

THE MINERAL RESOURCES AND THE MINING INDUSTRY
OF TASMANIA

The island of Tasmania contains a large number of minerals and rocks, many of which form deposits of great economic importance. The development and exploitation of these deposits has resulted in the establishment of the mining industry of the State.

This industry has proved to be one of the most important and has been mainly responsible for the State's prosperity and development in the past. The total production of minerals, metals etc. since the commencement of the industry amounts to over £50,000,000 but this does not include limestone, pyrites and building stones.

The following table (No. 1) shows the annual production from 1880 to 1924 inclusive:-

Table No. 1

<u>Year.</u>	<u>Value</u>	<u>Year.</u>	<u>Value</u>
1880	554,031	1903	1,354,044
1881	602,723	1904	1,379,204
1882	556,306	1905	1,729,129
1883	560,873	1906	2,257,147
1884	468,302	1907	2,277,159
1885	518,885	1908	1,650,027
1886	489,966	1909	1,574,995
1887	593,256	1910	1,432,193
1888	616,733	1911	1,349,497
1889	504,718	1912	1,493,502
1890	444,210	1913	1,415,700
1891	528,388	1914	1,007,038
1892	526,909	1915	1,225,575
1893	627,909	1916	1,521,050
1894	732,764	1917	1,584,290
1895	575,692	1918	1,750,574
1896	662,058	1919	1,301,090
1897	1,006,140	1920	1,421,104
1898	1,071,034	1921	822,851
1899	1,660,622	1922	1,013,415
1900	1,883,695	1923	1,219,456
1901	1,763,896	1924	1,496,804
1902	1,378,406	Unenumerated prior to 1884:	31,988
			50,640,398

The production reached a maximum of £2,277,159 in 1907, and has decreased almost steadily until 1921. However, it began to increase during 1922, and the last two years show a still greater revival.

The total value of the individual minerals and metals produced is given in the following table (No. 2):-

Table No. 2

<u>Mineral or Metal</u>	<u>Value</u>
Asbestos	£7,105
Barytes	6,893
Bismuth	23,052
Cadmium	1,175

<u>Mineral or Metal</u>	<u>Value</u>
Carbide	£265,889
Cement	105,130
Coal	1,618,246
Copper (Blister)	16,748,304
Copper (Matte)	133,736
Copper Ore	579,335
Gold	7,564,681
Iron Ore	25,701
Iron Pyrites	93,916
Limestone	268,568
Ochre	306
Osmiridium	308,897
Scheelite	112,468
Shale	7,253
Silver Lead	7,540,859
Tin	14,755,867
Wolfram	182,252
Zinc	258,777
Un-enumerated prior to 1894	31,988
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Total:	£50,640,398

Copper

The total production of copper ores, matte and metal, amounts to £17,461,375 and exceeds that of any other individual mineral or metal produced within the State. The greater portion of this production has been in the form of blister copper.

The principal deposits of copper ores are those near Mt. Lyell in the West coast district. These deposits are worked by the Mount Lyell Mining and Railway Company Limited, who treat their ore locally and produce blister copper. The present reserves are given as follows:-

	Tons (Dry)	Copper %	Silver Oz. per ton	Gold Oz. per ton
North Lyell Mine	907,768	6.0	1.33	0.015
Mt. Lyell and South Lyell	1,634,043	0.5	1.5	0.04

The ore of the North Lyell Mine consists of veins and splashes of bornite and chalcopyrite in schist. This deposit has been followed to a depth of 1100 feet, where it is at present being stoped. The Mount Lyell Ore consists of pyrites with low copper, but high gold and silver contents.

During the year 1924 the Company smelted 10,855 tons of ore from the Mt. Lyell Mine and 3923 tons of ores and 36,838 tons of concentrated ore from the North Mt. Lyell Mine. From this 6761 tons of blister copper valued at £488,989 and containing 6698 tons of copper 147,376 ozs. of silver and 2134 ozs. of gold were produced. The total number of men employed in the mines, reduction plant and railway department was 1012.

Dividends paid during the year amounted to £128,919/10/0, making the total from the inception of the Company £4,152,308.

The total production of metals since the inception of the Company is 192,910 tons of copper, 13,353,830 ozs. of silver and 382,530 ozs. of gold.

Copper ores also occur at the Jukes-Darwin field (adjacent to Mt. Lyell), the Mt. Balfour field in north-western Tasmania, and the Scamander district on the East Coast.

The production from these fields has, however, been small, and little or no work is being performed at present.

Tin

The annual production of tin was formerly greater than that of any other mineral or metal, but in recent years it has fallen below that of copper, silver and lead. The total production to date is £14,755,867 and this is exceeded by only one other metal, viz. copper.

Tin ore is obtained from two principal sources in Tasmania - primary deposits (including fissure lodes, replacements, etc.,) and secondary or alluvial deposits. Cassiterite is the principal mineral occurring in both these types of deposits. Stannite occurs to a much less extent, the principal deposit being that of the Oonah Mine, Zeehan.

Tin lodes occur chiefly in the west and north-western districts of Tasmania. The most important tin field is that of Mt. Bischoff, the principal mine being the world famous Mt. Bischoff. The deposits here are of the following types:- fissure veins, replacement-fissure deposits, greisen veins and aplite dykes. The Mt. Bischoff mine has treated 4,651,740 tons, from which has been obtained 77,797 tons of tin oxide valued at £5,398,376 out of which £2,539,500 has been distributed in dividends. The richest lodes in the Mt. Bischoff Mine represent replacement deposits in dolomitized pyroxenites.

During the year 1924, 74,790 tons of ore were crushed. Of this total 13,640 tons came from the underground workings. The tin oxide output was 335 net dry tons. (Average Assay 65.7) valued at £55,290. The average number of men employed was 205.

Continued improvements have been made with the treatment of tin bearing pyrites, and very shortly the quantity put through will be increased to 200 tons per week. The methods in use permit of pyrite with one half of one per cent tin being profitably handled. The recovery is very good.

Other mines in this district are the Mt. Bischoff Extended, Cleveland Mine, and several recently opened in the South Bischoff area.

Other fields on the west coast are those at Stanley River, Heemskirk, North Dundas, (Renison Bell Mine) and X River.

Lode mining has also been performed in the north-eastern districts, some of the principal mines being the Anchor, Story's Creek, Royal George etc.

Extensive deposits of alluvial tin ore have been worked in the north-eastern districts. The most important of these are located along the Ringarooma Valley where they represent Tertiary sediments formed along the course of a former river and its tributaries, and which are overlain in places by flows of basalt. The principal mines which have operated on these lines are the Arba, Briseis group and Pioneer Mines.

The Arba Mine situated near Branxholm worked continuously from 1903 to 1920 and treated 3,260,851 cubic yards of drift for a return of 1362 tons tin oxide, the average content being 0.93 lb. per cubic yard. Dividends paid during the above period amounted to £27,000. The total production of the mine amounts to at least 1900 tons of tin oxide.

The Briseis group (including the former Krushka Bros. Home, New Brothers Home, Briseis, Triangle and North Bros. Home Mines) operated on the Cascade lead. Up to the end of 1924 the Briseis Company removed 5,541,400 cubic yards of overburden and treated 9,111,800 cubic yards of drift for a return of 12,685 tons of tin oxide valued at £1,608,650, and paid £502,500 in dividends. It is estimated that apart from this, 9,600 tons of tin oxides were produced by the mine before being incorporated with the Briseis. The total production from this lead is therefore 22,285 tons of tin oxide.

The Pioneer Mine is situated on the Wyniford River lead. Since the commencement of sluicing in 1900 approximately 12½ million cubic yards of drift have been sluiced for a yield of 8,404 tons of tin oxide and paid £512,129 in dividends.

Numerous small mines have been worked in the Mt. Cameron district, and while no figures are available for the total production, it must be considerable. The south Mt. Cameron Mine has been one of the principal producers.

The most important mines working at present are the Endurance and Monarch. The total production from the North Eastern alluvial deposits amounts to approximately £7,000,000. Alluvial deposits are also being worked on the East Coast in the vicinity of St. Helens.

Iron

Tasmania possesses deposits of iron ore of a varied nature in different parts of the island. Very little development of these has, however, taken place, and the total production amounts to only £25,701. Many factors, such as the lack of transportation and other facilities have operated against their development, but with the improvement of these, and the extension of the Hydro Electric power facilities of the State, a much greater use in the future is probable.

The reserves of iron ore, as computed in 1919 are:-

Blythe River	17,000,000 tons
Dial Range & Penguin	700,000 "
Beaconsfield & Anderson's Creek	1,300,000 "
Long Plain	20,000,000 "
Zeehan District	2,900,000 "
Nelson River	unknown
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	41,900,000 tons
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Since the above calculation was made it is reported that the reserves in the Zeehan district have been considerably increased.

The Zeehan and Long Plains (Rio Tinto) deposits consist of magnetite, and the other deposits principally of haematite. The Rio Tinto is probably the most valuable, but is greatly hampered by lack of transport facilities. The Zeehan and Blythe River deposits are next in importance, and are better situated as regards transportation.

In addition, the Hampshire magnetite deposits, recently discovered, and the Paradise and Rocky River bodies, in the western district, contain very large reserves of high grade ore at present not capable of indication by figures.

Zinc

1. Zinc Ores:-

Pure zinc ores are not common in Tasmania, but are generally in association with those of lead. The largest reserves of zinc ores are those contained in the Read-Rosebery zinc-lead sulphide deposits which are described below. In addition to the Read-Rosebery deposits, zinc blende is found associated with argentiferous galena in the silver-lead mines of Tasmania, but little or nothing has been done to save the zinc products from these ores. This blende is generally of the black, ferriferous variety (marmatite). At the Swansea mine, Zeehan, resin blende occurs as an independent vein alongside galena, and contains two per cent of cadmium.

High grade zinc blende occurs at the Mariposa and Gomstock mines.

2. Zinc-lead Sulphide Ores:-

Large deposits of these ores exist in the Read-Rosebery district, on the west coast of the island. They occur as a fine-grained and intimate mixture of galena and sphalerite (zinc blende) representing metasomatic replacements of schistose, calcareous beds in the Read-Rosebery schist series by these minerals. The schist series has been folded by earth movements and two series of folds occur with axis at right angles to each other. The ore-bodies follow the folds and occur as a series of irregular domes and basins. The reserves are shown in the following table:-

	Amount	Metallic Contents			
		Gold oz. per ton	Silver oz. per ton	Lead %	Zinc %
Proved Ore	1,680,000	0.127	9.6	7.4	27.3
Probable Ore	915,000				

There are also possibilities of "prospective" reserves, but these cannot be expressed in figures. It is probable that development work carried out since the above estimation has increased the amount of reserves.

The output from these deposits amounts to only 295,737 tons, with a value of £383,416. The slow development of the deposits has been due to transportation difficulties, lack of rich oxidised ores, and difficulty of metallurgical treatment.

The principal mines which have operated in the past are the Hercules Primrose, Tasmanian Copper and Mount Read: of these the Hercules produced 60% of the total output.

The Electrolytic Zinc Company of Australia Ltd., now controls the greater part of these deposits, and during the past few years carried out experimental work at Zeehan with regard to the metallurgical treatment of these ores. Success has attended these operations and a small plant has been in operation during the past year.

From this plant 339 tons of lead concentrate has been produced containing 132 tons of lead and 11,952 ounces of silver and 7,915 tons of zinc calcines. The latter contained 2,447 tons of zinc valued at £80,656. Five tons of cadmium valued at £1,175 and also lead and silver amounted to 568 tons and 55,569 ounces respectively.

Metallic Zinc:

The Electrolytic Zinc Company has established a metallurgical plant for the extraction of zinc from its ores by electrolytic process.

Up till recently the whole of the concentrates and calcines used have been brought from Broken Hill, New South Wales. Small quantities are now being obtained from the Read-Rosebery ores as referred to above.

The plant at Risdon is now capable of producing 130 tons of zinc per day and uses 33,000 H.P. from the Hydro Electric Department of Tasmania.

During 1924 the production amounted to 46,372 tons of slab zinc valued at £1,550,022 and 159 tons of cadmium valued at £35,624, 1,377 men being employed.

Total production to date from ores other than Tasmanian amounts to 123,060 tons of slab zinc valued at £4,094,251 and 277 tons of Cadmium valued at £69,225.

Lead

The lead deposits of Tasmania consist of argentiferous galena and are largely developed throughout the west and north-western districts. The total production of silver lead ore amounts to £7,362,014, to which lead and silver have contributed approximately equal proportions, and is fourth on the list among the ores of Tasmania.

The most important fields are those of Zeehan, Dundas, Mt. Farrell, Waratah and Round Hill. The Zeehan field was, in the past, the most important producer - the principal mines being the Zeehan-Montana, British Zeehan, Oonah, Zeehan Queen, Mt. Zeehan, Silver Ring, Zeehan, Western, Florence, Silver Queen Extended, South Comstock, etc. The field contains numerous rich lodes, the chief economic mineral being galena which assays approximately 70 oz. of silver per ton and 70 per cent lead. The total production of the Zeehan field was approximately £5,000,000 of argentiferous galena, the leading producers being the Western (£481,952), Zeehan Montana (£484,068) and the Mt. Zeehan (at least £475,381). The principal mine at Dundas was the Comet, while some of the Read-Rosebery mines, such as the Hercules, produced quantities of silver-lead ore. In the Mt. Farrell and Waratah districts the largest producers have been the North Mt. Farrell and the Magnet Mines respectively: and, at the present time, these are the two most important silver-lead mines in Tasmania. The Round Hill Mine is the principal mine in that district.

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The Magnet lode consists of argentiferous galena, sphalerite, and manganosiderite, representing replacement of an ultra basic dyke, and is being worked at present 1000 feet from the surface. The total production to 1924 is 177,514 tons of ore containing 28,174 tons of lead and 6,291,861 ounces of silver valued at £1,395,973. The North Mt. Farrell Mine has produced up till the end of June 1924 3,000,000 ozs. of silver and 31,700 tons of lead with a total value of £771,000 and paid £77,943 in dividends. Individual productions for other mines and districts are not available.

Silver

No ores of commercial importance containing silver alone have been discovered in Tasmania, but large quantities of silver have been obtained from lead and copper ores. The quantity contained in the silver-lead ores amounts to at least 36,000,000 ounces valued at £4,000,000. The Mt. Lyell copper has contained 13,353,830 ozs. silver with a value of over £1,000,000. The total production is estimated at 50,000,000 ounces valued at £5,000,000.

Gold

Gold occurrences are restricted almost entirely to the north-eastern districts where it occurs in both lodes and alluvial deposits. In the past it has been one of the principal mineral products and stands third on the list as regards total production, which amounts to £7,526,479. Gold mining has, however, fallen off in recent years, and the total production will soon be exceeded by that of silver-lead ore.

The most important lode mining districts are Beaconsfield, Lefroy and Mathinna, others being Mangana, Tower Hill and Mt. Victoria. The Tasmania Mines at Beaconsfield produced 1,022,692 tons of ore containing approximately 854,600 ounces of gold, with a value of £3,612,680 and paid £772,671 in dividends. In the Lefroy district most of the mines were developed to 400 feet, but below this depth very little work was carried out. The New Golden Gate is the most important mine in the Mathinna district and treated up till 1913 approximately 290,000 tons of ore for 246,000 ounces of gold valued at £950,000 and paid £365,000 in dividends.

The most important alluvial field has been the Lisle Valley from which it is estimated that approximately 250,000 ounces of gold have been won. Quantities of alluvial gold have also been obtained at Mangana, Mathinna, Lefroy and Back Creek, and the Savage River.

In addition to these the gold production has been largely augmented by the 382,530 ounces contained in the Mt. Lyell Copper.

Osmiridium

Tasmania has, in recent years, been the largest producer of "free" osmiridium in the world. The total production has been 12,827 ounces, with a value of £289,255. The maximum annual production was reached in 1920 with 2,009 ounces of a value of £77,114, and the present production is below these figures.

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Up till the present the production has been almost exclusively derived from concentration in alluvial and detrital deposits along the courses of present streams. The source of this osmiridium is deposits occurring in structural planes in serpentine. The particular variety of serpentine in which they occur is that derived from peridotites composed of olivine and bronzite rich in alumina. Very little development has taken place in the mining of osmiridium in these rock formations.

The principal fields are situated in the portion of the West Coast district between Waratah and Dundas, the particular areas being located around Bald Hill, Mt. Stewart, Savage River and Wilson River. Recently another possible field has been discovered in the New River district, South Coast.

Nickel

Deposits of copper-nickel ores occur in the North Dundas district on the West Coast, and are the only ones in Australia from which nickel ore has been produced. The ore consists of pyrrhotite, pentlandite and chalcopyrite, and occurs in association with narrow dykes of basic and ultrabasic rocks. The Dundas Cuni Mining Company has produced 1,189 tons valued at approximately £60,000. From the Melbourne Copper Nickel Mine 2,849 tons of a value of £14,346 has been produced.

Other deposits are known at and near Trial Harbour, Mt. Dundas, Ring River and Heazlewood.

Titanium

Alluvial deposits containing rutile occur near Abbotsham, Forth and Arthur Rivers in north-western Tasmania. Ilmenite occurs in similar deposits at Upper Arthur's Lake and at localities around the coast of Tasmania. No development of these deposits has taken place.

Molybdenum

Molybdenum occurs in small quantities at several localities. A small amount has been produced from Mt. Stronach, and from the Squib Mine at Moina, but no deposit of economic importance has been proved, so far, to exist.

Arsenic

Arsenopyrite occurs plentifully in the ore deposits of Tasmania, but not in sufficient quantity to warrant its extraction. Larger deposits are known to exist at Dundas, Mt. Horror and Scamander, but have not yet been proved to be of economic importance. Cassiterite is associated with the Dundas deposit. This is likely to prove the most important of the known deposits. Gold and tin ore are common associates of arsenopyrite deposits.

Sulphur (Sulphides)

No deposits of native sulphur are known in Tasmania, but pyrite has been mined at several localities for its sulphur content. The largest deposit occurs at Mt. Lyell Mine, where it is smelted for its copper, silver and gold contents, and also shipped to Victoria for utilization in the Company's superphosphate works. The reserve of pyrites amounts to 1,634,043 tons, with an average sulphur content of 44 per cent. Cupriferous pyrite has also been mined at the Chester Mine in the North Pieman district.

Other producers have been the Susanite and Nynance Mines, Comstock. All the pyrites produced have been exported to the superphosphate works in Victoria. There is also the possibility in the future of the low grade pyritic-cassiterite deposits being utilized for their tin and sulphur contents. Pyrrhotite and marcasite in enormous quantities occur with cassiterite at Renison Bell and Mt. Bischoff.

The zinc-lead sulphides of the Read-Rosebery district are also being utilized for their sulphur content by the Electrolytic Zinc Company.

The zinc-blende is obtained by concentration at the Company's works at Risdon and shipped to the Zinc plant at Risdon. The sulphur dioxide produced during roasting operations is used for the manufacture of sulphuric acid and superphosphates. The total reserves estimated in 1919 are 1,680,000 tons actual and 915,000 tons probable reserve and with a large possible reserve. Recent development work has added largely to these figures. The average sulphur content is 36.2 per cent.

The production is recorded from 1915- to 1923 as 68,293 tons valued at £93,916, but the total production greatly exceeds these figures.

Tungsten

Both scheelite and wolfram deposits have been located in Tasmania. Scheelite occurs at only one locality - King Island. This deposit was worked between 1917 and 1920 and produced 589 tons with a value of £112,468 and paid £25,000 in dividends, but the enterprise had to finally close down owing to the decreased price of tungsten. Wolfram occurs in the Avoca and Middlesex districts. The Story's Creek Mine is situated in the Avoca district and produces both Wolfram and tin concentrates from the mixed ore by electro-magnetic and other processes.

The principal mine at Moina is the S. & M. Mine, from which tin, wolfram, and bismuth are obtained. Electro-magnetic separation is also employed with this ore. Other mines are the Squib, All Nations, Iris, Mt. Pelion, etc. The total production of wolfram amounts to 1,418 tons with a value of £132,252.

Bismuth

Bismuth is obtained from the tin-wolfram mines in the Middlesex district. The total production is 74 tons with a value of £23,052. Enormous deposits, but of very low grade, occur at Mt. Ramsay, and fairly rich ore is found at Heemskirk and North Dundas.

Antimony

Stibnite is known to occur near Cox's Bight, Southern Tasmania, and a parcel of many tons has been reported as having been obtained. No deposit of large size is known, but very little attention has been paid to this part of the island. Antimony is a very common associate of lead in the sulphide bodies of Zeehan and Ringville.

Monazite

Monazite occurs in alluvial sands on the Stanley River and on the East Coast; also at Yellow Band Plains and other places on the West Coast and at Fraser River, King Island.

Zircon

Zircon occurs in alluvial deposits, the most important being those at Sisters Creek and near Penguin, north-western Tasmania, and near the mouth of the Arthur River.

Gem Stones

Topaz is found in the alluvial tin deposits and also on Flinders Island, the stones from the latter locality being particularly large ones. Sapphires are also found at the former locality, but not in any great number. A few diamonds have been found in the western districts, but no deposits of value have been proved to exist. The large and good trade zircons are used for gems.

Coal

Coal seams exist in many localities in Tasmania and occur in a strata belonging to the Permo-Carboniferous, Trias-Jura, and Tertiary systems. The Permo-Carboniferous strata form the lower coal measures of Tasmania, and coal seams occur in these strata at the Barn-Bluff-Pelion, Preolenna and Mersey Fields in the north and at Mt. Cygnet and Bruny Island in the south.

The Trias-Jura strata form the upper coal measures and coal seams and are extensively developed in the eastern, midland and south-eastern portions of Tasmania. These seams constitute by far the greatest coal reserve of the State.

The Tertiary strata also contain coal seams, but so far they have proved of no importance.

The following statement explains the variation in character and composition of the coal found in the above systems:-

Permo-Carboniferous

Greta Coal Measures:	Kerogenites and humic-
	kerogenites
Tomago " "	Sub-anthracites and
	non-caking humic.

Trias-Jura

Sub-anthracites and non-caking humic.

Tertiary

Brown coal and lignites.

The total production of coal is somewhat in excess of 2,000,000 tons with a value of £1,600,000. The present annual production is 69,238 tons valued at £61,016. The greatest development has taken place in the Mt. Nicholas area on the East Coast, where the principal mines are the Mt. Nicholas and the Cornwall Coal Mines. The Cornwall Coal Mines have contributed one third, and with the Mt. Nicholas Mine one half of the total production.

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The coal reserves calculated on the basis of existing economic conditions, amount to 134,398,000 tons. On the basis adopted by the International Geological Congress the "actual" reserve is 124,980,000 tons, and the "probable" reserve 123,013,000 tons, with a still further unknown "possible" reserve.

The following figures show the analysis, evaporating power and calorific value of the average Tasmanian coal (Trias-Jura):

Moisture	4.36	per cent
Volatile Hydro-carbons	21.27	" "
Fixed Carbon	51.84	" "
Ash	22.64	" "
Sulphur	0.60	
Evaporating Power	10.49	
Calorific Value	10,145	B.T.U.

Oil Shale

Extensive deposits of oil shale occur in the northern and north-western parts of Tasmania, as beds on the horizon of the Greta coal measures of the Permo-Carboniferous system. Tasmanite shale forms the greater part of these deposits, and a recent estimate of the reserves of this shale is as follows:-

Latrobe-Railton-Kimberley area	30,000,000	tons
Beulah area	3,000,000	"
Quamby Bluff area	3,000,000	"
Nook area	800,000	"
Oonah area	<u>6,000,000</u>	"
	<u>42,800,000</u>	"

The average yield of crude oil from these shales is estimated at 40 gallons per ton, and the oil reserve therefore amounts to 1,712,000,000 gallons. Only a small amount of development work has been performed in connection with these shales and it has been mainly in the direction of experimental tests in connection with various types of retorts for distillation purposes.

The Tasmanian Cement Company have practically completed their plant for making cement and distilling oil-shale, and anticipate the commencement of operations very soon. The Australian Shale Oil Corporation are engaged in boring prior to erecting distillation and refining plants.

In the past the Railton-Latrobe Shale Oil Company and the Southern Cross Motor Fuels have erected and carried out distillation for short periods with production of crude oil.

Kerosene shales and cannel coals occur at Preolenna, and pelionite in the Barn-Bluff-Pelion area, but the reserves of these materials are very small compared with those of Tasmanite.

Limestone

Beds of limestone occur in strata of the Ordovician, Silurian, Permo-Carboniferous and Tertiary systems. The Ordovician limestone is of exceptionally good quality, and is used for a variety of purposes. At Ida Bay, south-eastern Tasmania, it is utilized in the manufacture of calcium carbide. At Railton, north-western

Tasmania, it is burnt for the production of quicklime, and is also to be used in the manufacture of cement in the immediate future. At Melrose, also in the north-west, it is quarried and exported to Newcastle, New South Wales, by the Broken Hill Proprietary Company for use as a flux in their iron works.

Silurian limestone occurs in the west and north-western districts, but its sole use so far has been for fluxing purposes at Mt. Lyell and Zeehan. Permo-Carboniferous limestone occurs in the north-east, east, and south-eastern districts. At Maria Island, the National Portland Cement Company are erecting cement works and will use the limestone of this age occurring there. At Bridgewater it is burnt for quicklime.

Tertiary limestone occurs at Table Cape in the north-west, and at Geilston Bay in the south-east. The Geilston Bay limestone is utilized by the Electrolytic Zinc Company in their metallurgical processes.

Partial statistics from 1900 to 1923 show a production of 885,043 tons with a value of £193,716, and 63,469 tons of quicklime with a value of £87,617. During the past two years the Broken Hill Proprietary Company have quarried 221,103 tons for use as a flux in their iron smelting plant.

Clay

Many deposits of clay are known to exist, but no investigation of these has been made. They are mainly of Tertiary to Recent age, but beds also occur in the Trias-Jura system. Bricks are manufactured from local clays in both Hobart and Launceston; tiles are made in both cities, and coloured earthenware is also produced in Launceston. Apart from these, the best known deposits are those at George's Bay, Rosevale and Kingston.

Cement Materials

The essential materials for making cement-limestone, clay and fuel have been described above. These often occur in close proximity to each other, and the conditions are therefore suitable for cement manufacture. Plants for this purpose are in course of erection at Railton, while the National Portland Cement Company at Maria Island have been producing for 12 months.

Asbestos

Asbestos deposits occur at Anderson's Creek near Beaconsfield in northern Tasmania, and consist of veins of asbestos in serpentine. They have been developed by means of quarries and open-cuts, and a quantity of rock and fibre obtained. The total production is recorded as 3,565 tons with a value of £7,105.

Barytes

Barytes deposits occur in the Jukes-Darwin field near Queenstown on the West Coast, and at Alma, Beulah and Mt. Roland on the north-west coast. Barytes has been mined at Queenstown, at Jukes and Beulah, and the total production to date is 1,799 tons valued at £6,893. But the largest deposits occur at Mount Block, six miles to the east of Guildford station on the Emu Bay Railway; they are, however, undeveloped.

Slates

Slates of commercial value occur in the Cambro-Ordovician system in at least two localities in Tasmania - Bangor and Arthur River. Bangor is situated 15 miles to the north of Launceston and slates were obtained both by open-cut methods and also underground mining, and considerable quantities placed on the market. The other locality is on the east bank of the Arthur River, 12 miles north of Waratah, where slates of value were reported, but have not yet been developed owing to the lack of transportation.

Sandstones

Sandstones suitable for many purposes occur in the Ross series of the Trias-Jura system, which are largely developed in the north-eastern, eastern, midland and south-eastern parts of the State. These sandstones are specially suitable for building, constructional and monumental purposes, grindstones, etc. They have been extensively quarried through the above districts for the building of houses, particularly in the earlier days of the settlement. In the cities of Hobart and Launceston and the townships throughout the country, the public and other large buildings are chiefly constructed of these sandstones.

They have also been used for bridges, as at Ross, Richmond and Pontville. At Ross these sandstones are specially adapted for grindstones, and large numbers of these are exported to Australia. In addition, these grindstones are the principal rocks used for tombstones, headstones, monuments etc.

Granite

Granite outcrops at many localities in Tasmania, but has not been utilized for any purpose. Black and white, or grey, granite exists at most of these outcrops, but pink and red varieties occur at Heemskirk and Gladstone.

Some of the deposits are well situated as regards transportation facilities, and should be capable of being used for building and ornamental purposes.

Paint Materials

Deposits of oxide of iron suitable for the manufacture of paint materials occur at Mowbray, near Launceston, Abbotsham near Ulverstone, and near Beaconsfield. The material from these localities has been used successfully by the Serpentine Paint Company and others in the production of paints.

Other possible sources are the calcined residues obtained in the roasting of low-grade pyritic tin ores.

SULPHIDE DEPOSITS

Tasmania possesses several large deposits of sulphide minerals. Pyrite occurs at the Mt. Lyell mine and also at the Chester mine. Zinc lead sulphide ores consisting of an intimate mixture of galena and sphalerite occur in the Mt. Read and Rosebery districts. Pyrrhotite and marcasite containing cassiterite occur at Mt. Bischoff and Renison Bell and form large low grade tin deposits which may possibly be used for their sulphur content in the future. The pyrite from the Mt. Lyell and Chester mines has been exported in considerable quantities for the manufacture of sulphuric acid. The Electrolytic Zinc Co. are commencing to use concentrated ores from the Read-Rosebery deposits for the manufacture of sulphuric acid and then super-phosphate.

The Chester Pyritic Deposit

This deposit is situated on the eastern fall of Mt. Kershaw, 7½ miles to the north on the township of Rosebery on the West Coast district. Transport facilities are good, the mine being connected by one mile of narrow-gauge tramway with Chester siding. The latter is situated on the Emu Bay Railway - 63 miles from the Seaport of Burnie on the North Coast. This railway also connects the field with Zeehan and also the port of Strahan on Macquarie Harbour.

The orebody occurs in Read-Rosebery schists series of Cambro-Ordovician age near the junction of the porphyroid suite of felsites, and keratophyres of similar age. The formation of the orebody was, however, connected with the later Devonian granitic intrusions.

The predominant mineral constituent of the orebody is pyrite; accessory minerals are chalcopyrite, galena sphalerite, haematite and limonite. Associated gangue minerals are pyrophyllite, barite, calcite, dolomite chlorite and talc. The orebodies consist essentially of pyrite in an argillaceous and siliceous gangue - mostly pyrophyllite and quartz.

The pyrite deposits are typically lenticular in form, coinciding in strike and dip with the planes of schistosity of the enclosing rock. The strike varies from 10 degrees to 20 degrees east of north; the dip is 60 degrees to 65 degrees in a south-easterly direction. The thickness of the lenses varies from 20 to 280 feet, their horizontal length on the surface at the main workings has been proved to exceed 600 feet, and may be continuous with the south-west workings 1500 feet distant. The extent and value of the orebody has been proved by diamond drilling to a depth of 300 feet below the outcrop.

The orebody is not homogenous throughout but contains lenses of varying composition from those with less than 10 per cent sulphur to those with over 30 per cent sulphur.

The deposit was worked by the Mt. Lyell Mining and Railway Co. the pyrite being shipped to Melbourne for manufacturing sulphuric acid in their superphosphate works. The outcrop was favourably situated for working by open cut and adits and these methods were adopted.

The estimate of probable ore down to the depth at which drilling has been carried out is 2,856,000 metric tons containing over 20 per cent sulphur. Below this depth there are large possible reserves. The reserves of sulphides containing over 35 per cent sulphur form a small proportion of the above but cannot be expressed in figures.

The total quantity of ore sent to the sulphuric acid works up till 30th September is given as 36,223 tons with an average of 37.25 per cent sulphur, the total number of units of sulphur being 1,349,412. Fuller particulars of this deposit and the working thereof are given in Tasmanian Geological Survey Bulletin No. 28.

The Mt. Lyell Pyritic Deposit

The Mt. Lyell group of mines is situated in the vicinity of the townships of Queenstown and Gormanston in the west coast district of Tasmania. Queenstown is connected by railway with the port of Strahan on Macquarie Harbour which is connected by Government Railway with Zeehan and thence by the Emu Bay Line with the railway system of the State. Gormanston is also connected by railway with Kelly Basin on Macquarie Harbour.

The orebodies of the Mt. Lyell occur in a series of schists in faulted relation to which a series of conglomerates are found. The main fault has a general north and south direction and numerous traverse faults are associated with it. The schists lie to the west of the main fault and the conglomerates to the east.

The deposits are of two types (1) mineralised bands of schist and (2) great lens-shaped masses of very pure sulphide ores. It is the latter type that is being considered here and of this type the Mt. Lyell and South Lyell bodies are the most important. These two deposits consist almost entirely of pyrite containing copper gold and silver. The Mt. Lyell orebody is described by J.W. Gregory as being "irregularly boat-shaped in form consisting of an elliptical mass, which tapers gradually downward and is then cut off below with a rounded base". The length at the outcrop was 800 feet and the width 200 feet. It has been worked to a depth of several hundred feet by a large open-cut and to still greater depths by underground workings, the depth of the deposit being about 730 feet. The South Lyell deposits probably represent the faulted extension of the Mt. Lyell deposit at depth. The ores of the deposit are of remarkable uniformity and purity. They consist almost entirely of iron pyrites containing copper, gold and silver. There is a little galena and less sphalerite present. The only important minerals forming gangue are quartz and barite.

The average composition of the ore it was considered payable to extract in 1902 was:-

Iron	40.30	per cent
Silica	4.42	" "
Barium sulphate	2.50	" "
Copper	2.35	" "
Alumina	2.04	" "
Sulphur	46.50	" "

Small shoots of richer ore (as regards copper, gold, silver) occurred but were soon extracted. They were more siliceous and the copper minerals were barite and chalcopyrite. The average analysis of these ores was:-

Iron	24.75	per cent
Silica	30.69	" "
Barium sulphate	1.48	" "
Copper	5.33	" "
Alumina	6.30	" "
Sulphur	30.00	" "

Other rich and small shoots contained tetrahedrite, redruthite, argentite and were also found and extracted.

The estimate of reserves by the general manager at the 30th September, 1924 are 1,666,724 metric tons (dry) containing 0.5 per cent copper 1.5 ozs. per ton of silver and 0.04 oz. per ton of gold. No figures as to the sulphur content of the reserves are available but it is probably similar to that quoted above (46.52 per cent). The ore from the Mt. Lyell mine together with that from other neighbouring mines eg. the North Mt. Lyell has been smelted since 1896 by the Mt. Lyell Mining and Railway Co. for the production of blister copper containing gold and silver.

In addition large amounts of the pyrite from the Mt. Lyell mine itself have been exported to Melbourne and utilised in the Company's sulphuric acid and superphosphate plant for the manufacture of these materials thus taking advantage of the sulphur content of the ore.

The Read-Rosebery Zinc Lead Sulphide Deposits

These deposits occur in an area embracing Mt. Read and the township of Rosebery in the West Coast district of Tasmania.

The Emu Bay Railway from Burnie (a seaport on the North Coast) to Zeehan passes through Rosebery (71 miles from Burnie). A road four miles in length connects Williamsford with Rosebery. Williamsford is also connected by the North East Dundas tramway (two foot gauge) from Zeehan. Zeehan is connected by Government Railway with Strahan on Macquarie Harbour.

The area in which the ores occur is composed of Cambro-Ordovician strata consisting of the Dundas slates and breccias, the Read-Rosebery schists and the felsites and keratophyres forming a conformable series in ascending order. This series includes rocks of sedimentary, pyroclastic and effusive origin, the pyroclastic and effusive members being related to the porphyroid suite of igneous rocks. These strata have been folded into a series of domes and basins by subsequent earth movements.

The orebodies occur in the Read-Rosebery schists and represent replacements of calcareous members of this series. The ores are chiefly those of zinc and lead and are referred to as zinc-lead sulphide deposits. The deposits are considered to be genetically associated with the intrusions of Devonian granite.

The ore is generally very fine grained and consists of an intimate mixture of sphalerite, pyrite, galena, etc.

but veins of coarsely crystalline minerals also occur. The ore is typically banded due to the occurrence of alternating bands of varying composition. The boundary between ore and country rock is sharp.

The average zinc-lead sulphide ore has the following mineralogical composition:-

Zinc blende	43.3	per cent
Pyrite	31.0	" "
Galena	10.4	" "
Quartz	5.5	" "
Silicate of alumina	2.5	" "
Calcite	2.4	" "
Barite	1.5	" "
Chalcopyrite	1.2	" "
Rhodochrosite	1.2	" "
Tetrahedrite	0.1	" "
Silver	10 oz.	" "
Gold	3 dwt.	" "

Although a great part of the orebodies contains over 90% sulphides yet on the average they contain approximately 85% sulphide and 15% gangue. The chemical composition of the average zinc-lead sulphide is:-

Sulphur	36.2	per cent
Zinc	27.3	" "
Iron	18.0	" "
Silica	7.2	" "
Lead	7.1	" "
Alumina	2.2	" "
Copper	0.9	" "
Magnesia	0.2	" "
Lime	Trace	
Silver	10.5 oz.	" "
Gold	0.15 oz.	" "

The size of the orebodies as disclosed by mine workings is indicated in the following table:-

<u>Name of Orebody</u>	<u>Length</u> <u>ft.</u>	<u>Max. Width</u> <u>ft.</u>	<u>Av. Width</u> <u>ft.</u>	<u>Proved</u> <u>Vertical</u> <u>Extent</u> <u>ft.</u>
"E" Orebody Hercules	300	100	50	400
"B,C,D" Orebody "	400	75	60	250
"A" Orebody	300	40	20	250
Large Lens Mt. Read	450	100	50	110
Orebody Rosebery	2200	60	25	500

The reserves of ore estimated in 1919 are given in the following table. Exploratory work by diamond drill and underground mine workings have undoubtedly added to these figures and future operations will also probably largely augment them.

	<u>Reserves</u>		
	<u>Actual</u>	<u>Probable</u>	<u>Possible</u>
	Metric tons	Metric tons	
Tamanian Copper			
Primrose	1,071,000	734,400	
Hercules	540,600	159,120	
North Tasmanian Copper		10,100	Large
South Hercules		5,050	
Mt. Read	<u>101,000</u>	<u>24,480</u>	
	<u>1,712,600</u>	<u>933,150</u>	

Up till recent years, attempts were made to mine, and in some cases treat, the ores from the numerous mines separately, but these ventures were almost entirely unsuccessful. The production of zinc lead ore during this period amounted to 301,652 metric tons with a value of £383,416.

The first attempt to amalgamate interests was made by the Mt. Lyell Mining and Railway Co. who included the Hercules, Tasmanian Copper and Primrose mines with other under the title of the Mt. Read and Rosebery Mines Ltd. Later the Electrolytic Zinc Co. took over these properties and are now operating thereon. The ore is mined and then transported to Zeehan where it is treated to obtain as good a zinc concentrate as possible. The argentiferous galena is shipped to lead smelters at Port Pirie and the zinc product to Risdon near Hobart. There the material is calcined as part of the process for the production of Electrolytic zinc and the sulphur dioxide produced during this operation is utilised for the manufacture of sulphuric acid and ultimately superphosphate. The sulphur content of the Read-Rosebery deposits is thus being utilised and the zinc lead sulphide ore must be regarded as the equivalent of iron pyrite from this aspect.

Low-grade Tin-Bearing Pyritic Deposits

Large deposits of pyritic minerals containing cassiterite occur at several localities in Tasmania. The principal ones are those at Mt. Bischoff and Renison Bell.

Mt. Bischoff is the locality of the well known tin mine of that name. It is situated at Waratah in north-western Tasmania which township is connected by a branch line, 10 miles in length, with the Emu Bay Railway at Guildford 38 miles from Burnie. Various types of lodes and orebodies occur within this mine and have, and are being, worked for their tin content. One type consists of bodies of pyritic minerals containing small amounts of cassiterite. These orebodies represent replacements of dolomites which were formed by alteration of ultrabasic intrusive rocks. The pyritic mineral is mainly pyrrhotite, but large amounts of marcasite probably formed from the pyrrhotite are also found. The pyrite in the ore at present being treated is recovered on concentrating tables and then calcined prior to further treatment for its content of cassiterite. The sulphide dioxide from the calcination is not utilised at present.

In the treatment of the whole of these pyritic deposits, the possibility of the utilisation of the sulphur as well as the tin content of the ore must be taken into consideration.

Similar low-grade pyritic tin deposits occur at the Renison Bell mine. This mine is situated adjacent to the siding of the same name on the Emu Bay Railway from Burnie to Zeehan, being 78 miles from the former terminus and port. These deposits are of the same nature and occur under similar geological conditions as the pyritic ones at Mt. Bischoff. There is the same possibility of utilisation of the ore for both the tin and sulphur content.

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