GSB40

[*Registered by the Postmaster-General for transmission through the post as a book*]

Tasmania

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BULLETIN

No. 40

Avoca Mineral District

BY

A. McINTOSH REID, Director of Mines,

and

Q. J. HENDERSON, Cadet Geologist

Issued under the authority of

The Honourable CLAUDE JAMES, M.H.A.

Minister for Mines for Tasmania

Tasmania:

Wholly set up and printed in Australia by

JOHN VAIL, GOVERNMENT PRINTER, HOBART

47511

1929

Price 2/6

TABLE OF CONTENTS.

	Page
SUMMARY	1
INTRODUCTION	3
Preliminary Statement	3
General Statement	3
Acknowledgments	4
CHAPTER I.—HISTORY OF DEVELOPMENT	5
Previous Literature	5
Early History and Exploration	6
Production	6
CHAPTER II.—GEOGRAPHY AND PHYSIOGRAPHY	7
Location and Area	7
Population and Industries	7
Roads and Railway	7
Climate	7
Topography	7
Drainage	8
Mountains	9
Glaciation	9
Topography in Relation to Mining	10
CHAPTER III.—GENERAL GEOLOGY	11
Geological and Structure Maps	11
General Statement	11
Sedimentary Formations	12
Cambro-Ordovician	12
Permo-Carboniferous	12
Trias-Jura	12
Tertiary	14
Quaternary and Recent	14
Igneous Rocks	15
Devonian Granites	15
Diabase	16
Basalt	18

Page

Structure ... 18
Faults ... 18
Differential Uplift ... 19
Folding ... 20
Strikes and Dips ... 20

CHAPTER IV.—ECONOMIC GEOLOGY ... 21
Mineralogy of the Ore-Deposits ... 21
Metallic Minerals ... 21
Non-Metallic Minerals ... 22
Genesis of the Ore-Deposits ... 23
Kinds of Ore-Deposit ... 24
Erosion of the Ore-Bodies ... 26

CHAPTER V.—MINING ECONOMICS ... 27
Power ... 27
Water-supply ... 27
Milling and Concentration of the Ore ... 27
Transport and Communication ... 28
Timber-supply ... 28
Labour ... 28
Exploration ... 28

CHAPTER VI.—THE MINING PROPERTIES ... 30
STORY CREEK AREA ... 30
Story Creek Mine ... 31
Story Creek Alluvial ... 40
Eastern Hill Mine ... 40
Lease 9584-M ... 42
Lease 10,178-M ... 43
Lease 10,304-M ... 43
Lease 9902-M—J. S. Goodall ... 44
Lease 10,176-M—H. J. Rubenach ... 45
Lease 10,108-M—E. L. Egan ... 45
Egan Prospect ... 45
McCormack Prospects ... 46
Lease 10,154-M ... 46
Lease 10,032-M ... 46
Lease 10,374-M—J. S. Goodall and G. F. Plummer ... 46
Lease 10,392-M—G. F. Plummer ... 48
Old Lease 3528-M ... 48

	Page
Lease 10,393-M—J. S. Goodall	48
Lease 10,345-M—M. A. Flaherty and others	49
Lease 10,158-M—A. T. Anderson and J. A. Crisp	50
Lutwyche Prospects	50
Lease 10,183-M	50
Lease 10,184-M	50
Crisp Prospects	52
Lease 10,222-M	52
Lease 10,223-M	52
Aberfoyle Tin Mine	52
Kookaburra Prospect	57
Lease 10,270-M—R. L. Slide	58
Lyons' Prospects	58
Mammoth Tin Areas	59
GIPP CREEK AREA	62
Lease 8811-M—G. H. Hodgman	63
Lease 9270-M	65
Lease 4709-M—Park and Bailey	66
Lease 6061-M—M. Hayes	68
Lease 4762-M—J. F. Egan	69
Lease 4547-M	69
Ben Lomond Mine	71
The Great Republic Mine	73
Rex Hill Tin Mine	74
Galena and Sphalerite Ore-Bodies	80
Flaherty's No. 2 Prospect	81
Dalrymple Tin Mine	82
South Lode	83
AVOCA AREA	83
New Henbury Mine	83
Lease 105 P-M	88
Lease 120 P-M	88
Lease 121 P-M	89
Leona Leases	89
Riverside Mine	90
Alford Creek Prospects	92
ST. PAUL TIN FIELD	93
Introduction	93
Area	93
Physiography	93

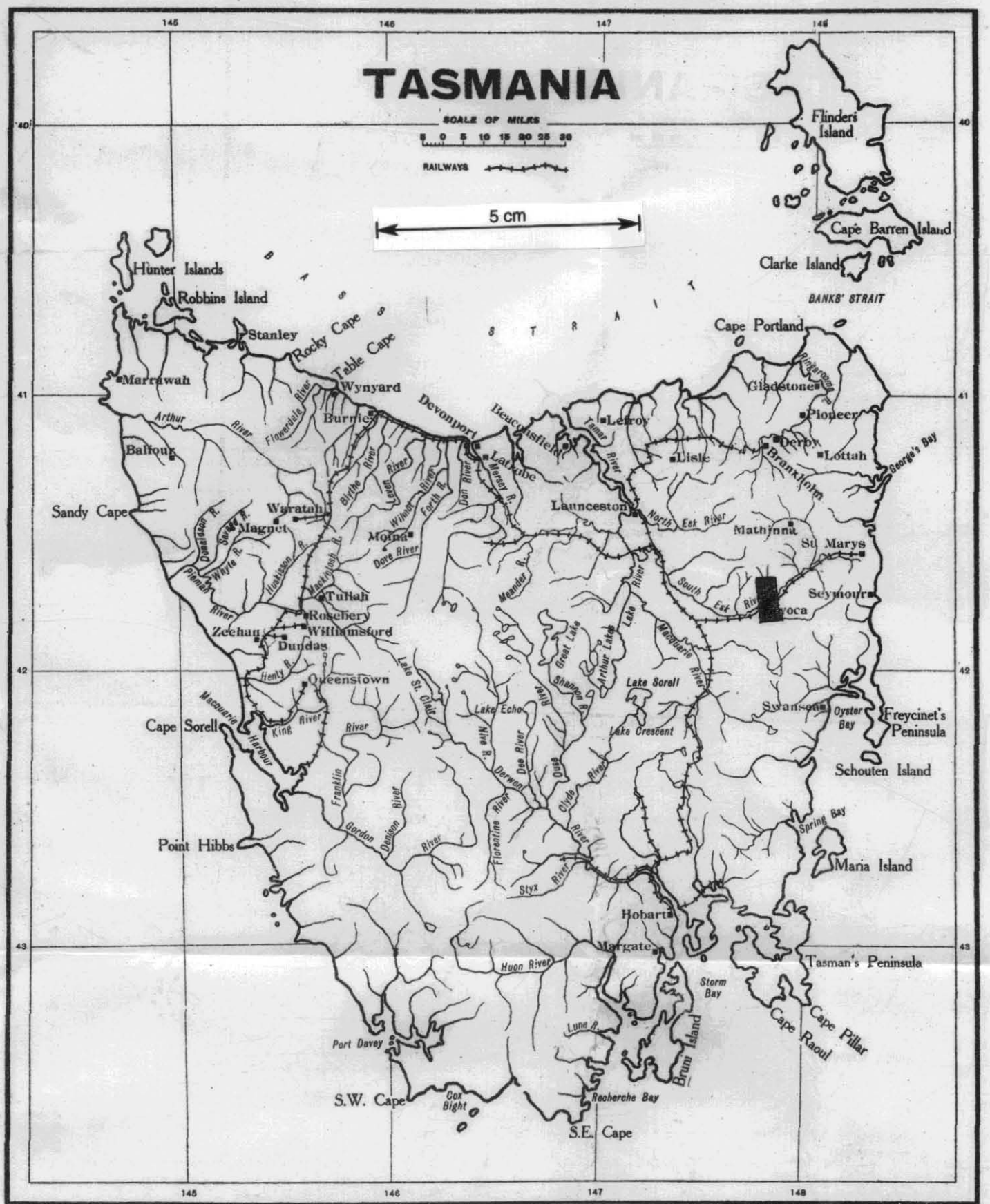
	Page
Geologic Relations	95
The Mining Properties	98
Roy Hill Tin Mine	98
Royal George Mine	106
Lease 10,007-M	112
Lease 10,006-M	114
Lease 10,008-M	115
St. Paul River Tin Ltd.	122
Hannah's Prospect	123
Lease 10,042-M	126
Lease 2596-M	126
Lease 4913-M	127
Lease 1769-M	127
Lease 1028-M	127
Unleased Ground	127
Brookstead Tin Mine	127
Old Lease 1470-91M	142
Old Lease 1471-91M	142
Ayre Prospect	143
Thompson Prospect	143

LIST OF PLATES

PLATE I LOCALITY MAP (FRONTISPIECE)

PLATE II GEOLOGICAL SKETCH MAP OF AVOCA TIN FIELD } AT THE END OF THE REPORT

PLATE III GEOLOGICAL SKETCH MAP OF STORY CREEK AREA } AT THE END OF THE REPORT



LOCALITY MAP

Photo Lithographed by John Vail, Government Printer, Hobart, Tasmania

The Avoca Mineral District.

SUMMARY.

AVOCA mineral district has been noted for its tin, wolfram, and coal mines, yet the mining of these products, although extended over a long period, has nowhere been performed on a large scale. In the early days of its history the miners concentrated attention on the easily workable alluvial and detrital deposits; then, using the crudest appliances for the separation of ore from gangue, they attacked the ore-bodies at their outcrops and gradually worked underground. At that stage it became necessary to raise capital for the opening of the ore-bodies by way of adit or shaft, and for this purpose companies were formed. One company only survived the many trials that beset them, although for a time others carried on their work fairly successfully.

It is suggested before any mining work be undertaken in future, that the ore-bodies be explored at depth by means of the drill. The value of many of them at surface is known.

A resume of the geological relations of the several formations will now be submitted for the guidance of those engaged in mining. In the first place, it should be noted that the deposition of the tin and wolfram ores, with their associates, represents one of the latest phases of the intrusion of a granitic magma into and under cover of Cambro-Ordovician slates, sandstones, quartzites, and tuffs. That magma underwent primary differentiation before intrusion and secondary differentiation after intrusion, consequently the solidified magma exhibits many variations in mineralogical composition, texture, and structure. Thus came coarse barren porphyritic granite and granodiorites representing the primary differentiates, and porphyries, graphic granites, pegmatites, ore-veins, alaskites, and quartz

veins representing the secondary differentiates. Some of the secondary are intrusive into the primary, others result from the effects of mineralisers upon the cooling primary magmas. Ore-bodies are found, therefore, representing segregations in porphyries, graphic granites, and pegmatites, and representing also fissure fillings and greisens, the latter, in many cases, contained in the former. The last phase of the intrusion is represented by barren alaskites and quartz vein dykes. Greisenisation effects are more or less general through all types of ore-body; but thoroughly greisenised vein-stones are found, some in distinct groups of veins, and many so closely spaced as to appear like one large ore-body, such as those exhibited in the Royal George Mine.

Large low-grade ore-bodies are represented by the porphyry dykes and the irregular bodies of graphic granite and pegmatite; comparatively smaller though richer bodies are represented by some of the quartz veins and greisen veins.

INTRODUCTION.

A.—Preliminary Statement.

Avoca tinfield has been, during the past 50 years, a steady, though small, contributor to the tin output of this State. During its long history no period of outstanding importance can be named. Its development, therefore, may be regarded as one of slow progression. No big mines, in the strictest sense of the term, have been opened within its boundaries, yet two (Story Creek and Royal George), at least, on a fairly large scale have been operated with some degree of success.

Avoca is not only a tinfield, but the source also of the present wolfram production of Tasmania. Twenty years ago the associated wolfram was regarded as an obnoxious impurity in the treatment of the tin ore, but its great application in the metal industry since that time, and particularly during and since the war, has brought it into the lists of highly marketable products. To-day, therefore, the mines in which wolfram is an associate of tin ore become important also for the production of that mineral.

Avoca is noted also for its coal areas, and as being the centre of a rich pastoral country.

B.—General Statement.

The field work upon which this report is based was performed during the months of October and November last year. The time available was not long enough to allow of a thorough survey of the whole area, but close attention was given to detail in the more important parts.

Two geological maps are presented to illustrate the geologic relations of the rock formations to one another and the ore-bodies thereto.

The report on Gipp Creek area, included herein, was prepared by P. B. Nye, Government Geologist, in August, 1926.

C.—ACKNOWLEDGMENTS.

Where so many have assisted the writers in their field work by conducting them to places of interest through pathless country, by furnishing information relating to the history of development of many defunct mines and prospects, furnishing information on existing mines, and by extending their hospitality, a seeming injustice might be done in singling out a few, therefore this general acknowledgment is made with gratitude in recognition of their services.

I.—HISTORY OF DEVELOPMENT.

Previous Literature.

The first official record of tin ore in this district appears in reports entitled "The St. Paul River Tin Deposits" and "Report on the Ben Lomond Tin Deposits," prepared by G. Thureau in 1881.

In 1892 A. Montgomery visited the districts, and presented the results of his investigations in "Report on the Ben Lomond District" and "Report on the Discoveries of Tin Ore on the Brookstead Estate," and in 1893 Montgomery submitted to the Secretary for Mines a "Report on the Roy Hill Tin Mine," and a "Second Report on the Brookstead Estate Tin Lodes."

The next record is that from the pen of W. H. Twelvetrees in a "Report on Some Tin Mines in the St. Paul River Valley, near Avoca," appearing in the annual report of the Secretary for Mines in 1899.

In 1901 Geo. A. Waller visited the other end of the field, and prepared a "Report on the Tin Mining District of Ben Lomond."

In 1905 W. H. Twelvetrees again visited the district, this time particularly in connection with coal, and his findings were recorded in the report "On Coal at Mount Rex."

The next report appears over the name of Loftus Hills, who, in 1915, presented an account of the tungsten deposits in "Mineral Resources No. 1."

In "The Coal Resources of Tasmania" A. McIntosh Reid deals with the coal areas of Avoca, and briefly refers to the tin-ore deposits.

In "Underground Water-supply Paper, No. 4, 1926," P. B. Nye mentions the occurrence of tin-ore and coal in this district.

Although the literature is extensive, some of it applies almost exclusively to coal and one report to tungsten.

Early History and Exploration.

The early history of this field has not been recorded in any work known to the writer. It is reported, however, that tin-mining commenced in 1872. Information relating to the discovery of tin ore at some places is given in the reports on individual mines.

Production.

Data relating to production are fractional. Until recent time no official record had been kept of the output of each mine, and the records of defunct companies have been lost.

It is estimated, however, on reliable authority, that the total output of concentrated tin ore exceeds 4500 tons, and the total output of wolfram is not less than 1500 tons.

II.—GEOGRAPHY AND PHYSIOGRAPHY.

Location and Area.

Avoca mineral field lies at the junction of St. Paul and South Esk Rivers, in the County of Cornwall, bordering on the County of Glamorgan, Eastern Tasmania. It is 2 to 10 miles from east to west, and 20½ miles from north to south, and occupies an area of 119 square miles.

Population and Industries.

The population of the district has remained almost stationary for many years, with slight fluctuations dependent upon mineral development. At present about 500 people are resident in the district, of which about 400 are directly or indirectly engaged in or dependent upon mining.

Although mining is more important at present, sheep-raising is the staple industry.

Roads and Railway.

Fingal railway, from Conara Junction, passes through Avoca and terminates at St. Marys, an important coal-mining centre. By rail Avoca is 16¾ miles from Conara and 52 miles from Launceston.

The main road to St. Marys and Scamander passes through Avoca, from which radiate also roads to Story Creek, Swansea, and to near settlements.

Climate.

The climate is mild, with no extremes of heat and cold. The annual precipitation averages 25·57 inches, distributed through all seasons, but more rain falls in winter than in any other season.

Snow falls in the highlands, and Ben Lomond is capped during the late autumn, winter, and early spring.

Topography.

The topographic features of this district may be traced back to Devonian time, when the surface appeared in the form of a dissected peneplain. This

is clearly seen in noting the positions of the basal beds of the Permo-Carboniferous formation, which everywhere are found occupying shallow valleys in the dissected platform of the older Palæozoic rocks. Moreover, taking into account the measures of displacements of faulted blocks and tilting, it is found that the basal measures lie at or about the one level. At the beginning of the Permo-Carboniferous period of sedimentation, therefore, the country presented the appearance of a dissected peneplain, not more than 600 feet above sea-level. During that and the succeeding period sedimentation continued at the varying rates of a gradually subsiding floor until its interruption by the upheavals, culminating in the intrusion of diabase in the forms of sills and laccolites, dykes, and irregular transgressive masses, followed by faults of minor and major magnitude. That disruption and upheaval ushered in a cycle of erosion of extraordinary intensity, which, with little interruption, has continued, although on the wane, to the present day.

The physiographic features, therefore, are due largely to the uplift of the land and intrusion of diabase, in upper Mesozoic time, to faulting, and to long continued erosion.

DRAINAGE.

During the long period since the intrusion of diabase, the main drainage channels, occupied by the South Esk and St. Paul Rivers, have been undergoing the sculptural effects of erosion, particularly by the action of flowing water. Their shapes reveal a chequered history: times of very active corrosion, interposed with periods of comparative quiescence and lateral erosion, and exceptional occasions of extraordinary floods like the recent cataclysm. These master streams, to which all others are tributary, follow courses conditioned by the trends of major lines of faults and lines of intrusion of diabase. They may be described as rift valleys, modified by erosion. In the late Tertiary they had reached base-level and, following a long period of relative stability, had, by lateral erosion, extended

their valleys 1 to 3 miles. In the lower part of the tributaries the valleys are wide and the flood-plains well developed, as in the master stream valleys. The two master streams, fed largely by surface run-off, have extreme and rapid fluctuations in height; and, after floods, layers of muds and sands are added to the soils of the plains.

The numerous mountain torrents flowing into the master streams have sharply incised valleys, following as a rule lines of contact between igneous and sedimentary rocks.

The relative resistance to erosion between the granites and diabase on the one side and sedimentary rocks—especially those of the younger formations—on the other, has resulted in the development of very high relief.

MOUNTAINS.

The vertical range betwen the tops of the mountains and the floors of the lowest valleys is over 3500 feet, Ben Lomond (5165 feet), the highest mountain, being in the northern part of the district. The highest mountains are built of or crowned with igneous rocks, from which the sedimentary have been denuded.

Ben Lomond, for instance, presents bold escarpments of columnar diabase over 1000 feet high. Around this great mountain mass deep talus of diabase covers the soft underlying Permo-Carboniferous rocks and effectively protects them from disintegration and removal.

St. Paul Dome, another prominent landmark, is likewise crowned with diabase, as are also Mount Lewis and Snow Mountain.

GLACIATION.

The effects of glaciation are not very well marked on the landscape. Doubtless large masses of the softer coal measure formations have been removed from the highlands by this agent of erosion, and some of the more prominent mountain features have been sculptured by glaciers; but the evidences indicate that the glaciers were small and of local action only.

Leading from the mountain ranges are many broad valleys floored with boulder clay, which could not have been transported by water. The boulders are sub-angular and consist almost wholly of diabase.

Hog-backs of granite, suggestive of glacier action, have been observed near the Swansea road-bridge over St. Paul River and near Roy Hill.

Other evidences, in the form of cirques and tarns, are not wanting.

Topography in Relation to Mining.

The deep dissection of the South Esk and St. Paul Rivers, and their numerous tributaries, has laid bare many ore-bodies and coal seams, and outcrops can now be traced without great difficulty along the valley sides. In addition to the advantages gained in exploration, the valleys provide means of attacking the ore-bodies by way of adit and open-cut.

The main lines of transport follow the valleys of the major streams, and the subsidiary lines their tributaries.

Thus the topographic features are such that the ore-bodies and coal seams are not difficult of access, and can be opened at comparatively little cost.

III.—GENERAL GEOLOGY.

Geological and Structure Maps.

Illustrating this bulletin are geological and structure maps showing also the physical features of the country and the positions of mines and settlements.

The maps are based upon the mineral charts of the district, as issued by the Lands and Surveys Department. Features were located by means of prismatic compass and chain, and elevations by the use of aneroid barometers, based upon the datum (653 feet) of Avoca railway-station.

These maps, although admittedly not accurate, give a fairly correct idea of relative position and of relief.

General Statement.

This field is occupied at surface by both sedimentary and igneous formations, the former represented by—

(1) Cambro-Ordovician slates, sandstones, tuffs, &c.;
(2) Permo-Carboniferous conglomerates, grits, sandstones, limestones, &c.;
(3) Trias-Jura siliceous sandstones, felspathic sandstones, coal seams, &c.;
(4) Tertiary gravels, drifts, clays, lignites, &c.; and
(5) Quaternary sands and gravels;

and the latter represented by—

(1) Devonian granites and granodiorites;
(2) Upper Mesozoic diabase; and
(3) Tertiary basalt.

The basement rocks (Cambro-Ordovician) occupy generally low lands, except at such places as Mount Foster, Story Creek, and Upper Aberfoyle Creek.

Before the invasion of granite in Devonian time these rocks had been subjected to compressive stresses, brought about by mountain building movements resulting in the formation of such structures as folds, cleavage planes, contortion, and schistosity. The granitic magma effected a varying degree of

metamorphosis on the intruded Cambro-Ordovician rocks, the variation having been due to relative susceptibility to attack, and to position in relation to the lines of attack; and effected also changes in structure, resulting from the dynamics of the intrusion. No doubt the intrusion brought about a great uplift of the land, for erosion set in and continued throughout the period, denuding the plutonic granite of a great part of its sedimentary cover. The surface had been reduced to a mature stage of peneplanation when the Permo-Carboniferous period of sedimentation came into being. No untoward geological event interrupted sedimentation until the close of the Triassic period, when came the intrusion of diabase and the concomitant uplift of land. Another cycle of erosion removed large sections of the Trias-Jura and Permo-Carboniferous strata from the Cambro-Ordovician rocks and from the Devonian granites, and, depositing the waste, formed the Tertiary sediments. At mid-Tertiary time basalt extrusions through narrow dykes temporarily checked the progress of sedimentation, and a subsequent uplift introduced the still existing cycle of erosion.

Sedimentary Formations.

Cambro-Ordovician.

The fundamental rocks of the district comprise clay slates, graphitic slates, arenaceous slates, argillaceous sandstones, quartzites, tuffs, lavas, and volcanic breccias. This series is remarkable as being the repository of some of the most important bodies of tin ore, lead ore, gold, and other metallic minerals. They are thus of particular interest from an economic point of view.

No organic remains have been seen in the rocks here, therefore the difficulty of assigning to them a definite place in the geological column.

In some parts the plastic members show the effects of compressive stresses in their schistose structure and their otherwise warped and contorted condition. The intercalated volcanic members have suffered more from the attacks of agents of weathering and of mineralisation. In places irregular

replacement ore-deposits have been discovered in them. These volcanic members appear to be of basaltic composition, and some, in the less weathered parts, exhibit the structure of sheets or volcanic flows.

Permo-Carboniferous.

Upon the peneplanated surface of older Palæozoic rocks rest the basal members of this formation. In the valleys of this dissected peneplain are found conglomerate and grit members, made up largely of quartz, quartzite, slate, and granite.

These basal members, especially where they rest upon granite, for example, at Roy Hill and Brookstead, contain tin ore, and in some places in profitable proportion. As a rule, however, the conglomerates and grits are so firmly cemented with silica and iron oxide that their disintegration becomes such a costly operation as not to allow of successful treatment. The grit members, in places, consist almost wholly of the waste of granite, and this arkose has in consequence often been mistaken for that rock. Succeeding members to those mentioned are sandstones, calcareous mudstones, limestones, and shales. Many fossil forms of organic life appear in the limestones, of which pecten and productus are prominent. Surviving fragments of beds are jotted here and there high up the sides of mountain ranges and cap many of the hills. It is difficult to form an estimate of the aggregate thickness of these beds throughout the district owing to major dislocations at many points; but in the St. Paul River area, for instance, the basal, beds lie at or about the 900-feet contour, and the uppermost at or about the 1500-feet contour.

Trias-Jura.

Conformably succeeding the Permo-Carboniferous, apparently without a break in the process of sedimentation, are the grits, siliceous sandstones, and shales, and the felpathic sandstones with intercalated beds of coal and shale of this age. Owing largely to the intense erosion that has prevailed since the close of the Mesozoic era, this formation

has been so greatly reduced that complete sections are not now existent at any part of the district. The coal measure series have been entirely removed in many parts, and in others remnants only of this once extensive member remain. These remnants are either covered with sills of diabase or buttressed by that rock, and so they are protected from the full forces brought into being by agents of erosion.

Tertiary.

In the broad valleys of the South Esk and St. Paul Rivers are beds of gravel, sand, clay, and shingle, which in places are covered with basaltic lava of mid-Tertiary age. The basal gravels and muds are made up largely of the waste of Trias-Jura and Permo-Carboniferous sediments, as evinced by the presence therein of pieces of coal and recognisable fragments of strata from those formations. The succeeding clays contain leaf impressions of many plants of this age. Very little granitic rock waste appears in these beds, therefore the Tertiary cycle of erosion did not result in the denudation of large areas of the tin-bearing granites. In consequence these beds are not likely to contain important concentrations of alluvial tin ore. The basal beds at their deepest have not been intersected, therefore the aggregate thickness of the series is not known.

Quaternary and Recent.

Overlying the Tertiary clays are beds of shingle, composed almost wholly of diabase. These beds contain very little tin ore but a comparatively large amount of ilmenite, which is a common accessory of diabase. They are succeeded by gravels and sands and detritus consisting of granite, mudstones and sandstones of Permo-Carboniferous age, diabase, quartzite, and quartz. At some places these beds, particularly the granitic ones, contain tin ore in fair proportion. They vary in thickness from 10 to 50 feet.

IGNEOUS ROCKS.

Devonian Granites.

The granites of this district are, in almost all respects, similar to those of Blue Tier and the north-eastern district generally, not only in mineralogical composition and texture, but also in their associations. Here are found differentiates of quite distinct characteristics, yet they are all closely related, and differ in age only in the order of their differentiation from the stock magma.

The most common rock type may be described as a porphyritic granite in which the phenocrysts are of soda-orthoclase, 1 to 3 inches long. These large crystals assume the Carlsbad twin form, and are distributed porphyritically and directionally through the ground mass, a granular mixture of quartz and felspar. Mica (biotite) is generally present, but quite subordinate to the other components.

This rock, apparently, is intruded by bodies of quartz porphyry, graphic granite and pegmatite, microgranites, aplite, and alaskite aplite.

Quartz porphyry presents itself in dyke form and along the margin of the granite body. Waller* records the discovery near the Great Republic Mine of quartz porphyry through which are distributed perfect double-ended crystals of quartz. Evidently this represents pegmatitic influences. Other noteworthy appearances of quartz porphyry are recorded at Roy Hill and Royal George Mines and at Goodall and Plummer's Prospect. In some places, associated with the bodies of quartz porphyry, are large bodies of normal biotite granite in which the component minerals are almost equidimensional.

One of the most important forms of granite, from an economic point of view, is that exhibiting an extraordinary intergrowth of quartz and felspar. These graphic granites are closely allied to pegmatites, representing, as they do, a late differentiate of the magma under the influence of mineralisers.

Eastward of Aberfoyle Creek another granitic rock, the hornblendic and pyroxenic variety, form-

* Waller, G. A.: Report on Tin Mining District of Ben Lomond, pp. 3-4.

ing apparently the peripheral portion of the batholithic body, outcrops through the Cambro-Ordovician sedimentary rocks. This is less acid than the "tin" granites of Story Creek, Avoca, and St. Paul River. Its ferro-magnesian mineral components are in much greater proportion, plagioclase becomes prominent among the felspars, and quartz takes a lower place in the scale; it is appropriately described as a granodiorite, with which, in Tasmania, many gold-bearing "reefs" are closely and genetically associated.

Here, therefore, are rocks of granitic nature, evidently derived from one homogeneous magma, which exhibit a marked variation in type. This heterogeneity, it is clear, has been produced as a result of differentiation before intrusion and, to a less extent, differentiation after intrusion.

Primary differentiation products are represented by normal biotite granite passing into granodiorite to the east of the northern section, with an alaskite phase westward, and by porphyritic granite consisting of phenocrysts of soda-orthoclase set in a medium-grained biotite, quartz, and felspar.

Differentiates of later formation are alaskite and graphic granite with secondary muscovite and ore minerals. Dykes of pegmatite and veins of greisen, quartz-mica, and quartz-tourmaline intrude the aforementioned; and dykes of barren alaskite aplite complete the processes of differentiation.

Diabase.

Diabase, consisting essentially of plagioclase and augite, is a very prominent rock feature of this district. The type represented here is of medium to coarse grain, and similar to the rock occupying such a large part of the central plateau and other areas in Tasmania.

It is intrusive into all formations up to the Trias-Jura, and is, therefore, younger, and probably of Cretaceous age. Several forms of intrusion are represented here, the form depending largely upon the physical condition of the intruded rock at the time of intrusion. The evidence available clearly indicates the conditions of the time.

The intrusion of diabase, which brought to an end the Triassic period of sedimentation, affected particularly the Carboniferous to Triassic formations, the older rocks suffering little from its metamorphic action. The explanation is quite simple. Before the Permo-Carboniferous sedimentation set in the Cambro-Ordovician rocks had been subjected to orogenic movements and the metamorphic effects of the granite intrusion. In those processes they became tilted, folded, contorted, and indurated. When in that condition, and covered with the horizontally disposed beds of the lower and upper coal-measure series of rocks, the diabase intrusion took place. In passing upward through the tilted Cambro-Ordivician rocks the diabase magma took the forms of dykes; entering the lighter, flat, recently consolidated beds of the Permo-Carboniferous formation, the invading magma insinuated its way between dissimilar beds in the forms of sills, uplifting, penetrating, dislocating, and breaking through into the overlying and incompletely consolidated Triassic beds, spreading out therein in the forms of irregular sills, and disrupting and uplifting the upper incoherent beds in great transgressive bodies.

Thus are found narrow, long dykes of diabase cut through Cambro-Ordovician strata and connected to sills and transgressive bodies in the Permo-Carboniferous and Triassic formations.

Consider, for instance, the mass of diabase between the Mount Christie Coal Mine and Bonney Plains. This body occupies the higher levels, and is completely surrounded by Triassic coal measures. On the east side the strata dip underneath the diabase towards the south-west, and on the west side they dip away from the diabase in the same direction and are apparently undisturbed. At the upper end of a valley leading eastward from Bonney Plains diabase forms the roof of Delta coal seam. A dip adit on this seam shows the thin sill of diabase resting directly upon the coal the whole way. The upper 3 feet of coal has been coked, but the lower 6 feet apparently has not been affected by the intrusive. Similar cases have been observed by the writer elsewhere.

A good illustration of the transgressive form of intrusion is presented by the mountain mass of Ben Lomond, which rises 5160 feet above sea-level and over 2000 feet above the Permo-Carboniferous strata at its base. Remnants of the Triassic formation with Delta and other coal seams carried up by the transgressive igneous material are found high on the eastern flanks of the mountain, and on the western side they not only rest upon diabase, but are completely surrounded by that rock. Similar transgressive masses are exhibited at Mount Lewis and Snow Mountain, at the southern end of the district, and St. Paul Dome represents the upper projection of another body that broke through the coal-measure formations.

Basalt.

Basalt, consisting essentially of plagioclase and augite, occupies parts of the valley floors of South Esk and St. Paul Rivers. It is generally of fine grain, dark in colour, and in parts vesicular.

Apparently the basalt found its way to surface through narrow fissures coursing parallel to, and perhaps coincident with, lines of Upper Mesozoic faulting. Basalt has not been found outside the valleys named, and is confined to narrow strips.

The thickness of the sheets varies between 40 and 100 feet, and the flow rests upon sands and gravels of Lower Tertiary age. A good section, showing basalt lava resting upon compacted Tertiary sands, is exposed at the upper bridge over St. Paul River.

STRUCTURE.

Faults.

Passing along the western side of this mineral district is a fault of major magnitude. This fault line has been examined from the western fall of Ben Lomond to Avoca. It follows closely the granite contact all the way. The direction of downward

displacement is south-westward, and the measurement of combined downthrow and uplift lies between 1500 and 2000 feet. Parallel to this great fault are many others of minor magnitude, such as that at Aberfoyle Mine. All this faulting is the indirect result of the great intrusion of diabase towards the close of the Mesozoic era.

Aberfoyle fault shows a westerly displacement of 40 to 60 feet. Minor faulting, affecting particularly the coal-bearing formation to the west, interferes with systematic mining, but not to prevent development on a commercial basis.

The major fault referred to is a unit in a block faulting system observable again westward of this field, and in faults lying parallel to South Esk and St. Paul Rivers, which are more prominent near Fingal.*

Differential Uplift.

At many places the dislocation, due to the intrusion of diabase, apparently affects the Permo-Carboniferous and Trias-Jura formations only. At Ben Lomond, for instance, Trias-Jura strata, including coal-beds, are found clinging to the mountain side at an elevation of 3800 feet above sea-level. The base of this formation cannot be seen, but apparently it rests directly upon Permo-Carboniferous strata, because pieces of limestone of that age are found nearby. Over 2 miles westward, again at a high altitude, remnants of the productive measures of the Trias-Jura lie protected between great buttresses of diabase. For the purpose of an illustration of differential uplift, the further information is given that Lower Permo-Carboniferous strata lie at the base (2400-feet contour) of Ben Lomond, upper members at 3500 feet, and at Gipp Creek coal-bearing strata, although affected by the fault also, lie at elevations of 1500 to 1900 feet only.

Differential uplift, due to intrusions of diabase, are observable also at Merrywood and at Mount Lewis.

* Nye, P. B.: Underground Water Supply Paper, No. 4, p. 21.

Folding.

Cambro-Ordovician rocks have been subjected to earth-movements, which have caused folding into anticlines and synclines. The strikes of the axes of the folds lie between 338 degrees and 315 degrees.

Strikes and Dips.

The strikes of the Cambro-Ordovician conform closely to the direction of the fold axes. In this area the dips are highly inclined in a north-westerly direction.

IV.—ECONOMIC GEOLOGY.

The mineral resources of Avoca consist of tin and tungsten ores, with also a little galena, sphalerite, and gold. Under present economic conditions tin and tungsten ores only become of commercial importance.

MINERALOGY OF THE ORE-DEPOSITS.

For convenience of description the important minerals of this district have been placed under the headings "Metallic" and "Non-metallic," as follows:—

Metallic Minerals:

Cassiterite or Tin Ore	Arsenopyrite
Wolfram	Pyrite
Galena	Martite
Sphalerite	Ilmenite
Chalcopyrite	Gold

Non-Metallic Minerals:

Topaz	Apatite
Pinite	Zircon
Chlorite	Talc
Tourmaline	Pleonaste
Fluorspar	

Metallic Minerals.

Cassiterite—(Tin Ore, Tinstone), Tin Oxide, SnO_2; oxygen 21·4 per cent., tin 78·6 per cent.—with a little ferric oxide, is the most important mineral product of the district.

Wolfram (Tungstate of Iron and Manganese, Fe Mn WO_4).—This mineral is the next in commercial importance, and is a prominent component of the Story Creek and some other ore-bodies.

Galena (Sulphide of Lead, Pb S) is found in association with sphalerite at Rex Hill Mine, in greisen at Flaherty Prospect, and in similar ore-bodies to the south of Ben Lomond.

Sphalerite (Sulphide of Zinc, Zn S).—An accessory of many greisen and pegmatite deposits.

Chalcopyrite (Copper Pyrites, Sulphide of Copper and Iron, Cu Fe S_2), (copper 34·5 per cent., iron 30·5 per cent., sulphur 35 per cent.).—A common component of quartz greisen bodies.

Arsenopyrite (Arsenical Pyrites, Arseno-sulphide of Iron, Fe As S).—This mineral is not abundant.

Pyrite (Iron Pyrites, Fe S_2).—A very common component of all the veins.

Martite (Sesquioxide of Iron, 69·9).—A variety of hematite deposited under high temperature conditions. This black mineral, set in a matrix of white quartz, with its bladed habit, is often mistaken for wolfram, with which it is often associated. It is a common component of the veinstone at the Story Creek and Aberfoyle Mines.

Ilmenite (Titanic Iron, Oxide of Iron, and Titanium, Fe Ti O_2) is not only an accessory component of the granitic rocks but of diabase.

Gold.—This metal is found associated with tin ore in the alluvial beds of South Esk River. It is found also in quartz veins to the east of this district.

Non-Metallic Minerals.

Topaz.—The simplest empirical formula is Al_2 Si O_4 F_2, but with a part of the fluorine commonly replaced by hydroxyl. Topaz is a common accessory component of the mineralised granite, especially of the pegmatites. It alters easily by hydration and by the action of percolating akaline solutions into compact muscovite or pinite. Its origin is due, in some cases, to the action of gaseous emanations containing fluorine upon felspar or mica. Topaz is found here in the tin-bearing granites, in greisen veins, pinitised bodies, and in some pegmatites.

Pinite.—This pale-green waxy mineral is an alteration product (by hydration or the action of alkaline solutions) of topaz or of felspar. In composition it is essentially a hydrous silicate of aluminium and potassium corresponding closely to mus-

covite, of which it is generally regarded as a compact massive variety. It is often mistaken for chlorite, which it resembles in appearance, but differs from in its content of alkalies.

Chlorite.—Under this general name a number of minerals are embraced which are closely related to the micas. They are silicates of aluminium or ferric iron, with magnesium or ferrous iron.

Tourmaline.—A complex silicate of boron and aluminium, with also magnesium, iron, or the alkalies prominent. It is a very common mineral, especially in the southern part of this district, where, with quartz, it composes many veins. It is a component of pegmatite, and in nodular form it appears in graphic granites and porphyries. Both green and black varieties are common, the green particularly in association with tin ore.

Fluorspar (Calcium Fluoride, Ca F_2).—A common minor component of many tin ore-bodies, such as that of Mount Rex. It appears in the form of pellucid, green, or purple cubes.

Apatite (Phosphate of Lime).—An accessory of the unaltered granite. Apatite is strongly attacked by carbonic acid waters, therefore it does not survive the effects of mineralisation.

Zircon (Zirconium Ortho-silicate, Zr Si O_4) is one of the commonest accessory components of the granite. The reddish varieties are often mistaken for ruby tin ore.

Talc.—An acid metasilicate of magnesium is found here as an alteration product of biotite.

Pleonaste (Iron-magnesium Spinel, $MgFeOH_2O_3$) is common in the tin-ore drifts and gravels.

Genesis of the Ore-Deposits.

Tin ore is always genetically associated with such siliceous rocks as granite in all its acidic varieties. It represents actually one of the final products of the residual portion of the granitic magma, which contained such mineralising agents as fluorine and boron, silica, and water. Hence tin ore is found in graphic granite, pegmatites, and pegmatitic quartz

veins, in greisen veins and other fissure fillings, and in felspathic segregations associated with minerals like topaz, tourmaline, and fluorspar, consisting of the gaseous elements and the compounds above mentioned, in combination with bases derived from the containing rocks.

These tin-ore bodies are not only contained in the upper portion of the granite, but in the intruded sedimentary rocks at or near the lines of contact or covering the granite, showing that metallic minerals in acid magmas, in contradistinction to those in basic magmas, tend to rise to the top. There the conditions of lower temperature and pressure were contributary causes of the precipitation of tin ore and wolfram and their associates. Some of the solutions were highly siliceous, for in some ore-veins the proportions of metallic minerals to quartz are very low. In some parts clear crystals of quartz are found containing cassiterite and bismuthinite, in other parts, as at Story Creek for example, clusters of long-bladed crystals of wolfram or of martite are contained in the body of quartz and coarse bunches of tin ore (cassiterite) near the walls of the veins.

Kinds of Ore-Deposits.

The ore-deposits may be placed in two divisions, namely—

Primary deposits and
Secondary deposits.

The primary deposits may be subdivided into—

(1) Magmatic segregations.
(2) Pegmatitic segregations.
(3) Dykes.
(4) Greisen veins.
(5) Quartz-tourmaline veins.
(6) Quartz-mica and quartz veins.
(7) Lead-zinc veins.

(1) These are tin-ore deposits in graphic granites, such as those of Plummer and Goodall's Prospect and Royal George Mine.

(2) Pegmatitic ore-bodies are found in both northern and southern areas, especially in association with graphic granites.

(3) Dykes of tin-bearing porphyry have been observed near Roy Hill, Plummer's Prospect, and at Ben Lomond Mine.

(4) Greisen veins, consisting of quartz, muscovite, pinite, tourmaline, and cassiterite, pyrite, and chalcopyrite, are very numerous, and provide one of the chief sources of tin ore.

(5) Quartz-tourmaline veins are more characteristic of the southern than the northern area, and some are tin-bearing. It is noteworthy that tin ore is more abundant in association with green than with black tourmaline. Where the quartz and tourmaline are intimately intermixed the veinstone appears blue in colour, and some are therefore referred to as " blue " veins.

(6) Quartz-mica and quartz veins are some of the most productive and largest bodies. These are exemplified by the Story Creek and Aberfoyle veins contained in Cambro-Ordovician sedimentary rocks.

(7) Lead-zinc veins in granite are exposed on the west bank of Story Creek, on the south side of Ben Lomond, and at Rex Hill Mine. That at Story Creek appears to be a greisen body not with any tin ore or its common associates. The Ben Lomond bodies, at a much higher elevation, are similar. At Mount Rex galena and sphalerite are of later origin, and therefore are not very closely related to the primary tin ore with which they are associated.

Secondary deposits may be subdivided into—

(1) Alluvial beds.

(2) Detrital accumulations.

(1) Alluvial deposits of Permo-Carboniferous, Tertiary, and Quaternary ages are represented in this district. Those of Permo-Carboniferous age consist of basal conglomerates and grits resting upon granites. Such are represented at Brookstead, Roy Hill, and elsewhere. Tertiary beds of considerable extent and depth lie upon the valley floors of South Esk and St. Paul Rivers. Except where they fringe granite mountains the tin-ore content is very low. This is explainable by the fact that the beds are built largely of the waste of the coal-measure strata and of diabase.

Quaternary gravels and sands resting upon Tertiary beds contain tin ore in St. Paul and South Esk valleys.

(2) Detrital accumulations overlying ore-bodies or lying nearby are scattered here and there in both the northern and southern areas. These are of no great extent, nor are they of any considerable value. Some have been sluiced for tin ore.

Erosion of the Ore-Bodies.

By reference to the section on topography it will be seen that the epi-Silurian or early Devonian intrusion of granite was accompanied by a great uplift, and there followed a period of erosion that continued to the end of the Devonian. That peneplanation process brought about the denudation of fairly large areas of granite from its cover of Cambro-Ordovician sediments and removed the upper parts of many ore-bodies, not only those contained in the granite but those in the Cambro-Ordoviciain rocks also. Peneplanation had almost reached base-level when, on a gradually subsiding floor, the Permo-Carboniferous sedimentation set in, continuing through that period and the Triassic until interrupted by the diabase invasion. The ore-bodies, therefore, remained well protected, under cover of the younger sediments and irruptives, until Tertiary time, since when agents of erosion have been actively engaged in disintegrating and removing these cover rocks. Over a large area the younger rocks have survived the attack; in places thin beds only remain; but in other places they have been entirely removed, and the underlying mineral-bearing rocks have been trenched to great depths.

Although the ore-bodies belong to the Devonian, and during that period were subjected to erosion, they were protected until Tertiary time from further injury, and many to-day remain under the protection of Permo-Carboniferous and Trias-Jura strata.

V.—MINING ECONOMICS.

In addition to the cost of mining, other factors, such as—

(1) Power;
(2) Water supply;
(3) Milling and concentration of ore;
(4) Transport and communication;
(5) Timber supply; and
(6) Labour supply—

have to be taken into account in arriving at a basis of calculation for the estimate of value of any particular ore-body at the time.

(1) Power.—Although electric power has not yet been provided, the Hydro-Electric Department has made a preliminary survey of the district, in order to ascertain possible requirements. Electric power is supplied by the Department for general industrial purposes at comparatively low rates, the terms varying in proportion to the amount required for any particular use.

(2) Water Supply.—Water for mining and treatment purposes is available for, or can be supplied to, any part of this district. In many places, however, conservation is necessary to provide requirements during summer. Except the valleys of South Esk and St. Paul Rivers, the catchment areas are small and the run-off from the rock-bound mountains very quick, therefore, although rain falls at intervals during all seasons, reservoirs are necessary to ensure a regular supply.

(3) No serious difficulty is presented in the milling and concentrating of any ore. At Story Creek Mine wolfram accompanies cassiterite (tin ore) and is concentrated with it by gravity processes, being afterwards separated from it by means of magnetic separators. Owing to the very brittle nature of wolfram, the ore is detached from the quartz gangue in as coarse condition as possible.

At Rex Hill Mine galena, sphalerite, and chalcopyrite are associated with tin ore. A separation

of galena from tin ore cannot be effected by ordinary water processes, but after concentration the galena can be removed with the aid of solvents.

At Royal George the bulk of the tin ore is coarse in grain, but a portion of it is locked up in the sulphidic minerals pyrite and chalcopyrite. It is separated from these by calcining and grinding and concentrating on tables of the Wilfley or Card type.

No great metallurgical difficulty is presented in the treatment of any ore found in this district.

(4) Transport and Communication.—All reasonable facilities are provided in every quarter.

(5) Timber for mining and milling purposes is available in every area.

(6) The nucleus of an efficient staff can be gathered from miners and engineers resident in the district.

Summarising the foregoing, it may be affirmed that everything combines to bring about favourable working conditions.

Exploration.

Many ore-bodies, of large dimensions but of average low grade have been explored a little in trenches and opened in shallow pits and adits. Such ore-bodies are likely to prove the mainstay of the district in future, and such can be thoroughly and economically explored by means of the drill only. These belong to the pegmatites, graphic granites, porphyry dykes, or greisen stockworks. Among them mention may be made of Plummer and Goodall Prospect, Royal George, Roy Hill, and Rex Hill. Each of those named, with others, requires exploration at depth in order to ascertain whether it is of such dimensions and value as to warrant the necessary outlay for its development and operation. They appear, from the available data, to be worthy of further exploration, and the drill is recommended for the purpose.

Many individual greisen veins and fissure fillings are so situated that they can be tested by way of adit. These are comparatively small, but though

narrow are very long, and maintain their average tin ore or wolfram content to a depth comparable with half their length at least.

The foregoing remarks have reference to primary ore-bodies; we shall deal now with those of a secondary character, such as the Tertiary and Quaternary alluvial beds. To test the deep beds of Tertiary age the drill, again, is the only instrument that can be used effectively. This, however, is difficult of operation in passing through the shingle and boulder beds.

VI.—THE MINING PROPERTIES.

This mineral district is geographically divided into a number of mining areas, namely:—

(1) Story Creek Field;
(2) Gipp Creek Field;
(3) Avoca Field; and
(4) St. Paul River Field.

Story Creek Area.

For the purpose of this report, advantage is taken of that natural division, and the following descriptions are presented in the order named, commencing with the most northerly one. It seems proper that the reports should begin with the Story Creek Field, for that is receiving the most attention, and of late years has not only been the mainstay of the district, but has produced more tin ore and wolfram than any other area.

No ore-body in this district has been explored to a greater depth than 400 feet. The most important mine (Story Creek) is not 300 feet deep; the Royal George is only 120 feet at its deepest point, and many ore-bodies of promise have not been explored to 100 feet. Most of the mines, at the lowest levels, reveal no diminution in the average value of the ore, yet not one is now producing ore at its normal capacity.

Looking up the records of present and past companies, one finds that the failures may be attributed to one or more of the following causes:—

(1) Insufficient initial capital;
(2) The use of inefficient machinery;
(3) The high cost of power;
(4) Small scale operations; and
(5) Costly methods of mining.

These difficulties can be overcome easily, and present-day operators can profit from the results of past mistakes. It may be stated that past work, although unsuccessful in many cases, gives results relating to the average value and nature of the tin-bearing stone and the sizes of the ore-shoots.

Nowadays the conditions are much better; ample electric power can be obtained at comparatively low

rates; sufficient water is available for all purposes during every season; facilities for transport and communication have been provided for every centre; and timber of many kinds, suitable for all uses, is everywhere at hand.

Story Creek Tin Mine.

The mine is being operated on a small scale by the Story Creek Tin Mining Syndicate, under the supervision of Mr. J. Miller. (It may be appropriate to mention here that Mr. Miller furnished much of the information contained in this report.) This syndicate of local investors about 15 years ago purchased the lease rights of the mine area from the small parties of miners who were then engaged in an endeavour to mine and treat the veinstone without the aid of machinery. During the preceding 30 years these rich and persistent veins were attacked by way of trench and underhand stope, and about 40 years ago a Melbourne company operated from the south side by way of adit openings. That company erected, and put into operation, a milling plant with water-wheel drive, but had not a successful career owing to the rapid fluctuations in the wolfram and tin markets.

The operations of the present syndicate may be regarded as satisfactory, taking into consideration the fact that from the smallest beginnings the mine has been opened to a depth of 230 feet and the veins explored along their courses 1200 to 2000 feet. Moreover, milling and concentrating plants; magnetic separators, and power plants have been purchased and erected, and a considerable sum has been distributed among shareholders from the proceeds of ore sales. When it is understood that such results have been obtained from small scale operations, the actual value of the mine becomes apparent. Under such conditions, however, the work cannot be carried on to the best advantage.

Area.

The syndicate holds from the Crown Consolidated Lease 7250-M, of 316 acres, and Lease 7105-M, of 20 acres

In addition the syndicate holds Water-rights 499-w and 1704-w.

The ground is held under lease for a term of 21 years, with the statutory right to renewal, at a rental of 5s. per acre per annum.

Situation and Access.

Story Creek township lies at the foot of, and on the southern and eastern sides of, Ben Lomond. It is reached by road from Avoca, being 14 miles therefrom. The first road section of 9 miles coincides with that to Gipp Creek. It is a road of steep grades and sharp curves, but is laid down on a firm foundation. Its ultimate rise of 1800 feet in 14 miles is suggestive of steepness.

The present cost of transport by motor-vehicle from Avoca railway-station to the mine is 32s. per ton, and from the mine to Avoca 22s. per ton. Avoca is 52 miles by rail from the port of Launceston.

Production.

The present rate of production of veinstone is only 35 tons per day, a rate far too low to allow of economical operation. That small output is the present limit, owing to shortage of power, to the backwardness of underground development, and to the low capacity of the milling and concentrating plant. The latest complete returns to hand (the year ended 30th June, 1927) show that from 9968 tons of stone tin ore to the value of £25,601 14s. 2d., and wolfram to the value of £6584 15s. 1d., were obtained at a cost of £26,664 2s. 7d., leaving a profit of £5056 17s. 10d. During that time £1684 was drawn from revenue for new plant and buildings; therefore the actual profit on working costs amounted to £6741.

Between January, 1916, and July, 1927, tin and tungsten ores were produced to the value of £255,612. Prior to 1916 at least £50,000 worth of mixed ores was produced, but no records were kept of the early work.

Ore-Veins.

Two veins are being worked, No. 1 striking N. 10 degrees W., and No. 2 N. 25 degrees W. Both veins dip to the west, No. 1 at an average angle of 20

degrees, and No. 2 at an average angle of 37 degrees. In each case the dip varies at different places in the vein, but the general dip remains constant. The variation in dip is due to pre-mineral differential slipping of the walls of each vein, resulting in the formation of flat steps here and there down the dip. These main veins, about 130 feet apart at adit-level, meet at No. 3 level at a depth of 480 feet on the dip and 230 feet vertical. North and south of the point of junction the veins diverge, but whether they merge into one another below this level is an unsettled question.

No. 1 vein measures 450 feet along the outcrop and 480 feet in the stopes, and the width measures 3 to 4 feet. Cross-vein, branching from No. 1, continues at outcrop a further distance of 1200 feet, and, where opened in the old south workings, varies in width from 2 to 2·5 feet. No. 2 vein can be traced at surface a distance of 2000 feet. It is opened in drives 1300 feet in length and in stopes 800 feet, where the width varies from 2 to 8 feet. At the lowest level of the main workings, No. 1 vein, of average width of 3 feet 11 inches, has been driven on 300 feet, and No. 2 vein, of average width of 5 feet 1 inch, has been driven on 210 feet. At the point of contact the total width is 18 feet.

The veins here and there enclose "horses" of quartzite, and at their ends split into smaller veins. At surface there are many branches, but these come together at adit-level. Branches of rich stone 10 to 20 inches wide remain unstoped in the upper levels of the mine.

Cross-faults, striking nearly east and west, displace the veins a few feet, but not far enough to interfere with the general scheme of operation. The fault planes carry a foot or more of soft puggy material, the presence of which serves a useful purpose in reducing the cost of cross-cutting. Selvage on the walls of the veins indicates post mineral movements.

The mineral contents of the veins consist principally of wolfram and cassiterite (tin ore), but pyrite and the black variety (martite) of hematite are also prominent. Wolfram and cassiterite appear in dis-

tinct and separate aggregates, no intergrowth being noticeable. These minerals, in great part, are found on or close to the walls, but in such places where enrichments occur both appear in the body of the vein in coarse crystalline forms. As a rule the distribution of the minerals is fairly regular. In some places, however, bonanzas weighing many hundred pounds have been found in the work of stoping. During the war years two of the bonanzas yielded £500 and £600 worth of tin ore and wolfram in 4 to 6 feet of driving. The wolfram often appears in large patches and bunches, its long black laths standing out prominently from the white quartz gangue. Tin Ore appears more plentiful on the hanging-wall sides of the veins, but is by no means confined thereto. It occurs in bunches and coarse blebs, and often crystallised. No fine tin ore or wolfram occurs here.

Martite, in long laths and black splashes, appears in the body of the vein. At first sight it may be mistaken for wolfram, which it so closely resembles in appearance. Pyrite likewise appears in bunches in the quartz, but not in intimate association with martite or any other metallic mineral component.

The ore-veins represent the infillings of fissures formed in the country-rocks, which consist of quartzite, slate, tuff, and sandstone striking north-west and dipping south-west at 70 degrees to 80 degrees. As inferred in an earlier part of this report, the great bulk of the materials of the veins consist of hard milky-white quartz. The widths of the veins vary according to the nature of the containing rock at the particular point of observation, being much narrower where contained in tuff or slate. Apparently, the country-rock has not been influential in the deposition of the ores. Almost as much tin ore and wolfram is present per linear foot where the vein is narrow as where it is wide. Great width of vein, therefore, is not necessarily of particular importance.

The pitch is northerly, for No. 2 vein at No. 1 level extends only 70 feet north of shaft, whereas at No. 3 level it extends to 300 feet.

The Vertical Range of the Ore.

No doubt can be held that the deposits are genetically connected with the neighbouring granite massif, and that the vein infillings were introduced from the granite magma. They were expelled as gases and liquid solutions at high temperature, and penetrated the fractured overlying sedimentary rocks, which had received great heat by radiations from the intruding magma. It may therefore be assumed that the veins and their metallic minerals continue into the underlying granite. A great depth is available, therefore, for future exploitation. It is expected that the proportion of wolfram will be found to gradually diminish with depth, and that the proportion of tin ore will be found fairly constant.

Average Value of the Veinstone.

Owing to the irregular distribution of wolfram and cassiterite through the quartz gauge, all attempts at sampling have proved ineffectual, milling and concentrating results only being reliable. The following statement, based on the records of production, gives a fair indication of average value.

During the past 11 years the yield per ton has varied from 0·75 to 1·75 per cent. tin oxide, and from 0·75 to 2 per cent. wolfram. During the past four years the relative proportions of these minerals have more closely approached uniformity, as may be seen by referring to the subjoined table.

Year.	Tons of Veinstone Treated.	Tin Oxide Saved. %	Wolfram Saved. %	Total Minerals Saved. %
1925	12,066	1·248	1·036	2·284
1926	8,090	1·095	1·420	2·515
1927	9,968	1·287	1·411	2·778
1928	7,751	1·194	1·490	2·684

(Note.—The figures for 1928 are up to June.)

The manager reports an extraction and saving of 80 to 90 per cent. of the mineral contents of the veinstone.

Ore Reserve.

The ore-veins have proved so consistent as regards extent and value that no misgiving has been felt as to the immediate future. Moreover, the rate of output has been so low that the development of a large reserve has not been deemed necessary. In consequence the syndicate has been content to maintain, by advancing development slowly, an actual reserve of 10,000 tons. That reserve, however, has been drawn upon lately.

The manager estimates a "probable" reserve of 50,000 tons, and a "possible" reserve of 100,000 tons above the lowest level of the mine workings. The writer could not verify these figures by actual measurement, but from observation the estimates seem to be founded on reliable data.

Development.

All work has been concentrated of late years at the main workings. The most recent of the important works has been the sinking of main shaft from adit-level to No. 3 level. This shaft, 12 feet by 6 feet clear of timbers, follows the dip of No. 1 ore-vein to its point of junction with No. 2. Through this opening all ore is raised to adit-level. Other development work, such as driving along the courses of the veins, has been confined of late to Nos. 2 and 3 levels.

Between main workings and the old south workings is a block of ground 500 feet in length awaiting development. At surface the veins are rich and outcrop prominently, therefore it seems safe to assume that equally important results will be obtained when the workings are extended to that block. That opinion appears justifiable when the reminder is given that the veins have maintained their sizes and ore contents at depth in both main and south workings. The intervening ground could be tapped to great advantage by way of Miers adit, which is 20 feet lower than main adit and close to the milling plant. This adit opens No. 1 vein, providing a

convenient means of attack, and the crosscut from it, if extended a few feet, would emerge a little above tramway level at the mill.

In addition to Nos. 1 and 2 veins are other but smaller bodies, which give promise of developing into profitable sources of ore. A carefully designed system of cross-cutting would, when put into effect, probably lead to very important results.

Method of Mining.

In the days of small-party operators the ore was excavated by trenching along the veins, underhand stoping the richest shoots as deep as possible, and by open-cutting. The veins at outcrops were so rich and persistent that such crude methods were successful.

In 1916 the present operators acquired the lease rights, and have since been actively engaged in underground work. The configuration of the country is such as to allow of operation by adit to an average depth of 100 feet. That facility allowed the syndicate to build up a sufficient reserve from revenue to enable it to gradually open the mine and equip it with machinery.

Owing to a shortage of power the lessees have been compelled to mine where the veins are largest. The ore is drilled by means of jack-hammers, working under an air-pressure of 60 lb. per square inch. Although the rock is hard, these small machines have proved very effective. One of the great difficulties is the handling of ore in the stopes owing to the low dips of the veins. This necessitates the driving of levels at much shorter intervals.

Ninety per cent. of the ore is removed, the remainder being left as pillars to support the roof. The underground workings, although extensive along the strikes of the veins, are at their deepest only 230 feet below the surface.

The Process of Milling and Concentrating.

The milling and concentrating plants are designed to separate the valuable minerals in as coarse condition as possible, and, by so doing, to reduce the

losses to a minimum. Both cassiterite and wolfram are brittle minerals, wolfram particularly; therefore coarse crushing and concentration are desiderata.

The operation of concentration may be divided into three processes, namely:—

(1) Crushing and gravitative concentration per medium of water.

(2) Calcining.

(3) Magnetic separation.

(1) This plant consists of two rock-breakers (one erected) of the gyratory type, revolving and screen ore-feeders, crushing rolls, trommels, jigs, classifiers, Card tables, tossing-tub, hydraulic cleaners, &c., driven by a 55-h.p. Tangye gas engine connected to a 75-h.p. Commonwealth wood-gas producer.

To avoid sliming, and with the object of treating a maximum tonnage with a minimum of loss, the ore is crushed to half-inch. The capacity of the plant is 30 to 35 tons per working day of 8 hours, and the extraction is from 80 to 90 per cent.

(2) In the process of concentration a large amount of tin-bearing pyrites is collected. This is subjected to the process of roasting in an Edwards mechanical furnace before retreatment.

(3) Wolfram is separated from tin ore in the mixed concentrate by means of electro-magnetic separators. This plant consists of crushing rolls, dryer, screen classifiers, two dynamos, and two "Rapid" type (Thompson-Davies patent) electro-magnetic separators, each having 3 poles, 3 discs, and a 15-inch feed-belt. This plant is driven by a 25-h.p. Tangye engine connected to a 33-h.p. Commonwealth wood-gas producer. As an illustration of the effectiveness of this plant, the following analyses of the latest products are given:—

Tin oxide: 72·3, 71·8, and 72·8 per cent.

Wolfram: 71·7, 72·18 per cent. tungstic acid.

(The wolfram product is sold to the British Metal Corporation, and is regarded as one of the best on the market.)

Water-Supply.

The syndicate holds two water-rights to Story Creek, which provide sufficient water for milling and concentrating purposes ten months of the year. During December and January, in the " dry " years, it is possible to keep the plants in continuous operation by returning the used water.

It is possible to conserve water by the construction of dams, but not in very large quantity, except at prohibitive expense.

Summary and Recommendation.

Story Creek tin-tungsten mine opens two vein systems of great length and profitable value, with several undeveloped offshoots to the southward. These veins are being worked on a very small scale under conditions that cannot be regarded as economical, yet the ores are produced at a profit. The conditions for mining and treatment are generally favourable, but the lay-out of the treatment plant with relation to the mine cannot be regarded as altogether satisfactory. That, however, is due to extraordinary circumstances in connection with the development of the mine. For instance, it would prove of great advantage to mine the ore from the south end, where, also, are suitable sites for power and milling plants. Taking everything into consideration, the general result reflects credit on the manager, who has exhibited a high degree of engineering skill.

It is recommended that consideration be given to the design of a treatment plant on modern lines with a capacity of 200 tons per day of 16 hours, providing also for the use of electric power. Such power may be obtainable soon at a low rate from the Hydro-Electric Department. which has planned the erection of a transmission line to pass through Story Creek area. Under such conditions of operation, Story Creek Mine—an important tin ore producer, and the most important wolfram producer in Tasmania—would become of much greater value to the State.

Story Creek Alluvial.

Southward from the point of confluence of Nisbet and Story Creeks the valley floor widens from 2 to 4 chains, and continues thus to Burn Marsh, over three-quarters of a mile downstream. The valley floor is occupied with 20 to 30 feet of quartz gravels and diabase boulders, with small proportions of quartzite and other rocks.

Tributary streams have already been worked for tin ore, and many years ago, under engineer Sutton, a Melbourne company attempted to work by hand the bed of Story Creek at a spot just over the boundary in Leasehold 7250-M, but the company was unable to get below 15 feet owing to heavy inflow of water. The ground worked was tin-bearing from top to bottom, but richer from a depth of 10 feet.

The older gravels are covered with tailing from Story Creek Mine to an average depth of 5 feet, the fall (1 in 95) not being enough to allow the stream to carry away this added burden.

Not many of the boulders exceed 12 inches in length, but stones upwards of 3 inches constitute three-quarters of the whole material. Trees, 1 to 3 feet in diameter, and spaced 30 to 50 feet apart, are distributed along certain reaches of the stream, otherwise the valley is free of all such obstruction, except light scrub.

This alluvial ground has not been bottomed at any point, all attempts having failed by shaft owing to water troubles, and by drill owing to the large proportion of hard diabase boulders. With a power-driven pump the water difficulty could be easily overcome.

On the evidence of local miners the beds of tributary streams contained rich concentrations of tin ore, therefore it seems safe to assume that the bed of the main streams likewise contains tin ore in profitable proportion.

Eastern Hill Mine.

Since the early days of development in this district, the several veins outcropping on this property have received the attentions of prospectors and

miners. The results of their work may be seen in the numerous long trenches, excavations, and pits that open the veins from one end to the other of the leased ground. Surface prospecting has certainly been very extensive, and has revealed many rich, though narrow, shoots of ore.

Of late years the present lessee (E. L. Egan) has opened two of the ore-bodies in shallow adits driven south-eastward from the bank of Story Creek. That, in brief, is the history of development since the discovery of tin ore here 40 years ago. Apparently the bodies were not regarded then as very promising because of their narrowness at outcrops. That reason, however, does not appear to have been quite sound in view of the fact that the veins on the adjoining property improved at depth in size and value.

Area, Situation, &c.

The land held under lease from the Crown comprises:—

Lease 9584-M, of 47 acres.
Lease 10178-M, of 40 acres.
Lease 10304-M, of 10 acres.

They conjoin, and the first lies adjacent to the eastern boundary of Consolidated Lease 7250-M of Story Creek Mine.

Production.

No records have been kept of production, but the total amount must have been at least 25 tons, judging by the extent of the excavations and the quality of the veinstone.

At the time of visit the lessee had ceased operations.

The Ore-Veins.

No less than seven veins of ore have been opened on these properties. Most of them lie parallel to one another, closely spaced, and seem to conform closely, if not exactly in some places, to the containing Cambro-Ordovician rocks in both strike and dip. They appear, moreover, to course almost parallel to

the Story Creek veins, of which they may prove, on closer examination, to be their faulted extensions. In any case, these veins are contained in the same narrow belt of fissured quartzites, slates, and tuffs as those of Story Creek and Aberfoyle. The presence of at least one line of faulting of considerable lateral displacement is indicated in the valley of Story Creek, and minor faults appear in the mine workings on the east bank.

The veins are similar to those of Storey Creek, and made of similar materials, but at surface are not as large. They contain cassiterite and wolfram, pyrite, and martite in dissociated crystal aggregates set in a gangue of white, milky quartz. A common accessory gangue mineral is secondary muscovite, abundant in some places and present everywhere.

Developments.

Lease 9584-M.

In an adit driven south-easterly along the course of one of these veins up to 12 inches of stone follows the tortuous trend of a bed of tuff. In some places the tuff encloses the veinstone, in others the tuff overlies it. A fault of small displacement intercepts the vein in this drive. The fault courses S. 45 degrees E., and dips north-easterly at 80 degrees. Apparently the country-rock here is not only disrupted, but generally disturbed, for no definite line of strike can be seen. Above and beyond the adit, however, the vein bears 22 degrees W. of N., and dips S. of W. at an angle of 40 degrees, and is opened in a shallow excavation 40 feet in length.

The lessee reports an average yield of 3 per cent. tin from the stone got from these adit workings, and a little greater yield from the open-cut, where the vein shows up to 9 inches in width.

Thirty feet south-westward a parallel vein, containing tin ore and wolfram, is opened in a cut 30 feet long and 6 feet deep.

Thirty feet farther south-westward is another vein of similar nature and size opened in a 20-feet cut. Others of the series show in the west side of the valley.

All can be traced to the hill-top, which appears in the form of an elongated plateau. There Main or Ross vein with the next (25 feet westwards and parallel) course N. 38 degrees W. and dip S.W. at a low angle. These have been worked out to depths of 6 to 10 feet over a length of 200 feet, and in one place a shaft on Ross vein follows it on the dip to 50 feet. Rich stone was obtained from these veins, which at surface are 5 to 12 inches wide.

Other veins of the series (seven in all) have been trenched and stoped upon where richest.

Lease 10,178-M.

Each of the seven veins, which are enclosed within an ore-channel only 300 feet in width, has been trenched upon at intervals throughout its course. These bodies bear 22° to 38° W. of N., changing here and there, but remaining parallel, and following a general average trend. Moreover, they keep of average size and quality.

Lease 10,304-M.

Strike veins, apparently the continuation of some of the seven, are opened in this section, where they cling to a bed of tuff, exhibiting the structure of that rock and other replacement phenomena. These are locally termed "clay lodes" because of their clayey nature, the clay being a decomposition product of the tuff. At some places the replacement is almost complete, and the veinstone there is of extraordinary richness; but such are few and far between, and the bodies are very small.

Economic Considerations.

In order to arrive at an idea of the resources of these properties the chief characteristics of the ore-veins will be briefly passed in review. First, it should be noted that there lie seven closely spaced parallel bodies, contained in the main ore-channel of the district and between the Story Creek and Aberfoyle Mines. The veins are narrow at surface, being in places but streaks of ore between two sharply defined walls. Although generally not less

than 3 inches, they widen to 18 inches, and are remarkably persistent along their strike, extending almost unbroken over half a mile in length. Moreover, they appear to be fairly consistent ore-carriers.

The ore-bodies on the other side of the stream opened in the Story Creek Mine are very narrow at surface, but at a depth of 230 feet are 4 and 5 feet in average width. These, likewise, may at a corresponding depth show a corresponding increase without loss in mineral content. Now it is possible to crosscut these veins, at a depth of 230 feet, by way of adit from the bank of Story Creek. (That is the only justifiable mode of attack.) A crosscut 600 feet in length would intersect the chief ore-veins at that depth, and definitely determine their value. Furthermore, that crosscut would serve as a drainage way, and become the main mine opening for many years.

It is unwise to anticipate results by providing for a big outlay based upon data obtained from the adjoining mine, nevertheless the similarity, if not identity, of the ore-veins justifies a fair expenditure upon adit exploration. On the accumulated evidence the prospect seems to be a good one.

LEASE 9902-M, 5 ACRES—LESSEE: J. S. GOODALL.

This 5-acre block lies close to, and a little beyond, the south-east corner of Lease 10,304-M. It encloses tin ore veins, and lies within the Story Creek-Aberfoyle ore-channel. The most important vein here is contained in a bed of tuff, which it in part replaces. Being a replacement of tuff, it conforms in strike and dip to that of the country-rock at that place. The strike there is 310°, and the dip south-westward.

In this vein comparatively little quartz appears with the coarsely crystallised tin ore, clay (the decomposition product of tuff) being the characteristic matrix of these bodies. A shallow shaft and a number of trenches expose the narrow vein to advantage, and show that the tin ore content varies greatly along the strike and dip. In places, rich natural concentrations of small size lead the prospector to

expect a more even distribution of tin ore and a greater width of it. Such concentrations, however, are local, and of no great economic importance. Replacement deposits are notoriously erratic, therefore no encouragement can be given to the expectation of an immediate change for the better.

LEASE 10,176-M—LESSEE: H. J. RUBENACH.

This 5-acre block adjoins Lease 9902-M on the south-east side, and it encloses a portion of the orebody cut in that property. Very little development work has been performed, therefore it is difficult to add further information regarding its nature. An examination of the outcrop shows little or no change in quality or size.

LEASE 10,108-M—LESSEE: E. L. EGAN.

This is a 5-acre block, lying close to the south-east corner of Lease 10,176-M. It lies on the same line of veins as the preceding, which show no change in nature.

EGAN PROSPECT.

The next to be described consist of a number of leaseholds occupying the country rising northward from Burn Marsh. These holdings are charted in the name of J. F. Egan, and consist of—

Lease 8847-M of 20 acres;
Lease 8849-M of 10 acres;
Lease 5510-M of 5 acres;
Lease 8848-M of 5 acres.

A number of thin tin-bearing veins, belonging to the same series, outcrop here and there. These veins have not been opened to any considerable extent, but detritus of veinstone has been worked at the north end of Burn Marsh, where a small watercourse enters it. There a " paddock " 100 feet long, 50 feet wide, and 3 to 6 feet deep has been sluiced for tin ore. The operation was performed under difficult conditions, yet, on the authority of the lessee, the results proved satisfactory. The only evidential value of that work, however, is its indication that the narrow veins contain tin ore in average proportion.

South-eastward of these leaseholds the Story Creek group of veins apparently pass underneath a thin bed of horizontally disposed, Permo-Carboniferous, pebbly mudstone to meet the Aberfoyle group in Leasehold 10,361-M.

McCormack Prospects.

These are enclosed within the boundaries of two leaseholds, 10,154-M and 10,032-M, each of 20 acres, charted in the name of R. E. McCormack, the latter section adjoining the north boundary of Consolidated Lease 10,361-M, of Aberfoyle Tin No Liability.

One of the Aberfoyle veins has been opened in trenches and an underlay shaft (32 feet deep) in this section. The vein, as represented in the heap of ore at the mouth of the shaft, is 4 to 6 inches wide, and consists of quartz, faced with tin ore. The veinstone, although very narrow, seems rich, and may widen at depth. Another vein outcrops, but has not been explored.

These leaseholds lie in a direct line with the Aberfoyle group of veins, which almost certainly extend into them. Surficial prospecting for the others would not be productive, because they are faulted westward and covered with pebbly mudstone, the basal member of the Permo-Carboniferous formation.

The value of these leaseholds depends upon the results obtained by Aberfoyle Tin No Liability in its adit crosscut. It would be inadvisable to attempt its exploration by shaft-sinking, because the same conditions apply here as at Aberfoyle, where the shaft method proved so costly.

Aside from the Aberfoyle veins, some of the Eastern Hill series may extend into this ground, under cover again of the pebbly mudstone.

Apparently no good purpose could be served by attempting exploratory works. Nothing remains, therefore, but to await developments.

Lease 10,374-M.

This 38-acre lease is charted in the names of J. S. Goodall and G. F. Plummer, who hold in connection therewith Water-right 2630-W.

The lease encloses a section of a dyke of tin-bearing graphic granite, opened about 30 years ago, in shallow pits and trenches. Recent exploration shows the dyke about 100 feet wide, following a ridge coursing 315°. At the north end the dyke passes under cover of Permo-Carboniferous arkose, and southward it continues exposed at least 500 feet towards Story Creek. Traces of it may be seen in the detritus workings on the south-east side of the stream leading into a steeply-rising hill, and in a cut on the bank of a small tributary.

The old cut (25 feet long, 5 feet wide, and 10 feet deep) exposes a large body of pegmatite, made up of felspars, quartz, tourmaline, and cassiterite, the last two being in comparatively small proportion. All component minerals are coarsely crystalline and intergrown. The cassiterite appears as a natural primary component of the pegmatite. Intrusive veins of greisen modify the pegmatite; felspars become pinitised; secondary flaky muscovite appears; tourmaline (green and black) shows up in greater abundance; and replacement of felspars with quartz becomes a prominent feature.

A number of holes have been sunk into the soft pegmatite, the material from which shows a fairly high proportion of tin ore. At these kaolinised pegmatite spots the distribution of ore is fairly uniform. This decomposed material is being ground-sluiced by the lessees, with the aid of a small volume of water and low pressure.

The actual value of the material of the dyke as a whole has not been determined, nor has its limits been defined, yet this very interesting body is worthy of close attention. It could be attacked to advantage by open-cutting from creek level (300 feet below the highest point of outcrop).

This body, like all such large ones, will prove to be of low average grade. Its average value will show whether it is of any present economic importance. If the results of surface sampling prove satisfactory, its value at depth should be determined by drilling.

LEASE 10,392-M.

This 28-acre lease, charted in the name of G. F. Plummer, lies south of and adjoining Leasehold 10,374-M just described.

The ore-veins on this leasehold consist of a number of narrow veins of quartz greisen contained in a granite porphyry, which lies parallel with the dyke of pegmatite, but separated therefrom by a barren 3-foot body of quartz. The porphyry consists of quartz and felspar phenocrysts, set in a matrix of similar minerals in intergrowth, each of which is easily distinguishable by eye.

The veins of greisen and the parallel veins of quartz-mica (6 inches to 2 feet wide) are tin-bearing, the ore as a rule being found encasing the stone or filling joints in it. This body has not been explored to any extent. On the east side detritus has been sluiced for tin ore to a depth of 3 feet, and the massive body has been traced across Story Creek.

No attempt has been made to open any of the veins, nor has any sampling been performed.

OLD LEASE 3528-M.

On this old leasehold, 20 chains south of the bridge and on the east side of Story Creek, are two veins, one of quartz in quartzite, the other of quartz-tourmaline and greisen in granite near the line of contact. They are parallel, and course north-west.

The northern one is exposed in shallow trenches, where it appears 1 to 2 feet wide and very poor.

The southern one is tin-bearing, and is exposed in a shaft and trenches. Neither appears to give encouraging prospects.

LEASE 10,393-M.

This 64-acre leasehold, charted in the name of J. S. Goodall, lies on the west side of Story Creek, about 3 miles south of the settlement of that name. The discovery of a very rich pocket of tin ore by Goodall led to surface prospecting, which disclosed " strike " ore-bodies in the Cambro-Ordovician quartzite and tuffs.

The rich body referred to consists of almost pure blocks of tin ore between tilted beds of quartzite. It is at this spot a complete replacement of the narrow tuff member of the rock formation. A little to the south and north the tuff appears unaffected by mineralisers, but further on partial replacement of that rock may be seen. In addition to that replacement body the fractured quartzite wall-rocks are filled with veinlets of quartz and cassiterite, the shoots being short and irregular. Associated minerals are arsenopyrite and chalcopyrite.

Parallel to this body, which courses 328°, are others of similar nature and character.

A number of trenches across the main body, and a shaft on the rich "make," show tin ore at those points. At a depth of 12 feet the rich pocket of tin ore opened in the shaft cut out, leaving only thin veinlets of quartz to mark the lines of entry of the mineralising solutions.

The results of the prospecting work thus performed may be be expressed as follows:—

(1) The ore-bodies as a whole are of low average grade, but they contain occasional small bonanzas.

(2) The ore-bodies are in part replacements of tuff, and in part the infillings of joints and fractures in quartzite.

(3) The ore-bodies, although persistent along their strike, are irregular along their dip, and vary in width from 2 to 8 feet.

(4) The value of the ore in this flat country can be determined only by close drilling or by shaft-sinking. The question arises: "Are they worthy of such attention?" It is recommended, in answer, that closer and deeper trenching be performed before consideration be given to drilling.

LEASE 10,345-M.

This 40-acre leasehold, charted in the names of E. Phillips, W. Flaherty, P. Flaherty, and M. A. Flaherty, lies north-west and adjoining that just described. It lies, moreover, on the same line of ore-body, which passes from the south-east corner through the section.

The ore-body in this leasehold has been trenched at short intervals over a distance of 15 chains. At each of these openings it carries tin ore, in some places much more than in others, but, as a whole, the grade is low, like that of the adjoining property.

A feature of these large irregular bodies is the coarsely crystalline condition of the tin ore. Its separation from the gangue and containing rock, and its concentration, can therefore be accomplished without preliminary comminution.

The remarks given in the foregoing report respecting the work of exploration may be applied also to this body.

LEASE 10,158-M—LESSEES: A. T. ANDERSON AND J. A. CRISP.

This 40-acre block adjoins, on the east side, Lease 10,361-M, of Aberfoyle Tin No Liability. It is wholly occupied at surface with Cambro-Ordovician strata, but as yet no discovery of importance is on record.

LUTWYCHE PROSPECTS.

The prospects under this title are enclosed within the bounds of Leases 10,183-M, of 40 acres, and 10,184-M, of 21 acres, both charted in the names of B. C. Lutwyche and J. Richards.

On Leasehold 10,184-M a trench exposes two tin-bearing veins, coursing 316° and dipping south-westward. The trench exhibits the two formations, about 2 feet wide, made up of quartz veinlets, with tin ore, the eastern one being rich at the place of exposure. They are similar in all respects to others in the neighbourhood, and appear to follow closely the strike of the containing rock from one end to the other of the section. Where they cross a small watercourse northward of the trench, leachings of limonite have accumulated and stained the rocks over a wide area. Many veinlets show through the quartzite and slate rocks nearby.

On Leasehold 10,183-M development works show another group of veins, and to much better advantage.

At the southern boundary, and about 400 feet east of the south-west corner, a north-east trench,

50 feet long, exposes a number of narrow veins of quartz coursing with the country rock. These are traversed by a series of tin-bearing veins of smaller dimensions.

Just over the boundary, in Leasehold 10,225-M, and 100 feet to the south-east of the aforementioned, a trench opens others of the series.

At a point 200 feet further east, and close to the boundary line, a quartz vein is opened in a shaft 17 feet deep. It is stated that 17 bags of tin ore were obtained as a result of that work. The veins bear N. 40° E. at this point, and may prove to be the continuation of that worked upon by the Kookaburra Syndicate. It does not continue unbroken at surface, but appears in 40-feet shoots here and there along its course.

North-east, 150 feet on the opposite side of a small stream, a 20-feet trench unearths a number of narrow veins of quartz, coursing with the country N. 40° W. They carry tin ore, but are irregular and not of much account at this place.

Four chains higher upstream a 10-inch vein outcrops, but has not been explored.

Ten chains north-westerly an adit crosscut has been driven 156 feet, on bearing S. 35° W., through hard slate and quartzite, towards a group of veins outcropping along a north-west ridge. The adit is 50 feet below the outcrop, and the face is 56 feet short of the objective. The ore-body, at outcrop on the ridge, is about 10 feet wide, made up of a number of very narrow tin-bearing veins of quartz coursing with the country rock. They are traceable along the ridge, over 400 feet in length.

Summarising the results of the foregoing observations, it is found that two distinct lines of mineralisation occur here: one closely follows the trend lines of the country rock; the other is almost normal thereto. The former, as might be expected, are the wider formations, but made up of very narrow veins of quartz, separated by wider bands of country rock. They are, moreover, sporadic and irregular, one short shoot following another *en echelon*; and their burden of tin ore is erratic in distribution. In the operation of mining the veinstone cannot be separated from the intervening rock, therefore dilu-

tion of the stone may so reduce its average value as to render it unprofitable. However, that remains to be proved after development.

As regards the latter: that is a cross-vein, apparently the continuation of the Kookaburra one, and represents the infilling of a fault fissure. In this, galena and sphalerite will be associated with the tin ore, and the concentrations will be sporadic.

These bodies are worthy of further attention. Their extensive development may be postponed, however, until the results of the Aberfoyle underground explorations become known, for the result of those works will indicate what might be expected in the neighbourhood.

Crisp Prospects.

Adjoining Lutwyche Prospect, on the north and west sides, are two leaseholds (10,222-M, of 40 acres, and 10,223-M, of 33 acres) charted in the name of J. A. Crisp.

Leasehold 10,222-M lies on the line of Aberfoyle ore-channel, and also on the line of the Lutwyche western series, which can be traced without difficulty in the property. Very little development work has been attempted, yet these offer as good a prospect as others in the neighbourhood. The veins are narrow, but tin-bearing, and are continuous over 300 feet along their strikes. They differ little in any particular from the other outcrops described.

Leasehold 10,223-M encloses the north-westerly extension of the Lutwyche east series, which here are exactly similar in character and nature. Little work has been performed to ascertain their value.

The remarks applied to the veins of the Aberfoyle area generally apply also to these.

Aberfoyle Tin Mine.

The tin ore-veins of this mine have been known some years, and during 1926 the prospectors opened them in trenches and shallow pits. No real development took place, however, until the Aberfoyle Tin No Liability acquired the leases and commenced operations. The company's early works, although ill-designed and costly, revealed a vein system of con-

siderable promise. After a rather critical beginning the second stage of development has been entered upon. The company has put into operation a well-designed plan of crosscutting, the results of which will show the value and size of the ore-veins at a depth of 230 feet. If the results prove satisfactory this crosscut will become the main gangway and drainage-way to that depth.

Area, Situation, &c.

The company holds under lease from the Crown—

Consolidated Area 10,361-M, of 200 acres.
Machinery Site 10,177-M, of 5 acres, at Aberfoyle Creek.
Water-right 2558-W and Dam Site 2553-W, of 4 acres.

The area held under lease occupies part of an elevated plateau about 2 miles south-east of Story Creek township. It is connected to the Avoca-Story Creek-road by a branch road of rather steep grades but of firm foundation. Avoca is 14 miles distant.

Structural Geology.

The ore-veins, of which two distinct series are unearthed, are contained in Cambro-Ordovician quartzites, slates, and tuffs. Here the containing rocks strike 320 degrees and dip south of west. One series of veins strikes 8 degrees to 10 degrees west of north, the other in conformity with the strike of the rock. In addition, cross fractures, filled with mineral-bearing quartz, course 22 degrees E. of N. From this it will be seen that the fracturing of the rock has been rather intricate. Apparently the north-easterly series represent fault fissures of Devonian age, and the bedded veins—which here are almost barren of tin ore and other metallic minerals—represent the final stages of mineral deposition. Parallel and close to the main series of veins is a well-defined fault plane of 40 feet downthrow to the west. This fault brings into juxtaposition Permo-Carboniferous pebbly mudstones and Cambro-Ordovician quartzites, and indicates that the movement took place immediately after the intrusion of Upper Mesozoic diabase, results of which may

be more strikingly seen in such prominent features as the great fault along the western side of the field and the mountain mass of Ben Lomond. The Aberfoyle fault is easily traceable over a mile in length, showing a well-defined line of contact between the two sedimentary formations of such widely separated ages. It is evident that the fault follows the veins, for it is filled with broken quartz containing oxidised metallic minerals, as shown in the underlay shaft. On the west side of the fault the mineral-bearing rocks are overlain with 40 feet of pebbly mudstone, completely hiding those rocks from view. It is probable that other veins underlie the mudstone. The crosscut, when extended beyond the known series, may expose other parallel bodies. The suggestion has been put forward that the veins of this series represent the off-shoots of one parent, the idea having been based on the evidence of increase in angle of dip of each vein from east to west. It is possible that at crosscut level the veins will be found merged one into another.

Aberfoyle plateau lies at an elevation of 2100 feet, or 500 feet below that of Story Creek settlement. The structural relations are difficult to decipher. It seems probable, however, that a parallel fault lies 20 chains westward of that described, and that a concomitant thrust westward brought about the lateral displacement of the Aberfoyle series, including their extensions into Lease 10,266-M (T. Lyons) and the Dalrymple property.

In Aberfoyle area the tin-rich veins course 8 degrees to 10 degrees W. of N. In the neighbouring areas the veins closely follow the cleavage or the bedding planes of the containing rocks.

The Ore-Veins.

The veins are similar to those of Story Creek in every particular but one. They consist of a group of parallel veins in quartzite, slate, and tuff, and are composed of cassiterite, martite, and pyrite, with also a little of chalcopyrite, arsenopyrite, and wolfram set in a matrix of quartz. The several metallic minerals are not as a rule intimately associated, but appear in dissociated blebs, veinlets, and

patches nearer the walls than the middle of the vein. Cassiterite in particular lies along the division between the vein quartz and the wall-rock, occasional blebs only being found in the body of the gangue.

The veins course 8 degrees to 10 degrees west of north parallel to a plane of faulting, and therefore not in conformity with the general direction of strike for the district. They dip westerly at angles of 40 degrees to 60 degrees, extend along the strike over 600 feet, and are from 3 inches to 20 inches in width.

Value of the Ore.

Attempts have been made by the company's engineer to sample the ores cut in the several veins. Such samplings, however, have proved futile for the purpose of arriving at an estimate of average value. Samples also have been taken of the mixed ore and wall-rock in the dumps, with results showing tin contents varying from 0·78 to 0·93 per cent.

The manager, by excluding as much wall-rock as possible, sluiced the stone and obtained a yield of 2 per cent. tin. That, therefore, appears to give an indication of the average tin content of the stone already opened up.

Developments.

The veins have been opened in trenches, excavations, and pits over 600 feet in length. (All of the workings were full of water at the time of visit, therefore actual examinations were confined to the shallowest trenches. Some information relating to the underground workings has been taken from a report prepared by J. B. Scott.) The mine workings consist of two shafts, about 100 feet apart, sunk to a depth of 60 feet, and connected at that level by crosscut. Eastern shaft follows a 20-inch vein on its underlay almost on the fault. At a depth of 30 feet short drives north and south expose the vein, and at 60-feet level a drive opens the vein 32 feet in a northerly direction. Near the end of the latter drive another vein appears on the hanging-wall side, about 2 feet in width. From the south side of the

crosscut the footwall vein is opened in a drive to 40 feet, where it is broken into a number of veinlets rich in cassiterite.

A vertical shaft, sunk on the western side of this ore-channel with the object of intersecting the veins at a depth of 100 feet, passes through pebbly mudstone, and enters the mineral-bearing rocks at 40 feet. At 60 feet a crosscut connects with the underlay shaft, and intersects four other veins on the way. These have not been opened in drives. A vein passed through in sinking the shaft has been opened on the south side a distance of 12 feet.

That stage in development had been reached before the appointment of W. E. Hitchcock to the position of mine superintendent. After making a preliminary examination, he recommended the crosscutting of the ore-channel by adit from the western boundary of Lease 10,158-M at a depth of 230 feet below the collar of the shaft. That work is now under way. Driving almost due west he hopes to intersect the bodies between 800 and 900 feet from the entrance. This mine opening will not only provide every facility for economic operation, but eliminate the heavy cost of pumping. The greatest difficulty has been experienced in developing by way of shaft, owing to the heavy inflow of water from the flat swamp lands occupied by pebbly mudstone, the water finding its way along the fault fissure. It is quite evident that under the present scheme the adit crosscut, although a big undertaking, will prove the least costly in the end, and will provide a way of attack for many years.

General Remarks.

At present these ore-bodies can only be regarded as veins of promise; in effect, the mine opens to view a prospect of success; but much development is necessary before any large outlay should be made on surface works and treatment plants. The establishment first of a large reserve of profitable ore is advised.

As regards the results of development to date, it may be stated that the veins have shown improvement both in size and value with depth, and it seems

safe to assume that they will continue without diminishing in value into the underlying granite, which is not likely to be met within 500 feet of the surface. The separation of the ores can be effected easily because of their coarse grain, their dissociation, and their distribution through a light gangue rock. No great difficulty need be apprehended in connection with any part of the mining operation.

KOOKABURRA PROSPECT.

This is enclosed within the boundaries of Lease 10,225-M, of 80 acres, charted in the names of A. E. Davies, A. H. Smith, and J. W. Ryan. The work of development began here at the time of the discovery of the Aberfoyle veins, but no effective work was performed prior to the advent of McPherson Reward Syndicate, which secured a working option early last year. The syndicate decided to crosscut at a depth of 120 feet a series of parallel tin-bearing quartz-veins opened in shallow excavations at the edge of the plateau. These, contrary to the usual course, bear N. 22 degrees E., and dip N. of W. at a high angle. They may represent the infillings of a series of fault fissures, although no decisive evidence of such faults appears at surface. These veins vary at the outcrop from 2 to 10 inches in width, and contain cassiterite (tin ore), pyrite, a little arsenopyrite, and chalcopyrite.

A little to the west of the plateau excavations the soil contains tin ore in fair proportion, evidently at points on the lines of extension of the two veins cut on Lutwyche's leasehold, 10,184-M. Those veins bear 316 degrees, and dip southward.

Development consists of an adit crosscut, 120 feet below plateau level, bearing 263 degrees a distance of 330 feet. On the way the several veinlets showing at surface are intersected, and at 265 feet the adit cuts through the largest vein exposed in surface excavations. That vein is composed of quartz, with coarsely crystallised tin ore, arsenopyrite, pyrite, galena, sphalerite, and chalcopyrite, cementing broken quartzite wall-rock. It courses here N. 22 degrees E., as at surface, and is opened a few feet on the north-east side of adit. The presence of

galena and sphalerite suggests a later infilling, and gives credence to the idea that these north-east trending veins belong to a series of fault fissures.

The face of the adit crosscut is in slate, which has been coated with limonite, indicating the existence of other bodies ahead.

Having driven so far toward the southern extensions of Lutwyche veins, it would be unwise to discontinue the underground crosscut. Lutwyche veins conform closely to the general strike of the ore-veins, and therefore are likely to prove more valuable than those of the original objective.

LEASE 10,270-M, 11 ACRES—LESSEE: R. L. SLIDE.

This is an L-shaped block bounding the southern part of Consolidated Leasehold 10,361-M on the east and south sides. The Aberfoyle fault passes through the block, and the veins trend in that direction, but none has been unearthed yet. Those on the west side of the fault are, of course, covered over with pebbly mudstone.

LYONS' PROSPECTS.

In the name of T. Lyons are five conjoined leaseholds, and one unconnected lying adjacent to and south-eastward of Consolidated Lease 10,361-M. They comprise the following leases:—

10,168-M, of 17 acres.
10,159-M, of 40 acres.
10,142-M, of 40 acres.
10,165-M, of 40 acres.
10,166-M, of 40 acres.
10,266-M, of 40 acres.

Those lying directly south are, with one exception, wholly occupied at surface with members of the Permo-Carboniferous formation, which rest in horizontal beds upon the mineral-bearing quartzites and slates of Cambro-Ordovician age. Surficial prospecting in these, therefore, is useless. They lie in direct line with the Aberfoyle ore-channel, and on Section 10,266-M two tin-bearing veins, apparently belonging to that series, outcrop where the later sedimentaries have been removed from the min-

eral-bearing rocks. The prospector is opening these veins for inspection. Where exposed they are very narrow, but are not unpromising.

Leaseholds 10,168-M and 10,159-M, to the east, offer better inducements to the prospector. Although they lie off the Aberfoyle ore-channel, another line trends in the direction of their position, and thin veins of quartz with tin ore outcrop here and there within their boundaries.

Mammoth Tin Areas No Liability.

Area, Situation, &c.

The holdings of this company consist of—

Mineral Lease 10,312-M, of 54 acres.
Mineral Lease 10,313-M, of 38 acres.
Mineral Lease 10,259-M, of 32 acres.
Water-right 2586-W.

They lie west and adjoining Consolidated Lease 7250-M, of Story Creek Mine.

Value of the Ore-Deposits.

In many respects some of these ore-veins are similar to those of Story Creek Mine, which lie parallel and half a mile to the eastward thereof. The similar ones are likewise contained in Cambro-Ordovician slates and quartzites, and consist of tin ore and its metallic associates set in a matrix of quartz. These, however, are, as a rule, not comparable in average richness at their outcrops, yet they all are more or less tin bearing. Unlike the Story Creek deposits, a large proportion of the ore here is fine in grain, in many places not being visible to the eye, yet yielding fair prospects after crushing and panning. Few remarkably rich pockets have been exposed in the operations of trenching and pitting.

The ore-veins, of which several are known, represent infillings of true fissures close to the line of contact between Cambro-Ordovician strata and the intruding granites. Some lie in the sedimentary rocks, some in the igneous, and a few pass from one formation to the other; some can be traced at surface long distances, others are covered in part with horizontally-disposed sandstones, grits, and conglom-

erates of Permo-Carboniferous age. These basal conglomerates and sandstones are in few places more than 20 feet in thickness, and therefore will not cause a serious hindrance to mining work. Their presence shows that the ore-bodies have been reduced but little since the time of deposition.

On the 32-acre block a vein-filling of quartz and muscovite contained in granite, and coursing N. 32 degrees W., is exposed in a hole at the roadside. Including the greisenised wall-rock (pinite-muscovite), the ore-body is about 2 feet in width. Going north it passes underneath sandstone and conglomerate of Permo-Carboniferous age, and reappears on the other fall of the hill, where openings show little change in its nature. At the north end five bags of tin ore have been got from small offshoots of quartz and cassiterite. Going south the ore-body outcrops strongly on that fall of the hill, and has been opened in shallow trenches. The tin ore can be seen in the quartz gangue, especially on the walls.

No. 2 ore-vein, coursing 310 degrees, and dipping south-westward at an angle of 40 degrees, crops out strongly at many points on the plateau. It consists of a vein-filling of quartz with tourmaline, pyrite, secondary mica, and a little tin ore, 12 inches wide, and 12 inches of greisenised wall-rock on both sides. It is contained in a hard rock composed of quartz, felspar, and tourmaline, the quartz and felspar of medium grain, the tourmaline in the form of long laths. Near the north boundary of the 32-acre block this vein enters quartzite, and its nature and character undergo a decisive change. It is 6 feet wide where opened in a small pit, and consists of milky quartz with tourmaline and muscovite. According to report it contains tin ore in the proportion of 0·25 per cent., but neither sulphides nor wolfram. Where it re-enters the granite the lode stone becomes a mica greisen with tourmaline and a little visible tin ore.

Eastward of No. 2 lode about 100 feet is another large body of quartz 5 feet wide, coursing 328 degrees, and contained in slate and tuff. It appears in the two pit openings exactly similar to that just described.

Another similar and parallel body of quartz, 3 feet wide, lies 150 feet farther eastward.

About 300 feet uphill west of Littler's Bend, at the crossing of Nisbett Creek, a flat body of lode stone, dipping at an angle of 20 degrees in a direction S. 28 degrees W., has been opened in deep cuts along the strike. It contains a higher proportion of tin ore and wolfram than the main bodies, and apparently is an offshoot of one of them. (It is a noteworthy fact that the offsprings at surface are much richer than the parent bodies.) This body is 3 to 12 inches in thickness, and is opened 130 feet in length. The gangue consists of quartz, secondary muscovite, and tourmaline, and is encased in a rock composed of quartz, felspar, and tourmaline, the felspar of which at surface is decomposed.

The evidence gained as a result of this investigation goes to show that the gently-inclined offshoots are very much richer at their outcrops than the steeply-inclined main bodies. Flat sections of the Story Creek ore-bodies are likewise much richer than the more highly inclined ones. From this the deduction follows that below the line of junction the main bodies should prove to be much richer than in their upper parts.

It may be possible to cut an adit from the valley of Nesbitt Creek to tap the ore-bodies below the plane of junction. No good result can be expected from superficial works of any character; therefore in this case shallow adits would serve no other purpose than to explore the offshoots only of the lodes. Very deep adits would, on the contrary, be very costly and long; therefore the aim should be to strike a mean depth in order to serve the purpose in view.

Summarising the foregoing statements, it is found that here are a number of parallel outcropping ore-bodies which pass unbroken through the containing rock, whether it be granite, slate, or quartzite, and that the irregular offshoots only contain tin ore at surface in any considerable proportion. The evidence goes to show, however, that below the plane of junction the main bodies may prove to be much richer than at surface. Whether the evidence warrants the necessary expenditure in crosscutting at depth to determine this is a moot question.

GIPP CREEK AREA.

Location and Access.

The Gipp Creek district is situated on the south flanks of Ben Lomond in North-Eastern Tasmania. Access is gained by means of a branch road from the Avoca to Story's-road. Avoca is a township and station on the St. Marys railway. The road from Avoca is 12 miles in length, and is passable for motor-vehicles, though the surface is poor at many places and the grades are sometimes heavy.

Geology.

The district is occupied chiefly by granitic rocks of Devonian age. To the north of the sections described below, slates and quartzites of the Cambro-Ordovician system outcrop, and represent a remnant of these rocks into which the granite was intruded. In Dillon Bottom, and at a few localities along Cradle Creek, Permo-Carboniferous pebbly shales and mudstone occur. Those in Cradle Creek are lying horizontally, and those in Dillon Bottom are standing vertically. The latter junction with the granite to the east, and at first sight the contact would appear to be an intrusive one. This, however, is not in accordance with evidence in adjacent parts of the district, and the real explanation is that the junction is a faulted one, and represents a point on the fault mapped by A. M. Reid in the examination of the Avoca coalfield.

Economic Geology.

The lodes occur entirely in the granitic rocks, and occupy a zone about 60 chains long and 25 chains wide. The general strike is 10° to 20° west of north, and the prevailing (and characteristic) dip is to the east, at angles of 20° to 30°. The lodes are generally of the quartz type, with cassiterite, wolfram, chalcopyrite, tourmaline, mica, and fluorite as associated minerals. The cassiterite and wolfram are the minerals of economic importance. Cassiterite predominates in the northern and wolfram in the northern part of the zone. A few typical greisen veins composed of quartz mica also occur, and carry metallic minerals similar to the

above. The lodes owe their origin to the passage of vapours and solutions through the granitic rock during the closing phases of its consolidation and, possibly, while the lower parts of the magma were still in a molten state. A feature of the southern part of the zone are vertical walls, which cut off the lodes and represent fault planes. At other parts the lodes are stated to terminate against veins of fine-grained white quartz ("crockery stone"), which may represent later fillings of fault planes, similar to those referred to above.

The Mining Properties.

Section 8811-M, 20 *Acres*: *G. H. Hodgman.*

This section is situated in the high ridge between Gipp Creek and Cradle Creek, and is occupied wholly by granite. Several adits, shafts, &c., occur on the property, but are now largely fallen in and destroyed. The greater part of these workings were probably carried out in the eighties by the Clune Tin Mining Company (formed in 1882). The mine became known as the Long Tunnel, and though held subsequently by the Long Tunnel Tin Mining Company (1891) and the St. Aubyn Mining Company (1901), little, if any, work appears to have been performed. On the surface, shallow underhand stoping has been carried out, along a length of several chains, on a lode which has a course of 350°, with a dip to the east ranging from 50° to 70°. At one place where the lode was not stoped it has two good walls of granite, with at least two veins of quartz between the walls. The width between the walls ranges from 2 to 4 feet, and the veins are 12 inches wide. A short adit of 10 feet in length connects with these stopes, and on the dump numerous pieces of ore are to be found. The lode would appear from this to consist of white reef quartz, with the following minerals: cassiterite, wolfram, chalcopyrite, and white mica. Cassiterite appears to have been the most important mineral, wolfram being subordinate. The chalcopyrite is reported by Montgomery to have occurred as a 2-inch vein, with rich tin ore in close vicinity to it. The underground workings cannot now be

inspected, and the following information is taken from previous reports by Montgomery (1892) and Waller (1901).

Montgomery reports on two underlay shafts and two adits. The two shafts were sunk 20 to 30 feet on the underlay above the lode, the northern one of which was 2 feet 3 inches thick. This shaft was then continued vertically to connect with an adit driven in a north-easterly direction to cut the above lode. The adit has a length of about 100 feet, at which distance it cuts a barren quartz lode, with a bearing of 350° and a dip to the east of 45°, this lode underlying the tin lode and being 50 feet to the west thereof. Another shaft was sunk on the lode to the south of the above one. From his observations, Montgomery recommended extending the adit to give the lode a practical trial, which he regarded as worthy of such. Waller also refers to the above adit and three underlay shafts. He states that the adit cut the barren lode at 93 feet, and a drive followed this lode for 180 feet at least. Two of the underlay shafts are said to have been sunk on the quartz-tourmaline (or tin) lode and one on the barren lode, although this seems to be the one described by Montgomery on the tin lode. In addition to the above, two other adits have been driven. One is situated several chains to the south of the above, but beyond being mentioned by Waller no description is given. No ore can be found on the dump, and it does not appear as though a lode was intersected. The other adit is the long one which gave the mine its name. This was driven from near the west central portion of the south boundary of the present lease, at a slight altitude above Gipp Creek. It was driven for 560 feet, but even at the time of Montgomery's visit it had fallen in beyond 300 feet. The first 200 feet had a bearing of 350°, when a change of course to 12° was made for 80 feet. At 280 feet a small lode, bearing 350° and dipping easterly at 50° to 60°, was intersected and followed northwards. This lode appears to be to the west of the lode found further north and parallel thereto. As remarked by the previous investigators, this adit should have been driven on the strike of the lode system in a generally easterly direction

instead of a northerly one, which is parallel to the lodes. The most important lode so far discovered is that which has been described as the tin lode, and on which a small amount of stoping was carried out. Waller appeared to believe that the upper adit had cut the lode, on account of pieces of ore at the entrance. Some of this may have come from the upper part of the underlay shaft which was sunk on the tin lode. If, however, this adit was not extended, as recommended by Montgomery, this is the first work that should be attempted on this section.

Section 9270-M, 10 *Acres.*

This section is situated immediately to the west of Gipp Creek, and was until recently leased by J. J. Goodall. It is occupied by the usual granite of the district. Near the north-western corner a greenish lode material, containing quartz and mica, occurs, strewn over the surface. Nearby, in the water-race, a formation, 15 inches in width and bearing 345°, has been exposed. It consists of a medium-grained greisen of quartz and mica, and good prospects of tin were obtained from the rubble. A few chains to the south loose pieces of a fine-grained honeycombed greisen are found. Some of these contain fine-grained tin distributed throughout the greisen. Further south, and between the water-race and the cart-track, a small excavation has been made, from which one bag of tin was sluiced. At the western end soft mica greisen occurs, and was followed to a depth of 7 feet. It is said to lie against a granite wall bearing east and west and dipping southerly. This greisen does not appear to extend eastwards. Two shafts have been sunk to the south to cut this mica greisen on its assumed underlay. In the western one a 4-inch vein of quartz-mica greisen is stated to have been cut. The eastern one intersected a formation, but without any mica. It would appear that either its greisen has no downward extension (which would be in accordance with its erratic nature), or the shafts are not sunk deep enough. The latter point could be settled by deepening the shafts. Several chains to the west a low knoll of tourmaline granite occurs. On the western side about 2 cwt. of slugs

of cassiterite were obtained from the soil, &c., resting on the granite. Pieces of dark-green tourmaline rock are also plentiful. In the shallow excavations a narrow vein of the tourmaline rock dips to the east at a very low angle. Above this vein mica greisen occurs in places, and is stated to give good prospects of cassiterite. The slugs of cassiterite were undoubtedly shed from these formations. Though possibly other ore would be found in them, the small size at the surface is not encouraging.

Section 4709-M, 5 *Acres*: *Park and Bailey.*

This section is situated to the east and north of Gipp Creek, near the sharp bend it takes to the east, a short distance below its junction with Cradle Creek. Though charted as above, the whole of the interest in it is held by Mr. E. Hayes. The section is occupied wholly by granites. Several lodes carrying wolfram have been located, and worked on a small scale, on this lease. One lode occurs near the south-east corner of the section. The oldest workings consist of a lower adit, driven on the lode, and surface sluicing along the outcrop of the lode to the north-west. It is stated that £160 worth of wolfram was won by these means in 1908 or 1909. Later, Mr. Hayes sluiced the dump from this adit and won £91 worth of wolfram. Later, another adit was driven, at a bearing of 350°, into the hill, and at an altitude of approximately 50 feet above the other. The lode is a quartz-wolfram one, and has a dip of 20° to the east. At the face it is 20 inches wide. A small amount of underhand stoping has been carried out beneath the approach to the adit, and gave 1½ ton of wolfram. The first 7 feet of the adit yielded 7 bags, the next 14 feet none, and a small overhead stope, at the face, 6 bags of ore. On the surface the north-western end of the sluicing shows the lode terminating against a vertical wall, with a bearing of 340°, which probably represents a fault plane. Future work should, therefore, be restricted to the eastern side of this fault. The lode is persistent in the faces available for inspection, and also, it is stated, in depth. The success of further work depends, of course, on the content of wolfram in the lode, as revealed by future

development work and the market value of the wolfram. It is difficult to determine the direction of the downthrow of the fault, and so no indication can be given as to the position of the western part of the lode. Two other parallel lodes occur near the central part of the south boundary of the section. An adit was driven at 330° for 20 feet, and cut the eastern one, which was then followed to the north and south. At the face of the south drive the lode is 20 inches wide, and is composed almost wholly of tourmaline. At the face of the north drive 6 inches of quartz and wolfram are showing. The lode has been stoped to the surface between these points, and yielded 39 bags of wolfram. The western one has been worked at the surface, and also opened up by an adit, now fallen in. The lode is a quartz one, and contained wolfram and tourmaline. It is stated that 1 ton of wolfram was obtained from the lode, and ½-ton of mixed cassiterite and wolfram from the detrital material to the west thereof. Both lodes have a northerly bearing and a low dip to the east. Their future exploration depends upon further development work exposing other shoots of ore. Near the north-west corner of the lease another lode has been exposed in shallow surface and underground workings. A vertical wall, representing a fault plane, crosses the lode at an acute angle, its bearing being 330°. The lode to the west of the fault has a general bearing of 340°, but little work has been done on it. At shallow depth this portion would terminate against the fault plane. At the southern end of the workings the eastern portion has been downthrown about 12 feet, but north along the fault this throw decreases to zero. The largest workings are situated on the northern part of the lode, east of the fault. The lode is here reported to be 1 foot wide, and to be a quartz-wolfram lode, with a little tourmaline, and to be still going underfoot in the workings. Eight tons of wolfram was obtained by Mr. Hayes in recent years. As in the above cases, future successful exploitation depends upon the finding of shoots of ore in the lode. To the north this lode continues into the 1-acre section (4762-M) of J. Egan.

Section 6061-M, 5 *Acres, M. Hayes.*

At the south-west corner a lode passes into this section from Section 4762-M. This lode has a northerly bearing, and has been opened up along practically the whole of its length adjacent to the western boundary of the section. It is stated that the lode had a width ranging up to 18 inches, and while poor at the outcrop, it was richer at shallow depths. The lode was a quartz-wolfram lode, and contained a small amount of cassiterite. To the north this lode should either intersect or continue as the lode (tunnel) on Section 9170. In view of the different bearings and difference in metallic contents the former explanation may be the more likely. This lode has been exposed over a greater length than any other, except, perhaps, that on Section 3927-M, and so seems to be worthy of further prospecting. The successful exploration depends upon locating payable shoots of ore along this length. On the northern half of this section extensive sluicing operations have been carried out along the course of an unnamed creek and a considerable distance up the southern bank thereof. Besides the detrital material several narrow gutters ran westerly through this ground. In the western portion of this sluiced area the material on the bottom contained mixed cassiterite and wolfram, while the upper layers are stated to have contained only cassiterite. The wolfram, and probably some of the tin ore, has been shed from any northerly continuation of the lodes on Sections 4709-M (western part) and 4762-M. Tin ore is being won from the material as far upstream as the workings have progressed. This ore has undoubtedly been shed from lodes (not necessarily large) occurring in the hills to the east of the workings. An irregular system of quartz-wolfram veins occurs in the eastern part of the sluiced ground. They have no definite strike, except such as to indicate a general northerly bearing, and dip to the east or south. The widths are also irregular, and as so far exposed the veins have no commercial importance. The tunnel lode at the re-entrant angle on 9170-M will extend, at shallow depth, into Section 6061-M. It

should be easily located near the north-westerly corner of this latter section, and opened up to shallow depths by an adit from the northern bank of the unnamed creek in that vicinity.

Section 4762-M, 1 *Acre: J. F. Egan.*

This section is situated between 6061-M on the north and 4709-M on the south side. The lode in the north-western corner of 4709-M continues into this section, and has been opened up at numerous places along its outcrop, until eventually it decreases to 2 inches in width. Another parallel lode occurs 20 to 30 feet to the east of the above. It has been opened up by shallow workings along its outcrop. It is stated that the width was 4 inches at the surface, but increased at depth. The lode is the quartz-wolfram type, and enclosed in soft granite walls. The southern continuation of the lode in the western part of 6061-M extends a short distance into this section. The southern end is marked by a fault crossing the lode at an acute angle. This fault may be the northern continuation of that present in the north-western corner of Lease 4709-M.

Section 4547-M, 5 *Acres.*

This section embraces practically all the workings known as the Tungsten Mine. It is situated on the south side of Gipp Creek, along the easterly flowing stretch south of the junction of this creek with Cradle Creek. The section is occupied by granite. Between 1899 and 1902 this mine was operated by the Ben Lomond Tungsten Mining Company No Liability, but the amount of work carried out was not great. Waller, in 1901, reported on the property as follows: "No. 1 vein, on which most of the work has been done, is from 18 inches to 2 feet in thickness, and consists of quartz, tourmaline, tungsten, and very small quantities of tin and galena. It is very flat, dipping not more than 20° to the south, while the strike is about east and west. No. 2 vein is parallel to No. 1, and perhaps 29 feet below it vertically. It is apparently of exactly the same nature, and about the same size. No. 1 vein has been opened up along its outcrop for a dis-

tance of two hundred feet, and the stone taken out until the overburden increased to 8 or 10 feet. In the eastern end of the workings a tunnel has been driven along the vein for a distance of 30 feet, and a portion of the vein has been stoped out. Some of the stone lying at grass is very rich in wolfram, and all of it contains a little. The vein will probably prove to be patchy, but, judging by the work done, the patches are fairly close together. Mr. T. Briggs, the late mine manager, tells me that 16 tons of wolfram ore was obtained, assaying 68 per cent. to 70 per cent. of tungstic acid. After the above company ceased to exist the leases were taken up by Mr. Briggs, the former manager, and a considerable amount of work was carried out. At least three other adits were driven in the lode, from the slope to Gipp Creek, and the greater part of the ore stoped out between them. These are probably on the No. 1 vein referred to by Waller. The methods of removing the wolfram from the quartz are not known, but were probably somewhat crude. Judging by the immense amount of quartz about and the manner in which it occurs, it would appear that the old dumps and tailings were gone over and perhaps sluiced at least once. The lode appears to have a general northerly strike and a flat dip to the east, which directions are different to those reported by Waller. The average width would appear to be 18 inches. Wolfram and tourmaline are practically the only minerals associated with the quartz. It is stated that at the southern end of the workings a "slide" was met with, and that the lode could not be traced further west. A shaft was sunk from a point several chains to the south-west of the most western part of the workings, to a depth of 30 or 40 feet, but did not cut the lode. The location of the shafts suggests that the downthrow of the fault was to the south, but it is difficult to see why the shaft should have been sunk so far from the last known outcrop of the lode. The northern end of the lode was also intersected by a fault. This fault is located just outside the entrance to the adits, and the lode was downthrown to the north, about 20 or 30 feet. The faulted portion of the lode, however, had only a slight extent,

due to its location on the steep fall of the hill. In the present state of the workings, and the numerous dumps on the property, it is difficult to locate the No. 2 vein referred to by Waller, and it seems probable that this faulted portion of No. 1 vein may represent such vein, the fault not being known to exist at that time. It is stated that the lode was still going underfoot, but this could not be verified. Judging by the amount of quartz on the dumps, a considerable amount of ore must have been stoped, and a corresponding quantity of wolfram obtained. No records are available as to the total production. Any extensive mining operations would have to be conducted by means of a shaft, and it is probable that more consistent and greater values would have to be found in this portion of the lode to make such operations probable.

Conclusions.

It has been seen that there exists in this district a zone containing numerous quartz lodes, with cassiterite and wolfram as economically important minerals. The lodes range up to several feet in width and up to 7 or 8 chains in length. The metallic ores are erratically distributed throughout the lodes. In the past the lodes have been worked on the surface and to shallow depths by adits. In this way the easily accessible shoots of ore have been mined, treated, and disposed of, and working then abandoned. At present the price of wolfram is low, and there is little encouragement to develop the lodes containing this mineral. The price of tin, however, is high, and those lodes containing cassiterite are beginning to receive attention. In both cases, future workings mean that the lodes will have to be followed in length and depth in order to locate the payable shoots of ore.

BEN LOMOND MINE.

As far back as 1892 operations at this mine had ceased, and the milling and concentrating plants had fallen into disrepair. Since that time no further effective work has been performed.

Four veins are known. No. 1, 2 feet in width, strikes N. 37° W., and dips easterly. It passes close to the main shaft, which opens it at a depth of 100 feet. Ninety feet north-west from main shaft it is opened again in a shaft 80 feet deep, and about 50 feet farther north-west another 80-feet shaft is sunk on the vein. The loose stone in the dumps shows that the lode material consists of greisen, composed of quartz, secondary mica, pinite, talc, and tourmaline, with also much fluorspar and pyrites.

No. 2 vein lies to the west of No. 1, and strikes N. 22° W., and dips easterly. This is opened in a cut 40 feet long, 15 feet wide, and 12 feet deep, the stone from which yielded 38 tons of tin ore. In the bottom of the cutting the stone is poor, consisting of a narrow vein of quartz in dense quartz greisen. No attempt has been made to explore the vein further along the dip or the strike.

Between Nos. 1 and 2 veins is a vein of quartz tourmaline, coursing N. 25° W., and dipping at a very high angle westerly. It consists of 12 inches of almost solid tourmaline and 12 inches of quartz, streaked with laths of tourmaline and flecked with a little cassiterite.

No. 3 lode lies about 100 feet west of No. 2, and, where opened in a shallow trench, consists of kaolinised and pinitised felspar, with a little tourmaline.

No. 4 lode, 60 feet further west, is composed of quartz-mica greisen, with a little cassiterite.

Still further west, 50 feet, is a lode of pyrite and quartz, running N. 25° W., and dipping easterly at a high angle.

These several parallel veins have been intersected, at a depth of 105 feet below the outcrop of No. 1, by an adit crosscut, 750 feet in length, bearing N. 57° E. This crosscut is not now accessible.

Old reports reveal the information that the veins become unpromising at depth. Probably, like that of the Great Republic, the tin ore exists in short shoots, separated by long sections of almost barren lode material.

In 1891 this mine was equipped with a battery of 10 stampers and a concentrating plant. It has long since been abandoned.

The Great Republic Mine.

Development work on this mine had passed the first stage as far back as 1890. Since that time company after company has continued the work, but none with results at all satisfactory. The last serious attempt at commercial operation was made by a Launceston company in 1917, which, in addition to mine development, erected a milling and concentrating plant to treat the ore removed from underground.

To-day the mine is full of water, therefore the writer is dependent upon others for information relating to the results of development underground. The first report in detail comes from the pen of A. Montgomery, Government Geologist, who, in 1892, wrote as follows:

> "The ore outcropping at surface was first opened in No. 1 underlay shaft to 67 feet, when it was found to be a 'pipe' vein pitching southerly. Another shaft (No. 2) showed also its southerly pitch, and then the decision was arrived at to sink a main shaft. From the 166-feet level of main shaft the crosscut to main lode intersected four veins, the first at 16 feet, others at 21 feet, 33 feet, and 36 feet. These veins are very small and poor. At 58 feet main vein was intersected, and then driven on 105 feet to connect with No. 2 underlay shafts. The vein is a mere fissure in the granite, rarely more than an inch wide, composed of quartz, kaolin, and fluorspar. Although the vein itself is very narrow the greisenised wall-rock, consisting of kaolin, pinite, and talc, with tin ore, is 2 to 3 feet wide, and is, in reality, the lode proper.
>
> "At 172-feet level a crosscut intersects the lode at 27 feet, and a drive opens it 163 feet in length.
>
> "At 336-feet level a crosscut intersects the lode at 27 feet, which there is 2 feet wide and rich. A northerly drive 40 feet in length opens a shoot of rich ore.
>
> "The lode down to No. 3 level proved rich, and a shoot between Nos. 2 and 3 levels was 10 feet in width.

"The shaft in later time was sunk to 450 feet, and the lode was intersected by crosscut and opened in a drive. At this level it did not show an improvement in quality nor maintain its size."

From the commencement of operations to 1892 the output of the mine amounted to 131·75 tons of tin ore, of 70 to 72 per cent. quality, from 1560 tons of stone, a yield of nearly 6 per cent. tin from the stone.

Since that time the output has not been fully recorded, but it may be stated that the total does not greatly exceed 200 tons.

The ore of this lode is undoubtedly rich, but the shoot is very short and of small average width. Its smallness does not warrant the heavy expenditure in development, therefore the only justifiable work that can be undertaken is the driving along the course of the vein—preferably south—in the search for other shoots.

Rex Hill Tin Mine.

The earliest record of this deposit dates prior to 1890, when, owing to the presence of galena and sphalerite, it was regarded as a lead-zinc lode. A little later the Rex Hill Silver Mining Company, in opening the ore-body, found that the tin content was greater than the lead, and thereafter became producers of tin ore in particular, but on a small scale only. In 1893 the Rex Hill Tin Mining Company Ltd. acquired the lease rights, and carried on mining operations intermittently until 1900, when they sold the mine to J. C. Macmichael and N. Gaunt for £3500, retaining a share interest. A company known as the Mount Rex Tin Mining Company N.L. was then organised in Launceston for the purpose of adding to the equipment, developing the ore bodies at deeper levels and producing tin ore on a commercial scale.

This company erected a 20-head battery of stampers and concentrating and calcining plants, and opened the ore-bodies at 140-feet, 215-feet, and 290-feet levels. During their operations a large amount of tin ore was produced and sent to the smelters.

In 1909 the company ceased operations and let the mine on tribute to a local party, who carried on successfully until 1913. The tributors found that the cylindrical body represented a great bulge in a 4-feet lode coursing closely with the magnetic north. This supposed new lode yielded material of high grade, and allowed them to carry on successfully a long time.

The present lessee (J. Stevenson), from information obtained at first hand during the period of his long association with the operators of this mine, and from information furnished by the tributors, holds the opinion that in the north and south extensions of the material as much tin ore remains as that already removed from the big section of the deposit. On the information thus gleaned from the several sources he is preparing plans for the reopening of the mine and its equipment.

At the times when the writer visited the mine the workings were inaccessible owing to inflow of water. However, he was enabled to examine that portion of the ore-body exposed in the open-cut and also the north and south extensions thereof. Information relating to the main workings has been drawn from old official reports prepared by A. Montgomery and by G. A. Waller, and from statements submitted by the members of the tribute party. Based on the data thus provided, his finding supports that of J. Stevenson.

Leases.

The mine is embraced in Consolidated Lease 9485-M, of 83 acres, charted in the name of J. Stevenson. A water-race (2317-W) connects the mine with Dam Site 2332-W, of 20 acres, and Dam Site 2317-W, of 40 acres, situated near the head of Buffalo Creek.

Location and Access.

The mine lies 5 miles north-west of Avoca, and is connected with that township by two roads. One, 6 miles in length, leads past Buena Vista Coal Mine;

the other, 12 miles in length, joins Story Creek-road at the plateau. The first is one of rather steep grades, but suitable for motor transport.

Avoca, on the Fingal Railway, lies 49 miles from Launceston, the nearest seaport.

Production.

The records of the production of ore by the early operators are not available. According to local authorities, the amount of concentrated tin ore produced prior to 1900 may be put in round figures at 300 tons. Between 1900 and 1913, but mostly between 1900 and 1905, the Mount Rex Tin Mining Company produced 650 tons of tin ore. Apparently, therefore, the total production amounted to 950 tons.

Geologic Relations.

The ore-bodies are contained in granitic rocks of Devonian age. The normal rock appears as a porphyritic granite, with large idiomorphic phenocrysts of felspar set in quartz and felspars and a very little biotite. Graphic granite, composed almost wholly of felspars and quartz, appears intrusive in the normal rock where the ore-bodies are richest. To the north the granitic rocks are overlain by basal strata of the Permo-Carboniferous system. The western boundary of the granite marks the line of a great fault plane trending north-westward, and with a downthrow to the south-west. Permo-Carboniferous rocks and Mesozoic diabase abut the granite on the downthrow side of the fault.

The Ore-Bodies.

The ore-bodies are closely associated with a graphic phase of the granitic rocks. They represent the infillings of fissures and the action of mineralising vapours and solutions upon the felspars and micas of the fissured rocks. There are illustrated gradations in ore-formation: showing, first, the deposition of tin ore and quartz under high temperature conditions; second, under waning conditions, quartz, tin ore, pyrite, and chalcopyrite; and the third and final stage, showing the deposition of quartz, chalcopyrite, sphalerite, and galena.

Thus it is found that the richest natural concentrations of tin ore with quartz occur in and along a fissure coursing almost due north. Light-brown to black tin ore, coarsely crystallised, fills joints in and is disseminated through greisen, and, in the fissure filling, tin ore may be seen filling geodes in quartz, and with sphalerite and pyrite implanted on it. On the crystallised vein-quartz a coating of secondary quartz appears in parts of the ore-body. Secondary mica (gilbertite the more common variety) and pinite, with fluorspar, in light-green to dark-purple cubic crystals, embedded in quartz, are of common occurrence. Occasional specimens show galena, chalcopyrite, pyrite, sphalerite, and secondary mica and quartz in intimate association.

The sulphidic minerals came at a stage later than the bulk of the tin ore, and are found with quartz and mica filling lateral joints in the wall-rock of the fissure. It is possible that the sulphides of lead, zinc, copper, and iron will become less prominent with depth, but they will not " peter out " altogether.

On the evidence available, it appears that the ore-body is a north-south one, 3 to 4 feet wide, passing through the middle of the large greisen body opened in the main workings. The lode proper is much richer than the associated greisen, as shown by the saving of 81 tons of tin ore from 1160 tons of stone, whereas the big body, as a whole, contained tin ore in the proportion of 1¼ per cent. only. The great lateral extent of the ore-body at this part was due to the development of flat joint planes in the wall-rocks, which provided easy means of access by mineralising solutions.

The northern and southern extensions of the ore-body have been defined along certain sections by means of trenches, but at surface it is not continuous. In the underground workings, however, the body, according to report, is strong and sharply defined, and continuous as far as explored.

Tin ore shows freely in the stone where opened in the trenches.

The Mine Workings.

The ore-body in the early days of the mine was attacked by way of an open-cut, which now exposes

a section 15 feet wide, 30 feet long, and 15 feet deep. At one end a shaft was sunk to 33 feet, and an adit was driven in a north-north-east direction to connect therewith.

The results of early developments appeared so encouraging that the company decided to sink a main shaft from a point about 50 feet south-east from the open-cut. Crosscuts were driven from the shaft at levels of 140 feet, 215 feet, and 290 feet, and all the richest ore over a length of 80 feet and a width of 30 feet was then stoped to surface.

In the later days of the company's operations it was so fully occupied in breaking ore to keep the 20-head mill going that no attention could be given to development, with the inevitable result that no developed ore remained to be broken. The mine was closed and let to a party of miners on tribute. These men had not the capital to enable them to sink the shaft, and therefore concentrated their attention on a small body of rich stone at one end of the large chamber at the 300-feet level. This they regarded as a distinct ore-body, but apparently it belongs to an extension of the main lode, and identical with that part intersected by diamond drill some time before the cessation of operations by the company. The tributors did not drive far along its course nor rise on the ore-body, but gouged the richest ore where easy of removal. They report that the last parcel of 4½ tons yielded 8 bags of concentrated tin ore.

Trench Workings.

What appears to be the southern extension of the ore-body is opened in trenches between 300 and 400 feet from the open-cut workings. Here the stones consist of greisen and quartz veins in which tin ore is visible, the body being 2 to 3 feet wide.

On the southern side of the open-cut the body of greisen has been opened in pits and trenches over a distance of 300 feet. The greisenisation of the graphic quartz-felspar rock is, in places, indistinct, and elsewhere not 2 feet. From the main body a vein leading south-westward has been opened in a long deep trench to a depth of 10 feet. It is reported that the material thereof was of average richness.

Not in one of the superficial workings does the ore-body exhibit any extraordinary feature, yet, where opened at depth, it is evidently well-defined, massive, and of high grade. If that can be accepted as an indication of improvement throughout its length, the prospect appears encouraging.

The shaft has three compartments, and is in good order. The mine may be regarded as a dry one, as it drains very little water from the rock.

The Grade of the Ore.

On the authority of G. A. Waller, late Assistant Government Geologist, the Mount Rex Tin Mining Company crushed 1160 tons of stone for 81 tons of ore, containing 68 per cent. tin. The tin content of that stone, therefore, was in the proportion of 4·75 per cent. It came from the lode proper, and not from the greisenised wall-rock, which also contains a fair amount of tin ore.

In 1902 the manager of the mine reported the average grade of stone to date as 2·1 per cent. Treatment returns in 1904 and 1905 showed tin contents of 1·3 and 1·4 per cent. According to the report of the battery manager, the falling-off in the grade of the ore from the 300-feet level may be held to the account of the mine manager, who sent unprofitable stone to the mill in order to keep it in continuous operation.

The late tributors stated that the new "make" of ore at the 300-feet level, over a width of 4 feet, yielded tin in the proportion of 4 per cent.

Apparently the quality of the stone is above the average of the district.

Ore Reserve.

No official data are available of computative value. The report may be accepted, however, that almost all the ore of value down to the 300-feet level has been removed from the bulged portion of the ore-body, but no ore has been taken from the lode on the north and south sides thereof.

Water-Supply.

A water-race, 280 feet above the shaft, delivers water from two large dams. At little cost the race and dams could be repaired and enlarged in order to provide sufficient water for the driving of milling and concentrating plants and the supply of the necessary wash-water.

General Remarks.

The history of development of this mine shows that the companies attempted its development and equipment with very little capital. In consequence of this they found themselves in difficulties almost from the beginning, and were, throughout their careers, unable to keep development well ahead of mining.

Although they failed, they demonstrated the value of one section of the ore-body, producing in the process over £100,000 worth of tin ore. That fact lends credence to the reports of the engineers and miners regarding the property, as quoted herein.

GALENA AND SPHALERITE ORE-BODIES.

South of the bluffs of Ben Lomond, at the head of Castle Carey Creek, a number of leaseholds were granted, in the early nineties, to work for galena and sphalerite. At that time the lines of iron-stained mudstone, and sandstone of Permo-Carboniferous age, and the bodies of siliceous limonite filling fissures in those rocks, were regarded as cappings of sulphidic bodies. These barren fissure fillings probably represent leachings from such underlying bodies, which, however, belong to the Devonian, an older age. In order to test one body, the Avoca Silver Proprietary Syndicate, of Melbourne, sank an 88-feet shaft into those fossiliferous beds, and crosscut them south-eastward 16 feet to tap the ore-body. Other bodies in the Permo-Carboniferous rocks, consisting of limonite and fragments of quartz, cemented with silica, run almost parallel in a south-easterly direction. The lode materials contain traces of silver only, and no other commercial mineral.

South-east, in the granite country, outcrop similar bodies, coursing 125°, and dipping S.W. at 76°. One consists of 4 to 6 feet of quartz, almost barren of metallic minerals, the other of siliceous limonite. Shafts 10 and 30 feet deep expose them at selected points.

West and adjoining the Castle Carey Company, in 1892, sank a shaft, 40 feet deep, on siliceous limonite.

The lode material in the Permo-Carboniferous country, composed of angular fragments of the country rock, cemented with limonite and silica and clayey matter, appears spongy and loosely knit, and apparently represents the infillings of fissures formed during the period of diabase intrusion. Their limonite was derived probably from pyrites lodes (pyrite-quartz bodies are numerous in the granite country outcropping nearby) by oxidation and conveyance by percolating waters.

Northward of the lastmentioned prospect, holes were sunk upon an ore-body consisting of galena, sphalerite, chalcopyrite, pinite, and fluorspar, set in a matrix of quartz. The contents of sulphidic minerals vary greatly from point to point, but such are nowhere prominent. The body is 3 to 6 feet in width.

In an adjoining section a body of felspar, quartz, and mica is found permeated with galena and sphalerite, and discoloured with oxide of manganese. A hole, 20 feet deep, reveals a felspathic body consisting of large white and pink felspars, greenish pinite, and quartz. This is a form of pegmatite.

About 15 chains N.N.W. from these workings a similar galena-bearing pegmatite appears, the two separated by ordinary granite. A trench, 5 feet deep, exposes a soft portion containing talc, chlorite, felspar, limonite, galena, kaolin, and quartz, with cerussite on the joint faces.

The prospect of such as these becoming of any commercial importance is very remote.

Flaherty's No. 2 Prospect.

This property, not held under lease, lies in the valley of Story Creek, and follows the right bank

of that stream over half a mile. It lies southward of the Aberfoyle Mine, beyond the tin-rich ore-bodies.

This is a form of greisen in which the felspars and micas of the vein wall-rocks have been replaced by black sphalerite, galena, and pyrite. In some places the proportions of those minerals are very high, but the average content, as shown in the following analysis, is too low to allow of profitable operation:—

Lead, 2·5 per cent.
Zinc, 1·8 per cent.
Copper, trace.
Tin, trace.

This ore-body, 4 to 6 feet in width, courses 328°, and is contained in a coarse porphyritic biotite granite. It has been opened in two shallow cuts, half a mile apart. Near the northern cut, on the left bank of Story Creek, a similar body has been opened in a short trench and adit. Apparently its course lies parallel to the other.

These ore-bodies are of no present economic importance, but are of peculiar interest in representing an outer or marginal phase of the mineral zone. They are similar to those exposed at the base of Ben Lomond, brief descriptions of which are given hereunder.

Dalrymple Tin Mine.

The ore-bodies of this mine were discovered, and opened in trenches and cuts, many years ago. At the richest parts of the outcrops a little tin ore was picked out and concentrated, but the first real attempt at production commenced in 1917. During the following year stone, containing tin ore in the proportion of 2 per cent., was mined and treated, and £1837 worth of concentrated ore was sent to the Mount Bischoff Registered smelting plant at Launceston.

The workings (adits and shaft) were inaccessible at time of visit, therefore an examination of the exposed ore-bodies could not be made. On the dump of main adit, gossanous material, in blocks up to 2 feet in diameter, consisting of cellular quartz, with

limonite, pinite, secondary crystalline mica, and kaolin, indicates a sulphidic greisen. Copper carbonate stains appear in the oxidised ore, and a little black sphalerite shows here and there.

Apparently the stone was of too low average grade to allow of profitable mining and treatment.

South Lode.

A large body of quartz-pinite greisen, heavily charged with pyrite and chalcopyrite (now much oxidised), and some cassiterite, was worked, many years ago, in two benches of an open-cut, and explored in shallow shafts and trenches. The open-cut exposed the ore-body 10 to 15 feet in width and over 100 feet in length. It has been traced farther in trenches, spaced about a chain apart. In the cut the body appears as a mass of jointed quartz-mica, studded with sulphidic minerals, stained with limonite, and the joints faced with cassiterite, which also is found as blebs in association with other minerals.

Apparently the stone, which was carted to a milling and concentrating plant, proved too poor to work under those conditions.

AVOCA AREA.

New Henbury Mine.

During 1923 a syndicate was formed in Launceston for the purpose of prospecting the alluvial deposits of Henbury Estate. After the expenditure of £200 in sinking pits into the deposit, the syndicate decided, on the results obtained, to form a small mining company. Carrying that decision into effect, the Henbury Alluvial Mining Compay No Liability, of £2000 nominal capital, was organised in December, 1925. The funds of that company were soon used up, and following a reorganisation, in August, 1926, the New Henbury Alluvial Mining Company No Liability, with a nominal capital of £6000, came into existence. In May, 1928, the capital was increased to £9000, for the purpose of purchasing the Henbury freehold, the purchase of plant and equip-

ment, and the acquisition of the water-rights of the Leona Tin Mining Company No Liability.

From that rough sketch of the history of development, showing that a comparatively large sum was laid out on purchases, the failure of the company to successfully carry on becomes understandable.

In order to assist the company the Government has undertaken the drilling of the alluvial ground on the Henbury Estate.

Area, Situation, &c.

The company holds under lease two groups of land, and also the Henbury freehold estate and the Quigley freehold. The holdings are as follow:—

Lease 105-P, of 10 acres
Lease 120-P, of 10 acres
Lease 121-P, of 10 acres
Henbury Estate, a freehold of 320 acres
Quigley freehold, of 94 acres
Story freehold of 100 acres

all near Story Creek;

Lease 2779-M, of 20 acres
Lease 9019-M, of 10 acres
Lease 10,343-M, of 6 acres
Lease 8713-M, of 5 acres

near the Leona Mine; and

Water-rights 323-93W and 2179-W.

The holdings are situated 4 to 6 miles to the north-east of Avoca, on the north side of South Esk River, and are connected, by 60 chains of road, to a siding on the Fingal Railway.

The freehold properties are well grassed, the Henbury one particularly, from which a rental of £160 per annum is now received by the company.

Production.

The production of tin ore by this company amounts to 14 tons. Complete details are not available, but the following statement, covering the

period 6th May to 25th July, 1928, conveys an idea of the scale of operations:—

Granitic drift treated, 12,000 cubic yards.
Average tin ore content, ¾-lb. per cubic yard.
Net dry weight of tin ore saved, 3 tons 18 cwt. 4 lb.

	£	s.	d.
Net proceeds	525	7	8
Expenditure	430	7	8
Profit on working cost	£95	0	0

The Ore-Deposits.

The ore-deposits may be divided, for purposes of description, into two classes, namely:—

(1) Detrital.
(2) Alluvial.
(*a*) Of Recent age; and
(*b*) Of Tertiary age.

(1) Detrital deposits lie along the lower southern slope of the granite range, and consist largely of the stable components (quartz and felspar) of the granitic rock, with also vein-quartz and tin ore. Near their sources some of these beds of detritus contain workable proportions of tin ore, especially such as have been subjected to the assorting action of flowing water. They, however, are of no lasting importance.

(2) The future of the mine as a tin ore producer depends upon the alluvial ground, particularly that occupying the main valley floor. There are found deposits of two ages: Recent, imposed upon Tertiary. The subterranean Tertiary gravels, consisting predominantly of diabase, quartzite, and the waste of Permo-Carboniferous sediments, are almost barren of tin ore, but contain a little gold. These materials were derived from rock formations on the east side of Story Creek, the limit of the tin-bearing country in that direction, and therefore their barrenness is explained. (It should be remembered, in the consideration of the conditions of formation, that until

Recent time the whole granite range was covered with strata of the coal-measure series, remnants of which still occupy the higher peaks.)

Recent deposits are composed largely of quartzite, quartz, and granite, with only occasional pebbles of diabase. These are the tin-bearing beds. They vary from 15 to 40 feet in depth, and extend over 200 acres of Henbury Estate. Apparently they divide into two deep leads from the point where the combined waters of Story and Aberfoyle Creeks debouch on the plain. The definition of these leads, the determination of their depths, and the estimation of the value of the materials are works about to be undertaken by the Department of Mines.

The Value of the Deposits.

The results of operations on the deposits in the higher ground clearly prove that the methods of sampling in use did not give a true representation of their value as a whole. Samples taken from the upper parts of pit dumps were accepted as representative of the average grade. Actually those samples show the value of the lowest bed only. The discovery of that mistake was made after a long working-test, and upset the calculations of the company, which hoped to receive sufficient revenue to enable it to explore the flood-plain country. Although the mountain streams flow direct to South Esk River, the proportion of tin ore in their gravel beds cannot be accepted as an indication of the amount contained in the Recent deposits of the flood-plain.

A few pits have been sunk into the flood-plain beds, but two only to bedrock. The manager reports that the tin ore occurs in profitable proportion.

Developments.

Henbury Estate.—Developments have been confined by the company to the sinking of a few pits, details of which are given hereunder:—

No. 1 pit:
Soil, to 8 feet.
Fine drift, 8 feet to 15 feet.
(The heavy inflow of water prevented further sinking.)

The company reports that the 7-feet bed of drift contains tin ore at the rate of 1·78 lb. per cubic yard.

No. 2 pit:

Soil, 8 feet.
Boulder wash and granitic drift, 10 feet.
Bottomed on decomposed diabase.

The comany estimates the tin ore content of the 10-feet bed of drift at 0·94 lb. per cubic yard.

No. 3 pit:

Soil, 4 feet.
Wash, 20 feet.
Floor of white clay.

The company estimates the tin ore content at 0·92 lb. per cubic yard.

No. 4 pit:

Soil, 4 feet.
Wash, 20 feet.
(Not bottomed.)

The company reports the tin ore content at 0·99 lb. per cubic yard.

(Note.—The results of drilling by the Department are not confirmatory of these high yields.)

Several shafts have been sunk from 40 to 52 feet into the older gravels near the north end of the block, but not with encouraging results. The section exposed in the 52-feet shaft is given hereunder:—

Shingle and gravel, composed largely of quartzite and quartz, with occasional boulders up to 12 inches, 22 feet.
Band of limonite, 0·1 foot.
Clay (yellowish-brown), 10·0 feet.
Fine granitic drift, containing traces of tin ore, 3·0 feet.
Sandy clay (yellow), with leaves and twigs, 9·0 feet (unbottomed).

The other pits expose beds of similar nature.

On the west side of this estate the Recent deposits of a small mountain stream rest upon firmly cemented gravels and sands of Upper Tertiary age,

6 to 8 feet deep. The older gravels consist largely of quartzite and granite, and contain seams rich in tin ore, which is coarse in size and sub-angular in outline. With the waterpower available it is impossible to effect the disintegration of the component pebbles and boulders.

Along Riley Creek, shafts 22 feet deep show materials containing tin ore in the proportion of 0·5 lb. per cubic yard. (Authority: Tasman Stanley, mine manager.) The upper reaches of this valley have been worked for tin ore. At the main workings the section shows 10 to 20 feet of tin-bearing granite detritus resting upon a hard, rounded floor of granite.

Lease 105P-M.

Tin ore production to date has been almost entirely from this 10-acre block of ground. The workings follow the valley floor of a small tributary of South Esk River up to the foot of the steeply rising granite mountain. Almost the whole body of Recent alluvial material has been worked for tin ore, the remaining portion being shallow and of little account.

The tin-bearing material of Recent age consists of 10 to 15 feet of granitic waste and quartz pebbles, and rests upon well-worn cemented shingle of granite and quartzite, 8 feet deep, which lies upon a granite bed. The older gravels also contain tin ore here, but not in greater proportion than 0·5 lb. per cubic yard. Their firmly cemented condition precludes the possibility of profitable operations. On the west side of the creek the Recent deposits rest directly upon the bedrock, which there is porphyritic, but exhibits graphic intergrowth of the less coarse components. Biotite is a primary component, and tourmaline, in veinlets and nodules, an accessory one.

Lease 120P-M, 10 *Acres*.

The lower half of this ground is occupied by alluvial and detrital materials of unknown depth and value. A covered gutter is indicated by a line of soakage leading towards the range. That line should be tested for tin ore. No exploratory work has been performed on this section.

Lease 121P-M, 10 *Acres.*

This area is occupied in large part by quartzite, with shingle of that rock strewn over it. That portion does not offer encouragement, but at the south-western corner Recent deposits appear at surface, and may prove worthy of attention.

LEONA LEASES.

These adjoin, on the north and west sides, a freehold of 200 acres, owned by C. W. Foster. They are not of any considerable importance as potential sources of alluvial tin ore, the deposits having already been worked out in part, but they are not valueless by any means.

Water-Supply.

The company holds first water-rights to Story Creek, a considerable stream carrying up to 30 sluiceheads during the months of the heaviest rainfall, but only 10 sluiceheads during summer. It is possible to dam the stream and conserve sufficient to ensure a continuous supply of 20 sluiceheads, and deliver the water at a lead of 400 feet above the river flats.

A low-level water-race connects the Leona leases to Story Creek, the main source of supply.

General Remarks.

A review of the foregoing account shows that the future of the company as a tin-ore producer depends upon the results obtained from the drilling operations being performed on the New Henbury Estate. Deposits on other holdings of the company are too small to prove of any considerable value. At the north-eastern corner of Henbury Farm, Story and Aberfoyle Creeks meet, and the combined streams form the eastern boundary of the property. These streams, Story Creek particularly, have carved their valleys deep into the granite and quartzite mountains, and have exposed and cut deeply into many tin-rich veins, the contents of which, to that depth, have been carried downstream and deposited on the flood-plain of South Esk River.

In that manner, and by that means, a very large quantity of tin ore must have been removed from the veins, deposited and concentrated in the recent alluvium, and have been of the plain. It seems, therefore, justifiable to expect that the results of the boring work will prove satisfactory as regards the average tin ore content of the material.

As regards working conditions, no better could be desired. The farm consists mostly of meadow land, with, at the north end, a little light scrub and a few trees. Moreover, the water-right to Story Creek will prove invaluable if the tests prove satisfactory. The recent deposits only are expected to be carriers of tin ore in profitable proportion.

Riverside Mine.

Early in 1927 the Riverside Tin Mining Company No Liability was organised in Hobart to acquire Lease 9926-M, of 80 acres, held in the name of J. A. Crisp. The company, after equipping the mine with pumping machinery and other necessary plant, commenced operations where the prospects appeared best, but after two short periods it decided to suspend operations. The clean-ups from the sluicing work proved very disappointing, and showed that the tin-bearing ground was of lower value than the estimate.

Situation and Access.

The block of land held under lease lies 2½ miles by road north of Avoca, and on the north bank of South Esk River. A branch leads from a point 1½ miles along Story Creek-road, on the north side of the river, to the mine. The grades are gentle, and the road is suitable for motor traffic.

The Ore-Deposits.

The ore-deposits are of alluvial nature, and are made up largely of fossiliferous mudstone of the Permo-Carboniferous formation. They now stand out as a low spur leading from the river along the west side of Rosier Creek to the steep slopes of the granite range of Castle Carey. A cursory examina-

tion is sufficient to discover that the materials of these deposits have been derived from the sediment-covered granite range, the fossiliferous mudstones from the Permo-Carboniferous rocks capping the range, and the tin ore from the waste of veinstone contained in the granite. It is quite evident also that these materials were conveyed to their places of rest in past ages by torrential waters flowing down the valleys of Rosier Creek and its tributaries, the main stream at that time occupying what is now a spur. The alluvial material is confined to a strip 3 chains wide and 10 chains long passing through the middle of the block. It is bounded on the west side by granite, on the east by recent stream wash, and rests upon soft decomposed granite. Where opened in shafts it varies in thickness from 6 to 16 feet, the average being 8 feet. The following section shows in the workings:—

	Feet.
Surficial detritus of granite and quartz	1
Clay	1·5
Fine to coarse gravel of granite, quartz, and mudstone	4·5
Boulder clay and coarse gravel	8·0
Soft granite floor	

Except the beds of detritus and clay, the whole material contains tin ore, but in variable proportion, the greater part being found in the lowest bed. The tin ore is of rather coarse grain size, the average being about 1/20 of an inch, and unassociated with any considerable quantity of other heavy minerals. It can be concentrated without difficulty to 70 per cent. tin grade. The coarse boulder wash, although compact and rather firmly cemented, disintegrates under water-pressure into its component parts, and then can be sluiced of its tin ore. The proportion of large boulders is high, requiring man-handling for their removal.

On the eastern portion of the block, between the creek and the old alluvial ground referred to, the granite is covered with a bed of tin-bearing quartz gravel of average depth 2 feet. It is not extensive, but it can be worked with ease by ground sluicing.

Development.

A number of holes have been sunk through the deposits to bedrock to test its value at the several points, but not sufficient exploratory work has been performed to provide the necessary data for calculation. Apparently greater care ought to have been taken in the collection of data, for the results obtained from actual working tests showed the deposits to have been of much less value than expected by the company, the returns having been only 25 per cent. of the estimated value. According to the reports of production, the deposits yielded tin ore in the proportion of 0·5 lb. per cubic yard only.

In past operations the uncompacted surficial material was sluiced with the use of storm water from Rosier Creek. In that manner a great part of the shallow ground was depleted of its tin ore. The work performed by the company showed the wash material compactly cemented and difficult of disintegration, except under fairly high pressure of water. The oil-engine used in raising water from the river and delivering it, under pressure, at the workings is apparently of the requisite power, but the pipes used in the conveyance of the water proved too weak to withstand the necessarily high pressure, therefore the operations were limited to the strength of the pipes.

General Remarks.

This is a small mine, and not a rich one. Whether it can be operated at a profit under existing conditions, and by means of the method in use, remains a moot point. In the hands of men working as a co-operative party better results might be obtained than by the company. In any event it would be idle to expect very profitable results.

ALFORD CREEK PROSPECTS.

This creek rises on the east side of St. Paul Dome, and flows northerly past Ormley to join the South Esk River. From Ormley, going southward, the creek lies entrenched in sandstones and quartzites of Cambro-Ordovician age until a point is reached

east of St. Paul Dome, where the bedrock is a fine-grained alaskite veined with greisen. Thence the country consists of sandstone and limestones of Permo-Carboniferous age, and of Mesozoic diabase.

The Cambro-Ordovician rocks are veined with granite, and lower downstream veins of quartz, 18 to 30 inches wide, traverse these rocks in a direction 315 degrees. These quartz veins contain neither gold nor silver.

ST. PAUL TIN FIELD.

Introduction.

This field, with that of Story Creek, belongs geologically to the Avoca district, and it is a part of that physiographic province, yet, for purpose of description, it is convenient to accept the natural division presented by St. Paul Dome and the conterminous range of mountains. That barrier separates the St. Paul and South Esk River systems to the line of their convergence at Benham Plain. Mineralogically also that range forms a distinct break, for the tin granites there pass underneath the post-mineral rock formations of which the upper part of the mountain is composed.

The acceptance of such division, arbitrary though it be, is asked in order that a separate report, and one in more detail, may be presented of this area.

Area.

St. Paul tin-mining field may be placed within the confines of St. Paul River Valley, for all the mines lie on one side or other of that channel. The potential tin-bearing part of the area is not large, being 7½ miles long from east to west and 5 miles wide from north to south, or 37½ square miles in extent.

Physiography.

St. Paul River flows along a wide "U"-shaped rift valley, flanked on the north by Mount St. Peter, St. Paul Dome, and Mount Foster, and on the south by Snow Mountain Range. The shape of the valley suggests a glacial agency in its sculpture, and to that allusion is added belief by further evidences in tribu-

tary valleys. On the north side of the road-bridge over St. Paul River a granite spur, projecting above the general level, shows enormous flat surfaces of granite planed in the forms of *roches montonnes*. Again, in the upper sections of the main valley, and in many of the tributary valleys, are deposits of boulder clay composed almost wholly of diabase, derived from the higher mountain ranges to the south and north. Such deposits could not have been formed by means of any other agent.

On the south side of the river-bridge vesicular basalt overlies compacted sands of Tertiary age. These sands, in the upper reaches, rest upon river gravels, composed almost wholly of diabase and the waste of the Permo-Carboniferous formation. There, however, the Tertiary sands are covered with dark-grey sandy clay, the deposition of which probably was due to the obstruction of the river by basaltic lava. The clays are overlain with 10 to 30 feet of granite tin-bearing sands of Recent age.

In connection with the development of the present topography, it is interesting to note that the Permo-Carboniferous strata were laid down on a very uneven floor of Cambro-Ordovician sandstones, tuffs, quartzites, and slates, and of Devonian granites. In the lower parts the basal member is a conglomerate (in many instances tin ore bearing) of well-rounded and assorted quartz and quartzite stones overlain with hard quartz grit, or arkose; in the upper parts fossiliferous mudstone, or a fossiliferous limestone, may be seen resting directly upon Cambro-Ordovician sediment or Devonian granite. The original epi-Devonian topography, therefore, probably exerts a modifying influence on the sculpture of the land since early Tertiary times.

The valley of St. Paul River, then, has been scooped out of all pre-Tertiary formations, such as Mesozoic diabase, Trias-Jura coal-measure sandstones, and Permo-Carboniferous strata, and the bedrocks have not only been denuded by the deep covering of those rocks, but have suffered corrosion themselves. It appears that the original river course followed the lines of a plane of Mesozoic faulting. The valley thus started became more generously

moulded by glaciers in Pleistocene time, and they, in turn, gave place to the present system of rivers which are now entrenched in their old beds.

St. Paul Dome (3368 feet above sea-level), capped with erosion-resisting diabase, stands out prominently from the less eminent peaks projecting from the northern mountain range. In somewhat like manner the diabase bluffs of Snow Mountain and Mount Lewis appear the most striking features of the southern range. In contradistinction, the broad valley floors of St. Paul River and its numerous tributaries lying between these sharply-inclined ranges present an opposite aspect, but one not the less striking.

Geologic Relations.

The oldest rocks (Cambro-Ordovician sediments and tuffs) in the district are well exposed on both sides of the valley, and rise to an altitude of 1800 feet above sea-level on the north side. The sediments consist largely of quartzites, but sandstones and phyllites are not unimportant members of the formation, and interbedded tuffs are prominent. Where this formation is tin-bearing, it is generally found that the tuff member has suffered more than the others from the effects of mineralising solutions, and tin ore replacements of that rock are therefore not uncommon marks.

In Devonian time a rising granite magma, charged with mineralisers, invaded the Cambro-Ordovician, effecting a complete metamorphosis of those rocks in direct contact, with a partial change of those nearby. Physical effects of the intrusion on the sedimentary rocks may be cited as fissuring and faulting. The granitic magma, differentiating in place, separated into a number of modifications, and thus are found represented here the rock varieties given in the order of their formation:—

(1) A porphyritic granite, consisting of quartz, felspars, and biotite, with large directionally arranged phenocrysts of soda orthoclase.

(2) Coarse graphic granite, with nests and veins of pegmatite.

(3) Quartz porphyry.
(4) Pegmatite of orthoclase felspar, tourmaline, and quartz.
(5) Alaskite.

The cooling and contraction of the granitic mass led to the opening of fissures in the intruded Cambro-Ordovician sediments and in the granite body, and in adjusting itself to the solid condition fault fissures were developed in the rock. Faulting of the granitic body took place along the north-east lines, which are marked by hard bluish quartz-tourmaline veins almost barren of tin ore. The reopening of these veins, however, led to the deposition of tin ore and quartz on the hanging-walls. The examination shows that the important greisen veins, coursing north-west and dipping south-west, are contained in graphic granite and quartz porphyry bodies which course about 280 degrees and dip south. It will therefore be noted that the tin-bearing bodies cross obliquely the containing rocks, and with them come to an end at the lines of faulting. The particular points of interest are:—

(1) Greisen veins in the quartz porphyry are siliceous, and contain a fairly high proportion of pyrite and chalcopyrite, and that they are narrower but closely spaced.
(2) Greisen veins in graphic granite are wider, more micaceous, and further apart than those in the quartz porphyry.
(3) The quartz porphyry greisen veins course on a slightly different bearing, and coalesce with those of the graphic granite.

After a period of erosion, during which the intrusive granite was denuded of its cover of Cambro-Ordovician sediments, the basal member of the Permo-Carboniferous (lower coal measure) formation was laid down horizontally upon the granite and quartzites. This consists of a conglomerate of well-worn quartz and quartzite stones with granite waste firmly cemented together, and in places containing a fairly

high proportion of tin ore. The next stratum in horizontal succession is a coarse grit or arkose, made up almost wholly of the waste of granite rocks, and this contains tin ore also in certain places. (As remarked in another part of this report, the basal conglomerate is found only at the lowest elevations of the older rocks, and in some places arkose, and its successors sandstone, mudstone, and limestone, rest directly on the bedrock at the higher elevations.) Deposition of Permo Carboniferous sediments continued upon a gradually subsiding floor, and, without serious interruption, the Trias-Jura coal measure series were laid down in successive beds upon them. That long-continued sedimentation came to an end with the intrusion of diabase, which, in the form of dykes, sills, and transgressive masses, completely disrupted both systems. At that time the Cambro-Ordovician sediments and Devonian granites had become deeply covered with Permo-Carboniferous and Trias-Jura strata, and the ore-bodies well protected from agents of erosion. The intrusion of the diabase, and the accompanying uplift of the land, brought into being the next cycle of erosion, which, excepting occasional interruptions of short duration, continued through the Cretaceous Period. In this process the bedrocks containing the ore-bodies were again exposed to view in the valley of the St. Paul River.

In early Tertiary time sedimentation on the floor of St. Paul Valley began with the deposition of materials from the disintegration of Mesozoic diabase and the coal measure strata. These beds are 50 to 100 feet thick, but are almost barren of tin ore. That period of sedimentation ended with the eruption of basalt in the mid-Tertiary and the concomitant land uplift. Vesicular basalt lava now covers Tertiary sediments in St. Paul Valley and on Benham Plain. Since that time Quaternary to Recent deposits of alluvium have been, and are being, laid down on top of the Tertiary muds and gravels lying on the bedrock of the valley floor. These latest deposits are tin-bearing in places, but are only 5 to 30 feet deep. In the valleys of tributary streams are tin-bearing deposits of recent age.

The Mining Properties.

ROY HILL TIN MINE.

One of the ore-bodies on the Roy Hill property—a freehold of 2560 acres—was discovered in 1890, another in 1892, and both were opened to shallow depths in 1893. During that and the following year the Roy Hill Freehold Proprietary Company, working on a small scale, produced several parcels of ore from shafts sunk on the richest shoots of the western ore-body. The grade of the ore there, at depths of 30 to 40 feet, becoming too low to allow of transport of the stone to other centres for treatment, a small milling and concentrating plant was erected at the top of the hill for that purpose. Records of later work are not available now, but it is known that the company ceased operations in 1895.

Subsequently the mine was let on tribute to Fritz Rubenach, who worked in open-cut along the deposit to the depth of water-level (30 feet) until 1898. Rubenach carted the material to St. Paul River, and there separated and concentrated the tin ore in sluice-boxes. Such methods of handling and treatment could have been applied only to ore of high grade, yet, according to report, the remuneration was quite satisfactory. Very little work has been performed since that time.

Situation and Access.

Roy Hill freehold is bounded on the north side by St. Paul River, and lies 9 miles by road south-east of Avoca, which is 49 miles by rail from Launceston. The Avoca to Swansea road passes through the property, and branch roads lead to the several mine openings.

Production.

The records of the production of tin ore from his mine are rather meagre. A little information, gleaned from official files, is given in the subjoined table, but this does not contain the complete record of production of any company or party.

The information may prove of interest in showing that the richest ore only has been mined and treated.

The tributors cleaned up some of the old excavations and extended the open-cut to 360 feet in length and 10 to 40 feet in width. At a few selected places they sank below the floor of the cut and obtained a little ore by stoping, but nowhere to a greater depth than 50 feet from the surface. They did not work systematically, but confined their operations, as much as possible, to the soft ground that could be treated by ordinary methods of sluicing.

It should be pointed out that a portion of the tin ore has been derived from tin-bearing basal conglomerate of the Permo-Carboniferous system which rested directly upon the quartz mica rock composing the ore-body. The returns, certainly, have been largely increased by the contents of this basal conglomerate. Nevertheless, some shoots in the ore-bodies were remarkably rich.

It is estimated by local residents that the total output from the western workings amounts at least to 100 tons of concentrated tin ore.

No. of Parcel.	Parcel Taken From	Treated by	Weight of Stone Treated.			Weight of Tin Ore Obtained.				Tin Content of Concentrate.	Tin Content of Crude Material.
			Tons	Cwts.	Qrs.	Tons	Cwts.	Qrs.	Lbs.	Per Cent.	Per Cent.
1	No. 2 shaft	Parke & Lacy's Works, Syndey	12	12	0	1	17	0	13	67·6	12·1
2	No. 4 shaft	....		....		0	7	1	22	69·0	....
3	No. 3 shaft	Clyde Smelting and Concentrating Works, Sydney	9	16	2	3	10	0	0	62·0	22·1
4	No. 3 shaft	T. Bateman, Launceston	4	18	0	1	19	3	0	73·3	22·2
5	Open Cut	Company	15	0	0	2	9	0	0	74·1	12·4
6	Open Cut	Company	40	0	0	4	18	0	0	70·1	8·6
7	Open Cut	Company	100	0	0	3	2	2	0	70·2	2·2
	Open Cut	F. Rubenach & others	803	0	0	45	0	0	0	65·6	8·68

The Ore-Bodies.

A large number of ore-bodies have been unearthed on this property, mostly greisen veins, but of those only four will receive special mention, namely:—

(1) Main ore-body near the western boundary of the property;
(2) Dyke lode, exposed in trenches and cuts on the east side of Snow Creek, and about 30 chains south of the road;
(3) Royal George group of ore-bodies that extend into Roy Hill property; and
(4) Lea Creek lode outcrops, on low hills, about 20 chains from the eastern boundary.

Main Ore-Body.

This is a large quartz-mica greisen body lying along the curved line of contact between granitic rocks and Cambro-Ordovician quartzites. It crops out on a low ridge from a mantle of Permo-Carboniferous conglomerates, grits, and sandstones disposed in horizontal beds, and, on the sides, from sandstone detritus and quartz gravel. Where the conglomerates and grits repose on the quartz-mica greisen of the ore-body they contain tin ore in variable proportion, in some places so high as to allow of profitable operation. Going south the ridge rises higher and higher, with the addition of other members of the formation, thus completely hiding the extension of the ore-body in that direction.

This ore-body is a deposit of greisen, following the sinuosities of the line of contact betwen quartzites and a modification of the intrusive granite. It is of horseshoe shape, formed at the intersection of two lines of mineralisation, and therefore irregular in both strike and dip, and the distribution of the tin ore is erratic. The average dip of the contact plane is 50° westward, but at the north end it is northward, and at No. 2 shaft eastward. Almost the whole of the outcropping granitic rock appears as greisen in various forms, but main underlay shaft exposes unaltered aplite and porphyritic material, consisting of orthoclase, quartz and a little muscovite, this being the extension of the dyke-rock further eastward.

Greisen in its many varieties (quartzose, quartz-mica, and quartz-mica-pinite) has been opened 10 to 30 feet in width, 360 feet in length, and 20 to 50 feet in depth. Its full width and length have not been determined, nor has it been thoroughly explored below 20 feet from the surface. In parts the altered rocks consist of secondary mica, pinite, and kaolin, and in that variety tin ore is most abundant, but tin ore is prominent also in the hard granular quartz stones. Black and brown tourmaline, in patches, blebs, nodules, and veinlets, stud or ramify not only the greisen but the unaltered granite; veinlets of white quartz, with cassiterite, fill irregular cracks in the greisen; and the cassiterite (tin ore) itself exhibits a similar irregularity of distribution. The greatest amount of rich ore was taken from the actual line of contact.

The most northerly shaft (No. 4) is vertical, and 50 feet deep. From the bottom a drive, bearing N. 20° W., reaches the quartzite wall at 34 feet. This wall-rock dips at an angle between 15° and 17° on a bearing N. 35° W. At the point of contact the rock consists of soft muscovite granite, and contains very little tin ore. At the bottom of the shaft a soft quartz-felspar rock appears, which likewise contains only a small amount of tin ore. This shaft seems to be beyond the line of intersection of the lodes, one of which is north-westerly in conformity with the true strike of the lodes of the area, the other having a more westerly strike.

Thirty-five feet east of No. 4 shaft the northern side of the dyke formation has been exposed in the open-cut, where soft, rubbly, micaceous greisen containing tin ore may be seen. At the end of the cut the quartz-mica greisen is much harder. Eighty feet farther eastward a long shallow trench, cut southward across the dyke, exposes similar tin-bearing quartz-greisen.

No. 5 shaft (32 feet), sunk on the underlay, followed a soft layer of the lodestuff, 1 to 5 feet wide, lying against the quartzite wall. This material is rich, but the quartz greisen immediately on the east side is poor. Between shafts 4 and 5 the stone has been open-cut to a depth of 20 feet.

No. 3 shaft (32 feet deep) lies 97 feet from No. 5, on a bearing S. 5° W. The rich ore has been removed to a depth of 22 feet. In the bottom of the shaft hard quartz-mica greisen appears, containing tin ore, but in proportion not comparable with that up the shaft.

Between Nos. 3 and 2 shafts the ore-body has been open-cut to a depth of 20 feet.

No. 2 shaft (35 feet) lies 119 feet on a bearing S. 15° E. from No. 3, and follows the quartzite wall. From surface to 12 feet the wall dipped westward, then turned over to the east on a dip of 80°. Rich tin ore was found, to a depth of 12 feet, in a flat vein dipping westward. This rests upon hard quartz-mica greisen containing a little ore.

No. 1 shaft lies 119 feet S.S.E. from No. 2, and is 50 feet deep. From the bottom of it a drive westward cuts the wall at 30 feet. The shaft followed the quartzite wall to 30 feet on a westerly dip of 78°, whence the dip flattened to 11°. The tin ore distribution through the hard quartz-greisen exposed in this shaft is very erratic, rich and poor sections alternating.

East of No. 1 shaft, about 40 feet, main underlay shaft has been sunk through unmineralised dyke rock (quartz-felspar) into the hard greisen. Ore from this shaft was delivered direct to an eight-head stamp battery and concentrating plant. Material on the dump, consisting largely of hard quartz-mica greisen, contains tin in the proportion of 0·3 per cent., this evidently being discarded as too poor for treatment.

North and south of the site of the old milling plant, shafts expose quartz-mica greisen, and to the south-east two shafts (one 40 feet) have been sunk through the basal beds of the Permo-Carboniferous formation into similar greisen.

Reviewing the results of the works performed here by the several operators, it appears evident at once that systematic exploration was beyond the means of any of them. Moreover, none had a true conception of the nature of the ore-bodies nor of their connection with the containing granitic rocks.

It should be noted, first, that what appears to be a true contact lode is actually an intersection of

two lines of lode near the contact between granite and quartzite, thus causing a complex extraordinary in mineral occurrence. One ore-body bears N. 15° W.; the other, the larger, N. 67° W., and they meet at Roy Hill. The larger is that known as the dyke deposit, exposed 20 chains to the eastward. Quartz felspar rock appears, which likewise contains only a small amount of tin ore. This shaft seems to be beyond the line of intersection of the lodes, one of which is north-westerly, in conformity with the true strike of the lodes of the area, the other having a more westerly strike.

Dyke lode is exposed in two deep trenches and a long open-cut. Whether each of the three openings has been made into a distinct and separate body is open to question, because no definite wall has been disclosed anywhere. The ore-body or bodies consist of greisenised quartz porphyry, jointed along a strike of 288° and a dip southward at 75°. The quartz greisen is veined with quartz and flecked with tourmaline (green and black), and the joint faces are implanted with coarsely crystallised tin ore. Tourmaline appears also in nodules, pegmatites, and veinlets. Secondary mica is a prominent component, and pinite is present. Tin ore is distributed through the body of the greisen rock also.

Grab samples of the materials on the dumps, including the closely jointed stone, contained tin in proportion as follows:—

No. 1 sample, 0·68 per cent.

No. 2 sample, 4·32 per cent.

No. 3 sample, 0·32 per cent.

No. 4 sample, 0·44 per cent.

Those results convey an idea of the average quality of the greisen opened in the several trenches and cuts.

This apparently is a very large body, loose lodestone strewing the ground over a width of 200 feet and a length of 800 feet. It is exposed in the floor of the valley of Snow Creek, but rises eastward into low hills, where the conditions for development may prove more favourable.

This promises to be an important ore-body. It is undoubtedly a very large one, though not explored sufficiently to form an opinion of its value. If the results of the rough sampling may be accepted as an indication of its average value, then the ore-body becomes worthy of the closest investigation.

Another ore-body, similar to that just described, outcrops on the low hills to the west of Lea Creek. This also contains tin ore and more tourmaline, but it has not received much attention.

Yet another and important ore-body is the north-western extension of the Royal George lode system. This has been opened in a number of trenches spaced at intervals over a length of 300 feet. The several veins of quartz-greisen that make up this system represent the upward projection of the north-pitching of the Royal George bodies. It is found in the adjoining property that the veins are much stronger, more heavily mineralised, and more clearly defined at a depth of 100 feet.

This body can be tapped, at a depth of 150 feet, by way of a crosscut, 800 feet in length, from Lea Creek. It is obvious that from an economic point of view this ore-body should be worked with the Royal George. An idea of the tin ore content of the stone may be gained by reference to the following table of analyses:—

No. of Sample	Place Taken from.	Tin Content.
		Per Cent.
1	Dyke lode	0·13
2	Dyke lode	0·98
3	Dyke lode	0·30
4	Dyke lode	0·42
5	Dyke lode	0·40
6	Dyke lode	0·80

Alluvial deposits, composed largely of the waste of the coal measure strata and diabase, occupy a very large part of Roy Hill Estate. Some people held to the belief that the Tertiary filling covers tin ore lodes, but their ideas have been dispelled as a result of exploratory works recently performed by Warner Hook, an English engineer.

In places, Recent drifts built up from the waste of granitic materials are tin-bearing, but they are not of any real value.

Royal George Mine.

The lodes of this mine were discovered and explored a little as far back as the eighties by a local syndicate. During the following two decades other syndicates attempted their development and working on a small scale, but not with any degree of success. Not until 1911, when the Royal George Tin Mining Company was organised in Launceston, did the mine receive sustained attention. The history of its development is written in the records of that company, which came to an end in 1922 after a rather troublesome career. The result of the work of the company enables us to-day to form a true conception of the value of the deposits and a fair idea of their extent and value; and it is upon the data thus obtained that the following statements are based.

Since the acquisition of the properties by the present lessees, work of a superficial character only has been performed. It is reported that the lessees contemplate the early resumption of development work as a preliminary to the re-equipment of the mine with plant of modern type.

Production.

The complete records of production of tin ore from this mine are not available, the deficiency relating to the early operators. It is estimated, on the basis of reports by local residents, that the total production of concentrated tin ore (65 to 70 per cent. grade) is not less than 900 tons, of which the late Royal George Tin Mining Company contributed the bulk. The particulars given hereunder convey an idea of the small scale of operations by that company.

The following shipments were delivered during the period May, 1918, to March, 1929:—

Date of Shipment.	Sold to.	Quantity.		Price Per Ton.			Amount Realised.		
		Tons	Cwt.	£	s.	d.	£	s.	d.
1918									
May 14	Mitsui	3	15	405	0	0	1518	15	0
May 28-29	Elder, Smith, & Co.	3	0	382	0	0	1146	0	0
June	Elder, Smith, & Co.	2	0	337	0	0	674	0	0
June	Elder, Smith, & Co.	3	0	345	10	0	1036	10	0
July	Lempriere & Co.	3	0	355	5	0	1065	15	0
July	Mitsui	3	0	400	0	0	1200	15	0
August	Lempriere & Co.	2	10	405	0	0	1012	10	0
August	Elder, Smith, & Co.	2	0	373	0	0	746	0	0
September	Barre, Johnson, & Co.	6	0	305	0	0	1830	0	0
October	Lempriere & Co.	3	0	315	0	0	945	0	0
November	Elder, Smith, & Co.	3	0	312	10	0	937	10	0
December	Elder, Smith, & Co.	3	0	290	0	0	870	0	0
1919									
January	Lempriere & Co.	10	0	215	0	0	2150	0	0
February	Lempriere & Co.	3	0	200	0	0	600	0	0
February	G. D. Gardner	2	6½	....			230	17	0
February	G. D. Gardner	2	6½	....			197	13	0
March	G. D. Gardner	2	15¾	....			290	19	0

Year.	Official Statistics.		Mine Manager's Report.		
	From Quarterly Returns.	From Annual Returns.	Ore.	Tin Oxide.	Value.
	Tons.	Tons.	Tons.	Tons.	£
1913	122·30 tin oxide	122·30 tin oxide	....	....	....
1914	81·30 tin oxide	81·50 tin oxide	....	....	....
1915	97·55 tin oxide	....	....	....	....
1916	....	130·662 tin oxide	....	....	....
1917	....	102·000 tin oxide	19,823	112·35	14,481
1918	....	111·60 tin oxide	20,264	109·25	21,421
1919	....	17·71 tin	3223	34·50	4726
1920	....	66·50 tin	18,667 (from No 2 level.)	89·0	14,808 ....

The following figures were also supplied by the Royal George Company:—

1.5.18	to 6.3.19	87·8 tons tin oxide.
30.4.18	to 4.3.19	92·0 tons tin oxide from 17,895 tons ore.
14.5.18	to 21.2.19	50·25 tons metallic tin sold for £15,732.
21.2.19	to 6.3.19	7·4 tons tins oxide sold for £719.

Area.

The syndicate holds the following mineral leases from the Crown for a period of 21 years, with the right of renewal at the end of that term:—

10,010-M, of 20 acres.
10,009-M, of 61 acres.
10,008-M, of 39 acres.
10,007-M, of 80 acres.
10,006-M, of 80 acres.

These leases are charted in the names of R. E. and L. J. Smith.

Situation and Access.

The mine is 10 miles east of Avoca, a mining and pastoral settlement on the Fingal Railway, 49 miles from the port of Launceston. Its position in relation to the local features is a mile and half south of St. Paul River, opposite Brookstead Estate, and south-east of St. Paul Dome. The Avoca-Swansea-road passes through the property, and a branch road connects the mine workings with the main road. The facilities for transport and communication are good.

Geology of the Ore-Bodies.

The rock of the greatest interest, and having the greatest economic bearing upon the deposition of tin ore, is the granite in all its various forms. On this property are representatives of many differentiates of the original magma, each exhibiting peculiarities that dissociate it from neighbouring bodies, but showing a close relationship to the parent stock. Thus, from the stock magma, whose closest representative here is a very coarse-grained granite with

biotite and large porphyritic felspars, sprang dykes of graphic granite veined with pegmatite and greisen, quartz and felspar porphyries also affected by agents of greisenisation, hard and barren-looking alaskites, occasional aplite and true pegmatite, and a medium-grained quartz-felspar rock with a little biotite and muscovite.

All varieties of dyke-rock, except alaskite, which intrudes the others at an angle almost normal to their strike, are traversed along their courses by numerous veins of tin-bearing quartz, mica-quartz, and quartz-tourmaline greisen from a few inches to 10 feet in width. These closely-veined dyke-rocks appear, in the aggregate, fully 300 feet in width, and contain all the tin ore-bearing greisen. It is apparent, therefore, that the ore-bodies are very closely connected with the latest phases of rock differentiation.

As regards the various kinds of greisen, it is noteworthy that the older bluish quartz-tourmaline bodies are not as rich as the younger white quartz-mica-tourmaline ones, and that the latter are less rich in tin ore than the mica greisen and pinite bodies. These gangue minerals mark the several stages of deposition under pneumatolytic to hydatogenic conditions.

Pyrite and chalcopyrite (and its oxidation product, malachite) are very common accessory components of the tin-rich vein material; their presence, therefore, should be regarded with favour. Both sulphidic minerals, like tourmaline, quartz, and cassiterite, are sometimes found pseudomorphous after felspars, sometimes metasomatically replacing them, and sometimes apparently of contemporaneous deposition. Crystals of cassiterite, implanted upon quartz crystals and filling cracks in quartz veins and quartz greisen, are not uncommon features of the ore-bodies.

Geologic Structure of the Ore-Bodies.

First, it should be noted that the tin-bearing greisens and pegmatites are contained in the dyke differentiates of the stock magma, and with them course in a general north-westerly direction. Sec-

ond, that the main series of greisen veins mentioned come to an abrupt end against north-easterly trending dykes of alaskite, with which are associated another series of veins composed of quartz-tourmaline. The sequence of events may be stated as follows:—

(1) The intrusion of graphic granite (closely allied to pegmatite).
(2) The intrusion of quartz and felspar porphyries.
(3) The intrusion of quartz-felspar-tourmaline, all bearing north-westerly.
(4) The intrusion of 1, 2, and 3, and the containing porphyritic granite, by alaskite.
(5) The cross-veining of 1, 2, and 3 along lines almost parallel to 4.
(6) The strike-veining of 1, 2, and 3 by greisen.

We therefore have two series of major fissures: one, filled with tin-bearing greisen, coursing north-west and dipping south-west, the other coursing north-eastward and dipping at a very high angle south-eastward. The former, especially where confined in the graphic granite dyke, are richly tin-bearing; the latter (composed of dense quartz tourmaline), except where reopened, are poor in tin ore. Apparently the blue quartz-tourmaline material of the latter was deposited before the emanation of the tin solutions, for on the hanging-wall side of the blue veinstones are later veins of quartz, with a little green and black tourmaline, and, in parts, much tin ore.

Reverting to the former, some of the two groups of veins, on slightly different angles, gradually converge, meet, and coalesce; others cross without deviating from their normal courses. Occasional veins, bearing north 80 degrees west, mark a line of minor fissuring. Such have not contributed largely to the tin production of the area, but one or two are fairly rich. These veins join, but do not intersect, the main lines.

A feature of particular prominence and importance is the pre-mineral faulting of the earlier granitic differentiates by the later alaskite. The direct

result of this faulting may be seen in the throw of the dyke-rocks in a north-easterly direction, and the subsequent opening of another set of fissures in the faulted extension of these rocks in Foster's freehold.

A close examination of the containing rocks of Lease 10,006-M will show that they differ from the dyke-rocks on Lease 10,007-M, and, unlike them, do not represent the latest phase of rock differentiation.

Erosion of the Ore-Bodies.

The determination of the amount of erosion allows the investigator to arrive at an idea of the depth extension of the tin-bearing veins. First, it should be understood that the granite (the carrier of tin ore) penetrated in Devonian time Cambro-Ordovician sediments and tuffs, that during the later Devonian time agents of erosion were continuously active, and large parts of the cover rock were completely removed from the intruding granite. In the course of that operation all the ore deposited in the overlying Cambro-Ordovician was removed, and the underlying granites were not only denuded, but suffered from the agents of erosion themselves. During succeeding periods, up to Cretaceous time, sedimentation was continuous, when another cycle of erosion started the removal of the sediments lately laid down. That, in turn, came to an end before a great amount of damage had been done, and, after another, but very short, interval of sedimentation, the present cycle came into being.

Strata of Permo-Carboniferous age still cover the granite, except in the lowest parts of the valley, showing that since the Devonian the ore-bodies have not suffered greatly, but have been well protected through the ensuing ages. In consequence of this it may be anticipated that the ore bodies will continue undiminished with respect to tin ore content to depth not less than 500 feet.

Lease 10,007-M, 80 *Acres.*

Mining operations on a commercial scale have been confined to the ore-bodies within the boundaries of this lease. Such mine openings consist of a long open-cut, an adit a few feet under the open-cut, and

underlay shaft and drive therefrom at a depth of 80 feet below the open-cut, and a number of trenches.

The open-cut is 850 feet long, 80 feet wide at the middle, tapering to 10 feet at the ends, and 40 feet deep. It opens the main ore-channel, but does not take in all the tin-ore veins, some of which have been exposed in trenches 30 to 50 feet beyond its walls. The middle of the cut is the meeting-place of two groups of gradually converging veins. At their intersection a massive body of veinstone 34 feet wide shows in the shaft-level workings. In point of fact, at that level each body is more sharply defined, wider, stronger, more sulphidic, and richer in tin ore than it is higher up. One group of veins courses north 45 degrees west, the other north 40 degrees west. The firstmentioned is made up of closely-spaced veins of greisenised coarse graphic granite. In some places greisenisation has produced a tin-bearing stone, consisting almost wholly of secondary quartz; in others pinite and secondary mica alterations of original felspars are noticeable features; again, other changes, such as that of quartz-mica greisen, are not uncommon, and, especially in the lower levels, pyrite, chalcopyrite, and tourmaline are abundant ore components. The sulphidic ores, in aggregates of very fine crystals, are pseudomorphous after felspar, and the tourmaline, although frequently interstitial, may often be seen encased with quartz in crystals of felspar, this illustrating contemporaneous formation. Cassiterite (tin ore) may likewise be found in fine crystal aggregates after felspar, but also in blebs and veinlets, and as infillings with quartz of joints and cracks in quartz greisen. The richest ore is a soft mica greisen.

Near the centre the containing rock is a quartz porphyry, consisting of phenocrysts of quartz set in a groundmass of quartz and felspar. With this comes a group of narrow veins of quartz and quartz-mica greisen so closely spaced as to lend the appearance of ribbon structure. These veins are only 2 to 6 inches wide, but they are spaced only 2 to 6 inches apart, and are, in the aggregate, 20 feet wide. Not only are the veins above average grade, but the

unaltered intervein material contains tin in the proportion of 0·15 to 0·32 per cent. The whole body is broken as ore and sent unsorted to the mill. In this material malachite, pyrite, and chalcopyrite are prominent ore materials, and tourmaline is particularly abundant.

In the open-cut part of the workings the richest ore has been removed, yet may be seen occasional veins entering the walls, and large masses of second-grade stone which, under good conditions, may receive attention. At the northern end the rich stone pitches northward into Roy Hill territory, where the body has been traced 300 feet beyond the boundary. At the southern end the veins, although of average grade, appear to diverge, leaving ever-widening bands of unaltered granite between them. Beyond the south end of the cut a number of trenches expose tin-bearing veinstone.

The underground workings consist of the adit or No. 1 level 40 to 60 feet below surface, and No. 2 or shaft level 60 feet below the adit. No. 2 level is opened by way of an underlay shaft inclined at an angle of 50 degrees north-westerly or in the direction of the strike of the ore-body. In consequence of this extraordinary design the shaft, if continued, would not prove of much use. A short crosscut from the footwall side of main vein connects with main drive 621 feet in length. Main vein from the crosscut to 408 feet is of average width 8 feet, at which point another body, containing 9 feet of solid veinstone, joins it, and the two widening form a massive body 34 feet across. Between points 480 and 530 feet the ore has been blocked out on ground floor over the full width (34 feet), and between 530 and 621 feet has been removed in part.

No attempt has been made by crosscutting to open any of the many parallel bodies.

That constitutes the whole of the effective work performed within the territory of this lease.

Lease 10,006-M, 80 *Acres.*

Coursing in a general south-easterly direction, almost diagonally through this 80-acre lease, are a number of ore-bodies, some parallel, others inter-

secting, composed of quartz-tourmaline, quartz-greisen, and quartz-mica greisen from a few inches to 5 feet in width. The main ones follow the axis of a sharp ridge rising gently in a south-easterly direction to the foothill of diabase-crowned Snow Mountain, where they pass underneath mudstones of Permo-Carboniferous age. These veins have been opened at short intervals in trenches and shafts from the northern to the southern boundary. In places they are rich, but the rich stone forms a narrow part only of the vein section, in some cases being not over 6 inches in width. Samples, carefully selected to ascertain the value of the several kinds of fissure filling and greisen, showed consistent results as regards each kind of material, but varying results as regards the different kinds. Thus the "blue" veins, composed of an intimate association of quartz and tourmaline, are invariably poor, but with occasional patches of tin ore; quartz, with secondary mica and a little tourmaline (green predominating), in separate veins, or as later infillings of reopened quartz-tourmaline blue veins, is usually rich. A good example of the latter is Bailey lode, a cross intersecting vein bearing N. 80 degrees E. This has been opened in two shafts, each 60 feet deep and about 150 feet apart, and in an adit 200 feet in length driven along its course. This continuation of the adit would serve to further explore this cross-vein and to crosscut the main lines of fissuring.

Although exploratory work only has been performed, and their value is not known, some of the many veins give promise of richness, but not comparable in magnitude with those of Lease 10,007-M.

Lease 10,008-M, 39 *Acres.*

Two trenches, about 100 feet apart, expose to better view an outcropping body of coarse graphic granite, veined and greisenised in a direction of N. 50 degrees W. This body lies close to the western boundary near the south-west corner, and soon passes into the adjoining Roy Hill property.

It is about 15 feet wide and tin-bearing, and is composed of pinitised pink felspar, secondary mica,

and quartz replacement of felspar, with much tourmaline and a little malachite. This constitutes all the available information regarding the body.

Ore Reserve.

The ore reserve of such bodies as those with all available data at hand would be very difficult of estimation; with incomplete data an attempt at an estimation would lead one into the bounds of conjecture. The writer, in an earlier report, endeavoured to put into figures such information as he had obtained from reliable sources, but on later consideration the futility of the attempt appeared so obvious that he, in this report, decided not to court justifiable criticism. No doubt the ore reserve of veinstone of 0·5 per cent. tin grade is very high indeed, but that reserve cannot be expressed in figures, because, except in one small section of the mine, two dimensions only are known. Moreover, although very many tin-bearing veins have been opened in trenches, adits, and shafts, two ore-bodies only have been worked on a commercial scale. Their value, lineal extent, and width have been determined, but their depth limit has *not* been determined.

The greater part of the ore, in what has been described as "the main lode channel of lease 10,007-M," has been removed above No. 1 or adit level. The main parallel veins, however, have not been attacked from that mine opening. In those lie large potential reserves of unknown value.

Between Nos. 1 and 2 levels (60 feet apart) on main ore-body the opened ore has been estimated at 23,000 tons of 0·74 per cent. tin grade.

As regards the reserve of ore contained in the veins opened in the ground of the other leases little can be said. There, again, the necessary three dimensions are not known.

The Average Value of the Lode Material.

The only reliable means of ascertaining the actual value of the run-of-mine ore is to accept the milling records as a basis for calculation. Unfortunately, fractions only of these records are available.

During eleven months of the year 1918-19 the Royal George Tin Mining Company treated 17,895 tons of material to get 92 tons of tin, showing that the yield was at the rate of 0·514 per cent. Tests of the tailing showed a lowest value of 0·15 per cent. tin; therefore the average grade of crude material mined and treated at that time was not less than 0·664 per cent. tin. That operation showed, moreover, that only 77·5 per cent. of the tin in the ore was saved in the milling and concentrating operations.

Those results receive confirmation from analyses of bulk samples of the lode material taken from the bins at the mine and at the mill, as given hereunder:—

	Per Cent. Tin.
No. 1 sample from mine bin	0·67
No. 2 sample from mine bin	0·54
No. 3 sample from mine bin	0·68
No. 4 sample from mill bin	0·45
No. 5 sample from mill bin	0·51

This average value of 0·57 per cent. tin represents the grade of stone in the shaft level; that is, the grade of stone being worked when the late company ceased operations. No doubt a considerable amount of wall-rock found its way into the ore-bins—it may be seen there mixed with the tin-bearing stone—but not as much as that mentioned in the estimate of the engineer. Probably not more than 15 per cent. of the material delivered to the mill consisted of tin-barren wall-rock. Excluding the 15 per cent. of waste, the average value works out at 0·655 per cent. tin.

Owing to the presence of water in the lowest part of the open-cut workings the ore-bodies there could not be investigated during this visit. Samples taken

of the stone left on the sides and middle of the open-cut at surface contained tin as follows:—

Nature of Stone.	Sample Taken From	Width of Sampled Stone	Content of Tin.
		In Feet.	Per Cent.
Porphyry dyke-rock with malachite	West side of open-cut	6	0·33
Porphyry dyke-rock with malachite	West side of open-cut	8	0·33
Quartz-mica greisen	Vein entering east wall of open-cut	3	1·22
Quartz-mica greisen	Vein entering west wall of open-cut	4	1·37
Quartz-greisen	Middle of open-cut	8	0·77
Mica-greisen	North-centre of open-cut	2	3·83
Quartz-greisen	South-east end of open-cut	5	0·44
Greisen veinlets and wall-rock	East side of open-cut	6	0·31
Greisen veinlets and wall-rock	East side of open-cut	10	0·28
Greisen veinlets and wall-rock	East side of open-cut	12	0·12

These figures, although not having any computative value, indicate that by careful selection a large quantity of valuable stone in the upper parts of the open-cut might be removed for treatment, and that the full width of the ore-channel has not been determined. Large-scale operations would allow of much comparatively low-grade material being mined and treated at a profit.

Just before the cessation of mining by the late company, bulk samples of the lode material, taken from workings below open-cut over a width of 34 feet, yielded tin in the proportion of 0·74 per cent. On the basis of all this evidence it may be safely assumed that the average grade of the ore is not less than 0·5 per cent.

Equipment of the Mine.

When the mine was under operation by the Royal George Mining Company the general equipment was of obsolete types, as considered even at that time. To-day such machinery is not in common use, certainly not in any well-designed plant.

A brief description follows:—

Two Cornish-type boilers, each 6 feet in diameter, and working under a steam-pressure of 120 lb. per square inch, provided power to two horizontal high-pressure engines, one condensing, the other non-condensing. One steam-engine drove the milling and concentrating plants, the other provided power for the crushing plant, the winch at the pit-head, and a generator for the electrically-driven pump at the river.

The milling plant then in use consisted of 30 stampers, in three batteries of 10 heads each. Ten heads weighed 900 lb., and 20 heads weighed 700 lb., each. This plant, at maximum, crushed 700 tons per working week of six days.

The concentrating plant received the coarser portion of the pulverised ore first in two-compartment jigs, the tailings from which passed to Forward-Down grinding pans and then to settlers of Spitzkasten type. Six Wilfley tables and a Buss slime table concentrated the tin ore and the associated pyritic minerals and separated them. The pyritic concentrate, after having been calcined in a nine-rabble Leggo furnace and reground, was retreated on three Card tables.

What remains of the plant is now of little or no commercial value.

Economic Considerations.

In the consideration of the economics of any mining scheme, the following are important factors:—

(1) The necessity for effecting a combination of interests of all lessees or mine-owners in the one economic area.

(2) The provision of a sufficient reserve of ore of profitable grade to warrant the estimated capital expenditure.

(3) The provision of a large and unfailing supply of water.
(4) The provision of power at cheap rates.
(5) The provision of adequate lines of transport and communication.

Notes on each of the subjects, as enumerated, will now be given as applied to this area:—

(1) The first effect upon the mind on looking over the Royal George workings appears the desire to criticise the design of the early operators, but when all the circumstances are taken into account this design of layout becomes apparent. One becomes impressed with the idea that the natural sites for the treatment plants and the mine openings lie in the adjoining Roy Hill property. First, it may be mentioned that the hill slopes steeply towards Lea Creek on that property, and that a large area of flat land extends towards Main-road, thus providing a large area for dumping tailing, suitable sites for the milling and concentrating plants, and a site for main adit opening to attack the ore-bodies from the deepest drainage level. Moreover, not only do the Royal George ore-bodies extend into the Roy Hill property, but they dip in that direction. An 800-feet crosscut would tap main ore-body of Royal George Mine at a depth of 180 feet below the summit of the hill, and intersect any parallel bodies on the way. That crosscut would provide a way of attack upon a large reserve of ore before the necessity for shaft-sinking need come up for consideration. Again, the natural site for a main shaft lies within the boundary of the Roy Hill property. From the foregoing it appears evident that either mining easements should be obtained over a section of the Roy Hill ground, or an amalgamation of interests should be effected between the lessees of one and the owners of the other. The latter scheme appears the better, because the ore-bodies of Roy Hill would provide other sources of supply. As large-scale operations are essential to success, the advantage to both parties cannot be over-emphasised. In the case of the Royal George Mine, it may be said that additions of ore from Roy Hill are not essential to successful operations, but the Roy Hill in itself cannot

be regarded as of any present individual value. On the east side of Royal George Mine, but not adjoining, lies Foster's freehold property (now owned by Michael Hannah, of Launceston), which could, with advantage to the owner, be included in the amalgamation scheme.

(2) The proving of a large reserve of ore as a first work in the scheme is quite obvious. Many mistakes have been made, as shown in the past history of both mines, by the erection of treatment plants before adequate reserves of ore had been developed. It may be claimed that a large reserve is in sight, and that past operations have determined the average value, but the desideratum now is information for future operations.

As regards the Royal George bodies, the main ones only have been tapped, and their size, lineal extent, and value have been determined; but little can be said about the many other promising bodies that lie parallel thereto. The deepest workings are only 80 to 120 feet below the surface.

Roy Hill main workings are only 50 feet deep, and the large dyke lode is opened in shallow cuts only.

The fact that 900 tons of tin ore have been produced from the Royal George and 100 tons from the Roy Hill lends encouragement to the belief that exploration with the diamond drill will reveal ample reserves of average grade (0·5 per cent. tin) material.

(3) Water supplies may be obtained from two sources:—

(*a*) St. Paul River; and

(*b*) Swan River at Snow Mountain.

Water may be pumped direct from St. Paul River or gravitated by way of a water-race from a point 10 miles by contour line higher upstream. Suitable sites for the construction of dam walls and the conservation of large supplies are available beyond Glencoe. Ditching would not be costly.

It is possible to conserve large supplies and divert the waters of Swan River into Snow Creek. This scheme may be worthy of consideration. In any

case no apprehension need be held as to serious difficulty in impounding sufficient water for large-scale operations.

(4) The Hydro-Electric Department has under consideration a scheme for the provision of electric power for this district, and a Bill with that purpose in view is receiving the attention of Parliament.

(5) The mines are well-served by a good road and the Fingal Railway.

The perusal of these reports will show that the prospects of establishing another branch of the tin-mining industry here are brighter to-day than at any time in the history of the district.

St. Paul River Tin Limited.

This property, recently acquired by the above-named English company, lies north-east of Royal George Mine and north of and adjoining Foster's freehold, and consists of leases—

8742-M, of 30 acres,
8971-M, of 24 acres,
4729-M, of 40 acres,

and the northern part of Foster's freehold, 110 acres.

The productive portion of these holdings, however, lies between St. Paul River and the Swansea-road (an area not exceeding 5 acres) and narrow gutters of tributary streams. It is therefore to those portions the following remarks particularly relate.

These alluvial beds occupy a narrow strip along the southern side of St. Paul River Valley, which is filled from a depth of 15 to 120 feet with almost barren shingle and alluvium of Tertiary age. Resting on the Tertiary lie the productive beds of Recent age to 15 feet in thickness. The Tertiary shingle consists almost wholly of diabase; the clays represent the waste of Permo-Carboniferous sediments, and the thin beds of sand the waste of granite. The recent sands and gravels are composed largely of granite and quartz derived from Foster's freehold and Royal George properties, with thin beds of dia-

base shingle near their base. The section given hereunder is typical:—

Soil	2·0	Recent (Productive)
Sandy clay	5·5	
Diabase shingle	0·3	
White granitic sand	1·0	
Yellow granitic sand	2·0	
Grey stiff clay, with particles of quartz	4·0	Tertiary (Unproductive)
Lignitic clay	1·5	
Grey stiff clay (not bottomed)	43·5	

Since the visit of inspection the company sank holes 70 to 90 feet deep without any great variation.

The recent beds only, therefore, contain tin ore in commercial proportion. These have been explored in a large number of pits from 6 to 16 feet deep. They consist of granite waste and quartz, few stones being over 6 inches in diameter and the bulk of the material fine in grain. Tin ore distribution is rather erratic; in some places the proportion is greater near the surface, in others near the bottom, and almost everywhere a little is found from top to bottom.

In the valleys of two small tributaries alluvial tin-bearing ground, 5 to 12 feet deep, has been explored by the prospectors and the company.

The Tertiary beds near the river, although very deep, are almost barren of tin ore.

The claim has been made that the recent alluvial ground of this area contains tin ore in the proportion of 1·5 to 2 lb. per cubic yard, but the indications, as a result of this examination, show that the average is not likely to exceed 0·5 lb. per cubic yard.

Hannah's Prospect.

This property, of 330 acres, better known as Foster's Freehold, lies on the east side of, and close to Royal George Mine. For many years several classes of ore-deposit have been worked on a very small scale, and intermittently, for the late owner. Over 50 tons of concentrated ore has been produced, mainly from the operations of tributors.

Developments consist of trenches, cuts, shallow pits, adits, and shafts designed chiefly as exploratory works.

Nature of the Ore-Bodies.

Two classes of deposit, namely:—

1. Primary—
   - (*a*) Greisen veins,
   - (*b*) Pegmatite bodies; and
2. Secondary—
   - (*a*) Alluvial,
   - (*b*) Detrital,

have been opened in the several workings.

The greisen veins are of two kinds: one consisting of quartz-tourmaline, and the other largely of quartz, with secondary mica and sulphidic minerals. A number of veins of both kinds have been opened on this property. They course 315 degrees to 330 degrees, and dip south-westerly at angles of 55 degrees to 75 degrees.

Pegmatite bodies of two kinds (one hard, the other soft) lie in juxtaposition, the plane of demarcation coursing 295 degrees and dipping south-westerly. The hard pegmatite, of medium grain size, consists of felspars, topaz (now pinite), a little fluorspar and quartz, an occasional crystal of biotite, and cassiterite and chalcopyrite, with large bunches of intergrown coarsely crystalline felspar, muscovite, and quartz. Cassiterite is more prominent along contraction planes, but bodies of extraordinary richness are occasionally found consisting of cassiterite, topaz, pinite, quartz, and with a little biotite lying between such planes. Such rich bodies are rare, irregular in outline, and small in size.

The soft pegmatite contains more tourmaline and less topaz than the hard one. It is composed largely of kaolinised felspar, but quartz is prominent. A close intergrowth of the component minerals is a marked feature of the stone, and a peculiar spotted appearance is given by blebs of tourmaline flecked through the white kaolin and quartz; but where pinite is present tourmaline is inconspicuous, and there

the stone appears greyish-white in colour. Occasional bunches of coarse pegmatite, consisting of quartz, pink felspar, and muscovite, lends additional colour to the rock. Cassiterite is not discernible, yet it is fairly evenly distributed, in small proportion, through the body.

The boundaries of this body have not been determined. Secondary deposits are not of any considerable value. Alluvial beds lie along the course of a small stream that runs through the property from south to north. Test pits sunk at intervals along the banks show 3 to 6 feet of tin-bearing alluvium, apparently in profitable proportion in some places. The lead, however, is very narrow, not more than 20 feet at any point.

Detritus from the waste of ore-bodies lies in thin superficial beds on the hill-slopes. The richest has been sluiced for its tin ore.

Workings.

An attempt was made, many years ago, by the late owner to work the pegmatite body on a commercial scale. As a preliminary work he erected a small milling and concentrating plant, consisting of 10 heads of stampers, each about 600 lb. in weight; one set of jigs, of four compartments; two Wilfley tables; and two steam-engines, one to drive the battery of stampers, the other to drive the concentrating machinery. At the same time a shaft was sunk about 30 feet in the richest part of the outcrops, and cuts were made along its course. The very rich material petered out, and an opening was then made into the soft ore-body, which gave the bulk of the material treated in the plant. Another pit sunk in the hard rock showed no better result. These shallow workings prove nothing but the existence of a promising ore-body of unknown dimensions and unknown value, and show that the topaz-rich rock contains the highest proportion of cassiterite (tin ore).

The Jennico vein of quartz-greisen was discovered by Noah Ware, and opened by a party of tributors in several shallow shafts and a long (300 feet) deep trench. The vein consists in part of a quartz filling

of a fissure, and in part of greisenised wall-rock. It courses 330° and dips south-westerly at 60°, the average trend line of the field. Tin-bearing throughout, it appears at first sight one of promise, but its rich sections are very short. Chalcopyrite and pyrite are common associates of the tin ore. The vein varies in width from 9 inches to 2 feet. It is worthy of further attention.

North of Jennico is a 2-feet vein running parallel. It consists largely of quartz, but contains tourmaline and a little cassiterite. A few shallow cuts expose it to better advantage.

On the west side of the creek the blue lode of quartz-tourmaline has been opened along its course in a long trench and a long shallow adit. It is tin-bearing, but the ore is very unevenly distributed, and not in high proportion at any part.

Farther south a similar body has been opened in a shaft and an adit. This, like the other, is well-defined and of great lineal extent but not rich. At its southern end it connects with a cross-vein of quartz-tourmaline, 1 to 2 feet wide, also tin-bearing. In addition to those mentioned many others of similar nature and character have been trenched upon, but none has proved of any real worth.

Future prospects centre at the pegmatite bodies and Jennico vein.

Lease 10,042-M.

This 40-acre lease lies west, and adjoining Hannah Prospect. Within its boundary-lines are enclosed a number of parallel quartz-tourmaline veins coursing 30°. They are up to 4 feet in width, and contain fairly rich, though short, shoots of tin ore, which appears in greater abundance in association with green tourmaline and where quartz predominates over black tourmaline. Pinite and secondary crystallised white micas are prominent in places.

The veins continue south-westward into Lease 2596-M.

Lease 2596-M, 40 Acres.

Sections of the veins briefly described above have been opened in shallow cuts in this ground. All can be attacked with ease by way of adit from this

quarter. Some widen greatly in this direction, one reaching a width of 9 feet, but none showing any improvement at surface in quality.

Lease 4913-M, 40 Acres.

A conspicuous parallel body of similar characteristics crops out here and there from its cover of grit. Tin ore shows in the stone in large crystals and crystalline aggregates. This body is 2 to 4 feet in width, and is traceable 300 to 400 feet in length.

Lease 1769-M, 5 Acres.

Greisen veins lead down the hillside through this ground, where the detritus from them has been sluiced for tin ore. These veins course 330° parallel to those of Lease 10,006-M. They are 6 inches to 2 feet in width, and contain shoots of fairly rich ore.

Lease 1028-M, 10 Acres.

Greisen veins, containing much green and black tourmaline, traverse this ground. The waste of these has ben sluiced for tin ore.

Unleased Ground.

Between Hannah Prospect and the Royal George Mine lie a number of north-east trending veins of greisen, consisting largely of quartz and green and black tourmaline. These cross-veins lie almost parallel to one another, and bear about 30°. Some are of considerable dimensions, and contain, in places, high proportions of tin ore, coarse in grain, and amber to red and black in colour. Their directions, at angles of 50° to 70° from the main trend lines, are of particular interest as marking transverse lines of contraction planes. Like the other set of fissures, they contain much more tin ore where they lie across graphic granite. A little work has been performed on them, but not sufficient to determine their value.

The Brookstead Tin Mine.

Tin ore, it is reported, was found in the valley of Main Creek by James Cowie (the original owner of the property) in 1828, and samples of the material

were sent to England by Surveyor Wedge. (If the report be true, this is the first authentic record of the occurrence of tin ore in Australasia.) Brookstead area, as a potential source of tin, however, did not come into prominence until 1890. In the following year the Brookstead Proprietary Tin Mining Company No Liability was formed for the purpose of testing the extent and value of the greisen veins traversing Mount Montgomery. After careful investigation it was considered that the valley of Main Creek provided the most convenient point of attack; accordingly, mining operations were commenced there on Main and Christoe veins, and a milling and concentrating plant was erected nearby to treat the excavated material. Details of the operations are not available; but it is stated that from 1300 tons of material treated in this plant 32·5 tons of concentrated tin ore was obtained. A recovery of tin ore, in the proportion of 2·5 per cent., would be considered satisfactory at the existing market rate for tin. The reasons for the cessation of operations by this company are not apparent. The veins continue unbroken, and their tin content, although variable, appears to be of average grade, yet the Company failed in its operations. That has been the only serious attempt to test the ore-bodies on a commercial scale. During the following period options of purchase were obtained successively by H. R. Hancock, of Adelaide, Bowes Kelly, of Melbourne, Fairthorn, of Launceston, and the Badak Tin Mining Company, of Melbourne. Hancock tested the more important veins by means of trenches and adits, and by means of shafts and bore-holes ascertained the extent and value of the alluvial deposits. His work may be characterised as thorough, but only part of the property was investigated. Bowes Kelly concentrated his attention on the alluvial deposits, especially those of Bailey Marsh and Main Creek. The operations of Fairthorne were confined to Bailey Marsh, from which he obtained over 8 tons of tin ore by sluicing the alluvial ground. The Badak Company, although giving more attention to the alluvial deposits, sampled the outcrops of the important veins and exposed them to better advan-

tage by trenching. The result of all this work was inconclusive, even with regard to the alluvial ground.

General Statement.

Owing to the short space of time that could be allotted to the work a reconnaisance survey only was made. In consequence of this the report lacks the finish and definiteness so requisite in order to arrive at a true conception of the actual value of the property as a source of tin; but, nevertheless, the information obtained and given herein, it is considered, should prove sufficient for the purpose in view. The object aimed at is to present a clear interpretation of the nature of the ore-bodies, their extent at surface, and their persistency in depth, and an account of the methods most suitable for their development and exploitation.

Topography.

Brookstead lies in the broad valley of St. Paul River, which is confined between two mountain ranges largely composed of diabase. The topography of the surrounding country is one of high relief, the most prominent features being due to the occurrence of erosion-resisting diabase and granite, and to the bold configuration resulting from the corroding effect of St. Paul River. The mountain ranges rise 1000 feet above river-level, and are clothed with heavy forests. St. Paul River is the major affluent of the South Esk, and joins it at Avoca. As far back as Tertiary time, it was a river of considerable magnitude, and had then carved its channel deep into the granite bed-rock. Periodic changes have brought about alternate stages of alluviation and degradation, as exhibited in the successive variations in the composition of fluviatile terraces observed on the valley sides, far above the present bed of the river, and also as shown in the nature of the Tertiary strata into which the river is again carving its channel. The nature of the terraces and other fluviatile deposits affords some evidence of the successive minor movements operating to produce topographic features. West of the homestead, near the present channel,

shafts and bore-holes have revealed beds of Tertiary shale rich in plant remains. These beds were penetrated at 45 feet, and were intersected to a depth of 80 feet, not reaching bottom. Underneath these shales it is possible that a deep lead of tin-bearing gravel occurs. The river bed at this depth is narrow, indicating a rapid erosion of the granite floor. This action was suddenly arrested by the subsidence of the land surface, and a long period of alluviation supervened resulting in the deposition of the shales and the gravels immediately overlying them. During the subsequent period of stability the gravels and the diabase shingle were laid up to the level of Dunn Terrace as the Tertiary river extended its borders and formed the very broad valley it meanders through to-day. The several terraces indicate successive uplifts, each giving renewed power to the river, which soon carved its course through the loose shingle, and is now entrenched within its former channel. The river has nearly reached the limit of its erosive power, and is formidable only in heavy flood. At the western end of the property vesicular basalt overlies soft Tertiary sandstone, with concretionary ironstone, and on Benham Plain vesicular basalt covers a large area formerly occupied by river drift. Numerous fast-following creeks, having their sources in Fingal Range and St. Paul Dome, flow southward, through Brookstead, into St. Paul River. These streams, bringing the waste of Trias-Jura and Permo-Carboniferous sediments and of Devonian granite, form deposits of Recent gravels on the plain in the bottom of the valley. Some of these deposits contain tin ore in profitable proportion.

The Ore-Deposits.

Kinds of Deposits.

The ore-bodies, aside from placers or alluvial deposits, consist of lode fissures and veins, the walls of which have been altered to greisen. At Mount Montgomery the closely spaced fissures have been formed into a solid ore-body by the greisenising action of fluorine-rich solutions. As a rule the tin

ore accompanies green tourmaline, gilbertite, vein quartz, and some sulphidic minerals, filling fissures in granite, whereas the intervening greisenised wall-rock is almost barren. Impregnation of the wall-rock varies from a few inches to 2 feet in the case of individual widely-spaced fissures, to 10 feet and more where they are closely grouped. The wall-rock is a porphyritic granite, consisting of large phenocrysts of idiomorphic soda orthoclase, corroded phenocrystic quartz, and a little biotite, the whole set in a younger generation of the same minerals. Orthoclase in crystals, sometimes 2 inches long, predominates over all other components. Near the veins muscovite is more abundant than biotite, and nodules and veinlets of black and green tourmaline become prominent. The porhyritic variety gives place to coarse-grained equi-dimensional granite, and again to aplite, which appears intrusive into the normal rock. Consisting largely of orthoclase, and other minerals easily susceptible to alteration, the normal granite in which ore-bodies are contained has been almost completely transformed into a quartz-tourmaline rock near the fissures.

All the fissures strike in a general north-westerly direction and dip at high angles to the south-west. Many of them persist unbroken over a mile in length, keeping their relative positions with remarkable regularity. They vary in width from 1 to 4 feet. Some occur in groups, whereas others are widely separated. All are tin-bearing; some are richer than others, and in these the richest concentrations of ore are found in shoots varying from 100 to 400 feet in length. Rich and poor shoots alternate, and pitch towards the north-west.

Alluvial or placer deposits are of three ages, namely:—

Tertiary;
Quaternary;
Recent.

The littoral deposit of early Permo-Carboniferous age forming the base of that formation, as exposed in Panel Marsh Valley, has not been included, because it is not a true placer deposit and because it is of no commercial importance.

Tertiary deposits represent the waste of Trias-Jura and Permo-Carboniferous rocks, diabase, and granite that has been accumulated in the bottom of St. Paul River valley. The base of the Tertiary has not been reached either by drilling or by shaft-sinking. Probably underneath the shales and clays, beyond which exploration works have not been carried, beds of tin-bearing gravels will be found of commercial importance. The uppermost bed consists largely of diabase shingle with interstitial tin-bearing granite drift. The large proportion of diabase reduces the value of this material much below the point of profitable operation.

Quaternary and Recent deposits may be grouped, for convenience of description, under one heading. They represent later accumulations, derived largely from the disintegration of the ore-bodies and granites, and, in the main, have been formed by tributary streams of St. Paul River. In places Quaternary and Recent gravels have been laid down on alluvial deposits of Tertiary age, and it is found that they are much richer than the uppermost bed of the Tertiary. The failure of operators to recognise this fact led to the abandonment of Main Creek section, because the almost barren Tertiary beds reduced the average grade of the two formations below the point of profitable production, whereas the Quaternary alone proved of fair value.

Nature of the Ore-Deposits.

All the ore-bodies in this area consist of greisen veins of one type or another. Greisen is an alteration product of granite, and represents one of the last phases of the action of the acid extract of the magma. It consists essentially of quartz, mica, and the fluorine and boron minerals, tourmaline and topaz, with also, in some cases, lithia micas. It occurs in large bodies of irregular outline, as in the case of Blue Lode, and also as a local alteration product of the wall-rock of fissures, as in the many veins traversing the areas. On Mount Montgomery, where the fissures are numerous and closely spaced, the intervening rock is wholly converted into greisen. Thus are found there alternate bands of tin-bearing green tourmaline, black tourmaline, hard mottled

quartz-tourmaline, containing little cassiterite, and occasional bands of quartz-mica. In places where the fissures are most widely spaced, greisenisation extends only a foot or two into the wall-rock. As a rule the fissure fillings, especially where the material consists largely of green tourmaline, are much richer in cassiterite than in the greisen of the walls. Cassiterite and tourmaline (both green and black) replace the orthoclase felspar, and the biotite component is also converted into black tourmaline. As a fissure filling, the gilbertite variety of mica is prominent in some parts, whereas in others the massive pinite variety is more abundant. Both appear to be indicative of the presence of cassiterite. It is possible that the massive pinite represents altered topaz, but fresh topaz has not been detected. These are not the only alterations that have taken place. In some sections of the ore-bodies quartz wholly replaces the felspar component of the granite, resulting in the formation of a hard, dense, pellucid quartz-rock, in which the original phenocrystic quartz is discernible with difficulty. Where the veins extend from the granite to the overlying invaded rock, as in the cases of the quartzites of the Blue Lode, a metasomatic alteration product, essentially similar to greisen, is formed in the quartzite.

Development.

Mount Montgomery.

Probably the most important ore-bodies are those outcropping on Mount Montgomery. These have been exposed to advantage in deep trenches and open-cuts. At the north-east end of Mount Montgomery an open-cut, 30 feet long, 15 feet wide, and 6 feet deep, exposes two fissures and intervening greisenised granite. The normal granite here is a medium-grained, equi-dimensional rock, consisting of quartz, orthoclase, and muscovite, with massive secondary mica and crystalline gilbertite. The quartz is phenocrystic, orthoclase is interstitial, and the mica is secondary. It contains nodules of black tourmaline. The greisen consists of waxy pinite and gilbertite, quartz, and black, green, and blue tourmaline. The greisen consists of waxy pinite

crystals, constitutes the bulk of the fissure filling. Cassiterite, in coarse crystalline form, is prominent, filling interstices in the gangue and in the greisen of the walls. It is reported that tin occurs here in the proportion of 1·4 per cent. Each of these fissures is 8 feet wide, and, assuming that the reported tin content is correct, should prove highly profitable. The tin occurs in clear, gem-like crystals of amber, ruby, resin, and grey colours. Because of its large proportion of crystallised black tourmaline this is known as the No. 1 Black Lode.

No. 2 Black Lode lies 120 feet to the south of No. 1, and, like it, consists largely of black tourmaline. The fissures are 6 and 10 feet wide, separated by an 8-feet band of greisen. Cassiterite is not discernible by eye, but it is present, though not in profitable proportion. Northward, at the summit of the mount, the greisen appears in a large body, composed almost wholly of quartz. Black tourmaline, in blotches, shows out prominently from the white quartz setting, and occasional blebs, of green tourmaline are noticeable. Cassiterite appears more abundant as facings in joints, but is not prominent in any association.

Three chains southward from No. 2 is a deep cutting across another group of fissures. One section, 10 feet wide, consists almost wholly of black tourmaline, with cassiterite sporadically distributed through it. Another consists of tourmaline, and gilbertite, and a little quartz; and a third fissure is filled with green tourmaline, quartz, and cassiterite. The last referred to is unusually rich at this point. Clean veinlets of cassiterite are found in joints in the quartz gangue, and also in blebs and bunches associated with green tourmaline. Its constant association with the green variety of tourmaline is pronounced. The rich ore-body is exposed to better advantage in a trench further westward. The blue mottled quartz-tourmaline represents the greisenised wall-rock of granite. In this case black tourmaline replaced felspar only, and the quartz with rounded outlines represents the original phenocrysts. These two trenches constitute all the development work performed on this No. 3 ore-body. Without access to analysis it is impossible to form a true

conception of its value, but it certainly appears to be rich, and is probably the most important body yet opened up.

The Mount Montgomery bodies apparently cut out a few hundred feet farther westward, but they reappear in Main Creek valley, and have been opened up there in trenches and adits.

On the south-western end of Mount Montgomery a trench has been cut in a soft aplitic granite, coursing in a north-westerly direction. This aplite contains a fair proportion of tin ore, and is worthy of careful attention.

Main Creek Workings.

In 1891 the Brookstead Proprietary Tin Mining Company commenced operations on Main and Christoe Lodes in the valley of Main Creek. Their operations consisted of the driving of an adit on Main Lode 271 feet, the erection of a milling and concentrating plant, and the construction of a tramway and a water-race. At this stage in the development of the mine the capital at the disposal of the company had been spent, and, having failed to comply with the terms of the agreement, their leases were forfeited and their assets were sold. Another company acquired the leases and stock, and continued the work of development and exploitation. According to reports a recovery of 2·5 per cent. tin was obtained from 1300 tons of material treated. The adit has since been continued by the several optionees to a point nearly 400 feet from the entrance. Over this distance the vein varies in width from 1 to 3 feet. The lode consists of greisen, enclosing a central vein or fissure filling richer in tin ore. The greisenised wall-rock of the fissure is composed of pellucid quartz, black and green tourmaline, pinite mica (massive), and a little cassiterite; and the veinstone consists of quartz, cassiterite, green tourmaline, fluorspar, much gilbertite, with also a considerable amount of chalcopyrite, sphalerite, arsenopyrite, and a little galena. As a rule the cassiterite is coarsely crystallised, and is disseminated through the body of the gangue. The associated sulphides, excepting chalcopyrite, are nowhere prominent, and are not likely to prove

troublesome. A striking feature is the sharp line of demarcation between the greisen and unaltered granite, and between the veinstone and greisen. This lode has been opened up at surface, by numerous open-cuts, for 600 feet on the hill-slope, showing no appreciable variation in size and value.

Christoe Vein lies 94 feet to the north-east of Main Vein, and is parallel to it. Where first opened up, on the level of Main adit, this vein was exceptionally rich in tin ore. The vein materials are similar to those of Main Vein, but it contains a large proportion of chalcopyrite, and it is of equal size. Christoe adit exposes ore of average grade a distance of 100 feet, and numerous cuts into the lode on the hillside show tin-bearing veinstone over 500 feet in length.

Between Main and Christoe Veins another, but smaller, body has been opened up. It is essentially similar to them, and is worthy of further attention.

West of Christoe Vein, about 200 feet, is another parallel vein, 2 feet wide, composed of similar materials, and apparently of equal quality. Trenches expose it to advantage on the side of the hill.

Hancock Vein outcrops 15 chains to the north, and has been driven on 60 feet in a south-easterly direction from the bank of Main Creek. This vein is 1 to 2 feet wide, with a well-defined wall on the south side and an irregular footwall. It lies in a nearly vertical plane, with a slight inclination to the south-west. A veinlet of clean cassiterite, up to half an inch thick, occupies the centre of the vein, which consists largely of green tourmaline, quartz, and gilbertite, with cassiterite, in fine grains and minute veinlets, sporadically distributed throughout its mass. Greisenisation has been very irregular here, unaltered blocks of granite occurring in the fissure, whereas at other points the greisen juts far into the footwall rock.

Ruby Vein, so called because of the quantity of ruby cassiterite found in it, is situated 15 chains to south-west of Main Vein, and Shamrock Vein lies 10 chains farther on. These veins are of average width and quality, and are essentially similar to those already described.

Reference to the map will clearly indicate the positions of the veins described, and will convey an idea of the large number exposed in other parts of the property. They are all similar, and, although varying in their content of tin from point to point, it is difficult to determine which are the richer without recourse to mining works. (In order to avoid repetition a description will not be given of the undeveloped veins of this type.)

On the ridge separating Williams Creek and Long Marsh three large lens-shaped bodies of greisen stand out prominently from unaltered quartzite and normal granite. These bodies are entirely different from the veins in the eastern part of the property. and, although very little cassiterite is discernible at the outcrop, it is considered possible that mining works might reveal profitable ore at a depth of 50 feet. One of the reasons for this assumption is that altered quartzite still forms a cover over the granite, and this rock is not susceptible to replacement by tin-bearing solutions. It is evident, therefore, that mine openings should reveal richer deposits in the greisenised granite. The southernmost is remarkably similar to ordinary greisen. The rock has a bluish hue, and consists of very hard quartz, flecked with black tourmaline. In the fissured part of the ore-body greenish-black tourmaline and a little cassiterite are present. A trench across this body reveals a small body of unaltered medium-grained granite.

Unaltered porphyritic granite separates this from the middle body, which exhibits similar features. A shaft was sunk 15 feet on this lode by H. R. Hancock, and bunches of ore rich in tin were found. No other exploratory works have been performed on these lodes.

These pipe-like ore-bodies are not uncommon. The tin ore in them is not so easy to trace as if it were contained in a channel between properly defined walls, because it may not be confined solely to the centre of the body, but extend into the true greisen and follow the sinuosities of the enclosing granite. Under these conditions the deposition of ore does not possess the regularity and constancy characteristic of fissure fillings or veins.

Placer or Alluvial Deposits.

Extensive deposits of tin-bearing placers occupy the lower slopes and the bottom of St. Paul River valley. They vary in age from lower Tertiary to Recent, but sedimentation has not been continuous. Alternate stages of alluviation and degradation are exhibited in the several terraces, at different elevations, by the change in the nature of the materials composing the deposits. These remarks apply particularly to the Tertiary gravels. Tributary streams of St. Paul River, southward from the mountain range, have cut through these old terraces, and have deposited tin-bearing gravels, 8 to 30 feet thick, on those beds. These younger deposits have been worked intermittently, with fair success, by tributors and by mining syndicates holding options of purchase.

It has already been stated in another part of this report that the value of the Tertiary deposits has not been determined. So far as the writer has been able to ascertain, not one of the many exploratory bore-holes and shafts has penetrated the lowest beds in which tin ore might be found. The gutter of the Tertiary deep-lead passes close by the homestead, and, 50 chains westward therefrom, crosses to the south side of the present river channel. Shafts sunk near the river expose 40 feet of diabase shingle, overlying 40 feet and more of greyish-black shale. Whether the granitic gravels below the shale will prove sufficiently thick and rich to warrant the removal of the almost barren overburden is open to speculation, and can be determined only by actual test. The granite rock cuts out two miles to the eastward of the homestead therefore it may be safely anticipated that diabase pebbles and boulders will constitute the bulk of the material. Holes sunk at Dunn's Terrace, which is the northern limit of the Tertiary gravels, reveal materials composed largely of diabase and the waste of Permo-Carboniferous and Trias-Jura strata. Blocks of Trias-Jura coal, evidently derived from the coal seams of this age exposed at Merrywood, are found scattered through the deposit. Apart from the deep-lead, the value of which is not known, Tertiary gravels, although containing tin ore, are of no economic importance.

Recent deposits of alluvial materials are not so extensive, but they are much richer, and they can be worked to greater advantage. Greater attention has, in consequence, been directed to these more easily accessible beds. The more important are the East Creek, Main Creek, Bailey Creek, and Panel Marsh deposits.

From East Creek workings nearly 40 tons of concentrated tin ore has been obtained. The workings are shallow and the gravels are light and easy to sluice. It is estimated by the owners that the tin ore occurs at the rate of 2 lb. per cubic yard of material. Grey, black, amber, and ruby cassiterite, from fine grains to pea size, showing little evidence of attrition, are found in association, and, without doubt, have been derived from the lode exposed on Mount Montgomery. The deposit is 50 to 100 feet wide, 6 to 10 feet deep, and 60 chains long.

Main Creek deposits are 10 to 20 chains wide, and extend from the river to a point within 30 chains of the old concentrating plant, a distance of 100 chains. The richest section, however, is that between a point 20 chains north of the homestead and the upper limit of Dunn Terrace. This section has been closely tested by means of shafts by the several operators, and the tin-bearing ground has been proved to a depth of 30 feet in the creek bed. The tin ore content of the gravel, they state, varies from ½-lb. to 5 lb. to a cubic yard, or an average of 2½ lb. It is an ore of coarse grain-size, and can be separated with ease by ordinary methods of sluicing. The old course of Main Creek followed the edge of Dunn Terrace, and the flood waters take that channel at the present day. Holes should be sunk along the line of this overflow channel to ascertain the value of the lead. Except on the east side, where it is granitic, the deposits consists largely of diabase shingle.

Bailey Creek deposits are equally important, and have received the most attention. Fairthorne Syndicate, working here 9 or 10 year ago, found that the proportion of tin ore was 2 lb. per cubic yard of material. They obtained 8¼ tons of tin ore in sluicing an acre of ground 10 to 12 feet deep. The material consists of well-assorted fine-grained granite waste,

with occasional boulders of diabase. Fairthorne's party concentrated the ore to 74 per cent. tin, but lost a considerable proportion in effecting this result. The work was performed by means of a hydraulic elevator, and nozzles were used in breaking down the alluvium and conveying it to the sump. Between Fairthorne's and the river a block of very rich ground was worked out many years ago. Dish tests of the dumped material, from shafts, yielded extraordinary rich prospects. The ground for a mile north of Fairthorne's has been tested by prospect shafts and proved to be of almost equal value. From the bottom of the sluiced ground a shaft was sunk 37 feet in Tertiary diabase shingle, and at that point the granite content became greater and the tin content higher.

Panel Marsh Creek empties into Bailey Creek near the confluence with St. Paul River. The gravels in this valley are of equal grade and the materials composing them are similar to those of Bailey and Main Creeks. It is 70 to 100 feet wide, 70 chains long, and 8 to 10 feet deep. Coarse in grain and angular, the ruby, amber, and grey tin ore is confined to the 3-feet band of coarse gravel resting on the bedrock. The overburden is almost barren, and is composed largely of the fine-grained waste of Permo-Carboniferous rocks. There is sufficient fall to admit of ground sluicing methods being employed in the concentration of the ore. The existing supply of water could easily be augmented by conducting the waters of Salmon Creek into this valley.

In the centre of Dunn's Terrace 4 feet of granite drift, of Recent age, rests on Tertiary diabase shingle, which has been sunk through to a depth of 40 feet. In places Trias-Jura sandstone constitutes an appreciable proportion of the material, and in one hole, near the water-race, granite drift occurs below the diabase shingle, indicating the approach of tin-bearing gravel. Two holes, 47 feet deep, at the north-east end of the Tertiary, it is reported, passed through material containing tin ore in the proportion of 1½ lb. per cubic yard.

Water-Supply.

Sufficient water can be conserved on the property for all ordinary requirements without having to draw upon the river supply, but if it is desired to utilise water for the generation of electric power to be used in the driving of plant, then other resources are required. The proprietors state that an unfailing supply, capable of generating 1200 h.p., has been found within a few miles of the estate.

Equipment.

The main equipment consists only of the milling and concentrating plant of old design. However, the plant, and the building in which it is housed, are in good repair, and parts of them could be put to use.

General Remarks.

The indications of the potentialities of Brookstead area are fairly encouraging, both in regard to the veins and lodes and the placer deposits. Perhaps the most striking features about the veins are their number, their continuity, and their regularity. The persistence of these veins along the strike is indicative of their continuance in depth, as the surface length is generally twice the depth they attain. Wherever exposed by trenching at random, tin ore is invariably found; in places not in profitable proportion, as might be expected, because the rich "makes" occur in shoots, but in other places rich ore has been exposed in them. Under the conditions of this examination an idea of their actual value could not be formed. One of the great advantages in the development of these veins is their favourable position relative to the topographic relief. Development by means of adits can be performed on each of the many veins to depths varying from 200 to 500 feet. Exploration by the use of the diamond drill, which is especially adapted to the search and development of such continuous ore-bodies, is recommended. As the tin ore is unevenly distributed in the veins, selective mining will have to be adopted for successful operation. Developments should be conducted on several veins simultaneously in order

to provide as large a reserve of ore as possible and to enable a large quantity to be treated daily.

In regard to the alluvial deposits, attention should be directed to those of Recent age. These could be exploited at a very low cost. The surface is clear of scrub, roots, and stumps, the materials are friable and in small particles, and the tin ore is of coarse grain size and almost free of heavy minerals.

The time at the writer's disposal was too short to enable him to investigate the ore-deposits thoroughly, and to prepare estimates of the quantity of ore available and its value. However, neither the lode nor the alluvial deposits can be regarded as a whole as being rich or very extensive.

Eastern Veins.

Towards the eastern boundary of Brookstead Estate two parallel and closely-spaced bodies of quartz tourmaline outcrop along a hill ridge coursing 90 degrees. They are contained in granite and dip southward at a high angle. A few shallow cuts expose the veins for examination, but do not reveal a shoot containing much tin ore.

OLD LEASES 1470-91M AND 1471-91M, EACH OF 40 ACRES.

These leaseholds adjoin Brookstead, near the north-east corner, and enclose two sets of quartz-tourmaline veins. The southern vein courses 282 degrees, and dips southward at a high angle. It is 3 to 5 feet wide, and outcrops strongly over 500 feet in length. Green and black tourmaline are prominent; tin ore is visible here and there in small particles; and iron oxide stain suggests a derivation from pyrite.

Cuts expose the body to a depth of 5 feet. The northern vein, coursing 292 degrees, and dipping southward, is 5 to 25 feet wide, and consists of quartz greisen with limonite, green and black tourmaline, and a little secondary mica. This is a very strong body, opened in shallow cuts over a distance of 400 feet.

Neither of these ore-veins contains tin ore in commercial quantity where opened. Better results

might be obtained north-westward, where the containing granitic rock becomes more favourable for ore-deposits.

Ayre Prospect.

On the north side of St. Paul River, and west of Brookstead, an outcropping body of tin ore was discovered and worked by Stanley and Fowler about ten years ago. The tin ore, coarsely crystallised and in high proportion, is contained in quartz-tourmaline, and is associated with the limonite oxidation product of pyrite and chalcopyrite. It lies between beds of quartzite, replaces a bed of tuff, and appears to be a short irregular shoot terminated by a "slide."

A shaft has been sunk 60 feet on an angle of 45 degrees in a direction of N. 77 degrees E. following the "slide." Apparently the shaft diverged from the dip of the tuff, for at 60 feet the ore cut out, and no trace remains. A drive cut a few feet west failed to locate it, but the drive probably got behind the slide. This conjecture could not be followed out, because the shaft was inaccessible at time of visit.

Being a replacement of tuff, and lying between two quartzite walls, its further exploration should not prove difficult.

Two lots of ore were carted to Royal George mill for treatment.

Thompson Prospect.

West of Ayre Prospect, 20 to 30 chains, a number of openings have been made in narrow veins of quartz and tourmaline, contained in quartzite. The prospects are not encouraging.

A. McINTOSH REID,
Director of Mines.

Q. J. HENDERSON,
Cadet Geologist.

PLATE II.

5 cm

GEOLOGICAL SKETCH MAP OF AVOCA TIN FIELD

SCALE

10 0 10 20 30 40 50 60 70 80 CHAINS

1 0 1 MILE

Q.J.H.

CHARACTERISTICS

Geological Boundaries

Contours

Main Roads

2nd Class

Water Races

LEGEND

SEDIMENTARY

RECENT — River Sands and Gravels

TERTIARY — River Gravels and Shingle

PERMO-CARBONIFEROUS — Sandstones Mudstones

CAMBRO-ORDOVICIAN — Quartzites Tuffs Slates

IGNEOUS

TERTIARY — Basalt

UPPER MESOZOIC — Diabase

DEVONIAN — Granite

REFERENCE

New Henbury Alluvial Mining Company No Lia
323
93W
2179
W
108 P
M
120 P
M
121 P
M
2779
M
9019
M

St. Paul River Tin Ltd.
8742
M
4729
M
8971
M

W. C. Inglis
9476
M

M. Hannah
271
W
516
W
758
W

L. J. & R. E. Smith
10006
M
10007
M
10008
M
10009
M
10010
M

A. L. Green
8713
M
10343
M

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania

PLATE III.

5 cm

GEOLOGICAL SKETCH MAP OF STORY CREEK AREA

SCALE

10 5 0 10 20 30 40 50 60 70 80 CHAINS

0 1/4 1/2 1 1 MILE

Q.J.H.

LEGEND

SEDIMENTARY

RECENT — River Sands and Gravels

TRIAS-JURA — Felspathic Sandstones

PERMO-CARBONIFEROUS — Sandstones Mudstones

CAMBRO-ORDOVICIAN — Quartzites Slates Tuffs

IGNEOUS

UPPER MESOZOIC — Diabase Talus

DEVONIAN — Granite

CHARACTERISTICS

Geological Boundaries

Contours

Main Roads

2nd Class Roads

Water Races

Tracks

Faults

Lodes

BEN LOMOND

RIVULET

Vickory Creek

BATEMAN LOOKOUT

Cradle Creek

LAWSON HILL

MT. REX

McGINTIE TIER

GREENSTONE HILL

BEN LOMOND MARSHES

Buffalo Creek

Hercules Creek

Sunfish Creek

AVOCA ROAD

Tasmania Creek

Tiger Creek

Archer Creek

Mistletoe Creek

Aberfoyle Creek

Consolidated Lease

ABERFOYLE RIVULET

REFERENCE

G. H. Hodgman	8811 M	R Hawkins	9974 M
	10090 M	G. F. Plummer	10392 M
C. McCormick	2630 W		10032 M
	10142 M	R. E. McCormack	10154 M
	10159 M		2558 W
	10165 M		2553 W
	10166 M	Aberfoyle Tin No Liability	10177 M
	10168 M		10361 M
Tom Lyons	10266 M		10183 M
	10270 M	B. C. Lutwyche and J. Richards	10184 M
	2561 W		
	2564 W	E. Phillips W. P. & M. A. Flaherty	10345 M
	10362 M		9584 M
E. Bedelph	2618 W	E. L Egan	10108 M
	10374 M		10178 M
G. F. Plummer and J. S. Goodall	2630 W		7150 M
H. J. Rubenach	10176 M	Donald McLeod	7250 M
A. T. Anderson	10157 M		499 W
Park & Bailey	4709 M		1704 W
E. Ryan	10317 M		
J. Stevenson	9485 M		
	2317 W		
	9219 M		
E. R. O. Hayes	6061 M		
	2246 W		
J. A. Crisp A. T. Anderson	10158 M		
	10222 M		
J. A. Crisp	10223 M		
	2573 W		
	10393 M		
J. S. Goodall	9902 M		
	10304 M		
J. S. Goodall J. F. Egan	10312 M		
	10313 M		
Mammoth Tin Areas	10259 M		
	2586 W		
A. E. Davies J. W. Ryan A. H. Smith	10225 M		
A. E. Davies E. L Egan	10365 M		
C. Shelton	5746 M		

J. F. Egan: 1236 W; 5510 M; 8847 M; 8848 M; 8849 M; 3927 M; 9170 M

J. F. Reynolds: 9024 M; 967 W

Tom Lyons: 2336 W

Director of Mines
14 may 1929.

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania