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No. I

THE MANGANA GOLDFIELD

W. H. TWELVETREES

Government Geologist

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THE MANGANA GOLDFIELD.

[Four Plans, Two Photos.]

I.—INTRODUCTION.

MANGANA is a small township, 5 miles from Fingal by road, situated on an alluvial flat which forms the floor of a valley bounded by hill spurs descending from Ben Lomond and Tower Hill. The hills rise steeply from the plain, and consequently give the place a picturesque aspect. The native name Mangana had some connection with the river, for *Mangana Lienta* signified the South Esk River, distant 4 miles to the south.* A back road over the hills runs north to the township of Mathinna, and a tourist track has recently been made to the shelter-hut near the summit of Ben Lomond, where Col. Legge has established a thermometer station. The grade of the track up that mountain is comparatively easy, and Mangana forms an excellent base for expeditions. Mountaineers cannot do better than place themselves in the hands of Mr. Donald McLeod, of the Alpine Hotel, Mangana, who will make all arrangements for the ascent.

The goldfield is situate in the area of slate and sandstone strata of Lower Silurian (Ordovician) age, which forms a large auriferous belt of country running through to the northern coast of the island, and embracing the goldmining districts of Scamander, Mathinna, Mt. Victoria, Warrentinna, and Lyndhurst. The exact prolongation of the strike of the Mangana strata would cut the River Tyne near its confluence with the South Esk, and not the Mathinna field, as frequently asserted. The line of the Mathinna strata extended south-east emerges on S. R. J. N. Talbot's 500 acres, in the bend of the South Esk River, near Fingal.

II.—PREVIOUS LITERATURE.

The following reports have been published by the Government of Tasmania:—

1. Gold at Mangana, by Chas. Gould, Government Geologist, 31st July, 1869 (Legislative Council Paper No. 20).

* Fenton's "History of Tasmania," 1884, p. 443. The word "Mun-na," however, denoted wattle-tree gum; and "Mungunna" was the word for fish.

2. On some portions of the Mangana Goldfield, by Alex. Montgomery, M.A., Government Geologist, 25th September, 1894 (Report of the Secretary for Mines, 1894-5).
3. On the strata in the shaft of the New Sovereign Mine, Mangana, by W. H. Twelvetrees, Government Geologist, 6th November, 1899.

Mr. Gould describes four reefs discovered by Mr. J. C. Goodall along the summit and flanks of the ridge dividing the tributaries of Major's Gully, which are charted as Golden and Fern Tree Gullies. He is of opinion that if the shafts which were then being sunk prove the reefs to hold as good in depth as they appeared to be on the surface, there is sufficient stone in sight for several years' crushing.

Mr. Montgomery reports on the Reunion, Cardinal, Buckland, and Alpine mines; and on Specimen Hill workings.

The report on the New Sovereign Mine is an examination of the shaft workings of the mine now owned by the Mangana (Tasmania) Gold Reefs Company, Limited, as far down as 280 feet, the then depth of the shaft.

III.—PHYSIOGRAPHY.

Mangana was originally called the Nook, and the little valley forms a veritable nook at the base of the high hill ranges which rise abruptly from its borders. These hills are lofty spurs, which divide mountain-stream channels or ravines known as Richardson's Creek, Calder's Gully, Major's Gully (resulting from the confluence of Fern Tree and Golden Gullies), Grant's Creek, Sharkey's Gully, Sailor's Gully, &c. The spurs rise immediately round Mangana to a height of 700 or 800 feet, and towards the north they continue rising, and constitute shoulders or buttresses of Tower Hill, the summit of which is nearly 6 miles north-west of the township, and 3900 feet above sea-level. About 1000 feet above and north of Mangana is a small farming settlement called the Towers. Richardson's Creek receives the waters of the various creeks mentioned above, and itself flows into the Tower Rivulet (locally known as Ben Lomond Creek), a tributary of the South Esk River, 3 miles west of Fingal. The latter river follows a tortuous course of nearly 100 miles, till it empties into the Tamar, at Launceston. In the lower part of Major's Gully the Creek flows under the surface of the shingle. The narrowness of these gullies and the steepness of their sides point

to the excavating work of the streamlets having been performed in comparatively recent times. When they cross the course of reefs, they do good service to the prospectors by exposing these, and enabling them to be worked by adit levels. In the northern part of the field the direction of the ravines is more or less north and south, coinciding approximately with the strike of the reef-lines, and these consequently contribute to the formation of spurs which resist denudation. Hence the most accessible parts of reefs are frequently at high elevations.

IV.—GEOLOGY.

The strata of the field consist of slate and sandstone, considered to belong to the Ordovician (Lower Silurian) system. No fossils have been found confirming this reference, which is made only on stratigraphical and analogical grounds. The alternations of sandstone and slate show the cleavage partings in the rock to be mostly coincident with the lines of bedding. The sandstone is generally crystalline, and the whole series has been subjected to the processes of compression and cleavage, which in Tasmania are believed to have operated strongly at the close of the Silurian. It is made up of finely-divided detritus, derived from the wearing down of quartz felspar (granite) rock masses, which have now entirely disappeared from the locality, if indeed they ever existed in this part of the island.

The general strike of the beds is N. 25° W., and east of the township their general dip (underlay) is to the north-east, while west of Mangana, on the hills above Calder's and Major's Gullies, and on the Black Boy spur in the township itself, the strata dip to the south-west.

An anticlinal arch appears to have existed over the present flat of the Fingal (Grant's Rivulet) valley in the north angle of the township, and the reef-lines throughout the district are probably related to the processes of compression and strain, which may be considered responsible for the formation of this arch.

A strong unconformity exists between the slates and the beds of grit, conglomerate, and mudstone, which overlay them, and which pertain to the Permo-Carboniferous system. On the hills north of the township, at a height of between 950 and 1000 feet above the level of the plain, a layer of this conglomerate, 30 or 40 feet thick, covers the Ordovician strata. The pebbles are quartz, and sometimes slate, embedded in a sandstone matrix. Small cliffs of this

conglomerate are exposed on the hill ridge between Calder's and Fern Tree Gullies, about 5 chains south of W. Gellibrand's 157 acres, at 1000 feet above Mangana. On the Alpine Hill, also between Richardson's Creek and Calder's Gully, stones of this conglomerate are strewn on the surface about 100 yards north of the Alpine outcrop workings. Boulders of reddish sand and grit enclose pebbles of sandstone, slate, and quartz. A little further south, between the Alpine hut and the Cardinal shafts, a few feet of Permo-Carboniferous sandstone appear to overlie the older slate. East of Mangana, at the head of Sharkey's Gully, near Talbot's gate on the divide, and at an elevation of between 600 and 700 feet above Mangana, the hill capping is composed of Permo-Carboniferous mudstone. The residue of this covering is nowhere thick, and it is easy to see that the slate throughout the district has nowhere suffered any great denudation since it was first buried below the Permo-Carboniferous sediments. From this fact it may be inferred that no great waste of gold quartz reefs can have taken place, and, consequently, that the amount of gold present in the alluvial does not afford a fair criterion of the value of the reefs. Fossiliferous mudstones occur high up the shoulder of Tower Hill, as well as on the Fingal township. The difference of level between the two exposures points to considerable faulting somewhere, but it would require a very close examination of the geology of the locality to locate the line of displacement. The plain through which the South Esk River flows consists partly of alluvial matter, which was deposited in Tertiary times, and this gravel has been shown by borings to go down below the level of the present river bed. This alluvial becomes shallower towards Mangana, and at the township it is not more than 30 or 40 feet in depth. It gradually gives place to the modern wash of the mountain creeks in ascending the gullies. In Tertiary times the deposit probably extended higher up the low hill on Robertson's Freehold, to the west of the township, but some denudation must have taken place during subsequent elevation of the land. These Tertiary deposits in the South Esk basin extended as far north from Fingal as the present site of Mathinna.

Igneous rocks appear at a few places on the Mangana field, but, genetically, are quite unrelated to the gold quartz reefs. The summit of Tower Hill is formed of diabase (greenstone or trap), the plagioclase-augite rock which everywhere is found intrusive in the coal measure sedimentaries (both upper and lower, *i.e.*, Permo-Carbon-

iferous and Mesozoic) as sheets, pipes, dykes, or in some other form. On the flanks of the hill below the summit is a fringe of Permo-Carboniferous strata, but whether these pass underneath the diabase or whether the latter cuts them off is as yet an open question.

On the track to the Alpine Mine, about 400 feet up the hill, is a small patch of diabase, which has come up through the slate at this spot. The igneous rock is here greatly decomposed, and does not appear to be exposed for a width of more than 20 feet.

A further exposure of the same rock is on the 20-acre block of Robertson's Freehold, west of Mangana. It occupies the western part of that block and the southern angle of the adjoining 31 acres, and extends westward to the mining sections, $\frac{1}{4}$ -mile distant, forming a considerable mass.

A similar rock forms the top of Ben Lomond, the Fingal Tier ("Bare Rock"), and other heights in the neighbourhood. Microscopical examination shows an absence of the type of structure which would denote a deep-seated (plutonic) rock, as well as of that which characterises effusive (volcanic) rocks. Their micro-architecture (diabase type) conforms with that of rock masses which exist as laccolites or intrusive sheets.

The age of these rocks is not older than late Mesozoic, as it is clear that they have intruded into our Upper Mesozoic shales and sandstone, but any closer determination than this seems impossible for the present.

The quartz reefs at Mangana are for the most part enclosed in the Ordovician slate and sandstone strata. Only at one point did I see what appears to be an upward extension of the reefs into the overlying Permo-Carboniferous, viz., on the Buckland Spur, where an exposure in a trench shows a somewhat feeble continuation of the quartz into the flat-lying younger sandstone. However, more extended examination is necessary before what would appear to involve a younger age for such a reef can be used decisively for building any theory upon it. Quartz veins have been observed in the coal-measure sandstone elsewhere (on Ben Lomond and near Buckland, as well as at Port Cygnet). But the Mangana reefs typically are confined to the older strata, and their occurrence is probably closely connected with the tectonic processes of folding, which may be conceived as having released and enclosed the siliceous residue of the granite magma. That reef-formation is in some way related to the bending of the beds may be inferred from the change in dip of

reefs when found east or west of the township. All the reefs east of the Fingal Valley axis have an easterly dip, while those on the Buckland or Alpine Spur dip to the west. It is highly possible that a reef or reefs may exist along the axial line of folding below the plain of the Fingal Valley.

V.—ECONOMIC GEOLOGY.

The gold-bearing quartz assumes the form of veins and reefs, for the most part running in northerly and north-westerly directions, generally conforming with the enclosing strata in strike and dip, and varying in width from mere threads to as much as 25 feet in width. Some of these reefs are barren, or at all events not payable. The quartz generally is white and glassy, and not as a rule charged very heavily with pyrites. Where pyrites is present, the dominant species is iron pyrites. Arsenopyrite is subordinate. Copper pyrites, galena, and blende occur sporadically, and are good indicators of the proximity of gold. The rich stone found near the surface in this district has probably been indebted to processes of solution and re-precipitation for its wonderful gold contents (Golden Entrance quartz having yielded $39\frac{1}{2}$ ozs. per ton). Some of the reef-channels have been the seat of subsequent movements, which have torn and forced apart both quartz and the slate laminæ, widening the reef and giving it a mottled appearance, which, if accompanied by pyrites, is a favourable augury for gold contents. Oxidised parallel partings in the stone are welcomed by the miner as very apt to carry gold. The reefs in the hills to the east of the township are in directions which cause them to cross the gullies, and the latter, notably Sharkey's and Sailor's, must have removed considerable quantities of quartz while carving out their channels. On the other hand, on Major's and the Alpine Hills, the ravines mainly run parallel with the reefs, which consequently have only been subject to the denudation going on upon the hill spurs.

It is probable that much of the alluvial gold which has come into Mangana from the north was not shed from the Alpine and Major Hill reefs, for these reefs are not cut by the main ravines. The local opinion is that the Permo-Carboniferous conglomerate or cement is responsible for a good deal of it.

Gold has been found both in the cementing sand of this conglomerate and in quartz contained therein, and the iron oxide with which much of the alluvial gold coming from the northern part of the field is coated confirms

the idea that gold is derived from the ferruginous cement. This is the view held locally, and much can be adduced in its support. There is not the slightest reason why alluvial and specimen gold should not exist in the Permo-Carboniferous conglomerate. During the time that it was being laid down the gold-bearing reefs were exposed, and must have shed their waste much as it is being shed to-day. It must be remembered, however, that these conglomerates were probably extensive sea beaches, and concentrations of gold in them were likely to be few and far between. Still, some auriferous runs may be found in them, and prospecting in this formation may be encouraged.

VI.—HISTORY.

The first discovery of payable gold in Tasmania was made at Mangana, in February, 1852, about 150 yards below the present bridge. The *Launceston Examiner*, of 18th February, 1852, stated:—

“Letters have been received in town announcing the discovery of gold within 4 miles of Fingal, by James Grant, Esq., of Tullochgorum. The following is an extract from a letter from a gentleman in the neighbourhood, dated the 16th instant:—‘Gold has been found within 4 miles of Fingal. I saw it myself. The largest piece was the size of a duck shot, the other pieces smaller.’”

Another paragraph appeared in the *Launceston Examiner*, of the 12th May, 1852:—

“James Grant, Esq., of Tullochgorum, has claimed on behalf of Keeling Richardson the reward of £500 offered by the Launceston committee in September last for the discovery of a goldfield in the northern side of the island. He states in the memorandum which he has submitted to the committee that, of the quantity forwarded, 1 oz. 38 grs. were procured by Keeling Richardson from about five bushels of soil, with the assistance of one man at the cradle, in eight hours.

“One of the pieces procured (a nugget) weighed 139 grs. The remainder consisted of smaller pieces.”

Mr. James Fenton, in his “History of Tasmania” (Hobart, 1884), writes on the subject as follows:—

“The first payable gold in Van Diemen’s Land was found at the Nook, 4 miles from Fingal, in February, 1852. It attracted about 200 persons for a short time. They thoroughly prospected the country round, and those who steadily persevered made it pay. Very minute

particles of gold-dust were procured along the Tower Hill Creek and on the hillsides, where beautiful specimens of crystallised quartz abounded, but in a few weeks the place was left in the hands of a few of the original claimants, who made a fair profit on their industry for a considerable time."

Mr. J. C. Goodall, the pioneer who has done so much in the way of prospecting and mining at Mangana for the last 42 years, has furnished me with the following statement, which gives some interesting historical information. He says:—

"I visited Mangana in 1866, and found the Union Company's quartz mine at work, this being the first gold-bearing reef discovered in the colony. The developments were being carried on by adits, and a 10-head battery was crushing the stone. On Grant's Creek the Fingal Company was shaft-sinking and quartz-crushing with a 10-head battery. The yield varied from 5 dwts. to nearly 1 oz. per ton, obtained by both companies. The Union was by far the more promising of the two mines. Its reef was from 4 to 12 feet wide, with some bulges of stone up to 20 feet, but the widest parts were poor, averaging from 3 to 7 dwts. per ton of fairly rough gold. An open-cut was put in half-way up the hill on a discovery of rich stone with very rough gold, so rich that I saw the manager crush over 50 lbs. weight in the mortar and it yielded over 4 ozs. gold. Several stones crushed by hand gave 1 dwt. of gold to the pound. In working this discovery barren reef matter and mullock were crushed with the richer stone, and the battery average was brought down to less than 10 dwts. per ton. Some time after this the Union Company closed down, and remained idle for years.

"The Fingal Company's mine was on a short shoot of stone worked to 170 feet in depth, and, on the whole, was not payable. The mine is situate on private property, and has been idle the last 30 years. I paid special attention to the country at the head of Fern Tree and Golden Gullies to ascertain whence the alluvial gold of Major's Gully was derived. On 10th January, 1869, I discovered the Tower Hill reef, showing good payable gold quartz, but to my astonishment I found it was on privately-owned land, 157 acres, belonging to the late William Gellibrand. Eventually a company was formed in Hobart, and I put up a 10-head battery. We had several crushings of good 2-oz. stone, but two or three poor crushings frightened

the shareholders and directors, and the mine was closed down. Only surface-scratching was afterwards done by co-operative parties, until the machinery was destroyed by fire. In 1877 I discovered the Alpine reef on Crown land, and secured the lease of Buckland's Freehold, on which estate I also discovered the Buckland No. 1 reef, which produced over 1000 ozs. of gold from 1319 tons quartz. The reef was from 18 inches wide at surface to 3 feet wide at the bottom of the winze, 170 feet. The Alpine and Buckland estates were floated into three separate companies in Hobart. The Alpine reef was not proved to any great depth (about 150 feet), and some excellent crushings were obtained. A few poor crushings caused work to be abandoned. Later I took up the forfeited Union leases, and discovered the Sovereign reef, on the top of the hill, which I worked for about a year, and then sold to a London company (Mangana Gold Reefs, Limited). I have prospected lately on the Buckland's Freehold, a 30 years' lease being held by Launceston investors, who also intend to start work on the Buckland No. 1 reef by putting in an adit 100 feet below the old workings. The last crushing from the bottom of the winze was 80 tons, yielding 152 ozs. gold, some 21 years ago."

Mr. James Fenton writes:—*

"The first quartz-crushing company (the Fingal) commenced operations in April, 1859. Its machinery was imperfect. It obtained about 250 ozs. of gold during the first four months. The stone crushed yielded 8 or 10 dwts."

Looking at Mangana as it is at present, with its numerous reefs exposed and mines idle and giving employment to not more than half a dozen men, it is difficult to realise that this was the first goldfield in the Colony. Although Mr. Fenton gives the priority to the Fingal Company,† I am informed that the Midland Company was the first quartz-mining company, which afterwards successively became the Union, the Reunion, the Sovereign, the New Sovereign, the Mangana (Gold) Reefs, Limited, all working on the reef in the Union or Sovereign Hill. Some of the richest quartz known in Tasmania came from this reef. All the gullies were scoured for gold in the old times, and responded excellently to the search. Major's

* "History of Tasmania," Hobart, 1884, p. 308.

† He probably means the company at the Fingal diggings, as the Mangana field was then called. This company was then known as the Midland.

Gully has the reputation of having been the best, and gave employment to 400 men in its palmy days. The largest nugget found on the field was obtained from Fern Tree Gully, which feeds Major's. It is variously reported as 7 ozs. and 11 ozs. in weight. Sharkey's Gully, opposite the hotel, also used to yield rich specimen quartz. The Golden Entrance Mine, on the divide between Sharkey's and Sailor's Gullies, has yielded about £10,000 of gold-bearing quartz, but it is now struggling along on tribute.

It is difficult to avoid recognising that in the old days a mistake was made in selling the mineral land round the township. The consequence is that many reefs are now on private property, and the mining population of Mangana, instead of prospecting and developing the lodes in the surrounding hills, leave their homes during the week and occupy themselves with tin-mining on Ben Lomond.

VII.—MINING.

(a) *Mangana Gold Reefs Mine.*

Mangana (Tas.) Gold Reefs, Limited.—Sections 1259-93g, 30 acres; Section 557-g, 10 acres; and 318-93g, 5 acres, battery site.

A gold quartz reef of variable width, but attaining in places a maximum width of 25 feet, runs right through the hill on Section 1259 from Sailor's Gully to Sharkey's Gully, and various outcrops have been also found on the southern section (557), one of which must be the southern continuation of the reef. It seems to be almost certain that the reef is traceable at surface for at least half a mile, and this is a strong indication of its persistence to a depth greater than that of the present workings.

The average bearing of the reef is N. 42° W., and the dip to the north-east. There is very little difference between the strike of the enclosing slate and of the reef itself; sometimes the bearing of both is identical; in dip, also, the reef follows the country.

Apart from the light decolourised slate in the superficial zone, the workings show mostly dark slate down to 200 feet below the gully, purple slate from 200 to 600 feet, and a compact grey slate between 600 and 800 feet. Where the reef is wide the quartz is mixed considerably with slate, giving the stone a mottled aspect. The width varies from under a foot to as much as 25 feet, of which, in the upper parts of the mine, from 4 to 6 feet of solid quartz is met with, the remainder being mixed quartz

and slate, occurring irregularly in the reef-channel. The slicken-sided lode slate points to reef movements subsequent to the deposition of the original vein quartz.

The reef minerals are pyrite, arsenopyrite, and a little galena and copper pyrites. The reef belongs to Beck's group of pyritic gold quartz reefs, in which the dominant sulphide is iron pyrites.

The former companies which worked this property (Union, Reunion, Sovereign) operated on the reef in the hill on the north side of Sailor's Gully, while the present company has explored it from a main shaft sunk to 800 feet below the gully floor. I am informed by Mr. J. C. Goodall that the first gold found in quartz at Mangana was obtained from this reef (Union). There is no return available of the total gold won, but it is certain that the amount was by no means inconsiderable, and some rich shoots were met with in the upper workings by the early companies.

Upper Adits in Hill.—As said above, the work done prior to the present company consisted of adits driven north-west into the hill on the course of the reef. These are at different levels from Sailor's Gully to within 60 feet of the apex of the Sovereign Hill, the highest one communicating with the summit by means of the Sovereign shaft. Altogether, these upper works comprise 2200 feet of driving, 300 feet of crosscutting, and 750 feet of sinking and rising, besides an unascertainable amount of stoping.

The main adit (No. 4) has been driven into the hill from near the new shaft at 25 feet below the collar of the latter, and has been extended north-west 550 feet. No. 3, 112 feet above No. 4, has been driven 720 feet; No. 2, 94 feet above No. 3, has been driven 625 feet; and No. 1, 137 feet above No. 2, has been driven 275 feet.

All these have been driven on the reef, which in places is from 10 to 20 feet wide. Its character is extremely irregular, often soft and mullocky, and again widening into large bodies of hard stone. The quartz is white and but little mineralised, and very largely dissected by bands of slate.

No. 4 Adit.—At a little distance in this adit the reef-channel is 5 to 6 feet wide, but soft and mullocky, developing into a mixture of quartz and slate, the quartz often showing in curved bands. A little north of the main shaft the reef has been stoped up to surface and down to No. 1 level in the new mine. It is reported to have carried very good gold at times.

At 190 feet in a crosscut has been driven out south-west for 100 feet without intersecting anything of importance. It passes through regularly laminated slate country, dipping north-east. At one point a small vein of valueless quartz was cut. The crosscut was of distinct use as establishing the non-existence of parallel reefs outside the main channel. Between this and the 180-foot air-shaft (Union shaft) the reef has been stoped to surface on 2 feet of quartz for 120 feet beyond the crosscut in the Union



PLATE 5

MANGANA REEFS SHAFT.

shaft, but beyond this there is not much quartz in this level. The face is 240 feet beyond the shaft, and this part of the adit is in soft, dark lode slate, which has been mostly worked with the pick. Short crosscuts would have to be put out each way behind the end to prove the width of the reef. The face carries lumpy white quartz for a width of 5 feet 8 inches. This stone, although barren, has a more favourable look than anywhere in this level north of the Union shaft. Further 400 feet of driving would bring this level under the Sovereign shaft, and in doing this it would pass below the large block of ground stoped

between the level above and the surface, and also meet the gold shoots pitching south.

East of the entrance to this adit a wide spur of quartz has run off to the east. Its full width has not been actually proved, but about 20 feet of it have been taken out and crushed. The stone for a width of 3 feet is reported to have returned 1 oz. gold per ton. What is left is valued at about 5 dwts. The hard bands of clean stone are said to carry the gold, which realised £4 per oz., the

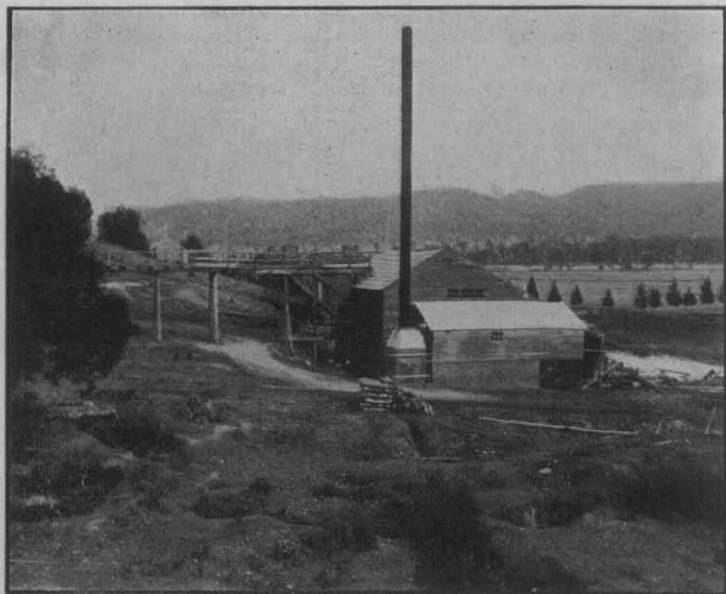


PLATE 6

MANGANA REEFS BATTERY.

highest value on the property, as the general range of the rest is from £3 10s. to £3 14s. per oz. The stone at the top of the hill was exceedingly rich, and it is said that the bulk of the gold was obtained from there.

No. 3 Adit.—This has been driven 720 feet. At the entrance the reef has an unusual westerly underlay. It is soft and small (2 feet 4 inches wide), and runs in soft arenaceous slate. As far as the Union shaft, the channel is mullocky and uninviting, but after passing the shaft the reef becomes harder. Its hanging-wall is smooth, and

footwall ragged. The level has followed a somewhat serpentine course. At about 250 feet north of the shaft the reef has been stoped up to No. 2. Just before this hard big stone comes in, and is exposed in the drive for a width of 9 feet. Some extraordinarily rich stone is reported to have been obtained from above this level—as much as 30 ozs. per ton. The shoot of golden stone appears to have been shorter in this level than in the one above it. I could not reach the end of the drive owing to it being blocked by a fall.

No. 2 Adit.—This has been driven 625 feet. Inside the entrance the reef is 7 feet wide, and there appears to be still more stone to the east. Quartz carrying gold 1 oz. per ton was obtained from here. Going north the reef attains a width of 12 feet. At about 100 feet from the Sovereign shaft the level is blocked by a fall of ground. The lode is said to have been lost in the end. The reef-channel has a westerly underlay in this adit.

No. 1 Adit.—This is the uppermost level, and has been driven 275 feet. The reef here consists of a channel of stone and mullock 20 feet wide. Near the entrance it is composed entirely of mullock. The quartz bodies here evidently make in bunches or blows. The Sovereign shaft, communicating with the apex of the hill, is 200 feet in, and there is a fine body of low-grade quartz here, estimated as worth a little under 4 dwts. gold per ton. From the large excavation seen, the stone has been worked up and down and in the side spurs. The reef becomes smaller after it passes the crown of the hill. In the end of the adit it is 3 feet wide, of which 18 inches are stone and the rest is mixed mullock and quartz. The sample taken from this adit by the manager and sent to London assayed 7 dwts. per ton.

Driving this adit 90 or 100 feet further would bring it out to daylight on the northern slope of the hill overlooking Sharkey's Gully, and No. 2 adit, if continued further 280 or 300 feet, would also emerge on the side of the hill, and even if driven only 150 feet it would come into country where it would have only 60 feet and less of backs.

These upper workings are evidently patchy, and the gold shoots seem short; but it seems to me worth while to relocate them and test the ground around and below them, so as to find some patches that would pay for working and relieve costs while development is going on at a greater depth. No. 4 adit might well be extended further

into the hill, and would have a fair chance of intersecting some of the principal shoots.

Workings from Main Shaft.

No. 1 Level, 115 feet.—The crosscut driven 29 feet south-west from shaft is in mottled stone and slate all the way. The drive north-west, 87 feet in length, is on the hanging-wall of the reef. Good stone has been driven on, and stone is still left inside the western wall of the drive. Solid stone is showing in the end. The reef has been worked from this level up to the No. 4, or main, adit, and down to the next level, 60 feet below, for a length of between 60 and 70 feet.

No. 2 Level, 174 feet.—This level has been driven north-west from the main shaft for a distance of 175 feet on the course of the reef. The reef is exposed in the chamber west of the shaft, showing about 5 feet of mottled quartz, nearly vertical. The stone has been taken out above this level for a length of about 100 feet. Fifty feet from the shaft is a short crosscut which intersects the reef, here 19 feet of mottled stone, dipping 50 degrees to the north-east. For 3 feet in this crosscut the quartz is very solid. Ninety feet beyond the crosscut solid stone 50 inches wide has been left standing, and the softer reef matter worked on each side of it. The west branch has been followed 10 or 12 feet, while the main drive has followed the eastern parting. Further north the stone enters the drive again, and the solid part of the reef widens out in the end to 19 feet. There seems to be plenty of quartz, and the problem is to find shoots of gold sufficient to pay for working. If this drive were continued it would meet the gold shoots from the hill workings.

No. 3 Level, 214 feet.—There is a wide band of reef matter here in the shaft, but the width has not been proved west. The formation is quartz and lode-slate. The level has been driven north-west at 12 feet west of the shaft, and continues on the reef for nearly 200 feet, but the end is partly blocked by a recent fall, owing to heavy rains. The reef as followed is $2\frac{1}{2}$ feet wide, consisting of mottled quartz and dark slate, with a good hanging-wall of black, greasy slate, dipping north-east. The slate forming the walls throughout the level is soft and mullocky. Old stopes exist above this level.

No. 4 Level, 319 feet.—A crosscut has been driven from the shaft north-east for 50 feet, and levels driven north-

west and south-east on the reef, the former for 150 feet and the latter for 125 feet.

Drive North.—The reef in this drive hugs the footwall side. The level begins on seams of quartz, and the formation is mullocky, which does not look very inviting, but the manager reports that it is worth 7 dwts. A cuddy east goes through slate seamed with flat veins of quartz, and fair stone (worth 7 or 8 dwts., I am informed) goes down in the sole of the level just opposite this. A little further north a rise has been put up to No. 3 level. Tributors worked here and did very well while the gold lasted, on a reef about 2 feet wide. Stone as high as 13 dwts. was got, but going up it grew poorer. Continuing in this level, some of the roof has been brought down by water, as the reef-channel is soft all the way. However, a change takes place in the end of the drive, and the first solid quartz in this level is met with. The face is solid white quartz, dipping north-east, at from 60 to 65 degrees. This stone is nicely mineralised. The manager informs me that it is worth about 3 dwts., but as there is fair gold at different points in the level the drive ought to be continued.

Drive South.—The reef is followed on the footwall side of drive, showing quartz veins 5 inches to 1 foot wide. The stone is said to be of good quality for this mine, and the manager recommends a rise being put up just south of the intersection of crosscut. The end of the level shows only dark slate with a few narrow veins of quartz. The drive here is apparently off the reef, and a short crosscut has been put in easterly 25 feet behind the end, but has only intersected a 7-inch flat vein of quartz. Some more cross-cutting is required to clear up matters.

No. 5 Level, 419 feet.—A crosscut north-easterly has been driven 137 feet from the shaft chamber. At 150 feet it intersected the reef. Throughout the crosscut the slate country is much disturbed and intersected by quartz veins, which are often greatly puckered. For the greater part of it the veins dip west; afterwards this underlay changes to east. Some of the veins are quite horizontal.

The reef has been driven on north-westerly for 90 feet on a mullocky channel. It must have been rather difficult to choose the place for driving, as the crosscut is crowded with quartz veins; but the right selection has evidently been made. About 40 feet from the beginning of the level a few tons of stone were taken out over the roof, returning, I am told, about 3 ozs. gold per ton. This stone showed

no visible gold, but was mineralised with pyrite, copper pyrites, and galena. The channel here is 10 feet wide, but without walls. Veins of quartz appear in the roof and wall of the drive, and at half a chain from the end a small crosscut has been opened, showing a band of quartz dipping east. The end of the level is in silicified, barren country, intersected by seams of quartz, and consisting mostly of siliceous lode slate. Though no gold has been found at this point, gold-bearing stone is quite likely to be met with if the drive is continued, as in the level above a nice shoot, though very short, was left going down at about this distance from the shaft. This level seems to have been stopped on account of poverty of the reef, and because no funds were available for prospecting.

The level 200 feet below leaves too great a distance between the two levels. Either No. 6 might have been driven, or a winze sunk from this drive.

No. 7 Level, 619 feet.—At this level crosscuts have been driven north-easterly and south-westerly, and from the eastern one a level has been driven 170 feet on a small reef.

The eastern crosscut has been driven 260 feet, nearly to the boundary of the section. At its commencement a few stray bands of quartz from the formation which descends with the shaft are seen. At 38 feet from the shaft a 3-inch vein of quartz runs across the crosscut, and 10 feet further along is more stone in the form of irregular veins, and still further is quartz in patches. The country is twisted round in curves, and the dip consequently is variable, sometimes vertical, or even west, but reverts to its normal easterly direction.

A couple of small stopes above the roof of the level have yielded 5 tons of stone; the yield is reported to have been 7 or 8 dwts. The quartz is apparently in bunches, as clean country is left in the roof; but it was never wide in this level, the stone being from 8 inches to a foot. Fifteen feet behind the end of the level a winze has been started in stone 4 to 6 inches wide. The end of the drive shows lumpy quartz 3 or 4 inches wide in the upper part of the face, dwindling as it goes down to a mere track of black slate. If this is the reef driven on in No. 5, as it in fact seems to be, its underlay has become much steeper between the two levels, increasing in fact from 55 degrees to 75 degrees inclination from the horizontal.

The west crosscut has been driven 110 feet south-westerly from the main shaft. Veins of quartz connected with

the shaft formation occur immediately on the western side of the shaft. Three feet behind the face of the crosscut a formation of quartz and slate about 4 feet wide was passed through. The quartz veins, 2 and 3 inches wide, twist with the folds of the country, and the stone is white and barren. This reef is not so strong in the roof, where it is represented by a few 2-inch veins of quartz, but in the lower half of the drive it is fairly strong on both sides. The stone is not very attractive looking, but should not be passed by without a short drive being put in. The end of crosscut is in light-coloured slate, dry, and regularly laminated.

No. 8 Level, 719 feet.—A chamber has been cut here and a drive put in for 40 feet in a north-westerly direction. Stone is scattered all over the roof of the drive, but the channel proper seems to be 3 feet wide, and is filled with mixed quartz and slate. The country-rock dips in its usual direction of north-east, while the quartz veins underlie south-westerly. The quartz is vitreous looking. The shaft here carries a reef-channel 7 or 8 feet wide, which tails out in hard slate in the western chamber.

No. 9 Level, 819 feet.—The bottom crosscuts have been driven at this level.

East Crosscut.—This has been driven 140 feet north-easterly from the shaft. At 12 feet from the shaft a block of slate with veins and patches of quartz occurs in the upper part of the crosscut. The quartz has come down from the shaft, but nothing is visible in the floor of the crosscut, so this seems to be the bottom of it. In this drive there is a barren cross-course with a little quartz on its hanging-wall crossing in a north-easterly direction, about $2\frac{1}{2}$ feet wide, and dipping north-westerly. The filling is dark slate. A little water is issuing from it, but the occurrence does not seem to be of any importance. In the end of the crosscut water is dripping, and a lode-channel of some sort is coming in with a north-easterly dip. The proper position for the main reef, judging from its position in No. 7 level, is about 40 feet ahead of this point.

West Crosscut.—This has been driven 113 feet south-westerly from the shaft. In the shaft itself stone has been passed through all the way from the chamber above, and is seen in the western chamber in the form of torn bands of quartz up to 6 inches in width. At 46 feet from the shaft a slide crosses the drive, striking N. 20° W., and dipping south-westerly. Half-way between this and the

shaft is a 3-inch vein of quartz visible in the roof, and 6 feet west of the fault is a patch of quartz, also in the roof.

It does not live to the south-eastern side of the drive, but its track in that side is indicated by somewhat softer slate. Just west of it some water trickles from the roof. When money is available, it might be driven on to make sure that nothing is neglected. Dish prospects have not shown any gold. In fact, no colours have been got from any trials at this level. The end of the crosscut is in grey slate, vertical, and very regularly laminated.

At 100 feet west of the shaft a drive is proceeding south-east on a reef-channel about 14 inches wide, and carrying in the end 5 or 6 inches of quartz. The footwall is smooth and well defined. The reef is nearly vertical, dipping at about 80 degrees to the north-east. Its filling is quartz and black lode slate. No mineral is discernible without washing. If the present angle of dip is maintained, this reef would enter the main shaft at about 280 feet lower down.

A small battery of 15 heads is situated at the mouth of Sailor's Gully, and is connected with the mine by tramway. The stamps are 7 cwts., and driven by a 14-horse power engine with Cornish boiler 28 feet by 6 feet 6 inches.

There is a Berdan pan with belt attached, and a sawmill connected with the plant for cutting all wood used in the mine; also an assay-house and furnaces, and a cyanide plant for treating the battery sand.

If the mine becomes payable, it will be by treating large quantities of stone, and for this the battery would have to be enlarged.

Everything at this mine is in good order, and the work carried out in a workmanlike and efficient manner. All that is necessary now is to settle the programme for future operations, and work with a definite object in view.

Reviewing the work done on this reef in former and recent years, it is undeniable that the deeper sinking has proved disappointing. The reason of this appears to be that the shaft has been sunk deep enough to pass out of the upper zone of gold-bearing stone, and not yet sufficiently deep to enter the second zone. The upper zone, as far as it has been proved, seems to occur in the reef from the surface down to about 200 feet, more or less. No stone has been taken out in quantity from lower than 300 feet.

Considering the developments in the upper part of the reef as being all connected with one another, and constituting a gold-bearing reef-shoot pitching at a rather low angle (30 to 40 degrees) to the south-west, there is a

probability that this will continue south-westerly into the adjoining section, which hitherto has only received desultory attention in the way of prospecting. Quartz has been cut in trenching at different points on this section on the slope of the hill falling towards Sailor's Gully, and I think this slope merits systematic exploration. Apart from the 300-foot level, no driving south has taken place from the main shaft, and it would be strange if the gold-bearing stone on the north of the shaft were not found on the south side as well. Exploring in this direction would necessarily mean following the stone successively to deeper levels. In addition to this work, it is worth considering whether the upper levels from No. 4 upwards, as well as the main adit, should not be continued north, so as to test the reef thoroughly below the hill workings. While this exploration work is in progress, prospecting might be undertaken in the upper adits, with a view of breaking stone that would at least pay crushing costs and relieve general expenses during search and development work down below. The whole proposition seems to be a low-grade one, and while considerable quantities of stone exist of a quality nearly payable, there is the chance that patches of sufficient extent may be found to raise the whole to an average that would pay for raising.

An alternative is to continue sinking the main shaft until another gold-bearing zone is met with; and such a zone, on the theory of parallel shoots, will probably in time be encountered, but at what depth it is impossible to say.

Underlay Reef.—This is on the company's property on the south side of Sharkey's Gully, bearing N. 50° W., and dipping easterly at about 30 degrees. It is thus a rather flat reef. At 5 chains south-east of the north-western corner of Section 1259 some very nice-looking quartz is exposed, laminated and impregnated with pyrites. This reef was worked between 30 and 40 years ago, and a trial crushing is reported to have yielded 6 dwts. It has been cut into for two or three chains, and seems to be fed by spurs of stone. One of these spurs is about 15 inches wide, a lode in itself. The reef is exposed to a width of 18 or 20 inches, but cannot be well examined, as the entrance to the underlay winze is blocked by a fall of stone. The workings now are evidently in a state that would discourage some from doing anything with the proposition, but the reef, *per se*, is somewhat attractive. It crosses Sharkey's Gully and passes north right through the old Union Jack section to the Fingal Mine in Grant's Gully, where it was worked

rather extensively. Reports of values vary from 6 to 10 dwts. On the south side of Sharkey's Ravine the reef strikes across a hill spur which would only allow of short and shallow drives on the reef-course unless a sufficient depth were secured by a shaft.

(b) *Golden Entrance Mine.*

Sections 1547-93G, 1569-93G, and 1568-93G—10 acres each.

This mine has been working intermittently since 1900, and is now being exploited on tribute by Messrs. Madden and Macleod. The reef was discovered by Mr. J. S. Goodall, Jun., since when 1050 tons of stone have been crushed for 2801 ounces of gold, of the value of £10,264 9s. 11d., averaging 2 ozs. 13 dwts. 8 grs. per ton. The first crushing yielded 39½ ozs. gold per ton.

The reef crosses Sailor's Gully. About 20 feet above the track on the north side of the gully a small cutting was made into the reef nine or 10 years ago by Mr. Goodall, and a little gold said to be obtained. A body of slate and quartz has been exposed for about 10 feet, and some blocks of solid quartz thrown out.

Lower Tunnel (No. 2).—This is about 150 feet above the gully. Angle of slope of hill, 30 degrees. The adit has been driven on the reef for 150 feet in a north-west direction. The reef dips east here, while there is a local underlay of the country to west. At 20 feet in is a shallow winze 7 feet, sunk on material carrying a little gold. The reef-channel is filled for the most part with soft decayed slate, with a rather regular veinlet of quartz and a few bunches of quartz in the formation. Six-inch veins of quartz cross in the roof and east wall. Those in the roof are rather solid, but on their strike they die out and are replaced by slate. Twenty-five feet behind the end the country-rock is a more massive and siliceous grey slate in the lower part of the drive. In the upper part a cross-course comes in, striking west and dipping north 55 degrees. The level has been driven through to the north wall of the cross-course, and has touched the siliceous wall-rock, which is freely impregnated with pyrites. Driving has stopped here, but it is not clear that the reef has been heaved. If a displacement has taken place the reef, according to the laws of faulting, should be sought to the west. The workings ahead show that there cannot have been much dislocation, and the best way would be to drive on and put in short crosscuts.

Winze Adit (No. 1).—This is 180 feet above the lower adit, and has been driven 270 feet on the reef on a course varying from N. 40 degrees to 46 degrees W. The reef dips north-easterly, and the country south-westerly. At the entrance a winze has been sunk to 100 feet on the hanging-wall, with a very steep dip. A little way in the adit is an air-pass to the level below. The stone stoped was from a few inches to 7 feet in the widest part. At 140 feet in the No. 2 shaft from surface passes through this adit. Half a chain beyond the shaft a fall of ground has blocked the level, but it has been driven 2 chains further north. The timber in roof prevented examination, but the stone above here was very rich—6 to 7 ounces gold per ton. This was not continuous, but in patches. Only a little stone is now seen in the level, clinging to the east wall. The channel is filled with black greasy slate and pug.

Twenty-five feet below the level is an intermediate drive, which has been driven both ways. The south drive is for about 40 feet, and carried good stone. I was informed that 81 tons were taken out for 289 ozs. The reef varies here from a few inches to 2½ feet at the widest. The south drive has been mostly stoped up to the level above, except just near the shaft and towards the south end.

No. 2 Level.—This is 45 feet below the collar of the main winze, and connects No. 2 shaft and winze. Towards the south end near the winze a small sink was made 6 feet below the floor of the level, and 50 tons of stone taken out and crushed for about 350 ozs. of gold. This was the last parcel mined and sent over to the Bairnsdale School of Mines for treatment. Just south of No. 2 shaft a pass goes down 24 feet to an adit driven from the north side of the hill.

The stopes above this level were in stone up to a foot in width. The sink referred to above shows quartz going down on the east side of the drive for a couple of inches wide only, but exceedingly rich stone was obtained from this point.

No. 3 Level.—This has been driven from the bottom of the main winze (No. 3 shaft) for 10 feet south and 50 feet north. The chain ladder had been taken away from the bottom, so these lower workings could not be examined. About 30 feet below No. 2 the track of the stone passes through the shaft corresponding with the southerly pitch of the make of quartz, but all along the No. 2 level there is very little stone.

Surface.—North of No. 2 shaft the outcrop of the reef twists in a serpentine way to the west, and resumes its normal bearing when it reaches No. 1 shaft. This change (accompanied by a flattening of the underlay) is also seen in the stopes above No. 1 level, but not in the level itself.

No. 1 Shaft.—This is 250 feet north of No. 2 shaft, and has been sunk to 108 feet. It is the point where work was first done on this mine. When 30 feet deep 480 ozs. of gold were won from 24 feet by 30 feet of reef, and one parcel of $4\frac{1}{2}$ tons is stated to have yielded 25 ozs. per ton. A few tons of gold-bearing quartz are lying outside the shaft, but were not considered rich enough to send away. There is a fair amount of pyrite in the stone, and the gold occurs in rusty patches, which represent decomposed pyrites. This probably accounts for the unusual richness of the quartz in free gold.

At 50 feet a level has been driven 30 feet south and 50 feet north. The ground has been stoped south for 15 feet from over the back of the level to surface, and north for 30 feet to 20 feet high. At 80 feet down, drives have been put in for 17 feet south and 30 feet north, and 20 feet north of shaft a winze connects the two levels.

No. 4 Shaft.—This is 31 feet north of No. 1 shaft, and has been sunk on the reef to a depth of 30 feet by the present workers. A few tons of stone have been raised, but not enough to send away yet. It is situate on the south brow of the hill, about 1566 feet above sea-level.

Sharkey's Gully Adit.—This has been driven on Section 1568 from the north side of the hill first as a crosscut in slate for 420 feet, and then on the course of the reef as far as 30 feet south of No. 2 shaft, and 24 feet below No. 2 level, with which it is connected by a pass. At first the reef-channel is about 2 feet 6 inches in width, filled with quartz and soft country. Near the end a little gold was met with, where there were a few inches of quartz and a soft "dig," about 18 inches altogether. The stone is mineralised.

A characteristic of the Entrance reef is a little parting, which forms a track that can be easily used as a means of identifying the reef. The stone occurs on each side of the soft parting.

General Remarks.—There is abundant scope for useful exploratory work at this mine. The bottom level on the south side of the hill should be extended so as to bring it below the upper workings, and shafts Nos. 2 and 3 deepened to connect with it. The ground below No. 3 level

and south of No. 3 shaft may be expected to carry the continuation of the shoot which was stoped above, but below a certain distance from the surface the lode enrichment will possibly be found not to continue. The reef in depth will then have its normal characteristics. If necessary, a lower tunnel can be put in from Sailor's Gully below No. 2, at a spot where there is a fine body of stone at surface, and fairly mineralised.

(c) *Alpine, Buckland, and Cardinal Mines.*

The mountain spur between Richardson's Creek and Calder's Gully comprises parts of two 320-acre blocks owned by C. and H. J. Buckland. Some important reefs have been worked on this spur, and several others have been discovered and trenced upon at surface.

Alpine Reefs.—These are about 1000 feet above Mangana, on the western of two sections once held by the Alpine Company, north of and adjoining the Buckland Gold Mining Company's section. The reefs were discovered by Mr. J. C. Goodall in 1877. About the centre of the section they appear to unite, and form a single reef, which continues north beyond the limits of the section, and disappears under a capping of Permo-Carboniferous conglomerate. The two reefs going south vary in width, but attain a maximum of 2 or 2½ feet. They seem, however, to be only a few feet apart, and perhaps may be better considered as one reef formation. An adit has been driven at 100 feet lower than the outcrop, and the reef stoped upwards. The Alpine Company erected a 10-head battery at the mouth of Calder's Gully, constructed an incline and tramway, and got between £2000 and £3000 of gold. Stone from the winze sunk to 100 feet below the adit is stated to have returned gold at the rate of 18 dwts. per ton. A low adit was started down in Calder's Gully, which it was calculated would give 600 feet of backs. This was driven over 400 feet, and from the face a horizontal diamond-drill bore was put in for further 545 feet, making 945 feet altogether, without reaching the reef. Mineralised rock was shown in several of the cores. According to the survey the eastern reef should be 600 or 700 feet ahead of the bore.

Buckland Reefs.—The Buckland No. 1 reef was also discovered in 1877 by Mr. J. C. Goodall, and an adit driven which intersected it at 160 feet. A winze was sunk 110 feet on it, and levels opened out on it north into the Alpine ground at 45 feet and at 70 feet. These were con-

nected by a winze, and an underlay winze was also sunk from the 70-foot level a further depth of 50 feet. At the 45-foot a level was also driven north. A good deal of stone was broken, which has been reported as having yielded from 12 dwts. to over 1 oz. gold per ton. Mr. J. C. Goodall informs me that 1319 tons quartz were broken, returning 1001 ozs. 13 dwts. gold, during the time that he was mine and battery manager—September 7, 1883, to September 16, 1884. The last 80 tons crushed during Mr. Peter Irvine's managership were from the lower levels, and gave 38 dwts. per ton.

At the tunnel level, 110 feet from surface, the length of payable stone, according to plan, was 85 feet, and beyond that, in a southerly direction, the drive was extended 150 feet, but met with no payable stone. The quartz stoped below this level seems to be pitching north, and at 30 feet down the mine plan shows a new shoot of gold as having come in, and continuing downwards in stone 5 feet wide. These workings are inaccessible now, so there are only reports to go upon, but these are from former managers who were well acquainted with the mine. Mr. Peter Irvine, who is still a respected inhabitant of Mangana, says the average width of stone was 3 feet, and its average quality all through equal to 18 dwts. per ton.

The low Alpine tunnel was unfortunately abandoned before success was achieved. At present too little is known of the reef to warrant such a long adit at such a depth, but eventually, if work at more moderate depths proves satisfactory, it may become advisable to extend it. For the present a more desirable course would be to prove the reef by an adit a more reasonable depth below the present workings.

Cardinal Reef.—This is on the western brow of the spur, and near its southern end. Its bearing is N. 28° W., and its dip south-west. Three shafts have been sunk along the line of reef. The principal one, I understand, is 100 feet deep, but none of them can be entered in their present condition. Complete figures relating to the former output are not available, but accounts point to 167 tons being raised from the 50-foot level stopes, returning 13 dwts. gold per ton. Some of the stone is said to have gone as high as 35 dwts. The reef in the bottom was not payable. Mr. Goodall, who has come to my assistance with many valuable statistics of this field, tells me that the reef in the south end was 4 inches to 12 inches wide, and in the north end about 2 feet, but poor. Mr. Macleod states

that tributors crushed 20 tons of stone left at the shaft for 8 or 9 dwts. per ton, and some odd parcels gave from 15 dwts to $1\frac{1}{2}$ oz. The Cardinal is in a reefing line which embraces some parallel reefs, one of which at least is of considerable size. Mr. Goodall has done a good deal of trenching in this zone, north of the Cardinal shafts, and has exposed a strong reef of solid quartz in half a dozen trenches and an open-cut at intervals for over 4 chains from south to north on the N. 20° W. course of the reef. The first trench is about $\frac{1}{4}$ -mile north of the Cardinal shaft, and west of the Cardinal reef. A hundred feet north of this trench is the open-cut, which has been carried down 16 feet, showing solid stone 8 feet in width. Apparently this reef is widening as it runs north, for it was not more than 4 feet at the most southerly trench. The most northerly trench (which I did not see) is reported as exposing 17 feet of quartz. The open-cut has given gold prospects, and prospects obtained from surface loam lower down on the slope indicate a possible source in this reef-belt, which is about 100 feet in width. The reef in question has been called No. 1 reef, on the Buckland Freehold, which leads to confusion with the old Buckland No. 1 Company, which worked a different reef altogether. As it is such a prominent reef, and is a permanent land-mark on this ridge, it might be called Goodall's No. 1 reef, for sake of distinction.

Adit prospecting suggests itself for any one undertaking mining here, as adits could easily be laid out to go right below the outcrop at any depth desired. As for the Cardinal reef, it thins as it comes north, and is apparently replaced by Goodall's No. 1.

It will be noted that both country and reefs on this hill dip to the south-west, being on the western half of the Fingal Valley anticline. The quartz of which the various outcrops consist is the massive white variety which so often characterises the surface exposures of the reefs of the Mangana field, and in some districts might be looked upon as unfavourable. Experience at Mangana, however, has shown that high yields of gold have been associated with vitreous-looking quartz, which is often intersected by oxidised partings, forming a favourite matrix for gold, and which in depth frequently changes its character altogether, and becomes a mottled, laminated stone, with a fair proportion of mineral. Whether any particular "buck" reef will behave in this way is another question, but at any rate the vitreous habit of the quartz is, *per se*, not sufficient reason for condemning the reefs.

(d) Tower Hill Mine.

This is an abandoned mine on W. Gellibrand's purchased land, 157 acres, 3 miles north-north-west from Mangana, and over 1000 feet above the township. Like so many of the Mangana reefs, this one was discovered by Mr. J. C. Goodall, in 1869. It was worked by a Hobart company, and Mr. Goodall tells me that at first several crushings of good stone were taken out (up to 2 ozs. per ton), but after some poor battery-runs work was suspended, and has not been resumed since, except by co-operative parties. No very clear idea of the reef can be formed from the workings in their present condition. It has a north-westerly bearing, and shows at surface about 4 feet of white mineralised stone, disappearing to the north. The mine is on the spur between Golden and Fern Tree Gullies, with adits driven from the eastern side.

About 5 chains south of Gellibrand's boundary are some cliffs of Permo-Carboniferous conglomerate and soft quartzose sandstone, with embedded pebbles of white quartz and slate; and nearer the mine sandstone, belonging to the same system occurs also, though the reef itself is in the older slate. The slate dips south-west. The reef has a north-east dip.

Descending hence down Fisher's Hill, towards Mangana, on the west side there is a good deal of loose quartz, heavily charged with arsenical pyrites. The hill consists largely of grey sandstone, freely veined with quartz.

I did not see the Golden Gully Mine, which is a little way up that gully on the east side. I am informed that some fairly nice stone occurred on surface. An adit was driven with 50 feet of backs, but though there was a good body of mineralised stone it was barren of gold.

On the west side of Major's Hill outcrops of quartz have been tested a little. Some of these have a kindly look; others are hard and white. On the ridge, which is a razor-back, are stones of quartz of fairly loose texture.

These hills north of Mangana do not appear to have had the work done on them which their reefs would require. Some of the alluvial gold found in the gullies must have been derived from them, and their lines are too long and persistent for gold not to exist in them at some point in their course.

The reef-line on Robertson's Freehold, further south, seems to correspond with the Major's Hill line, and the Buckland Hill line with the sections on Otway's Creek.

(e) Fingal Company's Mine.

This was worked at least 40 years ago, on Grant's Creek. The greatest depth attained was 170 feet, and the mine does not seem to have been a payable one. The workings are 2 chains from W. Robertson's boundary, on Tully and Downing's land, and are on two parallel reefs a chain apart. Most of the gold was got out of the western reef, which is supposed to be that of the Golden Entrance. A good deal of hard white quartz is lying about at surface. The eastern reef was worked about 100 feet down on the underlay, and corresponds approximately in position with the line of the Union Jack and underlay reef further south. The battery which was formerly here is supposed to have recovered 6 or 7 dwts. from the stone. Mr. Cundy worked out some blocks of stone here 10 years ago, and got 6 dwts. per ton.

This is the furthest north that these long reefs have been seen. It is a remarkable instance of the persistency of the reefs at Mangana. In this instance the Golden Entrance reef would be shown to have a length of $1\frac{1}{4}$ mile, and the underlay reef $\frac{3}{4}$ mile.

(f) Union Jack Mine.

This reef is the continuation of the underlay reef, which passes up the hill north of Sharkey's Gully into Section 1527-93c, which is the old Union Jack claim. A little north of the south-west angle of the section is an ancient adit, which has been driven on the course of the reef for 250 feet. The latter still has a flat underlay to the east. In the adit about 8 inches of stone are showing at first, but further in it becomes softer and somewhat broken. At 200 feet in an underlay rise slopes up to a shaft which was sunk from surface. The inclination of the reef is sufficiently flat to walk or scramble up the rise. The shaft is 70 or 80 feet above the adit. Above the latter is an upper tunnel, driven right through the crown of the hill, with only 30 feet of backs at the most. The entrance to this is now fallen in. From the bottom of the shaft a small parcel of 1-oz. stone was taken. The quartz used to be trammed from the upper tunnel along a horizontal tramway for 150 feet west, and sent down an incline to Sharkey's Gully for treatment in the old Union Quartz Company's battery. The reef is so flat that it crops out at surface at 100 feet west of the tunnel and 12 or 15 feet above tunnel level. It cuts the country, being much flatter than the parting planes of the slate. The

appearance of the stone corresponds well with that of the underlay reef in Sharkey's Gully.

Five or 6 chains east a large reef crops out, with an easterly underlay. It is 12 feet wide, and has the characteristic central parting of the Golden Entrance reef, which, in all probability, it is. It is strongly mineralised with pyrite and iron oxide. The eastern portion of it is the more solid. Its bearing is about N. 40° W. It has been trenced upon in one or two places, the most northerly being 80 feet south of the southern corner of Section 1589. This should be driven on lower down the hill, and a rise would then cut the underlay reef as well.

What is probably the same reef has been cut further north, on W. Robertson's eastern block, where a shaft has been sunk on it. It shows there solid quartz about 1 foot in width. A few feet further north a cut has been put in, but not deep enough to expose any quartz. About 200 feet lower down, going north on the same course, is a small pit, about 12 feet deep, of which 6 feet consist of hill debris or overburden. Doubtless the same reef continues to the old Fingal workings.

It is impossible to form an opinion of these reefs from the abandoned ancient workings, but if any work was justified then, there would seem to be warranty for further testing them.

(g) *Pincher Reef.*

This reef is on the hill east of the township, where it overlooks the entrance to the Fingal Valley, or Grant's Creek Valley. Some tunnelling and shaft-sinking have been done on it, but how much stone has been taken out cannot be seen, neither are results available. It has a strike of N. 50° E., and dips south-east at an angle of 70° , and shows a width of 2 feet 4 inches stone between walls. The country is hard sandstone.

(h) *Specimen Hill.*

This is a low, somewhat flat-topped hill, on Robertson's Freehold Blocks, west of the township, covered with wash on the lower slopes. A little surfacing has been done with encouraging results, but there is not enough pressure of water available. The crumbly quartz detritus lying on the surface has apparently been shed from a series of veins running through the hill in a north-north-west direction, and forming an auriferous belt of about a chain in width. The slate strata crop out on the top of the hill, striking N. 20° W., and dipping south-west. On the

southern block of the freehold property stones of Permo-Carboniferous grit and mudstone are scattered over the ground, and it is probable that there is an occurrence of beds belonging to that system *in situ* somewhere near here. This would indicate that the undiscovered fault which has brought these beds down from the upper level to the Fingal township horizon must pass north of this. On the two northern freehold blocks diabase comes in, and passes away to the west as an intrusion, cutting-off the slates. Its former Permo-Carboniferous covering has been entirely removed by denudation.

Some shafts have been sunk at intervals on the line of quartz leaders and veins. The most southerly is the Trilby shaft, which is 50 feet deep. Some very nice gold was got here on Crown land, a chain inside the east boundary of 829-93c, 10 acres. A quartz gold-bearing wash rests on a yellow clay, which covers the slate bed-rock. North of this several trenches have been cut and quartz veins exposed. The depth of the wash varies from 8 inches to a foot.

Further north, in the freehold land, is Goodall's shaft, near the top of the hill, which has been sunk on a mass of quartz leaders. Quartz detritus lies here everywhere on the surface. The shaft was sunk 40 or 50 feet 12 or 14 years ago. Just below it a strong body of hard valueless quartz has been exposed.

Brennan's tunnel is an adit which has been driven into the hill on the western side for about 200 feet, at a shallow level, not more than 30 feet below the crown of the hill. It was put in with the intention of cutting the reef, but only one or two veins were intersected. This was about nine years ago. I do not think the position selected was a favourable one for the best results, as if the adit were continued, it would eventually emerge on the east side of the hill above the leaders there. A few stones of white barren quartz are seen on the tip.

Some trenching has been done in the depression running down the east side of the hill, and passing through a belt of small veins, some of which are oxidised and have a kindly aspect; others, however, being hard and white. A tunnel was put in on this side some years ago, and a flat vein near it carried very fair gold. There is an old shaft just above the tunnel with quartz going down in the walls. Near this point is the head of the gully workings.

On Specimen Hill proper a shaft was sunk eight or nine years ago by Mr. Corbett to a depth of 130 feet in slate, dipping south-west. One or two gold-bearing leaders

were passed through in sinking. From the bottom a crosscut was driven east. I was informed that nothing was won from this, but some nice specimens were got from trenching near the shaft. A few tons of quartz and slate were sent away for crushing, and returned about 5 dwts. per ton.

In the earlier days many of the auriferous leaders on this hill were pounded up and washed. Just north of this point diggers started on the alluvial gold shed from this hill, and kept working round the foot and up the gullies, in which a considerable quantity of gold seems to have been concentrated. There has been so much gold obtained in this way from the surface that it is next to certain that more exists at a depth. Whether the numerous veins unite in depth and form a strong reef-channel can only be ascertained by actual work, but it is, to say the least, probable that they do. The hill being so low in elevation (50 to 100 feet) adit-driving cannot be thought of. Mr. Montgomery advised sinking rows of shallow shafts and connecting them by drives. This would be useful preliminary work, but the real work of testing the reef or reefs would best be carried out from a shaft sunk to some depth, and well below the broken ground, which may be expected to prevail above the level of the Mangana Valley. A water scheme has also to be devised.

(i) *Alluvial at Mangana Generally.*

The actual lead or ancient bed of the tributary which flowed formerly from Mangana into the valley now occupied by the South Esk, a good deal below the present bottom of that river, cannot be traced with confidence above Mangana township. The ground at the mouths of the present mountain creeks does not exceed 40 feet in depth, and has no doubt accumulated from the creeks which flow down narrow ravines of comparatively recent origin. All these valleys have given employment to diggers, who have at different times worked some of the ground over and over again. The alluvial ground below Mangana deepens towards the South Esk, and, probably owing to it being private property, has never been thoroughly tested. It must have received a certain amount of gold from creeks which have now disappeared with the erosion of the country, though owing to the direction of the lead coinciding with that of the strata, and being parallel with the bearing of the principal reefs, the quantity of gold finding its way into the drift is likely to be

less than if the main valley crossed the strata. If the land had been open for mining its value, no doubt, would have been tested ere now.

It is difficult to ascertain how much alluvial gold has been won at Mangana. An estimate made in 1884 placed it at £60,000 worth, and assigned 6000 to 8000 ozs. to Major's Gully alone. Later estimates state 5000 ozs. as the gross returns. No figures pretending to any degree of accuracy can be obtained.

Major's Gully is said to have supported 400 diggers at one time. Near its mouth the ground is deep and wet, water flowing beneath the shingle, which chokes and hides the channel from view.

(j) *Conclusion.*


The present condition of Mangana, considered as the earliest goldfield in the island, is somewhat pathetic. It has been left by investors on one side, while the stream of capital has flowed to other centres. And yet the phenomenal returns from some of the reefs should suggest that there is here a legitimate field for search. The reefs, too, are in the golden zone, which extends for such a distance in this part of Tasmania. Some of them are barren, others are gold-bearing, and the chances appear to be neither more nor less than those of other parts of this auriferous belt. The Mangana Reefs is the only property on which anything like deep work has been done; the workings on other reefs are shallow, and often mere scratchings. Mangana evidently has not had a thorough trial yet.

W. H. TWELVETREES,

Government Geologist.

Launceston, 22nd November, 1907.

MANGANA GOLD FIELD



SCALE OF CHAINS

W. H. Fielvestres
Government Geologist
November 1907

REFERENCE	
Tertiary drift merging into Recent Alluvium.	}
Mesozoic Diabase.	
Permo-Carboniferous.	*****
Ordovician: slate and sandstone.	
Quartz reefs.	—————
Shafts.	■
Dip and strike.	↗
Mine work generally.	✕
Barometric heights above sea level.	(1200)

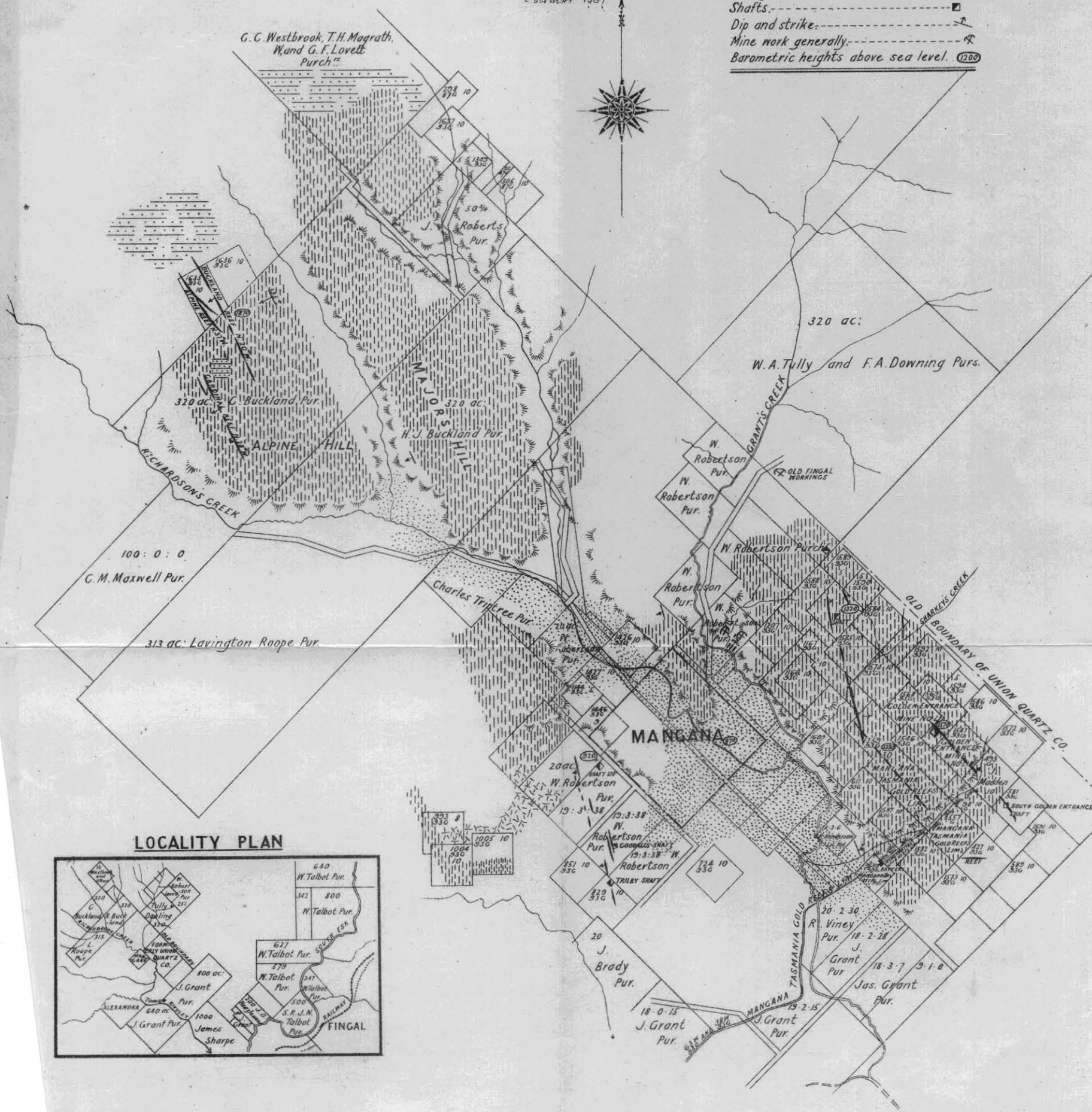
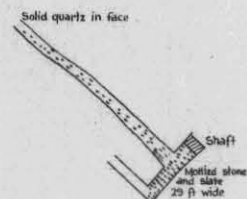
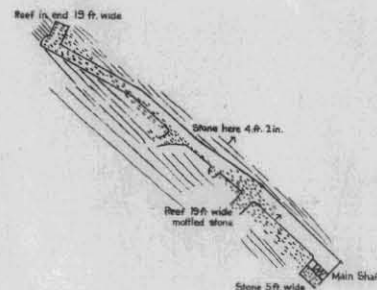


Photo-algraphed by John Vail. Government Printer Hobart, Tasmania

NO: 1. LEVEL
115. feet



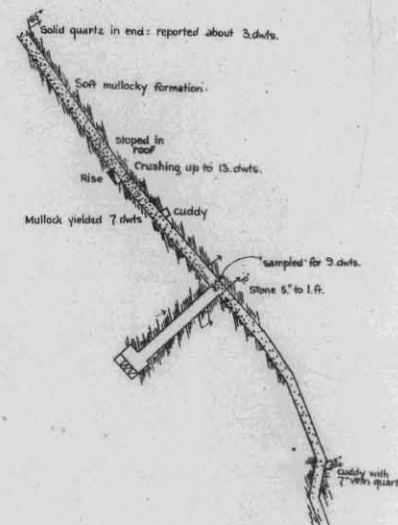
NO: 2. LEVEL
174. feet



NO: 3. LEVEL
219. feet



NO: 4. LEVEL
319. feet



NO: 5. LEVEL
419. feet

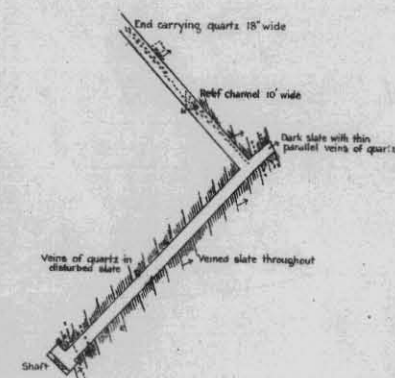


PLATE 2.

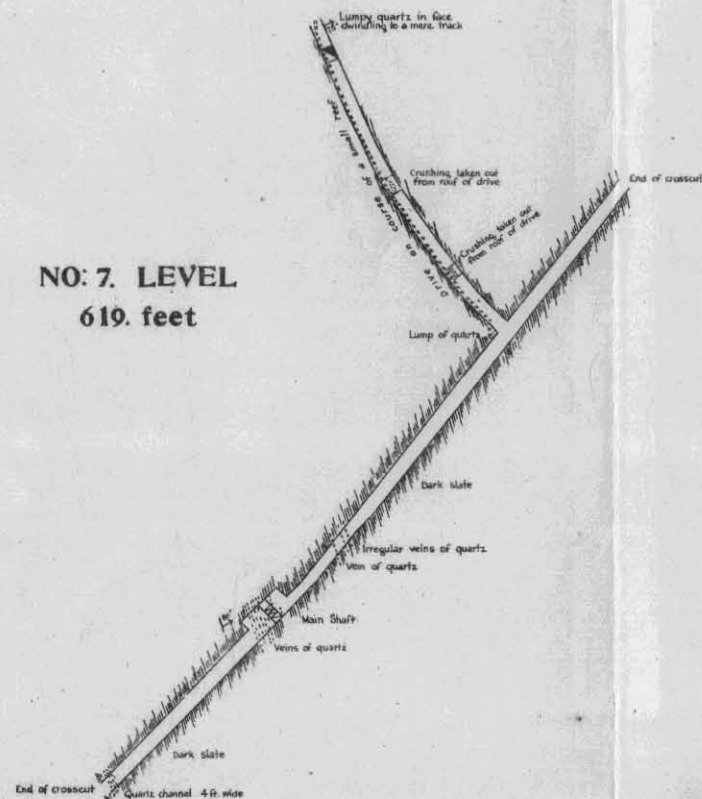
MANGANA GOLD REEFS
PLANS OF LEVELS

Scale of feet
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

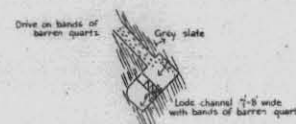
N. H. Threlkeld
Government Geologist
Nov. 1907.

5 cm

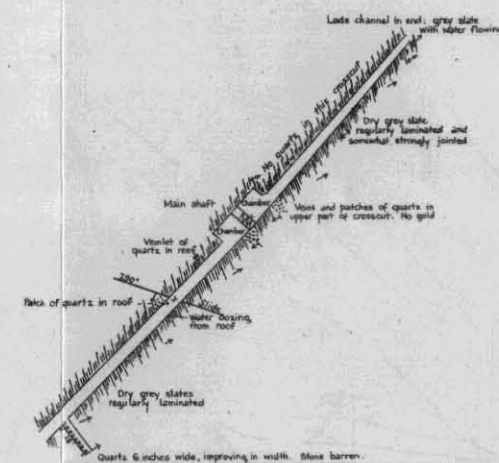
NO: 7. LEVEL
619. feet



NO: 8. LEVEL
719. feet



NO: 9. LEVEL
819. feet



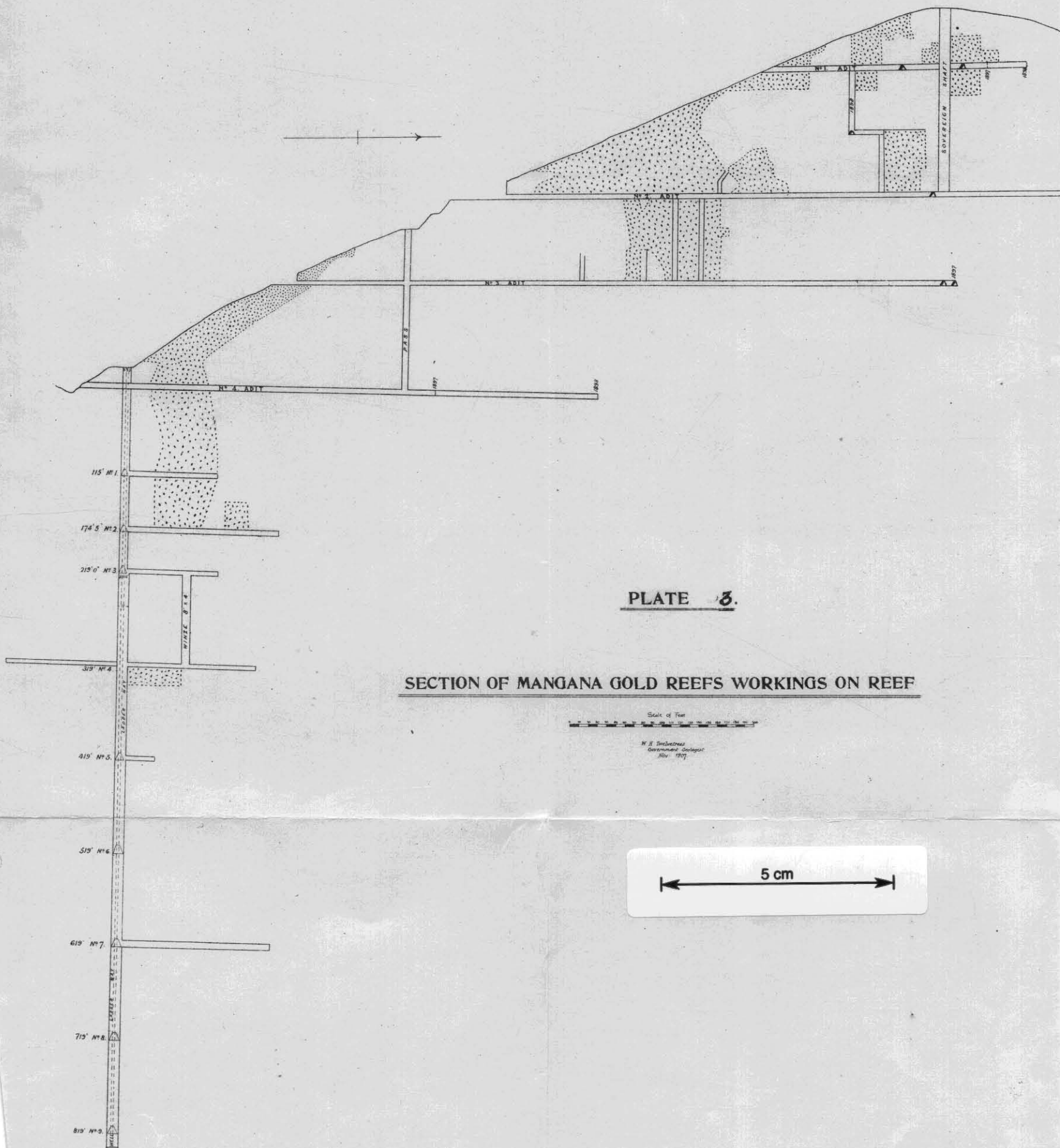


PLATE 3.

SECTION OF MANGANA GOLD REEFS WORKINGS ON REEF

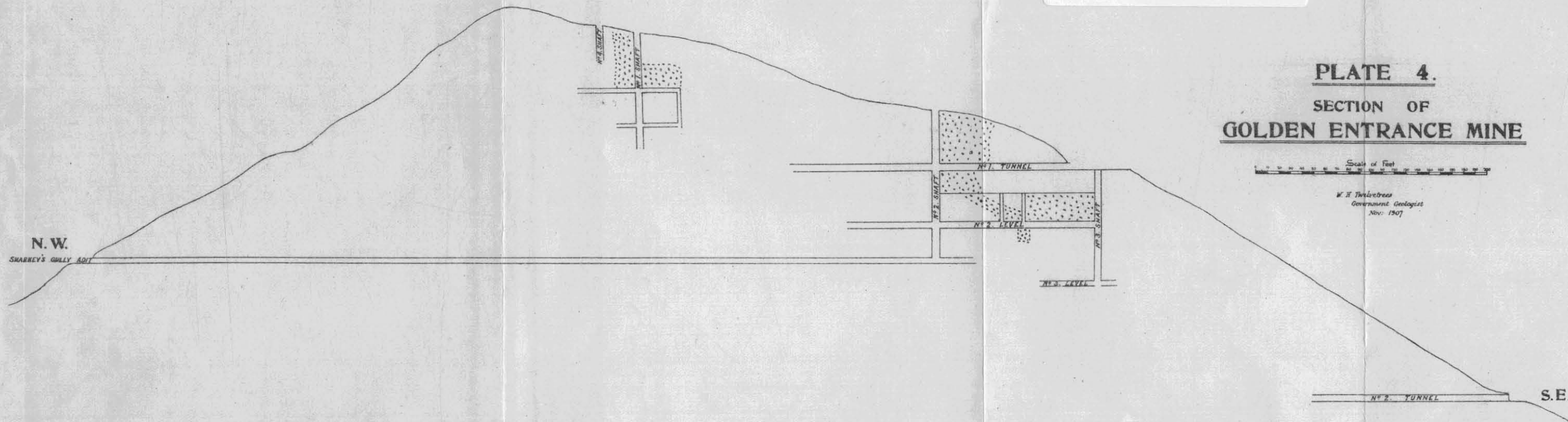


PLATE 4. **SECTION OF** **GOLDEN ENTRANCE MINE**

Scale of Feet

W. H. Twilley
 Government Geologist
 Nov. 1907

Photo-ographed by John Kull Government Printer Hobart Tasmania