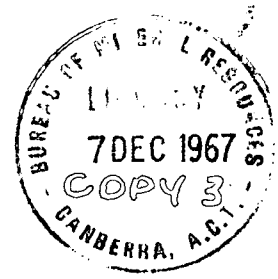
COMMONWEALTH OF AUSTRALIA



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AVAILABILITY OF PRIMARY FERTILIZER MATERIALS IN AUSTRALIA

by

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* Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia. Published with the approval of the Director.

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INTRODUCTION

Australia possesses large deposits of coal, lignite, sulphide ores, and gypsum. Of these, only sulphide ores have been used to any extent as a raw material for fertilizer manufacture, and even so, not all the available material is utilized for acid making. The discovery of a large phosphorite deposit was announced in 1966, but it is not yet certain that the deposit can be worked economically. A recently discovered saline lake deposit containing large reserves of potassium chloride is still being tested.

NATURAL GAS

Reserves of natural gas of possible economic importance have been discovered in Queensland, South Australia, Western Australia, Northern Territory, Papua, and off the Victorian coast in Bass Strait. Reliable estimates of reserves are not available for all the fields; only one well has been drilled into some of the reservoirs, and for some of the remainder, an estimate of reserves or the data to enable reserves to be calculated has not been made public. Reserves as far as they are known are listed in Table 1.

In addition to those listed, other potential sources are at Gin Gin in Western Australia and the gas associated with the oil in the Barrow Island and Pasco Island oilfields in Western Australia, and in the Kingfish and Halibut structures in Bass Strait. In Papua, the presence of substantial quantities of gas is suggested by large rates of flow during drillstem tests on wells at Puri, Iehi, Bwata, and Barikewa, and during a blowout at Kuru.

Most of the discoveries on the Australian mainland and in nearby waters have been made in the last few years, and so far, only the gas from the Roma area has been utilized. Since 1961, small quantities have been used for electricity generation at Roma, and at the Roma hospital. About 568 million cubic feet had been used by mid-1967.

Firm proposals have been announced for use of the gas from the Roma area in Queensland and from the Gidgealpa and Moomba fields in the north-east of South Australia, and Barracouta and Marlin fields in Bass Strait. Gas from Gidgealpa and Moomba is to be piped south to Adelaide, including Port Pirie and Whyalla, and will be used as a fuel, and possibly for electricity generation. The gas has a relatively high content of CO_2 - up to 21 percent at Moomba. Gas from Marlin and Barracouta will be piped to Dandenong on the outskirts of Melbourne; negotiations for sale of the gas in Sydney also have taken place. At both centres, the gas would be used as a fuel.

Gas from the Roma fields is to be piped to Brisbane, where it will be used for fertilizer manufacture, and also for heating purposes. The contract with the fertilizer company calls for the supply of 71×10^9 cubic feet of gas over a fifteen year period. The average composition of gas from the fields with largest reserves proved to date is shown in Table 2.

TABLE 1

RECOVERABLE RESERVES OF NATURAL GAS IN AUSTRALIA
(as far as known)

Field or area	Reserves (10^9 c. ft)
QUEENSLAND (a)	
Roma area (d)	127
Rolleston area	33
Gilmore	41
Others	5
Total	206
VICTORIA	
Barracouta) Marlin)	3,000 (e)
SOUTH AUSTRALIA	
Gidgealpa (b)	460 proved
Moomba (b)	340 proved
Mereenie) Palm Valley) (c)	1,500 indicated
WESTERN AUSTRALIA	
Dongara) Yardarino)	500

(a) Estimates by Queensland Department of Mines, as at 31st December, 1966.

(b) Estimates by South Australian Government, released on 22nd September, 1966.

(c) Estimate by Hetherington (1966).

(d) Aggregate of several fields, of which Bony Creek, (33,360 mm cf.) and Pickanjinnie (25,390 mm cf.) have the largest proved reserves.

(e) Total reserves are probably much larger than the announced proved reserves.

TABLE 2

COMPOSITION OF NATURAL GAS FROM ROMA FIELDS

Field	Methane percent	Ethane percent	Propane percent	Higher hydrocarbons percent
Bony Creek	84	5	2	several
Pickanjinnie Jurassic reservoir	87	5	3	some
Triassic reservoir	97	0.5	trace	trace

No firm proposals to use gas from any Australian fields except Roma for fertilizer manufacture have been announced, and further utilization of natural gas for this purpose seems unlikely for the time being.

All the Australian gas fields, excepting some of those in the Roma area, were discovered through wells drilled for oil. Large volumes of prospective sediments on land and the continental shelf have yet to be explored. As this is done further discovery of large volumes of natural gas, both associated with oil and non-associated, can be expected.

COAL

Coal is not used directly as a source of fertilizer raw materials in Australia. A few thousand tons of sulphate of ammonia is manufactured annually from by-products of coke-making.

Australia apparently possesses large reserves of black coal, but only a small part of these reserves are known well enough to be classed as measured or indicated. The amount of reserves in each of the states is shown in Table 3. Measured and indicated reserves on the main coalfields together with the production from the fields, are shown in Table 4. Many of the fields have been only partly tested, and it is likely that further work will greatly increase the measured and indicated reserves on these.

One of the major coal-bearing regions in Australia is the Sydney Basin in New South Wales; most of the total Australian production has come from the fields of this region. Another major coal-bearing region is the Bowen Basin in Queensland. In the past, production from this region has not been great, but intensive exploration has shown that the basin contains very large reserves of coal. Several new mines have been opened, or will be opened in the

near future, and production is increasing rapidly.

In addition to existing fields and those where mining has ceased, coal is known to occur in many other parts of Australia. The seams however, are either thin, of poor quality, or are too deeply buried for mining to be economic in the foreseeable future. It is unlikely that economic coal measures will be found outside the present coal basins except possibly for the Bonaparte Basin in Western Australia, where thin coal seams have been found in Upper Permian sediments.

TABLE 3

RESERVES OF BLACK COAL IN AUSTRALIA

State	Reserves (million metric tons)		
	Measured and indicated in situ	recoverable	Inferred in situ
New South Wales		2998	very large
Queensland	1684		very large
Western Australia	287	113	1623
South Australia		49	very small
Tasmania	3		137 (a)
Victoria	20		11

(a) Total of indicated and inferred reserves; some not economically recoverable at present.

TABLE 4

RESERVES AND PRODUCTION, MAIN COALFIELDS IN AUSTRALIA

Field	Measured and indicated reserves (million metric tons)	Production (thousand metric tons)	
		1962 - 1966	total to end of 1966
NEW SOUTH WALES			
Newcastle	782		
Cessnock - Maitland	183		
East Maitland	36	56,852	524,428
Singleton - Muswellbrook	914		
Tamworth - Gunnedah	41	493	
Western (a)	254	8152	100,153
Southern - South-western(b)	787	44,172	201,443
QUEENSLAND			
Collinsville	208	1663	11,619
Blair Athol	270	615	8053
Blackwater	308	nil	nil
Kianga - Moura	71	4946	5231
Callide	196	621	2994
Burrum	6	751	8287
Ipswich - Rosewood	355	9579	63,014
WESTERN AUSTRALIA			
Collie	113	4942	36,481
SOUTH AUSTRALIA			
Leigh Creek	49	8817	16,949

(a) Includes Lithgow and Kandos fields

(b) Includes Burragorang Valley, Bulli, etc. fields

LIGNITE

Lignite produced in Australia has not been used as a raw material for making fertilizer. Most of the Australian production has come from the vast deposits around Yallourn and Morwell in the Latrobe Valley, Victoria. Smaller deposits have been worked in other parts of the state. Reserves of the main deposits, and production from them are listed in Table 5. Lignite deposits in South Australia have also been tested, and their reserves are shown in Table 6. These deposits have not been worked, except for a small amount of production from Noarlunga, where total reserves are only 1.4 million tons. Lignite deposits are known to occur in other parts of Australia, but the seams are thin or deeply buried.

Total reserves in the Latrobe Valley include seams in the Loy Yang and Coolungoolun fields, east of Yallourn. These fields have not yet been exploited.

Lignite has been discovered at other places in Victoria, but further exploration is not likely to reveal major fields in addition to those listed in Table 5.

TABLE 5

RESERVES AND PRODUCTION OF LIGNITE IN VICTORIA

Field	Reserves in situ (million metric tons)		Production (thousand metric tons)	
	Measured and indicated	Inferred	1962 - 1966	Total to end of 1966
Latrobe Valley (a)	48,300	37,900	96,044.0	308,500.4
Bacchus Marsh-Altona (b)		9100	2450.1	8740.4
Anglesea	300	137	193.5	843.7
Gelliondale-Welshpool		1016	0.6	3163.6
Others	12			

(a) About 29,500 million metric tons have been proved to occur with less than 33 metres of overburden overlying the uppermost seam, but on the basis of present costs, and allowing for location of rivers and towns and engineering limitations, mining reserves are estimated at about 10,100 million tons.

(b) Mining reserves do not exceed 100 million tons.

TABLE 6

RESERVES OF MAIN LIGNITE DEPOSITS IN SOUTH AUSTRALIA

Field	In situ reserves (million metric tons)
Inkerman - Balaclava	406
Anna	64
Clinton	33
Moorlands	29
Bower	10

SULPHUR, SULPHIDE ORES, GYPSUM

The only deposits of native sulphur known in Australia and its territories are small deposits of volcanic origin on the north coast of New Britain and on Fergusson Island, Papua. Total reserves are only a few thousand tons, and no production has taken place.

Sulphuric acid is made from pyrite and base metal sulphide ores mined at several places in Australia. Reserves of gypsum are large, but the mineral has not been utilized as a source of sulphuric acid.

Sulphide Ores

Pyrite for sulphuric acid manufacture is mined at Norseman in Western Australia and Nairne in South Australia. Acid is made also from auriferous pyrite concentrate from Kalgoorlie in Western Australia, and by-product pyrite from copper mining at Mount Morgan in Queensland and Mount Lyell in Tasmania. Production and reserves at these places are shown in Table 7.

The only base metal sulphide ores from which sulphuric acid is made are those from Broken Hill in New South Wales and Read-Rosebery in Tasmania. Most of the Broken Hill (New South Wales) lead concentrates are treated at either Port Pirie (South Australia) or Cockle Creek (New South Wales). Some of the Broken Hill zinc concentrates are treated at Risdon (Tasmania) or Cockle Creek; the remainder of the zinc concentrates is exported. Read-Rosebery zinc concentrates are treated at Risdon.

Figures for the amounts of lead and zinc concentrates actually used for acid making are not available, as some of the gases are wasted to air at the plants. A total of 1,539,200 metric tons of lead concentrates and 1,640,300 tons of zinc concentrates were treated at the plants in the period 1962-66.

Gases from several base metal smelters are not utilized at present. These include Mount Isa (lead), Mount Morgan (copper), Mount Lyell (copper), and Cobar whose ore is treated at Port Kembla (copper). Zinc concentrates from Mount Isa, copper concentrates from Tennant Creek, and lead and lead-copper concentrates from Read-Rosebery are exported. Production of concentrates in the period 1962 - 1966 is shown in Table 8. Base metals are mined at other places in Australia, but the quantities are small compared to the total output of the main producing mines.

TABLE 7

PRODUCTION AND RESERVES, PYRITE USED FOR SULPHURIC ACID MANUFACTURE

Locality	Production (thousand metric tons)		Reserves (thousand metric tons)	Grade per cent
	1962-1966	Total to end of 1966		
Mount Morgan	85.7	503.0	9683 (b)	15
Mount Lyell	184.8	1,492.1	19,390 (c)	
Nairne	443.9	873.8	100,000 (approx.)	8
Kalgoorlie	105.9	179.1	881 (d)	
Norseman	200.6	827.4 (a)	1390	25

(a) Does not include 159,800 tons of selected ore produced from 1942 to 1956.

(b) Copper-gold ore; excludes marginal pyritic ore and pyrite in tailings dumps.

(c) Reserves of copper-gold ore; average pyrite content is less than 10 percent.

(d) Reserves of pyritic gold ore; includes only those orebodies whose ore is treated for sulphur recovery.

TABLE 8

SULPHUR CONTENT OF SULPHIDE MINERALS PRODUCED IN AUSTRALIA, 1962-1966

	Thousand metric tons
Lead concentrate	312.7
Lead-copper concentrate	14.4
Pyrite concentrate	452.0
Zinc concentrate	964.6
Total	1743.7

A few pyritic deposits were mined in the past for sulphuric acid raw material, but remaining reserves in most are probably small. Pyrite ore reserves in the Chester Mine, near Zeehan, were estimated in 1918 to be 2,840,000 metric tons with an average sulphur content of 20 percent.

The ore in several existing or proposed mines in addition to those already referred to, which are or will be worked on a moderate to large scale, contains important amounts of pyrite. Such mines include Savage River (iron), Bougainville (copper), Mount Cleveland (tin), Renison Bell (tin), Kambalda (nickel), and some Western Australian gold mines; the ore at the Ardlethan tin mines contains an unusually high proportion of galena and other sulphide minerals. The feasibility of recovering pyrite during treatment of Savage River ore has been investigated, but no plans for recovery of the pyrite have been announced.

Large sulphide deposits which are being tested, or have been tested and found to be sub-economic at present, include Brown's lead deposit at Rum Jungle (large but low grade), Macarthur River (reserves reported as 200 million tons averaging 4 percent Pb and 9 percent Zn), and Dugald River (reserves 1,000,000 tons averaging 1.6 percent Pb and 11.6 percent Zn). Indications of many other deposits have been reported. The discovery of additional large deposits as a result of the present intensive search for minerals in Australia seems likely.

Gypsum

Gypsum is mined from lake deposits at several places in Australia. The product is used mainly in cement and plaster of paris. Some is used for soil conditioning; the amount used annually for this purpose is not known, but is not large. None is used for acid making.

Gypsum has been mined at many places in south-eastern South Australia, central and south-western New South Wales, north-western Victoria, and the south-west and south of Western Australia. The main sources in recent years have been Stenhouse Bay, Lake Macdonnell, and Kangaroo Island, all in South Australia. Other less important sources include the Ivanhoe region in western New South Wales, Nowingie West and Yaapet in north-west Victoria, and Lake Seabrook and Lake Brown in the south-west of Western Australia.

Production from the main deposits and from each of the States, is shown in Table 9.

Total reserves of gypsum in Australia are unknown, because many deposits have never been tested. Most of the known reserves are in South Australia.

Reserves in the main Australian deposits which have been measured are shown in Table 10. Testing of other known lake deposits would add many millions of tons to the known reserves.

TABLE 9

GYPSUM PRODUCTION, AUSTRALIA

State or locality	1962-66 (thousand metric tons)	Total to end of 1966 (thousand metric tons)
New South Wales	306.8	2028.9
Victoria	586.7	1803.6
South Australia (total) including:	2713.9	8396.4
Stenhouse Bay	1116.6	4999.0
Lake Macdonnell	794.9	1432.3
Kangaroo Island	514.2	604.7
Western Australia	239.8	970.8
Australia (total)	3845.6	13,199.7

TABLE 10

RESERVES IN MAIN AUSTRALIAN GYPSUM DEPOSITS (AS FAR AS KNOWN)

Locality	Reserves (approximate) (million metric tons)	Grade (percent gypsum)
South Australia		
Lake Macdonnell	610	+94
Streaky Bay	30	+90
Moonabie	1.5	+80
Stenhouse Bay	3.6	
Salt Lake (Kangaroo Is.)	2	92
New South Wales		
Wentworth area	56	50-70(?)
Western Australia		
Lake Brown	1.1	90-95
Lake Seabrook	1	+95
Lake Cowan	1.9	90-94.5
	2.0	+95

POTASH MINERALS

Until this year, the only known indigenous raw materials for potash fertilizers were alunite and glauconite, and small uneconomic occurrences of jarosite. Only small quantites of alunite have been used for fertilizer manufacture. In 1967, it was announced that potassium chloride would be extracted from salt deposits in Lake McLeod, a salt lake north of Geraldton, Western Australia. Bitterns in the lake are estimated to contain 70 million tons of potassium chloride equivalent in solution, together with a much greater amount of sodium chloride.

Test drilling of several of the large dry salt lakes in South Australia did not disclose any potash-rich layers.

Alunite

Alunite forms surface deposits in several lakes in the south-west of Western Australia. The alunite layer is thin and impure in most of the lakes, but in Chandler Lake, Campion, the alunite-bearing mud is up to 6 metres thick. Drilling showed reserves to be 12,000,000 tons of alunite mud containing 60

percent alunite and 21 percent silica. The only production from the deposit was a total of 186,100 metric tons between 1944 and 1950.

In addition to the lake deposits, alunite occurs in several places in Western Australia as veins and nodules in weathered rocks. The veins are mostly thin, and none of the occurrences is likely to be economically workable. About 700 tons of alunite ore was obtained by selective mining and hand-picking at Kanowna, near Kalgoorlie, during the Great War, but mining ceased soon after the end of the war.

Alunite was mined from lenticular and pipe-like masses at Bulahdelah, New South Wales. A total of 71,400 metric tons of ore was obtained, with an alunite content ranging up to 89 percent. Mining ceased in 1952, and reserves are considered to be small.

Alunite forms nodules in shaly beds near Gulf St Vincent, South Australia. A few hundred tons were mined many years ago; the deposits are not regarded as having any economic interest.

Glauconite

Thick beds of glauconitic sandstone (greensand) occur north of Perth. Scattered exposures are known in a zone of variable width and about 80 kilometres long, and the sandstone has been encountered in wells south of this zone. Reserves around Dandaragan have been estimated as at least 6,000,000 tons of weathered material, 21 metres thick, containing 2.3 percent K_2O, which overlies 3,500,000 tons of fresh rock, 12 metres thick, containing 5.4 percent K_2O. Phosphatic rocks are associated with the greensand, but the best assays are only about 3 percent P_2O_5. The estimated reserves form only a small part of the known or inferred greensand occurrences.

Up to 1960, about 6500 tons of glauconite was recovered for use as a water-softening medium. No production has occurred since then.

Rocks with a high glauconite content are known to occur in several other parts of Australia, but no work aimed at testing their economic potential has been announced.

PHOSPHORITE AND APATITE

Phosphatic rock has been mined in small quantities for many years in Australia, and total recorded production to the end of 1966 was 426,790 metric tons. Of this total, about 238,000 tons was mined from small deposits in the Kapunda and Angaston districts, 65 to 70 km north-north-east and north-east of Adelaide, South Australia. The material has been used in agriculture, but because of its high content of iron and aluminium, is not suitable for superphosphate manufacture.

Deposits of guano produced by seabirds or bats have been worked at several places in Australia. Production from these sources probably does not exceed 200,000 tons; most of this came from islands in the Houtman Abrolhos, off Western Australia. Most of the deposits were small and have been worked out, or their quality is too poor for commercial use now-a-days.

Eighteen deposits of phosphate rock have been found in the Rum Jungle area, in the Northern Territory. Reserves outlined by drilling total 2.3 million tons of phosphate-rock containing 10 to 12 percent P_2O_5; the actual amount available is likely to be much greater than this. The largest known deposit contains proved and inferred reserves totalling 1.3 million tons of rock averaging 12 percent P_2O_5. Apart from the low grade of the deposits, the rock contains up to 25 percent dusty hematite, which makes it unsuitable for superphosphate manufacture. Preliminary tests suggest that the material might be usable as a ground rock fertilizer. There has been no production from the deposits, and none is planned at present.

Extensive deposits of phosphate rock were discovered in 1966, south of Duchess, a township 100 km south-west of Cloncurry. Reserves of high grade phosphate rock are said to be substantial, and reserves of lower grade rock which may be capable of beneficiation are reported to be even larger. The deposits are in a remote area, and their economic value has yet to be determined. A testing programme is now in progress.

Beds of phosphatic rock have been found at several other places in Australia, but their grade is too low to be of economic interest. The intensive search now being made for phosphate deposits could reveal large economic deposits.

Australia's main sources of supply of phosphate rock have been Christmas Island in the Indian Ocean and Nauru and Ocean Island in the south-west Pacific Ocean. Estimation of reserves on these islands is difficult because of the very uneven surface forming the floor of the phosphate rock.

Reserves of phosphate rock of all grades on Christmas Island have been estimated as 200 million tons. The lower grades need beneficiation before use as superphosphate raw material; some material is not suitable for this, but could be used, after treatment, as a phosphatic fertilizer. After Nauru, the island has been Australia's main source of phosphate rock.

Reserves on Nauru in mid-1966 were estimated as 59,722,000 wet metric tons; shipments to then amounted to 38,002,000 wet metric tons. Reserves on Ocean Island were estimated at the same time as 6,000,000 dry tons, and total shipments were 10,681,000 dry metric tons.

A survey of islands in the south-west Pacific showed that, excluding Ocean and Nauru Islands, deposits on Bellona Island, in the Solomon Islands, are the only ones suitable for exploitation. The deposits contain about

500,000 tons of grade 30.3 percent P_2O_5 and 4,500,000 tons of grade 22.3 percent P_2O_5; smaller deposits were found on other islands. No phosphate rock has been produced on any of the islands.

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