REPORT ON THE MINERAL FIELDS OF THE GAWLER RIVER, PENGUIN, DIAL RANGE, MOUNT HOUSETOP, TABLE CAPE, CAM RIVER, AND PORTION OF THE ARTHUR RIVER DISTRICTS.

Geological Surveyor's Office, Launceston, 29th July, 1895.

SIR,

I HAVE the honor to forward to you the following Report on the above fields, which were visited by me during last month and the beginning of the present one. Only a short time could be devoted to each of the localities examined, and, furthermore, very little mining work was in progress on any of them, consequently the various mineral occurrences could not be minutely investigated. In a great many instances the mining work that has been done was carried out a good many years ago, and the workings are now inaccessible, or practically so. In order to make a thorough examination of the mineral discoveries it would be necessary to employ quite a number of men in re-opening fallen-in and covered-up workings, and also in opening out for the first time a large number of places where signs of the presence of ores have been noticed but no mining work done. In the course of the Report it will appear how far each occurrence could be examined at present, and it will be seen that in almost every instance much time and labour would have to be expended before it could be definitely said that there is or is not a reasonable probability of payable mining being possible. This Report has, in consequence, to be couched in very general terms, without going into details as to the value and prospects of the various discoveries.

The country traversed on this occasion lay mostly near the coast, between Ulverstone and Rocky Cape, though excursions were also made inland to the Dial Range, the vicinity of Mount Housetop, and the Arthur River. The geological structure of the region is rather complex, there being a considerable number of formations of different ages represented in it at one part and another, some of sedimentary others of igneous origin. It will be convenient to describe the distribution and relations of these before passing on to deal with the various mineral fields each by itself. They will be mentioned in chronological order, the oldest being taken first.

Lower Silurian or Cambro-Silurian System.—Older Palæozoic rocks, quartzites, schists, metamorphic sandstones, slates, and crystalline limestones, which may belong to the same system as the Cambrian beds of Caroline Creek in the Mersey District, or to the Lower Silurian Gordon River and auriferous slates formation, are found at intervals throughout the region under observation, and are very well seen in natural sections along the coast. So far as I am aware no fossils have been found in these strata, but from their position and lithological character they may pretty safely be classed as above. As there is some reason to believe that the Cambrian strata at Caroline Creek are conformable with the Lower Silurian Gordon River series, it seems best for the present to use the wide term Cambro-Silurian. Some of the highly micaceous crystalline schists seen in the Inglis River, and the quartzites of Rocky Cape, may be even older than the Cambrian, and may belong to the Archæan system, like those at the head of the Forth River, at Cradle Mountain, at Port Davy, and elsewhere. Generally throughout the district these ancient rocks are very much covered with later overlying ones, and are seen only in the river gorges and on the coast where the covering strata have been removed, but they crop out strongly in the Sisters Hills and the Rocky Cape Range. The localities where they are seen will be mentioned more particularly in the course of this Report when describing the country in detail. These rocks are much seamed with quartz, often carrying pyrites, and are probably auriferous in parts. Throughout the district their general strike is from N.N.E. to N.E., but the dip changes frequently from easterly to westerly, the strata being much folded and contorted.

Upper Silurian System.—The Zeehan and Hazlewood series of rocks of Upper Silurian age were not seen anywhere *in situ* in this part of the country, but are said to occur to the south of the Arthur River, not far from Kay's diggings. That they did exist in the vicinity in former times is, however, certain, as water-worn boulders carrying impressions of *Pentamerus Tasmaniensis*, *P. Knightii*, and other characteristic forms of this period occur in the conglomerates of Big Creek, near Wynyard. On the side of the road from Table Cape to Stanley, where it rises to cross the Rocky Cape Range, some rather soft well-laminated slates are seen, lying inclined at rather low angles to the horizon. These may prove to be Upper Silurian, but also might belong to the same formation as the Wynyard conglomerates, which I take to be most probably not older than Devonian. In the gravels of the Inglis River, some 2½ miles below the junction of the Calder River, large boulders were seen of conglomerate similar to that of Mount Owen, Mount Claude,

and Stormont, and it was said that the rock occurred *in situ* not far away, but I was unable to get to it ; if so, it probably belongs to the Upper Silurian system. It may be here noted that in this part of the Inglis district the gold is said to be usually found only where the conglomerate boulders are plentiful, giving some support to the belief entertained on many of our western goldfields that the alluvial gold is largely derived from the disintegration of the conglomerate, which is itself only a strongly cemented gravel drift.

The Dial Range series of conglomerates, slates, tuffs, felsites, and breccias, is referred by Mr. R. M. Johnston in his "Geology of Tasmania," tentatively to the Upper Silurian system, but he also remarks, on page 85, that, "as before mentioned, it is not improbable that the Dial Range and Table Cape conglomerates may yet be grouped among the Devonian rocks of Tasmania." The Dial Range formation is seen resting on the upturned edges of the Cambro-Silurian strata on the Penguin beach at the old Neptune mine, and there consists of highly indurated felsitic tuffs, breccias largely composed of angular fragments of quartzite, hornstone, and jasper, with occasional rounded pebbles of the same, and tufaceous indurated sandstones containing occasional waterworn pebbles, but otherwise closely simulating a crystalline rock. The decomposed portions of this last rock show it to be largely composed of felspathic particles, intermixed with hornblende or some similar ferriferous silicate. The formation is found right to the top of the Dial Range, but occasional exposures of the older Cambro-Silurian strata at varying heights show that it is resting on a bedrock which rises going southward. On the Dial Range we find extensive beds of conglomerate, the pebbles being well rounded, unlike the breccias at the Neptune mine. Tufaceous beds seem, however, also to be found to some height on the range, and a much decomposed crystalline rock of dioritic character was also observed, but I could not determine whether it was a dyke or a lava flow with any certainty. In some of the sandstone beds on the beach ripple-marking is very distinct, and from this and the common occurrence of conglomerates it would appear that the strata were originally laid down very close to the shore. The hematite found near the Penguin Creek seems to form a bed of this formation, and points to occasional lacustrine conditions. On the beach the strata sometimes show a slight amount of curvature, but on the whole the beds of the formation lie fairly horizontal. In parts, especially where containing much felsitic matter, they are extremely hard. Strong joints cut through the beds, often giving an appearance to them as if they were dipping at high angles, but close inspection shows the true bedding planes to be very flat. The pebbles of the conglomerates and breccias are shorn across by the joints. It is evident from the quantity of tufaceous matter that occurs intermixed with ordinary sedimentary material that volcanic dust and other fragmentary matter have been sorted to some extent by aqueous agencies, partly, perhaps, by being showered into the sea and there arranged by the action of the waves, and partly by being washed from land surfaces by rains and streams. So far as I am aware, no fossils have been found in the Dial Range beds which would give any clue to their age. The distinct jointing and great amount of induration point to considerable antiquity, while the amount of curvature is much less than is seen in the Upper Silurian beds of Zeehan, Heazlewood, Middlesex, and Fingal, yet distinctly more than is usual in our Permo-Carboniferous strata. In Victoria in the Devonian period there was great volcanic activity, forming series of rocks of much the same character as those at the Dial Range, and it seems very likely that the latter should be referred to the same age.

To the south of Wynyard the formation above referred to as the "Table Cape conglomerates" is seen over rather an extensive area between the Inglis and the Cam Rivers, and as far back as the Campbell Range and Arthur River. It is to be seen best in the deep gullies of the creeks running through the district, the tops of the spurs between them being formed of more recent basalt. As the name of Table Cape is inseparably connected with the fossiliferous Eocene beds found on the shore at Freestone Cove, it will be best to distinguish these older strata by a different appellation, and call them the Wynyard formation. Beds of conglomerate are very prominent in the series, often containing large boulders of quartz, quartzite, metamorphic sandstones and slates, schist, red granite, and porphyry, with occasionally, as above mentioned, fossiliferous sandstones from the Upper Silurian system. These boulders are usually enclosed in a mudstone matrix. Beds of mudstone (argillaceous sandstone) containing numerous small pebbles are also common, and there are also thick beds of laminated slates and shales and of white and yellowish sandstones (freestones). Some of the shales and sandstones are very soft. On the beach under the Eocene beds there are very slight signs of curvature in the bedding planes of the slate of this formation, but not more than might perhaps be due to slight irregularities in the original deposition of the sediments, and generally throughout the district the strata lie very flat. In lithological character and bedding they very closely resemble those of our Permo-Carboniferous and Mesozoic Coal Measures. The material is not nearly so much indurated as that of the Dial Range formation, the joints do not cut through the pebbles in the conglomerates as a rule, and so far as I have observed there is an entire absence of felsitic tuffs and other volcanic matter. The formation, however, seems remarkably destitute of fossils, not a trace of one being observed during my examination of it, though search was constantly being made for them.

The evidence in favour of the Wynyard formation being considered to be of the same age as that of the Dial Range is mainly that of position. The former is found from sea-level to the top

of the Campbell Range, the latter from sea-level to the summit of the Dial Range; both are nearly horizontally bedded, both consist largely of conglomerates, both are, so far as yet known, destitute of fossils, and the two are only some seventeen miles apart. On the other hand, the conglomerates of the Wynyard formation are composed of very different material from those of the Dial Range, and the volcanic products so characteristic of the latter seem to be absent, and there is not the same amount of induration and jointing. To the east of the Dial Range we find the Permo-Carboniferous coal measures of the Mersey District, also horizontally bedded, and lithologically more similar to the Wynyard formation than to the beds of the Dial Range, but highly fossiliferous. There does not appear to be much more reason for assuming the identity in age of the Dial Range and Wynyard formations than of the former and the Lower Coal Measures.

The following fact tends to make us think that the Wynyard formation may really be of much the same age as the Mersey coal series:—From time to time pieces of cannel coal have been found on the beach near Wynyard, and also pretty high up the Inglis River and the Seabrook Creek. These have always been only floating pieces, the parent seam not having been seen *in situ*, but the circumstances under which they are described on good authority as being found seem to allow no doubt as to their really having come from the neighbourhood. If so, they must either have come from small undiscovered patches of the Coal Measures or from the Wynyard formation itself, unless we also admit the unlikely hypothesis that they may have been derived from the Earlier Tertiary gravels underlying the basalts, to be described later on. Seeing that the conglomerates contain numerous boulders from the older rocks, the possibility suggests itself that the pieces of cannel coal also may have been imbedded fragments, in which case the formation would be younger than the Coal Measures. The coal is said to have been tested in Melbourne and found to be an excellent Cannel, similar to the Joadja "shale" of New South Wales, which is the best gas coal in the world. A similar Cannel coal has been found at Barn Bluff (*see* my Report "on the country between Mole Creek and the Mount Dundas Silver Field, and on the discovery of coal at Barn Bluff" of 13th June, 1893.) This is of the same age as the Mersey Coal formation, and is overlaid by fossiliferous limestones and shales. It is possible that the Wynyard formation is the base of the Coal Measures, and that high up in it the fossiliferous beds and the coal seam may yet be found. Both for scientific and commercial purposes search for them is desirable. In New South Wales it has been noted that both above and below the Greta Coal series, which corresponds with the Mersey Coal Measures of Tasmania, there occur layers of erratic boulders, probably deposited by ice during periods of continued low temperature in the Southern Hemisphere. These cold periods might supply an explanation of the paucity of fossils in the Wynyard formation, and ice action would likewise account for the occurrence of large and heavy boulders in it in a mudstone matrix instead of the more usual one of coarse sand and gravel, which is the ordinary result of the sorting of detrital material by wave action. During my examination, however, I did not see any boulders exhibiting ice striation, or of such size as not to be accountable for by the ordinary forces at work on every sea shore.

Devonian and Permo-Carboniferous Systems.—From the above considerations it seems better to place the Dial Range formation provisionally in the Devonian System and the Wynyard one near the base of the Permo-Carboniferous, but much more knowledge is required before any classification will be satisfactory.

Eocene System.—At Freestone Cove, close to the Town of Wynyard, occurs the well known cliff section of the Table Cape Eocene beds, well described at length in Johnston's Geology of Tasmania. They rest upon the eroded surface of the Wynyard formation, which itself is seen close by lying unconformably on the Cambro-Silurian slates. Tertiary basalt covers the fossiliferous beds. The formation is of small extent, being known to appear inland in only one or two places.

Palæogene Gravels.—In the Penguin and Wynyard Districts we very commonly find high terraces and sheets of rounded quartz gravel, lying upon the above older formations and covered by later flows of basalt. The Wynyard District must have been very generally covered with this gravel prior to the eruption of the basalt. It always seems to contain more or less gold, and is probably the source of most of the metal that has been found in the district. In former Reports on the Beaconsfield Goldfield, Gladstone District, Corinna Goldfield, &c., similar occurrences of high terraces of gravel have been described, and it has been pointed out that the northern and western parts of our island must have undergone a great subsidence in Palæogene Tertiary times, which led to great accumulations of gravel being laid down along the shores, followed by basaltic outflows, and a subsequent elevatory movement which has brought the gravel deposits up to a considerable height above sea level. The Wynyard District affords another example of the same features. The creeks have cut deep down through the basaltic covering and the gravel beds into the underlying Wynyard formation, and even down to the Cambro-Silurian bedrock below this in places.

Neogene and Recent Gravels.—The movement of elevation after the basaltic period having been a slow one, and probably at times interrupted, we find occasional newer terraces of gravel lying on the slopes of the hills. There are also along the coast from Ulverstone to past Wynyard raised beaches and comparatively recent gravel flats, which have been elevated above high-water mark at no very distant date in past time.

Eruptive Rocks.—There are numerous proofs of igneous activity at different periods of the history of the region, various eruptive rocks being found in it. *Granite* occurs at Mount Housetop and to the westward thereof, and is seen on the Emu Bay and Bischoff Railway line close to the Hampshire Hills station. It is probably connected with the occurrences of this rock at Mount Bischoff and the Magnet Range to the south-west, and with that at Bell Mount tin-field to the south-east. At the latter place the granite is later in age than the Upper Silurian system, as it is intrusive through the strata of this, so probably the Mount Housetop granite is also later than Upper Silurian. It seems possible enough that the felsitic tuffs of the Dial Range formation are the ash-beds from the volcanoes of which the granite areas represent the roots. The granite is older, however, than the Wynyard formation, as boulders of it are commonly found in this, proving that great erosion of the volcanic material had taken place, and the deeper seated granitic portions of it been exposed before the boulder beds were laid down. The occurrence of a decomposed rock resembling *diorite* at the Dial Range has already been noted: it requires further investigation both as to its composition and mode of occurrence before its exact rock species and age can be determined. *Diabase* greenstone, similar to that found so commonly in the eastern and central districts of the colony, and, therefore, probably of Mesozoic age, is seen between Burnie and the Hampshire Hills at some points on the Emu Bay to Bischoff Railway line, and also on the Campbell Range near the Inglis River. A somewhat similar greenstone, containing, however, a little mica and free quartz, and also occasionally traversed by small quartz veins, is seen in the Mill Creek near the township of Somerset, and also on the beach between Cooey Creek and Stony Creek not far from Burnie. It may be a diorite, but pending microscopic examination I am inclined to consider it a quartz diabase, and to look upon it as merely a local variety of the more general diabase (gabbro) formation. In Tertiary times, towards the close of the Palæogene period, there were extensive eruptions of *Basalt* and basaltic tuffs, which are continually being met with throughout the region now being described, forming the valuable agricultural areas for which the Penguin and Table Cape districts are famed. On the beach at frequent intervals black basaltic dykes and flows of lava with columnar jointing are to be observed. In the neighbourhood of the lava flows the gravels and superficial detritus covered by them are frequently found to be converted into hard conglomerates and breccias, no doubt cemented together by the action of hot mineral-bearing solutions emanating from the lavas: excellent examples of this are seen on the beach at Heybridge Creek and on the hillside west of the creek, the conglomerates in the latter place forming small cliffs in which are caves, these being due to washing out of uncemented portions of the original superficial drift. Inland the basalt caps most of the hills for some distance from the coast, extending with only local interruptions up to the Surrey Hills and Waratah plateau along the Burnie-Waratah railway, and back on to the Campbell Range to the south of the Table Cape District.

In describing the mineral occurrences examined it will be necessary frequently to refer to the different formations mentioned above, and their relations in point of age, position, and origin will require to be kept in mind. It may now be useful to mention briefly the minerals of economic value that are found in the district, and the formations in which they occur. *Gold* is found in veins and reefs in the Cambro-Silurian rocks, and with silver and copper in those in the Dial Range formation, also in alluvial deposits of Tertiary and recent age, in gravel beds buried more or less under the basalt, in gravel terraces, and in the beds of the modern water-courses. In the granite areas *Tin ore* is found in veins and lodes and as alluvial deposits, some of the latter being superficial, others buried under basalt. *Silver-Lead* ores have been found in veins which appear likely to penetrate both the Dial Range and the Cambro-Silurian strata; so also *Copper ores.* At the Blythe River there is a very large deposit of *Iron ore* (Red Hematite: see "Report on a deposit of Iron Ore at the Blythe River" of 5th March, 1894) in the Cambro-Silurian rocks, and near the Penguin very similar ore is seen in the Dial Range formation; there is also a large deposit of brown hematite at the "Iron Cliffs" in the Penguin District. In the same vicinity there is some *Oxide of Manganese*, which generally appears to be of comparatively recent deposition. The occurrence of drift pieces of *Cannel Coal* in the Inglis River and Seabrook Creek has already been referred to. *Lignite* has been found near Penguin and in the Table Cape District among the beds of the Palæogene Tertiary deposits. *Zircons* and *Sapphires* are found near Jacobs' Boat Harbour in recent alluvial drift which is probably derived from the Cambro-Silurian formation. There are also *Limestones*, building *Sandstones*, and *Basalt* fit for building and road-making in several localities.

GAWLER RIVER DISTRICT.

Only a very small portion of the Gawler River district was examined, a short visit being made to a gold-bearing reef that had been discovered about two miles from Ulverstone, close to the river. A hole had been sunk 8 to 10 feet deep on the reef at the edge of an alluvial flat formed by the stream, and in it was seen a lode consisting of from 8 to 12 inches thickness of quartz, and some 6 inches of clay, the latter being on the walls. The quartz has a vitreous appearance, and contains a good deal of iron pyrites with a little copper pyrites and blende. Strike about W.N.W. and E.S.E., dip 67° to the northward. The enclosing country rock is a blue schist, much like a good deal of the Lefroy ground, and the reef cuts across its lamination. Several prospects washed

from the quartz gave very poor results, though a little gold was seen, and it would appear that the reef is auriferous, but as yet nothing like payable. It might, however, be prospected further with advantage, and should be traced both east and west along its strike and tested at intervals to find if its gold contents increase. On the west side of the river there is a considerable hill into which a tunnel might be driven on the course of the lode after this has been picked up at the foot of it. On the hillside to the east another hole has been sunk some 12 feet through loose superficial soil without finding the lode, and a little crosscutting is required to pick it up. Any gold-bearing lode of this nature, carrying favourable minerals such as the sulphides here present, and occurring in a defined shape between distinct walls, is worth taking some trouble to prove, as it might turn out that it has first been cut in a poor or small part, and may improve on being followed; while very doubtful as to its being of value, it seems to me that it ought to be further tested on the chance of better stone being found.

About six chains east of this discovery, in a small branch creek, there is a shaft sunk some 27 feet on a mass of schist and quartz, 8 to 12 feet wide, which may be a sort of lode. The schist and quartz are much interlaminated, and there is no well-defined reef. A little gold is said to have been got on the surface from some of the quartz veins, and "colours" are reported to be got from here down to the Gawler River. From time to time it has been reported that a little gold occurs in the Gawler River itself. All the land in this locality is private property, and special arrangements have to be made with the owners by prospectors anxious to search for minerals. Though nothing of much consequence has yet been found, it seems probable that the locality is of a favourable nature for minerals, more especially gold, and is therefore worth some attention from prospectors. The slate country may be referred to the Cambro-Silurian system.

PENGUIN AND DIAL RANGE DISTRICT.

The Penguin beach exposes an excellent horizontal section of the Dial Range formation resting uncomformably upon the Cambro-Silurian rocks. Here the latter consist of hard quartzites, slates, and in one place limestone, and on a ragged eroded surface of these, beds of breccia, tuff, and felsitic ash, all somewhat mixed with ordinary sedimentary material, have been deposited. In several places there are dykes of basalt of Tertiary age bursting through the older rocks and lava flows covering them. The tufaceous beds are highly indurated, and sometimes very strongly jointed, and are somewhat bent into flat ridges and hollows, the strike being about N. 5° W. The steepest dip noticed was 45°, which was much higher than usual, the beds lying very flat as a rule. Between the Penguin Creek and the old Neptune mine the beach shows numerous mineral veins, and signs of alteration of the country rock by its being penetrated by mineral-bearing solutions. Parts of the rock are found very thoroughly silicified, and a great deal of it is impregnated with pyrites. Iron pyrites are very common; copper pyrites much less so; but some of the stuff also shows frequent films of native copper on the joints.

Neptune Mine.—About a mile and a half along the beach east of the Penguin Creek we find on the flat ground just above high-water mark the shaft of the old Neptune mine. This is on private property, on a block of 600 acres, marked on the county plan (Devon No. 3) "Grant to Amos Drew." Mineral section 3596-87M was formerly held on the beach to the north-west from the shaft to take in the seaward continuations of the lodes. The shaft is now full of water. It was formerly unwatered by an 8-inch drawlift, which is variously stated to have been equal to the work and unable to cope with the water. The machinery is still on the mine, but requires repairing to put it in working order. The shaft is 10 feet by 4 feet 6 inches, and is said to be 100 feet deep, with levels from it at 50 feet and 100 feet. At the bottom level, on the last occasion when any work was done in the mine, they drove 175 feet to the N.E., and then met with an inflow of water, fresh, not salt, which was dammed off and work stopped. They also went some 75 feet to the south, met a hard bar of country, and stopped. I have not been able to get any good information as to the work done at the 50 feet level, and from there to surface. The lode is said to have been traced along the beach on a course N. 40° W., but nothing can now be seen but traces of it, the trenches along the outcrop being filled with beach-gravel. It is said to have dipped to the S.W., and the shaft was located so as to cut the reef at a vertical depth of about 400 feet. It is said that there was also a cross lode running about north and south not far from the shaft. A small piece of the ore shown to me consisted of very dense galena associated with carbonate of iron. At times it is said that there was from 9 inches to 12 inches in width of clean galena. The information was given to me that the galena averaged 75 per cent. of lead and 29 ounces of silver per ton, but sometimes had as much as 45 ounces of silver. Some quantity of ore is said to have been raised and smelted on the spot in a small hearth. Though the Cambro-Silurian strata are seen on the beach, it would seem from examination of the mullock-tips that the shaft and drives have been in the Dial Range formation in tuffs and breccias. The lode is said not to have been cut at all in the lower level, which is a pity, as this would have tested it pretty well. Having in this instance to depend entirely on somewhat conflicting hearsay reports of what was found in the mine, I cannot express any opinion as to the prospects of success if work were resumed; it would seem, however, to be a matter of no very great expense to provide more powerful pumping plant and continue the drive at 100 feet to cut the lode, when something definite would be ascertained about it. It will be

interesting to find what the lode looks like when it gets down through the breccias into the Cambro-Silurian strata, as it must before going very deep. There is a possibility of its becoming more regular and larger in the older rock.

Penguin Mine.—The shaft of this also is on the flat ground just above high-water mark, near the south boundary of Section 155-87M, now no longer held under lease. The machinery has been removed, and the shaft is full of water. It is said to have been 80 feet deep, and though so close to the shore, there was not a very great inflow of water. As at the Neptune, the outcrops of the lodes where formerly trenched upon are now full of gravel, and cannot be seen, and it is not clear what the owners had to go upon. For some three or four chains along the beach the breccia and tuff country (Dial Range formation) is much silicified and impregnated with sulphides, and is traversed by numerous veins of quartz and sulphides of iron, lead, zinc, copper, &c., and dolomite, running in a general northerly to north-easterly direction, forming rather a sort of stock-work than a lode. Native silver and rich argentiferous gray copper ore were sometimes found, some of the latter being said to have given assays of 230 ozs. silver to the ton. Near the old shaft there are still a few pieces of the ore from the mine lying about, and some of these show copper pyrites, iron pyrites, galena, blende, and arsenical gray copper ore (Tennantite, or more probably Epigenite) in quartz and dolomite. A few pieces collected by me were examined by the Government Analyst, and returned—

Gold.....	0 ozs. 1 dwt. 15 grs. per ton.
Silver.....	27 „ 15 „ 8 „
Copper.....	3·4 per cent.
Nickel.....	2·5 „
Cobalt.....	0·8 „
Lead.....	10·8 „

also traces of antimony, but no zinc. Specimens of the ore containing more of the sulphides and less of the gangue than those analysed, which were quite second-class ore, would doubtless give much higher returns. The nickel and cobalt in the ore add considerably to its value, and would be saved in smelting as a speiss in combination with the arsenic.

For the same reasons as in the case of the Neptune mine, I cannot say much as to the prospects of resuscitating this one. In one respect it appears to offer better inducement to try it again than the former, namely, that there is a considerable probability that the numerous veins scattered over a large area at surface will be found in the underlying older formation to make one or more definite lodes. I do not know how deep it would be necessary to go to get into the Cambro-Silurian strata, but do not think it would exceed 300 or 400 feet, possibly much less. It seems rather likely, from a theoretical point of view, that at the time the ground was shattered and mineral-bearing solutions began to go through it, the tufaceous formation was comparatively soft, and might well become greatly shaken and fissured by a force which would only make a clean fracture in the hard older rocks beneath. Solutions, especially hot ones charged with mineral substances, rising through such a clean fissure into a shattered pervious rock might very likely convert the latter into a sort of stockwork such as we now find, while beneath there would be an ordinary lode. Were the minerals in the scattered veins seen at surface concentrated into one lode the latter would probably be well worth working.

Hardy's Lode.—On the slope of the hill rising behind the flat on which the Penguin township is situated, some 10 chains or so W.S.W. from the Penguin mine, a small vein of galena has lately been found by Mr. Hardy in hard tufaceous country closely resembling diorite, but containing occasional rounded pebbles. The vein is small, and has been traced by a trench for some 14 feet in length. It has smooth well-defined walls, running N. 55° E., nearly straight towards the Penguin mine. The ore makes in a little chute about 3 feet long, and consists of 4 to 6 inches thickness of gossan and clayey matter, with ½ to 1½ inches of galena and cerussite, but the vein is pinched to a mere joint outside of this. It has not, however, been followed any distance along its course, or sunk upon more than a few feet. It looks like a true fissure-vein, and is worth tracing along its strike to pick up any other chutes of ore that may exist in it: these would then require to be further proved by sinking upon them. The value of the ore in silver is quite low as yet, a sample sent by me to the Government Analyst yielding 8 oz. 14 dwt. 8 grs. of silver per ton, traces of gold, and 49·3 per cent. of lead.

Some chains west of Hardy's workings, near General Wilson's house, there is an old shaft from which some clayey matter, consisting of quartz, kaolin, and yellow clayey oxide of iron, that most probably has come from some sort of lode, has been thrown out. As it might be silver-bearing, a sample was sent to the Government Analyst, but only traces of gold and silver were found by him in it. There is no means at present of seeing the size of the lode or of determining its course, and a fresh shaft would have to be sunk to further prospect it before anything could be said as to its probable value.

Sullock's Lode.—On the beach opposite Hardy's find Mr. Thos. Sullock has lately been working a large irregular lode-mass, which is somewhat similar to the occurrence at the Penguin

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mine. There are several outcrops of cherty quartz, containing iron pyrites plentifully, also other sulphides, and in one part magnetite. Native copper has also been found, and in parts of the lode there is much dolomite. A piece of quartz rich in gold is said to have been once picked up on the beach in this vicinity, and a little gold is reported in assays. Some of the quartz is much brecciated, and other portions radiated crystalline. The outcrop is much covered with beach *débris*, but appears to be wide and strong, and to have more than one branch running from the main body. The general strike is about N. 55° E. Mr. Sullock had sunk a shaft 18 feet deep on the outcrop below high-water mark, but this was filled with gravel when I saw it: in the bottom he got some quartz rock containing much pyrites. Near the shore line a branch goes off to the west of the main line of outcrop and along this branch stains of green carbonate of copper and a little native copper are seen at times. On the flat shore close to the road there is an old shaft said to be 30 feet deep, from which lode-matter consisting of dense quartz, oxide of iron, and pyrites, and dolomite with pyrites, has been thrown out. As there seems to be a large mineralised zone along the line of this "lode," I took three samples from various parts for assay, and the Government Analyst has examined them with the following results:—

Sample No. 8.	*Gold*, 0 oz.	1 dwt.	15 grs.	per ton ;	*Silver*, 0 oz.	8 dwts.	4 grs.	per ton.
„ 10.	„ 0	„ 2	„ 9	„ „ ;	„ 0	„ 8	„ 4	„ „
„ 13.	„ Traces			„	„ Traces			„

Sample No. 8 was from the shaft on the beach itself, and consisted of quartz, pyrites, pyrrhotite, magnetite, and some dolomite. No. 10 was from the old 30-ft. shaft on the shore, and was a dense mixture of quartz, oxide of iron and pyrites, with some dolomite. No. 13 was a highly silicious, somewhat cellular rock from part of the outcrop near high-water mark, and contained much magnetite, this often giving the quartz a black colour.

It seems most probable that this "lode," like the ore-bearing matter at the Penguin mine, is of the stockwork character, the tufaceous and felsitic country rock having been much silicified, altered, and impregnated with sulphides by the passage through it of hot mineral-bearing solutions. As with the Penguin deposit, it might also make into a regular lode in the underlying Cambro-Silurian country. Being gold-bearing to a small extent, there is some inducement to prospect it further at deeper levels.

Manganese.—On the beach close under Watcombe House there is a deposit of black oxide of manganese of probably Palæogene Tertiary age, from which some fairly good ore is reported to have been raised and shipped. It is so much covered over now that it can hardly be seen, and it would have to be opened out afresh to permit a judgment to be formed of its value.

Some little distance west of the Neptune mine there is a peculiar belt of earthy manganese boulders lying loose on the beach. This seems most likely to be a Tertiary deposit that has formerly been covered with basalt and so protected from erosion, but later on has been laid bare and is now in process of destruction by the waves.

Alluvial Gravels.—In a road-cutting behind the Penguin Recreation Ground we see a section of a large deposit of gravel containing some big boulders of conglomerate, lying on the top of a spur. The bedrock is not visible. This may be an old river deposit, and seems worth trying for alluvial gold. It may be one of the channels occupied by one of the streams of the neighbourhood before the outpouring of the basaltic matter filled their valleys and diverted them into new courses.

Inland Penguin District.

In the lower parts of the Penguin Creek the Cambro-Silurian slates and schists are seen for some distance up it, often containing irregular quartz veins with more or less pyrites, but none yet proved payably gold-bearing. Higher up the creek we find the Dial Range series of strata.

H. Good's Lode.—Near Mr. H. Good's house a line of ferruginous gossany matter has been found, which seems to be the outcrop of a lode. A small shaft has been sunk 20 feet deep following a vein of clayey and ferruginous lodestuff of somewhat promising appearance. Some assays from this are reported to have given encouraging results in silver. The lode is too little developed to enable an opinion to be formed of it, and would require to be trenched across at two or three places along its course, to have some prospecting shafts sunk upon it, and to be tested by a good many assays before it could be said to be likely to become of importance or not.

Devon Consols Lode.—At the head of Myrtle Creek some mining work has been done on a lode which traverses 80-acre mineral lease, 2524-87M. At the centre of this section the lode was seen in the creek, and some good copper pyrites is said to have been obtained from it. A drive was then made along the vein to the north-west (bearing 311° 45′), a distance of 170 feet. Some 40 feet in, a winze was sunk about 30 feet deep. Close to the mouth of the tunnel a shaft also has been sunk to a depth of 49 feet, but was not deep enough to cut the lode on its underlay; a small cross-cut was, however, made from the bottom of it to the lode. This shaft and the winze were full of water at the time of my visit. The lode is of the fissure type and faults

the country rock, the beds of grit and conglomerate on one side of it not corresponding with those opposite them on the other. The lode-matter is from 10 inches to 24 inches in width, and consists mostly of yellow and grey mottled clay, often showing numerous smooth friction planes through its mass parallel to the walls, which give it a streaked appearance. The walls are smooth and sometimes striated. The lode dips about 80° to the N.E., and along the hanging wall there is a vein of pyrites which appears and disappears three or four times in the length of the tunnel. It is generally small, there being only from one to two inches of clean pyrites, though there is often a good deal through the adjacent country, but it is said that at the bottom of the winze there was as much as 13 or 14 inches of it, and from the large lumps at the mouth of the tunnel it is clear that in some parts the vein must have been much larger than it shows at present in the accessible workings. A good deal of copper staining is often visible on the rock in the tunnel, and a little native copper is said to have been found in driving it, but there is very little copper visible in the ore, which is mostly crystalline iron pyrites. It was reported to me that some copper pyrites assaying 32 per cent. of copper had been got, and also that assays had returned as much as 6 ounces of gold to the ton, and in one case 7 per cent. (*sic*) of silver, which I hardly credit. The stuff now visible in the tunnel is very poor, as is shown by the following assay made by the Government Analyst of a sample taken by myself from all along the vein, a large number of chips from different parts being mixed together to obtain an average parcel:—

Gold, trace. Silver, 1 oz. 1 dwt. 5 grs. per ton. Copper, traces.

The country is mostly conglomerate (Dial Range formation), lying in flat beds, and traversed by strong more or less vertical joints. It might be worth seeing what the lode is like in the Cambro-Silurian country, which, according to an exposure in the Penguin creek in Mr. Barnes' land not far away, must lie under the conglomerate at no great depth. The prospects of the mine are not encouraging, but should any owner become satisfied that the assays of ore formerly obtained were worthy of credence, the best thing to be done to test it further would be to sink a shaft to give it a trial at a lower level. Some more driving on the course of the vein might also be done in the hope of coming upon chutes of ore.

Hematite Deposits.—On the flat top of the spur separating the Myrtle and Penguin Creeks, to the north-west of the Devon Consols mine, some work was done a few years ago by Messrs. Henry Law & Co. in search of hematite. A good deal of this ore is seen lying about the surface, some of it very pure and good, and several trenches have been made to cut it in the solid deposit. In one of these a flat layer 8 to 12 inches thick is seen, covered with a few feet of surface soil. The ore in this seems to be very good, and some has been shipped from it. At other cuttings the ore-bed is very impure, containing much silicious matter through it. There is, however, evidently a good deal of very pure dense ore about the locality, if we may judge by the loose pieces about the surface, and it could be very cheaply raised and taken to the Penguin wharf. When iron mining and smelting become established in the Australasian Colonies, this ore will probably be worth opening out. Pits and borings would be the best means of looking for it, as it is pretty clear that it forms a flat-bedded deposit in the Dial Range series of strata.

Further west, on Messrs. Brown's, Hudson's, Crawford's, and Good's properties along the Penguin Creek, the hematite ore is again found, very pure pieces being common. A few trenches have been made on Hudson's and Brown's land; in the former the quartzite bedrock (Cambro-Silurian) is exposed; in the latter there is much good ore, but also in places a great deal of objectionable silicious matter. The outcrop on Brown's land is a very large one. There was not time for a lengthy examination of this interesting occurrence of iron ore, and to get a proper idea of it a good many pits would have to be dug; but there is every reason to think that very large quantities of excellent ore could be won at small cost. A good deal of the hardest and purest stuff could probably be got by sluicing the Penguin Creek and its flats in the valley between Hudson's and Brown's outcrops. The ore seems most likely to be a bedded deposit, lying in flat layers like that worked by Messrs Law & Co., but no section of it is just now available. I do not think it has any connection with the "Iron Cliffs" deposit next to be described, though it is almost on the line where the latter might be expected to be met with. The Iron Cliffs ore is a brown hematite, quite unlike the dense red hematite now in question.

In passing over the above-named properties a few chips were taken here and there from the best-looking blocks of ore, and were tested by the Government Analyst in Hobart, the sample containing—

Peroxide of iron.....	98·0 per cent.
Silica	1·6 „
Sulphur	0·2 „

This is a very pure ore, suitable for making the best brands of iron and steel. Mr. Brown informed me that many years ago he sent some 30 tons of the ore to England, and got back a report that it was of the very best quality. Other tests made from time to time confirm this, Messrs. Law and others having obtained very favourable analyses. I was informed that the ore could be delivered at the Penguin Wharf at the present time for four shillings (4*s.*) a ton, and that

some had been actually taken out at that price, and if a tramway were made, which would be easy, the cost would be less. The ore is very similar to the hematite at the Blythe River, described in my Report of 5th March, 1894, and as the matter of the possibilities of iron smelting in the colonies has been fully gone into in that Report there is no need to again discuss it. It might be possible, however, to smelt a small amount of charcoal iron for special purposes locally, there being splendid supplies of wood for making charcoal. The utilisation in this way of the timber now useless and cumbersome in the district would be a great boon to the settlers, enabling them to earn something towards the cost of clearing their land. It is very doubtful if the time is quite ripe for this experiment, but it is sure to be tried some day, and these deposits of good iron ore must become very valuable in course of time.

Iron Cliffs.—About a mile and a half almost due west from Mount Montgomery to the S.W. of Mr. J. Ling's farm there is an immense outcrop of iron ore forming notable rugged outstanding rocks. The ground falls very steeply from Ling's farm down to M'Bride's Creek, a branch of the Penguin Creek, the slope being some 350 to 400 feet in vertical height in a distance of probably under ten chains. The outcrop is a wide one, probably quite 150 feet across, and runs somewhat obliquely down the slope in a more or less north and south direction. The ore is brown hematite (Limonite), often in concretionary, botryoidal, reniform, and stalactitic shapes, with occasional silicious and slaty portions. On the top of the cliffs, near Ling's fence, portion is micaceous, but gives a brown streak, unlike true micaceous iron ore (red hematite). The country rock enclosing the mass is not visible on the north side of the creek, but on the south it is seen to be the Dial Range formation. From the way in which the ore occurs in a line running down a steep hill slope presumably composed of nearly horizontal strata, from its want of any appearance of stratification, and from its structure, I am satisfied that the "Iron Cliffs" are the outcrop of a large lode. Quite similar limonite outcrops are seen in various places in the Dundas field, few, however, being so large and imposing as the huge masses here visible. Northward along the line the Tertiary basalt covers the lode outcrop, but it is seen again in one place on Ling's farm where a spring issues from under the basalt, the water running over a floor of iron ore. In Barnes' section, still further north, the iron ore contains much oxide of manganese, quartz, and heavy spar, and is plainly lode-matter. A piece taken from here by me, however, yielded only traces of gold and silver when assayed by the Government Analyst. As above remarked, the hematite iron on Good's, Hudson's, Brown's, and others' sections still further north is much on the line of the Iron Cliffs lode, but it is of quite different character, and probably a bedded deposit. It is possible, however, that some of the outcrops may prove to belong to the lode, and not all to the layer formation.

On the south side of M'Bride's Creek the iron ore is seen again in small quantity on the slopes of the gully, and some nice fibrous brown hematite was there obtained by me. It seems probable that the lode then bends a little to the west of south and gets covered by the basalt seen on Mr. Stott's farm. On the east boundary of this in the creek the felsitic and tufaceous country is much impregnated with sulphides of lead, zinc, iron, and copper, and numerous veins of dolomite and these sulphides have been observed. Some cuttings have been made into the rock, but though it is much mineralised, there is yet no sign of true lode-matter having been reached. It seems likely that a tunnel driven west here into the hill would strike the lode before long, but before doing anything to this a careful search should be made right up the bed of the creek from the Iron Cliffs to make sure that the lode has not crossed it and gone into the hill on the east bank.

The occurrence of the above metallic sulphides in the country close to the line of the lode may be regarded as indicating the probable nature of the filling of the latter, which will most likely be pyrites, carbonate of iron, quartz, and sulphides of lead, zinc, and copper. The huge size of the outcrop at the Cliffs points to the lode there being large, and it seems to me to be quite well worth trying to see what is in it below the gossan. From M'Bride's Creek tunnels could be put in along the lode both north and south, which would soon ascertain its value. Seeing that the lead ores got in the mines on the beach at the Penguin have usually been fairly valuable in silver, and that throughout the district there are traces of both this metal and gold, it appears very probable that the lode under the Cliffs may contain valuable ore. It is quite as well worth trying as most of the gossan lodes of the Dundas district, and has the great advantage over them of easy accessibility. Quite a short track would connect the tunnel on the lode with the Iron Cliffs road. It is a wonder to me that when mining was in progress in the district no one has tried to tunnel under the Iron Cliffs, as they certainly are the most promising lode outcrop in the whole district. With its splendid advantages of accessibility and ease of attack by tunnels, it most assuredly deserves a mining trial.

The brown hematite itself of the Cliffs may have some value as an iron ore in time to come, and could be very cheaply won by quarrying; it seems doubtful, however, if it would be pure enough for iron manufacture. Much of it would be excellent flux for silver-lead smelting-works.

Manganese Ore.—To the north of Mt. Montgomery, on some flat barren Crown land between Midgley's and Alexander's purchased blocks, a little rather earthy and impure black oxide of

manganese is found, apparently forming a bedded deposit which may be of the same age as the Dial Range conglomerates, or quite modern. It does not appear to be of economic value so far as now known.

DIAL RANGE DISTRICT.

Some four or five years ago several mineral leases were taken up on the east side of the Dial Range, and some little mining work was done; but before long interest in the locality died out, and the leases were all allowed to become void. The main part of the Range itself appears to be composed of conglomerates belonging to the Dial Range formation (Upper Silurian or Devonian), but the lower ground, where most of the mineral sections are, is made of Cambro-Silurian strata, the younger rocks having been denuded away more or less entirely.

Section 3472-87M, 80 *acres*.—A large creek passes through this section, and in this a lode of pyrites is seen which has had some work done upon it. An old cutting is noticeable, which is said to have been made over 30 years ago by the late Mr. C. Gould's men when he was examining this district. In this the lode was seen to be about 2 feet wide, with strike N. 20° W. and dip 72° to S.W., consisting of quartz and pyrites in laminated bands, a little oxidised in parts. Some of the quartz is very dense and carries a great deal of pyrites. About a chain further north, a tunnel was put in a few years ago to cut the lode, and a winze is said to have been sunk on this to a depth of 90 feet on the underlay, from which very solid pyrites were obtained in big lumps. The tunnel being much out of order, and the winze full of water, the lode could not be examined in these workings. A shaft 10 feet by 4 feet has also been sunk, it is said to a depth of 100 feet, but all work had to be stopped owing to the failure of the bank in which the Company's funds were deposited during the recent financial crisis. The information given to me was that the shaft was intended to be sunk 200 feet, at which depth it would reach the lode. The country is soft sandstone and slate with steep dip, striking about north and south. A good deal of very pure dense pyrites said to be from the winze was lying near the shaft, apparently put to one side for preservation. I took a number of chips from various parts and sent them to the Government Analyst, who found them to contain *Gold* at the rate of 20 grains to the ton and *Silver* 6½ dwts. to the ton, but no *Copper*. The lode is seen again on the track where it crosses the creek, and is said to be traceable for a long distance. It is a strong well-defined vein, and if further prospected may yet be proved to have chutes of valuable ore in it.

Section 2605-87M.—Towards the north boundary of this section a small shaft has been sunk, but nothing of value could be seen about it, the only stone looking at all like lode material near it being some hard quartzite with enclosed specks of pyrites. Further south, some 4 or 5 chains south of the north boundary, there is another shaft with a good deal of fair-looking gossan and a little pyrites. The hard old metamorphic sandstone country with quartz veins in it outcrops close by, but there is a lot of the Devonian conglomerate lying loose about the surface. From here there is more or less gossany material along a north and south line into section 2604-87M, and a trench has been cut through this some 12 feet deep on the top of a spur, showing the gossan going down in lode form. Probably it is the outcrop of a pyrites lode. There is a considerable thickness of lode-matter, which might turn out to be of value. It requires to be sunk and driven upon, and tested by numerous assays.

Section 2604–87M.—South-easterly from the above trench, at the centre of this section, we come to a shaft about 20 feet deep on a gossan mass, the course of which is not determinable without clearing away the scrub which has overgrown everything here. The material from this shaft having been reported to have given good assays in gold and silver, I took a few pieces and sent them to the Government Analyst, but he found only traces of gold and silver in the sample. The gossan is somewhat silicious and of rather favourable appearance.

Some 7 or 8 chains N.E. from this shaft there is an underlay shaft down 12 or 15 feet on a lode of gossan striking N. 72° E., and dipping southerly 45°, but though the stuff looked promising, the assay of my samples forwarded to the Government Analyst showed only traces of gold and 3 dwts. 6 grs. of silver to the ton. These gossan formations may perhaps improve when they are sunk upon, but present appearances are not favourable as to their being of much value. The country is a good deal broken by gullies, and if any valuable lodes are found it would probably be possible to do a good deal of work by means of adits. With present means of access it would be a hard matter to get heavy machinery on to the field.

Section 3468–87M.—In this section, close to the S.W. angle, there is an outcrop in a creek of a lode of pyrites and quartz much like that above-mentioned in Section 3472–87M. Strike N. 15° W., dip easterly 72°. It has not been cut into to show its thickness, and requires further opening before any opinion can be expressed as to its value.

Further south than these sections I was informed that there was a fairly long tunnel on a section which I had not time to visit, but from the information given to me it did not seem worth while to spend another day in again going up to the Dial Range to look at it. As will be seen

from the above, very little work has been done in the District, and not much encouragement received to go on further with it. It seems clear, however, that there are lodes and indications of minerals, and further prospecting may yet result in good discoveries. The ground is very thickly covered with scrub, and progress in exploring it is consequently very slow.

SULPHUR CREEK.

West of the Penguin Creek the older Cambro-Silurian strata are well seen along the beach, often very full of strings of quartz which often carry pyrites, and have sometimes been taken to be true lodes. On the side of the Sulphur Creek road, on the steep grade where it rises up from the flat ground along the shore, a piece of very rich gold-bearing stone, showing gold and pyrites freely, is said to have been recently found, but after examining it and seeing the place where it was said to have come from, the conclusion was forced upon me that the discovery was not genuine. The specimen had plainly come from some depth underground, and was most probably from one of the Lefroy mines. Some work had been done by Mr. M'Phail to find the reef from which the rich stone was supposed to have come, but as yet he has found nothing but small quartz veins such as are seen very commonly in the country rock where it is exposed on the beach.

West of the Sulphur Creek on the beach there is a band of ferruginous slate containing pyrites. When concentrated the pyrites is said to have yielded 8 dwts. gold to the ton on assay, but as there is only a small percentage of sulphides in the rock it would not pay to attempt to work them at this value.

MOUNT HOUSETOP DISTRICT.

From Mount Housetop northwards along the course of the Blythe River there is a considerable area of granite country, and in the southern portion of this several mineral leases have from time to time been taken up for tin ore, mostly between the Emu and Blythe Rivers from 3 to 4 miles N.W. from Mount Housetop on the heads of the Falls and Trial Creeks. A section, 238-91M, has also, however, been taken up N.N.E. of Mount Housetop, near the head of the Laurel Creek, on the east side of the Blythe River. My examination only included the principal discoveries at the Falls and Trial Creek. These lie from three to four miles E.N.E. from the Hampshire Hills station on the Emu Bay to Bischoff Railway, and less than a mile east of the eastern boundary of the V.D.L. Company's Hampshire Hills block. At the time of my visit no regular work was in progress on the field, only a little prospecting from time to time, and most of the mineral leases have been thrown up.

Going eastward from the Hampshire Hills station the country passed over for about three miles is all basaltic, even in the deep gullies of the Emu River and its tributary creeks. On the railway line a little above the station the granite rock is seen cropping out in a cutting, rather fine grained, and not unlike some of the stanniferous quartz porphyries of the Blue Tier tin-field in general appearance. A short distance east of the Hampshire Hills block boundary the granite again emerges from under the basalt, though runs of this cover it in places. It is worth noticing that as the granite is found high up on the west side of the valley of the Emu River on the railway line, and again equally high on the east side at the tin-field, but is not seen in the much lower ground between, there must have been an old valley in it before the coming of the basalt in much the same position as the one now existing. This fact may have importance in future if search for deep leads under the basalt is undertaken, as it will be seen further on there is some reason for expecting. The basaltic country followed by the railway line up from Burnie, flanked by older rocks along the Cam and Blythe Rivers on each side, may perhaps represent an old valley filled up with basaltic matter.

Most of the tin workings have been in the creeks for alluvial tin ore and in shallow ground, but there are also some deep alluvial gravels covered with basalt that have been a little prospected, and a little work has been done on some lodes. On section 1202-91M (formerly held by E. Spinks) a shaft was sunk some 19 feet on a soft lode of talcose matter and quartz running more or less north and south, said to be 4½ feet wide in the bottom of the shaft. This was fallen in and inaccessible, and the lode could not be seen at all when I visited the spot. Some of the soft lodestuff that had been thrown out of the shaft gave me a little tin ore when washed, but was poor. Some good ore is reported to have been raised, and a creek running up to the shaft is said to have been fairly good in alluvial tin, probably derived from the lode. It would seem therefore that there is some inducement to open the vein more thoroughly so as to ascertain if it is worth mining upon.

In the adjoining section 1277-91M (formerly J. Revel's) there is another soft lode also running about N. and S., on which a shaft has been sunk to a depth of 40 feet (full of water when I saw it). This is rather an interesting occurrence ; the lode-matter, about 18 inches in thickness, consists principally of kaolin carrying tin ore and tourmaline impregnated through it. Some very fair prospects are obtainable, and some of the stuff is quite rich. I was told that a good deal of it was so full of tin that it was carried over a hill by the prospectors some considerable distance to a small wooden "dolly" (or rough stamper) which they erected beside a suitable creek, and was there

crushed and sluiced. A small creek heading from the vicinity of the lode is said to have yielded a good deal of alluvial ore. This lode seems to me to be well worth looking into, as it promises to be valuable. Being in low ground it could not well be prospected by a tunnel, but a few windlass shafts sunk along its course would soon give information about it enough to show if its development would be worth persevering with.

A little west of these workings the track crosses another little creek which has been worked for alluvial tin on a somewhat fine-grained soft granite bottom. Here there is a great deal of angular and water-worn glassy quartz with tourmaline and occasional sapphires.

To the north west of section 2813-87M two branches of Falls Creek have been worked. Johnston's workings were in very shallow ground on a red granite bottom, in which numerous veins of quartz with tourmaline are exposed. Much crystalline quartz and schorl occur here in the wash. The ore was much contaminated with titaniferous iron ore difficult to separate, which lowered its value. Below the workings in the tail-race basalt comes in, showing spheroidal weathering, probably a dyke bursting through the granite. In Dale's workings on a neighbouring small creek the tin ore was very well water-worn and free from impurities, and had much well rounded water-worn quartz gravel associated with it. At the head of this creek there is a short tunnel, now fallen in, driven on a bed of waterworn "wash," which is found running into the spur. A shaft has also been sunk in the top of this spur, and gravel obtained from it, but I could not learn if bottom had been reached. It is evident that there exists here a considerable quantity of older water-worn gravel covered by surface soil which is partly of basaltic origin. Just at this point the gravel is not covered with solid basalt; but this appears close by, and I have little doubt but that it covers the bulk of the deposit. The place is worth prospecting further, and it will probably be found that the "wash" dips away under the basaltic country, and that this will cover "gutters" or old water-courses containing a good deal of ore. Practically nothing has been done to test this promising deposit. The occurrence of waterworn tin ore, fairly coarse in size, along with thoroughly rounded gravel, shows that it was not sluiced from the bedrock by the present short creeks, but by some older ones in which there was much more powerful attrition of the material carried along, and taking this in conjunction with other finds further south, there can be little doubt that the principal alluvial deposits of the district are to be looked for in an older system of water-channels now buried under the basalt to the westward of the granite area.

Close to the track from the Hampshire Hills to the tinfield, on Section 2813-87M, there are some holes sunk on outcrops of rather vitreous-looking quartz, which has not been found to carry any mineral of value. One of these gives further evidence of the existence of buried gravels to the westward, the granite bottom dipping rapidly in that direction under brown basaltic soil. In the west end of the trench well waterworn quartz "wash" came in under the brown soil, and with it came water, which led to the abandonment of further work. The granite crops out both north and south of this place, so this lead seems to be a small branch running to join a main gutter lying further westward under the principal basalt area. The gravel might be traced to the westward by shafts and bores with advantage.

Waterworn tin-ore, probably derived from a deep lead, is found also along the west side of the flats near the head of Trial Creek, at two places known as "The Big Tin" Creek and "The Knoll." At the first of these places very coarse well-waterworn tin-ore is found in very shallow soil consisting of weathered granite bedrock almost without gravel. Probably, we have here a case where the heavy tin-ore is all that remains of a portion of the lead which has been denuded away right down to the granite, all the lighter material being removed and only a little of the heaviest ore left on the bedrock. The basalt country is close at hand to the west, and search should be made along its edge for deep ground dipping under the lava rock. At "The Knoll" the same sort of thing is again noticed, coarse waterworn tin-ore with a very little rounded quartz gravel being found on the surface of some low rounded granite knolls. Here too the deep lead has probably been entirely washed away, leaving only a little of the heaviest tin-ore upon the bedrock, which has been cut to new shapes by the modern watercourses. At all the above places the tin-ore obtained is very pure and not associated with titaniferous iron-ore or other deleterious substances.

In what are called the Trial Flats, however, which are extensive, swampy flats covering some 100 acres to the south of Section 2813-87M, the tin ore is unsaleable, or nearly so, through being associated with a great deal of foreign matter, ilmenite, zircon, sapphire, garnet, and some heavy rare minerals, not removable by streaming. Much of the tin ore is well waterworn, much more so than the associated ilmenite, and may be derived from the deep lead. Holes sunk in various places throughout the flats have shown the alluvial ground to be from 7 to 9 feet deep as a rule, with an average depth of about $2\frac{1}{2}$ feet of gravel under the surface soil. The Trial Creek carries a good supply of water, but the ground being very flat is not easily worked. A good deal of cutting of races and tailraces has been done and some paddocks of ground taken out, but owing to the impurities in the tin ore saved the work has not been payable. The best method of working these flats would be by hydraulic elevators, but there would be some difficulty in getting a sufficiently large supply of water for them at a high enough elevation to be useful, without making a long water-race.

In Section 2813-87M there have been a few trenches and holes made on a lode of ferruginous granitic lode-stuff, which often shows impressions of large cubes of pyrites, which would no doubt be found unoxidised on sinking a little deeper. Some of this stuff being said to have given returns on assay of both gold and silver, I collected a few fragments of the more gossany material from one of the shafts and sent it to the Government Analyst, who found, however, only a minute trace of gold and no silver. The lode runs about north and south, and is seen again as about 8 feet wide of granitic-looking lode-stuff in the Trial Creek arranged in somewhat parallel ribs or layers of quartz with talc, chlorite, and pyrites; here it is not well defined and does not look at all promising. Ferruginous material is again seen on the same line to the east of the workings on Trial Flat, and again near the place where the "big tin" was found. At this last spot there is a large outcrop of crystalline quartz, and some silver is said to have been obtained in assays. At no part of the course did this lode seem to me to be worth spending much money upon in testing it.

Near "The Knoll," a flattish ferruginous vein of quartz and magnetite, with talc and a little pyrites was noticed, on which a trench had been cut, and not far from this some very solid hematite was picked up on surface.

In the gravel in the creeks and about the surface numerous stones of quartz, quartz and tourmaline, and other vein materials are commonly met with, so it seems likely that veins are frequent in the granite country. The district is clearly a mineral-bearing one, and therefore worth prospecting, and no doubt in time discoveries of greater value than anything now known will be made. At present the most promising ventures would appear to be the development of the tin-bearing kaolin lode in 1277–91M and of the deep lead on the west side of the field. The district is easily accessible, and is worth more attention from prospectors than it has received.

TABLE CAPE AND CAM RIVER DISTRICT.

The district between the Cam River and the Dip Range and Rocky Cape Hills is traversed by a number of rivers and creeks flowing to the northward, which have cut it into a series of roughly parallel ridges and gullies. Going due west from the mouth of the Cam River we should cross in succession the Seabrook Creek, Camp Creek, Big Creek, Blackfish Creek, the Inglis River, the Flowerdale River, and the Sisters Creek, besides numerous small tributaries of these. Camp Creek runs into the mouth of the estuary of the Inglis River, and Big Creek into the head of it; the Blackfish and Flowerdale join the Inglis a little higher up; and the Calder River comes in some 12 miles from the mouth of the Inglis. The country slopes gently seaward from the Campbell Range, the ridges between the gullies of the main creeks being approximately equal in altitude at corresponding distances from the Coast. There is generally a somewhat steep rise from a flat strip of low land of varying width along the coast on to the spurs, and these then are found to afford good grades for roads. Most of the main spurs have roads along them, but the deep gullies intervening prevent easy communication between points on adjoining ridges. The tops of the spurs are all formed of basalt and basaltic tuffs, probably thrown out from a large number of vents throughout the district, of which Mt. Hicks is the most prominent. Going down into the valleys, however, we soon get off the basalt and come on older formations. Immediately under the basalt there is nearly always a layer of white well-rounded quartz gravel, often containing gold, at an elevation of from 300 to 500 feet above the sea-level. The gravel is generally lower towards the coast than further inland, and as it is found more or less all over the district under the basalt at the same elevation approximately on each side of each spur and on opposite sides of each valley, it is clear that previous to the basaltic eruptions there was an extensive area of country sloping gently seawards covered more or less with gravel. No doubt the main cause of the formation of this sheet of gravel was the general subsidence of the North Coast in Palæogene Tertiary times above referred to. It is not clear if the area was under water at the time of the basaltic eruptions, or if it was more or less a land surface: possibly portion was under the sea and other parts formed low shelving shores. We find evidence of occasional lacustrine or estuarine formations in beds of carbonaceous gravel and shale with much lignite through them, but I neither saw any distinctively marine or freshwater fossils, nor heard of any having ever been found. It is a matter of great consequence from a gold-seeker's point of view whether the gravels were laid in position by wave-action along a beach or by running water on land, for beach-gravels, when auriferous at all, are not often payably so, while in river-gravels there is much more chance of finding payable gutters. From the uniform way in which the sheet of gravel is spread it seems most likely that it was laid down upon a beach. As, however, it was deposited during a period of subsidence when the sea was constantly encroaching on the shore, it is possible that the channels of streams carrying the gravel seaward became filled up and covered over in some instances without being destroyed by beach erosion, and consequently there may exist gutters in the deposits in which larger amounts of gold may be expected. It may be well here to repeat the remark made above, that we have also in the district several deposits of later gravels of probably younger age than the basalts lying at lower levels than the older sub-basaltic sheet: these are well seen on the Calder Road, where it rises off the flats (themselves composed of recent gravels), and where a branch runs off from it to the Inglis River, in the S.W. angle of the Parish of Quiggin. These and the flats near the shore are probably relics of beaches left behind by the gradual rising of the coast in Neogene and Recent times. They contain occasional

traces of gold, but are not regarded as payable, though there does not seem to have been much effort made to prove them by sinking holes to the bedrock. It seems likely that they may be payably auriferous in parts, especially in any gutters that may exist in the bottom.

The presence of the sub-basaltic gravels is constantly indicated throughout the district by springs, which issue from the gravel layer. Most of the small branch gullies are found to start from such springs, and the basalt has often been undermined and eroded away around them so as to form somewhat circular or semi-circular hollows with steep sides, like old quarries. It is noticeable, however, that the white gravel is not often seen in much quantity down the creeks springing from these terraces, the explanation being that the light small rounded stones composing it are rapidly swept entirely away out of the steep beds of the watercourses. As the springs indicate the position of depressions or channels in the bedrock underlying the gravel in which the water soaking through the surface can collect, they also show the most promising places for attacking the terraces by tunnelling in the hope of finding the old gutters. They are not necessarily themselves, however, the outlet of old gutters, for these may be stopped by hard basalt or clayey material, and the springs may only indicate the lower places in the edges of underground reservoirs filled with gravel and water, over which the water makes its escape.

In the lower parts of the valleys we come on Cambro-Silurian or, possibly, Archæan schists, &c. in the beds of the Inglis River, Cam River, and part of the Seabrook Creek, but more usually on the nearly horizontally stratified soft sandstones, shales, and mudstone conglomerates of the Wynyard formation. The conglomerates easily yield up the boulders of the older rocks, granite, schist, quartzite, &c. contained in them to the creeks which cut through them, the soft mudstone matrix rapidly wearing away and setting the hard enclosed stones free. The greater part of the drift material in the beds of the streams is therefore usually made up of the older gravel once enclosed in the conglomerates. It has been noticed in several of the creeks that when the bedrock is conglomerate the wash contains more and coarser gold than elsewhere, and it seems by no means impossible that these rocks are the source of much of the gold found in the streams. The forces that could move heavy boulders about could also move fairly large pieces of gold, and there is no reason why there should not be a little gold through the mass of the conglomerates. Should it be found eventually that these have been partly deposited by ice action, there would be no difficulty in supposing that at times auriferous drifts had been transported to sea by this agency. The boulders themselves are derived from formations favourable for the occurrence of gold-bearing lodes, and it is quite probable that these existed and that there was alluvial gold from their disintegration in the streams which formed and swept to sea the gravels we now find embedded in the conglomerates. The occurrence of much of the gold seems at times to favour the theory that it comes from the bedrock and not from the Tertiary gravels. So far as I know, however, no gold has ever been found *in situ* in the conglomerate. Close observation by the men working the creeks would probably throw much light on this matter. It may be urged with much force that as the Tertiary gravel layer once without doubt extended right over the places now cut out into valleys, immense quantities of material from these must have been sluiced by natural processes, and it is possible that the heavy gold has remained in the beds of the creeks as they were cut lower and lower, long after all the gravel in which it was once enveloped has been swept away. Both sources of the gold are possible and likely, and in either case the result is the same in one practical aspect, namely, that the alluvial gold is not derived directly from lodes, but indirectly from older alluvial accumulations, which may themselves have travelled a long way from the parent rocks before coming to rest. The Wynyard formation, as far as I saw it, seems quite destitute of quartz veins, and from its little indurated character is very unlikely to ever prove to be their matrix. The Cambro-Silurian strata are much more likely to be the real source of the gold, and where they crop out they often contain numerous quartz veins; but I did not hear of any gold with quartz attached to it having ever been picked up in the streams, or of any proved auriferous veins having been found. From want of recognition of the fact that most of the gold is derived from older detrital deposits, undue importance has often been attached to the occurrence of small quartz veins in the bedrock near where good gold has been sluiced out, these having been assumed to be the only possible source of the gold. It seems very likely that the gold has really come from some considerable distance inland.

A good deal of gold has been at one time and another obtained from this district, and a few men constantly make a living by sluicing even yet. The ground is nearly always shallow, and worked in a rough way by ground-sluicing. It appeared to me that more gold would be got if the work were carried out in a more systematic manner, the creek beds being thoroughly cleaned out instead of being only scratched along the actual watercourses, as is usually done. Most of the gullies known to be gold-bearing have, however, been worked more than once, and are now hardly likely to be worth going over again. In the Cam, Calder, and Inglis Rivers, however, there are larger gravel banks, which seem worth testing to ascertain their fitness for hydraulic sluicing. Also, there are all the sub-basaltic gravels to be worked yet if found payable.

A short description of each of the localities visited will now be given, with notes of whatever of interest was found in them.

Inglis River.—On the western fall of the ridge between the Flowerdale and Inglis Rivers, at two places on Messrs. Fenton's and Margetts' properties, I was shown outcrops of very impure lignite, little better than carbonaceous clay, lying immediately under the basalt at heights of about 265 and 320 feet respectively above sea level. In Margetts' ground there were layers containing much white quartz gravel. As these outcrops represent former swamps or peaty deposits, it is likely that they were formed in flat low-lying ground. As swampy flats along the courses of streams often have a deep channel traversing them, it seems possible that there may be deep gutters under these lignitic deposits which might contain gold. The carbonaceous layer is said to crop out also on the east side of the ridge on the fall to the Inglis. A little further south, some of the creeks running into the Inglis were found to issue from a white gravel layer lying immediately under the basalt, but were not auriferous, and the gravel here, though of likely appearance, does not give good prospects when washed. To the east of Mr. Margetts' property (264a. 2r. 17pls. near S.E. angle of Parish of Flowerdale), several small creeks have been worked with some success on each side of the Inglis River. On examining these it was found that they had not been worked higher than some old terraces of gravel left by the river when it ran at a higher level than at present. The highest of these terraces was noted to be 75 feet above the river, another was about 50 feet, and others lower. Where the branch creeks cut through these, and the material composing them had been sluiced by natural processes, the water-channels were payable for working. Some of the terraces are of considerable size, and would be worth prospecting to find if they are valuable enough to be worked by hydraulic sluicing, though I am not at all sanguine as to this being the case. The bottom rock is micaceous schist, striking about N. 80° E. On the east side of the river, in a branch creek which has been worked up for some distance, veins of quartz are not uncommon in the bedrock, and one larger one consisting of dolomite, quartz, and pyrites has been thought to be a lode, but is not clearly seen, and requires cutting into to be properly exposed to view. A few pieces of it were sent by me for analysis to the Government Analyst, but they were found to contain only traces of gold and silver. The gold along the Inglis is clearly derived from the older gravels formerly brought down by the river, and the source of these must be looked for before we shall find the source of the gold.

Calder River.—Some gold has been obtained at the junction of the Calder and Inglis Rivers, and from here for some distance up the Calder there are very considerable flats formed of river gravels, which give promise of being workable by hydraulic sluicing on a larger scale than any work hitherto carried out in the district. The bedrock here is the Wynyard formation, conglomerate low down, and shale and sandstone higher up in the sides of the valley. The white Tertiary gravel is seen at about 265 feet above the river or 435 feet above sea level on the old track down to the junction of the rivers, and above it there is basalt to the top of the spur, some 670 feet above the sea. A good many prospecting holes have been sunk in the flats alongside the river in days gone by, but the ground does not appear to have been found rich enough for ground-sluicing. More than half a mile above the junction the Calder makes an S-shaped bend through a large flat, and near the head of this a section is shown in the bank from surface down to bedrock, exposing about 5 feet of brown clayey soil on top with about 4 feet of rather coarse river wash beneath. The wash consists of boulders and gravel of the older rocks from the mudstone conglomerate strata. There is a little gold obtainable, enough to make the flats worth testing with a view to hydraulic working. A splendid supply of water at any desired pressure could be got from the Calder if the ground should prove worth working by this method. By cutting a straight channel for the river a good deal of the flat could be worked by ground-sluicing, but it would be far better to get water under high pressure to do the work, especially as there might be some difficulty in getting rid of water and tailings out of the lower parts of the flat and the present bed of the river. Hydraulic elevators would at once overcome any trouble in this respect. It would also be desirable to use these machines so as to stack the tailings out of the way and prevent them from going into the Inglis and being carried down by it to do possible damage to properties in the low land. My examination was far too hurried to enable me to give a positive opinion as to the value of these flats, but they seemed quite worth the trouble and expense of prospecting thoroughly with a view to hydraulic sluicing.

On the east side of the Calder a branch creek has been worked below Game's farm right up to the white gravels under the basalt, here 545 feet above sea level. Good heavy gold is said to have been got in this creek.

Moore's Plains.—These are composed of basalt, and lie at an elevation of about 850 feet above sea level, between the heads of the Blackfish and Big Creeks. Several gold-bearing creeks run into both these streams. From Moore's Plains I went eastward into Big Creek, on basalt country all the way; then over a ridge into some gullies which feed Camp Creek, which have been worked for gold. Here again the Wynyard formation, at this place shales and sandstone, was found to be the bedrock, and the creeks took their rise from beds of white gravel issuing from under the basalt.

Big Creek.—Some workings were also visited lower down Big Creek, not far from Wynyard, on the Timber Reserve to the west of Messrs. Moroney's and Bauld's selections. The same.

feature as above described was seen repeated, the creeks being gold-bearing on a bottom of mudstone conglomerate, sandstone, and shale, and heading from springs in beds of white gravel lying under the basalt capping. The white gravel layer was noted to be 380 feet and 335 feet above sea level at the heads of two small creeks. In one spot it was strongly cemented together by some silicious cement to a very hard conglomerate, probably due to hot silicious solutions emanating from the basalt flows when first poured out. In one of the larger creeks some fairly heavy gold has been found on conglomerate bedrock containing large boulders of granite, quartzite, fossiliferous sandstone, &c.

Camp Creek.—Some six miles up the Mount Hicks Road we come to a part of the district where a good deal of gold has been got in gullies running into Camp Creek and Seabrook Creek. The top of the spur on which the road lies is, as usual, basalt, but going down the road which leads through Messrs. Hyland's and Harris's properties we get below this, and come upon, first, white gravel, and then sandstones and shales of the Wynyard formation. In Hyland's ground, on what is called Pine Hill, there is a large area of gravel not covered with basalt, and several holes have been sunk to prospect it. Some of these went into soft sandy material which may be Tertiary or possibly only a soft bed of the Wynyard formation. A small creek known as Whitewash Creek, cutting through the gravels, has been worked with some success. Another, known as the Cornishman's Creek, has also been gold-bearing, and along this there seems to be considerably more depth of gravel in the terrace drifts than near Whitewash Creek. The gravels lie pretty high, 500 to 550 feet above sea level, and some 85 feet above Camp Creek, consequently to bring water on to the ground for sluicing it would probably be necessary to make a water-race of some length. It would take a good deal of time and labour to prospect this ground enough to enable me to say whether it would pay if water for sluicing were brought on to it, but it seems to me that the chance of success is good enough to warrant a systematic test being made to ascertain the quantity and quality of the gravel available, and the possibility and cost of bringing in an adequate supply of water.

In Mr. Harris's property, on the west side of Camp Creek, a tunnel has been driven some 70 or 80 feet into a spur, following a bed of somewhat coarse white wash which lies nearly horizontal. In parts of this fair prospects of gold are obtainable by panning, but not good enough to pay for blocking out the ground, and there does not seem to be enough depth of wash to warrant expense in bringing in a water-supply to work by the hydraulic method. As gravel is seen on the hillside above the tunnel some distance, however, it might be advisable to sink a shaft just under the edge of the basalt capping to try if the higher lying drift contains gold that would pay for removal of the stripping from above the layer of better wash on the bed-rock. On the west side of the same spur the gravel is again seen emerging from under the basalt, some 10 chains or so away, and there can be no doubt as to its forming a more or less continuous sheet right through. The bottom is a soft sandstone. The practical question is whether there is or is not a gutter under the spur in which the gold will be more concentrated. The best way to test this would be to put in a tunnel lower than the present one, so as to allow for a possible dip of the wash towards the centre of the spur. From time to time rises could be made up to the wash to ascertain its thickness and value. Should the gravel gradually dip below this tunnel, the presence of some sort of a gutter would be proved, and there would be a strong presumption that it would turn out to be worth working. The drive would then have to be continued on through the drift, and winzes and bores be put down in the floor to find out the deepest parts of the old channel. The depth of the gutter being known, another tunnel would have to be driven low enough to get below it, so as to admit of proper working of it. As the sandstone bottom rock is very soft, the prospecting by means of tunnels would be much more satisfactory than diamond-drill borings through the basalt capping. It is of great importance to the district to find out if gutters really do exist under some of the basalt spurs, and as there is much reason for hoping that this is the case, and as the finding of them would result in considerable mining development, an effort should be made to test the question at a few of the most promising localities, for example, at this tunnel, at the tunnel on Mr. Gilmour's land on the west side of Seabrook Creek, and at some old workings to the east of the Mt. Hicks road, not far from Mr. Hyland's place, to be described presently. The work would not be very expensive if systematically carried out, but is too heavy for the resources of ordinary prospectors. Seeing the benefit that would result to the district from the discovery of sub-basaltic leads, it seems to me that the local landowners might well subscribe to test the matter. Nearly all the likely ground is now private property, and the owners are therefore directly interested, and would benefit largely if good leads were found.

In a branch of Camp Creek in Mr. C. R. Mackenzie's block to the north of Pine Hill it is again seen that the wash runs under the basalt hills on each side of the gully. The bed of the creek has been worked more than once, and some small tunnels have been driven into the spurs following the gravel beds, but not much could be seen owing to these workings being very much collapsed.

On the east side of the Mount Hicks Road on the fall to a deep branch of Seabrook Creek we find some old shafts and tunnels on Mr. Cooper's land (formerly C. R. Mackenzie's), now much

fallen in. These show gravel again under the basalt at much the same level as on the Camp Creek side. One of the shafts is said to have been 20 feet deep. As far as can be seen there is a good deal of wash about here, and as gold has been got in it, and the creeks running from it have been auriferous, there is some inducement to give it a more thorough trial than it yet has been afforded.

Seabrook Creek.—East of the last described discoveries auriferous gravels are found quite similarly situated on the fall to Seabrook Creek on Messrs. Gilmour's and Hülls' land, and again at much the same elevation on the east side of the valley of Seabrook Creek. The bottom is usually here shales and pebbly mudstones of the Wynyard formation. The gravel layer is a good deal lower than that above described, being at an elevation of about 350 feet above the sea, corresponding with that on the timber reserve in Big Creek rather than with those of Pine Hill, which lie at an elevation of from 500 to 550 feet. More mining work has been done on the gravel on Mr. Gilmour's land than anywhere else in the district, a good deal of ground having been blocked out and sluiced. This was done a good many years ago, and the workings are now only partly accessible. In the tunnel there are prospects obtainable that show that the wash would pay handsomely if it could be sluiced directly, but from the fact that work was abandoned by the former miners it is pretty clear that it is not rich enough for blocking out. There is a very fair area of gravel without much basaltic covering, and it seems desirable to test it by a number of shafts to obtain a reliable estimate of the quantity of wash easily accessible and its average value, also of how much stripping would have to be removed from the top. The gravel in the tunnel lies in a flat layer, and does not appear to be dipping into the spur under the main basalt capping, but may do so further in. Part of it is seen to be strongly cemented together, forming a conglomerate, but probably this would only be in patches, and might not interfere much with working. Should exploration prove that there is a sufficient quantity of payable wash here to warrant hydraulic working, it seems probable that water could be got on to it by a race from the upper parts of Camp Creek and Big Creek. As previously said, this would be a good place to make a trial by tunnelling to see if the wash forms gutters under the basalt spurs.

On Mr. Hülls' land, again, there is a small tunnel into the bed of wash under the basalt at the head of a creek which has been worked, and nice-looking gravel is seen which contains a little gold. Here also a test might be made by tunnelling to look for a buried channel.

On the east side of Seabrook Creek, opposite Hülls' place, the largest gold nugget, some 3½ oz. in weight, ever reported to be found in this district was found some years ago in a branch creek heading from the sub-basaltic gravels. Most of the creeks hereabouts have had some gold in them.

A cut has lately been made through an elbow in the Seabrook Creek itself by Mr. Gilmour to try to lay bare part of the bed of the stream, so that it may be cleaned up for any gold that may be in it. The cut shows shaly black mudstone with small pebbles (Wynyard formation). At the time of my visit the creek was running in its old channel, but in summer it will be easy to divert it and try the part of the bed laid bare. The Seabrook Creek must contain more or less gold in its bed, because the creeks draining into it have many of them proved to be auriferous; but I do not anticipate very great success from this venture.

Lower down the Seabrook Creek alluvial gravel containing gold is seen at the head of a small branch creek near Mr. Cooper's house, which has been worked more than once by diggers. As usual, the creek heads from springs in a layer of wash lying under basalt. In one place a rather nice prospect was obtained during my visit from some coarse wash belonging to this layer. This gravel is not far from the coast, and is only about 150 feet above sea-level, being thus considerably lower than that at Gilmour's and Hülls' tunnels.

In Hodgetts' property, a mile or two higher up the creek, gravels are again met with cropping out from under the basalt about 220 feet above sea-level. The wash is of a favourable character, and seems to form a fairly thick layer, so would be worth cutting into enough to drain it and allow it to be tested. The creek issuing from the gravel has yielded some gold.

On the west side of Mr. Hodgetts' ground the old Cambro-Silurian or Archæan mica schist country with quartz veins in it crops out, and there is often much rubbly quartz in the surface soil. The first gold got in this part of the district was found close by here in the side of the Seabrook Creek, and fair prospects of gold are still to be had in the vicinity in a little of the creek wash that has been left unworked. I did not, however, see any likelihood of there being enough of this gravel to warrant expense in bringing in a water-race for sluicing. In a small branch creek Mr. Hodgetts has found a sort of quartz reef in blue soft schist country, but it had become so covered up that I could not see it. The quartz from it does not look at all likely to be gold-bearing. It is very unlikely that these quartz veins have had anything to do with shedding the gold found in the neighbourhood, which probably all comes from the sub-basaltic gravels, or possibly partly also from the conglomerates of the Wynyard formation.

Cam River.—A mile or two above the junction of the Guide and Cam Rivers there are some extensive alluvial flats along the banks of the latter, consisting of river gravel brought down by the stream. The river being in flood on the day of my visit, the natural sections of the gravel deposit usually seen on the banks were not accessible, and no shafts were available for getting prospects from the wash. Mr. J. H. Ware, who accompanied me, informed me that he had obtained very fair prospects in the lower gravels. There are two terraces of gravel visible in some places, the lower and larger one being only a little above the level of the river, and from 8 to 10 feet in depth. The wash seems of very likely character from what was seen of it. Should these flats be found to contain gold enough to pay for working, there is a very large quantity of material available for sluicing. In dry weather, in summer, a number of shafts should be sunk to thoroughly test the ground. A splendid supply of water for sluicing is at all times of the year obtainable from the Cam River, and very short water-races would be required to bring it in, but, as in the cases of the Calder and Inglis River flats, it would be preferable to go to some trouble to get high-pressure water. This would enable the deep holes in the flats to be cleaned out by hydraulic elevators. By cutting a straight channel through the flats also it would become possible to divert and work the existing river bed.

The country rock is Cambro-Silurian or Archæan schists, slates, and sandstones. In one part there is a very hard silicious jaspery belt through it that may be a large lode, but it requires some cutting into to determine its true nature. At another part there is a good deal of gossan, which may come from a lode, but it is not known to contain any metal of value.

At the first bridge up the Cam road after leaving the Cam township, a creek is seen running over a sheet of hard conglomerate, which proves to be only a very strongly cemented bed of the tertiary gravel. It seems likely to be auriferous, and as there are very likely to be layers of soft uncemented wash under the conglomerate, it would be worth taking some trouble to find where this lies upon the bedrock, and to ascertain the position of the old gutter which very possibly exists under the cemented sheet. The bottom stuff might well be payably gold-bearing.

Sisters Hills.—No discoveries of any value have been reported from the Sisters Hills, but as they are composed of older Palæozoic schists, sandstones, quartzites, &c., of favourable appearance, this piece of country seems worthy of more attention from prospectors than it has hitherto obtained. Veins of quartz are common, and sometimes they contain pyrites. One piece sent by me for assay to the Government Analyst gave, however, only traces of gold and silver.

Zircon deposit.—Near Jacobs' Boat Harbour, on Mr. R. L. Skinner's land, there is a small creek notable for yielding large numbers of zircons and occasional sapphires. Much of the alluvial drift in this creek is really very rich in these gems. The sides of the gully are basalt, but the stones in the wash are mostly hard sandstone and quartzite, probably from the older Palæozoic hills to the north. The gems are little waterworn as a rule, and have probably not travelled far. There is a good deal of flat gravelly ground along the course of the creek which could very easily be worked, and if a market could be got for the stones they could be raised in quantities here very cheaply. With the great extension of incandescent gas-lighting on the Welsbach and similar systems that will probably take place before long, it is not at all unlikely that this deposit may become of commercial value. Some of the larger zircons are of very fine colour, and can be cut satisfactorily. The sapphires seem mostly to be of poor colour and very much fractured.

ARTHUR RIVER DISTRICT.

Only a very short visit was made to the Arthur River District, to Kay's old diggings, and to the Campbell Hydraulic Company's property. The road from Table Cape to Mt. Bischoff was followed to the south of the Henrietta Plains, then Sprent's track to Kay's diggings on the Arthur, some little distance below the junction of the Hellyer River. The track keeps on basalt country for the most part, and rises to an altitude of about 1800 feet on the Campbell Range on the top of the divide between the Inglis and the Arthur Rivers. Near the Inglis a considerable outcrop of diabase greenstone is seen. Going down into the Arthur Valley the north side appears to be mostly composed of mudstone conglomerate of the Wynyard formation; on the south side it is hard schist and slate and metamorphic sandstone (Cambro-Silurian). It would almost seem as if the Arthur River at Kay's crossing ran along the junction of the two formations, quite possibly along a line of fault. Going from Kay's Crossing to Gray's Creek, and from this across Campbell's Creek and over the range on to the Arthur again at the Campbell Hydraulic Company's workings, the Wynyard formation is met with nearly all the way, and in one place is seen also on the south side of the river, but the usual bedrock there is the Cambro-Silurian rocks. On the north side I was informed by Mr. R. Quiggin that there are large outcrops of limestone not far from the track; these would probably be Cambro-Silurian also. On both sides of the river there are occasional gravel terraces met with, in one instance as much as 200 feet above the river, no doubt left behind by the stream as it has cut its way downwards into the country.

Kay's diggings are on the south side of the Arthur, which is crossed by a cage and wire rope. Here there is a lot of alluvial gravel of very varying depth, from 50 to 70 feet above the river level, and about 550 feet above the sea. Work has been confined to cleaning out the creeks by rough ground-sluicing. Some deep ground has been proved to exist, and there may be a considerable amount of this: it would take some time and labour to determine now how much of it is available and what is its value, as the old workings are too much covered up to give assistance. No one has been working on the field recently, except an occasional fossicker. Several small creeks have been worked, some said to have been very good. It seems probable that they obtained their gold by natural sluicing of older river terraces. The bedrock is schist and slate, sometimes with a good deal of calcareous matter and veins of calcite, striking N. 45° to 55° E., much twisted, and often seamed with quartz veins. There does not appear to be much prospect of this old field coming into notice again unless the run of deep ground turns out to be larger than seems likely. There may, however, be patches of ground worth working on the slopes left untouched by the diggers, and if wholesale stripping of the soil by sluicing were resorted to there would probably be gold found in very unlikely looking places. I did not hear of any gold being got on the north side of the river except in the edge of the river bed itself, though several terraces of gravel are seen.

Gray's Creek.—A little work has been done about two miles below Kay's diggings on the north bank of the Arthur, where this small creek cuts through some rather considerable gravel-banks lying 70 to 100 feet above the Arthur River. These gravels contain large rounded boulders of a great variety of rocks brought down by the stream when formerly running at a higher level than at present. The creek has been worked, but no thorough trial has been made to ascertain the extent and average value of the gravel terraces to show if they would pay for hydraulic sluicing.

Campbell's Creek.—This is a considerable stream, and runs into the Arthur some little distance below the last-mentioned one. Some work is said to have been done along its course in the lower portions where the old river terraces have presumably been sluiced in it.

Campbell Hydraulic Gold Mining Company.—This Company is prospecting, and preparing to work by hydraulic sluicing, some very extensive terraces of river-gravel some two or three miles below the mouth of Campbell's Creek, and a short distance above the point where a rather large river, not named on the maps, but called by the Company the Keith River, joins the Arthur on the south side. The gravel deposits are on the south side of the Arthur, and to reach them from Wynyard it is necessary to cross on a punt or wire-rope and cage which have been laid down by the Company. They form several terraces, at heights from 20 to 100 feet above the river, and cover a large area. Some 14 or 15 shafts from 10 feet to 20 feet in depth have been sunk in the various terraces, and one was put down 50 feet before reaching the bedrock. The "wash" is river-gravel, somewhat coarse and not cemented. The bottom is usually Cambro-Silurian slates, but in one shaft the flat-lying Wynyard formation is seen. The terraces are much broken by small watercourses, which however do not seem to have been worked, partly it is said on account of want of a good water supply. The prospects that were washed in my presence from the various shafts were not at all encouraging, the bulk of the gravel being evidently poor. On the bedrock they were better, but it must be remembered that in hydraulic sluicing the whole of the gravel must be sent through the races, and we are concerned with the average value of the stuff from surface to bedrock, and not only with the richer layer at the bottom. Mr. A. Pyke, who was in charge of the work, however, stated that he had washed several large samples of the gravel from some of the shafts as it was brought up, and was satisfied that it was rich enough on the average to pay for hydraulic treatment. Six dishes, about 150 lbs. weight in all, of the gravel thrown out from various shafts, taken from several different places in each heap, were washed when I was going over the ground, and yielded 0·046 grains of gold, equal to $\frac{7}{10}$ of a grain to the ton, or about 1 grain to the yard. One dish, about 25 lbs. weight, of bottom dirt gave 0·413 grains of gold, equal to 1 dwt. 13 grs. to the ton. One grain to the yard might be made to pay, especially if there should prove to be considerably better wash on the bottom as well, if there was a good supply of high-pressure water for sluicing, and also a good escape for tailings, but the workings would have to be on a large scale, and economically conducted. I did not go to see the Keith River, from which it is proposed to bring in a water supply, but was given to understand by men who knew it that there was always a copious flow of water in it, able to furnish 50 heads of water at all times of the year. As the highest gravels are about 100 feet above the Arthur, it will be necessary to bring in the water-race at a still higher level, and I should recommend that as much pressure as is obtainable without too great expense should be got from the first. The Keith River is said to have falls and rapids along its course which give it a very steep average grade: if so, a high-level race would not be much longer than a less efficient low-level one. The higher race would also cross the gullies higher up than the lower one, and would consequently have easier country for construction. As the ground to be worked is not rich, every advantage must be taken to secure efficient and economical working, and high-pressure water is of the greatest importance. Some of the flats near the river may prove difficult of drainage and clearance of tailings, and here the high-level water would permit the use of hydraulic elevators. At the time of my visit a start had been made with cutting a water-race to

carry about 18 heads of water, which would come in on the level of the second highest terrace; but it seems to me that it would be much better to construct the high race from the first. The work that has been done to prove the ground has been good so far as it goes, but it would have been much more satisfactory if the stuff from each test-shaft had been, no matter at what trouble, carried to a spot where it could be sluiced in a box, so that the gold in it from grass down to bed-rock could be weighed and the average value of the ground estimated with some precision. A great many more shafts also are required for a thorough test. Much money would be saved in hydraulic ventures if the mines were properly proved by preliminary work before the expense of bringing in a water supply is undertaken. The gravels are very favourably situated for working, and with a good supply of water at high pressure I see no reason why even less than a grain of gold to the yard should not be made to pay.

Should hydraulic sluicing result profitably in this vicinity, it is probable that gravel terraces fit for working would soon be found lower down the Arthur River as well. Bearing in mind the high terraces of the Corinna and Table Cape fields, it is likely that the lower Arthur district will also have high gravel deposits, and search should be made for these on the tops of high spurs as well as for more modern drifts in the creeks.

I have the honor to be,
Sir,
Your obedient Servant,

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

The Secretary for Mines, Hobart.