

In an east crosscut near the southern end of the 160 feet level south drive, a small quartz leader is exposed which is said to have carried gold values where it was worked in the adjoining lease, the United. The leader as exposed in the crosscut, lies parallel to and about fifteen feet east of the hanging wall of the porphyry, but does not contain payable gold values. The values in such quartz veins and leaders in other parts of Paddy's Flat are characteristically patchy, and a northern drive on this leader, with the object of prospecting for other shoots of auriferous quartz, seems worth while.

#### 4.—INGLISTON ALBERTS G.M., MEEKATHARRA.

(F. G. Forman, B.Sc.)

The following brief description of the geological features of the East Lode in the Ingliston Alberts Lease (late Ingliston Extended\*) is written after an examination made at the request of the Syndicate.

The East Lode is a shear zone in the black schist (altered peridotites) lying parallel to and about 180 feet east of the Paddy's Flat porphyry dyke. Throughout its greater part the East Lode lies close to a fine grained basaltic dolerite dyke, which is of later date than the ore body. This dyke and the ore body are not strictly parallel, and the effect where the dyke approaches closer than usual to the shear zone of the lode, is a partial squeezing out of the lode with a consequent reduction of the normal stopping width. This is purely a mechanical effect, so that should it be found on further development that the dip of the dyke changes, and the lode is consequently entirely pinched out, it should be found again without any alteration in values on the other side of the dyke.

The present lowest level on the East Lode is at 550 feet, and is driven north from the Faithful Shaft for a length of about 380 feet. All payable ore vertically above this level has been stoped out by the Ingliston Extended Company. The present holders, the Ingliston Alberts Syndicate, have sunk two winzes each 50 feet deep below the 550 feet level. These winzes, the No. 1 winze and the No. 2 winze, are 40 feet and 145 feet respectively north of the crosscut from the Faithful Shaft.

The lode at the bottom of the No. 1 winze is exposed over a width of 10 feet. The footwall or west side of the winze at the bottom appears to coincide with the footwall of the lode, but a definite hanging wall on the east side of the winze has not yet been exposed.

At the bottom of No. 2 winze the lode is exposed over a width of 16 feet. The western side or footwall of the winze appears to coincide with the footwall of the lode, but bore holes put out into the hanging wall still show gold values continuing.

It is stated by the Manager that the average value of the ore exposed in No. 1 winze and No. 2 winze is about 15dwts. of gold per ton. The basaltic dolerite dyke which lies close to the hanging wall of the lode at the upper levels, has not yet been exposed in either of the winzes.

\* A full description of the geology and ore deposits of the Ingliston Extended mine is contained in G.S.W.A. Bull. 68.

#### Conclusions.

The East Lode is of deep seated origin and the gold values are likely to continue to much greater depths than the present deepest workings.

The widening of the lode in the two winzes below the 550 feet level is probably due to the greater distance between it and the basaltic dolerite dyke which appears to have flattened its dip and has, therefore, retreated eastward away from the lode channel.

The present width of the lode is likely to be maintained in depth, unless a further change in the dip of the dolerite dyke causes it to again enter the lode channel.

Should the lode at greater depth be completely pinched out by the dolerite dyke, it should be found again without any alteration in gold values on the other side of the dyke, the barren interval depending on the width and dip of the dyke.

#### *Ingliston Alberts (Ingliston Extended) Main Spur.*

The main spur is a body of quartz almost vertical and striking parallel to and about 70 feet east of the west lode which lies on the hanging wall side of the Paddy's Flat porphyry dyke. The Main Spur has been faulted between the No. 1 and No. 2 levels. The effect of this faulting is shown diagrammatically in the plans or plate XV. and the section on plate XIX. of Bulletin 68.

It was suggested to the writer by the Underground Manager, that instead of the faulting being on one plane as depicted in Bulletin 68, it might be on two parallel planes and that in consequence a further body of ore might exist between these two planes somewhere between the No. 1 and No. 2 levels.

After inspection of the fault planes exposed at both levels, and a study of the plans and sections in Bulletin 68, the writer is of the opinion that the conditions as depicted by the plans and sections in Bulletin 68 actually do exist, and that therefore no isolated body of ore representing a displaced portion of the Main Spur will be found between the two levels.

#### 5.—SUGGESTED BORING FOR "DEEP LEADS," GREENBUSHES TINFIELD.

(F. G. Forman, B.Sc.)

The first locality examined was an extensive sandy flat at the head of Moulton Brook (locally known as Battler's Gully). On the old Battler's Hope leases, M.L's. 313-314, two deep shafts have been sunk, with the object of prospecting for a "deep lead." These shafts are now inaccessible, but the following extract from Bulletin 32 describes the conditions as found and coincides with descriptions supplied to me by miners with local knowledge.

Battler's Hope, M.L. 313-314.\* These old leases are situated at the head of Moulton's Brook, more generally known as Battler's Gully, and upon these, close to their dividing boundary, two deep shafts have been sunk, with the object of prospecting for a "deep lead."

The southern of these two was sunk to a depth of 126 feet, cutting the wash at 96 feet 3 inches, where it was about 15 inches in thickness and composed of numerous large well water worn boulders of quartz, quartzite, greisen and mica schist, with softer much decomposed rounded boulders of clayey ironstained rock, the whole being intermixed with ferruginous earth and sand.

At a depth of 106 feet below the wash a level was driven south-west in decomposed mica schist for a distance of 120 feet, which rose into it at a distance of 50 feet from the shaft. Another drive was also carried 40 feet north, when work had to be abandoned owing to the collapse of the shaft bottom.

Another shaft was sunk a little farther north to a depth of 103 feet, bottoming upon a hard diorite bar, which was driven in 6 feet. The wash in this shaft was cut at a depth of 93 feet, whilst a level drive 60 feet south from the shaft rose into it at a distance of 30 feet.

† From the appearance of the larger boulders at surface it is evident that a true "wash" or river-worn bouldery gravel was encountered, pointing to the existence in past times of running streams of considerable carrying power, and to different climatic conditions from those now prevailing.

A little tin ore was obtained by Mr. Johnston while working the "wash," but it was altogether too poor to be payable. The presence of the ore, nevertheless, gives ground for thinking that the "gutter" of the lead, when found, is likely to carry payable deposits. Above the "wash" there was in the shaft about four feet of dark clayey matter, covered by two feet six inches of fine drift, from which a good deal of water made into the shaft. On top of this drift there was a thin hard band or layer of oxide of iron cement, then 50 to 60 feet of brown mullocky material, with iron oxide concentrations and angular pieces of quartz. Mr. Johnston tells me that this has been repeatedly mistaken in the district for the true bedrock. Near surface the ground is hard white and brown cemented grit and sand. The succession of strata is as described by Mr. Johnston; the shaft being full of water I could not further verify them.

The "wash" and boulders at this shaft were very similar to those at the "Hard Graft" and adjacent shafts above mentioned, and I think there is much likelihood of their being all on the same deep lead.

This deep lead has evidently nothing to do with the present shape of the surface, its course being quite independent of the modern watercourses, and the latter are no guide as to where it might be expected to be met with. To the westward of the "Battler's Hope" it may be entirely removed by the modern erosion of the country, in which case some trace of it should be found where the old channel emerges on the more recent surface, or it may possibly continue as a buried lead, in that case probably going out somewhere towards the junction of Cowan's and Norilup Brooks. At Johnston's shaft the belt of deep ground is some 15 chains in width with shallow ground to north and south, and as the bedrock in the levels was dipping to the north-west it is evident that the shaft must be on the south side of the "gutter," though fairly well in the centre of the belt of deep ground. The next shaft should therefore be sunk further to the north.

From the above it will be seen that the evidence for the existence at this point of a "deep lead" at a depth of about 100 feet is fairly conclusive.

\* H. P. Woodward, Assistant Government Geologist, G.S.W.A., Bull. 32, page 66.

† A. Montgomery, M.A., F.G.S., State Mining Engineer, Dept. of Mines, W.A., Ann. Report, 1903.

From the Battler's Hope leases a sandy flat extends north-westward to Paper Bark Swamp, where dredging for alluvial tin has been successfully carried on, the belt of stanniferous wash extending north-westwards to the exceptionally rich ground on the north side of Spring Gully. Paper Bark Swamp has been worked to a depth of about 12 feet, the bottom of the excavations being marked by a layer, a few inches thick, of well water-worn quartz and greisen boulders resting on a stiff brownish clay. Well holes, up to ten feet deep, in this clay "bottom" have not revealed any tin, but it is doubtful that the clay really represents the true "bottom" of the alluvial wash.

Extending south-eastwards from the Battler's Hope leases through claim 863 to the East Phoenix Lease, M.L. 571, there is a line of stanniferous wash at a depth of 28-30 feet, which has been profitably worked from numerous shafts. The tin bearing layer is a fine to medium grained well water-worn "wash" which is said to have yielded in places as much as  $\frac{1}{2}$  cwt. of cassiterite to the cubic yard. During the early stages of the development of this shallow lead, some trouble was experienced during the winter months through water rising in the workings. It was found that by putting down bore holes or wells into the clay "bottom," the water immediately drained to some lower porous stratum. This proves that the clay "bottom" beneath the stanniferous wash is not the true "bottom" of the alluvial material, and where deeper alluvium exists beneath a known stanniferous wash there is every chance of other payable "leads" existing at greater depth in the deposits. That such "leads," if they exist, are likely to be of high grade is suggested by the highly profitable nature of the shallow wash already worked.

On the East Phoenix, M.L. 571, and the ground adjacent thereto, known as the Three C's, extensive but shallow dredging operations have been carried out at a profit. An inspection of the excavations shows that what has been taken as "bottom" is not the true base of the alluvial material, and that other alluvial beds with possible stanniferous "leads" may exist at greater depth.

Referring to the locality of the Three C's Woodward says\*: "The head of this gully consists of a large water-logged sandy flat, called the Three C's after the original holders of the lease, Messrs. Cowan, Castella, and Clark. In this flat, tin in small quantities occurs in the sand from the surface downwards, it appears to be of lacustrine origin, having been deposited at a subsequent period to that at which the "deep lead" crossed this area as an open valley, and prior to the cutting out of the present deep channel of Cowan's Brook."

The next locality visited was the vicinity of the old Hard Graft Leases, where a deposit of deep alluvial ground (Elliot's "Lead") has been extensively worked, extending westwards from the old Bunbury Lease at the lower end of Bunbury Gully. At the time of my inspection all the workings on this run were inaccessible. The following extract from Mr. Montgomery's report† is of interest.

\* Bulletin 32, page 65.

† Notes upon the Greenbushes Tinflds, A. Montgomery, M.A., F.G.S., State Mining Engineer. W.A. Dept. of Mines, Ann. Report, 1908.

The Bunbury Gully has been shallow ground all the way down, and has been pretty well worked out; but at the lower end there is a deposit of deep alluvial ground, through the Hard Graft and adjoining claims, which appears to belong to an entirely older set of alluvial deposits, and to be part of a "deep lead." In this the "wash" is composed of large well-rounded boulders, and the tin ore is much rounded and water-worn. Some of it is cemented with oxide of iron and requires crushing. I had no time to more than look over the dumps of a few of the claims in this part of the field, but the evidence of a "deep lead" was very obvious. It seemed to run across the course of the present valley, towards the Battler's Hope, and prospecting along this line seems very desirable.

On its south bank Elliot's "Lead" is very shallow, but attains a depth of sixty feet on the Hard Graft Lease. In other places the "lead" is much shallower, the average depth being about twenty feet. The deeper ground appears to represent holes beneath the general level of the "lead," and it is in these holes that the richer tin deposits seem to occur. This feature is said to have been noticeable also in other "leads" on the field.

At the western end of Elliot's "Lead" the stanniferous wash ended suddenly against a bank. This bank coincides with a low southerly pointing spur at the surface and probably represents a sudden bend in the old watercourse.

When this bank was struck, further prospecting on the south side led to the discovery of tin bearing wash at a shallow depth under an extensive sandy flat, known as Poverty Flat.

Poverty Flat has been the scene of profitable dredging operations, but the ground has only been worked to a shallow depth; the bottom of the excavation is obviously not on bedrock, and as the present "bottom" carried tin, if a deeper run exists it may prove to be very rich. The logical position in which to seek a continuation of Elliot's "Lead," which has contributed so richly in the past, is beneath Poverty Flat, where it would seem to have been diverted in a southerly direction after striking the bank mentioned above.

A very brief inspection was finally made of a "lead" running southwards from the old Glasgow Lease at the western end of the town across the main road, and in a southerly direction through the old Mt. Pleasant Lease to the head of Spring Gully.

Bedrock appears to have been reached on the Glasgow and the leases immediately adjoining, but an inspection of excavations on the leases to the south of the main road makes it appear doubtful if bedrock has been truly reached in this locality. A few judiciously located bores would serve to verify this point.

#### *Conclusions and Recommendations.*

The present investigation can in no way be considered complete for the Greenbushes Tinfield or even for the special localities examined. My inspection was confined wholly to a few of the places where mining operations suggested that undevel-

oped "deep leads" might exist, and the testing of which would involve the minimum of time and expense.

Mining operations have proved the existence of a "deep lead" in Elliot's Gully. This "lead" comes against a bank to the west of the Hard Graft Lease and then appears to turn sharply southwards beneath Poverty Flat. From this point it probably turns again and follows a north-westerly course beneath the Three C's and the East Phoenix Lease to the Battler's Hope Lease at the head of Moulton's Brook (Battler's Gully), at which point it has been picked up in the two deep shafts.

A second "deep lead" may exist, running from the rich ground on the north side of Spring Gully south-easterly through Paper Bark Swamp, and joining up with the first "lead" under the sandy flat in the vicinity of the Battler's Hope.

Below their junction the two "leads" probably run westward on the north side of Moulton Brook as shown on the map accompanying Bulletin 32.

The most certain and economical method of proving the existence of "deep leads" is by a series of hand bores put down to bedrock in a systematic manner.

The deep shaft on the Battler's Hope Lease would appear to be on the south side of and close to the "gutter" of a "deep lead." The position of this "gutter" should be fixed by a line of closely spaced bores in a northerly direction from the shaft; and, on the position of the "gutter" being defined, its length and possible value should be proved by other lines of bores put down across the supposed position of the "lead" at the surface.

Other lines of bores should be put down across the supposed position of the "deep lead" at Paper Bark Swamp, the East Phoenix Lease, and on Poverty Flat, with the object of prospecting the "deep lead" in these localities.

The fact that in all these localities tin has been recovered at a profit from the shallow ground suggests that the "deep lead," if it exists, should carry valuable tin deposits.

The location of the sites for the bore holes would of necessity have to be made on the ground, and it is essential, if boring is to be carried out, for a man with practical experience in sampling tin prospects to be present to collect samples for assay, and properly to record the results of the boring.

The greatest depth to which boring would be necessary would be little over one hundred feet, while the great majority of the holes would be much shallower, probably not more than 50-60 feet. The total number of holes to be put down can hardly be judged, but as the work proceeded and the shape and direction of the "lead" became known, fewer bores would be needed than in the earlier stages. The definition of the "gutter" of the "lead" in the four localities mentioned above would probably involve the sinking of from 20 to 30 holes, varying in depth from 60 to 100 feet.