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SML 451

STREAKY BAY

PROGRESS REPORTS TO LICENCE EXPIRY/SURRENDER FOR THE PERIOD 23/7/1970 TO 22/7/1971

Submitted by
Murumba Minerals NL
1970

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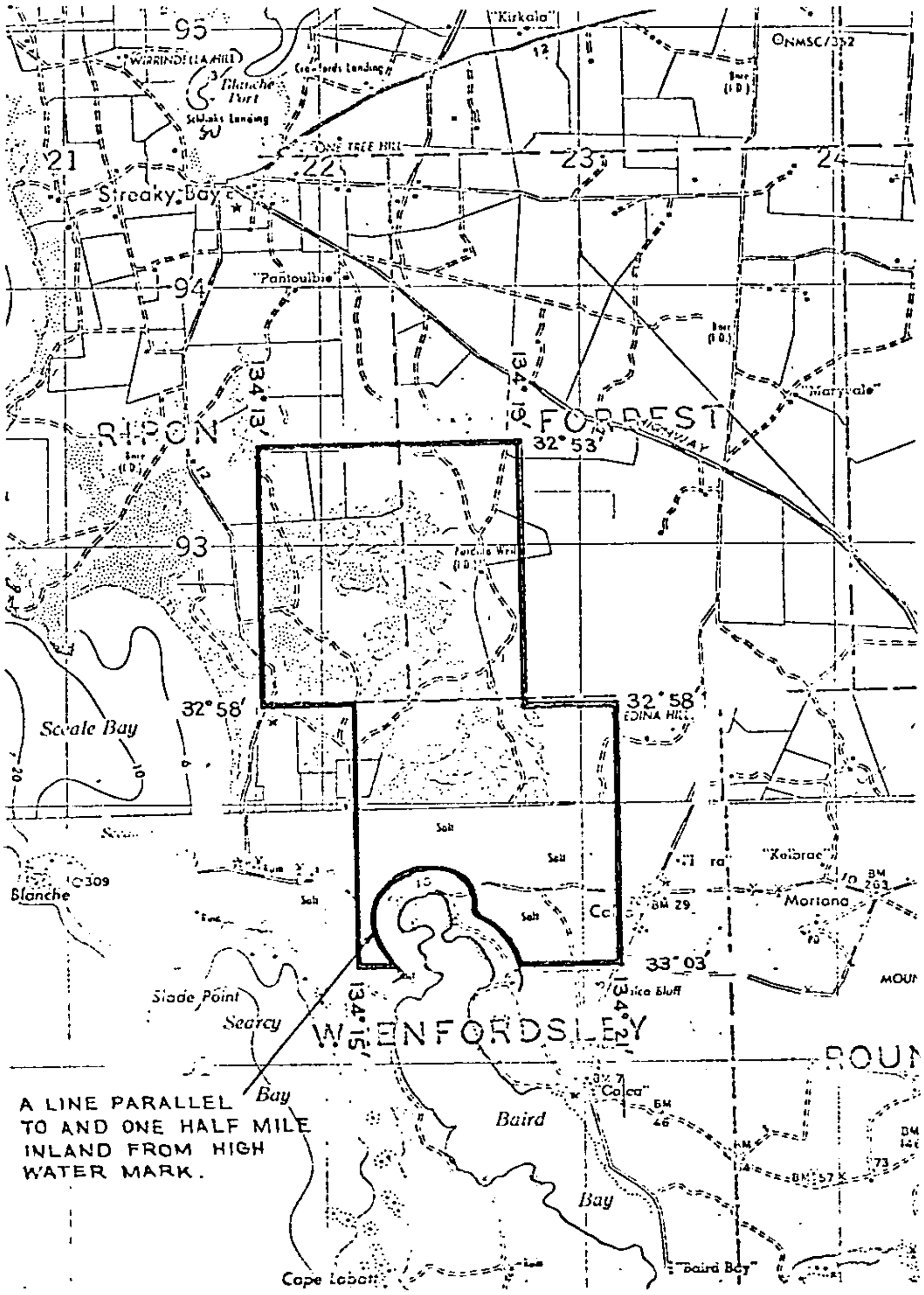

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MURUMBA MINERALS N.L.

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LOCALITY Streaky Bay area.

S.M.L. No. 451 EXPIRY DATE 22-7-71

CONTENTS ENVELOPE 1455

TENEMENT: S.M.L. 451

TENEMENT HOLDER: Murumba Minerals N.L.

STREAKY BAY GYPSUM DEPOSIT -
MINING AND TREATMENT METHODS
OVERALL ECONOMICS

by - J. Liddy, B.E.

1st September, 1970.

S.A. Report No. 7.

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SUMMARY

The methods and overall economics of the mining, transportation and treatment of the Streaky Bay Gypsum Deposit are discussed and developed.

The shortage of suitable fresh water in the Streaky Bay area may be a restriction on the production rate of washed gypsum.

The economics are such that a production rate of 400,000 tons per annum of washed gypsum will service the corresponding capital requirement at a rate of approximately 25 per cent.

analytical exploration

INTRODUCTION

Approximately 30,000,000 tons of gypsum of 90 per cent or higher purity, lies in a deposit near Streaky Bay, which is located on the Western Coast of South Australia. This report will discuss the mining, transportation and treatment of this gypsum and present the approximate relationship between rate of return on capital and production rate.

LOCATION AND NATURE OF THE GYPSUM DEPOSIT

The location of the gypsum deposit and more specifically the area for which a Special Mining Lease has been granted are shown in figures 1 and 2, Appendix A. The deposit lies 8 to 12 miles from Streaky Bay and 4 to 8 miles from Sceale Bay.

The gypsum occurs in lakes which are usually covered with water during the winter months and dry in summer. The ground water level does not drop much below 5ft (1).

S.G. Forbes (2) describes the deposit as follows :

The average depth of the deposit is approximately 6ft., with a maximum depth of 7ft. Sand, flour and crystalline forms of gypsum occur in the deposit. Average analytical results for the upper 5ft. of gypsum sand in the lake beds are gypsum 91 per cent, calcite 6 per cent, sodium chloride 2½ per cent and insolubles 3 per cent. Comparable figures for 630 million tons in the Lake MacDonnell area at present being worked, are gypsum 95 per cent, calcite 4 per cent and sodium chloride in the vicinity of 0.4 per cent. (The figure for sodium chloride does not refer to an average over the 630 million tons, but was estimated from a limited drilling programme (3)).

SALEABLE GRADES OF GYPSUM

The grade of gypsum saleable for use as a portland cement retarder or the manufacture of plaster depends largely on the nature of the impurities. An acceptable sodium chloride content for these uses is in the vicinity of 0.1 per cent. For plaster manufacture colour of the final product is also of prime importance. In general, the grade of gypsum marketable for these uses depends on tests demonstrating the production of a satisfactory final product.

For agricultural purposes there is greater tolerance of impurities as would be expected.

At present Elcor Chemical have a highly secret process operating successfully in the U.S. producing elemental sulphur from gypsum. The only information available concerning the feed at the moment is that high grade gypsum is being used, however operation of the plant is not necessarily restricted to this (4).

For all but, perhaps, agricultural use, Streaky Bay Gypsum will require washing to remove excessive sodium chloride and other impurities.

WASHING PLANT

AMDEL (5) have proposed a suitable washing plant for producing plaster grade gypsum. The suggested flow sheet is reproduced in appendix B, figure 1. The preliminary feasibility study is based on this flow sheet. For the most likely uses of the Streaky Bay Gypsum, a washing plant differing only in insignificant (at this stage) detail will be required. Further washing tests will be required at a later stage to finalize the flow sheet.

METHOD OF MINING AND TRANSPORTATION

Dredging is considered the most practical mining method because of the nature of the deposit. A suction dredge, with a cutting head is proposed. The gypsum will then be mined as a slurry. This will allow transportation over the lake surface and to washing and shipping facilities by pipeline. An added advantage of this means of mining and transportation is that it gives a continuous flow which could conceivably be fed directly to the washing plant.

Alternative mining methods, for example by dragline or bucket dredge, would involve movement of the mined gypsum over the lake surface by vehicular transport or perhaps conveyor belt. The soft nature of the lake surface rules out the use of drump trucks. A small railway could be used to transport the gypsum to the lake shore, however, this means of transport has not the desired flexibility. Transport across the lake surface by conveyor belt has all the flexibility of a pipeline but is likely to present a maintenance problem due to the number of exposed moving parts. Hovercraft would seem to provide an excellent means of transportation across the lake and possibly to shipping facilities, however for the purpose of this preliminary feasibility study, pipeline transportation is assumed.

If mining and transportation costs prove to be a major proportion of the total costs, it may be necessary to examine in greater detail the above alternatives.

SHIPPING FACILITIES

The existing shipping facility in the area is the Streaky Bay jetty. The jetty is about 1000 feet long of which about 250 feet is available for berthing. The depth of water at low tide is about 9ft 6 in, and this limits berthing to vessels of approximately 1,000 tons carrying capacity. Clearly, this facility is unsuitable for shipping gypsum except perhaps for the South Australian domestic market.

The development of a suitable deep-water shipping facility is necessary. The South Australian Department of Marine and Harbours have looked at the Streaky Bay area with a view to establishing a deep-water shipping facility. In their opinion, the only suitable areas are Baird Bay, Sceale Bay and Perforated Rocks. These are shown on the Admiralty Chart, appendix A, figure 4. Both Baird Bay and Perforated Rocks would require extensive dredging and rock cutting to open up a channel to the open sea. A facility in Sceale Bay would require no dredging but Sceale Bay is exposed to westerly weather.

The conservative opinion of the Department of Marine and Harbours, is that Sceale Bay, without the construction of some form of breakwater, may be unusable intermittently throughout the year for a total period of up to 6 months. No weather recordings have ever been taken in Sceale Bay.

For the purpose of this study Sceale Bay, because of very approximate costs estimated by the Department of Marine and Harbours for developing each site, its suitability for the disposal of the water used for washing the gypsum and its close proximity to the gypsum deposit, is considered the most promising site for the development of a deep-water facility. Before a final decision is made on the site for shipping facilities it will be necessary to have the Department of Marine and Harbours carry out a detailed study.

There is a possibility of financial assistance from the Commonwealth Government for the construction of shipping facilities if long term export contracts are won.

The conventional method of loading, that is by conveyor belt, is assumed for the purpose of this study. The gypsum, in a slurry, could be transported from shore to ship by pipeline. This would involve equipping the carrying vessels with dewatering facilities. Long term shipping contracts could possibly justify this.

UTILITIES

Sufficient land for siting of the gypsum washing plant will be available from the pastoral lessee (6).

Electricity requirements will be reasonably modest. The Streaky Bay Power requirements are at present supplied by generating facilities operated by the Streaky Bay District Council. For low gypsum production rates the council may be able to upgrade its plant to provide the necessary power. For larger gypsum production rates it may be necessary to purchase generating plant. However, if the power demand is large enough the Electricity Trust of South Australia would be interested in extending their service to Streaky Bay. When the production rate and hence power requirement has been decided, the Electricity Trust should be approached for their attitudes and suggestions. For the purpose of this preliminary study generating plant will be assumed necessary.

Freshwater will be necessary for washing the gypsum. Sceale Bay is located within 1½ miles of the Robinson Freshwater Basin. Streaky Bay obtains its water supply by pumping from an open trench in the Robinson Basin. The fresh groundwater of the Robinson Basin occurs as a thin layer resting upon and in contact with saline water (7).

Freshwater for washing gypsum, except at very low production rates, is unlikely to be available from the Robinson Basin.

The South Australian Engineering and Water Supply Department has been approached informally about likely sources of water. They are prepared to investigate the situation thoroughly on receipt of a written request outlining the water requirement.

A comprehensive hydrological study will be necessary before the final production rate can be decided. The unavailability of fresh water may preclude the production of washed gypsum at an economic rate.

For the purpose of the first look at the economics of washed gypsum production sufficient fresh ground water of suitable quality is assumed to be available from a nearby area.

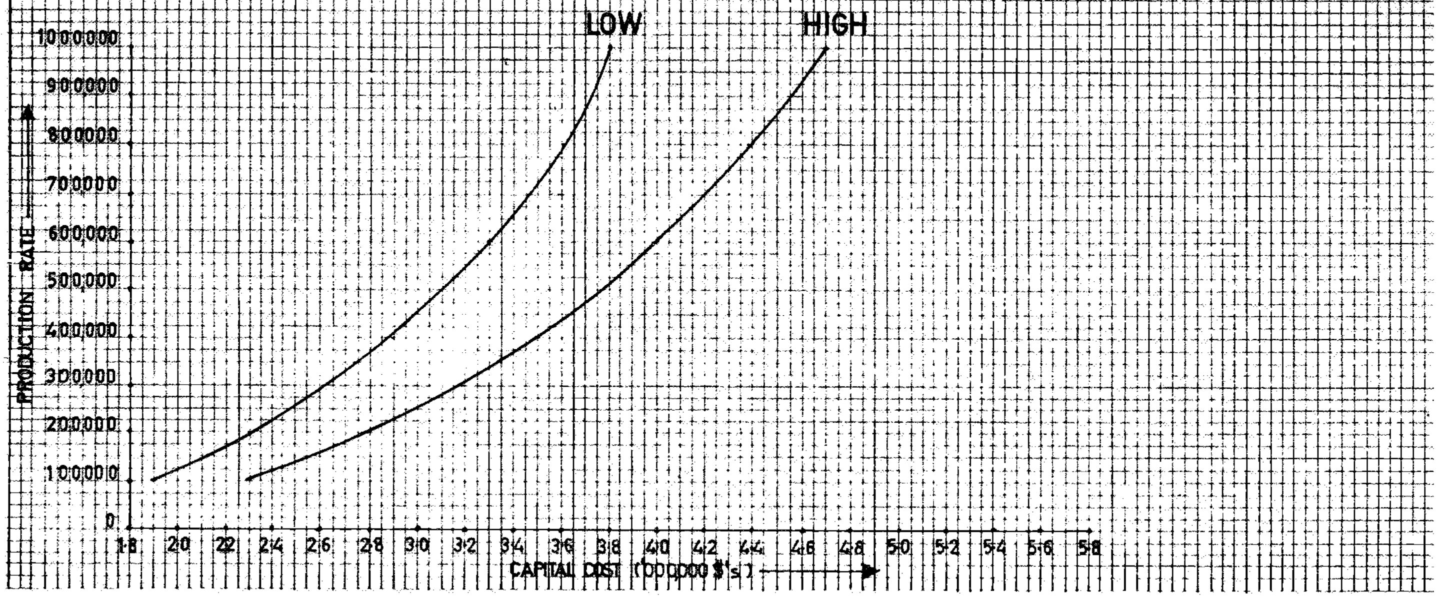
RATE OF PRODUCTION -v- RATE OF RETURN

Estimated costs and revenue for production rates of washed gypsum of 1,000,000 and 100,000 tons per annum are shown in table 1 of appendix 8. The costs have been estimated on high and low basis, which give an indication of the subjective confidence level of each estimate.

Assuming an exponential relationship between both capital and operating costs and rate of production, cost and rate of return envelopes can be constructed as shown in figures 1,2 and 3.

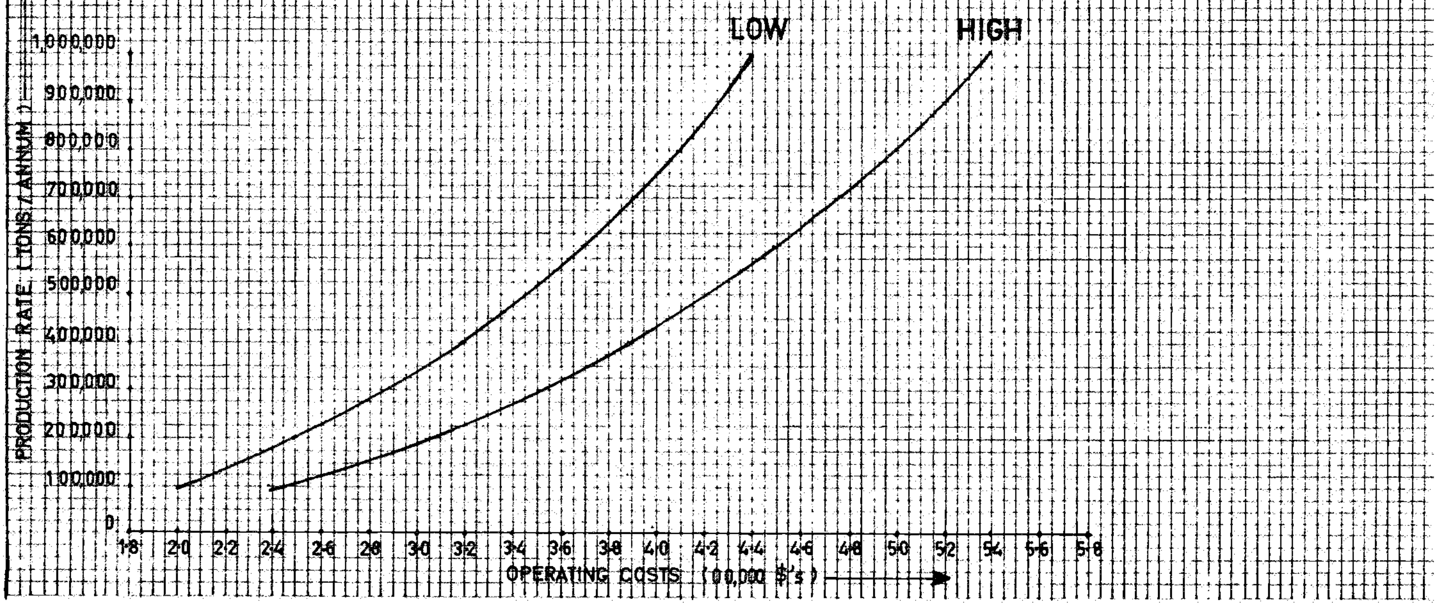
CAPITAL COST ENVELOPE

FIGURE 1.



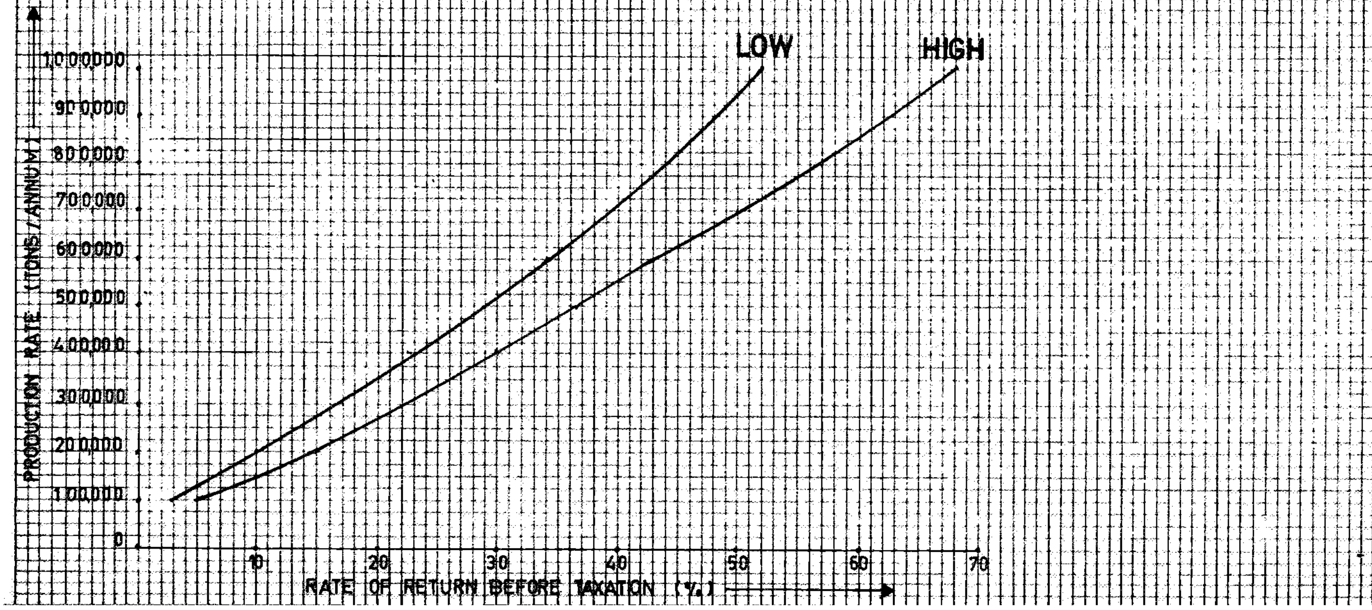
OPERATING COST ENVELOPE

FIGURE 2.



RATE OF RETURN ENVELOPE

FIGURE 3



A production rate for further investigation can be chosen from figure 3, according to the acceptable rate of return. For example, for a rate of return of 25 per cent before taxation, a production rate of approximately 400,000 tons per annum is necessary.

COSTS

By far the greatest proportion of total capital cost, about 70 per cent, is required for the provision of shipping facilities.

Mining and transportation require about 1/6th to 1/10th of the capital. Although the capital cost of mining and transportation may be able to be reduced by using different methods, operating cost will be increased and the overall economics of the project will not be greatly affected.

CONCLUSIONS

(1) The Streaky Bay Gypsum is unsuitable for all major possible uses unless it is washed. The shortage of suitable fresh water in the Streaky Bay area is likely to place a restriction on the production rate of washed gypsum. A hydrological study will be necessary to determine the likely sources of fresh water in the area.

(2) Further washing and friction factor tests will be required before design of the washing plant and slurry transportation pipeline can be completed.

(3) The provision of shipping facilities requires the major portion of capital; about 70 per cent of the total investment over the range of production rates from 1,000,000 to 100,000 tons per annum

(4) A rate of return on the capital invested of approximately 25 per cent per annum can be expected for a production rate of 400,000 tons per annum, provided sufficient fresh water can be supplied cheaply.

REFERENCES

(1) MANSFIELD, L.L. — Gypsum Deposit-Streaky Bay. AlternativeMining Methods Mining Review, 112 June 30th,1960.

(2) FORBES, B.G. — Gypsum Deposits near Streaky Bay and some other localities on Eyre Peninsula. Mining Review 110, pp.83-105, 1960.

(3) WILLINGTON, C.M. — Exploratory Drilling - Lake MacDonnell Gypsum Deposit. Mining Review 114, June 30, 1961.

(4) Engineering and Mining Jnl. July, 1968 v. 169 No.7 p.74

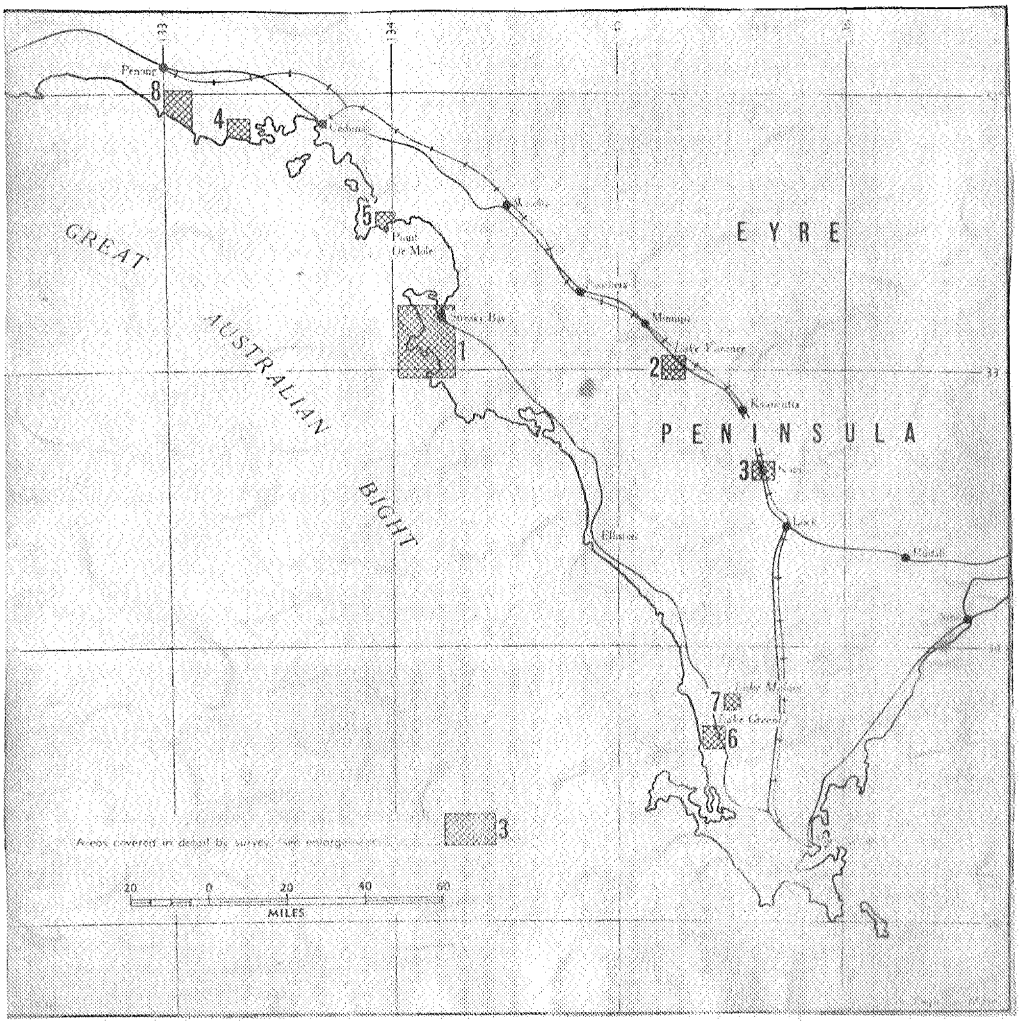
(5) ASHTON, B.E., MOFFITT, P.B. — Beneficiation of Streaky Bay Gypsum. Mining Review 112, pp.75-78, 1961.

(6) Conversation with Mr. D. Aney Town Clerk of Streaky Bay.

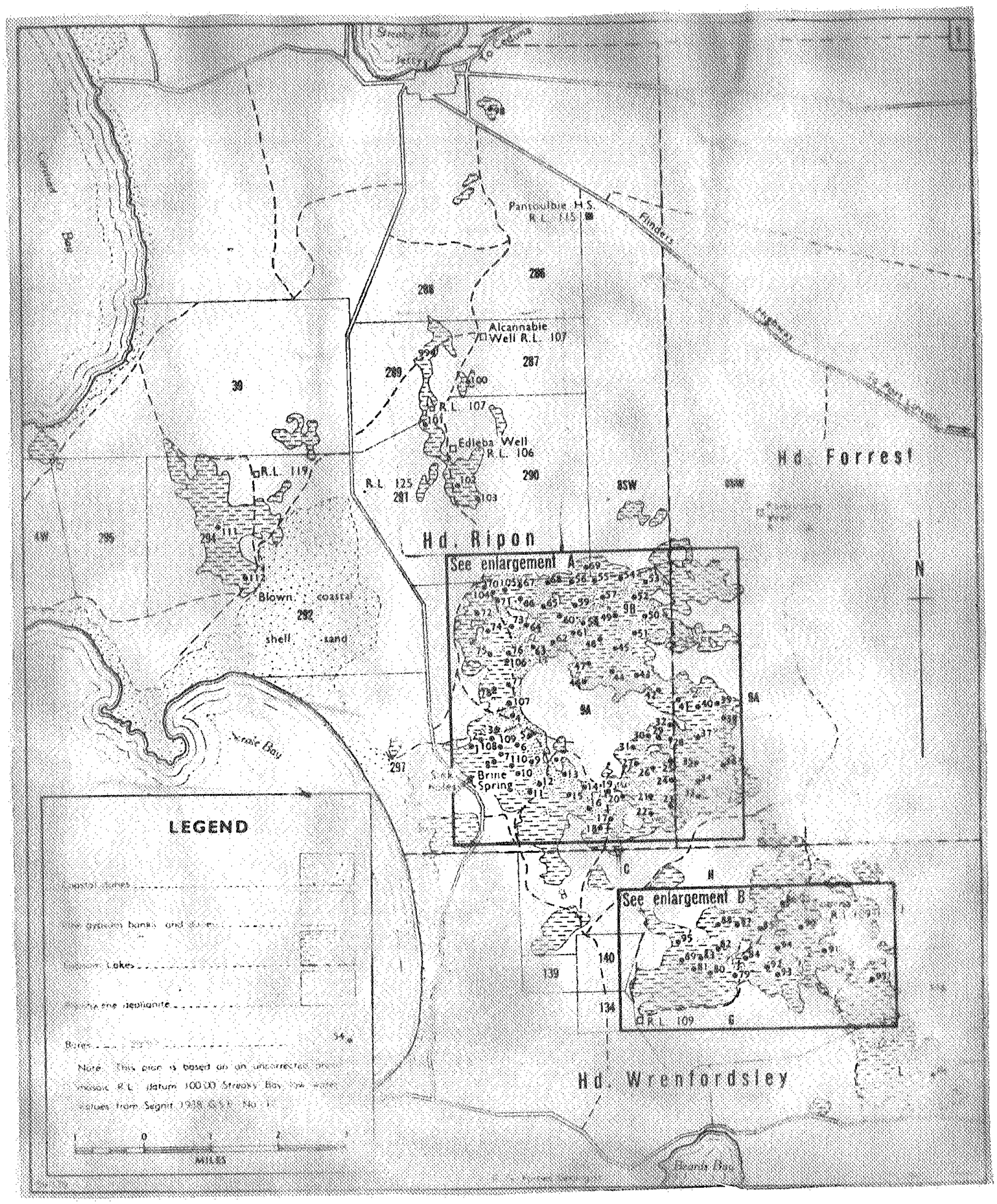
(7) SEGNIT, R.W., DRIDAN, J.R. — Geology and Development of Ground Water in the Robinson Fresh Water Basin, Eyre Peninsula. Geol. Survey S. Aust Bull. 17, 1938.

APPENDIX A

MAPS

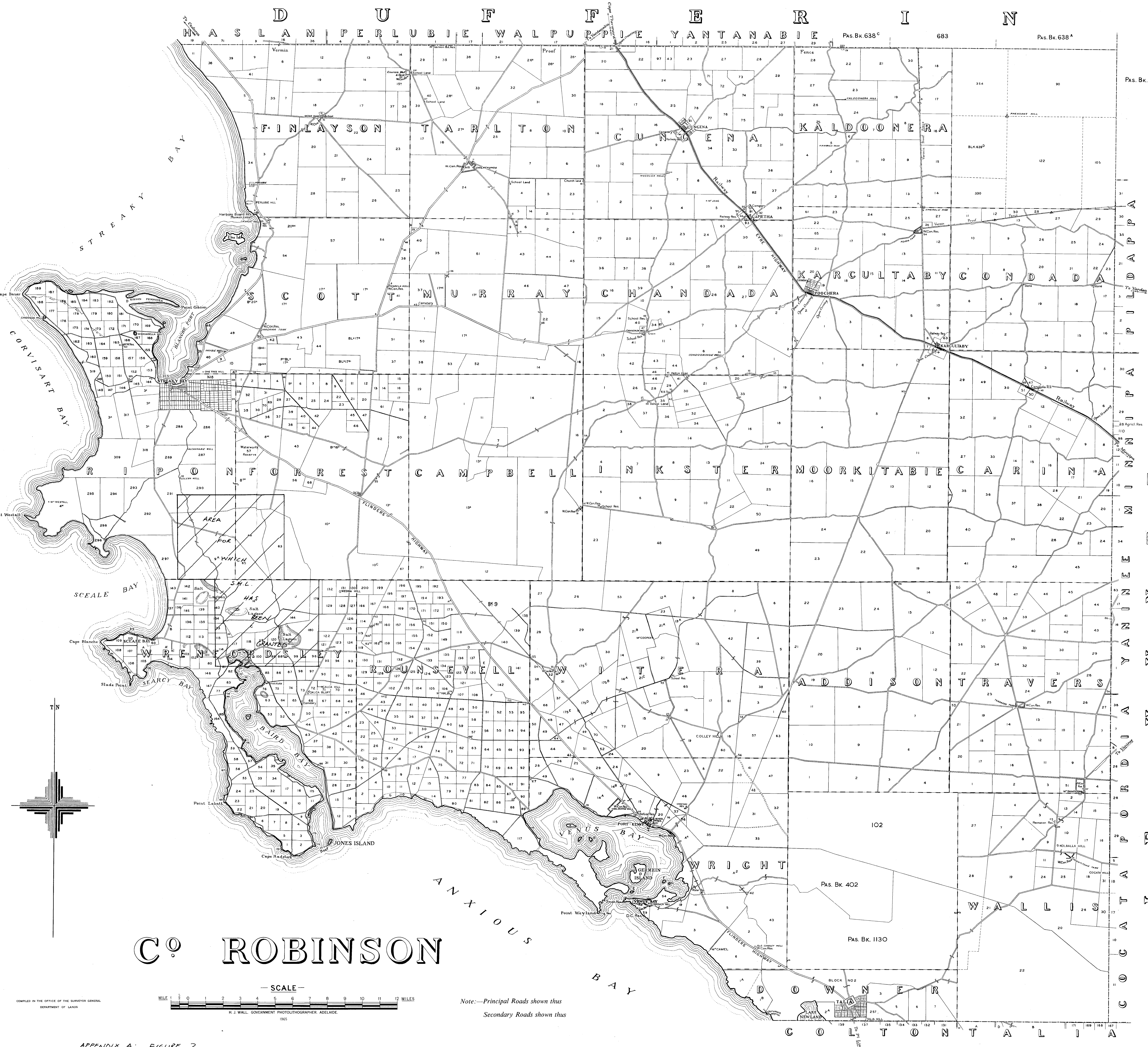


Appendix A : Figure 1 : Eyre Peninsula Gypsum Deposits : Locality Map.



Appendix A : Figure 3 : Streaky Bay Gypsum Deposit :

Geological Plan



APPENDIX A: FIGURE 2

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APPENDIX 8 - ESTIMATED COSTS AND REVENUE FOR PRODUCTION RATES OF WASHED GYPSUM OF 1,000,000 TONS PER ANNUM AND 100,000 TONS PER ANNUM.

Estimated costs and revenue for washed gypsum production rates of 1,000,000 and 100,000 tons per annum are shown in table 1. Notes on derivations of and assumptions made in estimating the individual cost figures appear below.

I. CAPITAL COSTS

1. Deep-sea shipping facilities.

The following shipping facilities were considered necessary :-

(a) for 1,000,000 tons per annum-suitable for handling vessels with a carrying capacity of 40,000 tons at a loading rate of 2,000 tons per hour.

(b) for 100,000 tons per annum - suitable for handling vessels with a carrying capacity of 10,000 tons at a loading rate of 500 tons per hour.

The estimates were made on the basis of the cost of a similar facility recently constructed at Port Giles in South Australia. A photograph of the Port Giles facility under construction is shown in the Department of Marine and Harbours, South Australia, Annual Report, 1968-69.

2. Dredge

Estimates on the basis of a budget quotation from Warman Equipment (International) Ltd., Artarmon, N.S.W.

3. <u>Slurry Pipeline</u>

(a) for 1,000,000 tons per annum an 11 inch diameter pipeline is required.

(b) for 100,000 tons per annum a 5 inch diameter pipeline is required.

The above diameters are subject to friction factor tests confirming the assumed friction factor.

Material costs were based on a budget quotation from Mephan Ferguson Pty. Ltd., outer Harbour, South Australia.

Labour costs were based on the construction of a similar pipeline on Eyre Peninsula last year by the Engineering and Water Supply Department of South Australia.

4. <u>Stage Pumping Stations</u>

Estimates based on a budget quotation from Warman Equipment (International) Ltd.

5. <u>Washing Plant</u>

The flow sheet is shown in figure 1.

(i) Feeders and Feed Hoppers:

Estimates for feeders based on a budget quotation from Warman Equipment (International) Ltd.

Estimates for feed hoppers based on a budget quotation from Rheem (Aust) Pty. Ltd., Wingfield, South Australia.

(ii) Rolls Crusher:

Estimates based on a budget quotation from Malco Industries Ltd., Croyden Park, South Australia.

(iii) Screen:

Estimates based on a budget quotation from Malco Industries Ltd.

(iv) Attrition, Agitators and Tanks:

Estimates based on budget quotations from Warman Equipment (International) Ltd, Dorr-Oliver Pty. Ltd., Crows Nest, N.S.W., Rheem (Aust) Pty. Ltd. and Lightnin Mixers Pty. Ltd., Stanmore, N.S.W.

(v) Classifiers:

Estimates based on a budget quotation from Warman Equipment (International) Ltd.

(vi) Pumps and Motors:

Estimates based on budget quotations from Warman Equipment (International) Ltd. and Joy Manufacturing Company Pty. Ltd., Mascot, N.S.W.

(vii) Cyclone:

Estimate based on budget quotation from Dorr-Oliver Pty. Ltd.

(viii) Pipes and fittings, Instrumentation &Electrical:

Estimates based on appropriate percentages of purchased equipment cost taken from 'Costs and Economics of the Australian Process Industries' * The following percentages were used:

Pipes and Fittings	20%
Instrumentation	1%
Electric Power Distribution	10%

* Buchanan R.H., and Sinclair C.G., 'Cost and Economics of the Australian Process Industries' with supplement, West Publishing Corporation Pty. Ltd.

(ix) Product and Feed Handling Equipment:

Inclined and horizontal belt conveyors will be necessary for transporting the gypsum short distances and for stacking it into heaps. An estimate has been made from personal cost information.

(x) Installation:

Installation is estimated as 20% of the purchased equipment cost. This is the combination of a percentage recommended by Buchanan and Sinclair and an additional allowance for the provision of accommodation.

6. Land and Land Development

(a) for 1,000,000 tons per annum - 40 acres of land will have to be purchased and cleared for the pipeline right-of-way, erection of washing plant, buildings and storage.

(b) for 100,000 tons per annum - a minimum of 30 acres will be required.

Land will be available at $10 to $20 per acre from the pastoral lessee according to Mr. D. Aney, Town Clerk of Streaky Bay. An additional allowance is made for levelling and clearing.

7. Motor Vehicles

Estimates have been based on the following requirements:

(a) for 1,000,000 tons per annum:
a six cylinder utility - for general use.
a four wheel drive utility - for pipeline and pumping station maintenance.
a small bulldozer - for handling the stored gypsum.

(b) for 100,000 tons per annum the four wheel drive vehicle can be used for both general use and maintenance work. The six cylinder utility is no longer needed.

A budget price for a suitable bulldozer was obtained from the S.A. Tractor Company, Enfield, South Australia.

8. Electric Power Generation and Distribution

Estimated power requirements are 6,000 H.P. for 1,000,000 tons per annum and 1,000 H.P. for 100,000 tons per annum. A budget quotation for diesel driven generators was obtained verbally from A.N.I. Aust. Pty. Ltd, Adelaide, South Australia.

9. Buildings

Requirements are an administration office, maintenance workshop and garage. Estimates have been based on a minimum standard.

10. Bore and Water Supply Piping

The location of and the possibility of using above for fresh water supply will depend on the results of a hydrological study. The rough estimates are made on the basis that the bore is within reasonable proximity of the washing plant.

11. Further Engineering and Commissioning Costs

Further work leading to the detailed design of the facilities must be carried out. Included are a hydrological survey, further washing tests and friction factor tests for accurate design of the pipeline.

Start-up costs are estimated at 10 per cent of purchased equipment costs from data collected by Buchanan and Sinclair.

12. Contingency Allowance

This is an attempt to account for changes in design which may result from further work.

II. ANNUAL OPERATING COSTS

1. Salary, wages and associated overheads

Manpower requirements are as follows :-

(a) for 1,000,000 tons per annum -

1 Manager
5 Process Operators
2 Engineer-operators for power plant.
1 Fitter
1 Electrician
2 Labourers

(b) for 100,000 tons per annum -

1 Manager
2 Process Operators
1 Engineer-operator for power plant.
1 Fitter/Electrician
2 Labourers.

The above assumes any major maintenance jobs will be done by contract labour.

2. Fuel

Diesel fuel requirements have been calculated on the basis of 0.375 lbs/BHP, hour.

3. Maintenance

Maintenance cost per annum is estimated at 5 per cent of fixed capital excluding cost of shipping facilities plus 0.5 per cent of cost of shipping facilities. These percentages are suggested by Buchanan and Sinclair.

4. Wharfage

Wharfage on gypsum is 15 cents per ton. However, when private shipping facilities are used, wharfage is generally charged at a quarter of this rate.

5. Depreciation Charges

The following depreciation rates have been used :-

Deep-sea shipping facilities	5%
Dredge	10%
Pipeline	5%
Stage pumping stations	5%
Washing Plant	10%
Motor Vehicles	10%
Electric power generators	5%
Buildings	5%
Bore and associated piping	5%

The rates are based on expected equipment life and are not necessarily the same as the depreciation rates used for taxation purposes.

6. Rates and Insurance

These are estimated at 0.5 per cent of fixed capital excluding cost of shipping facilities.

III. GROSS ANNUAL INCOME

This is based on an FOB price of $3 per ton. A separate report (see Marketing Survey by Peta Toop) will show that this is the probable selling price to South-East Asia.

APPENDIX B - TABLE 1.
SCHEDULE OF ESTIMATED COSTS.

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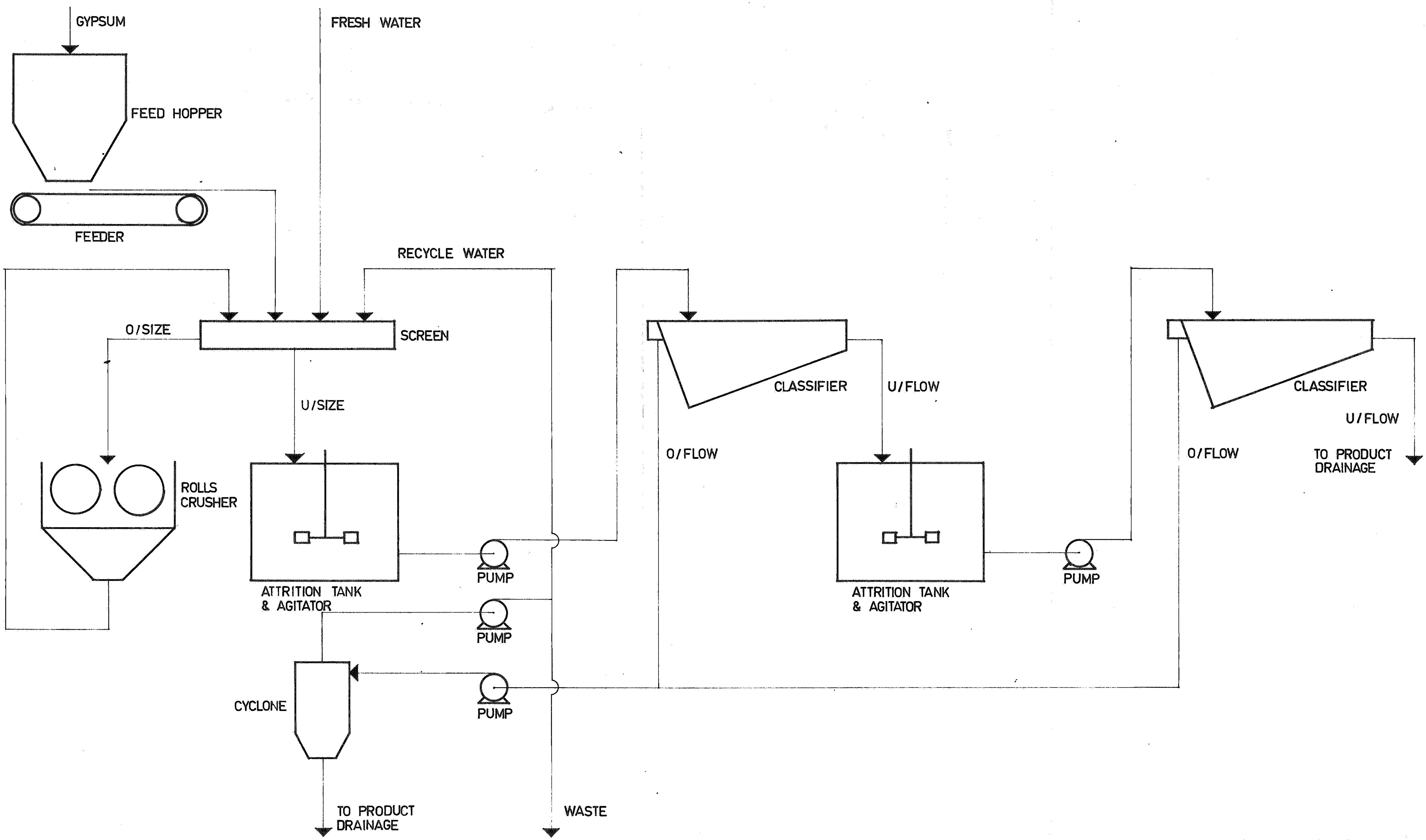
PRODUCTION RATE (TONS PER ANNUM)	100000		1000000	
	DOLLARS			
	HIGH	LOW	HIGH	LOW
1. CAPITAL COSTS				
1 Deep sea Shipping Facilities	1,800,000	1,500,000	2,800,000	2,300,000
2 Dredge	25,000	17,000	120,000	80,000
3 Slurry Pipeline 8 Miles Long (including installation)	100,000	80,000	320,000	250,000
4 Stage Pumping Stations in Slurry Pipeline	85,000	65,000	400,000	300,000
5 Washing Plant :				
1 Feeders & Feed Hoppers	2,000	1,700	10,000	7,000
2 Rolls Crusher	2,900	2,600	13,500	12,000
3 Screen	750	650	3,500	3,000
4 Attrition Agitators & Tanks	7,000	5,000	25,000	18,000
5 Classifiers	4,500	3,500	25,000	20,000
6 Pumps & Motors	10,000	8,500	45,000	40,000
7 Cyclone	800	600	2,500	2,000
8 Pipes & Fittings, Instrumentation, Electrical	8,700	7,000	39,000	32,000
9 Product & Feed Handling Equipment	1,100	800	8,000	6,000
10 Installation	6,000	4,500	25,000	20,000
6 Land & Land Development (including pipeline right of way)	1,200	900	1,800	1,400
7 Motor Vehicles	20,000	18,000	22,000	20,000
8 Electric Power Generation & Distribution	159,000	132,000	740,000	580,000
9 Buildings	30,000	25,000	40,000	33,000
10 Bore & Water Supply Piping	3,000	2,000	15,000	10,000
11 Further Engineering & Commissioning Costs	6,000	4,500	25,000	20,000
12 Contingency Allowance	3,000	2,300	12,500	10,000
TOTAL	2,280,000	1,880,000	4,700,000	3,770,000
2. ANNUAL OPERATING COSTS				
1 Salary, Wages & Associated Overheads	70,000	60,000	120,000	100,000
2 Fuel	500	400	2,500	2,000
3 Maintenance	32,000	26,000	107,000	83,000
4 Wharfage	3,750	3,750	37,500	37,500
5 Depreciation	120,000	97,000	250,000	200,000
6 Rates & Insurance	2,300	1,900	9,300	7,200
7 Contingency Allowance (3 per cent)	7,000	6,000	16,000	14,000
TOTAL	240,000	200,000	540,000	440,000
3. GROSS ANNUAL INCOME (BASED ON AN F.O.B. PRICE OF $3 PER TON)	300,000	300,000	3,000,000	3,000,000
4. NET ANNUAL INCOME BEFORE TAX	60,000	100,000	2,460,000	2,560,000
5. RATE OF RETURN BEFORE TAX (PERCENT PER ANNUM)	3	5	52	68

APPENDIX B - FIGURE 1
WASHING PLANT FLOWSHEET



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THE MARKET FOR GYPSUM

Anexa Report No. 80 by
September, 1970

P. Toop

12-11-70
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analytical exploration

GYPSUM : TABLE OF CONTENTS

ABSTRACT

Gypsum's largest use is in calcined gypsum or plaster of paris, a fire-resistant construction material. The level of demand for this product is dependent upon activity in housing construction in particular.

Gypsum is an essential element in portland cement, another major application, and is also used as a soil conditioner and fertilizer.

The market for gypsum is adequately supplied in Australia, which has an abundance of high grade reserves.

Australian gypsum production has increased steadily during the 1960's to supply not only the "domestic market" but also New Zealand and various S.E. Asian countries; in the latter, gypsum appears to be mainly used in portland cement, in contrast to the consumption pattern of the U.S.A. and Australia, where gypsum is used in plaster of paris: portland cement in the ratio of approximately 2:1.

So many regions throughout the world are endowed with gypsum deposits that consumer nations are able to obtain the major part of their requirements from local sources. Gypsum is a low-value product, for which transport costs must be minimized.

The North American and European gypsum markets are adequately

supplied by their own regions, which have large reserves.

The African market appears to be small. Australia has exported small quantities totalling 16,500 tons to Kenya and Tanzania in 1968.

New Zealand imports nearly all its requirements of 100,000 tons p.a. from Australia, but the market has probably been captured by the present major Australian exporter.

S.E. Asia is the most likely export market for Australian gypsum producers, which currently supply nearly half the total estimated export market of at least 300,000 tons p.a. However, one Australian exporter plans to increase his export market to 300,000 tons after 1971, so that this market may be closed to another Australian producer. Competition for the market could also come from within, as India has large undeveloped reserves, and Thailand has surplus production for export to Malaysia.

INTRODUCTION

Gypsum is the generic name for the mineral hydrous calcium sulphate ($CaSO_4 \cdot 2H_2O$) variously known as selenite, a transparent cleavable form, usually colourless; satin spar, a fibrous form with a silky lustre; alabaster, a massive fine grained variety, usually white and translucent; rock gypsum, a compact, granular form, coarser grained than alabaster; and gypsite, a soft, earthy impure form, noncoherent to slightly consolidated.

In its pure state, gypsum is composed of 32.5% lime (CaO), 46.6% sulphur trioxide (SO_3), and 20.9% water.

CONSUMPTION

Consumption of gypsum is basically a function of the level of activity in building and construction, as the two major uses of gypsum are as plaster of paris and in the manufacture of cement. Production and consumption of gypsum by individual countries tends to fluctuate slightly from year to year, though there is an average worldwide tendency for production to increase.

In the U.S., "As housing goes, so goes gypsum. The record shows that historically sales of gypsum products closely parallel housing starts. Every housing slump has eaten deeply into the profits of gypsum producers." [1.] In both the U.S.A. and Australia, slightly less than ⅔ of total gypsum consumption is accounted for by plaster and plaster products; this sector of the gypsum industry appears to be more sensitive to changes, especially in private home construction, than the 30% of gypsum production consumed in cement manufacture, which has shown a steady increase during the 1960's in both the U.S.A. and Australia.

In Australia, between 1964/65 and 1967/68, overall consumption of gypsum, in portland cement production, increased by 8.38%, at an average annual rate of 2.73%,

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1. ROCK PRODUCTS, December 1967, v. 70, No. 12, p.16

whilst the amount of gypsum used overall in plaster of paris production decreased by 1.71%, at an average annual rate of -1.51%. Similarly, in the U.S.A., between 1965 and 1968, use of gypsum in portland cement retarder increased overall by 9.10%, at an average annual rate of 3.18%, whereas gypsum used in building plasters, excluding prefabricated products and industrial uses of plaster of paris, decreased overall by 27.2%, at an average annual rate of -9.95%.

USES

1. Raw Gypsum

Portland Cement

The largest use of raw gypsum is in the manufacture of Portland cement. From 3% to a maximum of 6% by weight of gypsum or anhydrite is added to cement clinker before it is ground. This quantity of gypsum retards the setting and is an essential element of this important construction material.

According to the chemist of Southern Portland Cement Ltd., Berrima, N.S.W., the Australian Standard for cement manufacture states that the gypsum added to cement should contain not less than 30% sulphur trioxide, SO_3, which is equivalent to approximately 65% gypsum. [1] Southern Portland Cement would use no less than 80-85% gypsum, and do in fact use high grade 98% calcium sulphate supplied by Australian Plaster Industries from Thevenard, South Australia.

The N.S.W. Geological Survey's booklet on gypsum says that "the minimum grade of gypsum acceptable should contain 36% sulphur trioxide (equivalent to 77.39% $Ca\ SO_4-2H_2O$) but manufacturers prefer higher grades for

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1. Rule-of-thumb used by Southern Portland's chemist is SO_3 content x 2.15 = $CaSO_4-2H_2O$.

economic reasons." [2]

According to Southern Portland Cement, the main adulterant to be avoided is silica; a minimum salt content of 0.1-0.2% is an additional requirement. The Chemist also sees that "phosphates, alkalis, or organic matter are deleterious to cement manufacture." [3]

"The variety or grain size used is not critical but crystals, averaging from ¼-inch to ½-inch in length are the optimum size." [4] According to Southern Portland, the size of the gypsum material is not very important, as this is ground with the cement clinker, though less than 1-inch is desirable.

Agricultural Gypsum

Ground gypsum, known as land plaster or agricultural gypsum, is used as a fertilizer for soils deficient

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2. Geological Survey of N.S.W., The Mineral Industry of N.S.W. Series, No. 20, Gypsum, compiled by D.W. Wynn, Nov. '65, p.4.
3. Wynn, op. cit. p.5.
4. ibid.

in elemental sulphur,[1] and as a soil conditioner to counteract alkali in soils.[2]

In Australia, agricultural gypsum has been used to advantage, particularly in irrigation areas, as it improves the texture of heavy clayey soil, increasing the friability so that a greater penetration of irrigation water or rain is possible.

Gypsum is also used in the treatment of "salt patches" in irrigation areas, as the calcium from the gypsum replaces the sodium in the crystal lattice of the clay.

"As finely divided gypsum is more readily available to the soil, gypsite (kopi) or seed gypsum are the two forms most commonly used in agriculture. Coarse grained varieties of gypsum would have to be crushed before application." [3]

Agricultural gypsum usage would appear to fluctuate from year to year; for example, production of agricultural gypsum in Victoria in 1967 is estimated to have been about 140,000 tons, but, as a result of drought

1. Journal of the Australian Institute of Agricultural Science, v. 33, No. 2, June 1967, pp 127-129, J.K. Powrie, "Fragmented Rock Gypsum as a Sulphur Fertilizer".
2. Non-Metallic Minerals - A Review, Commonwealth Secretariat, Commodities Division, 1967, p.66.
3. Wynn, op. cit., p.4.

conditions in 1968, production of agricultural gypsum dropped to an estimated 8,000 tons. [1]

Australian consumption of agricultural gypsum could have approximated about 125,000 tons p.a. in the late 1960's. According to a mineral economist at the B.M.R., natural gypsum suffers little or no competition from artificial gypsum, which is a byproduct of phosphoric acid production, located at Yarraville, Victoria.

D. Danson of Ivanhoe, N.S.W., is reported to have sold gypsum to local farmers at $4.50 per ton in 1968, whereas a representative of Australian Gypsum Industries quoted the price of agricultural gypsum at $6.30 per ton, ex-mine, Ivanhoe, N.S.W., in 1970. It is unlikely that this discrepancy was due to price increases over time.

<u>Source of Sulphur</u>

The possibility of using gypsum or anhydrite as a raw material from which to manufacture sulphuric acid or sulphur attracted much attention in the U.S.A., particularly in 1967-68, because of the technical and commercial success achieved in Europe, [2] and the then high prices of elemental sulphur at around $50 per long ton. [3] Elcor Chemical Corp. and Power Gas Corp.

1. <u>Australian Mineral Industry 1968 Review</u>, B.M.R., p.127
2. <u>Mineral Facts and Problems</u>, USBM, Bulletin 630, p.416
3. <u>Chemical and Engineering News</u>, v.46, No. 24, June 3, 1968, "Sulphur-from-Gypsum processes to help phosphoric acid makers", p.13.

of America completed new plants in the U.S.A. in 1968 to produce sulphur and ammonium sulphate fertilizer respectively from gypsum.[1]

In Australia, which is particularly deficient in deposits of elemental sulphur, the increasing demand for and higher price of imports of elemental sulphur in 1968, made processes for extracting the sulphur content of gypsum appear more feasible from a cost point of view. As the process would have required considerable amounts of cheap fuel, Central Pacific Minerals N.L. took up prospective gypsum areas in the N.T., close to the large deposits of natural gas which had been established by the Magellan and Exoil group of Companies.[2] These gypsum areas have since been surrendered by Central Pacific.

Sulphur prices weakened considerably during late 1969, and the selling price was reported to be as low as U.S.$12 per ton in mid-1970 in Canada,[3] so that sulphur-from-gypsum processes which could produce elemental sulphur for U.S.$35-45 per ton are now costly by comparison.

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1. Minerals Yearbook 1968, vol. I-II, pp. 559-560, USBM
2. The Bulletin, April 13, 1968
3. Mining Journal, v.275, No. 7039, July 17, 1970 "Economic Anti-Pollution Recovery", p.43.

Miscellaneous Uses

Gypsum was used in the smelting of nickeliferous silicate ores in New Caledonia, but this process has now been replaced by smelting with a coke breeze in modern electric furnaces.[1]

Limited quantities of gypsum are used as a base for paint, as a filler in cotton and paper finishing industries, in the manufacture of chalks and crayons, in the purification of turbid water, and in the "burtonizing" of brewery water. Australian Gypsum Industries priced brewer's gypsum, which has been very well graded, at $38 per ton, whilst the price per ton of ordinary crushed gypsum was quoted at $19 per ton.

2. Calcined Gypsum

Plaster

According to the degree and method of calcining employed, different types of plaster for different uses can be produced. The most common type of plaster is the hemihydrate or "plaster of Paris" ($(CaSO_4)_2 \cdot H_2O$) which is produced at temperatures between 150° and 190°C.

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1. USBM. Bull. 630, op. cit., p.612.

With increasing temperature, more of the water of crystallisation is driven off giving a mixture of hemihydrate and anhydrite until finally, at between 500° - 1,000°C, an anhydrous plaster consisting of insoluble anhydrite, "dead-burned gypsum", is produced.

When mixed with water, all plasters revert to gypsum, but the setting time increases with the temperature used in calcination.[1.]

Gypsum's real importance has been as a fire-resistant construction material, if fire attacks a gypsum plaster wall, formation of steam from chemically combined water will consume heat and retard combustion and the remaining mineral portion of the wall is non-flammable.[2.]

"The Australian gypsum industry differs from its counterparts in Europe and America because of the local importance of fibrous plaster, which is an interior lining peculiar to Australasia. Fibrous plaster is gypsum reinforced with fibre (usually sisal) and cast into sheets and ornamental forms. A gypsum product which can be used in much the same way as fibrous plaster but which is an introduction from overseas is gypsum board,

1. Wynn, op. cit., p.5.
2. USBM, Bulletin 630, op. cit., p.411.

a sandwich of cast gypsum between two sheets of a special paper." [1.] Both C.S.R. and Australian Gypsum Industries supply plaster to the fibrous plaster trade, as well as marketing plasterboard, under the brands of Gyprock and Victor Board respectively. Calcined gypsum is also used in the manufacture of acoustic tiles, in insulating boards and in light-weight gypsum blocks.

Calcined gypsum is used for the manufacture of moulds, especially for pottery, sanitary ware, electrical porcelain industries. "A fired permeable ceramic mold material has been developed that can be used in place of molds made from plaster of Paris and gypsum." [2.] The extent of substitution, if any, is not known. Small amounts of calcined gypsum are used in mixtures as insulating filler between walls of safes and filing cabinets and coverings for pipes and boilers.

"Calcined gypsum is used in surgery for orthopedic bandages and for plaster casts....Calcined gypsum with special retardation is employed in making casts of dental work." [3.]

In Australia, Investo Manufacturing Co. P.L., a subsidiary of Australian Gypsum Industries, specializes

1. Eighth Commonwealth Mining and Metallurgical Congress, Pub's Vol. 3, "The Australian Mining, Metallurgical and Mineral Industry", ed. by J.T. Woodcock, 1965, pp. 386-87.
2. American Ceramic Society Bulletin, v.45 pt. 2, No. 11, No. 1966, pp.1014-1016. "A Permeable Ceramic Mold Material."
3. U.S.B.M. Bull. 630, op. cit. p.416.

in the production of special plasters and other products required particularly for the dental industry. A spokesman for the company reported that most of its products were imported from the U.K., and quoted English pottery plaster or art plaster at 6-10¢ per lb., depending on the size of the packs.

"For gypsum plasters there are no real substitutes, lime and hydraulic cement plasters being complementary rather than competitive. Though wood, natural fibres, aluminium and glass can be used instead of gypsum lath, (fibrous plaster sheeting), and wallboard in interior finishing, such materials would be chosen for reasons of art or prestige, and not of economy."[1.] Gypsum has an intrinsic advantage over some of these competitors in its fire-resistant and retardant properties.

In the U.S.A., "The growing factory-built concepts for both housing and business room modules and complete homes has turned largely to non-gypsum materials at present for finishing purposes, and if this industry increases its share of the construction market it may restrain demand increases for gypsum products."[2.]

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1. Non-Metallic Minerals - A Review, op. cit., p.66
2. U.S.B.M. Bull. 630, op. cit., p.420.

Australian Production and Exports

A large proportion of Australian gypsum production is controlled by two major plaster manufacturers, Australian Gypsum Industries Ltd. of Melbourne, estimated to account for more than 50% of total annual production, and the Colonial Sugar Refining Co. Ltd. of Sydney, estimated to account for more than 30% of annual production.[1]

Australian Gypsum Industries Ltd. operates through its subsidiaries, e.g. Waratah Gypsum P.L., Murray Valley Gypsum P.L., Griffith Gypsum Mines N.L., at Kowulka and Stenhouse Bay, S.A., Central Darling District, N.S.W., and Yaapeet, Vic. C.S.R., through subsidiaries, e.g. Brunswick Plaster Mills P.L. operates at Kangaroo Island and Lake MacDonnell, S.A., Hay and Hillston Mining Divisions, N.S.W., Nowingi, Vic., and Yellowdine, W.A.

According to A.M.I. Annual Review 1968, only a small proportion of gypsum production is sold on the open market, as the bulk of gypsum produced domestically is either controlled by consuming interests or is sold by producers under contract; hence, information on prices is limited. The average ex-mine values per ton of gypsum in 1968, as recorded by the

1. A.M.I. Annual Review 1962, a BMR mineral economist believes that these proportions have been maintained.

State Mines Departments, were : N.S.W. $4.66; Vic. $1.46; S.A. $2.47; W.A. $2.91.[1.]

The steady growth of Australian production of gypsum has been related both to expanding domestic requirements, particularly in the production of portland cement, and to cater for the growing export market. (See tables I and II).

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1. A.M.I. Annual Review, 1968, op. cit., p. 129.

TABLE I

GYPSUM: SALIENT STATISTICS 1962-68 (tons)

	1962	1963	1964	1965	1966	1967	1968
Production	630,910	687,319	786,503	833,521	801,552	914,084	845,845
Exports	139,407	143,773	205,501	138,668	231,510	207,674	247,078
Apparent Consumption	491,503	543,546	581,002	694,853	570,012	706,410	598,669

(SOURCE: AUSTRALIAN MINERAL INDUSTRY, REVIEWS 1964 and 1968)

TABLE II

EXPORTS OF GYPSUM 1962-68 (tons)

	1962	1963	1964	1965	1966	1967	1968
Formosa	-	-	6,360	-	46,820	62,007	38,515
Indonesia	-	-	-	5,000	5,500	13,801	10,389
Japan	22,237	42,793	19,030	-	-	-	-
Malaysia	17,197	14,340	30,204	19,011	16,411	4,954	85
New Zealand	79,081	76,955	104,308	100,601	107,982	86,334	84,317
Phillipines	11,000	8,235	29,685	11,553	38,472	26,182	52,317
Others	9,892	1,450	15,914	2,503	16,325	14,396	61,455
Total:	139,407	143,773	205,501	138,688	231,510	207,674	247,078

The major exporter is probably Australian Gypsum Industries. At its 1967 Annual General Meeting, the Company reported that "export sales from our Thevenard and Stenhouse Bay deposits to S.E. Asian countries and New Zealand were the highest year recorded, aggregating 239,922 tons. Since the closure of the Suez Canal it has proved more difficult to secure steamers to transport gypsum from Thevenard to these Eastern countries, mainly as we are limited to the use of 10,000 ton vessels because of the limitation in the depth of the sea channel and berth at Port Thevenard." At the 1968 Annual General Meeting, Australian Gypsum Industries noted, with respect to its gypsum exports, that securing reasonable shipping freights on overseas cargoes was still a problem.

Australia's largest export market is New Zealand, which has no domestic gypsum production, and imports almost all her needs from Australia. It is highly probable that nearly the total New Zealand market is supplied by Australian Gypsum Industries, which exports gypsum to an associated company, Victor Plasters Ltd., that operates plaster mills in Auckland and Christchurch.

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GYPSUM EXPORT PRICES (f.o.b.)

	1965	1966	1967	1968/69		1969/70	
	Price/Ton	Price/Ton	Price/Ton	Tons	Price/Ton	Tons	Price/ton
	$	$	$		$		$
Ceylon				7,893.5	3.67		
Fiji				3,300.0	3.03		
Hong Kong		3.00		12,329.7	3.08	6	
Indonesia				22,650.0	4.02	8,501	3.25
Kenya				11,000.0	4.00		
Malaysia	3.64		1.75	8,515.0	3.05		
New Zealand	6.00	5.57	6.00	94,157.5	5.62	101,731	5.78
Philippines				35,021.0	3.08	33,010	3.04
Singapore				12,999.0	3.23	11,864	3.20
Taiwan				50,226.1	3.78	42,068	3.05
Tanzania				5,500.0	4.00		
Other Countries				66.5		3,671	
Average Price	5.39	4.75	4.23		4.30		4.56

(SOURCES: Australian Mineral Industry Annual Reviews, 1965-68 and Overseas Trade. Note that prices for 1968/69 have been calculated from rounded figures.)

Average f.o.b. export prices to New Zealand have been considerably higher than those for other countries at $5.50-6.00 per ton. It is assumed that better quality gypsum, probably crushed and graded to strict specifications, is supplied to the New Zealand market.

Therefore, the N.Z. market for gypsum is probably captive, and it is thought by some observers that Australian Gypsum Industries could drop its price substantially to get rid of an unwanted competitor.

The '63 Annual Report of Australian Gypsum Industries stated that shipments of gypsum to Japan, Taiwan, Philippines and Malaya were "supplied almost exclusively to cement manufacturers". The Australian exports of gypsum to S.E. Asia are therefore assumed to be consumed almost entirely in the manufacture of cement. According to a BMR mineral economist, the use of plaster in S.E. Asia would probably be small as this is not a traditional construction material in this region.

C.S.R. is known to have exported to New Zealand prior to 1962 but no other information was available.

Until 1962, the only other exporter was Garrick Agnew P.L., with shipments of seed gypsum from Norseman, W.A., exclusively to Malaya. The commencement of exports from the Shark Bay area, W.A., in the final quarter of 1968, provided a boost which resulted in 1968 being a record year for gypsum exports. 51,015 tons were exported to Taiwan, Indonesia, and Malaysia by Garrick Agnew P.L. from the Useless Loop in the Shark Bay area.

Shark Bay Gypsum is owned by a consortium which includes Garrick Agnew P.L., Pilbara Minerals Investment Co. and Amad N.L., Shark Bay Gypsum concluded an agreement with the Adelaide Steamship Co., the majority shareholder in the Shark Bay Salt P.L., under which the latter will lease the evaporating ponds and other facilities built by the Company "at a modest rental".[1.] Garrick Agnew P.L. merged with J.O. Clough and Son P.L., which was involved in the redesign and re-construction work for the Shark Bay salt and gypsum projects of which it is now in charge of production, in July 1970, to form Agnew-Clough Ltd.[2.]

It is believed that Garrick Agnew has major contracts with Japan to supply gypsum from 1971 onwards and that the Company has a 1971 target of 150,000 tons of gypsum exports, which it anticipates to increase to 300,000 tons p.a. after 1971 in view of the "improving markets in the East". Gypsum from the Shark Bay area is reportedly shipped in 35,000 ton vessels.

1. Industrial Minerals, No. 28, Jan. 1970, p.31
2. Australian Financial Review, July 22, 1970

WORLD TRADE IN GYPSUM

The great bulk of gypsum and anhydrite entering world trade continued to do so in the crude state, with imports of calcined material remaining quite small in volume and value.[1.]

"Transportation is a large factor in the economics of the gypsum industry. Gypsum ore and finished products are heavy, bulky and relatively expensive to move; consequently production plants should be near the mine and the market area".[2.]

In order to maintain crude gypsum as a low-value product, transport costs must be minimised. "So many regions throughout the world are endowed with gypsum deposits, that the consumer nations are able to obtain the major part of their requirements from local sources."[3.]

Although the U.S.A. has adequate reserves of gypsum, the deposits are unevenly distributed throughout the nation. Regional shortages exist and consequently it is cheaper to import ore from Nova Scotia (Canada), Jamaica, the Dominican Republic and San Marco Island (Mexico), using low-cost water transportation to serve major markets in the Atlantic, Gulf and Northern Pacific coastal areas.[4.]

Therefore it appears that nations will meet their own gypsum needs, unless the high cost of domestic transport from deposits unsuitably distant from the major markets preclude this and it is cheaper to import crude gypsum from the surrounding regions.

1. NON METALLIC MINERALS A REVIEW, OP, CIT, p.69
2. USBM Bull. 630 op, cit, p. 419
3. ibid, p. 417
4. ibid, p. 419

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NORTH AMERICA

The U.S. is the world's largest producer and consumer of gypsum, producing nearly 1/5 of the world's crude gypsum and consuming slightly more than ⅓ of the world output of approximately 47 million long tons in 1967. U.S. imports are mainly derived from the world's two largest gypsum exporters - Canada, shipping nearly 4/5 of its 5 million ton output, and Mexico respectively.

EUROPE AND THE UNITED KINGDOM

In the E.E.C., of which France is the largest producer and exporter, most gypsum continued to be retained for home use in 1967. France produced slightly over 5 million tons, of which nearly 700,000 tons were exported. Almost the entire Italian production of 3 million tons is consumed domestically. West Germany, the third largest exporter in Western Europe, shipped 212,000 tons from the total 1,367,000 tons produced in 1968. Spain exported approximately 80% of an output of 3,816,000 tons to Andorra in 1966.

The main importers in Europe in 1968 were the Benelux countries with imports of more than ½ million tons, and the Scandinavian countries, which imported a total of 318,400 tons.

The Soviet Union consumes almost its entire 4.4 million ton output. Poland exported more than half of an output of 750,000 tons in 1966.

The United Kingdom imports about 145,000 tons of crude and calcined gypsum, from Ireland and France, in addition to its total output of about 4½ million tons. The United Kingdom makes small shipments of plasters to such countries as Australia and India.

AFRICA

Little is known about this market for gypsum, but it would seem to be small, with the gypsum mainly consumed in cement manufacture.

South Africa, the major producer, has an output of 314,000 tons, which rose steadily during the 1960's, and of which 16,300 tons were exported in 1968.

The U.A.R., the second largest producer, has an output fluctuating between 250,000 and 450,000 tons. 53,000 tons were exported in 1966, probably to Japan and Singapore, as in the previous year.

Algerian production is estimated to have remained static at 172,000 tons p.a. until 1967, whilst Moroccan production is estimated to have increased to 886,600 tons in 1967.

Kenyan output has increased from 27,000 tons in 1964, to 39,800 in 1967, probably to meet the needs of a growing cement industry, which takes almost the entire production of gypsum. Kenya imported 11,000 tons from Australia in 1968/69.

Tanzania's production increased markedly from 5,000 tons in 1966 to 17,000 in 1967, but fell back to less than 5,000 tons in 1968. Tanzania imported 5,500 tons from Australia in 1968/69.

The other African producers are minor; Somalia is the largest with 6,000 tons in 1967. Zambia is an importer, which acquired 16,000 tons in 1966 and 1,900 tons the following year.

Information on reserves is limited. "One of the largest gypsum deposits in the world occurs in Somalia, but although it is exposed at the surface and situated near the coast, it is unworked owing mainly to marketing difficulties. Also undeveloped are large gypsum deposits along the Red Sea coast in the Sudan." [1.]

SOUTH AMERICA

Nothing is known about the South American market. Total production would be about 70% that of Africa.

ASIA

In Asia output in three important producing countries - Iran (1,800,000), Iraq (500,000), Japan (578,000) - is nearly all for domestic consumption, mostly in the cement industry.[2.] Iran's exports have been mainly to neighbouring countries, such as Kuwait.

India is the second largest Asian producer, with output totalling 1,298,000 tons in 1968. "India is believed to have the largest reserve of gypsum in Asia, estimated at 998 million tons, but situated in generally unsuitable areas in relation to transportation facilities. Thus, utilization and possible export are restricted. Of the total reserves, 934 million tons are located in Rajasthan. The Government-owned Sindri Fertilisers and Chemicals Ltd. at Sindri, Bihir, remained the country's only large consumer using 650,000 tons grading 83-86% gypsum for the manufacture of ammonium sulphate. Approximately 370,000 tons of gypsum was consumed in domestic portland cement, and plaster of paris and insecticides accounted for an additional 10,000 tons." [3.]

1. Non-Metallic Minerals - A Review, op. cit., p. 66
2. ibid., p.69
3. Minerals Yearbook, 1968

Although figures are incomplete, imports by the countries of S.A. Asia, excluding New Zealand, which could probably be regarded as a captive market of Australian Gypsum Industries P.L., are estimated to approximate at least 300,000 long tons per annum (see Table 4).

TABLE 4. SOUTH EAST ASIAN IMPORTS

	Av. 1961-65	1966	1967	1968	1968/69	1969/70
Ceylon		15,660			7,894*	
Cambodia	('65) 4,491					
Hong Kong	9,900	17,800	4,400		12,330*	
Indonesia	(est) 5,500	5,500*	13,801*	10,389*	22,650*	8,501*
Japan	75,500	48,200	43,100	56,000		
Philippines	(est) 26,000	38,472*	26,182*	52,317*	35,021*	33,010*
Singapore	12,400	17,900	11,200		13,000*	11,884*
South Korea	31,700	70,300	81,000			
Taiwan	37,200	71,400	61,100	83,300	50,226*	42,068*
West Malaysia	22,300	25,700	29,900			
Total	224,991	310,932	270,683			

* Australian exports to country concerned.

SOURCES: Minerals Quarterly, vol. 1, No. 1, April '69, and vol. 1 No. 3, Oct. '69; USBM, Minerals Yearbook 1968; Australian Mineral Industry, Annual Reviews and Overseas Trade.

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Two of the chief importers in Asia remain "Japan, for whom overseas suppliers accounted for only a minor part of the market, and Taiwan, for whom imports were comparatively more important. Imports into both markets have fluctuated and trends are unclear; the sources have varied, but Egypt and Mexico have been prominent." [1.] In 1966, Japan took 30,000 tons from UAR, whilst Taiwan imported about 30,000 tons from Cyprus and 15,000 tons from Morocco, with 40,000 tons coming from Australia. Taiwan's production of cement increased more rapidly than Australia's output during the 1960's, and has probably surpassed Australia by now.[2.]

Another major market is South Korea; however, the sources of that country's imports may be a result of political influences, as in 1966, Mexico supplied 60,000 tons, and Canada and the U.S.A. 4,000 tons each.

There is possibly a measure of political pressure in the source of Cambodian and Hong Kong imports, as Mainland China shipped 4,000 tons to Cambodia in 1965 and nearly 8,000 tons to Hong Kong in 1966. China is reported to have large gypsum reserves and an estimated output of 600,000 tons p.a.

Production of gypsum in Thailand in 1968 "amounted to 126,077 tons, nearly 10 times as much as 1960. The ore now comes from three mines, of which that in Nakhon Sawan, in the northern region, is by far the most important. Significant also is the mine in Surat Thani, in the southern region. Trial shipments have been made to Malaysia which

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1. Non-Metallic Minerals: A review, op. cit., p. 73
2. Economic Bulletin for Asia and the Far East, 1968, U.N. Economic Survey of Asia and the Far East, vol. XIX, No. 4.

is the most likely export market, especially for the product mined in southern Thailand. But reserves of gypsum are known to be ,very large." [1.] The U.S.B.M. reported that Thailand became self-sufficient towards the end of 1966, when production was approximately 42,000 tons p.a., and 2,500 tons of high-grade gypsum were shipped to Malaysia. It was expected that exports would amount to at least 14,000 tons in 1967.[2.] Small shipments of gypsum were also sent to Japan and Hong Kong in 1965 and 1966.

Singapore is a most likely export market because it must import all its cement raw material needs and the government is encouraging the growth of the domestic cement industry by levying high import duties on cement and clinker.[3.]

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1. Mining Magazine, vo. 122, No. 4, April 1970
2. Minerals Year Book, 1968, vol. IV, op. cit.
3. Minerals Year Book, 1968, vol. IV, op. cit.

MARKETING POSSIBILITIES

The Australian gypsum market appears to be adequately supplied. The gypsum industry's structure, which is basically controlled by two major vertically integrated companies, and the abundance of high grade reserves, poses difficulties for a new producer seeking to enter the Australian gypsum market. According to one observer, competition is keen between the two major producers.

Both the European and North American markets are well supplied by their own regions, which have large reserves, e.g. in Canada and the Paris Basin. Transport costs would probably be very heavy.

The African market appears to be small, although there may be a possibility of exporting gypsum to some developing countries for use in cement manufacture within the next few years while production expands. Kenya and Tanzania took shipments of gypsum totalling 16,500 tons from Australia in 1968/69. However, Somalia and the Sudan have large as yet undeveloped reserves.

The most likely export market for an Australian producer appears to lie in S.E. Asia, where cement production grew rapidly during the 1960's, especially in Taiwan, West Malaysia, the Philippines and Thailand. A mineral economist at the B.M.R. sees Singapore, Hong Kong, the Philippines and Taiwan as the most likely export markets for further Australian gypsum production; all these countries already take a considerable proportion of their needs from Australia.

One Australian gypsum exporter, reported to have contracts with Japan, plans to increase his Asian export market to 300,000 tons p.a. after 1971. If the other Australian exporters retain their present share of the market, Australian gypsum would probably be fulfilling all S.E. Asian import requirements, as far as these have been estimated on reported import figures. There would, in this case, be little room for another gypsum exporter.

Both India and Thailand have large gypsum reserves. Indian reserves are as yet undeveloped, but Thailand, whose production increased rapidly during the 1960's, is already exporting to Malaysia. Competition for the market could therefore come from within Asia.

A B.M.R. mineral economist pointed out that not all Asian countries provided covered storing areas for gypsum, so that seed gypsum was leached under tropical conditions after more than 6 months, although crystalline gypsum remained unaffected. It is believed that there is no shelter in Singapore, Hong Kong, Taiwan and Malaysia.

The B.M.R. mineral economist believed that port and loading facilities were of great importance in developing a gypsum deposit for export purposes. Transporting the material to the port was also thought to be costly, and processing costs required less concern.

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   June 3, 1968, p. 13 "Sulphur from gypsum processes to help phosphoric acid makers".

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