REPORT ON THE MINERAL DISTRICTS OF MOUNTS HUXLEY, JUKES, AND DARWIN.

Government Geologist's Office,
Launceston, 30th November, 1900.

SIR,

IN compliance with your instructions, I left Queenstown on the 30th April last, to examine the new mineral fields situate on Mounts Jukes and Darwin, and, on my return, I visited Mount Huxley, where some underground prospecting is being conducted. I was accompanied by Mr. James Harrison, Inspector of Mines for the Western Division, to whom I was indebted for much assistance on this journey, and some of the enterprising citizens of Queenstown very thoughtfully provided me with a prospector, Mr. John Anderson, who acted as an efficient pilot in the wild and rugged country on Darwin. My thanks are also due to Messrs. Bean, Allen, Collins, and Sumpter, mining managers, living on the heights of Mounts Jukes and Darwin, also to Mr. Havill, on Mount Huxley, for without the shelter of their camps our party would have been badly off.

General Geology.

These three mountains are elevations on the West Coast range of Tasmania, which here has a linear direction of north and south, or a few degrees west of north, and they occupy a line 12 miles in length. Mount Huxley is the most northerly of the three, four miles south of Gormanston; the southern end of Mount Darwin is three miles north of Pillinger, in Kelly Basin. This chain rises to heights of between 3000 and 4000 feet, and is skirted on the east by the comparatively flat valley through which the North Lyell Railway runs. This valley is plainly a glacier one, for along the railway line, especially on its eastern side, are peculiar long hillocks of pebbly wash, which are nothing else than

glacial moraines. These have their long axes in a north and south direction, and are the lines of transported material left by the retreating glacier. I picked up a few ice-scratched stones from the ballast on the line. A powerful glacier would seem here to have descended to Kelly Basin. This is interesting, as furnishing some proof that the ancient glaciation was not confined to the higher elevations, but descended to not far from sea level, for this valley is not more than 500 feet above the level of Macquarie Harbour. The valley bottom is mostly button-grass soil, strewn with large quantities of angular white quartz. Below the soil are sedimentary rocks, sandstones, conglomerates, grits, quartzite, limestone, &c., belonging to the Silurian system. Descending from Lake Jukes eastward, these stratified rocks form the lower flank of the mountain down to the button-grass plains north of Darwin township, which are strewn with conglomerate, sand, and pebbles. On the railway line, where it passes through Spotswood's 40-acre section, one mile north of the township, there is an outcrop of grey non-fossiliferous limestone, and further south, approaching the town, the railway cutting exposes slates striking N.W. North-west, behind the township, soft brown schist strikes in the same direction. Ascending Mount Darwin from the township, yellow soft sandstones prevail, and higher up, soft greenish schist. These grey and greenish schists are the depositories of copper ore: they are intersected by various seams of quartz; the ore is pyritic, and its habit corresponds with that of the occurrences at Mount Lyell. I judge this belt of pyritic schist, which hangs on the eastern flank of Darwin, high above the plain, to be the southern continuation of the Lyell belt of copper-bearing strata. All the sandstones and schists strike a little west of north, and dip south of west. They accordingly underlay into the mountain range, which is not an axis of elevation, but a range carved out by the processes of denudation; they are not seen above an elevation of 1000 feet up the mountain side; they are then succeeded by a flinty-looking quartzose rock, locally called quartzite, which forms the upper part of the mountain mass, where not overlaid, as on Jukes, by conglomerates. On Darwin, the exposed thickness of this massive eruptive rock is considerable,

exceeding 2000 feet. It forms the crest of the ridge, but is accompanied by coarse granite towards the southern end. It varies in colour from white to reddish, and is changeable in structure, though the texture is mostly compact and dense. The characteristic pink or reddish-brown colour is probably an original feature, arising from the iron oxide which is minutely diffused in the rock. It has most frequently a homogeneous felsitic appearance, but is occasionally porphyritic, with quartz or green chloritic pseudomorphs after felspar. According to its variations and to different systems of petrology, it is quartz-porphyry, quartz-felsite, felsite and micro-granite (in the sense of micro-granitic quartz-porphyry). Genetically, it is the effusive modification of the granitic rock-magma, and may have been either a rhyolite lava, or a protrusion from, or the marginal part of a granite mass. In Germany it is regarded as effusive, and called quartz-porphyry, micro-granite, granophyre, felsite, felsophyre. In England, where it is intrusive, it goes under the name of quartz-porphyry, and also bears the name of felsite and quartz-felsite. The older rhyolite lavas are also called felsites in England. Where it is intrusive in large masses, I should like to call it quartz-porphyry; where it is a devitrified lava, felsite.

There is a difficulty in calling the present rock as a whole "quartz-porphyry," because, more often than not, it is non-porphyritic. It is often associated with chloritic and quartz schist, which I am tempted to regard as a modification of the felsitic rock, as the latter, even when massive, sometimes acquires a dark green colour, due to the development of chlorite. From an examination of numerous microscopical slices, it may be seen that the minute structure of the groundmass is crystalline, even when the larger constituents have separated out. It is not granite-porphyric, but has mostly the microgranitic and felsitic structure of quartz-porphyries, with a slightly granophyric tendency now and then.

The structure has a parallel in that of European quartz-porphyries, *e.g.*, the microgranite (quartz-porphyry with a crystalline granular groundmass) of the Donnersberg, in the Pfalz, where it occurs as a sheet; and the felsophyre (quartz-porphyry with a felsitic groundmass) of Elfdalen, in Sweden.

I have devoted a little time to the consideration of this rock for two reasons: first, because it is important to elucidate its relation to the copper deposits; and, secondly, because it is such a constant and integral feature of the West Coast mountain range, forming, as it does, a crest line for 40 miles from north to south, from Mount Farrell to Mount Darwin, and probably extending beyond these limits.

A distinct lamination, or a certain degree of fissility, may be observed in the rock, and this suggests that it was involved in the foliation of the West Coast schists. The granite which is here and there associated with it (at Mt. Farrell and South Darwin) appears to be of younger date. Field examination of these felsites has been so extremely scanty that their relative age to the strata which now form the schists cannot be regarded as settled, but, so far, I am inclined to think, they were contemporaneous and pre-granitic. In this case they are, probably, Silurian, but the age of the schists themselves is in doubt, for it would be unsafe to refer the latter to the age of the Queen River fossiliferous sandstones (Middle Silurian). Some brachiopoda belonging to this series have been found at Gormanston, but in the creek, and not *in situ*.

The felsite habitually merges into chloritic and quartzo-felspathic schists along its margins, both on the eastern and western sides of the belt, and even passes into these along its line of strike. This, and the occurrence of chloritic cupriferous schist in the heart of the felsite, seem to me to indicate that we are dealing with one and the same rockmass. Though the felsite is so massive, it probably had areas of weakness, in which it succumbed to a pressure which produced schistosity. In other parts the yielding was so slight that nothing more than a coarsely fissile structure resulted; and again, elsewhere, the rock is rigid and massive. In any case, the weight of evidence is in favour of an eruptive, and not a sedimentary, origin for these chlorite schists, in which an original porphyritic structure may occasionally be seen, sufficiently well-preserved to indicate their true nature.

In the felsite, iron and copper pyrites (the latter argentiferous and auriferous) occur as strings, patches, and along joint faces, also as branching veins; as impregnations

or replacements of the schist; and in the substance of large outcrops of hematite and magnetite. The outcrops of iron oxide are a characteristic feature of the felsite. They occur all along the line—on the Osborne Copper blocks, Mt. Farrell, at Red Hills, Mount Huxley, Mt. Jukes, and Mt. Darwin. They are frequently besprinkled with copper pyrites. This development of copper ore gives the stimulus to prospecting throughout the belt. No productive mine has yet been opened in this zone; that is to say, no mine has yet sold or reduced the ore raised. A few mines, such as Red Hills, Jukes Proprietary, Prince Darwin, and one or two others, have raised a little ore, and the developments in some of these seem to show that they are on the verge of becoming payable. I have not found any undoubted lode in the rock; the nearest approach to one is a large barren quartz reef on the crest of Darwin. The Tyndall Copper Mine may also be in a lode, but the huge iron ore masses seem to indicate, by their associated copper ore, that, somewhere, there exists cupriferous deposits which it is worth while searching for. This, in a nutshell, is the real position of the mining industry along this band of country. A large prospecting field is about to be opened up, and it deserves all the attention and assistance which geological science can furnish.

The iron ore occurs in linear masses in the substance of the igneous rock. The discussion of its origin is important, as bearing on that of the copper ore.

1. I think that we may put out of court the theory that the iron ores are detrital concentrations: they could only be so by being deposited in superficial depressions of the quartz porphyry, and there are no signs of sedimentation to support the hypothesis.

2. We may further exclude their origin by differentiation or segregation of a basic element (iron) during the cooling of a rock magma. They are manifestly subsequent to that phase of rock formation, as they have replaced the constituents of the original rock (as mentioned in a previous Report).

3. Again, we need not consider their origin by direct fissuring action, as lodes are nearly absent.

4. There is the theory that bodies of pyrites may have oxidised to limonite, and that such limonite has, by

metamorphism, become magnetite. If this supposition is correct, prospecting in depth will prove it.

5. There is a further possibility of the iron ore collecting from the adjacent country-rock and concentrating in the ore-bodies. We know very well that iron oxide is present in quantity in a finely-divided state in the quartz-porphyry, as indicated by its reddish colour, but the porphyry is poor in heavy silicates, which would yield appreciable quantities of iron, and the rock does not seem sufficiently permeable to allow steady molecular migration to take place.

If none of the above solutions are admissible, and I think only (4) and (5) have any chance, we may consider the remaining supposition that the felsitic belt, as well as the siliceous schists east and west of it, including the schists of Mount Lyell, have been permeated by later solutions from below, connected with the consolidation of the granites. These solutions may be conceived as carrying dissolved copper, and were forced through the superincumbent rock under a hydrostatic pressure, which compelled them to seek directions of easy passage along the existing lines of schistosity. Sedimentary and other rocks, already transformed to schists, as at Lyell, Read, &c., were most easily permeated with the mineral solutions and replaced by the precipitated mineral. In the harder quartz-porphyry those parts, the chloritic schistose porphyries, which were exceptionally soft and had a pronounced lamination, formed the most favoured channels for the deposition of copper ore, while in the more massive felsitic rock the ore was limited to joints and accidental fissures. The iron was introduced at the same time, collected from other parts of the rock-mass, or segregated, it is best to confess, in some way which we cannot at present trace. The persistent occurrences of magnetite and hematite along this line of quartz-porphyry suggest the prevalence of uniformly favourable conditions for their deposition, and I believe are best accounted for by ascribing them to heated solutions along the granite contact. A very important confirmation of this view is the fact that on South Mount Darwin, where we have an outcrop of granite parallel with the hematite (about 20 chains from it) the outcrops of magnetite and hematite are the largest on the entire

range; and the felsite towards the southern end, where the granite is most exposed, becomes unusually flinty and hackly—an indication of contact metamorphism. At Mount Farrell, too, at Harris' cage, the granite is ~~is~~ also associated with an outcrop of hematite near the contact with felsite.

In postulating a common source for the cupriferous deposits of the West Coast range, we account for the prevalence of copper all along the line, not only in the quartz porphyry itself, but also in the schists which flank it. Under the circumstances alluded to, it is reasonable to suppose that the copper in the deposits of Lyell, Read, Red Hills, Jukes, and Darwin has been derived from a common source. If the felsite was a lava flow, it cannot have been the source. The ore solutions were more probably connected with the granites; and I believe this will still hold good, even if it be shown hereafter that the felsite was intrusive, for its intrusion must have been anterior to the granite.

I think, in the present incomplete state of our knowledge, we cannot safely theorise further than I have ventured. Additional data are requisite for the formulation of a satisfactory explanation of the genesis of this metal; and these cannot be acquired without a prolonged residence on the field.

Ores found in this Belt.

Copper Pyrites (Chalcopyrite) is the most common ore of copper in the felsite and schists, often mechanically combined with iron pyrites, which is too apt to constitute the larger proportion of the mixture. It also occurs in the iron ore masses, but sparingly so far.

Bornite or Erubescite, containing more copper and less iron than the preceding, is derived from it, and below ground water-level will pass into it. It has been found in ramifying veins in the felsite at Lake Jukes.

Copper Glance, containing no iron and more copper than either of the preceding. At Lake Jukes.

Malachite and Azurite.—These are the blue and green carbonates of copper, appearing on faces and joint planes of the felsite on Mount Jukes.

Native Copper is present in the iron ore masses in small quantity, and occasionally in the felsite.

Magnetite and Hematite, occurring in veins and masses throughout the belt. In masses of considerable magnitude on the west slope of Darwin.

Galena.—Occasionally, in small quantities.

Gold.—In the pyrites on Jukes and Darwin: in the felsite at Mount Huxley: in ferruginous and quartz seams in the syenite-porphyry at King River Mine: in quartz at Harris' Reward. Alluvial in creeks on Mount Ellen, Mount Huxley, Mount Jukes. The copper ores contain small quantities of gold and silver.

The all-important question, seeing the tendency of copper pyrites in the felsite to occur in splashes, and in the schist as impregnations, is where to seek for the permanent ore bodies, which may be assumed to be near at hand. The iron ore may be taken as a general indicator; but the specially favourable channels appear to be bands of schistose chloritic rock. As a general rule, I noticed that where the rock is hard, massive, square-jointed, and void of fissility, it is unfavourable; but numerous observations will have to be made throughout this untried region before generalisations can be made safely.

Examining even the most massive occurrences of magnetite, as on the Prince Darwin section, where the solid iron ore is sprinkled with iron and copper pyrites, plenty of quartz can be seen in the substance of the ore, the indications of replaced country-rock being, to my mind, quite plain.

The magnetic oxide does not belong to the type found in basic rocks, such as serpentine and gabbro (containing titanium, nickel, cobalt, &c.), but is wholly in acid-eruptive rock. It is dense, crystalline, granular in texture, and passes by gradations into magnetitic hematite and hematite proper.

Mines on Mount Jukes.

These may be approached by a track from the North Lyell Railway on the east, or by the pack-track from Lynchford, which crosses the King River (by cage), near

Harris' Reward, and then proceeds east for 2½ miles. The usefulness of this track is discounted by having to cross in the cage. Passing eastwards, the path traverses the northern section of

King Jukes Mine.

The company has two 40-acre sections, 1737 and 1861-93M, which it has prospected for copper. These slope down steeply to the north, towards the King River, which flows far below, in the gorge between the mountains Jukes and Huxley. The country-rock is chloritic schist and felsite, the latter pink where fresh, but green where modified by a secondary development of chlorite. I visited an abandoned tunnel a little below the track, driven into mineralised chloritic felsite, dark-green, and black. The massive walls are only fissured country. These joints or fissures run with the tunnel east of south, and the pyritic ore takes the same direction. The face in the end is well splashed with copper pyrites, and some nice-looking copper ore is stacked outside the entrance. This mineralised band appeared at the tunnel mouth to be very wide. Any amount of backs is available, and, as the ore-bands seem to run parallel on different meridians in the same belt, crosscutting ought to open up new ground. It is probable that in this way soft zones of cupiriferous schist would be intersected, in which the ore seems generally to be more concentrated than in the harder rock. Appearances on this section are encouraging, and it is a pity that financial difficulties compelled the company to stop work for a time. The country-rock resembles some of that seen on the track between the White Spur and Mount Tyndall—dark-green, with red patches.

Jukes Comstock.

This section, 40 acres, No. 1713-93M, is N.E. and adjoining the preceding. It descends the steep northern slope of Mount Jukes to within a short distance of the King River. It is bounded on the N. by an 80-acre section, which has been floated into the Jukes Consols. I wished to examine Turner's property on my visit to Jukes, but the weather prevented me. The Comstock

has two tunnels driven into the hill below the Proprietary Mine, apparently on the same ore-belt. The upper tunnel, about 300 feet below the No. 2 Proprietary, had just been started at the time of my visit, and was 15 feet in. It was being driven in reddish felsite, carrying abundant iron pyrites, some of it very solid. Some of the ore from here assayed 3½ per cent. copper and 3½ dwts. gold. The lower tunnel is 250 feet beneath this, and was 84 feet into the hill, driven also through red felsite (quartz-porphyry), with patches and strings of copper and iron pyrites. A little galena has been found in a small seam of pug in the crosscut near entrance. This pug is four to five inches thick, and is the contact between the reddish quartz felsite and Silurian sandstone, which is here in the middle of the felsite country. The tunnel face is barren, but it is intended to crosscut east through the felsitic rock. This must be done, for there is no defined ore-channel, and, if work is restricted to the line of a tunnel, valuable ore-deposits may be missed. The tunnel, so far, has been a disappointment. Outside the entrance is a great face of carbonate-stained felsite, which suggested copper minerals further in. This leaching of carbonate was the first discovery of copper. Lime is sometimes associated with the ore. The huge cliffs contain a little mineral here and there, but the country is very tight and hard. If ore is found, it is likely to be clean. Some of the ore from the tunnel, assayed at the North Lyell office, contained copper 6·02 per cent., iron oxide 9·66 per cent., lime 3·90 per cent. Vigorous prospecting work is what is wanted here, and nothing better can be devised at present than the proposed crosscut, and, later, a lower tunnel. On this section the ore-bearing felsitic rock is bounded by sandstone on the west and pale schists on the east. Six men were working.

Jukes Consols.

The section below the preceding is an 80-acre one, partly on Mt. Huxley and partly on Mount Jukes, with the King River traversing it. It has a tunnel driven in the great felsitic belt, in which the other mines to the south are situate. Work was abandoned prior to my visit, and in the awful weather we experienced on the

mountain I did not think it worth the risk to descend the rocky precipice down to the drive; but I went down as far as the Comstock, the mine immediately above it, and could see very well that the cupriferous formation continued. I should say that the Consols have as good a prospect of tapping ore as the upper mines have.

North Mt. Jukes.

Section 2699-93M, 40 acres, situate between the King Jukes and the King River. The hill has been driven into, but without getting any ore worth speaking of. The ore-bearing formation, however, is there, and if the King Jukes strikes ore, this section is in a good position for the continuation of the deposit.

Mt. Jukes Proprietary.

Jas. Bean, Manager. Two 40-acre sections, 1711, 1712-93M, south of and adjoining Comstock at the north end of the mountain. The track to this mine is bad after leaving the King Jukes, being only a footpath on the precipitous side of the mountain. The King River is 1,500 feet below the upper tunnel. Satisfactory signs of industry were noticeable on this property; there were some good huts and a couple of blacksmiths' shops.

To the south and west is the lofty face of Mt. Jukes, capped with conglomerate, which reposes on the felsitic and chloritic schists. The mine works are in the rocky slopes at the base of this face. An upper tunnel (called No. 1) has been driven west in the S.W. corner of section 1711 for 125 feet. At 18 feet from the entrance it intersected a dark quartz schist ore-body 22 feet wide. To this grey quartzose schist, with blebs of quartz in the planes of lamination succeeded, and further in some seams of dark ore-impregnated schist were met with. The schist is often dark-green from chlorite. The dark schists are considered favourable for copper; the grey schist is dry and unpromising generally. These schists exhibit a rock unmistakably deformed, and their origin is not altogether free from doubt, but, from the preliminary examination which I have been able to make, I am inclined to think they are schistose felsites. They alternate with felsite, are formed in the middle of the

felsite zone, and are sometimes continuous with the latter rock on its strike. I have detected twinned felspars in them, and this supports an igneous origin. The face of the tunnel at present is in grey schist; but both grey and green are really the same rock and alternate. A winze has been sunk on the 22-feet ore-band 60 feet in-ground, which, though poor at times, may be described on the whole as payable. The best ore occurs at the bottom of the winze; a good sample from here assayed 15% copper, 2 ozs. 12 dwts. silver, 3½ dwts. gold. From the bottom of the winze a level has been driven 30 feet N. and 32 feet S. Behind the end of the south drive poor schist comes in. A crosscut west has been put in 24 feet across the ore body and has penetrated 5 feet into barren grey schist. Measuring from the east wall of drive there are 14 ft. of good ore succeeded by 10 ft. of impregnated schist which may do for milling on the spot. The crosscut has probably not exhausted the ore ground, as, doubtless, parellel zones exist. The west wall of level at bottom of winze is poor going north, but a crosscut east from this end passes through 10 ft. of dark impregnated schist suitable for dressing. I saw a pile of good ore at surface said to have been raised from this winze. The published average assay value of the lode in the winze and drive is 12 % copper, with small quantities of gold and silver. A piece of stone which I picked from the pile at the mouth of the tunnel and judged to be an average sample was assayed by Mr. W. F. Ward, Government Analyst, and returned 3·7 per cent. copper, with traces of gold and silver.

Further north, a lower tunnel, No. 2, 300 ft. below the upper one, is being driven S.W. to cut the schistose ore body above mentioned and connect with the upper workings. It will have to be about 500 feet in length in order to intersect the ore formation. Seams of copper pyrites and pyritous schist have been intersected in the tunnel. The ore from one of these seams is stated to have assayed 29 per cent. copper. The ore met with has no apparent connection with the band further west. At the entrance to this tunnel native copper is disseminated through the hard felsitic rock.

In the N.W. corner of this section there is a large hematite outcrop, which, considered by itself, would be

taken as the oxidised outcrop of the schistose ore body, for where it has been cut into down to 12 or 13 feet it seems to split up into veins of iron and copper pyrites in schist. But it must be interpreted in connection with other exposures in this field. The band of hematite passes N.W. into the Jukes-Comstock section.

Below the lower tunnel mineralised rock has been trenched across for 100 feet. It carries copper pyrites everywhere, but not sufficient to pay where exposed. The belt of felsitic and schist rock which carries ore on Mount Jukes is roughly about a mile in width, but in any one place it varies from 5 to 10 chains wide. The hematite appears and reappears in veins over a width of 5 or 6 chains.

There is no zinc associated with the ore on this field, and if enough copper can be found the mines will be opened out vigorously, despite the present inaccessibility of the claims. If the cage were done away with at the King river, and a bridge constructed, stores and ore could be packed *via* Lynchford, but the company's natural outlet will be to the North Lyell Railway. The set of mines just referred to are all at the north end of Mount Jukes. Their value at present is largely prospective, but the good ore in the Jukes Proprietary is decidedly encouraging. Defined lodes need not be looked for, but there may be numerous lenses of ore in the schist and in the felsite in connection with the hematite outcrops. The latter are ill understood at present. Future work will no doubt unravel the relations between the iron ore and the copper deposits. All facts which bear upon this relationship should be carefully noted. Communications upon the subject will be gladly received and acknowledged by this office.

To the east of Mount Jukes Proprietary is an 80-acre section held by the Great Southern Mount Jukes Co. The track south from the Proprietary to the Lake Jukes passes first through company's section held by the Great King Jukes syndicate, and next across the South Mount Jukes 80-acre block. Some surface prospecting has been done. The track skirts the eastern face of the Jukes range and passes over the schists, conglomerates, and sandstones which hang on the flank of the great quartz-felsite mass. The great white conglomerate cap

can be seen here resting on the central summit of Jukes.

The Queen Jukes sections comprise four 40-acre blocks, three of which are south of the King Jukes. There has been some driving in the steep eastern face of the mountain where the rock is mineralised, but very little work has been done up to the present.

At the survey camp the ascent is made to Lake Jukes through myrtle forest over sandstone, chloritic schist, and silurian red conglomerate, highly inclined.

West of the King and Queen Jukes are the Mount Jukes and Crown Jukes sections, also in the cupriferous zone, and this country would appear to run south through E. H. C. Oliphant's section. These lie in a part of the belt which was inaccessible to me. A published assay by Messrs. Spiedie & Co. of surface ore from the schist at approach to tunnel on the Crown Jukes gives, copper, 2·36 per cent., gold, 18 grs., silver, 19 dwts. 14 grs. per ton.

The inaccessibility of the 40-acres, 3632-93M, held by the Jukes and Darwin Junction Company, prevented my visiting the section during the short days of that season of the year. It is high up on the mountain, and I understand nothing payable was found, though only a little surface prospecting has been done on it. In position it is north-west of Lake Jukes mine, but I should judge it to be in the same cupriferous zone as the other mines on Jukes.

Imperial Jukes, 4046-93M, is an 80-acre section in the name of W. P. Motton, east of Lake Jukes. Some money has been expended in surface prospecting on a mineralised belt which traverses the block S.E. to N.W.

Lake Jukes.

This property comprises two 80-acre sections south of South Mount Jukes. The name is due to the existence of a deep lake high up on the mountain side. This sheet of water covers about 8 acres, nestling in a recess under steep cliffs. It freezes over in winter with 2½ inches of ice. Its appearance is that of a glacial tarn. There is no foundation whatever for the supposition that it is the crater of an extinct volcano. These mountains have been carved into their present shapes by the denuding

agencies of weather, water, ice, &c. Another lake exists on a neighbouring section to the S.E.

The Lake Jukes Mine is in massive quartz-felsite rock, which has been denuded into the form of a narrow spur, or razor-back, measuring, at the base, 600 or 700 feet across, and narrowing as it goes up. The mine had been working for a few months only when I was there. A lower tunnel was being driven in the face of the hard felsite to strike the veins of rich bornite and glance copper ore, which, at surface, ramify through the country. These veins are thin where cut into on the surface, but it is hoped they will widen out in depth. A possible drawback is the likelihood of the veins meandering through the rock instead of filling a straight fissure. From what I saw at surface, I fear this will be their habit. If they improve, the Lake Jukes will be an important mine, for the quality of the ore is the best on the field; and from the configuration of the country, I think a great depth will have to be attained before the rich secondary glance and erubescite give way to the poorer chalcopyrite, which will ultimately constitute the vein. There is more than one outcrop of such ore on the hill, and there ought to be a good deposit in connection with all this ore. It must come to light if perseveringly and judiciously sought. Picked samples of copper glance assayed 50 to 60 per cent copper, 9 ozs. silver, 2 dwts. gold per ton. A rich sample which I took of the bornite ore (accompanied by a little vein or vugh quartz) was assayed by Mr. W. F. Ward, Government Analyst, with the following result:—73·5 per cent. copper, 5·7 per cent. iron, with traces of gold and silver.

There is no blende here, but a little accessory galena is seen. Native copper is found in the rock, whence it has been carried into the creek. Stains and facings of azurite and green carbonate of copper are visible on joint faces in the rock. This is one of the few mines in the belt where there is a reasonable chance of the ore deposit turning to a lode. At Lake Jukes a quartz schist lies east of the quartz-felsite. A speckling of the latter is noticeable, which may be the commencement of a chloritising process. The rock, upon microscopical examination, is found to be identical with that at the Jukes Proprietary.

There is every encouragement for perseverance in testing these rich veins, for, if they make strong at a moderate depth, this mine will be an undoubted success.

A track is being cut to connect this claim with the low country to the east: about five miles ought to bring it to the railway. There are heavy falls of snow here in winter, and a good track will be indispensable.

Mount Darwin.

The ore-belt continues south from Jukes to Mt. Darwin, the two mountains being connected by a saddle.

The field, at present, may be described under two divisions, viz.:—North Mt. Darwin and South Mt. Darwin. At the Northern end are Hal Jukes and some other sections, which I did not visit. They are lying idle, waiting for the introduction of capital. The other mines in the northern division are on the eastern slope of the mountain, above the Darwin township, and by pack-tracks and aërial tramways could be put into easy communication with the North Lyell Railway, which runs through the flat country below. Naturally, these mines are favoured and fostered by North Lyell investors, who count upon them growing into important feeders of their railway line. This line furnishes them with a splendid get-away for their output, notwithstanding their lofty position on the side of this bold and majestic range.

Mt. Darwin Proprietary Mine.

Mr. B. Pearse, Manager. This Company has two forty-acre sections on the eastern slope of Mt. Darwin, 700 feet above the township, 3066, 3067-93M. The tunnel which is now being driven takes a S.W. direction across siliceous schists and quartzite. When I was there, the end was in quartzite, and it is intended to drive far enough to get below an ore body disclosed by surface trenching. At 130 feet in, a south drive has been put in 90 feet, and then a crosscut started parallel with the main tunnel. Little bunches of good copper ore were met with all along the drive. The country rock is grey quartz schist, and the ore resembles the siliceous ores of Mt. Lyell. The rock has no connection with the felsite, but forms a narrow belt flanking it on

the east. From the nature of the ore, and from its position, I take it to be the southern prolongation of the Lyell belt, 9 miles to the south of Gormanston. The line between here and the sections belonging to the Great Lyell South should be traced, and, if examined properly, will probably be found to be a more or less continuous ore-belt. This is an instance in which it may be permitted to place some confidence in geological reasoning, and, without actually travelling along this belt, I have not much hesitation in predicting its continuity. Future prospecting will, I believe, show this prediction to be justifiable. It has been too much the fashion to draw an arbitrary line at Mount Lyell, and to assume that the deposition of ore did not take place south of it. We have now the discovery of identical ore in similar schists on the same strike several miles to the south, and there are no reasons which require us to believe that the intervening country must be blank.

The mine was started in 1899; 8 men were employed at the time of my visit. Ore has been found at intervals along the line of formation for over a thousand feet, and the formation traverses both blocks. Ore at the show in the creek is stated to have yielded as much as 19 dwts. gold. Published assays of ore are—

(1.) Copper, 17 per cent. Silver, 10 ozs. Gold, 19 dwts. per ton.
(2.) „ 12 per cent. „ 9 ozs. „ 14 dwts. per ton.

a sample of the rich pyritic ore which I took has been assayed by Mr. W. F. Ward, the Government Analyst, as follows—

34 per cent. Copper, 2 ozs. 0 dwts. 20 grs. Silver per ton.

South Mount Lyell.

J. Dillon, Manager. The two 40-acre sections south of and adjoining the Darwin Proprietary, are held by the South Mt. Lyell Mining Company, Limited, 2158-9-93M. The mine is about 650 feet above the railway, and is in the same favourable grey schist as the Proprietary. The light yellow copper pyrites, which is the ore here, is identical with that of the Lyell district further north. The deposit is not in the form of a fissure lode, but constitutes a replacement of the schist. The schist is slightly talcose. It strikes N. 20° W., and a tunnel has been

driven S.W. across it, proving impregnations of copper all the way. At about 200 feet in, a winze has been started, where good ore showed, and some nice looking metal has been obtained, assaying 13½ per cent. copper, and 9 dwt. gold per ton. A pure sample which I selected from the ore paddock was assayed by the Government Analyst and yielded 33·1 per cent. copper, 2 ozs. 2 dwts. 11 grs. silver per ton, and traces of gold. Fifty feet further in, the tunnel passed over the top of black schist, also carrying pyrites. In the end of tunnel, the face shows schistose quartzite (or felsite?), also slightly impregnated with pyrites. There is an upper tunnel about 40 feet higher, which has been driven 100 feet, and a winze sunk at entrance. If the quartzose rock in the end of the lower tunnel is felsitic, a decided change of country will take place. Although the change may not be intrinsically favourable for ore, the contact zone is promising for ore deposition, and I regard the country all along this contact in the Proprietary and the south sections as likely ground. Ore may or may not be met with in the quartz-felsite, but will probably be found by sinking on the schist or tunnelling through it lower down, and then driving on parallel bands of mineralised country which will prevail at or near the boundary between the two descriptions of rock. There seems to me to be every inducement for courageous prospecting.

Mount Lyell Extended.

Mr. David Sumpter, Manager. Twenty chains south of the South Mount Lyell property is a 40-acre section, 2549-93M, held by the Mount Lyell Extended Company. This mine is 1500 feet above the railway, and in a splendid position for an aërial ropeway. The track south from South Mount Lyell, along the mountain side, crosses the cupriferous schists, and leaves them to the east; it then courses along pink, flinty, felsitic rock, often green with chlorite, and possessing some degree of lamination, in a N.W. direction, and with a S.W. dip into the mountain. This rock contains specular iron in veins and on the cleavage faces. Further south-west the rock merges into a chloritic schist, with disseminated iron pyrites.

Close to the manager's hut is a cut, in which explosives are stored, and which exposes a green chloritic schist impregnated with pyrite and specular iron. A couple of hundred feet higher up the hill a hole has been put into the same sort of schist, but harder, and containing more quartz. The rock is well impregnated with iron pyrite. To the west it is succeeded by talcose schists. The top cut is in speckled talcose schist, the chloritic specks bearing a resemblance to similar chloritic pseudomorphs in the felsites: this schist also carries iron pyrites. A lower cut in the chlorite schist shows iron and copper pyrites running through the rock in seams parallel with the laminations. The iron pyrite is abundant.

A tunnel has been driven across the soft talcose and chloritic schist for 107 feet. Some bunchy copper ore was found at the approach, and slight disseminations of iron pyrite throughout the course of the drive. The face is in greenish chloritic schist. The only thing to be done is to continue driving. Just N. of the tunnel is an open cut which exposes grey-green chlorite schist, seamed with copper pyrites, where soft, and charged with disseminated iron pyrites. The Lyell Extended appears to be west of the south Lyell and Darwin Proprietary zone. Search should be pursued where the schist rock appears the softest, as the softness is, apparently, the result of crushing and the deposition of mineral. Five men are employed here.

Mount Lyell Consols.

Manager, Mr. David Sumpter. S.W. and adjoining the Extended is the Mount Lyell Consols section, 2585-93M, 40 acres, about 2200 feet above the railway; consequently, a good height above the Extended. A tunnel has been driven 128 feet across green chloritic and talcose schist, with a hackly fracture, containing veins of iron pyrites and a little copper pyrites. The end is still in the same schist. About 30 feet higher up a cut has been put in hard green quartzitic schist, carrying a little copper and iron pyrites. The tunnel below has gone through this, and prospects are none too encouraging, for the country is hard and tight, and the soft schist, which carries the most ore, is absent. Four

men were employed here. I was greatly indebted to Mr. D. Sumpter for hospitality and assistance on the mountain.

To the N. of Lyell Consols is the Darwin Consols, Section 3196-93M, 66 acres, where some work has been done without much result, so far. Operations had been suspended here, as also on

Brumby's Sections,

2746-7-93M, 80 acres each, which are now known as the Melbourne Darwin and are ¾ mile west of the South Mt. Lyell. In going to these from the Lyell Extended a zone of felsite is passed over, and then, further west, chloritic schist. A belt of mineralised schist traverses the eastern section from S.E. to N.W. Three trenches have been cut in the schist just at the beginning of the western slope of the mountain. The strike of the schist is N. 20° W., and its dip, S.W., and rather flat, 45°. The rock carries iron and copper pyrites, sometimes associated with quartz. The principal trench or cutting has been put in 20 ft. on some pyritous schist, containing copper. Some of this is stated to have assayed 6 per cent. This is not the bulk value; but some of the ore could, under more favourable conditions, be concentrated, as there is not an excessive quantity of iron in it. This chloritic schist is on the strike of the felsite which forms the backbone of Darwin, and my interpretation of all these quartz and chloritic schists is, that they are crushed felsitic (quartz-porphyry) rock. The igneous rock has yielded, in these places, more to the crushing action, which has developed lamination and the minerals characteristic of dynamo-meta-morphism. The ground being flat, tunnelling is out of the question, unless excessive length is accepted, consequently, prospecting will be rather difficult. Some of the disadvantages of its position will be remedied by the construction of a track, which is necessary for the transport of material. The ease with which surface exposures of cupriferous schists have been discovered indicates the existence of a copper-bearing zone, which should be explored.

The properties on this mountain suffer from the absence of tracks. Some of the syndicates have cut

paths to their claims, but of an indifferent character, and there will always be some difficulty in getting supplies to the ground, even with the best of tracks. The enterprise already displayed by owners in prospecting their ground under difficult conditions commands attention, and is entitled to encouragement on the part of the State

The above comprise the mines which I visited on North Darwin. The remaining mines are on South Darwin, and on the western slope of the range.

South Darwin.

From Mt. Lyell Extended I ascended by a foot-track to the summit of the mountain. The crest is composed of quartz-felsite rock, and is clothed with grass. The rock is reddish in tint, and has a hackly fracture. At times it contains veins of hematite. The track runs south on the ridge of the mountain, and on the strike of the felsite. To the west is the Sorell range, separated by a tremendous valley, into which the winter's sun shines but little. The extreme southern end of Darwin is seen in the distance as a knob, several hundred feet lower than the northern apex.

Proceeding south a little to the east of the centre of the ridge, a line of granite is struck, which runs N. and S., flanking the felsite on the east. It is coarse-grained, and fresh specimens can hardly be obtained from the weathered exposures. It crumbles easily, weathers white, and the dark silicates are present only in very small quantity: the rock is composed practically of quartz and felspar, but the structure is granitic rather than aplitic.

Going down the western slope of the ridge by a steep footpath through the forest, we reach the 80-acre section, 2662-93M, of the

Prince Darwin Copper Mine.

The feature of this property is a large belt of hematite and magnetite traversing the section from N. to S., sometimes attaining a width of 200 feet. This large outcrop carries iron and copper pyrites, a little copper carbonate, and some native copper. Upon carefully

examining the hard green and red rock in which the iron ore is enclosed, I found it to be quartz felsite. On this section the felsite is sometimes brecciated.

The lower tunnel, 1500 feet below the summit of Mt. Darwin, has been driven 50 feet N.E. in hard green and red felsite. The rock carries a little iron pyrites as well as native copper, and the magnetic iron formation is a little ahead of the end.

An upper tunnel is being driven obliquely across the magnetite, which has disseminations of iron and copper pyrites, native copper, and is permeated with quartz. The rock is strongly magnetic, dark grey in colour, and has every appearance of being a replaced quartz-porphyry. The tunnel is 50 ft. in. Where a shot was put in above the tunnel, the ore assayed 2½ per cent. of copper, but it is believed to average 1½ per cent. all through. But the tunnel is in ore which appears to be improving with the drive. Mr. Cundy's recent assay of some ore showed 7 per cent. copper, 2 ozs. silver, 16 to 19 grs. gold. Speedy's assay of ore from the end was 7 per cent. copper, 3 ozs. 16 dwts. silver, 1 dwt. gold. It has sensibly improved in the last ten feet. Mr. Ward's assay of my sample is 54 per cent. iron oxide, but no gold, silver, copper. This looked a fair sample of the iron ore well sprinkled with iron pyrites, but not showing any copper to the eye. Lower down the hill, and about 3 chains above the west side-line is a parallel band of hematite about a chain wide. The rock is still felsitic. In the ore formation are quartz and remains of country rock. Some iron pyrites are found in it.

Going down the hill W. a fragmentary or brecciated felsite occurs, denoting shattering. This brecciated form is found down to the bottom of the valley.

The ore formation on the Prince Darwin is the most important on the field, and the task of exploring it should be taken in hand with earnestness. The iron outcrops are not, in my opinion, cappings of lodes; but it is necessary, nevertheless, to test them in depth, and see whether the oxide is accompanied by any sort of sulphide. In the neighbourhood of their margins ore deposits are most likely to occur, and, as the iron ore bodies, as well as the felsitic rock, dip west, the work for the Prince

Darwin owners is considerably facilitated. Up to the present, work has been retarded by the difficulty of of access to the mine. I am told it cost £10 to get the bellows and anvil to the smithy, but the proposed Government track from Kelly Basin to the south end of Darwin will put a new complexion on matters.

Casboult's Section.

4245–93M, 59 acres.—The iron ore formation continues southwards on this section. It is here a parallel lens with the huge outcrop on Prince Darwin, and is exposed for a width of about 15 feet just after crossing the boundary between the two sections. I saw some specular hematite in the outcrop, but no sulphidic ore. The country rock is still felsite. The surface is flat here, and it would be necessary to sink on the blow. Further south, on the same section, the continuation of the hematite crops out, still preserving a north-westerly bearing. Here, too, sinking would have to be undertaken, though a little more adit depth could be obtained than on the previous outcrop. This section has never been tested, and its resources may be said to be unknown.

South Prince Darwin.

Section 2689–93M, 80 acres. C. E. Russell and A. Machejefski.—This is south of Casboult's, and on the steep slope of the mountain falling away to the Clark River. A little below the brow of the hill is a wide and bold outcrop of hematite, which may be a parallel development to the large upper ore body on Prince Darwin. These outcrops habitually appear *en echelon*, instead of being prolonged in a direct line along the strike ; this fact is not detrimental, but each occurrence must stand on its own merits. The outcrop on this property carries the usual impregnations of iron pyrites, and will, doubtless, be properly tested as soon as proper conditions of work are established in this valley. The marginal portions and the adjacent country will probably be found to be the zones of ore deposition. In this untried country it is hazardous to predict whether or not the iron oxide will yield to sulphidic ore in depth.

Tasman Darwin.

Section 3365-93M, 70 acres. A. F. Brittingham.—This is south of and adjoining the South Prince Darwin. A tunnel has been driven S.W. for 50 feet, in dark, red-seamed, very hackly quartz-felsite, charged with a little iron pyrites, and stained with copper salts. The rock is sometimes green with chlorite. With the ore is associated some quartz, which is in nests and patches rather than in veins. The face of drive is in black flinty felsite. Higher up on the slope of the hill to the east is a large outcrop of hematite, 3 or 4 chains wide. A tunnel has been driven towards this band of iron ore, but was stopped within 60 or 70 feet from it. It would acquire 200 to 250 feet of backs, but afterwards sinking would be necessary. Still higher up hematite is well exposed, and shows along its junction with the country felsite plentiful splashes of iron pyrites, which must have been accompanied by copper, as a few azurite stains have appeared since the shots were put in. But this outcrop crosses only at the N.W. angle of the section. Like the rest, this property is awaiting better means of communication before work can be resumed to advantage. A specimen of magnetite I brought away with me from this section (from the open cut), when assayed by the Government Analyst, did not yield more than a trace of copper.

Tasman-Darwin Extended.

Section 2598-93M, 80 acres. A. Machejefski and C. E. Russell.—This is west of and adjoining the Tasman Darwin, and is situate high up on the S.W. slope of the mountain. Hematite veins and outcrops of moderate size occur in the western and central parts of the section. The work done on the property shows the occurrence of iron and copper pyrites, with native copper in the country rock, and the configuration of the country lends itself admirably to adit-driving, as the mountain side rises steeply. Though I did not see the huge blows here which are seen on some of the adjacent blocks, this section has the advantage of being nearest to the granite outcrop which occurs on the southern end of Darwin; and if the hematite, as seems probable, is connected in any way with the contact between the two rocks, the

property occupies an interesting and a promising position.

The ground falls away here south towards Macquarie Harbour, and there are sections in that direction in the names of C. E. Brown and J. Armstrong. I could not visit them, but was told that prospecting on them had disclosed a continuation of the same features which I have above described on the northern blocks.

Cowen's Section.

3934-93M, 61 acres, is situate on the top of the Darwin Ridge, to the east of Casboult's block (59 acres). The southern and eastern parts consist of granite, which underlies a covering of button-grass. Towards the northern boundary a shot in felsitic rock showed some iron pyrites, and on the northern side of the boundary, in Hepburn's, Lewis', and Hiscox's section 2663, 80 acres, hematite is disclosed, also with iron pyrites ; but owing to approaching darkness I could not fully examine these exposures.

North Prince Darwin.

Section 2632–93M (80 acres), north of and adjoining the Prince Darwin. It is located near the bottom of the valley under the precipitous western face of Mount Darwin. There are a couple of strong outcrops of hematite 9 or 10 feet wide, earthy to dense in character, and showing impregnations of iron and copper pyrites. One of these appear to have come in from the Prince Darwin Section. They are in chloritic felsitic schist, with a N.W. bearing and dip as usual to the S.W., and are about 500 feet apart. In the low tunnel, the ground passed through was chloritic schist, green and red, with occasional layers of brecciated felsite. The tunnel would strike the iron-ore body at a good depth in a short distance, but was stopped after driving 15 feet. Work was evidently begun here in a ridiculous, half-hearted way.

General Considerations.

From the above remarks, it will be seen that these Darwin Sections are still in an utterly undeveloped state. Hitherto the absence of railway communication and pack tracks, and their remoteness from any settlement whence supplies might be carried, have impeded work, and the

little work which has been done upon them has been achieved under such stupendous difficulties, that those who have attempted it deserve the utmost credit for their courage. Under these circumstances, there has not been much done which can serve as a certain guide in forming an opinion of the value of the ore formations. The field, however, is not on that account to be despised and shunned. On the contrary, I consider the outcrops and the nature of the enclosing rocks justify one in attaching considerable importance to the formations as receptacles of copper ore. It may be that prolonged and continuous prospecting is necessary to lay bare the ore channels, but there is every reason to hope that exploratory work will eventually succeed in disclosing them. On the top of the South Mount Darwin ridge, I came across a large quartz reef, which appeared barren, but fissure lodes seem to be quite the exception in the quartz-porphyry. The payable copper ore will, I think, be found to occur either (1) in the country-rock, where it has been rendered schistose or laminated by pressure and crushing, and is further softened by the decomposition of mineral, in a word, in the cupriferous chloritic schists; or (2) in such parts of the felsitic rock (often near its contact with granite) as have been permeated with silica and replaced by iron ore. Portions of the iron ore bodies (as at Prince Darwin) may possibly prove cupriferous enough to pay for working for copper. On the whole, however, I think it more likely that the richest deposits will be found outside the iron. As the conditions of life and work on these rugged heights grow easier, the chances of striking remunerative portions of the deposits will improve. A few successes will convert this great range into a busy hive of industry.

I wish to be sufficiently guarded to avoid raising, unduly, hopes with reference to any particular enterprise, but I recognise that a general expression of opinion is expected from me; and I feel warranted in saying that there is every incentive to perseverence. The mere fact that the mineral exposures are not always so solid as could be wished is a mere matter of accidental denudation; and the superficial or shallow indications, though they may be guides, are no measure of what may lie beneath them. The valleys east and west of Mount Darwin are valleys of denudation, where the softer rock

has been worn down and removed, leaving the hard granite and felsite backbone to form the mountain itself. We may be sure that the copper will continue down to its source, and that the water-level can form no bar to its existence below. It will take time and unlimited capital to explore this mountain thoroughly and systematically; but the work has already been commenced; and if it is persevered in there is a fair chance, fortified by every reason which mining geology can adduce, that this great range south of Lyell will, sooner or later, become a flourishing seat and centre of copper-mining in our Colony.

The market price of copper is now eminently satisfactory; and, consequently, the present is an advantageous time for prosecuting exploration. The copper stocks are low; the demand for the metal is increasing, and may be looked upon as certain to continue to do so. The present prices are not the result of manipulation of markets, but are undeniably the outcome of the state of the world's copper supply. There is every prospect of maintenance of values for some considerable time, as the numerous copper mines which have been started or resumed the last year or two cannot augment the total production appreciably all at once; and at the same time, the production, so far, is not overtaking the consumption.

The fact that no really payable mine has been opened yet must not be allowed to discourage exploration. The prospecting work, in consequence of the enormous difficulties in getting supplies to the field, has been trifling, and in no way commensurate with the importance of the indications. The indications, too, occurring in a country of new, unstudied rocks, require attention and examination before they can be profitably followed. Influx of capital has to be influenced, which requires time. There is therefore nothing extraordinary in the fact of progress being slow, painfully slow, from the investor's point of view. An improvement, however, seems about to occur in the conditions surrounding the work. Capitalists are beginning to turn their attention to the district, a useful railway line now skirts it from N. to S.; the projected North Lyell Smelters are necessary for the success of the field. A few tracks have been made, but more are requisite. Investors will have to exercise

patience. A great field like that of Jukes-Darwin cannot be developed in a day or a year, but it is encouraging to notice that there are already signs of a somewhat more marked success attending prospecting operations. Mt. Jukes Proprietary, Lake Jukes, and Prince Darwin are at present the most important centres in the quartz-felsite belt, and South Lyell and Darwin Proprietary in the siliceous schist zone. Looking at the circumstances quite soberly, I think my visit justifies me in saying that although no great metal deposit has been tapped as yet, the announcement of discoveries may at any time electrify the whole of the Jukes-Darwin range, and transform it into a mining centre of the first magnitude. The deposits will in all probability prove to be low grade propositions, but it is exactly such as these which modern mining enterprise most frequently turns to profitable account.

Mount Huxley.

On my return from Mount Darwin I proceeded to Lynchford, and visited the sections on Mount Huxley. This mountain is north of the King River and north of Mount Jukes, the river flowing between. It is another summit of the same chain, and its geology is similar, for the same quartz-felsite and chloritic and quartz schists continue to prevail. On the road from Lynchford, not a mile out of the township, is the old

King River Gold Mine.

Four men (Russell and party) were tributing when I passed. Several tunnels have been driven here, but only one is now open, the main tunnel. This has been put in by the side of a large reef or blow of quartz as wide as 10 feet, running with the country. The tunnel goes in at an angle, and comes back on the reef, which crosses the drive as a flat vein dipping N.W., and containing no gold. The tunnel is stated to be 400 or 500 feet long, but I could only get in 125 feet. At this point a crosscut N.E has been begun, and a rise was going up from crosscut. In 30 or 40 feet the rise is expected to strike the flat reef. Just behind the present end a small ¾-inch flat leader, black and quartzose, shows fine colours of

reef gold in the dish, and here and there some flat ferruginous clinker lies on the footwall of the reef. The gold is associated with the clinker, but none is referred to the reef itself. The country rock is soft yellow clay, with black irony seams, and the clay is stated to be auriferous only where intersected by the ferruginous seams. This clay seems to be a decomposed portion of the green eruptive rock which prevails from here to Lynchford, and which microscopical examination shows to be an augite-syenite porphyry. Segregations of silica, much resembling pebbles, have been taken for foreign inclusions, and have led to an ascription of tuffaceous origin to the rock. It must be admitted that the appearance of the pseudo-pebbles is deceptive. North of the mine the rock is laminated, and forms a kind of green schist, but nearer Lynchford it is massive. At times it is bleached, or, rather, preserves an original pale tint, and acquires a dense compact texture. One is tempted to speculate on its having any connection with the felsitic rock of the range, or with the keratophyre belt of Mounts Read and Black. Its age is not definable at present, but, as it is schistose in one part, and is traversed by quartz reef, I do not think it can be later than Silurian. It occupies the area between Lynchford and Specimen Creeks, but its boundaries require tracing. Students of Geology might profitably take this work in hand. In the course of the work, its relation to the asbestos found 20 chains N.E. of the King battery, would be studied. Just south of the railway and Queen River, clayey-banded slate occurs in the face of the hill, but, going up the Lynchford Creek towards the mine, the green syenite-porphyry continues on both sides of the track to just S.E. of the mine, where it occupies the creek bed and the hills on both sides. To the naked eye it is usually granular, specked more or less with black porphyritic crystals of augite. Patches and blebs of segregated siliceous matter, often with sharply defined regular outlines, simulate pebbles.

In this mine we have an instance of a phenomenon frequently met with on the West Coast, a decomposed rock, constituting a formation which is dependent for its gold contents on the veins of quartz traversing it. On this hypothesis, the country itself in the immediate

neighbourhood of the quartz stringers may be gold-bearing, but the gold has been derived from the veins, and not distributed promiscuously through the country as an original constituent. The ferruginous nature of the clay is probably due to the decomposition of the augite; but what really caused the extensive decomposition of the rock itself is not easy to surmise. The nature of the auriferous formation leads one to expect only a moderate yield from this mine. East of the mine the rock is replaced by slates and quartzites, afterwards sandstone and schist, until we ascend to.

Mt. Ellen Gold Mine.

There are 8 ten-acre gold sections here, charted in the name of J. B. Curran. On one of these is the old tunnel of the Mt. Huxley Mine. Mt. Ellen is really a spur of Mt. Owen, and not a part of Mt. Huxley at all. I found Mr. J. H. Havill living here, and he kindly showed me all there was to see.

What looks like the western boundary (though I am not sure as to this being the real limit in this direction) of the quartz-felsite, crosses Martin's Creek N.W. from Mt. Ellen. The felsitic rock and cupriferous chloritic schist form a belt over a mile wide. The old Huxley tunnel has been driven east over 100 feet in the felsite. For half the distance in, the felsitic rock has decomposed to a soft reddish clay seamed with flat quartz leaders and thin veins of iron ore. The laminations of the clay dip flat to the N.E. This soft material passes further in into massive cubically jointed hard felsite, though this softens again wherever the quartz appears. In the end of tunnel is a softish pink felsite. No gold has been found in the hard felsite: it seems restricted to the softer parts of the rock. The mouth of the old tunnel had fallen in, but had been cleared out by Mr. Havill, and a long approach of 70 feet hewn through the soft clay from 4 to 10 feet deep. The dish prospects obtained showed mossy gold and flakes, and some of the gold was attached to fragments of white quartz. The gold in this approach is apparently confined to the quartz and iron seams. The way to handle the stuff would be to take it down with the pick and send it along the approach for treatment at a lower level. A sample

I took from the cutting, when assayed by Mr. Ward, failed to show gold, but I had abundant opportunity of assuring myself that the formation does carry a little gold, though I should not like to commit myself to a definite estimate. In any case, the material would have to be very economically handled. To the east of this, at what is called the Eastern Point, the clay has been trenched through for a couple of hundred feet in length, and from this run, Mr. Havill, who is an energetic prospector, has washed a good deal of gold. In the soft iron-stained clay here are oxidised cubes of what was originally iron pyrite.

The tunnel above alluded to is near the top of a low hill, about 30 feet below the crown, and the ground would allow benches to be cut down to a depth of 100 feet below the present tunnel, making a total vertical height of 130 feet by 60 feet wide, and say 300 feet long, which could be worked without much difficulty. The visible soft ground is about 40 feet in depth.

The formation at Mt. Ellen is another illustration of auriferous deposits in decomposed rock; the gold is not alluvial, but *in sitû*. Prospects can be got from crushed clay in Martin's Creek to the N.W., below where the felsite crosses it, but not above; nor is gold found in Fraser's Creek, which comes into it from the E. Huxley gold, stated to be worth £3 15*s*. per oz., is known by its ragged form. The coarse water-worn gold from Nuggety Creek further north, where it joins the united stream of Martin's and Fraser's Creeks, is said to command £4 2*s*. 6*d*. per oz. We have here, evidently, an auriferous district, but the gold is sparingly distributed, and seems restricted to a few peculiar formations which may here and there contain concentrations fit for working where the circumstances are exceptionally favourable.

Mountain Maid.

Section 3956-93M, 80 acres, in the name of J. H. Havill. A trench has been cut E. and W. in siliceous schist (felsitic ?) for about 20 feet in length. The light grey schist is very flinty looking, sometimes talcose, and is impregnated with iron pyrites. It is said to be cupriferous. Its dip is S.W. About 140 feet lower down the hill a tunnel has been driven for 150 feet S.E.

to get below this outcrop. The adit is reddish dark and chocolate-coloured felsitic rock, carrying iron pyrites (and galena?). The country is hard and massive throughout. Near the approach an 18-inch seam of decomposed ferruginous felsite is stated to have assayed 9 dwts. gold. Care must be taken not to drive too far, for the flinty schist at surface may graduate downwards into felsite, and the continuation of the outcrop in depth may be passed without knowing it. There is nothing very definite or encouraging in the exposure at surface, and if no ore is found in the tunnel some more surface prospecting had better be undertaken before continuing expense underground. The position of the section is favourable for ore, as it is on the strike of the Mount Jukes belt.

Lady Havill.

Section 4064-93M., 80 acres, in the name of J. H. Havill. An outcrop in this section has been cut into to a depth of 10 or 11 feet in green chloritic schist impregnated with iron and a little copper pyrites. The idea is to test this by the level below and see whether it improves at that depth. Eighty feet lower down is a level being driven west of south into the hill, now 90 ft. in. The strike of the country is N. 20 deg. W., and the dip S.W. The schist is impregnated here and there with a little copper and iron pyrites. A little erubescite was visible. In this tunnel another 20 feet will intersect the downward extension of the outcrop. Behind the face a fair quantity of water is dripping through a band of harder rock.

On Havill's Section 4340-93M, 80 acres, I saw a few cuts in soft green talcose-looking schists with a little iron pyrites and hematite. I was told the formation contained copper, which is likely enough, but falling snow prevented thorough examination of these sections.

On another of Mr. Havill's sections, 4149-93M, 80 acres, further east, called the Red Blow Section, there is a bold outcrop of indurated ferruginous schist passing into hematite. This ought to be prospected. On a northern section (the Sunrise) 3713-93M, 39 acres, J. H. Havill, a little work has been done in pyritous rock, as shown by a small abandoned shaft, now full of water.

These sections on Mt. Huxley are in the cupriferous zone of Jukes and Darwin, and though they do not exhibit anything at present which may be described as encouraging, it must be remembered that a very insignificant amount of work has been done on them. Future work may give them an improved value.

Harris' Reward Gold Mine.

This is an abandoned mine, now about to be resumed, four miles from Lynchford, just south of the cage over the King River. A tunnel was driven on the course of a quartz reef for 60 feet, when it narrowed out, and 20 feet more driving failed to find any continuation of it. Further south a crosscut tunnel cut a little isolated quartz near the entrance, but 30 feet was driven without finding any more. Eight tons of quartz were taken from the surface, giving 15 ozs. gold. A shaft was sunk 40 feet for the reef, and a crosscut driven 10 feet, which cut a vein, stated to be 2 inches overhead and 5 inches underfoot. The water filling the shaft, work was discontinued. No pyrites appears in the quartz, but it contains a little galena, and the encasing sandstone (strike N. 20° W.) is chloritic. I saw a large boulder in the creek with good splashes of gold, and some stuff washed showed some light gold. The value of the gold here is said to be £3 17*s.* per oz. Nugent's shaft, at mouth of tunnel, is 35 feet deep, and went down on the reef, they say, 30 feet, but then lost it or went through it.

The quartz is said to be running with the country and dipping with it as well, which will explain its thinning out. The encasing sandstone is soft, and has been exposed to some disintegrating agency. No solid reef will be found here without sinking; and the probability is, as foreshadowed by its strike and dip, that it will be irregular and inconstant in width. I believe it is intended to sink a main shaft 100 feet and then open out, which is the best thing that could be done.

Oliphant's Asbestos Show.

Since my return some asbestos has been discovered about 20 chains north-east of the King River Mine

battery. Samples which I have seen are good in respect of infusibility, but inferior in point of purity and strength of fibre. They seemed to have come from oxidised rock, and the iron impairs the quality. From the nature of the rock I judge this asbestos to be altogether different from the chrysotile at Beaconsfield and elsewhere in serpentine rock in the Colony. This appears to be in acid rock, probably the quartz-felsite of the coast range, and the fibre is true asbestos, viz., derived from hornblende. The texture of the quartz-felsite is microgranitic. The seams of fibre are not likely to be so wide as they are apt to be in serpentine. It is the only occurrence of hornblende-asbestos yet known in the Colony, and should be prospected. It will be remembered that the famous Italian asbestos is of this nature, being a fibrous form of hornblende, as distinguished from Canadian asbestos, which is chrysotile, or fibrous serpentine. Some of the Lynchford asbestos might be utilised for paint: if the quality improves at other exposures, it is possible that the fibre could be treated for boiler-covering, &c. The seams should be well examined and driven on for short distances, as the fibre is likely to be found in bunches and pockets and swollen parts of the seams. A great deal will depend upon the shrewdness of the prospectors in recognising indications to be followed up.

This kind of asbestos requires a rather more expensive treatment than the ordinary serpentine fibre. The lumps have to be broken by machinery gently, so as to disintegrate them without rupturing the fibres, and this, together with the pockety nature of the occurrences, makes the mining of hornblende asbestos more costly than that of chrysotile deposits, as a rule.

Coal at Farm Cove.

Some Tertiary coal having been found on the shore of Macquarie Harbour, boring has been started in the neighbourhood by the Farm Cove Prospecting Association. When I was there, the bore was down 15 feet, through 13 feet of sand and 2 feet of sandy clay. The pump was stopping them temporarily, being too small for sand.

Three-quarters of a mile to the W., and 40 or 50 feet above sea-level, is a short drive, 12 feet long, W. of N. on a seam of lignite 2 feet 6 inches, dipping 5° N.E. Above the seam is a foot of soft grey pug or clay, often containing resin: above this a 4-inch seam of coal, then pug again. On the shores of Macquarie Harbour below this drive, flat carbonaceous seams are visible, and in the layers of brown sandy clay specimens of fossil leaves may be collected, showing the reticulation characteristic of European genera, and stamping this series of beds as of Tertiary age.

Mr. David Bissett informed me of a shaft sunk on the N. shore of Farm Cove to 58 feet below highwater mark, in sand, silt, and soft brown shale. No coal seam has been passed through; only a little lignite occurs wherever there is a change in the sedimentation. The bottom of the shaft is now in sand and brackish water. The fossil leaves which were shown to me were obscure and not decisive, but the formation continues round Pillinger harbour to the North Lyell brickyards, and there can be no doubt of the Tertiary age of these beds.

The Government Analyst's assay of the Farm Cove coal is—

Fixed Carbon.....	36·26 per cent.
Hydro-carbon.....	39·14 „
Ash	12·60 „

Sometimes the coal shows a woody texture, and is then lignite pure and simple; but I saw some very lustrous, jet-like varieties, which would come under the head of pitch coal—the higher quality of brown coal.

Such coal will probably be found at intervals all along the shore of Macquarie Harbour; for the bedding is flat, and the same strata appear to be continuous; but no bituminous coal will be found unless the bores pierce through the Tertiary beds and strike the Permo-carboniferous coal measures below. From the country north of Strahan I think it possible that the coal measures skirt Macquarie Harbour and lie beneath the Tertiary and recent sands along its shore; consequently,

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the present boring venture may, if persevered in, have some chance of striking true coal.

I have the honour to be,
Sir,
Your obedient Servant,
W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, *Esq.*,
Secretary for Mines, Hobart.

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA.

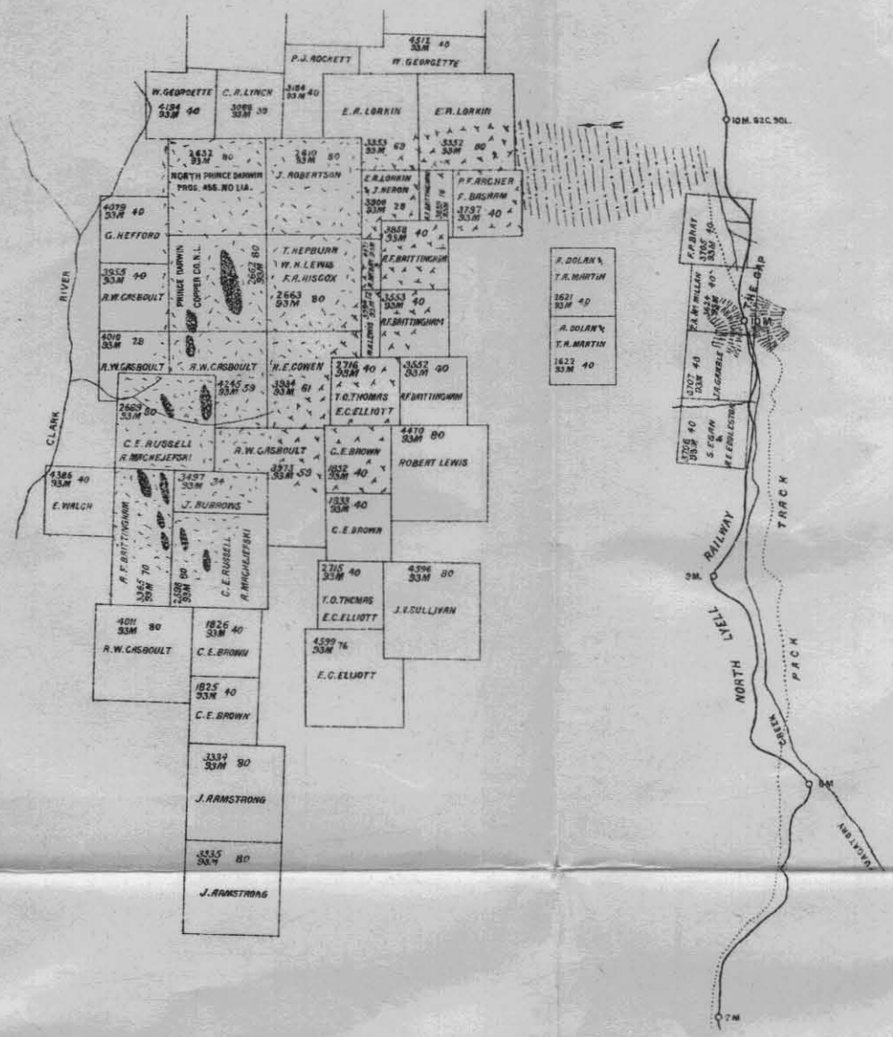
SKETCH MAP
SECTIONS ON SOUTH Mt DARWIN

Scale 20 10 0 20 40 60 Chains

MAGNETITE & HEMATITE
GRANITE
FELSITE
SCHIST

W.H Twelvetrees
Govt Geologist
Dec 1900

5 cm



SKETCH SECTION ACROSS SOUTH Mt DARWIN

SHEWING RELATIVE POSITIONS OF ROCKS

HORIZONTAL SCALE 20 10 0 20 40 60 CHAINS