THE DAN RIVULET GOLDFIELD

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PLANS

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INTRODUCTION

The Dan Rivulet Goldfield is one which has received a great deal of superficial attention but very little in the way of organised mine development. Every square mile has been vigorously prospected, thousands of shallow trenches dug, many adits driven and shallow shafts sunk, but seldom have the depths exceeded a hundred feet or so. It must not be supposed that this is because the ore shoots do not persist at depth. Indeed, only a mile to the South of this area lies the New Golden Gate Mine, once Tasmania's most important Gold Mine, 2,000 feet in depth, and producer of over 250,000 oz. of gold.

This is a field where exploration has been succeeded by exploitation rather than by development. Dozens of companies with impressive names but very limited capital have commenced operations, grabbed all the ore in sight near the surface with no regard to economy or safety, and then faded into oblivion. Little money has been invested in any one mine and, consequently, there has been little return. Thus the field has, quite unwarrantedly, gained a bad name.

The present survey has been undertaken with a view to preparing a geological map of the field, and, by the correlation of old and new evidence, throwing some light on the relations of the ore-bodies to structural features.

Time spent in the field amounted to fourteen weeks: from March 6th to April 3rd and from the 15th May to 23rd July, 1947. During the former period Mr. F. Blake was associated with the writer in field work.

PREVIOUS LITERATURE

No report on this field, as a whole, has yet been published but Twelvetrees has reported on the northern portion under the title "Report on the South Mt. Victoria Mining Field" and there have been several reports on individual mines.

The following are the reports, both published and typewritten, concerning this district.

Published -

Report on the Mt. Victoria, Dan Rivulet, Black Boy and Mangana Goldfields - G. Thureau, 1884.

Report on the Mathinna Goldfield - A. Montgomery. Report of Sec. for Mines, 1891-2.

(Although this deals with the Mathinna field, there is a paragraph on the Lady Mary Mine which is in the Dan Rivulet Area.)

Report on South Mt. Victoria Mining Field - W.H. Twelvetrees, 1904.

Typewritten Reports -

Report on the Hinemoa Mine	- R.J. Finucane 24.9.32
Departmental Report on Recent Prospecting Operations in the Vicinity of Lady Havelock and Larandah Mines	- Q.J. Henderson 29.7.36
City of Melbourne Mine, Mathinna	- P.B. Nye, 17.9.41
O'Briens Mine, Dan Rivulet	- P.B. Nye, 11.11.41

No Geological Map of any part of the District has previously been prepared, but there are a few old mine plans in existence.

LOCATION AND ACCESS

The area examined is bounded on the south by the South Esk River and on the other three sides by the plateau, into which the Dan Rivulet and its tributaries have carved their valleys. It is a rectangle measuring nine miles by three miles, the long side of which has a north-westerly bearing.

The township of Mathinna, which is connected by a second-class road, 17 miles in length, to the railhead at Fingal, lies about half a mile to the south of the South Esk.

A metalled road, of excellent grade, follows the valley of the Dan for about seven miles and roads branch from this towards Ringarooma and Pyengana. Although metalled in this area, these roads become unsuitable for normal motor traffic before they reach their destinations. The track, which led from the end of the metalled road near the O'Brien Company Mine to Alberton, is now overgrown and can only be followed in some places with difficulty. Old timber tracks make access easier to some parts of the area.

The alluvial flats on either side of the Dan have been cleared for grazing purposes as far north as Walker Creek and partially cleared to Havelock Creek. The remainder of the area has good belts of timber, including stringy bark, iron bark, peppermint and white gum, some of which is, at present, being exploited by various timber interests. Undergrowth is sparse in the south, but in the north, heavy undergrowth and steep valley sides make access difficult.

Rainfall -

The average monthly rainfall at Mathinna, the nearest meterological station is about 2.7 inches, varying from 167 points in November to 406 in June. The rainfall in the Dan Valley, particularly the northern portion, would be slightly in excess of this.

The decided difference in Summer and Winter Rainfall is reflected in the creek flow and in the Summer and Autumn many creeks become dry. However, there is always a good flow of water in the Dan, and a few tributaries such as Walker and Havelock Creeks do not dry up.

SURVEY METHODS

Through the centre of the area a control theodolite survey was established with branch theodolite surveys along the Ringarooma and Pyengana Roads and the road north of the South Esk River. From this control, compass and taping traverses were run to the various workings. Except in a few instances in the northern portion these were connected either to old lease corner pegs or to control points. Geological boundaries were traversed either by compass and taping or compass and pacing but all pacing traverses were closed and adjusted. Heights which have been based on the reduced level of the Fingal Railway Station (754 feet above sea level) by sets of aneroid readings, were established by theodolite, abney or aneroid or by a combination of these for checking purposes. The few old mine plans available and previous plans by Nye and Finucane have been incorporated in the plans issued.

PHYSIOGRAPHY

Into the Miocene peneplain, remnants of which remain round the periphery of the area, the Dan Rivulet and its tributaries and ancestors have eroded a series of valleys, varying from the mature to the extremely youthful. The greatest valley development occurred during the Pleistocene when the climate was extremely pluvial and hence erosion was intense and rapid, the streams carving out deep and wide beds. Then, as now, the general drainage system flowed in a south-easterly direction into the South-Esk River following the axial direction of the country rocks. However, the head of erosion had not advanced as far to the north as it is to-day.

In the south, the width of the Pleistocene Dan Valley is over a mile, and even small streams like Walker Creek had ancestors sufficiently large to deposit alluvium on a floor 20 chains in width. The present streams have cut beds into these Pleistocene deposits leaving terraces up to 20 feet above the present alluvium.

In the north, the valleys are more youthful, the walls sloping at angles of up to 45° to narrow, steep creek beds in which no alluvium has yet accumulated.

The original peneplain, the height of which (2,500 feet) is constant on the east and west, is 1,500 feet above the valley floor where the Dan empties into the Esk and represents the extreme limit of the present cycle of erosion.

The immediate topography is dominated by Mt. Blackboy, which rises to a height of 2,860 feet or 300 feet above the general plateau level. This extra elevation is due to a small dolerite sill, of which the upper 500 feet of the mountain is formed. The surface contour of Blackboy differs somewhat from the typical dolerite peaks of Mts. Victoria and Albert which lie to the north. Its outline is far more rounded; it is covered by timber to the summit; and its elevation is some 1,100 feet lower.

GEOLOGY

The most important compacted sediments in this area are the slates and quartzites of the

Mathinna Series. A remnant of Permian strata, 200 feet of sandstone, outcrops over a small area on Blackboy. Occupying much of the central portion are large deposits of Recent and Pleistocene Alluvium, accumulated by the Dan and its tributaries. Igneous activity is represented by Mesozoic dolerite, outcropping on the summit of Mt. Blackboy.

Lower Palaeozoic - Occupying the major portion of the area, is a series of Lower Palaeozoic Sediments, referred to the Mathinna Series, which outcrops widely throughout the north-eastern part of the State, but to which, due to the paucity of fossil evidence, no definite geological age can yet be assigned. Thought by the early geologists to belong to the Silurian, the Mathinna Series later was tentatively placed in the Cambro-Ordovician and later again in the Ordovician. In 1934, F. Blake, discovered some fragmental remains in a sandstone formation of this series near Warrentinna. These were examined by Dr. Isobel Cookson who compared them to a species of Hostimella, a fossil plant occurring in the Upper Silurian of Victoria. She is careful to point out, however, that the identification of the fragments as portions of a vascular land plant is by no means certain. Moreover both lithologically and structurally, the beds bear a great similarity to slates and quartzites of Ordovician age both in Victoria and New South Wales.

The sediments, then, consist essentially of slates and quartzites, with intermediate facies which may be described as arenaceous slates and argillaceous quartzites. The frequent alteration of the beds infers a rhythmic oscillation of the strand line during their deposition. Sometimes the movement was rapid as shown by the juxtaposition of a bed of slate and one of quartzite; sometimes gradual, when the intermediate type of facies occurs.

Unfortunately, this frequent alternation of beds, combined with the paucity of outcrops, makes it impossible to establish a key horizon in this series and, therefore, renders certain structural interpretations qualitative rather than quantitative.

In the unweathered state, both the slates and quartzites are dark blue in colour but weathering has taken place to a depth of about one hundred feet so that on the surface, the slates appear green, grey, purple or brown and the quartzite has weathered back to a brown often micaceous sandstone. This weathering has produced in the slate many deuteric minerals, the most common of which are muscovite and chlorite.

The metamorphism of the slates has not been sufficiently intense to form schists, but, in places, there is evidence of slight schistosity, and here, the rocks may be described as phyllites. All the true slates are very fissile, cleavage being well developed and, at right angles to the cleavage, a parting known as the grain plane is often present.

As the cleavage is so well developed, it usually masks the bedding. An exception to this is in Una Creek near the Hinemoa Mine where the slates have weathered along bedding planes rather than cleavage and the north-eastern side of the Hinemoa Ridge is a dip slope of about 35° down to Una Creek. Normally, however, the bedding can only be determined where the

character of the rock changes - either a junction between slate and quartzite or a change in colour of the slate. Earlier writers have either confused cleavage with bedding or have deplored the masking of bedding by cleavage. But cleavage, as well as bedding, is of great assistance in structural interpretation. The cleavage here is flow cleavage and is due to conditions of stress which have caused granulation of the rock mass and hence recrystallization and growth of platy and tabular minerals. These have formed in such a position that their long axes lie in the plane of easiest relief which for a non-rotational stress is at right angles to the maximum pressure. The cleavage direction in this area is sufficiently constant to merit the term regional cleavage. Cleavage is closely associated with folding and it is a fundamental assumption, largely born out by field evidence in all parts of the world, that it is parallel to the dip and strike of the axial planes of associated folds.

The fold axis, as indicated by the cleavage, varies in strike in different parts of this area. In the south it trends at 310° (observed cleavage strikes were all between 305° and 315°), at the Revenue Mine it is 320° and gradually increases to 335° on Strickland Spur. Further north again, it swings back to the north-west and, at Una Creek, is 310° again. The dip of the cleavage, and hence of the axial planes of the folds is usually vertical or closely approaches the vertical with a steep dip to the south-west. This indicates that the folding is nearly upright and symmetrical but with sometimes a slightly steeper dip of the beds to the south-west of an anticlinal axis.

By studying the relationship of the bedding to the cleavage, it can be seen that the axial plane of an anticline, striking as indicated above, occurs about the centre of the area and moreover, the anticline in plunging to the north-west. A few examples from various adits will make this clear. In the Laranda Adit, the cleavage is vertical and strikes at 330° while the bedding, as determined between slates of different colours, has a strike of 340° and a dip to the south-west at 65°. In Bailey's Adit, the cleavage is striking at 318° and vertical, while the bedding, clearly shown by a junction of slate and quartzite, has a strike of 310° and a dip to the north-east of 45°. The strata in these two adits are thus on opposite limbs of an anticline and the bedding is cutting across the cleavage towards the axis in a north-westerly direction, indicating that the fold is plunging that way.

In his report on the Mathinna Goldfield, an area immediately to the south, Finucane postulates a zone of close folding; that is several small folds occurring across the area. The evidence in this field, however, points to one major anticline, plunging to the north-west and deeply eroded by the Dan Rivulet and its ancestors. Certainly, there are many small folds, some of which have been directly observed, but these are in the nature of minor or drag folds, occurring on the limbs of the anticline and having their axes parallel to the main axial plane. One such small fold, about ten feet across can be seen on the northern bank of the South Esk, east of the Dan. The cleavage and bedding are both striking about 310° and the bedding clearly indicates a small anticlinal structure.

Permian

On the slopes of Blackboy, between the 2,150 and 2,350 foot contours, is a small annular belt of Permian Sediments, which have remained secure from erosion by the protection of the dolerite sill, which occurs above them. In the north and west, splendid outcrops occur in cliff faces up to 50 feet in height but on the south and east any outcrop has been covered by dolerite talus from above.

The rocks are essentially sandstones often micaceous, sometimes of such coarse grain size as to merit the name "grit". The basal members contain scattered pebbles, often arranged in bands, of quartz, quartzites and more rarely slate of the Mathinna Series. The weathering of the sandstones is typical; block weathering has produced small cliff faces which show subsiduary ripple and honeycomb weathering.

Structurally, these sandstones are in marked contrast to the sharply folded, underlying, Mathinna Series. They are horizontally bedded except where minor current bedding shows a few degrees of dip. It is interesting to note that the base of the Permian, here, is 500 feet below the underlying Mathinna Series at the Strickland Mine, three and a half miles to the west. This pre-supposes either a large scale fault of post-Permian Age, somewhere on the valley of the Dan or that the Permian sedimentation was on an uneven floor. Certainly, there is no direct evidence of Miocene faulting in this area.

The exact age of the Permian sediments is doubtful as no fossil evidence was discovered, but, lithologically, they may be correlated with the St. Mary's Basal Stage described by Voisey.

Alluvium

In the centre of the area, on either side of the Dan, are large deposits of alluvium of both Recent and Pleistocene origin. On the surface there is little to distinguish between that of the two periods, but a section of each, on either side of a large creek bed just south of where the road crosses Waterfall Creek, shows some differentiation. On the left bank, the Pleistocene deposit consists of large pebbles to small boulders of quartzite, quartz and some slate, entirely unsorted and semi-cemented by iron-stained matrix. The recent alluvium in the right bank consists of well sorted pebbles in an earthy matrix.

Conditions at the time of the Pleistocene were very pluvial and hence erosion was rapid - this accounts for the large unsorted boulders in the deposits and their wide extent. A thickness of 35 feet was measured near the South Esk River, but greater thicknesses may be expected closer to the Dan.

On the right bank of the Dan, near the Golden Horseshoe Sections are two small deposits of high level gravels. These show some consolidation and rounded to angular fragments are cemented by iron oxides. Their age may be earlier than Pleistocene and hence late Tertiary.

Igneous Rocks -

Devonian - Although no granitic rocks outcrop in the area, their intimate association with the ore

veins and close geographical location merit a brief description. Two miles east of Mt. Blackboy and in close proximity to the Pyengana Road, on a property known locally as Dilgers, is an extensive outcrop of igneous rock forming portion of the roof of a subsequent batholith, now exposed by erosion.

This rock is not a granite but a granodiorite, composed of quartz, felspar, hornblende, biotite and small amounts of such subsiduary minerals as apatite and zircon.

The Chief characteristic is the great predominance of lime-bearing plagioclase (in this case andesine) and the subordination of alkali-felspars. Orthoclase is present but only in very small quantities. Hornblende in the sections examined is slightly in excess of biotite.

This is the granodiorite, formed from the extensive magma, emanations from which have also been responsible for the quartz and metallic minerals found in the fissure veins in this and associated fields and it must occur vertically below the present field, though at what depth would be a matter of conjecture. About ten miles to the east of this field is a large area of granite outcropping and forming Rose's Tier. This is a true granite, containing quartz, abundant orthoclase, subordinate plagioclase, much biotite and very little hornblende. This is the granite with which the tin deposits of the State are associated and, although it may be another phase of intrusion from the same source magma from which the granodiorite was formed, it may be connected with quite a different orogenic period.

In microscopic section, these two acid igneous rocks are very different, but even in hand specimens, they are quite distinctive. The granodiorite is a darker even-grained rock while the granite is quite light in colour, with large felspar phenocrysts except for darker patches due to the aggregation of small biotite crystals.

Mesozoic -

Occupying the upper 500 feet of Mt. Blackboy, is the remnant of a small sill of dolerite, assignable, tentatively, to the Jurassic. Outcropping below the dolerite is about 200 feet of Permian Sediments belonging to the St. Mary's Basal Stage. This indicates that the dolerite was injected concordantly near the base of the Permian. Because of the small size of the intrusion, the rock is a fine-grained variety showing no phenocrysts in hand specimens.

In section, the rock is revealed as holocrystalline and ophitic, the tiny plagioclase (labradorite) laths being surrounded by a light coloured augite. The felspar is slightly in excess of the augite and accessory minerals are olivine (altering to iddingsite) and ilmenite.

The dolerite is exceedingly jointed and fresh specimens are difficult to obtain. Weathering along the joint planes has resulted in the formation of iron oxides. The jointing is generally vertical but in no definite direction.

Geological History -

The Geological Record beings here with the accumulation of vast quantities of sediments in a great Lower Palaeozoic geosyncline. The exact age is doubtful but the conditions of sedimentation are clear. Both in the Ordovician and Silurian eras (that is between three and four hundred million years ago) geosynclines stretched for thousands of miles along what is now the East Coast of Australia and Tasmania, between the ancient Australian Shield and the extinct landmass of Tasmantis. Great thicknesses of sediments on the floor of the geosyncline became compacted and their weight caused a down sagging of the floor so that the sediments early became warped and folded. A rhythmic rise and fall of the neighbouring coastline is reflected in the character of the sediments, sandstones (later metamorphosed to quartzites) forming during elevations and mudstones (later changed to slates) when the coastline receded. Marine life, at this time, was sparse and no definite remains of graptolites etc. have been identified.

Many millions of years after compaction, these sediments were subjected to great earth movements and deformation by folding and fracturing ensured. Great granitic magmas welled up towards the surface and hot mineral solutions found their way along the fracture channels in the rocks. Again, the exact period of this granitic intrusion and metallogenesis is in doubt, but it may be correlated with either that of the Middle Devonian or Lower Carboniferous Ages both of which are associated with mineralisation in other parts of Australia.

Then there followed a period of sedimentation and erosion during the Permian and Triassic Ages but only a small remnant of these sediments remains in this particular area. Towards the close of the Mesozoic, there was a great composite intrusion of dolerite, sills and discordant bodies being formed. The remains of a small sill near the base of the Permian has formed the upper portion of Mt. Blackboy.

During the Oligocene, a period of quiesance resulted in the formation of extensive peneplains, which were broken up to a large extent by earth movements during the Miocene. To the west, large scale block faulting resulted in the formation of the Ben Lomond Plateau, but here there is no evidence of any major faults. However, there must have been some echo of this great faulting and several minor faults, and movements along pre-existing fault zones occur trending in a north-westerly direction.

The great pluvial climate of the Pleistocene resulted in rapid and extensive erosion of the Oligocene plateau, and the formation of the wide alluvial plain of the Dan and its tributaries. A period of aridity followed, to be succeeded by the type of climate and moderate erosion which we know to-day.

Economic Geology -

The Quartz Veins

Epigenetic Deposits may be broadly divided into cavity filling and replacement types, but there is always some over-lapping. The fissure veins here are the result of cavity filling but that does not preclude a certain amount of replacement.

In considering any system of fissure veins, a distinction must be made between the two fundamental factors of their being; that is between the rock openings that formed the channel ways of the mineralising solutions and the solutions themselves. This involves a consideration of the structural features including mode of formation, localization and the physical features of the fissures themselves, and the physico-chemical features of the ore-forming processes.

Rock openings may include fractures in which there has been appreciable movement, that is faults, and those in which there has been little or no movement, that is joints. Here, there is no major displacement observable so that the fractures consist of minor faults and joints.

The origin of the fracture system is then the first point to be considered. Although in the field, the direction and inclination of fissure veins, and hence of the original fractures appears to be at random; no fracture is the result of pure accident but of some stress applied at some time to the containing rock mass. The origin of the stress is largely a matter of conjecture but some idea of the direction of stress and hence the direction and type of opening caused by it, has been made possible by a study of laboratory experiments in materials under stress.

In considering any rock mass subjected to stress, a correct orientation of the strain ellipsoid will enable the direction of maximum fracture to be determined. If the stress is sufficiently strong to overcome the internal resistance of the rock mass, fracture will occur along a few planes where shearing stress is at a maximum; that is, along planes of shear at about 45° to the direction of compression (or to the axis of least strain) and perpendicular to the intermediate axis of strain. The angle of the shear planes varies either way from the ideal 45° according to the competency of the rock mass. Although theoretically, two directions of shear fracture can occur, in practice, one direction is often developed to the subordination or even exclusion of the other. In addition to these two directions of shear fractures, tension openings are liable to occur parallel to the direction of compression and it is not uncommon in the field for shear openings to lead to tensional ones or even some intermediate direction between the two.

Applying this principle to the area under review, it can be seen that the most common direction of the quartz veins is north, south and east - west to that these occur in openings along shear planes. The tensional openings are presented by the north-east veins. Thus the force was in a north-easterly direction or in the same direction as that which caused the folding and cleavage. Whether the actual stresses causing the folding and fracture were phases of the same force can only be surmised. It is the custom to speak of zones of fractures and zones of flow and to sharply differentiate them but Griggs has pointed out that all experiments, to date, have shown that in any zone there will be some fracturing. There are a few veins in this field which do not conform to the above pattern. For instance, at the Mabel Section, the quartz veins have a strike of 315°. These may perhaps be explained by rock openings formed by tension during folding and would be developed before more normal openings.

As mentioned above, the force necessary to cause both the folding and fracturing is largely a matter of conjecture but it may well be connected with the uprising of the granitic magma which lies to the north-east of the area. It has been noticed that the shear openings, as well as being at angles of about 45° to the axis of least strain, approximate to the vertical, which means that the intermediate strain axis must be vertical and this is in accord with the vertical stress caused by an uprising magma. As the openings are largely along shearing planes, it would not be expected that they would persist for any great distance, either horizontally or vertically. That is, they would not persist as individual openings, but the zones of shear failure should be persistant and that is why many parallel veins are formed. An example may be taken from the nearby Golden Gate Mine where parallel reefs exist which have a vertical range of about 800 feet and are succeeded at depths by others.

The second aspect to be considered is the formation of the ore itself in the rock openings, which has been provided to receive it. The character of the ore formed largely depends on the composition and location of the source magma, and the precipitation gradient of the solutions, emanating from that magma. Here, as in most districts, it is difficult to obtain any direct evidence of the position and composition of the source magma, but the spatial relations of the neighbouring intrusives, justify the assumption that the hypogene solutions emanated from a deep lying portion of that magma, represented by the granodiorite outcropping on the property known as Dilgers, situated some three or four miles along the Pyengana Road.

The essential constituent of the veins is, of course, quartz and this varies from the dense white vitreous variety to that found in such tensional openings as in the Bright Star Adit, where space has been sufficient for the development of well formed crystals. Staining by iron and manganese oxides often colours the quartz brown or black, and oxides of these minerals are sometimes found in recognizable quantities, as in the Revenue Adit. The quartz is sometimes given a grey appearance by the inclusion of fine-grained sulphides. The most common sulphide found in association with quartz is arsenopyrite, this maybe so fine that it is only visible as a colouration in the quartz, but quite often, as at the Lady Havelock, large crystals are developed. Near the surface it is often weathered to green arsenical compounds. Pyrite is also associated with the quartz in recognisable amounts, and other sulphides present in small quantities include chalcopyrite galena and sphalerite. Whilst most of the gold content of the quartz is in the form of free gold some is contained in the sulphides. Twelvetrees states that for a number of years the pyritic concentrates from the New Golden Gate Mine yielded 10 oz. of gold per ton. At the Havelock Mine from 1900 to 1902, crushings of 621 tons yielded 382.1 oz. of gold and 12.5 cwt. of pyrites. From this pyrites 5 oz. 17 dwt. 19 grs. of gold was obtained showing that the sulphides contained at least 9 oz. 8.5 dwt. of gold per ton.

Ore Shoots -

Interesting as the development of the veins may be, and useful as their position certainly is, the ultimate aim of the economic geologist must be the positioning of the ore shoots themselves. The prediction of these in a large area such as this, with shallow and limited evidence only, is not an easy matter and

approaches the realm of conjecture. However, certain general rules of the occurrence of ore shoots may be formulated and local applications correlated. The first main consideration is, of course, the precipitation gradient of the gold-bearing solutions. In other words, is this area within a zone of sufficient distance from the source magma that, under the existing conditions of temperature and pressure, gold may have been precipitated from the magmatic emanations? Experience in various crushings and assay results from all parts of the field show that gold can, and has been precipitated. Moreover, the vertical range of auriferous deposition has been proved to be a wide one. In the neighbouring field of Mathinna, a vertical range of, at least, 2,000 feet has been proved at the New Golden Gate Mine. Even taking into consideration the closer proximity of the Dan Rivulet field to the outcropping portion of what is assumed to be the source magma, and hence to the underground portion of the magma, a vertical range of, at least, 1,000 feet should be expected.

The two most common types of ore-shoots to be anticipated in this field are the Intersection Shoots and Structure-controlled shoots. The different directions in which the quartz veins have been developed makes the occurrence of intersections very favourable, and, where they do intersect in this series of rocks, the formation of an ore-shoot usually occurs. It would appear that the shoot at the New Golden King Mine was formed in this way. The structure-controlled shoots may occur at any change of dip or strike of the veins. As the Mathinna Series is not homogeneous but consists of facies of rapidly changing competency, it may be expected that the veins will frequently change in direction when passing from slate to quartzite or vice versa. An example of a shoot formed by change of strike, and possibly also of dip, is at the City of Melbourne Mine. A beautiful example of a change of dip causing the formation of a large ore body occurs at the New Golden Gate Mine.

Wall controlled shoots may not be looked for here. The character of the wall rock does not seem to play a decisive role in the auriferous deposition and gold may be impartially precipitated in veins contained by slate, quartzite, or any intermediate type of rock. Secondary ore-shoots formed by enrichment by surface waters do not seem important here either, and, in the search for ore-shoots, particular attention should be paid to the intersection of veins and any changes in dip or strike.

Faulting -

There is no evidence in this area of any great post-mineral faulting and nowhere have the reefs and minor vein systems suffered any major displacement. Further to the west, during the Miocene, great blocks of country were uplifted by a series of north-westerly trending step faults. These terrific earth movements must have evoked some echoes in the neighbouring areas and evidence of these can be seen in the many minor faults, mostly with north-westerly strikes that have been observed during this survey. It must be pointed out that the same direction observable in this faulting and in the fold axes of the sediments is purely coincidental, the forces causing each, having occurred in widely separated Geological epochs. A few examples of this minor faulting may be cited to show the small effect it had on the displacement of quartz veins. In a surface stope at

the Lady Mary, a quartz vein 7" wide has been displaced 30" to the south-east by a fault striking at 315°. The displacement of a 6" quartz vein in the Upper Strickland Adit by a small north-westerly trending fault is only 12 inches. Other small faults have been observed in the Havelock Adit, strike 310° and dip to the south-west at 45°; Revenue Adit, strike 310° and dip to the north-east at 60°; and in the Bright Star Adit, strike 300° and dip to the south-west at 50°.

Alluvial Gold -

Between the valley of the Dan and the highest point where gold has been found in payable quantities (The Strickland Mine) is a vertical interval of nearly 1,500 feet. This means that, from Pleistocene times, a terrific amount of the Mathinna Series with the included gold reef has been eroded away and portion of this mass has been deposited in valley beds as Recent and Pleistocene Alluvium. Therefore, it is reasonable to suppose that quite an appreciable amount of gold is included at the base of the Alluvium. As far as can be ascertained, no serious work has been done to test these gravels. A small adit has been driven into the gravels on the northern bank of the South Esk, about 100 chains east of the Dan, and some gold is said to have been obtained from this. Near the old City of Melbourne track a few shallow prospect holes have been sunk but these are not in the alluvium proper but only in that which has accumulated in a small tributary gully.

If boring were attempted to test the gravels, the best place would be on the Pleistocene gravels at the junction of two leads, such as in the vicinity of Rayner's House, where the Walker Creek Pleistocene deposits meet those from the Dan.

The Mining Properties -

Most of the prospecting and mining was carried on, at least, fifty years ago. Shafts have become filled with water, many adits have fallen in, and most of the deeper workings are now inaccessible. Consequently, a description of the individual properties must, of necessity, be fragmentary and rely to a large extent on old reports and mine plans.

There was no work progressing on any property at the time of my survey, although two 10 - acre leases were still held.

Golden Horseshoe

This property lies on a small hill on the west bank of the Dan, about 40 chains north-west of H.A. Raynor's house, from which it can be reached by a foot track. The lease was first taken up by F. Milson in 1895, but there are no records of any production until 1907, when the Golden Horseshoe Gold Mining Company No Liability commenced operations. There has been a great deal of surface prospecting, but little in the way of development at depth. By 1909, the main shaft had been sunk to a depth of 110 feet and a crosscut put out for 40 feet without striking the lode, and a prospecting shaft sunk 80 feet in gold-bearing stone of limited extent. This latter shaft is probably the one about 80 feet south-west of the Main Shaft. It underlays at 80° to the north-west and suggests the strike of the vein was

about 60°. It now has water to within 10 feet of the surface and both shafts are inaccessible.

During 1910 the Company seems to have abandoned its underground exploration and concentrated on surface prospecting and the crushing of any quartz that could be obtained from surface workings: 1,604 tons of quartz were crushed for 144 oz. of gold. The gold content was not payable and by 1911 the Company had ceased operations. The total recorded production of the Company is 224 oz. of gold from 1,807 tons of quartz. The principal direction of the vein system, as disclosed by the surface workings, is east and west, so that it is the eastern component of the shear openings that is best developed here. In a surface stope, 60 feet south-east of the Main Shaft are two quartz veins, both striking at 90°. The more northerly is from 2-4 inches in width and appears to be vertical; the other is 3-5 inches wide and dips to the north at 60° so that it is possible that they junction at depth. The Main Shaft and the crosscut from it were apparently cut to intersect this formation at 100 feet. There is no information as to the direction of the crosscut but apparently it was to the south and no payable ore was intersected. This means either, that the formation did not increase in value at depth, or else it continued vertically and the crosscut did not reach it. A composite sample taken from this formation at the surface assayed 12 grains of gold and 8 dwt. 15 grs. of silver per ton.

At 440 feet south-east of the main shaft is a shaft underlaying to the north at 80°. The shaft itself is inaccessible but surface stoping to the west indicates a vein striking from 90° to 110° and dipping north at 80-85°. A sample taken at 25 feet below the surface assayed Gold - 1 dwt. 4 grs: Silver - 15 grs. About 400 feet east of these workings and 110 feet below, an adit has been driven for about 60 feet, doubtless with the idea of intersecting this vein at depth. If the strike of the vein persisted at 110°, then the adit has not been driven far enough; if it again swings back to 90°, and this is more likely, then the adit was commenced too far to the south. However, it is rather unlikely that the vein itself would persist for nearly five hundred feet, but being in the direction of shearing fracture it is more possible that parallel veins would make. At any rate the distance driven, 60 feet, is not sufficient to prove anything concrete.

At 110 feet north-east from the last mentioned shaft are two surface stopes extending for about 50 feet on an easterly vertical vein. The vein nowhere exceeds 6 inches in width and two samples taken about 45 feet apart and 15 feet below the surface assayed -

Gold - Trace and 15 grs.
Silver - 1 dwt.19 grs and 15 grs. respectively

The quartz from all the formations examined is of a white vitreous character showing staining by iron oxides, but no indication of any sulphide content.

Scattered over the lease are various other small shafts, holes and trenches which indicate a zealous, if haphazard search for surface formations. No real development has been done at depth so that the property cannot be condemned for poor gold content of surface formations which after all are merely cappings of deeper vein systems.

City of Melbourne Mine

This is situated in the foothills of Heaton Hill about 40 chains to the south-west of the Golden Horseshoe. A cart road formerly led from the metalled road at Raynor's house and sidled over a small hill to the mine.

It was in 1872 that the claim was first taken up but no records of workings or production survive. The mine was later abandoned but, subsequently, taken up by various lessees from 1887 to 1904. The New City of Melbourne Gold Mining Company N.L. was formed in 1894 and operated intermittently until 1902. Most of the underground work on the property was carried out at this time. Two inclined shafts were sunk and levels opened out prior to 1896 and a vertical shaft sunk after this date. A battery was erected near the Dan and yielded, in 1899, 60 oz. of gold. The leases were again taken up in 1903 but little subsequent work was done. During the quarter ended September, 1905, 22 oz. of gold were produced from 13 tons of quartz, and for the quarter ended June 1906, the production was 6.5 oz. from 25 tons.

The quartz occurs in reefs striking in two general directions, 90° and 45°. The former strike represents one of the shear fractures and the latter the tensional. They both dip steeply to the south at about 70° although in one place the dip changes to the north at 80°. The reef quartz is often very white and barren but sometimes has iron and manganese oxides associated and in the workings the darker colour of the quartz suggests the presence of a small quantity of finely divided sulphides.

In 1941, P.B. Nye visited the mine and made a comprehensive report on it. The following description of the workings is taken from that report.

"The main workings include three shafts and drives at two levels. For the purpose of convenience of description the shafts will be referred to as the Main and No. 1 and No. 2 shafts and the Levels as the No. 1 (or 50 feet) and No. 2 (or 90 feet) Levels. The Main shaft is a vertical one and is stated to be 100 feet deep, but it is filled with water to within about 80 feet of the surface. The Nos. 1 and 2 shafts are inclined shafts sunk on the reef. The No. 1 shaft was sunk to an inclined depth of 144 feet from the surface or 128 feet from the trench approach. The No. 2 shaft was sunk to an inclined depth of 90 feet. The levels are shown in the plans and sections on the attached plate.

The Main shaft is not shown on any of the available plans and it is not known whether, and how, it is connected to the No. 2 level from No. 1 shaft.

At present, the only underground workings that can be entered and examined are the Nos. 1 and 2 shafts and part of the No. 1level.

Examination of the ends of No. 1 shaft is difficult but a vein immediately under the hanging wall appears to persist down the shaft. At the top the vein appears to be 6 to 8 inches wide and at the bottom (No. 1 level) 6 inches wide. The vein may retain similar widths throughout the shaft, but at some places it seems to be narrower.

Going eastwards along the south drive at the No. 1 Level at 6 feet, a 2-inch vein is present on the footwall; at 12 feet a small amount of rubbly quartz between walls 36 inches apart; at 21 feet there are two veins, each 3 to 5 inches wide, one being on the footwall; at 36 feet a lens of white quartz commences and continues to the face. The last quartz referred to has a maximum width of 30 inches and at the face consists of a vein, 2 to 6 inches wide, with veinlets throughout a 24-inch formation. A small amount of stoping has been done above the back of the original drive and the mine section shows a stope 10 to 30 feet long extending downwards to the No. 2 level (owing to filling in the old drive the latter stope cannot be detected).

The west drive at the No. 1 level can be examined for 33 feet only. An unfilled stope rises above the level and connects with No. 2 shaft. There is a vein 4 to 9 inches wide, under the hanging wall. From 33 feet westwards the level and part of the stope are filled with waste rock which has rilled from No. 2 shaft. A sample across 6 inches taken from the back 3 feet west from the No. 1 shaft assayed 2.1 dwt. of gold per ton.

The reef has been stoped from the western end of the No. 2 Shaft. A vein up to 6 or 8 inches wide appears down the eastern end, but examination and sampling were almost impossible. A sample taken at a depth of about 25 feet assayed 38 dwt. per ton but this figure cannot be taken to indicate the average grade of the quartz.

According to the mine sections, the lower 20 to 25 feet of the No. 2 shaft must be filled with waste rock. The east and west drives cannot, therefore, be entered. At present, a western drive extends for 20 feet (probably on top of filling and 20 to 25 feet above the No. 1 level), and then turns to the south-west and is inclined downwards for a length of 20 feet. This suggests that from the surface to this level, the change of strike of the reef pitches to the west. The latter portion of the drive is in solid ground and, at the face, reveals a white quartz reef 20 inches wide. This portion of the reef dips to the north-west at 80°.

The downward extension of the No. 1 shaft and the No. 2 level cannot be entered, but are shown (from old mine plans) on the attached plate. It will be noted that the only stoping is that already referred to above from the east drive of the No. 1 level.

The latest date on the mine plans is 14.4.96 and it is not known, of course, if there were any stoping subsequent to that date.

No information is known as to the workings from the Main shaft but the latter was probably connected with the No. 2 level. One portion of the dump contains white quartz similar to that in the southern end of the No. 1 level. Mr. E.A. Lowe states that the last half-ton of quartz from the shaft was tipped into a launder and was later (after the mine workings were stopped) crushed and gave a good result.

This statement may represent what actually occurred but of course it cannot be verified or otherwise. In any case, the driving at the No. 2 level indicates that the reef channel has been well tested at the approximate depth of the bottom of the Main shaft.

The conditions in the mine were not satisfactory for sampling and many stagings would have to be erected to permit systematic sampling".

Further sampling was undertaken by Q.J. Henderson in 1942, mainly in No. 2 Shaft and the results which include up to 18 dwt. of gold per ton of quartz are shown on the accompanying plan.

The surface workings include some trenching on the reef and to the south-west, two long shallow, transverse trenches which, apparently, failed to pick up the lode. A sample taken from a trench, north-east of No. 2 Shaft across 7" of white vitreous quartz showed no gold content.

It would thus appear that there are two small ore shoots revealed by the workings. That to the east has a vertical pitch and seems to taper with depth. That to the west is larger and has a steep pitch to the east, which may, however, change to the west at depth. The shoots have been occasioned by the change of strike, and possibly in the western one by the change of dip, of the veins. The western shoot does not seem to have been stoped below the No. 1 level and it is possible that the easterly pitch steepens to, or even beyond, the vertical, and hence valuable stone may occur to the west below this level.

True Blue

Twenty chains west of the City of Melbourne is a 10-acre lease 808/93G containing some workings known as the True Blue, or sometimes, locally, as the Bell. This lease was held in 1896/97 on the site of a former 20-acre lease, which seems to have been applied for in 1872. The only workings are two shafts, the shallower of which is filled with water. The other is an underlay shaft about 45 feet in depth on the top of a small ridge. It is underlaying to the south at 80° and suggests an east-west reef, parallel to that at the City of Melbourne. A grab sample of white, iron stained quartz from the dump assayed but a trace of gold.

Lady Mary

Sixty chains north-west of the City of Melbourne Mine and forty chains south-west of the Dan, on section 511/93G of 10 acres, is the Lady Mary Mine. The section was first taken up in 1888 but after a very short trial, work was abandoned. In 1892, work was again resumed and during this year, the property was visited by Montgomery, who included a few paragraphs about the mine in his report, of that year, on the Mathinna Goldfield.

The quartz veins, which have a general north-easterly trend and are, therefore, the result of the in-filling of tensional fractures have been exposed over about 150 feet by a series of surface stopes

and shallow shafts. These stopes are still accessible in part and show three different veins which are all part of the same system, two striking at 45° and the most southerly at 65°. They dip to the south-east at angles from 70° to 80° and their width varies from 4 to 15 inches. The quartz is of the hard white vitreous variety, stained by iron oxides and containing black manganese oxide. A series of samples, the positions of which are shown on the plan gave the following assay results.

Sample	Vein Width	Sample Length	Gold dwts.	Gold grs.	Silver dwt.	Silver grs.
Lady Mary II	2 - 4"	4'	0	6	1	16
III	6 - 15"	15'	0	12	0	6
IV	7"	6'	1	13	0	12
V	7"	4'	0	12	0	6

A main shaft was sunk about 60 feet to the south-east of these stopes, presumably to intersect the formation at depth. At the time of Montgomery's visit the shaft had been sunk to a depth of 105 feet and the intention was to sink further before driving for the lode. It must have been sunk deeper as the dump shows blue unweathered slates whereas at 105 feet the country was still the weathered brown slates. To what depth the shaft was sunk and what crosscutting was necessary at that depth to intersect the lode is not known but, on the dump, there is certainly some quartz, greyish white in colour due to the presence of arsenopyrite, which shows some oxidation to green arsenical compounds. A grab sample of this quartz from the dump gave an assay result of 19 grains of gold and silver per ton.

Eighty feet north-east of the Main shaft is a small vertical shaft, 25 feet deep, in which, Montgomery states, a reef had been cut. If so, it might be an easterly continuation of the southern-most vein revealed in the old stopes.

There is no record of any production from the Lady Mary and it would suggest that the reef was intersected below 105 feet and proved unpayable at that depth.

Heaton

The Heaton Workings are situated about 20 chains north-west of the Lady Mary, on the opposite side of a small gully. No previous reports or statistics have been issued and the Main Shaft is inaccessible, so that only surface information is available. The workings are all situated on lease 1165/93G of 10 acres, the centre one of five abandoned leases stretching east and west. This was first taken up in 1895 and later acquired by the Heaton Gold Mining Company No Liability. The Mineral Industry for the quarter ended September, 1902, states that a new discovery was made by Clayton about 150 feet north of the old workings. Some rich specimens were recorded and a shaft sunk 15 feet and some trenching north carried out. The lease was last held in 1908 by Robert Hay.

The workings consist of a Main Shaft, several shallow shafts and surface stopes. The Main Shaft is vertical and contains water at about 120 feet. There

are two other shallow vertical shafts, and 200 feet north of the Main Shaft is a shallow underlay shaft, 20 feet deep. This has been put down on an oxidised quartz vein some 4" in width which strikes at 90° and dips to the south at 75°. A sample taken over four feet at the bottom of the shaft assayed gold - 12 grains and silver - 3 grains per ton.

The surface stoping indicates several veins parallel to this and all dipping south at steep angles. A sample taken from one of these, in a stope at 45 feet below the surface, assayed - gold - 2 dwt. 15 grs. and silver - 12 grs. per ton. This formation was 6" in width and had a strike of 90° and a dip to the south of 65°.

Two hundred and fifty feet north-west of the main shaft is an underlay shaft dipping south at 85°. This probably represents the scene of Clayton's discovery but has since fallen in.

The veins at the Heaton represent several parallel shear openings. They have no great width or value near the surface and insufficient work has been done to establish any length. If anything of interest was intersected in any possible main shaft workings, it is not known, but no paddock of quartz was seen in the dump.

King Solomon -

Another 20 chains north-west from the Heaton Sections are three 10-acre sections, the two eastern of which 604/93G and 605/93G contain the King Solomon Workings. No record exists of these workings but the leases seem to have been applied for in 1896 by W.A. Solomon and cancelled the same year.

Not only are the workings extremely superficial and haphazard but the veins themselves are small and irregular in direction. The workings consist of four shallow vertical shafts, averaging 25 feet in depth and a number of surface stopes and trenches. The veins, only a few inches in width strike in various directions but the most definite is a quartz vein 6" in width, exposed in a surface stope and striking 35° with a steep dip to the north-west. A sample taken over 10 feet vertically assayed 1 dwt. 4 grs. of gold per ton. The quartz is very white and dense with some iron staining but no contained sulphides.

The workings are too superficial for any deductions to be made about the vein system and the directions recorded at the surface may have no bearing on the positions at a reasonable depth. However, the general direction seems to be, as at the Lady Mary, in a north-easterly direction and probably represents the direction of tensional fracture.

Bright Star -

The most northerly of the preceding groups of workings is the Bright Star(also known as the Digby Coleman) which lies 30 chains beyond the King Solomon. The workings occur on lease 1087/93G of 10 acres which was originally applied for in 1888. Later, it was held in 1897 and taken up by the Bright Star Gold Mining Company No Liability.

The workings consist of an underlay shaft, now fallen in, some surface trenching and a short adit.

No veins of any size have been located but several between ½" and 3" in width, exposed both in the adit and surface workings, are of academic interest in that they follow the shear pattern of both 90° and 360°. Of different origin is a tensional opening exposed in the adit. This strikes at 60°, has a gentle dip, and contains 1 inch of crystalline quartz and 2 inches of clay between well defined quartzite walls. The quartz contains no gold but a sample taken from a surface cut over 6 feet on a 1" - 3" vein, striking east and dipping south, assayed 12 grains of gold and 6 grains of silver per ton.

The Adit has been driven south-east for 40 feet and at 20 feet and 32 feet small veins only 1" in width, striking at 90° have been intersected. The bedding in the quartzite is not well defined but is, perhaps, striking at 315° with a dip to the south-west at 75°.

New Golden King -

This, the deepest and best developed mine in the area, occupies an isolated position in relation to other workings and occurs some 2 miles south-east of the Dan River on the eastern edge of the zone of weakness with which the reefs are associated.

About half a mile beyond the Esk bridge along the Dan Rivulet Road a metalled road branches to the east and follows the South Esk River. A mile and a half along this road, an overgrown cart road leads in a northerly direction towards the New Golden King Mine. This can be followed up the valley of a dry creek for about a mile, but the workings are a further half mile, on a small spur between two heads of the creek.

There are no previous reports on this mine and the principal workings are in accessible but certain information is available from "The Mineral Industry" and a study of the underground mine plans.

The workings occur principally in two ten-acre leases 1670/93G and 1671/93G, first applied for in 1901. Later in that year, the New Golden King Gold Mining Company No Liability was formed and operations commenced with the sinking of a prospecting shaft and a main shaft. By the end of the year the main shaft was down to 122 feet and the No. 1 level commenced at that depth. An intermediate level at 65 feet was driven from the east shaft which probably corresponds to the prospecting shaft mentioned above. A crosscut of 30 feet was driven east at the No. 1 level, when the lode channel was met. This was driven on north and varied in width from a few inches to 5 feet, and wherever it widened the stone was payable. The country to the south was reported to be broken and a rise was put up to some old prospecting workings disclosing 6" of stone considerably east of No. 1 level workings.

During 1902 stoping was carried out on the reef and the recorded figures indicate a high gold content: 737 oz. of gold were obtained from the crushing of 264 tons of quartz and the treatment of 260 tons of sand. Meanwhile, the shaft had been sunk to a further 70 feet and No. 2 Level opened out at 192 feet. The reef at this level was poorer in quality and recorded production for 1903 was 593 oz. of gold from 1,350 tons of quartz crushed. The erratic behaviour of the lode

and the extreme hardness of the country rock - a dense blue quartzite - were factors that caused a decline in the companies activities during the next two years and after 1905 nothing further is recorded of the mine.

From the above information and a study of the underground plans, it can be seen that the reef, where intersected by crosscuts from the shaft, is striking at 360° and dipping to the west at 70°. The reef was probably discovered near the surface in the West Shaft. A reef passed through in the East Shaft at 25 feet and probably worked from the Intermediate Level would be a parallel one some 30 feet to the East of the Main Reef.

A partial elucidation of the vein system by an examination of the underground plans may be attempted. At number one level the reef was driven on for 30 feet on a bearing of 360°, showing that it had been formed by the filling of a shear opening. The drive then turns to the north-west and continues for about 50 feet. Now it is quite possible that the original shear opening had ended in an existing fracture formed by tension during folding and perhaps even mineralised to a certain extent. This is what has happended at the New Golden Gate Mine where the principal reefs end at a north-westerly "slide". After driving along this Golden King "slide" for about 50 feet, crosscuts were put out in an endeavour to locate the reef again but in this the company apparently failed.

To the south the reefs must die out at least near the surface. An adit was driven from a point 125 feet south-east of the shaft and 25 feet vertically below it in a westerly direction for 350 feet, but no definite reefs were intersected. Forty feet from the portal a winze was put down to the intermediate level and all this first portion is now fallen in, but entrance to the adit can be gained past here. However, if the reef worked between 1 and 2 levels, maintained a constant dip it should have been found about the position of the winze at adit level. At 100 feet from the portal are small black oxidised irregular veins; at 190 feet are small north-south fracture zones containing a little shattered quartz and at 305 feet a 1 inch quartz vein dipping east at 60°, but no defined reef channel was encountered in the adit. The country rock consists of hard bluish slate, well weathered in the first 200 feet of the adit. The bedding shows a strike of 300° with a dip to the north-east at 30° while the cleavage is striking 315° with a vertical dip. This shows that the workings are situated on the eastern limb of an anticline which is plunging to the north-west.

Two other small adits, one 36' and the other 18' have been driven south of the main adit. In the more easterly one a 2" vein of white vitreous quartz striking at 45° was intersected. The bedding observed in this adit by the inclusion of a narrow band of very fissile slates in argillaceous quartzite showed a dip to the south-west and this indicated the presence of a minor fold. The smaller adit revealed several 1" veins containing white vitreous quartz with no gold content.

Further exploration of this area, at depth, would probably reveal other quartz reefs parallel to the ones exploited - that is with a 360° strike. However, a diminution of values may also be expected at depth. This is not unreasonable when it is considered that the Golden King is probably nearer the source magma than other mines in this area and, because of that, may be close to the lower limit of the zone of auriferous precipitation.

The Waterfall Mine.

Situated on lease 325/G, 20 acres, this property is located on the south-easterly foothills of Mt. Blackboy and 15 chains west of Waterfall Creek. A road suitable for motor traffic branches from the Pyengana Road and leads to within half a mile of the workings.

The lease was taken up in 1903 by the Waterfalls Gold Prospecting Association No Liability and work was commenced in that year. The lease was cancelled in 1904. The workings consist of an underlay shaft with some stoping, two shallow shafts with some trenching and an adit.

F. Blake visited the property in 1936 and sampled a quartz vein exposed in a shallow shaft and surface stope for 16 feet. The vein is only 4 to 6 inches wide at the surface but at 7 feet it is 9 inches. The strike is about N.8° east and it is dipping to the east at a high angle. Samples indicated a low gold content varying from gold - nil to 2 dwt. 2 grs. and silver - nil to 13 grains. Sixty feet east of this and 30 feet below an underlay shaft has been sunk for about 70 feet on a vein trending N. 75°E and dipping to the north at 80°. Some stoping has also been carried out to the east and west. These workings have now collapsed but a sample taken from the collar of the shaft assayed gold - 2 dwt. 2 grs. and silver - 2 dwt. 15 grs. per ton. The sample consisted of quartz, stained and impregnated with iron oxide and containing some pyrite and represented portion of the lode capping. At approximately 100 feet below the collar of the shaft an adit has been driven for 280 feet - first for 260 feet on a bearing of 290° and then at 340° a crosscut has been put in for 20 feet. Nothing of any consequence was found in the adit. A few small irregular quartz veins of the order of 1" in thickness and having a general easterly or northerly strike were intersected at intervals. The country rock is of weathered slates and, owing to hill slip, gives some very contradictory cleavage directions for the first 200 feet. However, towards the end of the adit the normal direction of bedding and cleavage is obtained. The strike of the bedding is 305° with a north-easterly dip of 60°.

The mystifying thing about this mine is why the crosscut was stopped. If the vein continued, its dip of 80° it would reach adit level just about the position of the face in the crosscut, but there is no reason why the dip should not flatten and the few extra feet of crosscutting necessary to cut it would be negligible compared with total adit length.

October -

These workings are situated on lease 1083/93G of 10 acres, which borders the Ringarooma Road about three quarters of a mile beyond its junction with the Dan Rivulet Road. The lease was first applied for by Leslie Jolly in 1897 and a private report to him from J.M. Potter in 1898 mentions that by then the Main Shaft was down 84 feet and a level had been commenced at 80 feet.

The workings which are within 100 yards of the Ringarooma Road consist of three shafts, a vertical and two underlay. The underlay shafts are at bearings of 50° and 60° and dip to the north-west at 80°. This suggests that the direction of the lode is about 55° with a north-west dip and this agrees with the position of the Main Shaft which is 100 feet from the others in a north-westerly direction.

However, Potter gave the bearing of the main lode as N.20°W and stated that at 80 feet in the Main Shaft, levels had been driven 40 feet north and 40 feet south. Even if he is astray in his bearings, other information he gives may be considered. At 80 feet the lode was 80 feet long with an average width of 2.5 feet and an estimated value of 17 - 20 dwt. per ton. Also the stone was strong and of average width on the floor of the level and 4 feet lower on the bottom of the shaft. Whether any further development was attempted below this level is not known but the recommendation that an adit should be driven at a lower level was not adopted and the lease was forfeited in 1901.

A grab sample of quartz impregnated with arsenopyrite obtained from the dump of the more easterly underlay shaft assayed only 1 dwt. 13 grains per ton.

Ten chains west and 100 feet above the workings a formation containing crumbled iron-stained quartz carrying a little sulphide has been cut in a hole twelve feet deep. This is 3 feet wide, strikes 360° and dips to the west at 70° but a composite sample showed only a trace of gold and silver.

Mabel. -

This property is also known as Dan's Reward and is situated on lease 1213/93G, 10 acres, on a small spur just north of the old Ringarooma Road and midway between the present Ringarooma Road and the Dan Road. The lease was first held in 1896, and cancelled in 1897. It was again taken up in 1898 and after some developmental work, a trial crushing of 96 tons of quartz yielded the disappointing return of 38 oz. of gold and work was suspended.

During 1900 it was worked on tribute and some payable stone was raised from underfoot at the 100 foot level. A crushing of 22 tons yielded 38 oz. 13 dwt. of gold.

The workings are very superficial and consist of an underlay shaft which, according to old records, must be at least 100 feet deep, dipping north-east at about 85° and some surface cuts. In a trench to the north-west of the shaft a quartz vein 8" in width, strikes at 320o. It consists of dense pink coloured quartz and contains no gold content. A parallel vein to this is exposed in a collapsed cut 200 feet to the north-east. In this cut also can be seen a formation which makes for a few feet to a maximum width of 15" but narrows to a thread both up and down. An assay result of this showed gold - 19 grs. and silver - 6 grs. per ton.

The general direction of the veins and the poor results obtained during the working of the mine does not seem to warrant further development of this particular prospect.

Revenue -

This mine is located fifty chains north-west of the Mabel and 20 chains east of the Ringarooma Road. The area was first leased in 1897 but little work seems to have been done and the leases were cancelled in 1898. Operations were commenced in 1901 by the Revenue Prospecting Association. In 1902 a trial crushing of 18 tons of quartz yielded 23 oz.

11 dwt. of gold from a reef 4 to 5 feet wide so an adit was driven at a lower level and a battery purchased. However, when production was commenced, returns were very low, viz :-

Year.	Quarter Ended.	Quarter Crushed TONS	Gold OZ.
1902	December	50	14
1903	March	84	16
	June	150	24
	September	109	21
	December	-	6

an average yield of less than 4 dwt. per ton.

The leases were declared void in 1904.

The workings consist of some shallow shafts and surface stopes, all fallen in and an adit, 375 feet in length which is accessible. The vein system here has been formed in the east-west fracture system and as may be expected there are several parallel quartz formations, striking at 90° and dipping north at high angles, The most northerly can be followed for 150 feet in the surface workings and is dipping north at 80-85°. Other formations have been intersected in the adit at 155', 325' and 337' respectively from the portal. At 155' the formation which varies from 10 to 20 inches has been driven on for 16 feet to the west and a winze, since fallen in, put down to the east. The strike of the vein is 90° and is dipping north at a steep angle. A small fault displaces the reef 12". The quartz is white and crystalline and little stained with iron oxides. A sample taken from the western portion of the vein showed no gold and one from the eastern portion, across the face assayed gold - 1 dwt. 13 grs. and silver - 12 grs. per ton.

At 325 feet, a vein 18 inches in width and other smaller parallel ones have been driven on for 33 feet west and a few feet east and some stoping has been carried out. The vein is striking at 90° and dipping north at 80° and seems to have been cut off to the west by a mineralised fracture zone striking at 315°. A sample taken from this formation showed no gold content. The formation contains appreciable amounts of the oxides of iron and manganese. The third formation intersected in the adit, at 337' seems to be one that was worked from the surface. At the adit level it consists of several parallel veins, all small, the widest being 7", striking at 90° and dipping north at 80°. The quartz is more glassy but still very white and dense and an assay return showed but a trace of gold and 12 grains of silver. None of the quartz showed any sulphide content.

The country rock passed through in the adit is dark blue fissile slate, all more or less weathered. Several small faults are evident but there are no signs of major displacement. At 55 feet there is a small fault zone in which iron oxides have developed, striking at 310° and dipping north at 60°.

It would appear that although the vein system is regular and well developed in this mine, the gold content of the quartz is low. There is a possibility of improvement of values at depth and any future work here should be in testing the known veins at depth.

Sections 819/93G, 821/93G. -

A certain amount of prospecting work has been carried out on these two ten-acre sections which are located on the foothills of Blackboy, forty chains north-east of Baker's house and on the eastern bank of the Dan, On 819/93G a shaft has been sunk, 10 chains east of the Dan and 130 feet above it, on the northern edge of a small gully. This shaft which underlays to the south east has water to within 15 feet of the top and no formation could be seen, but some lumps of grey,quartz containing fine-grained, disseminated arsenopyrite are lying on the dump. A hand picked sample from this assayed gold - 6 dwt. 19 grs. and silver - 4 dwt. 10 grs. per ton. Two hundred yards farther up the gully on the opposite side is a small cut, 36 feet in length, which has exposed some massive quartzite impregnated with a network of quartz stringers. One definite quartz vein 1 - 2" in width seems to strike at 45°, but it is quite possible that the whole formation simply represents a surface floater.

At 120 and 140 feet north-west of the shaft are shallow trenches which show no sign of the lode. On Section 821/93G, ten chains north-west of the shaft and about the same distance from the Dan, an adit has been driven north-east into the side of a small gully for 70 feet. A few small parallel formations, containing some quartz but only a trace of gold and striking generally north-west has been intersected in this adit but nothing of any importance has been revealed. Considering the strike of the veins in the adit, it is unlikely that anything of value may be expected at depth.

Baileys -

These workings are on a five-acre section 11294/M, situated on the north bank of Walker Creek and half a mile above the crossing of the road to the O'Brien Mine. A cart road leads to within a few hundred feet of the workings which consist of an adit and two shallow shafts. The ground was first taken up in 1899 and again in 1902 and 1903. In 1934 the lease was applied for by H.T. Moses and H.A. Rayner who held it until 1942. The adit is driven in a general northerly direction. Just inside the portal is a narrow quartz vein striking at 355° and at 20 feet a winze, now full of water, has been sunk to a depth of 8 feet.

At 123 feet a formation carrying irregular stringers and bunches of quartz gradually makes into a definte dark grey quartz formation, 2 feet in width and containing arsenopyrite. This is striking at 360° and dipping east at 80°. A sample taken over 12 feet assayed 19 grs. of gold and 19 grs. of silver per ton. This make quickly narrows until at 158 feet it is only 3 inches wide and is cut off by a small fault striking at 290°.

At 193 feet the adit branches, one branch at 290° for 17 feet and the other at 360° for 25 feet. In the face of the right hand branch is exposed a fracture zone, 3 feet wide containing many small veins and striking at 50°.

A sample taken across this formation gave an assay result of gold and silver - nil. This is the same formation which is exposed in an underlay shaft, 31 feet deep and 120 feet above adit level. At the bottom of the shaft, the formation is far better defined than in the adit,

being 2 feet wide and containing quartz veins up to 6" in width. Here the strike is about 45° and it is dipping to the north-west at 78°. The quartz is hard, white and vitreous and contains some finely disseminated sulphides.

In the left hand branch a bed of quartzite 18" thick in fissile slates reveals a bedding strike of 310° and dip to the north-east at 45°. At the same time, the cleavage is 318° and vertical, so the workings are on the north-eastern limb and near the crest of a north-westerly plunging anticline. Thirty feet south-east of the adit entrance, just above creek level, is a shaft almost full of water.

From the work done, this does not appear a very favourable prospect as the main surface formation deteriorates at a depth of 90 feet.

O'Briens -

The O'Brien Company's workings are situated about six and a quarter miles north-west of Mathinna and a quarter of a mile west of the Dan. A metalled road, six miles in length leads from Mathinna to within a mile and a half of the property. From here a sidling road, accessible to motor vehicles in the dry season, leads to the workings.

The first leases, three ten-acre sections, were taken up in 1884 and the ground was leased almost continuously until 1911 but actual mining activity was confined mainly to two periods. The O'Brien Prospecting Association N.L. from 1888-1890 carried out underground work, including adits on the reefs and crushed some 900-1,200 tons of quartz. In 1910-1911 the New Golden Gate Company sunk the Main Shaft to 160 feet and carried out some crosscutting at the 145 foot level. H.A. Rayner held the principal section 1144 2/M of 10 acres, from 1935 to 1943, and I.B. and B.V. Chapman hold it, at the present time, as 17M/43.

Twelvetrees gives an account of the workings, in his report of 1904 and in 1941 Nye visited the property and compiled a typewritten report, relying mostly on evidence contained in old records.

Four main reefs can be traced on the property by surface and adit workings. The two most important are those exposed in Nos. 1 and 2 adits. These reefs are parallel, striking at 70° and having a steep, almost vertical dip to the south. In No. 1 adit, Twelvetrees reports that the reef was stoped for 160 feet, with 30 to 45 feet of backs. The old mine plans show stoping for only 60 feet but these may have been incomplete. The reef was reported to have been up to 24" wide and generally between 18" and 24", but, in the western face of the adit, appears to have pinched. Two winzes have been sunk from the adit floor by the O'Brien Company, one to a depth of 16 feet. It is reported that, later, the New Golden Gate Company deepened one of them to 60 feet. They are now filled with water.

It has been estimated that between 700 and 900 tons of quartz, averaging about 1 oz. of gold per ton have been treated from these workings in No. 1 Reef.

Starlight, Carnegie and King Edward.

These three mines lie in close proximity and latterly were located on the one consolidated lease may be considered together. The workings are located half a mile east of the O'Brien Company's workings on the opposite side of the Dan and may be reached by an old timber track, from the O'Brien Mine road, which fords the Dan and continues to an abandoned timber mill. All the workings are within a few hundred yards of this mill.

The Starlight and Carnegie leases were both originally taken up in 1889 and held by various lessees until 1904, while the King Edward lease was not applied for until 1902, cancelled in 1904 and held again for a short while in 1906. In 1935, S. Chapman and H.A. Rayner held the three leases as consolidated lease 11441/M, 30 acres. In 1942 this became void.

In 1904 Twelvetrees visited the three properties. Some production was going on then from the King Edward and the Carnegie but the Starlight workings were already inaccessible and his information is by heresay only. To-day the Carnegie workings are the only ones accessible and consist of two adits and some minor surface workings.

The No. 1 Carnegie Adit was driven for 113° for 30 feet when a reef striking at 100° and dipping north at 80° was intersected and driven on. At 80 feet from the entrance a winze was sunk 30 feet on this reef and from the bottom, short drives east and west were put out for 10 and 15 feet. Twelvetrees reports that although the reef widened at this depth it proved unpayable but samples by P.J. Plummer in 1939 gave the following results :-

Bottom of Winze. - Width 5'9" - Gold 1 oz.5 dwt. 23 grs.
- Silver 11 dwt. 8grs.

Twenty feet below drive " 3'0" - Gold 2 oz. 15 dwt. 0 grs.
- Silver 1 oz. 5 dwt. 6 grs.

Beyond the winze the reef has been stoped to the surface, 40 feet above, over a width of three to four feet. According to Twelvetrees most of the mine output in 1904 was coming from a "cross course" (that is a north and south vein) which intersected the main reef beyond the winze. This consisted of 18" of blue laminated quartz impregnated with arsenical pyrites and containing small inclusions of slate. A crushing of 100 tons of this quartz is said to have averaged 10 dwt. of gold per ton but samples taken by Twelvetrees assayed only 6 dwt. whereas from the main reef assays of 18 dwt. per ton were obtained. The payable quartz has been so well stoped out that it is difficult to-day to secure a good sample. Samples taken from the adit level near the winze and from the face of the stope near the surface assayed only - gold, trace and silver, 1 dwt. 13 grs. and gold, 15 grs. and silver, 15 grs. respectively.

One hundred feet north-west of this adit, No. 2 adit has been driven for 105 feet in a north-westerly direction. This is too far north to intersect the main reef but at 35 feet from the portal, a quartz formation up to 3'6" in width has been intersected. This is striking at 175° and dipping east at 80°. A sample of grey quartz

containing finely disseminated sulphides, chiefly arsenopyrite, taken across the maximum width assayed but a trace of gold. In the face of the adit are several narrow quartz stringers, striking generally north and south.

About 800 feet west of the reef exposed in No. 1 adit of the Carnegie, the old Starlight Company intersected the reef, in a long crosscut adit driven north from outside their lease boundary. They drove east on this for about 500 feet and stoped to the surface, 100 feet above, at intervals where the reef proved payable. A winze was also sunk on the reef from adit level to a depth of 32 feet and from this 30 tons of quartz averaging 16 dwt. per ton were extraced. The reef in these workings was said to be up to three feet in width and the yield of the mine is estimated to have been between 600 and 800 oz. of gold. Other parallel reefs were intersected in the crosscut adit but were stated to have been unpayable. A line of surface stopes indicates the course of the reef on the surface. Two hundred feet south of the main surface stoping, a fallen in shaft seems to indicate that some work was done on a parallel reef.

The King Edward workings, which are situated 1,000 feet north of the Starlight, consist of two adits driven into a north-south spur at a 40 foot vertical interval. Both have now fallen in and are inaccessible. The lower adit was driven at 75° for 115 feet where a few inches of rubbly quartz striking at 110° was intersected and driven on for 20 feet. The upper adit was driven on a small vein, striking at 100°. This gradually widens to a foot or two and at 66 feet from the entrance is divided by a horse of country. Both branches were driven on and stoped, the southern one for 15 to 20 feet. A winze was sunk at the reef junction and some rich ore is stated to have come from here.

In recent years, a trench was cut for about 20 feet on a bearing of 170°, one hundred feet above the upper adit. Irregular masses of quartz occur in the country rock, quartzite, but the work is too shallow to have any structural significance.

Some statistical information concerning the King Edward production, contained in the "Mineral Industry" is as follows:-

1904	..	51 oz.	of gold from 90 tons of quartz.
1905	..	255 oz.	of gold from 78 tons of quartz.
1906	..	17 oz.	of gold from 63 tons of quartz.

The system of reefs on these properties are among the most promising in the area and fully merit further development. The main reefs on the Starlight and Carnegie sections have been intermittently proved for a length of nearly 1,000 feet and, although the reef system is not payable over all its length at the levels worked, it is reasonable to suppose that shoots may improve at depth. Judging by the surface workings of the Starlight the course of the reef is 117°, while at the Carnegie, it is 100°. Therefore, either two separate reefs exist or else there is a change of strike between the two workings. If the former is so, the reefs should intersect and form an ore shoot; if the latter, then an ore shoot should also be expected due to the change of strike. Moreover, reefs are developed in fractures formed in both directions of shear so that rich shoots, at intersections, may be expected. A boring campaign

About 400 feet south east of No. 1 adit, a second adit was driven to intersect the parallel No. 2 Reef. The width of this Reef is stated to have been the same as No. 1, viz. up to 24" and it has been stoped to surface over a length of 80 feet, for an estimated yield of three to four hundred tons of quartz, averaging 18 to 20 dwt. of gold per ton.

Seventy feet east of No. 2 Reef, a north and south reef can be traced by a line of surface stopes. At the southern end a shaft, now filled with water, was sunk to 20 feet. This is the Ironstone Reef and Twelvetrees states that it is 10-12" in width, and 20 tons of quartz was treated from it for a recovery of 23 oz. of gold. This reef does not apparently persist to the north, otherwise it would have been intersected in No. 2 Adit.

A third Adit has been driven, about 600 feet south-west of No. 2 and 100 feet higher. At 50 feet this intersected a fourth reef, striking at 100° and dipping to the north at 78°. The adit itself has been filled in and is only accessible for 40 feet but the reef, itself, may be traced by surface stoping and examined in a shallow underlay shaft, accessible to 21 feet. The reef itself consists of dense white, vitreous quartz showing some iron staining and varies in width from 13" to 36".

All these workings described above are essentially superficial and the only work done to a reasonable depth is the sinking of the Main Shaft. Unfortunately, the Main Shaft now contains water and none of these workings can be examined. According to the Mine plans, the shaft was sunk to 160 feet and a level opened out at 145 feet. A crosscut was driven east for 41 feet, as shown in the mine plans, but for 200 feet according to local report. At any rate, there is no evidence of any reef intersection in this crosscut. A north-western crosscut was also driven for 107 feet, sufficiently far to cut any downward extension of No. 1 Reef. Whether this were intersected and, if so, whether it were payable, is a matter of argument. The mine plans show no drives from this crosscut and the Annual Report of the Secretary for Mines of 1911 contains the following statement. "A good deal of sinking and driving was done by this Company, at O'Brien's section, 8 or 9 miles to the north of Mathinna; but the lode did not prove to be payable below the old adit level". However, local opinion seems to be that the lode was intersected and the Company mislead by those actually working in the mine, as to its real value. It does not seem strange that, if the lode were struck, and it seems likely that it should be, no driving was done on it, even if it proved unpayable at one particular point.

The reef systems on this property are of interest in that they are revealed by the workings as striking in the three recognised directions, and it should, therefore, be expected that intersection shoots would occur. Unfortunately, although some valuable ore was recovered from shallow depth, insufficient developmental work has been done to study the reefs at a reasonable depth except in the Main Shaft workings. However, these are now inaccessible and no reliable information can be gained about them.

to test the reef at depth between the Starlight and Carnegie Sections would have the added benefit of proving if a shoot of ore exists at the intersection of the north-south vein exposed in the No. 2 Carnegie Adit with the main east-west reef. This campaign should then be extended to the east of the Carnegie workings to prove the existence of the reef continuation and its possible intersection with the extension of the O'Brien Company's reefs, which, if they persist, should intersect with the Carnegie Reef about 1,000 feet east of the Carnegie adit workings.

National Investment -

Twenty chains north-west of the O'Brien Mine, on lease 477/G, 10 acres, an adit has been driven for 106 feet. First applied for in 1888, this ground was taken up several times since, until in 1905, it was transferred to the National Investment Trust Corporation of England Limited. The adit is the only sign of activity and it is not known when it was driven but in 1908 the lease was declared void and has not been taken up since.

The adit is driven on a bearing of 263° for 35 feet where a quartz vein has been intersected and driven on for the remaining 70 feet. At 80 feet a winze has been sunk for 6 feet and a short rise put up. The vein consists of greyish quartz, with very fine sulphide inclusions and some iron staining. Where first intersected, it is 4-6" in width but, at the face, it is a mere track. At the bottom of the winze the width is 5". The strike is about 70° and hence is parallel to the main reefs in the O'Brien Company's workings. The dip is to the south at 45° to 50°. A composite sample taken at intervals along the length, assayed gold - 1 dwt. 13 grs. and silver - 1 dwt. 1 gr. per ton, and one from the bottom of the winze showed gold - 6 grs. and silver - 9 grs. per ton.

It would appear that this reef is comparable with those a few hundred yards to the south-east on the O'Brien sections but the portions exposed are neither as large nor as rich as those at the latter place.

Havelock -

The Havelock, or Hickson's mine, is located half a mile north-west of the O'Brien Mine and about 500 feet west of the old Alberton Track.. The workings are on Section 11782/M, 10 acres, one of the only two leases held at present in this area by I.B. and B.V. Chapman. The property was first leased some time prior to 1887 and was held by various individuals and companies at intermittent periods. The present lease was applied for in 1937, and transferred to the present lessees in 1945. No work was being done at the time of my visit.

In 1904, the mine was visited by Twelvetrees and even at that time the main workings were inaccessible.

The workings consist of an adit driven into the hill in a south-westerly direction for 170 feet, an underlay prospecting shaft and a main shaft, 200 feet deep with levels at 100 feet and 140 feet.

Two parallel reefs have been revealed in the workings; one on which the adit has been driven and the other further south, on which the levels have been opened from the main shaft. The adit has fallen in at the entrance and the first 50 feet are inaccessible. Entrance can be gained down a fallen-in portion at 50 feet and at 55 feet the formation is 12" wide. At 70 feet stoping has been carried out to the surface but beyond this for a few feet the vein narrows to a mere track. At 115 feet it has increased again to 16" and here the adit meets a shaft from the surface 30 feet above, around which stoping has been carried out, both above and below adit level. The adit is inaccessible beyond this point. The reef then is striking at 65° and dipping south at a high angle. Twelvetrees estimates its average width at 18 inches but it may be slightly less than this figure. The payable stone has been stoped out of course and a sample taken in the roof of the adit assayed gold - 3 dwt. 9 grs. silver - 1 dwt. 7 grs. per ton.

An underlay prospecting shaft, 30 ft. south-east of the adit mouth was sunk 50 feet and connected to the adit by stoping. It is stated that some good gold was obtained from these workings.

Seventy five feet further east the main shaft was sunk to work the reef at depth. However, a crosscut put in at 100 feet, intersected, at 30 feet, a reef which Twelvetrees believes to be a parallel one. It is quite possible, however, that it is the same reef as was worked in the adit. The dip of this may have flattened and in doing so formed the ore shoot which has been worked from the main shaft. Although Twelvetrees could not visit the workings, he obtained first hand information from the late manager who stated that the reef at No. 1 Level was followed for 200 feet in a south-westerly direction, the first 150 feet being payable. At No. 2 level (140 feet) the reef was driven on for 180 feet on stone, 18" in width, widening to 2 feet at the bottom and yielding 250 tons of 15 dwt quartz. The shaft was sunk to 200 feet but the company had trouble with their pumping plant and did not open out at that level.

Twelvetrees also quotes some production figures for the mine for 1900, 1901 and 1902. During these years, 621 tons of quartz was crushed for a return of 382 oz. of gold, or an average of 12 dwt. 7 1/3 grs. per ton. As well as this, nearly 6 oz. of gold was obtained from 12½ cwt. of pyrites. Not all the gold was extracted, as the Government Analyst in 1902 made the following assay:-

Blanketings	1 oz.	2 dwt.	1 grs.)	
Wilfley Concentrates	4 oz.	16 dwt.	9 grs.)	per ton
Tailings	0 oz.	4 dwt.	21 grs.)	

The history of the mine is not a happy one. One, or even two, strong reefs exist which seem to improve at depth. If there are two reefs, a still richer shoot could be expected at their junction. The mine appears to have been worked by Companies with insufficient capital and inefficient machinery and sometimes by tributors. Hence, only good ore has been picked out and little future developmental work attempted. There is every likelihood of the shoot that has been worked at shallow levels improving at depth and this mine has decided possibilities.

Lady Havelock -

These workings are situated on ground that has never been leased, on the southern slope of Strickland Spur

just north of Havelock Creek. Just before the cart road to the old mill on Havelock Creek reaches the creek, a shoe track branches off to the left. If this is followed for about 30 chains and the Creek then crossed, the workings may be found with difficulty among the scrub and tall ferns that have grown up around them. A brief report on the workings is contained in Twelvetrees' report on 1904 and, in 1936, Q.J. Henderson visited the locality and made a departmental report on prospecting operations then being carried out.

Ninety feet above creek level, a prospecting underlay shaft, 10 feet in depth, has been sunk on a quartz formation, striking at 90° and dipping to the south at 60°. The formation consists of solid lode material containing a quartz vein up to 10 inches in thickness but varying down to 2". The quartz is the grey massive variety containing much sulphide material of which crystals of arsenopyrite and pyrite can be distinguished in hand specimens. An assay of a composite sample from this shaft gave a result of gold - 18 dwt. 7 grs. and silver - 8 dwt. 12 grs. per ton.

Forty three feet below the collar of the shaft, an adit has been driven on a bearing of 351° for 93 feet. Just inside the entrance is a winze which has now fallen in. Twelvetrees reports that it was sunk for 10 to 12 feet on stone 6 - 8 inches in width, which, however, tailed out in a southern dip, the yield decreasing from 15 to 5 dwt. per ton. At 25 feet in the adit a short cuddy was cut to the west and 7 feet farther in a short drive was extended to the east. These have exposed a fairly flat quartz vein-averaging about 9" in width, striking at 45°, and dipping south-east at 45°. The quartz is grey in colour and contains abundant sulphides, principally arsenopyrite. An assay of this quartz showed gold - 3 dwt. 6 grs. and silver - 1 dwt. 23 grs. per ton.

Either of these two formations exposed in the adit may represent downward extensions of the shaft formation but in either case the values seem to decrease at depth.

A short adit, 30 feet below the No. 1 Adit, was driven on a bearing of 330°, evidently with the hope of intersecting the formation exposed in the Upper Adit. Nothing of interest was intersected here, however.

Although samples taken from these workings showed favourable results, the formations seem to decrease in value at depth. However, the work done is far too superficial for the property to be either commended or condemned.

Laranda -

These workings are situated on lease 459/87G of 10 acres about half way up Strickland Spur, a steep sided hill, lying between Havelock and Strickland Creeks. Beyond the O'Brien Company's workings a good cart road leads to an old mill site on Havelock Creek, and from here the edge of the spur may be followed for half a mile in distance and a rise of about 600 feet to the Laranda workings.

This ground was first leased from 1883 to 1884. It was again taken up in 1891 and cancelled in 1892. In 1904 when Twelvetrees visited the area some work was going on but the main adit had not yet been driven. In 1935,

Messrs. Beck and Cox did some prospecting work, surface trenching and a short crosscut from the adit, and the next year Q.J. Henderson visited the area and prepared a departmental report on these operations.

On the ridge of the spur, 600 feet above Havelock Creek a vertical shaft 30 feet in depth has been sunk. Two formations have been intersected in the shaft, averaging 4" in width, striking at 340°, dipping south-west at 75° and, when assayed, showing but a trace of gold. In the western wall of the shaft, a small vertical quartz vein 2" in width and striking at 315° gave an assay result of 15 grs. of gold per ton. About 200 feet south and 90 feet below the shaft an adit has been driven into the hill for 195 feet on a bearing of 360° in weathered slates. At 195 feet two short crosscuts have been put out, one to the west at 285° for 45 feet and the other at 55° for 35'. The western crosscut intersected only some irregular bunches and stringers (¼") of quartz but on the eastern crosscut a mullocky formation containing some quartz was cut at 20 feet. This is 14" in width, strikes at 360°, dips west at 75° and gave an assay result of 19 grs. of gold per ton.

This is possible a downward extention of the formation exposed in the shaft. If so the strike has altered by 20° but the formation in the shaft is so near the surface that no great credence can be placed in observed strikes and dips of formations. The original strike may have been distorted by surface movement, particularly on steep hillsides.

A further 90 feet below the adit mouth, and about 200 feet south of it, a quartz vein, 12" in width with a strike of 340° has been revealed in a small cut. A sample of this was assayed and resulted in gold - 9 dwt. 4 grs. and silver - 4 dwt. 4 grs. per ton. The quartz is impregnated with sulphides of which arsenopyrite is the most prevalent. Now it is possible that this vein represents a downward extention of the formation exposed in the adit. It is about 30 feet too far west if the dip and strike of the formation remained constant but, of course, either may vary. Certainly the observed dip of the quartz reef in the cut was east instead of west but that may be due to surface dislocation. At any rate, values improve towards the bottom of the hill and these workings lead on to the Lady Havelock which are situated near the base of the hill, The formation exposed in the adit is an interesting one and should improve in value as it goes down.

Several other small trenches are scattered about, seemingly at random near the top of the hill. These have disclosed various quartz formations containing little gold but because of their shallow depths and the steepness of the hill slopes, they are of little value in indicating anything stable at depth.

Strickland -

This mine is situated ¾ of a mile north-west of the Laranda, on section 11429M, 10 acres, and is on the highest leased ground in the district, being over 2,500 feet above sea level. It is situated on the summit of Strickland Spur, a steep spur between Havelock and Strickland Creeks and may be reached by following the edge of the spur rising

at about 15° up from the old mill site on Havelock Creek. As the mine is in the general plateau level, a long but easier route would be from the Ringarooma Road which traverses the plateau a mile or so to the west.

This section, together with several surrounding it, was first taken up in 1883 and from that time has been held at intervals by various lessees, the last being W.P. Cox who held it from 1935 to 1941.

The workings consist of two adits and an underlay shaft. The upper adit was driven at 220° for a distance of 30 feet on a quartz formation consisting of a number of quartz veins, the largest being 3" - 6" in width, with well defined walls and dipping to the north-west at 80°. The quartz is white to grey in colour, containing some arsenopyrite and a sample gave the following assay - Gold - 3 dwt. 15 grs. Silver - 2 dwt. 8 grs. per ton. The veins break up in the face of the drive.

The lower adit, 45 feet below, is the important one but, unfortunately, was 3 feet deep in water the time of the writer's visit. However, in 1904, Twelvetrees reported on the mine and an extract from his report is quoted.

"The Lower adit.....has been driven over 200 feet. Mr. Treverton reports 250 feet, but the last part of the tunnel was too wet for me to examine. Quartz was struck about 100 feet in and then lost by the drive which forked to the east. The lode, however, was picked up and the drive continued on the original strike, viz. south-west. The reef dips north-west. I examined the tunnel as far in as the water would permit and at the furthest point found the reef had been stoped out in the back to a height of 15 feet for an equal distance in length. It was here 9 inches to 2 feet of stone intermixed with country. The stone is a white quartz streaked with graphitic and slaty matter and having a kindly appearance. It has been followed a little underfoot but I could not see much as the winze and all excavations in the sole of the drive are now filled with water. I understand that the winzes show a reef of good quality stone, averaging about a foot in width. Mr. John Treverton, on authority considered reliable, reports that the last seven tons of quartz from the north winze averaged over 2½ oz. per ton, plus 2½ cwt. of concentrates saved (9 oz. per ton).

In the south winze the reef is said to be up to 2 feet in width and as the stope above the level also shows that the reef is wider than where it was first struck in the tunnel, it would seem that work has been abandoned just where it ought to have been continued".

Right on the top of the ridge, 95 feet above the lower adit an underlay shaft has been sunk, reported to be 70-90 feet in depth. This has now fallen in and is full of water as is a trench running at 220° from the shaft.

There is no doubt that it is the same formation which has been intersected in the two adits, the shaft and possibly the trench - that is quartz formation striking about 40° and dipping to the north west at 80°. If the lower adit continues on a bearing of 204° for the first 100 feet until the reef is struck, this position would be about 8 feet

north west of the reef intersected in the upper adit, 45 feet above and would agree with the 80° dip recorded in the upper adit. Now it can be seen that the value and width increases greatly in the depth between the two adits so that it is more than likely that it would increase still more at a deeper level. The slope of the hill is about 40° for several hundred feet to the valley of Strickland Creek so that adits could be driven on the course of the lode at much lower levels than at present. It would also seem desirable to clean out the lower adit and prove a possible horizontal extension of the lode.

An interesting feature of this mine is the vertical height at which auriferous quartz exists. It is, at least, 1,500 feet above some mines in the district and proves that the auriferous zone is a wide one and that many hundreds of feet have been removed from some reefs in the neighbourhood.

There has been some production from the mine but no statistics are available in departmental records.

Hinemoa -

This mine, the most northerly on the field, is situated on the north-eastern flank of a steep sided spur, contained between Una and Strickland Creeks about ten miles north-west of Mathinna. Beyond the O'Brien Company's Workings a good cart track can be followed for about half a mile to an old timber mill on Havelock Creek. The old Alberton track continues from here but becomes lost in dense bracken and scrub until after crossing Una Creek it can be seen sidling up a steep spur, north of the creek, at an angle of 12°. Although evergrown, it may be followed up the spur for about half a mile to where an overgrown branch track leads down to Una Creek 230 feet below. On the opposite side of Una Creek, the No. 1 Adit may be found about 30 feet above the creek, in the first gully coming in to Una Creek from the west above Strickland Creek.

The workings are contained in the northern portion of consolidated lease 1143?/M of 30 acres, comprising three former 10-acre leases, 1701/G, 1725/G and 1005/G. These leases were first acquired in 1903 and in that year the Hinemoa Company commenced operations. The leases have been held at various times since, the last lessees being S. Chapman & H.A. Rayner who applied for the consolidated lease in 1935 and held it until 1942. The original company drove an adit on north-south reef for about 200 feet and carried out a certain amount of surface trenching on the reef to the south. Latterly, an upper and lower adit have been driven to test the lode further to the south. Reports on the mine were made by Twelvetrees in 1904 and Pinucane in 1932 but since their reports the two later adits were driven.

The entrance to No. 1 Adit is in the bed of a small gully flowing down Hinemoa Spur to Una Creek. In the Summer this is dry, but during the writer's visit in July, the entrance was blocked by a solid wall of water. The adit is driven south on a quartz lode, showing great variation in width and dipping to the west at from 50° to 70°, but generally at 60°. At the top of the adit, the lode is one foot wide but at the portal is three feet. At 10 feet it narrows considerably and for about 40 feet consists only of a few bunches and stringers. From 60 to 80 feet its average width is 2 feet, while at 110 feet, it has widened to 3 feet and maintains this width for 60 feet. At 170 feet it narrows considerably

until in the face at 220 feet it consists of only a few 1" quartz veins. At 210 feet a short crosscut was put out to the east, as it was thought then that the narrowing of the lode was due to faulting. Nothing of interest was intersected in the crosscut.

Assay samples taken by Finucane gave the following results:-

Location.	Assay Value. Gold.	Silver	Width Ft.	In.
Brown of Adit	2oz. 4dwt. 10grs.	1oz. 13dwt. 23grs.	3	0
76'S. of Brow	0 " 10 " 11 "	0 " 7 " 14 "	2	6
111' S. of Brow	1 " 1 " 4 "	0 " 11 " 12 "	3	0
147' S. of Brow	0 " 9 " 16 "	0 " 3 " 9 "	2	3
167' S. of Brow	Trace	0 " 2 " 8 "	3	0
19' N. of Brow	0 " 7 " 1 "	0 " 4" 23"	1	0

which is an average of 15 dwt. per ton.

A series of trenches has been put down south of the adit on the surface outcropping of the lode which rises from the tunnel at an average of 20°. The hill slopes itself is between 40° amd 35° so that the surface is covered with a few feet of detrital matter. It has thus been a difficult matter to locate the lode and some trenches are either above or below it. The plan shows the position of these trenches and assay results obtained from sampling some of them.

Finucane, in 1932, recommended the driving of an adit to test the lode south of, and 100 feet above, the No. 1 Adit. This was driven at 180° but, since then, has fallen in at 38 feet and is impassible beyond here. There is no sign of the lode in the first 38 feet.

A lower adit was later commenced, 500 feet south east of No. 1 Adit, 18 feet above it, and 130 feet above Una Creek. This crosscut adit was driven on a bearing of 260° and 315 feet from the portal the lode was intersected 235 feet south of where it was last seen in the face at No. 1 Adit. It was driven on 46 feet to the north and 32 feet to the south and over this distance averaged 16" in width varying from 2 feet to 7 inches. The lode does not here consist of one solid quartz vein but several small parallel veins with bands of country rock, sometimes practically disappearing, sometimes as wide as the quartz.

The country rock, generally, consists of weathered slates, but the quartz veins occur in a narrow band of blue quartzite and, themselves, contain appreciable amounts of arsenopyrite and pyrite, the former often showing distinct banding and the latter occurring in large well formed cubes. Samples taken from this formation gave the following assay results :-

Position.	Width Ft.	In.	Assay Value. Gold.	Silver.
Adit Crosscut	2	2	0 dwt. 6 grs.	0 dwt. 9 grs.
20' N. of Adit Crosscut	1	0	1 " 19 "	0 " 19 "
12' S. of Adit Crosscut	0	7	0 " 19 "	0 " 12 "
32' S. of Adit Crosscut	2	0	1 " 23 "	1 " 23 "

Thus the same reef has been proved on the surface and at depth. (The lower adit cuts the lode at 160 feet below its outcrop)

for a distance of nearly 700 feet. Although values are low in places, nowhere is there no gold and the next step should be to ascertain if values and widths improve at depth. This should be done by sinking winzes from the adit where the stone shows the best results. It is reasonable to suppose that a formation which exists so regularly at the level tested should also persist at depth to, at least, three or four hundred feet.

Conclusions -

Because of their mode of origin, and from the field evidence described, it can be seen that the auriferous reefs of this field can not be expected to persist for any great distance, either horizontally or vertically, On the other hand, the expectation of rich ore shoots and parallel reefs is quite favourable. The history of the field has shown that the whole approach to mining has been unfortunate. That is, with a reef system such as this, it is vitally necessary that development should keep ahead of mining, crosscutting should be frequent, and exploration, at depth, should be vigorously prosecuted.

Instead of this, work has been mainly superficial and, when any deeper mining was attempted, it often had to be abandoned because of water difficulties. Shoots of rich ore near the surface have been absolutely cleaned out without regard to economy, safety or future operations. Assay results obtained from old workings indicate this and it is difficult to obtain a sample showing payable gold from any quartz that is left.

Nevertheless, the work done has shown that favourable prospects exist in several localities such as the Strickland, Havelock, O'Brien, Carnegie and Hinemoa. Of these, the most interesting is the line of reef on the Starlight and Carnegie sections and the possible intersection of these with the O'Brien Company's reef system. A boring campaign in this area should prove very beneficial and, if the Carnegie Reefs junction, as it seems evident from the available information that they do, then valuable ore shoots may be expected at those intersections. Apart from this, there are many strong persistent reefs in the locality which have not been proved below a hundred feet or so and which may well improve at depth. If, and when, the known reefs can be proved to be payable at a reasonable depth, then a vigorous policy of crosscutting should be implemented to reveal parallel reefs which can and do exist.

So much attention has been focussed on the reef formations in this field that the possibility of working the alluvial flats for gold seems to have been overlooked. A glance at the general map of the district will show the immense area of alluvial ground, both of Recent and Pleistocence origin. The depth of this is not known and, at any rate, would vary greatly, but it is reasonable to suppose that the Pleistocene deposits would have a thickness of about 50 feet in their deepest parts. It would not be wise to suggest any approach to treatment of the alluvium until some preliminary boring was done to determine if the gold, which undoubtedly has been eroded from the surrounding country has accumulated in payable quantities in any one area.

Signed
Terence D. Hughes.
9/9/47.