

QUEENSLAND
DEPARTMENT OF MINES

**MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE
1: 250,000 SHEET AREA, NORTH QUEENSLAND**

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MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE 1: 250,000 SHEET AREA, NORTH QUEENSLAND

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INTRODUCTION

Mapping of the Townsville 1:250,000 Sheet area was completed by a joint Geological Survey of Queensland - Bureau of Mineral Resources party in 1963, and the results were recorded by Wyatt et al (1965). This record gives some details of the ore deposits in relation to geology, but it was felt that the economic potential of the area was sufficient to warrant a separate account incorporating all recorded data on particular deposits and mine workings. Previous major investigations of the area are referred to by Wyatt et al and there are in addition a number of reports mainly on individual mines prepared in the Charters Towers District Office of the Geological Survey of Queensland. Much of the information on the smaller mines is recorded in Wardens' monthly and annual reports, published respectively in the Queensland Government Mining Journal and the Annual Reports of the Department of Mines. The extraction of this data was a laborious task, and for much of it I have to thank Mr. B. A. Coxhead and Miss T. de Leon (now Mrs. J. Hussey). Unfortunately published information for the past two or three years is very sparse but where possible the accounts of the more important mines have been extended to 1969.

From time to time, but more particularly during the past 10 to 15 years, exploration companies have given attention to the mineral potential of the area, especially the Kangaroo Hills Mineral Field. A number of reports embodying the results of their investigations under Authority to Prospect titles are available on open file at the Geological Survey, Brisbane.

MINING HISTORY

Before the establishment of Townsville in 1861 the area was isolated and remote, and attracted only prospectors seeking alluvial gold, which could be worked with a minimum of equipment and supplies. By 1864, however, a port was established, and the way was opened for the transport of necessities for all types of mining. Prospecting began in earnest in 1865, when some of the people of Townsville offered a reward for the finding of payable gold in the hinterland. This was quickly claimed, discoveries being reported from Star River in 1865 and Fanning River in 1866, but these proved to be un-economic.

Although Cape River (discovered in 1867), Ravenswood (1868), and Charters Towers (1871) are just outside the sheet area, the establishment of mining centres at these places gave strong impetus to prospecting over the whole district, and by the end of the century most of the mineral areas now known had been discovered.

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The area is predominantly a base metal rather than a gold producer. Unfortunately early-day mining officials were interested mainly in gold production and so gaps in the history of mining are many.

Silver is believed to have been discovered at Kangaroo Hills as early as 1871, although not worked there until twelve years later. At Argentine, on the Star River, a rush set in during 1881, and a township and smelter were established. The smelter proved to be a failure, and the rush subsided, leaving two of the better mines to struggle on for a time on the returns from exported ore. The 1880's also saw the first recorded production of tin from the Kangaroo Hills Field, although no doubt it had been mined there previously. Access to this field was by pack-horse from Ingham or Star Station, and conditions were difficult. Probably mining at this stage was confined to easily worked alluvial deposits.

The fall in metal prices in 1892 resulted in the virtual extinction of silver mining, but a small and somewhat erratic production of tin was maintained from Kangaroo Hills. In 1895 wolfram was discovered at Ollera Creek, and a trial shipment of 3 tons was sent overseas. This was followed by a total of 30½ tons in the following 5 years; but this mineral does not appear to have been very attractive to prospectors, and these early ventures were not sustained.

After 1900, a sharp revival took place in metal mining. Tin production, which had been rather erratic and unspectacular, rose abruptly to a maximum of 420 tons in 1905, mainly because of the capital brought to the area by the Mount Brown and Waverley companies. From 1903 to 1908, 37,000 ounces of silver was also produced in this area, and 130 tons of copper. A smelter was erected at Ewan by the Kangaroo Hills Mining and Smelting Company mainly to treat copper ores from Macaulay Creek, but this was a failure. Copper was also being produced from the Continong area on the western side of the Burdekin River. Wolfram became payable, and a small but steady production commenced from Kangaroo Hills and Ollera Creek, with smaller quantities of associated bismuth and molybdenite.

From about 1920 onwards mining ceased to be the mainstay of the area. Tin production continued through the 1920's, dropping to a low of 11 tons in 1931 and recovering to 118 tons in 1941. Since then, production has been less than 100 tons per annum. The mining of wolfram and associated metals was wiped out by the 1920 slump, but was resumed on a small scale from 1937 to 1957; the total production during this period was only 81 tons of wolfram, compared with over 400 tons from 1903 to 1920.

The most important mining product to-day is one which received scant mention in the past - the limestone at Calcium, near Reid River. These deposits have been known since 1878, and probably limestone was produced last century to satisfy the requirements of the cyaniders; however, the first recorded production was in 1900. The quarries have produced continuously since then, except between 1915 and 1920, the principal usage for many years being for lime-burning. Since 1955 production has been expanded very considerably to supply raw material for the Townsville cement works; the current rate is in excess of 130,000 tons per annum.

SOURCES AND ASSOCIATIONS OF THE ORE DEPOSITS

The tin mineralization of the Kangaroo Hills - Tinvale area, which is associated with the Oweenee Granite, can be regarded as a well-defined metallogenic province, as probably can the small wolfram area at Ollera. The remainder of the pre-Mesozoic rocks form part of the gold province which includes Charters Towers and Ravenswood on the adjoining Charters Towers sheet. The gold deposits occur in small groups, with only isolated deposits in between, and do not include any important producers. Superimposed on this pattern are sporadic areas of aberrant mineralization, such as the silver deposits

TABLE 1 : PRINCIPAL TYPES OF ORE DEPOSITS AND THEIR ASSOCIATIONS, TOWNSVILLE 1:250,000 SHEET AREA

Name of Area	Metal	Host Formation	Possible Source of Mineralizers	Resultant deposits and Remarks
Argentine	Silver-lead	Argentine Metamorphics Late Palaeozoic Granite Game Hill Beds	Late Palaeozoic granite	Veins, mostly striking N, dipping E
Argentine	Gold	No details - probably similar to silver-lead		
Dotswood	Copper	Percy Creek Volcanics	?	?
Fanning	Gold	Ravenswood Granodiorite Complex	Ravenswood Granodiorite Complex	Veins, usually small. One pipe-like body (Welcome)
Far Fanning	Gold	Dotswood Formation	Kitty O'Shea Intrusives	Veins and tabular stockworks. Predominant control E - W faults
Golden Valley - Mount Success	Gold	Fanning River Group, Ravenswood Granodiorite Complex, Late Palaeozoic rhyolite	Late Palaeozoic rhyolite Kitty O'Shea Intrusives	Pipes in contact zone (Mount Success) Veins (Golden Valley)
Grass Hut	Gold	Ravenswood Granodiorite Complex	Ravenswood Granodiorite Complex	Veins
Haughton Valley	Gold	Late Palaeozoic granite and metamorphics	Late Palaeozoic granite	Veins, and irregular patches on contact
Kangaroo Hills - Tinvale	Tin, tungsten	Oweenee Granite, Running River Metamorphics, Ewan Beds	Oweenee Granite probably, in the case of tin, via acid dykes	Erratic deposits mainly close to granite-sediment contacts. Much fracturing apparent, which commonly has controlling effect
Kangaroo Hills - Tinvale	Copper	Oweenee Granite, Argentine Metamorphics, Devono-Carboniferous sediments	Oweenee Granite	Rather erratic deposits in tabular "formations" controlled by shears. Probably hypothermal
Kangaroo Hills - Tinvale	Silver-lead	Ewan Beds	Oweenee Granite	Mainly pyrometamorphic contact deposits, skarns, etc. Few hydrothermal quartz veins
Magnetic Island	Gold	Permian-Mesozoic granite	Late Permian-Mesozoic granite	Small quartz veins
Ollera	Tungsten, molybdenum, bismuth	Late Palaeozoic granite	Late Palaeozoic granite, possibly via porphyry Oweenee Granite	Quartz pipes carrying erratic "bunches" of ore
Piccadilly	Gold	Dotswood Formation	?	Small quartz veins. E - W faults appear to exert predominant control

TABLE 2 : SUMMARIZED STRATIGRAPHY AND ASSOCIATED MINERALIZATION, TOWNSVILLE 1:250,000 SHEET AREA

(Stratigraphy after Wyatt, 1968b)

Age	Rock Unit		Lithology	Associated Mineralization * Possible source + Host Rock	
	Sedimentary or Extrusive	Intrusive			
Permian to Mesozoic		Granites of Mt. Elliott, Mt. Stewart, Magnetic Island (P-Mg)	Mainly biotite granite and adamellite	* + Magnetic Island) unimportant gold deposits * + Mount Elliott)	
Upper Carboniferous to Lower Permian	Volcanics of Stuart area - no formal name (C-Pv)		Intermediate to acid volcanics, rare coal measures	* + Thin seams coal	
		Kitty O'Shea Intrusives	Andesitic dykes	* Mount Success gold	
		A number of intrusives - no formal names	(C-Pg)	Granite, adamellite	* + Houghton Valley gold, Mt. Square Post gold, + Ollera wolfram, Woodstock iron
			(C-Pb)	Granodiorite, diorite	+ Argentine silver
			(C-Pp)	Acid porphyry to microgranite	
			(C-Pi)	Dolerite and micro-diorite	
(C-Ph)	Rhyolite and dacitic intrusion breccia	* Mount Success gold			
Undifferentiated - probably Carboniferous or Devonian	Sediments of coastal range - no formal name (Pzu)		Schist, hornfels, gneiss, quartzite, metasediments		
	Volcanics of coastal range - no formal names	(Cuy)	Rhyolitic and dacitic flows, breccia, agglomerate		
		(Cuv)	Rhyolitic and andesitic flows and pyroclastics		
	Tareela Volcanics (Ct)		Andesitic and rhyolitic flows and pyroclastics		
	Insolvency Gully Formation (Ci)		Subgreywacke, feldspathic sandstone, siltstone, mudstone, conglomerate, chert		

Upper Carboniferous	Sybil Group	St. James Volcanics (Cs)		Andesitic, rhyolitic flows and pyroclastics. Sub-greywacke	
		Marshs Creek Beds (Cm)		Conglomerate, sandstone, shale, limestone, etc.	
		Hells Gate Rhyolite (Ch)		Rhyolitic flows, pyroclastic, minor tuffaceous sediments	
		Ellenvale Beds (Ce)		Rhyolitic flows, pyroclastics; subgreywacke, sandstone, conglomerate, shale, mudstone	
		(No formation name) (C)		Shale, chert, limestone, subgreywacke, conglomerate; rhyolitic, andesitic flows, pyroclastics	
		Percy Creek Volcanics (Cp)		Andesitic flows, pyroclastics	+ Dotswood copper
			(Cg)	Coarse pink granite, minor microgranite	+ Kangaroo Hills tin, wolfram
	Oweenee Granite (Cgo)	Pink porphyritic granite, microgranite	* + Kangaroo Hills tin, wolfram * Macaulay Creek copper * Kangaroo Hills iron * Ollera wolfram		
Lower Carboniferous		Clarke River Formation (Ce)		Sandstone, shale, limestone, conglomerate	
		Piccadilly Formation (Ca)		Arkose, feldspathic sandstone, quartz conglomerate	
Upper Devonian to Lower Carboniferous		Game Hill Beds (D-Cg)		Sandstone, shale, limestone, conglomerate, subgreywacke	+ Argentine silver
		Star Beds (D-Cs)		Sandstone, shale, limestone, arkose, subgreywacke, conglomerate	+ Coppermine Creek copper
		Hardwick Formation (D-Ch)		Sandstone, shale, limestone etc.	
		Lollypop Formation (D-CI)		Feldspathic sandstone, conglomerate	

Table 2 (cont)

Age	Rock Unit		Lithology	Associated Mineralization * Possible source + Host Rock
	Sedimentary or Extrusive	Intrusive		
Middle Devonian to Lower Carboniferous	(No formation name) (D-C)		Sandstone, shale, conglomerate, limestone	+ Rio Tinto copper
Upper Devonian	Myrtlevale Beds (Dum)		Feldspathic sandstone, siltstone, shale	
	Dotswood Formation (Dud)		Feldspathic sandstone, arkose, conglomerate, shale, siltstone, tuff	+ Far Fanning gold, + Piccadilly gold, + Mt. Keelbottom copper
Middle Devonian	Fanning River Group (Dmf)		Arkose, subgreywacke, limestone, sandstone, shale	+ Calcium, limestone + Calcium area, gold + Woodstock, iron
Silurian to Lower Devonian		Lolworth Igneous Complex (S-Di)	Porphyritic granite	* + Gold deposits outside sheet area
		Ravenwood Granodiorite Complex (S-Dr)	Granodiorite, quartz-diorite, gabbro	+ Gold deposits outside sheet area. * Bunkers Hill gold
		Late acid-phase (S-Da)	Granite, aplite, adamellite	+ Fanning gold, Grass Hut gold, Newhaven gold, + Marmy Creek lead
	Kangaroo Hills Formation (S-Dk)		Sandstone, shale, greywacke, conglomerate	
	Tribute Hills Sandstone (S-Dt)		Quartz sandstone, siltstone	
	Greenvale Formation (Sg)		Siltstone, greywacke, sandstone, conglomerate	
Undifferentiated early Palaeozoic	Kirk River Beds (Pzk)		Micaceous shale, siltstone, lithic and feldspathic sandstone arkose	+ Bunkers Hill gold
	Ewan Beds (Pze)		Greywacke, lithic and quartzose conglomerate and sandstone	+ Kangaroo Hills tin, copper, wolfram, iron
	Charters Towers Metamorphics (Pzf)		Mica-schist, quartz-plagioclase-biotite gneiss	+ Gold deposits outside sheet area
Precambrian	Argentine Metamorphics (pCa)		Quartzite, schist, marble, gneiss, migmatite	+ Argentine silver, gold + Ponto gold
	Running River Metamorphics (pCr)		Quartzite, schist, amphibole	+ Kangaroo Hills tin, wolfram

at Argentine. Metallogenic associations in eastern Queensland have lately been reviewed by Webb (1969) on the basis of isotopic age-determination data. This review includes references to the mineralization in the Townsville Sheet area.

The associations of the various rocks and ore-bodies are summarized in Tables 1 and 2.

GOLD

The sheet area contains no major gold producing centres, but there are a number of scattered small deposits. In general, mineralization is of the quartz vein type, though there are exceptions such as the Welcome (Sala Siding) and Mount Success. The deposits are probably of several ages and associations.

ARGENTINE

Gold, both lode and alluvial, has been worked here, probably from the 1870's, but little is known of the occurrences. The total recorded production of the area is 1,700 tons of ore for 1,300 ounces bullion, and even allowing for unrecorded production it is probable that the area has yielded less than 2,000 ounces. In addition to the localities described below, there were mines at Dinner Creek (Bolger's Camp), Eight-mile, and North Star.

Argentine Extended(429-575). Apparently later incorporated in McCafferty's P.C. A small vein dipping westerly was followed by shafts at least 30 feet and 60 feet deep. Other claims were taken up in the same area, probably on the same line, without any great success. Between 1895 and 1898, 967 tons of ore gave 676 oz bullion. There is no record of later production, although the mine was worked from time to time until at least 1908 (Department of Mines, 1888, 1891-3, 1896-7, 1908-9).

Big Reef (locality unknown). Two crushings in 1913 from "a very large low grade proposition" averaged only thirteen shillings per ton, and nothing further was done (Department of Mines, 1914).

C.R.W. (430-572). At Six-mile Camp; was held in 1906 (Department of Mines, 1907).

Ponto. This was an early-day producing area, but no early history is recorded. In 1936 a trench 30 feet long and 8 feet deep was made on a lode reported to assay from 7 to 9 dwt per ton with a richer section on the footwall side. It was sampled under option but nothing eventuated (Warden, Charters Towers, 1936, p. 212).

Thermopylae. Near Argentine township. A large quartz lode carrying a little galena was worked for gold before silver-mining began in the area in 1881. It was then taken up for silver as the Caroline (Jack, 1886).

BUNKERS HILL

Situated 505-501, the country rock consists of slates of the Kirk River Beds intersected by small intrusions of granite (Ravenswood Granodiorite Complex). Auriferous white quartz carrying a little pyrite and iron staining occurs apparently as almost disconnected "blows" rather than defined veins. The deepest workings (60 ft) were abandoned

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in 1935, but reopened in 1950. The Mines Department Annual Report for 1950 states that a crushing came from a width of 14 feet, and apparently values were influenced by a "mineralized leader" 4 to 18 inches wide, intersecting the main ore-body. Recorded production, 1926 to 1934 and 1950, is 101½ tons for 222 oz bullion - probably about 150 oz gold (Reid 1926a; Department of Mines, 1927-36, 1951).

FANNING

The country is granodiorite and minor diorite of the Ravenswood Granodiorite Complex. The ore-bodies, apart from the exceptional Welcome deposit, are narrow steeply-dipping quartz veins with varying amounts of sulphides - pyrite, galena, sphalerite, and tetrahedrite. Gold values are rather sporadically distributed, and picking of the ore has always been necessary. The area is noted for high values but small tonnage - so small that it was not considered economic to bring a battery to the district until 1926, when a small company installed a 5-head plant at the Welcome.

Total recorded production is about 7,300 tons of ore for 6,000 oz bullion (probably about 4,500 oz gold), and about 1,150 oz gold obtained by smelting and cyanidation.

Butterfly (formerly Native Bee) (near 468-506). Six shafts have been sunk over a length of about 350 feet. These are 30 to 40 feet deep, except the main shaft which is 60 ft. At the bottom of the main shaft a drive follows for 25 feet a line of fissuring dipping about 60° SW. A 6-foot crosscut at the end of the drive followed a fissure dipping SE at about 70°. The first fissure carried small quartz veins, the second was associated with a diorite dyke. Nothing payable was found in either (Ball, 1941d).

Caledonia (about 465-509). Old workings are not documented. From 1919 to 1928 work done included sinking a new shaft to 180 feet and some driving at that depth. In 1937 the workings were extended to 223 feet depth. Stopping extends from this shaft to another, 150 feet distant, down to 120 feet, with some extensions to 185 feet. In the lower workings the vein averaged 8 inches in width. Recorded production is: 1919-28, ore 60 tons, gold 130 oz; 1937, ore 23 tons, gold 19 oz (Department of Mines, 1920, 1922-3, 1928-9; Lee, 1937).

Christian Kruck (near 463-509). Workings date from 1893 or earlier. There are at least five shafts, two of which are 130 feet and 120 feet deep. Only a few vein measurements are available, and these range from 1 inch to 12 inches. The small production figures suggest that the vein was generally small, and only very rich patches were workable. In addition to the recorded production some high grade ore was shipped to smelters. From 1893 to 1896, 31 tons of ore gave 86 oz bullion (probably about 60 oz gold), and from 1921 to 1940, 206 tons yielded 302 oz gold (Department of Mines, 1895, 1922, 1924-9, 1936-9, 1941; Inspector of Mines, 1926, p. 450; Warden, Charters Towers, 1931, p. 379; 1932, p. 212; 1935, p. 399).

Curlew (locality not known). Between 1893 and 1897, 35 tons yielded 138 oz bullion.

King Solomon (465-505). From 1893 to 1900, 45 tons yielded 88 oz bullion.

Kitty Cummins (about 466-511). The lode, which occupies a strong fissure between good walls 2½ feet apart in granite, strikes 295° and dips vertically. Apart from old surface workings, there is a shaft 100 feet deep with a drive 82 feet to the west at the 80-foot level. This shaft collapsed at the end of 1936. In 1937 a new shaft was sunk to

78 feet, but its relation to the other is not known. Recorded production (1933-6) is 340 tons for 155 oz gold (Denmead, 1935; Department of Mines, 1937-8),

Native Bee. See Butterfly.

Native Bee East (near 469-505). The country rock is red granite, but the lode occurs in altered dioritic material, apparently a dyke. It strikes ENE and dips southerly at 70°. The workings extend over a length of 250 feet. There are at least eight shafts, none of which is known to be deeper than about 20 feet, except the main shaft (63 feet). There are drives at 30 feet (46 feet west), at 35 feet (23 feet east), and at 48 feet (18 feet west, 10 feet east). The vein, 6 to 8 inches wide, carries pyrite and galena. Recorded production (1940-1) is 45 tons of ore for 14 oz gold (Ball, 1941d).

Rainbow (locality not known). A small but rich lode was worked to at least 45 feet in 1923 (Inspector of Mines, 1923, p. 398; Department of Mines, 1924).

Rose of Allandale (465-504). The vein, almost vertical, is associated with a diorite dyke which apparently formed the line of weakness followed by the fissure. The thickness of the vein ranges normally from 6 to 12 inches, with an observed maximum of 24 inches. In many places the greater part of the gold occurs in a small dogstooth quartz vein adjoining the footwall section of the main vein. Minor faulting is common. The vein has been proved to extend over 900 feet in this mine and the adjoining ones, and to a depth of 155 feet. Total recorded production is 605 tons for 547 oz gold, with about 280 oz gold in the "sand" (Morton, 1940b; Denmead, 1948c; Warden, Charters Towers, 1950, p. 127; Department of Mines, 1950, 1951).

Rose of Allandale No. 1 Southwest. Adjoining the Rose of Allandale. Three shafts were sunk, the deepest 55 feet. A shoot about 50 feet long was worked. 72 tons of ore gave 56.5 oz gold (Morton, 1941b).

Rose of Allandale No. 2 West. Adjoining the Rose of Allandale No. 1 SW. The vein was prospected to a depth of 55 feet, with 45 feet of driving at 40 feet. 33 tons of ore gave 2.6 oz gold (Morton, 1941c).

Sebastopol (locality not known). In 1903 there was a shaft 70 feet deep on an 8-inch vein dipping north. 30 tons of ore gave 31 oz bullion (Department of Mines, 1904).

Smith's Recompense (locality not known). In 1927, 32 tons of ore gave 14.5 oz gold (Department of Mines, 1928).

Welcome (468-510). An exceptional type of deposit near Sala Siding. It takes the form of an irregular circle, about 180 feet in diameter, of hydrothermally altered granite, bounded by a well-defined wall. The ore-body forms a narrow zone around part of the periphery. The ore consists of brecciated granite with introduced material - vein quartz, calcite, sulphides, and, in the upper levels, feldspar. The sulphides include sphalerite, pyrite, occasional chalcopyrite, and, very rarely, pyrrhotite. Gold was associated mainly with the sphalerite. Deposition appears to have been controlled by the attitude of the wall and small transverse shears.

The stoping width was mostly about four feet. Surface workings extend around much of the circle of alteration, but most of the ore was won from one section occupying about a third of the circumference. Payable values extended to about 80 feet depth, exploration below this being unsuccessful.

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In 1955-56 three diamond drillholes were put down by the Mines Department. These failed to discover any further payable sections along the periphery, and demonstrated that the "core" of the deposit, although hydrothermally altered, is only very weakly mineralized (Levingston, 1960).

From 1906 to 1953, 3,600 tons of ore gave about 2,600 oz gold.

Other Mines. Other mines known to have been worked, but on which nothing is otherwise recorded, are the Kookaburra, Lady Rebecca, New Churn, Milne's Reward and Leviathan.

FAR FANNING

Although gold was reported from here in 1866, and worked in desultory fashion for many years afterwards, it was not until the 1890's that much attention was paid to this field. The country rock is sandstone and shale of the Dotswood Formation, dipping 25 to 30° WSW. These sediments are cut by vertical or near-vertical acid dykes which possibly have some genetic connection with the mineralization, although intermediate dykes related to the Kitty O'Shea intrusive centre are also a possible source. The ore takes the form of veins or stringers in dykes or sediments. In the dykes networks of veins are formed, producing ore-bodies of appreciable width from which the small amount of crushing material had to be sorted; in the sediments small veins usually more or less conformable with the bedding occur singly. Recorded production from the area is 3,756 tons of ore for 2,398 oz bullion (about 1,600 oz gold), by far the most important producers being the Lancashire Lass and Lancashire Lass No. 1 W.

Bank of England. Immediately east of the Lancashire Lass. A 60-foot shaft in fine-grained sandstone cut a few small leaders. Two other shafts were sunk previously (Rands, 1898).

Great Caesar (447-537). Some work was done in 1933-36, but most of the workings are much older. The lode strikes 80° and dips 35° N, in shale and sandstone of the Dotswood Formation. As exposed at the surface it consists of two fissures 3 feet wide and 12 feet apart, but apparently mining was normally confined to 10 to 12 inches of the richest material. The ore was very arsenical. The main shaft is reported to be 85 feet deep, with 36 feet of driving at the 40-foot level.

There are numerous other shallow shafts and surface cuts on the lode outcrop. From 1933 to 1936, 51 tons of ore gave 19 oz gold (including cyanide recovery). Nothing is known of earlier returns (Denmead, 1947a).

Kitty O'Shea (about 443-540). Workings are : a 100-foot shaft on a vein reported to be 8 inches wide; a shaft 15 feet vertical and 8 feet underlie on a 2-inch vein; and an open cut which yielded 12 tons of 1 oz ore (Rands, 1898).

Lancashire Lass. This deposit is associated with a near-vertical dyke striking easterly. At the time of Rands' visit the working shaft was 60 feet deep and at the bottom showed 3 feet of feldspathic "formation" carrying horizontal pyritic quartz leaders and 2 feet of vein quartz with much pyrite. At 45 feet a drive connected with a shaft 100 feet to the east. Rands commented that the necessity for picking was well illustrated by the fact that three years' work on wide faces had yielded only 212 tons of crushing material. Subsequently an attempt was made to work the deposit without sorting, but this ended in failure. Total recorded production from the mine (1891 to 1900) was 1,890 tons of ore for 1,522 oz bullion (about 1,200 oz gold) (Rands, 1898; Department of Mines, 1900).

Lancashire Lass No. 1 West (Later Good Luck United, Mount Melba and True Blue). Fine-grained sandstone and purplish slate dip at 25 to 30° SW. A vein dipping 45° SW was followed to at least 100 feet on the underlie and three levels driven, the longest about 180 feet at about 50 feet V.D. In the southeastern end of the upper workings the fissure was up to 5 feet wide, with up to 2 feet of vein quartz carrying much pyrite, arsenopyrite and a little chalcopyrite. The vein in the northwestern end was much smaller - 3 to 4 inches. At the 48-foot (V.D.) level a stockwork of minor veins dips away from the main vein at 20° NE. This has been worked over a length of 190 feet with an average width of 5 feet and an average height of about 10 feet, down to a maximum depth (vertical) of about 60 feet. In 1946 a new shaft was commenced to tap this part of the workings, but did not meet them.

Recorded production under the name Mount Melba was 1,063 tons of ore for 551 oz bullion (about 230 oz gold). Rands records 117 tons ore for 153 oz bullion from the Good Luck United (Rands, 1898; Department of Mines, 1908, 1909; Denmead, 1946).

Mount Hogan (about 443-538). From 1898 to 1900, 378 tons of ore gave 145 oz bullion (about 125 oz gold) but there is no record of the workings (Rands, 1898; Department of Mines, 1909).

Mount Macalight (originally Mount Malachite?). In 1908, 50 tons of ore gave 7½ oz bullion. Nothing is known of the workings (Department of Mines, 1909).

Spotted Calf. About 0.4 miles east of the Lancashire Lass. The country rock is hard coarse sandstone. The main shaft, 60 feet deep, cut, a few feet above the bottom, a 2 foot 6 inch vein dipping 45° WNW. At 48 feet a small drive was made on a set of leaders dipping 30° N. An adjoining shaft showed a similar set. To the west, 15 tons of 1½ oz ore is reported to have been won from a third shaft (Rands, 1898).

Tunnelling Area. About 12 chains west of the Lancashire Lass. Some open workings yielded 300 tons of ¼ oz ore. Other workings are an adit below the main workings and an underlie shaft, by far the deepest in the area (Rands, 1898).

Union. 250 yards west of the Tunnelling Area. A shaft 70 feet deep cut a few leaders in sandstone, 1 to 4 inches wide, striking east. At the surface 150 tons of ½ oz ore was won (Rands, 1898).

GOLDEN VALLEY

Golden Valley (455-521) is only about a mile from Mount Success, and probably belongs to the same age of mineralization, but unlike the irregular pipe of Mount Success, the Golden Valley deposits are typical veins. The association of intrusive rhyolites with the veins points to them as the mineralizing agent. Gold was discovered here shortly after Mount Success, and worked until 1914. Several veins were discovered, but the Golden Valley vein was by far the most important. This lies between granite (Ravenswood Granodiorite Complex) and felsite (associated with the rhyolite), and dips 30° S. At the surface, workings are practically continuous over about 2,000 feet in length, but only three of the mines appear to have achieved any depth. Recorded production from the area, 1898-1914, is 2,227 tons for 4,923 oz bullion (probably about 3,500 oz gold) and other products (concentrate, etc.), of a total value of \$32,700.

Golden Valley P. C. The main shaft is 370 feet deep (underlie), and others are 200 feet (vertical) and 140 feet (underlie). The vein was composed of quartz with much sphalerite and pyrite and a little calcite. Near the surface it averaged about 6 inches in width and about 2 oz gold per ton, but in depth it was smaller and richer, the

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shoot in the lower levels trending to the east. To the east of the shaft the vein was truncated by a fault dipping southwest, but the existence of workings further to the east indicates that the continuation of the vein was found beyond the fault. This mine in its main period of operation probably produced by far the greater part of the gold won from the Golden Valley area. It was reopened in 1922 and again in 1934 but on each occasion closed after a small parcel of ore had been obtained. In addition to Golden Valley it was also known at different times as the Belinda and the Yellow Tulip (Rands, 1898; Denmead, 1935; Department of Mines, 1899, 1906-10, 1914-5, 1922, 1933, 1935).

Golden Valley Block. A shaft 500 feet south of the P. C. shaft cut a 7-inch vein at 90 feet, 18 inches to 2 feet of "formation" at 110 feet, and 3 feet 9 inches of "vein and formation" at 170 feet. This shaft is possibly the same as the straight shaft described under Golden Valley P. C. as 200 feet deep (Rands, 1898).

Golden Valley No. 1 East. An underlie shaft was sunk to 317 feet and at least four levels driven. Portion of the shoot worked in the P. C. extended into this ground. In 1921 a party unwatered the shaft and described the exposures as "formation" several feet wide carrying two small quartz veins high in gold values. The veins must have been too small as nothing more appears to have been done (Rands, 1898; Department of Mines, 1907-10, 1914, 1922).

Golden Valley No. 1 West. This has been worked to at least 45 feet depth by two shafts. The early workings were on a vein 6 inches wide yielding $4\frac{1}{2}$ oz bullion per ton (Rands, 1898).

Golden Valley No. 2 West. A small vein was cut at 40 feet depth (Rands, 1898).

Queen (same as Valley Queen?). A vein striking NNW and dipping at 30° W. in sandstone was worked in the early part of this century. A rich patch must have been found in 1903 when 8 tons of ore gave $90\frac{1}{2}$ oz bullion, but the overall recorded return - 141 tons for 157 oz bullion - is not encouraging (Department of Mines, 1901, 1904, 1907-8).

Rocky (about 460-521). A rich vein 3 inches wide was worked 1908-10 and 82 tons of ore yielded 164 oz bullion (about 130 oz gold) (Department of Mines, 1909-11).

GRASS HUT

It is not known when mining commenced in this area but it was in progress as early as 1887. In 1890 a company was formed and a township established, but this practically collapsed in the following year. From then until 1910 small parties produced intermittently.

There is no record of the nature of the ore-bodies or the extent of the workings. From what is now visible at the surface the veins, in hornblende granodiorite (Ravenswood Granodiorite Complex), appear to be almost vertical. They are composed normally of white quartz with a little pyrite. Here and there calcite takes the place of some of the quartz. Mr. Alford, who owns the surrounding country, advised that the City of Melbourne workings, at 300 feet, were the deepest in the area. Three shafts over a length of about 900 feet are the only indication of their lateral extent from the central main shaft. The other mines in the area appear to have been worked from only one shaft at each.

Total recorded production (1887 to 1910) is 1,933 tons for 2,000 oz bullion, ranging from 400 to 700 fine (Department of Mines, 1898, 1891-4, 1901-11).

HAUGHTON VALLEY

From the early days of the Ravenswood Goldfield, prospecting was carried over the Coast Range to the Haughton Valley area and a small production of alluvial gold was achieved. In 1931 there was a small rush to the area as a result of a rich crushing of lode from Mount Norman but it was found (Morton, 1931) that the gold occurred in a zone of greisenized granite separating normal biotite granite from the metamorphics (schists, quartzites, etc. of undifferentiated Palaeozoic age) into which it is intruded. The ore occurred as very rich but erratic "bunges" and production was small - 33½ tons for approximately 110 oz gold.

Further to the east are two occurrences of more usual type - Mount Square Post and Mount Sulphide.

Mount Square Post (worked as the Blue Doe and the June Ellen - near 485-520). Gold occurs in thin quartz veins in granite. Total recorded production, from surface work only, is 8 tons of 12 dwt ore. Galena, pyrite, chalcocopyrite and sphalerite are associated with the gold (Ridgway, 1946b; Connah, 1953a).

Mount Sulphide (also known as Gibraltar) (about 481-511). A quartz vein up to 3 feet 6 inches wide carries pyrite and galena. It was prospected in 1934-35 and again in 1940 for a yield of 64 tons of ore, which returned 52 oz gold and 707 oz of silver. Workings extend to a depth of 35 feet (Cribb, 1940b).

Saint-Smith (1020b) described a galena-bearing quartz vein being prospected in 1920, but its subsequent history is unknown.

MAGNETIC ISLAND

Small (1-foot or less) quartz veins occur in the granite of Magnetic Island and some alluvial gold has been won from the same locality. There is no record of production (Maitland, 1892).

MOUNT SUCCESS

The country rock consists of granite of the Ravenswood Granodiorite Complex overlain by sediments of the Fanning River Group. These sediments, originally limestone and shale, have been metasomatized to a variety of skarns. Most of this metasomatism has been produced by the intrusive rhyolite of Mount Success, but basic intrusives possibly related to the Kitty O'Shea intrusive centre are also present.

Mineralization has followed the curve of the granite-sediment contact over a length of some 2,000 feet, forming an arc concave to the west. The ore minerals include pyrite, marcasite, sphalerite, galena, chalcocopyrite and enargite, with quartz and calcite. There is some evidence of two phases of mineralization.

Mount Success (453-522). Payable values were found only in the vicinity of the Mount Success mine itself, at the far southwest of the mineralized zone. A pipe-like shoot some 20 to 30 feet in diameter was worked out to 130 feet depth, with exploratory workings extending to 178 feet.

During the working years, 1896 to 1908, recorded production was 1,982 tons of ore for 797 oz of bullion (probably about 650 oz gold) and concentrate valued at \$1,274. This last figure is definitely incomplete, as it is known to come from 453 tons treated in 1905. The returns from silver were greater than those from gold, so that the unrecorded

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concentrate presumably represents the greater part of the production value. Some alluvial gold was also produced in 1895 before the primary deposits were discovered.

The mine was re-opened briefly in 1950 but the prospects were considered not encouraging and no underground work was done (Rands, 1898; Ansley, 1908; Cameron, 1931; Reid, 1934; Carter, 1950; Department of Mines, 1897, 1898, 1901).

NEWHAVEN

The workings here (392-502) are on a single vein, discovered in 1896. It was worked until 1900 and except for a short period in 1933-4 has been closed ever since. The vein, in granite (Ravenswood Granodiorite Complex), is about 4 feet thick and practically vertical. It has been worked and prospected at the surface for a length of about 600 feet. The main shaft, in the centre of the deposit, is 150 feet deep; elsewhere the workings do not extend below 50 feet.

Total recorded production is 923 tons for 649 ounces bullion (probably about 400 oz gold).

PICCADILLY

The country consists of red beds - siltstones and fine sandstones - of the Dotswood Formation striking a little N of E and dipping southerly at 30° to 40°. They are somewhat indurated, and carry numerous cubes of pyrite. A major east-west fault which passes through the area has possibly helped to localize the mineralization.

The area was fairly intensively prospected from about 1892 onwards, and the number of prospectors employed suggests that probably a fair amount of alluvial and eluvial gold was won, of which there is no record. Only one vein is known to have been worked to any extent - the Piccadilly Reef. There were several claims on this vein, but most of the work was done on two of them. Owing to confusion in nomenclature it is impossible to separate the production from the two, and as they adjoined they are described together.

Piccadilly P. C. and No. 1 W. and Piccadilly Nos. 3 and 4 West (409-549). The vein, which is conformable with the bedding, consists of 3 to 4 inches of quartz carrying pyrite and possibly other sulphides. The workings in both mines reached 500 feet depth (inclined) but apart from one reference to one of the lower levels in the P. C. and No. 1 West being 635 feet long, nothing is known of their lateral extent. Although the ore was very rich, costs were high because of the small size of the vein, and because much of the gold was contained in the sulphide fraction and had to be recovered by smelting. The field closed in 1914, after a year or so of diminished output. Recorded production from the mines was 4,213 tons of ore for 7,297 oz bullion (probably about 5,500 oz gold) and concentrate, etc. valued at \$9,000. However, concentrate returns are available for only part of the output, and for those the value of the concentrate was comparable with that of the bullion, so that the head value of the ore must have averaged about 2½ oz per ton. During 1933-4 a further 140 oz was obtained by cyaniding 833 tons of the old tailings (Department of Mines, 1892-1912, 1934-5).

Great Britain. In 1913 reference was made to the "Piccadilly West and Great Britain" and in 1914 to the "Great Britain". Presumably it was on the Piccadilly Reef, but otherwise nothing is known of it. In 1914 ore totalling 36 tons gave 46 oz bullion (Department of Mines, 1914-5).

Scrub Bull (locality not known). From 1897 to 1899, 76 tons of ore yielded 231 oz bullion.

OTHER LOCALITIES

Jack (1891) reports having examined a vertical lode, 5 to 6 feet wide, named "Hein's Lode" in the limestone to the west of Double Barrel Creek, near Calcium. The lode is associated with specular hematite, garnet, crystalline calcite and copper staining - obviously one of the pyrometamorphic segregations of which there are many in the area. No production is recorded.

Jack (1879) also records small nuggets on the Ross River, near the "Kennedy Hotel" (about 7 m. W of Stuart) and suggests the gold was probably derived from Mount Stuart.

Dunstan (1913) listed occurrences of gold at Castle Hill, Townsville (in quartz) and Mount Elliot (in quartz, associated with pyrite and sphalerite). In each case the reference is to a specimen in the Geological Survey Museum and no further details are known.

SILVER, LEAD AND COPPER

Because of the association of these three metals in many of the mines, most of which are in the Kangaroo Hills area, they are conveniently considered together. Generally, the historical pattern throughout the area has been that of a "rush" late last century followed by sudden collapse and virtual neglect ever since. The principal areas are Ewan and Macaulay Creek (silver, lead, and copper) and Argentine (silver, lead).

A small, somewhat unusual, source of copper is the stannite ore of the Sardine mine, which has been described with the tin mines.

ARGENTINE (STAR RIVER) (Jack, 1886) - (centred on 430-570)

Gold deposits were worked here before silver was discovered, but apparently they were not important. Silver was discovered in 1881, and within a short time 120 properties, mostly Mineral Selections, had been taken up. Smelting works were built near the township of Argentine which had sprung up, but these soon closed and by the time R. L. Jack visited the field in 1886 only one mine was working. Jack considered that the failure of the smelters lay in the small amount of ore available, and the attempt to smelt the ore as mined, without concentration. Since 1886 the field has been practically abandoned, probably owing in large measure to the main part of it not being available for mining lease tenure.

The country consists of schist, slate, and gneiss of the Argentine Metamorphics, sandstone of the overlying Game Hill Beds, and late Palaeozoic granodiorite intrusive into them. The mining area is at the centre of a domal structure in the Game Hill Beds about 8 miles in diameter, from which the central part has been removed by erosion.

The ore-bodies, which occur in rocks of all three formations, range widely in strike and dip, but most strike within 20° of north and dip to the east. This trend is parallel to that of major faults to the north and west. The actual lode material ranges from brecciated country rock injected with sulphides through more siliceous types to quartz veins, in some cases gradations occurring along the length of a single lode. Primary ore has been worked in only a few mines, but even this limited exploration has yielded pyrite, arsenopyrite, chalcopyrite, sphalerite and stibnite, in addition to galena. It seems probable that, although there are patches of fairly pure galena, most of the primary ore is complex. This range of types in the primary ore is reflected in the secondary ore, which accounted for most of the output of the field. Generally lead oxide (massicot?),

cerussite and anglesite are the lead minerals, but linarite has been observed in one mine. Ironstone gossans frequently accompany the lead ores, and copper carbonates occur in places.

Although Jack refers to one of the veins of the area (the Thermopylae) as having been worked for gold before the discovery of silver, no gold is recorded from the silver ores, and possibly this was an isolated vein allied to the gold deposits further to the north, representing a different period of mineralization.

The age of mineralization at Argentine has not been established, except that it is younger than the Game Hill Beds. Recent work by Wyatt et al (1965) shows that, contrary to Jack's view, the granodiorite intrudes the Game Hill Beds. In the absence of any apparent alternative source the granodiorite magma is regarded as the likely origin of the mineralizing solutions.

The Mines

Jack lists 45 mines as having been worked and his map shows many others. As he notes, most of the areas were taken up for purely speculative reasons and little was done on them. Of those in his list, only four were worked to any extent - the Ard Righ, Colorado, Hero, and Northbrook. As Jack's report, which constitutes virtually the only record of these mines, is long since out of print, the details are summarized below.

Ard Righ (M. S. 2946). Three lodes have been worked in this ground. In the southwestern corner a shaft, estimated to be 40 feet deep, was sunk probably in search of the continuation of the lode in the southeastern corner of the Southern Cross. In the southeastern corner a shaft, reported to be 72 feet deep, is said to have cut the Overlander lode which was very pyritic at this point. A trench near the shaft was probably intended to cut the same lode. Near the northern boundary an open-cut and an underlie shaft about 50 feet deep worked a lode dipping 50° N. 100° E. Where exposed in the open cut the lode is 2 feet 6 inches wide, comprising mainly ironstone and broken schist. No other information is available on these particular workings, which were regarded as important ones in the early days of the field.

Colorado (M. S. 2960). The principal workings consisted of an adit 90 feet long; an underlie shaft connecting it to the surface; and drives from the adit totalling 243 feet in length. The lode explored strikes N. 35° E. and dips to the southeast. Over most of the exposed length it consisted of 1 to 3 inches of poor manganese-stained pyritic material, but towards the eastern end it improved to 6 to 8 inches with numerous strings of oxidized lead minerals and galena. Stopping was carried out over a length of about 66 feet. Three other adits, intended to cut this lode at other points, apparently failed to reach it.

In the workings from the main adit two other lodes were exposed. About 57 feet from the eastern end of the drive a vertical winze cut at 30 feet a lode striking north-northeast which was followed to the east-southeast for 30 feet on the underlie. This lode consisted of 2 feet of gangue with 3 to 8 inches of arsenopyrite, chalcopyrite and galena. The second was a north-striking lode which cut across the original one near the eastern end of the drive. This was followed to the north for 42 feet and this drive connected to the surface by a shaft. This lode, which dips 65° E., shows 1 to 3 inches of ore.

In the eastern part of the block workings were on a branch of the second lode exposed in the adjoining Ben Lomond (q. v.). This branch, dipping at 45° ENE. was followed in an adit 75 feet long, and a winze from it 20 feet deep. Another branch of the Ben Lomond lode was exposed in shallow surface workings and an adit intended to cut it was driven 25 feet.

Hero (M. S. 2919). This was the most important mine of the field, and the one for which the smelter was erected. It was worked during 1881-86 and 1887-92.

Jack (1886) described four lodes and the workings on them as follows :-

(1) Near the northern boundary a lode dips 60° ENE. The gossan is at least 2 feet wide and contains kernels of anglesite. Only a little surface work was done.

(2) To the south of (1). The lode dips southeast. It was opened by a shaft 15 feet vertical and 30 feet on the underlie, and by drives 15 feet each way at the bottom of the vertical section. There was also an open-cut adjoining the shaft. Jack commented "the ore must have come from within the limits of the shaft and open-cut, as there is hardly any left in any of the faces".

(3) West of (2), a small lode was partly exposed by a shallow shaft.

(4) On the southern boundary a lode dips 60° S. 10° E. It is 18 inches wide, of good, partially oxidized ore. A vertical shaft to cut this lode reached 40 feet (?), without attaining its objective.

The workings recorded by Connah (1955) on the basis of information supplied by A. W. Wilson consisted of three adits and workings below two of them. Although not certain, it is possible that the first two are on lodes (3) and (2) above.

(a) No. 1 adit 390 feet long, of which 360 feet was on the lode. Below this a winze was sunk 129 feet I. D. with drives to the southwest for 63 feet at 60 feet I. D. and 40 feet at 129 feet.

(b) 360 feet SSE of (a). No. 2 adit 300 feet long on a lode. Below it a winze 320 feet I. D., with drives 104 feet to the northeast and 130 feet to the southwest at 160 feet I. D. and 40 feet to the northeast and 60 feet to the southwest at 225 feet.

(c) 600 feet southwest of (b). No. 3 adit 200 feet long, intersecting a lode 5 feet wide at 170 feet, and from that point a drive 223 feet easterly. It is not known whether this lode is the same as the one in (b).

Apart from the reference in (c) no information is available as to the width of ore in any of these workings, nor is it known what stoping was done. The only recorded production was during 1886-9 when $125\frac{1}{2}$ tons of hand-picked ore returned 29,862 oz silver and 10.1 tons lead.

In 1965, No. 1 adit was reopened as far as the winze, which was then cleaned out to 60 feet depth. It was found that all ore adjoining these workings had been stoped out. No further work was done (Inspector of Mines, 1966).

Northbrook (M. S. 3042). This was the only mine still working when Jack visited Argentine in 1886. There are two lodes. The first was worked by a shaft which cut it at 12 feet and followed it for 34 feet on the underlie. The vertical section of the shaft passed through conglomerate of the Game Hill Beds (a tiny outlier) and the lode was cut in schist country, but whether the lode passed into the conglomerate is not recorded. The lode, 1 to 4 inches thick has a minor content of lead minerals. The second, further to the west, was worked by an adit ("Beazley's Tunnel"), which cut the lode at 72 feet, and an underlie 35 feet deep. The lode, which dips to the north at about 20° , consists of up to 6 inches of dense lead ore and up to 2 feet of gangue.

Smaller Mines

Many other properties have either been prospected to some extent or contain outcrops of lodes or quartz veins. The following summaries are based on Jack (1886).

Albion (M. S. 2921). The principal lode, mainly of quartz, dips 75° N. Workings were a pothole showing 6 inches of lode, and an underlie shaft probably over 20 feet deep. A small tunnel and trench further to the south exposed a small vein of similar quartz.

Alpha (M. S. 2887). The first silver mine on the field, opened in 1881. The main lode, traceable for 100 yards at the surface, dips 65° N. 20° E. Two shafts prospected it - one, 22 feet deep, started on 20 inches of oxidized ore which practically disappeared at the bottom; the second was 34 feet deep. At 150 feet south of the main lode, the "back lode" dips east-northeast at a lower angle. Its gossan, in addition to the usual oxidized minerals, contained linarite. One shaft, 9 feet deep, on this lode showed 3 inches of oxidized ore at the bottom.

Ben Lomond (M. S. 2962). There are three lodes. The first strikes north-northwest. An adit to reach it was stopped at 10 feet. The second, further north, strikes northwest. It has been prospected by many shallow openings. An adit to cut it stopped short, as probably did a shaft 20 feet deep. The third, to the east of the above, is a large quartz vein dipping east at a low angle.

Bonanza (M. S. 2904). The main lode dips north-northeast. Workings were an open-cut 20 feet long, a shaft 14 feet deep, and a vertical shaft still short of the lode at 30 feet depth. The ore is 2 to 8 inches wide, mainly lead oxide. About 100 yards to the north are another lode, 9 inches wide and dipping south-southeast, and a quartz vein striking north-northwest.

Bonanza North (M. S. 2908). Workings were a pothole on a 4-inch vertical quartz vein; a short adit on a quartz vein striking north-northwest; and a short adit which failed to cut a lode whose existence was inferred from "floaters" of ore.

Bowden and Party (M. S. 2992). A shaft was sunk at least 30 feet on a 3- to 4-inch vein of arsenopyrite dipping steeply east-southeast. To the southeast a lode showing a little gossan but mostly gangue, dips 60° SE.

Caroline (M. S. 2905). An east-west line of floaters of plumbiferous gossan and jaspery quartz suggested the presence of a lode, but no work was done.

Cleopatra (M. S. 2920). A lode dips 50° S. Workings consisted of an open-cut and a shaft 45 feet deep.

Croesus (M. S. 2925). A shallow pothole showed small amounts of lead, but two shafts, the deepest 30 feet, were apparently unsuccessful "blind-stabbing".

Eureka (M. S. 2895). Ferruginous floaters run east-southeast for about 100 yards. Two shafts were sunk a few feet but found only kernels of ore, not a definite lode.

Excelsior (M. S. 2956). A lode, striking N. 190° E. and dipping east at a low angle, was followed by a shaft about 40 feet deep, which showed plumbiferous gossan but nothing payable. To the north is another unexplored lode striking N. 170° E. and dipping east.

P. F. Hanran (M. S. 2983). The lode is probably a continuation of that in the northern part of the Royal Standard: if so it is at least $\frac{3}{4}$ mile long. It has a dip of 65° N, 55° E. In a small open-cut, the lode was about 6 feet wide, composed of oxidized lead ore and gossan. To the north a hole was sunk 11 feet on another lode.

Hope (M. S. 2923). A shaft about 12 feet deep, and another to the south, failed to yield ore.

Hubert and Party (M. S. 2975). Just outside the southeastern corner a trench and small cutting exposed a lode dipping south-southeast. It was about 18 inches wide, of which 8 to 10 inches consisted of chlorite and arsenopyrite. Near the northeastern corner is a quartz vein.

Humphrey and Party (M. S. 3026). This selection is in granite. A shaft was sunk 18 feet on a lode carrying oxidized lead ore. Two other lodes, one south of the shaft and dipping east-northeast, the other one near the northern end of the ground and dipping east have not yet been worked.

John Bull (M. S. 3074). A lode, dipping 60° S., runs across the southern part of the ground. In the southeastern corner a trench exposed a 22-inch lode, of which 3 to 5 inches is ore, the remainder quartz. On the eastern side of the ground potholes near a quartz "blow" showed a thin vein of galena, dipping 45° N, 105° E., conforming with the enclosing schist.

W. Jones (M. S. 2977 and 2978). On M. S. 2977 (Nil Desperandum) three shallow open-cuts worked a lode dipping 75° ESE. Of the 12 feet width to which the lode bulges, only $2\frac{1}{2}$ feet was worked, and even this was not rich. On the northern boundary a lode enters this ground from the adjoining Excelsior. On M. S. 2978 there are no workings. An unpayable lode 8 inches wide dips 75° SE near the southern boundary, and a large quartz vein runs north-northeast across the northern boundary into the Ben Lomond.

Lady Annie (M. S. 2917). Four lodes have been explored: (i) Near the southern boundary a shallow shaft was sunk on a narrow lode dipping northeast; (ii) Behind and parallel to this a second lode has been worked by a large open-cut; (iii) Behind and parallel to these a lode has been explored by a shaft 20 feet deep, and another, also 20 feet deep, was sunk in search of it; (iv) To the west of these, a gossany lode striking north has been explored by two shafts, 20 feet and 15 feet deep, with connecting drives.

Lily Maud (M. S. 2930). A large quartz vein strikes east on the northern boundary. No work has been done on it.

Morrison and Party. M. S. 3008 - A large, but apparently poor lode strikes north-northwest. M. S. 3018 - contains three definite quartz veins, boulders and small outcrops of vein quartz, and a "blow" of plumbiferous gossan. M. S. 3019 - a lode carrying oxidized lead ore dips east. In vacant ground to the south is another large lode carrying oxidized lead ore. M. S. 3023 - no lodes on the ground, but on vacant ground to the south a lode containing galena and cerussite, dipping 65° SE, has been opened by a shaft 35 feet deep. M. S. 3032 - no lodes exposed.

Murphy and Godson (Por. 73). The northward extension of the lode worked in "Beazley's Tunnel", on the Northbrook, was followed for 55 feet by an underlie shaft. The bottom of the shaft showed 6 inches of sulphide ore containing galena, sphalerite, pyrite and stibnite.

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Nonpariel (Por. 144). Workings were a shaft inclined at 45° to the east, a tunnel 50 feet in hard sandstone and a vertical shaft over 30 feet deep.

Overlander (M. S. 2931). In the centre of the ground, near a quartz "blow", a shaft was sunk on a lode dipping 60° SE. The ore, in two 1-foot sections three feet apart, appeared promising. On the northern boundary a shaft was sunk on a gossany lode showing oxidized lead ore, up to 8 inches wide, dipping east-southeast at a low angle. This ground also contains two other lodes, two quartz veins and a quartz "blow".

Prince of Wales (M. S. 2910). A shaft 12 feet deep and an open cut exposed a lode dipping 80° N. This lode, probably the same as that worked in the True Blue, is up to 6 feet thick, and carries erratically distributed values. South of this lode a pot-hole has produced lumps of fair ore.

Royal Standard (M. S. 2958). A lode dipping at more than 45° N. 105° E. runs across the northern boundary. Large, but apparently not rich, at its southern end it becomes a quartz vein. A shaft 30 feet deep failed to cut it. In the southern part of ground a strong gossany lode, showing traces of lead and copper, strikes 340° and dips easterly. In addition to these the ground contains at least four quartz veins (two of which may represent a lode found in the Struck Oil) and two small plumbiferous leaders conformable with the schist.

St. John's (M. S. 2907). A lode 3 to 14 inches wide, carrying ironstone, galena and oxidized lead ore, dipping north-northeast was worked by a shallow underlie and an open-cut. A few feet to the south is another lode dipping south, about 8 inches wide at the surface. A shaft was sunk to cut it.

Silver Lining (M. S. 2936). Two shafts, one 30 feet vertical, one 20 feet on the underlie, were sunk on a lode in granite. It strikes north-northwest and dips easterly and is at least $2\frac{1}{2}$ feet wide.

Southern Cross (M. S. 2961). An underlie shaft was sunk 25 feet on a small lode dipping 75° N. 80° E., near the southern boundary. Potholes in the southeastern part also showed a lode 2 feet 3 inches wide dipping 60° ENE and a vertical siliceous vein striking east. The southwestern part carried a group of quartz veins dipping northeast conformably with the country, and a similar group dipping southwest. These veins carry a little lead in places.

Struck Oil (M. S. 2994). The main lode, which dips 45° N. 80° E., lies on the hanging wall side of a large quartz vein. It is composite, its 11 feet width including about 4 feet of relatively unmineralized country in the middle. It was prospected by a trench and two holes 10 chains further north. Near the northern end a shaft was sunk 15 feet on a quartz vein dipping 60° S. 30° E. Three other quartz veins occur on the ground, one of which probably continues into the Washington No. 2.

True Blue (M. S. 2916). An underlie shaft was sunk on a lode carrying veins of galena, dipping N. 10° W. South of this an open-cut 8 feet deep worked a lode carrying galena and cerussite, striking east.

Union (M. S. 2924). A shaft was sunk 30 feet on a lode 6 feet wide of quartz and schist with bands of plumbiferous gossan up to 3 feet wide. Another shaft, 50 feet vertical, does not appear to have cut the lode. This lode is the same as one worked in the Royal Standard, some 12 chains of it extending into the Union. It here dips 60° E. To the east, potholes expose a gossany lode 2 inches to 2 feet in width striking north-northwest and dipping at a low angle easterly.

Washington No. 1 (M. S. 2998). A shaft was sunk about 20 feet on a plumbiferous quartz vein. This vein, probably the same as one in the Struck Oil, strikes 350° with steep easterly dip. Northeast of this is probably another, parallel lode.

Washington No. 2 (M. S. 2999). A vertical shaft, about 30 feet deep, and a pothole have been sunk on some ill-defined gossany plumbiferous veins, dipping northeast. Further north a line of gossan boulders suggests the presence of another lode.

West Excelsior (M. S. 2997). A pothole was sunk on a gossany leader dipping northeast. Further north a small quartz vein strikes north-northeast.

Williams and Party (M. S. 2941). A trench showed a 3-inch vein of plumbiferous gossan.

Venture (M. S. 2951). This block lies on sandstone of the Game Hill Beds. An adit was driven 100 feet, of which 25 feet follows a lode 3 to 6 inches wide carrying pyrite, arsenopyrite and a little galena. To the east is an open-cut on a large, poor lode striking north-northwest and dipping easterly at a small angle.

Other Holdings. Many Mineral Selections shown on Jack's map are not mentioned in his text, presumably because they showed nothing worth recording. Among these were : Alabama (2918), Charles Dickens (2934), Cornstalk (2935), Crassus (2925), East Alpha (3051), Filthy Lucre (2949), Great Britain (2970), Guanaxuato (2957), Lady Sarah (2947), Loot (2938), Nil Desperandum (2977), North Colorado (2969), N. E. Colorado (2981), N. W. Colorado (2989), Silver Mount (2929), Silver Valley (2948), Trevethan (2976) and Union Jack (2922).

MACAULAY CREEK (Cameron, 1901, 1906) (382-595)

The deposits occur in Oweenee Granite which here contains a greenish alteration product. The granite is intruded by east-west dykes of quartz feldspar porphyry and dolerite. The ore bodies lie in "formation" - a siliceous, altered, sheared granite. This "formation" does not possess defined walls, but grades with varying rapidity into unaltered granite. The bodies of "formation" take the form of a series of more or less linear segments combined in branching or zig-zag groups, and apparently are formed by shearing and alteration along short sections of intersecting fissures. Although most of the "formation" carries a small amount of copper, workable deposits are confined to irregular masses and pipes. These patches of ore owe their existence in large part to secondary deposition, and below water level no payable bodies were found. The ore minerals comprise sulphides of copper (including bornite), galena and sphalerite.

The deposits were worked about 1900-05. In 1902 the Kangaroo Hills Mining and Smelting Co. Ltd took over the mines and a smelter was built at Ewan. This was a failure, probably because there was insufficient primary ore available to supply the necessary sulphur. The presence of lead and zinc would also have added to smelting difficulties. When Cameron visited the area in 1906 the mines were closed, and the only detailed record of the workings is in his 1901 report, which is summarized below. The total recorded production up to the time of his visit was about 1,334 tons of ore.

The Mines

Western. A shaft was sunk 52 feet vertical and 18 feet underlie on a "formation" about 10 feet wide striking 120°. A crosscut to the south at 52 feet passed out of this "formation" but in its course encountered part of another, striking north. At 40 feet from the shaft a second "formation" up to 14 feet wide and roughly parallel with the

first, was met. A drive about 50 feet long was made on this second "formation", and a shaft sunk to 52 feet at its western end. Two pipe-like ore-bodies were met, one in the first shaft and the other where the crosscut met the second "formation". On the northern edge of the second formation is a well-defined wall beyond which is a dolerite dyke, about 6 feet wide where met in the crosscut. The relation of this dyke to the ore-bodies is not known. These ore-bodies produced 202 tons of high-grade ore (175 tons from the first and 27 from the second) assaying 133.17 oz silver per ton, 12.50 percent copper, 12.00 percent lead and 6.78 percent zinc, and 170 tons of low grade ore (130 tons from the first and 30 from the second) estimated to carry 28 oz silver per ton, 4.93 percent copper and 4.4 percent lead. The ore from the second pipe was all obtained from a small chamber at the level of the drive.

Prospecting Area. Half a mile east of the Western mine. The "formations" form a "V" with its vertex to the north, the western leg, striking southwest, being traceable over 400 ft, and the eastern, striking southeast, over 350 feet. Both legs are interrupted in their course by faults striking west of north, and a similar fault runs through the vertex. Three ore-bodies were found. At the western extremity a section not particularly encouraging in outcrop was opened by an open-cut and a shaft 30 feet deep, with 30 feet of driving from it. The drives showed only 3 to 4 feet of soft clayey gouge containing no ore, but the shaft and open-cut yielded 89 tons of ore averaging 43.6 oz silver per ton, 7 percent copper and 12.5 percent lead. Just to the southeast of the vertex of the "V", on the eastern leg, another open-cut and shallow shaft yielded 284 tons of ore assaying 13 oz silver per ton, 4.0 percent copper and 8.8 percent lead. The third, on a creek bank near the far end of the eastern leg, was being opened in 1901.

Mount Long. To the north of Copper Knob. There are two formations, one striking west and the second northwest, intersecting the southern wall of the first. An adit following the second formation reached the intersection in a little over 100 feet, and from that point the first formation was followed by drives for 100 feet, and two winzes. The first formation is bounded on the southern side, near its western end, by a dolerite dyke. Two patches of ore were found, one in each "formation", and this work produced altogether 124 tons of ore assaying 14 oz silver per ton, 2.45 percent copper, 6.5 percent lead, 2.89 percent zinc. A shaft 150 feet above the drive on the first "formation", and probably on its upward continuation, yielded 60 tons of ore assaying 66.9 oz silver per ton, 8.6 percent copper and 22.89 percent lead. In this shaft, which is 25 feet deep, the ore pinched from 3 or 4 feet at the surface to a few inches at the bottom.

Copper Knob. A "formation", possibly the same as that in the Prospecting Area, strikes irregularly westerly, dipping to the south. The worked part is about 200 feet long, with a maximum width of 16 feet. Workings are, from the western to the eastern end, a shallow open-cut; an underlie shaft 27 feet deep; an open-cut, from the floor of which is a shaft, 24 feet deep with a drive 52 feet to the west. Production was 465 tons of ore, practically all from the eastern open-cut, assaying 26 oz silver per ton, 3.65 percent copper, 7.17 percent lead and 3.10 percent zinc.

EWAN (Jack, 1892; Cameron, 1901, 1906; Reid, 1931b)

Silver-lead deposits were discovered here before 1890, and in 1890-92 the field experienced a sudden surge of activity followed by an even more rapid abandonment. Subsequently work has been done from time to time on odd mines, but there has never been any substantial production. Most of the deposits, particularly those explored in the 1890-1892 "boom" lie in an area where the Ewan Beds, here including a prominent limestone bed, have been extensively intruded by quartz porphyry. The limestone bed is the most important locus of deposition, and the resulting deposits are pyrometasomatic in type, comprising sporadic bodies of metallic sulphides in dense magnetite bodies associated with siliceous and garnetiferous rocks, dense siliceous veins, and irregular lenticular deposits on porphyry-slate contacts. The area, heavily intruded by porphyry dykes,

adjoins the intrusive contact between the Oweenee Granite and the Ewan Beds. The dykes include fine-grained types, similar to dykes in other parts of the Kangaroo Hills area known to be substantially younger than the granite, and coarser-grained apophyses of the granite. More detailed work is thus necessary to establish whether the granite is the source of the mineralizing solutions.

In addition to the pyrometasmatic deposits, there is a small number which, while confined to areas adjoining contacts, are more akin to hydrothermal type. The most important example of these is Mount Theckla.

The Mines

Mount Thekla (3747-6079) (copper-silver-lead). The deposit occurs in an area of steeply dipping, contorted sediments of the Ewan Beds a few chains south of the granite contact. Its immediate host is a feldspathic conglomerate dipping steeply to the west, lying between quartzite below and slate above. The conglomerate, about 30 feet in thickness, grades from a typical conglomerate at the base to a coarse sandstone at the top. The junction of the slate and conglomerate is the main depositional control, the deposit being formed by impregnation of the conglomerate with sulphides for a variable distance from the slate, which thus forms a well-defined hanging-wall. The primary ore minerals are chalcopyrite, galena, sphalerite, and pyrite; bornite, possibly secondary, is present at one level. The lode has been worked over a length of 140 feet to 40 feet depth by an open-cut, two adits below it, and a drive from a 40-foot shaft. A winze from one of the adits follows the lode to 197 feet, where a long adit connects with it. A level was driven from this winze at 126 feet and about this point the lode cut out. In the 197-foot adit are a few splashes of ore in country, but no defined lode.

Where worked the lode ranges from 3 to 11 feet in width, with an average of about 6 feet payable. Total recorded production is as follows :-

1901	(125 tons assaying 35 oz silver per ton, 21.5 percent copper, 10 percent lead (10 tons assaying 181.5 oz silver per ton, 29.2 percent copper, 10 percent lead
1941	(1.15 tons assaying 93 oz silver per ton, 26.0 percent copper (2.5 tons assaying 15.9 oz silver per ton, 16.1 percent copper

In addition, 280 tons of second grade ore was raised (but possibly never treated) carrying 20.7 oz silver per ton and 16.4 percent copper (Cameron, 1901, 1906; Horsley, 1905; Ball, 1941).

True Blue (silver-copper) (3806-6040). The country rock is conglomerate, quartzite, and slate of the Ewan Beds, dipping north. Jack describes three lodes, but only one has been extensively explored, the so-called "cross lode" lying northwest between the others and dipping northeast. It consists of siliceous vein material carrying sulphides, with accompanying deposition of sulphide in the quartzite wall-rock. It is very erratic in width, but would probably average 2 to 3 feet. The ore contains bornite, covellite, sphalerite and a little galena. Workings consist of shafts 78 and 100 feet deep, with driving and stoping at 25, 45, 60 and 100 feet, the lode being worked over a maximum length of 120 feet. Records of production are incomplete. Cameron (1906) states that about 70 tons of "bagging ore" had been shipped, averaging 20 percent copper and 63 oz silver per ton. In 1908 the Warden reported that a tribute party had raised 150 tons of ore, and that their concentrate (hand-picked ore?) averaged 70 oz silver per ton. In 1955 the workings were reopened, and 30 tons of ore produced 4.35 tons concentrate assaying 11.5 percent copper and 31 oz silver per ton (Jack, 1891; Cameron, 1901, 1906; Levinston, 1955).

Smaller Mines

Agnes Campbell (silver-lead) (3772-6021). A lode strikes west-southwest down a spur of Mount Brown, possibly running into the White Wings lease (Jack, 1892).

Black Star (silver-lead) (3799-6055). A garnetiferous lode strikes northeast from the White Star into this ground, where it is 5 to 12 feet wide. It was worked in two shallow trenches. The other lode found in the White Star is represented only by a little galena in decomposed country in a trench. Another ironstone-garnet lode outcrops in the lease but has not been worked (Jack, 1892).

Black Star South (silver-lead). Adjoining the Black Star. This ground contains part of the large magnetite body found in the White Star, and one quartz vein (Jack, 1892).

Blue Bell (silver) (3793-6044). At least four lodes occur in this lease, but no work had been done on them (Jack, 1892).

Bonnybrook (silver-copper) (3798-6045). Four lodes are exposed, two having been tested by shallow potholes and open-cuts (Jack, 1892).

Boomerang (silver-lead) (3803-6058). There are two lodes. The one worked, the "Queen Lode", runs into the lease from the Mount Moss Extended. This lode is 30 feet wide at the boundary, bulging to 100 feet or more in the middle of the lease. It is mainly quartz with low lead values, but there are richer values in a small east-west shoot. An adit to cut the lode in depth reached 106 feet without achieving its objective (Jack, 1892).

Caledonia (silver-lead) (3816-6037). A well defined quartz-chlorite lode, showing copper staining at the surface, has been tested by an underlie shaft 45 feet deep. The lode dips south, and the shoots pitch east. Lead carbonates appeared to 30 feet, and galena at 45 feet.

A large quartz lode enters this lease from Mount Cashel, but has not been worked (Jack, 1892).

Clan Douglas (silver-lead-copper). Situated "near the crest of a ridge on the western slope into a small left-bank tributary of the Burdekin River, just south of Dingo Creek" (Saint-Smith, 1916 - locality not identified). The lode, dipping north, replaces crushed quartzite along a shear zone. Some mining was done in the early days, and again in 1916, when an open-cut 9 feet deep was made on a 14-foot width of ore at the eastern end of the lode. The ore consists of galena, oxidized lead minerals (including pyromorphite) and smaller amounts of copper carbonate. A shallow open-cut at the western end of the lode outcrop showed similar ore. About 27 tons of ore was raised, reported to assay 28 percent lead, 19 oz per ton silver (Saint-Smith, 1916). No further production is recorded.

Comstock (silver-copper) (3821-6040). The main "True Blue" lode traverses this ground. Near the eastern boundary it is about 15 feet wide and is copper-stained. The workings are on a leader, 1 to 8 inches wide, to the north of the main lode near the western boundary. They consist of a shaft 33 feet deep and, from the bottom, a drive 6 feet to the northeast. The leader carried sphalerite, chalcopyrite and pyrite (Jack, 1892).

Copper Cap (copper) (about 385-602?). Some shallow testing was done in 1963 (Department of Mines, 1964).

Day Dawn (silver-copper) (3811-6057). Three lodes occur here. The first, which dips northwest, shows at the surface cupriferous gossany ore in a kaolin matrix. A shaft was sunk 72 feet on this but was abandoned when it was inexplicably flooded overnight. Two to three tons of carbonate ore are supposed to have been shipped. The second, the "Alpha Lode", follows the contorted southern edge of a limestone body. At the surface, it shows copper-staining in quartz-garnet rock. A shaft was sunk 75 feet alongside this "lode" and a crosscut at the bottom intersected only "hard siliceous ironstone". Further west "Regner and Newtons Hole", on the same "lode", raised about $\frac{1}{2}$ ton sulphide and oxidized lead ore. The third lode is unexplored (Jack, 1892).

Green Wonder (silver-lead). Situated 5 to 6 miles northwest of Ewan (exact position not known). Worked by an open-cut and shallow shaft in 1947, 25 tons of ore being raised, value not recorded (Warden, Charters Towers, 1947, pp. 307, 340).

Hidden Treasure (silver-lead) (3782-6042). A shaft has been sunk 75 feet on an ironstone lode with lead values near one edge, and a crosscut driven through the lode at 40 feet depth. The lode was 15 feet wide in this crosscut and carried a small proportion of cerussite throughout.

On a second lode, striking N. 28° E., a shaft has been sunk 75 feet and a drive made 30 feet to the south, just above the bottom. The drive exposed 2 to 4 feet of lode with copper and manganese staining and, in one place, native silver.

A third lode on this lease has not been worked (Jack, 1892).

Ingola (copper) (3879-6017). A chloritic lode with oxidized copper, chalcopyrite, and arsenopyrite, 8 feet wide, runs through this lease. It has not been worked (Jack, 1892).

Junction (copper-lead) (3809-6062). The Ewanton Company sank a shaft 25 feet on a lode striking east. It showed iron oxide, and copper and lead carbonates (Jack, 1892).

Junction South (copper-lead) (3809-6061). Three lodes run through this ground, one of which carried lead and copper carbonates, and another copper stains. No work has been done on them (Jack, 1892).

Kairanga (3760-6029). A shaft was sunk 16 feet on a quartz-ironstone lode striking N. 35° W. (Jack, 1892).

Mount Brown (copper-lead) (3776-6022). Gossany lode matter, carrying galena and copper carbonates is extensively developed near the margins of limestone beds (Jack, 1892).

Mount Cashel (copper) (3811-6040). The two True Blue lodes junction here, and an adit was begun to reach this junction. Three other quartz lodes run through the ground (Jack, 1892).

Mount Cashel East (copper). Adjoining Mount Cashel. One of the quartz lodes in the Mount Cashel lease runs into this ground, as does the main True Blue lode. This lode, very siliceous and copper stained, is very wide in the western part of the ground, and Gilbert's shaft has been sunk alongside it (Jack, 1892).

Mount Cook (copper) (3817-6041). The main True Blue lode traverses this ground, being 30 feet wide at the western end and becoming much smaller at the eastern. A shaft 12 feet deep near the western end shows quartz-chlorite lode with copper staining and specks of galena (Jack, 1892).

Mount Hishon (copper-lead) (3795-6050). There are three lodes. The first, striking south to south-southwest runs through sediments into porphyry. At the north it is siliceous; at the south, in the porphyry, it consists mainly of kaolin, 2 to 3 feet wide, with lead and copper carbonates. An adit was driven about 20 feet towards it. The second, also in porphyry, is quartz about 2½ feet wide, stained with copper and iron. The third, striking N. 35° E., is an ironstone-quartz lode, and has been followed by shafts 15 and 20 feet deep, the second of which shows galena in a vein about 1 foot wide (Jack, 1892).

Mount Hishon No. 1 East (copper). Adjoining Mount Hishon. A shallow shaft seeking the continuation of the Red Rover lode shows 3 feet of garnetiferous lode with copper staining dipping 75° NW., conformably with the sediments. Two holes seeking the continuation of a lode passing through the Black Star South and White Star expose quartz-garnet rock carrying a little lead. Two other siliceous lodes occur in the western part of the lease (Jack, 1892).

Mount Moss (copper-lead) (3821-6066). In this area and the adjoining Mount Moss South, ironstone deposits reach their maximum development. There are three ironstone-garnet type deposits, roughly parallel, in an area of limestone and porphyry. This "eastern lode" culminates in a high knob of garnet rock known as the "Iron Mountain". Near the base of this knob is a short adit, a winze (the "Mountain" shaft) to 50 feet from it, and a crosscut 30 feet west from the bottom of the winze. The deposit, a "gossany vein", carried arsenopyrite, chalcopyrite, sphalerite, fluorite, cerussite, native copper, copper carbonate, and atacamite.

Further southwest, at Powell's Knob, "Lillie's" shaft has been sunk 101 feet, with a drive 15 feet from the bottom. Some bornite was found here, as well as oxidized lead and copper minerals. The "central lode" is represented by two outcrops similar to the "eastern lode". It has not been worked.

The "western lode" includes the ferruginous mass known as Willett's Knob, which has been investigated as a source of iron (see under "Iron"). Away from Willett's Knob the "lode" (striking northwest) contains less magnetite and more garnet. "Beattie's Shaft", 90 feet deep, shows at the surface copper carbonate, chrysocolla, atacamite, zinc silicate, and manganese oxide, but the bottom shows only dense magnetite with a little manganese oxide (Jack, 1892; Reid, 1931b).

A cored drill hole in 1959 met low-grade copper-zinc mineralization at about 500 feet depth.

Mount Moss South (copper-lead) (3813-6061). The "western lode" continues into this ground from Mount Moss. The "Iron Ridge" shaft met cerussite in a hard siliceous matrix at 114 feet. "Elsie's Shaft", about 500 feet to the south, is on another garnetiferous body striking at N. 80° E. The shaft 42 feet deep, shows chrysocolla, pyrolusite, calcite, gypsum, cerussite, and a little galena, in garnet-rock. To the west of the shaft a little galena and cerussite were won from a pipe in limestone (Jack, 1892).

Mount Moss Extended (copper-lead) (3806-6056). A zone about 5 chains wide between a limestone bed and the porphyry contact has been erratically impregnated with lead and copper ores. "Howarth's Shaft", 130 feet deep, exposed some gossany ore; but the bottom and a short crosscut from it apparently showed no values. A little to the north, and a few chains southwesterly, shallow open-cuts exposed small patches of lead-copper ore (Jack, 1892; Reid, 1931b).

Mount Regner (copper) (3780-6022). Gossany, copper-stained, ferruginous and chloritic lode matter occurs in many places at the edge of limestone beds (Jack, 1892).

Pinnacles (copper) (3742-6000). A shaft 15 feet deep and some trenches, on a lode striking west-northwest in mica-schist, showed copper stainings but no ore (Jack, 1892).

Pinnacles Extended (copper-lead). Adjoining the Pinnacles on the western side. A shaft 10 feet depth, on a lode striking N. 140° E. through quartzite, showed quartz with a little copper carbonate and galena (Jack, 1892).

Rattler (copper-lead) (3810-6050). A shallow shaft was sunk on a vertical quartz lode striking N. 15° E. It is 5 feet wide and shows stainings of copper carbonate, needles of atacamite, and threads of galena (Jack, 1892).

Red Rover (lead) (3799-6050). The southern edge of a mass of porphyry strikes N. 75° E. and a lode follows it. It has been opened by a line of shallow shafts and one 112 feet deep. At 35 feet in the shaft the lode split and the "main" (hangingwall) section was followed. In the upper part of the shaft cerussite was plentiful, but in the lower portion only a soft clayey vein 3 to 4 feet thick carrying manganese oxide was present. A crosscut at 100 feet seeking the footwall section met 6 feet manganese oxide, 2 to 4 feet siliceous garnet rock and 4 feet porphyry (Jack, 1892).

Running River North (copper) (3890-6020). A garnetiferous lode, carrying chlorite, calcite and copper carbonate, strikes N. 95° E. and dips 60° S. As exposed in a shaft 22 feet deep it ranges from 1 to 2½ feet in width (Jack, 1892).

Running River South (copper-lead) (3883-6020). Several thin lodes carrying copper and lead carbonates strike north conformably with the enclosing schist. An adit 150 feet long traversed slate and schist, and near the face met dark slate containing insignificant copper values, which were followed by crosscuts (Jack, 1892).

Salmon (copper) (near 3759-6069). A copper lode has been worked in slate and quartzite (Ewan Beds) dipping 60° - 70° NW. The lode is largely conformable with the bedding, although in one place it is transgressive. The ore, malachite and azurite in quartz and kaolin gangue, occurs in steeply dipping pipes. The workings, consisting of a shallow open-cut and two shafts, with driving and stoping, have a maximum length of 60 feet (at the surface) and extend to about 75 feet depth. Recorded production is 129 tons of ore, carrying 21.6 - 41.2 percent copper and 0.5 - 5.4 oz silver per ton (Ball, 1941c).

Trump (lead-silver) (near 3804-6051). This old mine was reopened in 1947-1955. The dump was treated and the old workings reopened to 90 feet depth. A drive at 90 feet in the vertical shaft was found to be unpayable (6 percent lead) so a new shaft was sunk 25 feet and some open-cutting done. Costeaming and core drilling by a major company in 1958-59 did not result in any developments. Recorded production figures (incomplete) indicate that 98 tons of concentrate (usually about 50 percent lead, and 11 to 27 oz silver per ton) were produced from an unknown quantity of ore (possibly around 500 tons) (Department of Mines, 1947, 1954-6).

Uncle (lead-silver) (about 3714-6052?). Workings consist of an open-cut and two shafts, less than 40 feet deep. Recorded production (1955-57) was 540 tons of ore for 61 tons silver-lead concentrate (Department of Mines, 1956-58).

28. MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE
1:250,000 SHEET AREA, NORTH QUEENSLAND

Victory (copper) (3824-6042). The main True Blue lode which traverses this ground was reached by an adit 30 feet long, whose face shows copper-stained quartz with sphalerite and magnetite (Jack, 1892).

Victory Extended (copper). Adjoining the Victory. The main True Blue lode, traceable to the western part of the lease, has not been worked. To the south a shaft was sunk 33 feet on a parallel copper-stained quartz vein about 6 feet wide, dipping south (Jack, 1892).

Vigilant (3775-6040). Several "siliceous ironstone" bodies occur here, but no work has been done on them (Jack, 1892).

Walleroo (copper-lead) (3886-6025). Shafts 35 and 26 feet deep have been sunk on a lode striking southwest carrying amounts of lead, copper, and arsenopyrite. Ten inches of copper-stained ferruginous material cut by the second shaft represents one of three lodes lying just southeast of the shaft and dipping towards it at 45°, conformably with the country (Jack, 1892).

White Star (lead) (3802-6053). A siliceous lode with lead values extending into the adjacent schist strikes N. 118° E. It has been followed by a shaft 42 feet deep, with a drive 60 feet west-northwest. Another shaft had not met the lode at 73 feet depth. Other lodes of the garnet-ironstone type occur in this ground but have not been worked (Jack, 1892).

White Wings (copper-lead) (3766-6017). A large ferruginous lode striking N. 75° E. carries oxidized lead and copper, galena, and sphalerite. It has not been worked (Jack, 1892).

STOCKYARD CREEK

Copper and silver deposits were discovered here in 1902 and prospecting was carried out for eight or ten years after. In general not a great deal is known of these workings, or of the nature of the deposits.

Ambrose silver-copper mine. In the vicinity of Mount Oweenee (347-576). Worked during 1905-07 and possibly other periods. Three lodes, the Spray, Silverspray, and Lass O'Gowrie were worked to depths of at least 180 feet, 70 feet and 110 feet respectively. Values quoted range from 5 to 30 percent copper and 9 to 209 oz silver per ton, the lowest value being in "arsenical ore". The ore ranged from a few inches up to 3 feet in width, taking the form of lenticular patches in the lodes. Production is recorded for only part of 1907, and 1908 -- a total of 103 tons of ore valued at \$5,968 (Department of Mines, 1909).

Rio Tinto copper mine (366-567). The Argentine Metamorphics are faulted against Devonian-Carboniferous conglomerate and sandstone, both being intruded by quartz-feldspar porphyry dykes related to the Oweenee Granite. Copper mineralization extends from the fault into the adjoining conglomerate. Three lodes have been worked to a maximum depth of 150 feet. Surface exposures indicate that the lodes dipping steeply to the north were mostly kaolin, carrying copper and lead over less than 200 feet of length. Figures in manager's reports of the day indicate that the bodies exposed in the workings were often narrow (less than 1 foot) suggesting that the deposits may be lenticular, as they are in the Ambrose. Mining was in progress about 1905-08 but between 1945 and 1960 some surface prospecting was done (Levingston, 1957a) and in 1962 the Mines Department diamond drilled three holes under the workings in an attempt to locate the main ore-body. No values were found.

Stockyard Creek Silver Mining Syndicate. Stockyard Creek area, exact locality unknown. Coarse conglomerate rests upon altered sedimentary rock, the relation between the two being unknown. A kaolin lode occupies a zone at the junction of the conglomerate and other sediments. It has been followed by a shaft 65 feet, a crosscut 56 feet long a little west of south, and a drive 14 feet east. These workings expose kaolin, with the drive showing more siliceous matter and copper and lead carbonates. Assays made by the proprietors ranged from 3 to 966 oz silver per ton and 8 to 31 percent copper, but the ore was distributed in the lode in quantities too small to be payable.

Ten chains away a shaft was sunk 44 feet on a cupriferous quartz vein striking N, 10° W. and dipping steeply south. A lode channel 4 feet wide carries 12 inches of quartz carrying "tile ore", malachite and azurite. Ore treated totalled 67 tons yielding 5,000 oz silver (Maitland, 1893). (The first part of the description suggests that the Rio Tinto may have been included in this ground).

Small Mines. In 1907 several copper shows were prospected, including Barry and Party's, Copper Spur, Baker and Hanlon's, Pearl, and McIntyre and Kelly's (Inspector of Mines, 1907, p. 247). Their actual locations are not recorded.

OTHER LOCALITIES

Dotswood (Keelbottom) copper mine (442-545). The country is andesite of the late Middle or Upper Carboniferous Percy Creek Volcanics, dipping 30° - 50° ESE to SE. From the 1870's until 1901 much work was done here, including the building of a treatment plant. There is no record of the extent of the underground workings, nor of the nature of the ore-bodies explored, but the area carries floaters of siliceous epidote rock and quartz in veins up to a few inches wide, and the dumps indicate that copper values were restricted to these types of material. At least twelve shafts were sunk, probably none deeper than 200 feet, over an area about 14 chains by 10 chains. Native copper, malachite, azurite, and chrysocolla were the principal ore minerals. There is only one record of the width of lode - 14 feet in the 75 foot shaft - and of values - two bulk samples totalling 5 tons sent to Cockle Creek assayed :

"17 and 25 ft shafts"	gold trace, silver 1 oz per ton copper 5 percent
"75 ft shaft"	gold, silver and copper - traces only

The only reference to production from the mill - that concentrates from the first week's run were not up to expectations - is probably fair testimony to the poverty of the ore, which is further evidenced by the fact that little or nothing was ever produced from the mine (Jack, 1879b; Morton, 1944a).

Marmy Creek lead mine (448-504). In 1949-50 a small lode in the Ravenswood Granodiorite Complex was worked by an open-cut 35 feet long and 10 feet deep, and a shallow shaft. The lode consists of up to 2 feet 6 inches of quartz carrying patches and veins of galena and cerussite. The silver content was too low to materially add to profit, and only one parcel of ore is recorded as being sold - 7.8 tons dressed ore containing 1.2 tons lead and 16.34 silver (Denmead, 1949; Department of Mines, 1951).

Kennedy copper mine (412-585). This mine was already abandoned when visited by R. L. Jack in 1878. The country is slate, shale, and coarse sandstone of the Star Beds, rather contorted and heavily intruded by late Palaeozoic quartz-porphyry. The lode roughly follows the contact between the sediments and a large porphyry dyke. It dips 65° SE., and averaged 4 feet in width where exposed. Workings were two shafts, about 300 feet apart, of which the northernmost (apparently the more important) was somewhat

over 125 feet. Drives were made to the northeast for 50 feet at 65 feet depth, and 42 feet at about 120 feet depth. Above the top level the lode carried azurite, malachite, tenorite and cuprite, and most of the ore came from here. Between the two levels the lode was practically barren, and the lower workings exposed sulphides, including chalcopyrite (Jack, 1878).

TIN — LODE

Tin deposits form a well-defined metallogenetic province extending from the upper reaches of the Star River to Camel Creek in the south-eastern corner of the Einasleigh 1:250,000 sheet and bounded to the north and northeast by the coastal scarp. The mineralization corresponds to Phase I of the Herberton Metallogenetic epoch (Webb, 1969; Jones, 1947), and is related to Lower Carboniferous Granites (including the Oweenee Granite). These granites intrude the Running River Metamorphics and the Ewan Beds, and tin deposits are found in all three formations, with a particular concentration around the granite contact. In the Kangaroo Hills Field, the productive area is a northeast trending, rather narrow belt, the sediments forming virtually a roof pendant. The other productive area, Tinvale, is marked by the presence of Argentine Metamorphics, which are probably equivalent to the Running River Metamorphics, but the full extent of these is here masked by Tertiary basalt and laterite. The greatest concentration of productive mines is near Ewan, at the western end of the Kangaroo Hills Field, in a heavily faulted area. Transgressive faults, trending north-northwest to northwest, are conspicuous; the cognate set, being parallel to the strike of the sediments, is not so conspicuous and may be less well-developed. The major faults are rarely the actual loci of deposition. Their importance as structural controls appears to result from the extensive minor fracturing they produce in the country between them: it is these small fractures that are the actual proximate controls. Closely associated in space with tin deposits in this area is also a large amount of acid porphyry, at least part of which is intrusive. This presumably represents the final magmatic stage of the granite, and its emplacement was subject to the same controls.

The deposits take the form of more or less continuous bodies following portions of fracture planes, and as the fracture planes are part of a complex network, the deposits are erratic, often ill-defined, and difficult to follow. The ore shoots are generally elongated in the direction of the lode, but their length is usually only a few times their width, so that they are pipes rather than tabular bodies. In many cases they extend into the wall rock beyond the lode walls, approximating even more to equidimensional bodies. The commonest mineral of the lodes, in both the shoots and the barren sections, is chlorite, but quartz, kaolin and sometimes tourmaline also occur. Cassiterite is the normal tin mineral, but in the Sardine mine a well-developed shoot has been exposed carrying stannite as well as cassiterite. The possibility of this type of mineralization being found in other parts of the Ewan area cannot be overlooked, but in few cases has much exploration been carried into the sulphide zone.

The presence of stannite, and the fact that it is the largest producer on the field, make the Sardine to a certain extent atypical, but it has been more extensively explored, and subjected to more detailed examination, than any other mine in the area, and can be taken as exemplifying many of the structural characteristics of the field.

The earliest reference to tin mining is in the Warden's Annual Report for 1883, when two companies were projected to work areas near Douglas Creek. This was possibly the Mount Gray area, north of Kallanda (Ingham Sheet area). This burst of activity appears to have died quickly, and lode tin mining did not really get under way until 1898, when the Waverley group of leases was pegged at Oaky Creek. Since then mining has been carried on, with many changes of fortune, until the present. The most productive period was from 1900 to 1930.

Achilles (also known as "Lucky Fall") (3777-6018). The lodes are quartz-chlorite, ferruginous in places, and possibly containing, in addition to cassiterite, a little bismuth. One of the exposures showed a good deal of fluor spar. In 1892, concentrate totalling 32 tons was produced. The Mount Brown Company sank a shaft here in 1904 (Jack, 1892; Horsley, 1905; Department of Mines, 1893).

Aitken. See Haaken.

Alice (about 3796-6149?). A lode 6 to 10 inches wide was worked in 1937 (Department of Mines, 1938).

All Blue (near 411-615) (approx 1 mile NE of the "Surprise"). Oweenee Granite is cut by a quartz-chlorite lode up to 12 feet wide and traceable over a length of 300 feet, but only two pipe-like shoots, 3 to 4 feet wide and 30 feet apart have been productive. Recorded production is 57.25 tons of ore for 2.34 tons of concentrate worth \$728 (Morton, 1940a; Connah, (pers. comm.), Department of Mines, 1950).

Alligator. Situated in "The Ditch" Area, 10 miles ESE of Ewan. The mine was apparently worked for a few years from 1911. Workings consisted of a small open-cut and shallow shaft, which yielded about 5 tons of concentrate (47 percent tin). The ore was composed of dense chlorite and magnetite (Marks, 1913).

Altair (3786-6141). The only recorded production is 130 tons of about 5 percent ore to 1901. Workings are a trench 6 feet deep sunk on a chloritic lode 3 feet wide, the Lady Smith lode, which was exposed for 50 feet, and a shaft 165 feet deep 4 chains to the southwest of the trench (Cameron, 1901).

Ambrose (about 374-580). From a 63-foot shaft which had followed strong "heads" and some lode formation, a drive met old workings at 15 feet. Old fill was crushed for 0.86 tons concentrate (Inspector of Mines, 1969).

Another Try (near 379-615?). The country is granite. A chloritized lode, up to 4 feet 6 inches wide dipping 80° NNE has been opened up by two 15-foot shafts 17 feet apart and several trenches over a length of 5 chains. Tin ore about one inch thick occurred along a joing (Ridgway, 1947).

Harramundi (3751-6057). Several tons of low grade ore was raised from a costean on a wide belt of ferruginous crushed chloritic slate striking east-northeast (Saint-Smith, 1921).

H. B. (about 3803-6116?). First worked in 1925, and again in 1937, an attempt was made to dewater it in 1964. Workings are an open-cut 60 feet long and 14 feet deep and a shaft 85 feet deep. Recorded production is 184 tons of ore for 4.15 tons concentrate (Department of Mines, 1926, 1938-40, 1965; Inspector of Mines, 1967).

Belvedere (about 3762-6037). In 1969 old workings were reopened. A lode 2 to 3 feet wide in "slate" was followed to 20 feet where it cut out. Production (including material from surface and dump) was: ore 290 tons, concentrate 3.59 tons. In 1968 a further 0.69 tons concentrate was obtained (Inspector of Mines, 1968; Warden, Charters Towers, 1969).

Big Bertha (about 3865-6092?). A good lode was found here, but work was hampered by water (Department of Mines, 1930).

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Big Brill (near 3762-6071). This mine was worked intermittently from the early 1920's to 1957. The ore varied from 4 to 17 percent tin oxide and averaged 18 inches in width in a mineralized zone 8 feet wide; workings consisted of an 80-foot tunnel connecting with a shaft, and short drives. In 1966 a 95-foot adit stopped in intrusive rock (Department of Mines, 1926, 1929-31; Warden, Charters Towers, 1967).

Black Cat. Situated at Continong. A 31-foot shaft was sunk in 1934 on a lode 9 to 12 inches wide. Recorded production was 9 tons of ore carrying about 6 percent tin oxide (Department of Mines, 1935).

Black Diamond. Approximately $1\frac{1}{2}$ miles southwest of Tinvale Battery. Worked about 1912, again in 1935-7, a number of shallow shafts (up to 35 feet deep) were sunk on a southerly-dipping lode in coarse granite. A vertical shaft on the north side 110 feet deep failed to cut the lode. In 1967, 1.25 tons of ore yielded 0.19 tons concentrate (Laun, 1913; Warden, Charters Towers, 1937, p. 252; 1967).

Black Throat (about 365-609?). Two shafts, 23 feet and 25 feet deep, both passed out of ore at the bottom. Production: $9\frac{1}{2}$ tons ore for 1.75 tons of tin concentrates (Department of Mines, 1961, 1962).

Bloater (near 3750-6072). A flooded shaft, said to be 40 feet deep, had been sunk on a lode of dark grey quartz replacing crushed slate, dipping 80° NNW. To the southeast of this, several cuts were made on a lode striking northeast consisting of slate more or less replaced by quartz veins, but values were negligible. The mine was reopened briefly in 1942, 1.5 tons of ore yielding 0.2 tons concentrate worth \$96 (Saint-Smith, 1922b; Department of Mines, 1922, 1943).

Blue Bell (about 3793-6044). In 1965 and 1967, 87 tons of ore, mainly from open-cutting, yielded 0.98 tons concentrate (Inspector of Mines, 1966, 1968).

Blue Duck (3785-6022), immediately south of the Metropolitan. The country is quartz-feldspar porphyry which intrudes the Ewan Beds, and the lode, occupying a fissure in the porphyry, dips steeply to the north. The shaft is 49 feet deep, with drives 9 feet east at 34 feet and 44 feet west at 49 feet. The 49-foot level has been stoped and at the western end a winze 9 feet deep and an underhand stope 34 feet long have been made. The lode as exposed is 12 to 20 inches wide.

About 90 feet to the north is the Metropolitan lode parallel to the Blue Duck and between them is a sub-parallel lode worked by an open-cut and a shaft 23 feet deep.

Total recorded production is 132 tons of ore for 10.3 tons of concentrate, worth \$3200 (Morton, 1943; Ball, 1944; Department of Mines, 1937-42, 1962).

Boomerang (originally Birthday) (about 380-614?). A large lode of chloritic altered granite, striking $N. 95^{\circ} E.$ through coarse pink acid granite, was worked by an adit 20 feet long and an underlie shaft 20 feet deep, with some driving. Below these workings an adit 170 feet long and a crosscut 30 feet long intersected another shoot. Recorded production was $72\frac{1}{2}$ tons of ore for 13 tons concentrate (Marks, 1913; Saint-Smith, 1916, 1922c).

Boulder (about 381-606?). Two shafts were sunk in the late 1930's, one 30 feet and the other 62 feet, on a low grade lode. A production of 42 tons of ore yielded 1.35 tons of tin concentrate (Department of Mines, 1938).

Boulder Point (about 386-617?). A vertical lode of chloritized granite with a little garnet, biotite and copper staining has been explored by three shafts. In the deepest (34 feet) a drive has been made at 15 feet depth for 18 feet to the northwest. The country is coarse pink granite. Production was 47 tons of ore for 3.4 tons of concentrate (Carruthers, 1953).

Canary (3810-6110). The mine, which was worked 1921-25 with minor new work in 1933, 1938 and 1947, is situated in slate and quartzite of the Ewan Beds. These are intruded by granite about $\frac{1}{2}$ mile north of the mine and by a prominent porphyry dyke striking east-northeast about $\frac{1}{2}$ mile to the southwest. The lode crosses a northeast-striking zone of crushed sediments carrying quartz veins, steatite patches, and granitic veins. It dips very steeply west-southwest. The ore shoot worked averaged 14 feet long by 18 inches wide from the surface to 150 feet, where the lode split into small unpayable veins. The ore consists mainly of crushed quartzite carrying cassiterite and a little wolfram. Workings consist of a shaft 184 feet deep with levels at 32, 60, 80, 125 and 176 feet. From the 176-foot level a winze leads to the 205-foot level. An adit from the surface connects with these workings between 70 and 80 feet depth. Except for the 60-foot level, which is at least 130 feet long, the levels are probably all less than 100 feet. All known ore is stoped out. Recorded production is 417 tons of ore for 122.4 tons of concentrate (Saint-Smith, 1922c, d, 1923; Department of Mines, 1925, 1941, 1951).

Captain (about 385-605?). A series of costeans opened up a small high-grade seam of tin which cut out at less than 6 feet depth. One ton of ore was produced (Inspector of Mines, 1961, p. 259).

Chance. Described by the Warden among a group of mines in the Continong area, locality otherwise not recorded. A trench 4 feet 6 inches deep was made on a low-grade lode up to 18 inches wide. Production: 13 $\frac{1}{2}$ tons of ore yielded 1.95 tons of concentrates, worth \$360 (Department of Mines, 1934, 1935).

Cleopatra (3782-6025). This mine was an important producer as a unit of the Mount Brown group in the early part of this century, but there are no records covering that part of its history. It was worked again in 1929-33 and 1961-3. There are three shafts, 40, 100 and 130 feet deep, but nothing is known of the extent of the workings from them. Recorded production 1933: 9 $\frac{1}{2}$ tons of ore yielding 0.95 tons of concentrate, worth \$196; 1961: 0.75 tons 5 percent ore; 1966: 10 tons "screenings" for 0.98 tons concentrate (Horsley, 1905; Cameron, 1906; Department of Mines, 1934, 1963-4; Inspector of Mines, 1969).

Clinker. Situated southwest of the junction of Butterfly Creek and Running River — roughly 375-599. In 1958 an old shaft was cleaned out and extended to 20 feet depth and a new shallow shaft sunk close by. Some further work was done in 1965-6. Production was 43 tons of ore for 2.2 tons of concentrate. The concentrate was low-grade (usually about 45 percent tin, the main impurity being iron oxide) (Department of Mines, 1959; Inspector of Mines, 1966, 1967).

Codfish (near 3738-6072). Massive granite is cut by a lode up to 6 feet wide dipping 65° to 75° SSW. This mine was worked many years ago, again during 1949-53, and in 1964. The workings extend over 150 feet length at the surface, but the deepest, the main shaft, is only 28 feet deep. Recorded production is 131 tons of ore for 1.85 tons concentrate worth \$1,910 (Department of Mines, 1951, 1954; Hutchinson, 1964a).

Cypress (near 404-614?). Situated 3 miles west of the Surprise on Cypress Creek near Hidden Valley. The ore consists of kaolin and greisen. Some tin is also disseminated in practically unaltered granite. The workings consist of a shaft 25 feet deep, with drives 30 feet to the northwest and 5 feet to the southeast. Production was 29.5 tons of ore yielding 1.35 tons of concentrate worth \$466 (Morton, 1940a).

Daintree (including Standard and Lucky Hit workings). Situated 344-558, at Tinvale. The Daintree - Lucky Hit workings were by far the biggest producers in the Tinvale area. They were worked 1907-14, 1924, 1935-44 and 1951. The lodes occur in coarse porphyritic granite and have been formed by alteration and replacement of the granite on well-defined fissures dipping 45° SW. The Daintree lode channel carries a siliceous chloritic and tourmaline-bearing formation 10 feet wide over a length of 240 feet. The whole is stanniferous to some extent, but rich ore was confined to one or two veins 1 to 3 feet wide. The Lucky Hit lode channel, 100 feet behind the Daintree, was up to 20 feet wide in the 500 feet length exposed. One shoot found in it terminated at 30 feet from the surface; elsewhere it carried ore only in irregularly distributed bunches. Associated with the cassiterite were small amounts of pyrite and tetrahedrite. (Tetrahedrite concentrate assayed as high as 44 oz silver per ton). Concentrate analyses also showed traces of arsenic, bismuth and lead. Workings on the Lucky Hit lode included six shafts, 50 to 80 feet deep, and shallow shafts and open-cuts over a length of 500 feet. The productive workings, 240 feet long, were at the northern end, the only defined shoot being worked over 70 feet length to 30 feet depth. The Daintree lode workings are a connected group extending to 160 feet depth. From the surface to 20 feet a shoot was worked by an open-cut 190 feet long. Below that the workings became progressively shorter, reducing to 80 feet length at the 160-foot level. In front of both lodes is a vertical shaft 180 feet deep. A crosscut at 160 feet connects with the bottom Daintree level and continues into the footwall to intersect the Lucky Hit lode.

In 1962 the Queensland Mines Department diamond drilled three holes to explore the possibility that the Daintree shoot continued on a southerly pitch. It was found that the fissure continued, well-defined, but barren.

Total recorded production (both lodes) was 7,703 tons of ore for 270 tons of concentrate, valued at \$61,400 (Cameron, 1911; Morton, 1944b; Laun, 1913; Ball, 1941a).

Day Dawn. Possibly on the Day Dawn copper lease, 3811-6066. This mine was first worked in 1928 when 20 tons of low grade ore was raised. It was abandoned until 1951 when 15 tons was crushed for 0.2 tons of concentrate worth \$240. In 1968 a further 0.1 tons concentrate was obtained (Department of Mines, 1929, 1952; Warden, Charters Towers, 1968).

De Luxe. About 1 mile northeast of Ewan, exact locality indefinite. A 35-foot shaft was sunk in 1923, but the ore bodies were small and irregular (Department of Mines, 1924).

Dianna (3774-6142, near the Satellite). This mine was opened in 1959. Workings consist of an open-cut about 50 feet long and 25 feet deep and a shaft 14 feet deep. Production : 18 tons of ore yielded 0.52 tons of concentrates worth \$500 (Department of Mines, 1960-2, 1964).

Dolcoath (near 373-604). This deposit was worked in 1958-9 when 0.37 tons concentrate was obtained from 21½ tons of ore. The concentrate carried a large arsenic content and was unsaleable (Department of Mines, 1959-60).

Dolly Gray (about 380-617?). A chloritic lode, with small rich patches of cassiterite associated with quartz and pink fluor spar, was worked in 1915 and again in 1959-60. The only recorded working is a shaft 45 feet deep, and production was about 60 tons of high grade ore (Saint-Smith, 1916).

Doreen. About 4 miles north of Ewan, exact location not known. Worked in 1930 and 1940-2. Workings are a shaft 70 feet deep with drives 10 feet north at 12 feet,

12 feet south at 16 feet, and 19 feet west at 70 feet. Recorded production was 257 tons of ore for 5.15 tons of concentrate worth \$1,500 (Department of Mines, 1931, 1941-3).

Douglas (3800-6123). The country is granite. The lode is quartz-chlorite of maximum width 7 feet, containing finely disseminated cassiterite. It dips steeply north. Workings consist of a shaft 58 feet deep with drives 46 feet east at 7 feet, 24 feet east at 7 feet west at 23 feet, and 49 feet east and 23 feet west at 58 feet. The bottom level is connected to the surface by an adit 148 feet long. Recorded production is 60 tons of approx. 12 percent ore (Cameron, 1901).

Dream (near 3796-6120). This mine operated during 1957-61. The workings consisted of a shaft 75 feet deep with a drive 12 feet long. Recorded production: 37 tons of ore yielded 3.62 tons of concentrate. However, from information obtained from the holders, it is probable that the total is more like $6\frac{1}{2}$ tons from about 50 tons of ore (Department of Mines, 1958-9, 1962).

Ella. Situated about $\frac{1}{4}$ mile west of the Joker (about 409-614?). A narrow kaolinic lode carrying discontinuous threads of cassiterite lies in altered granite. The workings are a shaft 11 feet deep with a drive 6 feet to the east and a few pot-holes and trenches spread over a length of 50 feet. Recorded production (1951) is 2 tons of ore of unknown grade (Connah, pers. comm.).

Eureka (3785-6034). In 1965 a shaft was sunk 30 feet to old workings. A crushing of 5 tons ore yielded 0.13 tons concentrate (Inspector of Mines, 1966).

Excelsior (about 3974-6132?). The lode, 1 to 4 feet wide, dips almost vertically and strikes N. 85° W. The ore averaged from $3\frac{1}{2}$ to 5 percent tin. Workings consist of two shafts 67 feet apart. The eastern (No. 1) shaft is 70 feet deep and the western shaft 40 feet. A drive from the bottom of the latter connected with the 50-foot level of the No. 1 shaft. Recorded production 1940-43 and 1946-9 was 229 tons of ore for 11.9 tons of concentrate (Shepherd, 1943; Department of Mines, 1941-4, 1947-50).

Eye Witness (Location not known). A small but rich seam of cassiterite dipping steeply east was worked by shafts 48 feet, 35 feet and 25 feet deep. Recorded production 1936-39 was 16 tons of ore yielding 3.8 tons of concentrate worth \$1,204 (Department of Mines, 1937-8, 1940).

Faithful (about 3808-6138?). In 1952 a shaft was sunk 6 feet in a gully to connect with old workings. A new drive 13 feet long was made on a 1 foot 6 inch wide chloritic lode carrying an estimated 10 percent cassiterite. One ton of ore yielded 0.1 tons of concentrate (Department of Mines, 1953).

Florist (about 353-555?), about $1\frac{1}{2}$ miles southeast of White Springs. The ore-body, notable for its erratic course, continuity and richness, is in quartz-sericite schist of which the original bedding planes dip at 20° and the planes of schistosity at $65 - 75^{\circ}$ in direction N. 82° W. A fissure dipping 70° NE cuts the schist and within this fissure the ore-body - a quartz-cassiterite pipe - pitched at an average angle of $25 - 30^{\circ}$ to the northwest. Its course was extremely erratic, consisting mainly of a series of loops. It was sometimes called the "crankshaft lode" and this is well indicative of its overall form. It has been estimated that nearly 1,500 feet of pipe was telescoped into less than 400 feet of overall length. In that distance the pipe was continuous: it ranged in cross-section from 6 inches by 6 inches to 9 inches by 45 inches, generally being in the range 6 inches by 12 inches to 9 inches by 18 inches. The ore averaged nearly 40 percent cassiterite, in some places being virtually pure, the only other mineral present being quartz. Chlorite and tourmaline are present in places in the surrounding schist, but not in the pipe.

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The principal workings consist of an underlie shaft about 330 feet long, formed by grading the shaft as it followed the pipe, and various short extensions (raises, drives and winzes) following short projections from the pipe into the country. The average inclination of the shaft is 25°. Near the bottom the pipe disappeared, and although quite an amount of exploration was done no continuation of it was ever discovered. The mine was worked 1934-44, with an unsuccessful reopening in 1950.

Recorded production is 194 tons of ore for 67.5 tons of concentrate, worth \$26,000 (Blanchard, 1947; Ball, 1941b; Denmead, 1950; Connah, 1950a, b).

Flying Cloud. Situated about 2½ miles north of Ewan, exact location not known. In 1923 a shaft was sunk to 65 feet on a hard pyritic formation carrying a little cassiterite. Production 4.85 tons of ore yielded 0.52 tons of concentrate (Department of Mines, 1924).

Gard's Hope (near 3798-6151). Worked 1916, 1928-30 and 1953. The 1953 work included two shafts 9 feet and 10 feet deep on lodes up to 6 feet wide (Department of Mines, 1929-31, 1954).

Gladstone (3783-6029). This mine was first worked in 1906, and possibly for some time after. There is a shaft 90 feet deep, but otherwise nothing is known of the workings. It was reopened in 1937, 1960 and 1964, but crushings were virtually all from dump and other surface material, and old stope filling: 181 tons for 7.87 tons concentrate. A further 0.61 tons of concentrate was produced in 1968 (Cameron, 1906; Department of Mines, 1938, 1939, 1961; Hutchinson, 1964b; Inspector of Mines, 1965; Warden, Charters Towers, 1969).

Goanna (406-611?). This mine has operated intermittently since 1941. The shaft is at least 35 feet deep, and at 25 feet is a 20-foot drive. The ore vein in the end of this drive is described as 9 inches wide, wider and poorer in the bottom. Recorded production (1941-66) is: ore 47½ tons; concentrate 4.38 tons. In 1968 a further 0.31 tons concentrate was obtained (Department of Mines, 1942-3, 1947, 1962; Inspector of Mines, 1960-7; Warden, Charters Towers, 1968-9).

Goldfinch. See "B. B."

Goldfish (near 3759-6070). The country is slate, much disturbed and silicified by porphyry intrusions. Two shafts and two small cuts were made in 1921-2 on a copper-tin vein. Two other shafts on the same ground tested a copper vein and a tin vein. The ore included a bronze mineral which, from its description, Saint-Smith tentatively identified as stannite (Saint-Smith, 1921, 1922b).

Golden Cap (3780-6027). An old shaft (the Ulysses) was cleaned out in 1961 and 1965, producing 90 tons of a mixed copper-tin ore for a yield of 3.9 tons of concentrate (Inspector of Mines, 1961, p. 259, 1966).

Gordon. Situated north-northwest of the Sardine, and later included in the Sardine ground. Small shoots of tin occur in a lode composed of highly chloritized slate, dipping 45° ESE (Saint-Smith, 1922b).

Good Friday (Spring Creek Area). This ground was first worked about 1920, and again in 1952. A shaft 13 feet deep in altered granite with disseminated copper carbonates yielded several tons of chloritic ore carrying tin and wolfram. About 100 yards to the north a number of tin-wolfram "squibs" extend over a length of 200 feet and have been worked to a maximum of 20 feet depth (Levingston, 1952a).

Granite Castle (about 385-617?). This mine was worked intermittently from 1938 to 1960 to at least 92 feet depth. The total recorded production was 11 tons of ore yielding 1.55 tons of concentrate worth \$490 (Department of Mines, 1939, 1960-1).

Grasstree. Situated about 3 miles northwest of the Endeavour Battery, exact location not known. In 1940, 12 tons of ore yielded 1.45 tons of concentrate worth \$506 (Department of Mines, 1941).

Greenlight. Situated near Boomerang Creek, northwest of the Gregory Highway, exact location unknown. This mine operated in 1962. A shaft was sunk to 18 feet, a drive of 5 feet made along the lode, and the ore above stoped out. Two other shafts 6 feet deep were sunk nearby. Production consisted of 3½ tons of 75 percent ore (Department of Mines, 1963).

Groper (3740-6066). A chloritic lode in granite was followed by a shaft reported to be 90 feet deep. The lode dips 70° N. The shoot was rich, but production is not recorded (Saint-Smith, 1921).

Guy Mannering (3795-6048). This mine was one of the main sources of output of the Waverley Company from 1900 to 1906. It was reopened between 1939 and 1941, and again in 1963. Several lodes, striking east and dipping vertically, occur in granite. The most important of these has been explored over a distance of 700 feet at the surface, the deepest workings, at the eastern end, being a shaft 200 feet deep with levels at 50 feet (adit level), 100 feet and 200 feet. The main shoot worked, from the 100-foot level to a little above the 50-foot level, was about 70 feet in length and up to 2 feet wide and was cut off on the lower side by a "slide". At the 50-foot level three other parallel lodes were explored to a small extent, without success. The western workings comprise a short adit, a shaft 75 feet deep, and two shallower shafts, as well as prospecting trenches. A small shoot was worked here, from 18 inches to 6 feet in width. Total recorded production is: before 1901 - 980 tons ore for 49,05 tons concentrate (mainly from the western workings, but including an appreciable quantity from other leases of the Company); 1901-1906 - 3,260 tons of 3 percent ore (from the eastern workings); since 1906 - 51 tons of ore for 5.6 tons concentrate (Cameron, 1901, 1906; Department of Mines, 1940-1, 1943, 1964).

Haakon (about 379-607?). Also called Old Haaken, Aitken and Haaken. The lode consists of chloritized and kaolinized slate in a crushed zone of slate and quartzite, dipping 45° NW. The older workings, 1919-22, consist of an open-cut and a shaft 70 feet deep; new workings, 1961 and 1965, are an underlie shaft 55 feet deep, with drives 15 feet to the north and to the south as far as the old workings, and further open-cutting and trenching. The ore in the old workings is reported to have been 8 feet wide, and it carried a little copper as well as tin. Recorded production (1919-65) was 669 tons of ore for 13.47 tons of concentrate (Saint-Smith, 1922c; Department of Mines, 1962; Inspector of Mines, 1966).

Hadleigh Castle (about 385-605?). An old shaft was cleaned out in 1961 and an underlie 14 feet deep sunk on a tin shoot which cut out at that depth. Production was 2½ tons of ore for 0.29 tons concentrate (Department of Mines, 1962).

Hat Ridge (about 3766-6024?). In slate, much intruded by felsite, greisen and porphyry, is a lode consisting of chloritized felsite with many quartz veinlets. It is traceable for several chains but prospecting is recorded at only one point, where 10 inches of 10 percent ore was exposed (Saint-Smith, 1923).

Hawk (also known as Christmas Gift) (3781-6033). Some work was done in the 1920's. In 1936 and 1938, 14 tons of ore yielded 1.3 tons of concentrate, and in 1956, 9 tons yielded 0.6 tons of concentrate. The 1956 workings consisted of a shaft 45 feet deep and an open-cut (Inspector of Mines, 1956, p. 780; Department of Mines, 1929, 1937, 1939).

Hector (about 3798-6147?). In 1953-54 an old shaft was straightened and deepened to 40 feet. In 1959 it was sunk to 63 feet. A 10-foot drive east at the 30-foot level appears to have produced most of the ore. Total production, 1953-61, was 63.5 tons of ore yielding 8.25 tons of concentrate (Department of Mines, 1954-5, 1960-2).

Hitler (Spring Creek Area). In 1937 a 25-foot shaft was sunk on a chloritic lode 18 inches wide containing isolated patches of tin (Warden, Charters Towers, 1937).

Hopeful (about 380-615?). Principal workings consist of a shaft 76 feet deep with drives east and west at 25 feet and 45 feet. Recorded production (1950) was 12 tons of ore for 1.2 tons of concentrate worth £420 (Department of Mines, 1960; Warden, Charters Towers, 1950, p. 277; Inspector of Mines, 1960, p. 677).

Hope (Continong mining area). An open-cut 150 feet long and 8 feet deep and a shaft 15 feet deep produced about 8 tons of ore for a yield of 1.15 tons of concentrate worth \$388. The lode ranged from 4 to 6 inches in width (Department of Mines, 1938).

Iron Queen (3822-6072). Two diamond drill holes were put down close to the old Titanic workings by King Island Scheelite (1947) Ltd in 1963, but no results are available (Department of Mines, 1963, 1964, p. 100; Inspector of Mines, 1963).

Ivanhoe (3788-6150). This mine was worked sporadically between 1900 and 1906 for a total production of 69 tons of ore yielding 4.55 tons of concentrate. In 1964-5 a shaft was sunk 18 feet and a drive 15 feet long made. The floor of the drive exposed 1 foot of ore from which 9 tons yielded 0.25 tons concentrate (Cameron, 1901, 1906; Inspector of Mines, 1965, 1966).

Joan (near 3978-6140). The lode is in fine-grained white granite, within 150 feet of its contact with a coarse pink granite. The lode, chloritic and carrying abundant magnetite, a little copper carbonate and chalcopyrite, strikes east and dips vertically. Where worked it ranged from 1 to 4 feet in width. Workings are a shaft 40 feet deep with drives 6 feet east and 12 feet west. Production (1942) was a little over 13 tons of ore averaging 8½ percent concentrate (Shepherd, 1943).

Joker (about 409-614?). A massive chloritic lode up to 13 feet wide follows a strong joint system in granite. The workings extend over a length of two chains at the surface. The main shaft, near the southeastern end, is 50 feet deep, with drives 24 feet southeast and 10 feet northwest at 45 feet depth. A width of 3 to 6 feet of lode has been stoped over the levels, and 6 feet of ore is reported in the sink. Two other shafts, 47 feet and 25 feet, have also been sunk. Recorded production: before 1940, 175 tons of ore for 13.53 tons concentrate; 1940-58, 39 tons of 5 percent ore (Morton, 1940a; Department of Mines, 1952, 1954-6; Inspector of Mines, 1958).

Juggler (about 3835-6062?). A quartz-tourmaline lode dips steeply south-southwest probably conformably with the enclosing slate. Five shafts have been sunk over a length of 5 chains, the deepest reported to be 160 feet near the southwestern end. The shoot in this shaft (Cullen's shaft) pitched southwest to 30 foot depth, and some 30 feet of driving was done following it. At 25 feet depth a drive connects with the next shaft to the

northwest. A little driving was also done at 60 feet and 100 feet. The most easterly shaft was 60 feet deep. The lode ranged up to 12 inches wide, but values appear to have been confined to small lenticular shoots. Recorded production (about 1921 to 1946) was 138.5 tons of ore for 18.72 tons of concentrate (Saint-Smith, 1923; Reid, 1931c; Department of Mines, 1938, 1940, 1947).

Jupiter (3786-6146). Late last century a shaft was sunk 85 feet on a lode striking east. About 40 tons of 15 percent ore was raised (Cameron, 1901).

Kingfish (about 3786-6116?). A shaft was sunk 37 feet in 1953 in a creek bed. It was briefly re-opened in 1957. Total production was 47 tons of ore for 4.5 tons of concentrates worth \$1,400 (Department of Mines, 1954, 1958).

Last Chance (about 383-605?). More than 20 shafts, up to 100 feet deep, but mostly 20 to 30 feet, have been sunk over an area of 450 feet by 250 feet in granite. From their disposition it appears that a number of small shoots on several different lodges have been worked. In Cullen and Irwin's shaft, which produced about 10 tons of concentrate, a lode of quartz, chlorite and tourmaline, with patches of cassiterite and copper-staining, was followed to 73 feet. The lode 18 inches to 2 feet wide, dips 75° N. A shoot about 20 feet long was stoped between 25 and 45 feet depth.

Total recorded production was 157 tons of ore for 26.6 tons of concentrate, but Carruthers was supplied by miners with figures totalling over 50 tons of concentrate, and believed even these to be incomplete. In 1966 and 1968 a further 0.66 tons of concentrate was produced (Carruthers, 1953b, 1955b; Warden, Charters Towers, 1966, 1968).

Last Chance (Continong mining area). In 1937 a shaft was sunk to 50 feet on a lode 2 feet wide. Levels were driven to the west at 30 feet, and at the bottom. Production: 47 tons of ore yielded 3 tons of concentrate (Department of Mines, 1938).

Lion (about 376-599). A moderately well-defined, chloritic body 6 feet wide in Running River Metamorphics strikes N. 80° W. and is practically vertical. Since 1965, low-grade (2 percent) ore has been won by opencutting to 12 feet depth over a length of more than 100 feet. Old workings were deepened to 90 feet. Recorded production (including surface material) is 1,931 tons ore which gave 15.38 tons concentrate (Inspector of Mines, 1966-70).

Little Wonder (near Waverley, location not definite). This mine worked a rich lode about 1 foot wide. Production was about 20 tons of concentrate (up to 1904) (Horsley, 1905).

Lone Pine. A $\frac{1}{4}$ -inch vein was followed for several hundred feet by shallow workings at the surface, including an open-cut 50 by 3 feet by 8 feet. Recorded production (1961-3) was: ore 22 tons, concentrate 1.0 tons (Department of Mines, 1961; Inspector of Mines, 1964).

Lone Star (Continong mining area). In 1934 a shaft was sunk to 40 feet, and an 8-foot drive made at the bottom. Production was 18 tons of ore for 1.95 tons of concentrate worth \$662 (Department of Mines, 1935).

Lucky Dip (about 3702-5718). A number of shafts, the main one 40 feet deep, have worked a vein 3 to 6 inches wide. Recorded production (1967-8) is ore 6 tons; concentrate 0.4 tons (Inspector of Mines, 1968-9).

Lucky Fall. See "Achilles".

Lucky Hit (about 3785-6152?). The mine is located on a composite lode 18 feet wide containing eight separate ore veins, mainly quartz-chlorite with sericite and iron and manganese oxides. The veins range in width from a few inches to 5 feet. The country rock is granite.

Workings are an old shaft 25 feet deep and one which was sunk in 1951 to 19 feet. Production was 18 tons of ore for 0.65 tons of concentrate (Ridgway, 1947).

Lucky Hit (343-553). See "Daintree".

Mackerel (3749-6052). Saint-Smith (1922b) noted only a shallow shaft and a few small cuttings in a zone of crushed country rock. The mine had already been abandoned for a number of years.

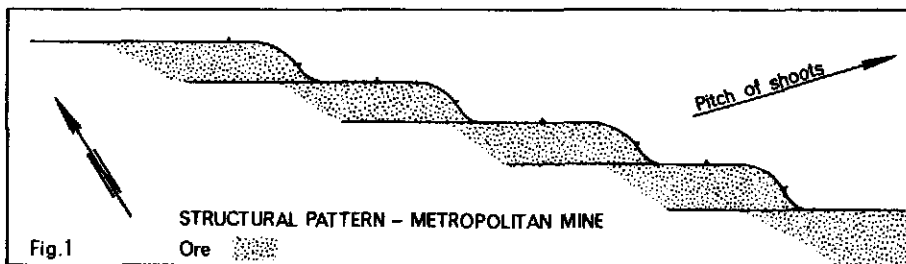
Magpie. Situated a few hundred yards northwest of the Red Gauntlet. Workings consist of three shafts, two of which are 26 feet deep and the third 12 feet. A drive was commenced in one of the 26-foot shafts at 20 feet depth. Production to the end of 1964 was 24 tons ore for 0.52 tons concentrate (Warden, Charters Towers, 1963, p. 547, 1964, p. 162; Inspector of Mines, 1965).

Maritana (near 3760-6065). Workings consist of a shaft 28 feet vertical and 22 feet underlie. A crosscut connects to another shaft 18 feet away. The country is altered chloritic slates and quartzites. Much iron oxide accompanies the tin ore. Production, 1920-5, amounted to 29 tons of ore for 2.5 tons of concentrate (Saint-Smith, 1922b; Department of Mines, 1921-2, 1926).

Marmion. See Narmion.

Mars (3791-6141). Workings are a shaft 72 feet deep, with a level at the bottom 32 feet long in a westerly direction on one lode, and two open-cuts 14 feet and 6 feet deep on another lode 1 foot wide in granite. Production to 1901 was 82 tons of estimated 10 percent ore (Cameron, 1901).

Metropolitan. This mine was one of the principal producers of the Mount Brown Mining Company early this century, and was re-opened for short periods several times since, the latest being 1962-3. The country rock is porphyry. The lode strikes at N. 120° E. and dips steeply to the north. The principal control is a series of parallel shears connected by cymoid curves, the displacements being right-handed in sense and pitching steeply to the east. Deposition of chloritic ore between pairs of these shears produced a series of short shoots, en echelon but forming a virtually continuous body. The structure is illustrated by the accompanying diagram.



Principal workings are a shaft 135 feet deep with drives at 50 feet and 100 feet which explored a shoot about 120 feet long and extending to 120 feet depth. The ore stoped was normally about 3 feet wide. Production figures are recorded only for 1925 and subsequently, totalling 340 tons of ore for 14.7 tons of concentrate, but it is known that up to 1906 the Mount Brown Company had produced 125½ tons of concentrate, of which a considerable amount must have come from the Metropolitan (Horsley, 1905; Cameron, 1906; Department of Mines, 1926, 1934-5, 1939, 1942, 1944, 1950, 1964).

Mignonette (Spring Creek Area). There are four shafts, 53, 12, 58 and 20 feet deep, which produced, from 1933 to 1937, 36 tons of ore for 9.5 tons of concentrate worth \$2,918 (Department of Mines, 1934, 1936-8).

Millers No. 2 (about 403-616?). A granitic lode up to 4 feet wide, carrying patches of tin ore, was worked over a length of 75 feet and to a minimum depth of 35 feet. Production prior to 1938 is not known. From 1938 to 1941, 76 tons of ore returned 3.15 tons of concentrate worth \$1,046 (Morton, 1940a; Department of Mines, 1939-42).

Minerva (about 3774-6143?). A chloritic lode in coarse granite dips steeply north. The old workings made by the Planet Company early this century, consisted of a shaft 102 feet deep with 47 feet of driving at the bottom. In the upper part of the shaft the lode was 4 feet wide, and in the lower part it is reported to have passed into lead. More recent workings are several shallow cuts on this lode, and shafts 35 feet and 20 feet deep on a lode dipping northeast, in addition to much shallow prospecting. Recorded production is 200 tons of estimated 5 percent ore from the old workings and 20 tons of estimated 12½ percent from the 35-foot shaft (Cameron, 1901; Saint-Smith, 1916; Department of Mines, 1959-60).

Monarch (about 3777-6024?). In 1958 a shaft was sunk 22 feet on a narrow lode which became unpayable below 16 feet. Production: 31 tons of ore for a return of 0.85 tons of concentrate (Department of Mines, 1959).

Mountain Maid and Mountain Maid Extended (about 387-609?). This mine was worked 1923-4, 1927-9, 1941 and 1959. The country rock is Running River Metamorphics. Two shafts, 90 and 70 feet deep and 40 feet apart, followed a lode 3 to 4 feet wide in places, which was stoped between them to 30 feet depth. This lode dips steeply southeast. Forty feet to the northwest a third shaft followed a parallel lode 10 to 12 inches wide to 50 feet depth and three levels up to 20 feet long were driven. A fourth shaft was sunk in 1959, and a drive put in 15 feet west at 12 feet depth, but its position in relation to the others is not known. Recorded production is 108 tons of ore for 13.4 tons of concentrate (Ball, 1941c; Department of Mines, 1959-60).

Mount Brown South (3779-6023). Jack (1892) mentioned "blocks of tin ore" but production prior to 1934 is not known. In 1934, 13 tons of ore returned 1.65 tons of concentrate worth \$542 (Department of Mines, 1935).

Mt. Kidston (3891-5967). The country is granite, and mineralization is controlled by a well-defined fissure dipping 60° ENE. The ore-bodies, consisting of greisenized granite impregnated with cassiterite, take the form of irregular pipes. At least four of these were worked, the largest averaging 80 tons of ore per vertical foot from the surface to 60 feet. Workings consist of the main shaft, 145 feet deep, with levels at 60 feet (100 feet southeast) and 105 feet (160 feet southeast connecting with the bottom of No. 2 shaft). Both the main shaft and No. 2 shaft followed pipes, and the others were found between them. No. 3 shaft is on the same line of lode; No. 4 is on a chloritic outcrop striking west to the west of the main lode; and No. 5, to the south, is 30 feet deep and produced some small patches of ore. Recorded production is 5,591 tons of ore for 113.5 tons of concentrate (Marks, 1913).

42. MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE
1:250,000 SHEET AREA, NORTH QUEENSLAND

In 1968, 0.75 tons concentrate was produced but no details are recorded (Warden, Charters Towers, 1968).

Mystery. Situated about 1 mile southwest of Tinvale. The lode occupies a well-defined fissure dipping 38° - 50° N, 20° W, in coarse acid granite. It consists of more or less chloritized and kaolinized granite with tourmaline and small amounts of quartz and cassiterite. The maximum thickness exposed is 4 feet 6 inches to 5 feet in a face at the bottom of the lower workings, the average being 2 to 3 feet.

The workings in 1911 consisted of two shafts about 50 feet apart and 40 feet deep between which most of the lode had been stoped out. The position of these shafts is now unknown.

Present workings consist of two shafts. The main shaft follows the trend of values on an irregular course to an inclined depth of 200 feet, below which level is a winze for a further 20 feet. The extent of the stoped area is not recorded. The second shaft is 35 feet vertical and 25 feet underlie, with a drive 42 feet long northwest from the bottom.

The mine worked before 1911, and again 1941-2, 1946, 1950-2 and 1962-8.

Recorded production amounts to 608 tons of ore for a return of 25.5 tons of concentrate (Cameron, 1911; Ball, 1941a; Levingston, 1952b; Department of Mines, 1953, 1965-8; Inspector of Mines, 1964-9).

Narmion (3812-6137). In the early reports called, more correctly, Mar-mion.

New Chum (3788-6008). Jack (1892) reported irregular masses of chloritic lode material heavily charged with arsenopyrite and varying amounts of cassiterite, with fluorite.

New Years Gift (about 379-604?). Nothing is known of the original working of this lease. It was reopened for two-year periods in 1924 and again in 1936. Two shafts 80 and 50 feet deep are connected by a level at 50 feet. Production for 1936-7 was 56.5 tons of ore which returned 1.4 tons of concentrate worth \$368 (Department of Mines, 1926, 1937-9).

Optimist. Also called Optermist (about 3804-6146?). Two shafts 12 feet deep are the principal workings. Production (1957-60) was 37 tons of 8 percent ore (Inspector of Mines, 1957, p. 540, 1960, p. 676; Department of Mines, 1960).

Orphan. Situated Continong area. In 1937 a shaft was sunk to 15 feet on an east-west vein of low-grade ore which became progressively poorer with depth (Department of Mines, 1938).

Pansy. Situated adjacent to the Mignonette at the head of Spring Creek. From 1935 to 1938 a total of 25.5 tons of ore returned 4.05 tons of concentrate worth \$1,200 (Department of Mines, 1936-7, 1939).

Perserverance (about 385-616?). Tin occurs in otherwise unaltered granite, deposited along fracture planes. Workings are a shaft 20 feet deep and an open-cut 80 feet long and up to 12 feet deep. The open-cut shows well-defined vertical walls 4 feet apart. Recorded production was 18 tons of ore for 4.25 tons concentrate (Cameron, 1906).

Perseverance (3799-6078). This mine, which lies in the Ewan Beds, was worked before 1920, then at irregular intervals to 1968. The lode, consisting of chloritized and kaolinized slate and quartzite, dips 25° WNW. Workings consist of a shaft 30 feet deep, and an adit 70 feet long connected with it, with a little work below the adit level. An attempt to remove the ground above adit level by open-cutting resulted in the collapse of the workings. Two other lodes, one striking northwest to the south-southeast of the shaft, and another parallel to the main lode west of the shaft, have been tested at the surface but not worked to any depth. Recorded production is 1,312 tons of ore for 40.43 tons concentrate (Cameron, 1906; Saint-Smith, 1922c; Department of Mines, 1960-2; Warden, Charters Towers, 1966; Inspector of Mines, 1969).

Plum Pudding (about 368-609?). This mine was worked in 1938-39. In 1963 a new shaft was sunk and an open-cut made. Recorded production was 330 tons of ore (mainly surface and dump) for 3.32 tons concentrate (Department of Mines, 1939-40, 1964; Inspector of Mines, 1965).

Poverty Point (about 3828-6062?). In 1959, about 2 tons of ore which returned 0.09 tons of concentrate was obtained from a small surface shoot (Department of Mines, 1960).

Queenslander (about 367-608?). Situated on the eastern slope of Biscuit Hill about $1\frac{1}{2}$ miles southwest of the Plum Pudding. Probably first worked in the early 1930's when 90 tons of ore from a lode 5 feet wide yielded 0.75 tons concentrate, two shafts were sunk to 30 feet in 1963-5. Work ceased when the shoot fell off in grade and size, and galena appeared. Production in that period was ore 30 tons, concentrate 0.89 tons; in addition, 260 tons of surface material, mostly from the Queenslander, which yielded 0.8 tons concentrate (Department of Mines, 1938-40; Warden, Charters Towers, 1964, p. 657; Inspector of Mines, 1965).

Rainbow (about 363-567?). An underlie shaft was sunk $17\frac{1}{2}$ feet on low grade tin ore 4 feet wide, and an area 20 feet wide stoped out. About 80 tons of ore yielded 1.15 tons of concentrate (Ball, 1946).

Red Gauntlet (3770-6138). Cameron (1901) gives the location of this lease but does not describe the workings. It appears to have produced a small quantity of ore up till 1903. In 1963 an open-cut was started (Cameron, 1901; Department of Mines, 1964).

Red King. Situated about half way between Zero and Pine Creek, near Hidden Valley, exact location not known. Dense chloritic bodies were exposed in four shafts, maximum depth 27 feet, extending over a length of 100 yards. The only recorded lode width was 7 feet 6 inches in No. 4 shaft; 29.5 tons of ore returned 2.1 tons of concentrate worth \$676 (Morton, 1940a).

Red Terror. Situated in the Ewan area, exact position unknown. In 1937 a shaft was sunk 20 feet on a thin vein of tin ore in a lode formation 2 feet wide; 14 tons of ore yielded 0.25 tons of concentrate worth \$98 (Department of Mines, 1938).

Rise and Shine (about 373-606?). In 1962 a shaft was sunk to 95 feet, the top 70 feet vertical, the remainder inclined to the north at 85° . The sides of the vertical part of the shaft below 50 feet have been stoped out. The ore grade dropped off appreciably in the last 7 feet of sinking. Production to the end of 1964 was 206 tons of ore which returned 6.48 tons of concentrate (Department of Mines, 1959, 1964; Inspector of Mines, 1963-5).

Rob Roy (3769-6144). Production up to 1906 was 67 tons of ore which yielded 14.35 tons of concentrate. The mine was re-opened briefly in 1936 but abandoned when values cut out (Cameron, 1901, 1906; Department of Mines, 1937).

The Rose (about 413-606?). Two shafts were sunk in 1948 and 1949, one to 85 feet; 42 tons of ore was raised for a return of 7.5 tons of concentrate (Department of Mines, 1949, 1950).

Ruby. Situated $\frac{1}{2}$ mile west of Tinvale. In 1911 two shafts had been sunk on a large lode in granite. Further work was done in 1928, 1936, 1948-51, including another shaft 40 feet deep and 15 feet of driving. Recorded production was 188 tons of ore for 6.55 tons of concentrate (Cameron, 1911; Laun, 1913; Department of Mines, 1951, 1952).

Salmon (3760-6070). This mine is in sediments of the Ewan Beds, intruded by porphyry, in the strongly developed crushed zone running north-easterly through the Sardine ground to the east. The main workings, abandoned before 1922, consist of a shaft, a small open-cut and an adit 30 feet long. The ore occupied the central position of a channel 6 to 8 feet wide. In 1946 a lens of quartz in the footwall, adjacent to old stopes, yielded at least 7 tons of ore. Recorded production (to 1922) was 172 tons of ore for 2.85 tons of concentrate (Saint-Smith, 1922b; Department of Mines, 1947; Ridgway, 1946a).

Sardine (3764-6070). Lenticular phyllites and quartzites (Ewan Beds) have a regional north-northeast strike and steep southerly dip, with flexuring producing local reversals of dip and variations of strike from north to northeast.

Important structural features are : (1) Fracture zones parallel with the regional strike. One of these, apparently slightly steeper in dip than the sediments, passes through the mine area and the ore bodies lie just beyond its eastern margins; (2) Fissures, faults and joints. Some steeply dipping fissures are completely transgressive, but many, influenced by bedding and the lenticularity of the sediments, follow arcuate courses with frequent branches and en echelon and linked structures. These structures are impressed on the ore shoots where controlled by these fissures. Fissures with low dips are also numerous and can act either as loci of, or barriers to, deposition; (3) Dykes, acid and basic. Quartz porphyry and quartz feldspar porphyry dykes, mainly discordant but with concordant tongues, are closely associated spatially with ore-shoots in the southern part of the mine. Dolerite dykes are mostly almost perpendicular to the bedding. One of these, about 6 feet wide, crosses the worked area, and appears to have acted as a barrier to porphyry intrusion and, to a smaller extent, to tin deposition.

The workings extend over 800 feet in length down to 230 feet vertical depth, with a short extension down to 443 feet. In all, at least five separate shoots have been worked, the most important, the original shoot, yielding about half the total output of the mine. Although the maximum stope length on the shoot was less than 200 feet, and the normal about 60 feet, it was worked over a vertical range of 440 feet. Although the ore was lenticular, the stopes were continuous, indicating that the series of lenses formed virtually one shoot. A cymoid or chatter-link structure appears probable (cf. Metropolitan). The other shoots, lenticular or pipe-like, showed no special structural features.

The lodes consist of crushed country rock with occasional quartz veins, and, in the oxidized zone, cassiterite and occasional arsenopyrite, chalcopyrite, and copper carbonate staining. In the semi-oxidized ore is a yellow mineral - probably varlamoffite, as this has been identified in similar material from the Sardine Peak mine. In the sulphide zone (beginning at various distances above and below No. 4 level) a complex mixture containing stannite was found, and since 1947 sulphide concentrates have formed the major part of the output. In the sulphide ore there have been found cassiterite, stannite, arsenopyrite, rutile, chalcopyrite, covellite, native bismuth, tenorite, chalcocite, and several

TABLE 3 : STANNITE PRODUCTION, SARDINE MINE

Based on figures given by Connah (1952) and Wyatt (1968)

Year	Ore tons	Concentrate tons	Remarks
1936-49	386	9.03	Dumps mostly derived from Sardine Tin Mines N. L. 's operations, 1920-32
1936-38	334.8	32.50	
1949	33.6	3.41	
1950	135.0	39.53	
1951	91.4	21.57	
1953	76.4	16.98	Contents Sn 4.07 tons, Cu 4.98 tons
1954	6.3	1.25	" 0.42 " 0.30 "
1955	77.4	19.08	" 4.64 " 4.98 "
1957	274.6	43.10	" 7.96 " 11.76 "
1958	72.0	7.62	" 1.69 " 2.25 "
1959	56.2	5.94	" 0.90 " 1.65 "
1960	38.0	2.30	" 0.59 " 0.57 "
1963	335.6	29.82	" 7.40 " 10.92 "
1964-65	506.6	46.16	" 11.94 " 11.90 "
1966	387.8	37.48	" 9.11 " 9.55 "
1967	1056.9	52.64	" 15.27 " 10.25 " Includes 464.3 tons of low-grade material (stope filling etc.) won in rehabilitation of the internal shaft
1968	527.6	17.46	Contents Sn 7.23 tons, Cu 1.15 tons
1969	547.0	30.00	

unidentified bismuth minerals. Analyses suggest that the "stannite" concentrate contains roughly one-third each of cassiterite and stannite.

Four diamond drill holes put down in 1961-64 by North Broken Hill Ltd were unsuccessful in exploring the continuation of ore in depth.

Since 1961 the deepest parts of the workings have been reopened and prospected, with little success. Better results were obtained in the Sardine North section, where two levels (Nos 5 and 6) were driven from No. 5 winze, 84 feet below No. 4 level. A pipe-like stannite shoot trending northeast and having an average diameter of 12 feet was worked from No. 4 to No. 6 level as well as a number of smaller bodies associated with it.

Recorded production (1919-1969) is 15,497 tons of ore for 1,628 tons cassiterite concentrate, and 4,932 tons of ore for 416 tons "stannite" concentrate (including 56.6 tons hand-picked) (Saint-Smith, 1922a, b, 1923; Reid, 1931a, 1932a, b; Anon, 1950; Wilson, 1921, 1926; Connah, 1952b; Wyatt, 1961, 1968c; Edwards, 1951; Edwards and Baker, 1953; Stillwell, 1950).

Sardine North. Adjoining the Sardine on the northeast. From 1920-1928 much exploration was done in an attempt to find ore bodies in this ground. In 1933 it was incorporated in the Sardine leases. Workings consist of a shaft 160 feet deep and three levels, the longest of which is 170 feet. The two upper levels are connected to the surface by adits. Production before 1933 was 188 tons of ore for 9.45 tons of concentrate. In 1949 the dump returned a further 1 ton of concentrate from 65.5 tons of ore. All ore mined since 1933 from this area has been included under production from the Sardine (Saint-Smith, 1922b, 1923; Reid, 1932; Connah, 1952; Carruthers, 1953; Wyatt, 1961).

Sardine Peak (3758-6070). This mine has been worked in several periods from 1945 to the present. The ore occurs as pipe-like chloritic and kaolinic bodies in sediments of the Ewan Beds. There are four shafts, the most important being about 210 feet vertical depth. After a 70-foot vertical section, this shaft follows a pipe pitching to the northeast. The pipe follows the dip of a shear dipping about 45°, in the lower workings dropping to a parallel shear 25 feet from the first. The ore is mostly kaolinized country (quartzite and slate) carrying cassiterite, and, in the bottom of the mine, pyrite, chalcoppyrite and stannite. Yellow coatings of varlamoffite occur on some of the ore. The grade of concentrate produced ranged from barely 30 percent tin in the upper parts of the pipe to almost 50 percent tin in the lower, but no work has been done to identify the impurity. Recorded production to the end of 1969 is ore 1,911 tons, concentrate 88.6 tons (Department of Mines, 1946-7, 1954, 1959-62; Inspector of Mines, 1966-9; Wyatt, 1968c).

Sardine South (3765-6067). This ground was taken up in 1921 because it adjoins the Sardine, and in 1933 it was incorporated in the Sardine. Workings consist of a shaft (Galton's) 60 feet deep with a short drive at the bottom (Saint-Smith, 1922b).

Satellite (3774-6141). Tin values were encountered only at the mouth of an adit and at the bottom of a 50-foot shaft connected with it. Production was 100 tons of approximately 8 percent ore (Cameron, 1901).

Saturn (3778-6140). There are four shafts from 20 to 50 feet deep and several trenches up to 200 feet long. Production was 50 tons of 5 percent ore (Cameron, 1901).

Scotch Mixture (about 3793-6152?). The main workings are on three parallel chloritic veins 18 inches to 2 feet apart containing minor amounts of quartz, feldspar, sericite, and cassiterite. They consist of a shaft 40 feet deep with stopes northwest and southeast from it along the lode for a length of 43 feet, and an open-cut 31 feet long and 9 feet deep. Two other parallel veins have also been worked by shallow holes. Recorded production was 4.38 tons concentrate (Ridgway, 1947a).

Seagull (3807-6064). This mine was worked in 1918-22, 1935, and 1939. The lode, mainly chloritic, was up to 7 feet wide. Tin occurred in irregular patches, the best being where the lode was cut by bands of kaolinized material probably associated with the extensive porphyry intrusions on the south side of the lode. Workings are a 60-foot shaft with a stope 30 feet high and 43 feet long at the bottom, and 100 feet to the east-southeast a 17-foot shaft with a drive 12 feet east from it. Recorded production was 534 tons of ore for 17 tons of concentrate (Saint-Smith, 1922a; Department of Mines, 1936-40).

Shrimp (3750-6054). The deposit occurs in steeply-dipping slate and quartzite of the Ewan Beds. The beds strike between N. and N. 40° E. with small scale contortions. They are intruded by quartz veins, producing silicification over large areas, and by dykes of quartz-porphry and porphyrite. The granite contact lies half a mile to the west. The deposits are associated particularly with a zone of crushing about 40 feet wide striking parallel with the country in the western part of the ground, swinging slightly more to the north in the eastern part. This crush zone is intersected by a later series of fractures perpendicular to it. Tin deposition, usually low grade, is spread over a wide area in the crush zone, with some richer patches, often associated with the cross-fractures. Two main areas were worked: in the northwestern part of the ground several pipe-like bodies gave rich returns for a short period; and to the southeast of this area shallow work was done in a zone running northeast suggesting that this part of the ground is erratically mineralized throughout. The ore in the first area carried sulphides - pyrite, arsenopyrite, and copper and bismuth minerals - rendering the concentrates low in grade and value. The second area was not worked to the sulphide zone but the presence of much ferruginous material suggests that sulphides would also be present here in the primary ore. The workings, most of which date from 1919-25, occupy an area of about 600 feet by 300 feet. In the northwestern area the pipe-like shoots were followed by seven shafts, the deepest being 84, 70 and 58 feet. The first two are reported to be connected by a crosscut and a drive which was stoped above to a height of 20 feet. The remaining workings are four open-cuts (with an adit from the main one passing under the others and connected to them by passes), two other shallow open-cuts, several shafts (maximum depth 60 feet), and an adit 160 feet long, originally intended to extend to the main open-cut (a further 140 feet). Recorded production is 2,998 tons of ore for 124 tons of concentrate, but this is incomplete. About two-thirds of the concentrate came from the low grade ore of the open-cut area, the other one-third from the higher grade shoots to the northwest (Saint-Smith, 1921, 1922b, 1923; Reid, 1931d; Carruthers, 1953a).

St. George (about 381-609?). A quartz-chlorite lode in altered granite carried a flatly-dipping ore shoot which was followed irregularly for about 60 feet. Production was 11.5 tons of ore for 3.55 tons of concentrate (Cameron, 1906).

Standard (Tinvale). See Daintree.

Sunbeam. (3752-6059). Saint-Smith (1922b) noted only shallow workings about 30 feet long on a lode 14 feet wide carrying very low tin values.

Sunflower (about 362-566?). About 1939 or 1940 an open-cut 23 feet long, 12 feet wide and 12 to 15 feet deep was made on a zone of sheared and altered granite with no visible "walls". The gangue was a quartz-chlorite-sericite mixture with some iron oxide, and the cassiterite was very fine grained. There is no record of production (Denmead, 1948a).

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Sunrise (3775-6028). In 1960 a shaft was sunk 15 feet and 2 tons of ore raised (Department of Mines, 1961).

Surprise (about 410-614?). The workings, most of which date between 1935 and 1940, consist of an open-cut 55 feet long, 12 feet wide and up to 24 feet deep on a quartz-greisen body striking east in pink granite. Within the greisen higher values were associated with irregular quartz patches, but on the southern edge four shafts, 23 to 50 feet deep, followed what is apparently a narrow chloritic lode. This lode, 1 to 2 feet wide in the easternmost shaft and dipping 70° - 75° S., is probably part of the downward extension of the main ore-body, but the exact relationship is obscure. Some driving and stoping has been done from these shafts, and all available ore appears to have been mined above $38\frac{1}{2}$ feet. Recorded production is 393.5 tons of ore for 23.9 tons of concentrate (Morton, 1940a; Carruthers, 1953b; Department of Mines, 1936-42).

Susan (3762-6051). Sediments of the Ewan Beds are cut by a shear dipping 30° NW. and a series of closely spaced shears dipping steeply to the northeast. Near their intersection is a pipe of ore which has been followed for a length of 30 feet to a vertical depth of 22 feet. Production (1968) was ore 36.5 tons, concentrate 1.3 tons (D. H. Wyatt, pers. comm.; Inspector of Mines, 1969).

Terrible Whale (3738-6071). This mine was worked for short periods in 1906 and 1916. A prominent belt of chloritized granite dipping about 80° N. was worked by two open-cuts, and four shallow shafts were sunk on a parallel lode 200 yards away. Production figures are not available but it appears the grade of ore varied from 2 to 12 percent (Saint-Smith, 1921).

Thin Edge (about 3797-6080). Some 12 tons of ore, yielding 0.3 tons concentrate, were won by open-cutting a 2-inch vein (Inspector of Mines, 1967).

Tinfish (3741-6056). The country is quartzite of the Ewan Beds, a little to the east of the granite contact. Several small open-cuts have been made on a lode of crushed quartzite with much chlorite, striking east-northeast, and an underlie shaft 10 feet deep on a "cross-lode" striking N. 10° W. and cutting across the first (Saint-Smith, 1922b).

Tin Syndicate. Part of the Terrible Whale (q. v.) (Saint-Smith, 1921).

Titanic (3816-6067). This mine was worked in the early part of this century to a depth of 110 feet and again in 1925, but there is no record of its production. See also Iron Queen (Department of Mines, 1926, pp. 299, 410).

Toby (about 381-606?). In 1936-37 an open-cut and a shaft 30 feet deep were sunk on a lode carrying very low tin values. Production was 76 tons of ore yielding 1.7 tons of concentrate worth \$500 (Department of Mines, 1938).

Toilers Hope. Situated 50 yards east of the Mignonette at the head of Spring Creek. A small surface lens of high-grade ore discovered in 1925, yielded 25 tons of ore for 9.75 tons of concentrate (Department of Mines, 1926).

Trey Bit (about 358-565). In 1966-7, a 35-foot shaft and a 20-foot drive followed a 2- to 6-inch vein. Production of 13 tons ore yielded 0.83 tons concentrate (Inspector of Mines, 1967-8).

Trump (about 410-614?). A thin chloritic lode was followed to 27 feet depth, where it widened to 27 inches. A drive was made 9 feet to the southeast. Production was recorded in 1937, 1939, and 1950, a total of 18 tons yielding 1.4 tons of concentrate worth \$540 (Morton, 1940a; Department of Mines, 1951).

Try Again. An alternative name for the Metropolitan, q. v.

Ulysses. See Golden Cap.

Violet. Situated 400 feet northwest of the Florist at White Springs. A shaft 27 feet deep inclined 60° was sunk on a surface lode 2 feet wide which pinched out at the bottom. Production was 18 tons of ore for 2.9 tons concentrate (Ball, 1941a).

Wako. Situated on the Guy Mannering leases, Waverley. This mine was worked periodically from 1935 to 1938 and in 1946. Two shafts 42 feet apart and 40 feet deep were sunk and connected by drives at 30 and 40 feet. Production of 125 tons of ore returned 7.7 tons of concentrate worth \$2,086 (Department of Mines, 1936-9, 1947).

Wait-a-While (location not known). In 1965, a 12-inch flat greisen vein was followed for 23 feet in an adit (Inspector of Mines, 1966).

Warrigal (about 3812-6143?). A lode in granite, approximately 2 feet 6 inches wide and dipping 65° - 70° N., was exposed in several potholes over a length of 30 feet (Cribb, 1940).

What's It (about 402-617?). An open-cut 12 feet deep and about 40 feet long was made on a lode containing chlorite and fluorite with patches of tin ore. Production was 15 tons of ore for 2.1 tons of concentrate worth \$640 (Morton, 1940a).

White Hope. Situated next to the Mystery at Tinvale. In 1937 a small lode was discovered and a shaft sunk 38 feet. Recorded production was 20 tons of ore for 0.86 tons concentrate (Warden, Charters Towers, 1937, p. 252; Department of Mines, 1938).

White Shark (about 381-613?). In 1939, 18 tons of ore yielded 0.4 tons of concentrate worth \$112. In 1950 the dump was retreated; 28 tons yielded 0.35 tons of concentrate worth \$308 (Department of Mines, 1931, 1940, 1951).

White Springs. The locality of White Springs is about 6 miles east of Tinvale, but the exact position of this mine is not known. In 1950, 4 tons of ore yielded 0.2 tons of concentrate worth \$176 (Department of Mines, 1951).

Wonder. Situated about a mile west of Tinvale dam. The country is coarse reddish granite, a wide extent of which is altered to tourmaline-bearing lode along fractures, some of the resultant veins carrying irregular shoots of tin. At the Wonder deposition follows this pattern, the lode being associated with a roughly parallel system of fractures (faults and joints) striking north over an area 500 feet long and up to 100 feet wide. This lode ranges from practically unaltered granite to a hard quartz-tourmaline mixture. Tin occurs as shoots, usually pipe-like, in these lodes, (picked ore carrying $2\frac{1}{2}$ to 4 percent cassiterite), and in odd rich pockets. Work has been carried on in a sporadic manner since 1913, and a large number of shallow shafts, open-cuts, and potholes are scattered over the area. The deepest workings are a shaft 50 feet deep with a drive north for 25 feet near the bottom. Features of the mine are the lack of any exploration in depth and of the country between the lodes. The outcrop is poor, and the possibility of a large low-grade

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deposit cannot be dismissed. Records of production are scanty but the best estimate available is that about 13 tons of concentrate has been produced from less than 500 tons of ore (Reid, 1928b; Morton, 1938; Ball, 1941a).

Yanks Shaft (near 3755-6063). Two shallow shafts were sunk in 1921 to seek a possible extension of mineralization between the Shrimp and the Sardine (Saint-Smith, 1922b).

Zig-Zag (location not known). Potholes and shallow shafts have been sunk to 25 feet, in one of them the lode being 3 to 8 inches wide. Recorded production (1920-22) was 56 tons of ore for 5.06 of concentrate (Department of Mines, 1921-3).

Other Mines. A number of mines of whose workings there is no recorded description are listed in Table 4.

TIN -- ALLUVIAL

Tin occurs on the Kangaroo Hills Field in Recent stream alluvium and Tertiary deep leads, but most of the workable alluvial deposits are on the Ingham Sheet to the north (de Keyser et al, 1964). In that area alluvial tin made up the major part of the production, but on the Townsville Sheet it was far less important than lode tin. The first production was from Running Creek, a tributary of the Star River, and no doubt small amounts have been won over the years from many other creeks, but there is no record of the workings. In some cases only the secondary concentrations in the creek beds have been worked, and lower-grade material still occurs in the banks, e. g. the Silver Spray, Gowrie Creek area (Wyatt, 1968).

Ruxton (347-602). Tertiary alluvial has been exposed by denudation in a zone some 20,000 feet long and up to 20,000 feet wide. The section is :-

Basalt	Up to 60 feet thick
Coarse quartz sand	" 40 "
Main stanniferous wash bed	" 10 "
White and yellow kaolin carrying traces of tin	5 to 15 "
Fine to medium quartz sand (barren)	Up to 15 "

(The two lower beds are found only in the deeper parts of the lead).

Several scattered areas where most of the overburden has been eroded have been tested by drilling. No details of results are available but preparations have been made to work the area. Owing to lack of water no production has yet been achieved.

Kallanda (near 376-613). To the south of the old township of Kallanda, a 10-foot bed of stanniferous alluvium is exposed over a length of 2,000 feet. It is overlain by 30 to 40 feet of basalt. No testing has been done to determine its possible extent (McKenna, 1965).

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TABLE 4 : MISCELLANEOUS LODE TIN MINES, TOWNSVILLE 1:250,000 SHEET AREA

Mine	Location	Period	Ore, tons	Concentrate		References *
				tons	Value \$	
Abbot	3789 - 6156	-	-	-	-	
Ajax	3717 - 6054	-	-	-	-	
Antares	3789 - 6141	-	-	-	-	
Brilliant	3789 - 6051	-	-	-	-	
Causeway	3802 - 6145	-	-	-	-	
Christmas Gift	3784 - 6036	1920's	-	-	-	1929
Comet	3796 - 6143	-	-	-	-	
Comet	3806 - 6053	1941	13.5	1.05	356	1942
Commonwealth	3712 - 6073	-	-	-	-	
Crisis	-	1968	-	0.2	-	1968
Cyclops	3793 - 6158	-	-	-	-	
Dan's Gift	3800 - 6080	1967	2	0.06	-	1967
Dawn Robert	367 - 6087	1938-40	115	15.15	2920	1939-41
Dead Horse	3801 - 6080	1965	38	0.26	-	Inspector, 1968
Ditch	10 m ESE of Ewan	1930, '37-8 '54	38	5	-	1931, '38-9, '55
Dolly Pot	-	1939	8	1.1	346	1940
Donahu	Near Waverley	1960	3	-	-	Ore estd. 4% Inspector, 1960
Doubtful	Near Waverley	1938	34	1.9	532	1939
Dundee	3822 - 6033	-	-	-	-	
Easter Gift	-	1939	12	0.25	80	1940
Echo	-	1967	1	0.1	-	Inspector, 1968
Eclipse	3792 - 6141	-	-	-	-	
Eclipse	3788 - 6022	-	-	-	-	
El Dorado	-	1968	-	0.14	-	1968
Electric Telegraph	3797 - 6076	-	-	-	-	
Empire	3787 - 6023	-	-	-	-	
Etna	3746 - 6102	-	-	-	-	
Fair Maiden of Perth	3805 - 6144	-	-	-	-	
Federation	3809 - 6074	-	-	-	-	
Florence	368 - 6077	1937-9	408	10	2736	1938-40
Go Ahead	-	1968	-	0.05	-	
Golden Pheasant	360 - 6087	1928-9	-	-	-	1929-30
Gracie	3814 - 6137	-	-	-	-	
Grasstree	374 - 6107	1940	12	1.45	506	1941
Green Frog Extended	3730 - 60477	1968	-	0.95	-	Inspector, 1969
Greenhead	389 - 6177	1939	4	1.35	408	1940
Green Terror	-	1938	19	1.9	460	1939
Grunter	3758 - 6058	-	-	-	-	
Hammer	394 - 6117	1941	2.5	0.95	380	1942
Hecla	3743 - 6112	-	-	-	-	
Herschel	3783 - 6149	-	-	-	-	
Hill End	381 - 6157	1939-41	45	4.5	1600	1940-2
Hinkler	380 - 6087	1938-40	104	7.2	1940	1937-41
Horseshoe	3779 - 6062	1964, '66	25	0.68	-	Inspector, 1965, 1967
Invercargill	½ m NE of the Ditch	1938	50	5.15	1390	1939

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Table 4 (cont)

Mine	Location	Period	Ore, tons	Concentrate		References *
				tons	Value \$	
Iron Mountain	383 - 607?	1934-9	313.5	5.4	1656	1935, 1940
Ivanhoe	3794 - 6152	1900-06	69	4.55	-	Cameron, 1901, 1906
Jackpot	3910 - 5980	1965	3	0.15	-	Inspector, 1966
Kangaroo Hills	3858 - 6062	-	-	-	-	
Kenilworth	3801 - 6151	-	-	-	-	
Kite	-	1933	5.75	0.5	180	1934
Krakatoa	3750 - 6100	-	-	-	-	
Lady Mabel	3849 - 6045	-	-	-	-	
Lady of the Lake	3806 - 6141	-	-	-	-	
Lammermoor	3791 - 6167	-	-	-	-	
Leonta	3812 - 6126	-	-	-	-	
Limestone	3809 - 6061	-	-	-	-	
Lookout	3790 - 6152	-	-	-	-	
Look West	3803 - 6051	-	-	-	-	
Lucky Star	3804 - 6048	-	-	-	-	
Luck At Last	-	1938	10	0.75	210	1939
Lucky Last	2½ m E of Pansy	1937	98	5.8	1744	1938
Maffra	½ m from Wacko	1938-9	24.5	5.05	1252	1939-40
Magnificent Casket	3806 - 6044	-	-	-	-	
Mercury	3781 - 6151	-	-	-	-	
Midlothian	3794 - 6155	-	-	-	-	
Minstrel	3811 - 6143	-	-	-	-	
Monastery	3778 - 6161	-	-	-	-	
Montey	-	1951	68	1.35	1700	1952
Mooregalla	3877 - 6030	-	-	-	-	
Mountain King	368 - 607?	1939	18.5	1.4	462	1940
Mountain Queen	-	1939	31	0.55	172	1940
Mr. Brown	3779 - 6025	1940, '66, '67	72	3.05	-	1941; Inspector, 1967-8
Mt. Kitchener	3809 - 6143	-	-	-	-	
Mt. Sara	3882 - 6050	-	-	-	-	
Mt. Spectacle	3826 - 6046	-	-	-	-	
Neptune	3790 - 6146	-	-	-	-	
Nigel	3803 - 6156	-	-	-	-	
Norway	3818 - 4060	-	-	-	-	
Pasco	3881 - 6023	-	-	-	-	
Peveril of the Peak	3802 - 6142	-	-	-	-	
Pirate	3803 - 6142	-	-	-	-	
Providence	368 - 612?	1939	17.5	2.0	568	1940
Pumpkin	387 - 608?	1939	6.75	1.25	400	1940
Queenslander	3792 - 6147	-	-	-	-	
Red Hen	Abt. 9 m NW of Ewan	1937-8	9.5	1.45	434	1938-9
Rip and Tare	3787 - 6027	1939	12	0.75	86	1940
Rise and Shine	3774 - 6029	-	-	-	-	
Separation	3777 - 6135	-	-	-	-	
Shark	3739 - 6067	-	-	-	-	

Table 4 (cont)

Mine	Location	Period	Ore, tons	Concentrate		References *
				tons	Value \$	
Sirius	3774 - 6145	-	-	-	-	
Southern Cross	3785 - 6135	Before 1906	54	2.4	-	Cameron, 1906
Specimen Flat	-	1966	18	0.07	-	Inspector, 1967
Spring Creek	-	1966	14.0	0.3	-	Inspector, 1967
Squib	359 - 566	1968	-	0.95	-	1968
Squib Ridge	359 - 565	1965, '68	-	0.3	-	1965, '69
Storm Bird	7 m W of Ewan	1939-40	12	2.3	742	1940
Stromboli	3745 - 6104	-	-	-	-	
Sunset	380 - 610?	1939	7	0.55	140	1940
Sunshine	3801 - 6078	-	-	-	-	
Talisman	3802 - 6153	-	-	-	-	
Trevally	3749 - 6060	-	-	-	-	
The Twin	374 - 608?	1950	51	2.4	1970	1951
Triple Chance	359 - 567	1964-7	79.75	2.63	-	Inspector, 1965-8
Two J's	Waverley	1939	30	1.5	452	1940
Two Jacks	3735 - 6068	1965	12	0.14	-	Inspector, 1966
Uranus	3785 - 6146	-	-	-	-	
Venus	3783 - 6143	-	-	-	-	
Vesta	3788 - 6140	-	-	-	-	
Vesuvius	3736 - 6114	-	-	-	-	
Victor	-	1968	-	0.19	-	1969
Victory	3828 - 6046	-	-	-	-	
Vigilant	3778 - 6042	-	-	-	-	
Waterfall	363 - 603?	-	-	-	-	
Woodstock	3798 - 6155	-	-	-	-	

* Where only a date is given the reference is to Annual Report of the Department of Mines, Queensland.

WOLFRAM, MOLYBDENITE AND BISMUTH

Wolfram has been mined in four areas - Ollera, Hidden Valley, Ewan-Waverley and Upper Star River.

Ollera (Cusack, 1904; Ball, 1911; Ridgway, 1948; Connah, 1952, 1953) has been the most important area, with a total of more than twenty mines having produced at one time or another. The deposits were discovered in 1895 and during the following four years 17 tons, mainly alluvial and eluvial, was produced. A slump in prices resulted in very little work then being done until 1903. From 1903 to 1906 was the heyday of the field, about half the total production being in that period. From 1906 to the beginning of the first World War the field was slack. It revived slightly during the War, to become virtually extinct with the slump in wolfram prices in 1920. Slight revivals took place in years of high prices (1937-9 and 1952-3) but returns were small. Total production is probably over 235 tons of wolfram, in addition to smaller amounts of the associated metals.

The host-rock of the deposits at Ollera is coarse red granite (late Palaeozoic). It is intruded in places by moderately fine-grained quartz porphyry, which has indurated the granite over a narrow zone adjacent to the contact. The full extent of this porphyry is not known, but one particular mass in the main part of the field covers 10 to 15 acres. The deposits, which are largely controlled by joints, are quartz bodies, normally in the form of pipes, and are accompanied by quartz-rock (silicified granite), greisen, and kaolin veins on joints. Although the pipes follow the normal pattern of their type in being irregular and branching they are not highly contorted in shape and usually each set of workings follows a fairly consistent course. Associated with the wolfram are molybdenite and bismuth, usually in subordinate amounts, although the relative proportions of the three metals vary from one pipe to another. Tin occurs as traces only and there is no record of any production.

The remainder of the Kangaroo Hills Field has produced lesser amounts from a number of small deposits spread over a wide area. Generally these are quartz veins but a few chloritic lodes serve as a reminder that the area is fundamentally a tin province with wolfram deposits only rarely developed. These deposits show a greater range of associated minerals than those at Ollera; biotite, chlorite, copper ores, feldspar, fluorite, kaolin, sericite, siderite, topaz, and tourmaline (in places the red variety, rubellite) have been recorded.

Before 1911 an estimated 30 tons of wolfram was won from the head of the Star River, near Hell Hole, on the Star River Field. There is no record of any later production, and the deposits must have been quickly exhausted.

Anna Hankin. At Ollera.

Back In (about 376-609?). The deposit lies near the contact of granite with slate, quartzite, etc. of the Ewan Beds. The immediate host rock is aplitic granite, presumably a dyke. Near the margin of the dyke the aplite is replaced apparently as a result of hydrothermal alteration by lode matter grading imperceptibly into the granite. The lode consists mainly of quartz, small patches of sericitic mineral, and occasional fluor spar. This type of material has been proved intermittently over a length of 300 feet and a width of 100 feet. Wolfram is sparsely distributed through the lode with occasional richer patches or concentrations on joints. At one point a small pocket of carbonate copper ore was found. Workings consist of four small open-cuts and two potholes. Recorded production was 7.32 cwt of concentrate from 80 tons of ore (picked from about 275 tons) and 4.2 cwt, probably mostly hand-dressed ore from rich patches (Connah, 1953).

Banksville. At Ollera.

Belle Vue. At Ollera. This mine has produced since the early days of the field, but little work has been done since about 1920. Four pipes in granite have been explored, of which one was by far the most important. This was worked for the first 100 feet of its length by open-cut, then for a further 200 feet by two adits 60 and 120 feet long, the last 50 feet of pipe being below the second adit. Because the pipe dips fairly flatly (40°) with the hillslope, the bottom workings are only about 80 feet below ground level. The pipe was characterized by the presence of large bunches of clean wolfram, and was responsible for the bulk of wolfram won from the lease. In the bottom it is reported to be 15 feet by 10 feet in section, but carrying little wolfram.

No. 2 pipe, carrying wolfram and molybdenite, split into three branches near the surface. It was followed by an adit 40 feet long and for 14 feet below it, and was reported to be 5 by 5 feet in the sink. No. 3, a large quartz body with a little feldspar, carried wolfram, molybdenite, and bismuth. It was worked by two open-cuts, one of which was 70 by 25 feet by 12 feet deep, but was not followed underground. No. 4 also split into three branches near the surface. It dipped at a small angle and was worked only to a shallow depth.

No detailed production figures are available for this lease, but the leaseholder estimated the total to be about 100 tons of wolfram, with a little molybdenite and bismuth (Cusack, 1904; Jackson, 1905; Ball, 1911; Morton, 1936; Ridgway, 1947; Connah, 1952a).

Better Luck. A quarter of a mile north of the Belle Vue on Ollera Creek. Two shafts were sunk on wolfram-bearing quartz pipes, and an adit 108 feet long connected with one of them. Four other pipes were opened near the end of this adit. Three of them came together and were followed in a winze below the adit. The fourth was followed by another shaft from the surface (Ridgway, 1948).

Birthday Gift. At Ollera, exact location not known. This mine was worked in the early 1900's but abandoned before 1911. Workings consisted of an adit with an easterly drive following the lode (Cusack, 1904; Ball, 1911).

Bonnie Jean. At Ollera. A quartz pipe dipping 45° W. has been followed to 41 feet by a shaft (Ratten, 1938).

Boomerang (3950-6109). Several narrow parallel lodes striking N. 80° E. cut a belt of dark gneiss 700 feet wide striking N. 20° E. The lodes, which dip steeply to vertically, are composed of quartz with small amounts of fluorspar, topaz and siderite. The wolfram is coarse-grained, and best values were found in the centre of the worked area, often adjacent to biotite-rich seams in the gneiss. Molybdenite occurs in considerable quantity, but has not been mined. Recorded production is (estimated) 15 tons of wolfram (Saint-Smith, 1916).

Boomerang or Kookaburra (about 413-616?). Wolfram occurs as spasmodic, irregular bunches of large crystals in a massive vertical white quartz lode at least 15 feet wide. The country rock is quartz porphyry. Workings consist of an open-cut about 36 feet long and 18 feet deep with a shaft sunk a further 13 feet in the floor. Owing to the spasmodic occurrence of the wolfram, mining costs were high. Less than 4 tons of 71 percent WO_3 concentrate was produced. One hundred feet west of the open-cut on what is probably a continuation of the lode, cassiterite is associated with fine-grained pyrite in chloritic quartz. One shaft, 16 feet deep, was sunk on it (Shepherd, 1943).

Bosun Extended. Just north of the Sailor Boy at Ollera. Cusack (1904) described this as a "gully raking" claim. It produced about $\frac{1}{2}$ cwt of wolfram concentrate.

Bouffon. On the southern part of the Ollera Field. In the 1950's systematic surface prospecting was done with a view to locating possible pipes of ore and about 13 cwt of wolfram concentrate was obtained. There are old workings on the ground, with molybdenite and wolfram on the dumps, but nothing is known of them (Connah, 1952a).

Bower Bird (about 388-612?). Two main shafts and an open-cut with connecting drives and a couple of shallow shafts are the principal workings. They have explored the lode over a length of 100 feet to a maximum depth of 49 feet. Four shallow shafts, the deepest 23 feet, lie in a parallel line to the northwest of the main workings. The lode consists mainly of greisen, quartz and fluor spar with a little sericite, and in the open-cut, rubellite. Stains of copper carbonates are common on joints. The country rock is banded quartzite and silicified grit of the Running River Metamorphics. From 1942 to 1954 about 11 tons of concentrate had been raised. Production before 1942 is not recorded (Connah, 1952; Carruthers, 1953b).

Chief. At Ollera. The roughly cylindrical pipe was only a few feet in diameter at the surface but in depth it increased in size and at the lower adit (95 feet below the outcrop) it was nearly 20 feet across (Ball, 1911). This lease was held by R. Bell in 1911, and from Ball's description it is quite likely that the ore body was that later known as No. 1 on the Belle Vue (q. v.).

Empress and Noble Triangle. Situated at the northern end of the Ollera Field. These workings include the old "No. 1 Claim" underlie reported to be 200 feet deep. Production from this shaft is not recorded. More recent work in 1950 and 1951 produced about \$2,000 worth of eluvial wolfram about 100 yards south of this underlie as well as 5 cwt from a ridge 150 yards to the west (Connah, 1952a).

Excellent (about 391-603). The shaft is at least 80 feet deep. In 1968, 37 tons yielded 3.85 tons concentrate (Inspector of Mines, 1969).

Fernery or Ferney. At Ollera, about a quarter of a mile north of the Belle Vue. An open-cut roughly 40 feet in diameter has been made on a patch of quartz rock (silicified granite) carrying bunches of wolfram and a little molybdenite and bismuth on joints. From the south edge of this open-cut three convergent pipes have been worked for short distances by drives and shafts, and exposures in other limited workings on the north side suggest the presence of another. Since 1947 work has been confined to a soft greisen zone 4 to 4½ feet wide between joints. This carries wolfram, molybdenite, and bismuth in similar manner to the quartz rock, but values are low and there has been little production (Ridgway, 1948; Connah, 1952a).

Good Luck (about 412-613?). A lode 1 to 3 feet wide strikes N. 84° E. in granite and has been traced for over 3 chains. It carries quartz veins, usually one on each wall, up to a maximum of 6 inches wide. Wolfram is scattered through the quartz veins with occasional concentrations. A trench 10 feet long and 4 feet deep yielded 2 cwt wolfram (Cribb, 1941b).

Gosner's Comet. Situated on the Star River, location not known. Nothing is known of the workings, but the vein is reported to have been less than 18 inches wide and to have carried less than 2 percent wolfram (Ball, 1911).

Hanging Flat (near 421-616). This claim was taken up in 1951. The workings comprise a trench 15 feet long and 2 to 6 feet deep. The lode consisted of glassy white quartz up to 4 feet wide along a strong vertical joint striking N. 82° E. in granite. A little molybdenite is associated with the wolfram. About 1 ton of ore returned 2 cwt of concentrate worth \$400 (Connah, 1951).

Heal's. At Ollera. A pipe at the intersection of two joints in granite was followed to 40 feet (Ratten, 1938).

Henry Jack. At Ollera.

Isabel. At Waverley (about 382-613?). A quartz segregation in granite, 50 feet wide and at least 400 feet long, strikes N. 75° W. There is no definite line of demarcation between the quartz and the granite, the transition taking place over a few feet. Wolfram values are associated with a strong joint dipping 68° ENE to vertical, the resulting shoot being a pipe less than 15 feet in diameter extending to a maximum depth of 80 feet. Fluorspar and a little bismuthinite occur with the wolfram. Workings consist of an open-cut 22 by 15 feet by 92 feet deep, an adit 100 feet long to the 86-foot crosscut level, and, from the adit just back from the open-cut, a winze 50 feet deep with a 50-foot crosscut at the bottom. The workings below adit level yielded only 2 cwt of wolfram and apparently the continuation of the main shoot has not been located. Local sources estimate total production to be about 70 tons of wolfram (Cameron, 1906; Ball, 1911; Shepherd, 1944b).

Jackhammer. At Ollera.

Jones Claim. At Waverley (about 379-615?). A wolfram and molybdenite lode lies between two well-defined "heads" in coarse acid granite. The gangue consists of crushed and altered granite with sericite and tourmaline. At the bottom of the main shaft (28 feet deep) the ore became very arsenical (Saint-Smith, 1916).

Just Lucky (about 411-615?). A quartz lode carrying wolfram and a little fluorite, 2 feet wide, dips very steeply south. Workings are an open-cut 60 feet long and up to 10 feet deep, and at least one shaft. A total of 26 tons of ore was produced for 12 cwt wolfram (Connah, pers. comm.).

Kandova or Kandover. At Ollera, exact location unknown. Later Rio Grande. A small open-cut was made on an ore body 9 inches to 2 feet 6 inches wide carrying wolfram and molybdenite. About 1 ton of wolfram was produced (Cusack, 1904).

A shaft was sunk 30 feet on a pipe 3 feet wide at the surface but much greater in depth (Ratten, 1938).

Last Hope (about 379-615?), about 250 yards southeast of the old Waverley Hotel. Two parallel joints 2 feet 6 inches apart in granite carrying $\frac{1}{2}$ inch of wolfram-bearing quartz and numerous small vugs containing wolfram are exposed in a costean 6 feet deep and 9 feet long. This costean, a shaft reported 20 feet deep and two potholes constitute the workings, which extend over a length of 50 feet (Ridgway, 1947).

Little Wonder. At Ollera. An open-cut produced about $\frac{1}{2}$ ton wolfram, and an underlie shaft was sunk to 120 feet (Cusack, 1904; Inspector of Mines, 1917, p. 624).

Lucky Fern. At Ollera (near Ferney?).

McArthur (about 408-616?). The country is coarse-grained granite. Wolfram occurs in a quartz lode, dipping 64° SSW., which can be traced for 150 feet. The principal workings are a shaft 32 feet deep, stoped each side for a total width of 11 feet between 20 feet and 32 feet. The lode ranges from 1 foot to 3 $\frac{1}{2}$ feet wide in this section, and the wolfram is associated with fluorspar, bismuthinite, and molybdenite. Production was 5.6 tons of estimated 5 percent ore (Shepherd, 1943).

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McKugan Extended. A very large greisen lode carried unpayable molybdenite (Inspector of Mines, 1917, p. 624).

Mitchell's Mine (about 3855-6131?). In 1943, 4½ tons of 20 percent ore was produced (Inspector of Mines, 1943, p. 104).

Mug's Luck (about 414-616?). A shaft was sunk to 20 feet in 1950 on a small quartz vein carrying wolfram. All mineralization disappeared at the bottom of the shaft and the claim was abandoned. Two tons of 1½ percent ore was raised (Department of Mines, 1951).

No. 1 Extended. At Ollera. (See also "Empress" and "Noble Triangle"). These workings include a number of trenches and shallow shafts, as well as the main underlie shaft 200 feet deep. The shoot in the shaft was a good producer but prospects at the bottom are poor (Inspector of Mines, 1917, p. 624, 1942).

Ollera Extended. At Ollera. An open-cut 135 feet long and 16 feet wide, runs east-west. From it a shaft 16 feet deep follows the ore body. In the first part of 1904, 2½ tons of hand-dressed wolfram was produced (Cusack, 1904).

Rio Grande. See Kandova.

Sailor Boy. Nearly half a mile north-northeast of the Belle Vue at Ollera. By the end of 1938 two shafts, one 200 feet deep and the other 110 feet, had been sunk on quartz pipes and some open-cutting had been done. Production from the mine was second only to the Belle Vue, but no actual figure is recorded (Cusack, 1904; Lee, 1938).

Sailor Lass Extended. At Ollera. The country is porphyry. A strong quartz pipe 3 feet in diameter has been followed to 26 feet (Inspector of Mines, 1942).

Shamrock (about 374-607?). In 1951-52, 3 cwt of wolfram was produced (Department of Mines, 1952, 1953).

Simpson's Wolfram (about 374-610?). At least six quartz-wolfram lodes in granite have been prospected, of which three have produced some ore. The lodes strike east and dip vertically or steeply to the north. The most easterly workings on the most northerly lode are an open-cut 30 feet long and 19 feet deep on a 1 foot width of chloritic material with quartz and disseminated wolfram. In a trench 35 feet to the west this lode has shrunk to 6 inches of low-grade material. The main workings, 600 feet west, and 80 feet to the south, consist of two shafts, one 35 feet deep on a lode 1 to 2 feet in width, and stoping and open-cutting down to 35 feet over a length of 110 feet. Further west again some 300 feet are two cuts 10 feet deep on what is probably the continuation of this lode. Two hundred feet south of these cuts are the workings on the third lode - an open-cut 50 feet long and 12 feet deep on a quartz-chloritic formation about 2 feet wide (Shepherd, 1943).

Spec. At Ollera, exact location unknown.

Unlimited (near 3854-6134). Slate and schist have been intruded by granite with intense alteration and intrusion by numerous apophyses. In the metamorphics, close to the contact, five pipes have been worked within an area 100 feet in diameter. The pipes consist of a biotite-quartz mixture containing wolfram, feldspar, fluor spar, traces of tourmaline, molybdenite, chalcopyrite, and bismuth, and, in one case, abundant topaz. The first pipe, discovered in 1942, was up to 5 feet across. In it, a lenticular shoot was

followed to 35 feet by the irregular "Main" shaft trending southeast. The shaft was continued to 50 feet in unpayable lode material. The "Limited" shaft followed to 71½ feet an irregular, steeply northeast-dipping pipe which averaged 1 cwt wolfram per foot of depth. Below 50 feet this pipe was mainly quartz with most of the wolfram occurring in a micaceous aureole. To the northeast of this shaft a small pipe, from its position a branch of the second, was followed to 28 feet for a small production. Two other small pipes were followed to 18 feet and 28 feet. Production (1942-52) was 15.65 tons wolfram (Shepherd, 1944a; Morton, 1946; Carruthers, 1953).

Vesuvius. At Ollera, exact location unknown.

Waverley. At Waverley, 300 feet northwest of the Minerva. The lode dips 75° NE. and occupies a narrow fissure in coarse acid granite. The workings consist of an old shaft at least 23 feet deep; a later shaft (Jansen's) 36 feet deep with a drive 11 feet northwest at the bottom; and a shallow trench to the southeast of the shafts. The lode exposed in the drive consists of a wolfram-quartz vein 1 inch thick on the hangingwall, then below it a band two or three inches thick of oxidised copper ore with a little wolfram and molybdenite. Between this and the footwall is 12 to 15 inches of kaolinised crushed granite, in places highly chloritized (Carruthers, 1952).

Wolfram King. At Ollera, a few chains north of the Belle Vue. This mine operated in the early 1900's and again in 1911 (Ball, 1911).

Wolfram Queen. At Ollera, exact location unknown. This mine was abandoned at the time of Ball's visit in 1911. In 1951 surface material was reworked for a yield of 2.75 cwt of wolfram (Ball, 1911; Department of Mines, 1952).

IRONSTONE

Ironstone has been produced from one deposit on the Sheet area, but other similar deposits have been examined from time to time as possible sources of iron ore. They are all pyrometasmatic segregations, lying between late Palaeozoic granites and limestone (Dotswood Formation or Ewan Beds). Geological information is available on only two localities, which, however, can reasonably be taken as typical.

EWAN

The contact between the Ewan Beds and an Upper Palaeozoic Granite is mineralized over a length of about 3 miles. Pyrite, sphalerite, arsenopyrite, and a variety of copper minerals have been recorded from the contact zone. Associated with this mineralization are skarns ranging in composition from siliceous contact-rocks to almost pure magnetite. The largest and most important of the magnetite bodies is that at Willett's Knob, about 3 miles north of Ewan. This is an imposing mass of dense magnetite 200 feet long and up to 120 feet wide with a grade of at least 60 percent iron. Two smaller bodies occur nearby and a large area is covered by floaters of magnetite. The deposit is surrounded by garnet rock. Possibly 200,000 tons of ironstone is available for quarrying but the deposit is not conveniently situated and so far no attempt has been made to exploit it (Jack, 1892; Reid, 1931; Levingston, 1954).

WOODSTOCK

(a) "Eastern Lode". Situated 481-542, on the upper tributaries of the Ross River. The deposit is composed of magnetite and hematite with considerable admixture of silicates, predominantly epidote, and is probably conformable with the limestone. It

extends over a length of about 1,200 feet with individual ironstone bodies, which are apparently lenticular, up to 30 feet in width. The deposit has been exploited recently for use in cement manufacture, total recorded production (1955-69) being 36,416 tons (Saint-Smith, 1920a; Morton, 1939; Levingston, 1962).

(b) "Cattle Creek" Deposit. (Half to one mile west of the "Eastern Lode"). Saint-Smith (1920a) considered that many thousands of tons were available. Morton (1939) stated that all the visible material is shoad, and concluded that "the field evidence being opposed to any expectation of ore being found in situ here, no importance can be attached to the area from an economic viewpoint". There is no record of any attempt at exploitation (Saint-Smith, 1920a; Morton, 1939).

LIMESTONE

Several parts of the sheet area are occupied by outcrops of limestone of the Fanning River Group and Ewan Beds, in addition to the anomalous "earth lime" at Reid River associated with andesite of the Ellenvale Beds. The deposits at Reid River (limestone and earth lime) have been exploited since last century to supply lime for the cyanide works at Charters Towers and for the sugar industry (mills and farms), and, in recent years, to supply raw material for the cement works at Townville. No production is recorded before 1900, although no doubt limestone must have been quarried before then. From 1900 to 1969, 1,830,368 tons is recorded, of which 90 percent has been produced for cement manufacture since 1955.

REID RIVER

Limestones of the Fanning River Group (Burdekin Formation) form conspicuous hills to the north of Reid River, near Calcium. Normally the deposits consist of good quality limestone up to 200 feet thick, overlain and/or underlain by up to 100 feet of "banded limestone" - alternations of limestone and other sediments in layers about 6 inches thick. The other sediments are altered by intrusion to a variety of hornfelses and chert. Fine grained dykes, acidic and basic, cut the limestones, usually with local thermal metamorphic effects. The area is faulted, some of the faults being of sufficient magnitude to completely disconnect deposits that were originally continuous. The following deposits have been described :-

(a) Inportions 62V, 59V, and 89V, Parish Wyoming are three deposits over a length of more than a mile. The central one, which has yielded most of the production of the area, outcrops on southeastern dip slopes of 25° - 30° over a length of some 1,500 feet. The quarry face on the northern end is over 100 feet high and boring has proved 130 feet of good quality material below this. A provisional estimate of reserves is 3 million tons, but much of this is cut by intrusions and will probably not be available for quarrying. Some reserves exist in the adjoining deposits, the northerly one of which has been drilled, but these are also extensively intruded.

(b) About a mile northwest of the quarry a large limestone deposit, dipping southeast, covers an area of about 70 acres. It has been disturbed by two major faults and portion has been downthrown too far to be available for quarrying. Possibly 30 million tons is available without cover, and a further 20 million under less than 50 feet of overburden.

(c) About 3 miles southeast of Philp's siding, between portions 100 and 394, a prominent range contains a large tonnage of limestone in several steeply-inclined beds. No detailed geological work has yet been done here.

(d) In the northern part of the same range, beds of limestone up to 40 feet thick occur over a width of 5 to 10 chains, and a quarry was formerly worked. On both sides of a gorge traversing these hills are large quantities of limestone, but this is not so conveniently situated, and some of it has been affected by intrusions.

(e) There are quite a number of other occurrences in the area, but these are less attractive than the ones described because of small size, poor quality, presence of intrusions and inaccessibility (Jack, 1879; Morton, 1928; Denmead, 1949a; Carruthers, 1954; Levingston, 1958a,b; Connah, 1958).

"EARTH LIME"

On portion 17, Parish Magenta is an unusual deposit some 10 acres in extent, with an indicated thickness of at least 20 feet. Beneath a thin soil cover is a layer of limestone which includes hard nodules but is predominantly very soft and earthy — so much so that most of it is suitable for agricultural use as mined. This gives place, at varying depths, to a more compact limestone which requires pulverizing. It is likely that the deposit resulted from extreme decomposition *in situ* of andesitic conglomerate of the Ellenvale Beds, which underlies the deposit and decomposed boulders of which occur in the limestone. Over the 5-acre lease reserves have been estimated at 14,000 tons per vertical foot (Denmead, 1949b).

FANNING RIVER

On the Fanning River to the north of Fanning River Station a bed of coralline limestone of the Burdekin Formation dips 20° ESE. To the east the outcrop forms a semi-circle of low hills and returns to the river 5 miles downstream. From $1\frac{1}{2}$ to 2 miles above the homestead the limestone is fairly pure, 400 feet thick, and dips 10° WSW. (Jack, 1879a, b; Jack and Etheridge, 1892; Hill, 1942; Connah, 1958).

BURDEKIN DOWNS

The limestones of the Burdekin Formation at Burdekin Downs are not as pure as those at Fanning River. The outcrops extend from the homestead for 6 miles up the Burdekin River, with variable strike and dip. The thickness is estimated at 450 feet (Jack, 1879, 1893; Hill, 1942; Connah, 1958).

EWAN

Small lenses of limestone occur in the Ewan Beds north and northeast of Ewan. They have suffered severe metasomatism and recrystallization (Jack, 1892; Reid, 1931; Connah, 1958).

CLAY

Clay and shale deposits in the vicinity of Townsville have been described by Denmead (1947), Ferguson (1948), and Hosking et al (1951). The clay occurs as Quaternary alluvial coastal plain deposits, usually admixed with sand. Conveniently located deposits of clay suitable for industrial use are rare. Two deposits are being worked at present. The first is near the old Partington brickworks and supplies clay for cement manufacture at Stuart. Since 1959, when North Australian Cement Limited took over the area, recorded production (1960-69) is 188,746 tons.

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A similar deposit has been worked since 1960 by Clay Industries at Kurukan, about 22 miles north of Townsville, where alluvial clay overlies laterite. Production (1960-69) for brick manufacture has been 77,972 tons.

Shale beds, interbedded with rhyolite and tuffaceous shale of Permo-Carboniferous age, occur in the hills behind Stuart Creek Goal. The maximum thickness exposed is 15 feet and so far the deposits have not attracted exploitation.

In other parts of the Sheet area possible deposits are too difficult to access or too far from potential markets to have encouraged any prospecting.

COAL

The Permo-Carboniferous volcanic sequence about and to the south of Townsville was regarded hopefully as a possible coalfield during the later part of the last century, and nine shafts and twelve bores, the deepest 520 feet, are recorded, most of them in the vicinity of Stuart. Two bores gave positive indications - one, about half a mile north of Partington, cut four seams. Jack (1887) and Maitland (1892) mentioned a small seam exposed near Stuart Railway Station, but Ball (1906) was unable to find it.

Ball considered that the prevalence of vulcanism at the time of deposition did not favour the formation of coal seams, and the subsequent disturbances and injections of igneous rocks were against their preservation. He concluded that there is little probability of workable seams being found (Ball, 1906; Dunstan, 1905; Jack, 1878, 1884, 1886a, b, 1887; Jack and Etheridge, 1892).

SAND, GRAVEL AND ROCK

Suitable deposits for obtaining these products are widespread, and the only problem is finding supplies as close as possible to where they are required.

Sand and gravel are present in large quantities in most of the streams, particularly on the gentler gradients to the west of the coastal divide. In Townsville, which is the predominant area of consumption, ample supplies for foreseeable needs are available from many points on the Ross River.

Crushed metalis, or has been, won from quarries at Castle Hill (granite), Bohle River (rhyolite), and Reid River (rhyolite). A deposit of highly jointed volcanic rock near Mount Louisa has yielded large quantities of cheap road metal, the jointing rendering the rock friable enough to be removed by ripping or light blasting. Supplies are drawn as required by the Townsville City Council but production is not regularly recorded.

GROUNDWATER

The area is one of monsoonal climate and the heavy rainfall of the wet season on soils desiccated during the warm dry months not only produces severe gully and sheet erosion, but results in a great waste of water in run-off. No detailed work has been done on the hydrology of the area and in many of the stratigraphic formations there are few wells, the occupiers relying on artificial surface storage. The following assessment is therefore very general.

1. Metamorphics. Bores in metamorphic rock generally are not good, and the areas are of poor potential.

2. Early Palaeozoic Sediments. No bores are known in these rock units, so the groundwater potential is unknown. Numerous earth tanks and dams have been constructed from which it could reasonably be deduced that the landholders have had little success in obtaining water from trial bores or wells.

3. Granite. The groundwater potential, particularly of the Ravenswood Granodiorite Complex, is high. Supplies are obtained from the surface layer of decomposed rock. In some of the Upper Palaeozoic granite areas there is strong fissuring and the prospects of supplies from these fissures are good. Unfortunately, most of the fissures traverse rough country where supplies have never been sought, so that this source is virtually untested.

4. Basalt. Good water supplies have been obtained from bores which have passed through the basalt into Tertiary alluvium between and under the flows. The chance of success in bore sites selected at random is high.

5. Campaspe Beds and Laterite. There is no record of bores in these areas, but neither are there many earth tanks. In general these areas yield poor grazing and probably there has not been much incentive to water them. The sandstones of the Campaspe Beds are generally argillaceous and do not appear to be likely aquifers.

6. Cainozoic Sediments of the Coastal Plain. Good supplies exist (as for example at Major Creek where irrigation is practised), but the aquifers have not been studied in detail although barren areas are known to occur. In general, these areas are the most promising within the Sheet borders for underground supplies.

TABLE 5 : MINERAL PRODUCTION, TOWNSVILLE 1:250, 000 SHEET AREA

Based on Wardens' Annual Reports

Year	Tin Conc. tons	Wolfram tons	Scheelite tons	Molybdenite tons	Bismuth tons	Wolfram- bismuth tons	Limestone tons	Ironstone tons
1883	40							
1884	27							
1885	105							
1886	127							
1887	110							
1888	90							
1889	85							
1890	38(b)							
1891	58							
1892	188							
1893	80							
1894	204							
1895	77	3						
1896	88	3						
1897	49							
1898	20	10						
1899	32	17						
1900	69	0.5					3,594	
1901	224.5						1,897	
1902	114						1,357	
1903	302.5	9					2,126	
1904	405.5	49.4		0.1	1.9	0.55	2,330	
1905	420	36		0.25	1.55		820	
1906	356	45		0.65			666	
1907	268.5	25		0.15	0.2		809	
1908	198	25		0.2			777	
1909	160.5	34.25		2.25			523	
1910	252.5	59.25		0.05	0.05		547	
1911	80.5	23.25		0.25		0.5	580	

1912	251	15.5		0.8	0.4		520
1913	244.5	23.25		0.55		0.15	600
1914	225	15.75		1.4		0.05	530
1915	134	21		4.5	0.05	0.4	
1916	136	14		5.5	0.25	0.1	
1917	86	18.8		2.0	0.3	1.5	
1918	71.5	4		1.35		1.05	
1919	93	5.5		1.3	0.3	0.65	
1920	263	1.9		1.6	0.1	0.45	
1921	276						671
1922	294						742
1923	124						81
1924	216						1,909
1925	146						2,883
1926	222.5						1,924
1927	259						625
1928	107.5						974
1929	99						1,410
1930	54						1,947
1931	11						2,010
1932	51.5						3,168
1933	60						3,857
1934	100	0.35			0.05		3,599
1935	104						999
1936	91						1,443
1937	147	4.25	0.65	0.2			881
1938	122	8	0.5	0.05	0.15		1,349
1939	136	3.1	0.1				1,351
1940	106	4.8	0.2				1,217
1941	118	3.9					1,102
1942	65	11.8					35
1943	35	6.6					11
1944	23	6.9	0.3				42
1945	17	6.3	0.75				124
1946	19	4.9					1,745

Table 5 (cont)

Year	Tin Conc. tons	Wolfram tons	Scheelite tons	Molybdenite tons	Bismuth tons	Wolfram- bismuth tons	Limestone tons	Ironstone tons
1947	31	1.75					763	
1948	37	2.5	0.1				3,142	
1949	33						3,275	
1950	69	2.15					2,267	
1951	16	6.9					1,458	
1952	26	3.3					5,299	
1953	23	1.8					6,672	
1954	25	0.05					3,773	
1955	56	0.95					63,375	924
1956	17.5	0.2					84,791	4,093
1957	38	0.5					102,040	4,273
1958	33.5						112,914	996
1959	37.5						92,083	1,323
1960	37						89,311	1,758
1961	58						90,371	1,746
1962	32						129,814	2,337
1963	33						127,913	3,069
1964	15						132,695	3,463
1965	21.5						150,108	3,035
1966	22.5						145,312	1,956
1967	124.4						140,370	1,840
1968	76.8						141,320	2,577
1969	48.9						147,527	3,026
Totals	9,688.6	540.35	2.6	23.15	5.30	5.40	1,830,368	36,416

Notes : (a) This includes a small production from the northern part of the Kangaroo Hills field, which is outside the sheet area. The figures refer to cassiterite. Stannite production from the Sardine is recorded separately - see table below.

(b) From Jack and Etheridge (1892). The Warden does not give any reference for that year.

REFERENCES

- ANONYMOUS, 1950 : An unusual mineral assemblage in ore from the Sardine tin mine, Kangaroo Hills. Qd Govt Min. J., 51, 553.
- ANSLEY, C., 1908 : Mount Success mine. Unpub. rep. filed Geol. Surv. Qd.
- BALL, C. W., 1941a : Tin mining at Tinvale, White Springs and Stockyard Creek, Kangaroo Hills district. Unpub. rep. Geol. Surv. Qd.
- _____, 1941b : Subsidy application, Florist mine, White Springs. Unpub. rep. Geol. Surv. Qd.
- _____, 1941c : Memorandum on Kangaroo Hills Mineral Field. Unpub. rep. Geol. Surv. Qd.
- _____, 1941d : Native Bee East and Butterfly mines, (Fanning). Unpub. rep. Geol. Surv. Qd.
- _____, 1944 : Blue Duck workings, Ewan. Qd Govt Min. J., 45, 240-241.
- BALL, L. C., 1906 : The coal measures near Townsville. Qd Govt Min. J., 7, 406-409.
- _____, 1911 : Wolfram and molybdenite in Queensland. Ollera. Qd Govt Min. J., 12, 564-65.
- BLANCHARD, R., 1947 : Some pipe deposits of Eastern Australia. Econ. Geol., 41, 292.
- CAMERON, W. E., 1901 : The Kangaroo Hills Mineral Field. Publs Geol. Surv. Qd, 167.
- _____, 1902 : The Kangaroo Hills Mineral Field. Qd Govt Min. J., 3, 21-28.
- _____, 1906 : Kangaroo Hills Mineral Field. Qd Govt Min. J., 7, 239-242.
- _____, 1911 : The tin lodes of Sandy Creek, Charters Towers district. Records No. 3, Publs Geol. Surv. Qd, 235, 40-43.
- _____, 1931 : Mount Success mine, Ravenswood Junction. Qd Govt Min. J., 32, 318.
- CARD, G. W., 1896 : The occurrence of copper at the Dottswood Mine, Queensland. Rec. Geol. Surv. N.S.W., 5(1), 39-41.
- CARRUTHERS, D. S., 1952 : Waverley wolfram. Unpub. rep. Geol. Surv. Qd.
- _____, 1953a : The Shrimp tin mine. Unpub. rep. Geol. Surv. Qd.
- _____, 1953b : Notes on present mining activities in the Ewan-Hidden Valley area. Unpub. rep. Geol. Surv. Qd.
- _____, 1953c : Bluewater Creek wolfram workings. Unpub. rep. Geol. Surv. Qd.
- _____, 1954 : Proposed diamond drilling at Ryan lime deposit, Calcium. Unpub. rep. Geol. Surv. Qd.
- _____, 1955a : Reconnaissance, Calcium district. Unpub. rep. Geol. Surv. Qd.

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- CARRUTHERS, D. S., 1955b : Last Chance tin claim - Ewan district. Qd Govt Min. J., 56, 352.
- CARTER, S. R., 1950 : Mount Success. Report to Mount Isa Mines Ltd. Geol. Surv. Qd Library.
- CONNAH, T. H., 1950a : Subsidy application, Florist tin mine. Unpub. rep. Geol. Surv. Qd.
- _____, 1950b : Florist tin mine. Unpub. rep. Geol. Surv. Qd.
- _____, 1951 : Hanging Flat claim. Unpub. rep. Geol. Surv. Qd.
- _____, 1952a : Ollera Wolfram Field. Qd Govt Min. J., 53, 56.
- _____, 1952b : Horseshoe and Bower Bird wolfram mines, Kangaroo Hills. Qd Govt Min. J., 53, 141-142.
- _____, 1952c : The Sardine tin mine, Kangaroo Hills. Qd Govt Min. J., 53, 963-972.
- _____, 1953a : Recent gold discovery near Woodstock. Unpub. rep. Geol. Surv. Qd.
- _____, 1953b : Back-In wolfram, Kangaroo Hills. Qd Govt Min. J., 54, 572-573.
- _____, 1955 : Request for drilling, Hero mine, Argentine Field. Unpub. rep. Geol. Surv. Qd.
- _____, 1958 : Summary Report - Limestone deposits of Queensland. Publs Geol. Surv. Qd, 292 (also Qd Govt Min. J., 59, 637-53, 738-55).
- CRIBB, H. G. S., 1940a : Re Warrigal claim - Waverley. Unpub. rep. Geol. Surv. Qd.
- _____, 1940b : Mount Sulphide, Mingela. Unpub. rep. Geol. Surv. Qd.
- _____, 1941a : Salmon mine, Ewan. Unpub. rep. Geol. Surv. Qd.
- _____, 1941b : Good Luck wolfram - Waterfall Creek, Kangaroo Hills. Qd Govt Min. J., 42, 28.
- CUSACK, J. K., 1904 : Ollera Creek Wolfram Field. Qd Govt Min. J., 5, 517.
- DE KEYSER, F., FARDON, R. S. H., and CUTTLER, L. G., 1964 : Geology of the Ingham 1:250,000 Geological Sheet area. Rec. Bur. Miner. Resour. Geol. Geophys. Aust. 1964/78 (unpub.).
- DENMEAD, A. K., 1935 : Report on inspection tour, May 1935. Unpub. rep. Geol. Surv. Qd.
- _____, 1946 : New True Blue mine, Far Fanning. Unpub. rep. Geol. Surv. Qd.
- _____, 1947a : Great Caesar mine, Fanning River. Qd Govt Min. J., 48, 268.
- _____, 1947b : Search for shale for brick making. Unpub. rep. Geol. Surv. Qd.

- DENMEAD, A. K., 1948a : Sunflower - Tinvale. Unpub. rep. Geol. Surv. Qd.
- _____, 1948b : Subsidy - Mount Moss claim, Kangaroo Hills. Unpub. rep. Geol. Surv. Qd.
- _____, 1948c : Subsidy, Rose of Allandale, Fanning Siding. Unpub. rep. Geol. Surv. Qd.
- _____, 1949a : Re Townsville cement works. Unpub. rep. Geol. Surv. Qd.
- _____, 1949b : Webb's Limestone, Reid River. Unpub. rep. Geol. Surv. Qd.
- _____, 1949c : Townsville cement works. Qd Govt Min. J., 50, 654.
- _____, 1949d : Marmy Creek lead mine. Unpub. rep. Geol. Surv. Qd.
- _____, 1950a : Subsidy - Florist tin mine, Tinvale. Unpub. rep. Geol. Surv. Qd.
- _____, 1950b : Subsidy, Welcome, Sala Siding. Unpub. rep. Geol. Surv. Qd.
- DEPARTMENT OF MINES, QD, 1879-1970 : Annual Reports for the years 1878 to 1969.
- DUNSTAN, B., 1905 : Boring for coal near Townsville. Publs Geol. Surv. Qd, 196.
- _____, 1914 : Queensland Mineral Index. Publs Geol. Surv. Qd, 241.
- EDWARDS, A. B., 1951 : Some occurrences of stannite in Australia. Proc. Australas. Inst. Min. Metall., 5, 160-161.
- _____, and BAKER, G., 1953 : The oxidation of stannite ore at the Sardine tin mine, Queensland. C. S. I. R. O. Aust. Report filed Geol. Surv. Qd.
- FERGUSON, J. A., 1948 : A review of some geological aspects of material resources in the Townsville area. Report filed Geol. Surv. Qd.
- GILLESPIE, T., 1892 : Manager's report to Directors of Hero Freehold Silver and Gold Mining Co. Ltd. Report filed Geol. Surv. Qd.
- GOETZEL, S., 1890 : Report to Directors of Hero Freehold Silver and Gold Mining Co. Ltd. Report filed Geol. Surv. Qd.
- HILL, D., 1942 : The Middle Devonian rugose corals of Queensland. Pt 3 : Burdekin Downs, Fanning River and Reid Gap, North Queensland. Proc. R. Soc. Qd, 53, 229.
- HORSLEY, S., 1905 : Kangaroo Hills and Star River Mineral Fields. A. Rep. Dep. Mines Qd for 1904, 109.
- HOSKING, J. S., FERGUSON, J. A., and HOLLAND, A. E., 1951 : An investigation of the clays near Townsville for their suitability for structural clay products. Bldg Res. Rep. M2-2-15, C. S. I. R. O. Aust.
- HUTCHINSON, G. H., 1964a : Application for subsidy - Codfish tin mine, Kangaroo Hills District.
- _____, 1964b : Application for subsidy - Gladstone tin mine, Kangaroo Hills Mineral Field. Unpub. rep. Dep. Mines Qd.
- INSPECTOR OF MINES, 1900-1969 : In Qd Govt Min. J., 1-70.

70. MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE
1:250,000 SHEET AREA, NORTH QUEENSLAND

- JACK, R. L., 1878 : Report on probability of the existence of a coalfield in the neighbourhood of Townsville. Unpub. rep. of the Government Geologist.
- _____, 1879a : On the geology and mineral resources of the district between Charters Towers Goldfield and the coast. Publs Geol. Surv. Qd, 1.
- _____, 1879b : Preliminary report on the geological features of the Coast Range between the Dalrymple and Charters Towers roads. Publs Geol. Surv. Qd, 2.
- _____, 1884 : Report of progress of the Government Geologist for the year 1883. Publs Geol. Surv. Qd, 15.
- _____, 1886a : On the Argentine (Star) silver mines, Kennedy District. Publs Geol. Surv. Qd, 26.
- _____, 1886b : Handbook of Queensland Geology. Publs Geol. Surv. Qd, 31.
- _____, 1886c : Underground water near Townsville. In Publs Geol. Surv. Qd, 22 (also A. Rep. Dep. Mines Qd for 1885, 57.
- _____, 1886d : Re portion 100, near Stuart's Creek. Unpub. rep. of the Government Geologist.
- _____, 1887 : Geological observations in the north of Queensland 1886-7. Publs Geol. Surv. Qd, 35.
- _____, 1891 : Annual progress report of the Geological Survey for the year 1890. Publs Geol. Surv. Qd, 82.
- _____, 1892 : Report on the Kangaroo Hills silver and tin mines. Publs Geol. Surv. Qd, 82.
- _____, 1893 : Annual progress report of the Geological Survey for the year 1892. Publs Geol. Surv. Qd, 94.
- _____, and ETHERIDGE, R., 1892 : Geology and Palaeontology of Queensland and New Guinea. Publs Geol. Surv. Qd, 92.
- JACKSON, C. F. V., 1905 : Ollera Creek wolfram field. Qd Govt Min. J., 6, 486.
- JONES, O. A., 1947 : Ore genesis in Queensland. Proc. R. Soc. Qd, 59 (1), 1-91.
- LAUN, E. J., 1913 : Stockyard and Sandy Creek tin mines. Qd Govt Min. J., 14, 159.
- _____, 1942 : Ollera Creek Wolfram field. Unpub. rep. to State Mining Engineer.
- LEE, J. W., 1938 : Wolfram at Ollera. Qd Govt Min. J., 39, 142.
- LEVINGSTON, K. R., 1952a : Good Friday mine. Unpub. rep. Geol. Surv. Qd.
- _____, 1952b : Mystery - Tinvale. Unpub. rep. Geol. Surv. Qd.
- _____, 1953 : Welcome mine, Sala Siding. Unpub. rep. Geol. Surv. Qd.
- _____, 1954 : Iron ore investigations, Ewan District. Unpub. rep. Geol. Surv. Qd.
- _____, 1955 : True Blue copper-silver-lead mine, Kangaroo Hills. Unpub. rep. Geol. Surv. Qd.

- LEVINGSTON, K. R., 1956 : Welcome mine, Sala Siding. Unpub. rep. Geol. Surv. Qd.
_____, 1957a : Future diamond drilling, Charters Towers area. Unpub. rep. Geol. Surv. Qd.
_____, 1957b : Welcome gold mine, Sala Siding. Unpub. rep. Geol. Surv. Qd.
_____, 1958a : Progress Report - Limestone deposits, Calcium. Unpub. rep. Geol. Surv. Qd.
_____, 1958b : Limestone deposits Nos. 4-7, Calcium. Unpub. rep. Geol. Surv. Qd.
_____, 1960 : Welcome gold mine, Sala Siding. Qd Govt Min. J., 61, 158-161.
_____, 1962 : Ironman, M. L. Appln. 77, Townsville - H. Hussey. Unpub. rep. Geol. Surv. Qd.
- MAITLAND, A. G., 1892 : The physical geology of Magnetic Island. Publs Geol. Surv. Qd., 75.
_____, 1893 : Silver mines at Stockyard Creek. In Publs Geol. Surv. Qd., 94, 12-13.
- MARKS, E. O., 1913 : Kangaroo Hills. Qd Govt Min. J., 14, 60-62.
- McKENNA, D., 1965 : General investigations within A. to P. 244M during 1964. Noranda Exploration Company Ltd. Geol. Surv. Qd Library.
- MORTON, C. C., 1925 : Loan application, D. Tuckett and party, Sala Siding. Unpub. rep. Geol. Surv. Qd.
_____, 1928 : Reid River limestone deposits - Great Northern Railway. Qd Govt Min. J., 29, 287-90.
_____, 1931 : Mt. Norman gold workings - Townsville District. Qd Govt Min. J., 32, 353-55.
_____, 1936a : Re Granite Bar claim - Station Creek - Hidden Valley. Unpub. rep. Geol. Surv. Qd.
_____, 1936b : Belle Vue wolfram mine, Ollera Creek. Unpub. rep. Geol. Surv. Qd.
_____, 1938 : Wonder Extended claim - Stannouston. Qd Govt Min. J., 39, 225-28.
_____, 1939 : Iron ore - Woodstock district. Unpub. rep. Geol. Surv. Qd.
_____, 1940a : Hidden Valley district. Qd Govt Min. J., 41, 310-312.
_____, 1940b : Rose of Allandale, Fanning Siding. Unpub. rep. Geol. Surv. Qd.
_____, 1941a : Kookaburra claim, Kangaroo Hills Field. Unpub. rep. Geol. Surv. Qd.

MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE
1:250,000 SHEET AREA, NORTH QUEENSLAND

MORTON, C. C., 1941b : Rose of Allandale No. 1 SW, Fanning. Unpub. rep. Geol. Surv. Qd.

_____, 1941c : Rose of Allandale No. 2 W, Fanning. Unpub. rep. Geol. Surv. Qd.

_____, 1943 : Blue Duck, Ewan. Unpub. rep. Geol. Surv. Qd.

_____, 1944a : Dotswood copper. Qd Govt Min. J., 45, 154-55.

_____, 1944b : Daintree mine, Tinvale. Qd Govt Min. J., 45, 266-269.

_____, 1946 : Unlimited wolfram claim, Kangaroo Hills. Qd Govt Min. J., 47, 43.

RANDS, W. H., 1898 : Gold mines at the Fanning and Mt. Success. Bull. Geo. Surv. Qd. 8, and Publs Geol. Surv. Qd. 133.

RATTEN, J. R., 1938 : Unpub. rep. to State Mining Engineer.

REID, J. H., 1926a : Recent gold discovery, Bunker's Hill, near Ravenswood. Qd Govt Min. J., 27, 202.

_____, 1926b : Wonder Extended tin mine, Stannouston. Qd Govt Min. J., 27, 280-82.

_____, 1931a : Sardine North mine, Kangaroo Hills. Qd Govt Min. J., 32, 222-24.

_____, 1931b : The Running River silver lead lodes, Kangaroo Hills Mineral Field. Qd Govt Min. J., 32, 263-68.

_____, 1931c : Juggler (or Jugular) mine, Kangaroo Hills. Qd Govt Min. J., 32, 222.

_____, 1931d : The Shrimp tin mine, Oaky Creek. Qd Govt Min. J., 32, 268.

_____, 1932a : Sardine mine, Oaky Creek, Kangaroo Hills. Unpub. rep. Geol. Surv. Qd.

_____, 1932b : Sardine tin mine. 26th half yearly report. Sardine Tin Mines N. L.

_____, 1933 : Hidden Valley Extended, Running River district. Qd Govt Min. J., 34, 32-33.

_____, 1934 : Some Ravenswood mines. Qd Govt Min. J., 35, 44.

RIDGWAY, J. E., 1946a : Salmon tin mine - Ewan. Unpub. rep. Geol. Surv. Qd.

_____, 1946b : Blue Doe workings, Haughton Valley. Qd Govt Min. J., 47,

_____, 1947a : Waverley. Unpub. rep. Geol. Surv. Qd.

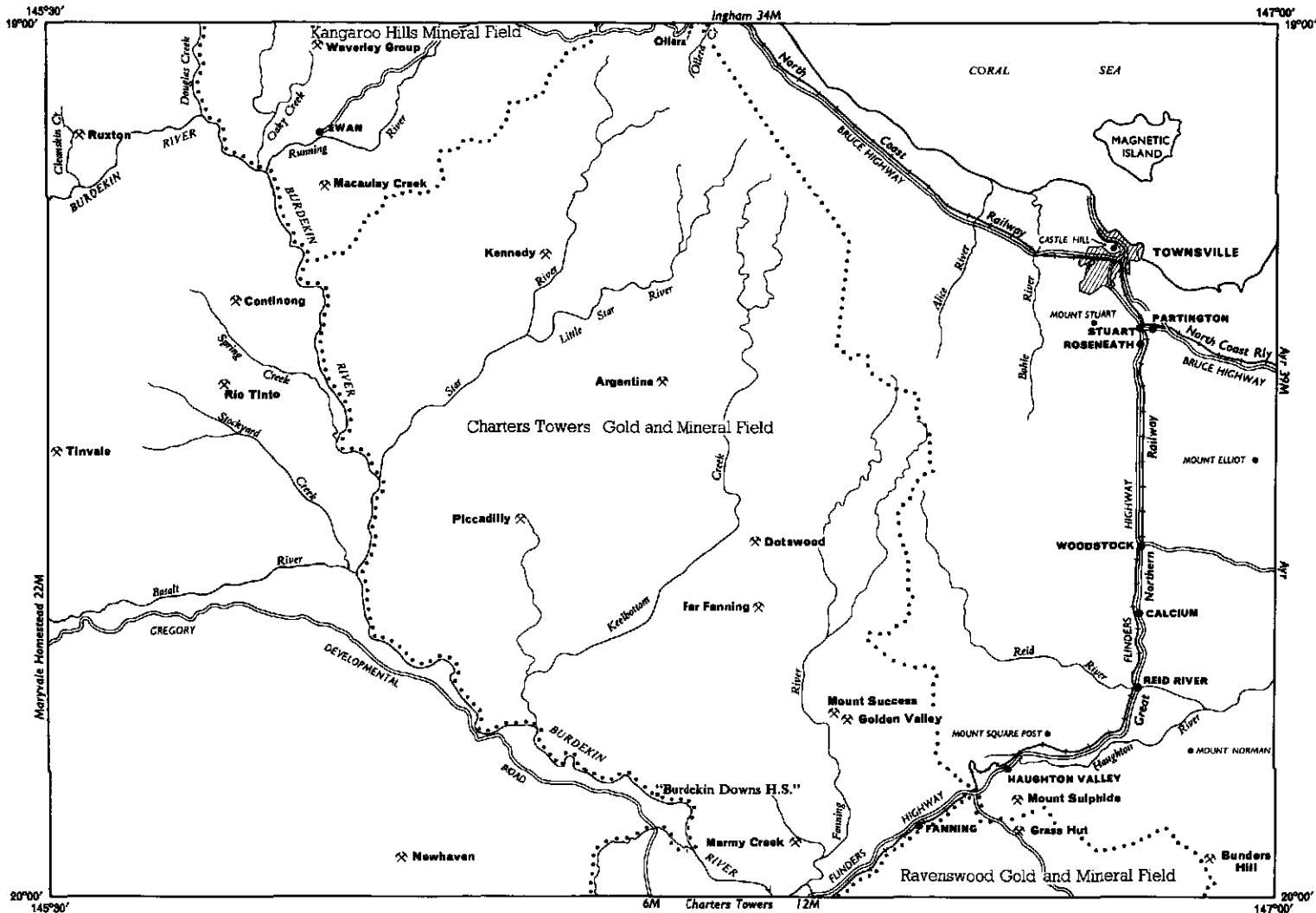
_____, 1948 : Ollera Wolfram Field. Qd Govt Min. J., 49, 13-14.

SAINT-SMITH, E. C., 1916 : Kangaroo Hills Mineral Field, North Queensland. Qd Govt Min. J., 17, 534-539.

- SAINT-SMITH, E. C., 1920a : Woodstock iron lodes. Qd Govt Min. J., 21, 501-502.
- _____, 1920b : Prospecting for gold, Haughton Valley, Great Northern Railway. Qd Govt Min. J., 21, 323.
- _____, 1921 : The (Ewan) Tin Syndicates leases, Kangaroo Hills Mineral Field. Qd Govt Min. J., 22, 352.
- _____, 1922a : Sardine tin mine, Kangaroo Hills. Qd Govt Min. J., 23, 5-6.
- _____, 1922b : Geology and mineral resources of portion of the southern section of Oaky Creek district, Kangaroo Hills Mineral Field. Qd Govt Min. J., 23, 309-314, 349-355.
- _____, 1922c : Notes on some tin mines of the Kangaroo Hills Field. Qd Govt Min. J., 23, 392-393.
- _____, 1922d : Canary tin mine, Kangaroo Hills tinfield. Qd Govt Min. J., 23, 263-64.
- _____, 1923 : The present condition of certain Kangaroo Hills tin mines, North Queensland. Qd Govt Min. J., 24, 202-207.
- SHEPHERD, S. H. L., 1943 : Notes on some wolfram and tin occurrences in the Hidden Valley-Waverley section of the Kangaroo Hills Mineral Field. Qd Govt Min. J., 44, 120.
- _____, 1944a : Unlimited wolfram mine, Williams Creek, Kangaroo Hills Mineral Field. Qd Govt Min. J., 45, 15.
- _____, 1944b : Isabel wolfram mine, near Waverley, Kangaroo Hills Mineral Field. Qd Govt Min. J., 45, 13-14.
- STILLWELL, F. L., 1950 : Stannite ore from the Sardine mine, Kangaroo Hills, Queensland. Mineragr. Rep., 433. C. S. I. R. O. Aust.
- WARDEN, CHARTERS TOWERS, 1900-1969 : In Qd Govt Min. J., 1-70.
- WARDEN, KANGAROO HILLS, 1900-1969 : In Qd Govt Min. J., 1-70.
- WARDEN, RAVENSWOOD, 1900-1969 : In Qd Govt Min. J., 1-70.
- WEBB, A. W., 1969 : Metallogenic epochs in Eastern Queensland. Proc. Australas. Inst. Min. Metall., 230, 29-37.
- WILSON, A. L., 1921 : Sardine Tin Mines N. L. Qd Govt Min. J., 22, 525.
- _____, 1926 : Sardine Tin Mines N. L. Qd Govt Min. J., 27, 453.
- WYATT, D. H., 1961 : The Sardine tin mine, Oaky Creek, Kangaroo Hills Mineral Field. Qd Govt Min. J., 62, 482-94.
- _____, 1968a : Silver Spray alluvial tin deposits, Gowrie Creek. Unpub. rep. Geol. Surv. Qd.
- _____, 1968b : Explanatory notes, Townsville, Qd - 1:250,000 geological series. Bur. Miner. Resour. Geol. Geophys. Aust.

MINERAL DEPOSITS AND MINES OF THE TOWNSVILLE
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- WYATT, D. H., 1968c : Recent developments at the Sardine tin mine, Oaky Creek, Kangaroo Hills Mineral Field. Qd Govt Min. J., 69, 547-55.
- WYATT, D. H., PAINE, A. G. L., HARDING, R. R., and CLARKE, D. E., 1965 : The geology of the Townsville 1:250,000 Sheet area, Queensland. Rec. Bur. Miner. Resour. Geol. Geophys. Aust., 1965/159 (unpub.).



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LOCALITY MAP TOWNSVILLE 1:250,000 SHEET AREA

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