GSB35

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

Tasmania

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BULLETIN

No. 35

The Sub-Basaltic Tin Deposits of the Ringarooma Valley

BY

P. B. NYE, M.Sc., B.M.E., Government Geologist

Issued under the authority of
The Honourable A. G. OGILVIE, M.H.A.
Minister for Mines for Tasmania

Tasmania:
Wholly set up and printed in Australia by
JOHN VAIL, GOVERNMENT PRINTER, HOBART

23529 1925 Price 2/6

TABLE OF CONTENTS.

VII.—THE MINING PROPERTIES—*continued.*

PLATE: GEOLOGICAL SURVEY MAP OF THE RINGAROOMA VALLEY AT THE END OF THE REPORT

The Sub-Basaltic Tin Deposits of the Ringarooma Valley.

I.—INTRODUCTION.

(1)—Preliminary Statement.

The Ringarooma Valley, in which the following investigation was carried out, is well known, not only for its rich deposits of alluvial tin ore, but also for its large extent of first-class basaltic soil.

The latter is particularly suitable for potato-growing, dairy-farming, cattle-raising, as well as other branches of the agricultural and pastoral industries, which have made the district a very prosperous one.

The deposits of tin ore have been equally responsible in the production of the prosperity of the district. They occur mainly in the form of deep leads—*i.e.*, deposits formed along the courses of former streams, and which have been covered by later sedimentary and igneous rocks. These deep leads represent the deposit along the streams of an ancient river system which drained the Ringarooma Valley of that period. This former Ringarooma Valley was filled with Tertiary sediments up to several hundred feet in thickness, and finally by Tertiary basaltic lava flows, with a thickness in places of 150 feet. The greater part of this cover of Tertiary sediments and basalt still remains intact, and the problem associated with the investigation was to determine as accurately as possible the courses of the streams forming the ancient drainage system.

Numerous mines have in the past been operating at various parts of the deep leads with varying degrees of success. The majority of these are now idle, or have been absorbed in other mines.

The only two mines operating on a large scale at the present time are the Briseis Mine at Derby, and the Pioneer Mine at Pioneer. Several parties of tributers are working at the Arba Mine at Branxholm, but the remainder of the mines are idle.

A considerable extent of sluicing has also been carried out on alluvial and detrital deposits to the south and south-east of Branxholm, notably at Ruby Flat, Anson's Creek, &c. Operations are still being carried out at the New Ruby Flat, Loyal Gordon, and Mt. Ruby Mines, and also by small parties at numerous other localities in this area.

Greisen lodes have also been found outcropping in this area, while others have been exposed during sluicing operations. These have received attention during past years, but no work is at present being performed.

(2)—General Statement.

The field work in the Ringarooma Valley was carried out during the period between the 19th May and 17th June, with the exception of the five days' interval between 1st June and 5th June. The area to the south-east of Branxholm was examined during the period from 25th August to 7th September.

The geological mapping was carried out with the aid of the mineral charts of Warrentinna, Kay No. 3, Kay No. 1, Kay No. 2, Kay No. 4, Moorina, South Boobyalla, and South Mt. Cameron, and land charts of Dorset, 4, 5a, and 5b. The topographical features were altered where necessary, and also added to in numerous cases. Contours at intervals of 100 feet are shown on the geological map (Plate I.), and further illustrate the topography. The contours are based on aneroid readings, the datum points used being the stations on the Launceston to Herrick railway.

(3)—Acknowledgments.

The writer desires to express his appreciation of the assistance and information given to him by Messrs. Lindesay Clark (manager, Briseis Mine), C. G. Ryan (manager, Pioneer Mine), A. J. Ritchie (manager, Mt. Ruby Mine), A. Power (manager, New Ruby Flat and Loyal Gordon Mines), and T. McDonald (representing the Granville syndicate), and also to the numerous other residents of the districts who helped in a similar manner.

II.—LITERATURE.

The following publications contain descriptions of parts or the whole of the district:—

Gould, Chas.: Geological Surveyor's Report on Part of County of Dorset 1864

Thureau, G.: Report on Some of the More Prominent Stanniferous Deposits in the Vicinity of the River Ringarooma, County of Dorset, Tasmania 1884

Thureau, G.: Report on Water Scheme for Supplying the North-Eastern Tin-mining Districts 1884

Montgomery, A.: Mineral Resources of Tasmania 1891

Montgomery, A.: Mineral Resources of Tasmania 1894

Smith, J. Harcourt: Report on the Alluvial Tin Mines at Derby 1899

Twelvetrees, W. H.: Report on the Arba Extended Tin Sections at Branxholm 1899

Twelvetrees, W. H.: Preliminary Report on the Deep-Lead or Infrabasaltic Stanniferous Gravels of the Ringarooma Valley, near Derby 1900

Lewis, J. B.: The New Brothers' Home No. 1 Tin Mining Company, Derby 1902-3

III.—HISTORY.

The early history of the Ringarooma was one of settlement for agricultural and pastoral purposes. The settlement of the north-eastern part of Tasmania commenced along the northern coast, and the port of Bridport and the township of Ringarooma (now Boobyalla) were established. At the same time it was also radiating outwards from Launceston, from which centre tracks and roads were extended. This settlement was carried out on areas on which the most fertile soils were found, and thus the districts of Piper's River, Lilydale, Ferny Hills, Scottsdale, &c., were founded. The occupation of land around what is now the Scottsdale district began about 1860, and that around Maurice, in the Ringarooma Valley, about the same time. In the two latter districts the rich basaltic soil of the locality formed the attraction for the settlers who occupied them. The development of the Ringarooma Valley proceeded very slowly, however, due to lack of transportation facilities.

The history of the district as a mining one began at a much later date. Gold was the first mineral discovered in the north-eastern part of Tasmania, but it had little or no influence on the development of the Ringarooma Valley. It is the later discovery of tin ore and the establishment of the tin-mining industry that has played such an important part in the present prosperity of the district.

Specimens of tin ore were apparently found in the north-eastern part of Tasmania before 1870, but such discoveries were not followed up. During 1872 several applications were made for licences to search for tin and other ores in the district to the east of Scottsdale. In December, 1872, Benjamin Brooks and party discovered specimens of tin ore near Mt. Maurice, or Patersonia, but were not successful in obtaining financial assistance to further prospect their discovery.

In February, 1874, G. R. Bell found alluvial tin ore at several places between Scamander River and George's Bay, and tin ore at Bell Hill, but did not develop these deposits. He followed this up in March, 1874, by prospecting for, and finding, alluvial tin ore in the Boobyalla River, near Little Mt. Horror. As a result eight mineral leases of 80 acres each were applied for by separate individuals, including Bell himself, for the Boobyalla Tin Mining Company. Operations continued for several months, and $4\frac{1}{2}$ cwt. of ore was forwarded to Launceston.

The company appears to have ceased operations in September, and the sections do not appear to have been surveyed.

Subsequently, in 1874, G. R. Bell made further discoveries of alluvial tin ore in the Upper Cascade River and at Thomas Plains (now Weldborough).

The latter part of 1874 and the succeeding years (1875 and 1876) were the times of numerous other discoveries. Prospecting revealed the alluvial deposits at Mt. Cameron, and ore was sent away in 1875. At the same time mines were being worked at the Winiford River, Blue Tier, Weldborough, Upper Cascade River, Moorina, Derby, Branxholm, &c. All the important discoveries, excepting the Pioneer and Arba mines, were made between 1874 and 1876.

The history of the mines is that familiar on many other mining fields. The fluctuating price of tin caused alternate periods of activity and idleness. The shallow and rich alluvial deposits along the streams gradually became worked out and exhausted.

In some cases the following of shallow deposits led to the discovery of the Tertiary sub-basaltic alluvial deposits, but these had also been independently found at Branxholm, Derby, Main Creek, &c. The mining of these deposits was a much larger problem, and one only to be undertaken by companies, which has been carried out at Pioneer, Moorina, Main Creek, Derby, and Branxholm. Of the companies operating such deposits, only the Pioneer at Pioneer and the Briseis at Derby have persisted, although it is only comparatively recently that the Arba at Branxholm ceased operations.

With the advent of the mining industry the necessity for better transport facilities was emphasised. The roads from Scottsdale, George's Bay, and Boobyalla were gradually improved in order to overcome these difficulties. In 1893 a railway was constructed as far as Scottsdale, and was later extended to Branxholm, and subsequently to Herrick. Not only did these facilities help the mining industry, they also assisted the agricultural and related industries of the district. At the present time dairy-farming, potato-growing, cattle-raising, and agriculture are carried out on the fertile basaltic soil. Also the timber industry came into existence, and sawmills have been, and are at present, operating throughout the district.

These industries (mining, timber, agriculture, &c.) have jointly contributed to the prosperity which the district is at present experiencing.

IV.—GEOGRAPHY AND PHYSIOGRAPHY.

(1)—LOCATION AND EXTENT.

The district described in this report is situated in the eastern portion of the County of Dorset, in the north-eastern part of Tasmania. It consists of a long tract of country along the course of the Ringarooma River, from Maurice to Pioneer, and extending from the latter township as far north as the western end of the Mt. Cameron Range.

It lies wholly within the Municipality of Ringarooma, and includes the townships of Ringarooma, Legerwood, Branxholm, Derby, Winnaleah, Moorina, Herrick, and Pioneer.

The total area of the district examined is between 90 and 100 square miles.

(2)—ACCESS.

Access to the district is readily available, either by road or railway, from Launceston, the chief centre of Northern Tasmania.

The Tasmanian Government Railway from Launceston to Herrick enters the district near Legerwood ($66\frac{1}{4}$ miles), and passes through it as far as Herrick, which is the terminus, and is $84\frac{3}{4}$ miles from Launceston.

The main road from Launceston to the North-East and East Coast districts also passes through the district. It enters near Legerwood, and passes out of the district at Moorina. The continuation of this road through Weldborough, Lottah, St. Helens, and Scamander is connected with St. Marys, the terminus of the Conara to St. Marys railway.

Herrick is connected with the small port of Boobyalla by two roads. One of these runs directly between these two places, but has a bad surface for a large proportion of its length. The other passes through Pioneer and Gladstone, and while it is of greater length, it is a much better road.

Numerous good by-roads traverse the district and connect outlying parts with the main road and the railway.

(3)—TOPOGRAPHY.

(*a*) *General Description.*

The topography of the Ringarooma Valley is essentially that of a long narrow plain, which has been largely dissected by the present Ringarooma River. The plain was formed by the flooding of, and deposition of sediments in, an ancient river valley, the sediments being later covered by flows of basaltic lava. The sides of the old valley form those of the present one, but have been modified by denudation.

The north-western side of the valley consists of a low range, which branches off the Billycock Tier in a north-easterly direction, and forms the divide between the head-waters of the Great Forester River and the Boobyalla River on the north-west and the Ringarooma River on the south-east. The south-eastern side of the valley is formed by the comparatively elevated country between Mt. Victoria and Weldborough, which is the divide between the Ringarooma River and the George River to the south.

To the north and east of Herrick and Pioneer the Ringarooma River has departed from its former course, and passes to the east of Mt. Cameron. The ancient river valley was also much wider at this locality, and a comparatively low-lying tract of country composed of Tertiary sediments extends northwards to the coast.

(b) *Mountains.*

No prominent hills or mountains occur within the district examined, the only elevated country being the sides of the ancient and present Ringarooma River valley. In close proximity, however, such mountains as Mt. Horror (2000 feet) and Mt. Cameron (1800 feet) occur to the north, and Mt. Victoria (3964 feet) and the elevated country of Weldborough and the Blue Tier to the south.

Small prominences on the latter elevated country are Murray Look-out, Bell Hill (2600 feet), Gray Hill or Bullman's Bluff (1860 feet), and Mt. Paris (1810 feet).

In the valley of the Ringarooma River the corrosion of the river through the basalt and underlying Tertiary sediments has formed steep cliff-faces. These are highest in the northern part, and in some cases rise to heights of 300 feet above the surrounding country.

(c) *Plains.*

The filling of the Ringarooma Valley with Tertiary sediments and basaltic lava flows caused the formation of a long narrow plain. The subsequent denudation of the Ringarooma River system has largely dissected this plain and divided it into a number of smaller ones.

(*d*) *Streams.*

The greater portion of the district examined is drained wholly by the Ringarooma River and its tributaries. This river rises by means of numerous branches in the elevated country between Mt. Victoria, Mt. Maurice, and Mt. Scott, the more important of these being the main stream itself and the Maurice River. It has a general northerly course as far as Branxholm, where it turns to the north-east and follows that course to the east of Mt. Cameron, where it changes its direction to north-west and enters Ringarooma Bay at Boobyalla.

The most important tributaries enter the river from the south and south-east side, and south to north are the Dorset River, Branxholm Creek, Black Creek, Cascade River, Main Creek, Weld River, Frome River, and Winiford River. The largest tributaries on the north-western side are Legerwood Rivulet, David Creek, and Bradshaw's Creek.

The northern part of the area is drained by the head-waters of the Boobyalla River and the Little Boobyalla River.

(4)—Climate and Meteorology.

The climate of the Ringarooma Valley is a moderately cold and wet one. It varies with the altitude, and the elevated country to the south is, of course, much colder and wetter. Snow falls only occasionally on the more elevated country. Severe frosts are experienced in the valley during the winter.

The following table (No. 1) gives the average monthly and yearly rainfall for all stations at which it is recorded in the district:—

TABLE No. 1.

Rainfall Data of the Ringarooma District.

Station.	Number of Years of Average.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Weldborough ...	4	297	191	195	260	502	795	686	558	537	653	342	219	5233
Ringarooma ...	26	267	176	314	351	475	698	577	517	498	460	984	292	4909
Branxholm ...	15	229	174	361	289	471	753	554	501	476	441	274	268	4791
Moorina... ...	15	197	145	363	294	461	694	482	454	433	391	263	310	4487
Pioneer	21	188	214	271	265	391	539	432	362	337	338	200	252	3789

The annual rainfall varies from 3789 to 5233 points, which represents a fairly high rainfall. It will be observed that the rainfall increases as the Ringarooma Valley is ascended from Pioneer to Ringarooma. This is due partly to the greater altitudes at the head of the valley, and partly to the proximity to the more elevated regions. The rain is not evenly distributed throughout the year, but it is essentially a winter rainfall, the months of May, June, July, August, September, and October being those of largest rainfall. June is the wettest month, and February the driest.

(5)—Vegetation and Timber.

The greater part of the district was formerly covered with forests and undergrowth of many kinds, but much of it has now been cleared for agricultural, mining, and sawmilling purposes.

Eucalypt forests are the common type, with myrtle trees occurring only at the higher altitudes, or in isolated localities along streams. The most plentiful species are stringy-bark, stringy-gum, white-gum, and peppermint. Blue-gum does not occur. The stringy-bark and stringy-gum trees are the most important ones from the sawmilling point of view.

Blackwood and lightwood trees are fairly numerous, and the former plays a large part in the timber industry, owing to its value for furniture-making, &c.

The above forests occur to the west, south-west, and south of Herrick. The district to the north-east and east of Herrick is almost treeless.

Practically all the basaltic land and adjacent regions have been cleared and grassed, and now sustain thriving dairying and cattle-raising industries. Potato-growing and agriculture are also practised.

The timber and sawmilling industry is being carried on to a large extent, though the valley itself is now almost depleted of timber, and operations are being continued further afield in the hills.

(6)—Relation of Mining to Topography.

(a) *Mining Operations.*

Owing to the fact that the alluvial tin deposits are buried under a large thickness of Tertiary sediments and basalt in the Ringarooma Valley, the topography is rather unfavourable for mining purposes.

In the Ruby Flat area, to the south-east of Branxholm, the topography is favourable for the exploitation of the primary and secondary tin deposits of that area.

(*b*) *Water-Supply and Power.*

The rainfall of the parts of the district from which water-supplies are drawn is probably at least 50 inches, which is moderately high, and one which should ensure a good water-supply. It is, however, a winter rainfall, and the rainfall during summer is comparatively low. This, combined with the fairly rapid run-off, makes the storage of water necessary to ensure a continuous supply throughout the year.

The youthful nature of the topography is favourable to the development of hydro-electric power, as the steep grade of the streams permits of suitable pressure heads being obtained.

V.—GEOLOGY.

(1)—INTRODUCTION.

(a) *Summary.*

The oldest rocks occurring within the district are the slates and sandstones (Mathinna series) referred to the Cambro-Ordovician period. They are intruded on a large scale by granite of Devonian age, which is a portion of the batholith of North-Eastern Tasmania. Diabase of Upper Mesozoic age occurs intrusive into the above rocks.

Gravels, grits, sands, and clays of Tertiary age overlie the above along the valley of the Ringarooma River. These are, in turn, overlain by flows of Tertiary basalt.

River alluvium of Pleistocene to Recent age has been formed along the courses of the streams.

(b) *Geological Map.*

A geological sketch-map of the district is shown on Plate I. On it are marked the geographical and topographical features, and, in addition, contours at 100-feet intervals.

The geological formations which outcrop at the surface, and the boundaries thereof, are indicated.

(2)—THE SEDIMENTARY ROCKS.

(a) *The Cambro-Ordovician System.*

The rocks of this system consist of slates, sandstones, and quartzites. The slates, where exposed on the surface, are light buff-coloured varieties, but those from mine workings are much darker. They are thinly laminated, but cleavage-planes, unless coincident with the bedding, are not prominent.

Light-coloured sandstones outcrop at the surface, but at depth they appear to be represented by darker-coloured quartzites and sandstones. The light colour of the slates and sandstones, and the alteration of quartzites to sandstones, are due to superficial weathering.

These rocks occupy a relatively small part of the surface, but they form the bedrock of the whole of the Ringarooma Valley between Maurice and Derby, and portion as far as

Winnaleah. They form an irregular tract of country, with a general north-westerly trend, which is bounded to the west, north-east, and east by granite. This tract attains its greatest width in the north, where it is about 9 miles wide across the strike of the rocks. Near Ringarooma it is narrower, and only 4 to 5 miles wide.

The areas in which these rocks occur are covered with soil, and so strikes and dips can only be recorded in artificial exposures, such as road and railway cuttings, &c.

The general strike is from north-north-west to south-south-east, but in one area it is east of north. The strata are folded into a series of anticlines and synclines, and dip at all angles up to 75 degrees. Between the cutting at the western end of Mara and the Telita station two anticlines, with intervening synclines, occur. There is also a faulted area in this section in which the strike of the beds is east of north, and the dip to the west. Other folds undoubtedly occur in other parts of the district, but cannot be detected.

These strata have therefore been intensely folded and faulted. No detailed section of the whole thickness of them could be obtained, but the total thickness must be considerable.

No fossils have been found in this series of rocks anywhere in the north-eastern part of Tasmania, so that their age cannot be definitely determined, and they are referred to the Cambro-Ordovician system. The same belt extends southwards to the Alberton and Mathinna goldfields, and is found in other localities in the north-east of Tasmania, and is referred to as the Mathinna slates and sandstones. The similar strata of the Balfour and the Bischoff slates and sandstones in North-Western Tasmania are correlated with this series. Lithologically and structurally it is very similar to the Ordovician system in Victoria, but no graptolites have yet been found in it.

(*b*) *The Tertiary System.*

The rocks of this system consist of conglomerates, gravels, grits, sands, and clays. The conglomerates and coarse gravels form the basal members, and are composed of boulders of granite, quartz, and metamorphosed sandstones in a finer matrix. The finer gravels consist of water-worn pebbles of white opaque reef quartz, and also of glassy quartz, such as that derived from granite. The grits form the greater portion of this system, and are composed of angular and partly-rounded pieces of glassy quartz, between $\frac{1}{8}$-inch and $\frac{1}{4}$-inch in diameter. These pieces of quartz have been derived from the disintegration of granite, and were deposited without undergoing any considerable amount of rounding by water action. Strangely enough, the other products of weathered granite, viz., mica and decomposed felspar, have been almost totally separated from the quartz. Beds of very stiff clay occur erratically within the system. The clays and sands are sometimes stained black, due to the presence of carbonaceous matter derived from wood and vegetation.

These rocks are horizontally bedded, except where local current-bedding is evident. Their thickness varies according to the position they occupy in the Ringarooma Valley. They are thickest at the north-eastern extremity of the district, and gradually decrease in thickness, until between Ringarooma and Maurice they peter out. This variation is due to the gradual filling-up of the ancient Ringarooma Valley, with its bottom sloping to the north-east, by horizontally-bedded sediments. The thickness also varies across the valley, being naturally greater in the portion where the ancient river flowed.

The lowest point in which the base of the Tertiary beds is exposed is in the Pioneer Mine workings, where the bedrock is about 200 feet above sea-level. To the north and west of Herrick the upper beds are overlain by basalt at altitudes of 650 feet above the sea. The total thickness is therefore at least 450 feet, and allowing for the slope of the Winifred lead into the Ringarooma lead, it must total at least 500 feet. At the Briseis Mine, on the Cascade lead, a thickness of 310 feet of Tertiary sediments is exposed, and at the junction of this lead with the Ringarooma lead the thickness must be between 350 and 400 feet. Further to the south-west the thickness cannot be measured or estimated, but it gradually decreases in that direction.

The system consists of the rock-types described above. The basal members consist of coarse conglomerates and gravels, which pass upwards into finer gravels or grits. The grits form the greater part of the system, and contain interbedded gravels and clays. The clays and the carbonaceous material are confined to the bottom part of the system, and are exposed only in mine workings such as the Briseis, Echo, Moorina, and Pioneer. A complete and detailed section is unobtainable, except at the Briseis Mine, from which the following general section was taken:—

Depth.	Thickness.	Strata.	
ft. 0	ft 0		
118	118	Hard, dense, fine-grained olivine basalt with large masses of olivine. Slightly vesicular at upper surface. Columnar and ball-and-socket jointing.	
120	2	Quartz grits and sands.	
160	40	Basalt completely decomposed, with exception or a few kernals in areas of spheroidal jointing and weathering. Highly vesicular at upper surface.	
190	30	Basalt completely decomposed, with exception of a few kernals in areas of spheroidal jointing and weathering. Highly vesicular at top.	
215	25	Quartz grits and gravels.	
240	25	Clay (pug) with quartz grit, and interbedded quartz grits and gravels.	
250	10	Gravels.	
260	10	Quartz grits, gravels, and clayey beds.	
270	10	Sands and quartz grits.	
275	5	Clay (pug) with quartz grit.	
285	10	Quartz gravels with pebbles up to ½-inch diameter.	
300	15	Clay with quartz grit.	
355	55	Strata not exposed. Probably quartz grits, gravels and clays as above.	
355	...	Present river-level.	
375	20	Quartz grits.	
415	40	Quartz grits, sands, and gravels.	
415	...	Black colouration, due to carbonaceous material, appears.	
425	10	Thinly-bedded sands with pieces of lignitised wood. Interbedded layer of quartz grits and coarse gravels.	
445	20	Sands with occasional pieces of lignitised wood.	
455	10	Sands and grits.	To north-east of section a 20-foot bed of clay occurs at this depth.
465	10	Grits and coarse gravels with pebbles up to 6-inch diameter. Rocks cemented with iron pyrite. Lead water issuing from gravels.	
475	10	Sands and grits cemented with iron pyrite, and containing numerous pieces of lignitised wood.	
495	20	White tenacious clay (pug).	
500	5	Basal beds of large boulders, white clay (pug), &c.	
		Decomposed granite.	

These Tertiary beds are found throughout the Ringarooma Valley, from Ringarooma in the south-west to Pioneer and the west end of Mt. Cameron in the north-east, and further north than the latter. They are thinnest near Ringarooma, but cover a fairly wide area. At Branxholm the width is less than $\frac{3}{4}$-mile, and near the Briseis Central Mine it is only $\frac{1}{2}$-mile. To the north-east of Derby it increases to $1\frac{1}{2}$ mile, and even greater, but it decreases again at the west end of Mt. Cameron. Further north they probably connect with other Tertiary beds, which extend more or less continuously along the northern coast. To the north of Herrick, near the western end of Mt. Cameron, the sediments are different in nature, and consist of fine sands and grits, which are abundantly stained and cemented by oxides of iron.

The only organic remains found in these sediments consist of pieces of wood and fossil fruits. The wood is very abundant at some localities, and occurs as pieces up to several feet in length. Several specimens of fruit have been obtained, but no leaves have yet been reported. These fossils have not been examined and described, so that no precise age-determination is possible, but generally they indicate a Tertiary age.

The field relations do not yield evidence for a precise age determination. The strata overlie Cambro-Ordovician slates and sandstones and Devonian granite, and are themselves overlain by basalt regarded as being of Tertiary age. In correlation with other districts in Tasmania, *e.g.*, Launceston Tertiary Basin, Sassafras, Waratah, Macquarie Harbour, and Derwent Valley, where similar unconsolidated fresh-water sediments are overlain by basalt, the sediments are regarded as of Lower Tertiary age, and the basalt as closing this period.

(*c*) *Pleistocene to Recent.*

Since the flows of Tertiary basaltic lava were poured out, the streams of the Ringarooma Valley have been busily engaged in cutting down their course to a depth somewhere near their original level. This process is not complete, but is now proceeding at a much slower rate than formerly, and since Pleistocene or Recent times deposits of alluvium, &c., have been accumulated at various points along the courses of the streams. These deposits consist mainly of river alluvium. Mine workings have revealed, however, that several feet of the upper layers consist of "shingle." This material is composed of flat pebbles up to 6 inches in diameter. The pebbles consist of Cambro-Ordovician rock types (sandstone, quartzite, and metamorphic types), and are water-worn and rounded at the edges. Similar alluvium, river gravels, and shingle have also been formed along the tributary streams of the Ringarooma River.

(3)—The Igneous Rocks.

(*a*) *Devonian.*

Granite outcrops over a large part of North-Eastern Tasmania, and is remarkably uniform in appearance and mineralogical composition. The typical granite is a coarse-grained holocrystalline rock, with numerous large porphyritic crystals of felspar, and consists essentially of quartz, felspar, and mica. The quartz is of the usual clear, glassy variety common in granitic rocks. It is very uniform in size (up to half an inch diameter), and only occasionally larger, and porphyritic in appearance. The felspar is a white variety showing multiple twinning, and represents one or more members of the plagioclase series. It occurs as large phenocrysts up to 3 inches in length, and also as smaller crystals in the remainder of the rock. Biotite is the usual mica present, and muscovite occurs only to a very small extent. The biotite was the first mineral to crystallise, and numerous small flakes are contained in the porphyritic felspars.

The rock is generally termed granite, but it is probably a granodiorite (excess plagioclase over orthoclase). Petrologically it is very similar to the Devonian granodiorites of Victoria.

In the Ringarooma Valley this rock occurs at the surface as two isolated bodies, one in the west of the district, and the other in the eastern part. The western body extends both to the north and south, and forms such prominent features as Ben Nevis, Mt. Maurice, Billycock Tier, Mt. Stronach, &c. The eastern body forms the elevated country around Weldborough and the Blue Tier, and extends further easterly to the coast. To the north it forms the Mt. Cameron Range and a large portion of the surrounding country, although it is covered by Tertiary and later deposits.

Though separated at the surface, these two bodies undoubtedly unite at depth, and with adjacent outcrops of granite form the batholith of North-Eastern Tasmania.

The age of the granite cannot be precisely fixed within the district. It is intrusive into, and therefore younger than, the Cambro-Ordovician rocks. It is overlain by Lower Tertiary sediments, and is therefore older than these. In other parts of Tasmania granite intrudes Silurian rocks, and is overlain by Permo-Carboniferous rocks, and it is therefore regarded as being of Devonian age. In accordance with this evidence the granite of the north-east is also regarded as Devonian.

In the vicinity of greisen and other forms of tin lodes, the normal granite is generally absent, and an even-grained muscovite or muscovite-biotite granite occurs. Tourmaline is also present in the granite, but while some of it may have been formed at the time of consolidation of the granite magma, most, if not all, appears to have been introduced during the period of mineralisation which accompanied the final phase of the consolidation.

In the district to the south-east of Branxholm the granite is overlain at many places by small areas of the Cambro-Ordovician rocks. The junction of these rocks represents the upper surface of the granite batholith, which is therefore intact at these places, and has suffered little denudation in adjacent areas.

(*b*) *Upper Mesozoic.*

Diabase of this age occurs in the south-western portion of the district. It is a medium to coarse-grained rock similar in every respect to that found in many parts of Tasmania, and consisting of plagioclase felspar and augite. It has been described so often that repetition here is unnecessary.

The rock occurs as an elongated dyke-like body about half a mile wide, and with a trend from north-west to south-east. To the north-west its extension is covered by Tertiary basalt, and it was not followed any great distance to the south-east. On its western extremity the rock is intrusive into Devonian granite, and on its eastern side it intrudes Cambro-Ordovician rocks. The diabase intrusion therefore took place along the junction of the granite and the Cambro-Ordovician slates.

The field evidence in this area proves the diabase to be post-Cambro-Ordovician and pre-Tertiary. At Mt. Victoria, to the south-east, it is intrusive into Permo-Carboniferous rocks. In other parts of Tasmania it also intrudes the Trias-Jura rocks. Its age is therefore post-Trias-Jura and pre-Tertiary, and it is generally referred to as Upper Mesozoic.

Numerous boulders of diabase occur along the south-western slopes of Bullman Bluff, but the rock cannot be found *in sitû*. These boulders are found in the country occupied by the Cambro-Ordovician rocks, and a short distance below the basalt capping of the hill. They are undoubtedly shed from a dyke which intrudes the Cambro-Ordovician rocks.

(c) *Tertiary.*

Basaltic lava flows filled the valley of the Ringarooma River, and completely covered the Tertiary sediments therein. Later denudation has removed portion of the basalt, but the rock at present occurs continuously from Maurice to the north of Herrick.

The rock is generally of the one type, but slight differences are discernible throughout the district. These are due mainly to the fact that several flows occurred, but variation is also present in the same flow.

The usual type is a dense, fine-grained, slightly vesicular basalt in which individual crystals cannot be detected in hand-specimens. Large patches of greenish-coloured olivine occur, but they weather so rapidly that their former presence can only be detected by the holes and depressions in the rock from which they have weathered out. Smaller areas of olivine are also present, and the rock is undoubtedly a basic olivine basalt, consisting probably of the essential minerals, felspar, augite, and olivine. The rock is amygdaloidal at some localities, but the amygdules are generally very small and cannot be satisfactory determined.

A sample of the material from one of the larger amygdules was analysed in the Mines Department laboratory, with the following results:—

Constituent.	Per Cent.
Silica (SiO_2)	40·4
Ferric Oxide (Fe_2O_3)	1·43
Alumina (Al_2O_3)	31·87
Lime (CaO)	5·75
Magnesia (MgO)	1·08
Ignition Loss at 250° C	17·00
TOTAL	97·53

The mineral therefore appears to be a hydrated calcium aluminium silicate analogous to a zeolite. On comparing the analyses and the formula calculated therefrom with known species it is found that the mineral contains an excess of alumina, as shown by the calculated formula—

$$(Ca\ Mg\ Na_2)O\ \ 2Al_2O_3\ \ 4SiO_2\ \ 5H_2O.$$

The basalt weathers very rapidly, and some flows are almost completely decomposed, while others remain quite fresh and hard.

Numerous flows are undoubtedly represented in the district, but it is difficult to detect different flows unless suitable exposures occur. Between Branxholm and Ringarooma only one flow appears to be present, but it is possible that at least two are represented between Legerwood and Ringarooma. South of Ringarooma the basalt rises to much greater altitudes, and is several hundred feet thick, which thickness may be made up of several flows.

To the north-east of Branxholm the different flows are more readily detected. At the Briseis Mine three flows are exposed in the workings. The bottom flow is 30 feet thick and slightly vesicular at the top, and is almost completely decomposed. The few unaltered portions consist of a fine-grained olivine basalt, similar to the usual type occurring within the district. The middle flow is 40 feet thick, and rests directly on the bottom one, and is almost completely decomposed in a similar manner. The unaltered kernals remaining are fine-grained, but somewhat coarser than the lower flow. Olivine occurs sparingly, and the rock appears less basic and more felspathic than the average type. The middle flow is slightly vesicular at the top, and a layer of grits, from a few inches to several feet thick, separates it from the upper flow. The upper flow is a dense, fine-grained, basic type, with abundant olivine, and slightly amygdaloidal in places. It is extremely resistant to the weather at certain localities, and forms a very rocky surface. This flow flooded the valley beyond the limits of the Tertiary sediments, and at its margin rests on the "rim-rock" of granite or slates and sandstones. It is at least 120 feet thick at its thickest part, and extends from Derby to the north-east as far as the basalt extends in that direction. The underlying flows are exposed along the railway between Herrick and Winnaleah, and are separated from the upper flow by several feet of grits.

A rather uncommon type of basalt forms the bottom flow over the Main Creek lead. It is an extremely coarse-grained type, individual crystals varying in length up to $\frac{3}{4}$-inch. The rock is largely composed of felspar, and olivine is absent. This coarse-grained type is present only in the Main Creek lead. If it has any connection with any of the other flows, it is probably with the middle flow of the Briseis Mine.

The source or sources of the flows have not been located, and they are probably still covered by the existing basalt. From the elevation of the basalt to the south of Ringarooma, and around Maurice, it is evident that part, at least, of the basaltic lava originated in this locality and flowed down the valley of the old Ringarooma River. The extreme southern edge of the basalt was not examined, and it is possible that the source may be readily located. In addition to this source it is also probable that others existed in the vicinity of Derby, and gave rise to the upper and possibly middle flows, and also to the coarse basalt of the Main Creek lead. Bullman's Bluff, or Gray's Hill, has been described as an extinct crater, but represents merely a surface flow at a much higher level (1800 feet above the sea) than those in the Ringarooma Valley.

Narrow dykes of completely decomposed igneous material occur in the granite country to the south-east of Branxholm. Many of these appear to represent decomposed basic rock-types, similar to basalt. Pieces of relatively unaltered basalt occur near some of these dykes, though none were found *in sitû*. It is probable, therefore, that some of the dykes were of basalt.

The basalt and underlying Tertiary rocks containing wood and plant remains are to be correlated with similar occurrences throughout Tasmania. The leaf-beds are referred to as Lower Tertiary, and the basalt is regarded as closing this period. The basalt of the Ringarooma Valley is therefore regarded as closing the period of Lower Tertiary sedimentation.

(4)—The Metamorphic Rocks.

Contact-metamorphic rocks are the only ones which occur within the district, and of these those which have been formed by the granitic intrusions are the only ones of any extent. The Cambro-Ordovician slates and sandstones have been altered for some distance from their contact with the granite. The alteration is, of course, greatest at the contact, but the actual contact is seldom exposed. In the deep railway cutting at the summit of the railway, between Legerwood and Tulendeena, a good section is exposed, although the rocks are largely weathered and decomposed. Adjacent to the granite the sedimentary rocks (sandstones) have recrystallised and formed a fine-grained rock containing contact metamorphic minerals, which have, however, been decomposed by weathering. Outside this zone of recrystallisation the effect is less, and the rocks have been altered to hornfels, quartzites, hardened sandstones, &c., until finally the normal types occur. The quartzites and indurated sandstones are the common types, and occur at Legerwood, Branxholm, and Derby.

The diabase has had little or no effect on the intruded rocks, and the action of the basalt on the underlying Tertiary sediments is negligible.

(5)—Structural Geology.

(a) *General.*

The structure of the district is comparatively simple. The Cambro-Ordovician rocks have been folded into a series of anticlines and synclines, and also largely faulted. These were intruded by a portion of a large granitic batholith. Diabase intrusions penetrated the above on a small scale. The above rocks were subjected to a long period of denudation, during which the river system of the ancient Ringarooma River was evolved. The valley of the main stream, and portion of its tributaries, were filled with Tertiary sediments to a thickness of 500 feet, which were in turn covered by flows of basalt up to 200 feet thick.

(b) *Folding.*

The Cambro-Ordovician sediments have been the only ones subjected to earth-movements, causing folding of the strata. These rocks have been folded into a number of steeply-dipping anticlines and synclines. The general strike is from north-north-west to south-south-east.

(c) *Faulting.*

Only a small amount of faulting could be detected in the district, and this occurred within the Cambro-Ordovician strata. It is probable that these rocks are largely affected by faults, the majority of which cannot be detected through lack of exposures. This faulting would be caused by the Devonian and any previous periods of diastrophism.

Faulting may also have occurred during the diabase intrusions, and at or near the close of the Tertiary sedimentation, but could not be detected.

(*d*) *Igneous Intrusions.*

The granite occurs as two separate intrusions into the Cambro-Ordovician rocks. These form parts of the batholith of the north-eastern districts of Tasmania, and at depth are undoubtedly connected with the main body of the latter, which underlies the district.

Only a small area of diabase is present, and this occurs as a large dyke-like body.

The Tertiary basalt occurs in the form of comparatively thin surface flows.

(6)—Geological History.

The geological history of the district is of great importance in connection with the alluvial tin deposits, and will therefore be considered in detail.

(1) *Cambro-Ordovician Sedimentation.*—The history of the district, as represented by the rocks at the surface, begins with the period of Cambro-Ordovician sedimentation. The rocks upon which these were laid down are nowhere exposed. Layers of clay and sand were formed during this period, probably under conditions of moderate depths.

(2) *Period or Periods of Diastrophism.*—At one or more periods after the deposition of the above sediments, intense earth-movements affected the rocks. The strata were folded into a series of anticlines and synclines, and also faulted. It is probable that the most important of these periods was that at the close of the Silurian sedimentation, and connected with the intrusions of Devonian granite.

(3) *Devonian Igneous Intrusions.*—Accompanying the diastrophism at the close of the Silurian period there occurred large intrusions of igneous magma throughout Tasmania. In the north-eastern district these intrusions were of granite magma, and the consolidation thereof resulted in the formation of the granite.

(4) *Period of Ore-Deposition.*—The closing stages of the consolidation of the granite magma, and the passage therefrom of vapours and solutions, resulted in the formation of the tin, gold, and other lodes of the north-eastern districts. The tin lodes were formed more particularly in the granite, and the gold ones in the intruded slates and sandstones.

(5) *Period of Denudation.*—From the close of the Silurian period until the commencement of the Permo-Carboniferous the district remained a land surface. Continued denudation throughout this period resulted in the formation of an extensive peneplain, probably throughout Tasmania.

(6) *Permo-Carboniferous Sedimentation.*—Although no Permo-Carboniferous strata are present in the district, they are known to occur to the north and south thereof, and undoubtedly covered part at least of the district. This Permo-Carboniferous sedimentation occurred on the peneplaned surface of the Cambro-Ordovician rocks and the granite.

(7) *Trias-Jura Sedimentation.*—Although no Trias-Jura rocks are present, it is possible that sedimentation occurred during this period, and that the sediments were laid down over part at least of the Permo-Carboniferous rocks.

(8) *Period of Denudation.*—After the close of the Permo-Carboniferous and Trias-Jura sedimentation, if either or both occurred, the district became a land surface, and a long period of denudation began. The Trias-Jura (if present) and the Permo-Carboniferous rocks were entirely removed, and the streams of a river system practically identical with that at the present time began to corrode their courses in the underlying granite, slates, and sandstones.

This denudation and stream-development continued until Lower Tertiary time, when the then Ringarooma River had a somewhat similar course to that of the present one as far as Branxholm and Derby, but then flowed more to the north, and continued its course to the west of the west end of the Mt. Cameron Range.

(9) *A Period of Relative Depression of the Land and Lower Tertiary Sedimentation.*—A relative depression of the land then commenced, either due to slow subsidence of the land or rise of the level of the ocean's surface. This appears to have been a slow process, and resulted in the damming up of the waters of the Ringarooma River. Sediments were deposited in the resulting lake, or fresh-water estuary, the material (sand, grit, &c.) being supplied by the main stream and its adjacent tributaries.

These processes continued until the sediments accumulated as far upstream as a point between Ringarooma and Maurice, and a thickness of at least 550 feet accumulated to the north of Herrick.

(10) *Extrusions of Basaltic Lava.*—The Lower Tertiary sedimentation was closed by flows of basaltic lava originating from several sources within the Ringarooma Valley. In some instances there were small intervals of time between successive flows, and small thicknesses of Tertiary sediments were deposited.

(11) *Relative Elevation of the Land.*—Contemporaneously with, or immediately succeeding, the basaltic lava flows, the land was elevated relatively to the sea by an amount not quite equal to that by which it was depressed during the Lower Tertiary sedimentation.

(12) *Period of Denudation and Development of the Present River System.*—The basalt flows had not completely filled the old Ringarooma Valley, and so the drainage system was able to re-establish itself in its former valley. The Ringarooma River developed a meandering course across the basalt between Ringarooma and Derby, but from Main Creek to the north-east it kept to the south-eastern edge of the basalt, and corroded a course in the granite. This course forced the Ringarooma River past the eastern end of the Mt. Cameron Range, and into a new channel, instead of its former one past the western end of Mt. Cameron.

The development of the Ringarooma River in its new course, of the lower portions of former tributaries, and of new tributaries, has proceeded in connection with the present cycle of denudation. The present Ringarooma River has nowhere cut down its course to the level of the older one.

During this period river gravels and alluvium have been deposited at certain localities along the course of the streams.

VI.—ECONOMIC GEOLOGY.

(1)—Introduction.

The most important deposits of metallic minerals in the north-eastern part of Tasmania are those of tin and gold, particularly the former. The tin ore is found in association with the large areas of granite, and occurs both as primary and alluvial deposits. It is particularly abundant within the district, and to the south-east, south, and east thereof in the vicinity of Ruby Flat, Weldborough, Blue Tier, and Mt. Cameron.

The gold lodes are associated with the Cambro-Ordovician slates and sandstones. The most important field is that of Mt. Victoria to the south, but others, such as Warrentinna and Forester, are situated to the north of the district.

Gemstones, such as topaz and sapphires, are found occasionally in the alluvial tin deposits.

Recently attention has been directed to deposits of arsenopyrite on the southern flanks of Mt. Horror, but they have not yet been proved of economic importance.

The deposits that will be described in this bulletin are the alluvial tin ores within the district examined.

(2)—Secondary Tin Deposits.

Secondary tin deposits of various ages from Tertiary to Recent have been formed within the district. The Recent ones occurred along the courses of the present streams, but were narrow and shallow and of no great length, and have been more or less exhausted. Others, *e.g.*, South Mt. Cameron, are more ancient than Recent.

Within the district examined those of Lower Tertiary age formed the special object of part of this investigation.

(*a*) *Lower Tertiary Alluvial Deposits.*

(i) *Nature of the Deposits.*—The Lower Tertiary alluvial deposits consist of conglomerates, gravels, grits, and sands containing cassiterite. The boulders in the conglomerates are chiefly of granite and white opaque quartz. The gravels, grits, and sands consist almost entirely of glassy quartz from decomposed granite, and a subordinate amount of white opaque quartz. The cassiterite is distributed throughout the " drifts " in the form of small pieces of the black variety. The distribution is not uniform, and concentration occurs at particular layers, one of the principal being the basal ones.

(ii) *Distribution.*—The Lower Tertiary sediments occupy a considerable area of the Ringarooma Valley, although they are generally covered by basalt, and outcrop at only a few points. The same general conditions prevailed with regard to the deposition of the sediments throughout the district, but this does not also apply to the cassiterite contained in the sediments. All the mines which have been operating on these deposits are situated on the south and south-east sides of the Ringarooma Valley. Further, as can be seen from the geological plan (Plate I.), the mines are situated on tributary "leads" entering the Ringarooma "lead" from the south or south-east. The Arba has worked the Branxholm Creek, or Arba, lead; the Briseis Extended (now the Briseis Central, and originally the Ringarooma Valley), the Valley Creek lead; the Briseis, Krushka Brothers' Home; New Brothers' Home, North Brothers' Home and Triangle mines on the Cascade lead; the Mutual and Sarah Ann and others, on the Main Creek lead; the Echo on the Weld River lead; the Moorina on the O.K. Creek lead; the South Pioneer probably on the Gladstone Creek lead; and the Pioneer on the Winiford River lead.

The workings of these mines have followed the leads downstream towards the Ringarooma lead, but none has yet reached the junction with the latter.

(iii) *Origin of the Deposits.*—The origin of the deposits has already been pictured in the descriptions above. At the commencement of the Lower Tertiary era a river system was developed consisting of a Ringarooma River and tributaries not much different from the present ones. Conglomerates and gravels were formed at some localities along these streams. When the Lower Tertiary subsidence occurred, the process of formation of the series of deposits now existing began. The greater portion of the material which went to form these deposits was contributed by the main stream and its tributaries from the south and south-east. At the same time as this material was brought along, the cassiterite was also washed into it. This process continued until the close of the sedimentation, but the amount of cassiterite enclosed was less in the upper beds of the series.

(iv) *The Cassiterite and Associated Minerals.*—The cassiterite is generally of the dark-black variety, and is present in small pieces not exceeding, as a rule, one-sixteenth of an inch in diameter. The small size is due to the distance the tin ore has had to travel, and this travelling has also undoubtedly influenced by physical means the production of the black colour.

Other minerals obtained along with the cassiterite, when concentrated from the drifts and dressed, are tourmaline, pyrite, pleonaste, monazite, topaz, corundum (including corundum, emery, and sapphire), and zircon. The pleonaste ("black jack") is the dark-black variety of spinel, and occurs in much larger pieces than the cassiterite. It is always very much water-worn and rounded, but partly rounded crystals of characteristic shape are common. The pyrite and tourmaline are found in the usual form of these minerals. The monazite is not very plentiful, but is fairly common in the Pioneer Mine. Topaz occurs only sparingly within the district, but is common in adjacent portions, such as Mt. Cameron and Weldborough. Zircon is well distributed, and varieties ranging in colour from nearly colourless, through yellow and brown (jargoon), to red (hyacinth) are present. It occurs in small rounded pieces generally not exceeding $\frac{1}{8}$-inch in diameter.

Common corundum is well distributed in small quantities throughout the district, but the sapphire is less common, and stones of value are rare.

These associated minerals are such that their origin is either the granite, or pegmatite, or gresien veins in the granite. Some of the zircon and pleonaste in the post-Tertiary deposits may have been derived from the basalt.

(v) *Source of the Cassiterite.*—A large amount of evidence exists upon this question, and there is little doubt that the granite is the source from which the cassiterite was derived. The tin-bearing drifts upon which the mines have operated occur along tributary leads, entering the Ringarooma lead from the south and south-east. The present and the older streams which formed these leads flowed over granite for nearly the whole of their lengths, so that the tin ore must have been obtained from this rock In addition, the minerals in association with the cassiterite are generally found to be of granitic origin. Further, the material, particularly the quartz grit and sand forming the drifts, has been derived principally from the decomposed granite.

That the tin ore actually does occur in the granite has already been proved at the Ruby Flat area, where it occurs in greisen veins and altered granite.

On the Blue Tier, near Lottah, cassiterite occurs in pegmatities, greisen veins, and to a large extent in zones of altered granite. At other localities on the Blue Tier and around Weldborough narrow and erratic tin-bearing greisen veins exist in the granite.

It is evident, therefore, that tin ore occurs in the granite in formations of several kinds. By disintegration of the granite it would be liberated and washed into existing streams, and pass eventually into the Lower Tertiary sediments.

(*b*) *Tertiary to Recent Alluvial and Detrital Deposits.*

Secondary deposits of tin ore have been found in various forms on practically the whole of the country to the south and south-east of the Ringarooma Valley. The most common type is the alluvial and gravel deposits along the courses of existirg streams, which have been in process of formation since Tertiary or Pleistocene time and up till the present. Another type is that formed by the detrital material which has accumulated on the sides of the valleys and hills. If tin-bearing formations occur in these localities the detritus is often sufficiently payable to work.

VII.—THE MINING PROPERTIES.

In describing the mines of the district, those operating on the deep leads will be described first. Each lead will be taken in turn, going from Branxholm (west) to Pioneer (east), and the mines on it described and the future prospects of the lead discussed.

It will be useful to give definitions of some of the local terms used in connection with the mines on the deep leads before describing the mines themselves:—

"Lead": valley of an ancient stream filled up with the Lower Tertiary sediments.

"Drifts": this term is applied to the material (grits, sands, &c.) which filled the ancient valleys, or, in other words, the Lower Tertiary sediments.

"Pug": the stiff clay which occurs interbedded with the grits, &c.

"Wash": river gravels, such as occur at the base of the drifts, along present streams, &c.

"Shingle": the coarse gravels found along the courses of the present streams, and formed almost entirely of flat, rounded pebbles of Cambro-Ordovician rock-types.

"Gutter": The deepest portion of the lead representing the course of the stream before its valley began to be filled with sediments.

"Reef": the sides of the ancient valley. Also referred to as "high reef." The two sides may be distinguished as eastern and western reef, &c.

"Bottom": the floor of the lead or ancient valley. Same meaning as bedrock.

(1)—Mt. Joseph Mine.

This old abandoned mine is situated on private property on the west bank of the Ringarooma River, at the narrow bend half a mile to the south-west of Branxholm.

Sluicing appears to have been carried out, but repeated falls from the steep cliffs have covered the working places. The work was performed on the Lower Tertiary grits, &c., which here form the eastern portion of the Ringarooma lead. It is stated that a considerable amount of tin ore was obtained from the working, but that it was mixed with a large amount of an iron mineral (presumably pyrite), which could not be easily separated from the cassiterite. This is given as the reason for the cessation of operations.

(2)—The Branxholm Creek Lead.

(*a*) *The Arba Tin Mining Company No Liability.*

Location and Access.—The Arba Mine is situated immediately to the north-east of Branxholm. The leases held by the company are the consolidated lease, 8772-m, of 190 acres, and 8659-m, of 40 acres. The latest workings have progressed beyond the former lease, and are situated on private land (charted in the name of J. R. Scott, 320 acres) to the north.

The main-road to the north-eastern districts passes through the property, and connects it with Branxholm railway-station, distant about $1\frac{1}{4}$ mile threfrom.

Previous Reports.—

Thureau, G.: Stanniferous Deposits at Ringarooma, 1884.

Montgomery, A.: The Mineral Resources of Tasmania, 1894.

Twelvetrees, W. H.: Preliminary Report on the Deep Lead or Infra-basaltic Stanniferous Gravels of the Ringarooma Valley, near Derby, 1900.

History.—Tin ore was first discovered on the land now held by the Arba Company in 1876, the site of the discovery being along the Branxholm Creek, south of the main-road. This discovery was made at the head of the Branxholm Creek lead, and may have included Recent as well as Tertiary deposits. The deeper Tertiary ground to the north was not found until a year or so later. Little is known about the early workings, but some time prior to 1883 the ground was being worked by a proprietary company known as the Arba Tin Mining Company. Operations must have been carried out on a large scale, as it is recorded that 40 miners were employed in 1883. They must also have been successful at some periods, as a production of 51 tons of tin ore is recorded for three months in 1886. The drifts were getting deeper as work progressed, and more costly equipment would be necessary to treat it. This was apparently the reason for the formation of the Arba Tin Mining Company No Liability in 1888. In the same year the Ormuz Tin Mining Company No Liability was formed to work ground situated on private property to the west. Operations were carried on intermittently until 1898 or 1899, when the Ormuz and Arba companies were incorporated. An extensive scheme was planned, including provision of machinery, repairing of races, &c. This programme, together with much developmental work, was carried out during the period between 1899 and 1902, and a certain amount of ore obtained in the process. Operations began in earnest during 1902, and continued until 1920. In addition to the Tertiary drifts in the Arba, Ormuz, and private land to the north, the Recent sands and gravels along the Branxholm Creek were acquired in 1913 under mineral lease. Work was carried out on this easement lease from 1913 to 1920. From 1920 onwards the mine has been let on tribute, and at present one party is continuing the work on the easement lease, and another is treating portion of the tailings dump; while a third party is working virgin ground on the adjoining private property.

Geology.—The bedrock in the greater part of the workings is the Devonian granite. It is intrusive into Cambro-Ordovician rocks, the junction being a short distance to the west of the Branxholm Creek, at the township, and crossing the creek near the lower end of the easement lease. Tertiary grits, gravels, and sand occur to the east of Branxholm Creek, and rest upon the granite. Basalt overlies the drifts on the private property to the north of the Arba consolidated lease. Recent gravels occur along the Branxholm Creek through the easement lease.

The Ore-Deposit.—The deposit which has been worked on the Arba consolidated lease and the private property to the north-west consists of the Tertiary stanniferous drifts of the Branxholm Creek lead. This lead departs from the course of the present creek near the southern end of the consolidated lease, and runs in a general north-north-easterly direction through this lease. It continues under the basalt forming the hill on the private property to the north-west, and then through the eastern portion of Lease 9247-M to junction with the Ringarooma lead near the present river.

At the north-eastern end of the workings a small tributary lead, formed by the ancestor of the small unnamed creek between Branxholm and Black creeks, should have entered the Branxholm Creek lead. The shape of the workings indicates that the lower part of this tributary lead was worked. Further north the Black Creek lead should have crossed the northern portion (now surrendered) of consolidated lease No. 8772. The drifts have, however, been denuded, except at the western end of this lead. Of these Tertiary deposits on the Arba mineral leases actually remaining intact, the only portion is that of the unnamed tributary lead.

The deposit in the easement lease is of Pleistocene to Recent age. The part of it to the north of the present lease (8659-M) has been partly worked out. In this northern portion it rested on Lower Tertiary drifts of the Ringarooma lead. In the present workings at the northern end of the lease the bedrock is metamorphosed Cambro-Ordovician rocks, and in a short distance the junction with the granite will be reached, and the latter will then become the bedrock. The deposit remaining does not exceed 5 chains in width, and (with overlying tailings) does not exceed 15 feet in depth. It will extend along the greater length of the lease, but does not represent a large amount of ground.

Production.—Complete records of the amount of tin ore produced from the Arba properties prior to 1903 do not exist. Incomplete records to June, 1903, show a total of 193·15 tons, and it is probable that the total amount to that date exceeds 500 tons. From June, 1903, until the end of 1920, 3,260,851 cubic yards of drifts were treated, for 1361·7 tons of tin ore. These figures refer to the Tertiary drifts, and do not include any records of the Ormuz workings between 1888 and 1898.

From the Recent deposits on the easement lease along the Branxholm Creek 562,859 cubic yards were treated, for 274·3 tons of tin ore between June, 1913, and the end of 1919. Since 1919 the mine has been let on a tribute, and up till the end of 1923 the production has been 96·75 tons of metallic tin, or 138·2 tons of oxide.

The recorded production is therefore 1967·35 tons of tin ore.

Methods of Working.—In the early days ground sluicing was probably the method used to treat the shallow ground, and was augmented later by hydraulic sluicing with nozzles, &c. From the commencement of the extensive operations in 1902 machinery and more powerful plants were used. The drifts and overburden were broken down by hydraulic sluicing with nozzles, &c. The broken material was raised from the bottom of the workings by hydraulic elevators and gravel-pumps, and deposited in bins. It was then elevated in large skips up an inclined tramway by the usual method of winding-ropes, pulleys on poppet-legs, and winding-engine. Wood was the fuel used for generating steam in the power plant. Tailings were dumped behind and to the east of the workings, and also down the valley of Black Creek.

The material in the easement lease was at first worked by a pumping plant on a dredge. The plant contained a gravel and nozzle pump operated by electric motors supplied with power from the main Arba plant. Later hydraulic sluicing was resorted to, and the material elevated by hydraulic elevator in overhead sluice-boxes.

Quantity and Value of the Ground.—Practically all the Tertiary drifts have been removed from the Arba leases, with the exception of small lengths of the unnamed tributary lead and the Black Creek lead. A short length of the former—perhaps 5 to 10 chains—may exist to the east of the main workings. The quantity of drift would be small, and the quality either similar or less than that on the main workings (about 1 lb. per cubic yard). A similar length of the Black Creek lead should exist on the forfeited portion of Consolidated Lease 8772-M, and also on the tailings lease, 172-91W. The quantity of drift in it would be comparatively small, and the value, though it has not been tested, should be similar to that in the Branxholm Creek lead.

Water-Supply.—The Arba Company holds water-rights along the Dorset River and Black Creek amounting in all to 52 sluiceheads.

Future Prospects.—Practically all the drifts on the mineral leases held by the company have been worked out, and during the later years of operation the workings were for the most part on the private property to the north-west. The future of the company must therefore depend upon the continuation of the work from this point. A discussion of the prospects will be given below in describing this private property.

(*b*) *Private Property (P. W. Edwards).*

The Branxholm Creek lead passes from the Arba lease under the basalt-covered hill to the north-west, charted as part of the 320 acres in the name of J. R. Scott, and now owned by P. W. Edwards. The Ormuz Company worked portion of this ground, and later, by arrangement, the Arba Company continued its workings into this property.

This hill consists of a capping of basalt overlying Tertiary drifts of the Branxholm Creek lead, and the southern edge of the drifts of the Ringarooma lead. Granite forms the bedrock, except a small area in the north-west

The Branxholm Creek lead passes under this hill in a general north-north-easterly direction for about 30 chains, until it reaches Lease 9247-M. About midway along the eastern side of the hill it should receive the tributary lead of the Black Creek from the east.

The southern part of the Branxholm Creek lead was worked by the Arba Company on its own leases, and then followed into the above property. The following figures show the results of the later years of the Arba workings, and also the totals and averages over a period of 17½ years. The average content of the drifts over this period was 0·933 lb. per cubic yard. From 1909 onwards it was generally over 1 lb. per yard, except in 1917, 1918, and 1919, when large quantities of overburden were removed. Further, the lower 30 feet of drifts were not treated, owing, apparently, to the insufficient capacity of the plant. As the highest values of the drifts are generally in this portion, the average value of the drifts was considerably lowered by not treating these layers.

In 1920, however, the content of material treated rose to 1·34 lb. per cubic yard. Considering the figures as a whole, it would appear that the drifts in the face should average, approximately, 1 lb. per cubic yard, especially if the basalt and any upper layers of barren drift were treated as overburden and removed separately.

Year.	Quantity Treated.	Working Costs.	Tin Ore Won.	Contents per Cubic Yard.
	cub. yds.	d.	tons.	
1909	197,516	6·05	175·3	—
1910	221,311	7·59	95·5	0·966
1911	242,935	6·32	116 6	1·07
1912	—	—	101·7	—
1913	265,554	—	80·55	—
1914	182,425	6·72	85·51	1·05
1915	137,259	—	81·95	1·33
1916	223,627	7·38	102·6	1·02
1917	190,886	9·88	45·14	0 536
1918	136,690	12·66	40·4	0·63
1919	154,159	14·01	53·0	0·77
1920	91,190	18·84	54·75	1·34
From 30/6/03 to 31/12/20	3,260,851	6·91	1361·7	0·933

It is stated that the face of the workings was 167 feet high, and that the bottom of the workings was 30 feet above the bottom of the drifts, which would make the thickness of drifts and basalt 197 feet. There is a thickness of about 50 feet of basalt on the hill, so that the total depth of drifts is 147 feet. This should increase as the lead dips to the north, and a larger thickness would exist at the northern end of the property. The basalt represents non-stanniferous overburden, which has to be removed; but it is very much decomposed, and can be almost entirely removed by hydraulic sluicing.

Any future working of the deposits on this property would really represent the continuation of the Arba workings, and its success or otherwise would depend upon the tin content of the drifts and the method and cost of working them. By 1920 the cost of the Arba working had mounted to 18·84 pence per cubic yard. The drifts would have to average 1 lb. per yard, with tin at £250 per ton, in order to pay (without profits) for this cost of working. The future profitable working, therefore, depends upon reduction of working costs by methods other than those used by the Arba Company. The greatest economies would probably result from the obtaining, if possible, of sufficient supplies of water, with suitable pressure-heads for sluicing the deposits, elevating the material partly or wholly by hydraulic elevators, and generating electric power for use where required.

(c) *Leases* 9247-M *and* 9282-M.

These two leases—9247-M, of 79 acres, and 9282-M, of 38 acres—have been recently acquired by P. W. Edwards. They are situated on the flats of the Ringarooma River and Black Creek, to the north and north-east of the private property discussed above.

The Branxholm Creek, after receiving the Black Creek lead, should pass out of the northern boundary of the private property, and traverse the eastern portion of Lease No. 9247-M in a general northerly direction, to join the Ringarooma lead approximately below the present river. The length of lead thus occurring is about 30 chains.

It is impossible to give even an approximation of the value of the drifts, as they are too far downstream to compare them with the Arba workings, and they have not been bored or worked. The first essential step before attempting to work these drifts should be a boring campaign to ascertain their value. If the value should be sufficient to justify their treatment, the drifts are very favourably situated for this purpose. The overburden consists only of a shallow depth of tailings and Recent alluvium, with perhaps a few feet of "shingle," the basalt having been removed by denudation. This absence of basaltic overburden, as well as some of the upper layers of only slightly stanniferous drifts, would result in low working costs.

This property could be worked either separately or in conjunction with that of the private land to the south. In the latter case the total length of the Branxholm Creek lead available would be about 60 chains, together with a small portion of the Black Creek lead.

(3)—The Valley Creek Lead.

The Briseis Central Tin Mining Company No Liability.

Location and Access.—The Briseis Central Mine is situated on the south bank of the Ringarooma River, near the junction of Valley Creek, between Branxholm and Derby. The leases held by the company at this locality are: 8413-M, of 20 acres; 7891-M, of 25 acres; and 7760-M, of 10 acres. Two other leases—8237-M, of 5 acres, and 8226-M, of 5 acres—are also held at the head of the Cascade River, in the vicinity of the dam-site.

The main-road from Launceston to the North-East and East Coast districts passes through the property midway between Branxholm and Derby. The Launceston to Herrick railway passes immediately to the north of the mine, which is connected by road to Branxholm station (3 miles), Telita (3 miles), and Derby (3¼ miles).

Previous Reports.—No official reports contain descriptions of the mine, although it is mentioned in the following:—

Montgomery, A.: The Mineral Resources of Tasmania, 1894.

Twelvetrees, W. H.: Preliminary Report on the Deep Lead or Infra-basaltic Stanniferous Gravels of the Ringarooma Valley, near Derby, 1900.

History.—The discovery of tin ore at this locality was not made until several years after the majority of those on the North-East Coast, as the first lease was not applied for until 1882. The property was held by several lessees until taken over and worked by the Ringarooma Valley Tin Mining Company No Liability. This company was formed in 1885, and continued operations at intervals until 1892, and the mine became known as the Ringarooma Valley Mine. The method of working is stated to have been very inefficient, and only a small amount of ground was treated. In 1904 the Briseis Extended Tin Mines Company No Liability was formed to work the deposit, and continued operations until 1910. A more modern plant was used and more material treated, but the lower portions of the drifts were not treated in the deeper parts of the workings. The Briseis Central Tin Mining Company No Liability was formed in 1918, and holds the property at the present time. No actual mining operations have been performed by this company, but sufficient water-rights to economically treat the deposits have been obtained, a long length of the main race constructed, and preliminary steps taken to construct a large dam. In addition, a large amount of boring has been carried out to test the property.

Geology.—The main-road from Branxholm to Derby runs practically along the boundary of the granite to the south and the flats of the Ringarooma River to the north. The granite forms the hills which rise steeply to the south, and which are part of the elevated granitic country around Weldborough. The flats of the Ringarooma River consist of a shallow depth of Recent alluvium containing several feet of shingle. To the north of the river Tertiary basalt overlies Lower Tertiary tin-bearing drifts. These latter deposits extend below the alluvial flats of the Ringarooma River and rest on a bedrock of granite.

Ore-Deposit.—The tin-bearing deposit which has been worked on this property consists of Lower Tertiary stanniferous drifts. The south-eastern boundary is the main-road at the locality where the Valley Creek crosses the road. The deposit is 300 to 400 feet wide at the top, and trends to the north-west below the river flats. It is shallow at its south-eastern end, but deepens to over 100 feet to the north-west. These drifts have been referred to as being portion of the main lead (the Ringarooma) and also as a tributary (the Valley Creek lead) thereof. The geological structure, as seen on the surface and revealed by the mining and boring operations, proves the latter view to be the correct one. This lead should join the Ringarooma lead at a distance of approximately half a mile from its south-eastern extremity. The leases include a length of about 1750 feet of this lead, the remaining portion (about 690 feet) being situated under the river or on private property north of the river. The depth of the junction of the two leads should be approximately 200 feet below the present river-level.

Production.—It is generally stated that the Ringarooma Valley Company produced about 400 tons of tin ore, but, according to Montgomery in 1894 (about two years after work ceased), the production was 90·5 tons of tin ore.

The official statistics show the production of the Briseis Extended Company to be 428·7 tons, obtained during the years 1905 to 1909.

The total production has therefore been 519·2 tons of tin ore.

Value of the Drifts.—Approximate estimates of the content of cassiterite in the drifts can be arrived at by two methods. Firstly, there are the results obtained by past working; and, secondly, the results from the boring operations carried out. The first is necessarily very approximate, as the amount of ground treated is not definitely known. The old workings cover an area of 15 acres, and have a maximum depth of 50 feet, and the assumption of an average depth of 40 feet is rather high than otherwise. These figures give a total volume of 968,000 cubic yards. The total production from this amount has been 520 tons, so that the content of tin ore was 1·2 lb. per cubic yard.

Several boring campaigns have been undertaken in order to test the drifts, both in the old workings and to the north of them. The earliest of these was in 1900, and gave results up to 2·48 lb. per cubic yard, the average being much lower than this. The upper portion of the ground in which these bores were put down was treated by the Briseis Extended Company at a later date. In 1920 a further campaign gave results in the old workings ranging from a little tin to 1½ lb. per cubic yard, but the results were generally lower than those previously obtained. Another campaign was carried out by a different operator in 1921, the results of which are given below. Judging by the records, this campaign was very thorough and efficient as far as it went, and the results obtained are probably as reliable as boring results can be. The tin content is calculated on the total depth of ground, which includes virgin drifts and any overlying tailings in the old workings. The content for virgin drifts will therefore be appreciably higher than the figure given. The figures show a tin content from a little tin up to 1·5 lb. per cubic yard, the average of the total number being 0·7 lb. by volume panned off, and 0·6 lb. by tube displacement. Bores 19 to 23 were sited along the gutter; bores 14 to 18 were sited across the gutter, and represent a section of the lead; while bores 7 to 13 are in the centre of the gutter, and Nos. 1 to 6 in shallow ground, possibly tailings, at the head of the workings. The average value of the ground, as shown by the section in Nos. 14 to 18, is 0·65 lb. per cubic yard by volume panned off, and 0·5 lb. by tube displacement, which results are slightly lower than those quoted above.

These figures are lower than those deduced from the results of past workings. The past workings were carried out in the upper part of the drifts, and it is generally found that the tin ore is more concentrated in the lower than the upper part of a lead, so that it would be reasonable to expect the lower drifts to contain more than 1·2 lb. per cubic yard. That this fact is not reflected in the boring results does not necessarily mean that it is not the case. At the bottom of the drifts, boulders of granite, quartz, &c., occur, among which concentrations of tin ore are likely to exist, and boring under such conditions is not necessarily accurate.

From the above review it is seen that approximate calculations of the results of past workings show a tin-ore content of 1·2 lb. per cubic yard, while boring of remaining portions of the drift indicate a content of 0·5 lb. per cubic yard, though the latter might reasonably be anticipated to contain a higher content.

Bore.	Total Depth.	Depth of Water.	Depth of Ground Treated.	Volume Panned Off.	By Tube Displacement.	Tin Ore Obtained.	From Volumes.	From Tube Displacement.
	ft.	ft.	ft.	cub. ft.	cub. ft.	gr.	lbs./cu. yd.	lbs./cu. yd.
1	15	12	3	0·10	0·20	Trace	Trace	Trace
2	28	22	6½	0·40	0·40	2·0	A little tin	A little tin
3	20	14	6	0·30	0·40	2·5	A little tin	A little tin
4	33	26	7	0·40	0·50	3·0	A little tin	A little tin
5	28	22	2	0·10	0·10	3·0	A little tin	A little tin
6	35	22	13	0·30	0·90	17·5	·2	·1
7	65	32	33	1·10	2·20	20·5	A little tin	A little tin
8	71	42	29	1·31	1·67	242·5	·7	·6
9	77	39	38½	1·93	2·23	618·0	1·2	1·1
10	96	41	43½	2·38	2·51	1002·0	1·5	1·5
11	93	38	47½	2·26	2·76	945·0	1·5	1·5
12	91	39	41	2·16	2·36	387·5	·7	·6
13	76	39	37	2·30	2·14	403·5	·7	·7
14	60	20	15	0·70	0·86	24·0	·1	·1
15	85	47	38	1·85	2·18	425·0	·9	·8
16	103	50	53	3·00	3·09	736·0	·9	·9
17	91	48	43	1·72	2·52	69·0	·2	·1
18	51	33	18	0·17	1·06	4·0	Nil	Nil
19	101	38	63	3·70	3·64	630·0	·7	·7
20	104	30	74	3·30	4·26	544·0	·6	·5
21	107	15	92	4·82	5·33	1087·0	·9	·8
22	97	14	83	4·14	4·80	356·0	·3	·3
23	105	23	83	4·11	4·79	375·0	·4	·3
	1632	706	869	42·55	50·88	7903·0	·7	·6

Quantity of Ground.—As already recorded above, the property contains about 1750 feet of the Valley Creek lead. At the upper and shallower end 1450 feet have been removed to a depth of 40 feet and a width of between 300 and 400 feet. Below these workings there exist virgin drifts 60 to 70 feet deep in the gutter, and which should increase rapidly in depth to the north-west. To the north-east of these old workings there is about 300 feet of the lead, and the gutter should be about 150 feet below the surface.

The quantity of drifts below the old workings should be approximately 600,000 cubic yards, and in the north-western part of the lead 300,000 cubic yards. The total quantity is therefore approximately 900,000 cubic yards. It depends upon the course of the Valley Creek lead as to whether a further length of it is situated upon the property or not.

Water Supply and Power.—The company holds the following water-rights:—

1883-w, for 34 sluiceheads.

2003-w, including 4 and 6 sluiceheads respectively and 3 dam-sites of 1, 2, and 3 acres respectively.

1873-w, of 89 acres, for dam-site.

In all, there is a total of 44 sluiceheads and 95 acres of dam-sites.

It is stated that the main dam-site is 1300 feet above the mine, near the head of the Cascade River.

The intake of the race is much lower down the river, and delivers the water at the mine with a pressure-head of 500 feet.

Facilities for Working.—The overburden on the drifts is the alluvium and shingle of the Ringarooma Flats, which do not exceed 10 feet in depth. Below this overburden the drifts occur, and are tin-bearing throughout, so that the actual overburden is not more than 10 feet in thickness.

There is plenty of space available for dumping purposes on the flats of the Ringarooma River adjacent to the mine.

If the water schemes as proposed by the company were carried into effect, there should be available sufficient water under suitable pressure to efficiently work the mine.

Conclusions.—The Valley Creek lead, a tributary of the Ringarooma lead, crosses the property of the Briseis Central Company. The drifts in it are stanniferous, and two attempts have been made in the past to work it, although apparently not financially successful. In the first attempt the material was moved by hand labour and trucked, each haulage-line, pump, &c., being operated by a separate engine, which operations could not be regarded as efficient. In the second attempt a more modern and efficient method of dredging and sluicing was used, but the plant was only capable of treating the drifts to a depth of 40 feet. In the first case 90·5 tons, and in the second 428·7 tons, of tin ore were obtained, indicating an approximate content of the drifts of 1·2 lb. per cubic yard. The boring campaigns of the lower drifts, and other parts of the lead, have not given an average result as high as this (the best campaign gave an average of 0·5 to 0·7 lb. per cubic yard), although it is generally found that the lower portions of leads have a higher value than the upper. Greater reliance must, however, be placed upon the results of actual working, and it is probable that the content may be as high as 1·2 lb. per cubic yard, and it should certainly be between 0·5 and 1·2 lb. per cubic yard; but the actual contents can, of course, only be proved by working.

There appears to be sufficient tin ore present, and sufficient drifts available, to justify working the deposit, provided the mine can be equipped at low capital cost. The conditions as regards overburden and disposal of tailings are very favourable, and should the water schemes be completed, there should be enough water at a suitable pressure to economically work the deposit. The success or otherwise of the mine will, of course, depend on the content of tin ore found in the Valley Creek lead and the cost of working.

Beyond the Valley Creek lead, after it passes below the Ringarooma River, the future is dependent upon the course of this lead and the content of tin ore in the Ringarooma lead after the junction of the former. No definite expression of opinion can be given upon this matter, and it can only be decided by boring or by working, should the latter prove successful, along the Valley Creek lead.

(4)—The Cascade River Lead.

(a) *The Briseis Tin and General Mining Company Limited.*

Location and Access.—The workings of this company are situated upon Consolidated Lease No. 6953-M, of 566 acres, adjacent to the township of Derby. The lease extends both to the north and south of the Ringarooma River, and in the latter direction includes a considerable length of the Cascade River. The company also holds by agreement the mining rights over the property (private) to the north.

The main-road from Launceston to the North-East and East Coast districts passes through the above lease. The Launceston to Herrick railway traverses the district to the north, and the mine is connected therewith by good roads to Derby station (1¾ mile) and Branxholm station (5 miles).

Previous Reports.—

Thureau, G.: Stanniferous Deposits at Ringarooma, 1884.

Montgomery, A.: The Mineral Resources of Tasmania, 1894.

Smith, J. Harcourt: Report on the Alluvial Tin Mines at Derby, 1899.

Twelvetrees, W. H.: Preliminary Report on the Deep Lead or Infra-Basaltic Stanniferous Gravels of the Ringarooma Valley, near Derby, 1900.

Lewis, J. B.: The New Brothers' Home (No. 1) Tin Mining Company, Derby, 1903.

History.—The land now leased by the Briseis Company includes much that was formerly leased and worked by other companies which have long since ceased operations.

Tin ore was first discovered by the Krushka Bros., either late in 1875 or early in 1876. The first lease (No. 205) was applied for in January, 1876, by C. Krushka, but was cancelled; another (No. 316) being applied for by F. Krushka in October of the same year. Other sections were quickly taken up along the course of the lead, and the work of treating the deposits and the formation of mining companies soon began.

The section taken up by F. Krushka was worked by the Krushka Bros., and became known as the Brothers' Home Mine. The drifts were treated down to stream-level, and gave splendid returns, the mine remaining the premier mine of the district for many years. Operations were continued until 1901, and then ceased, the lease being acquired by the Briseis Company.

The Brothers' Home (No. 1) Tin Mining Company was formed in 1880 to work the land to the south (No. 535, 80 acres) and east (No. 1586, 80 acres) of the Brothers' Home Mine. Operations were carried on intermittently until 1890, when the company was voluntarily wound up, and the New Brothers' Home Tin Mining Company No Liability was formed. Work was carried on at intervals until 1906, when arrangements were made with the Briseis Company to work the ground adjoining that of the latter company. In 1915 the land held by this company was included in the present consolidated lease of the Briseis Company.

The Briseis Tin Mining Company No Liability was formed in 1885 to work the ground to the east of the Brothers' Home and the Brothers' Home (No. 1) Mines, on sections first charted in the name of J. A. Thompson.

On the north side of the Ringarooma River the Triangle Tin Mining Company Registered was formed in 1882, and the North Brothers' Home Tin Mining Company Limited in 1883. The Triangle Mine was worked until the early nineties, but was idle afterwards. The Brothers' Home Extended Company was formed in 1895 to work the North Brothers' Home Mine, but was wound up in 1900. In the same year the Triangle and Brothers' Home Extended Mines were purchased by the Ringarooma Tin Mines Limited, who worked them until 1906.

The Briseis Company continued operations from its formation onwards, although hampered by shortage of water, lack of working facilities, low price of tin, &c. In 1900 the Briseis Tin Mining Company Limited was formed in London to further work the deposits. Provision was made for bringing in large and adequate supplies of water from the Cascade and Ringarooma Rivers, and the latter scheme was completed in 1902. The Brothers' Home Mine was acquired in 1902, and those of the Ringarooma Tin Mining Company in 1906. In 1907 arrangements were made for the adjoining parts of the Briseis and New Brothers' Home (No. 1) Mines to be worked by the former company. By 1909 practically the whole of the upper portion of the lead was worked out on these two properties, and operations were directed to following the lead to the north below the Brothers' Home workings, and ultimately below those of the Triangle and Brothers' Home Extended.

The main-road was diverted to the south of the river in 1912, and the Ringarooma River diversion completed in 1914. A second river diversion had to be made to the north in 1919. A third diversion was necessary in 1921, and was completed in 1923. A third diversion was to the south, and the workings are now situated to the north of the river, and can proceed uninterruptedly.

Geology.—The country to the south of the Ringarooma River is occupied almost entirely by granite, and the line of junction with the Cambro-Ordovician to the north is approximately along the course of the Ringarooma River. The old mine workings along the Cascade lead proved the presence of Tertiary basalt overlying Lower Tertiary sediments. The same association is found to the north of the river, where basalt with a maximum thickness of 200 feet overlies up to 310 feet of Tertiary sediments.

The Ore-Deposit.—The stanniferous drifts which have been worked are those of the Cascade lead. The present Cascade River departed from its former course near the south-east corner of the Briseis lease, and followed a parallel course on the north-eastern side. The Cascade lead is therefore found to the south-west of the present stream. The lead follows a general north-westerly course through the lease, and passes below the Ringarooma River immediately to the east of the township of Derby. It will continue on the same general course to join the Ringarooma lead near the Derby railway-station.

At the south-eastern end the bottom of the drifts was about at stream-level, but falls rapidly to the north-west, and the drifts become correspondingly thicker. At the Ringarooma River the gutter was 100 feet below river-level, and in the present workings it is 150 feet below.

Production.—Only very incomplete records of the amount of tin ore produced by the various companies exist. It is estimated by Mr. C. Lindesay Clark, general manager, that prior to the formation of the Briseis Company other companies had extracted from the Cascade lead 9600 tons of tin ore (cassiterite).

Up till the 31st December, 1922, the summary of results is—

Overburden removed	5,333,400 cubic yards
Drift treated	8,447,200 cubic yards
Black tin won	12,074 tons (74 per cent. to 75 per cent. tin)
Value	£1,512,000 (excluding 2 units smelting loss)
Dividends	£502,500

The results for 1923 make the total production of ore 12,427 tons, with a value of £1,564,000.

The total amount of ore obtained from the mines on the Cascade lead is therefore 22,027 tons.

Value of the Drifts.—From the above figures the value of the drifts treated up till 1922 was 3·2 lb. of tin ore per cubic yard.

It is stated that the average content of the drifts being treated at present is approximately 2 lb. per cubic yard. The upper portion of the drifts contains about 0·25 lb. per cubic yard.

Extension of the Lead.—The Cascade lead extends in a general north-westerly direction from the present workings towards the northern boundary of the lease. From the cliff faces on the north bank of the Ringarooma River three adits have been driven in a north-easterly direction at altitudes of 20 feet or so above river-level. Bores have been put down below these adits at regular intervals in order to determine the actual course of the lead.

The Cascade lead should pass from the Briseis lease into the private property to the north. Its junction with the Ringarooma lead should be in the vicinity of Derby station, but is dependent upon the course of the latter lead, which cannot be accurately determined on geological evidence alone.

Method of Working.—The methods of working have, of course, changed during the history of the mines. Hydraulic sluicing was introduced at an early date, but shortage of water-supplies greatly hampered operations. Some of the mines, such as Brothers' Home (No. 1), Triangle, and North Brothers' Home, worked the drifts by underground methods, successive layers of payable drifts being mined. The method of removal of overburden depended upon the hardness thereof. Hydraulic sluicing was resorted to where possible, but dry-stripping by hand labour or mechanical devices was used in other cases.

The present Briseis workings are 150 feet below the surface of the banks of the Ringarooma River. The overburden of soft and hard basalt is removed by sluicing. The fine material is conveyed through a race, elevated, and dumped, while the boulders are handled independently and trucked away. The drifts are removed by hydraulic sluicing. From the bottom of the workings the broken drifts and water are elevated by hydraulic elevator to the tail-race and sluice-boxes. The tailings are elevated by hydraulic elevator to the dump slightly above river-level. The water from the lower workings is pumped 100 feet into the river by means of two altered gravel pumps (centrifugal) in series. The pumps are rope-driven from two Francis turbines in series (300 h.p. at 700 revolutions per minute). Another pumping set consists of an Australian turbine (200 h.p.) and pump, while there is a small turbine and pump for a stand-by. The turbines are operated by water with 420-foot head, but lift their own water to river-level, so that the effective head is 320 feet. An emergency hydraulic elevator set is also available for pumping the water.

The gutter of the lead is followed in the workings, which are extended across the lead to such points that removal of further drifts from the side would not be payable. The basalt and a small thickness of the underlying drifts are regarded as overburden and removed accordingly.

Water-Supply.—The Briseis Company holds numerous water-rights amounting in all to a considerable quantity of water. On the Cascade River water-rights amount to 110 s.h. A dam is now being constructed on Lease 2083-w, of 187 acres, in this river, in connection with this supply. The water is conducted by a race $2\frac{1}{2}$ miles in length to a point above the mine, and is delivered by a 20-inch pipe-line with a pressure-head of 320 feet.

On the Maurice and Ringarooma Rivers water-rights amounting to 132 s.h. are held. The water is conveyed by a race, including several syphon pipe-lines, 20 miles in length. From the end of the race the water is delivered to the mine through a line of 30-inch pipes at a pressure-head of 420 feet.

In addition to the above, rights amounting to 36 s.h. are held on the Main Creek.

Future Prospects.—The mine workings are now on the north side of the Ringarooma River, and close to the basalt-capped cliffs to the north. The Cascade lead is trending to the north-west from the present workings, and is pursuing a parallel course to the Ringarooma River and the cliffs. For some distance, therefore, the working conditions will be the same as at present, namely, with basaltic overburden on the north-eastern side only. The mining operations are at present being profitably conducted, and this state of affairs should continue, the actual amount of profit, of course, being dependent on the content of the drifts, the market price of tin, and working expenses.

To the north-west of the workings the river has an easterly course, and the cliffs follow the river. The lead in following its north-western course will thus pass below the cliffs, and there will be basalt above and on both sides of it. A larger quantity of overburden will have to be removed, which will increase the working expenses. The question of profitably mining the lead under such conditions is purely an economic one, and will depend upon the content of the drifts, the market value of the tin ore produced, and the working expenses.

(*b*) *Prospects of the Extension of the Lead.*

As already noted, the Cascade lead extends through the Briseis leases, and continues in a general north-westerly direction to join the Ringarooma lead at a point approximately below the Derby railway-station. The Briseis Company is following the lead in this direction, with profitable results. No other point of attack need be considered, apart from the continuation of the Briseis workings, owing to the enormous difficulties and expense which would be incurred in attempting to open up a working place by removal of the 200 feet of basalt overburden and the 350 feet or more of underlying drifts.

As already stated above, the question of the successful exploitation of the continuation of the lead will arise when the lead passes below the basalt-capped cliffs to the north-west, and it will be entirely an economic one, depending upon the amount of tin ore obtained and the market value thereof, and the cost of obtaining same.

(5)—The Main Creek Lead.

(a) *Sarah Ann Tin Mine.*

A portion of the workings of the old Sarah Ann Tin Mining Company Registered (formed in 1882) are situated on the south-west bank of the Main Creek, about 25 chains from its junction with the Ringarooma River. In the bottom of the workings both granite and Cambro-Ordovician slates and sandstones occur, and the junction of the two is visible and easily determined as an intrusive one. Overlying the granite there are heavy conglomerates containing boulders of Cambro-Ordovician rocks, quartz, granite, &c., between which are small water-worn pebbles, sand, &c. In one of the faces about 50 feet of roughly stratified beds of sands and clays, with boulders, succeed the conglomerates. These conglomerates, sands, and clays represent Lower Tertiary sediments formed near the head of the Main Creek lead. The base of these beds is nearly 100 feet above the Main Creek, and their immediate extension to the north has been denuded by the present stream.

It was the drifts of this lead and the detrital material from them occurring on the hillside below that were worked at this locality. They appear to have been worked by the Sarah Ann Company in the early eighties, and by the Briseis Company during part of the period 1913-1918. The drifts represent the head of the Main Creek lead, and only a very short length of the lead can occur to the south of the faces which have been worked, so that the deposits are of little economic importance. The fact that the operations on them have been abandoned also suggests that the tin content is low.

(b) *Mutual Hill Tin Mine.*

The Mutual Hill is situated on the east bank of the Main Creek, immediately to the south of its junction with the Ringarooma River. The old workings are situated on the western slope of the hill adjacent to Main Creek.

Tin ore was discovered at this locality in 1884 on land leased by R. Bennall. The mine became known as the Mutual Hill, and appears to have been worked during the eighties. It was later held by numerous individuals and companies, including the Native Paint and Oxide Proprietary No Liability and the Tasmanian Tin Dredging Company Limited, but no record of any work exists. The Mutual Hill Tin Mines No Liability was formed in 1910 to work the deposit, but this does not appear to have been done, and in 1912 arrangements were made with the Briseis Company to equip and work the mine. The latter company carried out sluicing operations until 1918, since when the mine has been idle.

The Mutual Hill is a basalt-capped one, the basalt overlying Lower Tertiary sediments on the western side and granite on the eastern side. The Lower Tertiary sediments rest upon a bedrock of granite.

The deposit worked upon this hill consists of part of the stanniferous drifts of the Main Creek lead. The head of this lead occurs on the Sarah Ann workings described above, but the part of the lead between these and the Mutual Hill workings has been removed by the denudation of the present Main Creek. Similarly, the part of the lead to the north of the Mutual Hill has been removed by the Ringarooma River. There thus exists only a portion of the lead, with a length of 15 to 20 chains. Further, the whole of the width of the lead has not been preserved on the Mutual Hill, but only the eastern portion thereof.

The Briseis Company worked the deposits on Mutual Hill and adjacent flats from 1912 to 1918. The base of the drifts is about 50 feet above the present streams, so that they are easily treated. Tail-races were taken easterly into the drifts at two points along its length on the fall to Main Creek, and another from the fall to the Ringarooma River at the northern end of the deposit. The drifts and overburden were attacked from these points by hydraulic sluicing, the faces being extended to the north and south until they met, and also easterly into the hill. A fair proportion of the basaltic overburden consisted of boulders, which were dumped to the west of the workings. About 60 to 70 feet of drifts were exposed below the lowest basalt flow. Several flows of basalt are represented, with, in some cases, drifts between them. Incomplete records of the operations of the Briseis Company show a yield of 77·90 tons of tin ore during the years 1912 to 1918, the largest yield being 22 tons in 1917. The results were apparently unprofitable, as operations were discontinued. As stated above, the drifts on the hill represent the easterly portion only of the lead, and probably do not include the centre or gutter of the lead. As the best values are obtained in the latter portion of the lead, and the side drifts are relatively poor, the drifts would have too low a tin content to render their treatment profitable.

(*c*) *Private Property (Charted as W. Krushka,* 320 *Acres).*

This property occurs on the west side of the Ringarooma River opposite the junction of Main Creek. Old workings are found at two localities on this property on the steep slopes to the river. One is situated at the head of a small gully about 15 chains from the river. Two adits (now fallen in) have been driven, one being 60 feet below the other. It also appears as though sluicing operations have been carried on over a face 1 chain in width and for a distance of 1½ to 2 chains into the hillside. These workings have exposed clays and grits of the Lower Tertiary series.

The other workings are situated about 4 chains to the north-east. Two adits (now fallen in) have been driven at about the same level, but 2 chains apart. Sluicing operations have also been carried out, and there is a face 3 chains long and to a depth of 1½ chains into the hillside. Grits and clays have been exposed, and there is an overburden of hill-slip basaltic material.

The grits exposed represent the drifts of the Main Creek lead. The valley of the old Main Creek widens rapidly going north-westerly, and the drifts extend over a width of 40 to 50 chains to the west of the Ringarooma River. The above workings are situated on the south-western side of the lead, and are some distance above the bottom of it. It is impossible to ascertain upon what the workings were carried out, but there may have been rich stanniferous seams in the drifts. The extent of the workings is not large, and results were apparently not favourable. As already stated, however, the workings were some distance above the bottom of the lead, and this fact may have contributed to the unsuccessful nature of the work, as the upper drifts of a lead are usually poorer than the lower ones.

(d) Private Property (C. Krushka, 203 Acres).

Old workings occur at three localities on this property, and will be described separately.

(i) *South-Eastern Corner.*—A large working face (sometimes referred to as the Lone Brothers' Home) occurs here at a distance of 7 to 10 chains west of the river. It has been opened up from the small creek flowing north-easterly into the river. This has been used as a tail-race, and the operations have been extended to the south-west and south by hydraulic sluicing. The working is 7 to 8 chains long, 2 to 3 chains wide, and a high face has been formed to the west. In this face Lower Tertiary grits are exposed, with an overburden of very coarse-grained basalt. These grits represent the north-eastern portion of the drifts of the Main Creek lead. It could not be ascertained whether the workings followed the bedrock for the whole of their length, but they probably did not do so. The drifts treated were portion of those on the north-eastern side, and therefore likely to be poorer than those in the centre of the lead. For this reason the operations were probably unprofitable, although no record of the results obtained is in existence.

(ii) *North-Eastern Corner.*—Another old working occurs at the head of the next small creek to the north of that referred to above. From this creek sluicing operations were continued in a south-westerly direction for 4 chains in length and a width of 1 chain. The material in the workings consists of decomposed granite and hill-slip material from the basalt and drifts of the Main Creek lead to the south-west. There may have been a concentration of tin ore along the gully, but the hill-slip material is probably relatively poor.

(iii) *North-Central Portion.*—Mining operations have been carried out along the unnamed creek which flows north-westerly to join Krushka Creek near its junction with the Ringarooma River. The material treated was Recent and hill-slip material formed along the course of this and tributary creeks. The head of these workings reached the north-eastern edge of the drifts of the Main Creek lead. The drifts consist of grits with abundant lignite, and are overlain by coarse-grained basalt. The tin ore in the creeks was derived from these drifts, but, being right on the edge of the drifts and some distance above the gutter, they are probably too poor to work by themselves.

(e) *Future Prospects of the Main Creek Lead.*

Any future work on this lead should be devoted to that part on the western bank of the Ringarooma River. The gutter occurs about 30 to 40 feet above the river, and is situated approximately to the north-west of the sharp bend from north to south-east, adjacent to W. Krushka, 320 acres. Prospecting by means of trenches and shallow shafts, or shallow bore-holes, would quickly determine the position of the gutter. The gutter and central part of the lead should then be tested to determine the value of the drifts preparatory to any further work. Above the gutter, on the hill to the north, there will exist about 140 feet of drifts and 220 feet of basalt. The drifts would become thicker, and the basalt maintain the same thickness, as the lead was followed to the north-west.

The question of successfully mining the lead is purely an economic one, dependent upon the tin content of the drifts, the market value of the ore produced, and the working expenses in obtaining same. It can only be settled by the prospecting work outlined above, followed, if favourable, by actual mining operations. The working facilities would be favourable at first, as there would not be much overburden, and the tailings would have to be elevated only a short distance, if at all. As working progressed, however, the full thickness of the basalt overburden would be gradually encountered. Further, the dip of the bottom of the lead would be such that after a time the treated drifts would have to be elevated. The favourable conditions outlined above would, however, continue for a sufficient distance to enable the stanniferous content of the drifts to be ascertained by working even on a small scale.

(6)—The Weld River Lead.

(a) *The Echo Tin Mine.*

Location and Access.—The Echo Mine is situated on a group of mineral leases immediately to the north of Moorina, which are charted in the name of J. A. Thompson, and amount to 193·5 acres. The main part of the workings on the deep lead is situated upon Leases 3572-93M and 8640-M. The main-road through the north-eastern district passes within a few chains of the workings. Moorina is half a mile to the south along this road, and

Herrick, the terminus of the railway, is $1\frac{1}{2}$ mile to the north along a good branch-road off the main-road.

History.—Alluvial tin deposits have been worked in the vicinity of Moorina since the late seventies of the last century. They were situated chiefly along the Weld and Frome Rivers to the south of the Ringarooma River. Operations were also carried out to the north and west of the river, and progressed up the small unnamed creek which enters the river to the north of Moorina. The deposits worked were shallow ones of recent origin, but near the Moorina-road it was found that the shallow deposits dipping to the south-east gave place to others dipping to the north. This lead to the discovery of the Weld River lead in 1901. The lead was found on the leases of the Moorina Tin Mines Limited, which company was formed in 1900, and continued to work the lead until 1907. In 1911 the leases and water-rights of this company were purchased by J. A. Thompson, proprietor of the Weld River Tin Mining Company, and both the Weld and the Echo (or Moorina) Mines were worked up till 1922. The Echo Mine is not being worked at present.

Geology.—From the Herrick turn-off to the southern extremity of the Echo workings the main-road to Moorina runs along the boundary of the granite to the east and Tertiary sediments to the west. The granite also appears to the south of the workings. To the north-west the Tertiary sediments are overlain by Tertiary basalt. Small areas of Recent alluvial and detrital deposits occurred along the course of the unnamed creek and the Ringarooma River.

The Ore-Deposit.—The deposit worked in this mine was one composed of stanniferous drifts of Lower Tertiary age. These drifts filled the valley of the Weld River, and represent the lead of this stream. The part of the lead to the south of the workings was removed by denudation by the present Ringarooma River. To the north the lead continues in a general northerly direction to join the main lead of the ancient Ringarooma River at a point about $2\frac{1}{2}$ miles north-west of Herrick.

The workings are situated at the eastern side of the drifts where they junction with the granite. The bottom of the drifts or the bedrock of granite is not clearly exposed, and as the drifts extend 15 chains westward it is possible that the actual gutter of the lead was not worked, unless it is situated very close to the eastern side of the lead.

To the north-west the basalt covers the drifts in the vicinity of the main-road to Derby.

Production.—From the year 1902 till 1907, 77·95 tons of tin ore were produced from the Echo Mine. From 1908 onwards, until 1922, the production was not separated from that of the Weld Mine, worked by the same company, although the Echo worked during the greater part of the period. The recorded production of the two mines from 1908 until 1918 was 340·17 tons of tin ore, and from 1918 till 1922 it was 27·73 tons of metallic tin produced in the form of ore. It is probable that half of these figures represent the production of the Echo Mine, and the total production would therefore be not less than 265 tons of tin ore.

Working Facilities.—The lead extends to the north through the north portion of the leases, and still further for a distance of at least 2 miles until it joins the main Ringarooma lead. The lead will become wider and a larger thickness of drifts be present as it is followed in this direction. For a distance of 1½-mile from the workings no basalt overburden should be met with, except possibly a small area on the western side of the lead where it passes beneath the main-road. To the north of the railway-line basalt overburden would be encountered.

The facilities are thus favourable for working along 1½ miles of the lead.

Water-Supply.—Numerous water-rights are held by J. A. Thompson for working the Weld and the Echo Mines, the water being obtained from the Weld and the Frome Rivers. The total amount used for the Echo Mine was 22 sluiceheads.

Future Prospects.—The future working of the mine depends, of course, upon the stanniferous content of the drifts and the cost of extracting the tin ore. The tin content appears to have been sufficient to enable operations to be carried out over a period of 20 years with apparently some degree of success. The production fell somewhat towards the latter end of the working period, but this is to be attributed partly or wholly to the deeper nature of the ground and the need of a more powerful plant to elevate and treat the drifts. The value of the ground ahead of the workings will be similar to that worked, but it can only be satisfactorily determined by boring or further workings.

If the value of the ground is satisfactory, the absence of basalt overburden makes the conditions for working compare favourably with other leads of the district. For efficient working on a larger scale it is probable that a larger supply of water for sluicing and elevating purposes would be necessary.

(b) *Prospects of the Northern Part of the Lead.*

The same remarks apply generally to the continuation of the lead beyond the leases of the Echo Mine, as to that part within the leases which has been discussed above. If the tin content be proved by boring to be satisfactory, there is a length of 1½ mile of lead which can be easily worked, as there is little or no basalt overburden present. A boring campaign on this part of the lead is to be recommended.

(7)—The O.K. Creek Lead.

A small amount of work has been performed at a point about three-quarters of a mile to the south-south-east of Herrick. The land in this vicinity was first leased by the Moorina Tin Mining Company Registered, which was formed in 1881, but it is doubtful if the presence of a lead was known. The land was last held under lease as 7776-M, of 40 acres, in the name of R. H. White and C. H. Newman.

The workings occur near the south-eastern corner of this lease, and are several chains in length and one-half to 1 chain in width.

The material exposed in the workings consists of grits and clayey beds, very similar to those of the Weld River lead in the Echo Mine. These beds represent the drifts of a small lead formed by the ancestor of the present O.K. Creek.

Granite occurs immediately to the south-west, south, and east of the lead, and also forms the bedrock. The southern part of the lead has been denuded by the unnamed creek entering the Ringarooma River, and also by the river itself. The lead extends to the north-west, and passes about 20 chains to the east of Herrick, to ultimately join the Ringarooma lead nearly 2 miles to the north-north-west of Herrick.

For a distance of three-quarters of a mile from the workings the lead has no basaltic overburden, but from this point (immediately to the north of the Herrick-Boobyalla-road) the lead has for the most part a thick overburden of basalt.

The lead is only a small one relatively to those of the Branxholm Creek, Cascade River, Main Creek, &c., but it should increase somewhat in size to the north-west. The tin content is the determining factor as to whether the lead is of economic importance, and could be determined by boring or other methods. If the content be satisfactory the lead could be readily worked as far as the Boobyalla-road. Reliable information would then be known as to possibilities of success if the lead was followed further to the north-west, below the basalt overburden.

(8)—South Pioneer Lead.

The Pioneer Tin Mining Company Limited has worked a small and narrow run of deep ground on Leases 7969-M and 3297-M, to the south-west of their main workings. This deposit represents a small deep lead, formed probably by the ancestor of the Gladstone Creek, or else by a small creek which has been completely buried by the Lower Tertiary sediments. The lead traverses the leases referred to above, and passes to the west of the low hill of granite south-east of the recreation reserve, and then through the latter, to junction with the Wyniford River lead a short distance ahead of the Pioneer workings.

Where it has been worked the lead is only 1 chain wide, being confined between granite sides. The drifts gave a yield of 0·75 lb. per cubic yard, and the ground was proved to be up to 70 feet deep.

There is no basalt overburden, and the lead could be easily worked down to its junction with the Wyniford River lead.

(9)—The Wyniford River or Pioneer Lead.

(a) *The Pioneer Tin Mining Company Limited.*

Location and Access.—The Pioneer Tin Mine is situated upon Consolidated Lease No. 5353-M, of 456 acres, immediately to the north of the township of Bradshaw's Creek. The road from Herrick, the terminus of the railway, to South Mt. Cameron, Gladstone, and Boobyalla passes through Bradshaw's Creek, which is distant 3½ miles from Herrick.

Previous Reports.—Reference is made to the Pioneer Mine in the following reports:—

Thureau, G.: Stanniferous Deposits at Ringarooma, 1884.

Twelvetrees, W. H.: Preliminary Report on the Deep Lead or Infra-Basaltic Stanniferous Gravels of the Ringarooma Valley, near Derby; Secretary for Mines' Report, 1899-1900.

History.—The discovery of tin ore at the site of the Pioneer Mine was made by Wm. Bradshaw, who applied for a lease in 1877. This discovery was made near the junction of the creek which now bears his name and the Ringarooma River. The tin ore was probably found in the Recent gravels of Bradshaw's Creek, and was derived mainly by the denudation and re-sorting of the drifts of the deep lead which was later exposed.

The Pioneer Tin Mining Company Limited was formed in 1882 to work the deposit, but operations were not entirely successful. The working was then let on tribute, chiefly to Chinese, who carried on operations successfully until the late nineties. As the rich ground of the deep lead became exposed, the company took steps to equip and work the mine, construct water-races, dams, &c., and tested the property by boring. The company was reconstructed in 1900 in order to efficiently equip the mine and undertake operations on an extensive scale. Sluicing commenced in the same year, and operations have been carried out very successfuly and continuously up till the present time.

Geology.—The greater portion of the surface near the Pioneer Mine is occupied by Lower Tertiary sediments and surface soil and waste derived therefrom. Granite outcrops over the remaining portion as low hills above the general level of the district.

The Ore-Deposit.—The deposit worked in the Pioneer Mine consists of Lower Tertiary stanniferous sediments representing a deep lead. This lead was formed by the ancestor of the Wyniford River, which was a tributary of the ancient Ringarooma River. The lead enters the property from the east, near the junction of Bradshaw's Creek with the present Ringarooma River. It follows a sinuous course across the leases in a general west-north-westerly direction, and then passes out in a general westerly direction to join the main Ringarooma lead about 2 miles to the west.

Production.—Only very incomplete records of production prior to 1900 are in existence. These show a total amount of 145 tons, but it is probable that at least 500 tons of tin ore were obtained. From the commencement of sluicing in 1900 the total amount of tin ore produced has been approximately 7867·88 tons. This ore has been obtained from approximately 11,500,000 cubic yards of drifts, but portion of this total has been estimated in the absence of records. From 1912 to 1922, however, 3646·58 tons have been obtained from 6,618,800 cubic yards of drifts.

Value of the Drifts.—The tin content of the drifts has naturally varied as work has progressed down the lead, and also according to the position of the working face in the cross-section of the lead. Up to the year 1907 the average content of material treated was 2·161 lb. per cubic yard. During 1906 it was 1·637, and during 1907 1·604 lb. per cubic yard. From 1912 until 1922 the average content was 1·23 lb. per cubic yard. These figures suggest a decrease in the tin content of the drifts as work has progressed down the lead. This is due to the greater depth and width of drifts which occur as the lead approaches the main Ringarooma lead. The upper layers contain less tin ore than the lower ones, and becoming progressively greater in quantity, reduce the average content of the whole thickness of the drifts. This effect has been more pronounced in the case of the Pioneer workings, because the natural slope of the surface along Bradshaw's Creek is in a direction opposite to that of the dip of the bottom of the lead. At the eastern end of the workings the upper layers had been removed by denudation, and the lower ones only remained to be worked. As work progressed to the west, the surface rose and the bottom of the lead dipped, and a relatively large proportion of the upper drifts had to be treated.

Extension of the Lead.—The lead has been proved by boring operations to extend as far as the western boundary of the lease, beyond which it passes in a general westerly direction. Its exact course cannot then be traced, owing to the surface being wholly occupied by Tertiary drifts, but it should follow a general westerly course for 2 miles to join the main Ringarooma lead.

Method of Working.—The drifts are broken down by hydraulic sluicing, the stiff clayey layers being broken by means of explosives and hand labour. The face is worked in two benches, the upper drifts being removed from the upper one, which is kept well ahead of the lower. The face may also be attacked at two or more points across the lead. The sluiced material drains to a small sump, and is elevated by an hydraulic elevator. It is delivered to another sump, from which it is taken by an electrically-driven centrifugal gravel-pump and elevated another 100 feet. It then passes through the sluice-boxes, and the drained tailings are elevated and dumped by a mechanical elevator of the endless-belt type.

Water Supply and Power.—The Pioneer Company hold water-rights on the Weld River, Frome River and tributaries, and the Wyniford River and tributaries, amounting to 163 sluiceheads. The supplies from the latter two sources are taken by race to the large dam which has been constructed on the 191 acres dam-site (1068-w) on the Frome River. The water (145 sluiceheads) from this dam is used for the generation of electric power, which is transmitted to the mine. This water, as well as that (18 sluiceheads) from the Weld River and other streams, is then conducted by two separate races to the vicinity of the mine, where the supplies are united and taken across the Ringarooma River in a pipe-line for sluicing purposes.

Working Facilities.—The working facilities are extremely favourable. There is a total absence of the basaltic overburden so common in the Ringarooma Valley, and little or no overburden of barren drifts. The greatest depth of the drifts is 70 to 80 feet. The drifts are payable across a width of 1000 to 1200 feet, so that a very wide face is available for working, and the total quantity of payable drifts is large. The moderate depth of drifts and the general configuration of the land surface are such that no great elevation of tailings is necessary. Ample dumping ground exists in the old workings and the adjacent portions of the surface.

Future Prospects.—The future of the mine depends, of course, on the tin contents of the drifts, the cost of obtaining same, and the value of the product. There is no reason to expect any great difference in the tin content of the drifts from that obtained at present. The working facilities are excellent, and, with the supplies of water and electric power, should be conducive to low working costs. With a favourable price of tin the future of the mine should be a successful and prosperous one.

(b) *Prospects of the Western Extension of the Lead.*

As already indicated, the Wyniford River lead extends beyond the western boundary of the Pioneer lease in a general westerly direction, and should ultimately join the Ringarooma lead about 2 miles to the west. For one and a half miles of this continuation no basalt overlies the drifts, and the favourable conditions of the Pioneer Mine are present along this length. The conditions are not quite so favourable as at the Pioneer Mine, however, as the surface of the land rises to the west, and the total thickness of drifts will be gradually increasing. Thus a relatively greater proportion of the upper and poorer drifts will be present, and would have to be treated in any attempted working.

Whether this would reduce the average content of the drifts to such an extent that they could not be profitably treated cannot be definitely decided without actual tests. Before any work was contemplated a boring campaign would undoubtedly be a wise and necessary preliminary step. With the advance of the Pioneer workings in this direction the position is different, as evidence as to the value of the drifts is being obtained continuously as a result of the working.

(10)—The Ringarooma River Lead.

(a) *Reasons for Lack of Operations on the Lead.*

The above descriptions of the mines which have been, and are being, worked on the deep leads of the Ringarooma Valley show that they are all situated on tributary leads, and not a single one has been opened up on the main Ringarooma lead. In addition, it will be noticed that all these tributary leads enter the main one from the south, south-east, and eastern sides. Not only has no attempt been made to work the main lead, but only one attempt has been made to penetrate it by boring, and even in this case the bore was some distance off the centre of the lead, though on what was thought to be its course at that period. (This boring was carried out in David Creek, and was referred to by Thureau in 1884.)

The reasons for this neglect of the main lead are, of course, numerous. In the first place, the modern streams have not succeeded in exposing the bottom layers of drift at any locality to the north or north-east of Ringarooma township, as in the case of the tributary leads. The possible tin-bearing drifts have therefore not been exposed for testing, and possibly treatment by prospector and miner. Secondly, although its presence, but not its actual course, was known or suspected, the thick overburden of basalt, and to a less extent barren drifts, would be regarded as such insurmountable difficulties, that further thought would not be given to the testing of the underlying lead.

A further reason was the fact that the course of the lead was not known with any considerable degree of accuracy. The course could only be determined as the result of a detailed geological survey of the greater portion of the Ringarooma Valley. Such a survey had not been carried out, although considerable areas of the valley were briefly examined at different periods. While these enabled the course of the lead to be determined more or less accurately within these areas, yet the lack of opportunity to examine the adjacent areas naturally introduced an element of error into the deductions as to the course. Further, the deducted course happened to be within the area in which the lead is almost continuously overlain by basalt, the disadvantages of which have already been referred to.

The present investigation was more extended, and resulted in the tracing of the lead with a fair amount of accuracy. This course has been shown on the geological map (Plate I.).

(*b*) *Value of the Drifts.*

The tracing of the course of the lead, important as it is, is, however, only a preliminary step towards the determination of the most important factor, the value or stanniferous content of the lead. This content can only be determined by boring or actual treatment of the drifts, but a discussion of the factors influencing the content will serve a useful purpose in indicating the results likely to be obtained.

It will be seen that the Ringarooma and Maurice Rivers of Lower Tertiary time had their source in the granitic country around and to the south and south-east of Mt. Maurice. Tin ore occurs in this district, and so the heads of these streams may have contributed cassiterite to the gravels, &c., along their courses. The ancestor of the Dorset River probably flowed wholly over Cambro-Ordovician rocks, and derived little, if any, cassiterite therefrom. The Legerwood Rivulet and tributaries headed in granite country, and may have contributed a small amount of tin ore to the main valley. From the junction of the Dorset River northwards the tin-bearing granite occurs. All the small creeks, as far as the Branxholm Creek, would contribute their share of ore to the main lead. From the Branxholm Creek, Black Creek, Valley Creek, Cascade River, Main Creek, Weld and Frome Rivers, and Wyniford River, vast quantities of tin ore were washed along their courses, as is evident from the mines working on these leads. It is certain, also, that some of this proceeded further along their courses than the present working faces of the mines, and that considerable amounts must have entered the main lead. Thus it can reasonably be anticipated that the main lead contains tin ore, possibly along the whole of its course, but certainly getting more plentiful as Branxholm is approached from the south, and being particularly so from Branxholm down the lead. The Ringarooma River itself would have gathered little, if any, from its bedrock between Talawa and Winnaleah, but from Winnaleah to the north it is following wholly over granite, and may have derived considerable quantities from this source.

While the drifts of the main lead will undoubtedly contain cassiterite, it is the actual content that is of economic importance. The gravels in the gutter of the lead may even be as rich as those in the tributary leads. In the case of the overlying drifts, however, the determining factor is the relatively greater volume of drifts being deposited in the larger valley of the main stream than in the smaller valleys of the tributaries. This would necessarily mean that, even if as much cassiterite was being brought into the main valley, it would be distributed through a much greater volume of drifts, which would therefore have a much lower content in comparison with those of the tributary leads. Just how far this process operated is a problem which can only be solved by actual test of the main lead. It may be that the lead at the junction of tributary ones may be as rich, if not more so, than these tributaries. This may even apply to the whole of the lead from Branxholm down the lead, or to portions thereof. Or it may be that the lead is poorer than the tributary ones.

(*c*) *Testing the Lead.*

The best, and the least expensive, localities to test the lead are those in which the basalt overburden has been removed. This has actually been accomplished by the denudating action of the present Ringarooma River at several points along its course. These are: on the alluvial flats around and to the north-west of Branxholm railway-station; on the alluvial flats to the north-west of the Arba Hill; on the alluvial flats to the north-west of the Briseis Central; and north of the northern extremity of the basalt, three miles north of Herrick. At the first two localities the depth from the surface to the gutter of the lead would be 100 feet and 100 to 150 feet respectively, while in the last one it would be approximately 150 to 200 feet.

The course of the gutter of the lead is shown as accurately as it is possible to determine it. A line of test bores sited from this information would quickly locate it, and a further systematic scheme could then be undertaken to test the lead at any of these points. Such a campaign of boring is recommended as a necessary preliminary procedure to any proposed mining of the lead.

If the lead be so tested to the north of Herrick, and found payable, it could be readily traced beyond the northern limit of the district examined, by the same method of geological survey, followed by boring.

VIII.—CONCLUSIONS.

The geological examination of the portion of the Ringarooma Valley described above was carried out with the object of determining the courses of the numerous deep leads containing alluvial tin ore which have been proved to exist. This has been done as accurately as possible from the mapping of the geological features at the surface. When it is remembered that the valley of the ancient Ringarooma River was filled with sediments to a maximum depth of 500 feet, and basalt to a maximum depth of 200 feet, and these filled the valley in places to a width of one and a half miles, it will be readily understood that the location of the leads is not absolutely accurate. Nevertheless the locations are such that any preliminary boring scheme based on them would quickly locate the gutter of the lead, whence the remainder of the scheme could be more accurately planned.

The deep lead system consists of the main lead of the former Ringarooma River and numerous tributary leads entering it from the east. The upper parts of the tributary leads connect with streams which are tributaries of the present Ringarooma River, and so the tributary leads represent deposits along a system of tributary streams which were the ancestors of the present ones.

The Ringarooma River has nowhere corroded its course deeply enough to expose the gutter of the Ringarooma lead, but has in places exposed the gutters in the upper parts of some of the tributary leads.

It is at these exposed parts of the tributary leads that all the mines have been opened up. The most important leads are those of Branxholm Creek (and Black Creek), Valley Creek, Cascade River, Main Creek, Weld River, and Wyniford River. The Arba Mine was the principal one on the Branxholm Creek lead, but is idle at the present time. The same remarks apply to the Briseis Central Mine on the Valley Creek lead. The most important group of mines were those on the Cascade River lead, and included the Briseis, Brothers' Home, Brothers' Home (No. 1), (afterwards the New Brothers' Home), Triangle, North Brothers' Home (Brothers' Home Extended), and Ringarooma Tin Mines. The majority became wholly or partly worked out, and are all now included in the Briseis Mine, the workings of which are being steadily advanced down the Cascade River lead.

On the Main Creek lead the Mutual Hill Mine has been worked, but not with success.

The Echo Mine has been opened up on the Weld River lead, but not worked on a large scale. Boring operations are being carried out on this lead at the present time.

The Pioneer Mine has been successfully worked on the Wyniford River lead, and is still operating.

Future prospects of successful mining depend upon following the leads down their course towards their junction with the Ringarooma River lead. This involves the removal of a larger thickness of drifts and basalt overburden, and causes higher operating costs. The question of following of these leads therefore becomes an economic one, depending upon the cassiterite content of the drifts, the cost of working, and the market value of the recovered material. The same applies to the Ringarooma River lead itself, which is buried under the deepest overburden of all along the greater portion of its length. The most favourable localities to test this main lead have been discussed above.

There are thus portions of the tributary leads and the main lead itself which have not yet been worked, and which contain large supplies of alluvial tin ore. The question as to whether these can be successfully worked is entirely an economic one, depending upon the factors referred to above.

P. B. NYE, M.Sc., B.M.E.,
Government Geologist.

Hobart, September, 1924.

GEOLOGICAL SKETCH MAP
OF
THE RINGAROOMA VALLEY

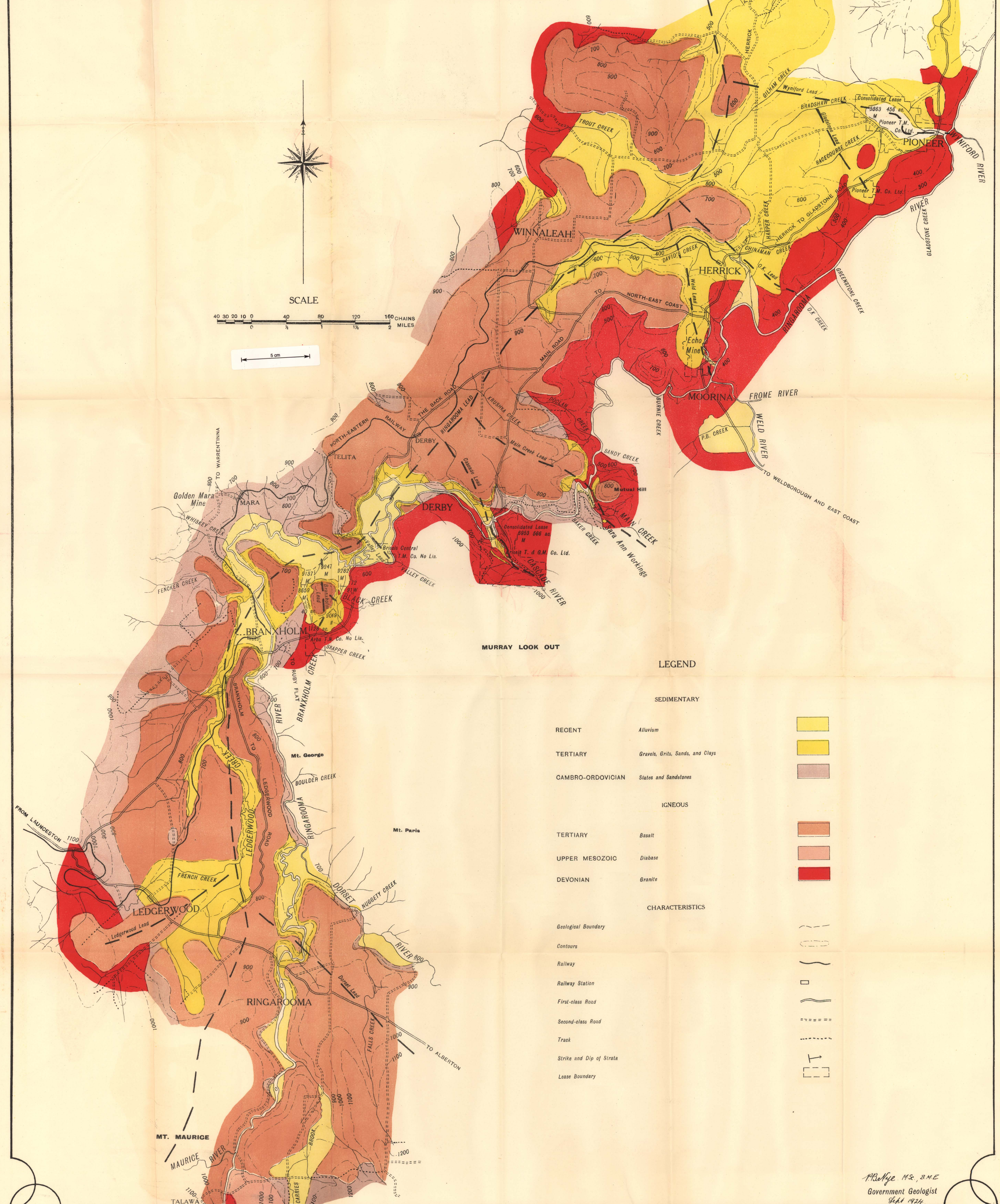

Photo Algraphed by John Vail, Government Printer Hobart, Tasmania.