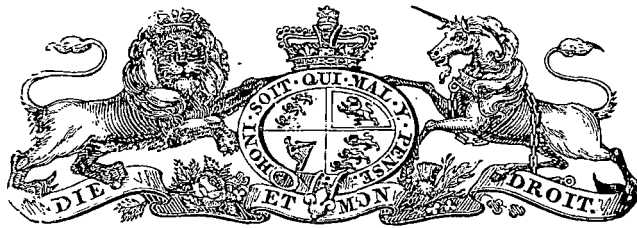


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REPORT ON THE DISCOVERIES OF TIN ORE  
ON THE BROOKSTEAD ESTATE :

BY A. MONTGOMERY, M.A., GEOLOGICAL SURVEYOR.

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Presented to both Houses of Parliament by His Excellency's Command.



## REPORT ON THE DISCOVERIES OF TIN ORE ON THE BROOKSTEAD ESTATE.

*Mines Office, Launceston, 18th November, 1892.*

SIR,

IN accordance with instructions, I made a short visit to the Brookstead Estate on the 6th and 7th of October last, and have now the honor to report on the occurrence of tin ore there. As only a very short time has elapsed since the tin-bearing lodes were found and a company formed to work them, very little work had been done; and I soon saw that it would be best to make only a preliminary general examination on this occasion, and to defer closer investigation to a future visit when the lodes shall have been better laid bare by trenches and mining works. The tin-bearing ground extends over some 6000 acres, and to examine it closely would require at least a month. The present Report, therefore, tells only of what was seen during a flying visit, and does not go into exact particulars of the position, size, and value of the various lodes.

### *Situation.—Access.*

The Brookstead Estate lies on the north bank of the St. Paul's River and to the south-east from St. Paul's Dome, and is distant from Avoca Railway Station by road about ten miles and a half. The road is a good one and nearly level, and access to the property is consequently very easy, the only obstacle liable to be encountered being the ford across the St. Paul's River from the road to the Brookstead homestead, which in wet weather is often impassable for vehicles: persons, however, can always cross even in floods, by means of a boat. Should the mines become of importance a bridge could be constructed without much difficulty or expense.

### *Geological Structure.*

The geological structure of the country to the southward of St. Paul's Dome is rather complex on account of the number of different formations represented. The top of the Dome is composed of diabase-greenstone, which also forms the Fingal Tier. Numerous dykes of this rock appear at intervals throughout the district, cutting through the older granite and Permo-carboniferous formations. Immediately beneath the greenstone on the slopes of St. Paul's Dome come the sandstones, mudstones, and conglomerates of the coal measures, which appear almost to completely surround the Fingal Tier, and in places carry seams of coal. It seems most probable that these beds run under the Fingal Tier, the greenstone being mainly a capping, though doubtless there are many dykes through the sedimentary strata connecting the covering mass with its source below. On the Brookstead Estate the rocks of the coal measures rest upon granite, though to the west and immediate south of St. Paul's Dome they are shown by Mr. Charles Gould's map (House of Assembly Journals, 1869, No. 20) of the Fingal Gold Field and Mount Nicholas Coal Field to be resting on Lower Palæozoic strata. The granites are similar to those of the other tin-fields of north-eastern Tasmania, Ben Lomond, the Blue Tier, Mount Cameron, &c., and are probably part of the same formation, the masses being connected in depth, though separated on the surface by miles of superficial strata. They are, however, almost certainly younger in point of age than the Silurian or pre-Silurian slates found in their neighbourhood at Gladstone, George's Bay, Story's Creek, the neck of the Freycinet Peninsula, and elsewhere, while they are older than the Permo-carboniferous marine beds, which frequently contain water-worn boulders derived from them. A large outcrop of granite is met with on the road from Avoca up the valley of the St. Paul's River about two miles out from the township and continues to the bridge across the river. This is probably the same granite as is met with again at Brookstead, though the two masses may not be continuous. The whole of the Brookstead Estate practically is on the granite formation, though greenstone dykes are seen in parts, and some of the spurs in the western portion are capped with coal-measures sandstones. It crops out again on the south side of the river opposite Brookstead homestead, and here, too, tin lodes have been found, as described by Mr. Thureau in his Report on Ben Lomond and the St. Paul's River in 1881. The valley of the St. Paul's River is mainly occupied by soft sandstones and clays of Tertiary age, covered in places by basalt of a scoriaceous character. This basalt is seen at Avoca railway station, and again, largely developed, on the Benham Estate, the road passing on to it immediately after crossing the bridge going eastward, and running over it for about two miles. Like the valley of the South Esk, that of the St. Paul's River has been deeper than at present in early Tertiary times, has been filled to a considerable depth with sediments.

during the prolonged period of subsidence which reigned prior to the eruption of the basalts over the whole of northern Tasmania, has had flows of basalt poured out over the sediments, and has since cut its way down through the basalts and these to its present level. An older channel, however, in all probability exists beneath the Tertiary strata and basalts, and there is a considerable probability that boring with diamond drills through these would reveal the existence of payable deposits of tin ore in the deeper parts of the gutter. When the alluvial deposits in the tributary creeks running into the St. Paul's River have been tested by practical working it will be possible to form a better opinion as to the probable value of the wash in the old sub-basaltic lead.

#### *Tin Ore in Coal Measures.*

Before passing from the consideration of the geological features of the district, an interesting fact may here be noted. On a spur to the west of Bayley's Marsh Creek the ridge of granite is crowned with huge castellated blocks of Permo-carboniferous grits and conglomerates, 400 to 500 feet above the marsh. The lowest layer of these beds resting upon the granite is a boulder conglomerate, containing water-worn lumps of granite and quartz, and among these very much water-worn tin ore has been found. This is one of the oldest deposits of alluvial tin that has been recorded within my knowledge. It goes far to show that the tin lodes existed in the granite formation even in Palæozoic times, before the conglomerates were laid down as beds of boulders by the waters of the Permo-carboniferous sea.

#### *Topography.*

On this occasion I did not examine any of the country outside of the Brookstead Estate. The ground is of a rather rugged nature, consisting of a succession of roughly parallel steep ridges divided by deep ravines running southerly from the high ridge between St. Paul's Dome and the Fingal Tier to the St. Paul's River. Along the river there is a variable width of flat alluvial land, 25 or 30 chains wide towards the homestead and east side of the river frontage, but narrowing towards the west side. Skirting the foot of the hills there are at places gravel terraces of considerable extent, the largest being at the mouth of the valley of the Main Creek, opposite the homestead. These may prove important in future alluvial mining.

The lodes run almost at right angles to the spurs containing them; and as the latter rise to heights of as much as 400 and 500 feet above the valleys separating them one from another, unusual facilities are afforded for working the lodes by driving straight into the hills along their course. The ridges being very steep, drives from the valleys will rapidly open up a considerable height of "backs" on the lodes. It is clear, too, that the erosion of numerous deep valleys across the course of the lodes must have resulted in the natural sluicing of large quantities of lode-matter, and there is therefore every reason to expect payable alluvial deposits in the beds of the present creeks, and more particularly in the bottom of the deep ground along the valley of the St. Paul's River.

#### *Land held for Mining purposes.*

The Brookstead Freehold comprises, according to the County of Cornwall Land Plan, 5469½ acres, and the right to use the whole of this for mining purposes has, I understand, been conceded by the owners to the Brookstead Proprietary Tin Mining Company, No Liability. To the north of lot 685 of the freehold four 80-acre sections have been taken up under mineral leases by S. Traill, viz., Nos. 1408-91M, 1409-91M, 1495-91M, and 1496-91M. To the north of the eastern block of the freehold (800-acre block) six 40-acre mineral sections, Nos. 1468-91M, 1469-91M, 1470-91M, 1471-91M, 1472-91M, and 1473-91M, have been taken up by C. L. Fitzgerald. Most of the lodes yet discovered are on the freehold, and much of the Crown land seems to be generally covered with superficial strata obscuring the granite, but it is probable that close prospecting will discover outcrops of the latter, and afford indications by which the lodes may be traced under the newer rocks. There may thus prove to be a considerable area of stanniferous Crown land; and as lots 1994, 136, 4311, 4312, 1956, 1955, 1958, 4310, and 1959, lying immediately north of the freehold property, are at present vacant, it is probable that a good many mineral sections will be taken up upon them.

It is understood to be the intention of the Brookstead Proprietary Company not to attempt to work the whole of the freehold, but to cut it up into blocks and dispose of these to other companies,—a policy which is to be commended, as otherwise the parent company alone could not possibly work all its ground.

#### *Lodes.*

A large number of tin-bearing lodes traverse the Brookstead property. They all seem to run nearly parallel to each other, the average course being about W.N.W. and E.S.E., and form a zone or belt of veins not less than a mile in width, and which has been traced between three and four miles in length. The number of lodes discovered at the time of my visit had been estimated at thirteen separate lines, but until the ground has been surveyed and the lodes mapped so that their relations to each other can be clearly seen, it is not possible to be positive as to the number. I do not think, however, that thirteen is any exaggeration, but rather believe that it will prove to be an under-estimate. Owing to the configuration of the country and the strike of the lodes we cannot see all the lodes on any one of the spurs of granite: the bearing of those seen on the western spurs carries them down under the alluvial flats of the St. Paul's River to the eastward, while those on the eastern spurs are not seen in the higher parts of the western ones on account of the superficial covering of coal measures or other later rocks. The lodes will have to be carefully traced from spur to spur by trenching and other means before it will be possible to identify those on one hill with those on the others, for their parallelism, similarity in appearance and mineral composition, and closeness to each other, makes it hard to distinguish between the various lines. For the same reason it is impossible to say with certainty, without actual tracing out of each line, whether they are continuous over long distances, or whether, as often happens with groups of lodes, the veins die out and are succeeded further along their course by other similar ones on nearly the same line. I expect, however, from what I have seen, that the lodes will prove to be continuous over fairly long distances.

The lode-stuff is as a rule mainly composed of quartz, but a great deal of tourmaline is also commonly present, and sometimes this mineral exceeds even the quartz in quantity, and in places large bunches of it occur nearly pure. There is also generally more or less mica, talc, and kaolin in the quartz, and fluor spar is not uncommon. Some of the outcrops are a good deal stained with oxide of iron. Tin ore occurs in bunches and strings, and also impregnated through the veinstone, often in fairly large crystals, but more commonly in pieces from the size of peas downwards. On the whole the crystals are fairly coarse, a fact to be borne in mind when deciding upon the sort of crushing machinery to be employed. In the loose stones lying on surface tin ore can generally be seen without much search, and the stone gives good results when pounded in a mortar and washed off. On this visit, however, I did not make many pestle-and-mortar tests, being satisfied with seeing the tin ore in the loose surface stones in every instance where I examined the outcrop: it was rarely necessary anywhere to pick up more than three or four pieces of the stone before tin ore could be discerned in it. It would have required much longer time than was at my disposal to have made anything approaching quantitative tests; in fact the two days I spent on the ground were fully occupied in simply travelling over it up and down the different spurs, and looking at only the most prominent characteristics. As previously said, no thorough examination could be made in less than a month, and even then a good deal of trenching into the outcrops should be done first in order to enable one to form a reliable opinion as to the value of the lodes.

The only mining work done up to the time of my seeing the property had been on the western side of the valley of the Main Creek, a small stream which runs down close to Brookstead homestead. Here some cuttings have been made on the steep hillside into three lodes lying parallel to each other. The largest of these were opened near the level of the creek is 10 feet wide, consisting of quartz, much tourmaline, a little talc, and fluor spar and cassiterite. A horse of partly decomposed granite divides it into two portions. The stone gives very good prospects when crushed and washed, and a fair quantity of rich stuff has been raised and stacked, giving a very favourable impression of the good average value of the lode. A trial crushing of 10 tons from this and another cutting higher up the hill on the same lode sent to Parke and Lacy's works in Sydney returned over 5 per cent. of black tin, or  $3\frac{1}{2}$  per cent. of metallic tin.

Should stone of this quality continue to be found the lode should be highly payable. In this cutting a small vein was found carrying arsenical and copper pyrites associated with tin ore. Though these minerals are troublesome to separate from the tin ore in dressing, yet they are generally considered favourable associates of tin. So long as they are confined to veins in the lode, which may be picked out from the rest, they will not cause much trouble in the dressing-sheds and smelting-works.

The same lode has again been cut into at heights of 100 and 230 feet above the Main Creek. At the latter place it was six feet wide between two nearly vertical fairly defined walls, and consisted of three feet of quartzose lodestuff on the south wall, two feet of soft greenish granite in the middle of the lode, and then another foot of quartzose lode matter on the north wall. The granitic parting seems to be generally poor, though traversed by occasional veins of tourmaline, rich in tin ore, but very nice stone was being raised from the quartzose portions on the walls. About 30 feet south of this cutting the outcrop of another lode is seen, but had not been opened up. The main lode, as it is called, though only so termed because the largest of the three on which work has been done, can be readily traced by loose surface stones, often showing good tin ore, to the top of the spur, a distance of probably 12 or 15 chains. On the crown of the ridge, 425 feet above the creek, it has again been touched by a trench, in which rich prospects can be got from the rubble forming the cap of the lode, but which is not deep enough to show what width it is. Wherever this lode has been cut, therefore, from the creek to the top of the hill it has shown tin, and in my judgment it shows every appearance of proving payable. On the western slope of the spur running down to Bayley's Marsh Creek the lode has been traced for some chains, and could probably be followed right down into the gully with little difficulty.

About a chain north of the lower cutting at the Main Creek another lode two feet wide has been laid bare, containing an extremely rich vein of tin ore. This appears to lie in the middle of the lode, the stuff on each side of it not being very rich. In the floor of the excavation it was three or four inches wide, and gave splendid prospects. The same lode has again been cut further to the west on the top of the spur, but here is poorer, though still containing some tin. Twenty or thirty yards north of this line another outcrop has been noticed in the lower part of the slope near the Main Creek, but no work has been done on this.

Going southward from the main lode along the spur between Main Creek and Bayley's Marsh several other outcrops have been noticed, but are as yet untouched. Very fair ore is seen in some of these, and one small tourmaline vein was extremely rich, a specimen from it being stated to have yielded 45 per cent. of metallic tin on assay. About 15 chains south of the main lode and on the western slope of the ridge a large outcrop showing tin pretty freely is taken to be identical with a lode seen on the eastern side of the Main Creek, and known as the "Ruby" lode, from the quantity of red or ruby tin found in it: if, so this would be a long and large lode.

Between the Main Creek and eastern boundary of the Brookstead Estate there are several outcrops of lodes, but without a map it is impossible for me to describe their exact position. No work has been done on them, but tin is showing freely in many of the stones picked up, and there seems every reason to believe that they will prove valuable when opened up. On the spur lying to the west of the creek known as No. 1 Creek, formerly worked for alluvial tin, these outcrops show very well, and there is also a nice looking one near the eastern boundary of the property east of this creek. One of the outcrops is almost all tourmaline in large blocks composed of interlaced acicular crystals. On the crown of the ridge between No. 1 Creek and the next gully to the west of it there is an immense outcrop five or six chains long and over a chain wide of loose blocks of lodestuff containing more or less tin and tourmaline. There should be a strong lode under these to account for their abundance. The outcrop stone here did not show so much tin as some of the other lodes, but with the immense quantity that is lying loose on the surface ready to be easily picked out and sent away for crushing, a very small percentage of tin would be profitable if means were provided for raising and crushing it cheaply and in quantity. It would be advisable to have a crushing of an average sample of this large outcrop at an early date to ascertain if it is rich enough to work, for if so there would be enough stone in sight to keep a fair-sized battery going for a considerable time. The block

of country between the Main Creek and the eastern boundary seems to be full of lodes, and, from the frequency with which they show tin, they ought to be valuable. There is a good deal of fair mining timber on this part of the ground, and other facilities for working are good. Unlike some of the western spurs there is no covering of later strata in this portion, and tracing the lodes would be easy and inexpensive. It should prove a valuable mining property.

On the spurs to the west of Bayley's Marsh there is usually on the higher parts a superficial covering of conglomerate and sandstone lying upon the granite and concealing the lodes, and dykes, and possibly flows, of diabase greenstone are also encountered. Still it can plainly be seen that the lodes continue on, for passing up and down along the flanks of the hills we keep coming across them, still preserving the same character as further east, and showing tin pretty freely. Two large and strong outcrops showing tin freely are seen on the western side of the spur east of Williams's Creek, lying parallel and about a quarter of a mile apart, and some three quarters of a mile further west we find another very large outcrop consisting of mainly of dense quartz, black with contained tourmaline. With this dense black quartz there is also some that is white and sugar-like, in which I saw some fair tin ore. The outcrop is 15 to 20 feet wide, and though not showing much tin deserves prospecting. Another black quartz lode seems to come into this one from the southward side near the big outcrop, this being the only case I have noticed of the occurrence of cross-lodes. Yet another outcrop is seen near the St. Paul's River west of the junction of Williams's Creek with it at the old alluvial workings.

Shortly, it may be said that from east to west of the Brookstead Estate from the alluvial ground to the southward up to the superficial capping to the northward, the ground is seamed with tin-bearing lodes of likely appearance and apparently considerable size. In the undeveloped state of the property it is premature to express a decided opinion of their value, further than by saying that all appearances are in favour of good lodes being found when the crops are broken into.

#### *Alluvial Ground.*

Besides lode-mining it is probable that there will be a considerable amount of alluvial work at Brookstead. A certain amount has already been done in the eastern part of the estate towards the mouth of No. 1 Creek, and again in the western part near the mouth of the Panel Marsh Creek. I was informed that 27 tons of tin ore had been raised from the eastern workings, and that work was suspended on account of want of water, or rather want of means to bring in a supply of water. The workings were shallow, and the wash light and easy to sluice. In a heap of old "hopperings" or coarser gravel thrown out of the sluice-boxes, tin ore was freely visible at the time I saw the ground. The lower part of the workings were on granite bottom, but higher up the small creek the ground appears to be deeper, and it seems probable that there is a gutter running under the gravel terrace to the west of the workings. This terrace is of very considerable size, extending right round to the Main Creek, and showing again also on the west side of this, and may contain a great deal of tin. In the workings a great deal of the gravel is quartz carrying tourmaline, evidently derived from the lodes, and much of the tin ore was but little waterworn. Seeing that the creeks cross right through the belt of lodes, and have sluiced by a natural process immense quantities of rock from them, it is reasonable to expect that rich tin deposits will be found in the gutters of the water-courses, particularly in their lower parts where they come out upon the valley of the St. Paul's River. The western workings were not so extensive as the eastern ones, and the ground in the creek itself was deeper. The gravel carries a good deal of clay in parts which interfered considerably with the saving of the tin. Altogether it is said that some 14 tons of ore were raised at this place. I saw one or two fair prospects washed here from some of the layers of gravel.

In all of the six or seven creeks which run through the estate into the St. Paul's River there is a good deal of alluvial gravel which is almost certainly tin-bearing. It has never been tested except as above, but from the position of the creeks with regard to the lodes there is every reason to expect that payable gravel will be found. In their lower parts the creeks run somewhat flat, and the prospector is likely to have to sink a good many feet in rather wet ground before reaching bottom. The difficulty of testing the alluvial ground, however, though considerable enough to discourage a prospector without means, is not so formidable as to offer any serious obstacle to a company. I should strongly recommend that the various valleys of the creeks and the terraces of gravel lying at the foot of the hills on the north side of the St. Paul's River should be prospected during the coming summer with all vigour. There appears to me to be every likelihood that there will be a large extent of payable alluvial ground from which the tin could be readily won. It need hardly be remarked that revenue from this source would be very acceptable to the Company while engaged in the more or less expensive work of tracing and opening up the lodes and erecting machinery for dressing the ore. I have no doubt that if payable gravel were found in a few places the whole of the alluvial ground would be readily taken up by tribute parties, and worked without expense to the Company. The ground might thus be opened up sufficiently to thoroughly learn its value and to show if it would be worth the expense of bringing in a high-level supply of water for systematic hydraulic working on a larger scale.

#### *Facilities for Working.*

Very rarely has a mining property better facilities for working than exist on the Brookstead Estate. The spurs containing the lodes are high and steep, and the ore can be won for many years from adits driven into them without the expense of winding and drainage machinery. As the veins run almost fairly across the spurs they could in most instances be worked from each side of the latter simultaneously and rapidly opened up. The valleys between the spurs would generally be easily traversed by tramways carrying the ore from the various lodes to a dressing-shed near the St. Paul's River. There being a large number of lodes, a large force of men could be kept constantly employed, ensuring a large output, and also that if one lode should run poor work would not stop in the battery, as ore could be got from other sources until the poor ground was passed through. Mining timber can be got readily and of very fair quality, and the granite country rock enclosing the lodes is likely to stand well even without much timber. The greatest advantage possessed by the property, however, is that a copious

and never-failing supply of water can be had from the St. Paul's River for driving dressing machinery and air compressors. This would, doubtless, require considerable expense in the first instance, but seems thoroughly practicable as far as one can judge before surveys have been made, and would lead to great economy in working. A fair supply of water can also be obtained from the Main Creek, Williams's Creek, and other small creeks, especially if care is taken to have storage reservoirs on them to impound flood-water. A large supply of water would allow of the cheap working of the alluvial ground as well as of the dressing machinery.

*Conclusion.*

I do not think that this can fail to prove a very valuable mineral district. It is in a different position from what it would have held had the estate been Crown land, for the entire shaping of its destiny is left in the hands of one company instead of being divided among a number. If well handled this should be an advantage, as a single management will permit of all work being laid out so that the different parts harmonise with each other and great economy results: on the other hand any serious errors on the part of the proprietary might jeopardise the good name of the field to an extent hardly possible when several separate mines are at work, as then the mistakes of one management are counterbalanced by the successes of another. It is of the utmost importance, therefore, that the Company should well consider their scheme of operations, and work from the beginning on a defined plan that will enable the best use to be made of the natural working facilities. For example, care should be taken that the working of the alluvial ground should not be unduly interfered with by tramways, water-races, and buildings; that the dressing-sheds should be placed so as to take ore from the lodes on more than one spur; that tailings should be effectively disposed of; and that the greatest advantage should be taken of water power. The first and most necessary thing to be done, of course, is to cut into the lodes and test them on a working scale with a small battery in several different places. Their value being thus determined, a topographical survey should be made showing the lodes, gullies, and spurs, and affording data for laying out of tramways and water-races. At the same time the available supply of water should be gauged, and trial surveys and estimates made for bringing it on to the ground, and in this connection the great advantage of high-pressure water should be borne in mind. It will then be possible to locate the works so as to command both the lodes and the dressing-sheds.

The Brookstead Proprietary Company have lately bought the 15-head battery and dressing-plant of the Cream Creek Tin Mining Company, and are now moving it to their own ground. This will serve very well for testing purposes in the meantime, but will have to be greatly enlarged later on if the development of the lodes comes up to expectations. Before finally settling on any type of dressing machinery a series of experiments should be made on the stone to determine whether the best commercial results are to be obtained by direct crushing in a battery, as has been hitherto usual in this Colony, or whether it would not be better to adopt the system of progressive crushing by which a large percentage of the tin ore would be saved in a comparatively coarse state. This question is not one to be decided off-hand, but requires investigation and numerous experiments. With comparatively coarse crystalline oxide of tin such as is in the Brookstead lodes the progressive system would presumably be the best, and would in all probability save the highest percentage, but it is a question if the less complex direct system would not give the best commercial results.

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

A. MCNTGOMERY, *M.A.*, *Geological Surveyor.*

*The Secretary of Mines, Hobart.*