar to the white limestone of our East Coast, and although Mr. Haast, at the time of my visit to that coal mine, had been unable to determine any connection between these rocks and the coal, yet he had a strong suspicion that they formed part of the series. Consequently, although I have seen no indication of coal among the *calcareous* rocks of the East Coast, except perhaps at Teawaite, I think we have at all events some reason to expect the *possibility* of its being found; and as from the broken nature of the country it might take years for one individual to explore it thoroughly, I would suggest that a reward for the discovery of the outcrop of workable seams of coal, might stimulate the perceptive faculties of shepherds and others, whose daily avocations lead them through the defiles of these regions.

On the beach here is some iron sand, whence derived it is difficult to say, unless it comes from the intrusive greenstone.

On the 24th January, Mr. Thomas Guthrie kindly accompanied me to point out some coal seams on the shore. Near the Nakaua river we found soft sandstones containing plant impressions and some coal seams about two inches thick. They were not continuous, but thinned out in a yard or two. The rocks are the same as those at Castle Point and dip slightly to the Westward.

Ascending from the beach, in about a mile, I again came upon the calcareous grits and the intrusive greenstone, both of which prevail in crossing the Trooper, the ridge separating the Whareama from the sea. 896 feet I make the height of this ridge.

From this range the Puketoe is visible, its tertiary character evident from this distance.

Descending from the Trooper, I crossed the alluvium of the Wharehama Valley, and ascended the hill next to Buxton's Taipo, composed of calcareous grit. The Taipo has a singular family resemblance to that at Tinui and also dips to the Westward. I thence descended to Telford's station, Awa toe toe, 136 feet above the sea.

Leaving Mr. Telford's on January 25th, I continued on the calcareous grits for about a mile, when the upper tertiary sandstone rocks again appeared, and I found turritella, venus, &c. The upper sandstone now continues all the way to Collins' bush, resting on the blue clay, or possibly in places on gravel.

The road crosses a ridge and descends upon Biscuit Creek, crosses another ridge and descends upon the Kaumengi, crosses a third ridge and descends upon the Tauera, crosses a fourth ridge and descends upon Te Ore Ore: the average height of the river flats being about 400 feet and of the ridges, where the road crosses, about 900 feet above the sea.

Reaching the Ruamahunga the upper sandstone has been left behind, and the drift gravel appears.

Stopping at Masterton for the night, I was informed that the plant beds of the East coast extends for a considerable distance up the Oahanga river.

In this journey I have settled the character of a large block of country, viz.,—the whole of the island within this Province lying to the N. E. of the Wairarapa, and between the Tararua and the East coast. It will of course be desirable to complete a traverse which I propose to make with you, from the gorge of the Manawatu to the Akitio river and the East coast, but as I have been through the gorge of the Manawatu, and as I have also been on the Rua Tauiwha plains and at Porongahau, I may very safely venture to predict that in the above named traverse, we shall find nothing but the above described tertiary and other rocks.

In none of these tertiary rocks can metallic ores be expected, (although the intrusive igneous rock may contain a little gold), nor do I expect any in the limestones and calcareous grits, for the following reasons.

1st. Because I see no indications of mineral lodes among them.

2nd. Because, although I have been unable to detect fossils among them and therefore cannot as yet assign to them their geological age; if not older tertiaries, from their lithological character they can hardly be older than of Mezozoic age, and therefore, supposing them to be of that age, although coal may be looked for, one cannot expect to find any of the metallic ores among them, save possibly ores of iron, of which however there is no appearance.

The date of dislocation and upheaval of these rocks would also, I imagine, militate against the argument of their containing metalic ores (there being no appearance of any previous disruption of these rocks which might have charged them with minerals). The intrusive plutonic rock must have penetrated them after the deposition of the upper sandstone, therefore probably in the Pliocene, or Post Pliocene era.

You will perceive that we have now established three nearly parallel lines of plutonic or volcanic action in this Province.

In the centre, the ancient rocks of the Rimutaka, Tararua, and Ruahine, with their spurs, folded and pressed together, and having a general direction of about N.N.E. true.

In the East, the calcareous and tertiary rocks, tilted on a line of about N.N.E. (magnetic) from the ancient rocks of Cape Palliser towards the Province of Hawke's Bay. In the West we have part of the volcanic chain of Ruapehu and Tongariro, ending abruptly, however, at the southern slope of Ruapehu, and perhaps I might include a fourth line in that neighbourhood, in the Kaimanawa range, but it is hardly in the Province.

From the central chain on both sides tertiary rocks extend East and West. I have therefore narrowed the area in which

metallic ores may be sought to the main central range above described, the Kaimanawa range in the Taupo country and the Aorangi range at Cape Palliser, save and except the chances of finding gold below, or in, the drift of the Wairarapa and the West Coast.

On the 26th of January, I returned to Wellington, with the expectation of finding a report from Melbourne, upon specimens of rocks which I had sent there for examination; in this I was disappointed, and as I had a little time to spare before the arrival of another mail, and found that some curiosity existed as to the results of a recent journey to the top of Tararua, by the valley of Wai Ngawa, I proceeded to Greytown on February 3rd, with the intention of making the ascent of that mountain.

However, after several days attempt to get hands to accompany me, I found that owing to the harvest and the bush fires I could neither get white men nor maories to undertake the journey at this time.

Mr. Thos. Kempton, who offered to go as guide, gave me however a very clear and intelligent account of his late journey. He appears to have travelled up the bed of the Wai Ngawa for three days, before emerging from the bush, and at a great incline, he thinks often three feet rise for four in advance. He then came out upon a grass country, extending to the top of the mountain, the vegetation consisting of a new sort of tussac, the common spear grass and the broad leaved spear grass (no doubt the "Spaniard" of the Middle Island) and wild parsley, which I suppose to be anise. To any one who knows the Middle Island the vegetation speaks for itself. He had reached the zone of grass, above the usual forest zone.

Arrived at the top he saw range after range to the Westward, of the same character, with bald grassy tops above the forest zone, and apparently nearly, if not quite, of the same height as the range on which he stood which shut out the view of the West Coast.

It is evident enough that the grass country must be covered with snow all winter. If it can be made of use, Mr. Kempton recommends a line to be cut into it by a leading spur opposite Ray's. On the descent he found out a better line of road which would shorten the ascent by a day. He describes the rocks as similar to those of the Rimutaka hill.

As all the rivers on that side of the Rimutaka and Tararua bring down similar gravel, this was to be expected, as the parallelism of the formations is obvious.

During this journey I felt two shocks of earthquake. One on Febuary 4th in the Upper Hutt, about 7. 15. a. m. the other on the 7th at Greytown, about 2 50. p m. Both were rather smart shocks.

On my return to Wellington on the 9th I found the expected report from Melbourne had arrived, a consideration of which I will reserve for a separate communication.

I have honor to be
SIR,
Your most obedient servant,
JAMES C. CRAWFORD
Government Geologist.

II.

REPORT ON MR. R. BROUGH SMYTH'S "NOTES ON THE SPECIMENS OF ROCKS COLLECTED IN THE PROVINCE OF WELLINGTON."

To His Honor
I. E. Featherston,
Superintendent of the Province
of Wellington.

Wellington, February 14th, 1863.

SIR,—In forwarding to you a copy of a report which I have received from Mr. Brough Smyth, of Melbourne, on specimens of rocks sent by me for examination, from various parts of this Province, I shall take the opportunity to point out what my plan of operations has been, and also show wherein I agree with Mr. B. Smyth's very able and valuable suggestions, and where, from causes of which he would necessarily be unacquainted, his views cannot perhaps be carried out.

In proceeding with the Geological Survey of the Province I have thought it advisable, first of all, to obtain a general knowledge of the whole rock formations within its limits; so that when it became necessary to employ men upon the Survey, I might be able to go on with continuous work; otherwise they might have been frequently unemployed, waiting for me to know in what direction to turn.

The kind offer of the Honorable G. S. Evans, Postmaster General in Victoria, to submit specimens of our rocks to the "Savans" in Melbourne for examination, came in aid of my views, and is the more useful, as we have no analytical chemist in this Province, and that, should I attempt to assay minerals myself, it would take up much time, probably the results could not be relied upon, and even the necessary re-agents and laboratory

plant cannot be procured without sending to Australia for them.

I therefore collected and sent to Melbourne specimens of rocks from many parts of the Province, but more particularly from these ranges, and awaiting the report, I made such excursions, especially those described in my last letter to you of the 11th instant, as, combined with my explorations last year, enable me to grasp all, or nearly all, the leading Geological features of the Province. By this means I have narrowed the area within which the search for minerals may be expected to be successful, to the main ranges of Rimutaka, Tararua, and Ruahine, with their spurs; the Aorangi range at Cape Palliser, and the Kai Manawa range in the Taupo country. I except coal, of which more hereafter.

You will observe in Mr. Brough Smyth's report, that granite appears among the specimens sent by me from the Upper Hutt. This confirms the opinion of that eminent geologist, the Rev. W. B. Clarke. Doubts, however, having been expressed, I have preferred waiting for confirmatory evidence before announcing the fact.

The theoretical proof which I gave in my letter of December 18th, 1861, of the existence of the "gold constants" in these ranges, is now confirmed by the discovery of granite, combined with the evidence of the ancient character of the bulk of the stratified rocks.

The granite is found in the ridge behind Mr. J. Brown's, in the Upper Hutt, which bounds on that side the Mungaroa swamp; and I have also found it on the Mungaroa Hill. It is very fine grained, and may easily be mistaken for a sandstone. It will doubtless be found nearer Wellington, and may come into use as a building stone. Near it is sandstone with quartz veins, and mudstones of two kinds, but I cannot yet say in what sequence.

With regard to metamorphic rocks, although the semi-crystalline sandstones and other rocks may be said to be of that character, yet as there are neither gneiss nor mica schists within these ranges, it will be advisable to abandon the term as applied to the rocks generally. The fact is, that the more the country is examined, the less metamorphic do the rocks appear.

Thin quartz veins appear to penetrate many of the rocks of these ranges, riddling them in all directions; but the larger quartz lodes are by no means so prominent as in the gold regions of Australia. That powerful lodes of quartz and other vein stones however traverse the rocks, every exploration tends to show; and I can mention one quartz lode fifteen feet wide and many others besides of considerable thickness. I believe the geological hammer now requires the aid of the pickaxe and crowbar, to expose the mineral veins.

Quartz lodes and other mineral veins seem principally exposed in the fractures of the anticlinal *axes*, which bears out my original impression that minerals will be found to lie deep, and this view will also affect the argument as to the locality of alluvial gold diggings.

If gold lies deep in the rocks while "in situ" the wearing away of these rocks (particularly as here in deep and steep vallies) will deposit it in the lower vallies only, and it may be plentiful there, while entirely absent from the higher ground.

It is suggestive that the rock taken from Mr. Barraud's well should resemble rocks from a district where sulphide of antimony and chrome iron are found, these being two of the minerals reported in the pyritous quartz lodes of the Petoni road. The sandstone with plant impressions, (No. 37,) from Porirua, being decided, on the high authority of Professor McCoy, as of mezozoic age, which with regard to coal, means oolitic, (the age of at all events the upper beds of the Australian Newcastle coal seams); and the mudstones being declared Palæozoic and probably silurian, it follows that we have sedimentary rocks of two eras in these ranges, folded however together in such a way that I foresee great difficulty in drawing the line of demarcation.

Mr. Brough Smyth's remarks with regard to gold seeking show a masterly grasp of the subject.

A reference to my letter to you of October 21st 1862, will show that I have most faith in gold being found, in the North Island, in the continuation of a line from the Middle Island Gold Fields to Coromandel, and that the present evidence is in favor of micaceous and talcose schists as the best gold bearing rocks of New Zealand; but I have also strong reasons to show, why the search for drift gold in this Province should not be hastily abandoned. I will first of all dispose of Barraud's well. This well is sunk for a few feet only through a sandstone and a felspatho siliceous rock. These rocks were said to be intersected by a vein stone, which was covered with rubbish when I visited the well, and unfortunately on the following day it was bricked up. There is neither drift nor

alluvium above the rock and only an inch or two of soil.

That gold dust might have been thrown into the well is possible; but the specimens sent to Melbourne were collected from the rubbish heap afterwards, and therefore not likely to contain any foreign mineral. I shall endeavour to make a further examination, particularly as more grains of gold are said to have been found in the neighbourhood and as I see some appearance of mineral veins close at hand.

I must now make some small corrections as to Mr. Brough Smyth's idea of our mountain chains. His view is, naturally enough, that our main ranges throw off spurs East and West, spreading across the country, whereas the remarkable feature is this, that the mountain ranges of the Rimutaka, Tararua, and Ruahine, including all the mountainous country in this neighbourhood, pass like a wall to the N.N.E. the spurs keeping on the whole the same direction as the main ranges. Of course one does not speak of a wall as built by a stone mason, a rigid line, nor do all the spurs and ridges adhere to a strictly N.N.E. course, but such is the main direction. The main strike of the rocks, being I should say about North (magnetic), with however many exceptions.

Most of the maps give an erroneous impression, by marking a range, curving from the Ruahine N.N.W. towards Taupo, which range does not exist, although the broken tertiary plateau may there reach an elevation of 2,000 feet. *

In its broadest part, from the coast opposite Mana to the Wairarapa, the main range does not appear to exceed twenty three miles wide. At the gorge of the Manawatu, the breadth following the curves of the river, is only about seven miles.

These mountains have assumed their form, less from upheaval than from lateral pressure. The strata are accordingly bent and folded upon each other, and the ranges are separated into a succession of sharp and nearly parallel ridges, culminating in height towards one or more central *axes*, but high and abrupt also at both sides, where the sea, or the tertiary rocks, meet them in a horizontal, or nearly horizontal line.

One consequence of this conformation is that the rivers, *while within the ranges*, run in ravines, rarely as in the instance of the Hutt, expanding into vallies.

If we take the valley of the Hutt as an anticlinal axis near the centre of direction of the range, we there find, in the central axis, the granite of the Upper Hutt and Mungaroa; but I have strong doubts whether we shall find it on the surface in the high parts of Tararua, although it may be assumed to form the hidden nucleus of that range. The basalts, like the diorite rocks of the Canterbury Province have not yet been found "in situ," and are not likely to appear in a prominent way; and the only rock which I can venture to call lava, in this main range, is the red rock of the Rimutaka, (on the authority of the Rev. W. B. Clarke,) but where it is found, and elsewhere in these ranges, there are no signs of volcanic vents.

The stratified rocks, sand stones, mudstones, slates &c., seem to, and I think will be found to continue to, occupy the main part of the ranges.

The accumulations of drift on the Eastern side of the ranges are fully equal to those on the West, and the tertiary rocks may be said, with some exceptions, to be of the same character and thickness on both sides of the main range. Mr. Brough Smyth, suggests as particularly worthy of immediate attention, the basins of the Hutt, the Waikanae, the Otaki, the Manawatu, the Rangitikei, and the Whanganui. I would omit the word immediate in reference to the three last named of these rivers and substitute for their names those of the Ruamahunga, and its tributaries on the right bank, the Waipoa, the Wai Ngawa, the Waiohine and the Tauhere Nikau, (perhaps this last cannot be called a tributary.)

Although I should like to see the head waters of the Whanganui prospected, yet, even supposing the natives would consent, the expense of a party would be enormous in proportion to the work done. I only found about *two yards* of the ancient rocks during a journey of some hundreds of miles in that direction, and then in the bed of the Waipare, a tributary of the Whanganui, with the hills, formed I believe of tertiary rocks, rising at an angle of 45° or thereabouts, on both sides, to a height of say 700 feet above the bed of the stream. I consider that the Upper Whanganui, must wait the progress of development of the gold fields from Coromandel through the Waikato country, which may throw sufficient light upon the subject.

The same remarks will apply to the Rangitikei River, and those rivers lying between it and the Whanganui. The heads of these rivers would answer Mr. Brough Smyth's idea of searching towards the sources of the streams, but a prospecting party to explore them must be fitted out

* For a description of the volcanic chain or block of mountains of Ruapehu and Tongariro, see my report of February 17th, 1862.

and kept supplied at great expense and must be prepared for very deep sinking, and as yet there is no road.

With regard to the Manawatu, although old drifts may lie beneath the tertiaries on its banks, and may eventually be worth sinking for, if we find any reasons to warrant the outlay, the river itself is most unlikely for gold. It presents the curious feature of rising in the tertiaries of the East Coast, bursting through the main range and thence again passing through tertiaries to the sea. The whole course of the river through the ancient rocks does not exceed seven miles and its stream there occupies the whole breadth of the channel.

Immediate explorations of the Hutt, the Waikanae, and the Otaki, with the Eastern Rivers previously named, I particularly concur in, for reasons which I shall presently show.

This brings me to the main point of my argument, which is, if gold exists where is it to be found, as drift and alluvial gold?

I have endeavoured to show the character of the mountain range and from this it will be seen that in general the rivers while confined to the range, run in very narrow and perpendicular channels. After entering the mountains and ascending for a few miles the beds of the streams, the ascent is rapid in the extreme, the drift disappears and the waters rush over a rocky bottom, or over large boulders of the surrounding rocks, and therefore drift gold, if present, could only be worked for a comparatively short distance up the mountain beds of those rivers.

Old drift gravels and clays may certainly be found in various places on the hills, as on the Mungaroa hill to a height of between 700 and 800 feet, but in general the rock is covered by a thin stratum of soil only, and where that is he case of course there are no diggings.

If we then consider the great denudation which has removed the rock from these vallies, say in the glacial epoch, we may ask where has the material gone to? The answer is obvious. It does not lie, or only to a small extent, within the hills, but has been swept into the Wairarapa country on the East, into the basin between Kapiti and the main range, on the West; and into the Hutt Valley on the S.S.W.

If these rocks contained gold, most, if not all it of would follow the same route.

I therefore would suggest that in a search for drift gold attention should be first directed to a careful examination of the Valley of the Hutt; and also, what I have already hinted at, that the question of *grappling with deep sinking in the Wairarapa and perhaps also on the West Coast should be considered*, combined with an investigation of the river beds previously mentioned as far as practicable.

As Mr. Brough Smyth also suggests that gold may be looked for in unexpected formations, I would not omit the blue clay. Although it is a fossiliferous rock it has a great appearance of being a drift formation, and I submit the following theory of its deposit, say to the Eastward of the Rimutaka and Tararua.

Suppose great degradation going on in the glacial epoch, along the Eastern vallies of these ranges and the materials carried to the Wairarapa,—what would be the natural order of deposition? Why, that the heavier boulders would be left in the vicinity of the range, while the lighter particles of earth, clay and sand would be carried to a greater distance. As a consequence one may expect both deposits to be, in places near the line of demarcation, mixed together; and as the lighter materials would be soonest exhausted, a deposit of gravel would latterly form over the clay. All this is carried out as far as I can yet speak. I have not as yet been able to find the blue clay to the Westward of the Ruamahunga, and the other conditions are found towards, and to the Eastward of that river. The elevated beds of gravel and blue clay, lying still farther to the Eastward, might not at that time have been upheaved by the force along the axis of elevation of the East Coast. Now, if the denuded rocks were gold bearing, most of the gold would be deposited, with the heavy gravel, near the mountains, but lighter particles might accompany the blue clay to a greater distance.

On the other hand the gravel and the blue clay may mark different, although consecutive periods.

The gold question will not be set at rest until the Wairarapa and the West coast plains are bottomed at several points.

Now that I have acquired a general knowledge of the rocks of the Province, I quite agree with Mr. Brough Smyth, that my attention should be directed to a minute investigation of some limited district. What I should now propose, with regard to the Geological Survey and apart from a search for gold, would be to make a detailed survey of the rocks of this range from East to West, mapping them and collecting specimens of every stratum,

taking for the purpose the only lines on which anything like a complete detailed survey can be made, viz, the scarped ends of the ranges from Terawiti to the Wairarapa and the next section further North, from the sea beyond Porirua, up the line of road to this harbour and thence over the Rimutaka to Featherston.

These traverses are absolutely necessary to show the sequence of the rocks and form a basis for further explorations, and as I find fresh mineral veins every time I cross the Rimutaka, we might expect to make some valuable discoveries. But I should like first to know the views of the Government as to the duty of the Government geologist in a search for gold.

Ought I now merely, as above, to point out the proper localities in which to look for that metal, and leave it to private enterprize to complete the research; or would the Government wish me to examine for the above purposes the localities indicated, viz the vallies of the Hutt &c.

In the latter case I should require a properly appointed party of three or four men, with tents, tools, a Californian pump, and a pack horse, with a good foreman, while if the search for gold should be left to private enterprize, a smaller party would suffice for the detailed survey.

Such an undertaking as the bottoming of the Wairarapa valley would necessarily require special consideration and authorization, for although a small sum might suffice for the work, yet unforeseen difficulties in depth and in the influx of water might arise.

In my letter of December 13th, 1862, I mentioned the discovery of the plant bed series of the Porirua harbor. Since that time I have discovered similar organisms in different directions—at Ohariu, on the banks of the Aka-tarewa, and on the Belmont line, and Mr. Mantell has even found them at the top of the Kai-warra-warra road. As Professor McCoy has decided these rocks to be carboniferous, of the oolitic age, I would fain hope that workable seams of coal will be found, and although appearances are not very encouraging, yet, after having seen the manner in which the Kowhai coal seams at Canterbury were hidden by drift, it will be a long time before I shall despair of success.

The traverse and survey of the rocks which I propose to make from the West coast to the Wairarapa by the line of road, would be a necessary preliminary to the search for coal.

I have discovered a black mineral at various points on the Rimutaka, hill, but its character is not yet determined.

For political reasons, it would probably be best that deep sinking should be tried in the Wairarapa, before attempting it on the west coast.

Mr. Brough Smyth will perceive why more attention has been paid to the discovery of quartz veins than of alluvial or drift diggings. The mass of drift having been thrown out of the mountains upon the adjacent plans or basins, rather than deposited within their own area, in a position which often renders it difficult to tell its thickness, or what rocks may lie between it and the undulation of the ancient rocks, I required some support to back my opinion in favour of deep sinking in the plains or basins. You will also observe that the country covered by horizontal tertiary formations can, for all present purposes, be disposed of geologically with great rapidity, while the inclined rocks of the main range require a most patient and searching investigation.

I have proved the "gold constants," and I have obtained strong evidence in favour of the probability of finding gold. But should the "gold constants" prove inconstant, and the precious metal elude our search, there is no reason to despair of making discoveries of other valuable metals. I have every reason to think that these ranges are full of mineral veins, and at the present moment I await reports on the character of those already found; but at the same time, I suspect that our mineral wealth lies deep, and will require an expenditure of skill, capital, and patience for its developement.

I have the honour to be
Sir.
Your most obedient Servant,

JAMES CRAWFORD,
Government Geologist.

[ENCLOSURE.]

Mr. R. Brough Smyth's Notes on the specimens of rocks collected in the Province of Wellington by the Honorable J. Coutts Crawford.

Melbourne, January 13th, 1863.

I have carefully examined the specimens of rocks brought from Wellington by the Honorable G. S. Evans. I have also read the printed reports of excursions made by Mr. Crawford in that Province, and the MSS. accompanying the specimens.

I have had some difficulty in fixing the several localities (not being provided with a good map) and I have not been

able to gather any information relative to the extent of the areas occupied by the several rock formations. Under these circumstances it is necessary to speak cautiously and to draw conclusions only when the evidence is clear.

Amongst the more important specimens of rock submitted, I recognise mudstones, similar in lithological character to the rocks occurring in the basin of the river Yarra, greyish blue mudstones with iron-pyrites and thin veins of alumite containing more or less silica, and quartz.

I also observe a very fine grained granite rock, and a rock, evidently derived wholly from the degradation of this, consisting of quartz, felspar and mica, with included pebbles of quartz.

Much of the granite rock contains veins of quartz.

Judging from the specimens submitted, it would appear that part of the valley of the Upper Hutt is occupied by plutonic rocks, but how far these extend, or whether the quartz veins intersecting the primary rocks also run into the granite, it is impossible at present to say.

In Mr. Crawford's report, dated the 24th October, 1861, it is stated that the metamorphic rocks fill a large area and compose the Rimutaka and Tararua ranges, but I do not recognise amongst the specimens any gneis, clay slates, or mica schists.

I regret that Dr. Evans' hurried visit did not admit of Mr. Crawford's giving more information respecting the quartz veins of the Province. I observe specimens of ferruginous quartz, milky quartz, and much chalcedonic quartz, but how the veins occur, or whether they are thick or thin is not stated, without this information it is impossible to give any useful opinion respecting them; for hand specimens may be obtained abundantly where the veins are thin, and, comparatively, few and unimportant.

One very interesting specimen of basalt, with glassy crystals of felspar, a fragment of a boulder from the bed of the Hutt, would indicate that igneous as well as plutonic rocks may be looked for in that part of the basin.

A fragment of a purple slate rock, marked "Hawtrey, Johnsonville" appears to me to be important in connexion with the specimen of quartz No. 11, from the same locality.

All the rocks, including the quartz and excepting the granites and conglomerates contain more or less iron pyrites, and the specimens taken from Barraud's well, which contain alumite, resemble very much the mudstones of the Heathcote District, where we find gold, sulphide of antimony, chrome iron, and a mineral resembling bournonite.

I submitted the fragment of sandstone marked No. 37, to Professor McCoy. He at once pronounced it as of mezozoic age, and similar to the coal formation of Merino in Victoria.

The other specimens are devoid of fossils, but the mudstones may, I think, be safely set down as palæozoic.

With but imperfect means of coming to a conclusion, it may be said that the rock formations of the Province of Wellington comprize

1. Recent accumulations.
2. Tertiaries, age unknown.
3. Carboniferous rocks of the oolitic age.
4. Mudstones, probably Silurian.
5. Granites and other plutonic rocks.

As the discovery of gold in remunerative quantities would no doubt have a most beneficial influence on the future prospects of the Province, I would recommend that the recent drifts should be carefully examined. Attention seems to have been directed rather to the quartz reefs than to these, but it must not be forgotten that elsewhere gold occurs in drifts and in Post pliocene accumulations in quite sufficient quantities to pay for working, in the midst of primary rocks in which there are but very thin and apparently unimportant veins of quartz, the exploration of which would never reward the enterprize of the quartz miner.

If the suite of specimens forwarded by Mr. Crawford fairly represent the rock formations of the Province it may safely be asserted that the search for gold may be prosecuted with every prospect of success. I have not yet had time to analyse any of the specimens, or indeed to apply any but the slightest chemical tests to one or two, and therefore I cannot say whether or not they contain gold, except as regard the fragments of rock and clay taken from Barraud's well. In these I detected a very small grain of gold.

Whether the gold found in the well is derived from small veins of quartz penetrating the mud stones, *or whether there is a thin surface stratum overlying the older rocks which is auriferous,* is well worth investigating, and I would recommend that the locality should be carefully examined. What is the prevailing rock in this neighbourhood? and has it been ascertained whether or not

the surface soil is auriferous? Is there any reason to believe that gold dust has accidentally fallen into the well and become mixed with the debris there? These questions would be answered by a not very laborious investigation.

Wherever we meet with silurian (or older) rocks intersected by veins of quartz, we may look with confidence for the discovery of metaliferous and mineral veins of more or less importance. It appears that we have all the conditions in the Province of Wellington. If I were to submit many of the rocks collected by Mr. Crawford to any gold miner in Victoria, he would recognise them at once as precisely similar to those occurring on some of the Victorian gold fields; and while a few specimens of the milky and ferruginious quartz are quite like our own, the chalcedonic quartz exactly resembles that found in the Northern gold fields of New South Wales. Without attaching too much importance to these resemblances (for quartz veins are not always auriferous) they yet serve to show the necessity for earnest and careful exploration of the country.

Looking to the physical geography of the North Island of New Zealand, one observes a main chain of mountains, running generally in a Northerly direction with Easterly and Westerly spurs of considerable extent. The position of this main chain (broken as the other lands may be) has determined the course of the principal river basins, the more important of which lie on the West side of the main range. If a geological map were constructed of this country it would not probably differ, in its main features, from many parts of Eastern Australia. We should find, I apprehend, the central axis composed of rocks of the primary age, with masses of intrusive granite, and many of the spurs of basalts and lavas of different ages. We should also find areas occupied by carboniferous rocks, and large tracts covered by tertiaries of greater or lesser thickness.

Though the information I have received is not very complete, it would appear that on the Eastern sea board rather thick tertiaries prevail (probably of the same age as the Murray tertiaries) and I would therefore recommend that the rivers flowing to the Westward should be first explored. There, I am led to believe, the quite recent accumulations of drift, similar to these occurring on our Victorian gold fields, are prevalent, and no very costly examinations would be required to ascertain whether or not these recent accumulations contain gold, or tin ore, or the ores of other metals, in remunerative quantities. There is no reason to believe that gold is more likely to occur on the Western side of the main chain than on the Eastern. But it is probable, owing to the local distribution of the rocks, that it will be found more easily on the Western side. The rivers in Victoria on the Eastern side are all auriferous.

I would suggest as particularly worthy of immediate attention the basins of the Hutt, the Waikanae, the Otaki, the Manawatu, the Rangitikei, and the Whanganui.

Unless careful attention be directed to the conditions under which gold occurs, a long period may elapse before any important discoveries are made in this part of New Zealand. Looking alone to the modes of occurrence of gold in Victoria, people in other countries may utterly neglect the most important localities, because the conditions there are not the same as here. In Victoria we find the silurian and metamorphic rocks every where intersected by veins of quartz, varying in thickness from a line to fifty feet. These quartz veins, nowhere, it is believed, penetrate the great masses of plutonic rocks which every where have broken through the sedimentary strata. They stop short at the granite boundaries, and the gold miner, accordingly, as a general rule, neglects the granite country. This peculiarity is due probably to the relative ages of the granites and the sedimentary rocks. The force which rent asunder and left wide fissures in the clay slate and schist formation was perhaps exerted before the granites came to occupy their present place, or perhaps the force was insufficient, or exerted so as not to affect the denser, tougher and harder plutonic rocks. It is a local peculiarity, not a condition universally occurring. Elsewhere gold is found in granite, in gneiss, in mica schist, in syenitic porphyry, in green stone, as well as in quartz veins intersecting rocks of the silurian age.

It may be looked for, and yet may be profitably worked in conglomerates much older than tertiaries.

Gold is found in quite modern drifts overlying granite rocks—not derived from auriferous quartz veins penetrating the granite but from veins in slate rocks which have wholly disappeared. The slate rocks have been denuded and their rich stores of gold have been left in holes and "pockets" of the granite, the bed on which the slate rocks were originally reposing. A granite country therefore (more especially if in the neighbourhood of schists) should not be neglected, but

explored carefully and anxiously. The gold said to have been found in Greaves' Gulley, may have been derived from auriferous veins penetrating sedimentary rocks, or it may have been derived directly from veins intersecting the granite.

If I might venture to offer a suggestion, I would say that instead of a hurried examination of a great extent of country, it would be more satisfactory to make a careful examination of a comparatively small area,—say the basin of the Hutt, the Otaki, or the Manawatu. I would recommend that the upper and lateral branches of these rivers (at some distance from the coast) should be carefully explored, and rough sketch maps made showing the various rock formations,—rough maps which might hereafter be amended, revised, and in some parts wholly altered as discoveries would from time to time, be made. The recent drifts filling the valleys of the small tributaries, should be carefully examined down to the bed rock, and the whole depth of each section washed very carefully. One or two careful examinations of this kind would in fact be the very best kind of "Prospecting." I would suggest just such examinations as Mr. Stutchbury made in New South Wales, and exactly such maps as he constructed.

I do not think explorations very near the coast will be productive of useful results. If we look to the rivers in Victoria we gather some useful hints for the gold prospector. Near the coast the sands of these rivers are almost invariably so poor in gold that they may be said practically to be non-auriferous. For many miles the Yarrowee is non-auriferous, and quite at its sources we have the Ballaarat Gold Field. The Coliban and Campaspe flow into the Murray through a pastoral country, but their tributaries, miles away from their embouchures, are now supporting large numbers of gold miners. The Loddon is only auriferous near its sources, and the same may be said of the Hopkins, the Wimmera, the Werribee, and every river in the country. A very slight consideration of the facts connected with the occurrence of gold in drifts and recent accumulations will show that the *sources* of streams, rather than the streams themselves, are most likely to yield the metal in remunerative quantities.

It is probably true that gold is widely disseminated in rocks of the oolitic age, but, according to our present knowledge in such a state of minute subdivision as to be wholly unavailable to the miner. The sludge from a puddling machine contains gold, but the greatest quantity is caught and retained in the box. And so we may consider this operation of nature by which great masses of rock have been worn down and washed as but another kind of *puddling*, and we must reach the source of that grand agency before we find the gold.

I have not alluded to the modifications likely to be produced in the strata of the drifts and recent tertiaries by glacial action. These should not be overlooked by the gold prospector. Where this force has been exerted gold may be distributed very unequally through the strata, and such rocks may quite puzzle even the experienced gold miner. Though it is true that the specific gravity of gold is sufficient under ordinary circumstances to determine its position on the surface of the bed rock, yet when the gold is imbedded in large fragments of quartz it may be found at all depths from the surface downwards, and in conducting explorations in drifts of this kind all the debris should be carefully examined.

As there are undoubtedly coal bearing rocks in the Province of Wellington no opportunity should be lost of shewing the extent, thickness, dip and general character of these.

R. Brough Smyth.

Printed under the Authority of the Government of the Province of Wellington, by Thomas McKenzie and James Muir, Printers for the time being for such Government.