1938.

WESTERN AUSTRALIA.

ANNUAL PROGRESS REPORT

of the

GEOLOGICAL SURVEY

for the

YEAR 1937

PERTH:

BY AUTHORITY: FRED. WM. SIMPSON, GOVERNMENT PRINTER.

1938.

F 1931/38.

Table of Contents.

Plates.

Annual Progress Report of the Geological Survey of Western Australia for the Year ended 31st December, 1937.

The Under Secretary for Mines.

I have the honour to submit, for the information of the Hon. the Minister for Mines, my report on the operations of the Geological Survey for the year 1937.

STAFF.

The staff remains at the same numerical strength as last year; it consists of four field geologists, a technical assistant, a junior clerk and a messenger.

Mr. G. H. Armstrong, who was appointed to this branch on loan from the Education Department in 1936, was recalled to his teaching duties in February, and the position occupied by him was filled by the appointment of Mr. M. O'Halloran, B.Sc., who commenced duty on the 22nd March. Mr. O'Halloran resigned at the end of July, and the vacancy was filled by the appointment of Mr. K. R. Miles, B.Sc. (Hons.), who, until his present appointment, was a lecturer in Geology at the University of Western Australia. Mr. Miles commenced duty on the 11th October.

Miss B. M. Bowley, B.Sc., Technical Assistant, resigned in August, and Mrs. G. Blatchford, B.A., was appointed to the vacant position, commencing duty on the 25th October.

FIELD WORK.

Government Geologist.—At the end of January I spent several days at Ravensthorpe on an inspection of the Gem Mine. The opportunity was also taken of inspecting, as far as possible, other old gold and copper mines of the district.

From the 20th February to the 2nd March I was absent in Melbourne, where I attended, as a member, a meeting of the Executive Committee for the Aerial Geological and Geophysical Survey of Northern Australia. This meeting was for the purpose of preparing the Annual Report of the Survey for the year 1936, and to discuss the programme of field work for 1937.

During May I made a geological reconnaissance in the Kundana-Black Flag area, north-west of Kalgoorlie, accompanied by Mr. Ellis. This reconnaissance was necessary in order to assist in the correlation of the rocks of the Kalgoorlie district with those being studied by field parties in the Yilgarn Goldfield.

In June I visited the Royal Standard Gold Mine at Yuin in the Yalgoo Goldfield, in order to advise on the selection of bore sites for the exploration of the reef below the old workings.

At the end of August I visited Norseman in order to inspect a supposed iron ore deposit, and while in the Kalgoorlie district on this inspection I was able to make inspections of the Spargo's Reward Gold Mine at Spargoville, and the Edjudina Mine at Yarri.

During part of September and October I was accompanied by Mr. Ellis on a general inspection of mining activities in the Gascoyne, Ashburton and Pilbara Goldfields. This inspection was made with the object of assisting prospectors in these portions of the State, who are seldom visited by members of the staff of the Geological Survey.

During November I paid a short visit to Greenbushes, in order to examine the possibilities of further development of the tin deposits in the "Deep Lead" system.

During December a short visit was paid to Manjimup in order to inspect a deposit of novaculite on the Perup River, east of Manjimup.

The remainder of my time was taken up with administrative and routine duties at Head Office.

H. A. Ellis, B.Sc., A.O.S.M., Geologist.—During January Mr. Ellis was engaged in the preparation of portions of the Annual Report for 1936, and in office work connected with the re-survey of the Yilgarn Goldfield. Towards the end of the month he proceeded to Southern Cross in order to complete field work at that centre, and returned to Head Office on the 9th February.

From the 10th February to the end of August he was occupied mainly with compiling plans and writing manuscript for Bulletin 97, descriptive of the geology of that portion of the Yilgarn Goldfield south of the Great Eastern Railway.

During this period he accompanied me on my visit to the Kundana-Black Flag area, and for some time was also engaged in preparing a mineral exhibit to be included in a general exhibition dealing with the primary and secondary industries of the State, which was organised in Perth during May.

He also spent one week of this period in field work in the Yilgarn Goldfield in order to clarify matters in doubt which appeared during the writing of the manuscript of the Yilgarn report.

Mr. Ellis accompanied me in September on my visit to the north-west part of the State, and during the latter part of October and early in November, was engaged in preparing plans and equipment for field work in the northern portion of the Yilgarn Goldfield, a re-survey of which it was proposed to commence as early as possible.

At the beginning of November Mr. Ellis commenced field work in the Yilgarn Goldfield, and returned to Perth on the 11th December. During this period he

was called on to make inspections at a new gold find six miles north of Riverina, and the Riverina Gold Mine in the North Coolgardie Goldfield.

R. A. Hobson, B.Sc. (Hons.), Geologist.—From January to August Mr. Hobson was engaged on the preparation of plans and the completion of his reports on field work carried out in the Yilgarn Goldfield during 1935 and 1936. During this period he made two brief visits to the Yilgarn Goldfield to obtain the latest information available on some of the mines which had been examined in the early part of the survey.

During September and October Mr. Hobson made preparations for field work in the Mt. Margaret Goldfield, and attended to routine duties in Head Office during my absence.

On the 30th October Mr. Hobson proceeded to Laverton in the Mt. Margaret Goldfield, and was engaged on field work in the Laverton district until the 17th December.

During the periods he was at Head Office, Mr. Hobson made a number of petrological examinations of rocks submitted to the Survey by members of the general public.

R. S. Matheson, B.Sc., Geologist.—During the whole of January Mr. Matheson was engaged in drafting work connected with the completion of the report on the re-survey of the Yilgarn Goldfield.

Early in February he made a geological examination of proposed dam sites on the North Dandalup River in the South-West district for the Water Supply Department.

The latter part of February and the whole period until August was taken up by Mr. Matheson in completing the manuscript of reports on the Yilgarn district in collaboration with Mr. Hobson.

One week during this period was occupied by a visit to the southern portion of the Yilgarn Goldfield in order to obtain up-to-date information on some of the mines.

From the 26th August to the 4th September Mr. Matheson made an investigation of the geology in the vicinity of the Clackline fireclay deposit. The remainder of the month was spent in making preparations for field work in the Mt. Margaret Goldfield.

On the 4th October Mr. Matheson proceeded to Laverton and was engaged until the end of November on field work in the Laverton district. During this period he paid a number of visits to Agnew, in the East Murchison Goldfield, in order to select bore sites for the Country Water Supply Department.

Mr. Matheson was occupied during December in writing a report on his inspection of the Lancefield Gold Mine.

M. O'Halloran, B.Sc., Geologist.—At the end of March Mr. O'Halloran made an inspection of the old "Deep Lead" at Siberia in the Coolgardie Goldfield, and for the greater part of May was engaged in an examination of the underground workings of the Lancefield Gold Mine at Beria in the Mt. Margaret Goldfield.

The remainder of his time was taken up in the collection of survey data for field work which it was proposed to carry out in the northern part of the Yilgarn Goldfield, and a portion of the Mt. Margaret Goldfield.

K. R. Miles, B.Sc. (Hons.), Geologist.—After his appointment on the 11th October until the 26th October, Mr. Miles was engaged at Head Office in compiling base maps and other data for field work in the Mt. Margaret Goldfield.

On the 26th October until the 17th December he was continuously engaged on field work in the Laverton district. He then returned to Head Office, and for the remainder of December was engaged in drafting work on the field plans, and also in petrological examination of rocks collected by the field party in the Laverton district.

HEAD OFFICE.

Miss B. M. Bowley, B.Sc., and Mrs. G. Blatchford, B.A., Technical Assistants.—Miss Bowley, and, after her retirement, Mrs. Blatchford, continued to perform the ordinary routine work of the office, and, as opportunity offered, made an advance with the compilation of a full index of the Survey's publications. The last index of Geological Survey Reports was published in 1910, as Bulletin 60, and progress has been made as rapidly as possible with a new index, which will give reference to all publications since that date.

Reports following on the work of the staff are attached, except where such are made for departmental purposes.

In conclusion, I take this opportunity of expressing my appreciation of the work and loyal support of each member of the staff during the past year.

F. G. FORMAN,
Government Geologist.

NOTES ON A RECONNAISSANCE OF THE GASCOYNE, ASHBURTON AND FORTESCUE DISTRICTS.

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

A reconnaissance of the above districts during September and October was undertaken primarily with the object of assisting prospectors in these areas.

On the whole, the workings visited were not sufficiently advanced, or were of insufficient value, to justify detailed descriptions, but the following notes on the more important centres visited are published in order to provide early information on the deposits referred to. As the district generally is to be the subject of detailed examination by officers attached to the staff of the Aerial Geological and Geophysical Survey of Northern Australia during the 1938 field season, detailed examination of the deposits was in no case undertaken.

SILVERSHEEN ASBESTOS LEASES. ASHBURTON GOLDFIELD.

The Silversheen Asbestos Leases are situated about eight miles by road east of Meilga Station homestead, and west of Mt. Elizabeth.

The asbestos, which is of the chrysotile variety, is silvery white in colour, and is obtained in seams of good quality material up to 4 inches wide, the average width being perhaps one inch. It occurs as an alteration product of dolomitic limestones which belong to the Brumby Creek beds of the Nullagine Series.

These beds in the locality of the leases strike approximately east and west and dip at angles of from 10 to 12 degrees to the south, and unconformably overlie schists of the Ashburton Series, which in this locality have an approximate east and west strike, and almost vertical dips.

The asbestos occurs in the dolomitic limestones in flat dipping veins parallel to the bedding planes and in steep dipping joint planes, close to the contact of an intrusive dolerite dyke, which strikes north and south, and has a practically vertical dip. The metamorphic effect caused by the intrusion extends only a short distance out from the dyke contact, and consequently the asbestos veins are fewer, and decrease in width with increasing distance from the contact. Development work shows that the greatest distance from the dyke to which the asbestos extends is about 17 feet.

Up to the present time the greater part of the development has proceeded on the eastern contact of the dyke. Sufficient work has been done to prove that asbestos also occurs along the western contact. Present development consists of the sinking of several shallow shafts close to the eastern dyke contact, and the connection of two of these by drives, from which a certain amount of stoping is proceeding. The Main Shaft is about 60 feet deep.

The dimensions of the deposit at present being developed on the eastern side of the dyke are limited. Development has shown that asbestos is not likely to be found further out from the dyke than about 17 feet. On the north the asbestos-bearing beds are limited by the outcrop of the contact of their base with the underlying metamorphic schists. About 500 feet south of this contact the limestones are cut off by a fault parallel to their strike. This fault has an upthrow to the south, and the limestone beds on the southern side, subsequent to their displacement, have been removed by erosion. The greatest possible length of the deposit is, therefore, about 500 feet. The effect of the fault on the south dipping limestone beds has been to reverse their dip close to the fault contact, so that the limestone is now in the form of a shallow syncline. The depth of the deposit is, therefore, limited by the depth below the present ground surface of the trough of this syncline, which at present appears likely to be about 100 feet. The depth, of course, will be less than this towards the outcrop of the base of the limestones, and at the fault contact it is not likely to be much more than 80 to 90 feet.

The asbestos on the western dyke contact still remains to be developed, but here again the dimensions of any valuable deposit will be limited to the same dimensions in length and depth, and probably to a similar dimension in width to that mentioned above for the asbestos on the eastern contact. The width, of course, will depend on the intensity of the metamorphic effect of the intrusive dyke on this side.

A second occurrence of chrysotile also associated with an intrusive dyke, has been found about one mile west of the workings described above. Its quality and the average length of fibre available have not yet been fully ascertained.

There is still ample scope for further prospecting in the district, as chrysotile asbestos is likely to be found as an alteration product wherever the Brumby Creek limestones have been intruded by dyke rocks.

THE MELROSE AND BELVEDERE GOLD MINES AND VICINITY, MT. STEWART STATION, ASHBURTON GOLDFIELD.

The country in the vicinity of the Melrose Gold Mine belongs to the Ashburton Series of metamorphosed sediments, presumably Pre-Cambrian in age, striking approximately north-west and south-east. The rocks consist of greywackes, quartzites and grits, with occasional bands of dolomitic limestone. In places, the series is intruded by basic dykes.

The Melrose Gold Mine is situated at the foot of and on the western side of a low hill, the core of which consists of a large mass of "bucky" white quartz, from which a number of quartz reefs extend in the form of "fingers," which lie generally parallel to the planes of bedding and schistosity of the country rocks.

The ore body in the Melrose Gold Mine consists of one of these quartz extensions from the main mass which forms the core of the hill. The reef is developed on the surface for a length of about 190 feet. It strikes approximately north-west and south-east, parallel to the bedding planes of the enclosing country rocks, and dips to the north-east at an angle of 45 to 50 degrees. Inspection of the surface outcrop, the 50ft. level and the bottom of the main shaft, which is 105 feet deep, indicates that the ore body has a decided pitch to the east at an angle of about 45 degrees.

The reef was encountered in a drive from the main shaft at the 50ft. level, and has been stoped from a point about 15 feet south of the shaft for a length of about 40 feet over a width of from 18 inches to 2 feet. The stope extends for some 15 to 20 feet above the back of the drive. About 60 feet south of the shaft on the same level the reef widens out to some 12 or 15 feet, and this width continues as far as the south face of the drive, which is about 100 feet south of the shaft. The reef has also been cut by a shaft 60 feet deep, which is situated on the line of the reef about 130 feet south of the main shaft.

The quartz constituting the ore body is extremely vughy, and is highly stained with iron oxides. The vughs and the iron staining are due to the alteration in the oxidised zone of the large amount of pyrite (or marcasite?) with which the quartz in the sulphide zone is impregnated. Although no unaltered sulphides were observed in the main workings of the Melrose Mine, it was obvious from an inspection of similar stone from other workings in the close vicinity, which had penetrated the sulphide zone, that the main reef would also contain large quantities of iron sulphides at depth.

From the appearance of the stone, and from the statement made by those in charge of the mine that the gold was very fine, it seems almost certain that the reef as far as developed, is heavily secondarily enriched, and it is therefore to be expected that, with downward continuation of the ore shoot into the sulphide zone, the gold values will decrease considerably.

I was informed by those in charge of the mine that they have obtained an over-all recovery of about 8 to 10 dwts. of gold from those portions of the reef which have been worked, and they also state that the face of the south drive at the 50ft. level is worth about 5 dwts. of gold per ton. On the other hand, Renzio and Party, who are now working the Belvedere Mine, and who previously worked the Melrose Mine on tribute, informed me that the south face of the 50ft.

level is very poor, and that the average value of the reef in the southernmost shaft, which the present owners of the Melrose Mine consider to be 5 dwts., is not more than 3½ to 4 dwts.

In the wide part of the reef at the 50ft. level, and in the stope above this section, it is significant that a large tonnage of quartz on the footwall side of the ore body, has not been mined.

I consider that the statement, by those in charge of the mine, of an over-all recovery of 8 to 10 dwts., is probably correct, but there is some doubt as to the continuation of these values further to the south.

If Renzio and Party are to be believed, the average grade south of present developments is not likely to be greater than from 3 to 4 dwts. My own observations lead me to believe that the values at present being obtained, are due to heavy secondary enrichment, and that there will be a considerable decrease in values below water level.

After examining the main workings, I made an inspection of a number of outcropping reefs in the vicinity, which were said to carry payable gold. Samples were taken in my presence from a number of these reefs and afterwards dollied. All the samples so treated, 6 in number, failed to show any trace of gold, with the exception of one, which revealed several colours.

In my opinion, there is little prospect of developing other ore bodies in the vicinity, comparable in size to the main workings of the Melrose, although it is possible that isolated short shoots may be found. One such, about 10 feet in length, and 8 to 10 feet in depth, has been worked over a width of 6 inches to a foot by Renzio and Party. Such possible small shoots could not be relied on to increase the tonnage available for treatment.

The Belvedere Leases are situated about eight miles east of the Melrose Gold Mine and in similar country. The ore body being worked by Renzio and Party, who hold the main leases, consists of quartz lenses and stringers up to 2 feet wide in places, which occupy a sheared or faulted zone cutting across the country, and striking about north and south with a steep dip to the west.

In Renzio and Party's main shaft the gold is found in quartz leaders, and also in the adjacent sheared rock material, which contains bunches of galena, cerussite and other altered lead minerals.

The ore bodies on these leases showed clear signs of secondary enrichment, and the gold values are likely to decrease if followed into the sulphide zone. Numerous other narrow quartz reefs and leaders in the vicinity are said to carry gold, but to what extent I was unable to judge as no samples were dollied.

Renzio informed me that he intended to install a three-head battery to treat the stone from his leases, and at the present time is boring in an adjacent creek bed, with the object of obtaining a water supply for crushing purposes.

A group of prospecting areas to the north of the Belvedere Leases was inspected, but the extremely narrow quartz leaders being worked on these by the holders are too narrow to be profitably mined. The prospectors are young men with no previous experience in mining, and in my opinion are wasting their time.

THE YAMPIRE GORGE CROCIDOLITE DEPOSITS, HAMERSLEY RANGE, NORTH-WEST DIVISION.

Yampire Gorge in the Hamersley Range carries a north flowing tributary of the Fortescue River and lies about 20 miles due south of Mulga Downs Station.

The Hamersley Range is made up of flat dipping sediments belonging to the upper part of the Nullagine series, presumably of late Pre-Cambrian age. The rocks exposed in Yampire Gorge consist predominantly of quartzites interbedded with siliceous or cherty ironstone. The deposits of crocidolite asbestos are everywhere associated with a banded ironstone which is highly siliceous and of a dark brown colour.

Bands of crocidolite occur at two horizons in the sedimentary beds. The lower horizon is close to the base of the cliffs of the Gorge, and contains a vein of crocidolite averaging about 2½ inches in thickness and lying parallel to the bedding planes of the ferruginous ironstone in which it occurs. The crocidolite immediately overlies a thin bed of dark green massive rock, which by microscopic examination appears to have a composition identical to that of the fibrous crocidolite. This massive rock, which weathers to a dark brown colour, is thought to be identical with potential crocidolite, which is commonly associated with the fibrous variety in the deposits of the Cape Province of Africa.

The second crocidolite-bearing horizon lies at an elevation of about 200 feet above the base of the cliffs, and the crocidolite here occurs in a number of narrow parallel veins lying in the bedding planes of a ferruginous quartzite in an exactly similar manner to the asbestos in the lower horizon. In this upper horizon some half dozen veins of crocidolite varying in width from one inch to ¼ or ⅛ of an inch are distributed through a ferruginous quartzite band over a width of about five feet, the aggregate thickness of crocidolite being about 4½ inches.

My examination did not include all the prospecting areas being worked, but from information supplied to me in conversation with a number of prospectors I was able to form the opinion that all the crocidolite occurred in a manner similar to that described above.

A considerable amount of fibre is available in the cliff faces and can be won without much difficulty at the outcrop. It is doubtful, however, whether the narrow width of the veins will permit of these deposits being worked economically by underground methods, owing to the large amount of worthless rock material which would necessarily have to be removed in recovering the valuable fibre.

These deposits are interesting in that they appear to be similar in their mode of occurrence to the deposits of blue asbestos or crocidolite, in Africa. The asbestos in the Cape Province of Africa is commonly referred to as "Cape Blue," and is found in seams interbedded with the banded ironstone of the lower Griqua Town series of the Transvaal system, which is probably the equivalent in age to the upper part of the Nullagine series in Western Australia. These deposits are fully described in Memoir No. 12 of the Geological Survey of the Union of South Africa. The conclusion is there arrived at that the crocidolite is of sedimentary origin and has been formed by the metamorphism of ferruginous quartzites, which are postulated to have had an original composition peculiarly suited to the formation of crocidolite.

Although no determination of the chemical composition of the Hamersley Range ferruginous quartzites has yet been made, the striking megascopic resemblance and mode of occurrence of the rocks to the abovementioned published description, suggest that they are similar in all respects.

PROGRESS REPORT ON THE GEOLOGICAL SURVEY OF THE YILGARN GOLDFIELD (NORTH OF THE GREAT EASTERN RAILWAY).

(By H. A. Ellis, B.Sc., A.O.S.M.)

The re-survey of that portion of the Yilgarn Goldfield situated south of the Great Eastern Railway having been completed in February, 1937, and the manuscript covering a report on the geology of that area compiled, the writer was instructed to continue the survey in that portion of the goldfield extending northwards from the Great Eastern Railway.

Field work was commenced by the writer and one field hand on November 8th, and continued until December 11th, when the field season ended.

During this period the boundaries of the Greenstone belt, extending from Hope's Hill northwards to Bullfinch, and a portion of the granitic and gneissic country westwards of the Bullfinch-Southern Cross Railway line were mapped.

The detailed knowledge of the structure of the schistose rocks obtained in the short period of investigation was insufficient to enable the broad geological structure worked out for the southern portion of the field to be correlated with that to the north. Further field work is necessary before this aim can be achieved. Several features of geological and economic importance noted during the survey of the southern part of the goldfield were found to recur in the northern part of the field so far investigated. Evidence available near the better exposed margins of the greenstone country confirms the conception of the processes of granitisation, the presence of which was suspected from an inspection of available outcrops near Southern Cross, and the occurrence of migmatites in some of the "rocks"* situated some distance from the greenstone areas suggests that this process has been widespread.

Many of the bare "rocks" examined in the country west of Bullfinch are massive, fine, medium, and in places coarse-grained biotite granites, similar in all respects to the "rocks" of the southern part of the field. The impression gained so far of the granitic and gneissic country is that there are extensive areas of replacement gneisses showing structure lines contiguous to the margins of the greenstone belts, and that much of the sandplain country is of a similar nature. The granite "rocks" appear to represent bosses probably underlain by granite masses of batholithic dimensions.

In several places in the areas occupied by sandplain, sections are exposed showing the passage downwards from a sand-plain surface through a ferruginous laterite to decomposed replacement gneiss. These occurrences tend to strengthen the conception of the origin of the sand-plains formed during the survey of the southern portion of the field, namely, that they were largely residual soils overlying areas of rock of granitic or gneissic composition.

*"Rocks"—A term in common use to designate the numerous elevated or flat granite outcrops which occur throughout the district.

The relation of gold-mining centres to the geological structure established for the southern part of the field is exemplified in the case of the main Bullfinch Mine, which occurs in a steep northerly pitching dragfold in a band of ferruginous quartzite and associated amphibolite schists, the minor structures of the mine being associated with a major west limb dragfold structure in the amphibolite schists of the Greenstone Series. Dragfolds in the first outcrops of jaspilite north of the Bullfinch Mine show a steep southerly pitch, and this suggests the occurrence of a synclinal crossfold immediately north of Bullfinch. Unfortunately, a wide alluviated area devoid of outcrops adjoins the mine to the north and obscures the necessary confirmatory evidence.

The rock types noted so far in the greenstone series are similar lithologically to those of the Southern Cross area. Two areas of rocks of ultra-basic composition, one of which is similar in all respects to the anthophyllite schist which outcrops so prominently in New Zealand Gully, south of Southern Cross, have been identified for the first time in this district. The anthophyllite schist outcrops prominently on Loc. 415, 4 miles S.S.E. of Corinthian, and the other patch of ultra-basic rock evidenced by a siliceous, bouldery and sometimes schistose ferruginous outcrop, in which specks of chromite are freely scattered, occurs on Loc. 567, 4 miles N.W. of Corinthian.

Several small outcrops of fresh massive quartz-dolerite have been noted on Loc. 581 and near the 18 mile peg on the Southern Cross-Bullfinch road, just south of Bullfinch.

No detailed work on the mining groups was undertaken during the short field season, but it is intended to carry out this work in conjunction with regional geological survey during the 1938 field season.

THE RIVERINA GOLD MINE, RIVERINA (30 MILES WEST OF MENZIES, NORTH COOLGARDIE GOLDFIELD).

(By H. A. Ellis, B.Sc., A.O.S.M., Geologist.)

INTRODUCTION.

An examination of the accessible workings of this mine was made on November 22nd and 23rd with the object of determining as far as possible the nature of occurrence of the auriferous bodies at present being worked in the mine.

It was possible to determine the pitch of the ore shoots, the faulting system which has dislocated the lodes, and the distribution of the lodes, and suggestions for the future development and prospects of the mine can now be made. During the examination the writer had the valuable help of Mr. N. Butcher, underground manager, and his careful observations made during the course of development work at the 300ft. and 400ft. levels greatly aided the progress of the examination.

The results of the inspection confirmed many of the conceptions of the geological features of the mine already held by the present management, and future development work should now proceed with some degree of confidence.

GENERAL GEOLOGY AND STRUCTURE.

The ore bodies consist of metasomatic replacements in well defined shear zones of considerable length in amphibolite schist, having a general north

and south strike and a practically vertical dip. The outcrop portions of the lodes have been worked in the past to a shallow depth, and in the oxidised zone the country has a schistose appearance, but becomes massive and jointed in depth. The country rock has all the appearance of being a metamorphosed doleritic lava which has been sheared in vertical planes in a general north and south direction, and subsequently mineralised along the shears for an average width of 4 to 5 feet over at least half a mile in length and 500 feet in depth as exposed in the mine workings.

The lodes are dislocated by several strong faults, and an intricate system of jointing has been set up in the wall rocks, along which pegmatite dykes, both large and small, have been injected. Some of these dykes cut the lodes without displacing them, and some occupy fault planes, along which movement of the lodes has taken place.

The mineralisation along the shears has resulted in the formation of a banded type of ore, very hard, in which silica and bands of partially replaced but silicified country rock predominate. Mineral sulphides and free gold occur, scattered unevenly through the banded ore, with local concentrations sometimes on one wall and sometimes on the other. Arsenopyrite, pyrite (pyrrhotite?) galena, zinc blende, and free gold were recognised, while chlorite, biotite and garnet, along with a dark coloured amphibole and silica, constitute the main non-metallic minerals seen in the ore. The lodes frequently have no defined walls, and mineralisation has proceeded some distance into the wall rock in some cases, the limits of payable ore having to be determined by sampling.

Granite outcrops in the flat country several miles to the east of the mine.

THE UNDERGROUND WORKINGS.

The workings from the north and south main shafts have been carried down to a depth of about 400 feet vertically, and stoping above this level has been carried out north and south from both shafts. In the northern workings only one lode has been found and worked, while in the south workings two parallel lodes, some 30 feet apart, have been mined. On the 300ft. level the ore channel has been proved to exist over a length of 2,600 feet and six ore shoots, totalling some 1,240 feet in stope length, have been found profitable to mine at this level.

The shear zones have been proved to carry payable values at the 400ft. level, and winzes down to the 500ft. level throughout the length of the workings have shown payable values and workable widths to this depth.

North of the new main shaft in the northern workings the lode has been cut off by a fault which has thrown the ore body to the west. The lode has been located in the north side of the fault at the 300ft. level, and its northerly continuation can now be followed for a considerable distance to the north under a line of old surface workings. Further north the lode will be found to be displaced to the east as indicated by a step across in this direction in the line of old surface workings. Development by driving in this direction has excellent prospects, as two known shoots are already indicated north of the new main shaft by surface workings.

The drive south on the bottom level of the north shaft encounters a faulted zone, and the lode is here faulted to the east, south of the fault. As far as can be ascertained from the stoping, the ore shoots in the northern workings are practically vertical.

In the southern workings being developed from what is known as the south shaft, two parallel shears containing payable ore have been worked at the 400ft. level, the western one of which has been worked in the past from the surface down to No. 4 level in a southerly pitching stope. The shoots in these lodes pitch south at 45 degrees and are not directly opposite each other in the two parallel lodes, the western shoot being situated south of the shoot in the east lode at the 400ft. level, being thus arranged *en échelon*. A winze sunk on the western lode for 100 feet below the No. 4 level at the end of the south drive shows good values and payable width at the bottom according to mine plans. A short drive from the bottom of this winze shown on the mine plan is obviously off the shear zone.

SUGGESTED FUTURE DEVELOPMENT.

There are no geological structural problems facing the development of the mine and the nature of the ore bodies, the distribution of the ore shoots, and the proved length and depth of the structural features, namely, the shears, in which the ore bodies occur, make only the occurrence of payable values and widths at the 500ft. level the deciding factor in contemplating development work from this level.

The winzes already sunk to the 500ft. level reveal payable values and widths at individual points over the length of the ore channel already driven on (2,600 feet), and prospects of locating new shoots whilst driving north and south at this level are very encouraging.

The best immediate development work, having in mind the winning of ore and the proving of the ore bodies, could be undertaken by continuing the north drive from the No. 4 level at the south shaft, and the sinking of the new main shaft to 500 feet. In the latter case the winzes are already down and a large block of ore would be available for stoping.

The obvious necessity also exists for the sinking of the south shaft to 500 feet, and the driving of a level north on the east lode at the 500ft. level to connect with south drives from the same level from the new main shaft. The continuation of this level north from the new main shaft is also necessary, and besides greatly facilitating the economic haulage of ore, this work would, if undertaken, have very good prospects of revealing new shoots of ore.

GENERAL REMARKS.

The workings south of the south shaft are approaching a fault zone, but the displacement will not be great, and will probably be to the east, as indicated by surface workings in this direction.

In the mining operations associated with the joining of the new main shaft and the south shaft on a 500ft. level, no geological problems with which the present management is not familiar would be encountered. The shoots are not seriously displaced by faulting between the 400ft. and 500ft. levels as is revealed by the winzes from the 400ft. level, and while driving south and north on the proposed 500ft. level from the south shaft the two shear zones give excellent promise of the recurrence of south pitching ore shoots above and below those already worked south and north of the south shaft at the 400ft. level.

The prospects of this mine down to the 500ft. level as revealed by the nature of the ore shoots at the 400ft. level and the winzes down to 500 feet are shown to be very good in the present state of the workings, and there is no obvious geological reason why payable values should not be expected below the 500ft. level.

As a future underground prospecting campaign, parallel ore bodies which may not have outcropped could be sought for in the country rock by means of a diamond drill. A study of the manner of occurrence of the shoots already worked would have to play a large part in the location of these bore sites.

MORLEY'S FIND (SIX MILES NORTH OF RIVERINA AND 30 MILES WEST OF MENZIES, NORTH COOLGARDIE GOLDFIELD).

(H. A. Ellis, B.Sc, A.O.S.M., Geologist.)

Rich patches of gold bearing quartz have recently been found in this locality in a belt of folded sediments and greenstones of sedimentary origin underlying a soil-covered flat immediately east of a ridge of fresh amphibolite schist, which probably represents schistose basaltic or doleritic lavas. The regional strike of the schistosity is north and south, and the dip steep to the east. Steep opposed dips are frequent in the schistose amphibolites to the west indicating tight folding.

Extensive outcrops of fine grained biotite granite occur half a mile north-west of the main mining localities, and numerous smaller granite masses, pegmatite dykes, aplite dykes and barren quartz reefs traverse both the fresh looking greenstone and the weathered sediments in which the reefs occur.

The quartz reefs so far found to be gold bearing lie parallel to the planes of schistosity of the country rock, and are much faulted with pegmatite and aplite dykes frequently occupying the fault planes. In most cases the relation of the pegmatite dykes to the quartz reefs is clear, the dykes being younger than the gold bearing reefs, but in one instance, on Morley's P.A. No. 781U at the south end of the area, the relation of a particularly rich concentration of auriferous quartz to a pegmatite dyke in transverse contact with it is not so clear. Unfortunately, mining operations have destroyed much of the evidence which would have revealed the interrelation of these two bodies.

With the exception of the gold occurrences in Monkcom's P.A. No. 793U, and Morley's P.A. No. 781U at the north and south ends of the area respectively, the auriferous bodies are of the lenticular quartz reef variety occurring in shear planes on or near the axial plane of a tight fold varying in width from five feet to a few inches, with rich short shoots of gold bearing quartz showing the influence of secondary enrichment. The deepest workings seen were 50 feet, and in each case the high surface values had terminated at or before this depth. The pitch of the shoots at the north end of the area is at about 45 degrees to the south and coincides with the pitch of the quartz filled dragfold being worked on Monkcom's P.A. No. 793U.

In the workings on this latter P.A. the surface workings are in the tightly folded synclinal portion of a dragfold, and in a shaft 40 feet deep sunk 40 feet south of the open cut, an anticlinal crest of a quartz filled fold appears in the bottom of the shaft pitching south at about 45 degrees. The nature of this occurrence has been explained to the prospector and the best method of mining it by an inclined winze demonstrated to him. The possible recurrence of similar pitching quartz bodies below and above the one already being worked, taking into consideration the direction of the regional dip of the strata, was also stressed.

The two short, nearly horizontal shoots of quartz which gave sensational values in shallow workings just below the ground surface on Morley's P.A. No. 781U (to be converted to a Reward G.M.L.) were found on close examination to be occurring in the westerly dipping portion of a gentle dragfold, the upper limb of which has been eroded. In the more southerly of the two workings from which the specimen stone was taken, the western wall rocks, though highly weathered, disclosed one perfectly preserved dragfold, the axis of which was horizontal, and whose axial plane dipped steeply to the east, showing that the westerly dipping limb in which the auriferous quartz occurred unquestionably formed part of a gentle dragfold in an incompetent bed in a series of steep easterly dipping strata.

There were probably similar concentrations of auriferous quartz above those now worked out where the dip changed from west to east in the strata which have been eroded. The structure has almost certainly been repeated in the upward continuation of this fold, and if auriferous quartz had been deposited in it as seems most likely, then the gold has gone to form alluvial deposits to the east.

The more northerly of the shallow workings in which the rich stone was found appears to have a gentle southerly pitch, while the pitch of the more southerly workings appears to be horizontal. A slight change of pitch is indicated here. The westerly dipping bed has recently been found between the two worked out shoots, and although the wall rock is exactly similar, there is no gold-bearing stone in this central hole.

The concentration of values seems to be confined to the westerly dipping limb, and possible recurrences of gold ore may be found by prospecting along the strike north and south of the present workings or by sinking a winze in the easterly dipping beds below the worked out deposits in the hope that the dip will again change to the west with a deposition of quartz at or near the bends.

The pegmatite dyke seen at the south end of the south patch cutting across the shoot, and from which point the shoot extends in a northerly direction, may or may not have been responsible for the introduction of the auriferous quartz in the immediate vicinity. Insufficient evidence is as yet available from the present workings to determine this point. There is a considerable development of pegmatite and granite dykes in the vicinity, and none of the workings, either in the shaft sunk to cut a quartz reef north of the rich patches or in an open cut and trenches on the same reef, reveal the true manner of occurrence of the dykes.

The conception that the auriferous quartz is derived from a granite magma is considerably strengthened by the presence of good gold values

in quartz showing small flakes of biotite mica dollied from the reef on Butcher and Sheen's P.A. No. 787U to the north.

The several reefs so far opened up show that the high values obtained at the surface do not continue below 50 feet, that the shoots are short and of irregular value, and that the thickness of the reefs is extremely variable, both along the strike and down the dip. The deposition of gold in cellular portions of the quartz, as well as in joint planes in decomposed wall rock, indicates the influence of local enrichment due to solution and deposition of primary gold. Prospecting work done to date (November, 1937) shows that the country rock is liberally intersected with pegmatite and granite dykes and that the reefs are faulted.

The area is one admirably suited for the prospector, but the work recently done by the Riverina Gold Mining Company, who held sampling options on the areas, has shown that there is not sufficient thickness of quartz nor continuity of values at even shallow depths to meet the requirements of a mining company.

The flat soil-covered country south of Monkeom's P.A. No. 793U at the northern end of the locality, and east and north of Morley's P.A. No. 781U at the south end, through which a drainage channel runs in a south-easterly direction, is likely to contain alluvial gold, and offers excellent chances of giving payable results from a series of closely spaced hand bores sunk to bed rock.

KING OF CREATION GOLD MINE, MT. MARGARET GOLDFIELD.

(By R. A. Hobson, B.Sc. (Hons.).)

The King of Creation Gold Mine is situated approximately 36 miles north of Laverton, and two miles east of the Erlistoun Road. The operating company holds a mining reserve and four leases (2289T, 2141T, 2327T, 2224T). At the time of inspection (November, 1937) work was confined to lease number 2141T.

The rocks in the vicinity are mainly metamorphosed sediments, consisting of phyllites, graphitic schists and quartzites, with lenses of massive greenstone. The broad distribution of these rocks has not been mapped, but they are known to extend several miles eastward of the workings, and a lesser distance westward. In the workings they have a general north strike, and dip westward at steep angles.

Access to the main workings is by a vertical shaft, approximately 130 feet deep. North from the main shaft the Water Shaft and the North Shaft give access to smaller workings, which are not connected with each other.

DESCRIPTION OF ORE BODIES.

Main Workings.—The main workings consist of an open cut and two levels—at 96 feet and 145 feet respectively. The 96ft. level consists of three approximately parallel drives, having an *en echelon* arrangement and connected by crosscuts. Going south the drives are stepped west, and will be referred to as the East Parallel Drive (this drive is north of the Main Shaft), the Drive off Main Shaft, and the Main South Drive respectively. From about the centre of the Main South Drive a winze gives access to the 145ft. level, at which level approximately 160 feet of driving has been done.

At the surface the open cut has a length of 270 feet, a maximum width of 40 feet, and an average width of 25 to 30 feet. The open cut extends to the 96ft. level, and has been the main source of ore crushed. At the 96ft. level the ore body has a stope length of 290 feet, and a maximum width of 40 feet. The ore body is of the lode type, and consists of quartzite, with minor quantities of phyllite, and varying quantities, frequently large, of vein quartz. Its strike and dip are parallel to that of the enclosing country, i.e., strike is north and dip west at steep angles. Best values are reported to be in vughy quartz or in open textured quartzite. At the south end of the open cut the lode formation is seen to continue at the surface for 150 feet, but values are reported to be unpayable.

Normal water level is at 100 feet, and therefore all ore from the open cut has come from within the zone of oxidation.

The lode formation at the 145ft. level is quite defined, but values are reported to be very erratic. Although this level is 45 feet below normal water level the rocks are still very weathered, and the zone of primary ore has not yet been reached. No work was in progress at this level at the time of inspection.

A structural control is not apparent from an examination of the present workings, but the general *en echelon* arrangement of the ore bodies suggests control by folding. There is nothing to suggest that the lode formation will not continue downwards, but the possibility of lower values being obtained in the primary ore due to the absence of secondary gold should be borne in mind.

Above the South Drive off the Main Shaft the ore body has a stope length of 100 feet, a maximum width of 10 feet, and an average width of approximately 8 feet. A continuation of this ore body north of the shaft consists of stringers of quartz in phyllite. No work was being done in this ore body at the time of inspection. In a winze and a crosscut, which intersected this lode formation 45 feet below the 96ft. level, values were found to be unpayable.

In the East Parallel Drive a large body of quartz has been driven on for 90 feet, but, except where originally intersected in the crosscut from the North Drive off Main Shaft, has been found to contain no values.

Water Shaft Workings.—The Water Shaft is 122 feet deep, and there are two levels at 60 and 100 feet respectively. Numerous small bodies of quartz have been intersected, but none have been stoped. A small quantity of ore has been obtained from an open cut, which is 70 feet long and has an average width of 6 to 7 feet.

North Shaft Workings.—The north shaft is 100 feet deep, and there are three levels at 40, 60 and 100 feet respectively. A quartz reef, striking and dipping parallel to the country, and having at the surface a length of 230 feet and an average width of approximately 8 feet, has been worked by an open cut to the 40ft. level, and stoped from the 100ft. level. The maximum stope length is 80 feet at the 100ft. level. Stoping is confined to the footwall portion of the reef, and there are also large quantities of quartz

in the drive south of the stope. Payable values were evidently confined to portions of the reef. No work was being done on this reef at the time of inspection.

PRODUCTION.

For the periods 1904-1913 and 1926-1937 Mines Department records show that 20,475 tons of ore have been crushed for a total of 4,464.84 ounces of gold, including only 11.66 ounces of specimen gold. From 1913-1926 no production is recorded. The average grade of the ore produced is therefore 4.4 dwts. An inspection of the yearly returns indicates that, except for 1904, the yearly average grade has not exceeded 9.4 dwts. gold per ton. The ore bodies are therefore to be regarded as of low grade.

CONCLUSIONS.

At the time of inspection work was confined to one ore body, from which the greater part of the ore crushed has been obtained. The average grade of the ore produced has been low. The present examination has not revealed any geological difficulties, and no reason is apparent why the lode formation should not continue downwards. The presence of the best values in vughy quartz or open textured quartzite is suggestive of secondary enrichment. No free gold, visible to the naked eye, is reported to be present in the ore body. All the ore so far produced has come from the zone of oxidation, and although the workings extend below normal water level the zone of primary ore has not yet been reached. Any general increase in values immediately above the zone of primary ore should be regarded as evidence of secondary enrichment, and values in the primary ore should be expected to drop away.

There appear to be no geological difficulties to complicate the testing of lodes immediately below the present workings.

REPORT ON THE CLACKLINE FIREBRICK CLAY PITS (SOUTH-WEST DIVISION).

(By R. S. Matheson, B.Sc.)

The brickyards embrace portions of Locations 18, 19, 171 and 172 (Lands Dept. Litho. 2A/40), and are situated on the north side of the Great Eastern Railway approximately one mile west of the Clackline Station.

GENERAL GEOLOGY.

The rocks of the area bear a striking resemblance to those of the Yilgarn System,* and consist of interbedded greenstones and erosion sediments which have undergone a high grade metamorphism. The main rock types are schistose greenstones, mica schists sillimanite schists and garnet schists, and they have been intruded by granite and epidiorite dykes. The general strike is N.N.W. and the dip 70° W.S.W. The country has been highly folded and sheared, but too small an area was mapped to arrive at any reliable structural interpretation. Some evidence suggesting the existence of minor structure can be seen in the workings, but it could not be interpreted.

Weathering has been the main process in the formation of the clays. The quality of the clay depends on the extent of weathering and the nature of the parent rock, and variations in quality are bound to occur vertically and along the strike of any rock band.

The following materials are used by the management in the production of the firebricks.

1. *Kaolinised Schistose Greenstone* (No. 1 Clay).—This material is puggy and white, and has a banded appearance due to the presence of black streaks. A gradation from this material, through biotite schist to only partly weathered greenstone schist, was observed. This alteration is identical with that seen by the writer in the underground workings of Marvel Loch Gold Development, N.L.** The kaolinised schistose greenstone is the predominant type of clay and its occurrence can be seen on the accompanying map (Plate I.).

2. *Kaolinised Dolerite* (No. 3 Clay).—This material is blocky, cream coloured, and contains scattered black specks, but there is no suggestion of banding. The clay is believed to be a weathering product of a dolerite dyke, because of its similarity to the decomposition products associated with the dolerite dyke outcropping in the creek, east-south-east of the north pit.

3. *Sillimanite Schist.* (No. 4 Clay).—The material is white to straw coloured, and sillimanite can be seen in the hand specimen. The sillimanite is a metamorphic mineral, and variations in the percentage of sillimanite in the rock are bound to occur.

4. *Kaolinised Mica Schist.*—The only occurrence of this material is in the crosscut off the east side of the north pit, and a gradation from white kaolin to hard mica schist was observed.

Mica schist is used in the manufacture of some bricks and at present is obtained from a point about one mile north of the brickyards. A band of mica schist occurs in the north pit and should be tested for its suitability in brick making as it is more conveniently located for cheap mining.

5. *Pegmatite.*—Decomposed pegmatite veins and stringers occur abundantly throughout the workings, and the material is being used as a "filler."

NORTH PIT.

The pegs, which were placed as guides for stripping the overburden from the useful clay bands, are shown on the map, but a little explanation is necessary.

The kaolinised schistose greenstone band is divided by a fissure along the north drive, into two qualities of clay, and the position of the fissure at the surface has been pegged. The higher quality kaolin lies to the east of the fissure, and the quality decreases as the biotite schist, in the face of the west crosscut, is approached.

The kaolinised mica schist band in the crosscut from the east side of the pit is 18 feet wide, but apparently lenses out before the east crosscut from the north drive is reached.

---

* G.S.W.A. Bulletin No. 97 in preparation.

** G.S.W.A. Bulletin No. 98 in preparation.

Talc schist* is showing in the face of the crosscut from the east side of the pit, and the west boundary has been pegged at the surface. The extent and usefulness of the talc schist, however, has yet to be investigated.

SOUTH PIT.

No explanation of the pegging is necessary but a few other things must be mentioned.

Judging from surface evidence the width of the kaolinised schistose greenstone in the end of the crosscut off the west side of the pit is much greater than that already exposed in the crosscut.

The kaolinised dolerite (No. 3 Clay), owing to its mode of origin, may cut across the strike of the country or may not persist along the strike.

Sillimanite schist, which is thought to be the northerly continuation of the sillimanite schist in the south pit, was found outcropping in the creek near the north pit, and the probable position of the bed between these two places is shown on the map.

The green clays disclosed in the south pit are decomposition products of schistose greenstone and may be stained with nontronite. These clays are of little use commercially as they cause excessive shrinkage.

There is obviously some discrepancy in the mapping of the geology in the workings off the north end of the south pit, but only further development work will clear up this point. Since garnet is a metamorphic mineral, the garnet schist will occur sporadically, so that the absence of garnet schist in the north drive at the boundary of the sillimanite schist does not refute the presence of faulting as shown.

* This is now believed to be only a decomposition product of the mica schist.

LANCEFIELD GOLD MINE.

MT. MARGARET GOLDFIELD.

(By R. S. Matheson, B.Sc.)

CONTENTS.

GENERAL REMARKS.

The Lancefield Gold Mine is situated at Beria, approximately 5 miles north-north-west of Laverton, in the Mt. Margaret Goldfield.

The area is featureless, except for a gentle rise in the country to the south-east, towards the Mt. Crawford line of hills.

The Lancefield G.M. Co. holds twenty leases embracing an area of approximately 371 acres, and these are shown on the accompanying geological plan (Plate II.). Mining operations in the past have been carried out on G.M.L's. 715T, 806T, 2221T and 2225T, but at present (November, 1937), work is confined to the latter three leases. Preparations are being made to retreat accumulated tailings.

The mine has been one of the largest producers in the State, and from 1899 to 1937 1,221,166.98 tons of ore were treated for an average value of 7.34 dwts. of gold per ton. The production table appears as Appendix A. at the end of this report.

Wells are the source of an adequate supply of water for domestic and mining purposes, ground water level being generally from 50 to 70 feet below the surface. Timber for fuel and underground use is unobtainable in the vicinity of Beria, and supplies are at present being carted a distance of about 30 miles.

GENERAL GEOLOGY.

The country rocks in the vicinity of the mine consist of metamorphosed basic lavas and tuffs, which have an average strike N. 30° E. and an average dip 40° south-eastward, and these are referred to throughout the report under the general term "Greenstone." Interbedded with the greenstones are several bands of ferruginous quartzite or jaspilite of sedimentary origin. It has been impossible to determine whether these bands of jaspilite are separate horizons, or whether they represent one bed which has been repeated by folding. The rocks are highly folded, and have been intruded by granite and quartz porphyry. Mapped with the granite, and undifferentiated from it on Plate II., are large areas of gneiss, granitised greenstone, and hybrid rocks, which are considered to owe their origin to the replacement or assimilation of large portions of the greenstones by the invading granite. All the rocks are presumed to be of Pre-Cambrian age.

Exposures in the vicinity of the Lancefield Gold Mine are very poor owing to deep weathering, and large areas are entirely masked by alluvium. The true nature of the greenstones was only determined after examining the exposures in the mine workings and bore cores.

Areal mapping, now in progress, suggests that the Lancefield ore body is situated on the eastern limb of a south-easterly pitching anticline. The main structure is complicated by minor folds, one of which has an important influence on the Lancefield ore body, and is referred to further in the section of this report dealing with recommendations and conclusions. This fold is indicated at the surface by a marked change in strike, near the south-west corner of the Lancefield group of leases, from N. 30° E. to N. 35° W.

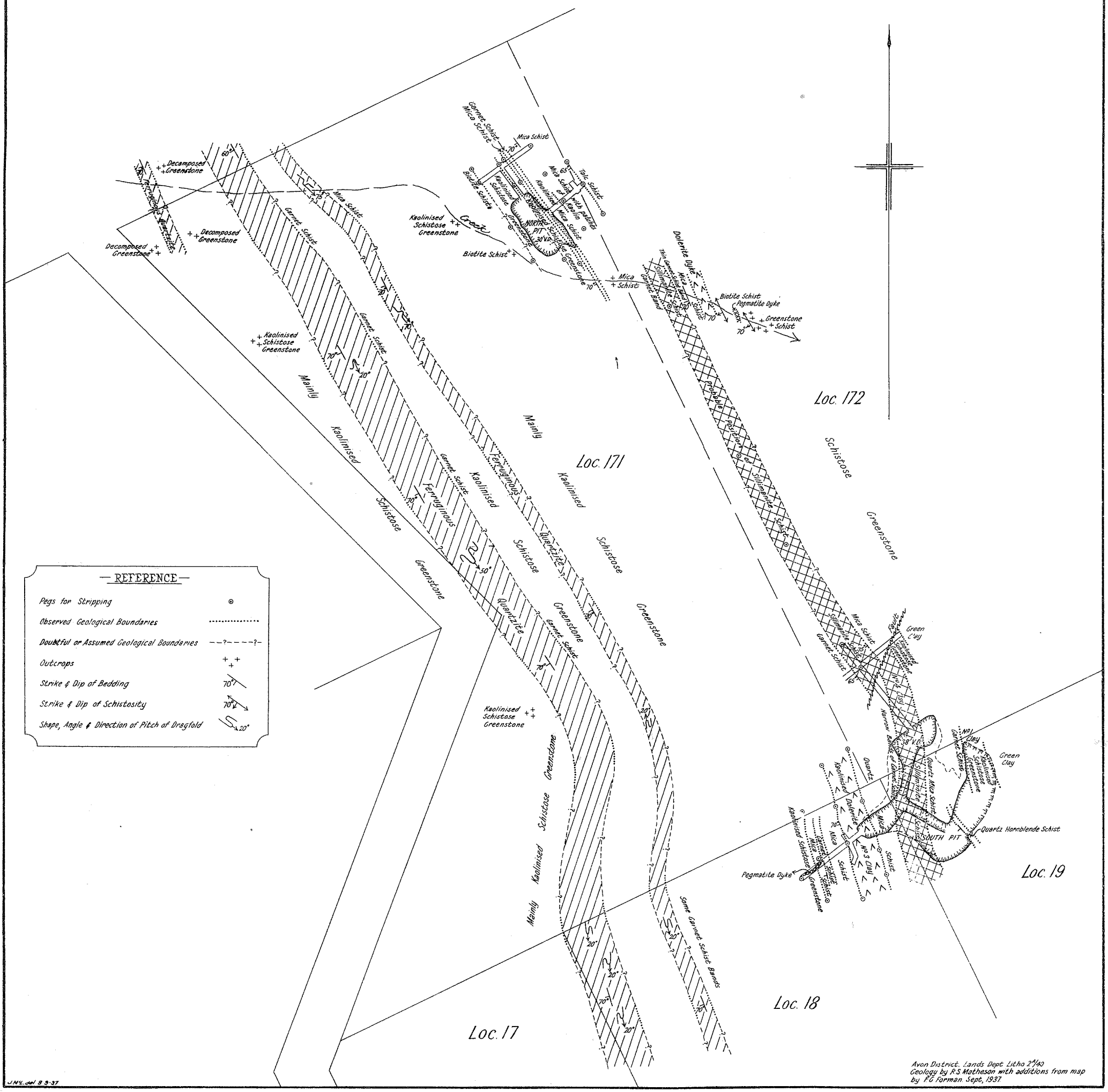
GEOLOGICAL MAP

IN

THE VICINITY OF

CLACKLINE FIREBRICK CLAYPITS

Scale 2 chains to an inch



REFERENCE

Pegs for Stripping	⊙
Observed Geological Boundaries	.....
Doubtful or Assumed Geological Boundaries	--?----?-
Outcrops	+ +
Strike & Dip of Bedding	70°
Strike & Dip of Schistosity	70°
Shape, Angle & Direction of Pitch of Dragfold	20°

Avon District. Lands Dept. Litho 2/40
Geology by R.S. Matheson with additions from map by F.G. Forman. Sept, 1937

J.N.L. del 8.9.37

The easterly pitches of dragfolds observed in the underground workings of the Lancefield G.M. would not normally be expected in the south-easterly pitching structure described above, and are thought to be due to local crossfolding.

THE COUNTRY ROCKS.

Information concerning the country rocks is meagre, owing to the small amount of crosscutting in the mine, and the almost complete absence of petrological descriptions of the bore cores, which themselves are not now available for examination.

Footwall Country.—Massive, greyish, coarse-grained greenstone, grading through greenstone schist to talc schist, constitutes the major portion of the footwall country. The footwall country is thought to have originally consisted entirely of the massive type of greenstone, the schists having been produced from it by shearing. The degree of dynamic metamorphism determines the nature of the country rocks, and the presence of talc schist indicates areas which have undergone the greatest changes. This fact has been useful in interpreting some of the geological structures in the underground workings. The footwall rocks are believed to be mainly of tuffaceous origin, and they are very susceptible to mineralisation.

Hanging Wall Country.—Exploratory work in the hanging wall country has disclosed metamorphosed basic lava. In contrast to the greyish colour and sheared nature of the footwall country, the hanging wall country has a dark greenish colour and generally a blocky jointing. The hanging wall rocks are also remarkably free from mineralisation.

The hanging wall country has been penetrated in very few places in the underground workings, and is best exposed in a short south-east crosscut off the north drive, No. 5 level.

The core of bore No. 5 (new) was megascopically examined by Mr. K. R. Miles, and the hanging wall section of it was found to consist entirely of metamorphosed basic lava. The log of the bore is included in this report in the section on diamond drilling. The lava is bleached and schistose in places, and variations in grain size occur, indicating that there may be more than one flow.

Intrusives.—The greenstones have been intruded by quartz porphyry, and this rock is encountered in several places in the workings.

A quartz porphyry sill, showing assimilation and chilling at its contact, is intersected in the Nos. 9, 10 and 11 level crosscuts off the main shaft.

An underground diamond drill hole, bored south-eastward from the bottom of the inclined tunnel, intersected quartz porphyry in the footwall country below the No. 13 level, which is probably an offshoot from the sill encountered in the upper levels.

THE ORE BODY.

The Lancefield ore body occurs in the most conspicuous of the western jaspilite beds shown on Plate II., and has been formed by the mineralisation of the jaspilite and the injection of auriferous quartz veins presumably by solutions emanating from the granitic magma. These quartz veins have penetrated the jaspilite, where it was fractured, sheared, and contorted, during folding.

The pay shoot occupies the full width of the jaspilite band, and has an average length of 560 feet and an average width of 20 feet. The general strike is N. 30° E., the dip 30 degrees in a direction S. 60° E., and the shoot pitches about 30 degrees in an easterly direction. The values are said to have been better on the hanging wall side of the ore body than on the footwall side, and the best values are generally in the vicinity of the quartz veins and stringers.

The main shoot has been stoped out from the surface to the No. 11 level (787 feet V.D.), and stoping is at present in progress between the No. 11 and No. 12 levels (860 feet V.D.).

The jaspilite has been mined in the past to a vertical depth of about 60 feet (reported* to have been the original ground water level) for some distance beyond the northern end of the main shoot. Abandonment of this section of the lode suggests that values became unpayable at depth, and that the stoped portion of this northern extension consisted of secondary enriched lode material overlying primary lode material with unpayable values. Owing to the inaccessibility of the upper levels, the oxidised zone could not be examined, but C. G. Gibson† states that—

> "The zone of oxidation stops a little above the 200ft. level, there being a small percentage of sulphide in the stone from this level; below the sulphides come in heavily . . ."

At the No. 13 level (968½ feet V.D.) which is at present being developed, the ore shoot has a length of 110 feet, and an average width of 5 feet. These dimensions are considerably less than those at higher levels, and the reasons for this marked decrease in size of the ore body, and the possibility of its return to more normal dimensions at a greater depth, are discussed later in this report.** The lode material is, however, reported to show an improvement in values at the No. 13 level, which is an indication that the values will persist with depth.

Mineral Associations.—The principal gangue mineral in the ore is quartz, with minor amounts of calcite which occurs as veinlets, and graphite which, besides being disseminated through the lode, is occasionally found on the hanging wall of the ore body.

The sulphide minerals are pyrite, arsenopyrite, pyrrhotite, chalcopyrite and sphalerite. The two reports appearing as Appendices B and C to this report, and dealing with the mineragraphy of the Lancefield ore, were kindly made available by the manager of the Lancefield Gold Mine, Mr. Fox. They serve to show the close association of the gold with the sulphides, and to explain the difficulties of cyanide extraction.

STRUCTURAL CONTROL.

The Lancefield ore body is best described by reference to a plane parallel to the average strike and dip of the lode. The determined strikes and dips vary greatly throughout the mine workings, and referred to the reference plane the lode shows numerous

* Gibson, C. G., G.S.W.A. Bull. No. 24, p. 19.
† G.S.W.A. Bull. No. 24, p. 19.
** See page 71.

domes, basins and saddles, which have been formed by the intersection of two systems of folding, one set with an axis parallel to the pitch of the ore body, and the other practically horizontal.

If each system of folding is considered separately it is found that the ore body has been thrown by it into alternate anticlines and synclines, which have affected the width of the lode. The width of the lode is generally less at the crests of anticlines than in the troughs of the adjacent synclines. A study of conditions in the underground workings, under the influence of the two systems of folding combined, shows that the lode is thinner on the domes than in the adjacent basins. Owing to the lack of uniformity in the magnitude of the folding, the relation between lode widths and geological structure can only be recognised by comparing adjacent folds of similar magnitude. If the two systems of folding, and also the folds within each system, were of the same order of magnitude, the ideal case would be presented and the maximum lode widths would invariably occur in the basins, and the minimum lode widths on the domes.

A lack of assay plans for the greater part of the workings makes it impossible to correlate values and geological structure, but there is some suggestion that the basins, besides locally containing the greatest widths of ore, may contain the best values. The section of the lode embraced by co-ordinates 100′ N. and 250′ N., and between the No. 8 and No. 9 levels, is reported to have contained the greatest widths and the best values, and this is the largest basin in the mine.

The decrease in the dimensions of the ore body at the No. 13 level is thought to be due to its proximity to the crest of an anticline with a horizontal axis (see Plate V.). It might be argued that this decrease in length and width of the lode could possibly be due to a lensing out of the jaspilite lode formation. It seems much more probable as a result of actual inspection of the ore body, and the known wide distribution of the jaspilite, that the decrease in width and length of the ore shoot is due to the influence of a fairly strong anticlinal fold with a horizontal axis. No such exceptionally marked changes in the width and length of the lode have been produced by the anticlines belonging to this system, which were encountered in the higher levels, but the writer is of the opinion that the fold now being approached is of a greater order of magnitude than the preceding ones. It is not intended to imply that the No. 13 level is at the crest of this fold, but the crest is somewhere between this level and the point of intersection of the lode by the No. 5 bore (new).

The above interpretation of the structure is based on the following evidence:—

1. Dragfolds—

   Small dragfolds belonging to both systems of folding are present in the workings, and the effect of geological structure on the width of the lode can be seen on a small scale in a few places.

2. Flattening in dip—

   Between the No. 11 and No. 12 levels there is a noticeable steepening in the dip of the ore body, but the dip flattens considerably as the No. 13 level is approached.

   Further evidence for this flattening in dip in the vicinity of the No. 13 level was obtained from an underground diamond drill hole off the bottom of the inclined tunnel, which at the time of inspection (November, 1937), had passed through 102 feet of footwall country without encountering the lode. The general dip must be flatter here than it is at the No. 13 level (see Plate IV.).

3. Intense dynamic metamorphism—

   In the winzes from the No. 11 and No. 12 levels more frequent changes in dip, associated with a thickening or thinning of the lode, are met with than in the upper levels.

   The predominant type of footwall country between the No. 11 and No. 13 levels is talc schist, indicating more intense dynamic metamorphism than previously encountered.

4. Decrease in stope length.

   The two systems of folding could easily cause the decrease in stope length at the No. 13 level. If an anticline with a horizontal axis crossed the pitching set of folds, there would be a tendency for the pitching synclines to close at the crest of the anticline and bring about a decrease in stope length.

5. Decrease in width of lode.

   If the structure is anticlinal, the decrease in width of the lode at the No. 13 level conforms with the behaviour of the ore body observed in the higher levels.

6. Lode at depth.

   The lode has been encountered on the pitch at a greater depth than the No. 13 level in bores Nos. 5, 6 and 7 (new), and a greater stope length than that at the No. 13 level is indicated. The shoot would be expected to regain gradually its original dimensions as the syncline succeeding the anticline inferred above is approached. (See Plate V.)

Faulting.—A vertical fault, which strikes north-westward and has slightly displaced the lode, is encountered in the long north drives throughout the workings, but it causes no serious obstacle to mining.

DIAMOND DRILLING.

The lode formation has been prospected at various depths by diamond drilling through the hanging wall country. In all, seventeen diamond drill holes have been put down, eight of which were drilled fairly recently. The presence of two sets of bores on the mine plans is rather confusing, particularly as the numbers overlap, and an attempt to clarify this has been made in the following table. The bores were all started vertically, but they have deflected up the dip, and the deeper the bore the greater is the deflection.

Unfortunately there are no petrological descriptions of the country encountered in these diamond drill holes, and in most cases the core has not been retained.

TABLE.

Old or New Bores.	Bore No.	Bore Depth.	Co-ordinates of Site.	Inclination.	Remarks.
		ft.			
Old	1	363	252′ S. 497′ E.	Vertical ...	Lode first encountered at 318ft. Value 42s. 26ft. wide.
Old	2	335	92′ S. 474′ E.	Vertical ...	Lode at 288ft. Value 34s. 25ft. wide.
Old	3	360	387′ S. 520′ E.	Vertical ...	Lode at 307ft. Value 22s. 8ft. wide.
Old	4	380	531′ S. 533′ E.	Vertical ...	No lode.
Old	5	356	35′ N. 591′ E.	Vertical ...	Lode at 326ft. Value 20s. 14ft. wide.
Old	6	389	105′ N. 449′ E.	Vertical ...	Lode at 200ft. Value 3s. 2ft. wide.
Old	7	535	291′ S. 641′ E.	Vertical ...	Lode at 357ft. Value 38s. 12ft. 3in. wide.
Old	8	370	233′ N. 569′ E.	Vertical ...	Lode at 316ft. Value 32s. 12ft. wide.
Old	9	418	526′ N. 641′ E.	Vertical ...	Lode at 388ft. Value 28s. 18ft. wide.
New	1	996	229′ N. 1,664′ E.	Vertical ...	No lode.
New	2	967	498′ N 1,608′ E.	Vertical ...	18ft. 6in. lode (from 924ft. to 942ft. 6in.).
New	3	1,236	734′ N. 1,964′ E.	Vertical ...	No lode.
New	4	335	766′ N. 414′ E.	Vertical ...	8ft. 1in. lode (from 294ft. 5in. to 302ft. 6in.).
New	5	1,299	1,028′ N. 1,899′ E.	Vertical ...	11ft. 2in. lode (from 1,247ft. 5in. to 1,258ft. 7in.).
New	6	1,300	1,159′ N. 1,830′ E.	Vertical ...	10ft. 2in. lode (from 1,250ft. 10in. to 1,261ft.).
New	7	1,248	882′ N. 1,934′ E.	Vertical ...	10ft. 9in. lode (from 1,201ft. to 1,211ft. 9in.).
New	8	1,315	1,290′ N. 1,758′ E.	Vertical ...	10ft. lode channel (from 1,259ft. to 1,269ft.).

The values stated above are based on the old price of gold (£4 per ounce). The widths are not the true widths of the lode as all the bores cut through the lode obliquely.

The core of bore No. 5 (new) was megascopically examined by Mr. K. R. Miles, and as it is one of the deepest bores it should give a representative section of the country.

Log of Diamond Drill Bore No. 5 (new).

0′	to	188′	No record.
188′	,,	230′	Weathered fine-grained greenstone schist.
230′	,,	266′	Slightly weathered greenstone schist.
266′	,,	318′	Fine-grained greenstone schist with patches of more massive greenstone (probably sheared lava).
318′	,,	413′	Dense greenstone with patches of schistose greenstone (lava).
413′	,,	416′	Fine grained greenstone schist (probably sheared lava).
416′	,,	462′	Dense greenstone (lava ?).
462′	,,	475′	Fine grained greenstone schist.
475′	,,	508′	Dense greenstone.
508′	,,	518′	Massive fine grained greenstone, varying to medium grained greenstone.
518′	,,	600′	Fine grained greenstone schist.
600′	,,	666′	Massive dense greenstone (lava).
666′	,,	674′	Massive dense greenstone (lava) (specimen at 671′), grades off to schistose greenstone.
674′	,,	693′	Fine grained greenstone schist.
693′	,,	703′	Dense greenstone with schistose bands.
703′	,,	704′	Very dense dark greenstone band—edge of lava flow (?)
704′	,,	716′	Dense greenstone with schistose bands.
716′	,,	721′	Dense greenstone.
721′	,,	750′	Medium grained greenstone partially schistose—varies to medium grained schistose greenstone.
750′	,,	754′	Medium grained greenstone varying to amphibolite (?) (specimen at 754′).
754′	,,	763′	Massive medium grained greenstone with bands of schist.
763′	,,	768′	Fine grained greenstone schist with more massive bands.
768′	,,	777′	Fine grained greenstone schist.
777′	,,	784′	Grades to medium grained partially sheared amphibolite.
784′	,,	787′	Rather massive medium grained greenstone.
787′	,,	825′	Fine grained greenstone schist.
825′	,,	859′	Massive dense greenstone (lava) (specimen at 853′)—with schistose bands and irregular quartz veinlets.
859′	,,	915′	Fine grained schistose greenstone with more massive bands.
915′	,,	922′	Massive fine grained greenstone (lava).
922′	,,	930′	Fine grained greenstone schist, containing patches of actinolite schist.
930′	,,	960′	Fine grained greenstone schist with irregular quartz veinlets generally mineralised.
960′	,,	971′	Fine grained greenstone (lava) with local changes to schist.
971′	,,	976′	Massive fine grained greenstone (lava).
976′	,,	983′	Schistose fine grained greenstone (lava).
983′	,,	989′	Massive fine grained greenstone (lava).
989′	,,	1,082′	Fine grained greenstone schist (probably sheared lava).
1,082′	,,	1,085′	Massive greenstone with muscovite pegmatite veinlet.
1,085′	,,	1,245′ 2″	Fine grained greenstone schist (sheared lava ?)—probably contains serpentine.
1,245′ 2″	,,	1,247′ 5″	Mineralised fine grained greenstone schist (sheared lava ?)—probably contains serpentine (no values).
1,247′ 5″	,,	1,258′ 7″	Lode material.
1,258′ 7″	,,	1,278′	Medium grained greenstone schist with patches of massive medium grained greenstone.
1,278′	,,	1,279′	Quartz vein.
1,279′	,,	1,335′	Medium grained greenstone schist with quartz stringers and local gradations into massive greenstone—in places strongly mineralised.
		1,335′	End of bore.

Description by K. R. Miles, 8/11/37.

Summary.—The hanging-wall country appears to consist entirely of metamorphosed basic lava. The rock is generally massive and dark greenish in colour, but schistosity and bleaching are frequently developed. Variations in grain size also occur, indicating that there may be more than one flow.

Numerous irregular veinlets of quartz and calcite were intersected by the bore, but they were not recorded.

RECOMMENDATIONS AND CONCLUSIONS.

1. The lode is expected to be very lenticular, and in places perhaps entirely absent, between the No. 13 level and its intersection by bores Nos. 5, 6 and 7 (new). Nevertheless the prospects of the ore body regaining its original dimensions deeper down are promising, and the diagrammatic longitudinal section (Plate V.) shows its probable behaviour with depth.

Diamond drilling is strongly recommended on the pitch of the shoot to intersect it 300 feet below the present limit of prospecting, and an increase in length and width is expected, provided that the granite on the east (see Plate II.) has not replaced the lode channel. This is a possibility, and the dip of the granite contact is the deciding factor. The granite is, however, not true granite, but a granitised zone, and it is to be hoped that the action has been confined to the horizons which show granitisation at the surface.

2. There is good evidence for the existence of parallel jaspilite beds in the footwall country, and these should be prospected, particularly opposite the main shoot.

A parallel jaspilite band, 3 feet wide and showing mineralisation, was intersected in the crosscut from the main shaft at the No. 8 level. Ore shoots may exist in this bed along the strike or down the dip. Underground diamond drilling would probably be the best method of prospecting, and initial drilling should be carried out westward from the large basin, in the main lode, between the No. 8 and No. 9 levels.

Mineralised outcrops of another jaspilite bed are exposed to the north-east of M.A. 15T, and samples from it are reported to have assayed from 1 to 2 dwts. gold per ton. Alluvium and tailings obscure any other outcrops of this bed, but it probably persists southwards through the leases. The prospecting of this jaspilite should not be neglected.

3. The area marked "A" on Plate II. embraces a sharp fold in the country which warrants prospecting. The area is devoid of outcrops, and whether or not the jaspilite exists in this place is problematical, but even if it is absent, auriferous quartz reefs may be present.

Auriferous quartz stringers and lode material, in talc schist are being mined at the "Beria Main Lode," G.M.L. 2216T, in this vicinity, but the workings are not in the most favourable position with regard to structure. The ore shoots occur in the noses of small folds. The presence of talc schist proves conclusively that the workings are in the Lancefield footwall country.

4. Small isolated, lenticular shoots of ore may exist in favourable structures along the strike of the main lode formation. Bore No. 9 (old) shows values below the No. 5 level, which were not encountered on that level, and this is probably an ore body of the type previously mentioned.

5. A jaspilite bed outcrops discontinuously, close to the granite contact, on the eastern side of Plate II., and it warrants prospecting due east of the main ore body. The jaspilite is dipping flatly towards the granite which is not a promising feature for its persistence with depth. It is characteristic of the jaspilites, however, that when intruded by granite they suffer bleaching over some distance, and as this bed appears to be the normal type the granite contact is probably dipping more or less parallel to it.

6. Prospecting should be done on the Mt. Crawford line of jaspilite, over the section extending from south-east to east of the Lancefield G.M. The intervening greenstone country is not without possibilities.

APPENDIX A.

Name of Lease or Company.	Mining Centre.	Lease No.	Period.	Alluvial.	Dollied and Specimens.	Ore Treated.	Gold Therefrom.	Total Gold.	Silver.
				fine ozs.	fine ozs	long tons.	fine ozs.	fine ozs.	fine ozs.
Lancefield G.M. Co., Ltd.	Beria	715T, 806T, 1206T, 1207T, 1483T, 1523T, 1524T, 1525T, 1542T, 1544T, 1548T	1899	....	....	5,768·00	1,923·61	1,923·61	....
Do. do.	do.	do. do.	1900	....	....	11,701·00	5,639·75	5,639·75	....
Do. do.	do.	do. do.	1901	....	....	16,847·00	6,256·55	6,256·55	....
Do. do.	do.	do. do.	1902	....	....	20,781·00	7,780·60	7,780·60	....
Do. do.	do.	do. do.	1903	....	....	21,928·00	7,068·29	7,068·29	....
Do. do.	do.	do. do.	1904	....	....	25,154·78	10,734·01	10,734·01	....
Do. do.	do.	do. do.	1905	....	....	47,693·00	15,383·22	15,383·22	430·81
Do. do.	do.	do. do.	1906	....	....	5,946·00	3,005·82	3,005·82	219·12
Do. do.	do.	do. do.	1907	....	....	61,906·00	25,993·20	25,993·20	3,420·32
Do. do.	do.	do. do.	1908	....	....	38,284·00	14,460·23	14,460·23	1,754·14
Do. do.	do.	do. do.	1909	....	....	46,961·00	19,458·08	19,458·08	3,258·87
Do. do.	do.	do. do.	1910	....	....	90,789·00	35,299·63	35,299·63	7,747·58
Do. do.	do.	do. do.	1911	....	....	95,305·00	37,505·50	37,505·50	8,189·85
Do. do.	do.	do. do.	1912	....	....	27,694·00	11,272·33	11,272·33	2,415·99
Kalgoorlie and Boulder Firewood Co., Ltd.	do.	do. do.	1914	....	....	10,977·00	2,954·97	2,954·97	417·18
Do do.	do.	do. do.	1915	....	....	39,746·00	14,062·33	14,062·33	2,083·77
Do. do.	do.	do. do.	1916	....	....	21,079·00	7,985·81	7,985·81	863·06
Lancefield Gold Mines, Ltd.	do.	715T, 806T, 1206T, 1523T, 1524T, 1525T, 1542T, 2050T, 2051T	1916	....	....	47,062·00	16,744·38	16,744·38	3,057·41
Do. do.	do.	do. do.	1917	....	....	76,453·00	26,929·64	26,929·64	4,609·99
Do. do.	do.	do. do.	1918	....	....	71,157·00	26,281·30	26,281·30	3,909·27
Do. do.	do.	do. do.	1919	....	....	78,068·00	28,649·74	28,649·74	5,124·80
Do. do.	do.	do. do.	1920	....	....	78,235·00	25,565·79	25,565·79	3,345·36
Do. do.	do.	do. do.	1921	....	....	1,679·57	2,981·77	2,981·77	966·05
Do. do.	do.	do. do.	1922	....	....	22·44	23·01	23·01	....
Do. do.	do.	do. do.	1923	....	....	49·51	346·09	346·09	....
Do. do.	do.	do. do.	1924	....	....	3·26	1,610·64	1,610·64	0·70
Do. do.	do.	do. do.	1925	....	....	....	999·30	999·30	68·00
Do. do.	do.	do. do.	1926	....	....	0·27	1,000·57	1,000·57	....
Do. do.	do.	do. do.	1927	....	....	....	1,015·15	1,015·15	....
Do. do.	do.	do. do.	1928	....	....	....	598·01	598·01	....
Lancefield Leases	do.	715T, 806T	1928	....	....	....	191·30	191·30	....
Do. do.	do.	do.	1929	....	....	....	401·82	401·82	....
Do. do.	do.	do.	1931	....	....	135·00	14·50	14·50	....
Do. do.	do.	do.	1932	....	....	0·15	2·28	2·28	....
Lancefield (W.A.) Gold Mine, N.L.	do.	715T, 806T, 2221T, 2225T, 2232T, 2233T, 2234T, 2235T, 2236T, 2245T	1935	....	....	62,045·00	19,054·30	19,054·30	....
Do. do.	do.	do. do.	1936	....	....	104,355·00	34,747·19	34,747·19	....
Do. do.	do.	do. do.	1937	....	....	113,342·00	34,477·12	34,477·12	....
		Total Production, 1899–1937		....	....	1,221,166·98	448,417·83	448,417·83	51,881·27

Grade of Ore = 0·367 fine ozs. gold per ton.
= 7·34 dwts. gold per ton.

APPENDIX B.

MINERAGRAPHIC INVESTIGATIONS OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

University of Melbourne,
September 16th, 1936.

Report No. 80.

ORE AND MILL PRODUCTS FROM LANCEFIELD G.M., W.A.

Five samples of ore and mill products from the Lancefield Mine, at Beria, W.A., have been submitted for examination by the Lancefield Company.

1. *Ore.*—The sample of ore is a highly siliceous specimen with disseminated sulphides. Pyrite is the most abundant sulphide, and, in addition, arsenopyrite, pyrrhotite, chalcopyrite, and sphalerite are present. In places, arsenopyrite is intimately intergrown with pyrite, while pyrrhotite, sphalerite, and chalcopyrite may occur as inclusions in pyrite and arsenopyrite, as well as forming isolated particles in the gangue.

Gold particles, .010 x .006mm. and .019 x .006mm., have been observed as isolated particles in the gangue. A gold particle, .004 x .005mm., has been observed at the junction of a particle of pyrrhotite with the gangue, similar to that illustrated in fig. 1* (.011 x .009mm.). A large gold particle, .032 x .015mm., has been observed on the margin of pyrite embedded in gangue, while a small gold particle, .004 x .005mm., has been observed attached to a minute crystal of arsenopyrite in the quartz.

2. *Drill Core.*—The sample of drill core is highly siliceous, with disseminated sulphides. Pyrrhotite is the abundant sulphide, while sphalerite and chalcopyrite are also more abundant than in the specimen of ore. Pyrite and arsenopyrite are also present. Gold particles, .002 x .022mm. and .004 x .004mm., have been observed isolated in quartz. A gold particle (fig. 1)* has been observed at the margin of pyrrhotite and quartz. Gold particles, .005 x .007mm. and .002 x .004mm., have been observed in narrow veins of sphalerite and chalcopyrite cutting pyrite.

3. *Flotation Tails.*—The sample of flotation tailings is found to contain a small amount of sulphides. The predominant sulphide is pyrrhotite. Such particles of pyrite and arsenopyrite, as observed in the material, are attached to, or embedded in, particles of gangue. No gold has been revealed in the prepared sections. Occasional grains of hematite and magnetite are present.

4. *Flotation Concentrate.*—Pyrite is the predominant sulphide in the flotation concentrate, as well as in the specimen of ore. Arsenopyrite, pyrrhotite, chalcopyrite, and sphalerite are also present. A considerable number of gold particles have been observed in this concentrate. There are comparatively large flakes, .086 x .020mm., which are apparently free, as well as smaller particles, .010 x .008mm. An irregular shaped particle, apparently free, with a crumpled appearance, is illustrated in fig. 2,* where it appears on the surface of the section as two isolated areas. There are also a number of particles with attached fragments of sulphides. One of these is illustrated in fig. 3,* where pyrrhotite is attached to one side of the gold particle. A large particle of gold, .039 x .037mm., has a thin film of arsenopyrite on one edge, while another particle of gold, .014 x .023mm., has an attached particle of pyrite.

A number of particles of gold have not been exposed during crushing, and occur in the flotation concentrate

* Figures not available. (R.S.M.)

* Figures not available. (R.S.M.)

as inclusions in pyrite or arsenopyrite and, in one case (fig. 6*) in pyrrhotite. Fig. 4* illustrates an extremely minute inclusion of gold in pyrite, while fig. 5* illustrates gold at the margin of a composite grain of pyrite and quartz. A gold particle, .003 x .003mm., has been observed at the margin of an inclusion of pyrrhotite in pyrite, while fig. 6* illustrates a minute inclusion of gold, .003 x .002mm., in an inclusion of pyrrhotite in arsenopyrite.

5. *Calcine Residues.*—Very little sulphide persists in the calcined product, and such particles as can be found occur as inclusions in particles of gangue. No gold has been observed in the prepared section. There occur, however, numerous particles of iron oxide, which are more or less pseudomorphous after the particles of sulphide.

If a particle of pyrite, such as illustrated in fig. 4,* is converted by roasting into a solid particle of iron oxide, it is obvious that the included particle of gold will not be exposed. Unless such particles are disintegrated by the oxidation, the included gold will not be recoverable by cyanidation.

The silver-bearing mineral in the ore has not been recognised.

Fig. 1.*—Drill Core. Gold particles situated on the margin of a particle of pyrrhotite embedded in quartz. Mag. 450. The white squares illustrate the relative size of a 200-mesh I.M.M. Screen.

Fig. 2.*—Gold particle in flotation concentrate, isolated from sulphides. It appears on the surface of the section as two areas isolated in the mounting medium. Other grains in the field are pyrite. Mag. 370.

Fig. 3.*—Gold particles in flotation concentrate. A particle of pyrrhotite is attached to the left side of the gold. Mag. 700.

Fig. 4.*—Particle of pyrite in flotation concentrate containing a minute inclusion of gold. Mag. 500.

Fig. 5.*—Composite grain with dotted outline of quartz and pyrite in the flotation concentrate. Gold is included in the marginal part of pyrite. Mag. 370.

Fig. 6.*—Minute particle of gold in an inclusion of pyrrhotite in arsenopyrite. Flotation concentrates. Mag. 700.

(Signed) FRANK L. STILLWELL.

APPENDIX C.

DESCRIPTION OF SAMPLE.

Approximately 50 lbs. of roasted concentrates were received and analysis of a typical sample of the material gave the following results:—

Analysis.†

		%
Silica	(SiO_2)	30·60
Alumina	(Al_2O_3)	2·50
Titania	(TiO_2)	0·11
Manganous oxide	(MnO)	0·10
Lime	(CaO)	4·26
Magnesia	(MgO)	2·24
Soda	(Na_2O)	0·08
Potash	(K_2O)	0·14
Water < 105° C.	(H_2O)	0·61
Water > 105° C.	(H_2O)	0·59
Carbon dioxide	(CO_2)	1·10
Total sulphur	(S)	2·03
Sulphur trioxide	(SO_3)	4·35
Sulphide sulphur	(S)	0·29
Total iron	(Fe)	36·00
Ferrous oxide	(FeO)	0·71
Total copper	(Cu)	0·37
Ammonia-soluble copper	(Cu)	0·09
Total arsenic	(As)	0·50
Total oxidised arsenic	(As as As_2O_3, As_2O_5)	0·22
Arsenious oxide	(As_2O_3)	0·17
Cobalt	(Co)	0·022
Zinc	(Zn)	0·45
Carbon	(C)	0·70

Assays.

The average head values of the small samples used in tests were as follows:—

Gold (Au)—91.50 dwts. per short ton of ore.
Silver (Ag)—37.96 dwts. per short ton of ore.

* Figures not available. (R.S.M.)

† Analysis carried out by the Imperial Chemical Industries.

MINERALS PRESENT.

Sulphide.—The material received contains a small amount of sulphides and examination of a flotation concentrate indicated that the principal sulphide was arsenopyrite; pyrite was also identified.

Carbon.—Carbonaceous material is present in the sample.

Gold.—Some free gold is present, mostly as fine grains and flakes. On examination, some of the particles were noted to be partly coated with iron oxides, but in no case was the coating such that difficulty might be expected in extracting this gold.

Silver.—A small amount of silver appears to be associated with gold as bullion, but from the results of tests it is considered that the majority of the silver content bears little or no relation to the gold content.

LANCEFIELD GROUP.

REPORT ON "BERIA MAIN LODE," G.M.L. 2216T, MT. MARGARET GOLDFIELD.

(K. R. Miles, B.Sc. (Hons.).)

This G.M.L. is situated just south of the Lancefield leases (see plan accompanying Lancefield report). The ore-bodies here consist of three approximately parallel lodes in an area of finely schistose greenstone and talc schist, with lenses of a dense greenstone which weathers to fine clay. This country appears to be in all respects similar to the footwall country of the main Lancefield lode. In marked contrast to the Lancefield lode, however, the lodes and country here strike approximately N. 30°—40° W. and dip 50°—60° N.E. with local variations due to minor folding.

The lode material consists of mineralised schist, which may or may not contain stringers of ferruginous quartz. The distribution of values in the lode appears to be somewhat sporadic, but for the most part the lodes are confined to definite bands in the schist. Here and there the lodes pinch and make, reaching a maximum width of about 14 feet, under the control of a number of minor dragfolds which have a fairly steep northerly pitch.

At the time of inspection (November, 1937), the East Lode was the only one being worked, there being two accessible shafts (shafts A and B). The Middle Lode is no longer accessible, while no work has been done on the West Lode for the last five or six years.

The East Lode has been opened up to 110 feet, V.D., with levels at 70 feet and 102 feet. The tortuous nature of these drives clearly shows the change in strike of the lode due to the dragfolding. Towards the centre of the lode stoping has been carried on from both the 70ft. and 102ft. levels, and here the lode has an average width of about nine feet. In the upper level the stope rises for 18 feet over a length of 45 feet. The faces at the north-western ends of the 102ft. level and of a small drive at 90 feet, have passed through the nose of a small dragfold which is pitching in the direction N. 50° E. at an angle of 40 degrees. Values are reported to occur in a narrow band about one foot wide on the western side of the drives but not in the faces. To follow the lode the drive should be continued at about 45° west of its present direction.

The water level in the East Lode varies from 102 feet at the south-eastern end (shaft B), to 110 feet at the north-western extremity.

PLATE II

LEGEND

Greenstone — Metamorphosed Fine to Medium Grained Basic Lavas, Amphibolite Schists and Massive Amphibolite Rocks

Granite and Associated Rocks

Jaspilite — QFe

Quartz — Q

REFERENCE TO SIGNS

Gold Mining Leases — G.M.L 806T

Machinery Area — M.A.7T

Tailings

Shafts

Buildings

Windmills

Wells

Drainage Channel

Tracks

Doubtful or Assumed Geological Boundaries

Strike and Dip of Schistosity — N10°E 60°

Strike of Schistosity with no observed Dip — N10°E

Outcrops with no observed Strike and Dip

G.M.L. 2324T
"Lancefield Nth. Block II"
G.M.L. 2323T
"Lancefield Nth. Block I"
G.M.L. 2308T
G.M.L. 2334T
"Lancefield No1 East"
"Lancefield Nth. Block 14"
G.M.L. 2279T
G.M.L. 2389T
G.M.L. 2278T
"Lancefield Deeps Extd. No1"
G.M.L. 2390T
"Yorkshire"
"Lancashire"
G.M.L. 715T
"Lancefield Deeps Extd. No2"
G.M.L. 2232T
"Lancefield Nth."
G.M.L. 2233T
G.M.L. 2259T
"Lancefield Deeps East"
"Lancefield Deeps Extd"
G.M.L. 2258T
"Lancefield Nth East"
"Lancefield East Extd"
G.M.L. 806T
G.M.L. 2221T
G.M.L. 2225T
G.M.L. 1544T
"Lancefield"
"New Lancefield Nth. Deeps"
"Lancefield East Deeps"
G.M.L. 2234T
G.M.L. 2257T
G.M.L. 2236T
G.M.L. 2255T
G.M.L. 2265T
"Beria East"
"Lancefield Sth. East Extd"
"Lancefield Extd Sth."
"Lancefield Sth."
G.M.L. 2235T
"Lancefield Extd."
"Mali Zmajon"
A
QFe Referred to in Text
G.M.L. 2332T
G.M.L. 2216T
"Roka"
G.M.L. 2264T
"Beria Main Lode"
"Ivan"
BERIA TOWNSITE
Hotel
M.A.15T
M.A.7T
G.M.L 2245T
MAIN SHAFT
Shaft A
Shaft B
Shaft C
Shaft D
Windmill
Well
Track
Creek
Dry
To Laverton
To Crawfords Soak
Granite, Gneiss, Quartz Porphyry and Granitised Greenstones
Granite, Gneiss, Quartz Porphyry and Granitised Greenstones
Greenstone
Greenstone Schist
Chiastolite Schist
Decomposed Greenstone Schist
Decomposed Greenstone
QFe
G.S.W.A. Camp

GEOLOGICAL SUBSURFACE MAP OF LANCEFIELD GROUP

Mt MARGARET GOLDFIELD

Scale 10 chains to an inch

10 8 6 4 2 0 10 20

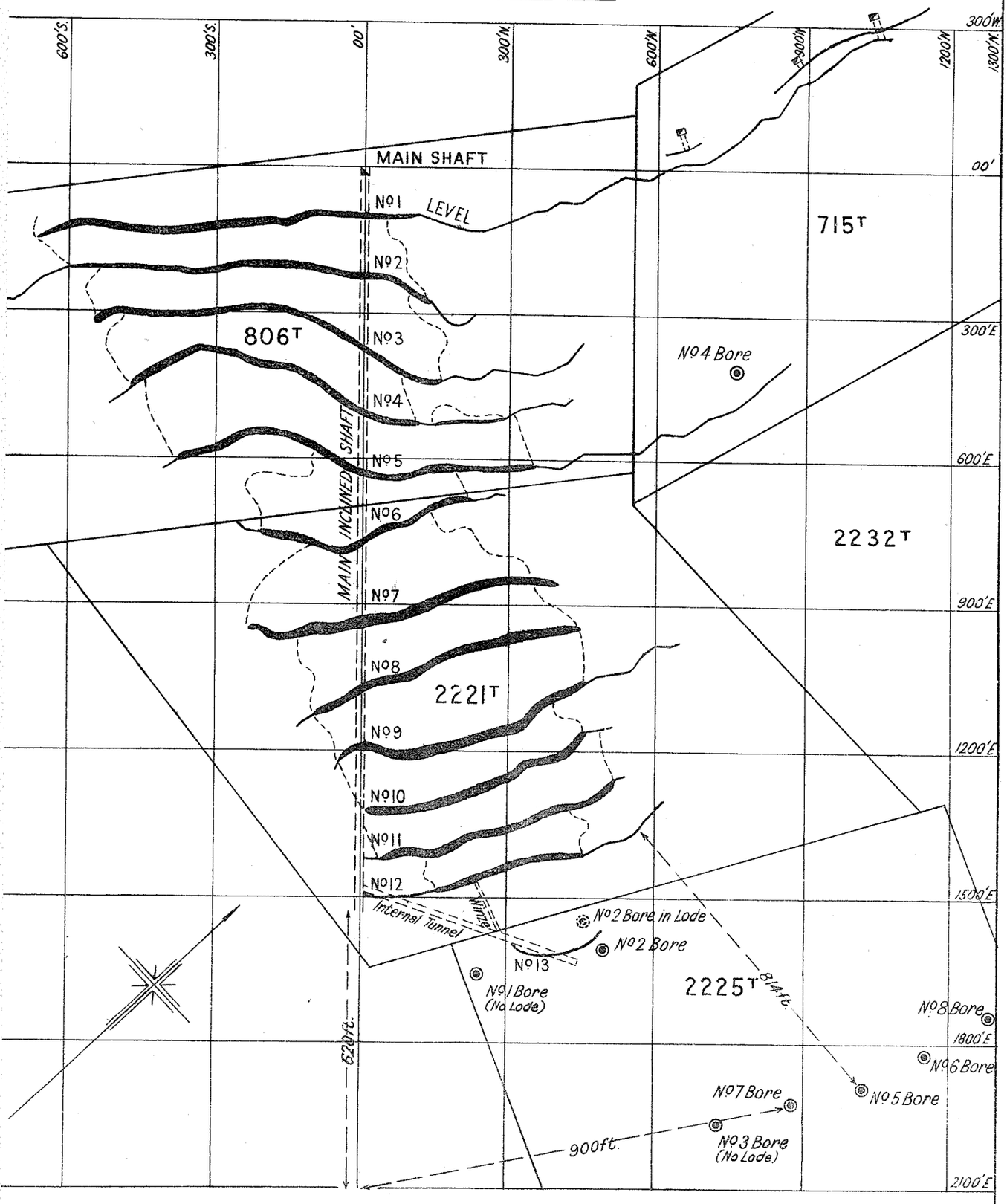
Survey data supplied by Mines Dept. Plane Table, Telescopic Alidade traverses & Geology by R.S. Matheson & K.R. Miles, Nov. 1937.

J.M'L del 28/1/38

PLATE III

PLAN OF
LANCEFIELD GOLD MINE

Scale 280 feet to an inch



Note:– The sections of the Levels shown in solid black represent the stoped portions

del. 15-1-38

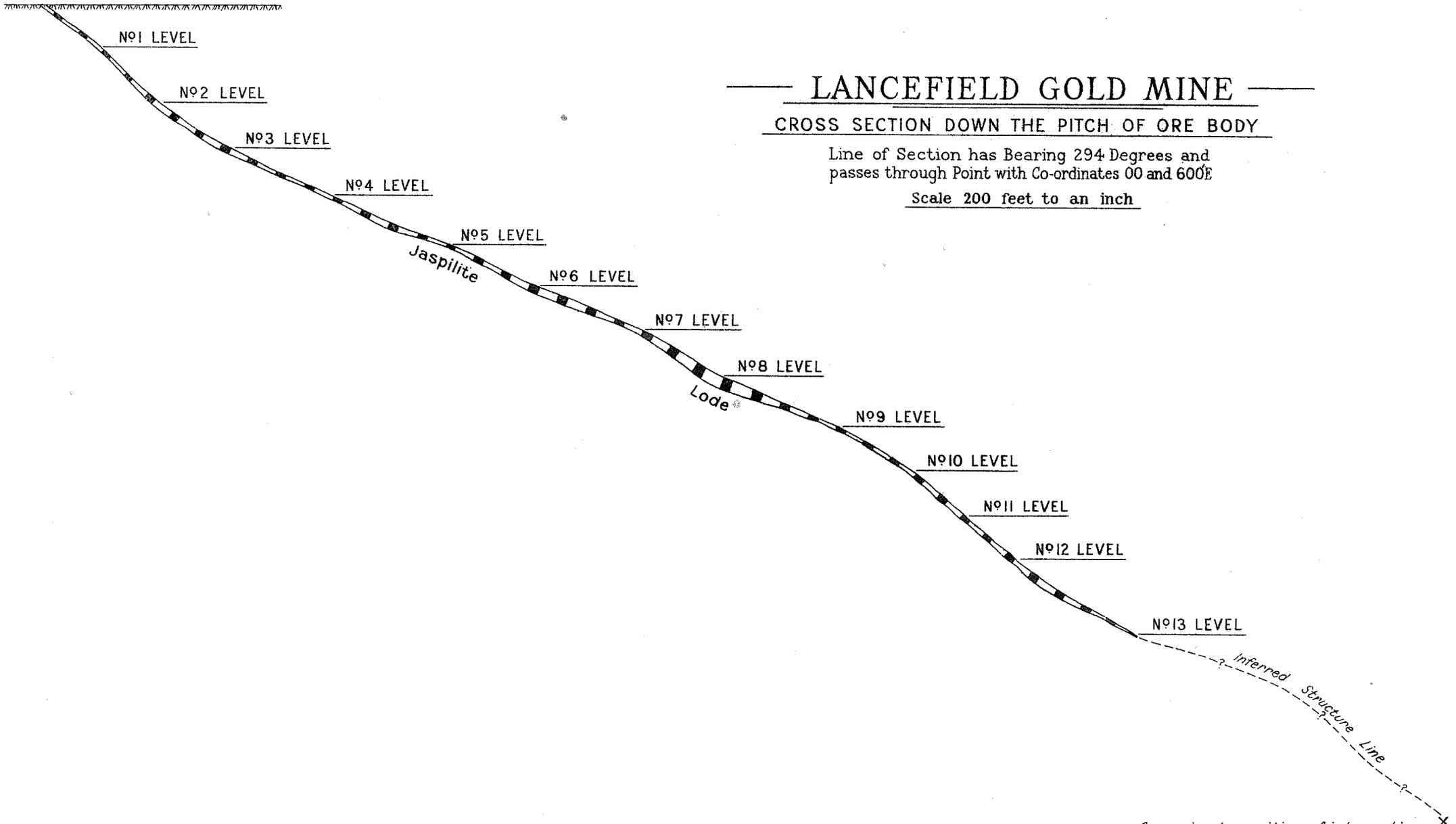
Plan supplied by Management. The stoping on No 12 Level and position of No 13 Level added by R.S. Matheson, Nov. 1937.

LANCEFIELD GOLD MINE

CROSS SECTION DOWN THE PITCH OF ORE BODY

Line of Section has Bearing 294 Degrees and passes through Point with Co-ordinates 00 and 600E

Scale 200 feet to an inch

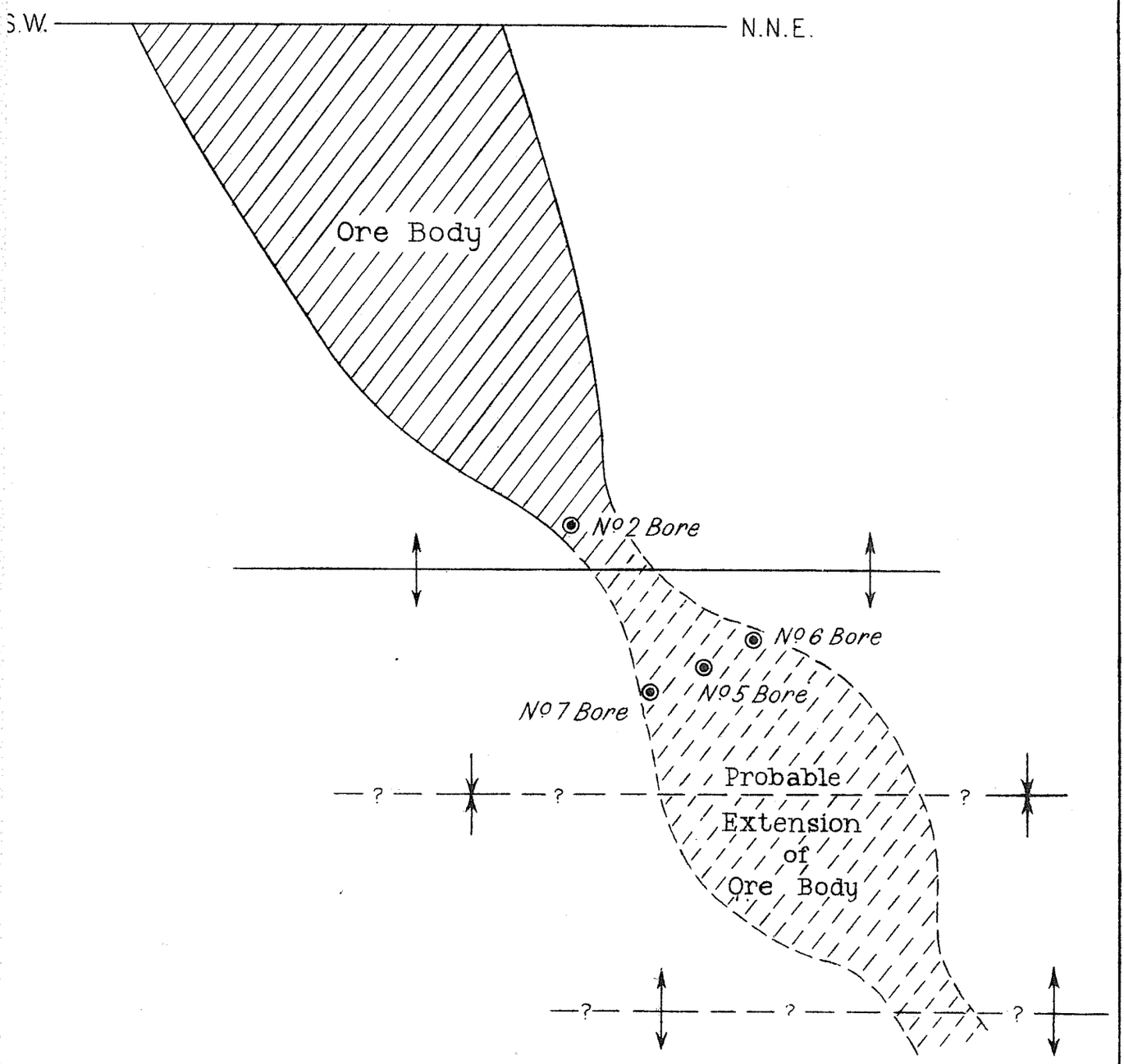


Section by R.S.Matheson; Nov 1937.
Widths of Lode are only approximate.

PLATE V

DIAGRAMATIC LONGITUDINAL SECTION
OF
LANCEFIELD ORE BODY

Not to Scale



McL. del. 17-1-38

Section by R.S. Matheson, Dec. 1937.

The West Lode has one accessible shaft, C., 50 feet, V.D., which leads to a short inclined winze opening into two large stopes. The first, which is approximately 60 feet long and 10 to 12 feet wide, was filled with water, which here reaches 70 feet V.D., so that the bottom of the stope could not be examined. It is understood, however, to extend to 100 feet V.D. The second stope which was reported to be of very similar dimensions to the first was inaccessible.

The average value of the lode material recently crushed is reported to have been 6 to 8 dwts. gold per ton. The fact that the values are poor at the surface but steadily improve with depth, with the best values occurring more or less close to the water level, points, I think, rather to the secondary nature of the lode. Consequently too much optimism as to the possibility of the good values extending into the sulphide zone should not be entertained and will not be justified until further testing has been carried out below water level.

The position of this G.M.L., and the strike and dip of the country in relation to the main Lancefield lode (see plan accompanying Lancefield Report), strongly suggest that it is situated in an extension of the footwall country of the Lancefield lode. Traces of an outcrop of ferruginous quartzites, very similar in appearance to the surface outcrops of the Lancefield lode, occur in the northwestern corner of the G.M.L., and it is suggested that these could well bear further investigation and prospecting.

INDEX.

INDEX—*continued.*

By Authority: FRED. WM. SIMPSON, Government Printer, Perth.