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GOVERNMENT GEOLOGIST

REPORT ON THE BELL MOUNT AND MIDDLESEX DISTRICT.

Government Geologist's Office,
Launceston, 17th June, 1907.

SIR,

I HAVE the honour to report that, in pursuance of instructions, I proceeded to this district on the 5th March, with the view of examining the deposits at present being proved or exploited by the mining companies of the field.

There are two routes of access to the district. The Mole Creek-road, *via* Liena and Lorinna, leads to the south end of the district over a distance of 20 miles to 25 miles. At present the field is more easily accessible *via* Sheffield and Wilmot. The coach takes the traveller from the Railton railway station to Sheffield, 8 miles; thence a mail-cart runs to Wilmot, 11 miles. A partly-made road is passable in fine weather by spring-cart or bullock teams from Wilmot to the Shepherd and Murphy Mine, 11 miles, or about 14 miles to the Bull Plain selections, after which the track is used by pack-horses for 5 miles to the Devon Mine on the Dove River.

Sheffield is on the high plain of Tertiary olivine basalt 900 feet above sea-level, with Mt. Roland to the south forming a rugged, picturesque mass, rising to 3100 feet above Sheffield. The run to the Forth Valley is through gently undulating country covered with the cultivated fields of thriving settlers. The chocolate soil, derived from the rapid waste of the basaltic lava sheet, is highly favourable for crops of oats and potatoes.

The older rocks are first seen on descending into the valley of the Forth. This river has carved out a deep gorge-channel down through the basalt capping into underlying sandstones, quartzite, and conglomerate of undetermined age. The bridge over the river here is about 200 feet above sea-level. The road then rises 600 feet to the township of Wilmot, bringing the traveller again on the basaltic sheet.

Wilmot, 11 miles from Sheffield, is the centre of a district with a present population of 800, which is rapidly increasing. Seven years ago dense scrub covered the site of the present township, but it is now a thriving little place, with school, store, bakery, post office, two boarding-houses, and a butter factory which is supplied by two

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thousand cows. All the ore from the mines passes through Wilmot to Devonport, the Devon Company having to pay £3 19s. 6d. per ton, and the Shepherd and Murphy £2 12s. 6d. per ton. The freight of potatoes from here to Devonport is £1 per ton. This myrtle land is all taken up on the divide between the Forth and Wilmot Rivers by sturdy, independent farmers, who are busy scrubbing and dairying, and are laying the foundations of a thriving pastoral and agricultural industry. It is not pleasing to see the great destruction of timber which necessarily goes on in the absence of a railway, which would enable it to be conveyed to other parts of the State where it would be used. Considerable divergence of opinion as to routes prevails in Barrington, Sheffield, and Wilmot, and the disagreements on this question have perhaps helped to retard decision on this matter; but if the West Coast is ever to be connected with this part of the island by a direct trunk-line from Mt. Farrell or Rosebery to the Mersey, the most direct and useful connection with the mineral country would be through Wilmot.

The enterprise of the Wilmot settlers, moreover, has advanced the question of route considerably within the last year or two, and is also now making out pretty clearly the direction in which settlement is destined to extend. Land is now taken up all along the south road from Wilmot to the V.D.L. track, at the Caledonia Mine, a distance of 17 miles, and selections are extending from this road in a westerly direction down into the valley of the Iris River and up to the boundary of the Middlesex Plains block. It is impossible to withhold admiration of the energy with which this great tract of waste uninhabited land is being reclaimed for the service of man. The only caution necessary is to see that in the eagerness and rush mineral-bearing land is not alienated, as there is reason to fear has happened in the past.

The road rises to an elevation of 2000 feet above sea-level at Bell Mount (so-called from its shape as seen from the Sheffield side), and after passing the Shepherd and Murphy Mine, to which a branch road descends, maintains a general height of 2300-2500 feet as far as Bull Plain, after which it rises gently between 100 and 200 feet to the old Caledonian camp on the V.D.L. Middlesex track. South of this track is the stupendous gorge of the Dove River, which has cut its channel down 1600 feet below the level of the surrounding country, and flows, a clear stream with much noise and force, at the bottom of

the valley. The heavily timbered sides and precipitous granite cliffs between which the rushing river pursues its headlong course combine in producing a scene of wild, rugged beauty which stamps itself indelibly on the traveller's mind and memory.

GEOLOGY.

The field as a whole consists of Silurian strata overlaid in parts by Tertiary basalt, and penetrated by granite and quartz-porphry usually considered to be of Devonian age. Still older rocks (pre-Silurian) occur at Bell Mount.

Time did not permit me to visit Mt. Roland, which is a few miles south of Sheffield, and is capped by conglomerate and red sandstone dipping away gently to the south. Mr. G. A. Waller reported that the bed-rock underlying the conglomerate at Mt. Roland is syenite. This has a very important bearing on the vexed question of the age of the conglomerates which so frequently form the summits of the mountain ranges of the West and North-West Coasts. This question is not so much whether they are Upper Silurian or Devonian, for we have nothing to guide us in this respect, as whether they are prior or subsequent to the consolidation of our metal-bearing granites. The fact that on Mt. Roland the conglomerate reposes on the granitic rock is suggestive of the intrusion, and therefore later age, of the latter, because it can hardly be supposed that the interval of time available would have been sufficient for the denudation of the country down to the horizon of the plutonic rock. Once, however, admit that the granite was intrusive into the conglomerates, and the search for ore-deposits in the latter need no longer be regarded as a vain quest. The hardness of the rock may be an unfavourable feature, but veins of quartz do occur in these conglomerates, and gold, *e.g.*, at Black Bluff, is associated with them.

Mr. G. A. Waller records *Rhynchonella* casts from the conglomerate series on the east slope of Mt. Jukes identical with the Upper Silurian specimens from Zeehan. I have recently received from Mr. Hartwell Conder, M.A., a tubicolar fossil cast from the conglomerate on the peaks of Mt. Lyell similar to those found in the fossiliferous sandstone at the Lyell Blocks Mine, and frequent also in the Silurian strata of the Middlesex district. These occurrences make the pre-granite age of the conglomerates very probable.

An outcrop of quartzite is seen on the road from Wil-mot, on A. C. Hall's farm; also yellow sandstone. This in all probability belongs to the Silurian. On the south boundary of the Parish of Narrawa the basaltic soil is left at Sloane's farm, and the series of ancient schists, flagstones, sandstones, and quartz-porphry begins. These form the hill known as Bell Mount, round the eastern and southern flanks of which the road winds, exposing the edges of the strata at about 2000 feet above sea-level. Thinly-bedded purple flagstones or arenaceous slates strike N.W.-S.E., almost vertical or with a slight dip to the north-east. These are followed by hard pink sandstone and a brown schistose quartz-porphry.

The Bell Mount flags and porphyry are the oldest rocks in the district. They are almost certainly pre-Silurian, but nothing more definite at present can be said about their age. Quartz veins occur in them, and indications of copper ore exist. These strata form a belt which evidently extends a little to the south, for similar rock has been observed on the Narrawa section, but it is cut out further south by the Silurian sandstones and granite.

After leaving the schist belt alternating exposures of Silurian sandstones and Tertiary basalt occur. Just where the branch road goes off to the Shepherd and Murphy Mine on W. D. Weston's block is quartzite, which disappears under the basaltic covering going south. The main road passes over the basalt in the north part of Section 1332, T. J. Clerke, but then enters the Silurian sandstones and quartzite country for the remainder of that section and the one immediately south, when high basaltic land supervenes and continues south as far as R. Quail's 104-acre section. At the creek south of this similar Silurian sandstones and conglomerates continue as far as the edge of the Dove River Gorge.

The sandstone, with characteristic fossil casts and impressions, extends, with interruptions by granite and quartz-porphry intrusions, over the Shepherd and Murphy and All Nations sections, where it carries tin and wolfram lodes. It is seen at the Caledonian camp and along the Five-mile Rise, as well as on Mt. Claude on the east side of the Forth. It is often hardened into a white quartzite. The most abundant fossil or impression of some organic remains is what is locally called "pipe-stem," somewhat resembling in form a part of the stem of an ordinary clay pipe. These are sometimes a foot in length, and slightly curved. They lie in all directions, sometimes

parallel with the bedding, sometimes vertical, and project from the surfaces of weathered stones, though their substance is wholly made up of quartz grains, and no structural parts have been preserved. Mr. Robt. Etheridge, of the Australian Museum, Sydney, to whom I submitted specimens, had thin sections prepared for microscopical examination, but in the absence of any signs of structure could not undertake to say what the specimens might represent. The forms which they most resemble appear to me to be the dwelling-tubes constructed by some tubicolar annelides, and if we must give the rock some more definite name than "pipe-stem," I should think that tubicolar sandstone would be a convenient one for the time.

Dr. Noetling, late paleontologist on the Geological Survey of India, to whom I showed the rock, also thought this interpretation a probable one. The same organisms occur at the base of Mt. Zeehan in similar white sandstone underlying conformably the fossiliferous limestones, sandstones, &c., of the Zeehan mining field, which, from Mr. Etheridge's determination of the fossils, are established as of Upper Silurian age. According to Mr. Waller's ideal section of Mount Zeehan, this tubicolar sandstone overlies the conglomerate, which he regards as the basal formation of the Upper Silurian. Examination of the conglomerates in different localities is needful before any general statement can be propounded with confidence, but meanwhile evidence of a close association between the two series is accumulating. This sandstone forms such an excellent stratigraphical horizon that its relations with its associated beds become very important for Tasmanian geology, and no opportunity of examination of it or the conglomerates in different places should be lost.

Mr. Waller sent some of the other fossils collected from this rock near Bell Mount and at the Five-mile Rise to Mr. R. Etheridge for determination, and as his identifications have not yet been published, I place them on record. Mr. Etheridge says:—

"The trilobite consists of the thorax and pygidium of one of the Phacopidae, either Phacops proper or Hausmannia, but without the cephalon (or head) it is difficult to say which.

"The Rhynchonella I believe to be *R. borealis*, v. *Schlotheimii* of the Middle and Upper Silurian.

"The remains in the yellow mudstone from the vicinity of Bell Mount are two: one is the surface cast of the

corallite mouths of a monticuliporid coral, but in this condition unnameable; the other is the impression of the valve of an *Orthis* of the type of *O. calligramma*, Dalman, of Middle Silurian age."

The sandstone and conglomerate formations extend westward across the Iris River, the higher ground at Stormont and Black Bluff being conglomerate. In the Bismuth Creek below the Shepherd and Murphy Mine, on Mr. T. J. Clerke's Section 2853, a dark limestone crosses the stream, and more of this rock is seen on A. C. Hall's section, 237 acres, towards the Iris River.

On the Shepherd and Murphy Section 1437-91m, under the battery and extending south up the hill, is a bed of wollastonite-epidote rock much charged with magnetite and intersected freely by veins of a flesh-coloured lime silicate mineral which has not yet been accurately determined, but which appears to be wollastonite. A tin-wolfram-bismuth lode passes through this bed, which is conformable with Silurian quartzite and sandstone (the tubicolar sandstone). The bed must have originally been limestone, and is a striking sample of contact metamorphism, the substance of the rock with the newly-formed lime minerals (wollastonite, epidote, vesuvianite, diopside, garnet, being the result of silication of the original limestone. The iron may be due to one of two processes, named by von Hise, either deposition from solutions carrying carbonate of iron, or the incomplete oxidation of the ferrous iron of the new silicates. Or there is the direct contact theory, according to which the iron is supposed to have been derived in solution from the granite associated with the gases or solutions which have permeated the sedimentary rock and caused its metamorphism. The nearest exposure of granite rock at the Shepherd and Murphy is the quartz-porphry in the southeast corner of Section 2134-91m, which no doubt underlies the field, and is responsible for the metamorphism.

A belt of quartz-porphry and granite stretches across the country from west to east on the southern half of Section 949m, T. J. Clerke, on Section 950m, H. Conder, on part of Section 1037-m, E. W. Clarke, across the Dalcoath sections and the blocks south of the Narrawa Creek to Mt. Claude. It reappears a couple of hundred feet down the Dove River Valley, and continues across the river till it meets with the ancient mica schists. There is reason therefore to believe that granite or quartz-por-

phyry exists at no great depth below the surface, between the Shepherd and Murphy and the Caledonian Mine.

The granite is everywhere to be regarded as the factor governing the mineralisation of the rocks in this field. Although lodes may be met with in the sedimentary strata, the metals which they contain (tin, wolfram, bismuth, molybdenite, copper, lead, gold, silver) obviously had their source in the granite magma. Vogt's views of the formation of tin veins still represent those most generally held, viz., that they originated during the consolidation of granite or immediately afterwards, and that the genetic process consisted in an extraction from the siliceous magma by means of hydrofluoric and hydrochloric acids of fluorides of silicon, tin, boron, and lithium.

The solution was pneumatolytic, the substances existing as gases contained in solutions, and ascending in existing channels in which the deposition of the metals took place. The wall rocks were usually metasomatically altered at the same time.

The deposits which are met with in the district may be classified as—

1. Pyrito-spathic lead veins—Devon Mine.
2. Pyritic lead veins—West side of Bell Mount.
3. Quartz-topaz, bismuth-wolfram-cassiterite veins—Shepherd and Murphy.
4. Quartz, bismuth-tungsten veins—All Nations.
5. Tin-bearing stockworks in granite and quartz-porphry—Dalcoath and All Nations.
6. Cupriferous quartz veins—Narrawa.
7. Pyritic gold quartz veins—Old Caledonian.
8. Alluvial deposits of gold, tin, and wolfram.

Thus, the district is eminently a mineral one, and now that it is being brought more in contact with the settlements of the North-West Coast, prospecting may receive a fresh impulse and fresh discoveries be made.

It would have an important effect on exploration if it could be determined that certain minerals in this district are characteristic of certain horizons. There is, however, nothing to show that any one of the metals affects a greater or less depth than any other.

The silver-lead lode at the Devon Mine is at the lowest depth of any in the field, both absolutely and relatively, viz., 1100 feet above sea-level and 1400 feet below the upper surface of the granite in a quartz-porphry modification of the granite mass. The minerals of the lode are gold and silver bearing galena and a little chalcopyrite.

The next lowest occurrence which I visited is a formation in granite-porphry south of the Narrawa Creek, on the fall to the Forth River, sunk upon by Mr. Black. This is about 1600 feet above sea-level. The metals are wolfram, bismuth, molybdenum, and a little gold.

The Narrawa lode has been opened upon in quartzite or indurated sandstone at about the same level as the preceding. The minerals present are silver, chalcopyrite, wolfram, and gold.

The Shepherd and Murphy lodes are in metamorphosed limestone and sandstone (or quartzite), at a height of from 1800 to 2200 feet above sea-level. These carry tin, wolfram, bismuth, and a little molybdenite.

The All Nations lode is in sandstone (or quartzite), at from 2300 to 2400 feet above the sea, and contains wolfram, with a little gold, bismuth, and a minute quantity of molybdenite. In the quartz-porphry on the same property tin and wolfram are disseminated.

It must be remembered that all the occurrences were once deep-seated, and that present heights above sea-level have no real bearing on the subject. The real datum line in the enquiry is the upper surface of the granite or porphyry. In the case of the Devon Mine the upper surface is 200 feet below the level of the tableland, so that that lode is really being worked at a considerable depth below the boundary of the granite. It is singular that no tin has been discovered in this lode.

With regard to the porphyry at the All Nations it is impossible to say how much of it has been removed by denudation, but having regard to the proximity of the Upper Silurian sediments it is not likely that the quantity wasted away has been considerable, and the lodes in sandstone on that property and at the Shepherd and Murphy cannot be very far from underlying granitic rock.

The conclusion therefore is that superficially the tin and wolfram deposits of the district appear to prevail at no great distance from the boundary-line between the sedimentary and the granitic rocks, penetrating into the granite and porphyry on the one side and into the overlying sandstones on the other.

This does not mean that wolfram or tin ore will necessarily die out as depth is gained, which would be an unwarrantable inference, but simply that in this field, as far as can be seen from the few trials which have been made, tin or wolfram veins most likely to be profitable should be looked for in the porphyries and granite of the

tableland and in the sandstones and quartzites adjacent to these. There is a very widely-spread idea that wolfram pinches and disappears in depth. This distrust is, I believe, largely due to the irregularity of the deposits in general. It is what may be described as a patchy mineral, occurring often in rich bunches with intervening blanks. This irregularity leads to irregular and costly mining, and when a blank is struck confidence in the mine frequently disappears and work is suspended. Thus, wolfram mining, perhaps more than any other, is marked by an abundance of abandoned attempts.

As a compensation in wolfram mining, the vughs and bunchy deposits often yield large quantities of ore.

The same remarks apply to tin ore. Tin lodes are admittedly extremely variable, and there is generally some uncertainty as to the permanence of any particular shoot or pay zone. But the occurrence of a blank should not lead to the belief that the deposit as a whole is exhausted.

Where tin and wolfram are in separate lodes, difficulties in treatment are non-existent; but where these ores co-exist in the same lode, and as at the Shepherd and Murphy Mine with bismuth as well, there is more trouble, as the concentrates have to be subjected to a process of magnetic separation before anything like the full value of the ore can be realised.

The demand for metallic tungsten has fluctuated considerably during the last few years, but has increased recently with its growing applications and uses in industry. It has long been familiar as an ingredient in the steel used for armour-plates, but a great use for it at present is in making the self-hardening steels for lathe tools, enabling lathes to be driven at a much greater speed than when ordinary tool-steel is used. The point seems to be that the friction heat which softens the common carbon steel tool does not affect the tungsten steel. This means a thorough revolution in works plants, and the consequence is that the world is being scoured for wolfram deposits at present. The recently-created motor industry is also absorbing increasing quantities of tungsten steel. A new metallic filament lamp, known as the Zircon-Wolfram lamp, has lately been introduced, and this application will increase the demand still further.

Molybdenum is now being used for the same metallurgical purpose as tungsten. It occurs in minute quantities,

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as the sulphide, molybdenite, on the Shepherd and Murphy, All Nations, and Packett's sections, but nothing sufficient to be payable has been discovered.

It is however widely disseminated in the granite and porphyry of the district, and possibly some deposits of value may eventually be discovered.

SHEPHERD AND MURPHY MINE.

This property is 12 miles south-west from Wilmot, and comprises the following sections, charted in the name of W. G. Soper:—1802-M, 79 acres; 1437-91M, 80 acres; 1456-91M, 80 acres; 2134-91M, 78 acres; and 187-93W, 5 acres. The mine is on Section 1437, on the northern slope of a hill spur descending to Bismuth Creek. The country to the north, west, and south of the mine is Tertiary basalt, but at the mine itself and across the creek on the east the lava sheet has been denuded, and the Silurian sandstone, or occasionally quartzite, is exposed. Some abrupt cliffs of solid basalt occur in the creek and on the roadside near the bridge, so that it is very evident that this valley must be of considerable age, and has been gouged out again through the basalt sheet, or the present creek crosses the channel of the older one, which was running east and west. At any rate, the old channel was very deep where the bridge is now.

Seven parallel lodes have been discovered on the hill spur, running east and west. Of these, Nos. 2, 4, and 6 are the most important. No. 6 is the most northerly, 600 feet south of it is No. 4 lode, while No. 5 lode is 93 feet north of No. 4. No. 3 lode is 87 feet south of No. 4, and No. 2 lode is 142 feet south of No. 4. No. 1 lode is about 150 feet south of No. 2 lode.

No. 6 is the lode on which most of the work has been done recently. At about 50 feet above the creek at the battery a crosscut adit (No. 3 adit) has been driven 390 feet in a south-easterly direction, intersecting the lode at that distance. From the point of intersection a drive has followed the course of the lode for 350 feet, with a mean bearing of a degree or two south of east. The lode is vertical, or with a northerly underlay if any, and averages about 22 inches in width. Its economic minerals are cassiterite, wolframite, and bismuthinite, in varying proportions. Roughly, the concentrates assay about 33 per cent. each of tin and wolfram. Thus, the last lot of concentrates from the mill went 32.5 per cent tin and 30.8

per cent. wolfram. The gangue is quartz, accompanied by pale fluorite, calcite, wollastonite, occasionally spodumene, a hydrated mica, and a little topaz. The adit has been continued 12 feet beyond the intersection of the lode. The country which it has traversed from start to finish is a belt of a peculiar massive-looking rock, breaking into large heads like an eruptive. There can be no doubt, however, that it is a metamorphic rock, and was originally limestone. Its essential components are lime minerals, wollastonite, vesuvianite, epidote, garnet. Numerous veins of a flesh-coloured mineral intersect it, which have a superficial resemblance to feldspar or carbonate of manganese. From investigations, however, carried out by Mr. W. F. Petterd, it would appear that the mineral is wollastonite (silicate of lime).

The presence of a good deal of magnetite makes the rock dark. Green mica is abundant in it locally. Limestone crops out a little further north, in the banks of the Bismuth Creek, on T. J. Clerke's Section 2853-M, and I picked up stones of it on Hall's 237 acres towards the Iris River. On this section Mr. Selwyn Brown found the metamorphic rock again, but I was unable to verify this. The drive west on the lode continues in the metamorphic lime-rock for about 120 feet, and then passes into quartzite or crystalline Silurian sandstone. The junction of the two rocks in the drive is very difficult to fix accurately, as the metamorphic rock loses its magnetite, and becomes lighter in colour as well as less massive and softer. As the rock grows softer the lode improves. Owing to the heads in the rock its true bearing is not easy to determine, but it appeared to me that the general strike was east of north, and the underlay west of north, the quartzite underlying it. But I must confess there is some doubt about this, owing to the difficulty mentioned. At the east end of the drive the lode splits, and a rise is going up on one of the legs to the level above. A block of lode 350 feet long by 100 feet in height has therefore been made accessible by this drive, and Mr. Hitchcock, the mining manager, estimates on a conservative basis that it will yield 3000 tons of ore stuff. At the west end of the drive the lode has also split, and how it behaves further west can only be ascertained by continuing the drive in that direction. The backs westward, however, will diminish, as there is a depression in the ground. It is uncertain, too, whether the drive would pass under the basalt or into it, for there is some reason to fear that the volcanic rock is

deeper to the west. However, it is a work that will have to be done some time or other.

The same lode was formerly cut in No. 2 adit 100 feet above the No. 3, at a point 50 feet east of the rise at the end of No. 3 level, and was driven on 86 feet east and 227 feet west. The adit was begun in soft shale and clay, changing to quartzite a few yards in. This is just south of the boundary of the metamorphic lime-rock. At 80 feet west the stopes begin, and have been carried to surface, a height of 30 to 50 feet above the level, on a lode between 1 and 2 feet in width. Going west the lode passed into the wollastonite rock and improved, which is in accordance with what has been observed in the level below. The split in the lode corresponds with the one below.

The lode, although split going east, maintains the same width of gangue in the aggregate, and the drive should be continued east for exploratory purposes, even though there is an east blank in the level above. A fresh shoot of ore must in time be met with. A work of prime importance also is to extend the low adit so as to intersect the other lodes in the hill. The owners will then be in a first-class position for developing their property.

No. 5 and No. 5a. Lodes.—These are comparatively unimportant at present. No. 5_a has been driven on a few yards east and west. The lode is in quartzite country, and from 5 to 8 inches wide, decreasing going west. A few feet further south is No. 5 lode, containing a little wolfram, but only 4 inches in width. These two veins are only 12 feet apart, and will possibly be found to unite.

No. 4 Lode.—This has been intersected by No. 1 adit 230 feet above the No. 3 adit in 258 feet of driving, and driven upon 85 feet east and 63 feet west.

The lode above this level has been stoped to surface some 50 or 60 feet. As the surface of the ground falls both east and west, nothing much is left to work upon. In the west end the lode is split up with 5 to 7 inches in the middle of the drive and a small seam on each side. A little coarse wolfram is showing in the gangue. An intermediate level driven west comes in from the surface 35 feet above it, and the ground has been stoped out between the two. A block of lode 180 feet by 60 feet has been stoped away here. The mouth of the intermediate adit is 130 feet from the east boundary of section, or from the No. 1 adit to the section boundary 400 feet.

This No. 4 lode has ranged between 8 inches and 2 feet in width, and carried profitable quantities of tin ore, with wolfram and bismuthinite and carbonate of bismuth.

Further east near the creek, just east of the boundary-line of Section 2134, a short adit (creek drive) has been driven south-west for 100 feet, and then continued west for 21 feet on No. 4 lode or one of its forks. The lode gangue shows a little tin oxide, wolfram, molybdenite, bismuthinite. This drive is 87 feet below the other workings on No. 4 lode, and is a piece of work which ought to be continued, so as to come below the old stopes above the levels from No. 1 adit. Continuing the drive about 100 feet would bring it below ore worked out at surface above the entrance to the intermediate adit, and an additional 100 feet would lead to below the old stopes mentioned above.

No. 3 Lode.—This was intersected by No. 1 adit 87 feet south of No. 4 lode. It is, however, merely a lode-track, and no work has been done on it.

No. 2 Lode.—This has been cut by No. 1 adit 145 feet south of No. 4 lode, and has been driven upon 163 feet east and 100 feet west. This lode and No. 4 were the lodes that were worked in Mr. Mitchell's time. No. 2 has an average width of 15 inches. Westward it will go into shallow country. It had some good shoots of bismuth ore, with tin and wolfram.

No. 1 Lode.—The adit has been continued 168 feet further south, and beyond the south boundary of the section. No. 1 lode is a vein 140 feet south of No. 2, and parallel in direction to the others.

The present position as regards ore at this mine seems to be as follows:—Nearly 200 tons of ore stuff ready for crushing were stacked outside the adits at the time of my visit, and ground estimated to yield between 5000 and 6000 tons of ore stuff has been made accessible. At present the east end on No. 6 lode and the end in the creek drive on No. 4 are perhaps not payable to drive, but having been driven the lode above them is payable to stope away. The split in the east end of No. 6 forms two branches each 8 or 10 inches wide, and these are still separate in the rise 25 feet above the level.

In the level the north branch is being carried, and the south one left for a time. The two ends mentioned must be kept going, for two levels should always be advancing if the ore reserves are to be maintained. Once the dress-

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ing-floors start there will be a constant drain on the stocks of ore in the mine, and progressive mine work will become more than ever a necessity. The floors were being remodelled at the time of my visit, and when ready they will comprise stone-breaker, rolls, jigs, 10 heads of stamps, 2 Wilfley tables, and 2 Frue vanners, and it is intended eventually to erect a magnetic separator at the mine.

The concentrates have an average value of about £100 per ton, which would give a value of £3 to each ton of crude ore. An improved water supply is being provided by the construction of a race $5\frac{1}{2}$ miles from the Weaning Paddock Creek. The lodes, though small, are persistent, and though several little displacements of them occur there is no serious faulting noticeable. There is very little doubt as to their continuance eastwards across the creek into the adjoining hill on Sections 1332 and 2134, and there is also no conceivable reason why they should not continue west across Section 1802 (with possible interruptions by basalt) into A. C. Hall's private land. For my own part I have not the slightest doubt but that they are there, and that some of this important group of veins extend right through from the Iris River on the west to beyond the All Nations sections on the east. In the latter direction they will eventually enter the granite-porphry rock exposed at surface. The great piece of work which in the future lies before the mine-owners is to prove the lodes in the hill by continuing the low adit right across the lode zone.

Up the hill in basaltic alluvial clay are boulders of cemented conglomerate, containing layers or bands of coarse black tin oxide accompanied by some topaz. The conglomerate consists of quartzite pebbles bound together by a siliceous cement, and is apparently the debris of an old alluvial deposit which has covered these lodes at one time or other. The most probable explanation is that the deposit was covered by the Tertiary basalt, and has been subsequently broken up and released by its denudation.

From the point of view of the mineralogist and mining geologist the lode at the Shepherd and Murphy Mine possesses a certain degree of interest. The coarse crystallisation of the gangue minerals might easily suggest a comparison with the structure of pegmatitic veins, and this reference is strengthened by the occurrence of beryl and spodumene, but there is a singular absence of feldspar and original mica.

The process which has been at work seems to have been that usually concerned in tin ore deposition, not dry sublimation, but deposition from gaseous solutions. Hence we see the usual association of tin ore with the fluorides (fluorspar and topaz) and hydrated mica, accompanied, however, by the lime products of the metamorphosed limestone through which the lode passes for a certain distance (wollastonite, calcite, vesuvianite, epidote, &c.). The hydrated mica in the lode, colourless to light-green in colour, requires analysis for exact identification of the species to which it belongs. There can be no doubt, however, that it is secondary. Such micas are known in some instances to have been derived from topaz and spodumene. The large flesh-coloured patches of the silicate of lime, wollastonite, in rosetted aggregates are striking characteristics of some portions of the lode.

A complete investigation of the complex mineral composition of these lodes may be recommended to students.

ALL NATIONS WOLFRAM MINE.

This property comprises four mineral sections, viz.:— 1332-M, 78 acres; 1019 and 949-M, each 78 acres, T. J. Clerke; and 2853-M, 80 acres, T. J. Clerke. These are situate about 12 miles south-west of Wilmot township, the main road from Wilmot towards the Caledonian Mine passing through the central (1332-M) section at an elevation of about 2000 feet above sea-level.

The main or No. 6 lode of the adjoining Shepherd and Murphy Mine has been worked to within 700 feet of the west boundary of Section 1332, and will apparently cross that boundary into the All Nations property at about 290 feet north of the south-west corner peg. The ground, covered with standing timber, then rises to the east to a height of about 600 feet, and no attempt has been made as yet to trace the lode through the section, but at 3 chains north of the south-east corner peg of Section 1332 the wolfram lode-line has been shown by a few trenches to cross the south-west portion of Section 1019-M and enter Section 949-M in a direction 10 degrees south of east. The last traverses in the east end of the Shepherd and Murphy No. 6 lode show a slight inclination to the south of east, and the probability is that this tin-wolfram-bismuth lode and the All Nations wolfram lode are either identical or connected. If so it is a remarkably persistent one, extending through nearly three sections, and possibly still further.

In Sections 1019 and 949 the lode has been opened upon by a deep open-cut along its course (now and then deep enough to necessitate covering with timber) for a length of 12½ chains, including a 30-foot tunnel at the western end of the workings. Along the open-cut line three shafts have been sunk, 20 feet, 53 feet, and 66 feet from surface respectively.

The lode varies from 6 inches to a foot, or occasionally even to 2 feet, in width, averaging perhaps 9 inches, and has been broken out nearly all along the open trench to a depth of 8 or 9 feet, in some places to 10 or 12 feet. It underlies steeply to the south, while the country dips to the north. It splits now and then, as at the lower shaft, but reunites. A branch has gone off north in the open-cut opposite the camp, and is not seen again, unless it has joined the main lode further east.

This lode is one of the most remarkable in the State, consisting of combed quartz crystals throughout, some of which are of great size and beauty. The crystals have been noticed as large as 14 inches in circumference. Some are pellucid; others are of the smoky variety. Vughs are frequent, and have been as much as 2 feet in width and 6 to 8 feet long. From one of these cavities as much as a ton of ore was obtained. The vughs are generally full of water, and the lode stuff is very hard between one vugh and another.

The lode mineral is the tungstate of iron, known by the name of wolfram. It occurs amorphous, or occasionally in imperfectly crystalline form, implanted on and between the quartz crystals of the lode, and can be very easily separated from the gangue.

The present owners have abstracted simply the smalls from the loose upper part of the lode by sluicing, leaving the harder lode-matter on the banks of the cutting for future treatment. The stones thrown out on the banks seem to be fairly-well charged with wolfram, and good dish prospects can be obtained everywhere from the smaller lode stuff associated with them.

A distinct feature of the ore in this lode is its purity. It is unaccompanied by pyrites or any deleterious mineral. Assays made by Messrs. W. & J. Lemprière, of Sydney, have shown the tungstic acid contents to go as high as 72.8 per cent.; and Mr. W. F. Ward, the Tasmanian Government Analyst, obtained by assay 72 per cent. The assays of bulk shipments, the original sale notes of which were shown to me, showed 66 per cent., 68½ per cent.

70.5 per cent., 70.6 per cent., 71 per cent., and 71½ per cent.

As the English standard is 66 per cent., and Australian quotations are usually based on 70 per cent. ore, the grade of this ore is very satisfactory. As far as is known it exceeds that of any other wolfram ore shipped from Tasmania, and would (for 71 per cent.), at present ruling prices in Launceston, fetch here £160 per ton.

A few flakes of molybdenite occur in the lode occasionally, and there is a selvage on the hanging-wall from 1 to 3 inches wide, containing carbonate of bismuth and gold. A good dish prospect of gold may be obtained from this selvage anywhere. Samples which I took from it have been assayed by Mr. W. F. Ward, Government Analyst, with the following results:—

Bismuth	4.8 per cent.
Gold	11 dwts. per ton.
Silver	4 dwts. per ton.

The owners have worked in a desultory way, in winter, when a little water was available, for the last two and a half years, with two or three men, sending out enough ore to pay for working and prospecting expenses. To date, they have shipped to Sydney 8 tons 3 cwts. wolfram ore.

A peculiarity is that no tin ore occurs in this lode, while the same lode (if the two are identical) in the adjoining mine carries tin, wolfram, and bismuth.

The length of the lode-line and its persistence would of themselves indicate its continuance in depth, besides which No. 6 lode, its supposed prolongation in the Shepherd and Murphy ground, is being worked 500 feet lower than the All Nations outcrop. The best part of this wolfram lode is comprised in a stretch of about 400 feet in length, in which shoots or patches of ore occur at intervals; in fact, nearly all the ore shipped has been won from this part of the lode.

Whether the shoots persist and widen out or not in depth will have to be ascertained by lower workings. Work was not proceeding while I was there, and I was unable to form a proper opinion as to the value of the lode at the lowest part of the workings, but the general appearance of the lode stuff thrown out from the trench was encouraging. I could see, however, that like all wolfram lodes, it is somewhat bunched. Barren stretches may be expected, alternating with richer parts.

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The highest backs available from the bottom of the western No. 1 shaft to the crown of the hill in advance of the present workings may be about 150 feet, and 40 feet additional may be secured by a crosscut to the shaft from the Narrawa Creek, a good deal of which would be an open drive. This would be the lowest depth at which the lode can be attacked by crosscutting on this side of the hill. This creek when I was there was sending down from one to two sluiceheads of water, and would probably supply sufficient water for dressing on the comparatively small scale required during five or six months in the year. By impounding it might be made to last longer.

The full development of the mine, however, must take place from the western side of the hill on Section 1332-m. The first step towards this is to trace the outcrop over the hill on that section by means of trenches, and to open an adit on its course eastwards. This will eventually come below the present workings in Section 949, only some 500 feet lower down. In the meantime it will be an exploratory adit, proving the lode, and if the latter answers expectations it can be easily worked and the ore stuff treated at works to be placed on the northern Section 2853-m lower down the Bismuth Creek.

An encouraging feature of the exploratory undertaking on Section 1332-m is that the lode in each of the bounding sections carries long and payable shoots of ore. If a fair amount of capital is introduced into this enterprise there is hardly scope for it in the present works on the eastern side only. It is apparent then that the natural and complete development of this property depends largely upon the discovery and behaviour of the lode on the western side of the hill in the unworked section.

On this side of the hill it must be remembered that the lode in all probability will be tin-wolfram, and the exploratory work will show whether the two outcrops belong to one and the same lode, or whether there are two lodes to be dealt with, one a pure wolfram lode and the other one carrying both metals.

Work could be continued at the same time on the lode on the eastern fall on a moderate scale, taking care to keep expenditure as low as possible. All this is on the understanding that the wolfram market remains favourable.

The price of this metal has doubled itself during the past year, and although the exact prices obtainable by producers is generally a matter for negotiation, the

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demand resulting from new uses is so strong that it is expected rates will continue firm for a considerable time. The steel industry is absorbing all it can obtain, and latest advices are that the market is in an excited state. Constant enquiries are being received respecting wolfram mines and discoveries, so that it seems likely that producers will be sure of a good market for some time to come. The consumption of tungsten for high-speed tool steel is rapidly increasing, and the great toughness which it imparts to steel (often in conjunction with molybdenum and chromium) makes it sought after by the manufacturers of armour plates and projectiles. It is also increasingly used in the manufacture of motor and other car axles, springs, &c. The world's annual output of wolfram ore is about 3000 tons, of which Australia contributes a little more than half.

Up the hill southwards search has been made for the Shepherd and Murphy No. 4 lode, which is a parallel one, 600 feet south of No. 6. Small veins carrying wolfram and carbonate of bismuth have been found, but no lode corresponding with the one sought for. Stones of white pebbly sandstone with tin ore on the joint faces are scattered on the surface, which have possibly come from a belt of conglomerate on the hill crest. A long costeaning trench up the hill from here discloses loose stones of quartz and veinstuff carrying tin ore, wolfram, and carbonate of bismuth.

These trenches require to be cut rather deep to lay bare any solid lodes. On the south side of the crest the ground falls rapidly to the Iris section (H. Conder, 950-m), and the conglomerate zone gives way to quartz-porphry, the marginal part of a granite mass. This quartz-porphry occupies the southern half of Section 949-m, and contains great possibilities. Veins which intersect it carry tin ore and wolfram. Most of the ore occurs on the joint faces of the rock, but some of it appears to be disseminated promiscuously, and it is by no means impossible that prospecting will result in discovering some part in which the ore is sufficiently concentrated to pay for working. A good deal of the alluvial tin and wolfram ore found in the Iris workings has doubtless been derived from this quartz-porphry, which also extends into that section. Some trenching was going on in the All Nations porphyry while I was at the mine, and some really good stones of ore were found. The nature of the rock warrants some expenditure in prospecting.

Down the Narrawa Creek, in Section 1019-m, alluvial tin ore has been won from time to time. A couple of tributors last winter took out 7 bags of high-grade ore. A wash from a few inches to 2 or 3 feet deep, and consisting of stones of quartzite, conglomerate, sandstone, and occasional lumps of vein-quartz, rests upon sandstone strata. Dishes of stuff washed showed about 2 ounces of tin ore per dish—black coarse tin with a few small topazes. The absence of wolfram indicates that the ore has not been derived from the veins on Section 949. I am rather inclined to think that it has come from some undiscovered source on the west side of the creek. As this is rather heavily timbered, it is not surprising that lodes have so far escaped discovery.

Lower down the creek the wash is deeper, where a party called the Lefroy Syndicate sluiced with a little water brought in from another small creek. Here the quartzite bed-rock is stained green with chlorite, and gives prospects of grey tin, quite different from the usual tin in the property, which is always black. By the side of the road, on Section 1332, there is a face of wash about 4 feet deep, which contains black and a little brown and resin tin ore. Prospects obtained were equal to $1\frac{1}{2}$ or 2 ozs. per dish. A man turned to recently and got 3 bags of ore from it. No wolfram is found in this deposit either.

These alluvial deposits are deserving of mention, not because they invite the attention of any other than individual workers or working parties, but principally because they point to the existence close at hand of some lode or lodes not yet discovered.

All these sections have plenty of myrtle and gum timber suitable for mining purposes. The only deficiency is water, and this difficulty must be met in the way mentioned above.

As matters stand, wolfram is the mineral at present available, but tin ore evidently exists at more than one spot on the property, and prospecting may bring payable deposits of it to light.

The strata through which the lode passes in all three sections consist of the "pipe-stem" sandstone or quartzite described in the earlier part of this report. The southern Shepherd and Murphy lodes, if they continue so far, will also be found in the same rock in Section 949-m.

IRIS CLAIM.

Section 950-m, 78 acres, H. Conder.—This is one of the sections formerly held by the Iris Tin Mining Company,

and was more recently acquired for a short time by the Tasmanian United Wolfram Company, Limited. In the northern part of the section a shallow alluvial deposit is being sluiced by tributors for a mixed tin and wolfram product, with a present value of about £100 per ton. The thickest wash seems to be about a foot, but as a rule it is not more than 3 or 4 inches, the overburden not carrying tin. Eight or 10 chains to the south of the workings basalt comes in, but at the workings and north of same the bed-rock is quartz-porphry, and tin-bearing veins in this rock have apparently supplied the mineral which is being won. The porphyry ascends from the workings northwards to the centre of T. J. Clerke's Section 949-m, and the waste from this has probably contributed to the formation of the wash. The tin and wolfram ores are very little water-worn, and are frequently attached to small pieces of vein-quartz. Small topazes are very frequent.

The value of the ground is said to improve as the northern boundary is approached, but I believe on the whole it does not exceed 6 or 7 lbs. per cubic yard. From first to last 95 to 100 tons ore are estimated to have been won from here, but most of the deposit is now worked out, and there does not appear to be sufficient scope to induce the initiation of a water scheme, which is essential if anything more than desultory winter work is contemplated. There is a possibility of lodes being discovered in the course of stripping down to the bed-rock, but this is a rather slender chance. The high position of the section is against obtaining a water supply, and I fear the present method of intermittent work with idle spells in summer is what will have to be looked forward to unless a lode discovery is made.

SECTION 1037-m, 20 ACRES, E. W. CLARKE.

No work is being done on this section. The All Nations' wolfram lode must pass into it, but how it will behave when it enters the porphyry which is in the southern part of the section cannot be foretold. The section is one which, from its position, merits prospecting.

PACKETT'S SECTION, 10 ACRES, 970-93G.

This is a gold section, now vacant, situate south of one of the Narrawa reward sections. About nine years ago the disintegrated and cemented sandstone was dollied for gold. A trench was cut and a small shaft sunk at the head of a gully

going down to the Narrawa Creek. The sandstone carries small leaders of quartz with a little wolfram, and half-way down the shaft disseminated pyrites was met with carrying a little gold. The gold won is said to have been worth £3 12s. per oz. It is difficult to say what there really is in the formation, but as the slope to the Narrawa Creek is very steep, it would not be difficult to prove it by means of an adit. It is evidently connected with tin or wolfram veins, and it is not far from the junction with porphyry and granite in the eastern part of the section.

SECTION 1442-93G, 10 ACRES.

This is east of the preceding. An Adit known as Spark's drive has been driven south-west into the hill on the south side of the track, first in sandstone and then in soft porphyry. This was ten years ago, and the tunnel is now too wet and muddy to enter, but outside the entrance are stones of coarse quartz or granite-porphry containing wolfram and molybdenite. Quartz veins intersect the porphyry and carry coarse crystals of ore. A little pyrite is visible in the rock, which greatly resembles some of the tin-bearing rock on the Blue Tier, East Coast. The entrance of the tunnel is in Silurian sandstone, but further in the porphyry must have been struck; also an east and west lode.

About 10 chains further east, but whether on the same section or not I could not determine, are some workings recently operated by Mr. Black, but now abandoned.

BLACK'S WORKINGS.

South of the track and a little above it a cut about 20 feet long has been put into the hillside, showing a lode striking W. 10° N., and dipping towards the south. The quartz is 5 or 6 inches wide, and carries coarse patches and crystals of wolfram, with some bismuth carbonate and iron pyrites. Some of the quartz is smoky. The country-rock is a dark mica granite.

Still further east and on the track is Black's underlay shaft, sunk 35 feet in granite-porphry, on what would seem to be a copper wolfram lode. Lode stone 8 to 10 inches wide, carrying iron and copper pyrites and black oxide of copper with wolfram is piled at mouth of shaft. Bearing of lode, N. 65° W. To the east of this the lode has been trenched upon, showing stone much oxidised at surface. There is nothing payable in this lode so far.

Nearly a hundred feet lower down the hill are two more shafts sunk by Mr. Black in granite-porphry, 35 and 45 feet deep, and about 40 feet from each other. A large formation of mica and specular iron ore has been sunk on, being followed down on the underlay and then passed through into granite. In the west shaft hornstone was struck, indicating some contact. The formation strikes north-west. The oxidised lode-matter is traversed by narrow seams of wolfram between thin selvages of dark-green mica, and by veins of comby quartz containing a little wolfram. Native bismuth has been found, and a speck or two of free gold. Quartz veins in the granite-porphry carry a little molybdenite.

Though nothing payable has been found, there would seem to be some possibilities here. To the south, over the range, is the old Dalcoath property, where a stanniferous stockwork exists, which was not payable in the old days, and which presents a problem somewhat resembling that offered by the Blue Tier tin deposits. This was not visited as there was no one who could show me any way of getting to it.

NARRAWA P.A., REWARD SECTION 35-93G, 20 ACRES.

This is the section north of Packett's. A descent is made 400 feet to the Narrawa Creek over Silurian sandstone country, and on the north side of the creek and about 30 feet above it a tunnel has been driven into the high hill range on the course of the lode for about 150 feet in a direction 25 degrees north of west. Two short crosscuts have been driven west, and a small cuddy also west.

The country-rock is a dark-grey quartzite, permeated with vein silica and impregnated with iron and arsenical pyrites, and a little copper pyrites carrying gold and silver. This impregnated zone forms the lode. I could not see that it had any defined boundaries. It rather appeared as if it might be an impregnated band in association with some fissure which has supplied the mineral. The degree of impregnation varies in different parts, being less in some parts than others, but the siliceous character of the formation is rather constant. A lot of red ferruginous mud is issuing from the tunnel, and much water is falling through its walls.

This and its abandonment for some time past make its examination difficult, and I found it useful to confirm my observations inside by looking over the tip. Among the stones I found some quartz carrying a little wolfram. It

is possible therefore that some such occurrence as this is the primary vein quartz which has started the silicification of the formation. Some selected pieces of the lode-formation which has been driven on picked up by me were assayed by Mr. W. F. Ward, Government Analyst, with the following results:—

Gold	4 dwts. per ton.
Silver	3 ozs. 1 dwt. per ton.
Copper	2.2 per cent.
Tin	Not detected.

It is evident that this lode shows abnormal features. It may belong to the group of cupriferous gold-quartz lodes, or it may be an extreme type of tungsten veins. No tourmaline is visible to the naked eye. A microscopical examination of the lode-material may reveal features which would lead to more definite conclusions, but I am inclined to think that the formation is an extreme member of the wolfram lodes so prevalent in this district. In driving this tunnel further the aim should be to locate some solid shoots of ore, and consequently frequent crosscutting will be necessary, for the formation is a wide one and the impregnation irregular. It is quite possible that payable shoots may be found, but close testing is absolutely necessary. The hill rises above the tunnel some 700 feet or more, and if anything payable is found, working it will be an easy matter.

Mr. Waller found some of the Bell Mount schistose porphyries on the Narrawa section. From this it is plain that the contact between the schist series and the Silurian sandstones is close at hand. But it will not be well to attach too great importance to this, as it is more probable that the granite contact was the dominating feature in the process of ore-deposition here, and it is extremely likely that the lode minerals in depth will be tin and wolfram.

BELL MOUNT GOLD DIGGINGS.

These are now virtually idle, the only worker being Mr. Alex. Campbell, the brother of the original discoverer, Malcolm Campbell. In 1892 and 1893 the wash was feverishly worked, but since then the field has been more or less dormant. It is impossible to get at the exact quantity of gold ore won. I am informed that the banks can only account for purchases of about 1000 ozs., but the most reliable estimates put the total at about 4000 ozs. Nuggets up to 22 ozs. have been found, and many weighing from 1

to 2 ozs. Bell, Poverty, Mosquito, and Basalt Creeks flow through the deposit of alluvial, which is from 18 inches to 18 or 20 feet in depth. The wash consists of sandstone and quartzite conglomerate and schist. The gold generally lies at the bottom of the wash, and below this is frequently a false bottom of black carbonaceous pug. The hill north of C. Adams' house is composed of a heavy quartzite wash with a bottom of pipeclay. Poverty Gully, as it was called, is between two mounds of made ground. There was only one payable claim in it, and the largest nugget got was 4 ozs. The stones in the valley evidently came from Bell Mount, but the wash of which the hills are composed has not been traced to its source. The bulk of the gold has been got from the larger gully to the west. In that creek (Bell Creek) the bed-rock is blue slate underlying the false bottom of dark pyritiferous pug. At the head of the old Amalgamated claim the rock is a soft sandstone, with a strike of N. 60° E., dipping to the south-east. In the upper west diggings there would seem to be a genuine lead, the only one on the field. The wash is composed of red sandstone conglomerate and pipe-stem (tubicolar) rock. It is significant, however, that the south end of the wash contains stones of basalt.

From what I could observe, I am inclined to refer the gold to quartz veins in the sandstones and conglomerates of the country, but too little is known of the country lying west of the Wilmot to say whether it has furnished most of the wash or not. Conglomerate and Silurian sandstone prevail in that country, but these rocks are also found all round. The matter is complicated by the occurrence of some Bell Mount schist in the wash. It is possible that there was here a large swamp or lake which was fed by streams coming from various directions. This supposition would solve the difficulties in an easy and natural way. The country to the north and west, preferably west, would be the source of the gold. That to the south is excluded, as it is tin-bearing country and would have shed tin and wolfram ore into the basin. The gold has not come far, and search may disclose the rich veins from which the gold won has been detached.

GREAT CALEDONIAN MINE.

This is in Silurian sandstone and quartzite at the top of the Five-mile Rise. A shaft was sunk, levels driven in sandstone permeated with veins of cellular silica, a crushing or two taken out and treated in a fifteen-head battery.

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It is difficult now to see what there was to work upon. The mine was soon abandoned, the battery removed, and everything at surface has since been destroyed by a fire. The store close by the track is the only existing relic. It is useful as a camp and shelter-place in this solitary spot.

THE DEVON MINE.

Section 1831-93M, 40 acres, leased by the Devon Mining Company, No Liability, and Section 4021-93M, 40 acres, in the name of J. C. Macmichael, but owned by the Company, are at the bottom of a deep gorge carved out by the Dove River. The mine is $2\frac{1}{4}$ miles south of the V.D.L. track, *i.e.*, as the crow flies, but the zig-zag bridle-path which leads down to it is nearly 3 miles in length. The Dove River flows through the sections, and the mine is on its precipitous banks, on Section 1831-93M. On the west bank is a galena lode carrying a variable width of ore, *viz.*, from a few inches up to a foot.

The lode-channel also varies in width from a few inches to 3 feet on the outcrop, and is filled with quartz-porphry and quartz, with occasional carbonate of iron. Pyrite is present in the gangue, so that the lode may be described as belonging to the pyrito-spathic group of lead veins, though siderite is only occasional. A little blende and chalcopyrite accompany the lead ore. Pyromorphite also occurs, and cerussite is plentiful in the upper part of the lode.

The bearing of the lode in the northern end of the workings is a degree east of north, and in the southern end 29 degrees west of south. The dip is very steep to the east.

The country-rock is a rather dense quartz-porphry, composed of a ground mass of granular quartz, in which lie scattered larger crystals of quartz, orthoclase, feldspar, and dark mica. The lode is in this rock, which passes into or joins granite in a southerly direction, while going north it abuts on quartzite or altered Silurian sediments. The hornstone which prevails at the contact makes it difficult to determine with the naked eye whether a given specimen belongs to the sedimentary or to the igneous series.

No tin or wolfram has been found associated with the galena, and there is nothing to show that the lode is in any way related to the stanniferous lode groups of the granite and porphyry of the Bell Mount district.

The output of the mine since 1899 has been 290 tons silver-lead ore. More than half this quantity assayed 5 dwts. 4 grs. gold per ton, 85½ ozs. silver per ton, and 55.9

per cent. lead. Lately $8\frac{1}{2}$ tons were sold, assaying 2 dwts. per ton gold, 80 ozs. silver, and 60 per cent. lead, and realising, after deducting returning charges, £18 12s. per ton nett. The high gold contents are unusual for our galena ores. A selected sample of clean galena which I took was assayed by Mr. W. F. Ward, Government Analyst, and returned 80 per cent. lead, 3 dwts. 6 grs. gold, and 112 ozs. silver per ton. Work was suspended at the mine for nearly four years, but was resumed last November, since when 25 tons of galena have been raised.

The first adit (or No. 1 tunnel) was driven at about 20 feet above river-level in a westerly direction, and at about 70 feet in intersected the lode. In driving this adit a small formation with a westerly underlay was met with, but it does not seem to contain anything solid in the shape of a lode. Further in, about 10 feet east of the intersection of the lode, a small seam (6 inches) of quartz and siderite was passed through. Where intersected, the lode on foot-wall is very small. It has been driven upon 104 feet south and 24 feet north. In the south drive the lode-formation is a gossanous quartz from 6 to 10 inches in width. Very little galena (1 inch) is showing in the end. There is a rise up 40 feet from this level, and the lode on top carries 4 or 5 inches of ore going south and 3 inches going north in a gossanous formation. The north drive has been driven about 180 or 200 feet over the top of an ore-shoot which has been stoped up from the level below. It is now unsafe beyond a few yards from the flat sheet.

The main crosscut at this level has been continued west from the flat sheet for 25 feet, and would, it is estimated, have to be driven half a chain further to cut a parallel gossan formation seen at surface nearly 200 feet above river-level. The gossan outcrop is about 9 feet wide, inter-laminated with porphyry, and is stated to carry 3 ounces of silver per ton. Its bearing is N. 90° E., and it is vertical or slightly dipping to the east.

No. 2 adit has been driven west from about 6 feet above the river at about 120 feet north of No. 1 approach, and just on the junction of the granite with porphyry. A small seam was cut in the approach, 3 inches wide, with a westerly dip. It will accordingly junction in depth with the main lode. At 70 feet in the lode was cut, but only 18 feet below the level above. The lode has been driven upon 70 feet north and 145 feet south. There is a fair quantity of pyrites in this part of the lode, and when the carbonate of iron comes in the galena seems to disappear.

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South Drive

Up to a foot of ore has been carried, but discontinuously. Beyond the stope a little cuddy has been driven to pick up the lode which was done a little further south. The lode crosses and recrosses the drive in the form of a mere track, but from 9 to 12 inches of ore are stated to be underfoot. In the south end it has pinched to a carbonate of iron track. In the level above this the ore extended about 60 feet further south, so it would appear that the shoots are pitching north. In the north drive a winze 17 feet from the flat sheet has been sunk 17 feet, and the lode in its north end was showing 8 inches wide when the water interfered with the work. Some clean seams of galena 3 inches wide are seen in the roof of this drive, but the end is barren, with bands of quartz and gossan continuing on the west wall.

A shaft has been sunk from surface 70 feet and 110 feet north of the winze, and a drive south started from the bottom, which will in time come 40 feet below the present bottom of the winze. This shaft had not been unwatered when I was at the mine, the water-level in it being within 30 feet of the top. I was told that the lode at bottom is good, and showing about 3 inches of ore. It has since been driven upon, and widened out to 8 inches of clean galena.

It will be gathered from this report that the Devon Mine has a small persistent lode carrying ore of a high grade. The cleanness of the ore has enabled work to be carried on without going to the expense so far of putting up concentrating plant, but of course the present stage of the work is a purely transitory one, as what the mine is going to be will depend upon exploration. The present shoot will have to be followed down still deeper, and as the shoots will probably all pitch north, driving south is indicated as soonest likely to meet with a new shoot. At the same time the adit crosscut should be continued, to cut the western lode.

An encouraging feature is the relative poorness of the gossan, which descends to the lowest level yet opened. It is likely that it has been depleted of its silver contents, and that these have been carried down to enrich the lode at a greater depth. At the mine I felt some anxiety as to how the lode would behave going south, as it seems as if it would shortly enter the granite which exists south of No. 1 adit, but from the plan it is evidently turning westwards, and thus following the apparent direction of the porphyry in which it lies. There is nothing to indicate that the lode will not descend to a great depth, or that the

ore in it is merely a superficial concentration ; and more than one shoot of ore will probably be met with on its course. Its only drawback is its small size.

The cost of transport of the ore to the coast has diminished of late years, but is still a heavy tax on the mineral, being £3 19s. 6d. per ton to Devonport. As long as the outlet from the mine is *via* Wilmot the freight must be heavy on account of the packing cost to the top of the Dove River Gorge, but the rate could be considerably reduced by the improvement of the road between the Caledonian and Wilmot, and more Government money could very well be expended on this. Whether the mine continues work or not, the road will benefit the settlers along the route, so there ought to be no hesitation on the part of the authorities in opening up suitable means of communication.

CONCLUSION.

The whole district is one of high interest from a mineral point of view. The granite contacts have given rise to ore deposits of a varied character—gold, silver-lead, tin, wolfram, copper, which though mostly concentrated in small lodes are of good grade. The lodes have so far been explored for the most part only in a tentative way, and some of them have given results which may be described as promising. The district is geologically connected with the country further west, where the same tubicolar sandstone and conglomerates prevail. Some gold mining of a prospecting nature is being carried on in that country by Mr. Black near the Black Bluff. Mr. Black has also tried some ventures in the Bell Mount district, but more than individual attempts are necessary in a field of this nature, because as a rule the lodes are small and require a good deal of progressive work to be carried on ahead of ore-winning. For the present the tin and wolfram mining will be chiefly centred in the Shepherd and Murphy group of lodes and their extensions towards the All Nations, and silver-lead mining at the Devon. However, a galena vein is known to exist between the Bell Diggings and Bell Mount, and the same mineral may crop up elsewhere. The tin-bearing porphyries and granites extend eastwards on the slopes to the Forth River, and pass over to Mt. Claude. Gold is rather widely distributed throughout the district, but though a fair amount of alluvial gold has been won, no veins of any great importance have been found. The

numerous small veins have shed their gold during the process of denudation, and this has been carried into the alluvial deposits which have been worked by diggers.

I do not think that the chances are in favour of any very high development of any one mineral. The field is more likely to prove one of numerous small and rich lodes.

The progress made in settlement ought to help mining on, if care be taken to prevent the further alienation of land upon which outcrops of mineral are likely to exist. The increasing number of settlers may be expected to keep the routes open to and from the mines, and by spreading more people over the land will tend to facilitate new discoveries of mineral. This district is on the eastern edge of the practically unproved country between here and Waratah, and the few mining attempts which are now being made along this fringe merit all the fostering care and encouragement which the State can legitimately afford.

I beg to thank Messrs. W. E. Hitchcock, R. Mitchell, W. Tresize, C. Adam, and Mr. T. J. Clerke for kind aid and information, and Mr. Alex. Campbell for fossils from the Bell diggings. These fossils indicate a Silurian age for the sandstones and quartzites.

I append a note furnished by Mr. W. F. Petterd on his examination of the spodumene mineral from the Shepherd and Murphy lode.

Owing to want of time a map does not accompany this report, but this matters less, as a geological sketch map of the Bell Mount district is attached to Mr. G. A. Waller's report of the 3rd April, 1901. That report should be read in conjunction with the present one.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq.,
Secretary for Mines, Hobart.

NOTE BY MR. W. F. PETTERD ON EXAMINATION OF ALTERED SPODUMENE FROM THE SHEPHERD AND MURPHY LODGE.

In forceps infusible: gives after considerable heating strong reaction for Li, and the same in powder on platinum wire glows and gives yellow flame of Ca. On coal in powder becomes somewhat white, but does not fuse or intumesce.

With Na₂CO₃ no reaction. With borax bead slight trace of Fe. In matrass the mineral in powder gives a distinct reaction for H₂O, showing the substance is hydrated, which is often the case in altered compounds. Apparently portion of the Si and Al is replaced by Ca, which is not unusual.

On strongly heating in the open tube it loses colour and becomes greyish-white. The mineral has a somewhat lamellar structure, cleavage fairly perfect; surface of cleavage faces inclined to be pearly. Fracture uneven, tough, lustre decidedly oily. Colour greenish-grey to almost olive-green, translucent at edges. Crystals prismatic, short, irregular, striated, and flattened or compressed. System apparently monoclinic. The substance is more often than not massive, with enclosed or attached crystals of cassiterite. In hot HCl a slight disengagement of CO₂. Specific gravity, 3.4. Hardness, 4.5. Optically, refraction and double-refraction strong. In thin sections colourless and non-pleochroic.

With radium bromide (of 1,800,000 intensity), using a thin sheet of metallic aluminium as a filter to the natural glow of the preparation interposed between the assay and the cell containing the radium, a pale greenish light is observed, which is apparently characteristic; but after the mineral was strongly heated in the platinum forceps it did not respond to the emanations.

Some experiments were carried out with spodumene from other localities:—

No. 1. A large crystal 6 inches in length, colour greenish, white, and opaque, from Peru, Maine, U.S. America. This gave a distinct response to the radium rays. A chip was also used, and powdered mineral. The light was pale greenish. As before, a thin sheet of metallic aluminium was used as a filter.

No. 2. A somewhat large cleavage mass, slightly greener in colour than the preceding, also opaque; from Phillip

River, Western Australia. The radescence in this instance was not nearly so clear as that of No. 1, but still quite noticeable both in a fragment and in powder.

No. 3. Portion of a large crystal of the usual colouration, from Ulo, Sweden. No result from either thin chip or powder. Apparently not appreciably affected by the rays, though the specimen is quite characteristic in all respects, and the locality is well known to mineralogists.

No. 4. Transparent varieties of spodumene all gave a bright response to the rays. They were as follows:—Hiddenite, colour bright green, from Alexandra County, North Carolina, U.S.A. Triphane, colour clear yellow, from Minas Geres, Brazil. Kunzite, colour violet, strongly dichroic, from Pala, South California, U.S.A. These were all strongly radescent. The last becomes incandescent when heated in powder with the radium bromide.