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DEPARTMENT OF MINES.

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(W. BARAGWANATH, Director.)

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MOLYBDENITE OCCURRENCES IN VICTORIA.

By H. Herman, B.C.E., M.M.E., F.G.S., late Director.

(NOTE ON PROSPECTIVE SUPPLIES OF MOLYBDENITE FOR WAR PURPOSES.)

In view of the importance of obtaining supplies of molybdenite for war purposes, I have, during the last few weeks, devoted some attention to the possibility of obtaining supplies of the mineral from this State.

In the first place, a circular for the guidance of miners and others in prospecting for molybdenum ores was issued to the number of over 3,300 throughout the State, copies being supplied to mining registrars, municipalities, newspapers, police stations, post offices, warden's offices, and libraries in order to facilitate their distribution and to familiarize those likely to be concerned with the appearance of the various ores, and the nature of the rocks in which they are most likely to be found. Following this, I have, at the request of the Minister of Mines, visited various parts of the State where there appeared (from information previously obtained from officers of the Department or furnished by others) to have some prospect of containing deposits of commercial value. The districts visited include Mount William, Maldon, Mount Moliagul, Mount Stanley, Simmon's Gap (near Bright), and Everton.

Many places where the mineral is known to occur only in sufficient quantity to be of purely mineralogical interest were necessarily excluded from my itinerary.

I found that in every case the mineral occurs in granite or rocks of allied type either in the rock itself or in quartz lodes or irregular quartz veins therein.

As a result of my inspections I am of the opinion that the prospects at Mount Stanley, Mount Moliagul, Simmon's Gap, and Everton all warrant further prospecting, not merely on the lodes already disclosed, but in rocks of similar character in the same neighbourhood or district. The lodes in the four localities last mentioned are all of the "contact" type, that is to say, they are in granite rocks, which are easily recognisable by any moderately experienced prospector, close to (that is, from within a few chains to half a mile or more) the line of junction with slate and sandstone "country." In addition to the places already mentioned, I have previously (during Easter of 1914) visited the molybdenite field at Wangrabelle¹, near Mallacoota Inlet, in the extreme east of the State. This field also I regard as one deserving of further prospecting as well as the development of several lodes which have already been opened up, in one case to a depth of about 100 feet.

Up to the present not any of the deposits have had sufficient prospecting or development to warrant the erection of a treatment plant.

The speedy design and erection of a suitable crushing and concentrating mill should present no difficulty in the event of further work being attended with satisfactory results. The cost of a plant to treat 150 to 200 tons of crude ore per week would probably be about 50 per cent. in excess of the cost of a plant of the same capacity for the treatment of sulphide-carrying gold ores only. The cost of any such plant would, of course, vary with the local conditions as to site, water supply, accessibility, &c., &c.

The uses of molybdenum are in a general way now fairly well known. The special demand for it at the present time is due principally to its properties

¹ Her. an, H. Recent mining in Croajingolong. Rec. Geol. Surv. Vict., Vol. IV., Part 1.

for hardening and toughening steel. In steel work it finds a place in propeller shafts, heavy cranks, guns, boilers, shells, tool steel, and armour plate; it is also utilized as a pigment in porcelain, silk goods, leather, and rubber. It also has a large chemical and technical use in analytical work.

Victoria has hitherto been a non-producer. New South Wales and Queensland have provided most of the Australian production, which has been a substantial one compared with the world's output.

Concentrates for market should contain 80 per cent. of molybdenite, preferably 90 per cent. or more. Lower percentages are attended with substantial reductions in prices per unit. As recently as 1909 the price was less than 20s. per unit, or £90 per ton of pure ore. The price rose to £133 in 1911, to £260 in October, 1913, to £326 in December, 1913, to £462 in January, 1914, to £560 in April, 1914 (all for 90 to 95 per cent. ore), and finally touched since the war started about £700 per ton.

Recently all Australian deposits have been commandeered by the Commonwealth Government at the price of 105s. per unit, equal to £525 per ton of pure ore.

Concentrates for market should be as free as possible from copper, arsenic, bismuth, and tungsten, the presence of which reduces the commercial value.

[1.9.15.]

MOLYBDENITE AT SIMMONS' GAP, NEAR BRIGHT.

H. Roach's molybdenite workings are about 12 miles by road and track from Bright, at Simmons' Gap, where Dungey's track from Bright to Omeo crosses, at an elevation of about 3,000 feet above sea-level, the range separating the watersheds of the Ovens and Kiewa Rivers.

Molybdenite (sulphide of molybdenum), with molybdite (molybdic ochre) and bismuthinite (sulphide of bismuth) in lesser quantity, shows freely in numerous quartz lodes, commonly striking from north-west to nearly north and south, visibly outcropping in many instances for 20 chains or more, and showing in individual cases varying widths from a few inches to perhaps 2 feet or 3 feet on the average. In one case a width of 6 feet or 7 feet shows in the outcrop for a chain or more. The lodes are in granite adjoining Ordovician sedimentary rocks.

The prospector's work, which has been carried on at intervals since the early part of 1914, has consisted chiefly of searching and knapping for ore along the outcrop. Within the last three months a shaft has been sunk 30 feet on a lode averaging about a foot wide, the quality of which could not be estimated in the shaft as sinking had been done on the eastern wall, and the lode had not been broken into.

So far, no indication has been found of the existence of easily-won molybdenite in considerable quantity; nor is there, in my opinion, any good reason for taking a highly optimistic view of the outlook. Nevertheless, I think that the prospector's tenacity and the exigencies of the times warrant a little assistance from the State in driving a tunnel on one of the lodes. It is unlikely that the issue, if successful, will be attained early enough to assist the demand for the present war purposes; the only chance in this direction being that patches of ore, coarse and rich enough for hand dressing (of which none have so far been found), may be early met with in the course of the work suggested.

[31.7.15.]

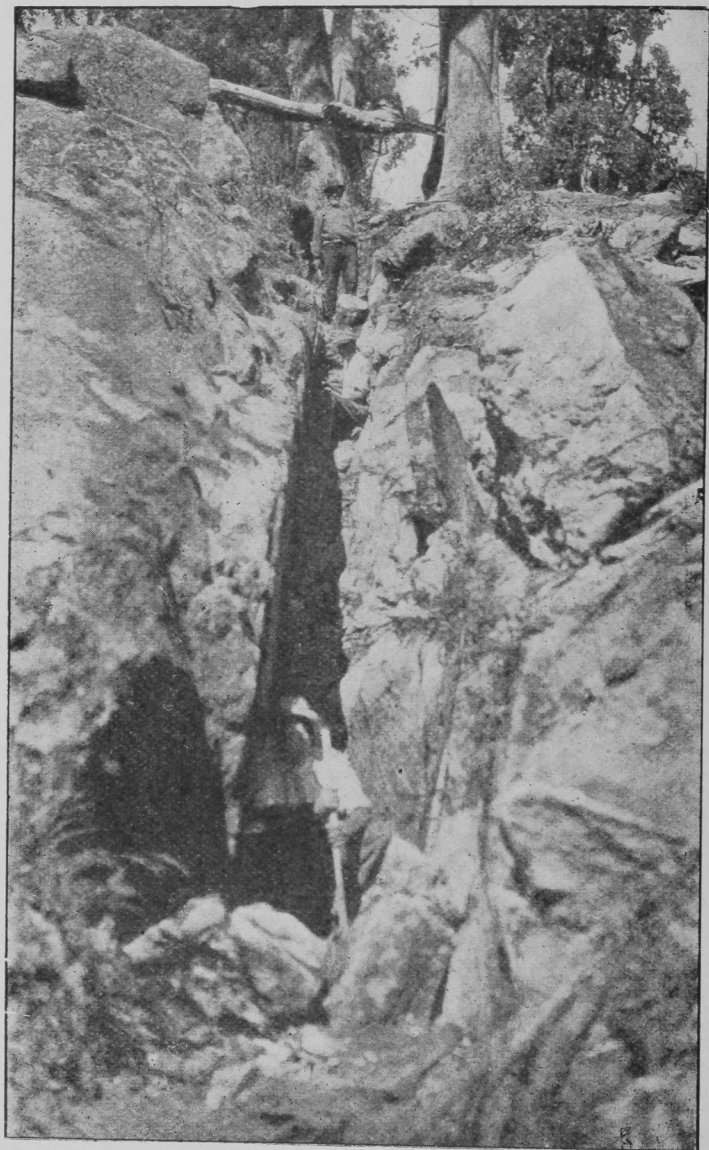


PLATE XXXV.
Molybdenite Lode, Mt. Stanley.

MOLYBDENITE NEAR STANLEY.

Two lode deposits of molybdenite occur near Stanley, and both are in granite country rock. (Fig. 65.)

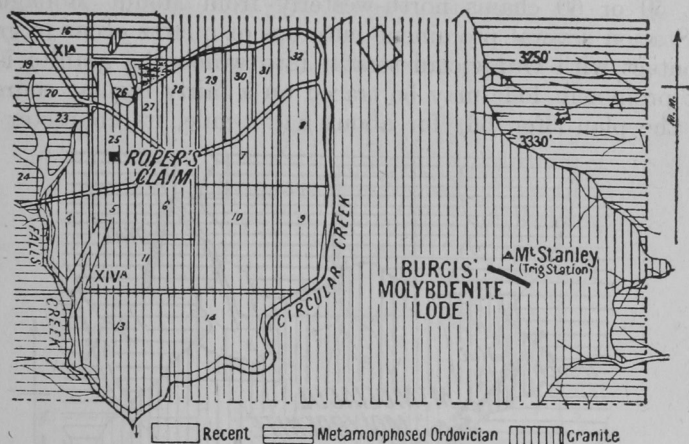


Fig. 65—Molybdenite Deposits, Parish of Stanley. Scale : 1 mile to 1 inch.

One deposit, held under lease by Mr. J. Burgis of Stanley, is in the form of a quartz lode, about 10 inches wide, about 9 chains southerly from the Trigonometrical Station on Mount Stanley. An open cut exposes the lode for a length of about 30 feet and a maximum depth of about 12 feet (Pl. XXXV.); molybdenite shows freely in the quartz gangue; a little ochre also is visible here and there. By shallow holes and costeans the outcrop has been traced on an east-south-east and west-north-west course for 15 or 20 chains. In the open cut the dip is 82° to 85° to the north-north-east.

This lode appears to be worth opening up by a tunnel below the open cut and following the lode easterly. Other lodes occur in the same locality; this appears to be the only one so far prospected.

The second deposit, known as Roper's, and held as a prospecting claim, is in Block 25, Section XI A., parish of Stanley, about 2 miles south-easterly from Stanley township. Here a hole a few feet deep has been put down on an irregular quartz vein; molybdenite may be seen both in the quartz and adjoining granite. "Shows" of molybdenite may be obtained in many places in the same locality, sometimes in quartz veins and sometimes in the granite itself.

Deposits of this character are hard to follow and, unless ore of better grade than that hitherto found can be located, I do not think sinking or driving would be warranted. It is quite possible that careful prospecting on the surface might be rewarded with pipes or veins similar to those worked and hand dressed by the prospectors of New South Wales and Queensland.

Samples of both deposits are in the Geological Survey museum.

[12.8.15.]

MOLYBDENITE AT MOUNT MOLIAGUL, MALDON, AND MOUNT WILLIAM.

MOUNT MOLIAGUL.

About 50 or 60 chains north-westerly from Mount Moliagul Trigonometical Station several prominent outcrops of quartz occur in granite close to the contact with Ordovician strata, into which the granite is intrusive. The most prominent lode may be traced on a fairly regular course (as indicated on the plan (Fig. 66) for about half-a-mile, its character being well

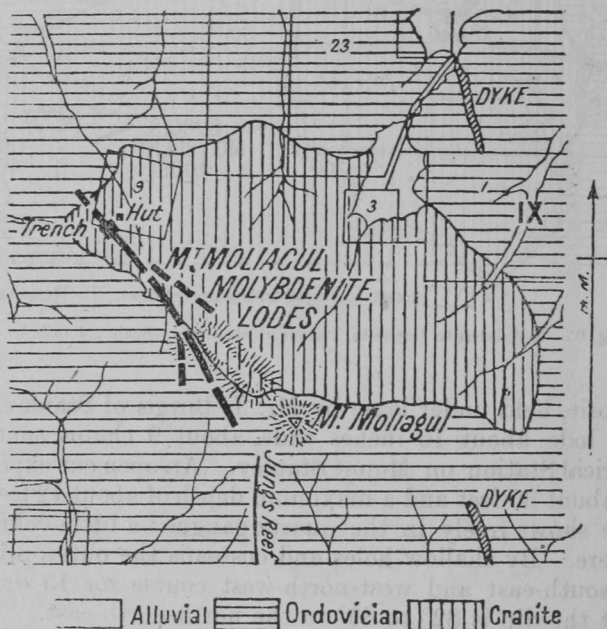


Fig. 66.—Molybdenite Lodes, Parish of Moliagul. Scale : 40 chains to 1 inch.

exposed in many places by open cuts, shallow holes, and trenches. From 1 ft. 6 in. to 2 feet of quartz may be seen in several places ; in one cut the lode was up to 4 feet wide. Molybdenite, with occasional molybdic ochre, was freely visible in many places. This lode appears well worth opening up. A tunnel from the northern side of the hill, on the course of the lode, would perhaps be the best means of quick prospecting at a moderate depth. If this proved satisfactory, a shaft would then be necessary.

MALDON.

At Maldon molybdenite has been known to occur for 30 or 40 years past. With Mr. Nankivell, District Mining Surveyor and Mining Registrar, I visited the slopes of Mount Tarrengower and briefly inspected the granite in two or three places where the mineral has been recorded, but did not find anything worth mention. Mr. Nankivell told me that no lease or claim for molybdenite has been marked out during his term of office, which commenced 22 years ago. I do not think anything has been found here worth developing.

MOUNT WILLIAM.

At Mount William I found that at one locality, prospected by surface knapping only by Mr. L. J. Phillip, of Mount William, occasional small crystals of molybdenite were to be seen in thin quartz veins (up to about 2 inches thick) in a hard quartz porphyry ; while at Pincombe's old tunnel gold workings splashes of molybdenite are visible on faces on the coarse-grained quartz-mica diorite, the country rock of the locality. Neither of

these occurrences (whose approximate positions are shown on the plan (Fig. 67) presents any inducement for molybdenum prospecting. At several other

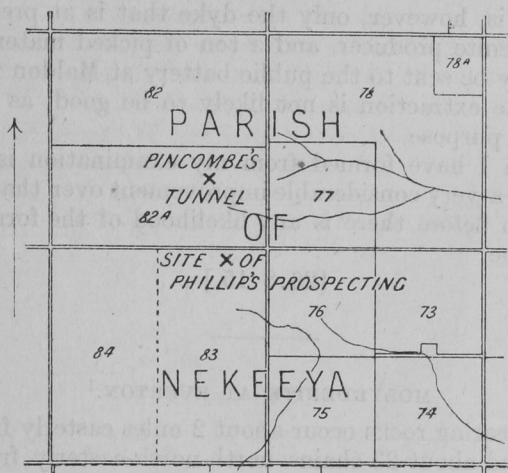


Fig. 67.—Molybdenite Occurrences at Mount William. Scale : 1 mile to 1 inch.

places on the Mount William gold-field “showings” of molybdenite occur which appear, from information I have gathered, to be of no greater importance. I cannot see any inducement, at present, for prospecting for war supplies any of the Mount William known deposits.

[16.8.15.]

MOLYBDENITE AT THE NEW DAY DAWN MINE, MALDON.

I visited Maldon on the 11th August, 1915 for the purpose of ascertaining whether any of the molybdenite occurrences at Maldon present any prospect of becoming commercially useful, and concluded that nothing worth special attention had been found.

In view, however, of a report in the *Argus* of the 23rd instant, that a formation 20 feet wide containing molybdenite exists at the New Day Dawn mine, I again visited Maldon on the 25th instant. I found that the ore body referred to in the press report was an elvan dyke, whose course has been traced for several miles in a north and south direction through the heart of the Maldon gold-field; and that on the mullock tip of the old Day Dawn shaft (now abandoned and inaccessible) about 70 chains north-north-westerly from the Maldon railway station, a considerable quantity of the dyke material has been deposited from the underground workings (probably, as Mr. Lock, mine manager of the New Day Dawn mine, informs me, from cross-cuts through the dyke at the 250-ft., 400-ft. and 600-ft. levels). Some of the dyke material on the tip shows molybdenite freely, but in the great bulk of it little or nothing can be seen.

At the New Day Dawn shaft, now working, and about 10 chains north of the old Day Dawn shaft, two levels have been opened at 80 feet and 150 feet deep. Four quartz lodes (the Jubilee, Day Dawn, Cricketer's Spur and Cumberland), trending nearly parallel with one another within a width of about 400 feet, are being prospected; from one of them, the Day Dawn, about 700 tons of stone have been crushed for yields of 1 oz. of gold per ton down to 6 dwt. In all of these lodes, Mr. Lock informs me, molybdenite occurs.

In the Day Dawn reef I could see the mineral freely; and in this reef the experience has been that the richer the stone in gold the more molybdenite does it carry. It is, however, only the dyke that is at present regarded as a possible molybdenite producer, and a ton of picked material from the old Day Dawn tip may be sent to the public battery at Maldon for trial. If this should be done the extraction is not likely to be good, as the plant is not suitable for the purpose.

The impression I have formed from my examination is that the grade will have to show a very considerable improvement over that of the material in the mullock tip before there is any likelihood of the formation becoming of commercial value.

[26.8.15.]

MOLYBDENITE AT EVERTON.¹

Molybdenum-bearing rocks occur about 2 miles easterly from the Everton railway station, and about 23 chains north-north-easterly from the 165-mile post on the Beechworth railway line. Molybdenite, with some molybdic ochre, has here been found by knapping in places over an area of 2 or 3 acres in irregular quartz veins in granite, and in the granite itself, close to the contact with sedimentary rocks, probably of Ordovician age, which may be seen immediately to the north. In one trench sunk 3 or 4 feet deep, about 3 chains southerly from the contact, molybdenite ore of high quality in a granite matrix has been broken out, and similar material is still showing in the solid face. This trench is the only work worth mention that can be seen, but what it reveals is, in my judgment, sufficiently promising to justify energetic prospecting by open cutting and trenching. The ground is held, I believe, under prospecting claim by J. Parkinson, now in camp (at Broadmeadows, probably); his interests are protected under the Mining By-Laws by virtue of his service for defence purposes.

Beyond the boundaries of Parkinson's claim, the granite adjacent to the contact with the slate and sandstone rocks is worthy of the attention of prospectors.

[31.8.15.]

MOUNT MOLIAGUL MOLYBDENITE SYNDICATE, MOUNT MOLIAGUL.²

The Mount Moliagul Molybdenite Syndicate holds leases Nos. 6032 (35 acres) and 6036 (34 acres), and has applied for leases 3306 (29 acres), 3311 (24 acres), and 3320 (18 acres). The issued and applied for leases form a compact area occupied by a granite mass containing many molybdenite-bearing quartz veins, and showing in many places molybdenite mineralization of the granite itself.

Numerous costeanes have been excavated; these show that the distribution of the molybdenite is widespread. This phase of mineralization is evidently general throughout the Mount Moliagul granite mass, but viewed as ore-deposits the molybdenite occurrences are sporadic.

For two reasons I did not attempt sampling of the various exposures of molybdenite-bearing rock—the task would have occupied several days, and the values obtained from the imperfectly developed faces would not be convincing.

¹ See page 295.

² See also p. 228.

The three localities to which the syndicate has devoted most attention and expenditure are marked A, B, C on the accompanying plan. "A" is an almost continuous trench about 800 feet long on a quartz vein, from a streak to more than a foot thick, carrying splashes and pockets of molybdenite freely. The prospects of remunerative returns from this vein do not, from a somewhat casual inspection, appear to be inviting. The trenches marked "B" and "C", particularly the latter, look much more promising as surface "shows." In "C" particularly, good quality ore shows freely in many places for the full length of the trench, more than 100 feet. Trench "B" also has encouraging prospects. (Fig. 68.)

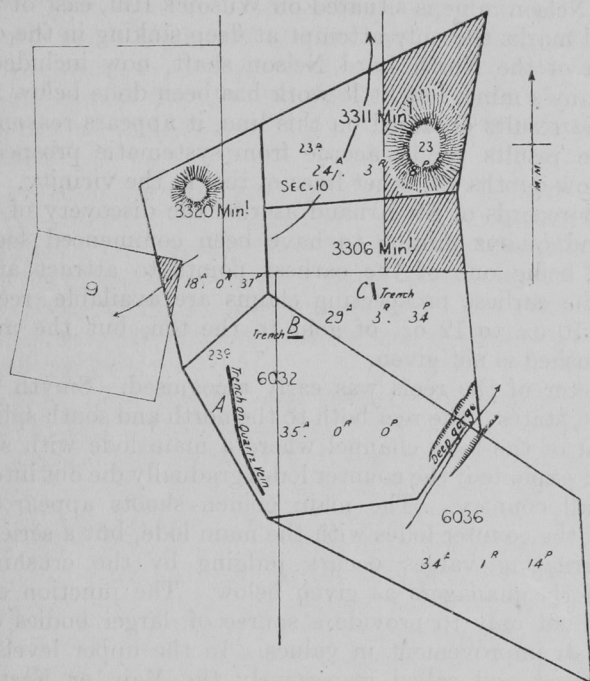


Fig 68.—Mount Moliagul Syndicate's Leases. Scale : 20 chains to 1 inch.

There is no apparent connexion between the veins and pockets of ore in the various trenches. As already indicated, there is apparently an irregular, though general, mineralization of the Mount Moliagul granite mass as a whole.

The impression left on me is that the deposits are worthy of energetic development. The syndicate is considering the erection of a mill at a cost of about £8,000 to treat 60 tons per day. Such a mill might or might not find ore sufficient to keep it fully occupied for more than a brief period, depending on the manner in which the faces would behave as the present limited quantity of ore actually visible would be extracted. It is very clear to me that separation or sorting of the material showing in the costeans is necessary; and the costs of mining or quarrying will largely depend on the proportion of worthless gangue to molybdenite rock of milling grade. What this proportion is likely to be will be ascertained only by an excavation or excavations of considerable dimensions. I suggest that an open cut near the bottom of trench "C" be made, carrying the floor in horizontally, and separating the excavated material into three grades and dumps, viz., gangue, low-grade ore of doubtful value, and milling ore. I think it would be wise to quarry and sort about 5,000 tons of rock at trench "C" on these lines before deciding on the erection of a mill.

[17.5.17.]

MOLYBDENITE AT WANGRABELLE, EAST GIPPSLAND.

A report on the molybdenite lodes at Wangrabelle appears in "Recent Mining in Croajingolong," by H. Herman, B.C.E., M.M.E., Director of Geological Survey.—*Records Geol. Surv., Vict.*, Vol. IV., Part 2.

LORD NELSON MINE, ST. ARNAUD.

By W. Baragwanath, Director.

The Lord Nelson mine is situated on Wilson's Hill, east of the St. Arnaud township, and marks the only attempt at deep sinking in the district. With the exception of the North Lord Nelson shaft, now included in the Lord Nelson Company's mine, but little work has been done below 1,000 feet, and, judging by the results obtained on this line, it appears reasonable to expect that favorable results would accrue from systematic prospecting, at comparative shallow depths, on other lines of reef in the vicinity.

The earlier records of St. Arnaud ascribe the discovery of alluvial to the year 1856, and quartz mining to have been commenced soon afterwards, Wilson's Hill being one of the earliest points to attract attention. Few yields from the earliest prospecting claims are available, records of yields giving up to 10 oz. to 12 oz. of gold to the ton, but the amount of this quality ore crushed is not given.

The character of the reefs was early recognised. Smyth,¹ quoting from Ulrich's report, states "the reef both to the north and south splits into veins." This is typical of the lode channel where a main lode with several counter lodes has been exploited; the counter lodes gradually die out into the foot-wall or hanging-wall country. The main golden shoots appear to follow the intersection of the counter lodes with the main lode, but a series of horizontal zones of alternating values occurs, judging by the crushings, and from the reports of the managers as given below. The junction of the counter lodes appears not only to provide a source of larger bodies of quartz, but also to cause an improvement in values. In the upper levels several reefs were thus noticed, and called respectively the Main or Eastern, Western, Clarke's, Paddy's, St. Patrick's and Ballarat reefs. Some of these were no doubt identical. In the deeper levels the counter reefs were known as veins, and were referred to as the New Find, New vein, Western vein, Mineral vein. In size, also, the counter lodes varied considerably, and, as a consequence, driving appears to have been done on the counter lode, while the main lode was left to be located again later by prospecting or in stopping operations. In the deepest level the main lode appears to have taken a true course with only one counter lode to form an enrichment; as a result the supply of ore is more limited.

A general description of the various lodes, as then exposed, is given in the report by H. S. Whitelaw,² 1898, while a summary of the workings of the Lord Nelson mine from 1886 to date is appended.

The earliest obtainable reports concerning the Lord Nelson company date back to the latter half of 1886, at which date operations were confined to between the 680-ft. and 900-ft. levels. Early in 1887, Mr. Z. Lane was appointed manager, and his name became almost synonymous with the Lord Nelson mine. In 1887 a double-cylinder winding engine was installed, as well as additions to the battery. The gold was alloyed with a considerable quantity of silver, and was valued at about £3 3s. per oz. Crushing proceeded

¹ Brough Smyth, R. Goldfields of Victoria, 1872.

² Whitelaw, H. S. St. Arnaud goldfield. Spec. Rep. Mines Depart., 1898.

at the rate of about 8,000 tons per half-year from 1887, and the value of the ore from about £1 per ton (half-year ending June, 1888) to £2 8s. (half-year ending June, 1891). Regular dividends ranging from £3,600 to £9,000 per half-year were paid, and progressive works and shaft-sinking were also carried on. From June, 1891, the tonnage and yields showed a falling off, and in 1892 an air-compressor plant was added, which facilitated operations.

In 1895, the tonnage was on the increase, the ore being valued at about £1 6s. 8d. per ton on the average. The cost of shaft-sinking from the 1,210-ft. to 1,310-ft. level during 1896 was £4 11s. per foot on contract, the contractors supplying explosives and using hand labour. Cross-cutting at the 1,310-ft. level cost £2. 1s. 6d. per foot. An average output of over 22,000 tons of ore per year was kept up from 1895 to 1901, with the exception of the early part of 1898, when, owing to an exceptional drought, the quantity of ore crushed was only half normal for five months. Regular dividends were paid, the maximum half-year being that ending December, 1896, when a sum of £13,500 was distributed.

In 1897 experiments were made to ascertain if the sand were amenable to treatment by cyanide; the battery engine was compounded and a saving in fuel resulted. The results from the tests by cyanide being successful, a plant capable of treating the whole of the sand from the battery as well as some of the accumulated tailings was erected. The return for the half-year ending December, 1899, left a very small margin of profit, only £16 12s. from £2,009 worth of gold.

The 1,410-ft. level in 1900 was opening up satisfactorily, large bodies of ore being in sight. Towards the end of 1900 the cyanide plant commenced to show a considerable profit. The value of the stone crushed from 1894 to 1901 ranged between £1 6s. 8d. per ton (half-year ending June, 1893) and £2 3s. 4d. per ton (half-year ending December, 1896). Dividends were kept up, and for the half-year ending December, 1903, £10,800 was distributed. At this date the workings had reached a depth of 1,610 feet, a progressive policy being adopted in keeping several years' ore in sight. Mr. Z. Lane relinquished management early in 1904, and towards the end of that year prospecting operations at the 780-ft. level resulted in the opening up of some highly payable ore which had been left west of the former workings. Meanwhile, the shaft was deepened and the 1,710-ft. level opened.

In 1905 a new pumping plant was erected and the battery and cyanide plant were remodelled. Dividend paying ceased and a heavy overdraft was incurred. By the end of 1906 the plant was completed and in working order. During 1907 a thorough and systematic overhaul of the old levels was made to locate any blocks of ore left in former operations. The 1,810-ft. level was opened and values here proved satisfactory. Early in 1908 the indebtedness to the bank was wiped out, but by the end of the year the ore mined left nothing for dividends; operations now extended from the 680-ft. level to the 1,930-ft. level.

In March, 1909, the North Lord Nelson Company having proved the lode at a depth of 2,080 feet to lie in their ground the two companies amalgamated, and the 2,080-ft. level workings were connected to the Lord Nelson shaft, which was deepened for the purpose. Little more than working expenses was obtained during 1910, as the cost of shaft-sinking and cross-cutting were considerable.

890-ft. Level.*—In the south drive at this level, at 280 feet from the cross-cut, the lode was found to split into two branches—one, known as Clarke's,

* See note, p. 220, regarding depths of levels.

carrying gold for 70 feet before becoming poor, and the other, the "Western," a fine body of quartz with but little gold. At this level the shoot of gold south of the cross-cut was 160 feet long and averaged 6 feet wide.

A short make of payable ore was located on Clarke's lode by continuing the south drive for 130 feet, making 480 feet from the cross-cut, but little work appears to have been done on it. Clarke's and the Western lodes supplied crushing material from above the 880-ft. level south until 1889.

In the north drive, at 135 feet from the main cross-cut, a prospecting cross-cut was put out west, and at 31 feet from the main lode it cut a formation 2 feet wide. This was called the New Vein, and drives north and south proved that it continued, and a length of 200 feet of good payable ore was opened up for stoping.

As work proceeded on this line it was found that the formation was the main lode, and cross-cuts were put in at the 680-ft., 780-ft., and 950-ft. levels, where the lode was intersected and proved to be well defined and payable. During 1890 this lode supplied much of the crushing material, and was proved to carry payable stone for a length of 280 feet from its junction with the other formations. The stopes above this level on the lode were exhausted about the middle of 1892.

950-ft. Level.—This level was opened early in 1888. At 91 feet from the shaft the western cross-cut intersected Paddy's lode, a body of quartz $2\frac{1}{2}$ feet wide showing gold freely. North of the cross-cut Paddy's lode was small and poor for 60 feet, but from this point to the junction with the Western lode at 110 feet north the value improved. The Western lode had a strike more westerly than Paddy's line, and payable quality ore was followed for a distance of 210 feet from the junction, making the total from the main cross-cut 320 feet. To the northern boundary at 350 feet the lode was small and poor. Stoping on the junction stone north of the cross-cut was commenced in 1889, and a supply of milling ore was kept up during the year. The southern stopes in 1889 furnished a large percentage of the ore crushed, and the supply was kept up until the end of 1890.

South at this level Paddy's lode was followed for 73 feet with varying results. The Western lode to 130 feet was small, but further on it improved in size and quality. At 287 feet south the lode was 10 feet wide and payable, this enlargement being due to a junction with Clarke's lode. Drives were put along both formations from the junction, but, after 80 feet of driving on Clarke's and 60 feet of driving on the Western lode, both pinched and became poor.

In 1891 a cross-cut was put in to the west, and the New vein, which had been cut at the level above in 1889, was located at 31 feet. This showed gold where cut, and drives north and south proved a lode 2 feet wide of payable quality for 240 feet. At 200 feet north of the cross-cut the New vein junctioned with the mass or main lode channel.

1,030-ft. Level.—This depth was reached by the main shaft and the cross-cut west started by June, 1889. At 101 feet from the shaft the lode was cut and a north drive started. At 112 feet from the cross-cut the Western lode junction was met with, the stone at this point being 6 feet wide, showing gold freely. Driving north on what was supposed to be the main lode was continued for 70 feet, but the formation was small, so a cross-cut west was put in at 20 feet from the face, or 150 feet from the main cross-cut, and this, after passing through a 6-ft. width of slate country, cut the lode, which proved to be 20 feet thick and in part payable. A connexion was made to the level above and proved payable ore throughout. The north drive

was continued to 328 feet in a wide lode, but at this distance it was not of payable quality. In 1892 a formation was cut at 142 feet from the main shaft and was driven on south for 100 feet, being small but payable.

The level above the lode was continued south for 200 feet in a formation 5 to 8 feet thick, intermixed with layers of slate, the whole being of a payable quality. At 283 feet from the cross-cut the lode split into two formations—Clarke's and the Western—each carrying gold which continued to 373 feet from the cross-cut on the Western, and 348 feet from the cross-cut on Clarke's. In the stopes at 140 feet south of the cross-cut a flat make of stone, which came out of the western country, joined the lode and caused an enrichment in values for a length of over 150 feet. This flat make pitched north until it reached the main lode. Stopping above the 1,030-ft. level was begun in 1890 and continued until June, 1896.

1,210-ft. Level.—The cross-cut at this level was commenced towards the end of 1894. At 194 feet the New vein was cut. Driving north and south was commenced on a lode 5 feet wide carrying gold. For a length of 220 feet south the lode continued strong, being up to 8 feet wide and of good quality. At 241 feet Clarke's lode was cut and followed for 37 feet, where the formation died out in hard country.

North of the cross-cut the lode split into two branches and drives were put in along both tracks, but the western one soon cut out, the eastern formation maintaining a width of over 6 feet and was followed for 237 feet, good payable ore existing the whole way, but the face showed signs of nearing the end of the shoot.

Prospecting on the Western branch revealed a formation known as the Western vein, west of the track driven on, and a lode 7 feet thick of payable ore was located and followed north and south. At 195 feet north the lode joined into the main drive and was proved to extend south 300 feet from this point. The stone throughout averaged 3 feet thick, and was of good quality. This formation was located at the level above towards the end of 1896, and good quality stone obtained there.

At this level a length of 662 feet of payable stone was worked, and consisted of several lodes which intersected in places, making a total of over 40 feet wide, the greater part of which was payable. Stopping commenced towards the end of 1895 on the Eastern lode, which averaged 9 feet in width; two winzes sunk from the level above proving payable ore throughout, and affording good ventilation. On the Western vein, discovered in 1896, stopping was carried out on a lode averaging 3 feet in width and for a length of 300 feet. The western reef stopes were exhausted in 1898 and the eastern stopes in 1899.

1,310-ft. Level.—This level was opened in December, 1896, but the lode was not cut until late in 1897. The cross-cut west passed through several quartz veins—at 200 feet the Eastern or Main lode; at 224 feet the Middle vein; and at 251 feet the Western vein. These lodes carried payable gold, and drives were started on each of them.

Eastern Lode.—For 100 feet north the lode averaged 6 feet wide of payable ore; at 180 feet north of the cross-cut the Western lode joined this lode, making a formation 9 feet wide. South on this main lode the drive carried an average of 4 feet of payable stone.

Middle Vein.—The drive south carried a lode 3 feet wide for 50 feet from the cross-cut. At 240 feet south the lode became broken. Payable ore was proved to the level above, both north and south of the cross-cut.

Western Vein.—The north drive for 30 feet carried a lode averaging 3 feet wide. The south drive proved the lode for 40 feet to average 3 feet in width. In 1901 a lode was met with between the Eastern and Middle lodes, and was found to join the latter at 100 feet north of the cross-cut, and a block of stone 100 feet long with an average width of 4 feet was opened up.

A little stoping was undertaken on this level prior to the end of 1898, and early the following year was in full swing on the three lodes, together with flat makes and parallel veins. In 1900 the length of stopes on the three main lines were—Eastern vein, 207 feet; Middle vein, 123 feet; Western vein, 100 feet. The main stopes were exhausted in 1901, at which date the new formation between the Eastern and Middle lodes was discovered, and stoping on this was continued until 1903, the lode ranging from 4 to 6 feet wide.

1,410-ft. Level.—Cross-cutting west was commenced early in 1899, and by October the lode was intersected at 280 feet from the shaft, and proved to be 24 ft. wide and of payable quality; the cross-cut having been laid out to cut the lode at its widest point, where a winze from the level above had been sunk. On driving north and south, the lode was found to split, a "horse of mullock," 5 ft. wide, separating the two branches. In the north drive the Eastern or main lode was 9 ft. wide at 6 feet from the cross-cut, but at 138 feet driving ceased in 1901, the lode being broken and not payable for over 50 feet. At 33 feet in this drive the Middle lode branched off, and at 34 feet south of the cross-cut the Western lode branched from the Middle lode. The Middle lode was driven on north 34 feet to the junction and south to 255 feet from the cross-cut, and ranged up to 6 ft. wide, standing nearly vertical; the drive was continued to 337 feet, a strong lode passing underfoot. The Western branch was 3 ft. wide at 25 feet north, and payable.

South from the cross-cut the Eastern or main lode was 10 feet wide at 40 feet; at 178 feet the Middle lode came in, and was payable; at 102 feet south the junction with the Middle lode was located. The Western lode was 9 ft. wide at 33 feet south, and payable. At this level the Middle lode was regarded as the main lode, and from the junction of the other lodes it was of good quality and appearance.

Stoping above this level was begun in 1900, the length of stone on the Eastern lode being 296 feet; on the Middle lode, 120 to 360 feet; and on the Western lode, 182 feet; the Eastern and Middle lodes averaged 6 ft. wide, and the Western ranged from 2 ft. to 3 ft. wide. Above the 1,410 ft. level a slide was cut in the stopes, and for a time caused an impoverishment in the gold values. The Western lode was stoped out by September, 1903, and the Eastern and Middle lodes early in 1904.

In 1905 prospecting was carried out, the north drive being extended 114 feet, 38 feet of which was in payable quartz. A south prospecting drive was extended from 337 feet to 623 feet from the cross-cut; three makes of quartz, each carrying gold, were passed through, but they were not payable.

1,510-ft. Level.—The shaft having reached this depth, cross-cutting west was begun in April, 1901, and before the end of the year the lode-channel was met with. At 300 feet from the shaft the footwall of the Eastern lode, a solid body of quartz 10 ft. thick, was met. At 310 feet the Middle lode, much broken up, was intersected. Driving north and south on both formations was undertaken. The Eastern and Middle lodes junctioned at 33 feet north of the cross-cut, the lode at this point being 18 ft. wide, but narrowed fast, going northerly.

The Middle lode for 60 feet south continued broken, but at this point a solid body of quartz 4 ft. wide came in. At 65 feet south of the cross-cut the junction of the Western and Middle lodes was met, and showed a pitch of 65 feet to the south from the level above. The Western was small, but the Eastern lode stone continued 6 ft. thick and of good payable quality for 14 feet. Below this level the Western lode was not met with.

Stoping above this level was commenced in 1902, the lengths and widths taken being—

Eastern lode, 150 feet at 1,410-ft. level to 198 feet at the 1,310-ft. level, the lode being from 5 to 6 feet wide.

Middle lode.—Stopes, 426 feet in length; the lode averaged 8 ft. wide.

Western lode.—Stopes from 44 to 73 feet in length; the lode averaged from 1 ft. 6 in. to 2 ft. 6 in. wide. The stopes were exhausted early in 1901.

1,610-ft. Level.—The west cross-cut was started early in 1903. At 350 feet the lode was passed through and driving started; at this level only the Middle and Eastern lodes were located, the Western having joined the Eastern at the 1,510-ft. level. The Middle lode averaged 8 ft. wide for 200 feet of good stone; the Eastern lode for about 120 feet averaged 8 ft. wide, but was worth only 4 dwt. to the ton. The payable shoots showed a decided shortening on the north end. In 1906 a drive on the Eastern lode broke through to the Middle lode drive at 79 feet; a stope 18 feet high was taken out, but proved this stone to be unpayable.

Two winzes were put down in the south drive—No. 1 at 98 feet south, and No. 2 at 184 feet south, both in payable quartz, in the latter winze 10 feet wide.

In the north drive the lode pinched out within 70 feet, but a new make came in, the formation being 8 ft. wide for a length of 40 feet; at 124 feet another blank was met with.

South from the cross-cut the Middle lode widened, being 8 ft. thick at 174 feet. At 303 feet the lode cut out, and the drive was in a blank to 347 feet. In 1907 a prospecting cross-cut was put out west for 54 feet at a point 300 feet south of the main cross-cut, but nothing of value was met. Stopping was commenced early in 1904 over a length of 357 to 427 feet, the lode ranging from 6 ft. to 8 ft. wide. The Western lode stopes were exhausted by the end of 1906, and the Eastern stopes, proving not payable, were discontinued.

1,710-ft. Level.—Cross-cutting west at this level was begun towards the end of 1904, and early in 1905 the lode-channel was passed through at 360 feet from the shaft, the formation consisting of three makes of stone with mullock intervening. In the north drive to 78 feet from the cross-cut the lode averaged 7 ft. wide and was payable; at 156 feet it cut out as it had done in the level above, and a prospecting drive was put in for 108 feet along the track without meeting any ore. In the south drive at 124 feet from the cross-cut the lode was 13 ft. wide and of good payable quality. To 306 feet south the lode was continuous, but at this point a blank was met.

Stoping was begun in July, 1905, and carried out over a length of 350 feet to 450 feet by a width of from 8 to 9 feet. In places the stopes were very heavy and required close timbering, and this feature became more prominent in the lower levels. The stopes in the southern end were exhausted by the end of 1907, the northern stopes later.

At 37 feet north of the cross-cut, a winze was sunk to a depth of 76 feet on a lode averaging 5 ft. of payable ore; below this the ore was of poor

quality. At 99 feet south of the cross-cut in No. 2 winze the lode split into three formations, making in all 5 ft. of payable quartz with 3 ft. of mullock between. At a depth of 80 feet the lode became poor.

1,810-ft. Level.—This level was reached in July, 1906, and cross-cutting west commenced after a well had been completed.

Early in 1907 the reef was cut at 410 feet from the shaft, and drives north 123 feet and south 198 feet put in, the lode at either end being small and poor. A length of 290 feet of payable ground was opened up, and stoping began by July, 1907. The south drive was continued to 243 feet from the cross-cut, the last 30 feet being along a track only.

A winze was sunk at 15 feet north of the cross-cut, near the northern end of the shoot of stone, and for 118 feet the lode was payable, and averaged $5\frac{1}{2}$ ft. wide.

At 110 feet south of the main cross-cut a winze was put down for 95 feet, the lode at the mouth of the winze being wide and showing payable prospects.

The stopes above this level were poor for a height of 20 feet to 30 feet, but gradually improved in value, although the lode, being heavy and wet, was costly to mine. The stopes were exhausted early in 1909, after having supplied 24,508 tons of ore.

1,930-ft. Level.—Cross-cutting at this level was begun early in 1908, and the lode-channel was intersected at 458 feet. By the end of the year the north drive had reached a distance of 60 feet and was stopped, while the south drive was in 171 feet, where a lode of payable value 6 ft. wide was exposed. At 175 feet the lode became small and poor, and continued so for 25 feet to the face. The north drive was extended to 146 feet from the cross-cut, where the lode pinched to 6 in. and became poor. The level was proved to have been driven along a zone of low values, part of the main shoot being too poor to stope, while the lode in the winzes from the level above was payable for the greater part of their depth. At 40 feet south of the main cross-cut a cross-cut west intersected a vein at 12 feet, which though irregular in size and value was driven on and yielded some rich ore; a stope 80 feet long was taken out on this vein which averaged 1 ft. 6 in. wide, and was worked to near the 1,810-ft. level, the lode in the block being very small.

At 140 feet south of the main cross-cut a winze was sunk to connect to the 2,085-ft. level. Stoping was in progress early in 1909, a length of 320 feet being taken out, the lode ranging in width from 6 ft. to 7 ft. wide. The Western vein though small was of good value. The stopes were exhausted early in 1911, after producing 24,738 tons of ore.

2,085-ft. Level.—This level was driven by the Lord Nelson North Company from their shaft, and cutting the lode on its western underlie to the west of the Lord Nelson Company's lease. The amalgamation of the two mines took place shortly afterwards, and a cross-cut was driven east from the level to connect with the Lord Nelson shaft, which was being deepened. Meanwhile a winze from the 1,930-ft. level of the Lord Nelson mine was connected, and a good ventilation secured. The cross-cut was connected to the main shaft, and the north shaft was abandoned by November, 1909; work was thus more economically carried on.

In driving this level the Lord Nelson North Company located two shoots of auriferous stone, the northern shoot being 100 feet in length and barely payable, while the main shoot was 330 feet in length of an average width of 7 ft. and in value from 10 dwt. to 14 dwt. to the ton.

The prospects on this level were an improvement on the upper levels, the lengthening and higher value of the main shoot of stone being apparent, and the northern shoot which, while irregular and patchy, was payable in part. The main lode-channel was driven on for a total of 790 feet, 390 feet being in

payable stone. For 140 feet in length at the south end of the level, the drive was in the hanging wall side of the lode, which here was 16 ft. wide, 12 ft. being payable ore. The lode was highly mineralized, and contained small seams of galena.

The Eastern lode was driven on for 55 feet, 35 feet being in payable stone, which at this level extended 70 feet further south than in the 1,930-ft. level. At from 300 feet to 350 feet south of the cross-cut a shoot of stone worth 1 oz. to the ton was driven through, and at 320 feet south a winze was sunk in good value ore 7 ft. wide. To a depth of 50 feet the lode averaged 5 ft. wide of good payable stone, then it split, and the western branch was followed, but this proved to be poor.

At 37 feet south of the main cross-cut a winze was sunk to a depth of 167 feet in a lode averaging 5 ft. wide, and payable. At 170 feet south of the cross-cut a winze was sunk, and to a depth of 22 ft. it was in 5 ft. of payable stone.

Stoping was commenced early in 1909, but owing to the necessity of hauling the ore through the Lord Nelson North shaft and carting to the Lord Nelson battery, the output was limited, a length of 350 feet being taken on stone averaging 7 ft. wide. After connecting to the main shaft in November, 1909, an increased supply was mined, over 10,000 tons of ore being produced for the half-year ending July, 1910, from the stopes over this level, a length of ore 470 feet, ranging from 3 ft. to 10 ft. wide. As the stopes were carried up the values decreased, and the length of ground stoped was shortened to 300 feet. The south shoot proved to be too poor to take out. These stopes were exhausted by the end of 1911, after yielding 33,788 tons of ore.

2,225-ft. Level.—Cross-cutting at this level was commenced about May, 1910. The lode was intersected at 550 feet from the shaft, and a connexion was made with the drive from the winze from the 2,080-ft. level at 37 feet south of the main cross-cut. In the north drive, for a length of 131 feet from the winze, payable stone 5 ft. wide was followed; this formation continued to 175 feet, where the main shoot of stone terminated, being at this level 40 feet further north than in the level above. To 397 feet from the winze the drive carried a lode of nice appearance and well mineralized, but too poor to be payable, with the exception of a small shoot of 60 feet, which carried payable values. South of the winze the lode averaged 5½ ft. for a length of 274 feet, where a contraction was met with, which, between the main shoot and the south shoot, was similar to that in the 2,085-ft. level. The south level was driven to 445 feet from the winze, and proved the south shoot of gold to be 80 feet long, and payable.

No. 1 winze was sunk at 20 feet south of the cross-cut to a depth of 195 feet on a lode showing payable values throughout. No. 2 winze, at 170 feet south of the cross-cut, was sunk in payable stone for 60 feet, but below this point it was in the footwall country.

Stoping was begun towards the end of 1910 on a large body of payable ore, the prospects being exceptionally favorable. In 1911 the stopes were in full swing and produced 23,831 tons of ore during the year; the main stopes were 420 feet in length on a lode averaging 7 ft. wide, while the south stopes were taken for a length of 70 feet to 90 feet; the stopes were depleted early in 1913, having produced 46,380 tons of ore.

2,405-ft. Level.—This depth being reached by the main shaft, cross-cutting was commenced towards the end of 1911. While this work proceeded, driving on the lode at this level was undertaken north and south of No. 1 winze from the 2,225-ft. level; the north drive at 48 feet from the winze showed 3½ ft. of ore, while the south drive to 45 feet was on a lode averaging 1 ft. 6 in. wide. The lode in both drives was highly mineralized, and payable.

A connexion with the drives was made in July, 1912, by which date the north drive was in 129 feet and the south drive 123 feet from the winze, the lode throughout averaging 3 ft. wide, while the two faces showed 4 ft. of payable stone. In the north drive, the lode from 129 to 247 feet averaged 2½ feet wide, cutting out at 275 feet north. South at 310 feet the lode cut out, but the drive was continued to cut the south shoot of stone, which came in at 400 feet and extended 475 feet. The lode averaged 2½ ft. in width, but was only worth 2½ dwt. to the ton.

At 260 feet south of the winze a cross-cut west cut a new make of stone, which cut out when driven on north, but to the south it was 2½ ft. wide. A branch drive was next opened along the Western vein from the main level at 220 feet south of No. 1 winze, the first 30 feet being in payable stone; 60 feet further on there was a poor lode, the face at 90 feet showing stone 2 ft. wide, carrying a little gold. At 455 feet south of the main cross-cut a prospecting cross-cut was put in 65 feet to the west. At 47 feet a lode (the continuation of the Western vein driven on from 220 feet south of the winze) 2 ft. wide and poor was passed through.

2,485-ft. Level.—At a point 245 feet south of the main cross-cut, at the 2,405-ft. level, a winze was sunk on the underlie of the lode to a depth of 89 feet. At a depth of 36 feet some rich ore was obtained, this point being near the junction of the Western vein and the main lode.

From the bottom of the winze a drive was put in south 84 feet on the Western lode, 20 feet being in payable ore. North of the winze for 61 feet the drive followed the main lode; for 30 feet the ore was payable, but the remainder was poor, although the lode continued over 4 ft. in width. Stopping above this level was commenced towards the end of 1913 on the short shoot of stone.

For several years prior to the amalgamation with the adjacent company the Lord Nelson Company began a systematic prospecting of the old levels, as the result of which the following works were undertaken.

680-ft. Level.—In 1905 a winze was sunk 100 feet and connected with the 780-ft. level for ventilation. In 1906 a rise at a point 399 feet north of the cross-cut was connected to the 600-ft. level, Wilson's Hill shaft, for further improving the ventilation. In the south drive, at 208 feet from the cross-cut, a block of stone 40 feet long and averaging 3 ft. wide was stoped. The main level was extended in a large body of poor ore. On the eastern branch of this lode some rich patches of ore were obtained in 1908, but the stone became small, and work was stopped by the end of the year.

780-ft. Level.—The old drive on the eastern reef was cleaned out and re-timbered for a distance of 161 feet. On cross-cutting west 22 feet, the Western lode was intersected, and averaged 5 feet in width. By stoping underfoot a depth of 15 feet the back of the 880 feet stopes was reached, the stone throughout being highly payable. The north drive on this reef for 178 feet carried a lode averaging 5 ft. wide. At 289 feet the lode was 7 ft. wide; a length of 350 feet of lode averaging 6 ft. wide was stoped during 1906. In the north end of the stopes the lode was 15 ft. wide for a length of 63 ft. at 58 feet over the level, but in the south end it was smaller, being only 3 ft. wide at 35 feet over the drive. Early in 1907 the stopes on the Middle lode were stoped, and a stope 42 feet long was taken out on the Western lode. This lode ranged from 1 ft. to 3 ft. wide, and was rich in places. Stoping was carried out on this lode, which averaged 1 ft. 6 in. wide, until the end of 1908, the 680-ft. level being reached; at this point the lode broke up and was unpayable. Stoping on St. Patrick's lode was undertaken for the half-year ending 1908, the stopes from the 880-ft. level breaking through to this level carrying payable stone.

880-ft. Level.—In 1907 a cross-cut driven west from the Middle lode at 16 feet cut the Western lode, on which a winze was sunk to the 940-ft. level. Driving north and south proved the lode to be payable, and for a length of 140 feet it averaged 1 ft. wide, and was stoped through to the 780-ft. level on profitable ore by June, 1908. At the main level a cross-cut through the old stopes cut St. Patrick's lode, which proved to be very rich at this point, and was stoped through to the 780-ft. level by the end of 1908.

940-ft. Level.—The stopes above the 1,030-ft. level broke through to these workings by the end of 1906. Stoping was carried out on the Western lode, which averaged 1 ft. 2 in. wide, and being cheaply worked was profitable. The length of stopes to the 880-ft. level was 80 feet.

1,030-ft. Level.—Towards the end of 1905 a make of payable quartz was located on the Western lode at this level, the block being 76 feet long and averaging 1 ft. wide and of good quality for a height of 30 feet. At 60 feet up the lode averaged 2 ft. wide, and was of payable quality up to the 940-ft. level.

1,110-ft. Level.—In 1906 a block of stone left on Paddy's lode, 80 feet in length, 30 feet high, and 2 ft. wide was re-opened. This was taken out to the 1,030-ft. level by the end of the year.

1,210-ft. Level.—In 1907 a cross-cut was put in to re-open an old drive on the Western lode to work a small quartz leader between the Western and the Middle lodes. This was cut and driven on for 87 feet on an average width of 12 in., and a winze was sunk to the 1,310-ft. level and holed through to the Western lode between the Middle lode and the "New Find" lode. At this 1,310-ft. level a drive of 145 feet was put in along the lode, which averaged 1 ft. in width and was of good value. Stoping was carried out on this lode and also on a mineral lode which averaged 3 ft. in width for a length of 100 feet. This mineral lode was located at the 1,210-ft. level, and averaged 4 ft. of payable ore for 150 feet. At this level the mineral lode was between the Middle and the Eastern lodes. The stopes shortened, and old workings were met with over this level in 1910. Within 10 feet of the 1,110-ft. level the lode averaged $3\frac{1}{2}$ ft. wide, and was of good value. The stopes were exhausted in June, 1910.

A prospecting cross-cut was carried out west from the hanging wall of the main lode at the 1,310-ft. level to meet the intersection of the Storm lode, but nothing was met with in 270 feet of cross-cutting or in a bore hole extended west of the cross-cut. The bore hole was plugged, as a heavy flow of water was cut.

Reviewing the career of the mine from 1886 to the present date the most striking feature is the falling off in the gold value of the lode as the deeper levels were reached. The year of maximum values was 1900, the ore being worth over £2 6s. per ton. The cyanide plant showed a considerable increase in recovery, which tended to compensate for a lower return from the battery, but, as mentioned above, a large quantity from the old dumps was treated. A proportion of the gold won was derived from the ore crushed from the upper levels. With the gradual falling off in receipts a curtailment of expenditure was apparent, and this has contributed to the mine's survival to the present time. Regular dividends were paid from 1888 to 1904, but thereafter until June, 1906, the payments were irregular. The erection and re-modelling of plant in 1906 and 1907 involved the Company in a considerable debt, but by careful management this was paid off by the end of 1910, and during 1911 and 1912 several dividends were paid.

As in all mines where operations are confined to a vertical system of lodes, shaft sinking was the chief consideration. The rate of progress of this work was as follows. At the beginning of 1887 the deepest level was 890

feet. Early in 1888 a further sink of 60 feet was carried out, and the 950-ft. level opened. By June, 1889, a further 65 feet had been sunk, and the 1,030-ft. level opened. In June, 1891, sinking was resumed, and a further depth of 80 feet reached, a level being opened at 1,110 feet from the surface. Early in 1893 a further sink of 100 feet was completed, and a plat was cut at the 1,310-ft. level, but the lode was not intersected at this depth until 1895. In August, 1896, sinking was resumed, and early in 1897 the 1,310-ft. level cross-cut was begun. Early in 1899 the shaft was deepened, and the 1,410-ft. level opened. The cross-cuts were becoming more lengthy as depth was reached, and at this depth amounted to 280 feet. In January, 1901, a contract was let to sink the shaft from the 1,410-ft. level a further depth of 100 feet at a cost of £3 15s. per foot, the contractors finding explosives and candles. The work was completed in 10 weeks, and cross-cutting was started at a depth of 1,510 feet. During the first half of year 1903 the shaft was deepened, and a level opened at 1,610 feet from the surface. Shaft sinking was resumed in 1904, and a plat cut at the 1,710-ft. level. Early in 1906 the mine manager recommended the sinking of the shaft a further 250 feet, but this was altered by the management to a sink of 100 feet, which was commenced in May, 1906, and the 1,810-ft. level was opened in August, 1906. Towards the end of 1907 sinking was resumed, and a lift of 120 feet undertaken; the 1,930-ft. level being opened early in 1908, the amount of cross-cutting at this level to reach the reef was 458 feet. In 1909, the amalgamation with the Lord Nelson North Company being effected, a cross-cut easterly was started from that company's 2,085-ft. level. The main shaft was connected to this cross-cut towards the close of 1909. By July, 1910, a plat was cut at a depth of 2,225 feet, and cross-cutting westerly started. By December, 1911, the shaft had reached its present depth, and the 2,405-ft. level was being opened. At this depth the length of the cross-cut was 620 feet, and to work the lode at lower levels a

winze was sunk in the south drive, and a depth of 80 feet attained.

Up to the end of December, 1913, the following results had been obtained by the Lord Nelson Company:—

Ore crushed, 623,462 tons.
Gold yield, 323,401 oz. 18 dwt.
Dividends, £265,350.
Capital called up, £38,700.

Capital called up by the Lord Nelson Company prior to amalgamation with the Lord Nelson North Company, and included in the above, £19,350.

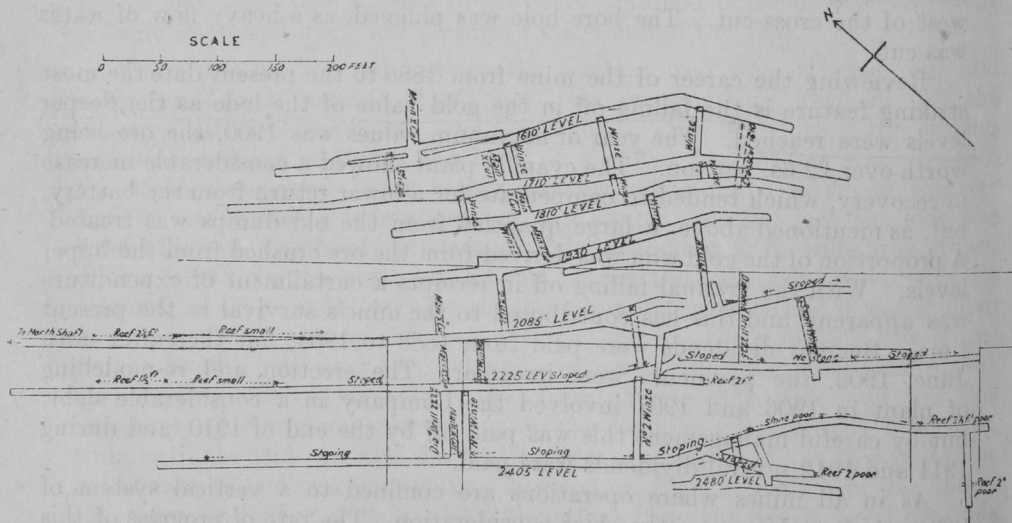


Fig. 69.—Plan showing levels below 1,600 ft. and relation to shaft: Lord Nelson mine.

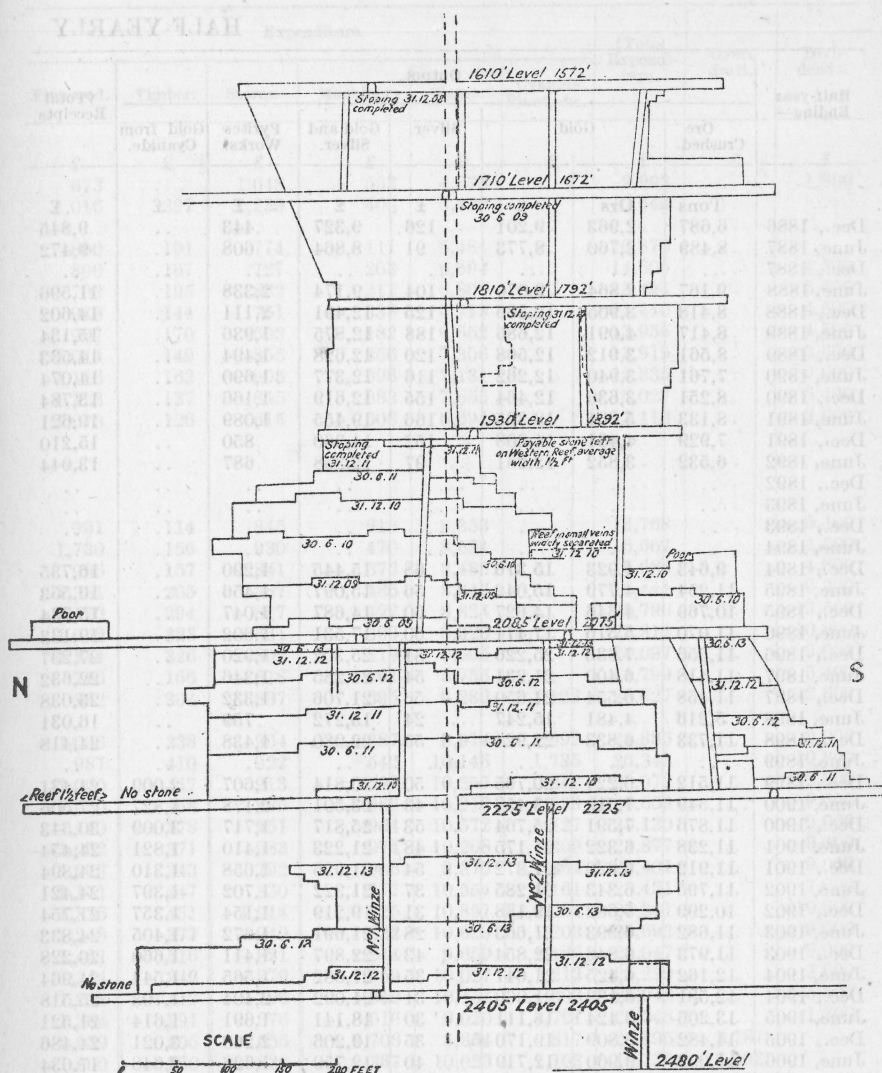


Fig. 70.—Longitudinal section shewing extent of stopes: Lord Nelson mine; looking east.

The depths of the various levels given in the above description of the mine are those used in the records kept by the company. The actual depths of some of the levels were determined by H. S. Whitelaw in 1914:—

Company's figures.				Actual depths.
1310 feet	..	..	..	1281 feet.
1410 "	..	..	..	1381 "
1510 "	..	..	..	1480.5 "
1610 "	..	..	..	1581.6 "
1710 "	..	..	..	1682.6 "
1810 "	..	..	..	1782.7 "
1930 "	..	..	..	1901.6 "
2085 "	..	..	..	2085 "

Below 2085 feet the company's figures for depths of levels are correct.

HALF-YEARLY

Half-year Ending—	Output.							†Total Receipts.
	Ore Crushed.	Gold.		Silver.	Gold and Silver.	Pyrites Works.	Gold from Cyanide.	
	Tons	Ozs	£	£	£	£	£	£
Dec., 1886	6,687	2,963	9,201	126	9,327	443	..	9,845
June, 1887	8,489	2,760	8,773	91	8,864	608	..	9,472
Dec., 1887	..	..	..	..	..	..	..	..
June, 1888	9,167	2,864	9,070	104	9,174	2,338	..	11,596
Dec., 1888	8,418	3,905	12,366	125	12,491	2,111	..	14,602
June, 1889	8,417	4,091	12,686	188	12,875	1,936	..	15,134
Dec., 1889	8,561	3,912	12,508	120	12,628	1,494	..	14,533
June, 1890	7,761	3,940	12,262	116	12,377	1,690	..	14,074
Dec., 1890	8,251	3,636	12,464	155	12,619	1,166	..	13,784
June, 1891	8,133	5,661	18,365	166	19,455	1,089	..	19,621
Dec., 1891	7,929	4,481	14,208	152	14,360	850	..	15,210
June, 1892	6,532	3,852	12,261	97	12,358	687	..	13,044
Dec., 1892	..	..	..	..	..	..	..	..
June, 1893	..	..	..	..	..	..	..	..
Dec., 1893	..	..	..	..	..	..	..	..
June, 1894	..	..	..	..	..	..	..	..
Dec., 1894	9,643	4,923	15,376	68	15,445	1,290	..	16,735
June, 1895	11,254	4,779	15,042	56	15,097	1,456	..	16,553
Dec., 1895	10,769	4,646	14,627	60	14,687	1,047	..	15,734
June, 1896	11,070	5,516	17,471	60	17,531	1,602	..	19,133
Dec., 1896	11,556	7,633	25,226	81	25,302	1,920	..	27,237
June, 1897	11,418	6,400	21,231	54	21,285	1,346	..	22,632
Dec., 1897	11,458	6,554	21,650	56	21,706	1,332	..	23,038
June, 1898	5,216	4,481	15,247	24	15,272	759	..	16,031
Dec., 1898	11,733	6,833	22,924	55	22,980	1,438	..	24,418
June, 1899	..	..	..	..	..	..	..	..
Dec., 1899	11,512	6,224	20,765	50	20,814	1,607	2,009	24,431
June, 1900	11,549	7,019	23,458	43	23,501	2,178	1,827	27,506
Dec., 1900	11,876	7,591	25,764	53	25,817	1,717	3,009	30,543
June, 1901	11,238	6,322	21,175	48	21,223	1,410	1,821	24,454
Dec., 1901	11,912	6,620	21,872	54	21,926	1,658	1,310	24,894
June, 1902	11,795	6,343	21,285	37	21,322	1,702	1,397	24,421
Dec., 1902	10,299	5,682	19,188	31	19,219	1,154	1,357	21,754
June, 1903	11,682	6,393	21,663	28	21,691	1,672	1,405	24,833
Dec., 1903	11,973	6,846	22,854	43	22,897	1,411	1,660	26,228
June, 1904	12,162	6,425	21,647	35	21,682	1,565	1,544	24,964
Dec., 1904	12,581	6,139	21,060	31	21,092	2,404	1,703	25,518
June, 1905	13,206	5,424	18,111	30	18,141	1,691	1,614	21,521
Dec., 1905	14,482	5,809	19,170	35	19,206	2,260	3,021	24,486
June, 1906	11,092	3,960	12,719	40	12,759	1,626	2,648	17,034
Dec., 1906	11,571	4,180	13,323	48	13,371	1,723	1,261	17,165
June, 1907	14,929	4,514	14,519	33	14,552	1,671	2,241	18,464
Dec., 1907	15,177	4,125	13,209	32	13,241	2,038	4,261	19,540
June, 1908	13,661	3,820	12,107	22	12,129	1,713	4,512	18,354
Dec., 1908	11,020	3,274	10,544	16	10,560	1,153	4,319	16,184
June, 1909	15,009	3,416	10,805	18	10,823	1,835	4,203	16,860
Dec., 1909	16,900	4,517	13,835	44	13,878	2,150	4,163	20,321
June, 1910	16,736	4,280	13,655	28	13,684	2,289	4,017	20,094
Dec., 1910	15,649	3,577	11,094	31	..	2,153	3,716	17,039
June, 1911	14,939	4,273	13,285	37	13,322	3,524	3,487	20,333
Dec., 1911	13,700	4,364	13,647	46	13,694	6,074*	3,806	23,584
June, 1912	10,165	3,648	11,365	44	11,410	6,146*	2,159	19,714
Dec., 1912	11,972	3,115	9,448	49	9,497	3,625*	5,220	18,342
June, 1913	12,578	2,218	6,814	25	6,839	1,791*	4,689	13,319
Dec., 1913	11,913	2,177	6,484	29	6,513	2,592*	4,964	14,069

* Includes gold from slimes plant. † From mine product only; does not include bank balance, &c.

RETURNS 1886-1914.

Expenditure.						†Total Expendi- ture.	Over- draft.	Divi- dends.
Firewood.	Timber.	Stores.	Machinery.	Wages.	Cyanide Plant, &c.			
£	£	£	£	£	£	£	£	£
673	..	1,048	533	4,675	..	9,993	..	1,800
1,016	227	1,230	405	5,470	..	10,644	..	..
..
800	191	774	111	6,484	..	10,870	..	..
800	167	727	203	6,694	..	14,600	..	4,500
793	195	832	211	6,806	..	15,494	..	5,400
949	144	751	338	6,713	..	14,440	..	4,500
907	170	693	182	6,652	..	13,955	..	4,500
1,014	149	855	256	7,306	..	13,919	..	3,600
1,116	163	905	396	7,131	..	19,335	..	9,000
1,123	137	855	683	7,655	..	16,027	..	5,400
1,073	126	615	608	6,694	..	13,113	..	3,600
..
..
..
991	114	845	613	8,353	..	16,768	..	5,400
1,730	156	930	470	8,531	..	16,567	..	4,500
996	157	841	372	8,485	..	15,686	..	4,500
1,351	205	887	485	8,647	..	18,441	..	6,300
1,170	294	817	422	8,824	..	25,796	..	13,500
1,052	323	661	399	8,926	..	22,814	..	10,800
1,144	326	802	419	9,665	..	24,097	..	9,000
746	166	618	261	5,735	..	14,799	..	5,400
862	304	837	395	9,286	1,123	26,827	..	12,600
..
1,096	338	964	387	9,914	1,992	24,885	..	9,000
987	410	922	542	10,146	1,735	26,348	..	10,800
1,020	447	913	539	10,357	2,242	30,072	..	12,600
1,050	358	895	666	10,216	1,628	24,653	..	9,000
1,149	378	951	954	10,572	1,127	25,130	..	9,000
1,092	371	983	974	10,268	1,309	24,877	..	9,000
1,073	343	792	905	9,375	1,364	23,401	..	9,000
1,171	447	830	777	10,554	1,161	23,431	..	7,200
1,336	451	1,014	625	10,851	1,254	27,341	..	10,800
1,248	377	940	822	10,629	1,203	24,693	..	9,000
1,431	516	821	2,244	9,659	1,126	26,047	..	9,000
1,344	349	879	1,959	10,027	1,213	21,220	..	3,600
1,298	412	796	4,650	10,151	1,603	24,942	..	5,400
1,304	391	676	6,016	9,020	1,721	22,348	..	1,800
2,039	305	655	6,706	8,854	817	20,895	3,787	..
1,660	360	830	367	10,023	1,103	15,739	7,382	..
1,589	453	802	1,147	9,938	1,882	16,949	4,284	..
1,595	372	638	499	9,947	2,134	16,447	1,643	..
1,862	313	703	596	9,207	2,750	16,454	..	..
1,821	466	867	613	10,396	3,002	18,538	..	..
2,500	305	927	915	10,288	2,668	19,673	1,373	..
2,198	476	882	930	9,634	2,892	18,128	700	..
2,175	469	878	501	9,547	2,187	16,777	..	..
2,117	349	863	777	9,018	2,561	20,333	..	3,600
2,087	595	814	819	8,571	2,812	22,443	..	3,600
2,299	346	710	639	7,655	3,229	21,289	..	3,600
2,243	571	755	1,017	8,784	2,727	18,888	..	1,800
2,179	405	419	607	8,303	2,050	14,803	82	..
2,708	305	619	549	7,583	2,167	14,639	519	..

† Exclusive of bank balance ; inclusive of office expenses, rates, taxes, &c.

[13.6.14.]

NOTE ON THE LORD NELSON MINE.

By H. Herman, B.C.E., M.M.E., F.G.S., late Director.

Full particulars of the work at the various levels of the Lord Nelson mine are embodied in a report recently furnished by Mr. W. Baragwanath, Senior Geologist.

From about 800 feet to about 1,700 feet deep, the Lord Nelson lode was highly payable. From about 1,700 feet to the present bottom workings the lode has yielded little profit. For the past seven years sinking has averaged about 100 feet per annum to maintain a monthly tonnage of about 2,000 tons. Provided ore can be won at this rate, all expenses (including Melbourne office) can be paid for less than 25s. per ton. Only about 1,400 tons of ore per month are now being treated, this reduction being due not to immediate shortage of ore, but to scarcity of miners, for which reason also level-driving and other development work desired to be carried on by Mr. W. J. Nichol, General Manager, has been suspended. Under these conditions of labour supply some poorer portions of the lode that would otherwise be stoped are likely to be left unworked, and suitable mill supplies above the 2,485-ft. level to become exhausted in about three months' time, when it is contemplated to shut the mine down. Work will then be restricted to cyaniding of tailings, of which there is an estimated supply of 120,000 tons, containing about 5s. per ton, and yielding about 1s. 6d. per ton profit.

About 125 hands are employed. Of these over 100 will have to seek other occupations should the mine close down.

Owing to increased cost of work (due to a substantial increase in the cost of labour and other reasons), and the absence of any profit during recent years, the present company has, I understand, quite made up its mind to wind up and get a final dividend out of plant and tailings. The lode is still a "strong" one at the deep levels, but 800 feet of sinking has been done without meeting the necessary improvement in values to yield fair profits. Any offer of State assistance to try the lode deeper would not, I understand alter the determination to stop operations as soon as extraction and treatment begin to show a loss.

In these circumstances I see no course open to those St. Arnaud people who desire to see the mine continue but to endeavour to come to some arrangement with the company to take over the mine, and then to enter on a development scheme. If they should be financially strong enough to do both these things, then I think the State might fairly share the risk of the development work with them. In view of the long cross-cutting now necessary to reach the lode from the shaft, it would, if arrangements to continue should be made, be in everybody's interest to try the lode by a winze to perhaps 150 feet deep below the 2,485-ft. level and do some driving and incidental work therefrom before deciding whether it is worth while sinking the main shaft further.

While the mine is a going concern the cost of sinking a good winze (or really a blind underlay shaft) from the 2,405-ft. level is estimated by Mr. Nichol at about £5 per foot, sinking main shaft at £6 per foot, cross-cutting £1 15s. per foot. The preliminary work of winze-sinking and driving therefrom would perhaps cost about £2,000; of sinking shaft, say, 300 feet, cross-cutting about 750 feet, and incidentals, a further £4,000. If these operations should be deferred until stoping has to be discontinued, general charges would have to be added, and the cost largely increased.

While there is nothing to indicate that any improvement of values would be found by deeper work, a lode of the Lord Nelson type always has a chance of "coming again."

[19.6.14.]

WOLFRAM LODES NEAR WEDDERBURN.

By H. Herman, B.C.E., M.M.E., F.G.S., late Director.

On the 17th instant, I visited the wolfram lodes on a group of granted or applied-for leases adjacent to the boundary between the parishes of Coonoor East (on the west) and Barrakee (on the east), as shown on the accompanying plan. The allotments in which the deposits are located are 42A, sec. B, of the former parish, and 103, 105, 106, 107, and 115 of the latter.

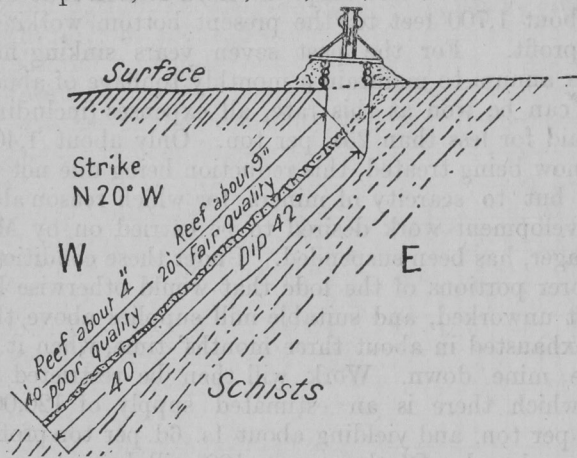


Fig. 72.—Transverse Section of Springwell Company's Wolfram Lode. Scale : 20 feet to 1 inch.

My attention was directed to six principal sites of prospecting—1 to 6 on the attached plan of leases. (Fig. 73.)

At No. 1 site, the Wedderburn-managed Springwell company has a shaft down about 40 feet on the dip of a quartz lode containing wolfram, and showing also some copper and iron pyrites, and a little copper carbonate and molybdenite. The upper 20 feet of the lode exposed in the shaft

averages about 9 inches wide, and shows wolfram freely in places; the lower 20 feet averages about 4 inches, and is poorer in wolfram. The lode strikes N. 20° W. (magnetic) and dips about 42° westerly; the outcrop does not show southerly from the shaft, except, perhaps, at about 2 chains distant, where a few blocks and fragments of quartz which may be on the line show for a few yards. Very little quartz shows on the line of strike northerly until at a distance of about 1 chain, where 3 ft. wide of solid quartz is visible in a trench; there is, however, a poor show of wolfram in this trench, which is apparently on a distinct quartz vein, whose outcrop shows strongly for about a chain on either side on a strike of N. 70° W. Nearly 1½ chains west of the shaft a quartz outcrop shows prominently for several chains on a north-north-westerly strike; nothing of value is so far known to occur in this vein.

About 13 chains east-south-easterly from the Springwell Company's shaft a quartz outcrop shows plainly for about 2 chains on a bearing of N. 15° W. This vein (site No. 2 on plan Fig. 73) is also on the Springwell Company's lease; it has been prospected by shallow trenches, and shows wolfram freely in specimens

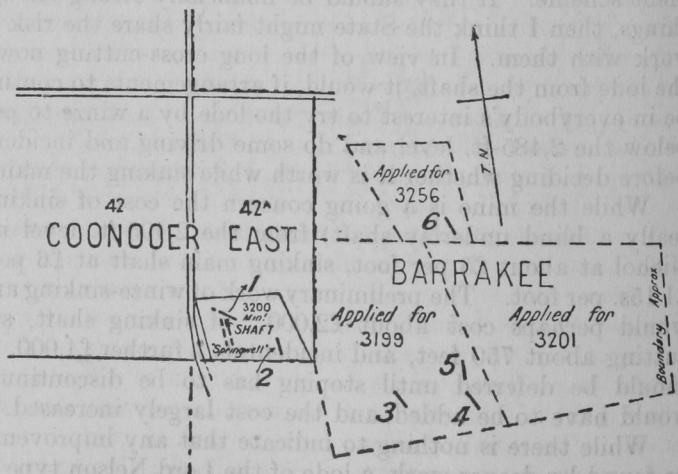


Fig. 73.—Plan showing Wolfram Lodes. Scale : 40 chains to 1 inch.

broken here and there. Its width cannot be clearly seen; it underlays apparently flat to the west. The thickness of the vein may not exceed 1 foot, although the outcrop is strong.

Further to the south-east, about 19 chains, is site No. 3, on lease application 3199 (which covers sites 4 and 5 also), where a quartz-wolfram vein about 8 in. wide dips westerly about 45° in schists dipping about 60° easterly. This vein strikes N. 37° W.; it has been sunk on for 12 to 15 feet on its dip and stoped for the same length; the outcrop is exposed in trenches for a couple of chains. Rich specimens may be obtained about the stoped faces; probably the richest surface portion was selected for stoping. Parcels aggregating 9 tons were sent from here (my guides informed me), and perhaps partly from site No. 4 (see hereunder), to the Wedderburn public battery and Ballarat School of Mines for treatment, for an aggregate yield of about 1 ton of wolfram and some gold.

Fourteen chains approximately to the east of site No. 3 at site No. 4, an underlay shaft has been sunk about 15 feet deep on a quartz-wolfram vein dipping 40° to 45° westerly in schists showing a higher easterly dip. At 10 feet deep there is a drive southerly about 10 feet on the vein, which here varies from a few inches to 9 in. wide, and shows good ore in many places. The strike is N. 30° W. The outcrop of this vein is not traceable beyond the actual workings; easterly and northerly for about 2 chains the surface is strewn with quartz.

About 5 chains nearly north-north-westerly from site No. 4 is site No. 5, where a shallow trench has been excavated about 40 feet long on a quartz outcrop striking N. 10° W. The full length of the outcrop exposed is about $1\frac{1}{4}$ chains; the thickness of the vein could not be ascertained; the dip is flat westerly, the dip of the enclosing schists apparently easterly. Good specimens of wolframitic quartz may be obtained here.

On a bearing a little west of north from site No. 5 and about 27 chains distant, is the last vein inspected—at site No. 6, on the lease plan. Here on lease application 3256, another quartz outcrop has been prospected by shallow holes in the surface soil for a length of 2 or 3 chains. Neither the width or dip of the vein is exposed; the bearing along the line of holes is N. 25° W. Some very good specimens of wolfram were taken by me from this lode.

SUMMARY.

The field appears to be worthy of a great deal more prospecting than it has hitherto received. The lodes are certainly not large, and there is no evidence at present that there is scope for company operations unless on a moderate scale. To compensate for smallness, some shoots of ore are clearly of good quality. The wolfram is coarse for the greater part, and should present no special difficulty in concentrating.

There are, I understand from local information, many other localities in the district where wolfram is known to occur, but an investigation into all these would have occupied several days. The deposits I examined are, I believe, those to which special attention has been paid by prospectors. If the owners of the various deposits would proceed energetically with prospecting operations, sinking shafts on the best surface shows of wolfram, and stoping ore of, say, $1\frac{1}{2}$ per cent. wolfram and upwards, sufficient inducement might offer at no distant date for the erection of a State crushing and concentrating plant. Allowing for mill losses, $1\frac{1}{2}$ per cent. ore would, on present market value, be equal to about $\frac{1}{2}$ oz. per ton in gold.

Specimens from the various lodes are in the Geological Survey museum.

NORTHERN HOPE MINE, BEAUFORT.

By W. Baragwanath, Director.

The workings of the Northern Hope mine for a considerable time—over three years—have been concentrated on the main lead trending north-eastwards from the town of Beaufort. This lead, on which comparatively no other work has been done for a length of $1\frac{1}{2}$ miles either way, receives numerous tributaries from the south side, and, judging by the extent of the shallow workings, these were gold-bearing, but on reaching the main lead work stopped. The Northern Hope Company worked portion of the main lead with payable results, but of late prospecting drives ahead of the worked ground have failed to locate any outlet to the payable ground, which appears to be of the nature of a large lagoon. In the payable ground, the wash was of a black colour, due to the presence of a ligneous clay, over which a light-coloured wash, not payably auriferous, was met.

Prospecting is now proceeding at three points where the deepest ground lies, but unless something of value is located during the next few days the prospect of the mine continuing operations is remote.

[3.6.16.]

PROSPECTING AT THE MOUNT MOLIAGUL MOLYBDENITE MINE, MOUNT MOLIAGUL.

By W. Baragwanath, Director.

The area on which prospecting has been carried out by the Mount Moliagul Molybdenite Syndicate lies on the north-western slope of Mount Moliagul, a granite boss surrounded by indurated sedimentary strata. Operations have been carried on for a period of eighteen months, during which time some 2,000 odd feet of trenching, varying from 3 feet to 10 feet in depth, together with open cuts approximating 500 cubic yards, has been done. These works extend over an area roughly 40 chains by 20 chains.

The most northerly workings consist of an open cut upwards of 120 feet long, and up to 40 feet wide, with a depth of 10 feet. This cutting is in a dyke of eurite or binary granite, the full width, extent, or nature of which cannot be estimated owing to overburden and partial decomposition of the rock; but, throughout the whole of the floor of this cutting, disseminated molybdenite is visible.

Southward of this cutting (10 chains) a trench in decomposed granite shows traces of molybdenite ore, while 2 chains further south, a 3-in. quartz vein is opened out for a length of a chain. This vein shows traces of molybdenite.

About 15 chains south-westerly from the first cutting, several cuttings and trenches have been opened. Here, a fine-grained eurite dyke, probably the continuation of that in the more northerly workings, but at an altitude of over 100 feet greater, has been opened for a width of 50 feet. Here the eurite dyke appears to dip west at an angle of 45° . In the veins, fair samples of molybdenite occur in places, the values not being as consistent as in the northern exposure, while segregations of richer molybdenite ore is noticeable. In the eurite dyke, a vein of felspar occurs, which is only about 4 inches wide, lying horizontally,

and on which only a little work has been done. If it is of quality suitable for commercial use, further prospecting might be advisable in search of larger deposits.

About 5 chains south of these workings, the end of a trench, bearing 10° east of south and extending for over 100 feet along a quartz vein, is met with. This quartz vein cuts across the strike of the dykes or eurite belts, and carries a little molybdenite throughout, with, at times, "pipes" of fair ore. The amount of richer ore available is unknown, as the trench is restricted to the more decomposed granite, except where work has been deepened on the "pipes."

Outside the syndicate's leases, quartz veins, carrying molybdenite from $\frac{1}{8}$ -in. to 1-in. wide, were noticed. These were set in hard granite and eurite, and are not of sufficient number to warrant belief in their value or continuity.

So far as carried out, the prospecting proves the existence of molybdenite to extend over a large area. The quartz veins appear to be places of concentration, likewise, also the smaller fissures. The values of these are not likely to be commercially profitable, but the widely disseminated ore in the northern cutting merits fully developing. Further north, towards the contact of the Ordovician rocks, should also be tested, as the values appear better nearer the edge of the granite.

[17.2.17.]

THE RISING STAR EXTENDED MINE, DAYLESFORD.

By W. Baragwanath, Director.

The Rising Star Extended Company was formed to exploit an area about 10 chains east of the Ballan-road, and a quarter of a mile south of the Public Park, Daylesford.

A lode track of fluccan, striking N. 40° W., and dipping from 67° to 75° west, was reputed to have yielded payable crushings in two shafts about 30 feet apart. The present party found the lode to consist of crushed slate and pug formation, very low in gold values. A shaft was sunk to a depth of 100 feet, following the dip of the formation, but, owing to foul air, I was unable to get to the cross-cut below.

About 15 chains northwards, a new shaft is being sunk, about 100 feet south of Foletti's workings. This shaft is now 50 feet in depth, having been sunk at the rate of 25 feet per week. In Foletti's workings, quartz spurs dipping to the south were worked to about 70 feet (water-level), and it is the proposal of the Rising Star Extended Company to sink to 100 feet to prove these quartz spurs. This shaft is in a good position, in east-dipping strata, in which black slates, containing *Tetragraptus fruticosus* and *Phyllograptus typus* were noticed in the rocks sunk through. Cross-cutting east and west at 100 feet would be good prospecting, as it is probable that other lodes may be located. The alluvial wash, in the vicinity of the shaft now being sunk, was rich in gold.

An examination of the south shaft workings will be made later, if the air in the cross-cut improves.

[20.9.15.]

NORTH PRINCE MINE, SMEATON.

By W. Baragwanath, Director.

Early in the seventies of last century while the Corinella Lead at Eganstown was being successfully worked, the downward continuation of the lead on the western side of Deep Creek was sought for by three parties, viz.:—The Ballarat, Sailor Prince, and North Prince, respectively. The claim of the latter is that now held by the present North Prince Company at Eastern Hill, Smeaton.

The Ballarat and the Sailor Prince companies are reputed to have worked the main lead with profitable results, but opinions are divided in regard to the North Prince Company, and with the exception of some 500 feet of lead tested by this company but little is known. The workings of the Sailor Prince mine lie nearly a mile distant from those of the former North Prince Company.

The original company drove a main tunnel bearing S.11°W. for a length of 4,000 feet, where a south-westerly drive of about 500 feet cut the lead which was apparently worked about 250 feet each way. The length of the tunnel, the air supply, and the poor character of the wash, are all ascribed causes of cessation of work in the mine, although £1,000 on a 10 per cent. basis was said to be paid in royalty from the gold won.

Some ten years ago a small party started to clean out and repair the tunnel which had collapsed, but after several hundred feet had been repaired the party ceased work. About two years ago the North Prince Company started to repair the tunnel, and this work, a long and costly job, has now been effected to a point of 2,209 feet from the entrance.

The objective of the present party was to test for reef-washes, and some bores over the tunnel were put up. These bores have located a narrow run of deep ground 30 feet over the back at a point 2,050 feet from the tunnel entrance. This run is about 40 feet wide with from 6 inches to 2 feet of kindly-looking wash overlain by 30 feet of black clay. The wash is quite dry, on a good hard bottom, and prospects a little gold. A trial parcel is now being tested, but it cannot be regarded as payable from the dish prospects, although such are not reliable in a nuggety run like the old Corinella lead. This new lead is of about the same level as the lead in the old workings 2,500 feet ahead, and its course is about 30° west of north while the other lead trends east and west.

West of the new lead the ground rises abruptly, and, if means be forthcoming, the manager proposes cleaning out another 500 feet of the old tunnel, and boring over the back to ascertain if reef wash or other runs exist. This work will cost about 12s. per foot, including timber, air pipes, and rails.

The area generally:—Part of the parish of Bullarook consists of a basaltic plain running north-westerly from Eastern Hill with bedrock exposed in the Deep Creek on the eastern side, and in Muddy Creek on the western flank. The general trend of any lead system will be north-westerly. The results of the old workings of the North Prince Company, also the Smeaton Company to the north-west proved only a very narrow run; possibly both runs are on the same lead. Near the Smeaton shaft an extensive bed of reef-wash was opened later and partly sluiced, but on account of disagreement with the land-owner it was

abandoned. The course of the old lead probably conforms roughly to the present marginal stream Deep Creek, and, if so, the deep lead proved at Campbelltown is its continuation.

The present lead workings are 40 feet above Deep Creek and 280 feet below the surface of the basalt plateau. No gold has yet been won by the company, but a clean up will take place within the next fortnight.

[8.8.16.]

POSEIDON ALLUVIAL GOLD MINE, TARNAGULLA.

By O. A. L. Whitelaw, Field Geologist.

The Poseidon Alluvial Gold mine is situated $3\frac{1}{2}$ miles north-east of the township of Tarnagulla. The Poseidon gold rush took place during the latter portion of 1906, and followed the Waanyarra and Nick o' Time rushes in the same locality.

The source of the Poseidon alluvial gold was the group of "indicator" slate and metasomatic quartz bands outcropping on the Woolshed Hill. This "indicator slate" belt, as shown on an unpublished plan¹, is somewhat less than half-a-mile in width, and has probably been repeated to the surface in many places by lateral folding. Probably the whole of the alluvial gold of the Poseidon, Nick o' Time, and adjacent leads, has been derived from the disintegration of the rocks of the "indicator belt."

The Poseidon gutter was, at its source, very shallow, many of the larger nuggets of gold being discovered just below the surface. These varied from 953 oz. downwards. For 30 chains from its source, the lead followed a direction slightly west of north; it then turned north and north-east. For the first 10 chains, the lead remained in the "indicator" belt, and yielded a large amount of alluvial gold; the succeeding 30 chains was beyond the "indicator" belt and was poorer, the largest recorded nugget being 40 oz. For the following section of 45 chains, the lead again cut through the "indicator" belt, and the gold values improved, the highest recorded nugget being 230 oz. The latter portion of this ground became too deep and wet to be worked by windlass and whip, and it was for the purpose of operating this deeper ground that the Poseidon Alluvial Company was formed in 1908.

No. 1 shaft was sunk at a point 200 feet south of the lead channel, and rock-levels were put out at a depth of 121 feet. The wash was panelled out for a distance of 600 feet south-east of a north and south line from the shaft, and for a distance of 200 feet north-east. The average width of the lead was about 90 feet, and the thickness of wash 3 feet. This section of the lead produced between $2\frac{1}{2}$ oz. and 3 oz. of gold to the fathom.

At 200 feet north-east of the north line from the No. 1 shaft, a sudden drop of 30 feet occurred in the floor of the lead. I was unable to examine a section at this point, but it is probable that it was occasioned by recent faulting. The floor of the lead above this fault is of typical Lower Ordovician slates and sandstones; and below the fault, glacial flags and conglomerate are almost flat-bedded away from the fault. The Ordovician rocks form a favorable bedrock for the retention of

¹ Howitt, A. M. . Unpublished plan of the Poseidon Goldfield.

the alluvial gold; the glacial rocks form a comparatively poor one. The variation of bedrock-level occasioned by this faulting necessitated the sinking of a new shaft for extending the bedrock levels and coping with the increased water.

This shaft is known as the No. 2, and was sunk on the northern side of the lead, at a point 440 feet slightly west of north from the No. 1 shaft. The main or bedrock level was opened at 182 feet deep, and was extended to the north of east a distance of 928 feet. At 185 feet, No. 1 rise was put up, and connected with the No. 1 shaft workings; at 595 feet, a south-east branch level was put out across the lead, a distance of 300 feet; and at 895 feet, the No. 3 rise was put up a height of 26 feet into the wash. From the top of the No. 3 rise, wash-drives were extended north-east 160 feet, south-east 70 feet, and north-west 125 feet.

From No. 1 rise to the south-east branch level practically the whole of the lead has been panelled out, yields varying between 1 oz. and 2 oz. to the fathom. North-east of the branch level very little panelling has been done, work being confined to extending wash drives along and across the lead. The wash opened by these drives is estimated to vary in value between 6 dwt. and 15 dwt. to the fathom.

The number of shares in the company is 35,000; the amount per share paid up is 14s.; and the amount of dividends paid, nil.

The following are the half-yearly returns of gold per fathom:—

Date.						Wash Dirt.	Yield.
						fathoms.	oz.
31st May, 1911	..	..	..	..	..	306	823
30th November, 1911	..	..	..	..	..	982	2,620
30th May, 1912,	..	..	..	..	..	1,018	1,460
30th November, 1912	..	..	..	..	..	287	326
31st May, 1913 ..	..	..	..	..	..	243	563
30th November, 1913	..	..	..	..	..	138	166
31st Eay, 1914	..	..	..	..	..	103	170
30th November, 1914	..	..	..	..	..	799	1,518
31st May, 1915 ..	..	..	..	..	..	790	1,107
Total	..	..	..	..	..	4,666	8,753

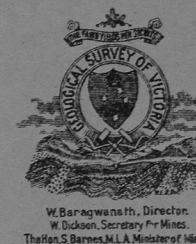
The plan accompanying this report (Pl. XXXVI.) shows that there has been a gradual diminution in gold values as the Poseidon lead is followed downwards. This is evidently due to two causes, viz:—

- (1) The gradual trend of the gutter away from the "indicator" belt.
- (2) That, at about 250 feet north-east of the No. 1 shaft, the lead left the Lower Ordovician rocks, and flowed over glacial beds, which, besides being unproductive of gold, form a comparatively poor rock bottom. The lead also appears to widen considerably on the glacial beds.

I am satisfied from the evidence that the Poseidon lead has been followed by the mine workings as far as the reef-drives have been extended, and that it will continue in the same north-easterly direction for an additional 1,000 feet. There appears to be no hope for an improvement in gold values while the wash rests on the glacial beds. If

- Scale-150 Feet to 1 inch

D. A. E. Whitlaw
1897-15



☐ Main Reef Level ☐ Wash Drives
☐ Lead blocked out
 → ← Dip of Bedrock



an improvement is to take place, it will probably be due to the lead again cutting into Lower Ordovician rocks, and to subsidiary leads from the "indicator" belt junctioning from the north-west.

As the glacial rocks may be of limited extent, the ground 500 feet north-east of the underground workings might be profitably tested by an additional series of three bores 150 feet apart, thus determining the trend of the lead and the nature of the bedrock. The position of the suggested bores are shown on the plan of underground workings.

[16.8.15.]

BORING TO THE WEST OF BALLARAT.

By W. Baragwanath, Director.

The Golden Point gutter from Ballarat East was worked in the city, and for a time southerly from it; but, on reaching a point near Smythe's-road, it turned westerly, and was followed by the Band and Albion Company's No. 3 shaft workings to a boundary of the Winter's Freehold Company's lease. The lead, where left, was wide (350 feet), and it was reputed to be of poor value. The bedrock level is about 975 feet above sea-level.

The Winter's Freehold Company worked north of this deep ground, and proved payable runs of alluvial wash on the high ground. Murray¹ contends that the Golden Point lead ran south, and that the Winter's lead was a tributary. This was so, but the main lead was not sought in the Winter's Freehold Company's workings. North of the Winter's Freehold mine, a lead was worked in the Park. Formed from a very extensive rich run of wash west of Pleasant-street, this lead was payable when the mine was closed down. The course of this lead was westerly, and the bedrock 1,100 feet above sea-level.

In 1891, several diamond-drill bores were put down along a north and south road near the cattle-yards. Bore No. 3 nearly located the Park lead, the level being 1,101 feet above sea; 12 feet of wash was proved in this bore. The bores south on this line were not conclusive; bores 4, 5, and 6 proved falling ground to the south, and instead of continuing south on this line, bores 7 and 8 were put down at right angles to the line, and were useless. At least two bores are required to be put down south of bore No. 6, the bedrock level of which is 983½ feet above sea. Bore No. 6 proved 8 ft. 6 in. of wash; while bore No. 5, 350 feet to the north, passed through 6 feet of wash at about 10 feet higher level. This ground is about 450 feet deep.

Going further north, the Inkerman lead was proved up to near the south-western side of the lake, and where abandoned it was of poor value, and 375 feet below the surface. The bedrock level here is 1,105 feet above sea.

The next west-falling lead is the Durham or Swamp lead, as proved by the City of Ballarat mine workings. The lead here is 530 feet from surface, and the bedrock level 986 feet above sea-level at a point due north of the line of the Alfredton bores.

¹ Prog. Rept. Geol. Surv. Vict., No. 1, pp. 63-88.

The Essex lead north of the Swamp lead was narrow; it trended west, and was 270 feet from the surface where left. Bedrock level here is 1,200 feet above sea-level.

The Rose Hill lead, about 3 miles north of the city, had a south-westerly trend, and northwards of this, a projection of bedrock runs westerly under Mount Rowan toward; some shallow ground exposed at Pound Hill to the west of Miner's Rest. The Great North-West company proved ground about 1,100 feet above sea-level on the supposed continuation of the Rose Hill lead.

To summarize, the Golden Point, Park, Inkerman, Swamp, Essex, and Rose Hill leads have all been proved up to practically a meridional line, and all are trending west. The respective bottoms above sea-level vary, the deepest being found in the Golden Point and the Swamp leads, where they practically coincide, viz., 975 feet and 986 feet above sea. Bore No. 6 of the Alfredton series was of similar level, 983 feet above sea.

Westwards of this meridional line, basalt extends for 6 miles with only one projection of bedrock at Bunker's and Sago Hill; but, on either side of this, the Cardigan and Haddon leads respectively trend towards the main channel.

The northern confine, Mount Rowan-Miners' Rest line, is not settled conclusively. A series of bores was put down in the parish of Dowling Forest in 1889 and 1890, but, being confined to a small cluster, they are most unsatisfactory. The bedrock level (deepest) was 1,040 feet above sea.

To prove this outlet, a line of bores along the southern township boundary of Miners' Rest should be put down, the first at the south-eastern corner of the township boundary, and one or two to the west of it.

The results of this boring cannot, in my opinion, prove an outlet to the leads of Ballarat West, as for many years I have been of opinion that a large lake or series of lakes of the plateau type once existed west of Ballarat.

Two methods of proving this appeal to me (a) to test the various leads to their outlets; (b) to endeavour to define the limits of the old lake, *i.e.*, its margin.

It is apparent that the grade of the leads from the eastern side must soon cease, as the level 980 feet above sea is identical with that at Trawalla on the east-falling leads 20 miles away, and the deepest ground proved midway, near Windermere, was 924 feet, a grade of 7 feet to the mile on the eastern side, and 4 feet to the mile on the western side; whereas the grade of the streams proved above the 980-ft. level was over 100 feet to the mile.

After bore sites No. 1 Alfredton and No. 2 Miner's Rest are completed to test the western course, a line of bores along the western edge of the Ballarat Common, starting from the north-western corner to Cardigan railway station as a centre, and thence south-westerly along the railway line towards Kopke would test the west-falling streams from the east, and probably give sufficient data to establish fully the lake theory.

A line 3 miles to the west, and parallel to this, could be put down later if prospects warranted.

CARLTON MINE, STEIGLITZ.

By W. Baragwanath, Director.

The shaft of the Carlton mine has been sunk to a depth of 160 feet, and it is equipped with an oil-engine, friction-hoist, and a set of pump gear.

At 160 feet, a diagonal cross-cut, bearing S. 36° E. has been put in. At 16 feet, the footwall of a lode, probably identical with that exposed on the surface 100 feet south-east of the shaft, was cut. A body of quartz 6 feet to 8 feet wide shows on a good wall dipping 65° west. At 54 feet, a 6-in. laminated lode was cut dipping 65° east. At 155 feet and 170 feet, flat quartz spurs were cut 6 inches and 8 inches wide respectively. At 302 feet, the footwall of the Clifton lode, with upwards of 6 feet of quartz, is exposed.

East of the Clifton lode, black slates, with laminated quartz threads broken by a strong fault, occur. As there is no doubt the lode at 302 feet is the Clifton, it is advisable now to rise to the Clifton shaft and secure good ventilation, following which a drive south should be put in to test the lode under the surface workings.

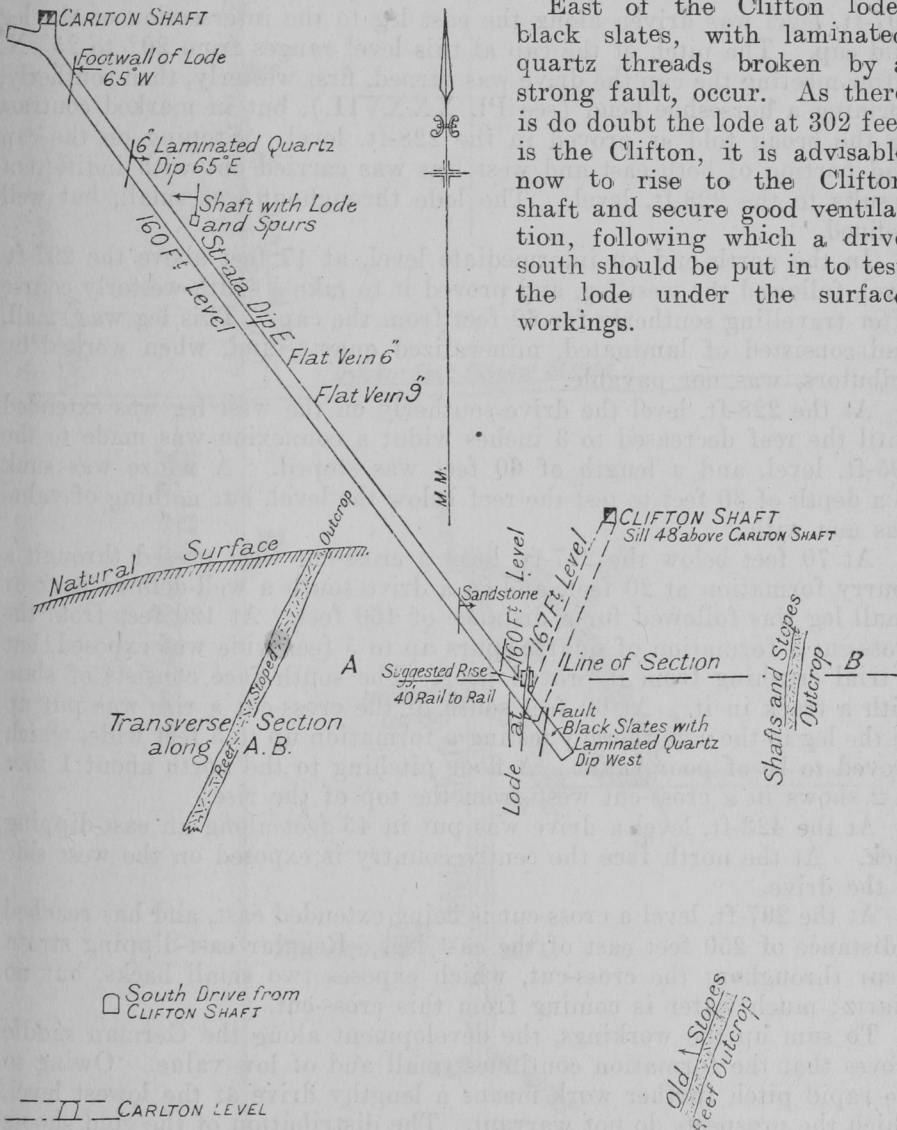


Fig. 74.—Plan and Transverse Section, Carlton Mine, Steiglitz. Scale : 80 feet to 1 inch.

To obtain a good holing, it is suggested that the drive north be put in 10 feet, and from it a rise be put so that the shoot just clears the line of the cross-cut.

The extension eastwards of the cross-cut may be considered later; but, if so, the angle should be varied so as to cut the strata at right angles, and not obliquely as at present.

[2.8.17.]

SOUTH WATTLE GULLY MINE, CHEWTON.

By W. Baragwanath, Director.

The chief work carried out at the South Wattle Gully mine since the date of my last visit—20th October, 1912—has been along the downward continuation of the German saddle reef. This reef was worked to the 228-ft. level prior to 1900, but little work was done below that level. The 297-ft. level was driven along the east leg to the intersection of the leg and cap. The pitch of the cap at this level ranges from 20° to 25° N. After meeting the cap the drive was turned, first westerly, then southerly, forming a horseshoe bend (see Pl. XXXVII.), but in marked contrast to the broad fold as proved in the 228-ft. level. Stopping on the cap and portion of both east and west legs was carried out with indifferent results to the 228-ft. level. The lode throughout was small, but well defined.

In the north end an intermediate level, at 17 feet above the 297-ft. level, followed the west leg, and proved it to take a south-westerly course after travelling southerly for 60 feet from the cap. This leg was small, and consisted of laminated, mineralized quartz, and, when worked by tributors, was not payable.

At the 228-ft. level the drive southerly on the west leg was extended until the reef decreased to 3 inches wide; a connexion was made to the 195-ft. level, and a length of 60 feet was stoped. A winze was sunk to a depth of 30 feet to test the reef below the level, but nothing of value was met with.

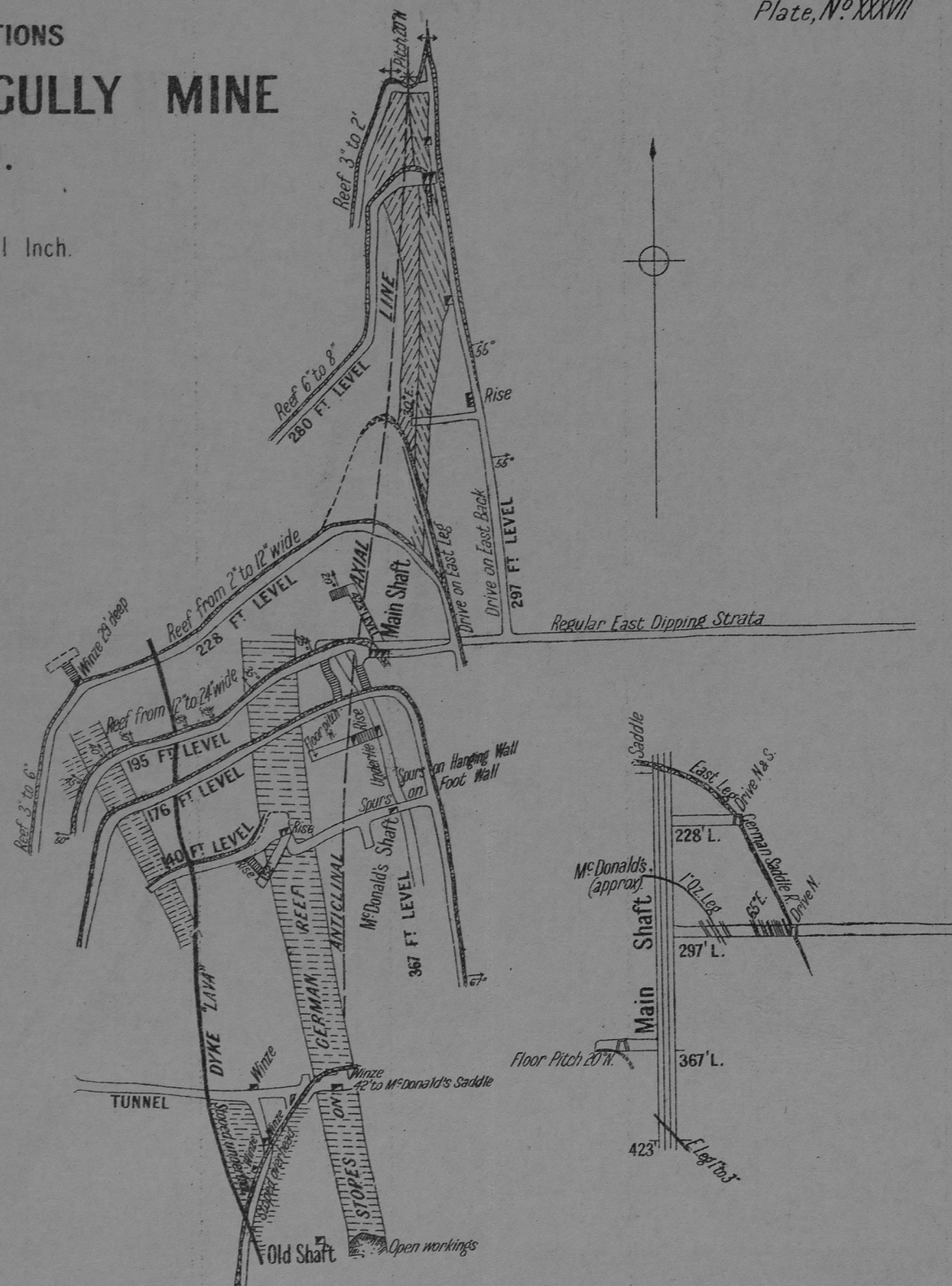
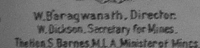
At 70 feet below the 297-ft. level a cross-cut west passed through a spurry formation at 20 feet, and in a drive south a well-defined back or small leg was followed for a distance of 160 feet. At 120 feet from the cross-cut a formation of quartz spurs up to 5 feet wide was exposed, but a trial crushing from it proved poor. The south face consists of slate with a track in it. At 60 feet south of the cross-cut a rise was put up on the leg to the cap, thereby testing a formation up to 5 feet wide, which proved to be of poor value. A floor pitching to the north about 1 foot in 2 shows in a cross-cut west from the top of the rise.

At the 423-ft. level a drive was put in 45 feet along an east-dipping back. At the north face the centre country is exposed on the west side of the drive.

At the 297-ft. level a cross-cut is being extended east, and has reached a distance of 250 feet east of the east leg. Regular east-dipping strata occur throughout the cross-cut, which exposes two small backs, but no quartz; much water is coming from this cross-cut.

To sum up the workings, the development along the German saddle proves that the formation continues small and of low value. Owing to the rapid pitch further work means a lengthy drive at the lowest level, which the prospects do not warrant. The distribution of the gold shoots on the broad fold appears to have become confined in depth, and exists

Scale. 100 Feet to 1 Inch.



only on the cap, that on the west leg dying out at the 228-ft. level. With the more acute folding in the lower levels-(297 feet and 280 feet) the reef increased in width but slightly. The shaft being sunk practically in centre country, passed through only one small track below the German formation; this small track was driven on at the 423-ft. level.

The further sinking of the shaft or driving south of a level in centre country is desirable work, and is essential to testing the mine. The formation driven on south at the 367-ft. level appears to be identical with that cut in the shaft at the 423-ft. level. At the 367-ft. level a well-defined leg carries laminated quartz up to 2 inches wide, with quartz spurs in places up to 5 feet in width. On the cap the formation is irregular, and forms a well-defined floor, with irregular quartz spurs; water is slowly percolating along the break, and precipitating much iron oxide on the wall and floor of this level.

The extension easterly of the cross-cut at the 297-ft. level is good prospecting work, but so far nothing of value has been intersected. The possibilities in this direction lie in the location of west-dipping faults or "leather jackets," such as exist on the parallel line to the west at Spring Gully, and which also have been worked at the Garfield and Quartz Hill mines. To correlate up this cross-cut with the workings of the Francis Ormond mine is, under the circumstances, impracticable. The Francis Ormond company worked a formation associated with an eastern back from near the centre country to about 300 feet east. The centre country here pitched north similar to that in the South Wattle Gully mine. Continuing the strike of the Francis Ormond reef to this mine would be useless, as in all probability the channel would reach the syncline long before covering the intervening distance.

At the South Wattle Gully mine the same stratigraphical position as worked in the Francis Ormond mine would probably have existed at at least 1,500 feet above the sill of the shaft. But the relative position, and this is important when the reef occurrences are concerned, of the workings of the Francis Ormond and the South Wattle Gully mines are identical in being on the east side of the same axial line and within the same distance from the centre, but not in the same strata.

As mentioned above, prospecting of centre country or the vicinity is likely to lead to opening of new quartz bodies below the present depth of the shaft, either by a drive south to intersect new strata on the northerly pitch, or by the deepening of the shaft.

[1.6.15.]

SPRING GULLY MINE, FRYERSTOWN.

By H. S. Whitelaw, Field Geologist.

A cross-section of the lower-level workings in the Spring Gully mine, Fryerstown, shows the main shaft, 904 feet deep, sunk in the eastern beds of the Emu line of reefs at 85 feet from centre country, the axis of which, prior to irregularities caused by faulting, was vertical between the surface and the bottom level at 886 feet. Portions of several small saddle reefs have been exposed under west-dipping faults, which dip across the eastern and with the western beds of the anticline.

Practically the whole of the gold won by the company was contained in quartz spurs associated with three of these faults, known as the Spring Gully (the uppermost), Thompson's, and the "New." The Spring Gully is the most important. Branching from it were innumerable quartz

spurs filling fractures which were the direct result of dislocation of the beds. These have been worked between the surface and the 378-ft. level for a width of between 20 feet and 60 feet, where they overlap those connected with the underlying Thompson's fault reef. The formation has been stoped for a width of 100 feet with highly payable results for a length of about 700 feet, the northern boundary of the shoot being a cross-course about 500 feet north of the shaft. The southern boundary is irregular at about 200 feet south of the shaft.

After the resources of these makes had become exhausted, deeper level prospecting was proceeded with, but nothing of promise was happened on until the 810-ft. north level, at 60 feet west of the shaft, on the intersection of the "New" fault and a small east leg, had been driven 50 feet or so from the cross-cut. Here gold, in what was thought to be payable quantity, was met with. It continued to show as the level progressed, and winzes were sunk on the fault at distances of 80 and 160 feet from the cross-cut. In these, immediately below the level, the prospects were considered sufficiently encouraging to warrant sinking the shaft another lift, which was undertaken in September, 1915.

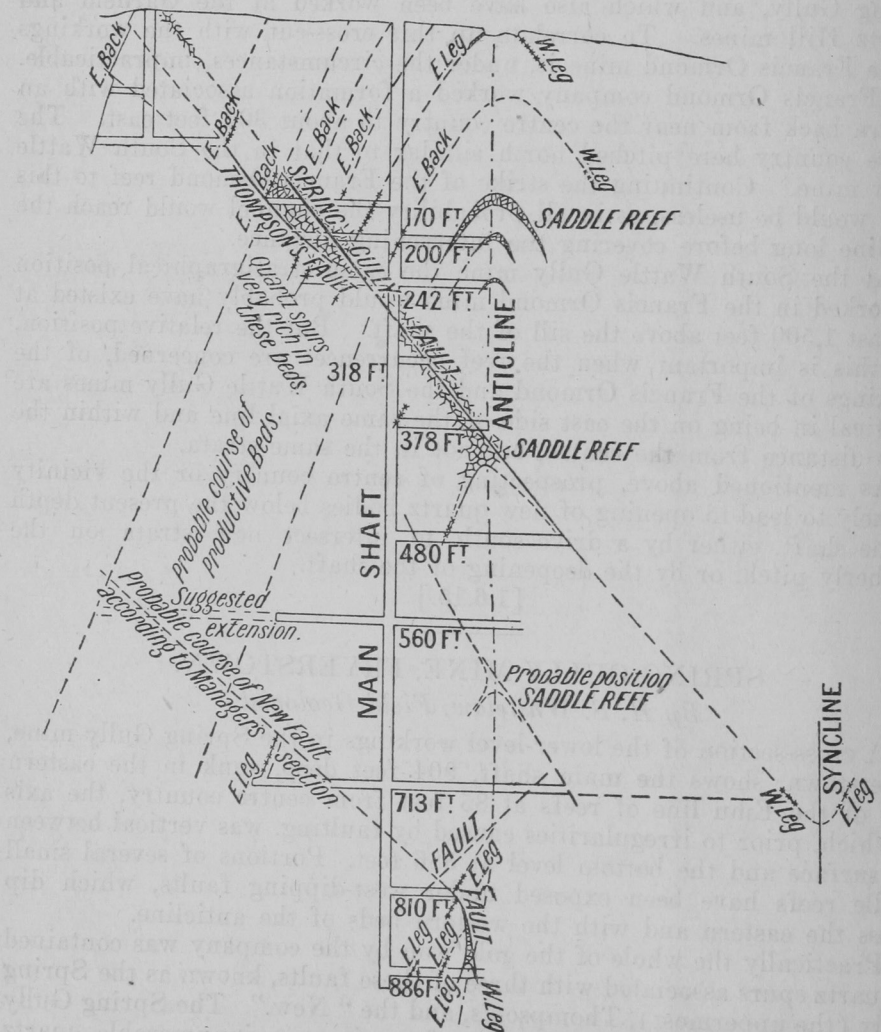


Fig. 75.—Transverse Section, Spring Gully Mine, Fryerstown. Scale : 200 feet to 1 inch.

At a depth of 886 feet a cross-cut was driven west, and, after passing through three small east legs and some spurs, the "New" fault on the west leg of a small saddle reef was intersected and driven on north about 85 feet. The stone on the slide is massive, highly charged with the sulphides of iron, zinc, and lead, and bears little resemblance to that of the leg proper, which is uniformly laminated, and forms the hanging wall of the reef. Rises were put up on the leg and slide stone, which at between 10 and 20 feet over the level commences to form the neck above the saddle reef, with disappointing results, proving, as they have, that the shoot of gold now being underhand stoped below the 810-ft. level does not continue below a depth of about 20 feet under the intersection of the fault and east leg.

Excepting that, in comparison with the Spring Gully, the "New" fault is a minor fracture, the structural conditions in these stopes are similar to those in the productive workings at shallow levels. A west-dipping fault has ruptured a belt of east-dipping beds, certain of which appear to be favorable to the occurrence of gold in spurs deposited in them. The reason for the greater dimensions and higher values of the shoot in the case of the Spring Gully reef lies probably in the greater fracturing the more favorable beds have been subjected to.

With the exception of a cross-cut driven into them at 180 feet south of the main shaft at a depth of 378 feet, these particular beds, according to the official plans, have not been seen below the workings on the Spring Gully and Thompson's reefs. Moreover, it would appear, from the same plans and the reduced cross-section (Fig. 75) that, below Thompson's fault, a fracture zone in these beds is not likely to exist until they are intersected by the upward continuation of the "New" fault, the spurs on which are now being worked under the 810-ft. level. This line of intersection could be prospected from the 560-ft. eastern cross-cut, which is already out 100 feet from the shaft, or by rising on the fault exposed at the top of the rise on an east leg above the 713-ft. eastern cross-cut. From the manager's section it is calculated that it would be necessary to extend the 560-ft. cross-cut about 100 feet.

As previously stated, the "New" fault is comparatively weak. The relative strength of the two may be gauged from the statement that where the Spring Gully fault crosses centre country the cap of the reef is 60 feet wide. The "New" fault makes only 5 to 7 feet of quartz. It is not suggested, therefore, that in its course through the downward continuation of the so-called productive beds the "New" fault will be accompanied by such massive spurs as were found associated with the shallow level faulting, but there is reason to think that any quartz deposited in them as the result of faulting may, ton for ton, be as rich as that already worked. At any rate, it would appear that before long some new development will be required to keep the mine alive, and the best prospects above the present bottom level would seem to lie in the direction indicated.

[16.5.16.]

ENDALL'S IRON DEPOSIT, CAMPBELL'S CREEK.

By H. S. Whitelaw, Field Geologist.

The iron deposit recently pegged out by the Endall Syndicate lies about $1\frac{1}{2}$ miles from the Campbell's Creek railway station. Although

its existence has been known for many years, it required the recent highly increased charges for import of pig iron to bring its potential value to the notice of those aware of its occurrence.

It is an ironstone gossan (oxidized pyrites) capping an auriferous quartz reef formed on an east-dipping fault in the normal Ordovician rocks of the district. In form it is a lenticle, a couple of chains in length along the strike, and, at its widest part, about 50 feet across. The outcrop is not solid for that width, a section across it showing two gossans, separated by a 10-ft. bed of slate. Following it to the north and south it decreases in width, and gradually merges into a ferruginous quartz reef, which, at the southern end, is about 2 feet wide, and has been prospected by a shallow open cut, and, on the eastern side, by a shaft now nearly full of water, and concerning which no information is available.

The original prospectors were evidently guided to this particular outcrop by tracing alluvial gold up a narrow gully, the source of which is the low ridge occupied and formed by the weather-resisting deposit it is now proposed to quarry for iron. The specimen gold found in this gully, it is said, was invariably associated with ironstone or iron-stained quartz. That the iron blow itself is auriferous has been proved (Colonel Field, an authority on the minerals of the district, informs me) by an assay, which gave 8 grains of gold to the ton.

Two other assays made of samples taken promiscuously, but, as it happens, from the central and apparently the best portion of the mass, gave returns of 55.1 per cent. and 53.2 per cent. of metallic iron. The first was made at the Castlemaine School of Mines by Mr. C. Steiner, the second at the Geological Survey laboratory. The resultant metal has not been further tested for the presence of deleterious impurities, but Mr. Steiner informs me that it is his intention immediately to submit an average sample to a thorough examination.

As the above percentages show the material to approach the standard iron value of normal limonite, the next concern of the syndicate should be the determination of available ore of payable value—that the whole outcrop is not of uniform quality is obvious by inspection.

The central mass is fairly compact with, in places, a sub-metallic lustre. Tracing it along its strike it tapers, and, becoming more and more siliceous, ultimately, as before stated, gives place to the common quartz reef of the field. Followed outwards—at right angles to its longer axis—the formation became ochreous, then earthy, and finally blends with the country rock. As a deposit it is exceptional only on account of its size. The upper portion of the majority of the Castlemaine reefs is an ironstone cap, but, in the generality of cases, this does not exceed in width that of the underlying reef of which it is part. The knob in question presents the appearance of a forking of the reef as it approaches the surface, the indications being that with depth the exposed branches will unite to form a pyritic quartz reef of the average width of those of the locality. To prove whether or not this is the case, I have suggested to those immediately concerned the advisability of sinking a shaft in the softer country rocks between the forked outcrops. This work would follow on a satisfactory test of the whole exposure. I understand, after discussion with Mr. Endall, that this preliminary sampling (say by trenching across the outcrop at the centres and ends) will shortly be undertaken, and bulk samples broken and forwarded to Thompson's foundry, at Castlemaine, or to one of the iron works in New South Wales. Mr. Endall, in a local furnace, smelted about 3 lb. of the ore,

from which he obtained about $1\frac{1}{2}$ lb. of metal, a sample of which is forwarded under separate cover. Should both quality and quantity be present, the wherewithal for the opening of a new and profitable local enterprise would exist, and consideration would then be given to whether the interests of the industry would be furthered better by the transport of the ore to the already established smelters in an adjoining State, or by the carriage of suitable fuel and flux to the mine.

It will be understood from the above that, unless the genesis of the ore is distinct from that of most other but smaller deposits to be found in the district, the proposition is as likely to prove as valuable (or as valueless) as a gold as it is an iron mine.

[28.7.17.]

MAGNESITE DEPOSITS AT REDESDALE.

By H. S. Whitelaw, Field Geologist.

The occurrence of magnesite in the Redesdale district has been known since road cuttings were first made (some 40 years ago) in the Coliban-Campaspe River basalt plateau, but it was not until the comparatively recent increased demand for the mineral set in that any attempt was made to develop the deposits which are situated between Redesdale and Lyal—townships between 5 and 6 miles distant.

A few months ago a Bendigo syndicate secured from Mr. Hamilton, a local land-holder, and from the Metcalf Shire Council, permission to sink on and remove outcrops on the private property of the former and the roads of the latter. Since then—during the last two months—the syndicate has forwarded to Melbourne firms some 30 tons of the material at a contract price of £2 2s. 6d. per ton f.o.b. at Spencer-street railway station.

At this price the syndicate could show a profit on the deal, but, owing either to a lack of experience on the part of the sellers, or a meticulous requirement of cleanliness on that of the buyers, much of the mineral trucked has been classed by the latter as useless. The last truck of 15 tons, I am informed, was not taken delivery of, the reason given by the purchasers of the first truck being that over 60 per cent. of the contents was "unsaleable magnesite." Half of the condemned portion was stated to have been broken too small, the remainder carried too thick a coating of clay. In consequence of this upset, the miners (2) engaged in working the veins were discharged, pending arrangement with other firms, one of which, in its requisition, states its preference for the finely broken material.

Without difficulty, and with trifling expense, each of these companies could be catered for from the one deposit. By a preliminary use of pitchforks in the loading, the more massive portions could be separated from the finer, and, if the industry develops, grizzlies could effectively be brought into operation. For the removal of the adhering clay some process of water washing must be resorted to. To obviate the cartage of the useless clay, this operation should, where possible, be conducted on the ground at the site of the only deposit that has been worked, but this is not practicable.

However, if one may judge from the appearance of the stone, about a dozen tons, now at grass in Hamilton's paddock, the small percentage of clay covering is not going to prove a bar to the development of the

deposits. The little that remains after a downpour of rain could easily be removed at the factory by hosing. Prospectors should, however, note the initial difficulties in the way of the advantageous disposal of the product of their labour.

The Bendigo syndicate's deposit, which is the best exposed to view, is about 2 miles north of Redesdale township. It was discovered by one of the miners employed by the syndicate, who, noticing a loose piece at the top of an old post-hole, cleaned out the hole, and, sinking 2 feet deeper, struck the top of a vein in the decomposed bedrock. This vein, 2 feet to 4 feet wide, has since been opened up for a chain in length, and to a depth of from 5 feet to 15 feet. The recent rains, in the absence of the miners, caused the collapse of the faces of the open cut, the *débris* covering most of the floor. Several local residents who have watched operations at this spot informed me that when work was suspended here the vein showed in both faces and along the floor for the length of the opening.

At the time of my visit it could be seen on a ledge at about 10 feet below the surface. It is here about 2 ft. 6 in. wide in Ordovician slate, pitching 10° S. and dipping 70° E. Its western boundary is a bedding plane somewhat resembling a "wall." This appearance has given rise to the opinion that the deposits occur in lode form. Parallel veins outcrop at intervals along Wedge Gully and southward to the Redesdale road turning $\frac{1}{4}$ mile distant. No work has been done on these, and no other deposits are known in this direction till Mr. Kelly's property in Redesdale township is reached. Samples shown me from here were earthy. Their value can be determined only by prospecting.

Going northward, a few nodules of good quality can be seen in a dam embankment thrown up from rocks further east in the series than those the syndicate has opened. Further north—perhaps a mile and a half—a solid outcrop of several cubic feet is exposed in a channel in a lane separating Messrs. Donovan's and McAuliffe's properties, and connecting the Lyal and Castlemaine roads. This, but for a filmy coat of iron oxide, is pure, of mammillary structure, and with sub-conchoidal fracture. Trenches cut close to the fence on either side of the lane and along the strike of the beds containing the outcrop failed to disclose an extension of the vein in either direction. A few chains further west along this lane, in a road cutting, there are exposed a number of veins too narrow to be of commercial value. Northward from the lane, in basalt forming the surface of Messrs. Donovan's and McAuliffe's properties, grains and nodules can be found in any number of places.

The above-mentioned localities comprise those of the so-called North Redesdale deposits, to all of which I was obligingly taken by Councillor Donovan. There are others at Lyal, 2 miles northward, and still others at intervals along the same belt to beyond Axedale, which is 12 miles north of Redesdale. Last week it was reported that a solid blow 5 feet wide, which could be traced for some chains in length, had been discovered on Crown lands near Lyal township. The finder states that he is not at present disposed to indicate the locality of the discovery.

So far as is known, the deposits in the bedrock of the district are confined to a belt of magnesium-bearing slates and sandstones about a quarter of a mile in width. In these, the magnesite occurs as segregated veins running as often across as with the beds. They are lenticular in form, and in mode of occurrence are distinct from lodes. They are not likely to be found to extend indefinitely in depth; in fact, may not exist

below water-level. That being so, and operations being restricted to shallow levels, the expansion of the industry must necessarily depend on the discovery of deposits other than those already exposed. That others exist goes without saying, but, unfortunately for the future, the bedrock along the anticline which brought the magnesium-carrying beds to the original surface has only here and there been denuded of its mantle of basalt.

The deposits in the exposed areas of bedrock will soon become exhausted, and if the industry is to become any way permanent the bedrock beneath the basalt must be searched. The present price paid for the mineral precludes the possibility of such work being undertaken with the likelihood of ultimate profit. The basalt flow varies in thickness from a mere covering to, at any rate, 50 feet, and where over 10 feet is particularly dense. Springs issue from under it in places even in summer time, so that, in addition to the cost of shaft-sinking or tunnelling, water troubles may have to be contended with.

The basalt itself contains magnesite sporadically disseminated as amygdulæ and nodules, and in places, when the containing rock has decomposed sufficiently, these have, by a sort of rough natural concentration, been re-deposited in the crab-hole depressions in the surface. Their presence below is indicated by gentle swellings of the surface soil, and already those local people who have become interested in the matter have become quite expert in locating them.

Mr. Donovan, previous to my visit, and for my guidance, had stacked half-a-dozen or so of the occurrences in one of his paddocks, and the Messrs. McAuliffe have opened up several of the depressions, so exposing some fair-quality material, which, however, appears to be a local concentration only, and not to occur in connected runs. If the prospecting of the basaltic areas is ever undertaken in earnest, some of these spots will probably be selected as shaft sites; but, though the presence of grains and earth at the surface is proof that the surrounding basalt is magnesite bearing, it is no indication of the existence of the mineral in the bedrock immediately below. That some of the magnesite to be seen in the basalt was collected from the bedrock while the flow moved over the old surface is probable, but the principal portion is obviously a decomposition product of the basalt itself, and is not in sufficient quantity to pay for extraction.

As a result of my observation, I conclude that unless the price of the mineral increases considerably, there will be no increased activity in locating deposits outside those small areas in the belt from which the basalt has been eroded. It is, of course, not possible from these to supply the whole demand of the trade, but it should be possible to forward regular supplies in such quantities as to insure profitable returns to co-operative parties for, at any rate, the duration of the war.

[24.7.17.]

WOLFRAM AT CORNELLA, NEAR HEATHCOTE.

By J. G. Easton, Assistant Field Geologist.

In accordance with instructions, I beg to report having inspected the new wolfram discovery on Mr. W. S. Hamilton's property, Heathcote. The Cornella Wolfram mine is 15 miles north-north-east of Heathcote, in allotments 81 and 82, parish of Cornella. Silurian sandstones form

the enclosing country rock, in which the wolfram-bearing reef occurs striking N. 12° W., and dipping 80° west, coinciding approximately with the strata and varying from 4 inches to 1 foot in width.

Small quartz formations have been opened up along the surface at intervals of several chains, over a length of half-a-mile, and in most of the prospecting holes inspected crystals of wolfram are seen in quartz. These quartz formations appear to be approximately on the same line, but as yet they are only surface scratched. The chief work has been done on the south end of the line in allotment 82, where a trench has been opened along the lode for 50 feet and up to 10 feet in depth, the reef ranging from 5 inches to 1 foot wide, and averaging about 9 inches. Specimens showing a fair percentage of wolfram are obtainable, but the general average of the ore at grass shows a low percentage. Mr. Farley, of Heathcote, has obtained 2 tons of picked ore from various points along the line, but he states he has a difficulty in getting it treated.

The lode is a crystalline quartz encased in hard sandstone walls, and appears to be practically free from other associated minerals, and, therefore, should present no difficulty in treatment by crushing and concentrating with a Wilfley table, if payable quantities of the wolfram ore were obtainable.

The surface indications are not sufficiently good to warrant any considerable outlay, as it would require about 3 per cent. of wolfram to cover expenses, unless the lode widens considerably, which it has not so far done at any of the points opened along the outcrops. On present prospects, it would not be payable to work, although the indications are sufficient to justify the sinking of a few shallow prospecting shafts.

[4.12.15.]

FREESTONE AT MOORABOOL RIVER, NEAR BALLAN.

By W. Baragwanath, Director.

Sim's freestone quarry is in the Little Whipstick forest, parish of Bungal. It has already been reported on by me—16th November, 1911.¹ At that date the workings were on a lower bed in the vicinity, but some distance up stream. The present quarry is located on the north-western bank of the Eastern Moorabool River, about 20 chains above the Ballan-Egerton road bridge. The face now exposed is about 12 feet in length and 8 feet to 10 feet in height, and reveals a fine-grained white freestone of good quality, dipping north-west into the hill. A small bed of slate and pebbly mudstone, 2 inches wide, separates the upper or exposed bed from a lower bed of similar texture and colour. Immediately over the bed now exposed is the old quarry, from which the stone used in building Hunterston homestead was taken over 50 years ago. The stone partly opened should make a workable face of at least 20 feet; and as the colour, quality, and texture are favorable, a marketable article could easily be produced. A good track to Llandeillo siding, a distance of 2½ miles, could be made.

Samples of the stone from the latest quarry have been forwarded to the Geological Survey museum. These are rough, but if worked the quality of the stone can be readily seen.

[16.9.16.]

¹ Rec. Geol. Surv. Vict., Vol. IV., pt. 1, p. 44.

PIGMENT DEPOSITS, BACCHUS MARSH.

By R. A. Keble, Assistant Field Geologist.

At Coimadai a serious effort has been made to open up a variety of pigments, consisting for the most part of slate stained with ferric oxide. The costeens inspected are all located on allotment 11, parish of Coimadai, in Lower Ordovician slates belonging to either the Castlemaine or Bendigo series, graptolites having been found to establish this fact. The import of this is that several pigment slates from Bendigo, and belonging to that series, have been supplied by this Department to pigment manufacturers, who have adjudged them to be of excellent quality, giving the desired shades and having a good body and covering power. The difficulty at Bendigo, however, has been to obtain a bed of sufficient size to warrant opening up. The colloids in these particular slates seem to play an important part in respect to both body and covering power.

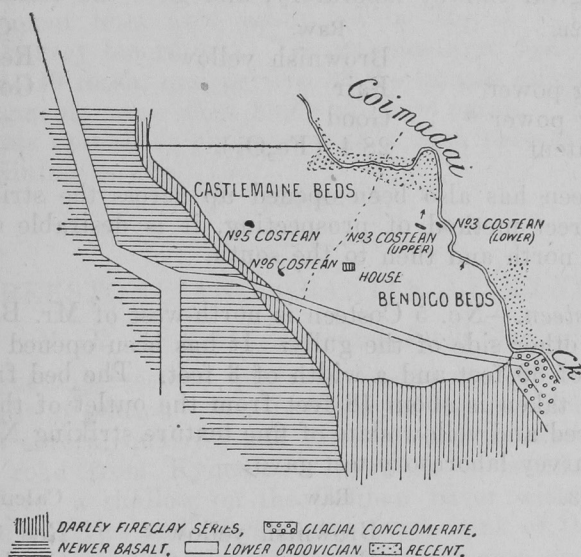


Fig. 76.—Plan showing Pigment Deposits, allotment 11, Coimadai. Scale : 40 chains to 1 inch.

No. 3 Lower Costeen.—This costeen has been opened up on the south side of the Coimadai Creek in Bendigo slates and sandstones, the pigment bodies being, of course, the slates, which have a strike of about north and south, and dip 75° west. A foot of surface soil covers a face varying from 6 feet to 18 feet in height. The length of the costeen is 25 feet and its breadth 10 feet. It has been opened up across the strike, which, from a prospecting point of view, is desirable. The pigment body, however, should be opened up to the south, where the greatest quantity will be found.

A sample from the costeen was tested at the Geological Survey laboratory, and gave the following results:—

No. 102/18.	Raw.	Calcined
Colour	Brownish yellow	Red
Covering power	Fair	Fair
Staining power	Fair	—
Iron content	17.7% (Fe_2O_3)	—
		Gritty

Another sample taken a few feet to the west of the last sample was tested, and gave the following result:—

No. 102A.	Raw.	Calcined.
Colour	Brownish yellow	Red
Covering power	Poor	Poor
Staining power	Poor	—
Iron content	2.6 (Fe_2O_3)	—

No. 3 Upper Costeen.—No. 3 Upper Costeen is about 250 feet up the slope, and south-west of the No. 3 Lower Costeen. The face shows much fractured slate bands and occasional bands of sandstone; the strike is about N. 15° E., and the dip westerly to an ill-defined syncline at the western end of the costeen. The presence of kaolin at the western end suggests the proximity of a dyke. The pigment body consists of highly ferruginous slates. A sample from this body was tested at the Geological Survey laboratory, and gave the following result:—

No. 102B.	Raw.	Calcined.
Colour	Brownish yellow	Red
Covering power	Fair	Good
Staining power	Good	—
Iron content	28.4 (Fe_2O_3)	—

This costeen has also been opened up across the strike. Although it is the correct method of prospecting, it is desirable to open it up firstly to the north and then to the south.

No. 5 Costeen.—No. 5 Costeen is north-west of Mr. Bennett's homestead on the other side of the gully. It has been opened up into a hill for a length of 30 feet and a width of 3 feet. The bed from which my samples were taken is about 18 feet from the outlet of the costeen, and is a mottled red and yellow slate of fine texture striking N. 50° E. The Geological Survey laboratory test gave:—

No. 103.	Raw.	Calcined.
Colour	Brownish yellow	Red
Covering power	Fair	Good
Staining power	Good	—
Iron content	32.0% (Fe_2O_3)	—

Another sample taken from this costeen was tested:—

No. 105.	Raw.	Calcined.
Colour	Brownish yellow	Red
Covering power	Good	Good
Staining power	Poor	—
Iron content	8.3% (Fe_2O_3)	—
	Gritty	Gritty

As to opening up the pigment body, the same remarks apply as to the No. 3 Lower and Upper Costeens.

No. 6 Costeen.—No. 6 Costeen is situated about 100 yards from the Bacchus Marsh-Coimadai road, to the west of the homestead. The pigment body is a yellow slate of fine texture in bands of considerable width. The strike is about north, in which direction it should be opened up to insure quantity.

The Geological Survey laboratory test of the body was as follows:—

No. 104.	Raw.	Calcined.
Colour	Dark Brown	Dark Brown
Covering power	Fair	Fair
Staining power	Poor	—
Iron content	7.4% (Fe_2O_3)	—
	Gritty	Gritty

Many bands of slates of various shades will be found by costeeing. The general strike of the beds is north or a few degrees west of north. It should be borne in mind that in prospecting it is a good practice to open up the beds in approximately an east and west direction, that is, across the strike of the beds. To insure a quantity of any desired pigment, the beds should be opened up in the direction of the strike, firstly towards the slope of the hill, to facilitate working and drainage of the cut, and latterly into the hill.

The pigment tests were conducted by Mr. J. C. Watson, of the Geological Survey laboratory. The samples were finely ground, passed through the 120 mesh, and portion of the sample burnt. The raw and calcined pigments were then made up into paints. It is to be noted from the tests that those pigments with a high percentage of iron gave the best staining results.

[26.4.18.]

FREESTONE AND GRANITE AT KYNETON.

By R. A. Keble, Assistant Field Geologist.

The Kyneton freestone quarries are about $3\frac{3}{4}$ miles west of the Kyneton railway station. Mr. J. Grant, of the Art School, Daylesford, pointed out several quarries and faces opened up sixty or more years ago. The road from Kyneton is metalled to within half-a-mile of Keegan's Ford, a shallow on the Coliban River within a stone-throw of the main quarries and faces on the north bank of the river, permitting of access to that portion of the freestone area on the south bank. Redesdale Junction, where there is a railway siding, is about 3 miles north of this ford, approached by a well-graded metalled road.

THE FREESTONE SERIES.

The quarries and faces have been opened up in either a white or a brown freestone bed, two of a series consisting of alternating fine and coarse-grained sandstones of diverse shades, grits, and conglomerates, usually lying within a few degrees of the horizontal, and having many characteristics in common with the Bacchus Marsh and Greendale freestone series. Some outcrops of the brown bed exhibit a freestone almost identical in appearance with the Sydney sandstone.

In the first instance the freestone series has been preserved from erosion by faulting, being situated on a fault block which has moved along two parallel faults coinciding approximately with the eastern and western boundaries as delimited on the sketch plan. At a later stage the basalt has acted as a protective covering, and still completely overlies the sandstones to the north and south. At a still later stage the river has cut its valley through the basalt into the sandstone series and removed much of it. From these considerations, the

most convenient faces for working are likely to be found along the lines marked "probable outcrop, &c.," on the sketch plan (Fig. 77)

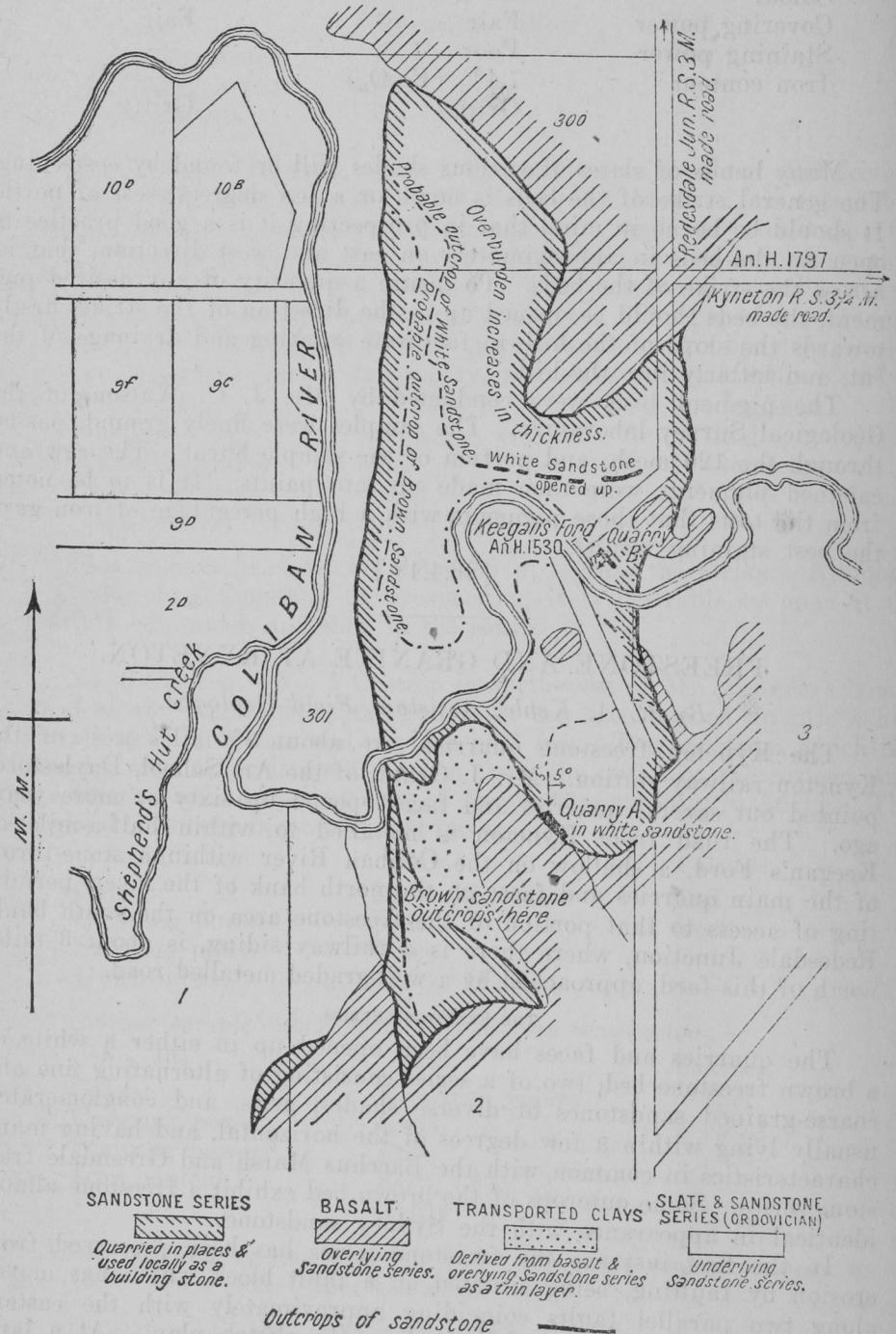


Fig. 77.—Sketch plan. Scale: 20 chains to 1 inch.

If the stone pitches consistently south, as it appears to, the north bank, especially where the contours are low, would present the best facilities for operating with a minimum of expense and labour.

The following (Fig. 78) is a generalized section of the series showing the approximate relative positions of the white and brown beds.

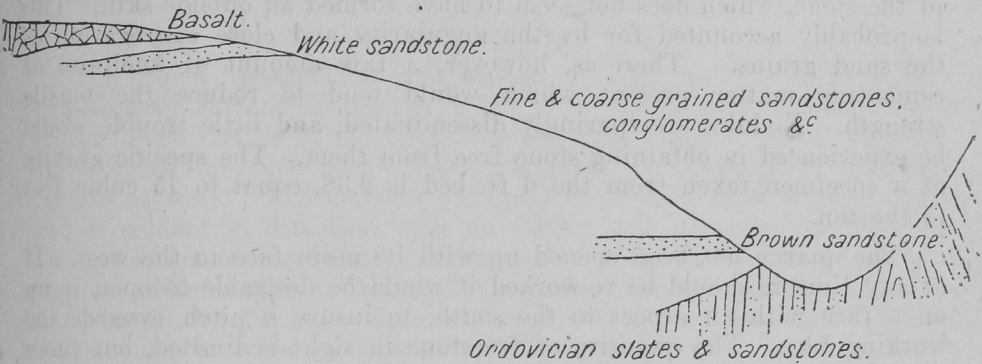


Fig. 78.—Sketch Section. Not to scale.

WHITE FREESTONE.

The white freestone has been opened up in several places north and south of the river. The quarry marked "A" on the sketch plan shows the following face:—

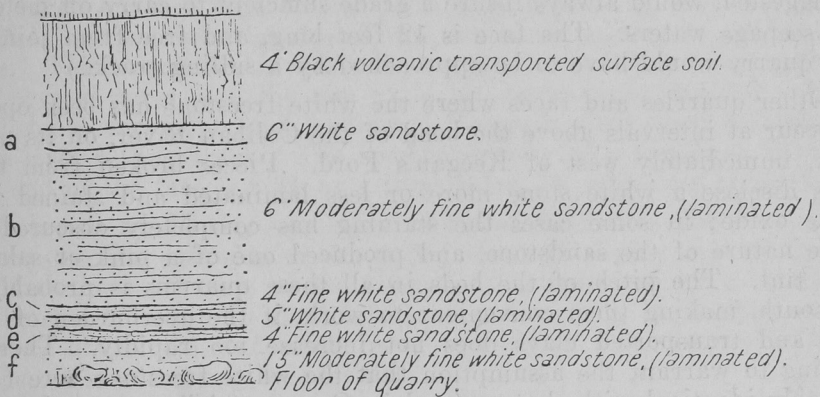


Fig. 79.—Section showing the face at Quarry A. Scale: 8 feet to 1 inch.

Across the gully, a few yards further north, the section was as follows:—

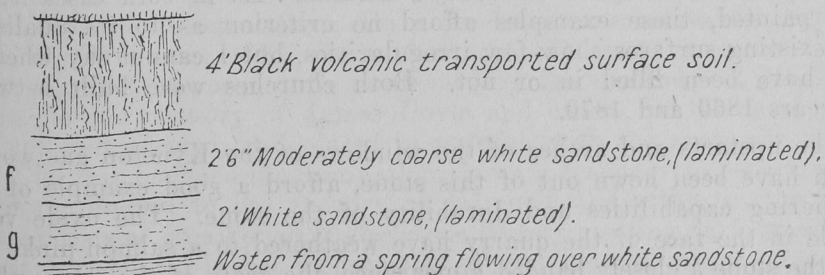


Fig. 80.—Section north of Quarry A, across the Gully. Scale: 8 feet to 1 inch.

Although these faces were opened up more than sixty years ago, the tool marks are still sharp, which is remarkable, considering the softness of the stone, which does not seem to have formed an outside skin. This is probably accounted for by the angularity and close aggregation of the sand grains. There is, however, a fair amount of kaolinite or cementing matter present which would tend to reduce the tensile strength. Nodules are sparingly disseminated, and little trouble would be experienced in obtaining stone free from them. The specific gravity of a specimen taken from the 6 ft. bed is 2.38, equal to 15 cubic feet to the ton.

The quarry has been opened up with its main face to the west. If at any time it should be re-worked it would be desirable to open it up on a face with an aspect to the south, to insure a pitch towards the working face. The quantity of freestone in sight is limited, but there is undoubtedly a considerable amount available beneath the overburden to the east and north-east. The ferric oxide staining, visible in the existing face between the laminae and the overburden, would increase in these directions, but the dumping area would be greater, a desideratum, owing to the steepness of the slope.

If the quarry were worked from the present face, drainage troubles would sooner or later be experienced, as the stone would have to be followed downwards at a low angle; a face with an aspect to the south, as suggested, would always insure a grade sufficient to carry off meteoric and seepage waters. The face is 12 feet long, and free from jointing. The quarry would have to be approached by a sidling track.

Other quarries and faces where the white freestone has been opened up occur at intervals above the bend of the Coliban River, on its north bank, immediately west of Keegan's Ford. Pieces broken from these faces disclose a white stone more or less laminated and stained with ferric oxide; in some cases the staining has completely obscured the white nature of the sandstone, and produced one of a pink or salmon-pink tint. The pitch of the beds in all these quarries is probably to the south, making them convenient to work, if the overburden of residual and transported clays does not increase too rapidly. There is nothing to warrant the assumption that the white freestone here (it is probably identical with that exposed in Quarry "A" on the other side of the river) has improved in colour or in quality.

LOCAL USE OF THE WHITE FREESTONE.

The white freestone, it is stated, has been used in a course below the windows of St. Paul's Church, Kyneton, and in the Gothic windows, tracery, and doorway of St. Mary's Church. As in both cases it has been painted, these examples afford no criterion as to its qualities. The existing surfaces show few irregularities, but I cannot say whether they have been filled in or not. Both churches were built between the years 1860 and 1870.

The upstarts and arches of the windows of the Kyneton gas works, which have been hewn out of this stone, afford a good example of the weathering capabilities and durability of the stone. The oxide veins visible in the face of the quarry have weathered to a salmon-pink, and give the stone a closely banded appearance, the grain of the stone, which has been placed vertically, being quite apparent. It, moreover, shows

a fair amount of flaking, but it should be expressly stated that the upstarts front directly on to the street, where they would be subject to a fair amount of wear and tear.

BROWN FREESTONE.

The brown freestone has been opened up at the quarry marked "B," immediately east of Keegan's Ford. The face has a south-westerly aspect for 60 feet, is 12 feet high, and discloses a bed of sandstone pitching towards the face at an angle of about 17° , making it very convenient to work. The master-joints appear to be a little west of north and coincident in direction with the strike; but it cannot be said that either the master or minor-jointing has a decided direction, nor is it regular. The roughly trimmed stone on the dump varies from one-man stone to the largest sizes required for building purposes, showing that the jointing is wide. The western end of the face is fairly hard, brown sandstone composed of angular and sub-angular quartz cemented together with a moderate amount of kaolinite, and concentrically banded with ferric oxide due to the infiltration of meteoric waters containing iron. The eastern end shows the existence of nodules, which detracts from the appearance of the stone, reducing its durability and its chance of weathering to an even colour tone.

Although this quarry has been opened for more than fifty years, the tamping holes and tool marks are quite sharp. The stone that has been taken out has been blasted with high explosives, and the beds in the face are somewhat shattered, the fractures leading to the tamping holes. The overburden is small, the average being below 3 feet probably over several acres, and the site could be conveniently drained. Access from the Government road leading to Keegan's Ford could be had by a short level sidling track. The specific gravity of a specimen from the west end of the face is 2.58, or a little below 14 cubic feet to the ton.

A brown sandstone, seemingly identical with that just mentioned, outcrops on the east side of the gully, about 15 chains west of Quarry "A," on the south side of the river. It is indicated by a thick line on the sketch map. In the absence of a face, it is impossible to estimate the dip, strike, and pitch, or the quality of this occurrence or the height of face likely to be available.

LOCAL USE OF THE BROWN SANDSTONE.

The brown sandstone has been used in St. Paul's Church as the terminals of the pinnacles on the front elevation and as protruding blocks at intervals below the eaves; there, however, it is too far from the eye to permit of a satisfactory inspection.

It has been used freely in the graveyard, where ample evidence is afforded as to its durability. On a headstone erected to the memory of J. R. Davies, in 1852, the arrises are still sharp, and the carved figure in relief has been quite unaffected by the weather. A headstone erected to the memory of James Doyle and others, in the same year, was not well selected, and placed in position with the grain the wrong way. In this instance the lamination shows a tendency to separate. A tombstone erected to the memory of Edmund McCarthy, in the same year, consists of a casket weighing about $3\frac{1}{2}$ cwt., resting on four spherical castors about 3 inches in diameter, placed at each corner of a rectangular basalt base. The lower portion of the casket has been selected

from a piece of stone showing nodules freely; it has weathered badly, crumbled, and affords an unsightly contrast with the other freestone in the tomb, which has been well selected, and has stood the test of the intervening years well.

A headstone, bearing the name of James Kelly, erected to his memory in 1854, is quite equal to the best Sydney sandstone. It was erected by McGear, mason, Kyneton, and is intact in every particular, the lettering and carving being quite sharp. Unlike the other headstones of similar material and the same age, it has been sawn. In these and other examples in the graveyard the stone is of even colour as regards that chosen for each headstone, suggesting that the concentric staining visible in the face at the quarry at Keegan's Ford disappears on exposure.

SUMMARY OF CONCLUSIONS.

The white sandstone is of uneven quality, the best being streaked with ferric oxide, which becomes accentuated with the lapse of time. It does not appear to harden, and is seemingly of low tensile strength. Stone of better quality may be found, and if any prospecting should be undertaken, I would suggest that it be sought for on the north bank of the river, opposite its confluence with Shepherd's Hut Creek, some distance up the slope.

The brown sandstone is of much better quality, easily quarried, and widely jointed. If well selected, it works up into a stone of handsome tone and considerable durability. The danger in working it is that the nodules, which are apparent in portion of the face, will increase in number and add to the amount of useless stone. The quarryman should be seized with the fact that these nodules occur fortuitously, and experience is the only guide in locating a face likely to be free from them. All stone taken out should be stipulated to be free from nodules. Clean stone would enter into favorable competition with the Sydney sandstone.

If the quarry, from where the headstone erected to the memory of James Kelly was taken, could be located, a large quantity of stone of excellent quality might ultimately be found. There should be no difficulty in obtaining skilled labour in the district. Other beds of building stone might exist throughout the area. The time at my disposal did not permit of a minute examination of the beds stratigraphically between the two beds already mentioned.

GRANITE FROM EAST OF KYNETON.

In the yard of Mr. W. T. Jones, monumental mason, Piper-street, Kyneton, some slabs of granite were inspected, which, he informed me, were obtained from a "floater" or granite tor, some $3\frac{1}{2}$ miles east of the town. The stone is a granodiorite, with an unusual amount of white felspar. It also contains a quantity of biotite or black mica.

One of the slabs in the yard was jointed and discoloured, the discolouration along the joint being due to the passage of ferric oxide in solution, a defect that might be expected in a "floater." The slabs, however, were of fair size, and generally free from joints, pointing to the fact that the jointing is wide in the vicinity of the "floater."

ZIELKE'S GOLD MINE, GLSBORNE.

By J. G. Easton, Assistant Field Geologist.

Zielke's mine is situated in the north-east corner of Crown allotment 43H, parish of Bullengarook, county of Bourke, and immediately to the north of the Saltwater River. The formation here consists of light-grey, white, brown, and black slates, mudstones, and sandstones, belonging to the Castlemaine zone of the Lower Ordovician.

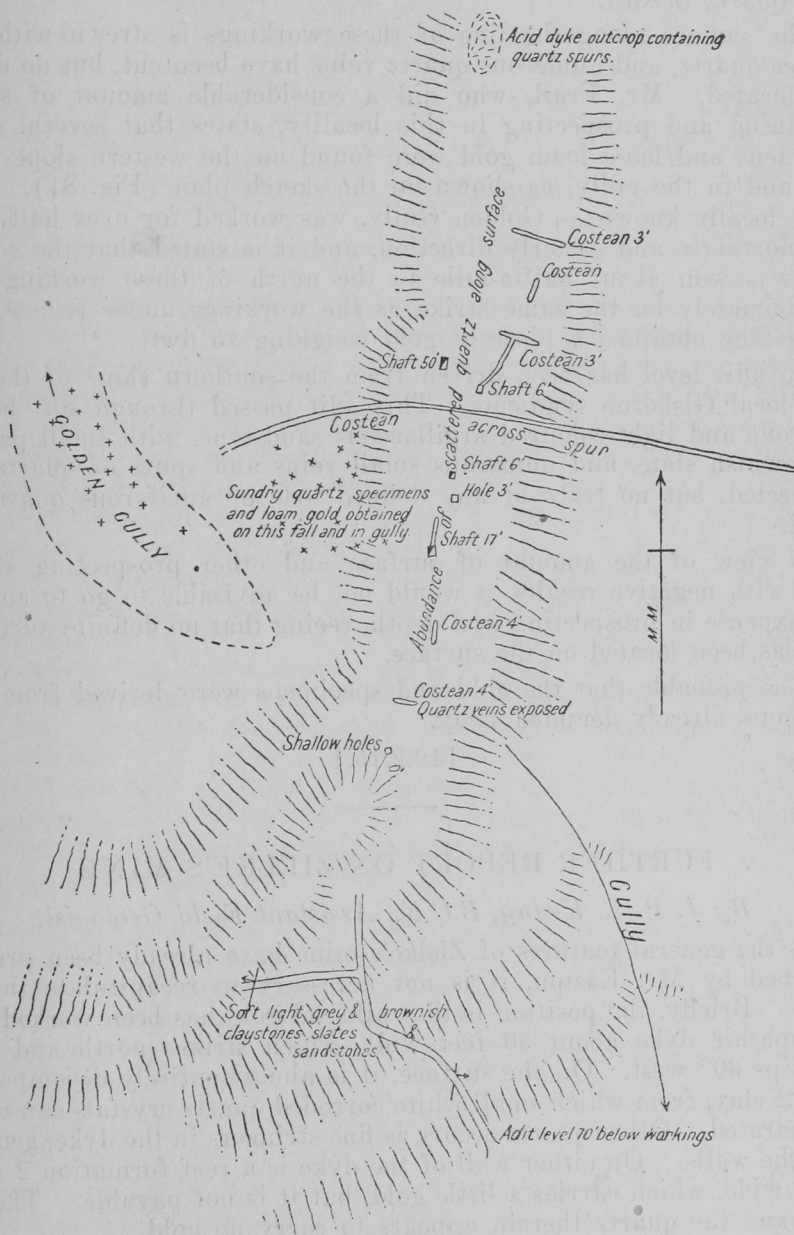


Fig. 81.—Zielke's Mine, Parish of Bullengarook. Scale: 120 feet to 1 inch.

The work already done consists of a series of shallow shafts and a considerable number of shallow costeans extending over a length of over 300 feet along, and also across, the crown of a spur, as shown in the

accompanying sketch plan (Fig. 81). The deepest shaft is said to have been sunk to a depth of 50 feet, and a cross-cut has been driven east for a distance of 12 feet, intersecting a broken, spurry quartz reef about 3 feet wide, but not auriferous. Another shaft further to the north, now fallen in, was sunk to a depth of 17 feet; a small quartz spur, about 2 inches wide, and dipping to the west, was cut in it, and was worked out in a soft white claystone, yielding about 2 oz. of gold, which appears to have been about the only gold secured from quartz *in situ*.

The surface along the line of these workings is strewn with loose surface quartz, and numerous quartz veins have been cut, but no defined reef located. Mr. Frail, who did a considerable amount of surface costeaning and prospecting in this locality, states that several quartz specimens and loose loam gold were found on the western slope of the spur and in the gully, as shown on the sketch plan (Fig. 81). This gully, locally known as Golden Gully, was worked for over half-a-mile in a northerly and easterly direction, and it is stated that the coarsest gold was won about half-a-mile to the north of these workings, and approximately on the same strike as the workings under review, from which they obtained a piece of gold weighing 15 dwt.

An adit level has been driven from the southern slope of the spur by a local Gisborne syndicate. This adit passed through soft beds of claystone and light-coloured argillaceous sandstone, with small partings of brownish slate, and numerous small veins and spurs of quartz were intersected, but no trace of any defined lode or auriferous quartz was found.

In view of the amount of surface and other prospecting already done, with negative results, it would not be advisable to go to any further expense in prospecting at a depth, seeing that no definite auriferous lode has been located on the surface.

It is probable that the gold and specimens were derived from veins and spurs already denuded away.

[12.2.15.]

FURTHER REPORT ON ZIELKE'S MINE.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

As the general features of Zielke's mine have already been precisely described by Mr. Easton, it is not necessary to recapitulate them in detail. Briefly, the position is that alluvial gold has been worked up to a felspathic dyke about 50 feet wide, which strikes north and south, and dips 60° west. On the surface, it is almost entirely decomposed to a white clay, from which small white corroded quartz crystals can readily be separated. Other quartz occurs as fine stringers in the dyke, generally near the walls. On either wall of the dyke is a reef formation 2 feet to 3 feet wide, which carries a little gold, but it is not payable. The dyke itself and the quartz therein appears to carry no gold.

On the south end of the mine, an adit has been driven to the eastern wall of the dyke. North of this adit, for a distance of about 300 feet, there are numerous cuts on the dyke, and a costeen has been put in right across the spur. Two shafts, both 60 feet deep, have been sunk;

and that to the west of the dyke is 20 feet north of this costeen. In this shaft, at 60 feet deep, there is a cross-cut east 50 feet in length.

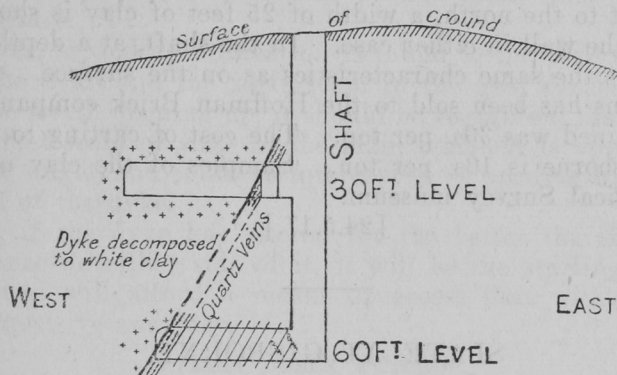


Fig. 82.—Transverse Section, Zielke's Mine. Scale: 40 feet to 1 inch.

It passes through white and grey slates and mudstones, which dip to the west, and in the face bands of black slate are showing. At 40 feet from the shaft, a quartz vein 6 inches wide, and dipping 20° east, was passed through. Prospects of gold were obtained from this vein, but the gold contents must be extremely variable. Two samples were taken, which were assayed at the Geological Survey laboratory. One gave 16 grains of gold per ton, and the other only a trace. The dyke has not been cut in this shaft, but it will probably be intersected by extending the cross-cut east. The second shaft is 50 feet north of the costeen across the spur. A section of this shaft is attached hereto. In this shaft, at a depth of 30 feet, there is a cross-cut west for 31 feet, which intersects the dyke 6 feet west of the shaft. On the footwall of the dyke, there is a 3-ft. lode formation of slate and quartz veins carrying a little gold. A crushing of 5 tons from this formation yielded $1\frac{1}{2}$ dwt. of gold to the ton. The lode material here contains a considerable amount of clay, and some of the gold may have been lost. The cross-cut at the 30-ft. level has been extended 25 feet west in the dyke without reaching the hanging wall. At the 60-ft. level, a cross-cut has been extended 25 feet west to the footwall of the dyke, which shows the same characteristics here as on the surface (Fig. 82).

About $\frac{1}{4}$ mile north of these shafts, a shaft 25 feet deep has been sunk just south of the point where Golden Gully crosses the line of the dyke. From this shaft, cross-cuts have been driven 12 feet west and 20 feet east. This cross-cut shows a formation 30 feet wide of quartz slate, and quartzite bands intersected by pug walls dipping to the west. It is stated that one band of quartz a foot wide was estimated to be worth 6 dwt. to the ton. This formation appears to be about 30 feet west of the dyke.

There is no doubt that the alluvial gold won in Golden Gully has been derived from the lode formations on the walls of the dyke, but it must be borne in mind that this gold probably represents the result of the denudation of hundreds of feet of the lodes. If prospecting at the mine is continued, some payable stone may be located; but, taking into account the amount of work already done for practically no result, the prospects of the property do not justify further prospecting for gold.

There is a possibility of developing the mine as a clay proposition, as the quantity of clay available is large, white, and of uniform colour and quality. In the adit, a width of 12 feet is exposed, and in the shaft, about 300 feet to the north, a width of 25 feet of clay is showing, without reaching the wall in either case. In the shaft, at a depth of 60 feet, the clay shows the same characteristics as on the surface. It is stated that a few tons has been sold to the Hoffman Brick company, and that the price obtained was 30s. per ton. The cost of carting to the railway station at Gisborne is 10s. per ton. Samples of the clay may be seen at the Geological Survey museum.

[24.5.17.]

SLATE AT GISBORNE.

By R. A. Keble, Assistant Field Geologist.

BULLENGAROOK QUARRIES.

Undoubtedly, the best slate for texture, strength, low porosity, and quantity is the 24-ft. band exposed in the gold prospecting tunnel, a little to the west of the main open cut. Pyrites was observed at the fractured end of some of the slate, and may be troublesome in some portions of the band; its cleavage cannot be definitely determined until a pillar has been taken out, but small pieces obtained at the time of my visit gave sufficient promise of a slate cleaving four, or perhaps five, to the inch. As most of the prospecting work has been done, I would suggest that a pillar with a cross-section, the dimensions of a "duchess," (24 in. x 12 in.) be taken out of the west wall of the tunnel and split. It would then be possible to subject the slate to standard tests, and establish a comparison. I would emphasize the necessity of having the cleavage test performed by a skilled slate cleaver, and the pillar marked to indicate its position in the tunnel, so that the direction of the grain may be accurately fixed.

It may not be out of place to state that, almost without exception, the finest slates are obtained near masses of igneous rocks, such as a granite mass, boss, dyke, &c.; it is considered that the igneous rocks induce cleavage and durability. On the presumption that the dyke occurring in the gold prospecting tunnel has caused secondary silification, specimens were taken at intervals along the west wall of the tunnel.

If the best slate is proved to be within the zone of secondary silification, it may be found that the most economical way of working it is by putting a cut into the soft slate along the wall of the dyke. This method of working places two other bands of slate, namely, those 16 feet and 13 feet wide, within the range of operations. These bands, although hard, may be easily split and yield much good slate. The intrusion of the dyke may have shattered them, and this is suggested by many joints evident in the band nearest the dyke. The band from which most of the slate came is still in the face of the main open cut.

As the syncline exposed in this face has a northerly pitch, the further into the hill operations extended the further apart the limbs of the syncline became. The driving of the tunnel along the west limb, and along the east limb from the east face, represents a stage in former

operations when it was recognised that the open-cut method was no longer profitable, owing to the divergence of the bands. As they were too narrow to follow far, tunnelling operations soon became unprofitable, and any future operations conducted on the same lines are likely to meet with failure.

If, however, secondary silification is found to improve the slate contiguous to the dyke, and the 24-ft. seam in the gold prospecting tunnel is found to be worth opening up, it should be recognised that the western limb of the best seam of slate in the main open-cut is approaching the dyke at a low angle, and could be intercepted by opening up a cut along the east wall of the dyke.

In short, if the dyke has altered for the better the slate within a certain distance on either side of it, it will be the starting-point of all operations, and will afford a means of access that will, at the same time, be inexpensive and easy.

PYREET CREEK OUTCROP.

On a tributary of the Pyreet Creek, there is a wide band of slate exposed in the bed of the stream and up the steep slope of a spur to the south. The band, where exposed in the bed of the creek, is comparatively hard for a green slate, and shows signs of alteration. Slabs up to 24 inches long and 12 inches wide were obtained, which are obviously from an outcrop; the slate split well, but was brittle—a fault due, no doubt, to weathering.

There is a made road to within a mile of the locality, which is about 4 miles from Gisborne. The gradient from the road to the outcrop is steep and rough, and if prospecting warranted, opening up the slate would necessitate the formation of a carefully graded sideling track. The outcrop is most advantageously located for open-cut operations on a large scale.

I am of opinion that, below the decomposition zone, this slate would be found to be durable, and have a good splitting cleavage. It could be readily and inexpensively prospected at a point indicated by me to Mr. Grant. As there are no survey marks to tie on to, I was unable to fix this point on a plan. A tunnel into the side of the hill would be the least expensive way of getting out a pillar for the standard tests. If these proved satisfactory, the position for a cut could be fixed from the data obtained in prospecting operations.

[19.7.18.]

GREENSTONE (EPIDIORITE) AT CERES, NEAR GEELONG.

By W. H. Ferguson, Assistant Field Geologist.

The approximate position of the principal outcrops of greenstone at Ceres is shown on the parish plan of Barrabool (Fig. 83), and some suitable sites for quarries occur along the outcrops. The rock shows freely in allotments Nos. 21 and 22, parish of Barrabool, about 6 miles west of the Market-square, Geelong. Several outcrops are within half-a-mile, and one within 10 chains of a main road, and all are on private property. The area occupied by the epidiorite, about 1 square mile, is shown on quarter-sheet No. 24, S.E. The small outcrop shown on the sheet in allotment No. 23, parish of Barrabool, was not visited.

THE VARIOUS OUTCROPS.

There is an outcrop on Mr. James Anderson's property, marked 1 on the parish plan, upwards of 100 feet of quarry face could be obtained here (Fig. 83).

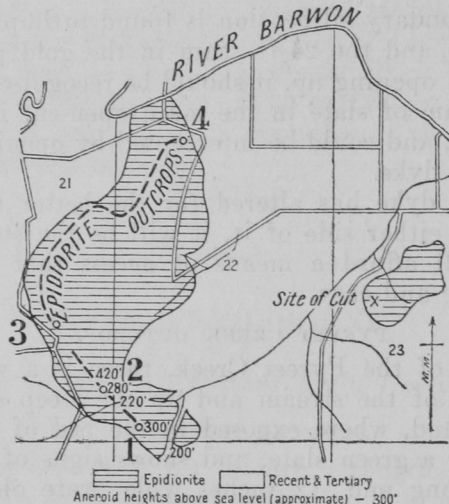


Fig. 83.—Plan. Scale: 1 mile to 1 inch.

Site 2.—This is north of Spring Creek; here there is a landslip; the Tertiary limestone appears to have slipped off the greenstone, and this site appears to be a good one for a quarry; a quarry face of greenstone 100 feet high could readily be obtained. The site is less than half-a-mile from an open road, to which a direct level track could be made. Blocks of stone, measuring up to 3 ft. x 2 ft. x 12 ft. outcrop here. Site 3 is in a gully running north-westward to the Barwon River, and there is a good outcrop of stone. A considerable amount of stone could be obtained here without much expenditure in opening up a quarry; but the get out is not so good as at some of the other sites.

Site No. 4 is close to Dowling's Ford, on the Barwon River, and here a large amount of stone is scattered over the surface, mostly in small blocks. This site is within a few chains of an open road, but it would be difficult to get a good quarry face.

Along the western edge of the area shown on the quarter-sheet, the stone outcrops freely for about a mile. Cubes of 3 feet diameter could be obtained from the surface stone. Apparently, the best site for a quarry is the one marked No. 2, close to the junctions of allotments Nos. 21 and 22, parish of Barrabool.

All over the outcrops the stone varies slightly in character, the principal difference being that one band is coarser than another, but good stone can be obtained anywhere along the outcrops.

There is, in the Geological Survey Museum, a 1-ft. cube of this stone, which was obtained many years ago, and it still retains a very fine polish, the scrollwork on it contrasting well with the polished surface.

The stone is very tough and difficult to break, but probably would not be so hard to polish as a granite, and would be very suitable for monumental work and building purposes. The specific gravity is high and the rock should be suitable for breakwaters and harbor works, also for road-making material.

The greenstone contains a large amount of mineral allied to hornblende; in this respect, it resembles some of the country rocks of the West Australian mines, and the possibility of some of the rock containing fine gold should not be altogether overlooked.

For microscopic description, see p. 312.

[17.8.16.]

GREENSTONE AT CERES.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The general features of the epidiorite outcrops at Ceres, near Geelong, have been described by Mr. Ferguson in his report of 17th August, 1916. Two distinct outcrops are shown on the coloured geological map of quarter-sheet 24 S.E. The syndicate has confined its attention to the eastern and smaller outcrop, which is easily accessible by a good road. This outcrop is less extensive than is indicated on the geological plan, as the eastern portion of the area consists of porphyritic granite. The granite and epidiorite outcrops form a ridge rising about 150 feet above the level of the road to the west, the junction of the two formations following the crest of the ridge.

The syndicate has put a cut into the hill at the spot marked X on the plan (Fig. 83). The cut is 5 feet wide, 40 feet long, and 10 feet high at the face. The rock, as exposed in the cut, consists of irregularly rounded blocks of solid stone up to 5 feet in length, embedded in yellow clay, chalcedonic quartz, and a little decomposed felspar. An attempt was made to blast some of the larger boulders to facilitate their removal, but, owing to the extreme hardness of the stone, the workmen could not bore it. At present, a boulder weighing about a ton occupies the face of the cut, and work has been stopped.

There is, at present, nothing to show at what depth solid rock will be found, and bores could not be put down without a diamond drill. Possibly, the rock at the site of the open-cut is decomposed more than the average, owing to the presence of a pyritic segregation (now altered to ironstone) in the original rock. I think it would be advisable to put another trial cut into the hill at a spot about 3 chains north-east of the present cut. Judging by surface indications, more solid rock will be met here. The cut could be on the same contour level as the present cut, and should be about 10 feet wide, so that large boulders could be packed at one side without blocking the cut.

If the stone proved unsuitable here, the larger western outcrop might be tested, as suggested by Mr. Ferguson, at site 2, about 20 chains north of the south-west corner of allotment 22, parish of Barrabool. Considering the proposition generally, the locality is accessible, and, provided that stone of suitable quality can be found at a reasonable depth, any quantity could readily be obtained.

The extreme hardness and toughness of the stone may preclude its use as a building stone on account of the high cost of quarrying, but as an ornamental stone it will doubtless find a market. Whether the demand will be sufficient to justify the necessary equipment is a point which will have to be considered. The possibilities of the stone justify further preliminary work, as suggested above. The future policy will depend upon the result of that work.

Should a quarry be opened up, the amount of waste material is likely to be considerable. Use may be found for portion of this as

road-making material. For light traffic, the stone would give a rough surface; but for heavy traffic, such as that in the vicinity of the Fyansford cement works, it should be found useful.

A sample of ironstone from the cut was assayed at the Geological Survey laboratory, and gave a trace (*i.e.*, less than 16 grains per ton) of gold and of silver. No platinum was present. Should bodies of nodular ironstone be revealed in any future operations, samples might be submitted to the Department for assay.

[3.10.17.]

GREENSTONE AT CERES.

By A. M. Howitt, Field Geologist.

The Green Granite Company's quarries are at Ceres, near Geelong. The general occurrence of the epidiorite rock was examined with a view to ascertaining whether the soft decomposed rock would continue to a depth below the present quarry workings.

The epidiorite occurs as an elongated boss-like intrusion, which would have boundaries or walls probably more or less nearly vertical. The north-west boundary or wall of the epidiorite rock cannot be defined on the long hill-slope, which in some places shows evidence of small landslips and a general slipping down of the rocks on the north-west slope of the hill.

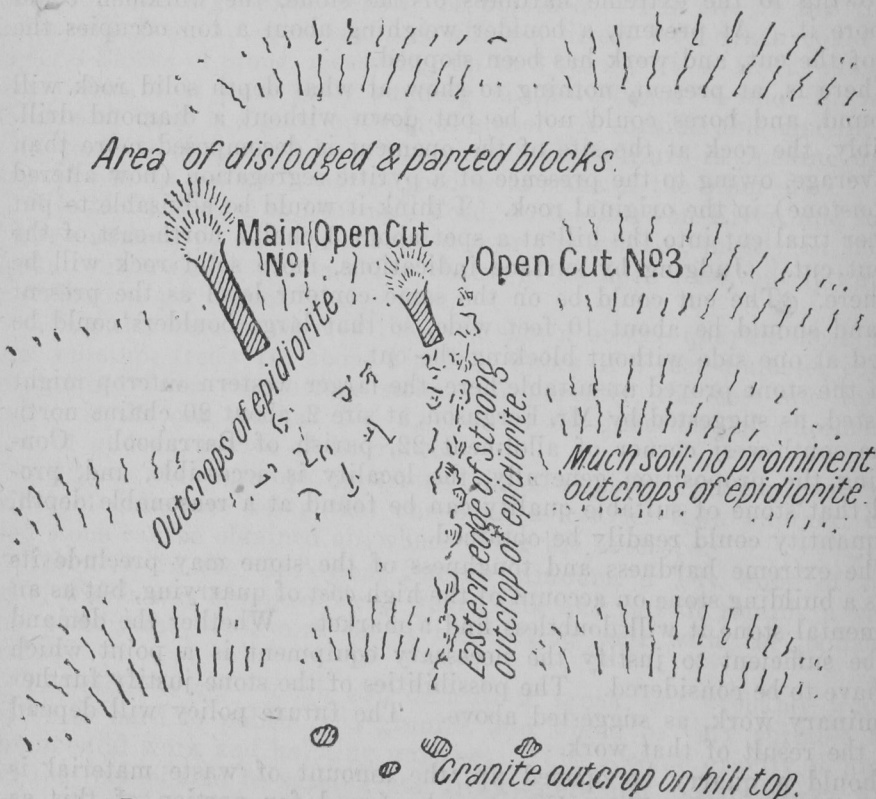


Fig. 84.—Epidiorite Quarries at Ceres, near Geelong. Scale: 100 feet to 1 inch.

Close jointing in the epidiorite has allowed moisture and other agents to penetrate and decompose the rhomboidal-shaped blocks, gradually destroying their angular shapes to form oval blocks of hard epidiorite lying in a series of soft concentric layers of decomposed rock. The epidiorite blocks near the north-western wall have been dislodged from their original position, and have slipped down hill; the jointed blocks next to them have become bent over and parted, allowing speedy decomposition in concentric layers, and re-depositing of leached iron as ferric oxide along certain joint spaces (Fig. 85). As the hill-top is approached, and away from the disturbed portion of the epidiorite on the north-western boundary wall, more settled and normal close-jointed rock may be expected.

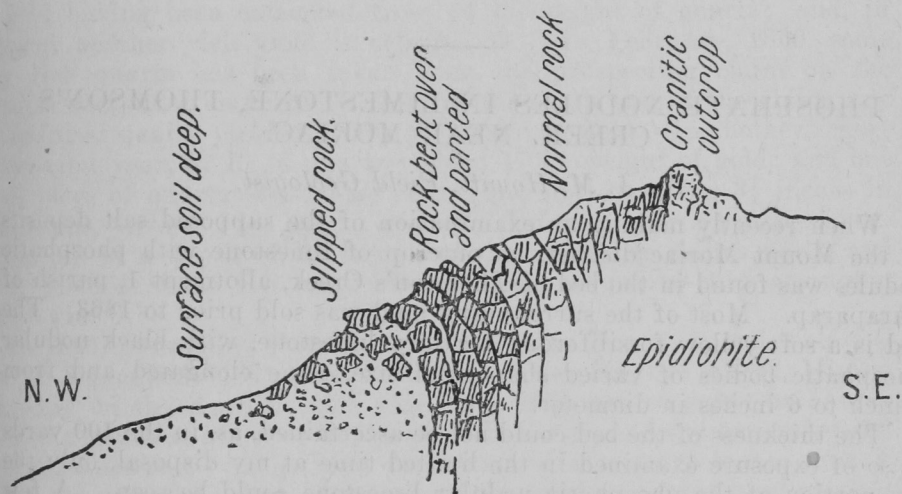


Fig. 85.—Section showing Epidiorite Rocks at Ceres. Not to scale.

The No. 1, or "main" cut, was put in where blocks of epidiorite outcropped, but owing to the displacement of and the bending over of these jointed blocks, and their consequent decomposition, an uneven series of hard and soft rocks has been met with, the present face of the main cut having a most discouraging appearance.

To sink a shaft from this main cut cannot be recommended, as the general slipping of the epidiorite and the resultant decomposition may continue for a considerable depth here. (Fig. 84.)

The No. 2, or "shaft" cut, was put in at about 6 chains north-easterly from the No. 1, or "main" cut. It passed through a number of fairly large jointed blocks of epidiorite, which had been displaced from the main rock mass and carried downhill by a landslip, which, although small, plainly shows out on the hill contour. From this cut, which is 10 feet high in the face, a shaft has been sunk about 20 feet, from the bottom of which a bore was put down for a further 20 feet without meeting solid rock; the decomposed rocks and small hard blocks include some of the granitic rock, which occurs well above the slip and near the hill-top.

The No. 3, or "middle" cut, bears S. 20° E., and is 1½ chains east of the "main" cut, being close to the outcrop on which Mr. J. P. L. Kenny considered it would be advisable to open cut. The present face of this cut is 8 feet high, and shows jointed epidiorite of both coarse and fine texture, and of a fairly settled and undecomposed character, indicating that the effects of slip movements are passing out, and that more settled, close-jointed epidiorite may be met with. One block here

measured 4 ft. x 3 ft. x 3 ft., but the average blocks are much smaller. The No. 3, or "middle" cut, might be continued in a southerly direction, so as to keep within the line of out-cropping epidiorite rock, and at the same time making away from the unsettled zone and towards the hill-top. By extending this cut, more compact and undecomposed rock will probably be met with; but it cannot be said that larger jointing is likely to be found. Such a cut as the above would extend about 130 feet from the present face, and give over 30 feet of a face when near the hill-top.

The extension of No. 3 "middle" cut is warranted by the evidence obtained, but shaft sinking at any of the present workings cannot be recommended.

[18.9.18.]

PHOSPHATE NODULES IN LIMESTONE, THOMSON'S CREEK, NEAR MORIAC.

By A. M. Howitt, Field Geologist.

When recently making an examination of the supposed salt deposits in the Mount Moriac district, an outcrop of limestone with phosphatic nodules was found in the bed of Thomson's Creek, allotment 1, parish of Paraparap. Most of the surrounding land was sold prior to 1863. The bed is a soft yellow fossiliferous Tertiary limestone, with black nodular phosphatic bodies of varied shape and size, some elongated and from 1 inch to 6 inches in diameter.

The thickness of the bed could not be ascertained, as, in the 100 yards or so of exposure examined in the limited time at my disposal, only the top portion of the phosphatic nodular limestone could be seen. A few samples of the nodules and their containing limestone were collected for proximate analysis at the Geological Survey laboratory.

Assay No.	Field No.	Description.	Percentage P_2O_5
59	1	Black nodule	22.6
60	2	" "	26.6
61	3	" "	23.1
62	4	Yellow calcareous marl	Under 1
63	5	Brown " "	" 1

The phosphoric acid is present as a phosphate of lime. As the deposit is close to the Wensleydale-Moriac-Geelong line (1 mile distant), and $1\frac{1}{2}$ miles from the Moriac railway station, a further examination might be advisable to see if there are better exposures along Thompson's Creek, and nearer to the railway line. The nodules are high in phosphoric acid content, and if the bed proves thick, any concentration of the nodules would be worth further average sampling.

[16.2.19.]

THE SWEDISH REEF, ONE TREE HILL, QUEENSTOWN.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The One Tree Hill workings, near Queenstown, are on three parallel reef lines, known as the Swedish, Moonlight, and Buck reefs respectively.

From the hill, which forms part of the divide between Watson's Creek and Diamond Creek, the gullies trending north-west and south carried alluvial gold, with some nuggets, an unusual occurrence in the gold-fields to the east of Melbourne. The reefs were worked in the "Fifties," and but little information regarding the yields obtained is now available.

In a report upon the mine by Mr. J. Easton, Assistant Field Geologist, dated 12th November, 1914, the following information regarding the yields is given:—"In 1859, Hamilton and party obtained 144 oz. from 90 lbs. weight of quartz, at a depth of 21 feet from the surface, on No. 2 claim; again, on the 18th August, 1859, the yield of gold from the Swedish reef on One Tree Hill is greater than ever, 15 lb. weight of gold having been extracted from 60 lb. weight of quartz; and, in October, another rich yield is referred to. In February, 1860, some very rich quartz has been taken from the prospecting claim on the Swedish reef, at a depth of 65 feet; in the south end of the claim, one bucketful of quartz yielded over 5 lb. weight of gold. In another report of the same year, 57 lb. of quartz yielded 17 lb. weight of gold; and one small piece of quartz from same claim, and not exceeding $3\frac{1}{2}$ inches in dimensions, yielded 3 lb. weight of gold. Inferior quartz averaged 4 oz. to the ton at a depth of 65 feet; and the adjoining claims north and south yielded about the same average from a quartz reef averaging 1 foot wide."

In 1860, a company was formed to work the Nos. 2, 3, and 4 claims, and in September, 1861, the workings of the Smyth's Creek Mining Company on the Swedish reef, One Tree Hill, are recorded as having reached a depth of 200 feet in one of their shafts, and the reef increased from 6 inches to 15 inches, and the quartz became much richer than it was at a depth of 100 feet; 216 tons are recorded as having been crushed up to 150 feet in depth, but no yields are recorded. The reefs have a general strike of N. 35° E., and they all dip about 70° to the west.

The Swedish reef is the most westerly, and has been extensively worked from shafts, and an adit driven north along the line. The Moonlight reef, 110 feet east, has also been worked continuously on the surface. On the Buck reef, one shoot was noted worked to a shallow depth. The outcrop of this reef which carried quartz 3 feet wide in places, is 50 feet east of the Moonlight line.

To test these reefs at a lower level, an adit, now 744 feet in length, has been driven in an easterly direction. It cut what is probably the Swedish reef at 337 feet. The reef was 2 inches wide, dipping west 60° , and was not payable. A drive was continued south on the line, and at 50 feet a small fault was passed through; beyond the fault, the reef was irregular, and further south it appears to sink out altogether. From the end of the drive south, a cross-cut was put out easterly. The Swedish line should have been cut in the cross-cut at about 30 feet, but no indication of the reef was met, and the cross-cut was continued to 165 feet, where a reef from 3 inches to 1 foot wide, and dipping 58° west, was cut.

This reef, which carried a trace of gold, is probably the Moonlight line. Drives were extended 10 feet north and 22 feet south on it. The cross-cut has now been extended 40 feet easterly beyond the reef; a further extension of about 25 feet should intersect the Buck reef.

Future prospecting of the Swedish reef by a rise from a point about 40 feet along the cross-cut, may reveal this reef above the level, and possibly payable stone may be found below the old stopes.

The Moonlight reef was intersected by the cross-cut directly below the old workings, and a rise on the reef from the adit-level will give the best means of prospecting it.

The Buck reef should be cut, as already stated, by an extension of the cross-cut of about 25 feet, but, as on the surface above the cross-cut it carries no gold, and the nearest shoot (which is only worked to a shallow depth) is about 100 feet south, the prospects of striking payable stone on it are not over promising.

[7.1.18.]

DANDENONG SHIRE STONE QUARRY.

By O. A. L. Whitelaw, Field Geologist.

The proposed stone quarry for the Dandenong Shire is situated about 3 miles to the north-east of the township of Dandenong, in a Crown reserve held for police purposes.

The specific object of my investigation was to determine the quantity and quality of some stone located by the Shire Engineer. The rock in question is of the diorite type, and is intruded into the granite rocks. The diorite can be traced for a considerable length, and occurs as two dykes, the western being about 10 feet and the eastern 6 feet in thickness. Separating the two is 40 feet to 60 feet of granite—the latter is slightly friable near the surface owing to decomposition. This defect should disappear at a shallow depth, and the stone should then become useful for road metal, pitchers, and stone supports. The basic material of the dyke should make excellent road metal, and, occurring as it does as bodies intrusive to the granite, no fear need be entertained as to its downward extension. The specific gravity of the dyke-rock is 2.73, and of the granite 2.65 (approximately).

Taking the conservative estimate of a 10-ft. width for the western dyke, a 6-ft. for the eastern dyke, with a 45-ft. width of intervening granite, we get the following quantities for each 100 feet of quarry to a depth of 30 feet:—

Western dyke, 10 feet wide (unbroken),	13.2 cubic feet per ton	
Eastern dyke, 6 feet wide (unbroken),	13.2 cubic feet per ton	2,270 tons
Granite, 45 feet wide (unbroken)	13.7 cubic feet per ton	1,360 tons
		7,390 tons ¹
		11,020 tons

¹ Deduction for decomposition, 25 per cent.

The quality and quantity of workable rock may be accepted as quite suitable for the purpose required by the Dandenong Shire Council, while the site of operations may be made available by easy grade to their existing hopper by a slight alteration of route to the tramway already constructed to the old quarry.

[6.12.15.]

WOLFRAM AT BRITANNIA CREEK, WARBURTON.

By A. M. Howitt, Field Geologist.

At Warburton, two leases for wolfram are held by Pearce and Rowe, the northern one, No. 3272 (41 acres 0 roods 26 perches) is on Bullock Creek, where very little prospecting has been yet done; and the southern, No. 3273 (46 acres 2 roods 13 per.) on which the main prospecting tunnels and cuts have been put in along the steep slopes of Britannia Creek.

GEOLOGY.

The rock formations are granodiorite, with occasional narrow, more acidic segregation veins approximately parallel to the wolfram-bearing quartz veins. These quartz veins contain much schorl (black tourmaline) in places closely associated with the wolfram crystals, and they strike, on the average, N. 25° W., and dip 60° to 75° to the west. A series of manganese-bearing veins dip to the east at low angles, faulting the wolfram bearing veins (Fig. 86).

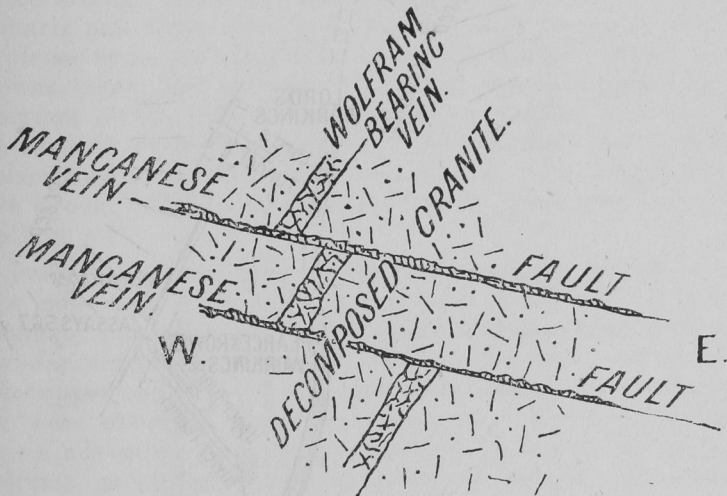


Fig 86.—Section North of Lord's Workings. Scale : 2 feet to 1 inch.

The granodiorite is decomposed to a soft yellow-brown rock, with here and there an occasional hard kernel of undecomposed rock.

PAST WORK.

The wolfram was first discovered in 1907 by Lord and party, of Hermon's Mill. It is stated that Lord obtained 15 cwt. of wolfram

from a surface patch, and subsequently worked a short shoot of wolfram in a quartz vein from 1 inch to 6 inches wide. In all, it is stated that Lord obtained about 2 tons of wolfram from this 20-ft. x 20-ft. shoot, together with the rich surface patch.

Later, Tuxen Brothers took up two leases, but no developments followed, and the leases became void. Pearce and Rowe, in March, 1916, took up the leases, and have carried out much prospecting work by means of tunnels and cuts, both on the alluvial and lode wolfram.

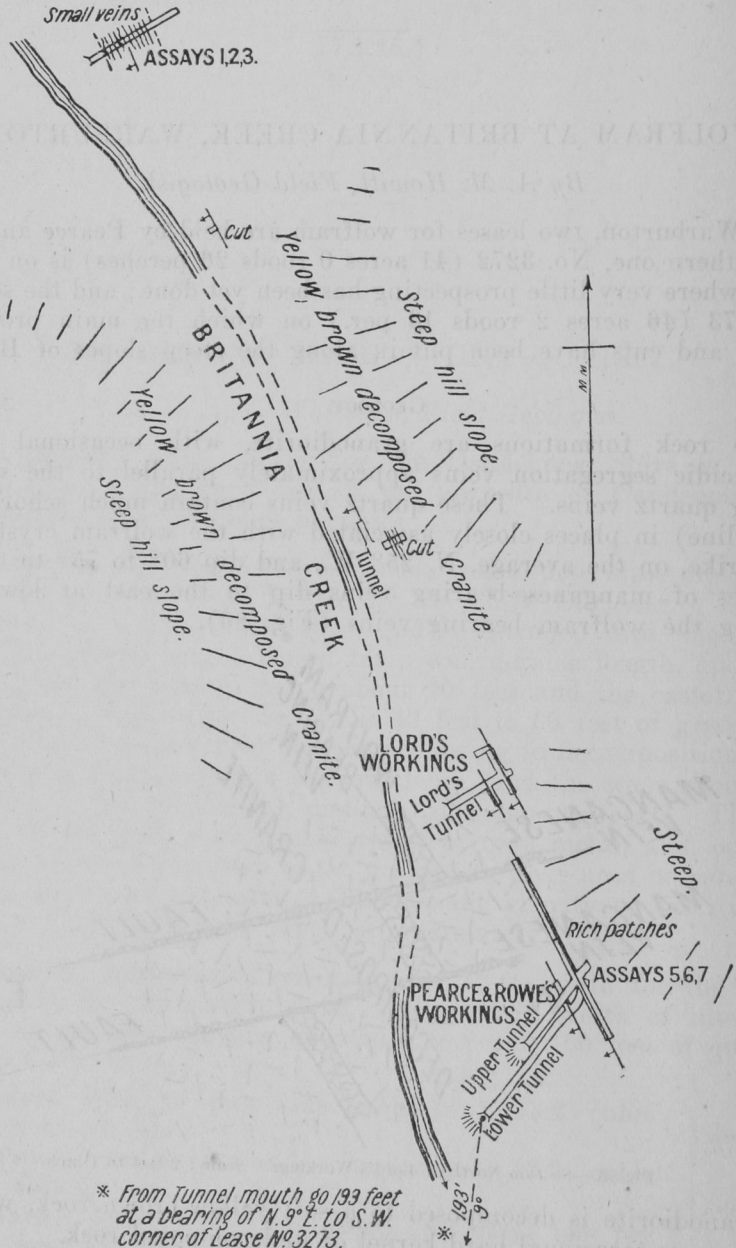


Fig. 87.—Sketch Plan. Scale : 120 feet to 1 inch.

PRESENT WORKINGS.

On the north, as shown on the attached sketch plan, a tunnel has been driven 57 feet through decomposed granodiorite in an easterly

direction, cutting about eighteen small west-dipping quartz and tourmaline tracks and vein-bulges of 1 inch to 4 inches wide. The Geological Survey laboratory assays from ore in this tunnel gave:—

Field No.	Assay No.	Description.	Tungstic Acid.
No. 1	721	Average sample of decomposed rock and eighteen quartz-tourmaline veins	Percentage. 0·02
No. 2	722	Average sample of eighteen quartz-tourmaline tracks and veins	0·21
No. 3	723	Decomposed granodiorite between veins of quartz and tourmaline	Nil

The assays indicate that the wolfram or tungsten ore values in this north tunnel are very low. An assay for gold and silver was also made on these samples, the result being a trace only.

Going south-easterly from the 57-ft. north tunnel, a small cut is passed at $1\frac{1}{2}$ chains, and at 5 chains a north-east and south-west prospecting cut and a small north-westerly tunnel has been put in along narrow quartz-tourmaline veins, with a little wolfram ore. Two chains further on, in a south-easterly direction, Lord's tunnel workings are met with (Fig. 87). Further on, 2 chains south-easterly, Pearce and Rowe have done their main work by means of two tunnels.

The upper tunnel is about 20 feet lower than Lord's tunnel, and has been driven 65 feet, at a bearing of N. 33° E., intersecting the main lode at 55 feet. Here the lode strikes N. 26° W., and dips 65° to 70° south-west; drives north-westerly 74 feet, and south-easterly 36 feet, proved the main quartz-tourmaline lode to be from 1 inch up to 6 inches wide, carrying rich patches and short shoots of coarse wolfram in places; but, on the average, along the roof of the drive, there are several blanks in the quartz and tourmaline lode showing only traces of wolfram ore, and in places none. A sample from one of the soft brown tourmaline patches was taken, but on assay the result was disappointing; yet, in some portions of the lode, these tourmaline clusters surround wolfram ore. Geological Survey laboratory.—Main tunnel, No. 7 (727), soft, brown-black tourmaline, &c.; tungstic acid, nil. The length of the main lode here is over 100 feet, though narrow in places and very patchy in wolfram ore.

The lower tunnel has been driven north-easterly for 92 feet, cutting the main lode-track at 74 feet. A drive north-westerly 15 feet exposed a little quartz and some tourmaline along a slickensided wall with pug, which so far constitutes the main lode at this level, which is 45 feet below the upper tunnel. Pearce and party state that prospects of fine wolfram were obtained along the lode-track. Further driving north-westerly is advisable along this lode-track to see if the wider quartz with wolfram, as worked above, pitches north-westerly and makes ahead in the drive.

The prospecting work done has proved that there are many small quartz and tourmaline veins in places containing wolfram ore; and one, the main, averaging 1 inch up to 6 inches wide; but further general prospecting along the line of quartz veins, by tunnels and drives, is necessary to discover, if possible, wider veins and more consistent shoots of ore. The leases enclose much ground to be prospected north-westerly along the strike of the ore belt.

The country is difficult to prospect on account of the dense undergrowth and steep slopes of the hills. So far, the soft, decomposed rock formations have been easily and cheaply tunnelled, but harder granodiorite is sure to be encountered sooner or later as work proceeds, and then mining costs will rapidly increase.

The alluvial deposits are, at the present time, the most favorable, and should be worked profitably if of similar value to the reported small tests. They are from 1 foot to 4 feet deep, confined in the narrow creek, averaging about 1 chain in width, but up to 4 chains wide in places. Some small washings are stated to have yielded 4 lb., and up to 7 lb., of wolfram to the cubic yard. This alluvial wolfram is, in places, coarse, and many specimens of quartz, tourmaline, and wolfram together are seen. Associated with the finer material, there are scheelite and stream tin in small quantity, and a few small topaz crystals. Large boulders of hard granodiorite rock occur in the alluvial deposits. The northern lease on Bullock Creek has been little prospected, either for lode or alluvial wolfram, but the alluvial deposits appear to be similar to those on Britannia Creek; and, considering the wolfram belt strikes along the east side of Bullock Creek, they should be well worth prospecting.

[29.1.17.]

MATTHEWS' GOLD MINE, FLOWERDALE.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

Matthews' gold mine is about 3 miles northerly from the Flowerdale hotel. A 5-head battery driven by a portable engine has been erected on the mine. The country rock is intersected in places by small horizontal veins and threads of quartz, and assays from an open cut adjacent to the battery are stated to have averaged about 4 dwt. to the ton. Trial crushings, however, failed to yield 2 dwt., and an adit about 40 feet long driven in a southerly direction from the open cut shows clean country, with no trace of a lode formation. Recent assays from some small threads of oxidized quartz, about 2 chains south of the battery, are reported to have yielded 24 dwt. of gold to the ton. A sample from a small heap of crush dirt, saved from this spot and dollied in my presence, gave a prospect equal to about 2 dwt. per ton, and it is not likely that payable stone can be mined here. About 6 chains south of the battery another cut has been put in on quartz veins, and there is an old shaft about 20 feet deep stated to have given assays equal to 4 dwt. to 10 dwt. per ton for that depth. Dish prospects taken from the veins indicated values of about 5 dwt. per ton, but the adjacent rock carries little or no gold. The gold is fine, and it is doubtful if stone that would yield 3 dwt. per ton through the battery could be mined here. As the plant is on the mine a trial crushing of 20 or 30 tons might be put through from this spot. Should the result not be payable the prospects of the mine would hardly justify further expenditure.

[11.4.19.]

THE GOLDEN BOWER MINE, UPPER YARRA.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The Golden Bower Mine is situated near the head of Donovan's Creek, a tributary of the Yarra River from the north. Access to the mine is gained by the road from Marysville to Woods Point, known as the "Yarra track." The turn-off to the mine is 17 miles from Marysville, and the mine is about a mile from the road, and 600 feet or 700 feet below it.

Two parallel lodes, 300 feet apart, and running nearly north and south, have been worked. The most easterly is the Golden Bower lode; the quartz here averages about 6 inches wide, and is found on either wall of a dyke 2 feet to 4 feet wide. A shoot 130 feet long has been worked to a depth of 70 feet. The Golden Bower lode was the first discovered, and near it the prospectors erected a battery on the creek. They drove an adit (now collapsed) 60 feet below the reef outcrop. At 12 feet below this adit-level the stone appears to have become unpayable, and, with the exception of a trial crushing of 10 tons taken out by the present company, no gold has been won from it since.

On the Star lode no dyke is present, and a shoot 350 feet long has been worked here to a depth of 400 feet. The lode was first worked from an adit cutting the lode 80 feet below the outcrop. Later another adit was driven from the creek level, cutting both lines. The Golden Bower dyke was intersected at 60 feet, but it was evidently not recognised as such, and the adit was continued to 140 feet, where a drive was extended 320 feet south in clean country; the dyke was subsequently located in crosscuts east, but nothing payable was met with.

The lower adit-level was continued to the Star lode, a total distance of 552 feet, and drives were extended about 185 feet north and 380 feet south on it. The lode proved payable, and was stoped out from the lower adit-level to the surface. With this the original company ceased work, and the mine lay idle for a number of years. About twelve years ago it was taken up by a Melbourne syndicate, and a start was made to sink a winze below the lower adit-level. Water proved troublesome, and the syndicate abandoned the mine.

Soon after Kirwan and party started work, they sank the winze to 115 feet, put in levels at 75 feet and 115 feet, and stoped out a block 250 feet long to a depth of 135 feet below the adit. According to the records of the Mines Department, Kirwan and party won 514 oz. 10 dwt. of gold from 439 tons of quartz, an average of 23.4 dwt. to the ton. Kirwan and party were unable to continue, as the water could not be kept down by hand labour.

The present company was formed about five years ago to further develop the mine. A race, about 10 miles long, and giving a head of 90 feet above the lower adit-level, was cut from Cumberland Creek to the mine. The water under pressure was carried into the adit and utilized to drive a Pelton wheel at the winze. A winch and pumps were installed, power for both being derived from the Pelton wheel. This novel arrangement proved a success, and the winze was carried

down to 160 feet. The lode was stoped out to 12 feet below the 160-ft. level and also a block of stone 110 feet long was taken out on the south end of Kirwan's stopes. Below the adit-level the shoot pitches south at about 25° , and in the bottom level was 160 feet from the winze. What is possibly another shoot was cut in the winze. At the 160-ft. level a drive north for 20 feet proved payable stone, but a drive north of 80 feet at the 115-ft. level failed to intersect it, and the extent of payable stone has not been determined. Below the 160-ft. level a winze was sunk 45 feet, and an underhand stope 12 feet deep was taken out for a length of 170 feet. Water troubles and the south pitch of the shoot made further sinking with the present appliances inexpedient, and the company ceased work on the Star lode.

Of late the company has been prospecting the Golden Bower lode. A connexion has been made with the old stopes, and the workings are without doubt on the right line. The lode is disturbed by slides, and values are not payable; a trial crushing of 10 tons yielded 18 dwt. gold to the ton. There are two places where this lode might easily be further tested:—

(1) At 175 feet in the drive south a cross-cut east of 25 feet cuts a 6-in. quartz vein. This vein, which also shows in a rise to the south, appears to be 6 feet west of the reef and dyke, so that the cross-cut would cut the lode if extended 6 feet further. If the lode were located here, a drive south would prospect it below the old stopes.

(2) At 250 feet in the drive south a cross-cut has been put in 70 feet east from a rise at 17 feet above the level. No dyke was cut in this cross-cut, but one of the slides was intersected, and the dyke has evidently been displaced by it. A rise of a few feet at a point about 20 feet along the cross-cut will probably reveal the dyke.

Possibly payable stone may be obtained above the adit-level on the Golden Bower lode, but prospects are not over-promising. On the Star lode the length and value of the shoot may justify a main shaft. The shoot is 350 feet long; the ore is evidently improving in value with depth, as the following returns show:—

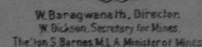
		Average value to the ton.		Depth.
		dwt.		feet.
Original owners	18.6	0-200
Kirwan and party..	23.4	200-300
Golden Bower Company	26.3	300-400

The present company's milling includes lower grade ore left by Kirwan and party. The company's last crushing of 202 tons yielded 327 oz., an average of 32 dwt. to the ton. On the other hand, the reef is small, its average width is about 6 inches, and the work done by the present company has returned no profit to the shareholders.

To further develop the mine two alternative schemes present themselves—

- (a) To sink the present winze deeper.
- (b) To sink a new main shaft.

(a) The first scheme is not, in my opinion, to be recommended. The winze would first have to be enlarged and an oil engine or other motive power installed. Long south drives would be necessary to reach

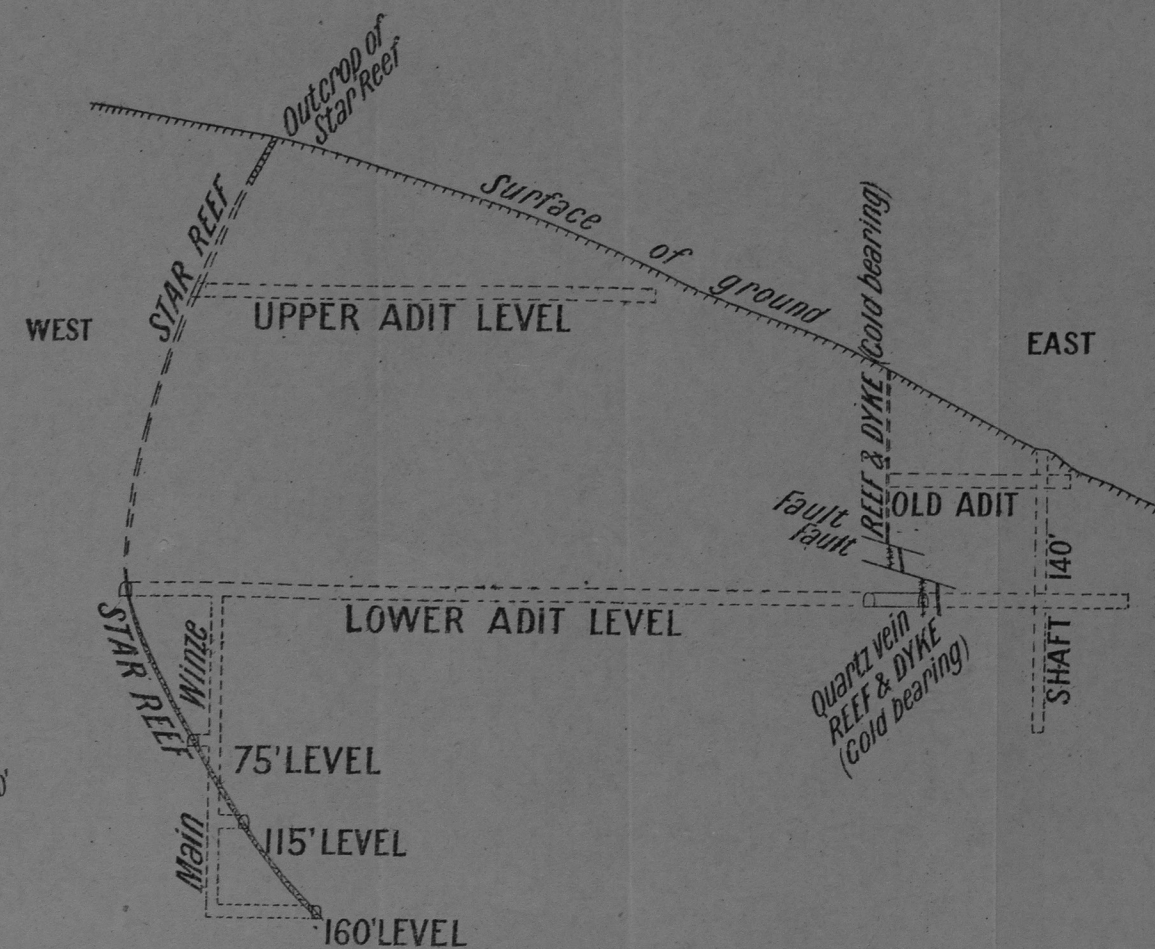
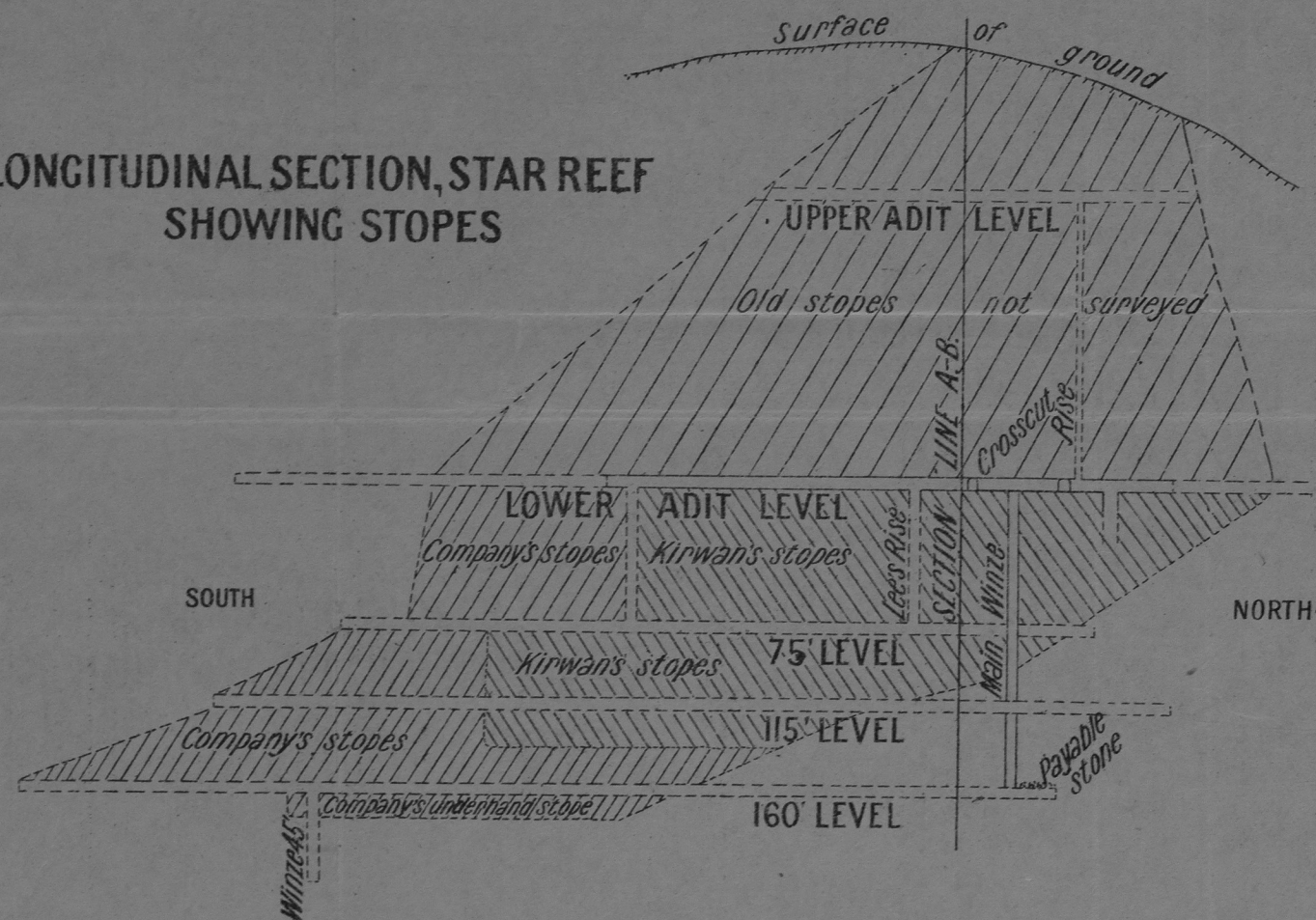


SCALE OF FEET

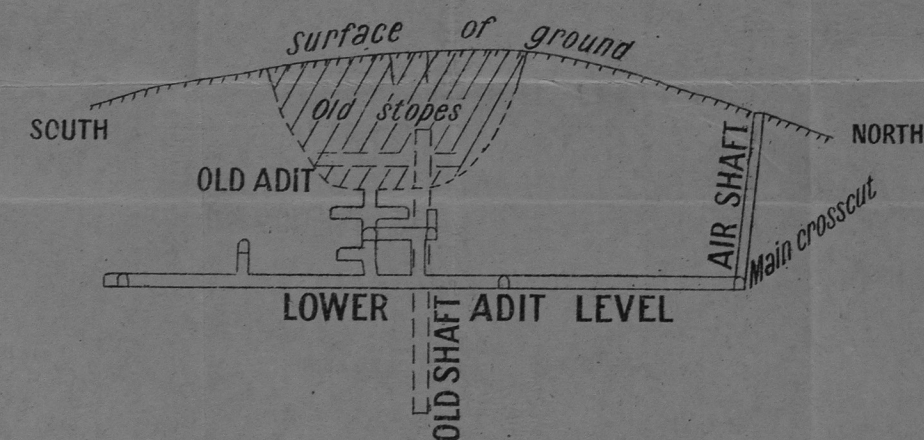


NOTE - Workings shown in dotted lines are taken from Mine Manager's plans.

J. P. Kenny
23.4.18



TRANSVERSE SECTION A-B.



LONGITUDINAL SECTION, GOLDEN BOWER REEF
SHOWING STOPEs

the shoot, and working costs would be high. The operations, on the whole, are not likely to be any more profitable than the present company's work has been.

(b) The sinking of a new main shaft at least merits investigation. A suitable site could probably be found with surface level about 100 feet above the lower adit-level, so that a sink of 500 feet would give approximately 200 feet of backs below the old stopes. The present plant could be utilized to bale the water from the old workings while sinking was in progress.

A rough estimate of the cost of sinking to 500 feet with the plant necessary is given below:—

	£
Plant—boiler, steam winch (say, two 8-in. cylinders), housing, &c.	600
Sinking 500 feet, at £6 per foot	3,000
Driving and cross-cutting, say, 1,000 feet, at £1 10s. per foot	1,500
Total	£5,100

From below the adit-level, in a vertical depth of 160 feet, the lode has yielded 2,382 oz. gold from 1,857 tons of quartz, an average of 25.7 dwt. to the ton. If the lode maintains this value for the next 200 feet it would yield 2,977 oz. gold from 2,322 tons of ore.

The value of ore carrying 25.7 dwt. gold to the ton is 102.8s. per ton; so that if the ore can be mined and milled at a cost of 50s. per ton, a profit of about 50s. per ton would be made, and 2,322 tons would give a total profit of £5,800, to obtain which an outlay of £5,100 on plant and mine development would be necessary, leaving a net profit of £700.

These figures indicate that, should the shoot maintain its length and value, which, unfortunately, is frequently not the case, a plant capable of sinking to 500 feet would yield a margin on capital cost and working expenses; and by sinking to 600 feet, should the same conditions continue, the mine would yield profitable returns. The value of the gold won is over £4 per oz. In addition to iron pyrites, sulphides of copper and antimony are present in small quantities, sufficient, possibly, to prevent the tailings from being successfully cyanided. The high and increasing costs of machinery and stores, and the uncertainty of future supplies, make costs difficult to estimate, and the present time cannot be regarded as opportune, but the mine does appear to be a genuine prospecting proposition.

The underground workings of the mine are shown on the accompanying plans and sections. (Pl. XXXVIII.). The winze is now full of water, and the position of the workings below the lower adit-level has been laid down from the mine manager's plans.

Yields.

The following yields from the mine are recorded in the returns of the Mines Department. The yields for 1868, and possibly 1869, probably include ore from both the Golden Bower and Star lodes, while subsequent crushings are from the Star lode only:—

Date.	Ore Crushed. Tons.	Gold per Ton. dwt.	Total Gold. Oz.	dwt.	Remarks.
Sept., 1868	885	24.1	1,064	14	Golden Bower reef.
Dec., 1868	637	15.0	479	0	Golden Bower and New Star reefs.
June, 1869	120	12.9	77	15	Star lode, depth, 200 feet.
Dec., 1869	698	18.0	628	4	Depth, 250 feet, claims amalgamated.
Mar., 1870	500	10.0	250	0	
Sept., 1870	137	20.0	137	0	
Mar., 1871	80	33.7	134	17	
June, 1871	95	35.2	167	1	
1905	20	44.7	44	15	Kirwan and party.
1906	11	21.4	11	15	" "
1906	343	22.3	383	0	" "
1907	65	23.1	75	0	" "
1913	336	19.6	350	0	Golden Bower company
1914	492	27.2	670	4	" " "
1915	388	28.8	541	4	" " "
1916	202	32.3	337	0	" " "
Total	5,009	21.3	5,351	9	

[23.4.19.]

FELSPAR AT NAYOOK.

By L. H. Ower, Assistant Boring Engineer.

At about a mile north of allotment 106, parish of Jindivick, while engaged in 1910 mining for alluvial tin in the adjoining gullies, an attempt was made to locate the lode from which the tin was derived, and, with this purpose in view, a shaft was sunk by Jones and party on the crest of a narrow spur, to a depth of 90 feet in granite. At 60 feet from the surface crystalline feldspar about 1 ft. 6 in. thick and lying approximately horizontal, was met with, and driven on for a few feet both east and west.

A small excavation on the point of the spur, about 9 chains south from, and about 50 feet lower than, the shaft shows massive quartz and feldspar crystals; but, owing to dense vegetation and detritus, no other outcrops of this material have been found.

From the information obtained it would be difficult to form an estimate of the amount of feldspar available; but, should the lessees consider the proposition payable, they should ascertain this as rapidly as possible. The best method of prospecting would be to re-open the shaft, which is apparently in good order, and drive westward along

the deposit towards the gully. This will give information as to the character and inclination of the felspar vein, and, if the find is worth developing, the drive could afterwards be utilized as the main tunnel. The felspar obtained would be stacked in the meantime, as no vehicle roads exist in the vicinity; but, if the mineral available should justify it, a tramway about $2\frac{1}{2}$ miles long could be constructed along the valley to join with Collins' timber tram in allotment 107, Jindivick.

A sample of the felspar was tested at the Geological Survey laboratory (G.S. 10/675), and was favorably reported on. At $1,400^{\circ}$ C. it fused completely to a white mass, which, when applied as a slip, produced a good glaze.

[16.5.16.]

THE MAIN REEF MINE, MAINDAMPLE.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The Main Reef mine workings, situated at Maindample, about a mile south of the railway station, include three of a group of reefs which were opened up in the locality about 25 years ago.

The country rock consists of slates, and occasional thin beds of sandstone of Silurian age, with a general strike of $N. 40^{\circ} W.$

The Main Reef workings lie for the most part in a semicircular basin, flanked by a ridge 200 feet above the gully in which the shaft is located. The three lines included in the lease are known as Anderson's reef, the Main reef, and the Lady Hopetoun reef.

Anderson's reef is the most easterly. To the north it has a strike of $W. 20^{\circ} S.$, but after crossing the ridge it turns southerly with a strike of $S. 23^{\circ} W.$ Throughout its course this reef cuts obliquely across the bedding of the country rock in its strike. The southern portion of the reef has been worked on the surface for a length of 120 feet. Two shafts have been sunk on the reef, and an adit 80 feet in length has been driven on the line. The deepest workings are on the south end of the reef, where a shoot 50 feet long is said to have been stoped to a depth of about 120 feet from the surface. This work was done before the present company was formed, and records of the gold won have not been published. The company has recently cut this reef at a depth of 365 feet below its outcrop, as will be described later.

The Main reef, as its name indicates, is the most important of the lines in the lease. On the surface the line can be traced for a length of over 500 feet. Two separate shoots about 200 feet apart have been worked. An old adit 140 feet long cuts the reef at a depth of 80 feet. From this adit drives were extended north and south along the line. The north shoot evidently carried the best values, and from the adit it was worked to a depth of 170 feet from the surface. Particulars of the yields from these old workings are not available. This reef has been further developed by the present company, as is described below.

The Lady Hopetoun reef outcrops 190 feet west of the Main reef, and is parallel to it. A shoot 50 feet long has been stoped on this reef,

and the workings are said to be about 90 feet deep. Complete records of the yields are not available; two crushings are given below:—

Date.	Ore crushed.	Gold.		Gold per ton.			Depth.
		tons.	oz. dwt.	oz.	dwt.	gr.	
Dec. 1890	65	73	0	1	2	11	—
June 1891	90	83	7	0	18	12	50

The present Main Reef Company has sunk a shaft 240 feet deep, with levels at 140 and 240 feet. (Pl. XXXIX.)

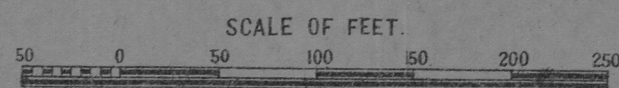
No. 1 Level, Hopetoun Reef.—At the 140-ft. level, a north-easterly cross-cut intersects the Main reef at 285 feet, and the Lady Hopetoun reef at 520 feet. On the latter reef a drive was extended 215 feet north, and a shoot 50 feet long was stoped to 40 feet above the level. From this stope a crushing of 26 tons yielded 24 oz. 9 dwt. of gold, an average of 18 dwt. 9.4 gr. to the ton, the reef being from 6 inches to 1 ft. 6 in. wide.

No. 1 Level, Main Reef.—In driving the No. 1 cross-cut a fault line was intersected at 270 feet from the shaft. It was anticipated that the Main reef would be cut at about that distance, and drives were extended 75 feet south and 290 feet north on this fault wall before the Main reef channel was located 15 feet further west. The precise effect of this fault on the reef cannot now be seen, but probably it is a reversed fault, with a throw of about 20 feet. In the face of the drive south at the No. 1 level the Main reef channel intersects the fault. On the south shoot a block 90 feet long has been stoped to a maximum height of 60 feet above the level, and beyond this a rise connects with the old adit-level. The north shoot has been stoped almost continuously for a length of 180 feet, and to a height of 50 feet above the No. 1 level. In the north end of these stopes the reef was 4 feet wide, and was worked up to a slide 30 feet above the level, but all the available ore appears to have been taken out both above and below the slide.

The company's stopes here have been carried up to a point 80 feet above the No. 1 level, or 170 feet from the surface, where the old stopes from a winze sunk below the adit-level were met. In the north drive at the No. 1 level a cross-reef was intersected at about 200 feet from the main cross-cut, and on the eastern side of the Main reef. This cross-reef carried payable stone, and was stoped for a length of 50 feet, and to a height of 45 feet above the level. Payable stone is said to go underfoot here.

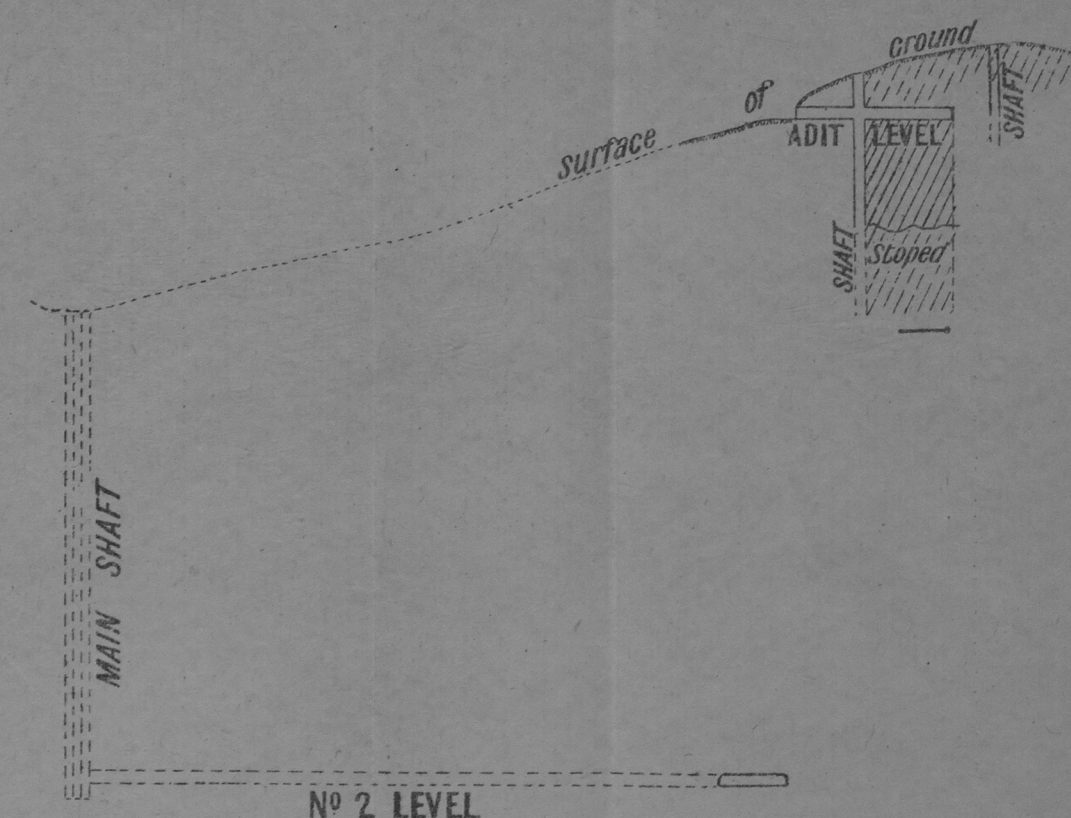
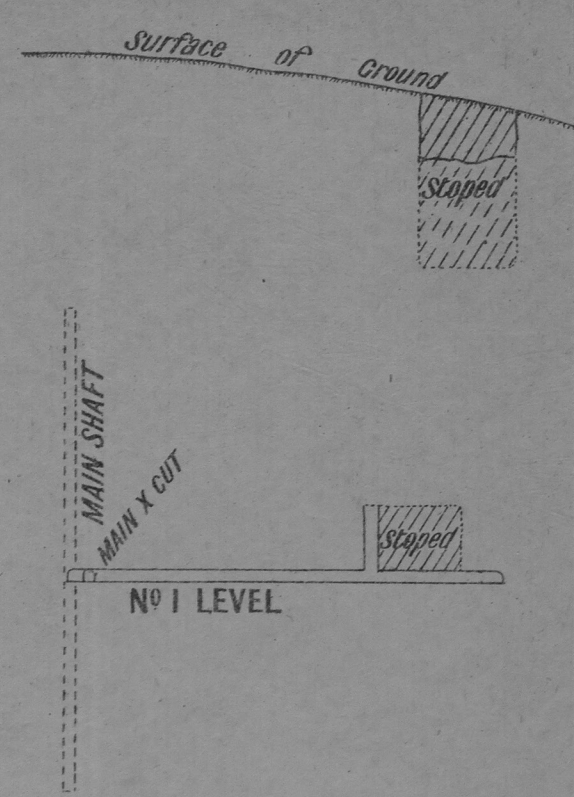
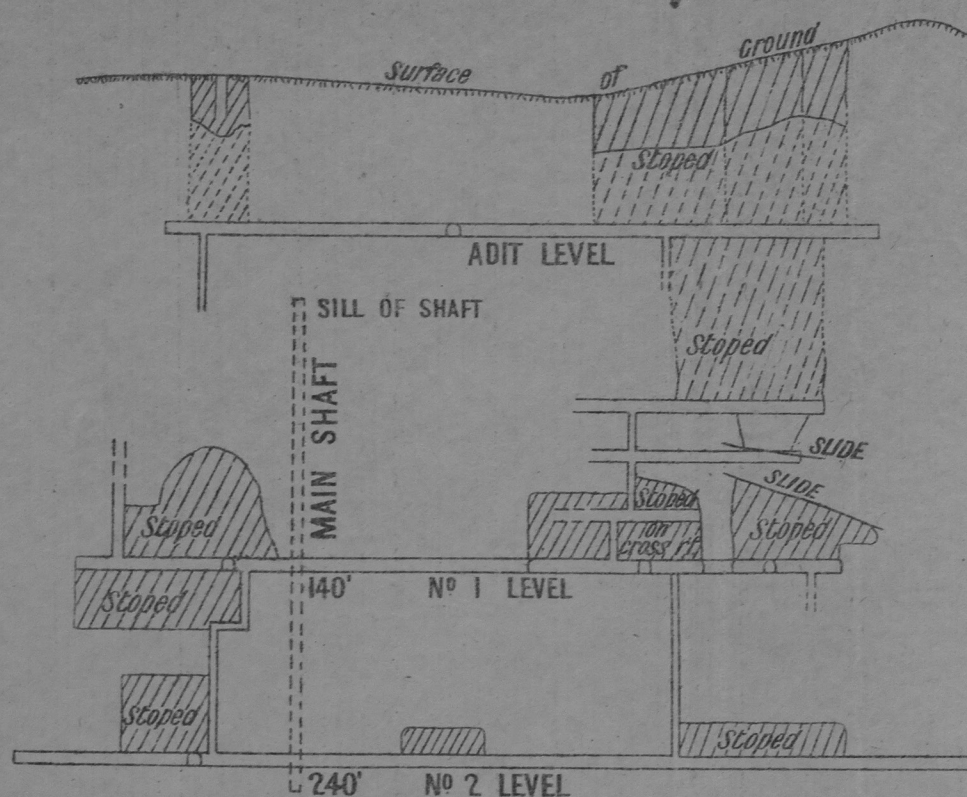
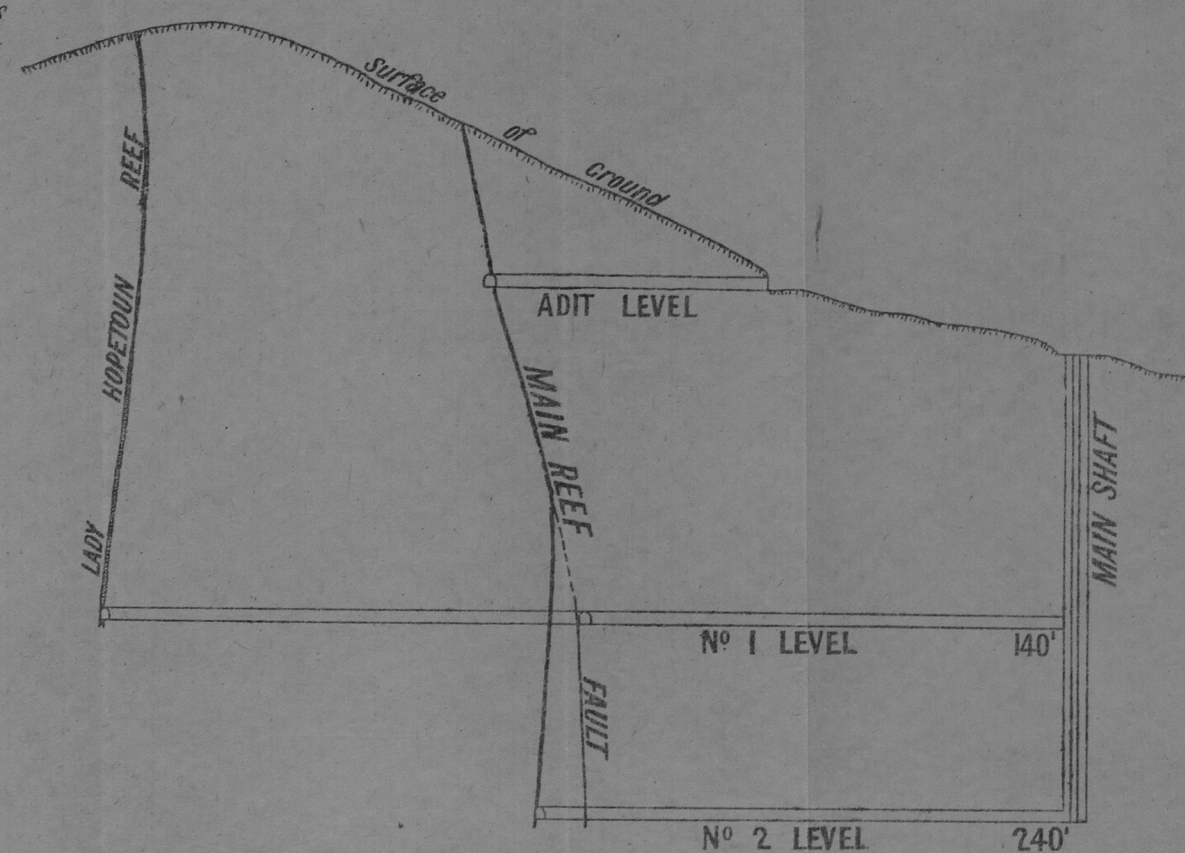
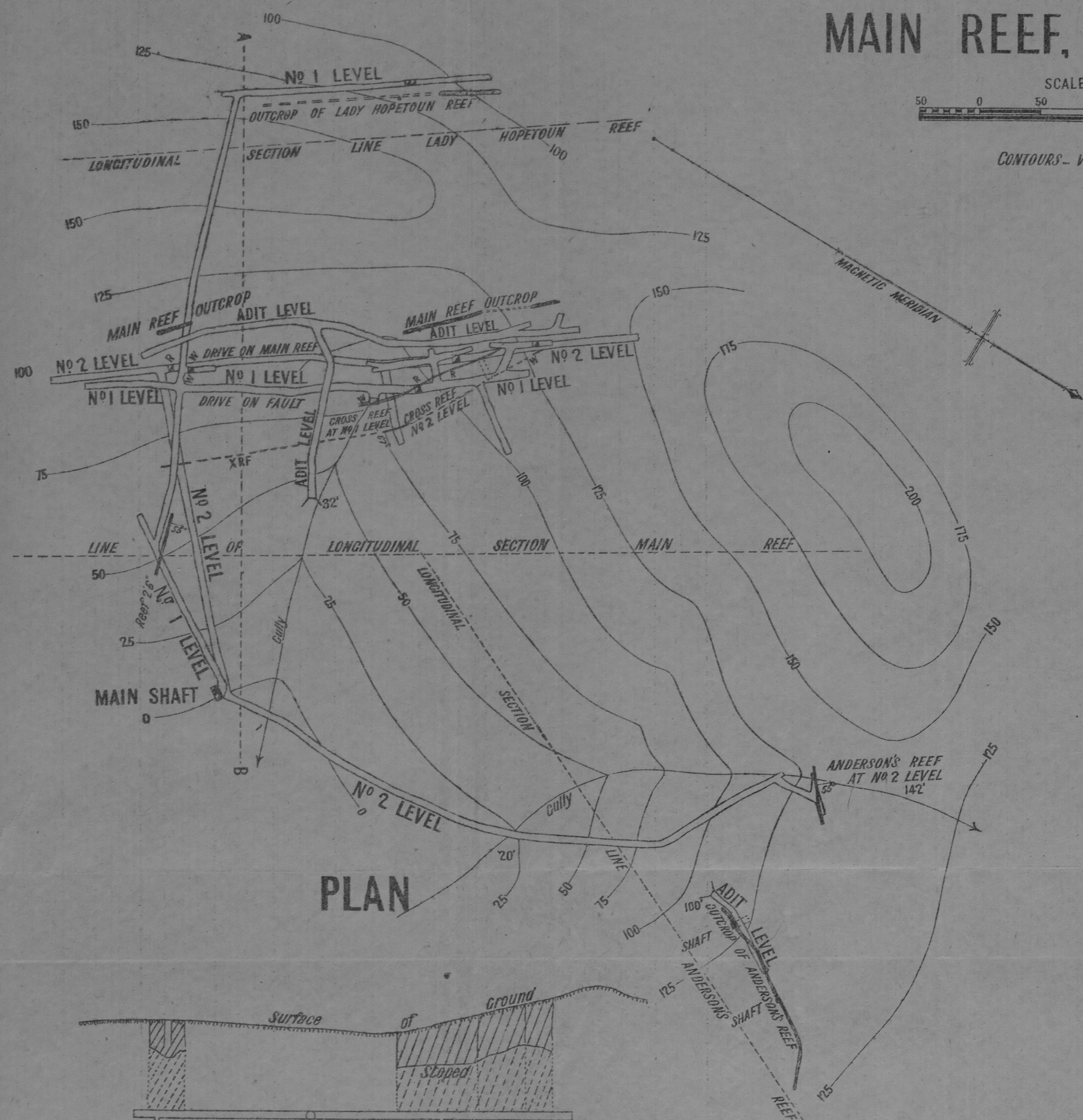
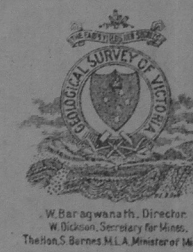
No. 2 Level, Main Reef.—At the 240-ft. No. 2 level a north-easterly cross-cut 270 feet in length intersects the Main reef. From this cross-cut a drive has been extended 394 feet north. The south shoot has been stoped for a length of 50 feet, and to a height of 50 feet above the No. 2 level; while below the No. 1 level this shoot has been stoped for a length of 90 feet, and to a depth of 30 feet. The north shoot has been stoped 90 feet long and 25 feet high above the No. 2 level. From the north drive at this level, and at a point 185 feet from the main cross-cut, another cross-cut was put out 65 feet easterly to test the cross-reef worked above the No. 1 level. In this cross-cut, at 55 feet, what is probably the track of the cross-reef was cut. Here it carries no quartz, and it is possible that this cross-cut is too far south. Another cross-cut should be driven easterly at a point about 80 feet further north.

MAIN REEF, MAINDAMPLE.



CONTOURS - VERTICAL INTERVAL 25'

Compiled from Mine plans



LONGITUDINAL SECTION ON MAIN REEF

LONGITUDINAL SECTION ON LADY HOPETOUN REEF

LONGITUDINAL SECTION ON ANDERSON'S REEF

Such a cross-cut would intersect the cross-reef in about 20 feet, and may locate a continuation of the payable stone worked on this reef above the No. 1 level.

No. 2 Level, Anderson's Reef.—At the No. 2 level a drive 540 feet in length has now been put out in a north-westerly direction to Anderson's reef. Drives have been extended 12 feet north and 24 feet south, on the line, which carries from 1 foot to 1 ft. 3 in. of mineralized quartz, with a little gold. On the surface the shoot on this reef was 50 feet long, and the workings are said to be about 125 feet deep. As the outcrop of the reef is 125 feet above the sill of the shaft, there are 240 feet of backs between the old workings and the No. 2 level. The face of the north drive on the reef at the No. 2 level is about 40 feet south of the south end of the shoot on the surface, and as the reef has been worked on the surface for a length of 120 feet it can be best prospected by extending a drive north for 100 feet.

The record of yields won by the present company is as follows:—

Main reef—729 tons, for 463 oz. 10 dwt. of gold, or an average of 12 dwt. 17.18 gr. per ton.

Hopetoun reef—26 tons, for 24 oz. 9 dwt. of gold, average 18 dwt. 19.4 gr. per ton.

Total:—755 tons crushed for 487 oz. 19 dwt., average 12 dwt. 22.2 gr. per ton. The average assay value of the tailings is 3 dwt. 11 gr. per ton. These figures show that the stone milled carried good values, but two factors have combined to enhance costs—

- (1) The necessary development work in proportion to the tonnage milled has been considerable.
- (2) The average width of the stone is small, and both width and values are variable. The reef in places is 4 ft. wide, but the average width is 1 ft. 3 in. or 1 ft. 6 in.

This mine is well equipped for economical working, the plant including an 11-head battery, two concentrating tables, air-compressor, and rock drills, with a steam winch for winding and bailing.

Should the prospecting work on Anderson's reef at the No. 2 level disclose payable stone, a successful run may then be expected. A plan of the mine workings is furnished herewith.

[24.7.17.]

LOWER ORDOVICIAN ROCKS NEAR BOOLARRA, SOUTH GIPPSLAND.

By W. H. Ferguson, Assistant Field Geologist.

On allotments Nos. 8 and 10, section A, parish of Budgeree, about $2\frac{1}{2}$ miles easterly from Boolarra, there is an outcrop of Lower Palæozoic rocks. The outcrop is very limited, and may cover about 30 acres; it is bounded by Tertiary sedimentaries and volcanic rocks, and the former occupy a higher level on the spur, having come down over the older rocks. These Lower Palæozoic strata consist of slate and altered sedimentaries, which will be referred to later. The strike, taken at one very limited and not very reliable exposure, was N.E., and the dip 50°

south-east. Pale yellow and buff-coloured soft decomposed slates and pale blue slate were noticed at the surface. Probably, at a little depth from the surface the normal slates were once the ordinary blue, blue-black, and black slates, such as may be seen on many of the Victorian gold-fields, but they have all been more or less altered.

Fossils were searched for, and a small number of graptolites were found. These are rather scrappy, and it would be difficult to get a good collection. Mr. R. A. Keble has examined the fossils, and considers they are Lancefieldian.* The rocks have all been more or less altered, not with the micaceous metamorphism so common in Victoria, but with the siliceous alteration such as occurs at the Longwood railway station; at Tatong; at Mount Deddick and the Tara Range, where the altered rocks contain graptolites; and, as I consider, at the Lady's Pass near Heathcote in the so-called Heathcoteian.

Some of the Boolarra rocks are extremely siliceous and cherty, and with some rocks the silification has gone so far that the slate has lost its dark colour, and is now white. The time when the metamorphism took place is an interesting problem which will be referred to, and while so doing, it will be necessary to take into consideration the formations surrounding the outcrop and their condition.

Tertiary sediments and volcanic rocks (basalt, &c.), surround the Ordovician outcrop, and in many places on the eastern and western sides of it pieces of breccia may be picked up. This is a handsome rock resembling the Heathcote breccia; it is very siliceous, and appears to have been formed by the cementing together of fragments of slate, &c., which reposed upon the Ordovician rocks previous to the deposition of the Tertiary grits and sands.

On the northern side of the outcrop there is a very prominent band of quartzite. Some of it is coarse grained, but much is fine grained, and resembles in appearance statuary marble, while much of it is white and sparkling. The quartzite here, as in other parts of the district, appears to underlie the older volcanic basalts. It evidently was originally composed of sand and grit as large as grains of wheat; these particles were cemented together and now form a hard, brittle, sometimes flinty, rock—white, grey, or red in colour.

Basalt partly surrounds or is in close proximity to the Ordovician, and it is possible that with it came heated waters capable of dissolving silica; these attacked the Tertiary sands and grits, and also the Ordovician slates dissolving silica and re-depositing it. If the Ordovician rocks were kept in superheated waters under pressure for ages, it is quite possible that they would become quite changed in character. That the Ordovician slates now contain silica beyond their normal amount seems certain, and samples Nos. 1 and 2 from allotment No. 10, parish of Budgerie, show a small cavity lined with minute quartz crystals. If the solutions in Tertiary time could form siliceous breccia, as it seems they have, it appears to me possible that they could at the same period come up through, or pass down into, the slates, and alter their character also.

A little prospecting has been done on the Ordovician rocks, and a few holes in search of reefs have been sunk, one being on a decomposed basic dyke which is now a clay, but only colours of gold were found. Very little true vein quartz was seen, but there is some metasomatic quartz.

* The Lancefield zone forms either the base of the Ordovician or the top of the Cambrian.

Across Sassafra Creek east of the Ordovician rocks there is a small outcrop of Jurassic rock, from which one sandstone sample showed slightly basal characteristics; unfortunately the younger rock could not be traced to its contact with the older. Samples of slate with graptolites, cherts, and altered Ordovician rocks, breccias, and quartzites have been forwarded to the Geological Survey museum.

[16.5.17]

BAUXITE CLAYS AT NARRACAN SOUTH.

By O. A. L. Whitelaw, Field Geologist.

The deposits of clay containing hydrated alumina were found at Narracan South by Mr. Donald Clark, Chief Inspector of Technical Schools, who forwarded to the Geological Survey laboratory a sample which gave a return of 25 per cent. of free alumina. (Assay No. 367/1918.)

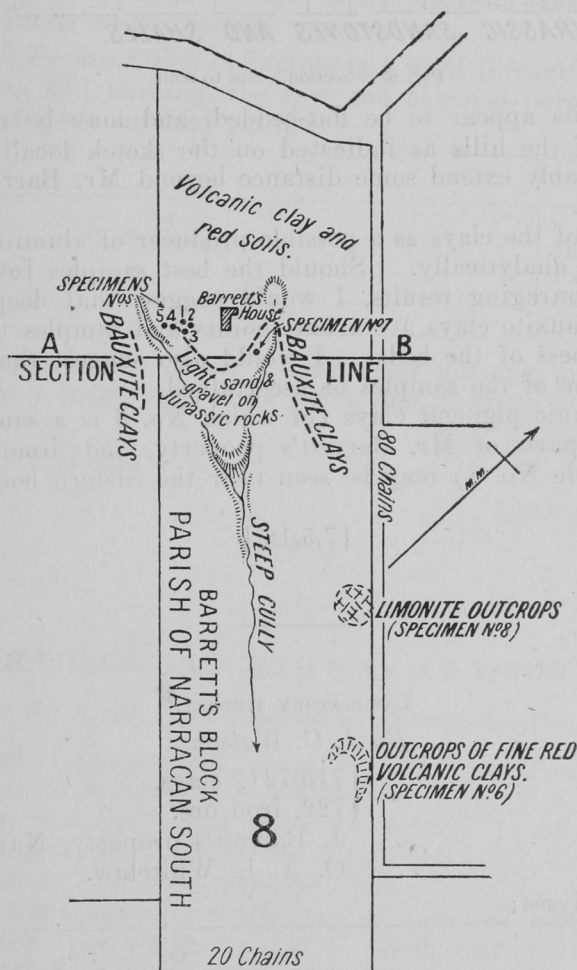


Fig. 88.—Bauxite Deposits at Narracan South. Scale : 20 chains to 1 inch.

The chief deposit examined was that occurring in allotment 8, parish of Narracan South. The material obtained by Mr. Clark, and also of samples Nos. 1 to 5, forwarded in connexion with this report, were obtained from an excavation made for a dairy cellar about 2 chains

from the western side of Mr. Barrett's house. About 4 feet of clay is exposed in the excavation, while several additional feet may be seen outcropping through the soil just below the excavation. There would appear to be about 15 feet of clay in appearance similar to the original sample tested for Mr. Donald Clark.

Overlying the bauxite clays are red volcanic soils and clay, and underlying it thin beds of sand and gravel a few feet in thickness. These rest on the Jurassic beds of the coal-fields.

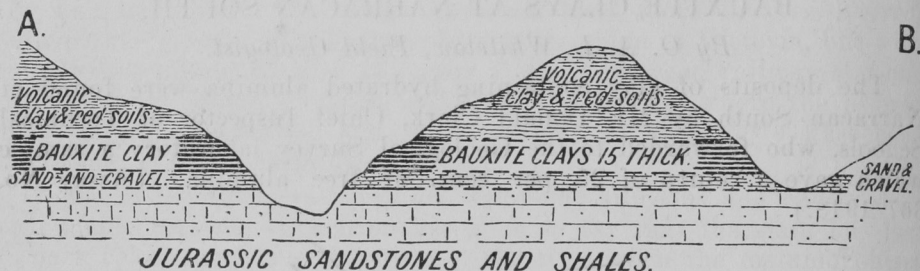


Fig. 89.—Section. Not to scale.

The deposits appear to be flat-bedded, and may be traced around the contour of the hills as indicated on the sketch locality-plan (Fig. 88), and probably extend some distance beyond Mr. Barrett's property (Allotment 8).

The value of the clays as a possible producer of aluminium can only be determined analytically. Should the best samples forwarded herewith give encouraging results, I would suggest that deep costeans be put into the bauxite clays at various points and samples taken through the full thickness of the beds. I would also suggest that the specific gravity of some of the samples be ascertained.

Some volcanic pigment clays (of which No. 6 is a sample) outcrop over various parts of Mr. Barrett's property, and limonite of good quality (sample No. 8) may be seen near the eastern boundary of his property.

[7.5.18.]

LABORATORY REPORT.

By J. C. Watson.

Samples	..	..	{ 715-721, clays.
			{ 722, iron ore.
Locality	..	..	J. Barrett's property, Narracan South.
Sender	..	..	O. A. L. Whitelaw.

Partial analyses:—

No.	715.	716.	717.	718.	719.	720.	721.
	%	%	%	%	%	%	%
SiO ₂	14.84	13.20	25.34	18.48	11.18	31.00	12.36
Al ₂ O ₃	55.40	56.79	50.10	54.30	59.95	33.53	57.23
Fe ₂ O ₃	2.69	2.07	1.13	1.74	1.13	21.13	3.49

Assuming that all the silica present in each of the above analyses is in combination with alumina as pure kaolin (alumino-disilicic acid), the amounts of free alumina in excess is as follows:—

No.	715.	716.	717.	718.	719.	720.	721.
	%	%	%	%	%	%	%
Uncombined Al_2O_3	42.2	45.3	28.1	38.3	50.1	6.5	46.4

According to Searle (*Refractory Material*), the best samples of raw bauxite vary between the following limits:—

SiO_2	..	..	..	3 to 25 per cent.
Al_2O_3	..	..	..	50 to 90 per cent.
Fe_2O_3	..	..	..	0.5 to 12 per cent.

It would appear that all the above samples except No. 720 fall within the limits set for bauxite clays.

No. 720, *Pigment Test*.—Sample is a hard ferruginous clay. After fine grinding and burning, the raw and calcined portions were mixed with oil and made up into paints:—

	Raw.	Burnt.
Colour	Dark red	Dark red
Covering power	Fair ..	Fair
Staining power	Fair ..	Fair

The sample, which is not altered after burning, produces a paint which leaves a rough surface on wood, due to gritty matter present:—

Fe_2O_3	..	..	..	..	21.1 per cent.
No. 722, <i>Limonite</i> .—					
Fe_2O_3	..	..	..	..	78.9 per cent.

[17.8.18.]

SUPPOSED NATURAL WAX AT TOONGABBIE.

By L. H. Ower, Assistant Boring Engineer.

In the bed of Stony Creek, about $1\frac{1}{4}$ miles from Toongabbie, a shaft has been sunk to a depth of about 40 feet. Heavy river shingle predominates in this shaft, and there are several "made" hills of this material in the vicinity. Below the shingle bed are Tertiary clays, more or less ligneous, and from amongst these, I am informed, the wax-bearing clay was obtained. A specimen of supposed natural wax proved on examination to be ligneous material. The shaft was full of water at the time of my visit, and none of the supposed wax was visible on the spoil heap.

Stony Creek here debouches from the ranges, the slates and sandstones outcropping about a quarter of a mile further up the creek. About 10 chains to the westward a bore was sunk some 30 years ago to a depth of 175 feet in sands, clays, &c., the object being to strike oil,

but the prospectors were evidently misled by the iridescent iron oxide films on the water, a common occurrence in marshy ground.

A Tertiary hill, about 80 feet above the level of the creek, occurs to the south-westward. On the further slope of this hill there is a shaft 40 feet deep, from which black and brown clays have been obtained. It is reported that, while sinking this shaft, a man was overcome by the gas (probably marsh gas) in it. The material derived from these shafts appears similar to that in the beds passed through while boring for brown coal.

The Geological Survey laboratory report on this material is as follows:—

No. 613 (1916).—The substance was subjected to prolonged treatment with ether to extract wax, if present.

Further extractions have been made with other solvents—benzine, carbon tetrachloride, and benzol.

The result shows that a small amount of bituminous material is present, such as is common to all brown coal. There is no montan wax present.

The amount of bitumen obtained is about 1 per cent. This agrees with the analysis originally made.

ANALYSIS.

H ₂ O	..	..	..	..	38.09 per cent.
V.H.C.	..	..	..	..	16.05 per cent.
F.C.	..	..	..	..	5.48 per cent.
Ash	..	..	..	..	40.38 per cent.
					<hr/>
					100.00 per cent.
					<hr/>

[23.11.16.]

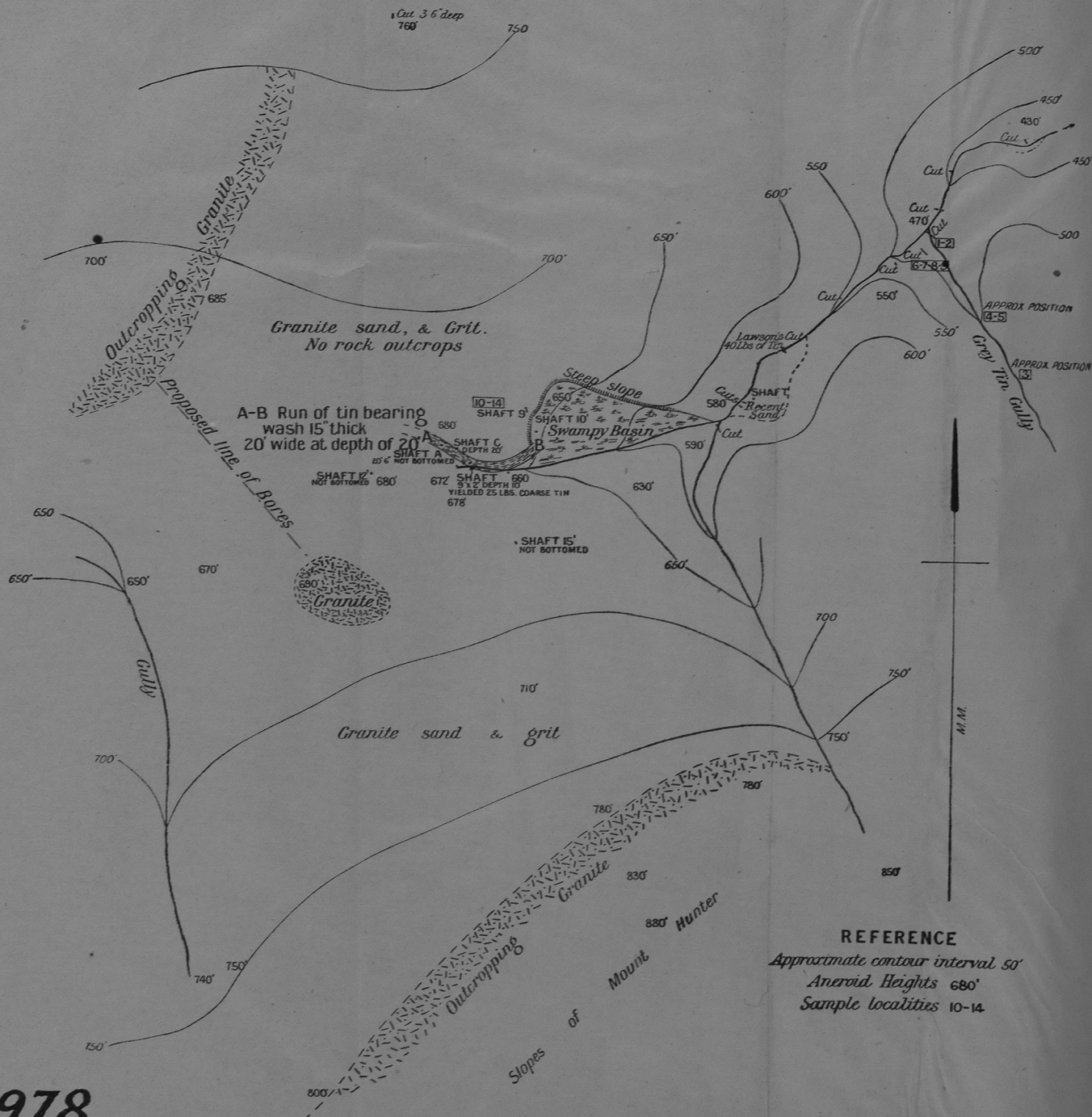
TIN DEPOSITS AT WILSON'S PROMONTORY.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

I beg to report that I visited Wilson's Promontory on the 20th ult. and inspected the work done by Richardson and party in prospecting for tin to the north of Mount Hunter. The country in the locality consists of a granite ridge rising to a height of 1,136 feet at Mount Hunter, flanked by Tertiary formations with more recent alluvial deposits and sand dunes. Tin was originally discovered in a gully running east from a saddle just north of the mount. The party have put down numerous shallow holes and cuts at various points along the creek, proving tin in places for a length of 20 chains. One cut up the gully, put in about fourteen years ago by the original prospector, the length of which is 55 feet, is reported to have yielded 40 lb. of tin oxide. In the tributary gully, known as Grey Tin Gully, tin oxide has also been discovered. The wash is from a few inches to a foot in thickness, resting on a hard granite bottom at a depth of 2 or 3 feet. Dish prospects were taken at various points in these gullies, as indicated on the accompanying plan. The tin oxide obtained was weighed at the Geological

Approximate contour interval 50.

J. L. Kinnear
263 '9.



Approximate contour interval 50'
Aneroid Heights 680'
Sample localities 10-14

Survey laboratory, and the results, estimated in pounds per cubic yard, are as follow:—Sample Nos. 1-9, Assay Nos. 225-232/19.

Sample No.						Value, lb. Tin Oxide per Cubic Yard.
1	..	..	..	..	..	0·15
2	..	..	..	..	..	0·15
3	..	..	..	..	..	0·33
4	..	..	..	..	..	1·46
5	..	..	..	..	..	1·56
6	..	..	..	..	..	0·52
7	..	..	..	..	..	0·45
8	..	..	..	..	..	0·27
9	..	..	..	..	..	0·16

In another creek, about a quarter of a mile to the north, a little tin can be got in dish prospects; the upper part of this creek may contain payable values, and is worth prospecting. The creeks discharge into a flat on the east side of Mount Hunter, containing about 1,000 acres. Payable prospects here at a workable depth would indicate a big proposition; but, as the flat appears to be formed entirely of drift sand with a maximum elevation of about 10 feet above high-water mark, and as the granite spurs dip under the flat with comparatively steep slopes—20°-25°—it seems likely that the depth will be considerable, and values, if any, low. The ground is worth testing, and this could be done at a small outlay by sinking hand bores to determine the value of the drift sand and the depth of the bedrock.

The work done in the gullies goes to show that no extensive bodies exist here, and that values are variable; the best returns are likely to be won from pot holes in the granite.

At the head of the main gully an interesting development has occurred. The prospectors followed the tin up the gully until they reached the head of it, and finally located the source of the tin in a high-level run crossing a wide saddle on the main spur running north from Mount Hunter. This saddle, which is 700 feet above sea-level, for a width of 9 chains and a length of 15 chains is almost level, and for the most part consists of granitic sand and grit, with no rock outcrops. On the eastern edge of this saddle the prospectors have located, at a depth of 20 feet, a defined run of tin-bearing wash, apparently about 20 feet wide, with 12 inches to 15 inches of wash, on a soft granite bottom, the sinking being through white granitic sand and grit, with an occasional band of pipe-clay carrying no tin oxide. Pieces of cassiterite up to $\frac{1}{2}$ -in. in length have been obtained, and the sample is mostly coarse and black in colour, with a little grey, ruby and resin tin. Sufficient work has not yet been done to determine the direction and value of the run, but results so far are promising. From the bottom of one 9-ft. x 2-ft. shaft, the prospectors informed me they obtained 25 lb. weight of coarse tin oxide. From the bottom of the 20-ft. shaft, marked "C" on the accompanying plan, there are drives 6 feet north-east, 8 feet south-west, and 12 feet north-west. In the face of the south-west drive, the wash is 1 foot thick, and two dishes gave prospects of 35 lb. and 50 lb. per cubic yard respectively. (Pl. XL.)

Dish prospects taken and washed in my presence or by me, and the tin oxide obtained weighed at the Mines Department laboratory, gave the following results:—Sample Nos. 10-20, Assay Nos. 234-244/19.

Sample No.	Description.	Contents, lb. Tin Oxide per Cubic Yard.
10	From 12-in. wash in face of south-west drive, Shaft C ..	35.54
11	From 12-in. wash in face of south-west drive, Shaft C ..	50.25
12	Decomposed granite below wash, south-west drive, Shaft C ..	16.32
13	Face, north-east drive, Shaft C, wash 6 inches ..	1.05
14	From north-west drive, Shaft C ..	0.45
15	From wash at grass	0.22
16	From wash at grass	0.50
17	From wash at grass	1.80
18	From wash at grass	0.41
19	From wash at grass	0.46
20	From small heap of wash at grass	6.45

Average
0.68 lb.
per
cubic
yard

About 80 tons of wash are at grass, and five samples taken from the heap gave an average equal to 0.68 lb. of tin oxide per cubic yard. Prospecting has, so far, been carried on by sinking shafts along the run. The work could be carried out much more expeditiously and economically by the use of a hand-boring plant, and I would suggest that a line of bores be put down to the west of the present workings where indicated on the plan. North-east from the workings, there is an area of sand and grit, and a continuation of the run may be picked up here. Whether the run has a fall to the east or to the west has not yet been determined. When this point is settled, and the position of the run located, an adit driven on the wash from its outlet is the most economical method of working the deposit. The sands and clays covering the wash, and which are 20 feet thick, carry little or no tin oxide. The available water supply is very limited, and the removal of the overburden does not seem feasible. Timber suitable for mining is not readily accessible, and would have to be brought some distance. The occurrence is interesting, suggesting the probable origin of the Toora tin mine deposits, and also opening up possibilities of similar occurrences elsewhere. A spur about three-quarters of a mile north-westerly carries a deposit of sand and grit, and a continuation of the run may be found here. The work done has proved the existence of a small run with good values of tin oxide; further prospecting is necessary to determine its course.

[28.3.19.]

COPPER AT CARRAJUNG, SOUTH GIPPSLAND.

By W. H. Ferguson, Assistant Field Geologist.

On Bruthen Creek, parish of Carrajung, about 16 miles northwards from Yarram, Lucas and party are prospecting for copper.

Some work has been done in allotments Nos. 44, 45, 46, parish of Carrajung. About a dozen shallow shafts have been sunk along the bed of Bruthen Creek over a distance of about 30 chains. The holes appear to have been sunk in decomposed basalt and decomposed

volcanic ash or tuff, and all are full of water, or have been filled in with rock. As in these holes nothing could be seen of the occurrence of the copper, Mr. Lucas had another prospecting hole sunk to a depth of 5 ft. 6 in. The sinking was mostly through older basalt, very much decomposed; part has a purplish tint, and part is, in colour, green to dirty white. It is probably a magnesian silicate, a decomposition product of olivine or augite, which the original rock may have contained.

Mr. Lucas stated that he got copper—either native or carbonate—in all the shafts he had sunk; that copper was never seen at the surface, but began to show a few feet below, and the deeper the shaft the greater the amount of copper ore observed in the rock.

The deepest shaft is 20 feet. The shaft I saw sunk was started at random in the rock in the bed of the creek; it was wet and muddy, and the rock could not be examined under the best conditions. This shaft was 5 ft. 6 in. deep; at 4 feet from the surface a few nodules of siliceous and feldspathic matter were found that contained small, but distinct, crystals of native copper. Nodules were found at intervals in the rock to the bottom of the shaft. It was not ascertained whether these quartzose nodules were isolated segregations, or were connected with joint or movement planes containing similar material. The nodules were about the size of walnuts; each contained some copper, but they formed but a small proportion of the amount of rock removed while sinking the shaft.

The prospecting has proved that copper occurs in the volcanics for 30 chains along Bruthen Creek, and, apparently within this distance, any hole sunk to a depth of 10 feet would disclose some copper. This discovery of native copper in decomposed volcanic rocks—basalt and possibly tuff—is, I believe, new to Victoria, and possesses a high scientific interest.

During my visit I collected samples for assay, and specimens for the Geological Survey museum. The samples have been assayed at the Geological Survey laboratory, with the following results:—Samples Nos. 320 and 321, portion of the rock passed through in sinking the new shaft and the windlass shaft lower down the creek yielded no copper and only a trace of gold and silver. No. 319, sample of siliceous nodules found while sinking the new shaft (5 ft. 6 in.), gave—gold, a trace; silver, 1 dwt. 7 gr.; copper, 0.5 per cent. per ton of sample. These assays show the material to be too poor to be of commercial value.

Mr. Lucas informed me that it was his intention to further sink the new shaft, and, if this work be done, it would be advisable that all the siliceous copper-bearing material be kept, weighed, and forwarded as a bulk sample for assay. If this were done, then it would be known how much copper might be expected to occur in so many cubic yards of rock.

GENERAL GEOLOGY.

A large area in the Carrajung and Won Wron districts is covered with Tertiary grits and sands. Along Bruthen Creek, near allotment 44, Carrajung, the sandy series occupies the high ground, and low in the valley of the Bruthen Creek, and in that of a small branch of it

known as the Copper Ore Creek, a series of volcanic rocks outcrops. In allotment 44, Carrajung, and close to the Yarram-road, the Bruthen Creek ripples over hard, dense, black older basalt, and still lower down there are layers of bedded ash and tuffs and volcanic mud.

The Tertiaries yield a poor, and the volcanics a fertile, soil.

[25.5.16.]

WORKING MINERS GOLD MINE, KEVINGTON.

By O. A. L. Whitelaw, Field Geologist.

The present workings of the Working Miners mine at Kevington are situated at the head of Barney's Gully, half a mile south-east of the Kevington Hotel, and they are carried on by means of adits.

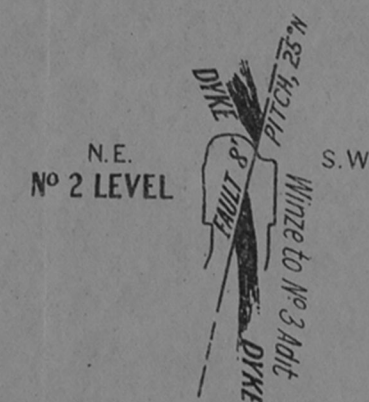
No. 1 adit, 1,450 feet above sea-level, has been driven south-easterly along the dyke a distance of 417 feet. At 118 feet from the entrance an auriferous shoot was cut and continued along to 224 feet. This was stoped back to the surface. Yields are said to have varied between 3 dwt. and 3 oz. of gold to the ton. At 189 feet a winze was sunk from which very rich gold is said to have been obtained. The width of the dyke ranges from 3 to 5 feet, and it dips westerly at 70° to 75° . The average pitch of the gold shoot is 20° north, which coincides with the pitch of the bedding planes.

No. 2 adit is 42 feet below No. 1 adit, and it was driven for 81 feet as a crosscut, at which point the dyke was intersected. A level was driven north-west for 74 feet. Two prospecting rises were put up and fair prospects are said to have been obtained. The dip of the dyke varies between 62° and 72° south-west, and the pitch of the beds is 23° north.

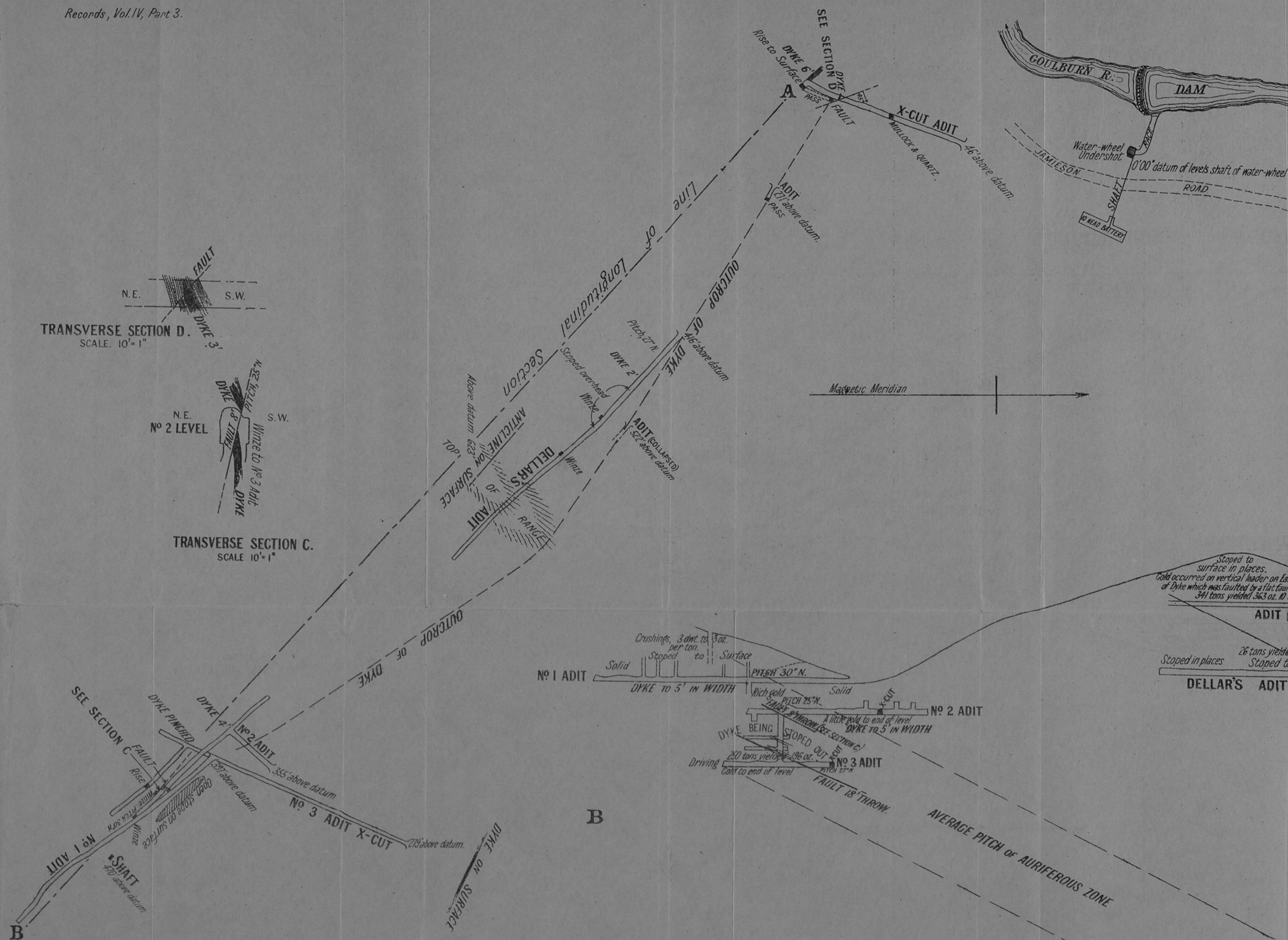
The south level was driven 207 feet from the cross-cut. At 149 feet a winze was sunk 30 feet and subsequently connected with a rise from the No. 3 level. At the end of the level a winze was sunk 12 feet. The section of dyke between the winzes is payably auriferous, and is at present being stoped out. A fault occurs along this level (see Section C. Pl. XLI.), which displaces the dyke 8 feet. The dyke varies between 2 feet and 6 feet in width, and the pitches range from 15° to 33° to the north.

No. 3 level, 118 feet below No. 2, was driven as a cross-cut for 418 feet; at 372 feet a lode-track was cut and driven south-east for 40 feet before the dyke appeared in the floor of the level pitching 27° north. The south level had reached 183 feet when I last inspected it, and was still being extended. At 83 feet from the cross-cut a rise was put up and connected with No. 1 winze in No. 2 level. Intermediate levels have been put out, and the dyke is in process of being stoped. A fault which displaces the dyke 18 feet was cut in the rise; the dyke stone appears equally auriferous above and below the fault. The last crushing from the mine was broken from those stopes adjacent to the rise from No. 5 level, and in driving No. 3 level itself, 250 tons were crushed for 196 oz. of gold.

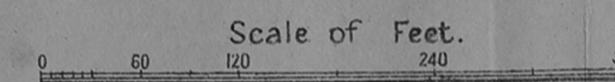
The quartz occurrences are of three types—(1) Irregular leaders through the dyke, (2) Lenses of quartz nearly vertical in section and crossing the dyke from wall to wall diagonally. These pitch north along



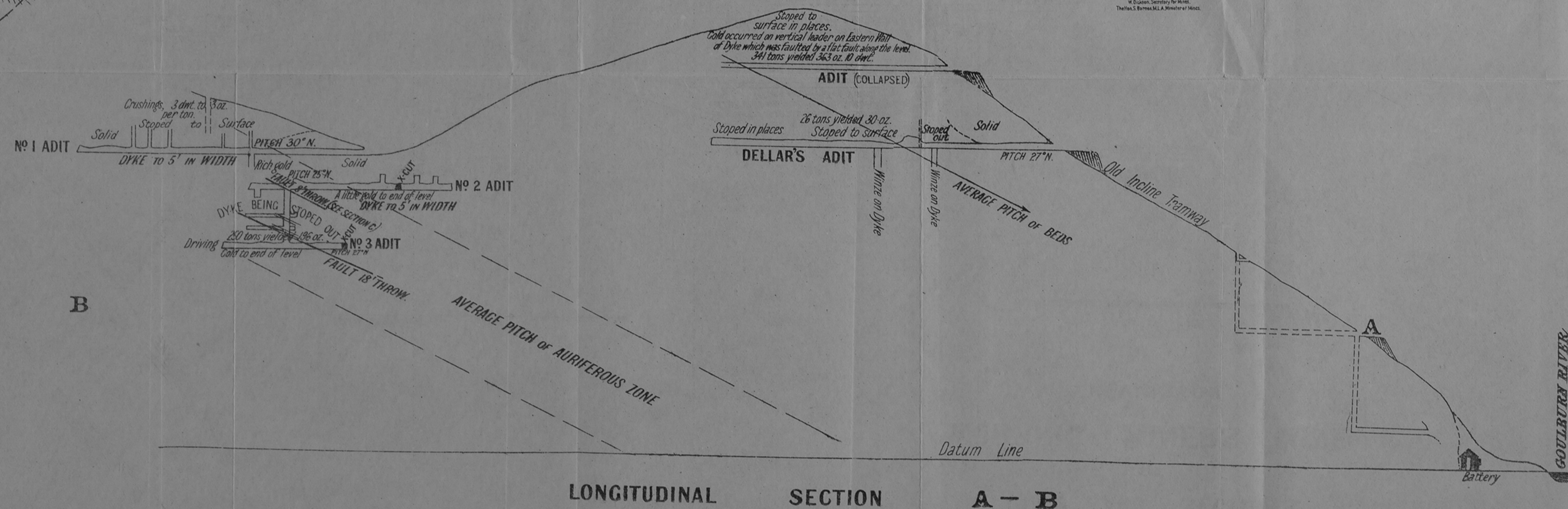
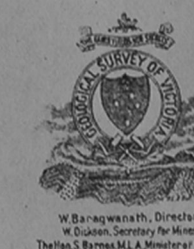
TRANSVERSE SECTION C.
SCALE 10' = 1"



PLAN AND SECTIONS
OF
WORKING MINERS MINE
KEVINGTON.



D. A. R. White
27. 6. '16



the dyke at the same angle of pitch as the bedding planes, and are up to several feet in thickness (Fig. 90).

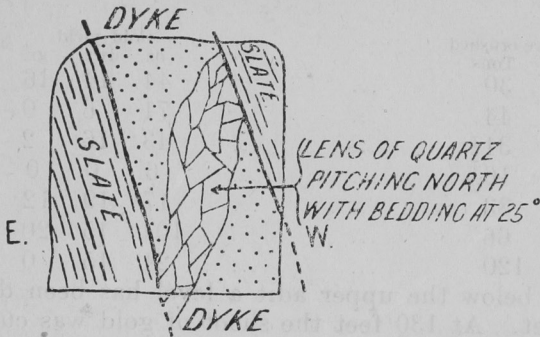


Fig. 90.—Transverse Section showing Type of Quartz Vein (No. 2). Not to scale.

(3) This type consists of practically vertical veins of quartz usually an inch or two in thickness, but in one or two instances widening to 1 ft. 6 in. These are confined to the dyke, and do not penetrate the slate walls. They intersect types Nos. 1 and 2, and cause an enrichment in those veins where intersected. They are not influenced by the pitch of the quartz lenses (Type 2) or bedding planes (Fig. 91).

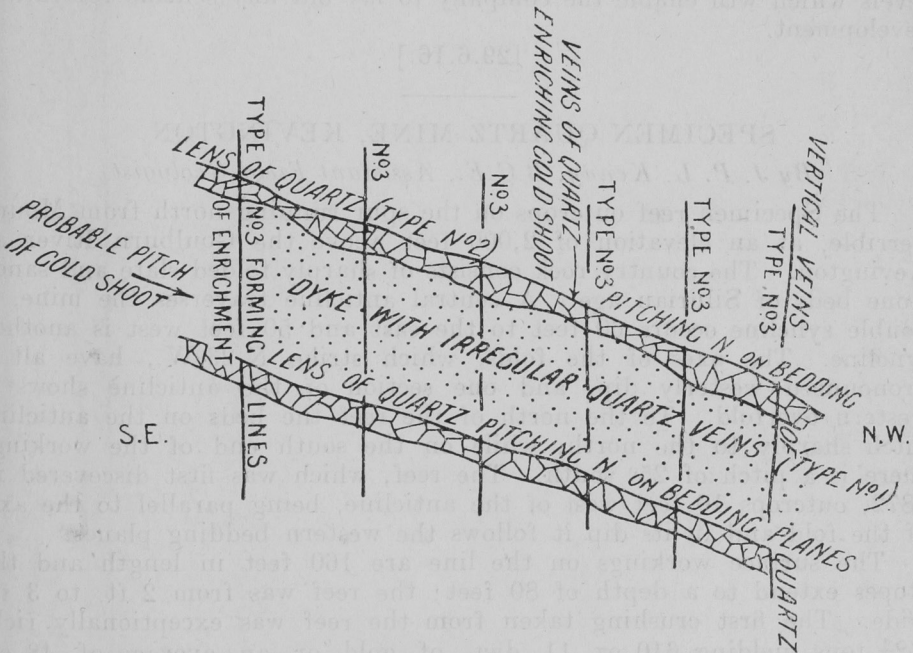


Fig. 91.—Longitudinal Section showing Types of Quartz Veins (Nos. 1, 2, 3.) Not to scale.

The richer gold occurrences are where the quartz veins of types 2 and 3 intersect each other, but this influence is probably, as in other similar mines in the district, confined to a certain zone lying between the bedding planes encompassing the dyke and pitching away with those planes—in this case about 25° to the north. (Section A.B. on Pl. XLI.)

An additional shoot of gold has been opened up on the northern slope of the hill, but it has not been operated on by the present company.

The top adit has collapsed, but is stated to be about 300 feet in length. The greater portion of the gold was obtained from a vertical vein of quartz on the eastern wall of the dyke. This vertical was cut

off by a fault at the level, and has not since been located. Mr. William Dellar has obliged me with the following crushings taken from 1890 to 1892:—

Ore crushed. Tons.			Gold yield.		
			oz.	dwt.	gr.
30	...	...	44	14	16
44	...	...	71	6	0
31½	...	...	43	16	2
16½	...	...	6	0	0
33	...	...	17	19	12
66	...	...	104	15	20
120	...	...	21	15	0

At 106 feet below the upper adit a level has been driven along the dyke for 500 feet. At 130 feet the shoot of gold was cut, and has been stoped out along the level for about 200 feet. At points the stopes extend up to the upper level and the surface. The gold yields are said to have ranged from 2 dwt. to 2 oz. to the ton. The pitches here are to the north at about the same angle as the company's workings.

The mine is equipped with a 10-head battery driven by an under-shot water-wheel.

The accompanying plan and sections (Pl. XLI) give distances and levels which will enable the company to lay out any scheme for future development.

[29.6.16.]

SPECIMEN QUARTZ MINE, KEVINGTON.

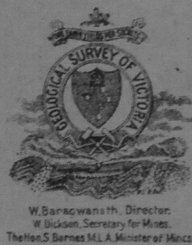
By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The Specimen reef outcrops on the spur running north from Mount Terrible, at an elevation of 2,000 feet above the Goulburn River at Kevington. The country rock consists of sharply folded slate and sandstone beds of Silurian age. A central anticline traverses the mine, a double syncline occurs 60 feet to the east and 50 feet west is another syncline. The axes of the folds, which strike N.23°W., have all a pronounced westerly dip, and one section of the anticline shows a western overfold. To the north of the reef the beds on the anticline pitch sharply to the north, while on the south end of the workings there is a pitch of 25° south. The reef, which was first discovered in 1872, outcrops 10 feet west of the anticline, being parallel to the axis of the fold and in its dip it follows the western bedding planes.

The surface workings on the line are 160 feet in length and the stopes extend to a depth of 80 feet; the reef was from 2 ft. to 3 ft. wide. The first crushing taken from the reef was exceptionally rich, 12½ tons yielding 610 oz. 11 dwt. of gold, or an average of 48 oz. 17 dwt. to the ton. Two underlay shafts were sunk on the reef and three main adit-levels have been driven in addition to a short level further north. The reef was stoped to a depth of 10 feet below the No. 1 level. The country is disturbed by slides dipping west, but an examination of the reef in the bottom of the old stopes showed no indication of faulting there; on the other hand it was evident that the auriferous stone had split up into small leaders dipping west.

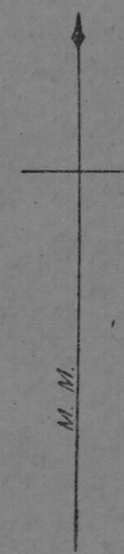
A main wall continues down below the point at which the reef splits up and this wall is, I think, the reef channel. It has been prospected at the No. 2 level by a drive along it 220 feet in length, while at the No. 3 level a drive follows it for 140 feet; a rise on the wall also connects the No. 3 level with the old stopes which are 90 feet

PLAN & SECTIONS OF SPECIMEN QUARTZ GOLD MINE MOUNT TERRIBLE KEVINGTON.



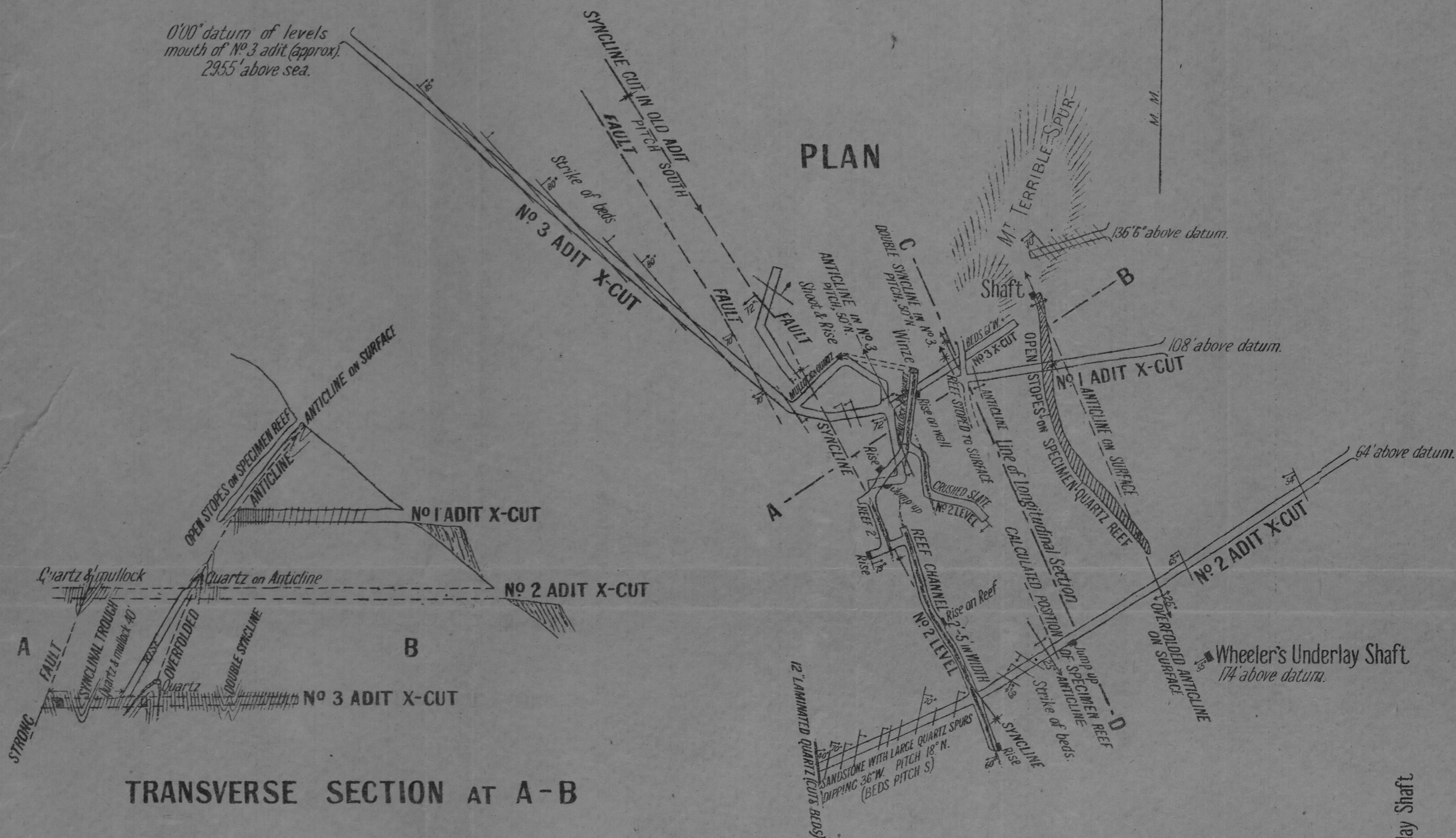
B. A. L. Whistler
12. 7. 16

Scale of Feet.

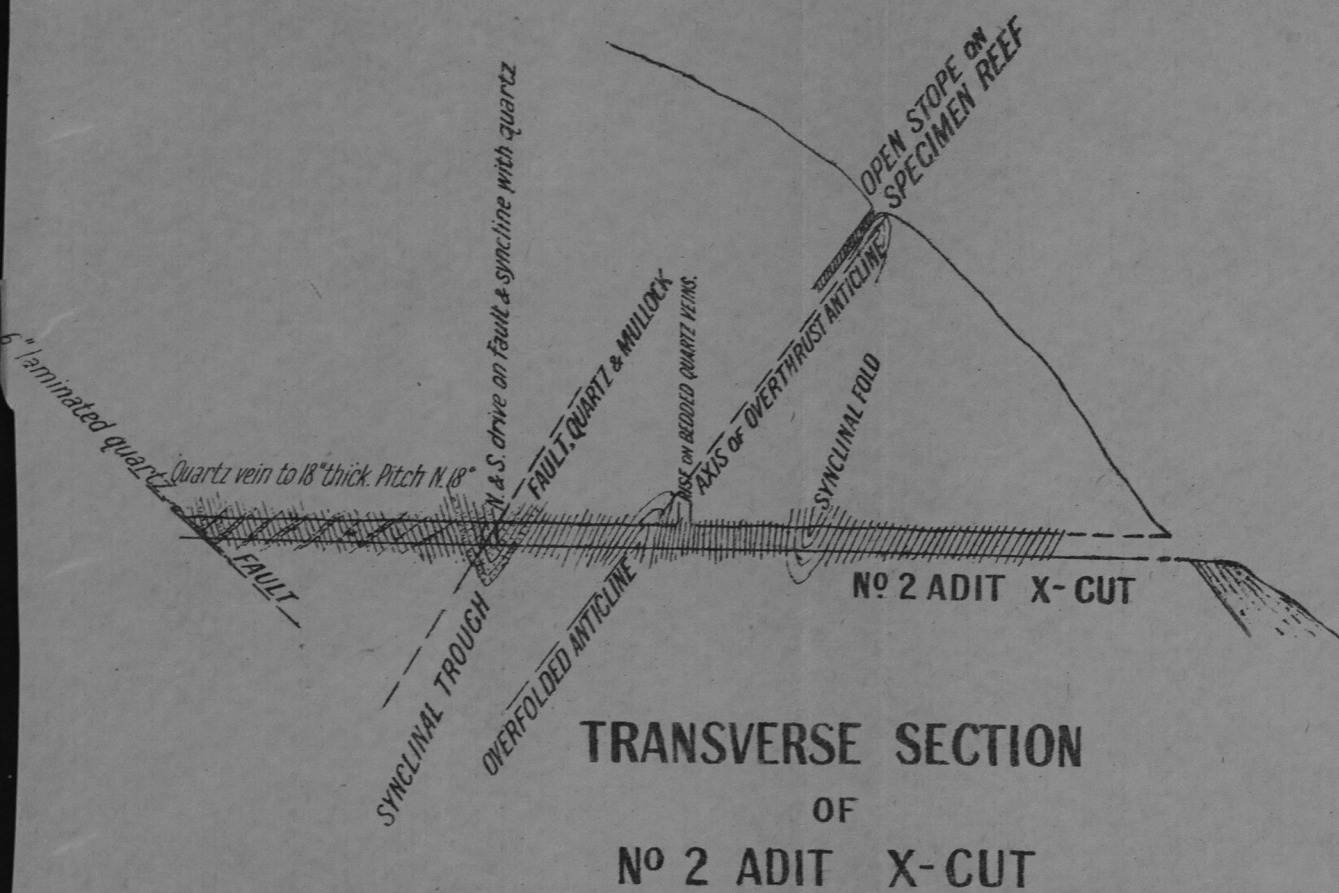


0'00" datum of levels
mouth of No 3 adit (approx).
2955' above sea.

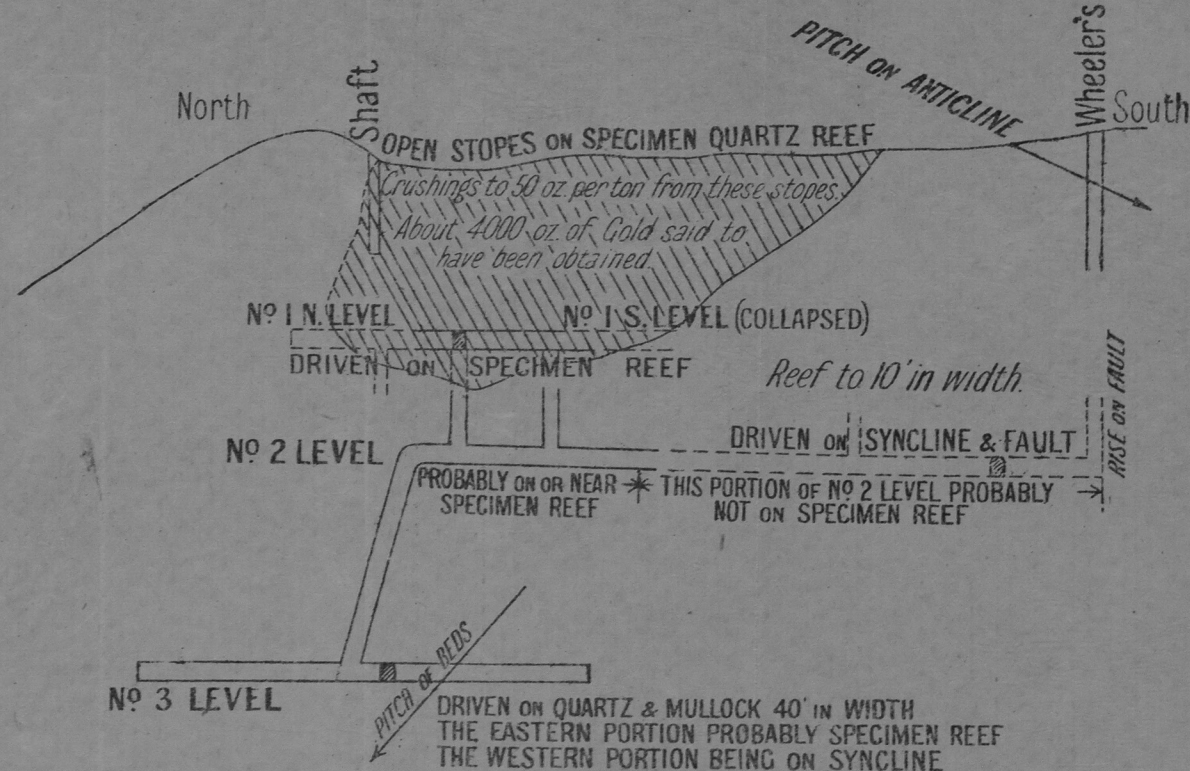
PLAN



TRANSVERSE SECTION AT A-B



TRANSVERSE SECTION OF No 2 ADIT X-CUT



LONGITUDINAL SECTION C-D

above that level. These workings have proved the existence of bodies of quartz, carrying a little gold, below the old stopes, the formation in places being 5 feet wide, but nothing payable has been discovered. The present company is at work in the No. 3 level and has driven a cross-cut 80 feet in a north-easterly direction to cut the reef channel 80 feet north of the old stopes.

It is possible that the main wall below the old stopes may carry another shoot at a deeper level, and to further prospect the reef I recommend that a winze be sunk on this wall below the No. 3 level. The point where the No. 3 cross-cut intersects the main wall is a suitable spot for sinking, as the hanging wall here carries 6 inches of quartz.

The following crushings are recorded from the mine; the list appears to be complete as far as the early crushings are concerned, but some small crushings may have been obtained since.

Date.	Ore crushed.	Gold Yield.		Gold per ton.		Depth.
	tons.	oz.	dwt.	oz.	dwt.	
Sept. 1872	12½	610	11	48	17	Surface to 32 ft.
Dec. 1872	34½	728	0	21	2	32 ft. to 80 ft.
June 1873	50½	250	0	4	19	—
Dec. 1875	133	458	0	3	9	100 ft.
March 1876	47	57	0	1	4	50 ft.
Total	277½	2,103	11	7	11	

A plan of the mine workings by Mr. O. A. L. Whitelaw, to which the work recently done has been added, is furnished herewith. (Pl. XLII.)

[27.7.17.]

LUCK'S ALL GOLD MINE, ENOCH'S POINT.

By O. A. L. Whitelaw, Field Geologist.

An examination of the work carried out by the Luck's All Gold Mine Company at Enoch's Point subsequent to my report of 2.3.12¹ has now been made (16.3.16).

Above the No. 2 level several gold bearing quartz veins have been opened up adjacent to old stopes, and near the north end of the dyke-bulge fair gold is now showing in a stope which has been opened upon what is probably Littlewood's reef.

There is probably a fair amount of ore available above the No. 2 level which would prove payable should a rise and pass be put up from No. 3 to No. 2 level at the right point. The rise now being used on Sutcliffe's reef is quite unsuitable on account of the number of times the crushing material has to be handled.

In the No. 3 (bottom adit) the company has extended the north-western cross-cut a distance of 90 feet and cut several veins which are the downward extension of reefs worked above. If the shoots of gold live down to the No. 3 level they are to the east of the north-western cross-cut. In addition a drive was also put out 25 feet north-west of Sutcliffe's rise for a distance of 225 feet, at which point the eastern slates were cut. At 85 feet and 125 feet auriferous leaders were cut; 1 in. or 2 in. of quartz in the hanging-wall was extremely rich for a length of 10 feet and 16 feet respectively, but the leaders were rendered unpayable in crushing by the ground being broken for a width of

¹ Rec. Geol. Surv. Vict., Vol. IV., Pt. I., pp. 69-71.

10 feet or more. The shoots of gold in these veins do not come vertically down the reefs, but are inclined from the western towards the eastern wall.

The amount of prospecting done in the No. 3 level is quite inadequate to prospect the various reefs cut, there being room for a shoot of gold in each between the two cross-cuts driven (see underground plans, Pl. XLIII.).

To thoroughly test the value of the various reefs cut in the No. 3 cross-cut it is necessary that the following work be carried out:—

1. The purchase of 900 feet of double steel rails;
2. An incline rise, to be used as pass and travelling way; put up from the north-west cross-cut on the nearest defined reef 200 feet north-west of Sutcliffe's reef.
3. The north-west cross-cut to be extended an additional 200 feet from the present face on a bearing of N. 30° W. (magnetic).
4. The four most defined reefs cut beyond 200 feet north-west of Sutcliffe's rise to have levels driven at least 100 feet east.

Should the proposed prospecting justify the expenditure it would be advisable to remove the present crushing plant to a point near the junction of Warner's Creek and the Big River, erect a pelton wheel, and convey the ore by level and gravitation trains to the battery.

The cost of the work here outlined is estimated to be as follows:—

1. Rails to be purchased at the Company's discretion.			
2. Incline rise on reef, 120 feet at £2	...	...	£240 0 0
3. Extension of north-west cross-cut, 200 feet at £2 10s.			500 0 0
4. Levels on reefs 100 feet each, 400 ft. at £2 10s.	...		1,000 0 0
TOTAL			£1,740 0 0

[16.3.16.]

HUNT'S GOLD MINE, GAFFNEY'S CREEK.

By O. A. L. Whitelaw, Field Geologist.

The Hunt's Gold Mining Company's workings are situated upon the east side of the spur dividing Raspberry and Gaffney's Creeks and are upon the well-defined dyke known as "Hunt's," which is a prolongation of the A1 group a little over 2 miles north of the main mine, and half-a-mile south of where worked by the New Dempsey's Gold Mining Company.

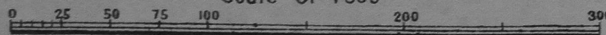
Hunt's dyke normally varies between 4 ft. and 8 ft. in width, and strikes with the enclosing sediments N. 40° W. and dips 84° west. At the position of Hunt's open cut the dyke has evidently struck a pre-existing fault in the Silurian rocks and has been diverted across the strata for a distance of over 200 feet. Along the fault the dyke increases to 25 feet wide, and it is in the quartz veins in the dyke and in the fractured country adjacent to the fault line that mining operations have been conducted. The auriferous "pipe" thus formed is about 220 feet in length, with a maximum width of 100 feet. This pipe was worked by open cut and shallow adits to a depth of about 300 feet.



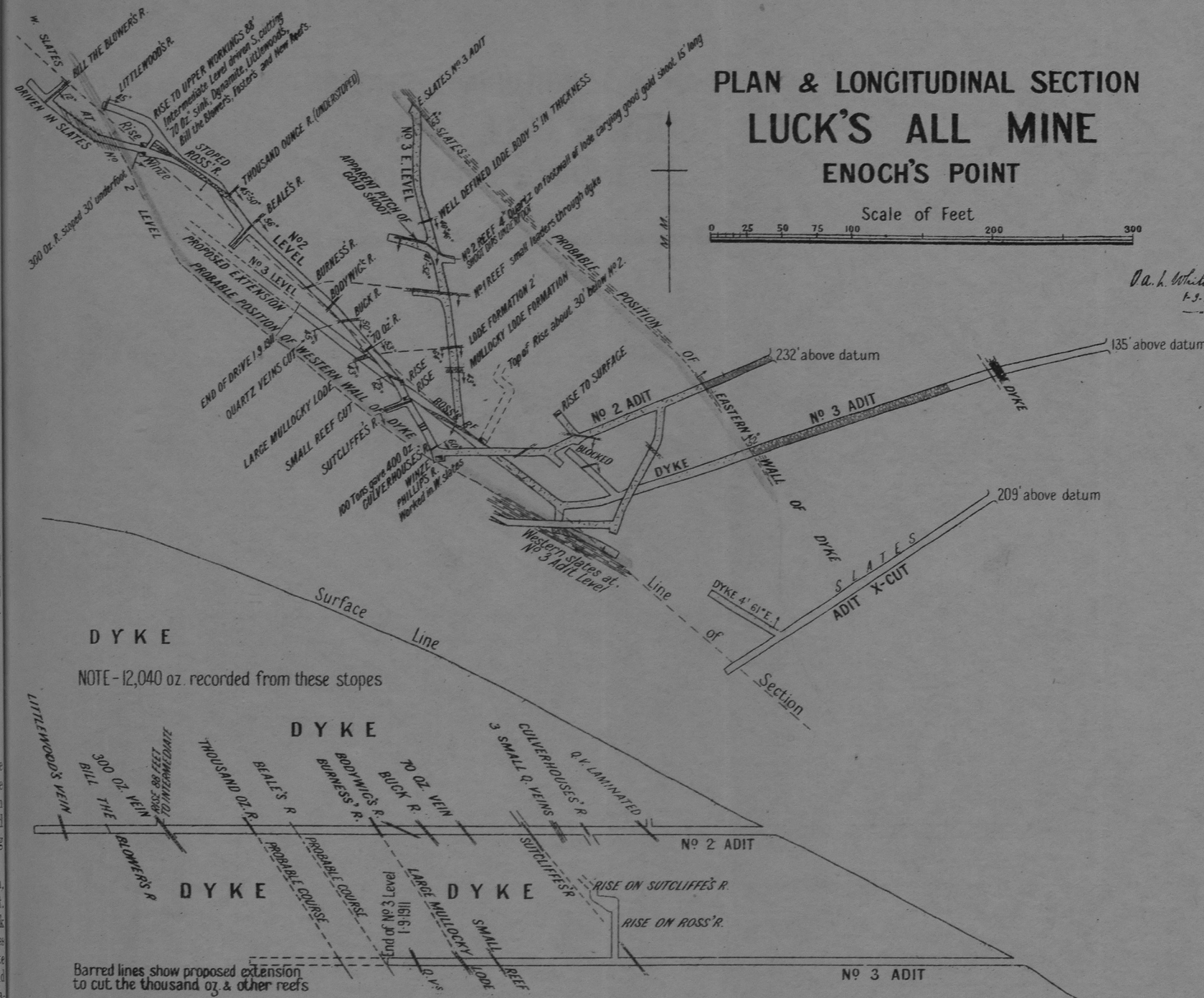
W. Baragwanath, Director.
W. Dudson, Secretary for Mines.
The Hon. S. Barnes M.L.A. Minister of Mines.

PLAN & LONGITUDINAL SECTION LUCK'S ALL MINE ENOCH'S POINT

Scale of Feet



O. A. Whitelaw
1-3-1911



The mine was controlled by Messrs. Justice and Hogarth from 1863-1869, and the former gentleman states that between 20,000 and

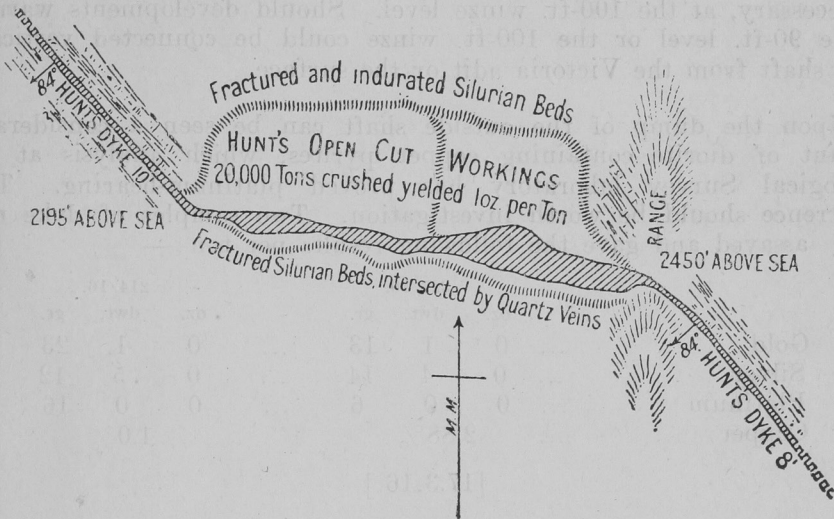


Fig. 92.—Plan showing Open Cut Workings, Hunt's Mine, Gaffney's Creek.
Scale : 120 feet to 1 inch.

25,000 tons of ore were crushed, which averaged about one ounce to the ton.

At a later date an adit, known as the Victoria, was driven from a point 25 feet above Gaffney's Creek and cut the pipe about 220 feet below the lower end of the open cut; a shaft was also sunk from a chamber in the adit to a depth of 60 feet. The ground worked in the shaft and for 30 feet over the Victoria level is reported not to have been remunerative.

At a still later date a shaft was sunk from the surface about 1,000 feet north of the open cut. This is said to be 240 feet in depth and is now full of water. At 90 feet a level was driven south upon Hunt's dyke a distance of 930 feet, and a sloping rise was put into the shaft sunk from the Victoria level. A winze was also sunk near the end of the 90-ft. level from the outside shaft to a depth of 100 feet. It is generally asserted that the 90-ft. level was not extended sufficiently far enough to cut the pipe which was worked down from the open cut.

It appears that the dyke has been cut, if not properly prospected, to the following depths below the ground proven payable:—

	feet.
To Victoria level	30
To sill of outside shaft	50
To first level in outside shaft	90
	<hr/> 170
Less (say) 20 feet rise in level	150
To winze end of 90-ft. level	100
	<hr/> 250
Total depth below productive ground	250

The proper policy to ascertain if the payably auriferous conditions of Hunt's mine continue downward would be to unwater the outside shaft at the 90-ft. level; explore the pipe at that level, and also, if necessary, at the 100-ft. winze level. Should developments warrant it the 90-ft. level or the 100-ft. winze could be connected vertically by a shaft from the Victoria adit or the surface.

Upon the dump of the outside shaft can be seen a considerable amount of diorite containing copper pyrites, which analysis at the Geological Survey laboratory has proved platinum-bearing. This occurrence should be worth investigation. Two samples of dyke rock were assayed and gave the following results per ton:—

			227/10.			214/16.		
			oz.	dwt.	gr.	oz.	dwt.	gr.
Gold	...	...	0	1	13	...	0	1 23
Silver	...	...	0	4	14	...	0	5 12
Platinum	...	...	0	0	6	...	0	0 16
Copper	...	...	2.88%			1.0%		

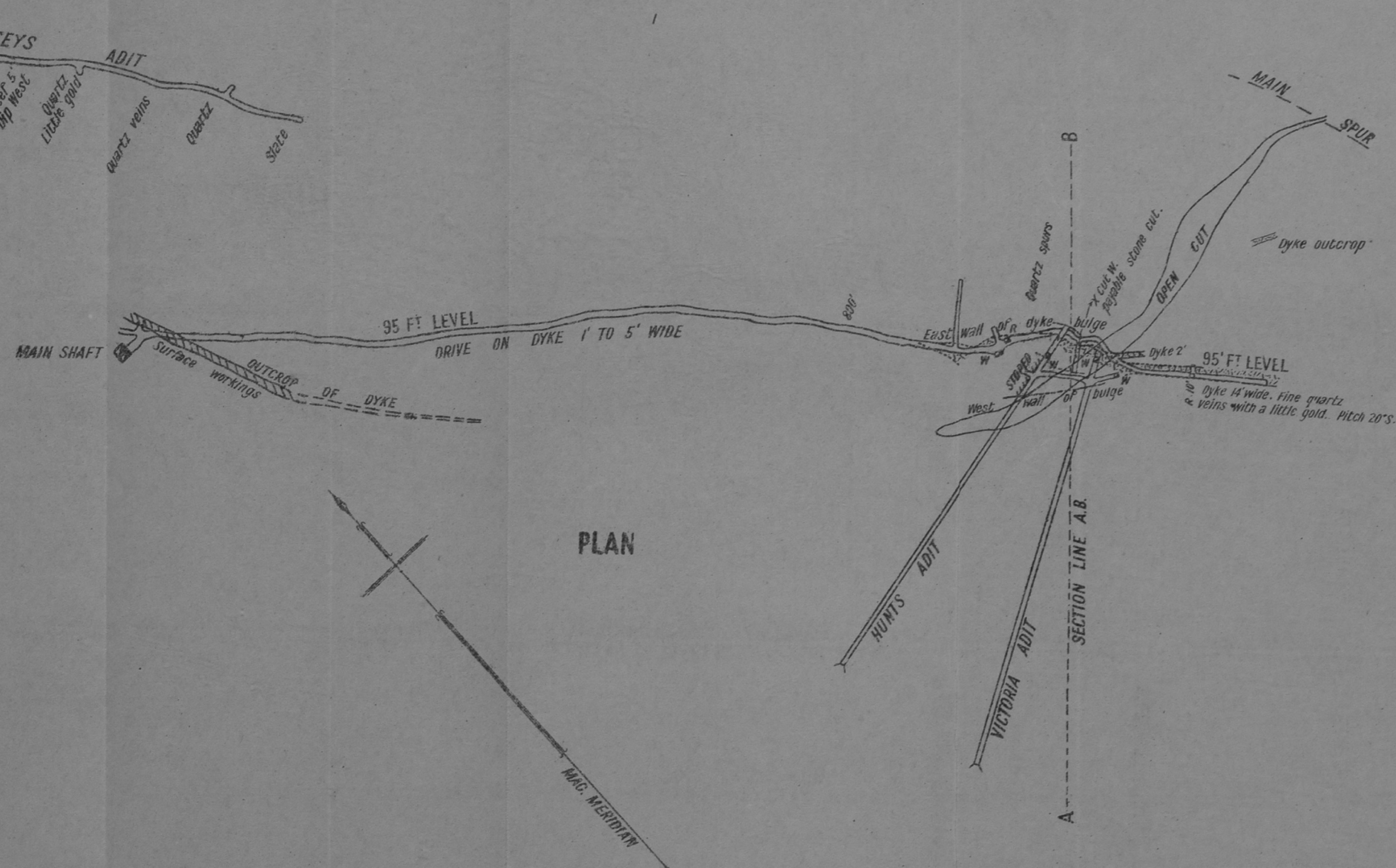
[17.3.16.]

HUNT'S GOLD MINE, GAFFNEY'S CREEK.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The Hunt's gold mine workings are on a dyke line which crosses Gaffney's Creek about half-a-mile above the township of that name. It is stated that the line can be traced south to the A1 mine, about 3 miles distant. From that point, where it crosses Gaffney's Creek, the dyke outcrop, which here is from 2 feet to 6 feet wide, can be traced for about 1,000 feet along the spur in a south-easterly direction. It then makes a lenticular bulge, with a maximum width of 80 feet in a length of 220 feet, and beyond the bulge the outcrop takes a more easterly course to the top of the spur. North of the bulge the dyke dips east, while to the south it has a decided dip to the west. The change in the strike of the outcrop is due to this change of dip in conjunction with the steep western slope of the spur. At the top of the spur the dyke outcrop resumes its south-easterly strike again.

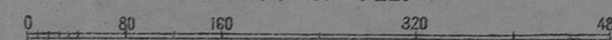
Within the area held by the present company two shoots have been worked. The north shoot, or, rather, succession of short shoots, has a total length of 130 feet. The south shoot extends on the surface from the north side of the dyke bulge to the top of the spur, and has a total length of 560 feet; its position is indicated by a continuous open-cut. The workings include two adits known as Hunt's and the Victoria adit respectively driven easterly to the dyke bulge from the creek, and a main shaft sunk to a total depth of 240 feet below the creek level, with levels at 95 feet, 175 feet, and 225 feet. It is said that the north shoot was worked down to the 95-ft. level at intervals for a length of 120 feet, and that a block 50 feet long had been stoped down to the 175-ft. level, while below that level no stoping has been done. The recorded yields from the 95-ft. and 175-ft. levels are 1,980 tons crushed for 415 oz. gold, an average of 4.7 dwt. to the ton.



HUNTS DYKE COLD MINE

CAFFNEY'S CREEK

SCALE OF FEET

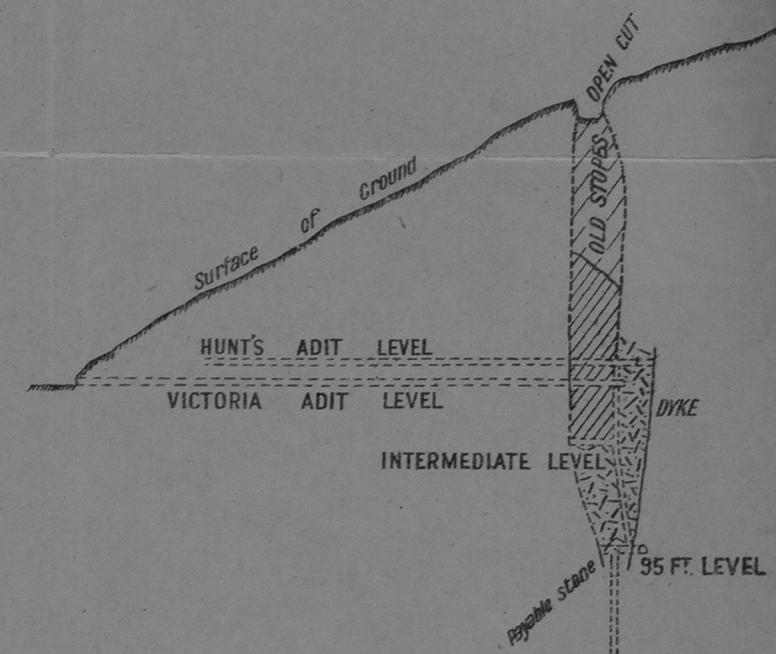
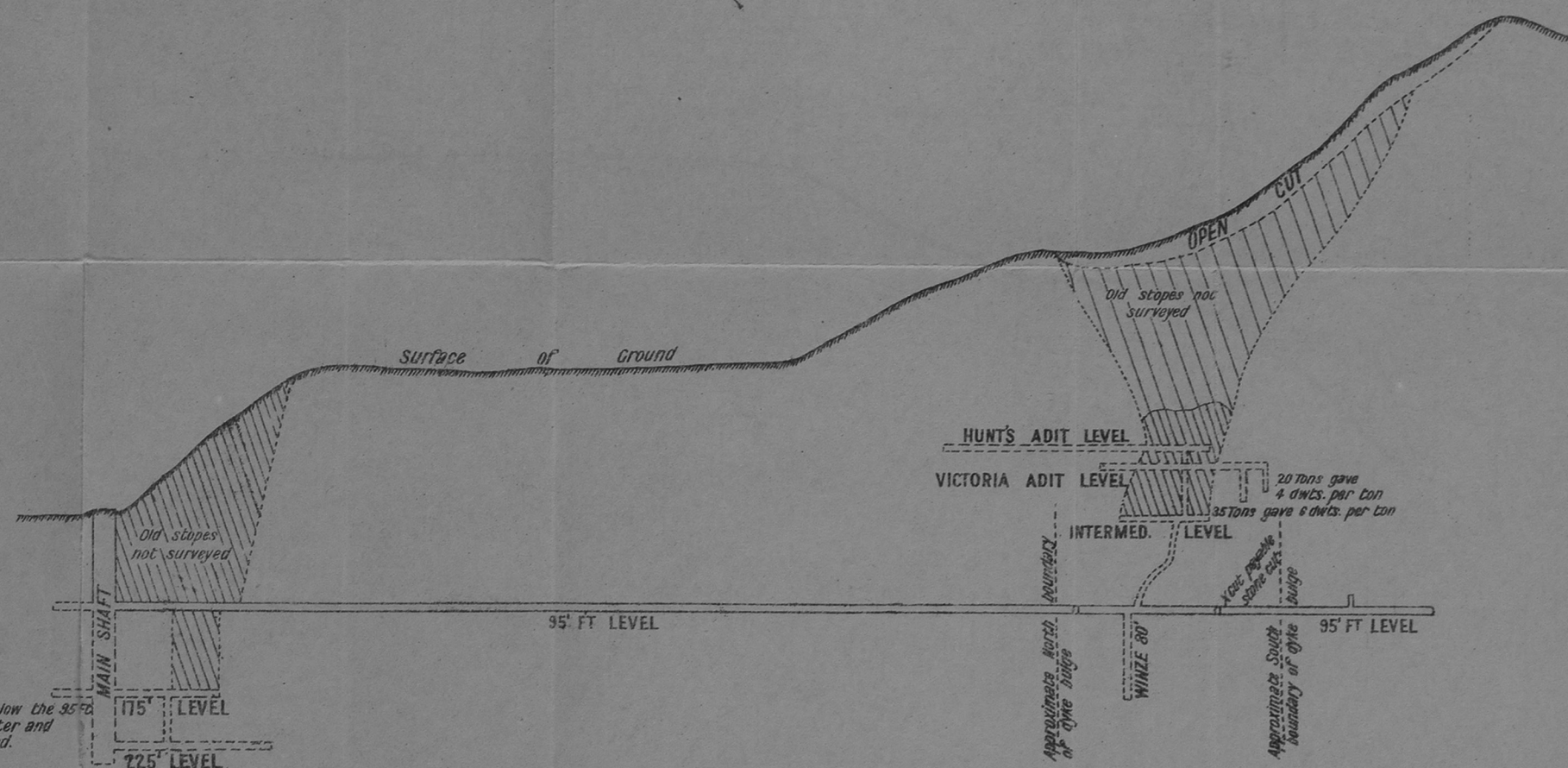


compiled from mine plans

W. B. Bannister
30.5.12



W. Bannister, Director.
W. Bannister, Secretary for Mines.
The Hon. S. Bannister M.L.A. Minister of Mines.



At Hunt's adit, at a depth of 200 feet, the dyke has been stoped on the western wall for a length of 70 feet and a width of 40 feet. The shoot, it is said, was worked down to an intermediate level 65 feet below Hunt's adit. (Pl. XLIV.)

From the main shaft the 95-ft. level has now been extended 1,300 feet south-easterly on the line of the dyke. At 900 feet the dyke bulge is intersected, and thence to the southern limit of the bulge, at 1,120 feet, the drive is either on the eastern wall or in the adjoining country rock. Beyond the bulge the dyke splits into two branches; the eastern is 2 feet wide and the western is 14 feet wide; from this point to the face the veins, which dip south, carry a little gold. A cross-cut has recently been put out to the west wall of the dyke bulge, and in this cross-cut, since my inspection, a payable vein has been cut.

The dyke is traversed by numerous quartz veins, dipping at about 20°, usually north and south away from the dyke bulge. The veins vary from a thread to a foot or more in thickness, and, where payable, practically the whole of the dyke rock and quartz must be crushed.

Although the dyke has been extensively worked on the surface, much of the ore was low-grade, as is shown by the annexed returns. The ore above the creek level was easily broken, convenient to handle, and water power was available for crushing. Under these circumstances, ore worth 2 dwt. per ton was mined and milled at a profit, while mullock, left as filling and on the surface by the first owners, and worth 1 dwt. per ton, yielded profitable returns when subsequently crushed.

Below the creek level, and apart from the north shoot, it seems that payable stone should be looked for in the dyke bulge and near the western wall.

Three facts point to this conclusion:—

(1) Payable stone has recently been cut at the 95-ft. level in a cross-cut to the west wall of the dyke bulge.

(2) At Hunt's adit-level, where the old workings reach the greatest depth, the dyke has been stoped 40 feet wide to the western wall; the remaining 40 feet on the eastern wall is untouched.

(3) At the 95-ft. level, where the south drive approaches the western wall, as it does south of the dyke bulge, the veins carry a little gold; north of this point no gold was obtained.

The drive south at the 95-ft. level has practically reached the south end of the open-cut, and a further extension of it is not desirable. From the cross-cut at the 95-ft. level a rise to the old workings will prospect the ground above, and give a connexion for air. Should payable stone be found north of the cross-cut, a winze 90 feet to the north, and said to be 80 feet deep, offers the best means of opening up the dyke below the level.

YIELDS.

The following yields from the mine are taken from the quarterly returns of the Mines Department. Originally the northern portion of

the present company's lease was held by the Hunt's Company, while the Victoria Company's lease adjoined it to the south.

HUNT'S COMPANY.

Year.	Ore crushed.	Gold won.	Gold per ton.	Depth.	
				feet.	feet.
	tons.	oz.	dwt.	Surface	— 50
1864	1,080	495	9·2		
1865	1,695	1,842	21·7		
1866	4,270	1,222	5·7	69	— 100
1867	5,272	3,107	11·8	150	— 250
1868	5,155	2,306	8·9	200	— 350
1869	6,361	2,362	7·4	220	— 400
1870	2,750	556	4·0	200	— 220
1871	2,800	231	1·6	150	— 320
1875	2,900	245	1·7	Mullock	—
1876	1,000	58	1·2	Mullock	—
1876	1,100	172	3·1	80	
1877	3,300	351	2·1	50	— 60
1878	1,450	489	6·7	50	— 120
1879	1,600	77	1·0	80	— 150
1880	2,700	94	0·7	100	
1881	350	13	0·7	50	
1882	750	31	0·8		
1883	800	42	1·1	Surface	
1884	800	54	1·3	Surface	— 250
1885	100	22	4·4		
1886	850	169	4·0	100	
1887	1,030	223	4·3	100	— 125
Total	48,113	14,091	5·86		

VICTORIA COMPANY.

Year.	Ore crushed.	Gold won.	Gold per ton.	Depth.	
				feet.	feet.
	tons.	oz.	dwt.	feet.	feet.
1865	100	100	20·0	80	— 150
1866	1,595	476	6·0	150	— 170
1867	4,265	463	2·2	300	
1868	2,951	407	2·8	130	
1869	2,588	415	3·2	150	
1870	5,500	434	1·6	150	
1871	2,055	415	4·0	200	— 280
1872	1,280	197	3·1	150	— 200
1873	1,100	112	2·0	175	— 280
1874	1,120	169	1·9	250	
1875	30	4	2·7	250	— 300
1876	1,140	172	3·0	200	— 250
1877	2,500	79	0·6	200	
1879	420	122	5·8		
1880	285	43	3·0	150	
Total	26,929	3,548	2·6		

From Hunt's and the Victoria Companies combined a total of 75,042 tons has been crushed for a yield of 17,639 oz., an average of 4.7 dwt. to the ton.



W. Baragwanath, Director.
W. Dickson, Secretary for Mines.
The Hon. S. Barnes, M.L.A. Minister of Mines.

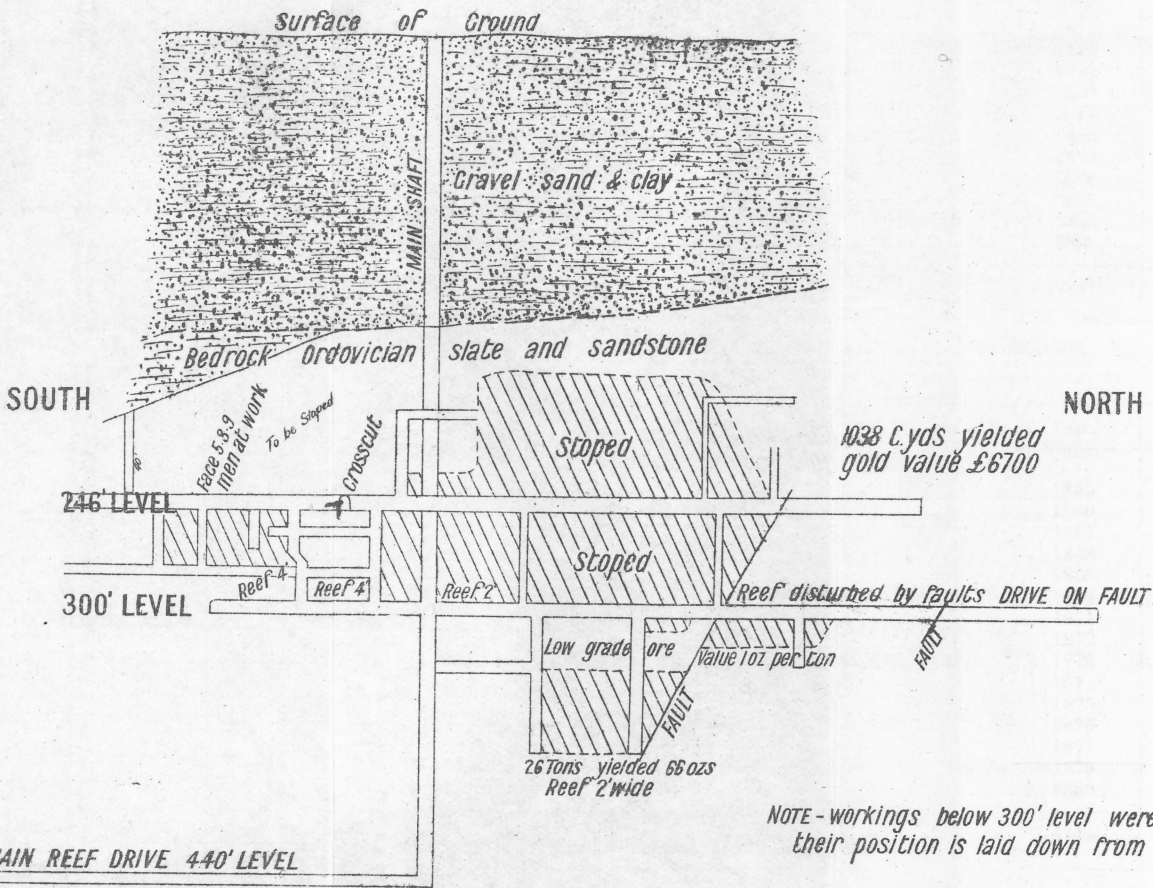
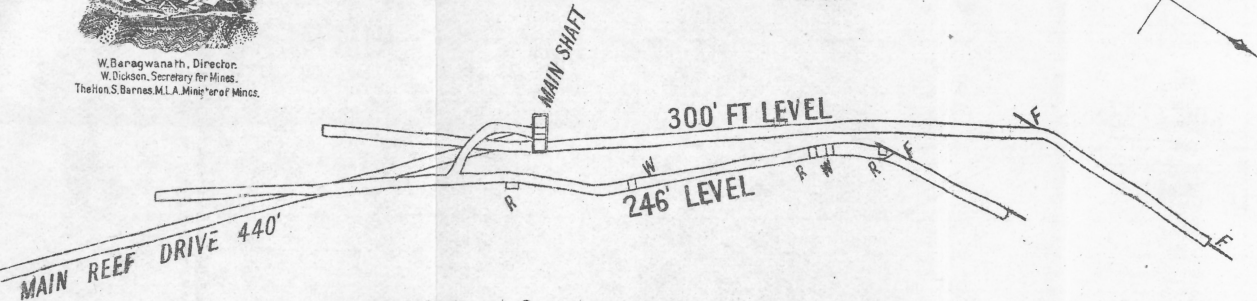
PLAN

GREAT SOUTHERN REEF
RUTHERGLEN

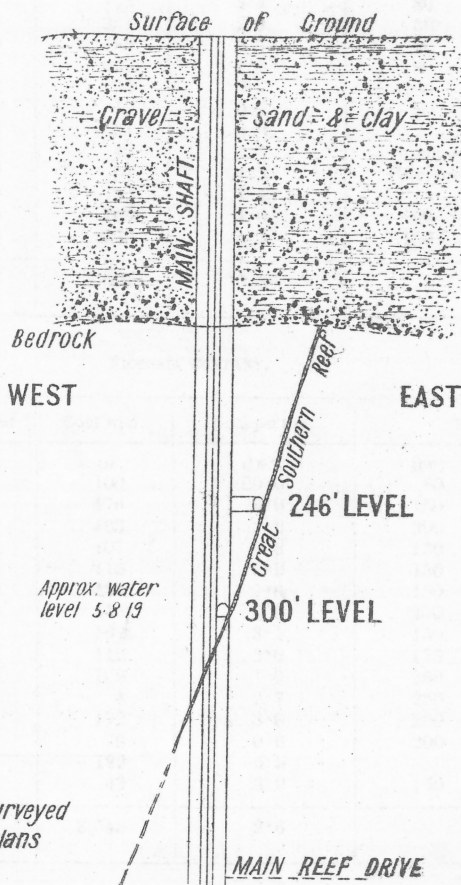
Scale of Feet



NOTE - Additions as taken from Inspector Greer's plan.
Jan 28th 1920.



LONGITUDINAL SECTION



TRANSVERSE SECTION

NOTE - workings below 300' level were not surveyed
their position is laid down from mine plans

GREAT ELDORADO GOLD MINE, GAFFNEY'S CREEK.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The general features of the Great Eldorado mine have already been described in reports by O. A. L. Whitelaw, to which I beg to refer.¹ Briefly, the position is that a dyke bulge 600 feet long and 140 feet wide, carrying auriferous quartz reefs dipping north, has been worked to a depth of 350 feet by adits from the north. An adit from the south, 264 feet below the old workings, has now been extended to the dyke bulge, and a rise has been started to connect with a winze from the old bottom level. The position of the rise is well chosen, as far as the evidence available from the old workings goes; the rise is near the western wall of the dyke, and near the southern apex of the bulge. Its position is based on surveys by O. A. L. Whitelaw and F. J. Coote. The bearing of the rise is $335^{\circ} 15'$, and its underlay is 44° S.E., and the course laid down has been precisely followed by the mine manager. The estimated total distance to rise is 367 ft. 6 in. On 19th April, 1918, the rise was up 100 feet. Several small quartz veins had been passed through, but nothing payable had been cut. The dyke bulge has a uniform westerly dip from the surface to the lower adit-level; near the surface it has also a decided pitch to the south. The work recently done seems to indicate that the southern apex of the bulge below the old workings has an almost vertical course.

[23.5.18.]

LILY OF THE VALLEY MINE, ABERFELDY.

By W. Baragwanath, Director.

At the Lily of the Valley mine, Aberfeldy, a tunnel 1,450 feet in length has been driven to intersect a lode which exists in an upper tunnel about 250 feet above. The lower tunnel is considerably beyond the point where the lode should be cut if it lives down, but not sufficient evidence is available from the upper workings to say if the lode worked there is continuous or not.

The only work I can suggest is what should have been done before launching out on a lower tunnel, viz., to sink a winze on the lode from the upper tunnel and north of the present winze, and drive on the lode to ascertain the strike, dip, and length of the gold shoot. If this work be carried out, and the necessary data secured, there may be a possibility of locating the continuation of the shoot at the lower level.

[10.12.18.]

THE GREAT SOUTHERN REEF, RUTHERGLEN.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

In sinking the main shaft at the Great Southern alluvial mine in 1895 an auriferous reef was cut at a depth of 290 feet. The company drove north on the reef, and crushed 95 tons of quartz for a yield of 59 oz. 9 dwt. of gold. Further prospecting failed to reveal anything payable, and quartz mining ceased. In 1915, when the alluvial ground had been worked out the mine was taken up by Messrs. Curtain and Cross, who resumed work on the reef. No attempt was made to keep

¹ Woods Point. Mem. Geol. Surv. Vict., No. 3.

down the water, which, at the time of my visit, was above the 300-ft. level, and rising at the rate of a foot per month.

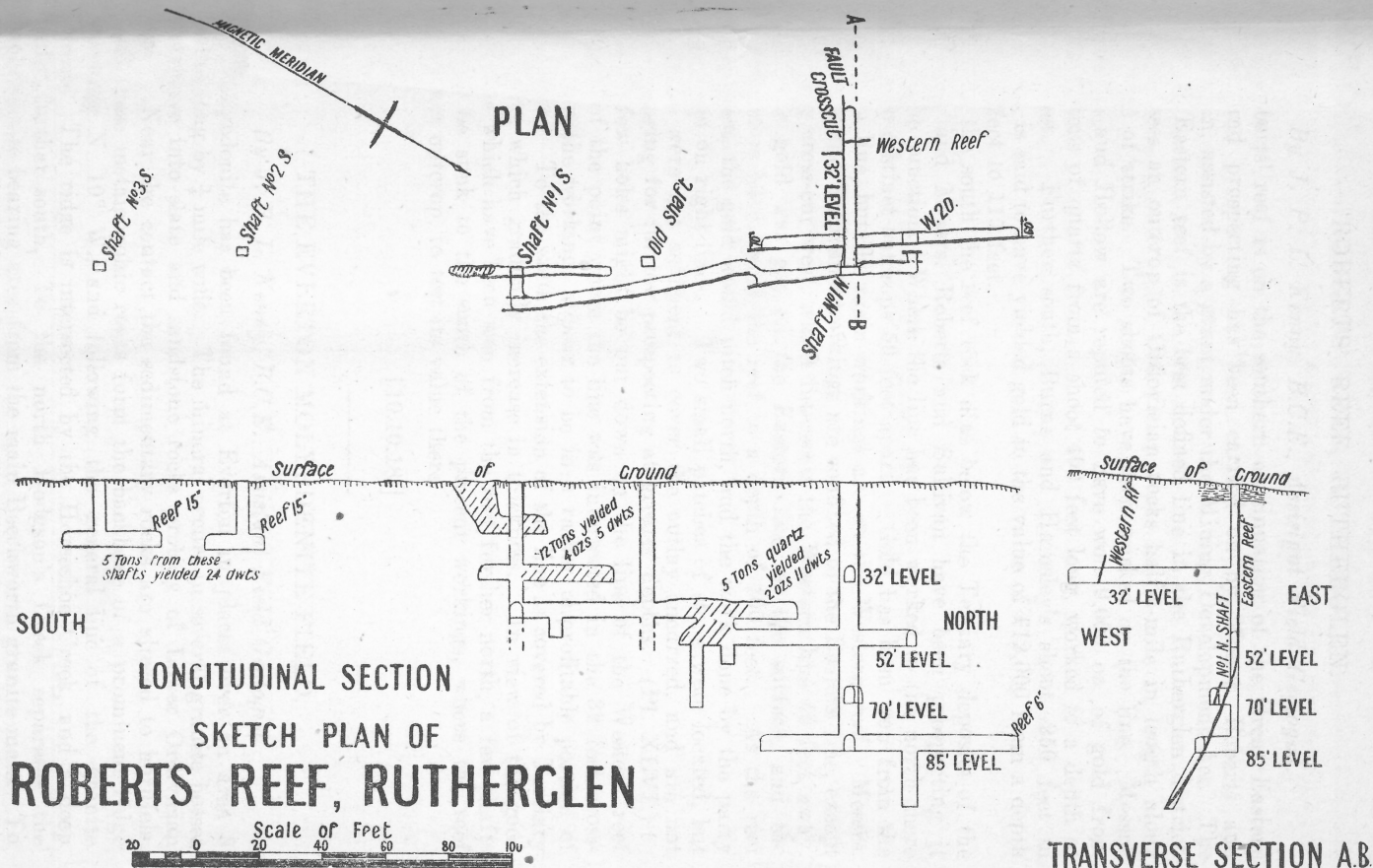
The workings and information in regard to the reef at this level are taken from a sketch and notes supplied by the mine manager. In the shaft, which is said to be 440 feet in depth, the bedrock was cut at 150 feet, the sinking to this depth being through Tertiary gravels. In a report on the Rutherglen gold-field by R. A. F. Murray, in 1895, it is recorded that the track of the reef was cut at the 389-ft. level, at 70 feet from the shaft, where the reef carried two good walls, and had an underlay of 45° west. Possibly 389 feet is the depth of the main reef drive. The general strike of the reef is N. 30° W., and the average width is 1 ft. 8 in.; about the 246-ft. level the dip of the reef is 73° west, but below this level the reef becomes flatter.

At the 300-ft. level the drive extends 345 feet north on a reef from 4 inches to 4 feet wide. To the south the drive is 110 feet in length. Below the level two winzes 70 feet deep were sunk; just below the level values were poor, but at 370 feet in the winzes the reef carried good ore. It is stated that the last crushing of 26 tons from these winzes yielded 66 oz. of gold, and that stone of equal value was left in the bottom, as the water in the shaft rose above the 300-ft. level. The shoot was 60 feet long, and the reef 2 feet wide. On the 300-ft. level north a minor fault was cut at 145 feet, and from this point to 260 feet the reef was disturbed by numerous small faults. At 260 feet a main fault wall has apparently been cut, and the drive follows it for 100 feet on a bearing of N. 1° W. without intersecting the reef beyond the fault. Above the 300-ft. level the main shoot has been stoped for 145 feet in length up to the first fault, and also in places in the disturbed country beyond it. (Pl. XLV.)

At the 246-ft. level the reef has been stoped from the shaft to the first fault at 175 feet north; but the drive has not been extended beyond this point. The face of the drive south was 120 feet from the shaft at the time of my visit, and was being extended. Two walls, a foot apart, were showing, with quartz veins pitching south and carrying a little gold. The shoot was stoped up 70 feet above the level. At this point, which is 25 feet below the overlying gravels, the stone became unpayable, so that apparently the shoot never reached the old surface of the bedrock. The shoot appears to pitch north, as is usual with west-dipping reefs in this district.

Possibly further bodies of payable stone may be found in undisturbed country at deeper levels if the reef were located north of the main fault, which shows at the 300-ft. level. It is probable that the Great Southern reef is on the line of the Great Eastern reef, which has been profitably worked further north. In Mr. Murray's report on the Rutherglen gold-field, already referred to, it is stated that Messrs. Harris and Hollow won 9,000 oz. of gold from 3,000 ton of quartz from this reef. From the Great Southern reef the present owners have won £6,700 worth of gold from 1,038 cubic yards of quartz, so that the ore has averaged about 32 dwt. to the ton.

The good results obtained from the Great Southern reef, which was discovered by accident, suggest that systematic prospecting of this and other lines in places where the outcrop is covered by shallow Tertiary deposits may lead to the discovery of other, and possibly more extensive bodies of payable ore.



ROBERTS' REEF, RUTHERGLEN.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

Roberts' reef is on the southern continuation of the Great Eastern reef, and prospecting has been carried on by Messrs. Roberts and Sullivan, assisted by a grant under the Mining Development Act. The Great Eastern reef is the best defined line in the Rutherglen district. It crosses an outcrop of Ordovician rocks half-a-mile in length along its line of strike. Two shoots have been worked on the line. Messrs. Harris and Hollow are reputed to have won 9,000 oz. of gold from 3,000 tons of quartz from a shoot 400 feet long, worked to a depth of 120 feet. Further south, Burns and Hainsley's shoot, 250 feet in length, is said to have yielded gold to the value of £12,000 from a depth of 90 feet to 115 feet.

To the south the reef rock dips below the Tertiary deposits of the plains, and Messrs. Roberts and Sullivan have been prospecting it near the junction. Where the line has been worked to the north there are two distinct outcrops 50 feet apart. Gold has been won from the Eastern line, but the main workings are on the Western reef. Messrs. Roberts and Sullivan's workings are confined to the Eastern line, except for one cross-cut west, which intersects the Western line 45 feet away. A little gold was got on the Eastern line on the surface, and the prospectors have tested the reef to a depth of 100 feet. As the reef dips west, the gold would pitch north, and the work done by the party has been on right lines. Two small patches of stone were located, but returns were not sufficient to cover the outlay incurred, and are not encouraging for further prospecting at greater depths. (Pl. XLVI.)

A few holes might be put down on the line of the Western reef south of the point where the line was intersected in the 32 feet cross-cut, but the workings appear to be in a rather unprofitable portion of the line. To the south the extension of the line is covered by Tertiary deposits, which gradually increase in thickness. In view of the good returns which have been won from the reef further north, a few shafts might be sunk to the south of the present workings, where the reef does not outcrop, to test its value there.

[10.10.18.]

THE EVERTON MOLYBDENITE FIELD.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

Molybdenite has been found at Everton in places over an area 3 miles long by $\frac{1}{4}$ mile wide. The mineral occurs in several granite bosses intrusive into slate and sandstone rocks probably of Lower Ordovician age.¹ Near the contact the sedimentary rocks are altered to hornfels, and these metamorphic rocks form the backbone of a prominent ridge running N. 10° W., and following the general line of the granite bosses. The ridge is intersected by the Horseshoe Creek, and a deep gully further south. To the north Hodgson's Creek separates the molybdenite bearing area from the main Beechworth granite mass. To the south of the field is a low granite rise about $\frac{3}{4}$ mile in diameter; the granite bosses carrying molybdenite occur as an irregular chain linking

¹ Rec. Geol. Surv. Vict., Vol. II., Part 2, pp. 142-3.

these two outcrops. To the south the ridge is flanked by the Recent and Post Pliocene gravels and clays of Bowman's Forest basin and the valley of the Owens River. (Pl. XLVII.)

The Everton-Beechworth railway line passes through the field at a point 2 miles from the former railway station. A direct road following the line is not in good order, and another road through Everton township 4 miles long is often used. The most northerly boss is separated from the Beechworth granite mass by an area of Recent sands and clays. Through these deposits a creek tributary to Hodgson's Creek has cut its way, exposing the granite bed-rock at a depth of 10 feet to 15 feet, and forming a direct connexion between the molybdenite bearing boss and the main granite area, suggesting that the bosses are all apophyses from one granite mass connecting the whole chain at a depth.

DYKES.

The rocks are penetrated by two classes of dykes—(1) Pegmatite; (2) Porphyry.

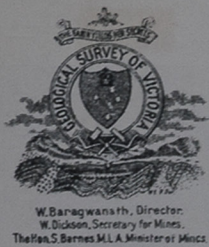
(1) Pegmatite dykes associated with the granite bosses occur in the surrounding sedimentary rocks. A pegmatite dyke was located $\frac{1}{4}$ mile south of Hodgson's Creek in lease 3355. The dyke is 5 feet wide, and two shafts have been sunk upon it. The most northerly shaft is 60 feet deep, and from the bottom a drive goes 20 feet south. The pegmatite is intersected by quartz veins carrying a little molybdenite. About 5 chains south another shaft 40 feet deep has been sunk on the dyke. From the bottom of this shaft there is a drive north for 8 feet. The pegmatite here carries a little molybdenite, and copper is also present; azurite and malachite occurring in small quantities. Near the south end of the field in allotments 8E and 8F, parish of Murmungee, lease 1011, a pegmatite also occurs. One outcrop 2 chains long and 6 feet to 10 feet wide consists of pink felspar and quartz, the felspar predominating. Other smaller outcrops show coarsely crystalline quartz, felspar, and muscovite.




(2) Quartz felspar porphyry dykes up to 20 feet in width intersect both the granite and the surrounding sedimentary rocks. The outcrops are conspicuous, and some of the lines can be traced for over a mile in length. These dykes are of later origin than the granite bosses, and carry no molybdenite. In lease 3392 a cross-cut passed through a porphyry dyke occurring as barren rock in the ore bearing granite. Leases have been taken up on these porphyry dykes, but no trace of molybdenite has been found in them.

OCCURRENCE OF MOLYBDENITE.

Molybdenite occurs in the granite bosses where the rock is intersected by irregular veins and secretions of quartz; when these are absent little or no molybdenite is present. The veins are usually a few inches, rarely a foot, in thickness. Molybdenite occurs in the solid granite, in the quartz veins and on joint planes in the granite. A little molybdenite is found at times in quartz veins, and on joint planes in the hornfels near the granite contact. In the Standard molybdenite mine, where the richest ore body yet discovered on the field occurs, no definite walls can be assigned to the formation. The apex of the ore body, which is dome shaped, did not extend to the surface, but coarse molybdenite occurred on the surface above it. The occurrence suggests that the deposition occurred in the last stage of the solidification of the granite, siliceous ore bearing solutions permeating the granite, possibly while the mass

EVERTON MOLYBDENITE FIELD



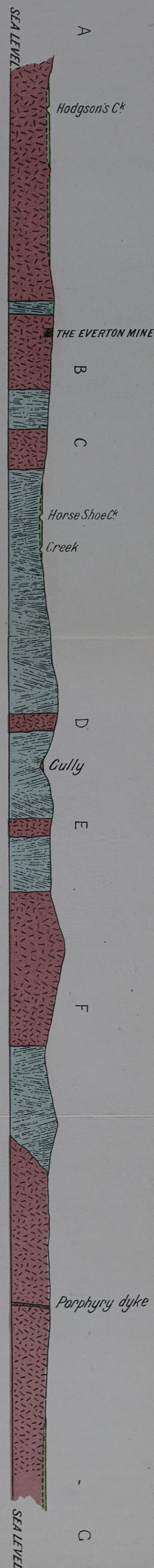
 Granite  Schist  Post Pliocene

Dykes , Aneroid heights above sea level 1260'.

Scale -20 Chains to one Inch.

Contour interval 100'
Lease Nos 3355 M!

J. P. L. Kenny B. C. E
Assistant Field Geologist

Section **A to C** on plan (looking East)

was still in a viscous condition filling any fissures, and possibly replacing some of the original constituents of the granite with quartz by metasomatic action. Molybdic ochre is found in small quantities near the surface, and finely disseminated pyrites occurs as an accessory mineral, giving by its oxidation a characteristic "burnt" appearance to the rock where molybdenite is present.

MINING.

On the north end of the field, two shafts 40 feet and 60 feet respectively have been sunk on a pegmatite dyke in lease 3355, as already described. The work done on the various granite outcrops is detailed below in order from north to south.

Lease 3392.—Only about an acre of granite actually outcrops in this lease. An area of about 70 acres, possibly molybdenite bearing, is covered by sand and clay about 12 feet thick, and exposed only along a creek bed. A shaft 45 feet deep was sunk in the granite near the south boundary of the lease, and a drive was extended 35 feet westerly, passing through a barren porphyry dyke. The granite was ore bearing, and some coarse molybdenite was seen. Several shallow holes were also put down near the shaft, and all showed a little molybdenite. Generally, prospects here are encouraging, but no ore body with over 1 per cent. molybdenite has been located.

Lease 3317.—This lease includes about 8 acres of the No. 1 outcrop. Three shafts 20, 40, and 50 feet deep respectively have been put down, and in each shaft quartz veins carrying a little molybdenite were located without meeting anything payable. A defined quartz reef 1 foot wide, strike N. 30° W., outcrops in this lease. The surface stone carries no values, and a shaft is being sunk on the reef to test it at a deeper level.

No. 2 Outcrop, Leases 3313, 3280.—This area, which is oval-shaped, 20 chains long, with a maximum width of 12 chains, contains the Standard molybdenite mine. On the surface ore 1 ft. 6 in. wide, with 5 per cent. of molybdenite, was located near the contact of the granite with the hornfels. The ore seemed to have a trend in a south south-westerly direction, and an adit (No. 2) was started about 50 feet below and 100 feet south. This adit intersected the main ore body now being worked. In shape this ore body so far as worked resembles a segment of a sphere. At the No. 2 adit-level, it is roughly circular in plan with an average diameter of 20 feet at the floor of the level, and cutting out 10 feet above it. The upper dome-shaped portion of the ore body consisted of concentric layers, but below this no defined walls can be seen. An open cut (No. 1) was brought in to the formation 13 feet below the No. 2 adit-level, and to this level, and going underfoot, the ore has maintained its quality, and appears to be still increasing in size. The mine manager's report, dated 24th March, 1919, gives the width of the formation at the No. 1 open cut level as 27 feet. What are the width and value of the formation below this level can only be proved by further development work.

The ore body may continue as a pipe maintaining a fairly regular width and value; it may prove to be a succession of lenticles separated by low-grade ore, or present values may extend only to a certain depth with low-grade ore below. Molybdenite is not uniformly distributed through the ore body. Of the rock broken so far, approximately one-half, containing less than 1 per cent. molybdenite, is sent over the mullock tip. The remainder is hand-picked, giving two grades of ore—one grade with

about 10 per cent. molybdenite is sent to Melbourne for treatment, and the remainder, estimated to carry 3 per cent. to 4 per cent. molybdenite, is stacked for future treatment. Of the ore saved, about one-fourth is 10 per cent. ore, so that, after rejecting ore with less than 1 per cent., the average content of the remainder broken is about 5 per cent. molybdenite. At present, the ore is paid for at the rate of £5 per unit on the assumption of an 80 per cent. extraction, *e.g.*, a parcel of ore assaying 10 per cent., is worth $8 \times £5 = £40$ per ton, less freight and treatment charges.

The returns from the mine to date are given below:—

Date.				Yield.				Assay, MoS ₂ , per cent.	Net Value.	
				tons	cwt.	qr.	lb.	%	£	s. d.
1918—6th May ..	..	..	..	6	7	1	18	9·075	192	11 9
15th April ..	..	..	..	5	11	1	4	8·69	158	10 6
31st May ..	..	..	..	6	2	1	18	9·25	188	15 1
14th August ..	..	..	..	4	4	1	18	7·3	96	16 6
19th September ..	..	..	..	4	12	2	18	8·05	120	12 1
15th October ..	..	..	..	3	1	0	19	10·53	109	18 11
1919—28th March ..	..	..	..	7	8	1	26	9·7	244	6 8
Total ..	..	..	..	37	7	3	9	..	1,111	11 6

These results show that 37½ tons of ore have been treated for a net return of £1,111 11s. 6d. A plant capable of treating 50 tons per week is being erected by the company, and it is estimated that, exclusive of development work, ore carrying 1 per cent. of molybdenite will pay costs of mining and treatment. An ore body 20 feet in diameter, and carrying 50 per cent. of unpayable ore, would yield about 12 tons of ore for treatment for each foot in depth; an ore body 27 feet wide under the same conditions would yield about 22 tons for each foot in depth.

The No. 1 open cut marks the limit of this system of mining on the main ore body, and for its further development sinking will be necessary. Prospecting work is being carried on to the south of the No. 1 open cut, and other payable ore bodies may be developed here. An open cut (No. 2) 200 feet south-east of No. 1 has been extended 80 feet into the hill; fair ore is showing in places, but nothing payable. An adit (No. 3) 80 feet further east at 30 feet intersected a wall, strike north-east, beyond which fair ore 3 feet wide was passed through, and thence to the face, a distance of 60 feet; the granite carried $\frac{1}{4}$ to $\frac{1}{2}$ % of molybdenite. A drive on the wall cut at 30 feet in this adit would further prospect this formation. South-easterly from this adit and 160 feet distant an adit was driven 90 feet, and near the south boundary of the outcrop a shaft was sunk 20 feet without revealing anything of value in either case. (Pl. XLVIII.)

No. 3 Outcrop, Lease 3280.—This outcrop just north of the Everton-Beechworth railway, is about 8 acres in extent. A shaft about 45 feet deep was put down near the south boundary of the lease, and proved a little molybdenite in small quartz veins.

No. 4 Outcrop, Lease 3403.—This outcrop, 3 or 4 chains in diameter, is included in lease 3403. A little molybdenite shows in places, but no work has been done.

A hand-drawn geological cross-section diagram. On the left, a sloped area is labeled 'Culling'. To its right, a horizontal line represents the 'Surface of Ground'. Below this surface, a shaded, irregular area is labeled 'Stoped'. Further down, a horizontal line is labeled 'No. 2 ADIT LEVEL'. Below the adit level, another shaded area is labeled 'Ore body'. The text 'NOT OPEN CUT' is written near the ore body. The diagram is drawn on a piece of paper with a vertical crease down the center.

TRANSVERSE SECTION A.B.

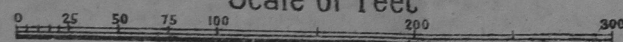


W. Baragwanath, Director.
W. Dickson, Secretary for Mines.
The Hon. S. Baines, M.L.A. Minister of Mines.

SKETCH PLAN OF THE EVERTON MOLYBDENITE MINE

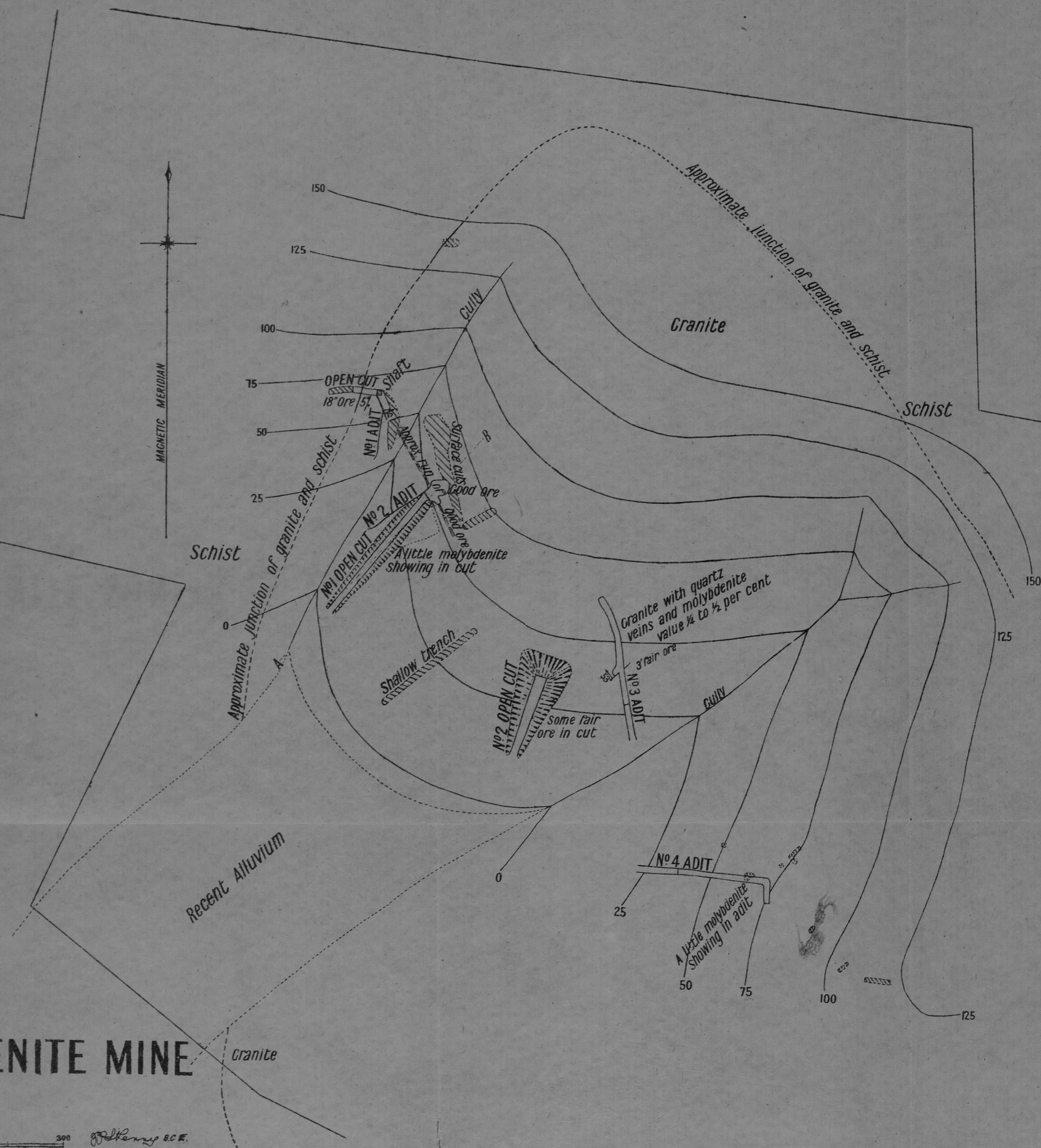
EVERTON

Scale of Feet



Contour interval approx. 25'

W. H. H. B.C.E.
11.4.19.



No. 5 Outcrop, Leases 3404 and 3387.—This is also a small area about 4 chains in diameter. It contains a solid quartz reef 3 feet wide, strike east and west, carrying pyrite and a little molybdenite. There is an old shaft a few feet deep on this reef, probably sunk to prospect the reef for gold. No recent work has been done on this outcrop, which should be further prospected.

No. 6 Outcrop, Leases 3386, 7007, 7009.—This area is fairly extensive, being 33 chains long and 10 to 15 chains wide. In lease 3386 an adit has been driven 38 feet in hard granite, and a little molybdenite can be seen in places. Six chains west a quartz vein 6 feet thick dipping 60° west, and carrying fair ore in places, has been opened up by a cut 42 feet long. In lease 7007 no prospecting beyond surface knapping has been done, pending, I understand, satisfactory arrangements with the land-owners. Molybdenite shows at various places on the surface, and prospecting shafts should be put down here.

No. 7 Outcrop, Leases 1011, 3407, 3408.—This area, roughly circular, and about $\frac{1}{4}$ mile in diameter, marks the southern limit of the field. A little molybdenite shows in the south-west portion of the area, but few quartz veins are present, and indications here are not promising.

A number of leases have been pegged out beyond the proved limits of the field. Some of these leases contain no granite outcrops, others include only the porphyry dykes already described; in either case the prospect of locating payable molybdenite is small. The production of molybdenite in New South Wales and Queensland for the past four years is given below as far as figures are available:—

Year.							New South Wales.	Queensland.
							tons.	tons.
1915	..	..	..	..	..	..	32	97
1916	..	..	..	..	..	..	54	81
1917	..	..	..	..	..	..	..	111
1918	..	..	..	..	..	..	..	110

To the end of 1916, Queensland produced 70 per cent. of the world's supply of molybdenite.

The price of £5 per ton unit as fixed by the Federal Government holds good until six months after the war; possibly lower rates will rule when that time expires. The present position on the Everton field is that in the Standard molybdenite mine a body of ore has been worked from its apex to a point 23 feet below, maintaining its value and increasing in width, and the existence of a large body of low-grade ore has been proved. On the north end of the field, several shafts in well selected sites have given encouraging prospects in places, but nothing payable has been located. On the south end of the field prospects justify prospecting work, but no sinking has yet been done.

McLEAN'S REEF, MURMUNGEE.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The Cullinan Company, at Murmungee, has been prospecting the south end of McLean's reef, the north workings of which I have described in a previous report. In the ground now being tested, two shoots have been worked on the surface. The north shoot is 30 feet long and the south shoot 60 feet. The two shoots are 40 feet apart transversely, but as the country is much disturbed by slides and cross-courses, they are probably two portions of one shoot. At the south shoot the reef dips 35° west. An adit has been driven for this shoot 105 feet below the reef outcrop. At 200 feet the adit passed through a fault channel; at 240 feet a reef formation 5 feet wide was intersected, and the adit was continued to 360 feet in clean country. The fault channel carries quartz at the adit-level, but it seems probable that the reef formation is McLean's reef, and that the movement on the fault has been a downward tilting to the east of it. McLean's reef where worked east of the fault dips 35° west, while the reef formation west of the fault dips 80° west. (Pl. XLIX.)

From the adit, drives were extended 60 feet north and 100 feet south along the fault channel, and three cross-cuts have been put out west to the reef. In the north cross-cut payable stone was struck, and a shoot 15 feet long has been stoped for 32 feet above the level, and about 50 feet below. This is possibly a continuation of the north shoot; but to the south nothing payable has been met. The south shoot was worked down to the fault, a depth of 60 feet, but below it seems to be unpayable. The reef worked from the north cross-cut at the adit-level consists of quartz veins in country rock, and the whole formation is 10 feet wide. The cross-cuts west at 50 feet and 100 feet in the drive south might both be extended a few feet west, as neither of them seems to have reached the western wall. Failing a development in these cross-cuts the prospects of getting payable stone above the adit-level are not promising. In the south drive a reef, carrying a little gold, makes on the fault; in the face it is 3 feet wide. It is possible that this is McLean's reef, and that the auriferous portion of it has been faulted down below the level. A winze 25 feet deep might be sunk in the south drive on the west side of the fault, and just south of it to the main adit in order to test this reef below the level.

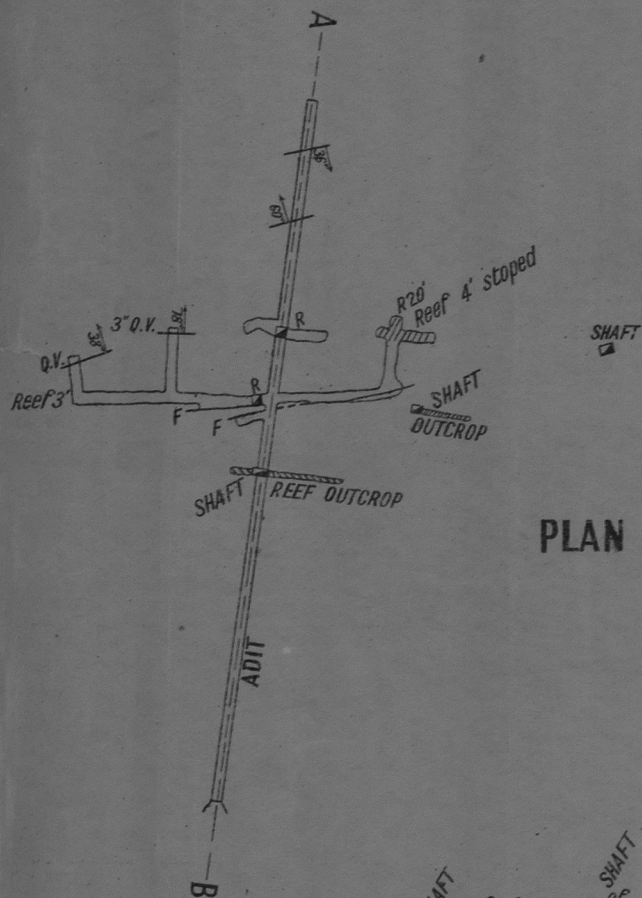
[6.6.18.]

HOMEWARD BOUND MINE, HILLSBOROUGH.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

The Homeward Bound reef at Hillsborough occurs in an area of sedimentary rocks, probably of Ordovician age, metamorphosed to schists and quartzites by the intrusion of an adjacent granitic mass. A description of the mine with a plan of the workings has already been given by E. J. Dunn, F.G.S.¹ On the surface five lines of reef can be traced. The most easterly is the Von Moltke reef, where a shoot about 50 feet long has been worked down to below the Homeward Bound adit-level. The Homeward Bound line itself strikes N. 15° E., and dips to the west. It bifurcates at the Homeward Bound shaft, and the south-west branch is known as the "Cuddy" reef; 100 feet south of the shaft

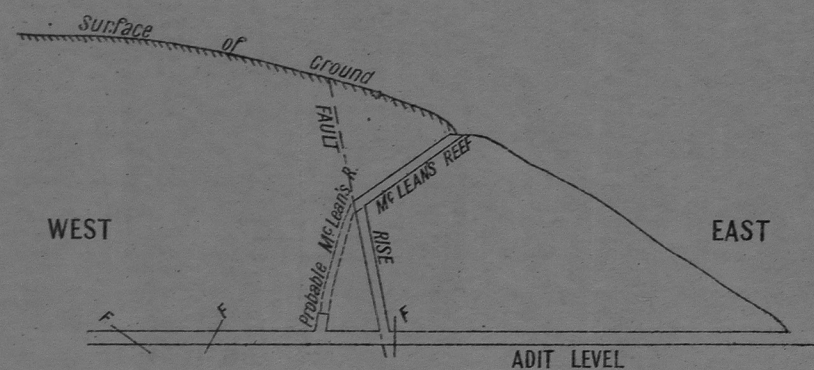
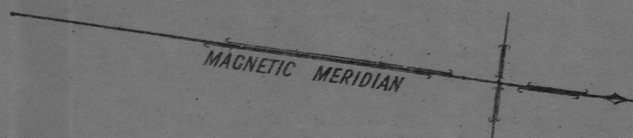
¹ Rec. Geol. Surv. Vict., Vol. I., Part 4.



SCALE OF FEET



J. P. Kenney B.C.A.
6.6.18



TRANSVERSE SECTION A-B

it again bifurcates, and the eastern portion, which has a meridional strike, is known as the Track reef. The Bon Accord line lies about 500 feet to the west of the Track reef.

The Homeward Bound reef was discovered in 1865, and was worked continuously until 1880. The reef was from 4 feet to 20 feet wide, and was worked to a depth of about 400 feet by an underlay shaft. The reef was cut off on the surface 25 feet north of the shaft by a fault. It is said that this fault came into the shaft at a depth of 200 feet, and that below this point the shaft turned to the south following the reef on the fault. The old workings collapsed many years ago, and are now altogether inaccessible. An open cut 200 feet long and 50 feet wide, due in part to the subsidence of the ground, marks the position of the workings. The recorded yields of the mine up to 1883 show that 26,407 oz. 17 dwt. of gold were won from 45,135 tons of quartz, an average of 11.7 dwt. per ton.

The Bon Accord reef can be traced on the surface for a distance of 500 feet, and six shafts have been sunk on the line. The main shaft, sunk by an English company, is said to be 400 feet deep, with a cross-cut east from the bottom 400 feet in length. It seems unlikely that the Homeward Bound reef extends south to this point, as nothing resembling it was met in this cross-cut, or in the present company's north-west and Track reef drives, which are described below. In 1872, an adit was started 570 feet below the sill of the Homeward Bound shaft. It was originally driven to the Von Moltke reef, and was subsequently extended west until it reached a total length of 1,150 feet. In the face a reef, which is probably the Track reef, was cut. The cross-cut was stopped here, and from a point 150 feet back, a drive was extended 720 feet in a north-westerly direction, passing through the Track reef at 220 feet. I was not able to examine this north-west drive. The company's plans indicate that in the last 200 feet a reef 6 inches to 2 feet wide was showing. At 720 feet the north-west drive was stopped, and a drive north was started on the Track reef, and carried to 540 feet. At this point a cross-cut west was started, and at 200 feet the reef was cut in 1913. Drives have been extended 80 feet north, and 130 feet south, along the reef. At 50 feet south a fault with a right hand heave of 12 feet was cut. The shoot on the level was 80 feet long, and the reef is from 4 feet to 10 feet in width. Two rises have been put up, one on each end of the shoot, and the reef between the rises has been stoped out. The stopes have been carried up to a height of 185 feet above the rail level, and if the Homeward Bound shaft is 420 feet deep, as reported, a connexion should have been made with the old workings, but so far this has not been done.

In these circumstances, the question has arisen as to whether the present workings are on a different line. As the old shaft is inaccessible, and its position can only be plotted approximately, a definite answer cannot be given; but after a review of all the available evidence, I think it is likely that the workings are on the old shoot, and that if a rise is carried up on the south side of the fault a connexion will soon be made with the Homeward Bound shaft, which is probably not so deep as reported.

When the stopes above the adit-level are exhausted, two alternatives for future work will remain—(1) To sink a winze below the adit-level, (2) to cross-cut for the Bon Accord reef. As the mine is equipped with an air compressing plant, a winze could be sunk without difficulty; but

as the ore at the adit-level was low grade the prospects of getting payable values below are not promising.

On the Bon Accord reef, the main shaft, according to Mr. Craven's plan, is 400 feet deep. This would leave 200 feet of backs above the present adit-level. I have no information regarding the length of the shoot, or width and value of the reef at 400 feet. The records of the English company, which last worked the reef, if available, would show this. Up to the end of 1890, the recorded yields from the Bon Accord reef are 7,185 tons crushed for 5,378 oz. 1 dwt. gold, an average of 14.9 dwt. to the ton.

A whim shaft 250 feet deep on the Bon Accord reef marks approximately the north end of the main shoot, and a point below this shaft is a suitable objective. From the end of the present company's north-west drive, a cross-cut west of 100 feet would cut the Bon Accord reef, and then a drive south of 140 feet would reach a point below the whim shaft. By starting the cross-cut at a point 130 feet back from the face of the north-west drive, the objective could be reached by a cross-cut of 170 feet. Taking the cost of cross-cutting to be £3 per foot, and driving £2 per foot, the cost would compare as follows:—

From end of north-west drive—	£
Cross-cutting 100 feet at £3 per foot	300
Driving 140 feet at £2 per foot	280
Total cost	580

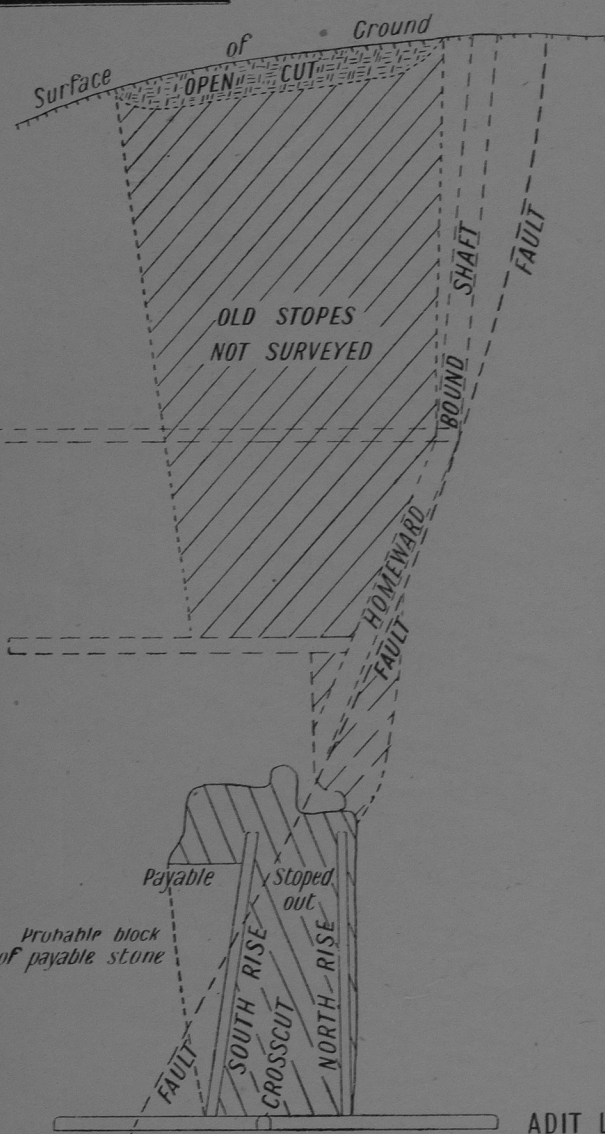
From point 130 feet back—	£
Cross-cutting 170 feet at £3 per foot	510

A cross-cut from a point 130 feet back from the face of the north-west drive would entail less first cost, and would also reduce the length of level necessary to the objective point by 200 feet.

YIELDS.

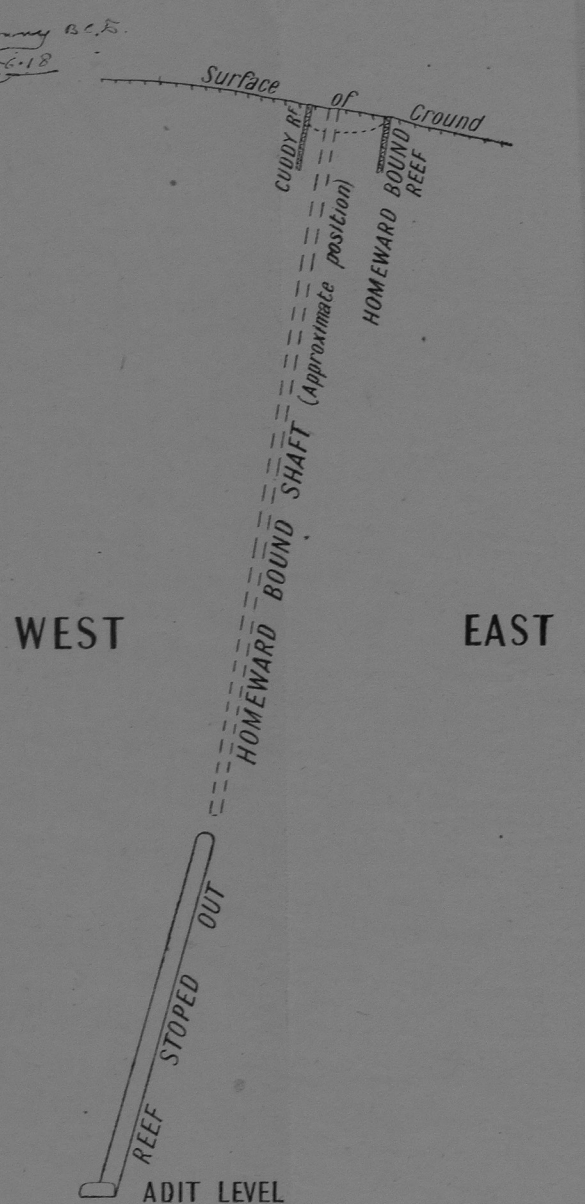
Complete lists of the yields from the Homeward Bound and Bon Accord reefs are given in Mr. Dunn's report. From the Homeward Bound reef to the end of 1893, the total recorded yields are 45,135 tons crushed for 26,407 oz. 17 dwt., an average of 11.7 dwt. per ton. The present company's returns are appended:—

Date.	Ore crushed.	Gold yield.	Gold per Ton.
	tons.	oz. dwt.	dwt.
1913—September	15	2 15	3.7
1914—June	311	68 14	4.4
„ September	540	189 13	7.0
„ December	711	266 4	7.5
1915—March	562	176 16	6.3
„ June	921	320 0	6.9
„ September	755	257 1	6.8
„ December	643	206 2	6.4
1916—December	740	155 12	4.2
1917—March	802	197 11	4.9
„ June	670	134 8	4.0
„ September	609	134 3	4.4
„ December	681	340 18	10.0
1918—March	552	366 14	13.3
„ April	176	123 18	14.1
Total	8,688	2,940 9	6.8



LONGITUDINAL SECTION A.B.

LEVEL OF ADIT MOUTH



TRANSVERSE SECTION C.D.

In addition, 637 oz. 13 dwt. gold was recovered by cyaniding the tailings, and £1,707 was realized from the sale of pyrites. Including these returns, the total yield since 1913 is 4,004 oz. 2 dwt., an average of 9.2 dwt. per ton. Including the yields prior to 1913, the total gold won from the Homeward Bound reef is 30,411 oz. 19 dwt. from 53,823 tons, an average of 11.3 dwt. per ton.

[18.6.18.]

THE MOUNT CUDGEWA TIN SLUICING MINE.

By J. G. Easton, Assistant Field Geologist.

The Mt. Cudgewa tin sluicing company's lease is situated near the south-west corner of allotment 27, parish of Canabore, county of Benambra, and is reached by road and pack track from Tallangatta railway station, a distance of about 22 miles.

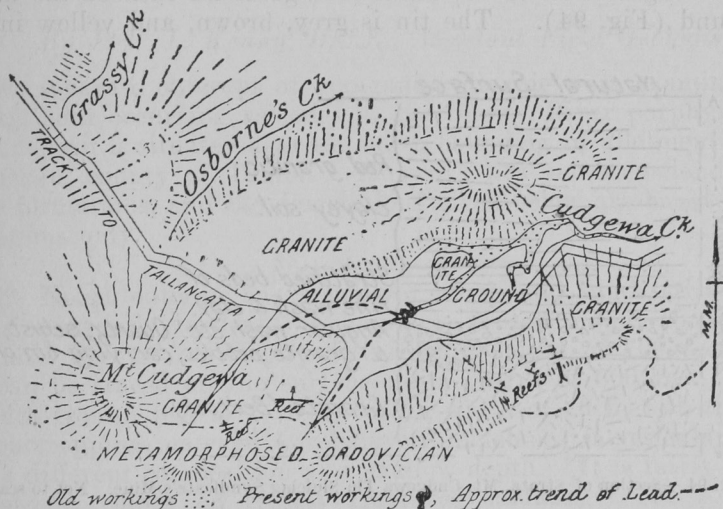


Fig. 93.—Geological Sketch Plan. Scale: 40 chains to 1 inch.

The leased land, consisting of an alluvial flat or basin, on the very head of Cudgewa Creek, at an elevation of over 3,000 feet above sea-level, covers about 80 acres. A narrow main gutter or lead runs through the centre of the flat, with sundry short tributaries branching off from it, as shown by the old workings on the sketch geological plan of the locality. Tin was discovered here in 1873, and was worked for some years by co-operative parties, who are reputed to have obtained some very rich patches; but it is impossible to ascertain the quantity won. The main gutter is said to have averaged about 15 feet wide, with the depth of ground varying up to about 20 feet. The co-operative parties all worked the ground by ordinary ground sluicing, and driving on the wash when water was scarce. Latterly, work was only possible in wet weather and during the winter season.

The syndicate has equipped the mine with two portable engines, of 14 and 25 h.p. respectively, for pumping water to the face, and for elevating the wash to the boxes. They also have a third old portable engine on Osborne's Creek, about half-a-mile to the north-west, for the purpose of supplying additional water when required. A reservoir has

been built in the old workings to conserve the available water, and by use of a settling dam, the syndicate is enabled to use the water over and over again.

Since commencing sluicing operations about the middle of July, 1916, at the face on the old gutter, the syndicate has extended the workings about 170 feet upstream, besides putting in two lateral cuts, as shown on the plan. About 10,000 cubic yards of material have been treated for a yield of 5 tons 16 cwt. of tin; the first 2 tons 18 cwt. was not cleaned, and contained a considerable percentage of titaniferous iron and impurities; the balance was treated by the Willoughby process, and was estimated to go from 70 per cent. to 75 per cent. of tin. The first portion of this ground included some of the old workings. A further paddock, containing about 5,200 cubic yards, is just being cleaned up, and should give a fair estimate of the average value of the ground, as it covers a width of about 150 feet, including the main channel and portion of the high reef. The depth of ground averages about 21 feet. The following section of the main face gives an idea of the nature of the ground (Fig. 94). The tin is grey, brown, and yellow in colour,

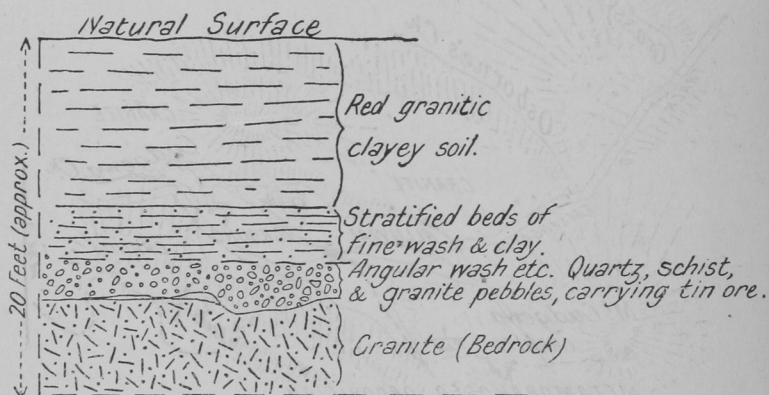


Fig. 94.—Section of Strata, Mt. Cudgewa Tin Sluicing Syndicate's Mine. Not to scale.

and chiefly rough and angular; but occasional well-rounded pieces are found, which is probably due to attrition in potholes. As is usually the case, the bulk of the stream tin is confined to the bed-rock wash.

The chief points of note are:—

- (1) The main stanniferous gutter above the present face is likely to bifurcate, as shown on the plan (Fig. 93), and these bifurcations cannot possibly continue beyond a distance of 20 and 25 chains respectively.
- (2) That the yield from the present clean up, together with the result of work immediately ahead, should prove whether the claim is likely to be a payable proposition or not.
- (3) The undoubted source of the cassiterite is quartz spurs and reefs in the immediate vicinity, some of which are exposed in the bed-rock of the present workings.
- (4) The fact that the present season is one of the wettest on record, has been decidedly favorable to mining operations in this locality, seeing that scarcity of water has always

been regarded as the drawback to successful working. The present management has not required to draw on their subsidiary water supply from Osborne's and Grassy Creeks.

[12.12.16.]

MANGANESE DEPOSITS AT JACKSON'S CROSSING, SNOWY RIVER.

By J. P. L. Kenny, B.C.E., Assistant Field Geologist.

Two separate outcrops of manganese dioxide were examined in this locality, both occurring as lodes in the Snowy River porphyries. The No. 1 deposit is situated near the north boundary of allotment 39, parish of Buchan, county of Tambo. No work has yet been done on either of the formations, and the descriptions given below are based on surface indications only.

NO. 1. MANGANESE OUTCROP.

The No. 1 outcrop has a general north and south strike, and the lode is apparently vertical. The outcrop crosses a spur about a quarter of a mile west of the Snowy River, at a height of 700 feet above it, and can be traced on the surface for a length of 300 feet. It varies in width from 3 feet to 15 feet, with a width of 10 feet on the average. The outcropping material (probably psilomelane) is vesicular, and may have a different composition at a shallow depth. It is fairly hard, with a steel-grey colour on freshly fractured surfaces. The soil capping the lode is of a light chocolate colour, distinct from the grey soil of the porphyries.

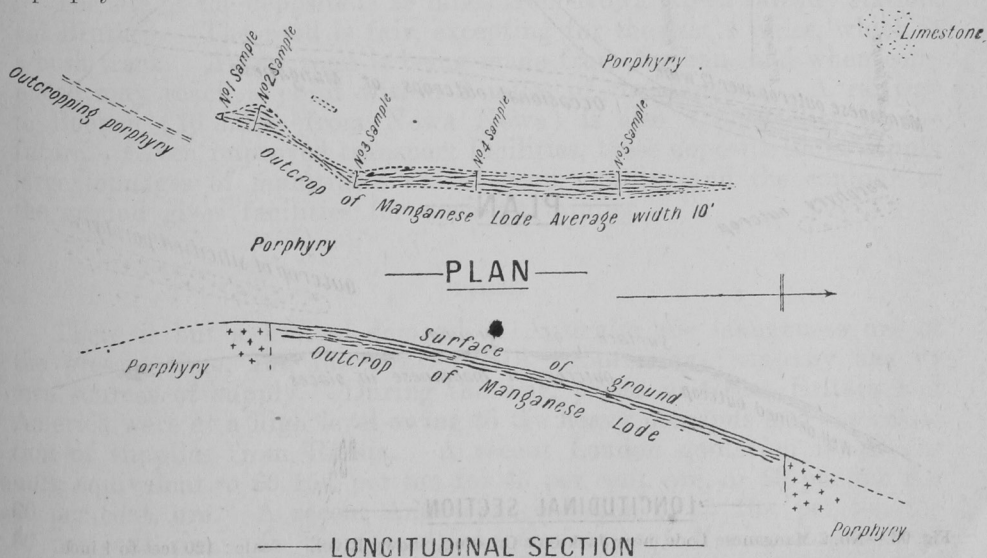


Fig. 95.—No. 1 Manganese Lode, near Jackson's Crossing, Snowy River. Scale : 120 feet to 1 inch.

Five assay samples, taken right across the lode, were broken at intervals along the outcrop, as indicated on the accompanying sketch plan, and assayed at the Geological Survey laboratory, with the following results:—

Assay No.		Sample No.	Width of Lode.	Mn.
			feet.	percentage.
210/19	..	1	4	40.41
211	..	2	15	45.52
212	..	3	9	46.11
213	..	4	12	48.07
214	..	5	15	47.31

These five samples were mixed each in proportion to the width of lode it represented, and the bulk sample so obtained assayed 45.65 per cent. manganese, its contents in manganese, iron, silica, sulphur, and phosphorus being as follows (Assay No. 215):—

			Percentage.		Percentage.
MnO ₂	..	..	72.22	..	(Mn 45.65)
Fe ₂ O ₃	..	..	6.09	..	(Fe 4.26)
SiO ₂	..	..	7.49		
S.	..	..	0.58		
P.	..	..	0.03		

NO. 2. MANGANESE OUTCROP.

The No. 2 outcrop, near the west boundary of allotment 39, parish of Buchan, distant about three-quarters of a mile from the No. 1 deposit, shows on the track to Davidson's homestead, and is distant

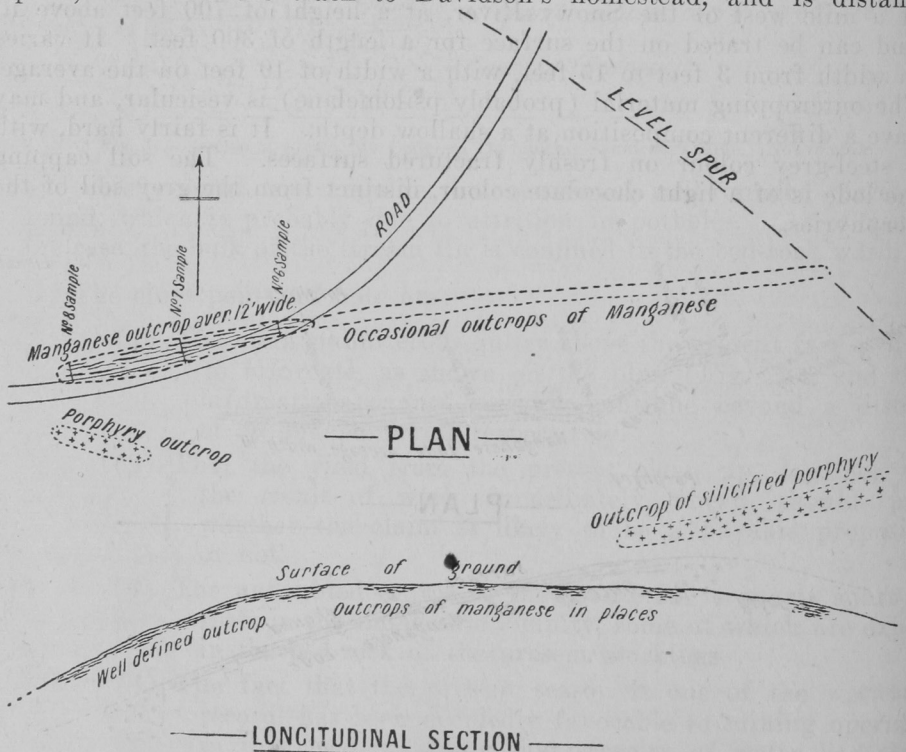


Fig. 96.—No. 2 Manganese Lode, near Jackson's Crossing, Snowy River. Scale: 120 feet to 1 inch.

about half-a-mile therefrom. A strong outcrop shows for a length of 150 feet, with a width of 12 feet on the average. The lode strikes E. 10° N., and easterly from the outcrop, for a distance of 300 feet to the top of the spur, occasional outcrops of manganese dioxide can be seen; for a further distance of about 6 chains beyond the ridge, the colour of the soil, for a width of about 25 feet, indicates the presence of manganese, and an occasional piece of the ore can be picked up. A little work done in costeening along the line of this lode may reveal ore bodies much more extensive than the present outcrop. Three samples taken across the lode outcrop, and assayed at the Geological Survey laboratory, gave the following results:—

Assay No.	Sample No.	Width of Lode.	Mn.
		feet.	Percentage.
216/19	6	10	42.05
217	7	12	46.71
218	8	12	48.37

A bulk sample taken from these, as already described for the previous samples, gave 45.36 per cent. of Mn., and had the following composition in manganese, iron, silica, sulphur, and phosphorus (Assay No. 219/19):—

	Percentage.	Percentage.
MnO ₂	71.76	(Mn 45.36)
Fe ₂ O ₃	5.87	(Fe 4.11)
SiO ₂	8.27	
S.	0.40	
P.	0.05	

ACCESS.

The site of the deposits is 29 miles from Nowa Nowa railway station, *viâ* Bruthen. The road is fair, excepting for the last 4 miles, which is a bush track. A new road is being made from Buchan, and when completed may reach a point within 2 miles of the deposits. A railway to Buchan (16 miles from Nowa Nowa) is also a possibility of the future. Given improved transport facilities, these deposits could supply large tonnages of manganese ore of good quality, and the contour of the ground gives facilities for open-cut mining.

PRICES.

There is but a limited demand in Australia for manganese ore at the present time, and the Broken Hill Proprietary Company has its own sources of supply. During the war, prices in Great Britain and America were at a high level owing to the heavy demands and the cessation of supplies from Russia. A recent London quotation is 3s. per unit, equivalent to £6 15s. per ton for 45 per cent. ore, or £9 per ton for 60 per cent. ore. A recent American quotation is £9 10s. per ton for 60 per cent. ore. In the *Queensland Government Mining Journal*, of 15th February, 1919, the following scale of prices is quoted as ruling in September, 1918 (presumably in Queensland), for manganese ores

containing not more than 8 per cent. silica and 0.10 per cent. phosphorus:—

Percentage.		£	s.	d.	
40	Manganese and over	..	3	7	0 per ton
43	" "	..	3	15	0 "
45	" "	..	4	2	6 "
47	" "	..	4	10	0 "
50	" "	..	5	0	0 "
53	" "	..	5	10	0 "

The above prices are subject to deductions, as follows:—

	s.	d.	
For each 1 per cent. silica above 8 per cent.	0	6	per ton
For each 1 per cent. iron above 4 per cent.	3	6	"
For each 0.01 per cent. phosphorus above			
0.10 per cent.	..	1	6 "

In the steel industry, manganese is used in two forms—as speigeleisen, containing 10 per cent. to 40 per cent. Mn.; and as ferromanganese, with 70 per cent. to 80 per cent. Mn. Ferromanganese with 70 per cent. Mn. is worth 200 dollars (£41 13s. 4d.) a ton in United States of America; and, with large ore bodies available, the possibility of exporting the metal in this form merits consideration.

[24.3.19.]

SOME SILVER-LEAD AND OTHER DEPOSITS IN EAST GIPPSLAND.

By H. S. Whitelaw, Field Geologist.

This report is on some mineral deposits in Eastern Gippsland which were inspected recently in company with the Honorable James Cameron, M.L.A.

I may mention that all of the localities inspected had previously been visited by other officers of the Department, since when, with the exception of that by the Buchan Prospecting Syndicate, little or no prospecting has been done.

The recent advance in price of the industrial metals has again drawn attention to the district, and, even in Bendigo, since my return, inquiries have been made as to the position of the deposits and the general conditions surrounding them.

MOUNT DEDDICK.

One lode only was inspected here—the United—the most southern, and one of the strongest on the field. It was discovered on the crown of a leading spur trending north-westerly from Mount Foster, an Ordovician inlier, $2\frac{1}{2}$ miles southerly from the junction of the Snowy and Deddick Rivers. The country rock is granitic, outside of which, up to date, no silver-lead deposit has yet been found in this particular locality. By pot-holes, shallow open-cuts, and short tunnels (the longest 50 feet in length) the lode—crushed country and quartz—seamed and impregnated with galena, has been traced for a quarter of a mile down the eastern slope of the spur, and westerly to the Snowy River, $1\frac{1}{2}$ miles distant. The general direction of what appears to be the main branch of the formation is about E. 20° N., in the upper tunnel, close on 300 feet below the summit of the spur, the walls fork, the southern prong taking a nearly east-west strike. Between the walls, which, where enclosing the lode proper, are from 2 to 6 feet

apart, galena was found in veins and bunches; outside the walls—for 20 feet on the footwall side—the country is impregnated with galena and iron pyrites. Over 100 tons of lode stuff were broken from these workings, and about 10 tons, in bags weighing each about 1 cwt., is stacked in the tunnel. These contain, it is estimated by Mr. Reedy, who worked this and other lodes in the vicinity, and who conducted me over the ground, 30% to 40% of lead and 17 oz. of silver per ton.

Although the rich pocket into which this tunnel was driven would appear to be practically exhausted, strings and particles of galena show in the faces, back and bottom, in such forms as to suggest the extension of the workings might lead to the discovery of other bulges. With the view of prospecting for lower-level makes, a tunnel was started at rather more than 100 feet below the upper one. This latter is in about 30 feet, and shows galena-studded lode material in the face. The first of any future work on this lode should be the extension of the lower tunnel which, if driven to a point vertically below the summit of the spur, would command about 400 feet of backs.

The chief handicap facing future prospectors of this field is the difficulty of transport. The strongest lodes exposed are all on the eastern side of the Snowy River, which is not always fordable. From the river to Wulgulmerang, on the western side, there is an even-graded side-cutting track, about 8 miles in length, over which a motor lorry could travel with ease. From Wulgulmerang to Nowa Nowa, 50 miles, the track for the most part is hilly, rough, and, in winter, greasy. Deviation trial surveys have demonstrated that the worst of the hills on this section can be circumnavigated without difficulty and at no great expense. It should be said here that, so far as the field has been opened up, prospects do not warrant the expenditure of any large sum on its further development; but prospectors would be encouraged to further test the numerous known lodes and search for others, which there is good reason to suppose exist, if the bridle track from the United tunnel to the river were cleared and the carriage track from the river to Wulgulmerang cleared and repaired. So far as is known, there is only one landslip along the course of the latter. If that be so, the whole of the necessary work on the river section could be accomplished, probably, by a couple of men in a month. This done, a load of a ton or a ton and a half could be hauled from the river to the Gelantipy plateau coach road.

GELANTIPY.

Mr. D. McRae, who is interested in the locality, guided me to what is known as the Glen Shiel lode, between Butcher's Creek and the Snowy River, about $1\frac{1}{2}$ miles east of the Buchan-Gelantipy-road.

The lode was discovered many years ago, and several attempts have since been made to locate a payable ore shoot in it. The deepest shaft is said to be 80 feet, at which depth the formation is 10 feet wide, and estimated by Mr. McRae to be worth £1 per ton. The gangue is peculiarly-evenly laminated quartz on the footwall half, the remainder quartz and country rock (porphyry). Several assays and two crushings have been taken from it. The former showed gold contents between a trace and $7\frac{1}{2}$ dwt. per ton, silver from 1 oz. 12 dwt. to 240 oz. per ton. The ore is evidently not evenly disseminated, the gold being invisibly distributed. A few tons sent to Parker's works, Mr. McRae states, yielded 50 oz. silver and 16 dwt. gold per ton, the treatment cost

being £1 per ton. Ten tons crushed at the Bairnsdale School of Mines yielded 30 oz. of silver and 4 dwt. 10 gr. of gold per ton. Besides native silver, iron pyrites, barite, and specular and micaceous hematite are present. The lode, over the half-mile it has been traced, strikes nearly east and west, and dips slightly southward. With better transport facilities provided, it is certain this and other, more or less parallel, lodes in the vicinity would receive attention.

Close by there is a compact 5-ft. lode-like barites formation, which has been opened up to a depth of between 3 feet and 6 feet and for a length of 30 feet. Most of the material broken from this open cut was carted to and stacked on the Gelantipy-road. Several tons from the stack were sent to Melbourne. The returns, it would seem, were not profitable, for the remainder was spread as road metal. The vein is of good even quality, flesh-pink in colour, for a width of 1 ft. 6 in. on the northern wall. On the southern side it is stained with dendritic manganese markings, which may be superficial only. There are other smaller deposits of better colour in the vicinity and further afield—notably on Mr. Hunter's property, west of the Gelantipy Hotel; at Canni Creek, South Buchan; and at Mount Tara; but, even now that there is an increased demand for it at £4 per ton, it is doubtful whether they can be profitably handled.

BUCHAN.

About 4 miles east-south-easterly from Buchan, on the southern side of Back Creek, 1 mile from the Snowy River, is the Back Creek silver-lead mine, the history of which is contained in several departmental publications. Recently a rabbit-trapper uncovered, in limestone, the gossan cap of what appears to be the continuation of the old vein, a few chains south-east from the old workings; 8 tons from this were sent to Melbourne for treatment. Mr. Mackieson, who kindly conducted me to the locality, informed me that the return from 8 tons from here were treated in Melbourne, and showed a profit of about a shilling a ton.

Like the Back Creek vein, which was small—3 in. to 12 in. wide—the recent find appears to be very irregular, and, so far as opened up, does not present a very inviting appearance. In portions from which the sulphides have not been entirely leached there are bunches of fair quality galena, which would probably be found in greater quantity at a depth where oxidation has not played so great a part; but the inspecting officer who recently reported on an application for Government assistance was not impressed with the prospects of the vein becoming payable with depth.

BUCHAN PROSPECTING SYNDICATE.

The lode being worked by this syndicate is about 5 miles south-east of Buchan; it was originally known as the Tara Crown, and yielded a few good gold returns and a quantity of silver-lead ore before it was abandoned at 36 feet below the surface. After lying untouched for some years the ground was secured by Mr. Gunn, of Warragul, the Buchan Prospecting Syndicate formed to work the deeper ground as a silver-lead proposition, and operations commenced by driving southward a tunnel, which, when the reef was reached, would give between 90 and 100 feet of backs. Before cutting the reef in the tunnel an important fault, striking south-westerly, was met, the crushed country (porphyry) for 10 feet beyond which is rather heavily impregnated

with green copper carbonate. The tunnel was extended to 325 feet from the mouth, passing through, without it being recognised as such, the lode at 249 feet.

A survey by Mr. Rae, battery manager, indicated that the lode, if it existed at the depth, should have been seen at 250 feet. An examination of the country at this spot discovered the lode-track, but no trace of galena. That notwithstanding, it was decided to open out on the eastern side of the cross-cut. Following the first firing, gold was seen, and a small crushing, broken from lode matter 10 feet wide, yielded 30 dwt. of gold to the ton, a return which induced the syndicate to erect a ten-head battery on the creek bank, a couple of hundred feet below. This is automatically fed by trucks travelling an inclined double tramway. Since opening out from the tunnel, levels have been driven 70 feet east and 60 feet west. At about 45 feet along the latter the copper-bearing fault previously mentioned was intersected, and beyond it the lode has not been recovered. Prospects, it is said, were particularly encouraging at the line of dislocation of the lode, where a kaolin seam, about 3 inches wide, was intersected. This, which extended only the height and width of the level, contained coarse gold. Assuming the lode to have been heaved northward, a short cross-cut was driven in that direction, passing through some copper carbonate strings, but no lode track. Nothing further has been done west of the tunnel. Over the east level the lode has been taken out one stope high for a length of 40 feet; a rise which connects with an old shaft from the surface, 90 feet above, was put up at 22 feet from the tunnel, and a winze at 45 feet, sunk 35 feet, down which, at 20 feet below, the level men are now working in what is considered payable dirt.

In all about 400 tons of ore have been crushed with just about payable results, the gold being worth little more than £3 per oz. Mr. Rae, becoming suspicious of his gold recovery, took, at regular intervals, extending over a period sufficiently long to give a fair indication of average loss, samples of slimes, and forwarded a quantity to the Bairnsdale School of Mines for assay. The loss of gold was determined as 2 dwt., and of silver 4 oz. per ton of ore crushed, the recovery of which would assure a substantial profit over working expenses. One of the causes of the poor recovery is obviously the clayey condition of the water supply, which is drawn from a dam that has not been replenished for six months, rain not having fallen in the locality during that period. With an average rainfall, conditions would improve, but even with a plentiful supply of clear water it would still be necessary, for high extraction, to install one or two concentrating tables.

The lode matter consists of quartz and decomposed porphyry, 2 feet to 10 feet wide, through which is disseminated iron and copper pyrites, carbonate of lead and argentiferous galena. The decomposition is greatest in the vicinity of flat blue pug floors, dipping west, and it is about these that the best ore is found. The gossany material overlying one of these is now being worked from the winze. The same floor shows near the face of the east level, which should be extended beyond the horse of mullock which here fills most of the space between the walls. Further, another attempt should be made to recover the lode beyond the fault in the west level. A plan and inspection of the workings convey the impression that the lost portion might be found by cross-cutting south at a point opposite the branch north cross-cut, which was driven with the same object in view.

It would appear that little of value exists above the levels, and that, therefore, the future of the mine must depend on the extension of the levels and the sinking of winzes. Success on the part of this syndicate would attract attention to other outcrops close handy. One, parallel to that being worked, should be cut at 100 feet below the surface by extending the tunnel a few feet. What is probably the western extension of the main lode has been opened up about 30 chains distant, and at some depth below the tunnel level, from a branch gully running into the creek on which the battery is built. The lode here is more highly mineralized, and more compact in structure, than where exposed in the tunnel workings, conditions which, perhaps, augur well for the permanency of the lodes in the locality. From these workings, Mr. Gunn informs me, a party of men, after constructing a short race to the spot, made wages for some weeks by sluicing material overlying the cap stone.

North-east from the syndicate's property, Parker and party hold two leases, known as the Gwennie May and Hit or Miss. On the former they have driven, at a level, deeper by about 100 feet than the syndicate's workings, a tunnel 56 feet towards the lode, which it is estimated should be intersected by an additional 100 feet of driving. Work is suspended here pending official consideration of an application for Government assistance. Still further afield—about 2 miles—is the Orbest tunnel, a satisfactory yield from picked stone from which was reported last week.

The work done in this belt—Mount Tara to Mount Deddick—has, on the whole, proved disappointing. Rich patches of auriferous quartz and silver-lead ore have been unearthed at intervals in shallow ground, but nothing in the nature of an ore-shoot, such as is common to the older fields, has yet been discovered. Outside the picturesque Buchan township settlement is scattered and scanty. Few of the residents are directly interested in mining, fewer still possessed of practical mining knowledge. Outsiders find the country, away from the limestone areas, rugged and uninviting, and up to date have not seen fit (or sufficient inducement) to persevere in following a lode below water-level. Consequently prospecting is spasmodic, the metalliferous belt at present being practically neglected. It would seem, however, that the recent advance in the price of silver and lead may bring about something of a revival, and that Deddick, disappointing as it has proved, may shortly be the scene of some activity. Further prospecting of the lodes there must surely lead to the discovery of other pockets of ore, which, though they might not have paid to break twenty years ago, may now, with the changed conditions—higher value at one end and reduced railway charges at the other—yield a fair profit to the miner.

[10.10.17.]

PETROLOGICAL REPORTS.

By E. W. Skeats, D.Sc.

Epidiorite from Ceres, near Geelong. Slice Nos. 1843-1844.

Specimen No. 1843.—The rock is dark in colour, of medium coarse texture, and has a specific gravity of 2.93.

One face has been polished. It takes a fair polish, but is not quite uniform owing to variations in hardness of the constituent minerals.

Microscopic Characters.—The rock originally consisted of crystals of augite and plagioclase felspar.

It has been almost completely re-crystallized owing to stresses induced by dynamic metamorphism, but does not show foliation. It now consists of the following minerals:—Partially altered plagioclase showing remains of lamellar twinning and plagioclase completely altered and re-crystallized to a granular aggregate of albite felspar and zoisite. The augite in places remains partially unchanged, but for the most part is re-crystallized as platy and fibrous masses of secondary hornblende (actinolite and tremolite) and chlorite. The original texture of the rock was probably medium grained, and it was probably a *diabase* or *dolerite*. In its present metamorphic condition it is perhaps best described as an *Epidiorite*.

It would make a fairly handsome ornamental stone, but its great hardness and toughness make it expensive to work and difficult to polish.

Specimen No. 1844.—The rock is similar to Specimen No. 1843, but is rather coarser in texture. Its specific gravity is 2.96. It takes a similar polish to Specimen No. 1843.

Microscopic Characters.—The original content was probably as in No. 1843—augite and plagioclase. Complete re-crystallization under metamorphism has produced the same minerals as in No. 1843, namely: clear secondary albite, original plagioclase altered to albite and zoisite, actinolite and tremolite have developed from the alteration of augite. No foliation has been produced. The rock is now considerably coarser-grained than No. 1843. This may have been an original feature, and if so, the rock was probably a *gabbro* originally, and its higher specific gravity would tend to support this conclusion.

As, however, the present minerals are practically all secondary, the coarse texture may also be secondary, and the rock may also have been originally a *diabase* or *dolerite*. In its present condition the rock may be described as an *Epidiorite*. As an ornamental stone it would be expensive to work and difficult to polish.

Orthoclase with Albite inter-growths, Stawell. Slice No. 1845.

Specimen No. 1845.—The specimen is flesh-coloured to orange in tint. Its specific gravity is 2.54.

Microscopic Characters.—In thin section the specimen is seen to consist of a large crystal of felspar. It is seen to consist of a parallel or sub-parallel inter-growth of two species. Thin somewhat irregular streaks are somewhat altered, have a higher refractive index and rather higher polarization colours (white) than the bulk of the specimen. These layers are probably inclusions of albite—the soda felspar. The bulk of the section consists of a felspar with very low polarization colours (neutral tints) and with no evidence of twinning. The specimen consists probably of orthoclase, the potash felspar, with inter-growths of albite, the soda felspar. The colour of the specimen indicates a very slight admixture with iron oxide, probably not sufficient in amount to impair its usefulness as a glaze for pottery, for which purpose it is presumed the specimen is submitted.

Olivine Dolerite from Fish Creek, South Gippsland. No. 1842.

Specimen No. 1842.—The rock, which was collected by the Director of Geological Survey from a proposed quarry site, is dark-grey in colour, fairly coarse-grained, of even texture except for a few vesicular cavities. Its specific gravity is 2.91. A cubic foot solid of the stone would, therefore, weigh about 174½ pounds—a rather higher value than that of average Victorian basalts, or “bluestones.”

The minerals which can be identified in the hand specimen are felspar, augite, and olivine.

Microscopic Examination.—The rock has a relatively coarse-grained texture. The darker minerals consist of crystals of augite, olivine, and magnetite. Two colourless minerals are present. The most abundant consist of elongated or lath-shaped crystals, showing the lamellar twinning and rather high extinction angle characteristic of labradorite felspar. A small quantity of another colourless mineral, the last to crystallize, occurs, filling up the interstices between the felspars. It has a lower refractive index than the felspar, and is isotropic. I have not been able to identify it with certainty, but it may be analcite, or a cubical form of the feldspathoid group.

The coloured minerals consist of olivine, somewhat altered to serpentine along cracks, of brown to violet titaniferous augite, and an opaque iron ore which is either magnetite or ilmenite.

The rock is moderately coarse-grained, and may be described as an *olivine-dolerite*.

Its rather coarse texture suggests that it may come from an intrusive mass such as a volcanic plug, but it might also occur as the middle part of a thick lava flow. Only the mode of occurrence of the rock in the field could, if the evidence is available, definitely decide between these two alternatives.

[1.11.16.]

Olivine Basalt from Leongatha. No. 1872.

Specimen No. 1872.—The rock is basaltic in appearance, and of moderately coarse grain.

Texture.—The rock has a moderately coarse grain. The felspars are inter-grown with and partly wrapped round by augite. Olivine crystals are prominent.

Minerals Present in Order of Abundance.—Plagioclase felspar probably an acid labradorite, showing prominent lamellar twinning, and lath-shaped character.

Olivine, in clear, colourless crystals, with some alteration to serpentine along cracks.

Brown to violet augite, probably titaniferous, in irregular shaped crystals.

Magnetite or ilmenite. A few black, elongated crystals.

Through the rock are scattered some colourless patches, in which pale chlorite occurs, but which consist mainly of interlocking crystals of low refractive index and very low polarization colours. These are possibly zeolites.

The rock may be described as a medium-grained *olivine basalt*.

[17.1.18.]

REPORT OF AN EXAMINATION OF MATERIAL OBTAINED FROM A BORE AT TORQUAY.¹

By Frederick Chapman, A.L.S., F.R.M.S., &c., Palæontologist, the National Museum, Melbourne, Hon. Palæontologist to the Geological Survey.

INTRODUCTORY NOTE.

Early in the year 1912, whilst working out the relationship of the Victorian Tertiary strata, the writer suggested that a short boring be put down in the neighbourhood of Bird Rock, Torquay, for the purpose of testing the downward succession at that locality. This suggestion was adopted by Mr. E. J. Dunn, then Director of the Geological Survey of Victoria, and carried out between 6th and 12th March, 1912. A boring was made which passed through 70 feet of strata. The actual boring was performed by means of augers and chisels, and this being so, the samples obviously contained no very large shells, except in fragments. However, many smaller fossils remained intact, and have afforded some valuable information as to the exact group of rocks to which they belong. A diary of this bore can be found in the Annual Report of the Victorian Department of Mines for 1912, p. 51.

SITE.

The spot chosen was about the middle of the anticline at Bird Rock, and as near to high-water mark as was convenient for working. This choice was made in order to get the deepest vertical range possible in the bore. The bore-hole is at present sealed up and is available for re-opening at any time if required.

GENERAL SUCCESSION OF STRATA.

Top of bore in blue shelly marl.

						feet.	inches.
Blue marl	..	..	..	..	..	23	3
Sandstone	..	..	..	..	..	0	7
Dark-green sandy marl	..	..	..	..	..	3	2
Greensand	..	..	..	..	..	4	0
Dark-grey sandy marl	..	..	..	..	..	5	0
Blue, grey and brown marl	..	..	..	..	..	14	0
Brown sandy marls	..	..	..	..	..	20	0
Total	..	..	..	..	..	70	0

EXAMINATION OF SAMPLES.

Owing to pressure of other work the writer has been unable to furnish a report on these samples earlier.

The samples were marked off at intervals of about 12 inches or sometimes less. As it is only requisite to obtain a general review of the fossiliferous contents, with results bearing on the determination of the exact horizon or age of the deposits bored into, it was judged sufficient that samples for microscopic and megascopic study might be taken at intervals of 6 or 8 feet, or where there was a striking lithological break, as the case happened.

The samples selected with the above in view were taken from the following depths:—

ft.	in.	ft.	in.	ft.	in.	ft.	in.
5	9 to	6	6	42	0 to	43	0
13	3 to	14	3	49	0 to	50	0
24	0 to	25	0	53	0 to	55	0
27	0 to	28	0	58	0 to	59	0
34	0 to	35	0	64	0 to	65	0
37	0 to	38	0	69	0 to	70	0

DETAILED RESULTS OF MATERIAL FROM BORING AT TORQUAY.

5 ft. 9 in. to 6 ft. 6 in. from the surface.

Lithological Details.—Pale greenish grey when moist. A fine-grained sandy marl; highly calcareous. It consists of fine terrigenous material, mainly quartz, with a few scattered grains of zircon, numerous shell-fragments and calcareous sponge-spicules.

Fossils.—

Foraminifera.—*Miliolina agglutinans*, d'Orb. sp.; *M. auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. seminulum*, Linné sp.; *Clavulina angularis*, d'Orb.; *Cassidulina oblonga*, Reuss; *C. subglobosa*, Brady; *Truncatulina ungeriana*, d'Orb. sp.; *T. wuellerstorfi*, Schw. sp.; *Rotalia calcar*, Linné sp.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Polyzoa.—*Cellaria acutimarginata*, MacGill. sp.; *C. australis*, MacGill.; *C. rigida*, MacGill. var. *perampla*, Waters.

Pelecypoda.—Fragments, indet.

Ostracoda.—(?) *Bairdia australis*, Chapm.; *Cytherella pulchra*, G.S.B.

13 feet 3 inches to 14 feet 3 inches from the surface.

Lithological Details.—Dark ashen grey when moist. A fine-grained sandy marl. Fine terrigenous material with abundant sponge-spicules and shell fragments. Zircons numerous.

Fossils.—

Foraminifera.—*Spiroloculina torquayensis*, sp. nov.; *Miliolina agglutinans*, d'Orb. sp.; *M. auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *Sigmoilina sigmoidea*, Brady sp.; *Cornuspira crassisepta*, Brady; *Textularia gibbosa*, d'Orb.; *Gaudryina rugosa*, d'Orb.; *Clavulina textularioidea*, Goës; *Nodosaria* (D.) *obliqua*, L. sp.; *Polymorphina communis*, d'Orb.; *P. elegantissima*, P. and J.; *Sphæroidina bulloides*, d'Orb.; *Truncatulina reticulata*, Czjzek sp.; *T. ungeriana*, d'Orb. sp.; *Anomalina ammonoides*, Reuss sp.; *Nonionina depressula*, W. and J. sp.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Polyzoa.—*Cellaria acutimarginata*, MacGill. sp.; *C. rigida*, var. *ampla* Waters; *Lekythopora hystrix*, MacGill.

Pelecypoda.—Fragments, indet.

Ostracoda.—*Cythere scutigera*, G.S.B.

24 feet to 25 feet from the surface.

Lithological Details.—A pale-green sandy marl. A terrigenous deposit with few sponge-spicules, foraminifera and shell-fragments. The washings reveal numerous glauconite grains, mainly casts of foraminiferal shells.

Fossils.—

Foraminifera.—*Biloculina bulloides*, d'Orb.; *Miliolina agglutinans*, d'Orb. sp.; *M. auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. vulgaris*, d'Orb. sp.; *Sigmoilina sigmoidea*, Brady sp.; *Cornuspira striolata*, Brady; *Textularia gibbosa*, d'Orb.; *Gaudryina rugosa*, d'Orb.; *Clavulina angularis*, d'Orb.; *C. rudis*, Costa sp.; *Nodosaria* (D.) *costulata*, Reuss; *Polymorphina elegantissima*, P. and J.; *Sphæroidina bulloides*, d'Orb.; *Carpenteria proteiformis*, Goës; *Anomalina ammonoides*, Reuss sp.; *Truncatulina haidingeri*, d'Orb. sp.; *Pulvinulina repanda*, F. and M. sp., var. *concamerata*, Mont.; *Nonionina depressula*, W. and J. sp.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Annelida.—*Serpula* sp.

Polyzoa.—*Cellaria acutimarginata*, MacGill. sp.; *C. angustiloba*, Busk sp.; *C. australis*, MacGill.; *C. rigida*, var. *venusta*, MacGill.; *Selenaria marginata*, var. *lucens*, MacGill.; *Schizoporella phymatopora*, Reuss.

Pelecypoda.—Fragments, indet.

Scaphopoda.—*Dentalium mantelli*, Zittel.

Gasteropoda.—*Turritella tristira*, Tate; *Cerithiopsis* sp. near *angasi*, Semper.

27 feet to 28 feet from the surface.

Lithological Details.—A sandy marl of a dark-green colour; the residue after washing is a shelly sand with much glauconite (abundant casts of foraminifera). This sample gives a medium strong phosphatic reaction.

Fossils.—

Foraminifera.—*Miliolina agglutinans*, d'Orb. sp.; *M. auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. vulgaris*, d'Orb. sp.; *Cornuspira striolata*, Brady; *Gaudryina pupoides*, d'Orb.; *G. rugosa*, d'Orb.; *Clavulina communis*, d'Orb.; *Nodosaria* (D.) *costulata*, Reuss; *Polymorphina communis*, d'Orb.; *P. elegantissima*, P. and J.; *P. gibba*, d'Orb.; *P. problema*, d'Orb.; *Spirulina limbata*, Brady; *Truncatulina ungeriana*, d'Orb. sp.; *Pulvinulina repanda*, F. and M. sp., var. *concamerata*, Mont.; *Rotalia papillosa*, var. *compressiuscula*, Brady; *R. soldanii*, d'Orb.

Polyzoa.—*Selenaria cupola*, T. Woods sp.; *S. marginata*, var. *lucens*, MacGill.

Pelecypoda.—Fragments, indet.

Gasteropoda.—*Turritella tristira*, Tate.

34 feet to 35 feet from the surface.

Lithological Details.—A pale-green sandy marl. A fine terrigenous deposit with much shelly matter and sponge-spicules.

Fossils.—

Foraminifera.—*Miliolina agglutinans*, d'Orb. sp.; *M. auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. vulgaris*, d'Orb. sp.; *Textularia gibbosa*, d'Orb.; *Cassidulina oblonga*, Reuss; *C. subglobosa*, Brady; *Nodosaria* (D.) *obliqua*, L. sp.; *Polymorphina oblonga*, d'Orb.; *Truncatulina haidingeri*, d'Orb. sp.; *T. ungeriana*, d'Orb. sp.; *Pulvinulina repanda*, F. and M. sp., var. *concamerata*, Mont.; *P. truncatulinoides*, d'Orb. sp.; *Rotalia calcar*, d'Orb.; *R. papillosa*, var. *compressiuscula*, Brady; *R. soldanii*, d'Orb.; *Nonionina umbilicatulina*, Mont. sp.

Spongiæ.—*Plectoninia halli*, Hinde (spicules).

Polyzoa.—*Cellaria australis*, MacGill.; *Selenaria concinna*, T. Woods; *S. cupola*, T. Woods sp.; *S. marginata*, var. *lucens*, MacGill.

Pelecypoda.—Fragments, indet.

Gasteropoda.—*Turritella acricula*, Tate; *T. tristira*, Tate.

37 feet to 38 feet from the surface.

Lithological Details.—A dark-brown shelly marl with sponge-spicules and quartz grains.

Fossils.—

Foraminifera.—*Miliolina auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. vulgaris*, d'Orb. sp.; *Textularia gibbosa*, d'Orb.; *Cassidulina subglobosa*, Brady; *Nodosaria comata*, Batsch sp.; *N. (D.) obliqua*, L. sp.; *Polymorphina elegantissima*, P. and J.; *Rotalia papillosa*, var. *compressiuscula*, Brady.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Anthozoa.—*Bathyactis* sp. (juv.); *Mopsea hamiltonensis*, Thomson sp.

Polyzoa.—*Selenaria cupola*, T. Woods sp.; *S. marginata*, var. *lucens*, MacGill.; *Micropora* sp.

Pelecypoda.—Fragments, indet.

Gasteropoda.—*Turritella tristira*, Tate; *Volvulella inflator*, Cossmann.

42 feet to 43 feet from the surface.

Lithological Details.—A pale-brown sandy marl with sponge-spicules, quartz grains and foraminifera. The organisms are rolled and broken.

Fossils.—

Foraminifera.—*Miliolina auberiana*, d'Orb. sp.; *Cornuspira crassisepta*, Brady; *Polymorphina elegantissima*, P. and J.; *Rotalia papillosa*, var. *compressiuscula*, Brady.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Polyzoa.—*Selenaria marginata*, T. Woods.

Pelecypoda.—Fragments, indet.

Gasteropoda.—*Turritella tristira*, Tate; *T. gemmulata*, Tate; *Margarella kitsoni*, sp. nov.

49 feet to 50 feet from the surface.

Lithological Details.—A light-brown gritty marl. Sponge-spicules and quartz grains abundant. Some glauconite grains, ossicles of *Antedon*, ostracoda, foraminifera and echinoid spines.

Fossils.—

Foraminifera.—*Miliolina auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. ferussacii*, d'Orb. sp.; *M. vulgaris*, d'Orb. sp.; *Cornuspira striolata*, Brady; *Cassidulina subglobosa*, Brady; *Nodosaria (D.) obliqua*, L. sp.; *Polymorphina elegantissima*, P. and J.; *Sphæroidina bulloides*, d'Orb.; *Pulvinulina elegans*, d'Orb. sp.; *Rotalia papillosa*, var. *compressiuscula*, Brady.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Polyzoa.—*Cellaria rigida*, var. *perampla*, Waters, and var. *venusta*, MacGill.; *Lunulites parvicella*, T. Woods, sp.; *Selenaria marginata*, var. *lucens*, MacGill.

Echinodermata.—Echinoid plates and spines, indet.; *Antedon* sp. (ossicles).

Pelecypoda.—*Venus (Chione) halli*, Pritchard sp.

Gasteropoda.—*Turritella tristira*, Tate; *T. gemmulata*, Tate; *Voluta* sp. (juv.)

53 feet to 54 feet from the surface.

Lithological Details.—A light-brown marl with streaks of glauconitic sand.

Fossils.—

Foraminifera.—*Biloculina depressa*, d'Orb.; *B. irregularis*, d'Orb.; *Miliolina auberiana*, d'Orb. sp.; *M. cuvieriana*, d'Orb. sp.; *M. vulgaris*, d'Orb. sp.; *Textularia brevis*, d'Orb.; *Spiroplecta sagittula*, DeFr. sp.; *Bulimina elegantissima*, d'Orb.; *Cassidulina subglobosa*, Brady; *Nodosaria (D.) obliqua*, L. sp.; *Polymorphina elegantissima*, P. and J.; *Anomalina ammonoides*, Reuss sp.; *Rotalia papillosa*, var. *compressiuscula*, Brady; *R. soldanii*, d'Orb.

Anthozoa.—*Trematotrochus fenestratus*, T. Woods sp.

Echinodermata.—Echinoid spines, indet.

Polyzoa.—*Cellaria australis*, MacGill.; *Selenaria marginata*, var. *lucens*, MacGill.; *Porina gracilis*, M. Edw. sp.

Pelecypoda.—Fragments, indet.

Gasteropoda.—*Turritella gemmulata*, Tate ; *T. tristira*, Tate ; *Natica polita*, T. Woods.

58 feet to 59 feet from the surface.

Lithological Details.—A pale-brown gritty marl with sponge-spicules and well-preserved foraminifera.

Fossils.—

Foraminifera.—*Spiroloculina grata*, Terquem ; *Miliolina cuvieriana*, d'Orb. sp. ; *M. rupertiana*, Brady ; *M. vulgaris*, d'Orb. sp. ; *Sigmoilina sigmoidea*, Brady sp. ; *Cornuspira crassisepta*, Brady ; *C. involvens*, Reuss sp. ; *Textularia gibbosa*, d'Orb. ; *Nodosaria scalaris*, Batsch sp., var. *separans*, Brady ; *N. (D.) obliqua*, L. sp. ; *Cristellaria articulata*, Reuss ; *Polymorphina elegantissima*, P. and J. ; *P. oblonga*, d'Orb. ; *Truncatulina ungeriana*, d'Orb. sp. ; *Rotalia papillosa*, var. *compressiuscula*, Brady ; *R. soldanii*, d'Orb.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Polyzoa.—*Selenaria cupola*, T. Woods sp.

Pelecypoda.—*Glycimeris maccoyi*, Johnst. sp.

Scaphopoda.—*Dentalium aratum*, Tate.

Gasteropoda.—*Natica polita*, T. Woods ; *Turritella gemmulata*, Tate ; *T. tristira*, Tate ; *Murex trochospira*, Tate.

Ostracoda.—*Cytherella pulchra*, G. S. Brady.

64 feet to 65 feet from the surface.

Lithological Details.—A pale-grey sandy marl with sponge-spicules and shell fragments. Foraminifera numerous and well preserved ; also echinoid spines and plates.

Fossils.—

Foraminifera.—*Miliolina agglutinans*, d'Orb. sp. ; *M. auberiana*, d'Orb. sp. ; *M. cuvieriana*, d'Orb. sp. ; *M. vulgaris*, d'Orb. sp. ; *Textularia brevis*, d'Orb. ; *Clavulina angularis*, d'Orb. ; *C. rudis*, Costa sp. ; *Bulimina contraria*, Rss. sp. ; *Polymorphina elegantissima*, P. and J. ; *Sphæroidina bulloides*, d'Orb. ; *Discorbina valvulata*, d'Orb. sp. ; *Truncatulina ungeriana*, d'Orb. sp. ; *Anomalina ammonoides*, Rss. sp. ; *Pulvinulina repanda*, F. and M. sp., var. *concamerata*, Mont.

Anthozoa.—*Trematotrochus fenestratus*, T. Woods sp.

Echinodermata.—Echinoid spines and plates, indet.

Polyzoa.—*Cellaria acutimarginata*, MacGill sp. ; *C. australis*, MacGill. ; *C. rigida*, var. *venusta*, MacGill. ; *Selenaria marginata*, var. *lucens*, MacGill.

Pelecypoda.—*Glycimeris maccoyi*, Johnst. sp. ; *Dimya* sp.

Scaphopoda.—*Dentalium mantelli*, Zittel.

Gasteropoda.—*Turritella tristira*, Tate ; *Mangilia sandleroides*, T. Woods sp. ; *Ringuicula tenuilirata*, Cossmann.

Ostracoda.—*Cytherella pulchra*, G.S.B.

Pisces.—Otoliths of teleosteans.

69 feet to 70 feet from the surface.

Lithological Details.—A fine gritty marl, fawn-coloured, with sponge-spicules and quartz sand.

Fossils.—

Foraminifera.—*Miliolina auberiana*, d'Orb. sp. ; *M. cuvieriana*, d'Orb. sp. ; *M. vulgaris*, d'Orb. sp. ; *Haplophragmium sphæroidiniforme*,

Brady; *Textularia brevis*, d'Orb.; *Cassidulina subglobosa*, Brady; *Marginulina costata*, Batsch sp.; *Truncatulina ungeriana*, d'Orb. sp.; *Anomalina ammonoides*, Reuss sp.; *Rotalia papillosa*, var. *compressiuscula*, Brady.

Spongiæ.—*Plectroninia halli*, Hinde (spicules).

Polyzoa.—*Cellaria rigida*, var. *venusta*, MacGill.

Pisces.—Otoliths of teleosteans.

NOTES ON NEW AND INTERESTING SPECIES.

Order—FORAMINIFERA.

GENUS—*Spiroloculina*, d'Orbigny.

SPIROLOCULINA TORQUAYENSIS, sp. nov. Pl. LI., figs. 1, 2.

Description.—Test resembling an attenuated form of *Spiroloculina canaliculata*, d'Orb., having sulcated facial surfaces and square but concave edges. The shell surface is finely striated throughout.

Dimensions.—Length of holotype, 2.2 mm.; greatest width, .65 mm.

Occurrence.—Two examples found, at 13 ft. 3 in. to 14 ft. 3 in. from the surface.

GENUS—*Miliolina*, Williamson.

MILIOLINA RUPERTIANA, Brady.

Miliolina rupertiana, Brady, 1884, Rep. Chall., vol. IX., p. 178, pl. VII., figs. 7-12.

Observations.—It is interesting to note this species as a fossil, for I do not remember its occurrence other than as a recent form. It is found living in tropical or sub-tropical areas at present, and generally associated with coral sand. The localities noted are the southern shores of Papua, west of Torres Strait; the north-west coast of Ceylon; the Gulf of Suez; and from the east coast of Madagascar. All of these are in quite shallow water (2-28 fathoms).

Occurrence.—Three examples found, at 58 feet to 59 feet from the surface.

GENUS—*Carpenteria*, Gray.

CARPENTERIA PROTEIFORMIS, Goës, var. *pecte*, var. nov. Pl. LI., fig. 3.

Description.—This variety is much more abundant in the Victorian older Tertiary (Balcombian and Janjukian) than the type species. It is distinguished by the great development of the earlier series of chambers, plaited together and forming almost a rotaline coil, hence the varietal name. The surface ornament is generally more verrucose than in the specific form.

In the living condition the species *C. proteiformis*¹ has been found only in tropical waters, as in the West Indies, Admiralty Islands and Torres Strait.

Occurrence.—Found at a depth of 24 feet to 25 feet from the surface.

Class—SPONGIÆ.

CALCISPONGIÆ.

GENUS—*Plectroninia*, Hinde.

Plectroninia halli, Hinde.

Plectroninia halli, Hinde, 1900, Quart. Journ. Geol. Soc., vol. LVI., p. 51, pl. III., figs. 1-83; pl. IV. figs. 1-11.

Observations.—The fine washings are usually crowded with these little calcareous spicules. They are generally the tri-radiate flesh-spicules, with occasionally a styliform rod. This species is not uncommon in the Janjukian, the sponge-bodies occurring in the Lower Moorabool Valley and at Flinders. It is also sparingly found in the Balcombian at Mornington.

¹ See Rep. Chall. vol. IX. 1884, p. 679, pl. XCVII. figs. 8-14.

Class—GASTEROPODA.

GENUS—**Turritella**, Lamarck.

TURRITELLA GEMMULATA, Tate.

Turritella gemmulata, Tate. Trans. R. Soc. S. Austr., vol. XVII. 1893, p. 338, pl. VIII., fig. 11.

Observations.—Tate records this species from Muddy Creek and Torquay; whilst Dennant and Kitson list it from the Aire Coast, Fishing Point, and Maude, in addition to those localities.

GENUS—**Marginella**, Lamarck.

MARGINELLA KITSONI, sp. nov. Pl. LI., fig. 4.

Description.—Shell small, subovate, with rounded and gently graded shoulder. Spire low, with three whorls. Body whorl full, shining, marked with inequidistant varices and striæ. Inner columella with four plaits. Outer lip moderately thin with nearly obsolete denticles. In form like a short variety of *Marginella woodsi*, Tate.

Dimensions.—Length, 3 mm.; greatest breadth, 2·5 mm.

Observations.—This species is well represented in the Dennant collection in the National Museum, and was named in MS. as above. The localities from which Mr. Dennant's specimens came are Guerard's Hill, Cape Otway, Shelford, Fishing Point, Picnic Point (Janjukian); and Muddy Creek, older beds (Balcombian).

Relationship.—The recent species, *Marginella shorehami*, Pritch. and Gatl.¹ resembles the present in many particulars, though not so broad in the body whorl, whilst the plaits are more numerous, seven in the recent form as compared with four in the fossil.

The recent Victorian species, *M. turbinata*, Sowerby², has also some points of resemblance. It is, however, a much larger shell, is more conical, depressed on the sides, having a higher spire, and varices on the shoulder, and with the fourth columellar plait widely spaced from the three anterior.

Occurrence.—Two specimens, 42 feet to 43 feet from the surface.

GENUS—**Mangilia**, Risso.

MANGILIA SANDLEROIDES, T. Woods sp.

Pleurotoma sandleroides, T. Woods, 1876, Rep. Roy. Soc., Tas., for 1875, p. 104.

Observations.—This species was originally described from the Tertiary (Janjukian) of Table Cape. It is related, as stated by Tenison Woods, to *Pleurotoma sandleri*, Partsch, a Vienna Basin fossil of Miocene age. Tenison Woods, in describing the above species, refers to its relationship with the "Australian Mangelias, with which it would probably be associated by many naturalists." The above species may eventually prove to belong to Hedley's genus, *Guraleus*, the type of which is *Mangilia pictus*, Ad. and Ang.

Occurrence.—64 to feet 65 feet from the surface.

GENUS—**Volvula**, Adams.

Volvula inflator, Cossmann sp.

Volvulella inflator, Cossmann, 1897, Trans. R. Soc., S. Austr., vol. XXI., p. 9, pl. I., figs. 24, 25.

Observations.—The original locality of this fossil is Table Cape, Tasmania, and Dennant and Kitson add Torquay, the beds at Bird Rock being of similar age. It is thus a restricted Janjukian fossil.

Occurrence.—One specimen, 37 feet to 38 feet from the surface.

¹ Proc. R. Soc. Vict., vol. XI. N.S. pt. I. 1898, p. 179, pl. XX. fig. 2.

² Sowerby, Thes. Conch., vol. I. 1846, p. 385, pl. LXXV. fig. 70. Tryon, Man. Conch. vol. V. 1883, p. 23, pl. VII. fig. 4. Pritchard and Gatliff, Proc. R. Soc. Vict., vol. XI. N.S. pt. I. 1898, p. 191.

Class—CRUSTACEA.

Super-order—Ostracoda.

GENUS—**Cythere**, Muller.

CYTHERE SCUTIGERA, G. S. Brady, Pl. LI., fig. 5.

Cythere scutigera, G. S. Brady, 1880, Rep. Chall. Zool., vol. I., pt. III., p. 109, pl. XXII., figs. 5a-f. Chapman, 1914, Proc. R. Soc., Vict., vol. XXVII. N.S., pt. I., p. 41, pl. VIII., fig. 27.

Observations.—The fossil specimens referred to the above species, whilst agreeing in the essential characters of the carapace, are not so strongly aculeate as in the living examples. The fossils are finely and sparsely prickly, this feature applying to the anterior border as with the rest of the shell surface. The outlines in edge view in both cases are similarly tumid.

The present example is undoubtedly older even than that from the Mallee Bore, which came from the soft chalky polyzoal rock at 442 to 444 feet. The Torquay specimen occurs in the blue marl which there underlies the polyzoal rock.

Occurrence.—One example found at 13 ft. 3 in. to 14 ft. 3 in. from the surface.

LIST OF FOSSILS.

Foraminifera—

Bilocolina bulloides, d'Orbigny.

„ *depressa*, d'Orbigny.

„ *irregularis*, d'Orbigny.

Spiroloculina grata, Terquem.

„ *torquayensis*, sp. nov.

Miliolina agglutinans, d'Orb. sp.

„ *auberiana*, d'Orb. sp.

„ *curvieriana*, d'Orb. sp.

„ *ferussacii*, d'Orb. sp.

„ *rupertiana*, d'Orb. sp.

„ *seminulum*, Linné sp.

„ *vulgaris*, d'Orb. sp.

Sigmoilina sigmoidea, Brady sp.

Cornuspira crassisepta, Brady.

„ *striolata*, Brady.

Haplophragmium sphaeroidiniforme, Brady.

Textularia brevis, d'Orb.

„ *gibbosa*, d'Orb.

Gaudryina pupoides, d'Orb.

„ *rugosa*, d'Orb.

Spiroplecta sagittula, Defr. sp.

Clavulina angularis, d'Orb.

„ *rudis*, Costa sp.

„ *textularoidea*, Goës.

Bulimina contraria, Reuss sp.

„ *elegantissima*, d'Orb.

Cassidulina oblonga, Reuss.

„ *subglobosa*, Brady.

Nodosaria comata, Batsch sp.

„ *scalaris*, Batsch sp. var. *separans*, Brady.

„ (*Dentalina*) *costulata*, Reuss.

„ „ *obliqua*, L. sp.

Marginulina costata, Batsch sp.

Cristellaria articulata, Reuss.

- Polymorphina communis*, d'Orb.
 „ *elegantissima*, Parker and Jones.
 „ *gibba*, d'Orb.
 „ *problema*, d'Orb.
Sphæroidina bulloides, d'Orb.
Spirillina limbata, Brady.
Discorbina valvulata, d'Orb. sp.
Carpenteria proteiformis, Goës, var. *plecte*, var. nov.
Truncatulina haidingeri, d'Orb. sp.
 „ *reticulata*, Czjzek sp.
 „ *ungeriana*, d'Orb. sp.
 „ *ruellerstorfi*, Schwager sp.
Anomalina ammonoides, Reuss sp.
Pulvinulina elegans, d'Orb. sp.
 „ *repanda*, Fichtel and Moll sp., var. *concamerata*, Mont.
 „ *truncatulinoides*, d'Orb. sp.
Rotalia calcar, L. sp.
 „ *papillosa*, var. *compressiuscula*, Brady.
 „ *soldanii*, d'Orb.
Nonionina depressula, Walker and Jacob sp.
 „ *umbilicatula*, Montagu sp.
- Spongiæ—
Plectroninia halli, Hinde (spicules).
- Anthozoa—
Bathyactis sp. (juv.)
Trematotrochus fenestratus, T. Woods sp.
Mopsea hamiltonensis, Thomson sp.
- Echinoderma—
 Plates and spines, indet.
Antedon sp. (ossicles).
- Annelida—
Serpula sp.
- Polyzoa—
Cellaria acutimarginata, MacGill. sp.
 „ *angustiloba*, Busk sp.
 „ *australia*, MacGill.
 „ *rigida*, MacGill, var. *perampla*, Waters.
 „ „ var. *venusta*, MacGill.
Lunulites parvicella, T. Woods sp.
Selenaria concinna, T. Woods.
 „ *cupola*, T. Woods sp.
 „ *marginata*, T. W. var. *lucens*, MacGill.
Micropora sp.
Schizoporella phymatopora, Reuss.
Porina gracilis, M. Edwards sp.
Lekythopora hystrix, MacGill.
- Pelecypoda—
Dimya sp.
Glycimeris maccoyi, Johnst. sp.
Venus (Chione) halli, Pritch. sp.
- Scaphopoda—
Dentalium aratum, Tate.
 „ *mantelli*, Zittel.

Gasteropoda—

- Natica polita*, T. Woods.
Cerithiopsis aff. *angasi*, Semper.
Turritella acricula, Tate.
 „ *gemmulata*, Tate.
 „ *tristira*, Tate.
Murex tochospira, Tate.
Marginella kitsoni, sp. nov.
Voluta sp. (juv.)
Mangilia sandleroides, T. Woods sp.
Volvula inflator, Cossmann sp.
Ringuicula tenuilirata, Cossman.

Ostracoda—

- ? *Bairdia australis*, Chapman.
Cythere scutigera, G. S. Brady.
Cytherella pulchra, G. S. Brady.

Pisces—

- Otoliths of teleosts.

SUMMARY.

The foregoing results of an examination of the detailed structure and contents of the Torquay boring prove that down to 70 feet the strata are still in the Janjukian series.

The fact that green sands and marls with a Janjukian fauna prevail throughout, points to a downward extension of the lower beds of the Bird Rock Cliffs, at least to 70 feet below the level of the boring at the surface.

Judging by the sections in the Mallee bores and in South Australia, there should come below these green sandy marls a series of estuarine and brackish water beds, as are indeed found at Anglesea and elsewhere along the Otway coast.

Such restricted fossils as *Mopsea hamiltonensis*, *Venus (Chione) halli*, and *Volvula inflator*, point to the Janjukian age of these lower strata with certitude; whilst a numerous fauna, which, although not restricted, is more typical of Janjukian beds, is well represented in this series. Amongst the latter are: *Carpenteria proteiformis*, var. *plecte*, *Turritella gemmulata*, *Marginella kitsoni* and *Mangilia sandleroides*.

EXPLANATION OF PLATE LI.

- Fig. 1.—*Spiroloculina torquayensis*, sp. nov. Lateral aspect.
 „ 2.—*S. torquayensis*, sp. nov. Oblique edge view, showing channelled periphery.
 „ 3.—*Carpenteria proteiformis*, Goës, var. *plecte*, var. nov.
 „ 4.—*Marginella kitsoni*, sp. nov. Shell selected as holotype from the Dennant coll., Fishing Point, Cape Otway District. (Janjukian.)
 „ 5.—*Cythere scutigera*, G. S. Brady. Lateral aspect of left valve.
 All figures magnified 26 diameters.

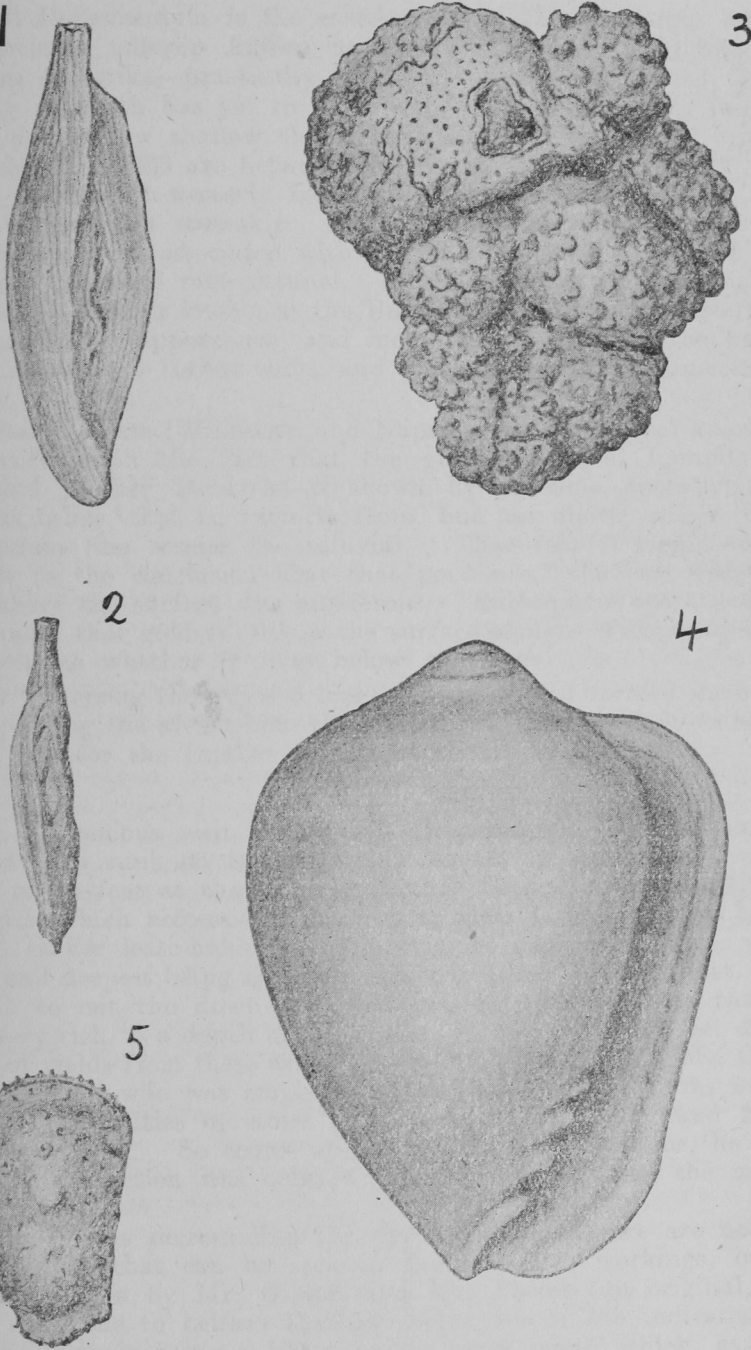


PLATE LI.

1, 2. *Spiroloculina torquayensis*, sp. nov. 3. *Carpenteria proteiformis*, Goës, var. plecte, var. nov. 4. *Marginella kitsoni*, sp. nov. 5. *Cythere scutigera*, G. S. Brady.