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REPORT ON THE GENERAL GEOLOGICAL STRUCTURE AND TIN-BEARING GRAVELS OF THE GLADSTONE DISTRICT.

Geological Surveyor's Office, Launceston, 27th July, 1891.

SIR,

I have the honor to report having made a general geological examination of the Gladstone District, and more especially of the ground held there for tin-mining purposes, with the object of collecting information that might prove of service to the mining industry by throwing greater light upon the origin and mode of deposition of the tin-bearing gravels, their extent, and their distribution throughout the district.

A general view of the topography of the country round Gladstone is best obtained from the top of Mount Cameron, 1808 feet above sea level. The mountain consists of a cluster of rocky peaks connected by high ridges, the group being divided into three main spurs by the valleys of the Campbell's and Sapphire Creeks. It is isolated from all other neighbouring ranges, being surrounded on all sides by low-lying country, which slopes gently seaward from the foot of the mountain towards Boobyalla, and on the inland side rises gradually in rolling low ridges up the Ringarooma valley towards the foothills of the Blue Tier and the high ground near Branxholm. On the western side the wide flat low-lying valley of the Boobyalla River divides it from Mount Horror. Towards the eastward there is little high country, the low Ringarooma Tier and the distant Mount William being the most prominent features, but the whole consists of a succession of low ridges, separated by plains anl a few deeper valleys, that of the Ringarooma River being the most important. The land is generally but sparsely timbered, and large open spaces clothed with native grasses give it a park-like character. The open grass land generally denotes the presence immediately under the surface of a hard, somewhat ferruginous, cement layer or "pan," which is especially found covering the deposits of gravel. The ridges and slopes where the solid bedrock lies near the surface, when not too rocky, generally bear more vegetation than where the "pan" occurs.

The general aspect of the country as seen from the top of Mount Cameron suggests that the low-lying country has been planed down to a pretty uniform level by marine erosion, and has subsequently been furrowed into minor ridges and valleys by the action of running water and other sub-aerial agencies. It would therefore appear as if the sea had once covered all the low-lying ground and extended inland to the foot of the ranges. This appearance is general at intervals all along the northern coast of the Colony, and the probability is that, as a matter of fact, the land has risen very considerably since the end of the Early Tertiary (Palæogene) Period. This explanation is of great service in reading the history of the various gravel deposits, enabling them to be correlated and their differences explained with a success which no other theory appears to me to approach. Further evidence in support of it is given below.

General Geological Structure.—The bedrock visible throughout the district is either granite or ancient sedimentary slates and sandstones of probably Lower Silurian age. On these rest gravels of ages ranging from the early Tertiary down to the present time. No Upper Palæozoic or Mesozoic rocks of our Coal Measure series have, to my knowledge, ever been found in the vicinity of Gladstone intervening between these two formations. Recent basalts, probably of Tertiary age, are sparingly found, however, and must be taken some notice of.

Granite.—The Mount Cameron Range is part of a large mass of granite country which extends from between Boobyalla and Gladstone southward to Branxholm and the George's River, and includes the whole of the Blue Tier Range and its offshoots. The boundary between the granite and slate formations is a very sinuous line, but may be said to run roughly about N.W. and S.E. through a point just west of Gladstone township. The granite is of the same character as that composing the Blue Tier, the Billycock Tier, Mount Stronach, and other granitic hills of the North-eastern District, namely, a felspar porphyry consisting

of quartz, mica (*biotite* mostly), and felspar in coarse granular mixture, with large felspar crystals porphyritically developed. In vughs in the granite the quartz frequently is found in large black crystals of fine quality. Generally the rock is of a whitish light grey colour, but occasionally it is red, the felspar being of a brick-red colour. In parts it may be seen of a warm cream colour, and without the large porphyritic felspar crystals. The rock is very subject to decomposition, the felspar rapidly altering to kaolin, and the mica to clayey and serpentinous earths. The insoluble quartz grains alone remain unaffected by the atmospheric agencies. They are angular, and rarely show any approach to definite crystalline form, and range from the size of small shot to that of peas, forming therefore a very light gravel when broken down by the weather and very readily moved by running water; whence it happens that the rarer large quartz crystals and masses found in vughs and veins of the granite being left behind by the lighter material, form a preponderating proportion of the heavier wash. This serves as some measure of the amount of concentration of the heavy material in the creek beds, for every cubic yard of coarse gravel must represent some hundreds of yards of broken down granite, as the latter contains only a very small percentage of vein rock and large crystals. Similar reasoning will show that if even a very small quantity of tin ore exists through the granite, whether in the rock itself or in small veins through it, the concentration has been sufficient to allow of very considerable quantities having been gathered together in the creeks. There can be little doubt that the granite does contain a little tin in its mass irrespective of any occurring in veins traversing it. Every little creek on the granite bedrock is found to contain some tin ore, and tin-bearing veins are so rare that they cannot be relied on as the source of this. In a previous report on the Blue Tier District I suggested that a good deal of the alluvial tin ore was derived from the disintegration of the granite bedrock, and my examination of the tin-bearing creeks of Mount Cameron tends to confirm that belief.

The fine quartz from the disintegration of the granite is a very useful indicator of the proximity of the bedrock. It is washed clean by rains, and gathered together by small runnels of water into white patches, often resembling small hailstones. If on examination the grains were found to be sharp and angular, I have found that in every case that came under my notice further search showed the bedrock to be immediately under the surface,—in fact, the surface soil was only disintegrated rock. Where, however, there was a considerable percentage of rounded water-worn grains, there was always alluvial material underneath. This simple observation was of great service when the nature of the bedrock was not at once visible. Where the fine quartz gravel has been much water-worn, it generally forms fine rounded grains like rice or barley in appearance and size.

The granite has been evidently intruded through the Silurian strata, as is shown by the very sinuous boundary between the two formations, and the fact that the slates and sandstones at the contact are often greatly metamorphosed and rendered somewhat crystalline. A shaft sunk on the Mount Cameron Company's ground went for some seventy feet through slate, and then struck granite. The strike of the Silurian beds is in many places fairly against the granitic masses, which thus cut them off sharply. The intrusions of granite are therefore post-Silurian in date.

In my former report on the Blue Tier District, the occurrence was noted of a second variety of granite traversing the above-mentioned felspar porphyry as dykes, and generally carrying a great deal of tin ore impregnated through it. Somewhat similar rock is also found at Gladstone and here, too, is apparently much more richly stanniferous than the ordinary granite. As at the Blue Tier it varies greatly in composition, being in parts composed almost wholly of quartz and mica or hydro-mica, and in other parts of about equal quantities of quartz and felspar, while in other places, again, all three constituents of granite are found. Much of the mica is white and silvery *(muscovite)*, thus differing from the black mica *(biotite)*, of the country rock. Quartz is generally predominant, however, and in much larger crystals than the felspar and mica ; hence though the rock is by no means a typical *quartz-porphyry*, in the absence of a better name this one may be given to it. Where veins traverse this porphyry the felspar is generally gone from their immediate neighbourhood and the mica become hydrated, while infiltration of silica has cemented the material into a hard solid rock. Often a vein of well formed vein-quartz runs through the centre of the altered mass. These veins are often very rich in tin ore, both in the quartz and in the altered country rock. Several of these quartz-porphyry dykes have been found in the Gladstone District; the largest, perhaps, being on the Fly-by-Night claim, where it lies between the Silurian formation and the main granite mass. This would suggest a probability of its being a contact alteration product, that is, that the portion of the granite coming in contact with the sedimentary rock had been altered in composition and crystallised differently from the main mass in consequence. As, however, there is not this alteration at other points of the contact, and, besides, the porphyry traverses the main granite itself on the Esk Company's ground, it would seem that its being a contact mass on the Fly-by-Night is only accidental. The intrusive character of the quartz-porphyry is not so clear as at the Blue Tier, and it may prove on further examination not to be a true dyke, but rather granite altered by fracture and infiltration of metamorphosing solutions. At present, however, I incline to the belief that it is dyke-stuff intruded though the granite.

Running a few degrees east of north from above the Esk Company's pumping plant on the east side of the river is another outcrop of the quartz-porphyry, and still another occurs further on on the old Empress claim. These may prove to be connected with the Fly-by-Night dyke, but as yet no attempt has been made to trace them through. Since my visit to the district I have been informed of the recent discovery of a large soft granitic lode rich in tin ore on the Mount Cameron Company's property, from the appearance of specimens from which I should think that it is probably connected with the adjacent Fly-by-Night dyke, if not really a continuation of it. On the Esk Company's sections, on the slopes towards Harden's Ravine, several tin-bearing veins have been cut by trenches, but I am not sure whether they are in another dyke of quartz-porphyry or are simply small lodes in the granite. They are small and rather irregular, but often carry excellent tin ore. More extensive trenching across their course is required to make clear their true nature. In the quartz-porphyry dykes tin-bearing veins are very numerous, and run in all directions. On the Fly-by-Night section there are a great many of them, and so much rich stone can be readily obtained as to render it probable that the rock would be payable if systematically worked. On Mallinson's section, No. 167, there is something more like a definite lode than the generality of the veins. Here, in the width of about a chain, are found three or four veins of quartz impregnated

with silvery talc and flanked by bands of blackish greasy talc, the whole width of the lode bands ranging from one to five feet. Tin occurs pretty freely in these bands, and in what is said to be a bulk sample taken from a shaft on one of them as much as 12½ per cent. of dressed tin ore is reported to have been obtained. This lode is worth prospecting: it could easily be tested by a short adit and drives along its course. Neither here nor on the Fly-by-Night ground has any real mining work been done to try the lodes—nothing, indeed, but a few trenches and pits. Endeavours have been confined to searching for definite lodes to which it was supposed the numerous veins would lead. As the tin ore appears to be impregnated through the bulk of the quartz-porphyry generally, and segregated especially in the vicinity of the veins rather than confined to them, it appears to me that efforts should be made to ascertain the average value of the formation rather than to trace the separate veins. These do not seem at all likely to be permanent, and it is very doubtful if definite lodes exist at all in the formation. The experience of the Anchor mine at the Blue Tier in crushing the quartz-porphyry dyke there in bulk proves that this treatment is the proper one to pursue, and not rooting out small rich veins. No great amount of attention has yet been paid at Gladstone to the stanniferous dykes, but they are, in my opinion, promising enough to be worth a systematic trial, which would ascertain if they would pay for treatment in bulk. Both the Fly-by-Night and Mallinson's dykes offer extremely good facilities for cheap extraction of the ore by open quarrying. One per cent of dressed tin in the stone, taken as it comes, ought to pay all expenses and leave a margin of profit, provided that a sufficiently large quantity per diem were treated. This may seem to some an absurdly low estimate of cost of extraction and crushing, but numerous examples of successful dividend paying mines could be cited where the value of the rock mined is much less than that represented by one per cent of tin ore, and in some of these cases the ore has to be raised from a depth of as much as 2000 feet with concomitant pumping as well as winding expenses. It has been thoroughly demonstrated that no mines pay so well and steadily as those where there are very large quantities of low grade ore of only sufficient value to give a small profit over expenses of treatment on a large scale. Worked on a small scale they would be unpayable, but, with the greater economies possible in working on a large scale, handsome profits are realised. Great quantity of material dealt with is the secret of their success. What is required now, therefore, in the case of these dykes at Gladstone, is to ascertain the quantity and value of the stanniferous rock easily available. The course of the porphyry formations should be ascertained by trenches, and a number of small shafts should be sunk in them at regular intervals so as fairly to sample the rock. The stone from these shafts should be all crushed and dressed without any picking of good stone or rejection of bad. The result of the crushing would show what could be expected from the porphyry as a whole, and would allow of a calculation being made as to whether it could be made to pay when milled on a large scale. Even if the rock as a whole would not pay to work it would be seen by such a trial if it would be possible to select large quantities of payable stone without having to remove so much poor rock as to cause a loss. It may be pointed out that the cost of such a thorough test, implying as it does the provision of a small experimental battery for crushing the rock from the shafts, would not be greater than has to be sunk in preliminary prospecting operations in many other mines where the results obtained are often not nearly so definite nor the prospects so good.

Silurian Formation.—The bedrock underneath the township of Gladstone, and, generally, east and north-east from it, is composed of metamorphic slates and sandstones having an average north-and-south strike (my observations of strike vary from N. 7° E. to N. 15° W.), and standing nearly vertical, such dip as there is varying from easterly to westerly very frequently, and within short distances. Both the sandstones and the slates are, as a rule, rather soft, and easily weather to clays, but there are also hard bands of silicious semi-crystalline sandstones, which resist both atmospheric and mechanical disintegration well, and hence form a large proportion of the river gravels. The rock, as a rule, however, does not appear to have undergone any extreme metamorphism. Though continually searching for them I was not able to find any fossils in the formation, nor could I hear of any ever having been found. From the lithological character and mode of occurrence of the rocks, however, I take them to belong to the Silurian system.

Wherever the bedrock is bared by sluicing operations it is seen to contain many veins of quartz, some of white colour, some dull grey and very dense; these veins supply a large proportion of the gravel derived from this rock, the slates and sandstones themselves generally soon becoming reduced to clay and sand on account of their softness. Sometimes the vein quartz contains both tin ore and gold. Besides these small veins several larger quartz reefs have been found, and at one time it was hoped that Gladstone would become a goldfield, but the reefs all turned out badly on being subjected to practical trial. The most celebrated lode was that known as the Royal Tasman, close to the township. Out of a great many conflicting statements with regard to this, I incline to believe that one the truth which said that there was a small patch of auriferous stone in this lode, but that it very soon gave out and no more was found. The belief seems to be universal that the small crushings first obtained were "salted," and hence many persons regard the Royal Tasman gold as a fraud from first to last; but from the most reliable information I have been able to obtain locally from men who worked in the mine, I believe that there was really some gold genuinely got. The truth of this matter is of importance to the future of the District, for the failure of the Royal Tasman has utterly damned it in public estimation as an auriferous country, and hence prevented it from getting the attention which it fairly deserves. The Silurian formation elsewhere, at Beaconsfield, Lisle, Denison, Golconda, &c., and in Victoria has been the home of auriferous reefs, and there is rather reason to believe that such are likely to be found in the Gladstone District than that the formation should be barren. A good deal of gold is found in the alluvial gravels resting on and derived from the Silurian bedrock, as much as seven ounces to the ton of tin ore having been obtained in cleaning up the sluices used for saving the latter. The formation is therefore clearly auriferous round Gladstone as elsewhere, and all that the failure of the reefs worked should imply is simply that the right lodes have not been found yet. In some of the goldfields of Victoria there are dozens of worthless reefs for every one that is payable. Any new discovery should stand on its own merits, and not be judged by the ill success of its predecessors. In fairness to the District it is necessary to make these remarks, as there is a very general impression among the mining public that no gold can by any possibility come out of Gladstone.

Basalts.—These rocks are of no importance in the immediate vicinity of the Gladstone tinfield, but are found to the north-east of it towards the Mussel Roe and the Ringarooma Tier. I have only seen occasional stones indicating the proximity of narrow dykes in one or two other parts of the field, near the head of the Mount Cameron Water race, for example. Their presence is only noted at present because of their probably being contemporaneous with the basaltic flows between Moorina and the Billycock Tier, which overlie the oldest stanniferous gravels.

Gravel Deposits.—It has been stated above that these range in time of deposition from the early Tertiary period to the present time. There are evidences of a long-continued cutting down of the Ringarooma Valley, which has resulted in the formation of successive terraces of gravels varying considerably in their composition, and it appears to me certain that this has been due to an elevation of the land rather than to the simple erosion of the river channel. In order to understand the problem of the modes of deposition of the gravels, it is necessary to leave the immediate neighbourhood of Gladstone, and consider the evidence afforded by the mines at Branxholm, Derby, and Bradshaw's Creek. These have been reported on by Mr. Thureau, F.G.S., in 1884, (see "Report on the Stanniferous Deposits at Ringarooma," No. 99, 1884.) As shown in his map, it is certain that an old channel of the Ringarooma River ran under the basaltic plateau which extends from Derby to David's Creek. Two tributary channels joined it much in the position of the present Cascade River and Main Creek. The mines at Derby afford excellent sections of the whole formation, from which we may note, first, that the bottom of the ancient channel was at least 70 feet below that of the present river, as that depth has been proved by borings in the North Brothers' Home Mine; secondly, that the present river channel cuts across the old beds of the Cascade River and Main Creek; thirdly, that the ancient channels must have slowly filled up with fine quartz gravel, carrying tin ore, till the surface of the gravel stood quite 100 feet above the present river level; fourthly, that the gravel then became covered over with upwards of 200 feet of volcanic ashes and basaltic lava flows; and, lastly, that the existing Ringarooma River has cut its way down through all these deposits and through hard granite rock down to its present position. The river was doubtless diverted from its old course when the ancient channel became filled with streams of basaltic lava, and began to cut a fresh channel through the granite on to which it was forced, and has continued to wear this deeper and deeper ever since. From below the junction with the Main Creek the Ringarooma seems to have abandoned its old course altogether, flowing to the east of Mount Cameron, whereas the old channel lay to the westward of it. The present channel is rock-bound all the way from the Main Creek to below Gladstone, and there is no place where there is any break in the rock showing where it might have rejoined the ancient channel. The Pioneer Mine appears to be either on the edge of the old lead or in a tributary leading into it, but borings here and at David's Creek have proved the bottom of this deep ground to be far below the bottom of the present river, thus agreeing with the borings in the North Brothers' Home in showing that the ancient channel was deeper than the present one. If the old and new channels do not run into one another above Bradshaw's Creek they certainly do not join between there and Mount Cameron, as there is a ridge of granite forming a barrier all the way. The continuation of the rich Brothers' Home lead is therefore to be sought for in the low ground running down past the western side of Mount Cameron, a position in which the general topography of the country of itself indicates that it will be likely to be found. It is well known that there is very deep ground along this line.

Reverting to the sections at Derby, it is clear that, previous to the filling up of the old channel with gravel, there must have been a period when the river was engaged in cutting it out and wearing it deeper and deeper. While this was in progress no large amount of gravel could accumulate in it. The present Ringarooma River has very little fall in it; consequently, when the old river was engaged in cutting its channel, which is so much lower than the present one, it is pretty certain that the general level of the land was much higher than at present. The gradual filling of the channel was most probably the result of a subsidence of the land, causing a reduction of the grade of the river bed and consequent cessation of scour. The subsidence appears to have terminated with the eruption of the basaltic lavas, as the stream again began to cut its way downwards, showing that an elevation of the land had taken place, either with considerable rapidity, or, as is more likely, with a slow gradual movement. During this period of elevation the Ringarooma has excavated its present valley, the various terraces of gravel representing old river flats which have been cut through and left behind by the stream. The elevation of the land must have been accompanied by a recession of the seashore, resulting in the formation of successive beach terraces or raised beaches. These would be cut through by the river in its downward course, so that the terraces of gravel may often be both of river and beach formation, and it could often happen that the higher terraces were beaches while the later lower ones were purely of river origin. The variation in the character of the alluvial deposits at different levels is thus often easily explainable.

The great age of the oldest gravels in the mines at the Brothers' Home is clear from the consideration that a long period of time must be allowed for the gradual filling up of the old channel to the level of the lowest volcanic beds, for the deposition of the latter, and for the subsequent erosion through hard rock of the present Ringarooma Valley. The outflows of basalt in other parts of the colony are considered to have taken place towards the end of the Palæogene period, and there is every reason to believe that those at Derby were contemporaneous with them. No good fossil evidence of age has yet been obtained, for, though leaves were said to have been found in some of the mud-bands passed through in sinking at David's Creek, they were not preserved by the workmen or submitted to any scientific authority for identification. In the workings of the Brothers' Home Mine occasional lumps of old timber, blackened and almost converted into lignite, have been at times found, but the species of wood has not, so far as I know, been determined. Still I think there need be no hesitation in referring the sub-basaltic gravels to the early Tertiary or Palæogene period.

In my recent Report on the Beaconsfield District I referred to the alluvial gravels there, and showed that in the Early Tertiary Period the land stood at least 300 feet higher than now; that it was subsequently to the filling of the Ophir Deep Lead depressed to a level at least 250 feet lower than the present one, and that it has subsequently risen to its present position. These movements of the earth tally with the evidence

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of the Ringarooma Valley as above described. When, in the Early Tertiary Period, the land stood much higher than now, the Brothers' Home and Ophir Lead channels were being contemporaneously scooped out; then came the great subsidence which piled gravels up to 250 feet above sea level on the slopes of the Cabbage-tree Hill, and caused the old Ringarooma channel to fill up; next came the basaltic flows; and since then a movement of elevation has resulted in the sweeping of the greater part of the accumulated gravels from the Beaconsfield flat, and the erosion of the present Ringarooma Valley. As the bottom of the Ophir Lead is below sea-level it may be assumed that the old Ringarooma lead also runs below sea level towards its outlet. The deposits along its course will, therefore, certainly be very wet and difficult to work.

As it seems certain that the Ringarooma lead must go to the west of Mount Cameron, away from the course of the present river, so it would also appear that the ancient stream corresponding to the modern Great Mussel Roe River ran in a considerably different position from that of the latter. This, at least, is the most probable explantion of another series of ancient alluvial gravels encountered along the course of the Mount Cameron Water-race. On the west side of the race, near the second siphon, there is a somewhat high round hill, apparently entirely composed of small, thoroughly-rounded, granitic quartz gravel. At the foot of this hill the water-race passes through some rather hard cement, composed of rounded quartz gravel also. Several springs towards the base of the hill show where water finds its way out of it. No prospecting, more than sinking one or two small pits, has been done to show if this hill is tin-bearing. It appears to me well worth trying further, as being probably portion of an ancient lead. Further down the Mussel Roe River more deep ground is encountered on F. Whitaker's section, No. 2498-87M, and to the north of it for some considerable distance. Workings on the section named were carried on some time ago, a tail-race having been brought in through soft granite from the Mussel Roe Valley. The granite bottom dips rapidly underfoot at the intake of the tail-race, hence the bottom drift could not be worked. The top drift consisted of sand, granitic quartz gravel well rounded, and well-rounded coarser quartz gravel, all mixed with a good deal of white clay, and containing a fair amount of tin ore. Borings proved a depth of 40 feet below the level of the tail-race without finding any bottom. Some distance north of these workings a deep shaft was sunk some years ago without reaching bottom. Some lignitised wood was obtained in this shaft, but it was all so crumbled that I could make nothing of the few small specimens I was able to find lying about, further than that the wood was thoroughly converted into lignite, showing the deposit to be an old one. This shaft is in a flat. To the north of it there is a gravel hill, which slopes down to the Mussel Roe River. Several springs occur on its northward slope, and I was informed by Mr. Richards, who has done much prospecting in this district, that at the foot of the hill in the bed of the Mussel Roe the ground appeared to be very soft and deep, as he could thrust a long pole a great way down into it, evidently through gravel. It would seem from this that the old lead which evidently exists in this locality crossed the Mussel Roe and went more to the north-west, a course which would connect these gravels with some other ancient deposits to be mentioned presently. I had only time for a flying visit to this part of the field, and was not able to examine it so closely as it deserves, but it seems extremely likely that there is a deep lead running through it, and very possibly connected with the hill near No. 2 siphon above mentioned. From its soft nature this deep ground is extremely difficult to prospect, but the tin ore got in the upper parts of the drift in Whitaker's workings gives good ground for believing that in the gutter of the lead very good tin ore will be found. By driving in from the northward, where the Mussel Roe crosses the lead, it is probable that the ground could be well tested. Should it prove payable an ample supply of water for working is close at hand in the Mount Cameron Water-race. This neglected part of the field is worthy of attention from men who are disposed to risk some money in the necessary, somewhat expensive, prospecting. It is beyond the resources of working miners to develop without capital to assist them, and this, I think, is what has led to its lying idle so long.

The course of this old lead after crossing the Mussel Roe is not clearly traceable, being often broken by erosion of more modern valleys, and overlaid by more recent deposits. A number of deposits of cement, however, extending from the Mussel Roe to the Aberfoyle country may, perhaps, be portions of it, though perhaps of later and marine origin. My reason for connecting them with the Mussel Roe Deep Lead is that the cement is made up of rounded granitic quartz particles similar to those of the gravels of Whitaker's workings. Further, there is reason, as we shall see, to believe that these cements are considerably older than the other gravels of the district. The cement is a rather hard conglomerate, sometimes very hard and solid, and not unlike granite in appearance; it is often mistaken locally for bedrock, and called quartz porphyry, but may be easily distinguished from the crystalline rocks by the well-rounded character of its constituent pebbles. It forms the small hill sometimes called the Edina Sugarloaf, and is also found to the north-east of it under the long siphon of the Mount Cameron Water-race, near Ogilvie's dam (58-87w.) About two miles north of the long siphon along the Water-race the latter leaves the cement or conglomerate formation and runs over slate and sandstone bed rock—(I prefer to use the name "cement" instead of the more strictly scientific "conglomerate," as the former name is better understood by miners as being wash or gravel converted into stone by some binding material.) To the north, or north-west rather, of the point where the Water-race leaves the cement I have not seen the latter for a long distance—not till the Aberfoyle country is reached, where the Brown Hill, near Tea-tree Lagoon, is again composed of it, and also some low hills north-west from the Mount Cameron Water-race Storage Reservoir (80-87w.), generally known as Matthewson's Lagoon. Between the Edina Sugarloaf and the Brown Hill there is a line of very deep ground, as to the nature of which I am in considerable doubt, whether to refer it to the same formation as the cement or to a later one. This deep ground, strangely enough, lies on the watershed between the Ringarooma and Mussel Roe Rivers, in the northern portion at any rate. The northern extension of the Mount Cameron Water-race, from about half a mile north of the crossing of the Cape Portland road, all lies upon this deep ground, which here seems to be over a mile in width. Numerous shafts have been sunk in a fine white gravel drift, some as deep as 70 feet without reaching the bottom. The character of the gravel—fine water-worn quartz pebbles derived from degradation of granite—points to a connection between this deep ground and that higher up the Mussel Roe. There is a break in the continuity of the deep ground where the road from Bell's Bridge to Cape Portland runs across its course. I have not been able to detect any sign of an old deep lead crossing this road, and it would seem that the

valley of the Pig-and-Whistle Creek has cut right down through it; if so, the bottom of the lead above this road will be above the level of the Ringarooma River, and therefore capable of drainage into it. To the south-east of this blank space deep ground is again found in the old Tamar and Garfield Companies' workings, and extending from thence to the cement near the Edina Sugarloaf. I am inclined to believe that the line of deep ground thus traced between the Edina Sugarloaf and the Brown Hill does represent the general course of an old lead, but that the upper portions of the gravels have been greatly disturbed since their first deposition. The lead, if there ever was one, was the channel of an older Mussel Roe River, cut out when the land was at a higher level than now, and filled when the subsidence took place which filled also the old Ringarooma lead. This subsidence probably brought the sea in over all the country just described, causing a re-distribution and re-arrangement of the surface gravels, though not likely to have affected the lower deposits in the gutter. While the sea was again receding in the subsequent period of elevation further re-arrangement of the surface gravels would result. The existence of the Edina Sugarloaf and the Brown Hills as hills shows that they were once parts of a much more extensive deposit, which has been greatly worn away, leaving these harder portions standing out. This wearing away in all probability took place partly during the encroachment and retrogression of the sea, and partly owing to ordinary sub-aerial agencies afterwards.

There are several things which point to the presence of the sea over these deep gravels. For example, the cuttings for the northern extension of the Government race are nearly all in a brown, somewhat ferruginous, cemented sand, often clayey. Nodules of oxide of iron, containing sand, and loose white sand, are pretty common. The sand is such as is found by the sea shore, and the cement might well have been formed in a shallow lagoon behind sandhills fringing the sea shore, as is so commonly seen along our coasts at the present day. Whether laid down in exactly this way or not, the sand shows that the sea was probably close at hand when it was deposited. In the old Martha and Tamar claims deposits of what appear to be sea sand are also found, and in the latter, more especially, there is evidence of lagoon deposition. Two sections through the workings of the old Tamar claim are appended hereto. Towards the northern and north-western end of the workings the Silurian bedrock is visible, dipping rapidly to the south east. On this lay heavy gravel, consisting of rounded and sub-angular small boulders and stones of sandstone, quartz, and dark chalcedony, the sandstone of the bedrock predominating. The chalcedony is identical with the material in a well defined lode or vein of it found on the old Eureka claim, across Harden's Ravine from the Tamar. A few stones of quartz-porphyry similar to that in Mallinson's dyke also occur, and to further show that this gravel is partly derived from adjacent granite bedrock crystals of black quartz are not uncommon. All this heavy wash has now been sluiced away, and its relation to the sands composing the walls of the excavation is not therefore so clear as if it could be seen *in situ*, but it is nearly certain that it is of later origin than the latter, and I think represents a place where the old deep ground was subsequently cut away by water action and replaced by later gravels. On working more to the south east the heavy gravel gave out, and in its stead layers of sand were encountered, which were found to surround the gravel except on the northern side, where the hillside falls away. The walls of the excavation are now all composed of sand. The layers are sometimes cemented by oxide of iron, and often contain hard cakes of oxide of iron. In parts there is a good deal of clay. Much carbonaceous matter is found through the sands; but though I searched for a long time I was unsuccessful in getting any leaves, by which the age of the deposit might be estimated. In the bottom of the present face lies a layer about 8 feet in thickness, mainly composed of fragments of timber, partly and sometimes wholly converted into lignite. Some of the wood is very little altered, and still splits freely. The fragments of timber seem to be mostly roots, logs, and pieces of heavy branches—ordinary drift-wood, in fact. They are mixed up with sand and mud and a little fine gravel. Concretions of iron pyrites are often found on the wood, and occasionally partly replace its substance. The wood has not yet been microscopically examined, but seems almost certainly that of a species of pine. In other parts of the colony, as at Breadalbane and Corra Lynn, fossil wood and lignite are found consisting mainly of coniferous tree remains, and it would seem that in Early Tertiary times members of the pine family were the commonest forest trees. The coniferous woods of this deposit themselves therefore point to its belonging to the oldest alluvial gravels, and give ground for believing that I am right in connecting this with a Palæogene Mussel Roe lead contemporaneous with the Ringarooma deep lead. This belief is substantiated further by the fact of more recent, but still old, gravel having been deposited in an eroded portion of the sand deposit as above described, and by the apparent connection of the Tamar workings by deep ground with those of the Garfield, and on to the cements of the Edina Sugarloaf. Not that I think that the Tamar sand beds were laid down by river action in the old Mussel Roe channel, but rather that they are among the very highest beds of the filling of it deposited when this part of the country was almost at sea level, and the old channel formed a shallow estuary or lagoon. The layer of drift-wood; the sharp sea sand; the prevalence of ferruginous and carbonaceous stains; the false bedding often seen in the sand,—all point to an estuarine or lagoon formation. Above the sand beds there is a layer about 11 feet thick of fine quartz gravel, which most probably indicates a further advance inland of the sea, and complete submergence of the lagoon deposits.

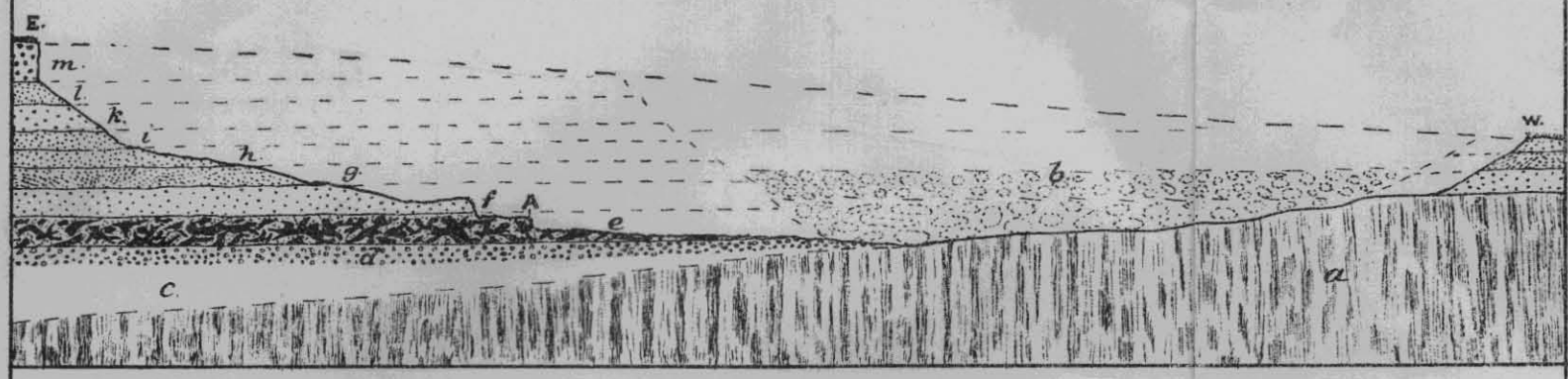
The old Martha workings in one place show a face about 20 feet deep, composed of very small quartz gravel and sand, the latter fine sea-sand as in the Tamar claim. The bottom bedrock is dipping away from the Ringarooma Valley, more towards that of the Pig-and-Whistle Creek. As these beds of sand in the Martha are quite 60 feet lower than the similar ones in the Tamar, they are not likely to belong to the same horizon, but they also give evidence of the former presence of the sea running up much along the line of the supposed Mussel Roe lead.

The sands in the old Tamar mine were found to contain a little extremely fine tin ore, which, though not itself nearly payable, bears witness to the presence of tin in the rivers running into the sea at the time of its deposition, and thus gives promise of better results when the true river channels are discovered.

The deep gravel and sand formation extends from the Tamar workings, round the head of Harden's Ravine, to the old Garfield Company's workings on Section 2077-87M. These, again, are connected by a spur which appears to be entirely composed of fine quartz gravel with the high-level dam of the Esk Com-

7/17

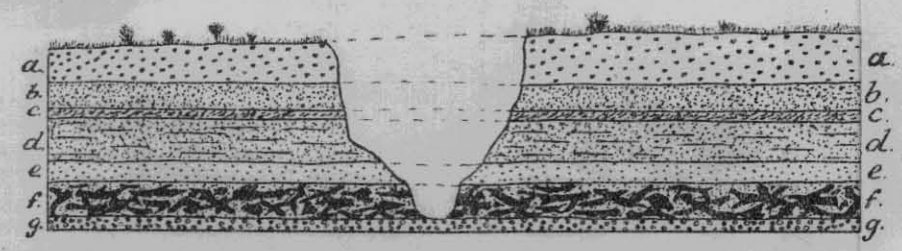
SCALE. 60 FEET TO AN INCH.



LONGITUDINAL SECTION ON LINE BEARING N.77°W.

THROUGH THE OLD TAMAR WORKINGS.

a. Silurian bed rock. b. More recent gravels, sluiced away c. Possible deep ground. d. Bed of small gravel. e. Bed of lignite and sand. m. Fine quartz gravel, somewhat cemented. f. g. h. i. k. l. Beds of loose and cemented, often ferruginous and clayey, sand.

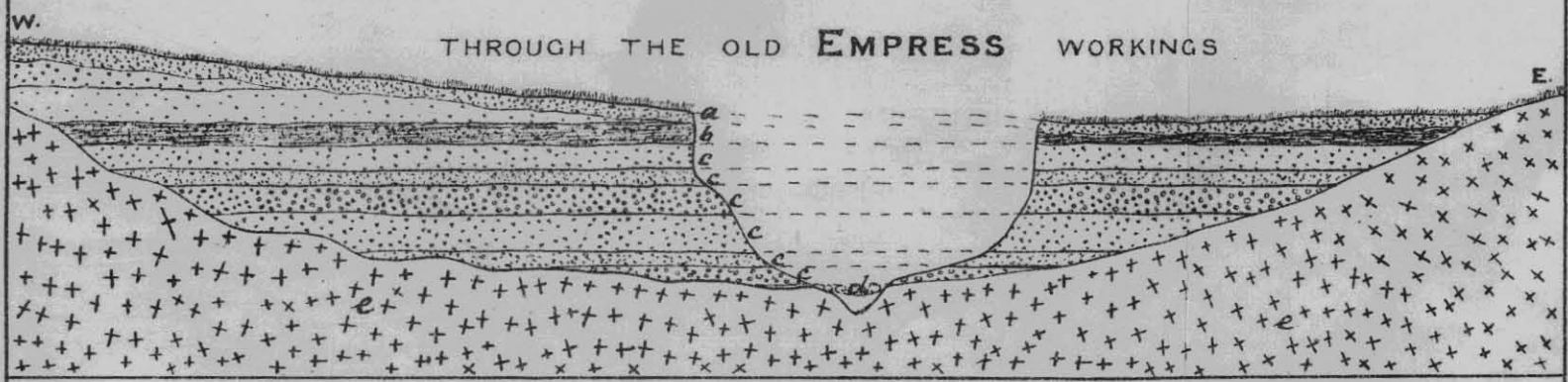


CROSS SECTION OF THE ABOVE AT POINT A.

a. Cemented rounded fine quartz gravel. b. Sand, in parts pretty strongly cemented by oxide of iron. c. Clayey whitish sand, in places red iron cement. d. Brown sand generally cemented with oxide of iron, with numerous hard cakes of oxide of iron: in some parts this bed is not cemented at all, but is simply loose sand. e. Loose whitish sand with small quartz pebbles. f. Lignite mixed with sand, mud, and gravel. g. Layer of small pebbles.

CROSS SECTION

THROUGH THE OLD EMPRESS WORKINGS



a - Surface cement crust. b. Clay c.c.c. Layers of more or less fine gravels and coarse sand. d. Heavy wash, now all sluiced away. e. Granite bed-rock.

5 cm

pany. The excavations for this show no bedrock, but only fine rounded quartz gravel and yellowish-brown sandy clay. A somewhat large cutting between this and the Eureka dam shows the Silurian bedrock not far from the surface, and south of the Esk dam solid granite crops out, so that in this part there does not appear to be a great depth of gravel. The cutting shows the following section in the face :—

	Feet.
Surface soil and ferruginous cemented clayey fine gravel of rounded quartz pebbles and granitic quartz grit	3
Very clayey layer, containing gravel	2
Coarse brown sand, sometimes false-bedded, with occasional small gravel in horizontal layers	11
Coarse gravel of sub-angular fragments of the Silurian bedrock and angular and sub-angular quartz	1
Silurian slate and sandstone bottom.	

The coarse gravel resting on the bottom seems to have formed only a very small proportion of the whole mass, and to have been immediately derived from the bedrock below, though a few stones from lodes in the granite and black crystals show that part of it was transported from neighbouring granite bottom. The Silurian bedrock is again seen in a cutting at the back of the Eureka dam. Between the Garfield and Tamar claims, however, numerous shafts have been sunk without reaching bottom, generally not to greater depths than from 20 to 40 feet on account of the soft running nature of the fine gravel and sand passed through, which was often regular quicksand. In the eastern side of the Garfield workings the Silurian bedrock is visible, but towards the outlet the ground has not been bottomed, and large quantities of sand are encountered. It seems likely, therefore, that the deepest ground lies east of the Tamar and west of the Garfield cuttings. The average depth of the latter is from 6 feet to 16 feet. The following section was observed as a representative one, in one of the faces :—

	Feet.
Surface soil	1
Ferruginous cemented sand	1
Fine well-rounded gravel, with one bed of coarser gravel near the middle of the layer	7
Small very well waterworn quartz and quartzite gravel, with softened slate fragments and stones of Silurian sandstone	2½
Coarse sand and fine gravel, rather cemented, not bottomed	3

The beds of fine gravel and sand make and thin out again in short distances. The beds of sand often show false bedding. The Garfield workings are about 40 feet higher than the top of the Tamar face. These gravels were doubtless laid down when further subsidence of the land had sunk the Tamar beds well under water and brought the sea further up the old river valley.

It will be seen from the above that neither the Tamar nor the Garfield workings give direct evidence of belonging to the same formation as the cements of the Edina Sugar-loaf and the Brown Hill, but they go to show that deep ground exists along the line connecting these places, and that this deep ground was filled by the advance of the sea inland, which must have been at its furthest when the basalts of the Brothers' Home were being poured out. Should the reference of the cement deposits to an old Mussel Roe River bed be correct, it is clear that the river valley would be the most favourable place for the accumulation of deep masses of gravel during the advance of the sea, hence it is somewhere under these marine gravels that we should look for the ancient river deposits. The theory has enough plausibility in it at any rate to be worth testing by borings, though these would be difficult of execution on account of the quicksands.

The deep ground between the Pig-and-Whistle Creek and the Aberfoyle would, probably, be the lower part of the old Mussel Roe Valley, but mostly filled with marine gravels. The old river channel, with its probably richer gravels, is, most likely, covered to a very considerable depth. The shafts sunk in this part of the district have nearly all gone through a succession of fine quartz gravel and sand beds poor in tin. If my theory of these being the ancient river gravels, washed over and over again by marine action, is correct, very little tin could be expected in them until the deeper unmoved river deposits are reached. These, also, it might be presumed, would not be so rich as higher up in the leads nearer to the granite formation. Beyond noting the ferruginous clayey sands found in the northern extension of the Mount Cameron water-race as of probable estuarine or lagoon formation, as above mentioned, I have not been able to get much evidence about the deep ground in this lower part of the old valley. The Lochaber workings possibly belong to this formation. The upper beds are very like those of the Tamar, and the bottom appears to be getting deeper towards the north west, thus sloping towards the main area of deep ground. The following section was noted in these workings :—

	feet.
Soil and cemented gravel	2
Sand, very fine gravel, and clay	15
Rather fine quartz gravel	10
Coarse angular sandstone and quartz stones and gravel	5
Brown cemented fine gravel	10
Bottom of Silurian slate.	

These workings have produced very fair tin, mostly from the heavier lower wash. This often contains somewhat large quartz boulders and pieces of waterworn quartz porphyry. The upper beds are in horizontal layers. The pebbles are mostly of quartz, but some of Silurian sandstones and of quartzite. Black quartz crystals are not uncommon. As these workings lie very low down, the outlet of the tail-race being not more than, perhaps, fifteen feet above the Ringarooma River, it seems possible that they are approaching much nearer to the old lead, which may account for their much greater richness in tin as compared with the higher Tamar and Garfield gravels. I am inclined to refer the Lochaber deposits, however, rather to the marine series than to the true river gravels of the old lead.

If the sea had once covered all the Gladstone district to a height above the Esk dam, as assumed in the foregoing, it would, probably, have left traces of its presence in other parts than those mentioned. It may be said at once that no shells or purely marine organisms have been found to clearly prove the former presence of the sea, but when we consider that most of the deposits preserved were originally shifting sands and gravels, and that these are generally very poor in organic remains, and that only small patches of the marine beds have yet been laid open to view, it is not at all surprising that shells have not been found. Other evidence is, nevertheless, available. This is best obtained in the terraces on the north slope of Mount Cameron. These are completely cut off from the Ringarooma Valley by high spurs of granite running down from the mountain, so that they cannot have been laid down by the river even when at a much higher level. The Mount Cameron Company's claim, and those of Mr. L. Petersen, afford information as to these terraces. The longest and largest one is that in which Petersen's principal workings are situated. It extends right along the foot of Mount Cameron for over two miles, about parallel to the range, and may be located on the map of the district by the water-races running along it. The top of this terrace preserves a pretty uniform level of about 90 feet above the township of Gladstone. There are, however, remains of two still higher terraces—one near the middle of Section 916, 130 feet above Gladstone, and the other, a small patch only, about six chains S. 5° W. from Wilson and Petersen's old dam (W.R., 45), 190 feet above Gladstone. As the township is about 270 feet above the sea, gravels are, therefore, found on the slopes of Mount Cameron to a height of 460 feet. The character of the terrace gravel is considerably different from that of the modern river gravel, and would itself indicate a marine origin as more probable than a fluviatile one. The pebbles consist mostly of hard quartz, thoroughly rounded and polished by long continued attrition, and generally rather egg-shaped than in the flattened disks most common in river gravels. Besides the quartz there is often in some of the terraces a considerable amount of quartzite derived from the old Archæan rocks, which is a very ancient metamorphic sandstone now often sub-transparent, but still showing the constituent grains and stratification planes. Wherever this is found it is most thoroughly waterworn. It is a very hard stone, and must have required an immense amount of rolling about to wear it into the shapes found. This rock does not occur in the newer river gravels, except in very small quantity, and even when it is found it is so much more thoroughly polished than the rest of the gravel that it is plainly derived from older gravels which have been washed down into the river bed. The successive terraces from the highest down to the present river level are characterised by a marked diminution going downwards of the percentage of quartzite in the gravels. The highest terraces contain the largest proportion of it, and the least of gravel such as is now being brought down by the river. As it does not appear to be brought down at the present time by the Ringarooma, it is improbable that the quartzite occurs *in situ* anywhere up its valley, and if so the occurrence of it in the higher terraces must be attributed to some other source than the river. Exactly similar quartzite is found in the old gravel deposits which are met with at intervals along the road from Scottsdale to Moorina, in some also near Lilydale, and on the top of the Sandhill, near Launceston. All these old gravels doubtless are remains from the time when the land was much lower, and the sea beach reached to points now far inland. The quartzite pebbles have been derived from the Archæan conglomerates and quartzites found at places along the north coast of the Island, and spread all along the beaches by the action of the waves.

It is noteworthy that the beach terraces on the north slope of Mount Cameron are much more free from these pebbles than the other high marine terraces up the Ringarooma Valley. This is most likely due to the high granite spurs which separate these localities. These spurs would form capes round which the drift beach gravel could not easily pass. Petersen's workings show the wash of the North Mount Cameron terraces to be composed almost entirely of *débris* from the granite of the mountain, fine quartz gravel and sand, coarse heavy lumps of vein quartz, and crystals of black quartz. The heavy gravel on the granite bottom is often not much waterworn, while the higher lighter gravels show extreme attrition. As there are no large streams on the north slope of the mountain to round these gravels, we must conclude that their shape is due to ceaseless washing backwards and forwards on the sea beach. The beds of gravel lie fairly horizontal, but generally slope slightly seaward. The granite bottom confirms the view of the beach formation of these terraces, being uneven but not furrowed into regular gutters as when cut out by running streams, and sloping gently seaward. The bottom when stripped shows much the appearance presented by a flat granitic beach of the present day. The distribution of the tin ore is in accordance with this theory, being in flat layers through the drift, and not concentrated in the furrows of the bottom; indeed, these have been found to be so generally poor that they are often not cleaned out in working. The beach being a natural buddle has served to concentrate the tin ore just as black iron sand is often seen concentrated on our coasts at the present time, and the layers of ore thus formed have become covered with further deposits of gravel, and so preserved. A very similar occurrence is seen in the black sand beach-leads of the West Coast of New Zealand, where layers of black iron sand containing gold are worked in what is without any doubt an old beach formation, and on the beach at Charleston and elsewhere "beach-combers" make a living by working similar beds forming at the present day.

Taking a line northward from Petersen's main workings it is found that a succession of terraces parallel to the large one, and at successively lower levels, extend seaward for some distance. Between each terrace and the next lower one the granite bottom often crops out. Some of the layers of gravel are very shallow, and none seem to be very deep. These terraces represent successive stages in the retrogression of the sea-shore.

I have dwelt at length on the facts which prove that the sea was at one time washing the flanks of Mount Cameron and extending far up the Ringarooma Valley, because this is the key to the problem of the manner of formation of all the terrace gravels right up the latter. It is easy now to understand that as the land rose and the sea receded terrace after terrace of gravel was left behind. These have since been so cut away by the water running over the surface that only fragments of them now remain. The highest terraces were probably of purely beach formation, but as the sea retired the waters of the Ringarooma began to carve into the ground, and the lower terraces are in most instances of river origin. As above pointed out, the percentage of quartzite in the gravel gives a clue to its origin, whether beach or river.

In consequence of their mode of deposition we should expect to find somewhat similar gravels at the same elevation above sea level. I append a table of heights of various points in the district noted by me with an aneroid barometer, which shows approximately which deposits are at or about one level. The newer river terraces can of course only be correlated by taking the fall of the river into account as well as the absolute elevation. As a matter of fact the various gravel deposits do agree with considerable exactness with those at corresponding levels elsewhere through the district, thus substantiating the theory of their formation above advanced. We may now classify the gravels as follows :—

(I.) *Palæogene.*—A. *Older River Gravels,* including cements of Edina, Sugarloaf, and Brown Hills.

B. *Newer Marine Deposits*—Tamar, Garfield, and Lochaber claims.

(II.) *Neogene.*—A. *Older Beach Gravels*—Petersen's terrace, Mount Cameron Company's terrace. Colossus terrace, Enterprise terrace.

B. *Mixed Beach and River Gravels*—Scotia, Aberfoyle, and Gladstone terraces.

C. *River Gravels*—Simpson's terraces at South Mount Cameron, lowest terraces in the neighbourhood of the Ringarooma River.

1. *Palæogene*—A *and* B, *Older and Newer River and Marine Gravels.*—These already have been considered at length, and need not be now reverted to. They are the filling of the old Mussel Roe lead as first laid down by the river and afterwards by the sea. One point of some importance has not yet been mentioned, namely, that boulders of the cement or conglomerate frequently occur in the later gravels of the Neogene period, showing that the old wash had been already hardened and subjected to erosion when the latter were being laid down. The much greater antiquity of the cement is, therefore, evident. I have observed boulders of the old cement in some workings up Smith's Creek at South Mount Cameron, some distance above Mr. John Simpson's house, in J. W. Brown's old workings near Ogilvie's Bridge, in Ogilvie's Edina claim, in the Scotia Company's workings, and in Nobes's claim at the Aberfoyle, and was informed that it was frequently met with in other claims. In these workings it is a very hard conglomerate, composed of small rounded quartz pebbles, cemented by a siliceous cement into a very solid stone, which rings when struck, and breaks with a flinty fracture. In Brown's and the Edina claims it is found in large tabular masses, sometimes five or six feet square and one to two feet thick, resting loosely on the granite bedrock, but surrounded and sometimes underlaid by the gravel. Most of these large tables are smooth and polished on the upper surface, and have been considerably worn there by water. The polished surfaces appear to have received more of the siliceous cementing material than the rest of the mass, and often there is a sort of thin transparent siliceous skin or gloss on the surface. The appearance is such as would result from the passage of a solution carrying dissolved silica over fine quartz gravel, loose or somewhat cemented. The solution would at first penetrate freely into the porous stone, and so cement the particles strongly together, but as, owing to this action, the mass would become denser, and less easily penetrated, after a time only the surface layers would be permeated by the solution, and finally it would flow over the surface without going into the now hard rock at all. It is difficult to imagine how these large flat angular blocks of conglomerate could have been moved far from where they were formed, and I incline to the opinion that near Ogilvie's Bridge they are almost *in situ*, and are fragments showing that the old cement formation was once much more extensive. In the Scotia claim the pieces seen were much waterworn, and had probably been transported a long way from their original position.

II. *Neogene*—A. *Older Beach Gravels, Mount Cameron Company's Section, No.* 100.—On this ground a considerable patch of wash belonging to the older beach gravels has been worked out with payable results. It formed a shallow capping, not probably more than 10 feet deep anywhere, on the top of a ridge between the Fly-by-Night Creek and a small branch of the Mount Cameron Creek. The bottom is of slate, much decomposed to clay in the upper portions. Tin ore was often found in these upper clays, evidently having sunk down slowly into them, just as gold has often been found in the pipeclay (decomposed slate) bottom of many Victorian gravel deposits. All the tin ore obtained in this claim was extremely waterworn. The slate bottom is rather uneven, but flattish on the whole, and shows no true gutters eroded by running water. The wash lies in horizontal layers, and is composed of somewhat angular and sub-angular pieces of quartz and Silurian sandstone, with some well-rounded pebbles of quartz and quartzite. There are also occasionally rounded boulders of a brecciated rock, consisting of angular fragments of Silurian bedrock, cemented by black and white chalcedonic quartz. This may perhaps be of contemporaneous origin with the conglomerates of the Edina workings. On the whole the heavier material of this terrace appears to have been derived chiefly from the bedrock upon which the gravel rests, and not to have travelled very far. A good deal of coarse sand and fine gravel occurs enclosing the heavier stuff. The deposit is covered with a somewhat ferruginous hard cement which has protected it very much from erosion. Below the principal workings in the small creek the bedrock changes to granite, and at the contact of this with the sandstone and slate formation there is a small lode of silicified granitic matter, about three feet wide. Stones from this or a similar lode are found at times among the wash. It may be mentioned that the gravels of this claim contained a good deal of gold, as well as tin ore. The main body of gravel has all been worked over, and at the time of my visit the only mining going on was being done by Chinese, who were stripping the surface soil and putting it through sluices. Under this soil patches of cement were occasionally visible, and there is a possibility that on breaking through some of these some heavier gravel left in depressions of the bedrock may be found, though there does not seem to be much hope of getting any extensive patches.

At the easternmost corner of this section, and on that known as the Fly-by-night claim (1130M) adjacent to it, there is rather a thick deposit of hard ferruginous cemented sand and fine gravel, from two to four feet thick. Some of it is very black, as if originally formed in a swamp or lagoon. Under it lies a little quartz wash containing tin. The cement itself contains tin, but would require crushing, as it is too hard to be broken up in the sluices. Several small holes have been sunk through the cement here and there, and one considerable excavation has been made, but it has not been considered worth working. It is probable that if a series of trenches were run through the cement several underlying patches of gravel would be discovered.

Petersen's Claim (Section 823).—A very large excavation has here been made in a part of the long beach terrace formerly mentioned. The bedrock is granite, lying pretty flat, but with a slight slope seawards. The wash is mostly well water-worn small quartz gravel, with coarser subangular pieces of quartz on the bottom, all evidently derived from granite rock. The following section of one of the faces was noted :—

Fine gravel, somewhat cemented with clayey and ferruginous matter...	7 feet
Fine quartz gravel, a little cemented, white in colour, showing false bedding.....	5 feet
White clayey sand.....	½ foot
Wash in nearly horizontal layers of fine and somewhat coarse quartz gravel.....	12 feet
Heavy subangular quartz stones.....	½ foot
Granite bottom.	

This has the reputation of having been a very profitable claim, and the large extent of the workings all made by one man pretty conclusively prove that such has been the case. Tin is easily seen in many places in the wash. Lying rather high up on the mountain there is difficulty in getting constant supplies of water for working. Could a copious and never-failing supply of water at high pressure be brought on to this ground it ought to pay remarkably well. This claim may be taken as proving the general value of the long terrace lying to the westward from it, on which very little work has been done for want of water. Several test shafts have been sunk at intervals along this terrace, and very satisfactory proof obtained of there being both quantity and quality of tin-bearing gravel.

The higher terraces above mentioned are of small extent, but are said to be worth working when water can be obtained for them, which is but very seldom.

The lower terraces running parallel to the main one are of considerable extent, and some work has been done on parts of them with fairly payable results. A considerable excavation has been made on the boundary between Sections 1047M and 2286–87M, about 2½ chains south-east from the westernmost corner of the former. The face presents the following section :—

	Feet	inches.
Surface soil and white sand like sea sand.....	1	6
Ferruginous and clayey cemented coarse quartz sand.....	4	0
Tough white clay with much sand in it.....	4	0
Wash, quartz gravel with good tin, finer towards the top, coarser towards the bottom of the layer.....	1	6
False bottom of clayey sand, which changes to gravel in parts of the same horizontal layer.....	1	0
Layers of finer and coarser quartz gravel with a little sandstone, and lenticular clayey sand patches.....	8	0
Granite bottom.		

In this opening a junction of the granite and Silurian formations is seen, the latter slightly overlying the former. Very fair tin has been obtained, and there appears to be a large quantity of gravel ahead to be mined.

It appears to me that these beach terraces along the north slope of Mount Cameron are among the most important gravels in the district. There is a large extent of unworked ground which has given good prospects, and when water can be got a large amount of tin ore will probably be obtained. The obstacle which has prevented their being worked is that all the available water supplies have been secured by the Mount Cameron Company, the owners of the Fly-by-Night claim, Petersen, and one or two others, who require all that they can get for their own claims.

Enterprise Claim (Section 128.)—A shallow patch of ancient wash forms the top of a flat-rounded small hill on this section. The workings cover a large area, but are of small depth. The wash is composed of well rounded gravel, mostly quartz, but also in part quartzite. The bottom rock is granite. On the top of the hill I did not see the bottom, and am not certain if the workings have reached the bedrock. There appears to be a considerable amount of gravel yet to be worked, but the top ground being very high there is difficulty in getting water on to it. The claim has been very rich in the past.

Colossus Claim, South Mount Cameron.—I am inclined to class the gravels of this claim with the beach deposits on account of their occurring in a large flat even layer rather than in leads or channels, and from the gravel being mostly composed of very well-rounded quartz pebbles with only a few of hard sandstone. The same sort of gravel is found at intervals along the road from South Mount Cameron to Gladstone at much the same height as the Colossus terrace, so that the deposit must have covered a very considerable area. The Colossus Company have opened several excavations in the gravel, working it by means of water pumped from the Ringarooma River. I do not think that the ground will pay for mining so long as water has to be thus so expensively obtained. The results of working up to date are not encouraging. Owing to the flatness of the bedrock on which the gravel rests, difficulty will be experienced in getting in tail-races as the work of stripping proceeds.

B. *Mixed Beach and River Gravels.*—These deposits are characterised by containing a varying proportion of flattened shingle derived from the river, and were probably laid down on beaches in an estuary at the mouth of the river. They are intermediate between the purely beach deposits and the true river terraces. The majority of the gravels close to Gladstone township belong to this class. They lie in fairly horizontal layers on comparatively flat but uneven bottoms, which do not, as a rule, show well defined stream channels, and which, therefore, appear more likely to have been cut into their shape by marine than by river action. A section from the township of Gladstone to Bell's Bridge would show a succession of steplike layers or terraces of gravel with the bedrock cropping out between each pair. None of the layers

of gravel appear to be very deep, ranging from three or four feet up to ten or twelve feet on an average, though sometimes as deep as thirty feet. A well in the yard of the *Gladstone Hotel* is said to have gone through thirty feet of wash. None of the highest gravels appear to have been thought worth working, though numerous prospect holes have been sunk. These top terraces are largely composed of small well-rounded quartz and quartzite pebbles, with a good deal of clay and sand. The highest workings close to the township are those on Butler's section, on the slope towards the Mount Cameron Creek. At the time of my visit a start had been made here, and an excavation about 12 feet deep worked out. There was a good deal of coarse gravel in the face, covered by a layer of finer gravel mixed with clay. The first clean-up was disappointing, not being payable. Whether the ground will improve remains to be seen.

The next terrace that has been worked is what is known as the Syndicate's claim, belonging to Messrs. Carlinn, M'Kimmie, and Matthewson. Here a great deal of work has been done with, I understand, payable results. The wash has been of an average depth of from 10 to 15 feet, the bottom being very uneven. There is a top layer from 2 to 3 feet thick of ferruginous cement, composed of fine quartz gravel well rounded. Below this comes the wash consisting of layers of finer and coarser well rounded quartz, quartzites, and jasper gravel. In the bottom layer there is a good deal of broken Silurian bedrock, and sub-angular quartz. The next terrace below the Syndicate's claim is that in which the workings of E. R. Groves, T. Morrissey, and Jas. Ogilvie (now, however, part of the Syndicate's claim) are situated. There are considerable depths of gravel in this terrace, which has proved to carry tin rather unevenly, some of the workings being payable and others poor. There is yet much untried ground in this terrace, and it will, no doubt, all be worked in time. Ogilvie's face is about 18 feet deep. There is a top layer of three feet of brown quartz-grit cement, then a succession of layers of finer and coarser gravels lying fairly horizontal. Quartz and quartzite make up the bulk of the pebbles in the upper drift, but near the bottom there is a good deal of rounded and sub-angular Silurian fragments from the bedrock and quartz from the veins in it.

On the Mussel Roe Road, north of Ogilvie's Bridge, there are two large terrace-workings, executed by C. A. Ogilvie and J. W. Brown respectively. A little to the north of Ogilvie's workings there are some gravels seen on the roadside that may belong to the older and higher Enterprise terrace. In Ogilvie's workings the wash averages about 10 feet in depth, and is overlaid by from 4 to 6 feet of sandy clay. It consists of thinnish horizontal layers of quarts, quartzite, and metamorphic slate and sandstone gravel of rather small size interspersed with granitic grit or coarse sand. The deepest part of the ground is furthest away from the outlet, and a new tailrace has had to be brought in in order to get fall to work with. This deposit is reported to have given payable returns, and extends over a large area, so that there will be work for a long time in sluicing it away. It may possibly be connected directly with the Enterprise gravels, though I believe it is a lower terrace.

The granite bedrock crops out between these workings of Ogilvie's and J. W. Brown's, which latter lie just north of Ogilvie's Bridge. The cutting is from 30 to 40 feet deep in the deepest parts. The wash is coarser than in Ogilvie's face, and the river gravels predominate over the beach quartz and quartzites. Indeed, this deposit might be as well classed with the river gravels proper as with the present division. The large blocks of cement found here have been already mentioned. These workings have been abandoned and the ground given up, so it may be presumed that it was unprofitable. This is unfortunate, as there is still a large quantity of gravel in this terrace if it could be made to pay.

Lower down the river, and on the east side of it, is James Ogilvie's Edina claim (section 1251M). Both in height and in the character of the gravels in it, this corresponds very well with the terrace worked by C. Ogilvie above described.

Mention should not be omitted of the old Empress claim in the list of gravels of this division. The workings are situated on sections 677 and 164, and run nearly due north across a ridge separating Harden's Ravine from the low country east of Bell's Bridge. Forming a gulch as they do at right angles to the course of the spur, they afford a striking example of the difference in the course of the present and ancient streams. The gravels were laid down in a saddle between two granite hills, and have been cut away on each side by the modern watercourses, until only a small portion is left as a ridge filling the old saddle. There is said to have been a sort of channel or gutter along which the workings were carried, but it must have been quite a shallow one, for the gutter now seen has evidently been cut out by sluicing, and the beds of wash run off nearly horizontally in layers on each side. A cross-section of the workings is given to show this. On the west side the surface shows gravel for about 10 or 12 chains, right to the old fluming on the top of the hill from which the pipes for the Tamar workings were led. On the east side the granite crops out about 4 chains from the cutting. It appears to me that this ground has been abandoned too soon: for though the bottom doubtless rises on both sides, on the western side there is room for other gutters like the one worked, and the total quantity of gravel left untouched must still be very large. It may have been prospected, but I saw no traces of the pits if there were any. The wash is in horizontal layers; the heavy rich gravel having been in the shallow channel aforesaid. That which now composes the walls of the cutting is nearly all fine gravel and coarse granitic sand. The gravel is well-rounded quartz for the most part, and the sand shows false-bedding frequently.

The claims on the Scotia terrace also appear to have been formed by the joint action of sea and river rather than by either separately. The gravel is composed of about equal proportions of quartz, quartzite, and Silurian sandstone, all much rounded. The workings average 10 to 15 feet in depth. On the bottom (Silurian) there is coarse gravel with a good deal of subangular quartz. The bedrock bottom runs very flat and without definite water channels, and slopes gently to the north-west. The wash is overlaid by 4 feet of sandy clay and 2 feet of surface cement. The Scotia Company and J. W. Brown have opened six faces in this terrace with payable results. The terrace is very extensive, and should give work for many years to come. The flatness of the bottom and consequent trouble in getting fall for the tail-races is the principal drawback to future success.

Further down the river we come to the sections held by the Aberfoyle Company, Messrs. G. B. B. Elliott, Nobes, and others, on an extensive area of gravel generally spoken of as the Aberfoyle country. The bedrock here is granite. The wash is, as a rule, much smaller than at the Scotia, but otherwise very similar, and has decidedly more the appearance of beach gravel than of river. Most likely these deposits were laid down at the mouth of the river where it debouched upon a wide flat beach. They are generally not very deep where opened by working. The tin obtained in this part of the district has been very patchy, and on the whole the ground does not appear to be very rich, though good enough to ensure being worked. Like all alluvial ground where there is large quantity of somewhat poor gravel, this should be worked with a copious supply of water so as to move the stuff rapidly. There appears to be a disposition on the part of owners to economise by using little water and that of low pressure, but all sluicing experience has gone to show that this is false economy, and that it pays to use much water and the greatest available pressure, even though the first cost of pipes to bring in a high pressure supply is very considerable. Another direction in which it appears to me that much money and labour are lost is in the bad location of tail-races. All over the field numbers of expensive tail-races are seen, now out of use, and superseded by others still more expensive. Numbers of pits should be sunk all over the ground to be worked so as to ascertain the shape of the bottom, and the trail-races should be designed in the first instance to command the whole of the deposit, either from the first, or with comparatively small expense from time to time in deepening them. At present they seem to be taken in, in a very happy-go-lucky style, without any system.

The workings on Nobes's Section, at the Aberfoyle, show a very interesting section, which, as work proceeds, will very likely throw much light upon the subject of the old Palæogene deep ground. A tail-race has been constructed running north-west from a swampy river flat, evidently an old angle of the Ringarooma River, about east from the Brown Hill. The race passes through sandy clay containing numerous rounded large boulders of the Palæogene quartz-conglomerate, on one of which I noticed very faint leaf markings, not recognisable as to species. Higher up the race a black stiff clay is encountered, coloured with carbonaceous matter, but not yielding me any leaves. The cement boulders seem to be in the bottom layers of this clay and below them. Some are very large and heavy. The clay forms a false bottom on which the superincumbent gravels are being worked. These are nearly horizontally bedded, but have a slight dip south-east or away from the Brown Hill. The section seen in the face was the following:—

	feet	inches.
Surface soil	0	6
Layers of gravel, clay, and sand, but mostly sandy clay	10	0
Coarser gravel	0	6
Coarse sand with some clay	4	0
Coarse gravel and sand	2	6
Fine sand, much false-bedded, with occasional layers of wash	10	0
Black stiff clay false-bottom.		

A party of Chinese were working this at the time of my visit, and had just had a payable clean-up of their sluice. The conglomerate boulders belong to the same formation as the Brown Hill and the cements near Matthewson's Lagoon.

C. *River Gravels.*—These are characterised by the predominance of river shingle, consisting of flattened pieces of Silurian slates and sandstones. The quartz in them is generally sub-angular. Rounded quartzite pebbles are of rare occurrence. No hard-and-fast line can be drawn between these and the last division, some of the lower gravels of the latter and higher of this being very similar, the Mary claim, for example, being very like parts of Groves and Morrissey's terrace in character of gravel. These deposits were laid down in the bed of the river when it flowed at a somewhat higher level than now.

Near Gladstone the claims belonging to this class all lie on the east side of the river, with the exception of Mr. James Ogilvie's workings, which are in flat ground close to the river, and practically in part of its present channel. The terraces on sections held by F. Whitaker, east of Bell's Bridge, the Mary claim, Bromby and Dickenson's section, and Rushton and M'Kimmie's claim, near the Scotia ground, are all composed of river gravels. The Mary claim has been a very good one, and is still getting good tin. In the old workings there appears to have been difficulty in getting the tail-races low enough to work the back parts of the terrace. Rushton and M'Kimmie also appear to have a good claim. Besides their workings on the terrace they have opened up one of the river flats, but could not get drainage without using a hydraulic elevator. At South Mount Cameron the terraces worked so successfully by Mr. John Simpson near Smith's Creek, and the Red, White, and Blue claim, on the other side of the Ringarooma, are also river wash.

Two attempts have been made to work the gravels lying alongside the present river and under flood level, the most enterprising being that of the Long Reach Dredging and Tin Mining Syndicate at South Mount Cameron. This Company, at large expense, erected at their claim a Priestman dredge for raising the gravel. The plant was at first encumbered with a number of elevators and appliances of one sort and another, which were thrown out when the machinery got to practical work. Without going into details the following general description of the plant will be of interest as showing what can be done by this method of working. Two large punts were built, one of which carried the engine and crane of the Priestman dredge, and the other the trommels for separating out the coarse stones, the sluice-boxes for washing the finer stuff, and a Robey portable 12 h.p. engine, which drove the trommels and worked a centrifugal pump which raised the water required for washing the gravel. The engine for the Priestman dredge was of eight horse power. The grabs were made with teeth which fitted closely together when closed, with alternating pick and chisel points. The punts were moored to stumps of trees on the bank, and could be easily moved by hauling on the wire rope moorings into any desired position. The material raised by the grabs was dropped into a hopper, and thence into the trommel, into which also was discharged the water from the centrifugal pump. The trommel had holes $\frac{3}{4}$-inches in diameter, and was set on an inclination of one in nine when working, the punt being ballasted so that it would remain level when the hopper was full of material. The fine gravel passing through the trommel passed over sluice-boxes or ties, where it was raked by a workman, and thence by a swinging launder into the tail-race on the bank, and so into the river.

The heavy stones from the trommel discharged themselves into trucks, and were run into the river by manual labour. During the four months that the dredge was at work an excavation was made into the flat alluvial deposit forming the bank of the river about 250 feet long, 50 feet wide, and 15 feet deep, nearly 7000 cubic yards of material being handled, thus averaging about 70 cubic yards per day. Mr. Bewley, who was in charge of the operations, estimated the performance at 100 tons a day, or 600 tons a week, which agrees closely with the above estimate, a cubic yard weighing about a ton and a half. The cost per week for working expenses was £25, or tenpence per ton. Heavy trees and stumps in the surface soil added greatly to the expense. Under favourable conditions the expense might be reduced to sixpence a ton, but I do not think that any lower estimate could safely be made of the probable expense of this method of working in any of the tin districts of this Colony. The first cost of the plant is heavy, and though it works very efficiently and treats a large quantity of material, I feel pretty sure that the expense of running it is too great to make it profitable under any ordinary circumstances. A machine that will handle quantities of gravel at a cost not exceeding 1½*d.* to 2*d.* a yard is what is required for most tin-bearing gravels. The Dredging Company were particularly unfortunate, only obtaining about a ton of tin ore all the time. This, probably, is not a fair sample of the wash obtainable in the river bed: it is more likely that they were unlucky enough to begin work in a particularly poor place. It may be mentioned that there was some gold in the tin ore obtained, but I did not learn how much. The plant is now being dismantled and sold off.

The other attempt to work the river flats is being made by Mr. Jas. Ogilvie, with a hydraulic elevator of very primitive construction. The upraise pipe in use was simply ordinary thin galvanised iron tubing, and for a throat-piece a bit of cast-iron water-pipe was being used. The material was being raised 12 feet vertically by means of a pressure of 150 feet of water, brought across the river in pipes from the Mount Cameron Water-race. About three heads of water were being used for elevating, and two heads for sluicing. With the head available, not nearly so much water would be required for the elevator if it were of good construction. Mr. Ogilvie is to be congratulated on his enterprise in trying this method of working, which is one new to the district, though long in successful use in New Zealand and California. The hydraulic elevators are without doubt the most suitable machines for working the low-lying gravels by the side of the river, and the bed of the stream itself when the water is diverted by wing-dams, or taken away in flumes. A great deal of the difficulty experienced in the higher terraces also in getting rid of the tailings could be obviated by their use to elevate the gravel a few feet so as to permit it to be sluiced back into old workings. The tail-races would then only require to have enough fall to carry the finer tailings and waste water. There is not much printed information available as to the working of these machines, so I have collected as much as seemed desirable, and append it to this Report.

Water Supply.—The prosperity of every alluvial mining district depends more than anything upon the sufficiency or otherwise of the supply of water for sluicing purposes. The country round Gladstone is not well situated for being easily supplied with water, the only really high ground in the vicinity being the Mount Cameron Range, which, however, is not of sufficient extent to furnish constant streams of water. Between Mount Cameron and the Blue Tier, where never-failing supplies might be got, there is much low country, so low as to necessitate either very long lines of pipes or very high flumes in order that water might be brought over it to command the higher gravels. By the construction of the Mount Cameron Water-race the eastern side of the Ringarooma River has become possessed of a good supply of water, though even this race does not command the high deep ground near the old Garfield claim. On the Gladstone side of the river the owners of claims have still to be contented with the intermittent supplies available from storm waters which are not nearly enough for requirements, or with the water raised from the Ringarooma River by the Esk Company. Every small depression of the ground where a little rain-water can be caught and stored, and every little streamlet has therefore been secured by one or another claim-holder, and in wet weather a good deal of work goes on with this water. The disadvantages of this way of working with very small streams of water and much manual labour are very obvious when compared with the hydraulic method, and the only compensating advantage is that the water is cheap. In most cases, however, a steady supply of water of fairly high pressure would give the owner more profit, even if he had to buy it, than this intermittent working can. In order to get constant supplies of water various pumping plants have been at one time and another erected to force it from the Ringarooma River up to the claims. The Tamar and Scotia plants have been dismantled, and the only ones now at work are those belonging to the Esk and Colossus companies. The Esk machinery is very ingenious, the river being utilised to drive the pumps. A dam about 29 feet high has been put across the stream, acting as a weir in flood-time, and at ordinary times diverting part of the whole of the river into a flume which carries the water on to an overshot water-wheel, 20 feet in diameter, and with 18 feet of breast, said to be able to develop 97 horse-power. The wheel works reciprocating horizontal plungers twenty inches in diameter and with a stroke of 8 feet. These are fed with water directly from the flume overhead. A balance-bob is provided for overcoming the dead point in the revolution of the crank working the plungers. The plant labours under the serious disadvantage that it is liable to be submerged by floods, and even when there is only a heavy fresh in the river the disturbed water below the weir partly chokes the free working of the wheel. Water is forced to the Eureka and Esk dams on the eastern side of the river, and to a point on much the same level as the Eureka dam on the Gladstone side. Water raised by this plant is also brought across the Ringarooma from the eastern side by a line of pipes on a rough suspension bridge to the Syndicate's claim. The cost of working the machinery is about £30 a month, without counting cost of repairs of damage done by floods. All the claims near Gladstone township are now supplied with this water, which is sold for 18*s.* a sluice-head. In one case I noticed a piece of very bad policy. In order to save pipes the water was allowed to run downhill in a rough race a vertical distance of between 60 and 70 feet before being taken into pipes and led to the working face. The party were working with about 30 feet of head when they might have had 100. The difference in quantity of work done by the latter head would very soon pay for the pipes, especially as the gravel was somewhat clayey and hard to break down.

It has been proposed to bring a branch of the Mount Cameron Race across to the Gladstone side to serve the claims there. The branch would leave the main race at a point to the south-east of the Edina Sugarloaf, bend round the south side of the latter, and be carried by a siphon across the Ringarooma Valley, then round the shoulder of Ogilvie's Sugarloaf, and so to Gladstone, the total length being a little over five miles. The cost of a race to carry 20 sluice-heads of water is estimated at under £4000. There is no doubt but that such a race would be a great boon to the district. The end of the race at Gladstone is well above all the payable gravels, and it would command the whole of the ground between the township and the Ringarooma at Bell's Bridge. Here there is still more ground to work than has yet been taken out, and, worked vigorously with all the available water, there is probably at least three years' constant work. The principal other tin-bearing ground commanded would be the large terraces near Ogilvie's Bridge, worked by Ogilvie and Brown. The Enterprise terrace is, unfortunately, too high to be reached. On the two terraces there is work for the whole of the water for quite three years, as far as I can judge without actual measurement. There is thus work in sight for the water to be brought across for at least six years, in which time the race ought to have paid for itself, and given a fair interest as well. By the end of that period it is probable that the extensions of the workings on the east side of the river would require all the water that the main race is able to supply. In bringing this branch race over to Gladstone, the Government would, of course, be entering into competition with the Esk ~~Company, who are~~ now supplying most of the claims; (not, however, those near Ogilvie's Bridge.) It is not my province to enter into the question of the desirability of the State pursuing such a policy; but, leaving the Esk Company's claims to consideration out of account, there is no doubt in my mind as to the expediency of the work.

Another plan for supplying the Gladstone claims with water has been often suggested, and is worth consideration. It would have the great advantage of being a high level supply, and commanding the terraces on the north slope of Mount Cameron, which cannot be reached by either the Esk water or that of the Government race. On the other hand, there is great doubt as to whether a constant supply could be maintained all the year round. This scheme is to construct a large dam in the Deep Valley, at the head of Campbell's Creek. This valley lies pretty flat, and receives the drainage from the ridges all round, the catchment being about a square mile or rather more. It seems possible to construct a very large reservoir here with comparatively small expense, the sides of the valley coming together towards the outlet. The bottom is solid granite, which would afford an excellent foundation, and material for the dam could be cheaply got from the steep mountain sides. I have not been able to get any records of the rainfall at Gladstone, but that at Boobyalla is recorded in the Official Meteorological Reports. In 1888 there were 88 wet days, and a total rainfall of 19·86 inches. The maximum fall in any one month was in June, 4·23 inches; and the minimum in March, 0·10 inches. In 1889 there were 103 wet days, and a total rainfall of 36·04 inches, the maximum monthly fall being 10·39 inches, in November, and the minimum 0·67 inches, in February. The rainfall on the top of Mount Cameron is greater than at Boobyalla, but these figures will serve as some guide as to the quantity that could be collected. The average rainfall per square mile is 680,000 cubic feet, or 19 sluice-heads per day of 24 hours for each of the 191 wet days in the two years. If every drop of water were conserved this would only give a daily supply of five sluice-heads (equal to 15 sluice-heads for the working day of eight hours). The dam would have to be large enough to store the entire rainfall of any one month, and would be better to be able to take three months' rainfall. This might be taken at a maximum of 15 inches, which would require for the dam a capacity of 34,848,000 cubic feet, or 217,295,000 gallons. I doubt very much if this size of dam could be made without unreasonable expense, even though the ground is so very favourable for storage of water. A tolerably accurate survey would be required to test the possibility of this scheme. There is no doubt that a large reservoir in the Deep Valley would furnish a very good supply of water during the wetter months, but I do not think it could be relied on for a constant one. It might perhaps give enough water to enable the high gravels to be worked, and for this alone it deserves to be critically considered.

Prospects of the District.—My examination of the District was too short to permit of making surveys to determine the relative amounts of worked and unworked gravels, but I have no hesitation in saying that there is still far more ground untouched than has yet been sluiced, and that there are many years' work in sight still. The terraces near Petersen's claim and in the vicinity of the Scotia have hardly been more than commenced upon, and the large area of gravel at the Aberfoyle is still practically untouched. The Lochaber claim is working into still deeper ground, and will take years to work out. When the shallower gravels are exhausted there is still the deep ground to fall back upon. The value of this is unproved as yet, but it is likely that parts of it at least will be worth working. Finally, the District is not done with as a producer of alluvial tin until the bed of the Ringarooma River itself has been worked out. Various trials have been made of this in various ways with results less encouraging than might have been expected, still there can be no doubt that the bed of a river like the Ringarooma, which passes through tin-bearing country all along its course, and receives innumerable creeks which have all borne tin, must contain large quantities of ore It is a large ground-sluice, and cannot fail to have much tin concentrated in it. I cannot believe but that systematic and well-directed work on it would be remunerative.

It is a matter of national importance to ascertain the course and value of the old Ringarooma and Mussel Roe leads. The experience of the mines at Branxholm, Brothers' Home, and Bradshaw's Creek has demonstrated that the Ringarooma lead is especially a most valuable one, and every effort should be made to trace it further, and test it by borings. This is work which requires money, and is beyond the means of local claim-holders, and I would therefore invite the attention of mining adventurers to it, with every confidence that they will find it an unusually promising and legitimate enterprise. The Mussel Roe lead is more problematical, but also deserves attention. I would recommend that a more detailed geological survey of both these leads should be made, and that series of borings should be executed in places indicated by the survey as most likely to give reliable information as to the deposits. I am strongly of opinion that most valuable results would follow from such borings.

I have, &c.

The Secretary of Mines, Hobart. A. MONTGOMERY, *M.A., Geological Surveyor.*

TABLE of Approximate Heights above Sea-level of various points in the Gladstone District, determined by Aneroid Barometer.

(These heights are only rough approximations, and must not be relied on as accurate, having been taken with only one barometer, and during a period in which the barometer was very unsteady.)

	Feet.
Ogilvie's old dam, Deep Valley	679
Crossing of creek, Deep Valley, track to Sapphire Creek	612
Highest terrace gravels, near Wilson and Petersen's dam	460
Top of saddle, Mussel Roe Road, near Ogilvie's Sugar-loaf	450
Esk Company's dam	414
High gravel terrace, section 916, north of First Sugar-loaf	400
Top of Garfield terrace	396
Ridge of gravel between Eureka and Esk dams	387
Embankment of old Star dam	378
Petersen's terrace	364
Bottom of workings 6 chains south of Eureka dam	360
Top of old Tamar face	358
Top of old Enterprise workings	351
Gravel on road near dredging plant, South Mount Cameron	346
Top of Esk Company's pipes, Gladstone side of river	342
Eureka dam	338
Bridge on road at Old Star Creek	336
Top of ridge between Empress workings and Ringarooma River	333
Top of Edina Sugarloaf	329
Top of proposed Government siphon across Ringarooma River (Gladstone end)	328
End of proposed Government branch race	304
Terrace of gravel on road near Campbell's Creek	319
Top of Colossus terrace, South Mount Cameron	312
Bottom of Petersen's large excavation	310
Terrace of gravel on Dredging Company's section	308
Top of Pioneer Company's workings, Bradshaw's Creek	290
Top of C. A. Ogilvie's large excavation near Ogilvie's Bridge	288
Top of old Empress workings	279
Top of Mount Cameron Company's workings	279
Floor of *Gladstone Hotel*, Gladstone	270
Old shaft in deep ground, Upper Mussel Roe	266
Mallinson's workings on old Eureka claim	266
Terrace of gravel, Smith's Creek, South Mount Cameron	265
Top of spur between Mount Cameron and Fly-by-Night Creeks, on track	261
Gravel ridge, near Waterman's cottage, Scotia	257
Top of terrace, section 2286-87M, worked by Chinese and Petersen	256
Floor of Mr. John Simpson's house, South Mount Cameron	250
Top of Brown Hill, Aberfoyle	247
Bottom of C. A. Ogilvie's workings in creek near his house	245
Bottom gravels in Mount Cameron Company's workings	245
Top of Red, White, and Blue terrace, South Mount Cameron	245
Bottom of excavation, Ogilvie's Edina face	243
Outcrop of granite bedrock on road between C. A. Ogilvie's and J. W. Brown's workings	243
Intake of Scotia Branch, Mount Cameron Water-race	239
Top of Matthewson, Carlinn, and M'Kimmie's workings, 2195-87M	238
Bottom of workings, old Empress claim	234
Top of Scotia Company's gravels, near water-race	234
Bottom of cement layer, Fly-by-Night workings	234
Bridge over Smith's Creek, South Mount Cameron	234
General level of country westward of Lochaber claim	216
End of Mount Cameron Water-race, turn-off to lagoon	216
Ringarooma River, at outlet of Colossus tail-race	207
Top of Matthewson, Carlinn, and M'Kimmie's workings on 1282M	207
Top of Scotia Company's working face	198
Top of J. W. Brown's workings, near Ogilvie's Bridge	198
Top of Whitaker's workings, north-east of Bell's Bridge	198
Ringarooma River, at outlet of Simpson's tail-race, South Mt. Cameron	193
Top of old Martha workings	192
Top of Groves's workings, section 1188M	191
Top of Lochaber working face	189
Ringarooma River at Priestman Dredge, South Mount Cameron	187
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(These last two heights are not likely to be nearly correct, but are given for what they may be worth.)