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COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORD No. 1961-85

AUSTRALIAN SOURCES OF IRON ORE

by

J. BARRIE

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PREFACE

Summary Report No.44 - Iron - is in the course of preparation and is expected to be published early in 1962.

The sources section of this report, originally compiled by J.Barrie in 1957, revised by J.B.Firman in 1959, and again revised by J.Barrie in 1961, has now been brought up to date to 30th June, 1961, and checked by the Mines Departments of the States.

Because of the current interest in iron deposits in Australia it has been decided to make available this section in roneoed form so that it may be of immediate service to the community.

It should be mentioned that prospecting for iron ore is proceeding actively in several States, and particularly in Western Australia, so that the position is being continually altered by discoveries of additional prospects, of which details are not available in time for inclusion in this report.

The compilation of this report has been made possible only by the co-operation of the Commonwealth and State Government Departments and of the companies concerned with the production of iron ore. This assistance is gratefully acknowledged.

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AUSTRALIAN SOURCES (I.M.R.B. 1922, David, 1950)

Australia, from its known resources, cannot be regarded as being as well endowed with deposits of high-grade iron ore as are America, Europe and Asia. Australian iron ore resources consist of about 400 million tons of demonstrated reserves, about 200 million tons of inferred reserves, about 150 million tons of indicated and inferred marginal resources (of which about 130 million tons are inferred), and a comparatively large tonnage of latent resources (2,000 - 3,000 million tons). The current annual rate of consumption is about 4 million tons, but this could conceivably rise to 9 million tons by 1970. Demonstrated reserves are sufficient for 30 - 40 years on the basis of the higher annual rate of consumption. Marginal and latent resources are potential ores only and may never become an economic source of iron.

Iron ores are widely distributed throughout Australia and its Territories, but the bulk of production has come from the Middleback Ranges near Whyalla in South Australia, and Yampi Sound in Western Australia. Small production has come from other deposits including current production from Koolyanobbing, Western Australia.

Fig. 1 shows the principal localities for iron ore in Australia, and Table 1 shows the known resources of iron ore in each State and Territory, and the total resources for Australia.

In the tables, and elsewhere in the text, the term Reserves is restricted to deposits considered to be exploitable under existing conditions (including price, technology and special local conditions). The reserves have been subdivided into two classes - demonstrated and inferred - according to the degree of uncertainty involved in the estimates. Demonstrated reserves are the sum of measured and indicated reserves in the standard classification "measured, indicated, and inferred".

Potential ores have been subdivided into Marginal Resources and Latent Resources according to the degree by which circumstances would have to change to enable the deposits to be worked economically.

It is emphasised that in the tables attached to this review it is not a valid procedure to add together tonnage figures for Reserves with tonnage figures for Marginal or Latent Resources.

TABLE 1 - Australia

Ore Reserves (Millions of tons)

	Demonstrated	Inferred
Queensland	-	-
New South Wales	-	-
Victoria	-	-
Tasmania	50.0	150.0
South Australia	206.1	30.6
Western Australia	153.7	40.9
Northern Territory	-	-
Papua and New Guinea	-	-
Total	409.8	221.5

Marginal Resources (Millions of tons)

	Indicated	Inferred
Queensland	3.3	11.1
New South Wales	3.3	8.2
Victoria	5.5	3.7
Tasmania	3.0	8.5
South Australia	0.4	-
Western Australia	-	97.2
Northern Territory	-	-
Papua and New Guinea	-	-
Total	15.5	128.7

Latent Resources*(Millions of tons)

	Possible Size
Queensland	large
New South Wales	-
Victoria	-
Tasmania	-
South Australia	2140
Western Australia	256+
Northern Territory	large
Papua and New Guinea	0.2

* Includes only those deposits for which figures are available.

QUEENSLAND (Brooks, 1957)

Queensland contains many deposits of iron ore, but they are mostly either small, or low grade, or situated in remote areas, and are therefore not economic at present. Small amounts have been mined for use in cement and paint manufacture, and in fluxing, but no iron ore has been produced for iron and steel manufacture. The largest deposits are located in north-western Queensland but the distance from a seaport or source of coal has prevented their development. Many of the occurrences in the coastal belt are high-grade, contact metamorphic deposits, but the reserves are insignificant. The principal deposits and resources are summarized in the following table.

TABLE II - Queensland

Marginal Resources (Millions of Tons)

Deposit	Indicated	Inferred	% Fe	Iron Minerals
Iron Range (Black Hill)	Unknown - Deposit being tested		Good Quality	Hematite.
Iron Island	0.1	0.5 *	67	Magnetite & Hematite
Mt. Biggenden	0.2	0.3	57	Magnetite
Mt. Philp	2.7	7.0	36.6-48.5	Hematite & Magnetite
Mt. Oxide	-	2.5	51	Hematite-specularite
Mt. Lucy	0.3	-	68	Magnetite
Mt. Leviathan	-	0.5	57	Average iron probably lower
Willet's Knob	-	0.2	66	Magnetite
Black Creek	-	0.1	57	Hematite
Total	3.3	11.1		

* Below high water mark.

Latent Resources (Millions of tons)

Deposit	Possible Size	Possible Grade & Impurities	Remarks
Constance Range	Large (?)	40% (?) Fe	Under investigation.
Hematite Range	Not known	45% Fe	Hematite.
Wild River	Small	54% Fe	Hematite.
Mt. Coolon	Not known	57% Fe, 29% SiO_2	
Mt. Wyatt	Small	38% Fe, 29% SiO_2	
Mt. Perry	0.2	34-43% Fe	
Glasseford Ck.	Less than 0.5	(?)	
Dawson Valley	Large (?)	(?)	Oolitic Ironstone

Cloncurry District

Several iron ore deposits are known in the Cloncurry District in north-western Queensland. The largest of these is that of Mt. Philp (Carter and Brooks, 1955), 48 miles south-west of Cloncurry. The deposit occurs in a succession of highly altered basic volcanic, and calcareous and arenaceous rocks. The ore is chiefly hematite and magnetite, and occurs in irregular outcrop 11,000 feet long and averaging 85 feet wide. The deposit contains marginal resources consisting of 2,700,000 tons indicated, and 7,000,000 tons inferred. Iron content ranges from 36.6 to 48.5 per cent iron. Silica content ranges from 28.7 to 39.3. per cent, phosphorus, sulphur and manganese are all less than 0.05 per cent and titanium less than 0.5 per cent.

The Leviathan or Black Mountain deposit, (Carter and Brooks, 1955) two miles south-west of Cloncurry, is composed of siliceous ironstone (hematite and magnetite) and appears to be similar to the deposit at Mt. Philp. The marginal resources above plain level are 500,000 tons (inferred) with a grade of about 57 per cent iron and 17 per cent silica.

At Mt. Oxide (Blanchard, 1939), 110 miles north-west of Cloncurry, a deposit of hematite-specularite, some 800 feet long and everaging about 100 feet in width, forms the hanging wall of the Mt. Oxide copper orebody. The average grade of the ore is 51 per cent iron and 13 per cent silica. The marginal resources are 2,500,000 tons (inferred).

The Hematite Range deposit (Jensen, 1941), in the Lochness area 80 miles north-west of Cloncurry, consists of two parallel replacement bodies, 150 feet apart, in limestone. The easterly body is about 300 feet wide and the westerly body about 150 feet wide. The highest points are about 500 feet above the plain level. Jensen reports that the belt can be followed for nearly a mile without appreciable diminution in width. A chip sample of the eastern outcrop assayed 44.82 per cent iron and 0.21 per cent phosphorus. The iron-ore resources are not known.

Other deposits in the Cloncurry district, but with no economic importance, include Dugald River, Mt. Pisa, and Mt. Dore.

Apart from all other considerations the remote location of the Cloncurry deposits would prevent them from being exploited economically at present.

Other Areas

Constance Range (Carter and Zimmerman, 1960) Sedimentary iron ore occurs throughout an area of about 250 square miles in the Upper Proterozoic Mullera Formation of the Constance Range area, about 100 miles north of Camooweal and 100 miles south-west of Burketown, on the Gulf of Carpentaria. The deposits were found in the course of a regional survey of the Cloncurry-Lawn Hill area by the Bureau of Mineral Resources and the Geological Survey of Queensland between 1950 and 1954.

The strata are folded into a series of domes and basins, with dips generally less than 40°, but steeper dips are found near some faults. The deposits occur in two major structural basins, whose shapes have been greatly modified by the numerous faults in the area. They are not metamorphosed.

Potential ore beds range from 5 to 40 feet in thickness and are confined to a zone, containing shallow water siltstones and sandstones, ranging from less than 10 to 320 feet in thickness. The ore beds are generally oolitic and contain hematite and siderite, commonly in intimate association with chalcedonic and fine grained silica. The siderite is mostly replaced by chalcedonic silica in the weathered zone, where some limonite and goethite also occur. Chamositic santstone is associated with the other iron-bearing beds. The bulk average iron content of the better grade ore deposits is probably about 40 per cent. These deposits constitute only a very small proportion of the total iron bearing strata present.

The deposits are being extensively investigated by the Broken Hill Pty. Co. Ltd. Although testing will not be completed for some years it may be tentatively stated that the near-outcrop material has been proved to be uneconomic. Laboratory research indicates that if sufficient tonnages of carbonate (unweathered) ore can be proved by drilling the deposits would become an economic proposition. Latest drilling returns (1961) are encouraging.

The iron ore resources of this area are tentatively classified as latent.

Iron Range (A.G.G.S.N.A. 1937 Levingston, 1954). The iron ore deposits of the Iron Range in the Claudie River Gold and Mineral Field, near the coast of Cape York Peninsula, consist of several discontinuous lenses of specular hematite closely interlaminated with metamorphosed sediments. The largest deposit crops out almost continuously for a distance of 2½ miles and has a maximum width of 130 feet. The average grade of this deposit, based on 23 samples from outcrops and trenches, is 45 per cent iron and 25 to 30 per cent silica. Ore reserves were estimated at 5,000 tons per vertical foot.

An aeromagnetic survey in 1958 disclosed a strong anomaly in rough country near by. This area (Black Hill) was subsequently found to contain some good quality hematite with a high manganese content. Extensive prospecting of this area is being continued by the Broken Hill Pty. Co. Ltd. Latest drilling results have been disappointing. The deposit has the advantage of being close to a port.

At Mt. Lucy, near Almaden in the Chillagoe district, a high-grade deposit of magnetite ore associated with garnet rock occurs at the contact of Silurian limestone and intrusive granite. The marginal resources are 300,000 tons (indicated) averaging 68 per cent iron.

At Mt. Biggenden (Dunstan, 1917) 34 miles west of Maryborough, a deposit of massive magnetite, with disseminated bismuth minerals and gold, replaces slate. The deposit has been mined for the gold and bismuth.

The deposit contains marginal resources estimated at 200,000 tons (indicated) and 300,000 tons (inferred), with an average grade of 57 percent iron. From 1942 to 1954 some 18,000 tons of magnetite tailings from the gold and bismuth plant were used in cement manufacture at Darra, Brisbane.

Iron Island, (Ball, 1904) one of the Duke of Northumberland Isles, midway between Rockhampton and Mackay, contains a deposit of magnetite, with some hematite, metasomatically replacing Devonian limestone and shale. Mt. Morgan Gold Mining Co. Ltd. used 390,000 tons of ironstone from the island for fluxing purposes. The deposit contains marginal resources estimated at 100,000 tons (indicated) with a grade of 67 percent iron, with a further 500,000 tons (inferred) below high water mark.

Dawson Valley (Jensen, 1926). On Dawson Vale, Springvale, Estramadura and Cockatoo station properties in the Dawson Valley, 15 to 25 miles south of Cracow, oolitic ironstone forms thick and extensive masses. The oolitic ironstone is interbedded with shales in the Bundamba Group of Triassic age. An investigation of the deposits has been initiated but the size and grade are not known.

Other localities where iron deposits are known include Wild River, near Herberton - 70-80,000 tons (inferred) of marginal ore containing 54 percent iron, Willet's Knob, north-west of Townsville - 200,000 tons (inferred) of ore containing 66 per cent iron, and Black Creek, near Mt. Garnet - 100,000 tons (inferred) of marginal ore containing 57 percent iron.

Other deposits, classified as latent resources, are known at Mt. Coolon, south-west of Bowen, Mt. Wyatt, south-east of Mt. Morgan, and Mt. Perry and Glassford Creek, west of Gladstone.

Other occurrences are known in Queensland, but they have no significance as sources of iron because, although reasonably situated for transport, they are all too small, or low-grade or both.

NEW SOUTH WALES

New South Wales is not well supplied with iron ores. Many deposits exist, but for the most part they are small, and from most of them the best ore has already been removed. The following table summarizes the principal deposits and reserves for the State.

TABLE III - New South Wales (Griffin & Wynn, 1961)

Marginal Resources (Millions of tons)

Deposit	Indicated	Inferred	% Fe	Iron Minerals
Williams & Karuah Rivers		2.0	36-52	Titaniferous Magnetite
Tallawang	0.1	-	65	Magnetite, hematite, limonite
Cadia	0.7.	1.0	25-65	Magnetite, specular hematite, & carbonate ore
Carcoar	0.6	-	52-65	Hematite, limonite & magnetite
Mittagong & Picton (various)	-	1.5	?	Limonite
Goulburn-Breadalbane				
1. Taylors Siding	0.5	-	50	Limonite & hematite
2. Tirrana	0.1	0.2	51-56	Limonite
3. Others	-	0.6	?	Mostly limonite
Crookwell	0.3	-	52-54	Limonite
Broula	-	0.1	65-67	Magnetite
Paddys River (ACT)	-	1.0	64	Magnetite
Michelago	0.3	-	47	Hematite & limonite
Mandurama-Woodstock	-	0.4	56	Limonite
Mudgee	-	0.1	54	Limonite
Newbridge-Blayney- Orange	-	0.1	44-50	Limonite & magnetite
Rylestone-Cudgegong	-	0.4	39-56	Limonite
Wallerawang-Pipers Flat	-	0.2	26-54	Limonite
Wombeyan Caves	-	0.3	?	Limonite, magnetite, hematite.
Jerrawa	-	small	?	Limonite
Mt. Gobonderry (Fifield)	-	small	60	Hematite
Pt. Macquarie	0.5		38-50	Magnetite & hematite
Fine Flower	0.2		67-71.4	Magnetite
Tabulam		0.2	45-48	Siliceous hematite-magnetite
Tarago		0.1	57-67	Magnetite and hematit
Total	3.3	8.2		

Note : The ferruginous deposits of the Bundanoon-Wingello and Tingha-Inverell-Emmaville areas are ferruginous bauxite and are not expected to be used as a source of iron.

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At Port Macquarie (Harrison, 1955) on the North Coast of New South Wales, deposits of magnetite-hematite have been quarried continuously since 1903 for use in gas purification. Before 1903 some ore was mined for its cobalt and manganese content. The iron ores are residual deposits derived from the weathering of underlying serpentine. The thickness of residual material over the serpentine reaches 60 feet and averages about 16 feet. The ore contains 38 to 50 per cent iron, 7 to 17 per cent silica, and 6 to 16 per cent alumina. Reserves have not been determined but they appeared to be sufficient for fifty years at the 1950-51 rate of production, namely 10,000 to 12,000 tons per annum.

Bedded titaniferous magnetite ore occurs in the Williams and Karuah River District, near Port Stephens. The ore contains 36 to 52 per cent iron and about 0.65 per cent P_2O_5; TiO_2 ranges from 3 to 16 per cent and silica from 10 to 28 per cent. Resources consist of 2,000,000 tons (inferred) of marginal ore.

Tabulam. (Kenny, 1950). A small deposit of siliceous hematite-magnetite crops out at Plumbago Creek near Tabulam, about 45 miles west of Lismore. Assays of samples from the deposit gave a range of iron of 45 to 48 per cent, and silica 23 to 26 per cent. The marginal resources are about 200,000 tons (inferred).

Tallawang (Lloyd, 1939a; Rayner 1956). This deposit is located 10 miles north-west of Gulgong, close to the Gulgong-Dunedoo road. It is associated with Silurian rocks, and granite and peridotite intrusives. The ore consists chiefly of magnetite, and contains 65 per cent iron, 5 per cent silica and 0.1 per cent phosphorus. Between 1901 and 1927 approximately 500,000 tons of ore were quarried, and together with ores from Cadia and Carcoar, were smelted at Lithgow. Australian Magnetite Pty. Ltd., mined 3,787 tons of ore, for use as a heavy medium in the cleaning of coal, during 1951-1955. About 100,000 tons of high-grade ore remain.

Fine Flower Three high grade deposits of magnetite crop out at Gordon Brook near Fine Flower, 28 miles north-west of Grafton. Assays of the ore range from 67 to 71.4 per cent. The marginal resources are approximately 200,000 tons (indicated). A quantity of ore was mined during 1960 mainly for use in coal washing plants.

Cadia (Raggatt, 1939). At Cadia, 14 miles south-south-west of Orange, there are two deposits, one and a half miles apart, known as the Iron Duke and Copper Gully ore deposits. Both were originally worked for copper, and in addition small amounts of gold and silver were obtained. The iron ore occurs as a replacement of folded Silurian sediments, probably including limestone. The ore-bearing solutions were a late differentiate phase of a monzonite magma, the monzonite itself also being mineralized.

The iron ore consists mostly of magnetic hematite with some pyrite. At shallow depths this grades into pyrite with copper carbonates and sulphides. The content of iron in analysed samples ranges from 25 to 65 per cent, with an average of 52 per cent; phosphorus is less than 0.025 per cent, and silica is as much as 28 per cent. About 4,000,000 tons of ore of various grades (including that containing copper, gold and silver) have been quarried. Total marginal resources are estimated at 1,700,000 tons.

Carcoar (Lloyd, 1939b). At Coombing Park, two miles south of Carcoar, several iron ore deposits occur along a line or zone of intense folding and shearing. The ore is mainly hematite with a little limonite, magnetite and manganese oxide. The iron content ranges from 52 to 65 per cent; silica and phosphorus may be as much as 10 per cent and 0.17 per cent respectively. Although the ore is high-grade, the orebodies contain a considerable amount of country rock and it has been profitable to mine only one deposit. During the late 1890's and early 1900's many thousands of tons of ore were mined for use as a flux, chiefly at the Dapto smelting works. The output for the three year period 1898 to 1900 is recorded as 17,000 tons of ore averaging 59 per cent iron. In 1907 the production of pig iron from Coombing Park ore was commenced at Lithgow, and from then until 1923 nearly 1,000,000 tons of ore were quarried for this purpose. None has been mined since 1923. Resources are estimated at 600,000 tons (indicated) of marginal ore.

Mittagong-Picton. Deposits of limonite from chalybeate springs occur at numerous places between Mittagong and Picton. They are too small to be of economic value, but are of interest inasmuch as the first iron ore smelted in New South Wales was from a spring deposit at Mittagong. The deposits contain 1,500,000 tons (inferred) of marginal ore.

Goulburn-Breadalbane (Raggatt, 1940). Scattered throughout this district are many small iron ore deposits which may be grouped, according to their origin, as follows :

(a) Superficial deposits - Tirranna, Kingsdale, Norwood, Joppa Junction, McCauley's and Bangalore Creek (South Komulga), and Jerrara Creek. Many of these are associated with limestone.

(b) Lateritic Bauxite - These occur in the south-east corner of the area at Bungonia, Jacqua-Yarralow, Nerrimunga, and Windellama.

(c) Lodes - Taylor's Siding (Bredalbane)

The principal deposit is at Taylor's Siding, four miles west of Breadalbane. The ore consists of hard dense limonite and magnetic micaceous hematite, and averages about 50 per cent iron, 20 per cent silica, 0.23 per cent phosphorus pentoxide, and 0.07 per cent manganese. Over 50,000 tons of ore were produced from this deposit during 1918 to 1929, but the actual tonnage since production began cannot be determined as the returns

for the early period were included among those of other localities. During 1935 and the war years, 1941 to 1945, about 172,000 tons of ore were mined. Indicated marginal resources are of the order of 500,000 tons.

The Tirrana deposit, near Goulburn, has an exposed length of over 1,300 feet and an average width of 40 feet. The ore consists of limonite and contains from 51 to 56 per cent iron and 3 to 7 per cent silica. The deposit was worked by Australian Iron and Steel Limited during 1939 to 1945, and 18,807 tons of ore were mined. The marginal resources ~~contain~~ are 100,000 tons (~~inferred~~ indicated and 200,000 tons (inferred). ~~of marginal ore~~.

Crookwell (Mulholland, 1941). A deposit of limonite occurs in Silurian sedimentary rocks 5 miles north of Crookwell about 100 miles south-west of Sydney. The deposit is conformable with the beds and dips west at 40° to 45°. It has an average exposed width of 100 feet, and quarry workings have extended to 90 feet in depth. Ore minded during the years 1940 to 1945 and sent to Port Kembla ranged from 52 to 54 per cent iron. Total production for these years was 500,488 tons. The deposit has not been worked since 1945. Resources are marginal and are estimated at 300,000 tons (indicated).

Jerrawa (Mulholland, 1941). Several deposits of limonite crop out 5 to 7 miles south-east of Jerrawa between "The Gap" on the Yass-Gunning Road and the "Limekilns" about two and a half miles further south. The ore occurs as shallow pockets in altered Silurian shales. The outcrops form a series of lenses in two parallel zones about 100 feet apart and extending in a direction north 20° west for 2 miles. The only recorded production from these deposits is for the years 1941 and 1942, when 15,504 tons of ore were quarried by Australian Iron and Steel Limited. The resources of this deposit are marginal and small.

At Broula, ten miles south-west of Cowra, a deposit of magnetite was worked during the 1941-1945 period, and 144,272 tons of ore averaging about 56 per cent iron, were produced. The deposit contains 100,000 tons (inferred) of marginal ore.

Upper Murrumbidgee Region. In the area from the Australian Capital Territory south to Cooma there are several deposits of iron ore apparently related to the Silurian granites. The larger deposits are on Paddy's River, (Jaquet, 1901), near its junction with the Cotter River, and at Michelago and Burra (Lloyd, 1941). The Paddy's River deposit, about 14 miles west of Canberra, contains magnetite together with some zinc, copper and lead minerals. The possibility of working the deposit has been investigated, but no mining has taken place. The resources are estimated to be ~~500,000~~ 1,000,000 tons (inferred) of marginal ore.

During the 1939-1945 war, 208,515 tons of siliceous hematite and limonite averaging about 47 per cent iron were mined from several small deposits in the Michelago-Burra area. These deposits contain 300,000 tons

(~~inferred~~ indicated) of marginal ore. Small quantities of umber, associated with the ironstone at Michelago, have been mined at intervals.

Extensive deposits of low-grade ferruginous bauxite occur in the Bundanoon-Wingelo district (4,000,000 tons) and the Tinga-Inverell-Emmaville district (15,000,000 tons). The composition of the bauxite ranges from 2.7 to 7.5 per cent silica, 31.0 to 53.9 per cent alumina, and 5.7 to 37.4 per cent ferric oxide. Such deposits could not be used as a primary source of iron.

Other localities include Wombeyan Caves, Mudgee, and the Mandurama-Woodstock, Newbridge-Blayney-Orange, Rylestone-Cudgegong and Wallerawang-Pipers Flat areas.

VICTORIA.

No iron deposit of commercial importance has yet been found in Victoria but several small deposits are known. The most important deposit contains magnetite and hematite while others contain mostly limonite. The only production came from Lal Lal in the "eighties" when an attempt was made to produce pig iron. The marginal resources of the principal deposits are summarized in the following table.

TABLE IV - Victoria.

Marginal Resources (Millions of tons)

Deposit	Indicated	Inferred	% Fe	Iron Minerals
Nowa Nowa	5.5	1.0	45-68	Magnetite & hematite
Lal Lal	-	2.0	?	Limonite
Mirboo North	-	0.5	45-50	Limonite
Casterton	-	0.2	28-44	Limonite
Other localities	small			
Total Victoria	5.5.	3.7		

Nowa Nowa (Whitelaw, 1920; Howitt, 1925, Kenny, 1925, Bell 1959). In the Nowa Nowa district of East Gippsland several lenticular iron ore bodies, aligned in a general north-north-east direction, crop out over a distance of about 10 miles. The ore consists of massive and micaceous hematite at the surface, passing in depth to magnetite with micaceous hematite, pyrite and chalcopyrite. Analyses of numerous samples from the southern part of the area show a range of iron content from 45 to 68 per cent, (average about 50 percent) phosphorus 0.001 to 0.034 per cent, sulphur trace to 4 per cent, silica 6 to 27 per cent, and manganese 0 to 0.18 per cent. Towards the north higher manganese contents are encountered in limonite deposits, the "Iron Mask" deposit showing up to 13 per cent manganese. No production has been recorded from this field. In recent years further geological and geophysical surveys have been made and a drilling campaign begun in 1953 was completed in 1959. Resources are estimated to be 5.5 to 6 million tons (indicated) and 1 million tons (inferred).

Buchan. (Teichert & Talent, 1958) An irregular, wedge-shaped body of limonite crops out on the east side of Tara Creek, near Mt. Tara, about 5 miles south of Buchan and 12 miles north-north-west of Nowa Nowa. The deposit consists of friable, pale brown, yellow, red and buff limonite capped by about 1 foot of hard secondarily enriched ironstone. The texture varies from granular (with grains up to half inch size) to clayey. The deposit is associated with the Buchan Caves Limestone. The grade varies from about 45 to 50 per cent iron. Reserves are unknown. The limonite is being quarried by open cut methods for use in the scrubbing of gas for the Melbourne gas supply. Production during 1959 amounted to 5,244 tons.

Lal Lal (Krause, 1880; Baragwanath, 1922). At Lal Lal, about 12 miles south-east of Ballarat, a deposit of bog iron ore, estimated to contain about 2,000,000 tons of marginal ore (inferred), is associated with Tertiary lignites. An attempt was made in the "eighties" to manufacture pig iron, and about 2,000 tons were produced, but the experiment was unsuccessful financially, largely because of lack of knowledge and the high cost of production.

Mirboo North (Gregory, 1907). Near Mirboo North, about 20 miles south-west of Yallourn, a deposit of limonite is estimated to contain marginal resources of about 500,000 tons of ore (inferred) with a grade of 45 to 50 per cent iron. The limonite occurs as concretionary masses overlying mottled clay. The deposit also contains ochre.

Casterton (Dunn, 1912). Several deposits of limonite occur near Merino in the Casterton district, in the south-west corner of the State. The deposits consist of 2 to 3 feet of pisolitic iron ore overlying 2 to 3 feet of more compact limonite, and contain from 28 to 44 per cent iron. The deposits have been quarried for use as road metal and also for the ballasting of railway tracks.

Dookie (Dunn 1917). Limonite together with manganese ore occurs at Mt. Major, near Dookie, about 20 miles east of Shepparton. The grades of several samples range from 39 to 48 per cent iron and 12 to 16 per cent manganese.

Gordon. A small deposit of nodular and stratified limonite, with a small admixture of highly ferruginous clay and ochre occurs on the northern bank of Greenhill's Gully near Gordon, about 15 miles east of Ballarat. The iron content ranges from 50 to 53 per cent, and phosphorus 0.5 to 0.7 per cent.

Coimadai (Jenkins, 1901). A small deposit of limonite derived from the weathering of ferruginous Tertiary beds occurs at Coimadai, about 10 miles north of Bacchus Marsh, but it is of little or no commercial importance.

Barongarook. Near Barongarook railway station 7 miles south-east of Colac, small bodies of limonite and hematite occur among gravelly, sandy and clayey beds resting on volcanic clays. The deposits are of little or no economic importance.

TASMANIA

The known iron ore deposits of Tasmania occur in the north, north-west and west coast areas and the principal deposits and reserves are summarized in the following table:-

TABLE V - Tasmania

Ore Reserves (Millions of tons)

Deposit	Reserves Indicated / Demonstrated	Inferred	% Fe	Iron Minerals
Savage River	50	150	45	Magnetite

Marginal Resources (Millions of tons)

Deposit	Indicated	Inferred	% Fe	Iron Minerals
Meredith, Paradise & Rocky Rivers		2.0	56	Magnetite
Comstock (Tenth Legion)	3.0	1.5	30-69	"
Natone		2.0	65	Hematite & magnetite
Highclere		1.0	66	Magnetite
Beaconsfield		1.0	38-43	Hematite & magnetite
Hampshire		1.0	65	Magnetite
Other Localities		small		
Total	3.0	8.5		

Numerous disconnected masses of ironstone crop out in a belt of metamorphosed amphibolite ½ a mile wide and about 25 miles long extending north from the Meredith River to the upper reaches of the Savage River. The most important of these deposits occurs where the belt crosses the Savage River. Others are the Long Plains deposit and those of the Meredith, Paradise and Rocky Rivers.

Savage River (formerly Rio Tinto). (Hughes, 1958, 1961; Symons, 1959; Tetlow 1960b). These large magnetite deposits, by far the largest in Tasmania, are situated on either side of the Savage River, about 20 miles south-west of Waratah.

The magnetite has formed as a magmatic segregation and occurs within an amphibolite mass which is intrusive into Pre-cambrian quartz schist and slate. All these rocks have later (in the Devonian) been intruded by siliceous and sulphide solutions. The terrain is very rugged but the deposits are ideally suited for open-cut mining. Impurities in the ore are titanium and sulphur with smaller amounts of phosphorous and vanadium.

In 1956 the Bureau of Mineral Resources carried out an aeromagnetic survey which disclosed several anomalies. Subsequent ground magnetic surveys were followed by a drilling program, conducted by the Tasmanian Mines Department, commencing in 1957. In March, 1961 a licence to investigate the deposits was granted to a private interest with attached conditions involving a considerable increase in the drilling rate, and extensive metallurgical research, with a view to establishing a steel industry. Drilling to date (March, 1961), combined with the geophysical work has indicated four magnetite rich zones containing approximately 50,000,000 tons (~~indicated~~ demonstrated) of ore with a further 150,000,000 tons inferred, with an average of about 45 per cent iron.

The Long Plains (Tetlow, 1960a) deposit is the name now given to a magnetically anomalous area about 8 miles south of the main Savage River deposits. The area is reported to contain minor marginal resources of magnetite ore similar in character to that at Savage River with a grade of 45 to 50 per cent iron.

Meredith, Paradise and Rocky Rivers (Reid 1924). These deposits are the southern-most extension of the Savage River magnetite deposits, although in this locality a quartz hematite body (probably of secondary origin) is also present. These rivers (like the Savage) are tributaries of the Pieman and the deposits occur some 14 miles inland from the Pieman mouth. Only the magnetite is considered to be of commercial value. Resources are marginal and are estimated at 2,000,000 tons of ore (inferred) averaging 56 per cent iron.

Comstock (Tenth Legion) (Blake, 1940, Hughes, 1959 a). These deposits, situated about 5 miles west of Zeehan, consist principally of magnetite with minor amounts of hematite and limonite. They occur as irregularly shaped and discontinuous lenses almost wholly contained in serpentine dykes and associated lime-silicate rocks. The ore contains 30 to 69 per cent iron, 0.04 to 1.78 per cent manganese, 0 to 13 per cent silica, and trace to 0.14 per cent P_2O_5. The deposits have not been mined but have been prospected extensively, mainly by adits, since their discovery in 1885. Marginal resources are 3,000,000 tons (indicated) and 1,500,000 tons (inferred). Boring was carried out in 1957-58 by the Tasmanian Department of Mines and this showed that the magnetite extends to at least 200 feet below the surface but concentrations become more sporadic at depth and a much lower grade of ore results.

Natone (Blake, 1958a). Natone is situated less than 10 miles south of Burnie, a port in north-western Tasmania. The iron ore consists of hematite and magnetite and occurs in a shear zone striking north-easterly in Precambrian quartzites and phyllites. The mineralization is genetically related to granite which crops out to the west. Minor development has taken place near the surface and this shows very patchy material, the best of which assays 65 per cent iron. However, recent geophysical work has indicated that the main body of iron lies south-west of the surface workings. The Natone deposits are marginal and are estimated to contain 2,000,000 tons of ore (inferred).

Highclere (Blake, 1958b). Like the Natone deposits, those at Highclere (an area also close to Burnie) have had their inferred reserves considerably enlarged as the result of a geophysical survey in 1957. Their occurrence is also much the same as at Natone except that here the principal ore seems to be magnetite, and hematite is a minor constituent. Little surface and no underground prospecting has taken place but the deposits appear to occur in three main lenses. A sample from near the surface showed 66 per cent iron. The deposits are marginal and contain 1,000,000 tons of ore (inferred).

Hampshire (Reid, 1924). The Hampshire deposits are situated about 6 miles from the Hampshire Station on the Burnie-Zeehan railway. Two areas, about 2 miles apart, contain magnetite of high grade (50-67 per cent iron) occurring as small roof pendants in a large granite mass. The western area is very small and the eastern, although of large areal extent, is not expected to be very deep. There has been a limited production from small open cuts in this area. Marginal resources of the deposit are 1,000,000 tons (inferred) averaging 65 percent iron.

Blythe River (Blake, 1958c). These deposits crop out on both banks of the river five miles from its mouth. They consist of an irregular distribution of dense hematite and silica (as quartz, quartzite, and jasper) in steeply dipping country rock. The iron content varies considerably throughout the formation. Local concentrations of hematite average about 65 per cent iron; reserves of this material are small.

Dial Range - Penguin Creek. Both these deposits occur south of Penguin, a sea-coast town 12 miles east of Burnie. That in the Dial Range is a series of narrow replacement bodies of red hematite in Owen Conglomerate and has no commercial value. The Penguin Creek deposit consists of boulders of hematite set in a matrix of soft clayey hematite and limonite. These boulders are high in iron (68 per cent) but there is much matrix.

Between 1897 and 1908 over 40,000 tons of ore were mined for fluxing purposes. Since 1946 a few hundred tons per annum have been used for gas purification, and since 1957 the deposit has been supplying the cement works at Railton with about 5,000 tons per annum.

Iron Cliffs (Burns, 1961). This deposit consists mainly of limonite, thus differing from the Penguin Creek and Dial Range occurrences, though it is probably physically connected with that at Penguin Creek. It is about 6 miles south-south-west of Penguin on the west side of the Dial Range. The ore contains about 45 per cent iron.

Beaconsfield (Nye 1930, Hughes, 1959b). A chromiferous iron-ore deposit occurs at Anderson's Creek, some three miles west of Beaconsfield, in central northern Tasmania. It is a thin horizontal layer overlying serpentine. The deposit contains ochreous and hard types of iron ore, including hematite and magnetite. The hematite is derived from weathering of the serpentine and the magnetite from magnetite veins in the serpentine. The ore is of low grade, containing 38 to 43 per cent iron, 12 to 17 per cent silica, 10 to 13 per cent alumina, and 5 to 8 per cent chromium oxide. Resources are marginal and consist of 1,000,000 tons of ore (inferred).

Nelson River. At the Nelson River, on the far north-west coast, a deposit of hematite crops out over a distance of 33 chains and averages 20 feet in width. Some magnetite and limonite are also present and the silica content is high. The ore averages about 50 per cent iron.

SOUTH AUSTRALIA

Jack (1922, 1953) has described 19 deposits of iron ore in South Australia. Although several have been mined for various purposes including fluxing, the most important are those in the Middleback Ranges, which have provided most of the ore for the Australian steel industry. The following table summarises the principal deposits and their reserves.

TABLE VI - South Australia

Ore Reserves (Millions of tons)

Deposit	Demonstrated	Inferred	% Fe
Middleback Ranges	165.0	18.1	60-64
	41.1	12.5	47-54
Totals	206.1	30.6	

Marginal Resources (Millions of tons)

Deposit	Indicated	Inferred	% Fe
Koolka	0.4 (above 100 ft. depth)		66
Mt. Jagged	small		65 (up to 5% TiO_2)
Total	0.4		

Latent Resources (Millions of tons)

Deposit	Possible size	Possible grade and impurities	Remarks
Middleback Area	1800	25-30%Fe, 50-60%SiO_2	jaspilite generally; includes substantial tonnages of magnetic schists indicated by drilling.
Western Areas:			
Wilgena Hill	60.0	40%Fe	jaspilite
Earea Dam	2.0.	57%Fe	"
Mt. Christie	3.0 above plain level	53%Fe, 17%SiO_2	"
West Well	2-5.0 "	45%Fe	"
Muckanippie	5-10.0 "	50%Fe	"
North Eastern Areas:			
Braemar (Razorback Ridge)	200	30%Fe	jaspilite: includes 100m tons above plain level and 37m tons per 100ft. below plain level.
Cutana	1.0	45%Fe, 24% insolubles.	limonite, hematite
Billeroo	0.4 above 100ft. depth	50%Fe, 26% "	magnetite, hematite

North Eastern Areas (Cont'd.):

Maldorky Hill	5.0	19.5 -52%Fe	jaspilite
Other N.E. Areas	50 (?)	30-40%Fe	"
Malcolm Creek	2.0 above 100ft. depth	40%Fe	"
Mt. Bessemer	0.5	53-57%Fe	hematite: now within the South Para Reservoir.
Peeralilla	small	50%Fe, 7%SiO_2	limonite
Oodlawirra	small	51%Fe, 8%SiO_2	limonite, ochre.
Donnelly's	0.3	49%Fe, 15% insolubles.	limonite, hematite.

MIDDLEBACK RANGES

The largest and most important of South Australia's iron ore deposits are those of the Middleback Ranges, in the north-east part of Eyre Peninsula (Rudd and Miles, 1953: Miles, 1954). The deposits occur in three main groups of ridges and hills disposed along a distance of nearly 40 miles, with a general meridional alignment.

There are 12 orebodies of bedded hematite, generally in synclinal structures, and in association with aluminous schists and banded hematite quartzite. The principal deposits are the Iron Monarch, Iron Knob, Iron Prince, Iron Baron, and Iron Duke. Some ore has been produced from all except the last named. South Australian ore reserves are confined to these deposits.

The ores consist essentially of hematite, and have an iron content of 63 to 68 percent, phosphorus 0.02 to 0.05 percent, and sulphur 0.05 to 0.07 percent. The manganese content is generally low, from 0.2 to 0.5 percent, but locally, in the Iron Monarch deposit, is as much as 30 percent. (Edwards, 1953.)

The Iron Knob orebody, which was the first of the deposits to be worked, strikes northerly and occupies the core of a hill. It has been quarried over a length of 1,600 feet, and has a maximum width of 200 feet. Production began in 1903, and up to 1915 over 700,000 tons of ore had been mined. Since 1915 most production in the area has come from the Iron Monarch deposit. The name "Iron Knob" is frequently used to include both Iron Knob and Iron Monarch.

The Iron Monarch orebody is roughly circular in plan, with a mean diameter slightly greater than 2,000 feet. It has been developed by benches to a depth of 350 feet below the original crest of the hill. The ore is high-grade hematite, and is in part manganiferous. Similar manganiferous ore occurs in the Cork Lease, and sporadic occurrrnces of manganese minerals are also found in the Iron Duke, Iron Prince, Iron Queen, and the Kimba Lease. Production of iron ore from the Iron Monarch during 1959 was about 2,400,000 tons, of which about 90 percent went to New South Wales for steel-making, and the balance to the Whyalla blast furnace.

The Iron Prince is at the north end of the Middleback Ranges and occupies the core of a prominent hill. It has been explored by tunnels, and opened up by a quarry at its southern end.

The Iron Baron hill is extensively covered with iron ore "float" but a tunnel through the hill exposed mainly schist, with no trace of iron ore in the centre of the hill. The ore lies chiefly on the western slope of the

hill where it occupies a synclinal "keel".

The Iron Duke orebody lies at the southern end of the Middleback Ranges and occurs chiefly in the low-dipping west limb of a north-pitching syncline. It has been explored by adit and winze.

Other less important orebodies are the Iron Duchess, Racecourse and the Iron Queen, Iron Knight, Iron Warrier and several minor occurrences at other localities in the Middleback and Ash Ranges.

The total production of iron ore from the area to the end of 1960 was 74,721,717 tons. Total ore reserves in the area at the end of 1959 were 206,100,000 tons (demonstrated) and 30,600,000 tons (inferred). Production for the year 1960 was 3,436,601 tons of which 62 percent came from the Iron Monarch deposit and 28 percent from the Iron Baron deposit. Broken Hill Pty. Co. Ltd shipped most of this ore to their east-coast steel plants but selected foundary grade ore was sent to the Whyalla blast furnaces for the production of foundary pig.

NORTH-WESTERN AREAS.

Mt. Christie area (S.A.D.M., 1960; Crawford, 1957a). Several small scattered deposits of bedded iron formations (jaspilite, quartz-hematite) crop out in the vicinity of Mt. Christie, 18 miles north of Wynbring on the Trans-Australian Railway. The known outcrops are confined to low hills between Finger-post Hill, about 1½ miles north-west of Mt. Christie and Claude Hill, about 3 miles south-east of Mt. Christie. The outcrops range from 10 to 100 feet in width over strike lengths of 100 to 2,000 feet. Numerous samples assayed gave a range of iron content ~~to~~ 45 to 60 percent with an average grade of 53 percent. From Dips are commonly steep but range from 40 to 80 degrees. The resources of the known outcrops have been estimated at 3,000,000 tons above plain level (maximum height about 100 feet).

Other groups of similar deposits in the general area are the West Well Group, 2,000,000 - 5,000,000 tons above plain level averaging about 45 percent iron, and the Muckanippie Group, 5,000,000 - 10,000,000 tons above plain level averaging about 50 percent iron.

Wilgena Hill. Large resources of bedded iron formation occur near Tarcoola, on the Trans-Australian Railway, 314 miles by rail from Port Pirie. The principal deposit is at Wilgena Hill, 8 miles east of Tarcoola. The deposit consists of one large hill 200 to 300 feet high and approximately 4,000 feet long and 1,000 feet wide. About one quarter to one third of the hill consists of jaspilite averaging about 40 percent iron. Resources have been estimated at 60,000,000 tons above plain level (S.A.D.M., 1960).

A smaller deposit containing about 2,000,000 tons of quartz-hematite averaging about 57 percent iron occurs at Earea Dam, (Crawford, 1957b) 10 miles south of the Trans-Australian Railway and about 20 miles south-east of Wilgena Hill.

NORTH-EASTERN AREAS.

Bedded iron formations comprise a succession of relatively narrow but persistent beds in the Proterozoic sediments of the Olary Province (Campana & King, 1958). Small isolated deposits of medium to high grade iron ore occur also in the Archaean crystalline basement. Several of the more conspicuous outcrops of both types have been known since the earliest mining periods. Some of these, principally the Cutana or Grant quarries, were worked

to provide iron oxide flux for the Broken Hill smelting operations.

The bedded iron formations are extensively developed in the Braemar area south of Yunta. The principal deposit is Razorback Ridge (S.A.D.M., 1960), where beds dipping up to 40 degrees aggregate about 500 feet in thickness over a length of about 12,000 feet and crop out to a height of 300 to 400 feet above plain level. Resources in this deposit are estimated at 100,000,000 tons above plain level and 35,000,000 tons per 100 foot depth below plain level. Samples from the deposit have assayed from 25 to 40 percent iron. The average grade of the deposit is considered to be about 30 percent.

The most notable of the smaller occurrences are Cutana, Billeroo, Koolka, and Maldorky Hill.

At Cutana 10 miles south of Mingery, on the Broken Hill railway small deposits of limonite with a little hematite were quarried for use as ironstone flux in the lead smelters at Broken Hill. Resources are 1,000,000 tons (indicated) with an iron content of 45 percent.

The Billeroo lodes, 34 miles west of Olary, are composed of magnetite and hematite partly replacing schist. The resources of this deposit consist of 400,000 tons of ore (indicated) containing 40–60 percent iron.

Koolka (Jack, 1922) Two small high-grade lenticular bodies of magnetic hematite crop out about 6 miles north of Bimbowrie Homestead, 29 miles north-north-west of Olary. The largest and northern outcrop has been estimated to contain about 50,000 tons above plain level and 2,700 tons per vertical foot depth, or a total of 320,000 tons above 100 feet depth. The southern outcrop contains about 94,000 tons above 100 feet depth of which 10,000 tons are contained in the outcrop. Both deposits average about 66 percent iron.

Maldorky Hill. Hematite rich beds are exposed in high hills over a strike length of several miles in an area 2 to 3 miles north-east of Maldorky Hill and 6 miles south-west of Radium Hill. The average width of the formation is 50 to 60 feet, but the amount of interbedded slate varies considerably. Chip samples taken at random across the outcrops in several localities showed an iron content ranging from 19.5 to 52.0 percent (Sprigg, 1951).

OTHER AREAS

Malcolm Creek (S.A.D.M., 1960) A sedimentary concentration of hematite in basal beds of the Proterozoic Aldgate sandstone crops out near Malcolm Creek, 4½ miles south of Williamstown, and about 3 miles south of the Mt. Bessemer deposit (see following). The bed averages about 50 feet in thickness and dips to the east at 50 degrees. The best outcrop is 1500 feet in length rising to about 100 feet above creek level. Discontinuous outcrops occur to the south over a distance of one mile. Resources are estimated at 450,000 tons above creek level averaging about 40 percent iron. A total of about 2,000,000 tons per 100 foot depth are inferred for the whole area.

Of the various small deposits worked for iron oxide for smelting operations at Port Pirie the most notable are the Mt. Bessemer, Peeralilla, Mt. Jagged, Oodlawirra, and Donnelly's Ironstone Quarries near Quorn.

At Mt. Bessemer, near Williamstown in the Mt. Lofty Ranges an estimated 40,000 tons of micaceous hematite were produced for use as an ironstone flux. The deposits are conformable with, and are replacements of, a sequence of sedimentary rocks dipping east at 40° to 50°. Resources at Mt. Bessemer consist of 500,000 tons of ore (indicated) containing 53–57 percent iron.

However, the deposit is no longer available for mining as it is within the South Para Reservoir.

The Peeralilla deposit, 7 miles north of Victor Harbour, consists of limonite, of which 8,000 to 10,000 tons were quarried for the smelters at Port Pirie. The ore averages about 50 percent iron.

At Mt. Jagged, 13 miles north of Victor Harbour, "bunches" of hematite and limonite occur in a feldspathized schist. The deposit was formerly worked to provide ore for the production of pig iron, and later for flux. However, the fact that the deposit is small and that the ore contains up to 5 percent titanium oxide, which is detrimental in smelting, has precluded its economic exploitation. Jack estimated that between 1,000 and 2,000 tons of ore had been quarried.

Oodlawirra. Before the ores from Iron Knob were used for fluxing, ferruginous flux was quarried from deposits about 60 miles north-east of Port Pirie. The deposits are of no importance for iron smelting, but appreciable quantities of ochre are available for use in the manufacture of red oxide paint. The output of the quarries up to 1903 was 18,000 tons of a minimum grade of 51 percent iron.

Donnelly's Ironstone Quarries are situated 14 miles from Quorn. The deposit contains mostly limonite with a little hematite, and averages about 49 percent iron. The ore was at one time used as a flux at the Port Pirie smelters, 17,000 tons having been quarried for this purpose. Resources consist of 300,000 tons of ore (indicated) with an iron content of 49 percent.

OTHER LOCALITIES where small amounts of iron ore have been mined include Angaston, Barossa, Burra, Birdwood, Clinton, Crystal Brook, Gladstone, Gum Creek, Huddleston, Kapunda, Kersbrook, Normanville, Pekina, Port Lincoln and Parra Wirra.

WESTERN AUSTRALIA (Connolly, 1959)

Many deposits of iron ore occur in Western Australia. The principal deposits are Yampi Sound and Koolyanobbing, which supply ore to the steel works at Port Kembla and Newcastle in New South Wales and the iron plant at Wundowie in Western Australia respectively. The following table shows the most important deposits and their resources :

TABLE VII - Western Australia

Ore Reserves (Millions of tons)

Deposit	Reserves Demonstrated	Inferred	%Fe	Iron Minerals
Yampi Sound	(74.2		64-69	Hematite
	(10.5		54	"
Koolyanobbing	69.0		62	Limonite & hematite
Bungalbin		40.9	63	
Totals	153.7	40.9		

Marginal Resources (Millions of tons)

Deposit	Indicated	Inferred	%Fe	Surface grades only unless otherwise stated
Mt. Caudan	Not known		50-60	
Mt. Mason		0.5	67	
Mt. Gibson		2.2	65	
Tallering Peak		3.5	65	(grade does not persist to depth)
Weld Range		18.8	64	
Mt. Hale		1.4	68	
Mt. Gould		15.0	67	
Mt. Goldsworthy		(25.0 -includes 8.0 above plain level	60 + 50	grade persists at depth
		(6.0		
Mt. Walton		2.5	63	
Joyner's Find		2.3	68	
Scott River		10.0	40 +	
Roy Hill		10.0	63.4	
Total		97.2		

Latent Resources (Millions of tons)

Deposit	Possible Size	Possible Grade & impurities	Remarks
Yampi Sound	55.1	54-67% Fe	Hematite
Port Hedland	17.7	50-55% Fe, 5-10% SiO_2	Oolitic beds
Mt. Rankin	1	45% Fe	Ferruginous jaspilite
Eenuin	4	34% Fe	"
Golden Valley	2.2	37% Fe	"
Day's Find	2	27-34% Fe	"
Norseman	18	32-39% Fe	"
Bremer Range	16.5	40% Fe	"
Boolygoo Range	Not known - tens of millions of tons perhaps.	40% Fe	"
Maynard Hills	61	37% Fe	"
Montagu Range	12	34% Fe	"
Gabanintha	0.2	54% Fe	Titaniferous Magnetite
Mt. Magnet area	19	36% Fe	Ferruginous jaspilite
Edjudina Range	Tens of millions of tons perhaps.	38% Fe	"
Ida Range (Excluding Mt. Mason)	7	37-42% Fe	"
Brooking Hills	23	38% Fe	"
Evanston	1	31% Fe	"
Johnston Range	13	37% Fe	"
Die Hardy Range	1.6	37% Fe	"
Riedels Find	1.4	37% Fe	"

The Yampi Sound deposits (Canavan, 1953) 160 miles north-east of Broome, are the most important in the State. The northern boundary of the Sound is a line of islands, three of which, Cockatoo, Koolan Island and Irvine Island, contain iron ore. The deposits on Cockatoo Island and Koolan Island have been prospected by costeans, adits, and drillholes. Production from the deposit on Cockatoo Island began in 1951 and to the end of 1960 4,789,220 tons averaging 63.5 percent iron had been mined. The ore is shipped by Broken Hill Pty. Co. Ltd. to the steelworks at Newcastle and Port Kembla, in New South Wales.

Banded hematite quartzite is the dominant rock of the islands, The ratio of the hematite to silica varies; the orebodies occur where the hematite is dominant.

The principal ore horizon on Koolan Island is an overturned bed of hematite dipping south at 50° and traversing the southern part of the island. The orebody is about 6,500 feet long and 100 feet wide, and rises to a mean height above high-water level of 525 feet.

On Cockatoo Island the main orebody has the same attitude as that on Koolan Island, and is probably either a continuation of the same bed

or occurs on the same horizon. It is about 7,000 feet long, ranges from 20 to 150 feet wide, and has an average height above high-water level of 260 feet.

The ore from Yampi Sound contains about 2 per cent silica, with manganese, phosphorus, and sulphur each less than 0.1 per cent. Reserves above high water mark are 84.7 million tons (demonstrated).

Koolyanobbing (Miles, 1953, Ellis 1958). These deposits are situated 35 miles north-east of Southern Cross Railway Station, and are the second largest deposits of iron ore in Western Australia. Four lenses of high grade ore occur near the highest point of the Koolyanobbing Hills, and a fifth orebody forms a prominent ridge 4 miles to the north-west and is known as Dowd's Hill. At the surface the Koolyanobbing orebodies consist predominantly of massive or banded limonite, containing varying quantities of fine-grained hematite and veinlets of coarsely crystalline micaceous (specular) hematite. The Dowd's Hill ore is dominantly massive banded hematite and micaceous hematite, with lesser amounts of limonite.

Ore reserves down to water level have been estimated at about 69,000,000 tons, containing 62 per cent iron and only minor amounts of silica, phosphorus, sulphur and manganese. Drilling shows that the deposits continue downwards as massive banded magnetite ore bodies for at least 1250 feet vertically below the outcrop. Mining of the deposits began early in 1950 to supply ore to the State charcoal iron plant at Wundowie, near Perth. Production of iron ore for 1959 was 53,629 tons.

Bungalbin-Mt. Walton. (Sofoulis, 1960). These deposits, situated about 40 miles north and north-west of Koolyanobbing, occur in jaspilitic rocks forming the backbone of an arched greenstone belt, 5 to 10 miles in width and extending from Mt. Jackson in the north-west to Ryan's Find in the south-east, a total length of approximately 100 miles.

Three high grade hematitic lenses occur near Bungalbin and a fourth about 10 miles north-west of Mt. Walton. Numerous chip samples from across the deposits show an average grade of 63 per cent irom and low silica, sulphur, phosphorus, titanium, and manganese content. Total reserves of the three orebodies at Bungalbin are 40.9 million tons (inferred). The Mt. Walton orebody contains 2.5 million tons (inferred) marginal resources. In addition to these high grade deposits the iron bearing jaspilite zone of this belt contains millions of tons of lower grade material ranging from 30 to 50 per cent iron.

The Mt. Caudan deposit, south-west of Southern Cross in the Yilgarn Goldfield, is a lode deposit consisting, at the surface, predominantly of limonite, and has an average iron content of 60.38 per cent. Silica (2.93 per cent), phosphorus and sulphur are present in minor quantities. At depth a drill hole passed through massive pyrrhotite between 603 and 707 feet and siderite between 495 and 525 feet. The ore reserves are unknown but not large.

Mt. Mason, about 150 miles north-west of Kalgoorlie, contains of a large lenticular body of hematite associated with ferruginous quartz-schist. An analysis of the ore indicated an iron content of 67 per cent and

negligible amounts of silica, phosphorus and sulphur. The ore reserves are unknown but believed to be less than 500,000 tons. Huge additional tonnages of lower grade ore are available in the Mt. Ida Range north and south of Mt. Mason. The range has a total length of approximately 15 miles. The grade of ore varies between 37 and 42 per cent.

Mt. Gibson, south of Lake Monger and west of Lake Moore, in the Yalgoo Gold Field, consists of ferruginous jaspilite containing bands and lenses of hematite. The main orebody consists of two lenses of hematite with a combined length of 1,200 feet and an average width of 50 feet and rises to a height of about 300 feet above plain level. The average iron content, based on several analyses, is 65 per cent. The marginal resources are 2,250,000 tons (inferred) above the level of the surrounding plain.

At Tallering Peak, 75 miles north-east of Geraldton, a formation of ferruginous jaspilite contains lenses of hematite, the largest of which is 550 feet long and 25 to 95 feet wide, and forms ridges rising to 550 feet above the level of the surrounding plain. The highest grade ore contains more than 68 per cent iron and the average surface grade is 64.9 per cent. The marginal resources are 3,500,000 tons (inferred) of which less than 1,000,000 tons are in the oxidised zone.

Weld Range (Wilgie Mia) (Miles, 1953). The Weld Range is in the Murchsion Gold Field, between 35 and 40 miles north-west of Cue, the nearest railhead. The Wilgie Mia Mine is well known as an ochre mine, but it also contains high-grade hematite ore assaying from 50 to 68 per cent iron. The orebodies occur solely within the banded jaspilite horizons of the Range. The principal deposit is a lens of high-grade banded hematite about 60 feet wide and 1,900 feet long. The marginal resources of the area are 18,810,000 tons (inferred) above the level of the surrounding plain.

At Mt. Hale about 100 miles north-west of Meekatharra, at least two important outcrops of iron ore occur. The summit of Mt. Hale is composed of quartz schist with bands and lenses of hematite. One of the bands of hematite crops out for a quarter of a mile and averages about 70 feet in width. A similar band crops out beneath the western summit of Mt. Hale and can be followed along the range to a point just south of the summit of Mt. Mathews. An analysis of the ore at Mt. Hale indicated an iron content of 67.77 per cent. Marginal resources are 1,380,000 tons (inferred) above plain level.

Mt. Gould, about 25 miles north of Mt. Hale, contains a lenticular lode of hematite with an average iron content of 66.98 per cent. The marginal resources above the level of the surrounding plain are 14,970,000 tons (inferred).

Mt. Goldsworthy. (Low, 1961) Several lenses of hematite, apparently discontinuous and extending in an east-west direction over a distance of approximately 100 chains, crop out near Mt. Goldsworthy in the Ellerine Hills, 70 miles east of Port Hedland. The main, or No. 1, lens is almost 2,000 feet long, averages 190 feet in width, and dips northerly at about 85 degrees. It forms the backbone of a ridge rising to an average height of about 200 feet above the general plain level. Based on all available data including 4 holes drilled during 1960, the marginal resources are 25 million tons (inferred) of greater than 60 per cent iron, of which approximately

8 million tons are above plain level. In addition a thin lens averaging about 40 feet in width, close to the footwall side of the No. 1 lens, contains 6 million tons (inferred) of ore averaging about 50 per cent iron and 32 per cent silica. Two other prominent lenses of hematite have not been sampled or drilled but cover a smaller outcrop area and are considered to be of lower grade.

At Joyner's Find, about 23 miles south-west of Wiluna, iron-rich jaspilite beds occur interbedded with greenstone schists. The deposit is marginal and contains an inferred tonnage of 2,300,000 tons with an iron content of 68 per cent.

Scott River. (de la Hunty, 1960) This deposit is located about 8½ miles north-east of Augusta and about 4 miles east of the mouth of the Scott River. The main deposit crops out over a minimum area of 2 square miles and 9 shallow drill holes have disclosed an average thickness of about 6 feet. The deposit is of the bog-iron type and as such is unsuitable for blast furnace requirements, but is suitable for "sponge-iron" processing. Although insufficient testing has been done to permit a tonnage estimate being made, it is indicated that tonnages of the order of 10,000,000 may be expected, with excellent prospects of extensions.

Latest reports (April, 1961) show that a shipment of 500 tons is being sent to Japan for metallurgical testing with a view to establishing an export trade with that country.

Roy Hill (Sofoulis, 1959) These deposits were discovered in 1959 by a member of the Western Australian Geological Survey while engaged in regional mapping. They are located about 6 miles north of Roy Hill Station (homestead) 340 miles north of Meekatharra railway station. The ore deposits consist of several patches of hematitic ore forming a lateritoid capping to a dissected undulating surface which varies in elevation from plain level to 300 feet above. A composite sample made up of equal parts by weight of several chip samples taken from down the face of washaways in the area gave a total iron content of 63.4 per cent. The marginal resources of the deposits are 10 million tons (inferred).

Titaniferous iron ores occur at Gabanintha, Mogumber, Collie and at Andover near Roebourne. The iron content of these deposits ranges from 50 to 55 per cent and titanium oxide from 10 to 28 per cent. Research on the smelting of such ore will be necessary to prove if these deposits are likely to be of economic importance in the future. Reserves are very small.

Other localities for iron in this State are shown in the table above.

NORTHERN TERRITORY

Several deposits of iron ore are known in the Northern Territory, but none of them is of economic importance at the present time. The principal deposits are those in the Roper River-Hodgsons Downs area.

Roper River-Hodgsons Downs (Cochrane & Edwards, 1960). Gently dipping Upper Proterozoic sediments in the Roper River-Hodgsons Downs area, near the Gulf of Carpentaria, include a series of pisolitic and oolitic ironstone formations. Almost all the ironstone is associated with a sedimentary group which occurs in two basins, one about 1,200 square miles in extent in the western half of the area, and a smaller one of about 300 square miles extent in the eastern half of the area.

The ironstones occur chiefly in the larger basin and near the Roper River comprise three beds from top to bottom, 3 to 12 feet, 12 to 40 feet, and 3 to 30 feet thick respectively. The upper beds are separated by about 15 feet of sandstone and shale, while the lower bed is separated from the middle bed by 40 to 70 feet of sandstone and shale. The lowest bed, which has the highest grade, ranges in iron content from 45 to 52 per cent. Southwestwards, near Hodgsons Downs, the ironstone occurs only in what appears to be a major development of the lower horizon. Although the quantity of ferruginous material in the deposits is not known the surface geology together with the areal extent of the deposits suggests that the latent resources may be of the order of hundreds of millions of tons.

Rum Jungle-Waterhouse Area. Extensive deposits of banded iron formation crop out over the whole of the area surrounding the Rum Jungle and Waterhouse Granites, about 40 miles south of Darwin. It is considered that the aggregate thickness of the iron rich bands would be about 50 feet over a potential strike length of 20 to 40 miles. The grade of the iron rich bands varies from 20 to 40 per cent iron.

Burrundie Area (Crohn, 1961). Reconnaissance surveys have shown that an area of approximately 8 miles by 4 miles in the vicinity of Maude and Francis Creeks, near Burrundie, about 100 miles south-east of Darwin, contains six groups of prominent ironstone deposits. The deposits crop out discontinuously over a length of about 15 miles in a favourable bed of Lower Proterozoic Masson Formation. The total length of ironstone outcrop is about 15,000 feet; the width ranges from 30 to 80 feet, and the minimum depth is estimated to range from 100 feet to 200 feet. Although assay results are not yet available, the highest grade of ironstone has been visually estimated at about 60 per cent. One of the largest deposits has an ironstone potential of 10,000 tons per vertical foot.

Mt. Bundey. A strongly magnetic deposit of hematite with an aggregate length of 3,000 feet and an average width of about 40 feet crops out at Mt. Bundey, 30 miles east of Manton Dam. The deposit possibly contains 600,000 tons of ore to 25 feet depth below the surrounding country; although the grade is not known it is considered to be high.

Other localities where iron deposits have been reported include Pine Creek, Adelaide River, and Finniss River.

TERRITORY OF PAPUA AND NEW GUINEA

(Nye and Fisher, 1954)

Lenses of iron ore occur in parts of the Suloga Peninsula on Woodlark Island. The ore is generally magnetite (in places oxidised to hematite) with some pyrite and in places chalcopyrite. An aerial magnetometer survey (1955) gave no suggestion of any major deposit of magnetite, either at the surface or under thin cover. Copper associated with these lenses of iron ore is probably of more economic importance than the iron.

Small bodies of iron ore crop out on, and adjacent to, Rangarere plantation, near Cape Lambert, New Britain. The ore consists of magnetite with some hematite, and carries amounts of pyrite ranging from 1 to 20 per cent locally. The ores contain from 50 to 70 per cent iron, and the deposit has been estimated to contain 81,000 tons of ore indicated, with an additional 91,000 tons inferred (Gardner, 1956).

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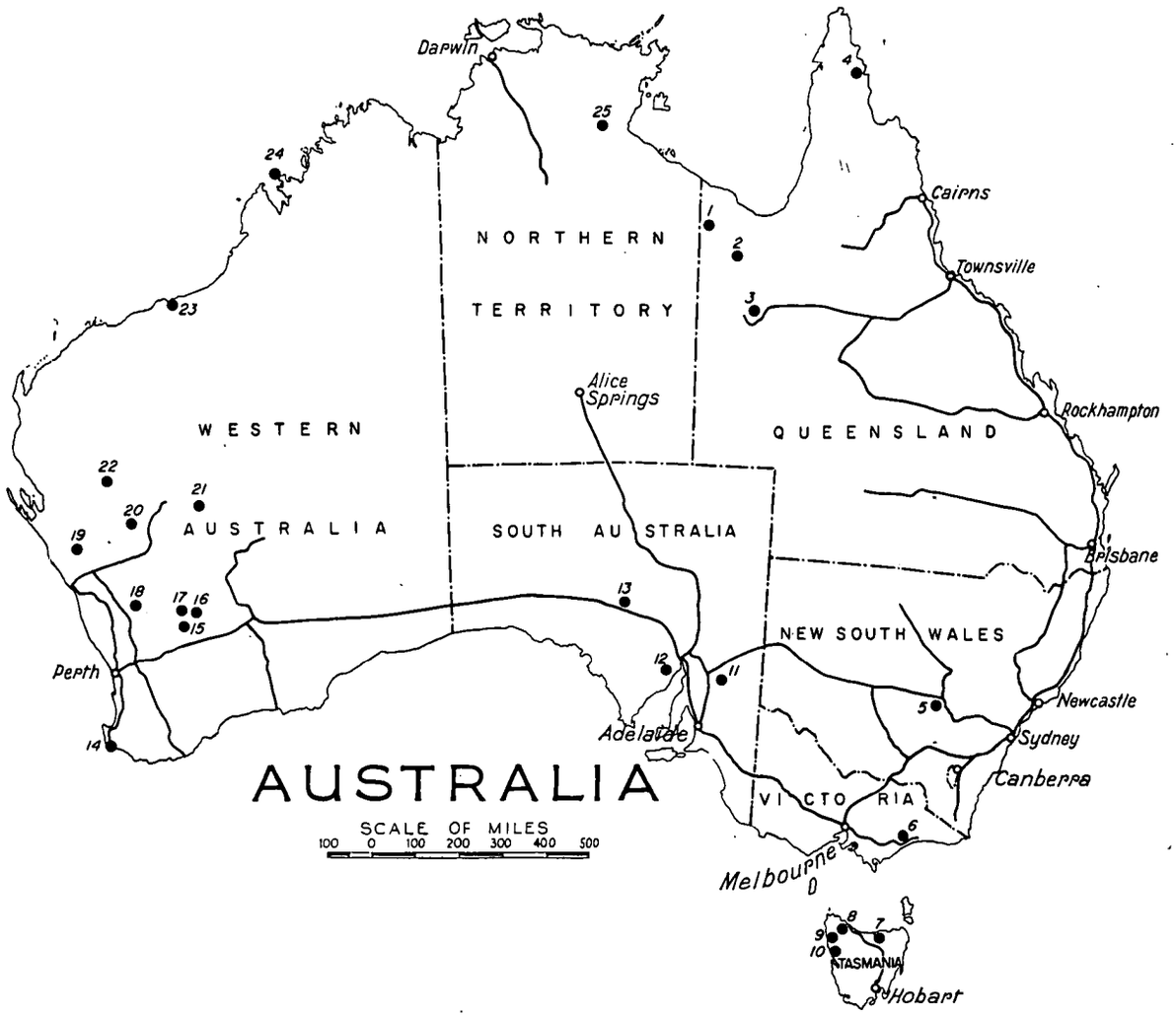
FIG. 1



PRINCIPAL LOCALITIES FOR IRON

Deposits exceeding 1,000,000 tons

1. Constance Range
2. Mt. Oxide
3. Mt. Philp
4. Iron Range
5. Cadia-Carcoar
6. Nowa Nowa
7. Beaconsfield
8. Natone-Highclere
9. Savage River-Long Plains
10. Comstock
11. Braemar
12. Middleback Ranges
13. Wilgena Hill
14. Scott River
15. Koolyanobbing
16. Mt. Walton
17. Bungalbin
18. Mt. Gibson
19. Tallering Peak
20. Wilgie Mia (Weld Range)
21. Joyner's Find
22. Mt. Hale-Mt. Gould
23. Mt. Goldsworthy
24. Yampi Sound
25. Roper River-Hodgson's Downs

Bureau of Mineral Resources, Geology and Geophysics. June 1961. To accompany Record 1961/85

Aus 3/1 EJ