24th April, 1969.

Memorandum to : F. S. ANDERSON, ESQ.

Copy : A. J. Rew, Esq.

From : N. A. Gilberthorpe

Brown's Prospect
Technical Report 3/69

1. Sufficient work has now been completed at a cost of $944,000 to assess the degree of attraction of Brown's Prospect as a mining operation.

2. Technical Report 3/69 provides this assessment and concludes that the grade of the deposit is far too low to support a mining operation at present metal prices.

3. Both lead and copper prices would have to double to make Brown's an attractive proposition at 15% D.C.F. return on investment.

4. There is no foreseeable breakthrough to a treatment method which will yield a profitable recovery of nickel and cobalt.

5. Scope and justification exist to continue a modest research programme on nickel and cobalt recovery.

6. It is believed a reliable case exists to retain the title to Brown's leases for some time to come.

7. It is recommended that exploration on Brown's Prospect be suspended indefinitely and future expenditure restricted to continue a modest metallurgical research programme estimated to cost $10-15,000 per annum.

N. A. Gilberthorpe

NAG:JGG

CONZINC RIOTINTO OF AUSTRALIA LIMITED

GENERAL MINING DIVISION

TECHNICAL REPORT NO. 3/69

"B R O W N ' S P R O S P E C T -
A F I N A N C I A L A S S E S S M E N T"

Author: G.W.McGregor
Division Mining
Engineer

Issued: N.A.Gilberthorpe
General Manager

Distribution:

- Directors (2)
  G.M.D. (2)
  A.M.&S. Rum Jungle (1)
  C.R.A.E. (1)
  Research (1)
  Library (1)

Melbourne,
March, 1969.

CONTENTS

APPENDICES

BROWN'S PROSPECT - A FINANCIAL ASSESSMENT

OBJECTS

A number of questions were posed in N. A. Gilberthorpe's memorandum to the author, dated 14th January, 1969. These were:

- Should research and exploration expenditure continue on Brown's Prospect?
- If so, at what expenditure level and at what rate?
- If not, what is the future of the prospect and how may the title be retained?

This assessment sets out to answer these questions.

(See Appendix I for full text of N. A. Gilberthorpe's memorandum).

SUMMARY

Brown's Prospect has been held by the Company since 1956. In the intervening years approximate expenditure on exploration has been $944,000. A further $84,000 will be spent in completing the current underground checking programme.

A number of feasibility studies have been made on the working of the deposit but all came to the same conclusion, that unless nickel and cobalt could be recovered the prospect was not viable.

Recent test work on bulk samples from underground exploration shows that nickel and cobalt cannot be concentrated by simple flotation processes.

The summarised results of the current assessment follow in the form of a financial development.

Premises:

1.	Production Rate	2 million tons ore per year
2.	Total Capital Employed	$41 million
3.	Ore Reserves	13,643,000 tons
4.	Ore Grade	5.5 % Pb
		0.27% Cu
5.	Products	50% Pb concentrate
		20% Cu concentrate
6.	Recovery	
	Mining (dilution 20%)	80%
	Ore dressing	80% Pb
		85% Cu
	Overall	64% Pb
		68% Cu
7.	Waste : Ore Ratio	6.4 : 1

8. Metal Prices:

(in concentrates delivered Japan)

Pb	$A 166 per ton Pb
Cu	$A 607 per ton Cu

(Market prices:

Pb ingots	£UK 85 per ton
Cu bars	£UK308 per ton)

9. Operating Costs:

Mining	$3.89 per ton of ore
Milling	0.85
Admin. and general	0.26
	$5.00 per ton of ore

10. Realisation Costs:

Concentrate cartage to Darwin	$4.20 per ton of concentrate
Wharfage	$7.00 per ton of concentrate
Shipping to Japan	$12.00 per ton of concentrate

Derivations:

1. Recovered grade

Pb	5.5% x 64%	3.52% Pb
Cu	0.27% x 68%	0.18% Cu

2. Ratio of concentration

Pb	50% ÷ 3.52%	14.2
Cu	20% ÷ 0.18%	111.0

3. Concentrates produced per annum

Pb	2,000,000 ÷ 14.2	141,000 tons
Cu	2,000,000 ÷ 111.0	18,000 tons

4. Metal in concentrates per annum

Pb	141,000 x 50%	70,500 tons
Cu	18,000 x 20%	3,600 tons

5. Operating costs per annum

2,000,000 x $5.00	$10,000,000

6. Realisation costs per annum

Cartage 172,000 x $4.20 (159,000 + 8% moisture)	$ 722,000
Wharfage 172,000 x $7.00	$1,204,000
Shipping 172,000 x $12	$2,060,000
	$3,986,000

7. Revenue per annum

Pb 70,500 x $166	$11,700,000
Cu 3,600 x $607	$ 2,185,000
	$13,885,000

8. Reserve Life

$$\frac{13,643,000}{2,000,000}$$ 6.8 years

Economics

		$A million
1.	Mine capital and preproduction expenses	29,000
	Interest and working capital	12,200
	Total	41,200
2.	Annual deficit (Revenue less Operating & Realisation Costs)	0,101

3. Return on investment with both lead and copper prices increased by 65% is 1.0% DCF.

4. Return on investment with both lead and copper prices increased by 100% is 15.0% DCF.

5. Return on investment at today's prices with theoretical nickel and cobalt included is nil.

CONCLUSIONS

1. Brown's orebody is not of high enough grade to support a mining operation at present day metal prices.

2. Both lead and copper prices would have to double to make Brown's an attractive proposition, (15% DCF return).

3. The addition of nickel and cobalt recovery to that of lead and copper would not be sufficient to make Brown's a viable proposition at present day prices.

4. The present programme of underground development has served its primary purpose in providing bulk samples for metallurgical testing.

5. The secondary purpose of checking the validity of previous drilling has proceeded far enough to indicate that no significant alteration in grades can be expected.

6. While completion of the underground drilling programme would under normal circumstances be desirable in view of the money spent to date on shaft sinking and driving, it can scarcely be warranted in the case of an orebody so far from being economic.

   Confirming the validity of stated ore reserves would be merely an academic exercise.

7. Sufficient money has been spent on Brown's prospect to date to provide a very strong case for Australian Mining & Smelting Company Limited to continue to hold the leases pending a rise in the price of metals, and improvement in extractive technology.

8. This study points up the conclusions reached by M. G. Baillie and validates his recommendation that it would be worthwhile to proceed on a low priority basis with a modest programme (say one officer) to investigate the potential of some of the less conventional schemes which might be applicable to cobalt and nickel recovery.

RECOMMENDATIONS.

1. Expenditure on exploration at Brown's Prospect should be discontinued forthwith.

2. Research on nickel and cobalt recovery should continue, using concentrates on hand, but this should be of low priority.

3. Brown's leases should be held for as long as it is possible to obtain exemption from the conditions of tenure.

4. No further mining design work should be carried out.

5. At such time as lead and copper prices increase substantially, and nickel - cobalt recovery techniques are developed the project should be reviewed.

DISCOURSE

1. Review of Work Done to Date

1.1 Scope

1.1.1 Exploration

Brown's prospecting leases were taken out as mining leases by Australian Mining & Smelting Company Limited in 1956 after drilling by Enterprise Exploration Proprietary Limited had shown the presence of an interesting lead-copper ore body.

Drilling continued through to 1962 but work on the prospect was then terminated.

In 1965 a decision was made to sink a shaft to a depth of 450 feet in the orebody, and drive, cross cut, and diamond drill underground to provide more information on the ore reserves and the metallurgical behaviour of the ore. This work commenced in 1966 and is now nearing completion.

The results of early exploration were written up by C.L. Knight and I.G. Whitcher, C.R.A. Exploration Proprietary Limited report N.T. 67, March 1959.

Ore reserves were stated to be:

	Tons	%Pb	%Cu	%Co
Sulphide ore	20,542,000	5.4	0.19	0.11
Oxidised ore	2,196,000	4.0	0.47	0.09

Zn (0.3%) and Ni (0.11%) were also present in the sulphide ore, and Ag averaged 1.4 dwt per ton for each 1% Pb.

No meaningful re-assessment of the ore reserves has been carried out since. F.E. Hughes reported the possibility of lower grades in his report NT.67, July 1968, but pointed out that this could be a local phenomenon confined to the shaft area.

It would now appear that this was so; there is at present nothing to indicate that the ore reserve is appreciably different from that stated by Knight & Whitcher, or that the grades are significantly lower.

The ore body is approximately 2,300 feet long and varies in width from 240 feet near the

surface to 40 feet at a depth of 1000 feet. The dip is variable but near vertical in most places. The first 50 feet is oxidised and contains a discrete copper ore body of small size.

1.1.2 Mining Design

A number of reports have been written on the mining of the orebody.

The first, by W.E. Romig, June 1957, suggested shallow open pitting followed by underground mass caving, at a rate of 1,000,000 tons per year. Profitability depended on the sale of Cobalt and Nickel.

T. Barlow, 1960, reported on the feasibility of open pit mining to a depth of 400 feet and R.B. Moffitt incorporated Barlow's planning in his study of the deposit dated August 1965. Once again, the exercise showed an unattractive end result even though an

optimistic view was taken on oxidised metal recovery. Further expenditure on prospecting and metallurgical testing was recommended.

D. Haigh has recently designed an open pit with a depth of 600 feet and taken out quantities for side slopes varying from 40° to 50°.

1.2 Cost

Expenditure by Enterprise Exploration Ltd. on Brown's Prospect between 1956 and 1962 is summarised in K. Hoare's memorandum of 11th November, 1965 as follows:

	£	$
Geological	35,682	
Drilling	157,170	
Metallurgical	43,196	
Administration	37,348	
Leases	1,280	
Total	£274,676	$549,352

In April 1966 a grant of $100,000 was made for further prospecting work, and subsequently two further grants, each of $100,000 were made for shaft sinking, cross cutting, underground diamond drilling and metallurgical testing.

To the end of April 1968, expenditure from these grants had totalled $25[illegible]12. (McDowell memo No. 103, 16th May, 1968).

Since then the average rate of expenditure has been $14,000 per period. Therefore, the total to the end of February 1969 is estimated to be close to $400,000. - see Appendix V.

Total

1956 to February 1969 $944,250

Cost to Complete Present Underground Programme

The programme of driving, cross cutting and diamond drilling is scheduled for completion in September of this year.

Estimated cost

7 periods at $12,000 $84,000

2. Results of Metallurgical Test Work

Work recently carried out on Brown's ore has been reported by M. G. Baillie in his memorandum of 14th January, 1969 - see Appendix II.

The conclusions are:

1. Cobalt and nickel cannot be recovered by flotation into a suitable concentrate for further treatment.

2. Copper recovery of 85% into a concentrate assaying 20% Cu is possible.

3. Lead recovery of 80% into a concentrate assaying 50% Pb is possible.

This memorandum also assesses the capital cost of establishing a flotation mill to treat 2 million tons of ore per year:

Capital Cost	$5.1 million
Estimated Operating Cost	$0.75 per ton ore

These results and costs have been adopted in the current assessment. M. Baillie has further advised that the oxidised ore should not be taken into consideration.

3. Assessment of Mining Costs

3.1 Assumptions

3.1.1 This study is based on 2 million tons of ore per year to conform with M. Baillie's metallurgical report of 14th January, 1969. (Note: R.B. Moffitt's report of August 1965 based on 1 million tons of ore per year).

3.1.2 Quantities of lead-copper ore and waste taken from D. Haigh's median open pit design with 45° batters, 600 foot depth are:

Volumes

Total excavated rock	56,043,000 c. yds.
Total waste rock	47,440,000 c. yds.
Total ore	8,603,000 c. yds.
Sulphide ore	7,579,000 c. yds.

Tonnages

(Density: 1.8 tons per bank yard)

Total excavated rock	100,877,000 tons
Total waste rock	85,392,000 tons
Total ore	15,485,000 tons *
Sulphide ore	13,643,000 tons

Neglecting oxide ore the quantities become:

Sulphide ore	13,643,000 tons * should be 12!
Waste rock	87,234,000 tons
Total excavation	100,877,000 tons
Ore : waste ratio	1 : 6.4

3.1.3 It is assumed that mining will be carried out on two shifts of eight hours, six days per week, forty weeks per year. This will allow for 20% loss in time and efficiency due to wet weather over the monsoon period.

3.1.4 Milling costs have already been taken out by M.G. Baillie and these are accepted. However, provision is made for housing mill personnel, and mill staff salaries are added.

3.2 Unit Costs

Wages:	average $1.75 per hour; plus 50% for contract open-pit operators and tradesmen, i.e., $2.62 per hour.
Diesel Fuel:	14 cents/gallon.
Electricity:	3 cents/kwh
Rail Haulage:	64 miles Rum Jungle to Darwin $4.20/ton (Possibility of reduction)
Wharfage Darwin:	$7.00/ton
Housing Cost:	3 bedroom, Rum Jungle $20,000.

Capital cost of rail siding at Brown's $100,000.

3.3 Mining Data

3.3.1 Hours worked:

Allow $\frac{3}{4}$ hr. per shift for stopping and starting losses.

Machine hours per year

$7.25 \times 2 \times 6 \times 40 = 3,480$ hours

Pay hours per year per man

$8 \times 6 \times 50 = 2,400$ hours

3.3.2 Annual Mining rate:

Tons of ore per year 2 million

Total excavation per year 2 million + (2 million x 6.4)

= 14,800,000 tons

3.3.3 Hourly excavation rate:

$$\frac{14,800,000}{3,480} = 4,253 \text{ tons}$$

3.3.4 Life of mine:

$$\frac{13,643,000}{2,000,000} = 6.8 \text{ years}$$

3.4 Mining Equipment

3.4.1 Shovels

Total bucket capacity to mine 4,253 tons per hour:

Operational & mechanical efficiency	85%
Bucket factor	85%
Swell factor	75%
Cycle time	25 seconds
Cycles per hour	144

Cubic yards per hour:

$$\frac{4,253}{1.8 \times 0.85 \times 0.85 \times 0.75} = 4360 \text{ c. yds.}$$

Bucket size:

$$\frac{4,360}{144} = 30.28 \text{ c. yds.}$$

Number of shovels:

3 10-c. yd. machines

3.4.2 Trucks

Assumptions:

Average gradient	1 in 10
Av. speed loaded	10 m.p.h.
Av. speed empty	20 m.p.h.
Av. speed	15 m.p.h.
Haul distance (round trip)	2 miles
Truck capacity assumed	100 tons
Truck availability	60%

Cycle time:

load	2 min. 20 sec.
travel full	6 min.
empty	1 min.
travel empty	3 min.
spot	1 min 40 sec.
	14 min.

∴ each truck makes 4 trips per hour and carries 400 tons per hour.

Hourly tonnage : 4,253

Number of trucks : $\frac{4,253}{400 \times 0.60} = 18$

3.4.3 Drills

Assumptions:

bench height	50 feet
grid spacing	18' x 15'

Cubic yards per hour:

$$\frac{4,253}{1.8} = 2,363$$

$$\text{area} = \frac{2,363 \times 27}{50} = 1,276 \text{ sq. ft.}$$

holes per hour:

$$\frac{1276}{18 \times 15} = 4.72$$

feet drilled per hour:

$$4.72 \times 50 = 236 \text{ feet}$$

Number of drills:

One rotary drill (45R) will be more than adequate to drill all requirements.

3.4.4 Major Auxiliary Items

Bulldozers:

one for each shovel	3
one for tiphead	1
one general duties	1
Total	5

i.e., 5 D9 bulldozers with rippers

Graders:

2 Cat. 12

Water Carts:

2 converted dump trucks.

3.4.5 List of All Capital Items

		$A000
3	10 c.yd. shovels at $750,000	2,250
18	100 ton trucks at $200,000	3,600
5	D9 bulldozers at $110,000	550
2	Cat. 12 graders at $30,000	60
1	45R rotary drill at $670,000	670
2	50-ton water carts at $200,000	400

3.4.5 List of All Capital Items (Cont'd)

		$A000
1	20-ton explosives truck at $50,000	50
2	6000 g.p.h. pumps at $20,000	40
6000	ft. 8" Ø pipeline at $3/ft.	20
2	7-ton service trucks at $20,000	40
12	runabout vehicles at $4,000	50
6000	ft. power line at $7/ft.	40
6	portable transformers at $5000	30
6	cable crossings at $1000	6
3	cable sleds at $1000	3
1	ambulance at $10,000	10
1	fire-engine at $10,000	10
1	magazine at $10,000	10
1	workshop plus equipment	60
1	store	40
1	office	20
1	barracks	60

3.4.5 List of All Capital Items (Cont'd)

		$A000
1	mess	30
1	recreation hut	10
	houses	3,810
	sewage disposal	20
	water supply	20
	communications (20 sets at $500)	10
	siding	100
		12,019
	30% contingency	4,000
	Total mining capital	$16 million

3.5 Manning Schedule

(2 shift basis)

3.5.1 Daily Paid

Shovel operators	3x2	6
Shovel oilers	3x2	6
Truck drivers (100T)	12x2	24
Bulldozer drivers	5x2	10
Grader drivers	2x2	4

3.5.1 Daily Paid (Cont'd)

Water cart drivers	2x2	4	
Drillers	2x2	4	
Shot firers	2x2	4	
Pump attendants	1x2	2	
Truck drivers (7T)	1x2	2	
Duty drivers	2x2	4	
		70	
Fitters	4x2	8	
Welders	2x2	4	
Mechanics	8x2	16	
Electrician	2x2	4	
Labourers	8x2	16	
		48	
Gardeners		2	
Mess hands		12	
Services hands		6	
Monitors		4	
Watchmen		4	
		28	
Carpenter		1	
Painter		1	
Plumber		1	
Assistants		3	
		6	152

3.5.2 Staff

Manager	1
Production Superintendent	1
Mine Superintendent	1
Asst. Mine Superintendent	1
Mine foremen	4
Geologist	1
Surveyor	1
Asst. Surveyor	1
Draftsmen	2
Chief Engineer	1
Asst. Engineer	1
Engineering foremen	3
Services foreman	1
Office Manager	1
Accountant	1
Asst. Accountant	1
Chief Clerk	1
Department clerks	3

3.5.2 Staff (Cont'd)

Accounts clerks	4
Chief Storeman	1
Storemen	4
Typists	6
Personnel Officer	1
Secretary	1
Catering Officer	1
	44

152
4 ½
9 6

3.5.3 Mill Manning

(for housing purposes only)

Operators	8x4	32
Cleaners	2x4	8
		40
Fitters	2x4	8
Electricians	2	2
		10

Staff

Chief Metallurgist	1
Plant Metallurgists	2
Research Metallurgists	2
Mill foremen	4
Laboratory assistants	4
Clerks	2
Typists	2
	17

3.5.4 Total Manning

Daily paid operators	110	
tradesmen	64	
general hands	28	
Total	202	
Total Staff	61	

3.6 Cost of Labour (excluding mill)

70 operators (mine) at $2.62/hr. 2400 hrs/yr	440,160
35 tradesmen at $2.62/hr 2400 hrs/yr	220,080
47 general hands and trades assistants at $1.75/hr 2400 hrs/yr	197,400
	$857,640

Staff Salaries (excluding mill)

44 x $6000 x 2	$528,000

Mill Staff

17 x $6000 x 2	$204,000

HOUSING REQUIREMEN
- RUM JUNGLE -
BATCHELOR AR
FOR CRA's DE
MENT OF BRON
DEPOSIT. - OR
ESTIMATE.

3.7 Housing Requirements

202 daily paid workers

61 staff

Provide housing for 75% of staff, i.e.,	45
Single quarters, female staff	8
Single quarters, male staff	8
Provide housing for 66% of daily paid workers, i.e.,	133
Barracks for remainder, i.e.,	69

Cost of Housing

178 houses at $20,000		3,560,000
1 Single girls' quarters	Motel style	20,000
1 Single men's quarters	Motel style	20,000
9 8-men barrack blocks	Motel style	180,000
1 Guesthouse at $30,000		30,000
		$3,810,000

3.8 Annual Operating Costs

3.8.1 Mining

Labour	Daily paid	857,640
	Staff	528,000
		1,385,640

Stores

Parts: (10% of value of machines i.e., 10% of $10,412,000)	1,041,000
Fuel & Tyres:	
18 trucks at 2 cents/ton mile	
14,800,000 tons x 2 miles x 2 cents	592,000
5 tractors, 4000 hrs each, 16 galls per hour, at 14 cents/gall	44,800
Other vehicles	50,000
Explosives:	
0.75 lbs. gelignite per ton excavated at 40 cents/lb including fuse & detonators 14,800,000 x 0.75 x 40 cents	4,440,000
	6,167,800

3.8.1 Mining (Cont'd)

Power

0.40 kwh per ton excavated at 3 cents per kwh 14,800,000 x 0.40 x 3 cents	177,600
0.1 kwh per ton drilled	44,000
	221,600
Total mining cost	$7,775,040
Cost per ton excavated $\frac{7,775,040}{14,800,000}$	$0.5253/ton
Cost per ton of ore $\frac{7,775,040}{2,000,000}$	$3.8875/ton ore

3.8.2 Milling costs (after Baillie)	$0.75 per ton ore
Add mill staff salaries	0.10
	$0.85 per ton ore

3.8.3 Administration and General

Melbourne Office	$100,000
Royalties	$100,000
Subsidies	$ 50,000
Contingencies	$170,000
Insurances	$100,000
	$520,000

$0.26 per ton ore

3.8.4 Total Operating Cost

$5.00 per ton ore

4. Schedule of Smelter Payments.

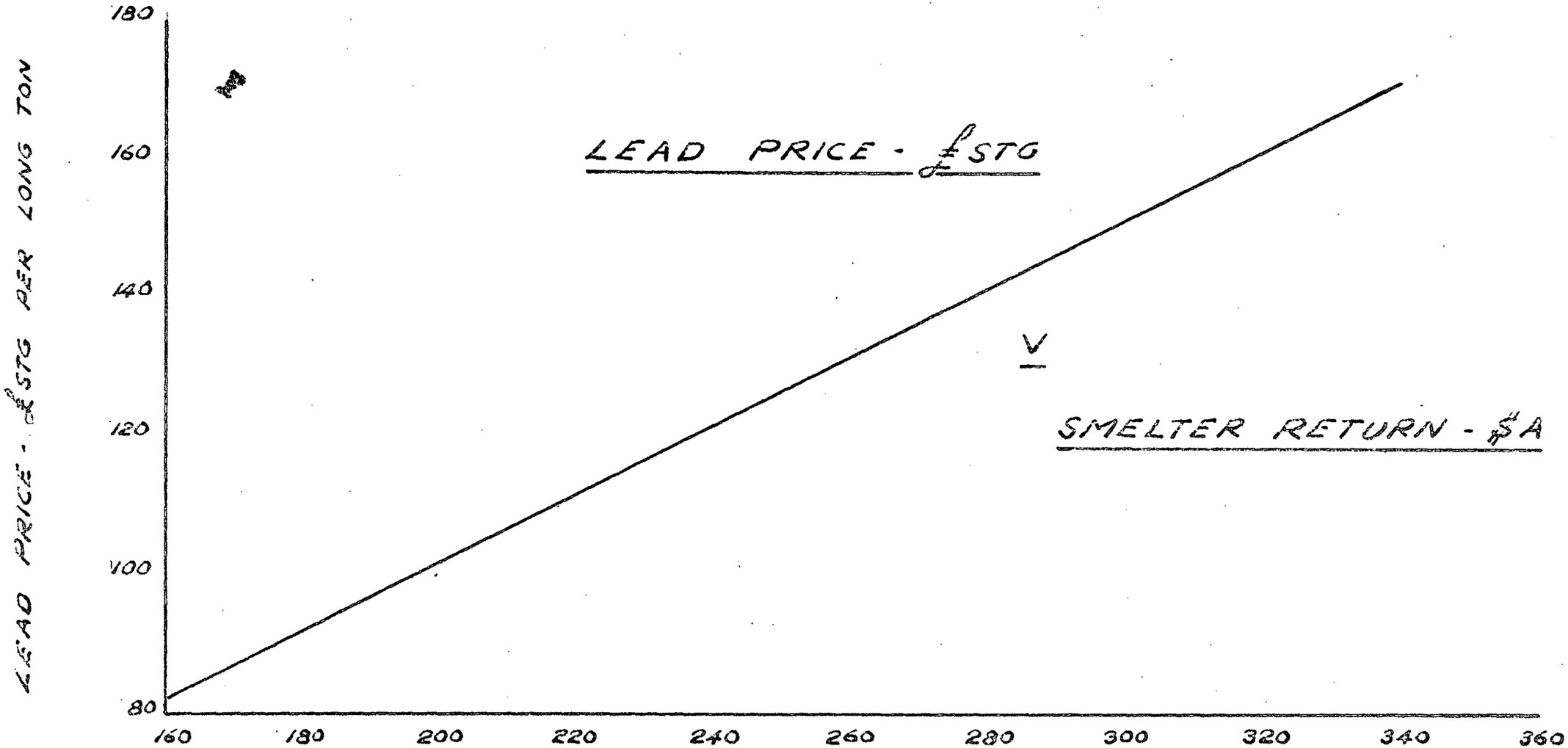
Pb - paid for 94% of Pb in concentrates, less treatment charge of £UK.6 per long dry ton of concentrates.

Cu - paid for full Cu content less 1 unit at Zambian producers price less 1.3 cents U.S. per lb., less a treatment charge of $US.15 per dry metric ton. (Producers price £UK.308).

4.1 Lead payment per ton Pb in 50% concentrate

$$£UK.85 \times \frac{94}{100} - 3 = £76.90$$

$$\frac{76.90 \times 20}{9.25} = \$A166$$


LEAD PRICE - £STG PER LONG TON
180
160
140
120
100
80
LEAD PRICE - £STG
V
SMELTER RETURN - $A
160
180
200
220
240
260
280
300
320
340
360
SMELTER RETURN - $A PER LONG TON
OF LEAD IN 50% CONCENTRATE

C.W.M.G. 1-3-69

4.2 Copper Payment per ton in 20% concentrate

£UK.308 = $US.740 per long ton Cu

$\frac{19}{20}$ x 740 = $US.703 per long ton Cu

less $0.013 per lb = 0.013 x 2240
= $29.10

703 - 29.10 = $US.673.90 per long ton

less $US.15 per dry metric ton of concentrate

i.e., $\frac{15 \times 1.016 \times 20}{100}$ per long ton Cu

= $US.3.20

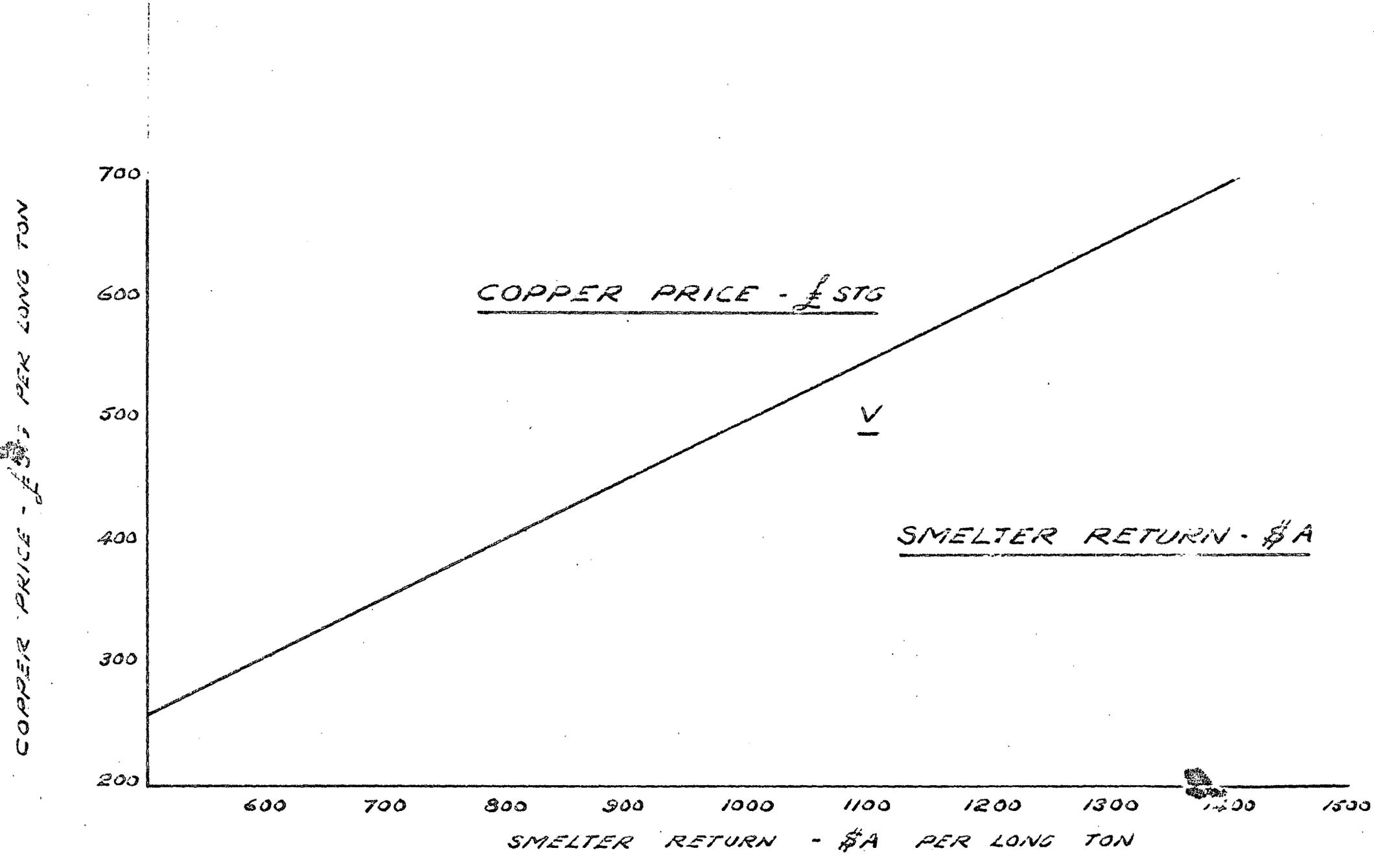
673.90 - 3.20 = $US.670.70 per long ton Cu

= $A607

1 long ton = 1.016 metric tons

£UK.1 = $US.2.40

= $A 2.16


COPPER PRICE - £ STG PER LONG TON
700
600
500
400
300
200
COPPER PRICE - £ STG
V
SMELTER RETURN - $A
600
700
800
900
1000
1100
1200
1300
1400
1500
SMELTER RETURN - $A PER LONG TON
OF COPPER IN 20% CONCENTRATE

G.N.M.C. 1-3-69

5. Effect of Metal Prices on Economics

Consider lead and copper prices increased by 65% -

Pb at £139 per long ton

Cu at £502 per long ton

Smelter return (from graphs) -

Pb $A 274

Cu $A1001

Total funds employed:

	$A million	$A million
Mine capital	21.000	
Interest at 10% over 2 yrs	4.400	25.400
Pre-production	8.000	
Interest at 10% over 1 yr.	0.800	8.800
Working capital	7.000	7.000
Total		41.200

Revenue per annum:

Pb 70,500 x 274	19.310
Cu 3,600 x 1001	3.605
	22.915

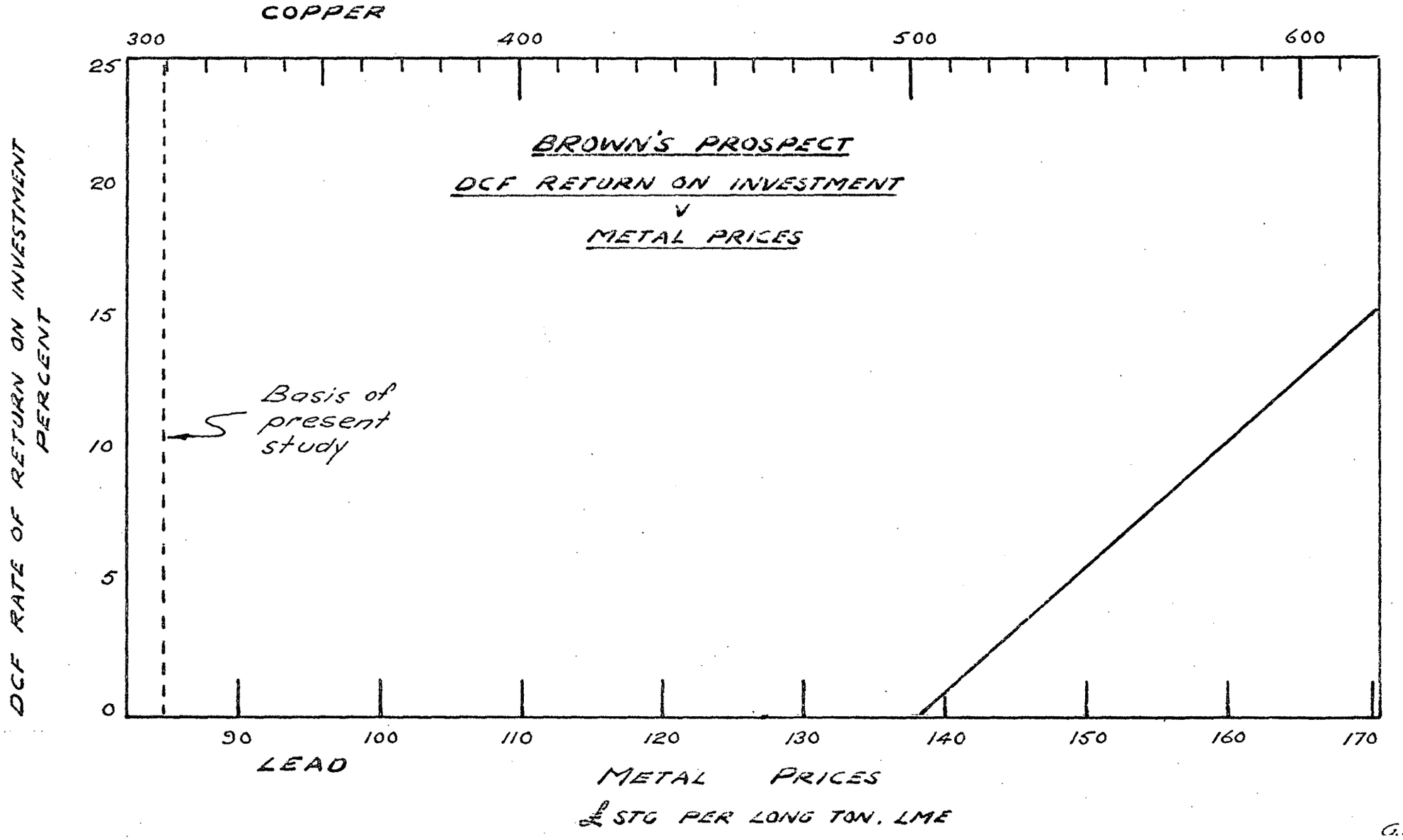
Gross Surplus:

Revenue	22.915
Ore cost	13.986
	$8,929

Payback:

	$A million p.a.
Gross surplus	8.929
Deduct	
Depreciation over 7 years on mine capital and pre-production expenses	4.150
Result	4.779
Deduct	
Tax at 36%	1.720
Nett income	3.059
Add	
Depreciation	4.150
Cash flow	7.209
Payback $\frac{41.200}{7.209}$	5.7 years
Return on investment:	1.9% DCF

Returns for further price increases are graphed on the next page.


COPPER
300
400
500
600
BROWN'S PROSPECT
DCF RETURN ON INVESTMENT
V
METAL PRICES
DCF RATE OF RETURN ON INVESTMENT
PERCENT
25
20
15
10
5
0
Basis of present study
90
100
110
120
130
140
150
160
170
LEAD
METAL PRICES
£ STG PER LONG TON. LME

G.N.M°G 1-3-65

6. Effect of Nickel - Cobalt Recovery

6.1 Nickel

70% recovery of 0.14% N:	2,000 tons p.a.
2000 tons at $0.70 per lb. in concentrates, at Japanese port	$3,000,000 p.a.

6.2 Cobalt

70% recovery of 0.11% Co	1,540 tons p.a.
1540 tons at $1.10 per lb. (assumed) in concentrates at Japanese port	$3,800,000 p.a.

If it be assumed that all costs of mining, milling and transport are met by lead and copper then nickel and cobalt would provide an annual gross surplus of approximately $6 million, and annual cash flow of $5 million.

This is insufficient to return the capital over the life of the mine. The D.C.F. rate of return is therefore less than zero.

7. Effect of Contract Excavation

Assumption: $0.75 per ton contract price (based on Moffitt's figure of 12/- per c.yd.).

Annual Operating Cost:

Contract	
14,800,000 tons at $0.75	$11,100,000
Supervision	
20 mining staff at $12,000	
17 milling staff at $12,000	$ 440,000
Milling	
2,000,000 tons at $0.75	$ 1,500,000
Administration & general	$ 520,000
	$13,560,000
Realisation Costs	$ 3,986,000
Total Operating & Realisation	$17,546,000
Annual Revenue	$13,885,000
Annual Loss	$ 3,661,000

G. A. McGregor.

APPENDIX I

COPY ONLY

14th January, 1969.

Memorandum to : G. W. McGREGOR, ESQ.

Copies : N. R. McDowell, Esq.

Dr. J. C. Nixon

D. S. Carruthers, Esq.

From : N. A. Gilberthorpe

Brown's Prospect

Should we continue research and exploration expenditure on Brown's Prospect? If so, at what expenditure level and with what objective? If not, what is the future of the prospect and how do we retain the title?

Investigation work on this prospect has reached a stage where answers must be provided to those questions. Would you undertake this assignment please and aim to complete it not later than February 28, 1969. To arrive at these answers the suggested approach is:

Review briefly the scope and cost of work done to date including Romig's report dated June, 1957.

Gather in results of latest metallurgical testing from Amdel now being processed and translated into economic terms by M.G. Baillie.

Through Noel McDowell, liaise with Haigh of TEP who has been working up preliminary estimates of engineering and community costs attached to Brown's development.

Combine all information and derive a complete study, classification grade 4 or grade 3. Adopt two cases, one at 3000 tons per day and the other at 6000 tons per day using CRA metal prices and return on investment of 10% and 15% DCF. Should the viability be doubtful with these parameters, extend the study to point up metal prices required to make an operation viable.

Seek opinion from Dr. Nixon on the desirability of persevering with further test work, pressure leaching for example.

From this work the answers posed in the first paragraph will emerge after due consideration is given to the practical aspects of maintaining our title and access to the prospect.

(sgd) N. A. Gilberthorpe

APPENDIX II

COPY ONLY

14th January, 1969.

Memorandum to : N. A. GILBERTHORPE, ESQ.

Copy to : Dr. J. C. Nixon

From : M. G. Baillie

Brown's Deposit - Processing Costs and Recovery

Experimental testing of Brown's ore has been proceeding at Amdel for some time. Broadly the aim of this work has been to investigate the potential of flotation to upgrade Brown's ore into -

(a) a series of separate sulphide concentrates for sale

(b) a bulk sulphide concentrate for sale or further treatment

(c) a combination of separate concentrates and bulk concentrates.

Sufficient work has now been done for the following summary of results to be prepared:-

1. Copper can be recovered into a concentrate assaying 20% Cu with a recovery of 85%.

2. Approximately 80 percent of the lead can be recovered in a concentrate assaying 50 percent lead. Under the conditions required for this result, cobalt and nickel report mainly with the tailings and are not recoverable in an acceptable concentrate by flotation.

3. Alternatively, about 40 percent of the lead can be recovered in a concentrate assaying 52 percent lead and a further 54 percent in a lead-cobalt middling assaying 6 percent lead and 0.16 percent cobalt (80 percent cobalt recovery). This middling is very little different in composition to the feed material and represents 50 percent of the total feed to the circuit.

From the above results, the following conclusions are drawn for preliminary evaluation purposes:-

1. Cobalt and nickel cannot be recovered by flotation into a suitable concentrate for further treatment. Their value must therefore be ignored in preliminary cost evaluations.

2. Copper recovery of 85% into a concentrate assaying 20% Cu is possible.

3. Lead recovery of 80% into a concentrate assaying 50% Pb is possible.

Based on the conclusions set out, Figure 1, which is a flowsheet for an operation treating 2 million tons per annum of Brown's ore, has been prepared. It is a conventional flotation mill.

Capital Costs

Using Figure 1 and costs of equipment delivered by sea to Bougainville as a guide, the following major equipment costs have been estimated:-

Major Equipment Costs	$ 000
Feed Hopper	10
Feeder	20
Grizzly	10
Primary Crusher	50
Conveyor	60
Magnet and Surge Bins (12,000 tons)	60
Screen	20
Secondary crushing (1 x Standard 7' Symons)	100
Conveyors	50
Screens	40
Belt feeders	20
Surge Bins (5,000 tons)	30
Conveyor and tripper	40
Tertiary crusher	110
Feeder belts	30
Rodmill and motor	125

Major Equipment Costs (Cont'd)	$ 000
Cyclones, feed pumps and motors	40
Ball mill (1)	125
Ball mill (2)	200
Cyclones, feed pumps and motors (2 sets)	80
Flotation cells (16 x 300 ft^3)	80
Pumps, pulp distributors etc.	20
Concentrate thickeners (1 x 125')	75
" " (1 x 50')	45
Filtration	20
Pumps, agitation etc.	20
Reagent makeup	20
Tailings thickener and disposal	100
TOTAL	1,600

To this total must be added the factored cost of the following, which are estimated as a percentage of the delivered equipment cost.

Installation	50%
Piping	25%
Instruments	15%
Electrical	20%
Buildings, foundations etc.	25%
Services	20%
Engineering, construction, contractors	40%
Contingency	25%
	220%

Total cost of operational plant is thus (3.2 x 1.6) =

$5.1 million

Operating Costs

Operating costs are very difficult to estimate from first principles at this stage, hence they have been estimated by analogy with both the Bougainville costs and published costs for other plants.

Estimated operating cost is $0.75 per ton of ore treated

i.e., $1.5 million per annum.

Concentrate Recovered

The average grade of ore fed to the mill is:

5.5% Pb.; 0.27% Cu.

Annual recovery of concentrates is then as follows:-

Copper concentrates

Total weight	27,000 tons per annum
Weight of copper	4,600 " " "

Lead concentrates

Total weight	176,000 tons per annum
Weight of lead	88,000 " " "

Comments

The conclusions drawn from the experimental programme do not rule out the possibility of developing a scheme which might permit cobalt and nickel to be recovered from Brown's ore, although they do indicate that such a scheme would have to be based on unconventional technology. Even if such a scheme is feasible and proves to be economic, its development and the demonstration of its reliability would be a long term project; and there is of course no guarantee of success at this stage.

In my opinion, the current prospects for developing an economic scheme are very uncertain, and I consider it would not be desirable to expend significant sums of money on any phase of Brown's development if the economics of the simple flotation plant described above do not appear attractive.

On the other hand, worthwhile quantities of various types of concentrate which can be produced from Brown's ore have been provided by the current test programme, and it would be worthwhile to proceed on a low priority basis with a modest programme (say one officer) to investigate the potential of some of the less conventional schemes which might be applicable to cobalt and nickel recovery.

(sgd) M. G. Baillie

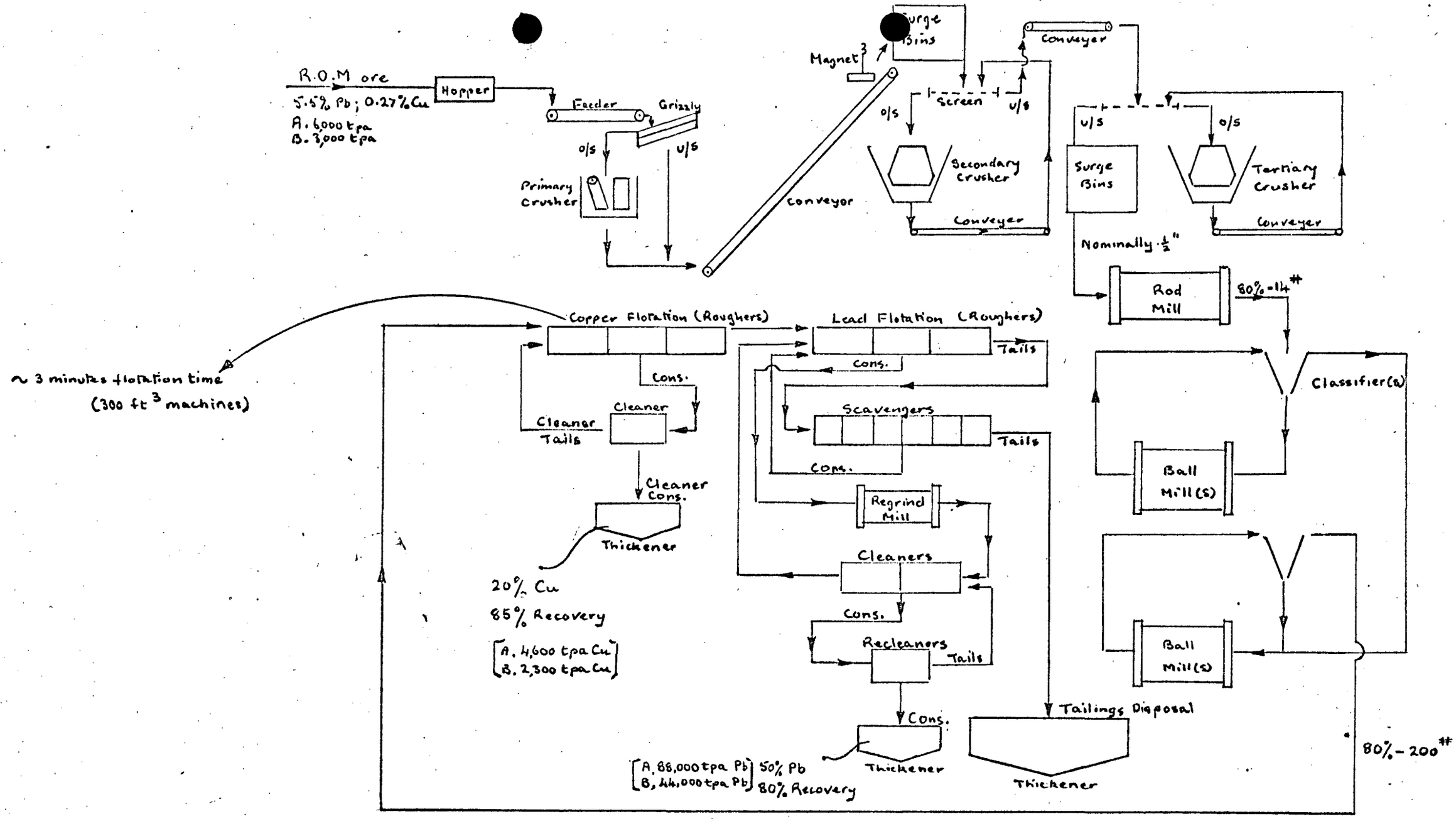


Fig. 1

Flowsheet of Flotation Plant to Treat Brown's Ore

APPENDIX III

BROWN'S SHAFT - DRIVING & DIAMOND DRILLING PROGRAMME

28-1-69

No 3 LEVEL - WEST DRIVE

DRIVE

X-CUT

No 3 LEVEL - EAST DRIVE

DRIVE

X-CUT

No 2 LEVEL WEST DRIVE

DRIVE

X-CUT

No 2 LEVEL EAST DRIVE

DRIVE

X-CUT

DIAMOND DRILLING

No 3 LEVEL

No 2 LEVEL

R. AGNEW

KVESIG

R. AGNEW

R. AGNEW

KVESIG

R. AGNEW

KVESIG

W DRIVE

1210'

INCLINED HOLES E & W DRIVE

550'

W DRIVE

500'

E DRIVE

976'

INCLINED HOLES W DRIVE E DRIVE

230

590'

25/11 8/2 22/1 8/3 22/3 5/4 10/4 3/5 17/5 5/6 14/6 25/6 12/7 26/7 9/8 23/8 6/9 20/9

APPENDIX IV

List of References
Brown's Deposit
Rum Jungle

Romig, W.E. "A Preliminary Study of Brown's Prospect, N.T." Melbourne. Vic. June 1957.

Knight, C.L.
Whitcher, I.G. "Brown's Lead Orebody, Rum Jungle, N.T." C.R.A.E. Ref. No. NT67 March 1959.

Moffitt, R.B. "A Study of Brown's Lead-Copper Deposit, Northern Territory" Rum Jungle, August 1965.

Hughes, F.E. "Brown's Deposit - Rum Jungle" C.R.A.E. Ref. No. 67. July 1968.

Mathiesen, G. Updating of D.A. Berkman's report on heap leaching of copper in Brown's Deposit. February, 1969.

List of Graphs, Calculations and Summaries held at Rum Jungle relevant to the evaluation of Brown's Deposit:

1. Total Open Cut Excavation Calculation to obtain Excavation Volume for each:
   (a) Pit depths (nominal) from 100' to 600'
   (b) Batter slopes 40°, 45° and 50° each with 35° batter from RL 5200 to surface
   (c) N.B.: Volumes increased by 5% to allow for roads and berms.

2. Drawings showing cross sectional dimensions of each open cut design from 100' to 600' depth and varying batter slopes of 40°, 45° and 50°.
   Drawings Nos. B278, 279 280.

3. Summary of Volumes and Tonnages for each open cut design as detailed in (2) above. Details shown:
   (a) Oxidised ore tonnage
   (b) Primary ore tonnage
   (c) Total excavated rock
   (d) Total waste rock
   (e) Waste to ore ratio
   (f) Total ore in pit
   (g) Net remaining to 1,000' depth.

4. Volume of Pit (ore plus waste) between RL 5300 and RL 5200. To be used in calculation of earth-moving equipment requirements.

5. Graphs:

   (a) Unit cost ($ per B.C.Y.) of excavation versus Total cost of total pit excavation for each depth and batter slope combination.

   (b) Unit cost ($ per ton) to excavate ore versus Total cost of total pit excavation (for all).

   (c) Varying L.M.E. values of metals versus Total L.M.E. value of metals in entire ore body for lead, zinc and copper.

   (d) Total ore (B.C.Y.) versus Total pit excavation (for each pit depth and batter angle).

   (e) Pit depth (feet) versus Waste to ore ratio.

   (f) Pit depth (feet) versus Total pit excavation (B.C.Y.).

6. General notes on Mine Area, Township requirements, Labour requirements - incomplete as to numbers.

7. General (only) Flow Sheets of:

   (a) Mining

   (b) Mill

   (c) Transport

8. Updating of D.A. Berkman's report on heap leaching of copper in Brown's Deposit.

APPENDIX V

COPY ONLY

5th March, 1969.

Memorandum to : FILE

Copies to : N.A. Gilberthorpe, Esq.
G. W. McGregor, Esq.

From : J.B. Day

Australian Mining and Smelting Company Limited
Planned Expenditure - Brown's Prospect

I refer to an enquiry from Mr. G.W. McGregor as to whether expenditure on Brown's Prospect is within the sum approved.

Attached is a copy of a note prepared for Mr. A.J. Rew by the Budgeting and Planning Department on 23rd August, 1968, regarding planned expenditure for the year 1969, and forecast expenditure for the four subsequent years 1970/1973.

This showed planned expenditure for 1969 of $240,000, plus the sum of $133,000 for the years 1970/1973.

On 26th August, 1968, Mr. Rew advised that this matter was discussed during the then recent visit by the Chairman to the Rum Jungle area, and confirmed that the

estimated expenditure be included in the Plan on the higher basis indicated in the note from the Budgeting and Planning Department.

Similarly, an amount of $144,000 had been included in the 1968 Plan in addition to planned expenditure of $120,000 for 1967.

These plans had been submitted to and approved by the Board of C.R.A. and, therefore, including expenditure of $65,989 in 1966 which was covered by a specific application to spend $100,000 approved by the Chairman in April, 1966, the total amount approved up to the end of 1969 is $570,000, made up as follows:-

1966	$ 66,000
1967	$120,000
1968	$144,000
1969	$240,000
	$570,000

Actual expenditure to 8th February, 1969, amounts to $394,898, as set out below:-

1966	$ 65,989
1967	$132,638
1968	$181,826
1969	$ 14,445
	$394,898

In the above-mentioned note to Mr. Rew, it was reported that actual expenditure during 1967 was $133,000 and that expenditure during 1968 was then estimated at $167,000.

It is understood from the Budgeting and Planning Department that no specific applications are made by the Exploration Division for approval of exploration expenditure, other than for capital expenditure.

The procedure is that an Exploration Plan is submitted along with other operational plans and, when approved, expenditure may proceed. This is, of course, expected to conform to the Plan.

(sgd) J. B. Day

OPEN FILE

BROWN'S PROSPECT

A FINANCIAL ASSESSMENT.

REF. 1 of 3

TWO of THREE

M6.

8.4

General Mining Division
Technical Report No. 3/69

"BROWN'S PROSPECT - A FINANCIAL ASSESSMENT"

G. W. McGregor
Melbourne
March 1969

24th April, 1969.

Memorandum to : F. S. ANDERSON, ESQ.

Copy : A. J. Rew, Esq.

From : N. A. Gilberthorpe

Brown's Prospect
Technical Report 3/69

1. Sufficient work has now been completed at a cost of $944,000 to assess the degree of attraction of Brown's Prospect as a mining operation.

2. Technical Report 3/69 provides this assessment and concludes that the grade of the deposit is far too low to support a mining operation at present metal prices.

3. Both lead and copper prices would have to double to make Brown's an attractive proposition at 15% D.C.F. return on investment.

4. There is no foreseeable breakthrough to a treatment method which will yield a profitable recovery of nickel and cobalt.

5. Scope and justification exist to continue a modest research programme on nickel and cobalt recovery.

6. It is believed a reliable case exists to retain the title to Brown's leases for some time to come.

7. It is recommended that exploration on Brown's Prospect be suspended indefinitely and future expenditure restricted to continue a modest metallurgical research programme estimated to cost $10-15,000 per annum.

N. A. Gilberthorpe

NAG:JGG

CONZINC RIOTINTO OF AUSTRALIA LIMITED

GENERAL MINING DIVISION

TECHNICAL REPORT NO. 3/69

"B R O W N ' S P R O S P E C T -
A F I N A N C I A L A S S E S S M E N T"

Author: G.W.McGregor
Division Mining
Engineer

Issued: N.A.Gilberthorpe
General Manager

Distribution:

- Directors (2)
  G.M.D. (2)
  A.M.&S. Rum Jungle (1)
  C.R.A.E. (1)
  Research (1)
  Library (1)

Melbourne,
March, 1969.

CONTENTS

APPENDICES

BROWN'S PROSPECT - A FINANCIAL ASSESSMENT

OBJECTS

A number of questions were posed in N. A. Gilberthorpe's memorandum to the author, dated 14th January, 1969. These were:

- Should research and exploration expenditure continue on Brown's Prospect?
- If so, at what expenditure level and at what rate?
- If not, what is the future of the prospect and how may the title be retained?

This assessment sets out to answer these questions.

(See Appendix I for full text of N. A. Gilberthorpe's memorandum).

SUMMARY

Brown's Prospect has been held by the Company since 1956. In the intervening years approximate expenditure on exploration has been $944,000. A further $84,000 will be spent in completing the current underground checking programme.

A number of feasibility studies have been made on the working of the deposit but all came to the same conclusion, that unless nickel and cobalt could be recovered the prospect was not viable.

Recent test work on bulk samples from underground exploration shows that nickel and cobalt cannot be concentrated by simple flotation processes.

The summarised results of the current assessment follow in the form of a financial development.

Premises:

1.	Production Rate	2 million tons ore per year
2.	Total Capital Employed	$41 million
3.	Ore Reserves	13,643,000 tons
4.	Ore Grade	5.5 % Pb
		0.27% Cu
5.	Products	50% Pb concentrate
		20% Cu concentrate
6.	Recovery	
	Mining (dilution 20%)	80%
	Ore dressing	80% Pb
		85% Cu
	Overall	64% Pb
		68% Cu
7.	Waste : Ore Ratio	6.4 : 1

8. Metal Prices:

(in concentrates delivered Japan)

Pb	$A 166 per ton Pb
Cu	$A 607 per ton Cu

(Market prices:

Pb ingots	£UK 85 per ton
Cu bars	£UK308 per ton)

9. Operating Costs:

Mining	$3.89 per ton of ore
Milling	0.85
Admin. and general	0.26
	$5.00 per ton of ore

10. Realisation Costs:

Concentrate cartage to Darwin	$4.20 per ton of concentrate
Wharfage	$7.00 per ton of concentrate
Shipping to Japan	$12.00 per ton of concentrate

Derivations:

1. Recovered grade

Pb	5.5% x 64%	3.52% Pb
Cu	0.27% x 68%	0.18% Cu

2. Ratio of concentration

Pb	50% ÷ 3.52%	14.2
Cu	20% ÷ 0.18%	111.0

3. Concentrates produced per annum

Pb	2,000,000 ÷ 14.2	141,000 tons
Cu	2,000,000 ÷ 111.0	18,000 tons

4. Metal in concentrates per annum

Pb	141,000 x 50%	70,500 tons
Cu	18,000 x 20%	3,600 tons

5. Operating costs per annum

2,000,000 x $5.00	$10,000,000

6. Realisation costs per annum

Cartage 172,000 x $4.20 (159,000 + 8% moisture)	$ 722,000
Wharfage 172,000 x $7.00	$1,204,000
Shipping 172,000 x $12	$2,060,000
	$3,986,000

7. Revenue per annum

Pb 70,500 x $166	$11,700,000
Cu 3,600 x $607	$ 2,185,000
	$13,885,000

8. Reserve Life

$$\frac{13,643,000}{2,000,000}$$

6.8 years

Economics

		$A million
1.	Mine capital and preproduction expenses	29,000
	Interest and working capital	12,200
	Total	41,200
2.	Annual deficit (Revenue less Operating & Realisation Costs)	0,101

3. Return on investment with both lead and copper prices increased by 65% is 1.0% DCF.

4. Return on investment with both lead and copper prices increased by 100% is 15.0% DCF.

5. Return on investment at today's prices with theoretical nickel and cobalt included is nil.

CONCLUSIONS

1. Brown's orebody is not of high enough grade to support a mining operation at present day metal prices.

2. Both lead and copper prices would have to double to make Brown's an attractive proposition, (15% DCF return).

3. The addition of nickel and cobalt recovery to that of lead and copper would not be sufficient to make Brown's a viable proposition at present day prices.

4. The present programme of underground development has served its primary purpose in providing bulk samples for metallurgical testing.

5. The secondary purpose of checking the validity of previous drilling has proceeded far enough to indicate that no significant alteration in grades can be expected.

6. While completion of the underground drilling programme would under normal circumstances be desirable in view of the money spent to date on shaft sinking and driving, it can scarcely be warranted in the case of an orebody so far from being economic.

   Confirming the validity of stated ore reserves would be merely an academic exercise.

7. Sufficient money has been spent on Brown's prospect to date to provide a very strong case for Australian Mining & Smelting Company Limited to continue to hold the leases pending a rise in the price of metals, and improvement in extractive technology.

8. This study points up the conclusions reached by M. G. Baillie and validates his recommendation that it would be worthwhile to proceed on a low priority basis with a modest programme (say one officer) to investigate the potential of some of the less conventional schemes which might be applicable to cobalt and nickel recovery.

RECOMMENDATIONS.

1. Expenditure on exploration at Brown's Prospect should be discontinued forthwith.

2. Research on nickel and cobalt recovery should continue, using concentrates on hand, but this should be of low priority.

3. Brown's leases should be held for as long as it is possible to obtain exemption from the conditions of tenure.

4. No further mining design work should be carried out.

5. At such time as lead and copper prices increase substantially, and nickel - cobalt recovery techniques are developed the project should be reviewed.

DISCOURSE

1. Review of Work Done to Date

1.1 Scope

1.1.1 Exploration

Brown's prospecting leases were taken out as mining leases by Australian Mining & Smelting Company Limited in 1956 after drilling by Enterprise Exploration Proprietary Limited had shown the presence of an interesting lead-copper ore body.

Drilling continued through to 1962 but work on the prospect was then terminated.

In 1965 a decision was made to sink a shaft to a depth of 450 feet in the orebody, and drive, cross cut, and diamond drill underground to provide more information on the ore reserves and the metallurgical behaviour of the ore. This work commenced in 1966 and is now nearing completion.

The results of early exploration were written up by C.L. Knight and I.G. Whitcher, C.R.A. Exploration Proprietary Limited report N.T. 67, March 1959.

Ore reserves were stated to be:

	Tons	%Pb	%Cu	%Co
Sulphide ore	20,542,000	5.4	0.19	0.11
Oxidised ore	2,196,000	4.0	0.47	0.09

Zn (0.3%) and Ni (0.14%) were also present in the sulphide ore, and Ag averaged 1.4 dwt per ton for each 1% Pb.

No meaningful re-assessment of the ore reserves has been carried out since. F.E. Hughes reported the possibility of lower grades in his report NT.67, July 1968, but pointed out that this could be a local phenomenon confined to the shaft area.

It would now appear that this was so; there is at present nothing to indicate that the ore reserve is appreciably different from that stated by Knight & Whitcher, or that the grades are significantly lower.

The ore body is approximately 2,300 feet long and varies in width from 240 feet near the

surface to 40 feet at a depth of 1000 feet. The dip is variable but near vertical in most places. The first 50 feet is oxidised and contains a discrete copper ore body of small size.

1.1.2 Mining Design

A number of reports have been written on the mining of the orebody.

The first, by W.E. Romig, June 1957, suggested shallow open pitting followed by underground mass caving, at a rate of 1,000,000 tons per year. Profitability depended on the sale of Cobalt and Nickel.

T. Barlow, 1960, reported on the feasibility of open pit mining to a depth of 400 feet and R.B. Moffitt incorporated Barlow's planning in his study of the deposit dated August 1965. Once again, the exercise showed an unattractive end result even though an

optimistic view was taken on oxidised metal recovery. Further expenditure on prospecting and metallurgical testing was recommended.

D. Haigh has recently designed an open pit with a depth of 600 feet and taken out quantities for side slopes varying from 40° to 50°.

1.2 Cost

Expenditure by Enterprise Exploration Ltd. on Brown's Prospect between 1956 and 1962 is summarised in K. Hoare's memorandum of 11th November, 1965 as follows:

	£	$
Geological	35,682	
Drilling	157,170	
Metallurgical	43,196	
Administration	37,348	
Leases	1,280	
Total	£274,676	$549,352

In April 1966 a grant of $100,000 was made for further prospecting work, and subsequently two further grants, each of $100,000 were made for shaft sinking, cross cutting, underground diamond drilling and metallurgical testing.

To the end of April 1968, expenditure from these grants had totalled $25[illegible]12. (McDowell memo No. 103, 16th May, 1968).

Since then the average rate of expenditure has been $14,000 per period. Therefore, the total to the end of February 1969 is estimated to be close to $400,000. - see Appendix V.

Total

1956 to February 1969 $344,250

Cost to Complete Present Underground Programme

The programme of driving, cross cutting and diamond drilling is scheduled for completion in September of this year.

Estimated cost

7 periods at $12,000 $84,000

2. Results of Metallurgical Test Work

Work recently carried out on Brown's ore has been reported by M. G. Baillie in his memorandum of 14th January, 1969 - see Appendix II.

The conclusions are:

1. Cobalt and nickel cannot be recovered by flotation into a suitable concentrate for further treatment.

2. Copper recovery of 85% into a concentrate assaying 20% Cu is possible.

3. Lead recovery of 80% into a concentrate assaying 50% Pb is possible.

This memorandum also assesses the capital cost of establishing a flotation mill to treat 2 million tons of ore per year:

Capital Cost	$5.1 million
Estimated Operating Cost	$0.75 per ton ore

These results and costs have been adopted in the current assessment. M. Baillie has further advised that the oxidised ore should not be taken into consideration.

3. Assessment of Mining Costs

3.1 Assumptions

3.1.1 This study is based on 2 million tons of ore per year to conform with M. Baillie's metallurgical report of 14th January, 1969. (Note: R.B. Moffitt's report of August 1965 based on 1 million tons of ore per year).

3.1.2 Quantities of lead-copper ore and waste taken from D. Haigh's median open pit design with 45° batters, 600 foot depth are:

Volumes

Total excavated rock	56,043,000 c. yds.
Total waste rock	47,440,000 c. yds.
Total ore	8,603,000 c. yds.
Sulphide ore	7,579,000 c. yds.

Tonnages

(Density: 1.8 tons per bank yard)

Total excavated rock	100,877,000 tons
Total waste rock	85,392,000 tons
Total ore	15,485,000 tons
Sulphide ore	13,643,000 tons

Neglecting oxide ore the quantities become:

Sulphide ore	13,643,000 tons
Waste rock	87,234,000 tons
Total excavation	100,877,000 tons
Ore : waste ratio	1 : 6.4

3.1.3 It is assumed that mining will be carried out on two shifts of eight hours, six days per week, forty weeks per year. This will allow for 20% loss in time and efficiency due to wet weather over the monsoon period.

3.1.4 Milling costs have already been taken out by M.G. Baillie and these are accepted. However, provision is made for housing mill personnel, and mill staff salaries are added.

3.2 Unit Costs

Wages:	average $1.75 per hour; plus 50% for contract open-pit operators and tradesmen, i.e., $2.62 per hour.
Diesel Fuel:	14 cents/gallon.
Electricity:	3 cents/kwh
Rail Haulage:	64 miles Rum Jungle to Darwin $4.20/ton (Possibility of reduction)
Wharfage Darwin:	$7.00/ton
Housing Cost:	3 bedroom, Rum Jungle $20,000.

Capital cost of rail siding at Brown's $100,000.

3.3 Mining Data

3.3.1 Hours worked:

Allow $\frac{3}{4}$ hr. per shift for stopping and starting losses.

Machine hours per year

$7.25 \times 2 \times 6 \times 40 = 3,480$ hours

Pay hours per year per man

$8 \times 6 \times 50 = 2,400$ hours

3.3.2 Annual Mining rate:

Tons of ore per year 2 million

Total excavation per year 2 million + (2 million x 6.4)

= 14,800,000 tons

3.3.3 Hourly excavation rate:

$$\frac{14,800,000}{3,480} = 4,253 \text{ tons}$$

3.3.4 Life of mine:

$$\frac{13,643,000}{2,000,000} = 6.8 \text{ years}$$

3.4 Mining Equipment

3.4.1 Shovels

Total bucket capacity to mine 4,253 tons per hour:

Operational & mechanical efficiency	85%
Bucket factor	85%
Swell factor	75%
Cycle time	25 seconds
Cycles per hour	144

Cubic yards per hour:

$$\frac{4,253}{1.8 \times 0.85 \times 0.85 \times 0.75} = 4360 \text{ c. yds.}$$

Bucket size:

$$\frac{4,360}{144} = 30.28 \text{ c. yds.}$$

Number of shovels:

3 10-c. yd. machines

3.4.2 Trucks

Assumptions:

Average gradient	1 in 10
Av. speed loaded	10 m.p.h.
Av. speed empty	20 m.p.h.
Av. speed	15 m.p.h.
Haul distance (round trip)	2 miles
Truck capacity assumed	100 tons
Truck availability	60%

Cycle time:

load	2 min. 20 sec.
travel full	6 min.
empty	1 min.
travel empty	3 min.
spot	1 min 40 sec.
	14 min.

∴ each truck makes 4 trips per hour and carries 400 tons per hour.

Hourly tonnage : 4,253

Number of trucks : $\frac{4,253}{400 \times 0.60} = 18$

3.4.3 Drills

Assumptions:

bench height	50 feet
grid spacing	18' x 15'

Cubic yards per hour:

$$\frac{4,253}{1.8} = 2,363$$

$$\text{area} = \frac{2,363 \times 27}{50} = 1,276 \text{ sq. ft.}$$

holes per hour:

$$\frac{1276}{18 \times 15} = 4.72$$

feet drilled per hour:

$$4.72 \times 50 = 236 \text{ feet}$$

Number of drills:

One rotary drill (45R) will be more than adequate to drill all requirements.

3.4.4 Major Auxiliary Items

Bulldozers:

one for each shovel	3
one for tiphead	1
one general duties	1
Total	5

i.e., 5 D9 bulldozers with rippers

Graders:

2 Cat. 12

Water Carts:

2 converted dump trucks.

3.4.5 List of All Capital Items

		$A000
3	10 c.yd. shovels at $750,000	2,250
18	100 ton trucks at $200,000	3,600
5	D9 bulldozers at $110,000	550
2	Cat. 12 graders at $30,000	60
1	45R rotary drill at $670,000	670
2	50-ton water carts at $200,000	400

3.4.5 List of All Capital Items (Cont'd)

		$A000
1	20-ton explosives truck at $50,000	50
2	6000 g.p.h. pumps at $20,000	40
6000	ft. 8" Ø pipeline at $3/ft.	20
2	7-ton service trucks at $20,000	40
12	runabout vehicles at $4,000	50
6000	ft. power line at $7/ft.	40
6	portable transformers at $5000	30
6	cable crossings at $1000	6
3	cable sleds at $1000	3
1	ambulance at $10,000	10
1	fire-engine at $10,000	10
1	magazine at $10,000	10
1	workshop plus equipment	60
1	store	40
1	office	20
1	barracks	60

3.4.5 List of All Capital Items (Cont'd)

		$A000
1	mess	30
1	recreation hut	10
	houses	3,810
	sewage disposal	20
	water supply	20
	communications (20 sets at $500)	10
	siding	100
		12,019
	30% contingency	4,000
	Total mining capital	$16 million

3.5 Manning Schedule

(2 shift basis)

3.5.1 Daily Paid

Shovel operators	3x2	6
Shovel oilers	3x2	6
Truck drivers (100T)	12x2	24
Bulldozer drivers	5x2	10
Grader drivers	2x2	4

3.5.1 Daily Paid (Cont'd)

Water cart drivers	2x2	4
Drillers	2x2	4
Shot firers	2x2	4
Pump attendants	1x2	2
Truck drivers (7T)	1x2	2
Duty drivers	2x2	4
		70
Fitters	4x2	8
Welders	2x2	4
Mechanics	8x2	16
Electrician	2x2	4
Labourers	8x2	16
		48
Gardeners		2
Mess hands		12
Services hands		6
Monitors		4
Watchmen		4
		28
Carpenter		1
Painter		1
Plumber		1
Assistants		3
		6
		152

3.5.2 Staff

Manager	1
Production Superintendent	1
Mine Superintendent	1
Asst. Mine Superintendent	1
Mine foremen	4
Geologist	1
Surveyor	1
Asst. Surveyor	1
Draftsmen	2
Chief Engineer	1
Asst. Engineer	1
Engineering foremen	3
Services foreman	1
Office Manager	1
Accountant	1
Asst. Accountant	1
Chief Clerk	1
Department clerks	3

3.5.2 Staff (Cont'd)

Accounts clerks	4
Chief Storeman	1
Storemen	4
Typists	6
Personnel Officer	1
Secretary	1
Catering Officer	1
	44

3.5.3 Mill Manning

(for housing purposes only)

Operators	8x4	32
Cleaners	2x4	8
		40
Fitters	2x4	8
Electricians	2	2
		10

Staff

Chief Metallurgist	1
Plant Metallurgists	2
Research Metallurgists	2
Mill foremen	4
Laboratory assistants	4
Clerks	2
Typists	2
	17

3.5.4 Total Manning

Daily paid operators	110	
tradesmen	64	
general hands	28	
Total	202	
Total Staff	61	

3.6 Cost of Labour (excluding mill)

70 operators (mine) at $2.62/hr. 2400 hrs/yr	440,160
35 tradesmen at $2.62/hr 2400 hrs/yr	220,080
47 general hands and trades assistants at $1.75/hr 2400 hrs/yr	197,400
	$857,640

Staff Salaries (excluding mill)

44 x $6000 x 2	$528,000

Mill Staff

17 x $6000 x 2	$204,000

3.7 Housing Requirements

202 daily paid workers

61 staff

Provide housing for 75% of staff, i.e.,	45
Single quarters, female staff	8
Single quarters, male staff	8
Provide housing for 66% of daily paid workers, i.e.,	133
Barracks for remainder, i.e.,	69

Cost of Housing

178 houses at $20,000		3,560,000
1 Single girls' quarters	Motel style	20,000
1 Single men's quarters	Motel style	20,000
9 8-men barrack blocks	Motel style	180,000
1 Guesthouse at $30,000		30,000
		$3,810,000

3.8 Annual Operating Costs

3.8.1 Mining

Labour	Daily paid	857,640
	Staff	528,000
		1,385,640

Stores

Parts: (10% of value of machines i.e., 10% of $10,412,000)	1,041,000
Fuel & Tyres:	
18 trucks at 2 cents/ton mile	
14,800,000 tons x 2 miles x 2 cents	592,000
5 tractors, 4000 hrs each, 16 galls per hour, at 14 cents/gall	44,800
Other vehicles	50,000
Explosives:	
0.75 lbs. gelignite per ton excavated at 40 cents/lb including fuse & detonators 14,800,000 x 0.75 x 40 cents	4,440,000
	6,167,800

3.8.1 Mining (Cont'd)

Power

0.40 kwh per ton excavated at 3 cents per kwh 14,800,000 x 0.40 x 3 cents	177,600
0.1 kwh per ton drilled	44,000
	221,600
Total mining cost	$7,775,040
Cost per ton excavated $\frac{7,775,040}{14,800,000}$	$0.5253/ton
Cost per ton of ore $\frac{7,775,040}{2,000,000}$	$3.8875/ton ore

3.8.2 Milling costs (after Baillie)	$0.75 per ton ore
Add mill staff salaries	0.10
	$0.85 per ton ore

3.8.3 Administration and General

Melbourne Office	$100,000
Royalties	$100,000
Subsidies	$ 50,000
Contingencies	$170,000
Insurances	$100,000
	$520,000

$0.26 per ton ore

3.8.4 Total Operating Cost

$5.00 per ton ore

4. Schedule of Smelter Payments.

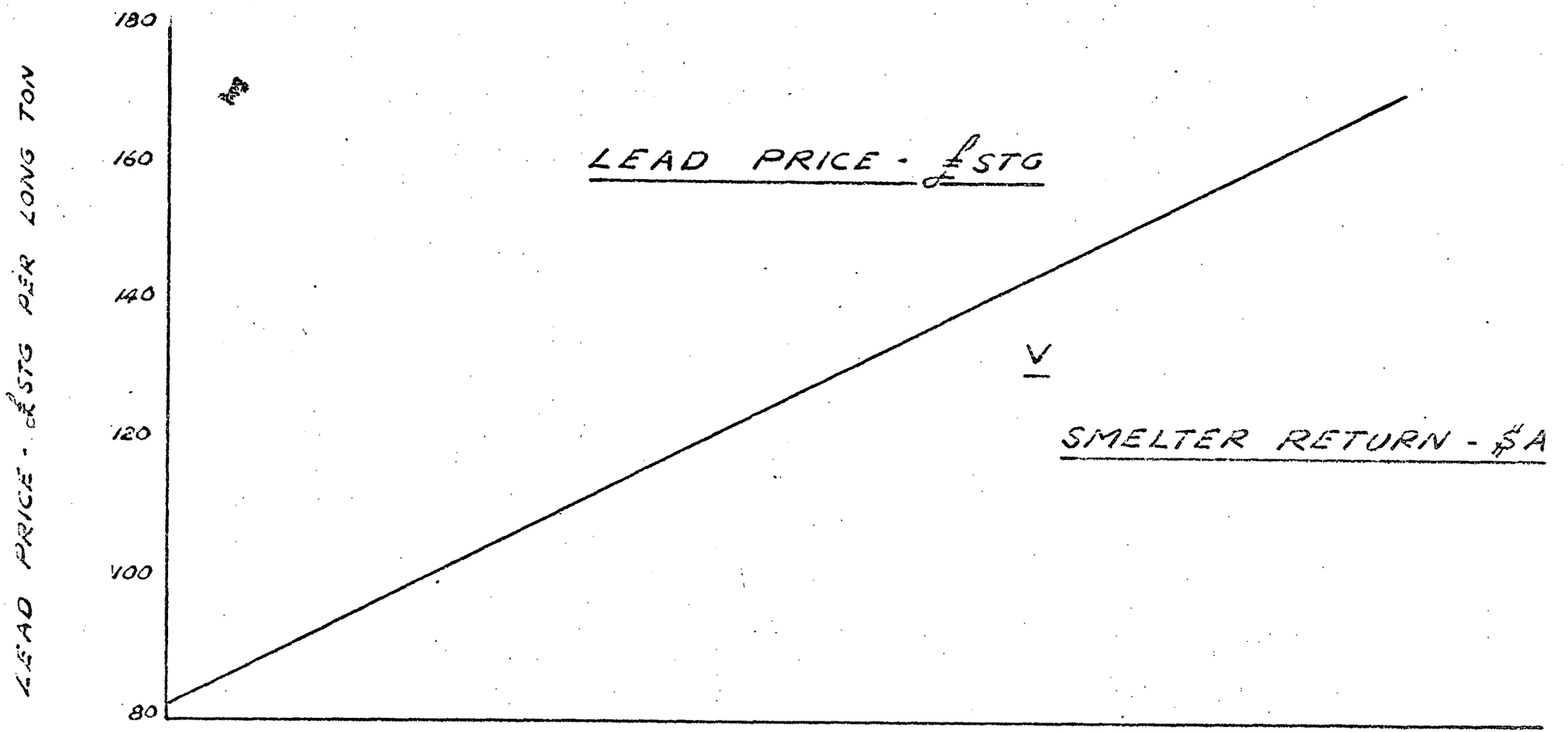
Pb - paid for 94% of Pb in concentrates, less treatment charge of £UK.6 per long dry ton of concentrates.

Cu - paid for full Cu content less 1 unit at Zambian producers price less 1.3 cents U.S. per lb., less a treatment charge of $US.15 per dry metric ton. (Producers price £UK.308).

4.1 Lead payment per ton Pb in 50% concentrate

$$£UK.85 \times \frac{94}{100} - 3 = £76.90$$

$$\frac{76.90 \times 20}{9.25} = \$A166$$


LEAD PRICE - £STG PER LONG TON
180
160
140
120
100
80
LEAD PRICE - £STG
SMELTER RETURN - $A
160
180
200
220
240
260
280
300
320
340
360
SMELTER RETURN - $A PER LONG TON
OF LEAD IN 50% CONCENTRATE

G.W.M.G 1-3-69

4.2 Copper Payment per ton in 20% concentrate

£UK.308 = $US.740 per long ton Cu

$\frac{19}{20}$ x 740 = $US.703 per long ton Cu

less $0.013 per lb = 0.013 x 2240

= $29.10

703 - 29.10 = $US.673.90 per long ton

less $US.15 per dry metric ton of concentrate

i.e., $\frac{15 \times 1.016 \times 20}{100}$ per long ton Cu

= $US.3.20

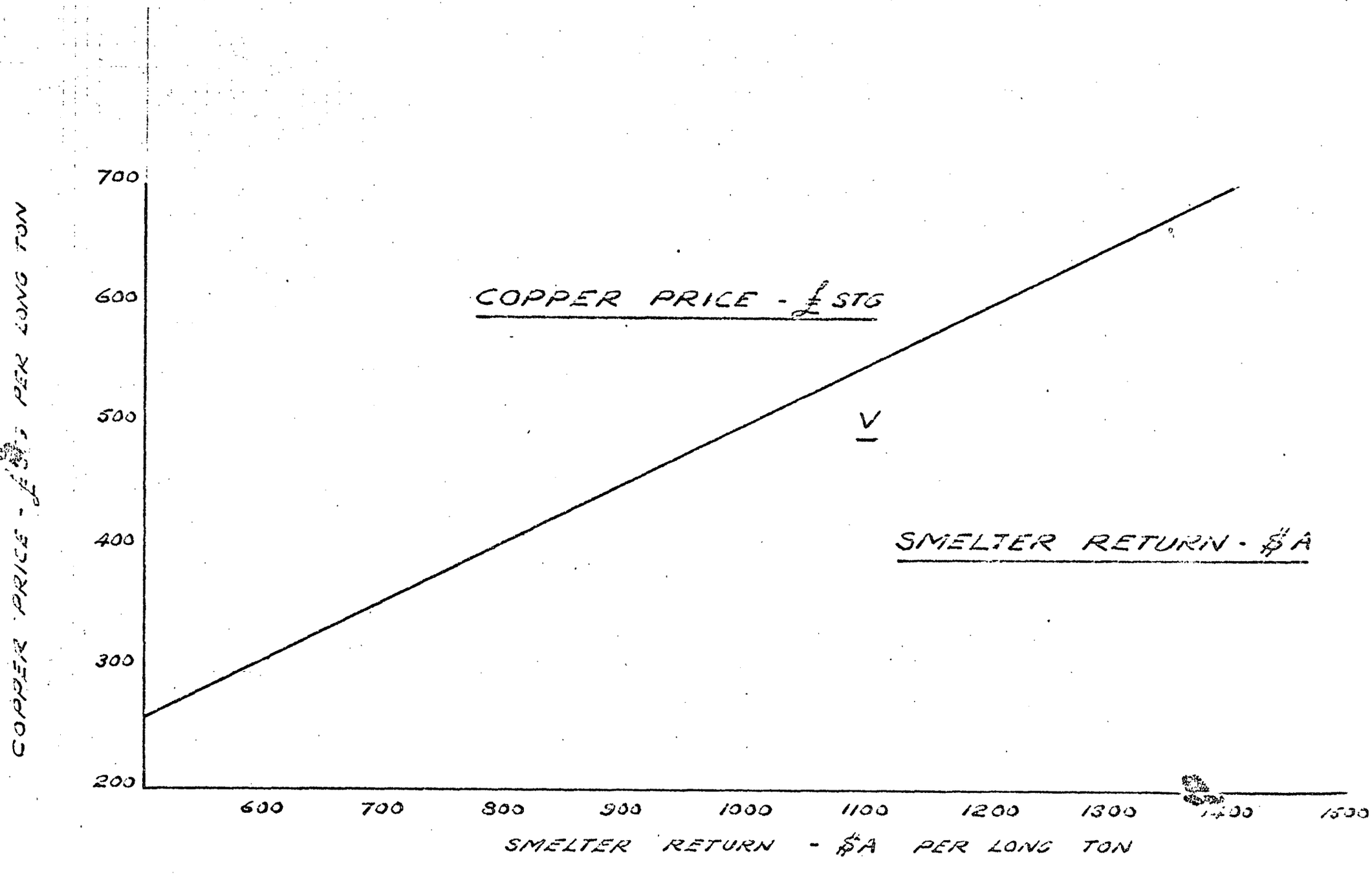
673.90 - 3.20 = $US.670.70 per long ton Cu

= $A607

1 long ton = 1.016 metric tons

£UK.1 = $US.2.40

= $A 2.16


COPPER PRICE - £ STG PER LONG TON
700
600
500
400
300
200
COPPER PRICE - £ STG
V
SMELTER RETURN - $A
600
700
800
900
1000
1100
1200
1300
1400
1500
SMELTER RETURN - $A PER LONG TON
OF COPPER IN 20% CONCENTRATE

5. Effect of Metal Prices on Economics

Consider lead and copper prices increased by 65% -

Pb at £139 per long ton

Cu at £502 per long ton

Smelter return (from graphs) -

Pb $A 274

Cu $A1001

Total funds employed:

	$A million	$A million
Mine capital	21.000	
Interest at 10% over 2 yrs	4.400	25.400
Pre-production	8.000	
Interest at 10% over 1 yr.	0.800	8.800
Working capital	7.000	7.000
Total		41.200

Revenue per annum:

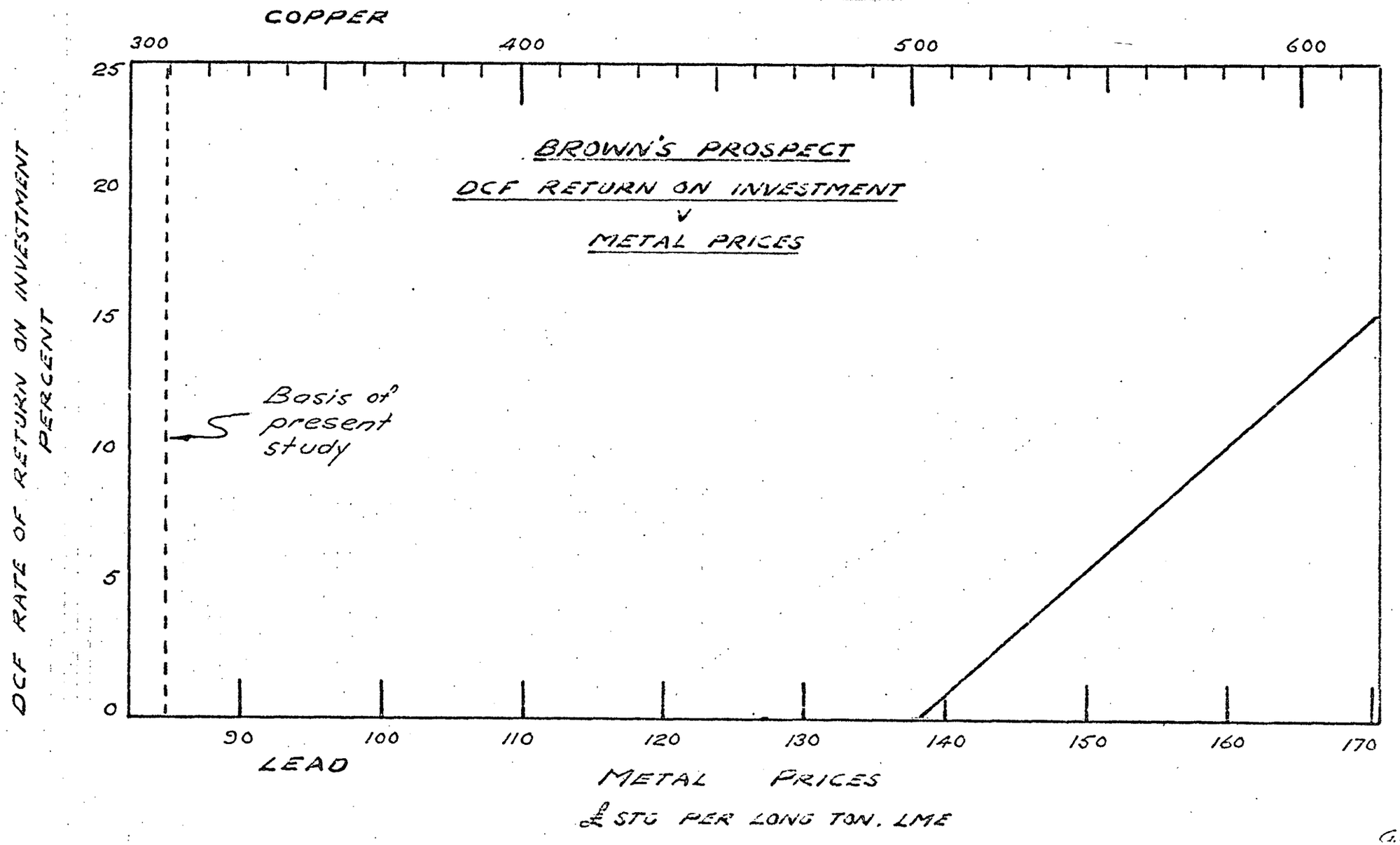
Pb 70,500 x 274	19.310
Cu 3,600 x 1001	3.605
	22.915

Gross Surplus:

Revenue	22.915
Ore cost	13.986
	$8,929

	$A million p.a.
Payback:	
Gross surplus	8.929
Deduct	
Depreciation over 7 years on mine capital and pre-production expenses	4.150
Result	4.779
Deduct	
Tax at 36%	1.720
Nett income	3.059
Add	
Depreciation	4.150
Cash flow	7.209
Payback $\frac{41.200}{7.209}$	5.7 years
Return on investment:	1.0% DCF

Returns for further price increases are graphed on the next page.


COPPER
300
400
500
600
25
20
15
10
5
0
BROWN'S PROSPECT
DCF RETURN ON INVESTMENT
V
METAL PRICES
Basis of present study
DCF RATE OF RETURN ON INVESTMENT
PERCENT
90
100
110
120
130
140
150
160
170
LEAD
METAL PRICES
£ STG PER LONG TON, LME

G.M.M.G. 1-3-6

6. Effect of Nickel - Cobalt Recovery

6.1 Nickel

70% recovery of 0.14% N:	2,000 tons p.a.
2000 tons at $0.70 per lb. in concentrates, at Japanese port	$3,000,000 p.a.

6.2 Cobalt

70% recovery of 0.11% Co	1,540 tons p.a.
1540 tons at $1.10 per lb. (assumed) in concentrates at Japanese port	$3,800,000 p.a.

If it be assumed that all costs of mining, milling and transport are met by lead and copper then nickel and cobalt would provide an annual gross surplus of approximately $6 million, and annual cash flow of $5 million.

This is insufficient to return the capital over the life of the mine. The D.C.F. rate of return is therefore less than zero.

7. Effect of Contract Excavation

Assumption: $0.75 per ton contract price (based on Moffitt's figure of 12/- per c.yd.).

Annual Operating Cost:

Contract	
14,800,000 tons at $0.75	$11,100,000
Supervision	
20 mining staff at $12,000	
17 milling staff at $12,000	$ 440,000
Milling	
2,000,000 tons at $0.75	$ 1,500,000
Administration & general	$ 520,000
	$13,560,000
Realisation Costs	$ 3,986,000
Total Operating & Realisation	$17,546,000
Annual Revenue	$13,885,000
Annual Loss	$ 3,661,000

G. A. McGregor.

APPENDIX I

COPY ONLY

14th January, 1969.

Memorandum to : G. W. McGREGOR, ESQ.

Copies : N. R. McDowell, Esq.

Dr. J. C. Nixon

D. S. Carruthers, Esq.

From : N. A. Gilberthorpe

Brown's Prospect

Should we continue research and exploration expenditure on Brown's Prospect? If so, at what expenditure level and with what objective? If not, what is the future of the prospect and how do we retain the title?

Investigation work on this prospect has reached a stage where answers must be provided to those questions. Would you undertake this assignment please and aim to complete it not later than February 28, 1969. To arrive at these answers the suggested approach is:

Review briefly the scope and cost of work done to date including Romig's report dated June, 1957.

Gather in results of latest metallurgical testing from Amdel now being processed and translated into economic terms by M.G. Baillie.

Through Noel McDowell, liaise with Haigh of TEP who has been working up preliminary estimates of engineering and community costs attached to Brown's development.

Combine all information and derive a complete study, classification grade 4 or grade 3. Adopt two cases, one at 3000 tons per day and the other at 6000 tons per day using CRA metal prices and return on investment of 10% and 15% DCF. Should the viability be doubtful with these parameters, extend the study to point up metal prices required to make an operation viable.

Seek opinion from Dr. Nixon on the desirability of persevering with further test work, pressure leaching for example.

From this work the answers posed in the first paragraph will emerge after due consideration is given to the practical aspects of maintaining our title and access to the prospect.

(sgd) N. A. Gilberthorpe

APPENDIX II

COPY ONLY

14th January, 1969.

Memorandum to : N. A. GILBERTHORPE, ESQ.

Copy to : Dr. J. C. Nixon

From : M. G. Baillie

Brown's Deposit - Processing Costs and Recovery

Experimental testing of Brown's ore has been proceeding at Amdel for some time. Broadly the aim of this work has been to investigate the potential of flotation to upgrade Brown's ore into -

(a) a series of separate sulphide concentrates for sale

(b) a bulk sulphide concentrate for sale or further treatment

(c) a combination of separate concentrates and bulk concentrates.

Sufficient work has now been done for the following summary of results to be prepared:-

1. Copper can be recovered into a concentrate assaying 20% Cu with a recovery of 85%.

2. Approximately 80 percent of the lead can be recovered in a concentrate assaying 50 percent lead. Under the conditions required for this result, cobalt and nickel report mainly with the tailings and are not recoverable in an acceptable concentrate by flotation.

3. Alternatively, about 40 percent of the lead can be recovered in a concentrate assaying 52 percent lead and a further 54 percent in a lead-cobalt middling assaying 6 percent lead and 0.16 percent cobalt (80 percent cobalt recovery). This middling is very little different in composition to the feed material and represents 50 percent of the total feed to the circuit.

From the above results, the following conclusions are drawn for preliminary evaluation purposes:-

1. Cobalt and nickel cannot be recovered by flotation into a suitable concentrate for further treatment. Their value must therefore be ignored in preliminary cost evaluations.

2. Copper recovery of 85% into a concentrate assaying 20% Cu is possible.

3. Lead recovery of 80% into a concentrate assaying 50% Pb is possible.

Based on the conclusions set out, Figure 1, which is a flowsheet for an operation treating 2 million tons per annum of Brown's ore, has been prepared. It is a conventional flotation mill.

Capital Costs

Using Figure 1 and costs of equipment delivered by sea to Bougainville as a guide, the following major equipment costs have been estimated:-

Major Equipment Costs	$ 000
Feed Hopper	10
Feeder	20
Grizzly	10
Primary Crusher	50
Conveyor	60
Magnet and Surge Bins (12,000 tons)	60
Screen	20
Secondary crushing (1 x Standard 7' Symons)	100
Conveyors	50
Screens	40
Belt feeders	20
Surge Bins (5,000 tons)	30
Conveyor and tripper	40
Tertiary crusher	110
Feeder belts	30
Rodmill and motor	125

Major Equipment Costs (Cont'd)	$ 000
Cyclones, feed pumps and motors	40
Ball mill (1)	125
Ball mill (2)	200
Cyclones, feed pumps and motors (2 sets)	80
Flotation cells (16 x 300 ft^3)	80
Pumps, pulp distributors etc.	20
Concentrate thickeners (1 x 125')	75
" " (1 x 50')	45
Filtration	20
Pumps, agitation etc.	20
Reagent makeup	20
Tailings thickener and disposal	100
TOTAL	1,600

To this total must be added the factored cost of the following, which are estimated as a percentage of the delivered equipment cost.

Installation	50%
Piping	25%
Instruments	15%
Electrical	20%
Buildings, foundations etc.	25%
Services	20%
Engineering, construction, contractors	40%
Contingency	25%
	220%

Total cost of operational plant is thus (3.2 x 1.6) =

$5.1 million

Operating Costs

Operating costs are very difficult to estimate from first principles at this stage, hence they have been estimated by analogy with both the Bougainville costs and published costs for other plants.

Estimated operating cost is $0.75 per ton of ore treated

i.e., $1.5 million per annum.

Concentrate Recovered

The average grade of ore fed to the mill is:

5.5% Pb.; 0.2% Cu.

Annual recovery of concentrates is then as follows:-

Copper concentrates

Total weight	27,000 tons per annum
Weight of copper	4,600 " " "

Lead concentrates

Total weight	176,000 tons per annum
Weight of lead	88,000 " " "

Comments

The conclusions drawn from the experimental programme do not rule out the possibility of developing a scheme which might permit cobalt and nickel to be recovered from Brown's ore, although they do indicate that such a scheme would have to be based on unconventional technology. Even if such a scheme is feasible and proves to be economic, its development and the demonstration of its reliability would be a long term project; and there is of course no guarantee of success at this stage.

In my opinion, the current prospects for developing an economic scheme are very uncertain, and I consider it would not be desirable to expend significant sums of money on any phase of Brown's development if the economics of the simple flotation plant described above do not appear attractive.

On the other hand, worthwhile quantities of various types of concentrate which can be produced from Brown's ore have been provided by the current test programme, and it would be worthwhile to proceed on a low priority basis with a modest programme (say one officer) to investigate the potential of some of the less conventional schemes which might be applicable to cobalt and nickel recovery.

(sgd) M. G. Baillie

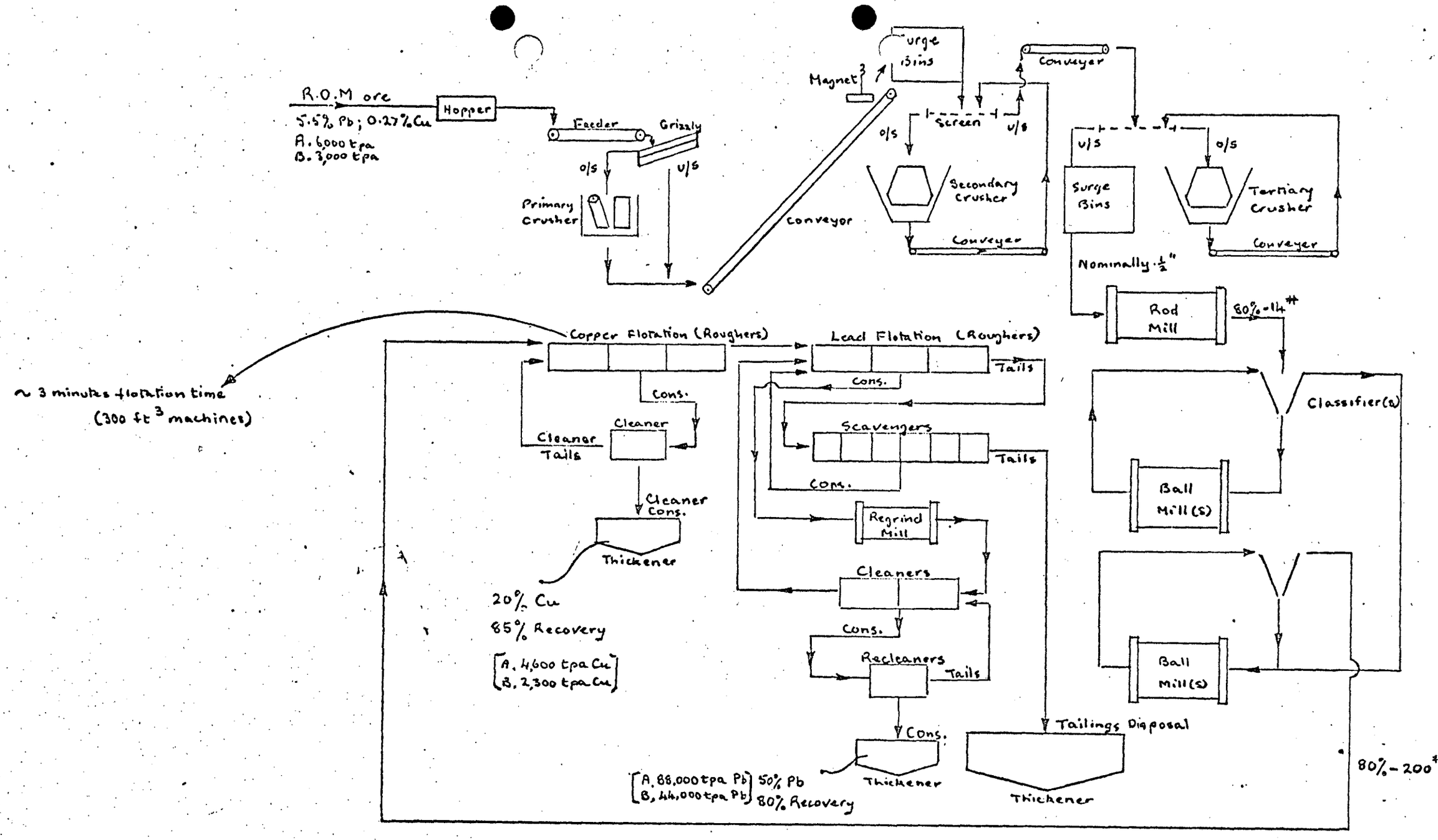


Fig. 1

Flowsheet of Flotation Plant to Treat Brown's Ore

APPENDIX III

BROWN'S SHAFT - DRIVING & DIAMOND DRILLING PROGRAMME

28-1-6

No 3 LEVEL - WEST DRIVE

DRIVE

X-CUT

No 3 LEVEL - EAST DRIVE

DRIVE

X-CUT

No 2 LEVEL WEST DRIVE

DRIVE

X-CUT

No 2 LEVEL EAST DRIVE

DRIVE

X-CUT

DIAMOND DRILLING

No 3 LEVEL

No 2 LEVEL

R AGNEW

KVESIC

R AGNEW

KVESIC

R AGNEW

KVESIC

R AGNEW

KVESIC

W DRIVE 1210'

INCLINED HOLES E & W DRIVE 550'

W DRIVE 500'

E DRIVE 976'

INCLINED HOLES W DRIVE E DRIVE 230' 590'

25/11 3/2 22/11 8/3 22/3 5/4 12/4 3/5 17/5 21/5 14/6 22/6 12/7 24/7 7/8 23/8 6/9 19/9

APPENDIX IV

List of References
Brown's Deposit
Rum Jungle

Romig, W.E. "A Preliminary Study of Brown's Prospect, N.T." Melbourne. Vic. June 1957.

Knight, C.L.
Whitcher, I.G. "Brown's Lead Orebody, Rum Jungle, N.T." C.R.A.E. Ref. No. NT67 March 1959.

Moffitt, R.B. "A Study of Brown's Lead-Copper Deposit, Northern Territory" Rum Jungle, August 1965.

Hughes, F.E. "Brown's Deposit - Rum Jungle" C.R.A.E. Ref. No. 67. July 1968.

Mathiesen, G. Updating of D.A. Berkman's report on heap leaching of copper in Brown's Deposit. February, 1969.

List of Graphs, Calculations and Summaries held at Rum Jungle relevant to the evaluation of Brown's Deposit:

1. Total Open Cut Excavation Calculation to obtain Excavation Volume for each:
   (a) Pit depths (nominal) from 100' to 600'
   (b) Batter slopes 40°, 45° and 50° each with 35° batter from RL 5200 to surface
   (c) N.B.: Volumes increased by 5% to allow for roads and berms.

2. Drawings showing cross sectional dimensions of each open cut design from 100' to 600' depth and varying batter slopes of 40°, 45° and 50°.
   Drawings Nos. B278, 279 280.

3. Summary of Volumes and Tonnages for each open cut design as detailed in (2) above. Details shown:
   (a) Oxidised ore tonnage
   (b) Primary ore tonnage
   (c) Total excavated rock
   (d) Total waste rock
   (e) Waste to ore ratio
   (f) Total ore in pit
   (g) Net remaining to 1,000' depth.

4. Volume of Pit (ore plus waste) between RL 5300 and RL 5200. To be used in calculation of earth-moving equipment requirements.

5. Graphs:

   (a) Unit cost ($ per B.C.Y.) of excavation versus Total cost of total pit excavation for each depth and batter slope combination.

   (b) Unit cost ($ per ton) to excavate ore versus Total cost of total pit excavation (for all).

   (c) Varying L.M.E. values of metals versus Total L.M.E. value of metals in entire ore body for lead, zinc and copper.

   (d) Total ore (B.C.Y.) versus Total pit excavation (for each pit depth and batter angle).

   (e) Pit depth (feet) versus Waste to ore ratio.

   (f) Pit depth (feet) versus Total pit excavation (B.C.Y.).

6. General notes on Mine Area, Township requirements, Labour requirements - incomplete as to numbers.

7. General (only) Flow Sheets of:

   (a) Mining

   (b) Mill

   (c) Transport

8. Updating of D.A. Berkman's report on heap leaching of copper in Brown's Deposit.

APPENDIX V

COPY ONLY

5th March, 1969.

Memorandum to : FILE

Copies to : N.A. Gilberthorpe, Esq.
G. W. McGregor, Esq.

From : J.B. Day

Australian Mining and Smelting Company Limited
Planned Expenditure - Brown's Prospect

I refer to an enquiry from Mr. G.W. McGregor as to whether expenditure on Brown's Prospect is within the sum approved.

Attached is a copy of a note prepared for Mr. A.J. Rew by the Budgeting and Planning Department on 23rd August, 1968, regarding planned expenditure for the year 1969, and forecast expenditure for the four subsequent years 1970/1973.

This showed planned expenditure for 1969 of $240,000, plus the sum of $133,000 for the years 1970/1973.

On 26th August, 1968, Mr. Rew advised that this matter was discussed during the then recent visit by the Chairman to the Rum Jungle area, and confirmed that the

estimated expenditure be included in the Plan on the higher basis indicated in the note from the Budgeting and Planning Department.

Similarly, an amount of $144,000 had been included in the 1968 Plan in addition to planned expenditure of $120,000 for 1967.

These plans had been submitted to and approved by the Board of C.R.A. and, therefore, including expenditure of $65,989 in 1966 which was covered by a specific application to spend $100,000 approved by the Chairman in April, 1966, the total amount approved up to the end of 1969 is $570,000, made up as follows:-

1966	$ 66,000
1967	$120,000
1968	$144,000
1969	$240,000
	$570,000

Actual expenditure to 8th February, 1969, amounts to $394,898, as set out below:-

1966	$ 65,989
1967	$132,638
1968	$181,826
1969	$ 14,445
	$394,898

In the above-mentioned note to Mr. Rew, it was reported that actual expenditure during 1967 was $133,000 and that expenditure during 1968 was then estimated at $167,000.

It is understood from the Budgeting and Planning Department that no specific applications are made by the Exploration Division for approval of exploration expenditure, other than for capital expenditure.

The procedure is that an Exploration Plan is submitted along with other operational plans and, when approved, expenditure may proceed. This is, of course, expected to conform to the Plan.

(sgd) J. B. Day

Brown's Lead Deposit - Feasibility Study Report
Meeting Between National Development and Interior -
Draft Agenda

---

(1) Summary of comments and possible "action" on report

- any additions or variations to list attached.

(2) Revised cash flow analysis

- validity of price and other assumptions in Interior's analysis (attached);
- prospects of viability.

(3) Method of approach and issues for discussion with C.R.A. if our assessment is that

(a) project is likely to be viable;

(b) project is clearly not viable at this stage.

(4) Any need for further work or another meeting.

(5) Arrangements for meeting with Company.

General Mining Division
Technical Report No. 3/69

"BROWN'S PROSPECT - A FINANCIAL ASSESSMENT"

G. W. McGregor
Melbourne
March 1969

24th April, 1969.

Memorandum to : F. S. ANDERSON, ESQ.

Copy : A. J. Rew, Esq.

From : N. A. Gilberthorpe

Brown's Prospect
Technical Report 3/69

1. Sufficient work has now been completed at a cost of $944,000 to assess the degree of attraction of Brown's Prospect as a mining operation.

2. Technical Report 3/69 provides this assessment and concludes that the grade of the deposit is far too low to support a mining operation at present metal prices.

3. Both lead and copper prices would have to double to make Brown's an attractive proposition at 15% D.C.F. return on investment.

4. There is no foreseeable breakthrough to a treatment method which will yield a profitable recovery of nickel and cobalt.

5. Scope and justification exist to continue a modest research programme on nickel and cobalt recovery.

6. It is believed a reliable case exists to retain the title to Brown's leases for some time to come.

7. It is recommended that exploration on Brown's Prospect be suspended indefinitely and future expenditure restricted to continue a modest metallurgical research programme estimated to cost $10-15,000 per annum.

N. A. Gilberthorpe

NAG:JGG

CONZINC RIOTINTO OF AUSTRALIA LIMITED

GENERAL MINING DIVISION

TECHNICAL REPORT NO. 3/69

"B R O W N ' S P R O S P E C T -
A F I N A N C I A L A S S E S S M E N T"

Author: G.W.McGregor
Division Mining
Engineer

Issued: N.A.Gilberthorpe
General Manager

Distribution:

- Directors (2)
  G.M.D. (2)
  A.M.&S. Rum Jungle (1)
  C.R.A.E. (1)
  Research (1)
  Library (1)

Melbourne,
March, 1969.

CONTENTS

APPENDICES

BROWN'S PROSPECT - A FINANCIAL ASSESSMENT

OBJECTS

A number of questions were posed in N. A. Gilberthorpe's memorandum to the author, dated 14th January, 1969. These were:

- Should research and exploration expenditure continue on Brown's Prospect?
- If so, at what expenditure level and at what rate?
- If not, what is the future of the prospect and how may the title be retained?

This assessment sets out to answer these questions.

(See Appendix I for full text of N. A. Gilberthorpe's memorandum).

SUMMARY

Brown's Prospect has been held by the Company since 1956. In the intervening years approximate expenditure on exploration has been $944,000. A further $84,000 will be spent in completing the current underground checking programme.

A number of feasibility studies have been made on the working of the deposit but all came to the same conclusion, that unless nickel and cobalt could be recovered the prospect was not viable.

Recent test work on bulk samples from underground exploration shows that nickel and cobalt cannot be concentrated by simple flotation processes.

The summarised results of the current assessment follow in the form of a financial development.

Premises:

1.	Production Rate	2 million tons ore per year
2.	Total Capital Employed	$41 million
3.	Ore Reserves	13,643,000 tons
4.	Ore Grade	5.5% Pb
		0.27% Cu
5.	Products	50% Pb concentrate
		20% Cu concentrate
6.	Recovery	
	Mining (dilution 20%)	80%
	Ore dressing	80% Pb
		85% Cu
	Overall	64% Pb
		68% Cu
7.	Waste : Ore Ratio	6.4 : 1

8. Metal Prices:

(in concentrates delivered Japan)

Pb	$A 166 per ton Pb
Cu	$A 607 per ton Cu

(Market prices:

Pb ingots	£UK 85 per ton
Cu bars	£UK308 per ton)

9. Operating Costs:

Mining	$3.89 per ton of ore
Milling	0.85
Admin. and general	0.26
	$5.00 per ton of ore

10. Realisation Costs:

Concentrate cartage to Darwin	$4.20 per ton of concentrate
Wharfage	$7.00 per ton of concentrate
Shipping to Japan	$12.00 per ton of concentrate

Derivations:

1. Recovered grade

Pb	5.5% x 64%	3.52% Pb
Cu	0.27% x 68%	0.18% Cu

2. Ratio of concentration

Pb	50% ÷ 3.52%	14.2
Cu	20% ÷ 0.18%	111.0

3. Concentrates produced per annum

Pb	2,000,000 ÷ 14.2	141,000 tons
Cu	2,000,000 ÷ 111.0	18,000 tons

4. Metal in concentrates per annum

Pb	141,000 x 50%	70,500 tons
Cu	18,000 x 20%	3,600 tons

5. Operating costs per annum

2,000,000 x $5.00	$10,000,000

6. Realisation costs per annum

Cartage 172,000 x $4.20 (159,000 + 8% moisture)	$ 722,000
Wharfage 172,000 x $7.00	$1,204,000
Shipping 172,000 x $12	$2,060,000
	$3,986,000

7. Revenue per annum

Pb 70,500 x $166	$11,700,000
Cu 3,600 x $607	$ 2,185,000
	$13,885,000

8. Reserve Life

$$\frac{13,643,000}{2,000,000}$$

6.8 years

Economics

		$A million
1.	Mine capital and preproduction expenses	29,000
	Interest and working capital	12,200
	Total	41,200
2.	Annual deficit (Revenue less Operating & Realisation Costs)	0,101

3. Return on investment with both lead and copper prices increased by 65% is 1.0% DCF.

4. Return on investment with both lead and copper prices increased by 100% is 15.0% DCF.

5. Return on investment at today's prices with theoretical nickel and cobalt included is nil.

CONCLUSIONS

1. Brown's orebody is not of high enough grade to support a mining operation at present day metal prices.

2. Both lead and copper prices would have to double to make Brown's an attractive proposition, (15% DCF return).

3. The addition of nickel and cobalt recovery to that of lead and copper would not be sufficient to make Brown's a viable proposition at present day prices.

4. The present programme of underground development has served its primary purpose in providing bulk samples for metallurgical testing.

5. The secondary purpose of checking the validity of previous drilling has proceeded far enough to indicate that no significant alteration in grades can be expected.

6. While completion of the underground drilling programme would under normal circumstances be desirable in view of the money spent to date on shaft sinking and driving, it can scarcely be warranted in the case of an orebody so far from being economic.

   Confirming the validity of stated ore reserves would be merely an academic exercise.

7. Sufficient money has been spent on Brown's prospect to date to provide a very strong case for Australian Mining & Smelting Company Limited to continue to hold the leases pending a rise in the price of metals, and improvement in extractive technology.

8. This study points up the conclusions reached by M. G. Baillie and validates his recommendation that it would be worthwhile to proceed on a low priority basis with a modest programme (say one officer) to investigate the potential of some of the less conventional schemes which might be applicable to cobalt and nickel recovery.

RECOMMENDATIONS.

1. Expenditure on exploration at Brown's Prospect should be discontinued forthwith.

2. Research on nickel and cobalt recovery should continue, using concentrates on hand, but this should be of low priority.

3. Brown's leases should be held for as long as it is possible to obtain exemption from the conditions of tenure.

4. No further mining design work should be carried out.

5. At such time as lead and copper prices increase substantially, and nickel - cobalt recovery techniques are developed the project should be reviewed.

DISCOURSE

1. Review of Work Done to Date

1.1 Scope

1.1.1 Exploration

Brown's prospecting leases were taken out as mining leases by Australian Mining & Smelting Company Limited in 1956 after drilling by Enterprise Exploration Proprietary Limited had shown the presence of an interesting lead-copper ore body.

Drilling continued through to 1962 but work on the prospect was then terminated.

In 1965 a decision was made to sink a shaft to a depth of 450 feet in the orebody, and drive, cross cut, and diamond drill underground to provide more information on the ore reserves and the metallurgical behaviour of the ore. This work commenced in 1966 and is now nearing completion.

The results of early exploration were written up by C.L. Knight and I.G. Whitcher, C.R.A. Exploration Proprietary Limited report N.T. 67, March 1959.

Ore reserves were stated to be:

	Tons	%Pb	%Cu	%Co
Sulphide ore	20,542,000	5.4	0.19	0.11
Oxidised ore	2,196,000	4.0	0.47	0.09

Zn (0.3%) and Ni (0.14%) were also present in the sulphide ore, and Ag averaged 1.4 dwt per ton for each 1% Pb.

No meaningful re-assessment of the ore reserves has been carried out since. F.E. Hughes reported the possibility of lower grades in his report NT.67, July 1968, but pointed out that this could be a local phenomenon confined to the shaft area.

It would now appear that this was so; there is at present nothing to indicate that the ore reserve is appreciably different from that stated by Knight & Whitcher, or that the grades are significantly lower.

The ore body is approximately 2,300 feet long and varies in width from 240 feet near the

surface to 40 feet at a depth of 1000 feet. The dip is variable but near vertical in most places. The first 50 feet is oxidised and contains a discrete copper ore body of small size.

1.1.2 Mining Design

A number of reports have been written on the mining of the orebody.

The first, by W.E. Romig, June 1957, suggested shallow open pitting followed by underground mass caving, at a rate of 1,000,000 tons per year. Profitability depended on the sale of Cobalt and Nickel.

T. Barlow, 1960, reported on the feasibility of open pit mining to a depth of 400 feet and R.B. Moffitt incorporated Barlow's planning in his study of the deposit dated August 1965. Once again, the exercise showed an unattractive end result even though an

optimistic view was taken on oxidised metal recovery. Further expenditure on prospecting and metallurgical testing was recommended.

D. Haigh has recently designed an open pit with a depth of 600 feet and taken out quantities for side slopes varying from 40° to 50°.

1.2 Cost

Expenditure by Enterprise Exploration Ltd. on Brown's Prospect between 1956 and 1962 is summarised in K. Hoare's memorandum of 11th November, 1965 as follows:

	£	$
Geological	35,682	
Drilling	157,170	
Metallurgical	43,196	
Administration	37,348	
Leases	1,280	
Total	£274,676	$549,352

In April 1966 a grant of $100,000 was made for further prospecting work, and subsequently two further grants, each of $100,000 were made for shaft sinking, cross cutting, underground diamond drilling and metallurgical testing.

To the end of April 1968, expenditure from these grants had totalled $25[illegible]12. (McDowell memo No. 103, 16th May, 1968).

Since then the average rate of expenditure has been $14,000 per period. Therefore, the total to the end of February 1969 is estimated to be close to $400,000. - see Appendix V.

Total

1956 to February 1969 $944,250

Cost to Complete Present Underground Programme

The programme of driving, cross cutting and diamond drilling is scheduled for completion in September of this year.

Estimated cost

7 periods at $12,000 $84,000

2. Results of Metallurgical Test Work

Work recently carried out on Brown's ore has been reported by M. G. Baillie in his memorandum of 14th January, 1969 - see Appendix II.

The conclusions are:

1. Cobalt and nickel cannot be recovered by flotation into a suitable concentrate for further treatment.

2. Copper recovery of 85% into a concentrate assaying 20% Cu is possible.

3. Lead recovery of 80% into a concentrate assaying 50% Pb is possible.

This memorandum also assesses the capital cost of establishing a flotation mill to treat 2 million tons of ore per year:

Capital Cost	$5.1 million
Estimated Operating Cost	$0.75 per ton ore

These results and costs have been adopted in the current assessment. M. Baillie has further advised that the oxidised ore should not be taken into consideration.

3. Assessment of Mining Costs

3.1 Assumptions

3.1.1 This study is based on 2 million tons of ore per year to conform with M. Baillie's metallurgical report of 14th January, 1969. (Note: R.B. Moffitt's report of August 1965 based on 1 million tons of ore per year).

3.1.2 Quantities of lead-copper ore and waste taken from D. Haigh's median open pit design with 45° batters, 600 foot depth are:

Volumes

Total excavated rock	56,043,000 c. yds.
Total waste rock	47,440,000 c. yds.
Total ore	8,603,000 c. yds.
Sulphide ore	7,579,000 c. yds.

Tonnages

(Density: 1.8 tons per bank yard)

Total excavated rock	100,877,000 tons
Total waste rock	85,392,000 tons
Total ore	15,485,000 tons
Sulphide ore	13,643,000 tons

Neglecting oxide ore the quantities become:

Sulphide ore	13,643,000 tons
Waste rock	87,234,000 tons
Total excavation	100,877,000 tons
Ore : waste ratio	1 : 6.4

3.1.3 It is assumed that mining will be carried out on two shifts of eight hours, six days per week, forty weeks per year. This will allow for 20% loss in time and efficiency due to wet weather over the monsoon period.

3.1.4 Milling costs have already been taken out by M.G. Baillie and these are accepted. However, provision is made for housing mill personnel, and mill staff salaries are added.

3.2 Unit Costs

Wages:	average $1.75 per hour; plus 50% for contract open-pit operators and tradesmen, i.e., $2.62 per hour.
Diesel Fuel:	14 cents/gallon.
Electricity:	3 cents/kwh
Rail Haulage:	64 miles Rum Jungle to Darwin : $4.20/ton $2.00 (Possibility of reduction)
Wharfage Darwin:	$7.00/ton $4.00
Housing Cost:	3 bedroom, Rum Jungle $20,000.

Capital cost of rail siding at Brown's $100,000.

3.3 Mining Data

3.3.1 Hours worked:

Allow $\frac{3}{4}$ hr. per shift for stopping and starting losses.

Machine hours per year

$7.25 \times 2 \times 6 \times 40 = 3,480$ hours

Pay hours per year per man

$8 \times 6 \times 50 = 2,400$ hours

3.3.2 Annual Mining rate:

Tons of ore per year 2 million

Total excavation per year 2 million + (2 million x 6.4)

= 14,800,000 tons

3.3.3 Hourly excavation rate:

$$\frac{14,800,000}{3,480} = 4,253 \text{ tons}$$

3.3.4 Life of mine:

$$\frac{13,643,000}{2,000,000} = 6.8 \text{ years}$$

3.4 Mining Equipment

3.4.1 Shovels

Total bucket capacity to mine 4,253 tons per hour:

Operational & mechanical efficiency	85%
Bucket factor	85%
Swell factor	75%
Cycle time	25 seconds
Cycles per hour	144

Cubic yards per hour:

$$\frac{4,253}{1.8 \times 0.85 \times 0.85 \times 0.75} = 4360 \text{ c. yds.}$$

Bucket size:

$$\frac{4,360}{144} = 30.28 \text{ c. yds.}$$

Number of shovels:

3 10-c. yd. machines

3.4.2 Trucks

Assumptions:

Average gradient	1 in 10
Av. speed loaded	10 m.p.h.
Av. speed empty	20 m.p.h.
Av. speed	15 m.p.h.
Haul distance (round trip)	2 miles
Truck capacity assumed	100 tons
Truck availability	60%

Cycle time:

load	2 min. 20 sec.
travel full	6 min.
empty	1 min.
travel empty	3 min.
spot	1 min 40 sec.
	14 min.

∴ each truck makes 4 trips per hour and carries 400 tons per hour.

Hourly tonnage : 4,253

Number of trucks : $\frac{4,253}{400 \times 0.60} = 18$

3.4.3 Drills

Assumptions:

bench height	50 feet
grid spacing	18' x 15'

Cubic yards per hour:

$$\frac{4,253}{1.8} = 2,363$$

$$\text{area} = \frac{2,363 \times 27}{50} = 1,276 \text{ sq. ft.}$$

holes per hour:

$$\frac{1276}{18 \times 15} = 4.72$$

feet drilled per hour:

$$4.72 \times 50 = 236 \text{ feet}$$

Number of drills:

One rotary drill (45R) will be more than adequate to drill all requirements.

3.4.4 Major Auxiliary Items

Bulldozers:

one for each shovel	3
one for tiphead	1
one general duties	1
Total	5

i.e., 5 D9 bulldozers with rippers

why not offset with trucks

Graders:

2 Cat. 12

Water Carts:

2 converted dump trucks.

3.4.5 List of All Capital Items

		$A000
3	10 c.yd. shovels at $750,000	2,250
18	100 ton trucks at $200,000	3,600
5	D9 bulldozers at $110,000	550
2	Cat. 12 graders at $30,000	60
1	45R rotary drill at $670,000	670
2	50-ton water carts at $200,000	400

3.4.5 List of All Capital Items (Cont'd)

		$A000
1	20-ton explosives truck at $50,000	50
2	6000 g.p.h. pumps at $20,000	40
6000	ft. 8" Ø pipeline at $3/ft.	20
2	7-ton service trucks at $20,000	40
12	runabout vehicles at $4,000	50
6000	ft. power line at $7/ft.	40
6	portable transformers at $5000	30
6	cable crossings at $1000	6
3	cable sleds at $1000	3
1	ambulance at $10,000	10
1	fire-engine at $10,000	10
1	magazine at $10,000	10
1	workshop plus equipment	60
1	store	40
1	office	20
1	barracks	60

3.4.5 List of All Capital Items (Cont'd)

		$A000
1	mess	30
1	recreation hut	10
	houses	3,810
	sewage disposal	20
	water supply	20
	communications (20 sets at $500)	10
	siding	100
		12,019
	30% contingency	4,000
	Total mining capital	$16 million

3.5 Manning Schedule

(2 shift basis)

3.5.1 Daily Paid

Shovel operators	3x2	6
Shovel oilers	3x2	6
Truck drivers (100T)	12x2	24
Bulldozer drivers	5x2	10
Grader drivers	2x2	4

3.5.1 Daily Paid (Cont'd)

Water cart drivers	2x2	4	
Drillers	2x2	4	
Shot firers	2x2	4	
Pump attendants	1x2	2	
Truck drivers (7T)	1x2	2	
Duty drivers	2x2	4	
		70	
Fitters	4x2	8	
Welders	2x2	4	
Mechanics	8x2	16	
Electrician	2x2	4	
Labourers	8x2	16	
		48	
Gardeners		2	
Mess hands		12	
Services hands		6	
Monitors		4	
Watchmen		4	
		28	
Carpenter		1	
Painter		1	
Plumber		1	
Assistants		3	
		6	152

3.5.2 Staff

Manager	1
Production Superintendent	1
Mine Superintendent	1
Asst. Mine Superintendent	1
Mine foremen	4
Geologist	1
Surveyor	1
Asst. Surveyor	1
Draftsmen	2
Chief Engineer	1
Asst. Engineer	1
Engineering foremen	3
Services foreman	1
Office Manager	1
Accountant	1
Asst. Accountant	1
Chief Clerk	1
Department clerks	3

3.5.2 Staff (Cont'd)

Accounts clerks	4
Chief Storeman	1
Storemen	4
Typists	6
Personnel Officer	1
Secretary	1
Catering Officer	1
	44

3.5.3 Mill Manning

(for housing purposes only)

Operators	8x4	32
Cleaners	2x4	8
		40
Fitters	2x4	8
Electricians	2	2
		10

Staff

Chief Metallurgist	1
Plant Metallurgists	2
Research Metallurgists	2
Mill foremen	4
Laboratory assistants	4
Clerks	2
Typists	2
	17

3.5.4 Total Manning

Daily paid operators	110	
tradesmen	64	
general hands	28	
Total	202	
Total Staff	61	

3.6 Cost of Labour (excluding mill)

70 operators (mine) at $2.62/hr. 2400 hrs/yr	440,160
35 tradesmen at $2.62/hr 2400 hrs/yr	220,080
47 general hands and trades assistants at $1.75/hr 2400 hrs/yr	197,400
	$857,640

Staff Salaries (excluding mill)

44 x $6000 x 2	$528,000

Mill Staff

17 x $6000 x 2	$204,000

3.7 Housing Requirements

202 daily paid workers

61 staff

Provide housing for 75% of staff, i.e.,	45
Single quarters, female staff	8
Single quarters, male staff	8
Provide housing for 66% of daily paid workers, i.e.,	133
Barracks for remainder, i.e.,	69

Cost of Housing

178 houses at $20,000		3,560,000
1 Single girls' quarters	Motel style	20,000
1 Single men's quarters		20,000
9 8-men barrack blocks		180,000
1 Guesthouse at $30,000		30,000
		$3,810,000

3.8 Annual Operating Costs

3.8.1 Mining

Labour	Daily paid	857,640	202
	Staff	528,000	61
		1,385,640	

Stores

Parts: (10% of value of machines i.e., 10% of $10,412,000)	1,041,000
Fuel & Tyres:	
18 trucks at 2 cents/ton mile	
14,800,000 tons x 2 miles x 2 cents	592,000
5 tractors, 4000 hrs each, 16 galls per hour, at 14 cents/gall	44,800
Other vehicles	50,000
Explosives:	
0.75 lbs. gelignite per ton excavated at 40 cents/lb including fuse & detonators 14,800,000 x 0.75 x 40 cents	4,440,000
	6,167,800

3.8.1 Mining (Cont'd)

Power

0.40 kwh per ton excavated at 3 cents per kwh 14,800,000 x 0.40 x 3 cents	177,600
0.1 kwh per ton drilled	44,000
	221,600
Total mining cost	$7,775,040
Cost per ton excavated $\frac{7,775,040}{14,800,000}$	$0.5253/ton
Cost per ton of ore $\frac{7,775,040}{2,000,000}$	$3.8875/ton ore

3.8.2 Milling costs (after Baillie)	$0.75 per ton ore
Add mill staff salaries	0.10
	$0.85 per ton ore

3.8.3 Administration and General

Melbourne Office	$100,000
Royalties	$100,000
Subsidies	$ 50,000
Contingencies	$170,000
Insurances	$100,000
	$520,000

$0.26 per ton ore

3.8.4 Total Operating Cost

$5.00 per ton ore

4. Schedule of Smelter Payments. 43%

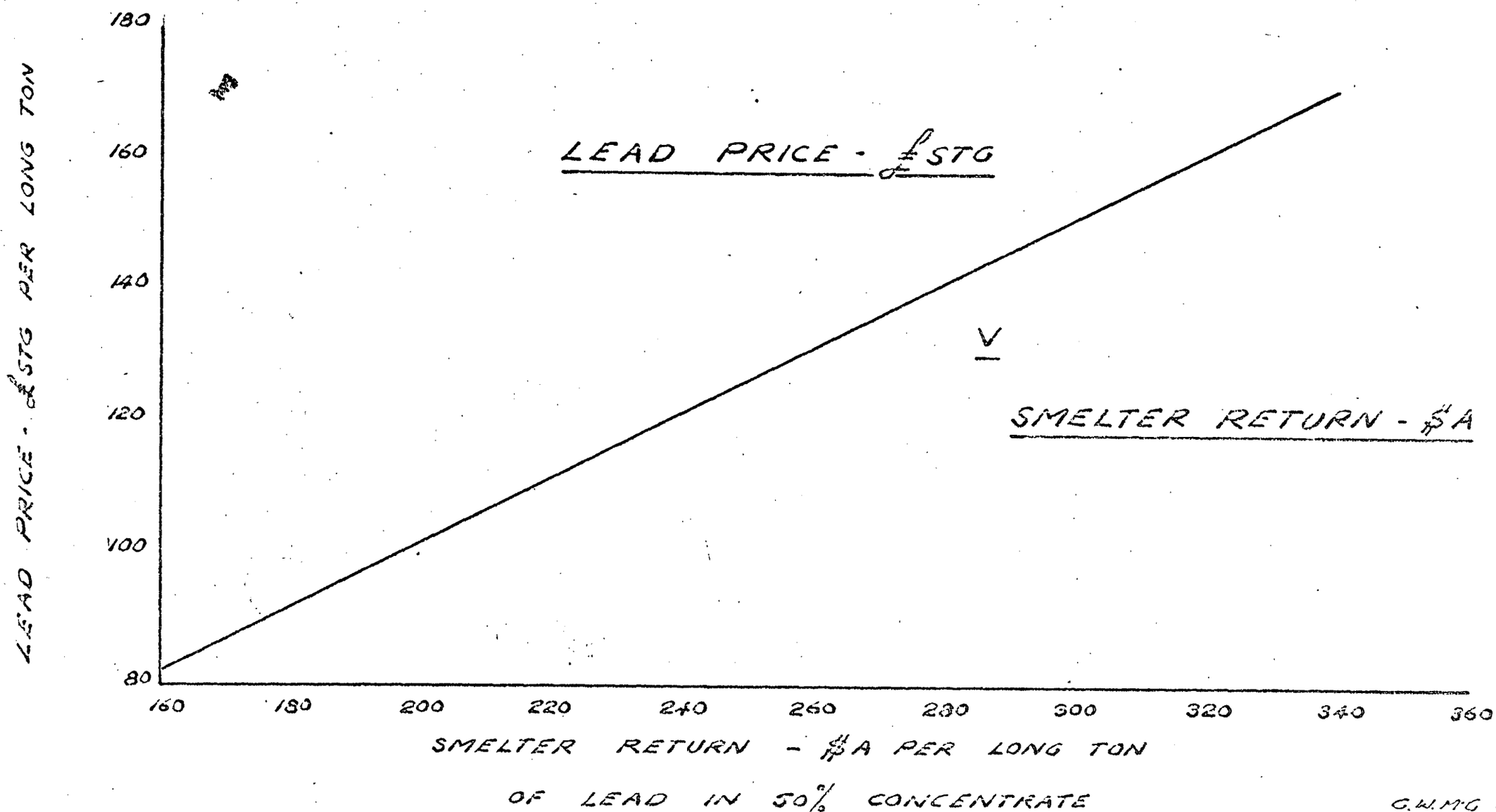
Pb - paid for 94% of Pb in concentrates, less treatment charge of £UK.6 per long dry ton of concentrates. 95%

Cu - paid for full Cu content less 1 unit at 99%
Zambian producers price less 1.3 cents U.S. per lb., less a treatment charge of $US.15 per dry metric ton.
(Producers price £UK.308).

4.1 Lead payment per ton Pb in 50% concentrate

£UK.85 x $\frac{94}{100}$ - ~~3~~ 12 = £76.90 ~~£67.90~~

$\frac{76.90 \times 20}{9.25}$ = $A166 ~~$147~~


LEAD PRICE - £STG PER LONG TON
180
160
140
120
100
80
LEAD PRICE - £STG
V
SMELTER RETURN - $A
160
180
200
220
240
260
280
300
320
340
360
SMELTER RETURN - $A PER LONG TON
OF LEAD IN 50% CONCENTRATE

G.W.M.G 1-3-69

4.2 Copper Payment per ton in 20% concentrate

£UK.308 = $US.740 per long ton Cu

$\frac{19}{20}$ x 740 = $US.703 per long ton Cu

less $0.013 per lb = 0.013 x 2240

= $29.10

703 - 29.10 = $US.673.90 per long ton

less $US.15 per dry metric ton of concentrate

i.e., $\frac{15 \times 1.016 \times 20}{100}$ per long ton Cu

= $US.3.20

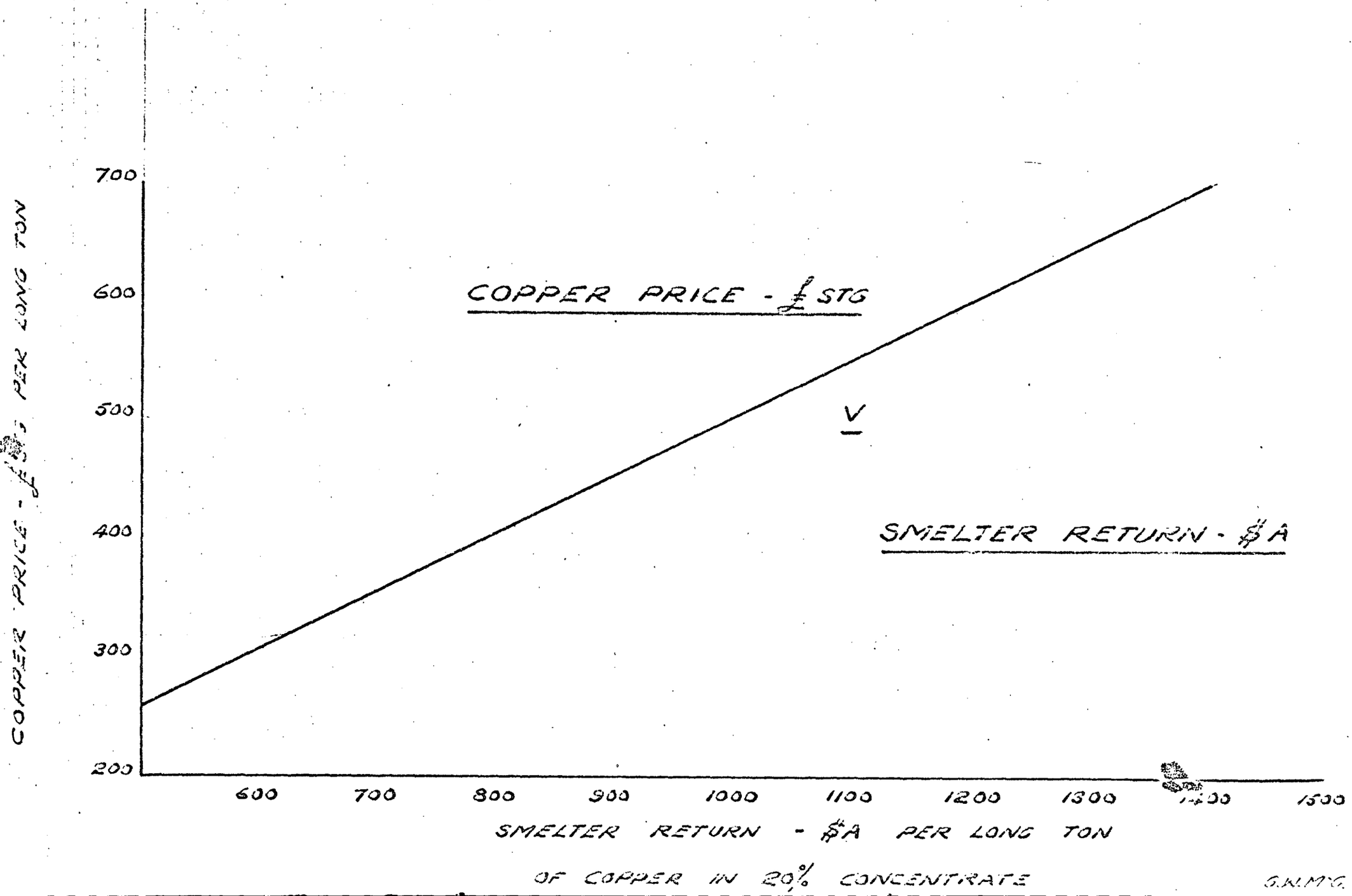
673.90 - 3.20 = $US.670.70 per long ton Cu

= $A607

1 long ton = 1.016 metric tons

£UK.1 = $US.2.40

= $A 2.16


COPPER PRICE - £ STG PER LONG TON
700
600
500
400
300
200
COPPER PRICE - £ STG
V
SMELTER RETURN - $A
600
700
800
900
1000
1100
1200
1300
1400
1500
SMELTER RETURN - $A PER LONG TON
OF COPPER IN 20% CONCENTRATE

5. Effect of Metal Prices on Economics

Consider lead and copper prices increased by 65% -

Pb at £139 per long ton

Cu at £502 per long ton

Smelter return (from graphs) -

Pb $A 274

Cu $A1001

Total funds employed:

	$A million	$A million
Mine capital	21.000	
Interest at 10% over 2 yrs	4.400	25.400
Pre-production	8.000	
Interest at 10% over 1 yr.	0.800	8.800
Working capital	7.000	7.000
Total		41.200

Revenue per annum:

Pb 70,500 x 274	19.310	23,617
Cu 3,600 x 1001	3.605	
	22.915	

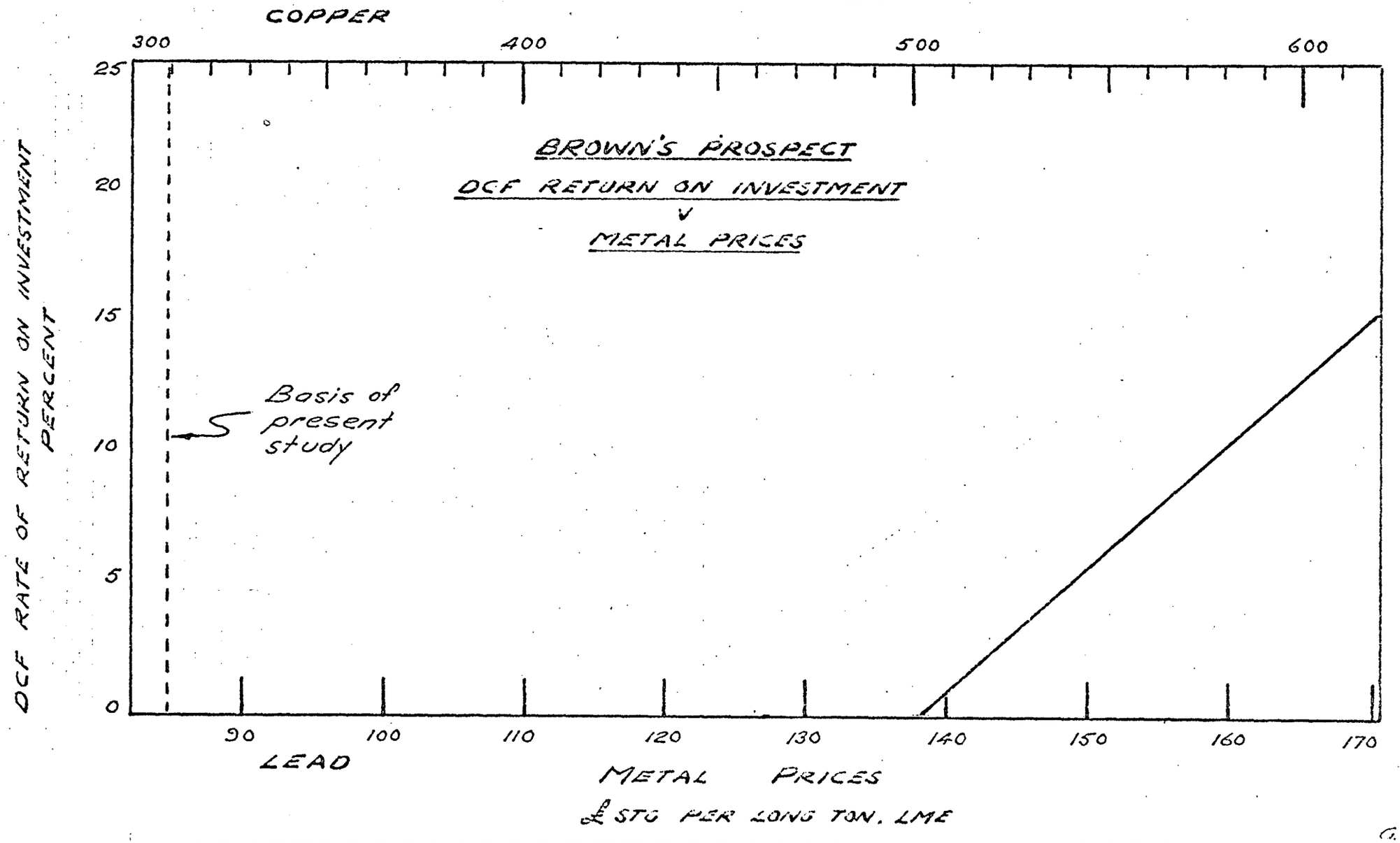
Gross Surplus:

Revenue	22.915	
Ore cost	13.986	
	$8.929	

	$A million p.a.	
Payback:		
Gross surplus	8.929	14059
Deduct		
Depreciation over 7 years on mine capital and pre-production expenses	4.150	4150
Result	4.779	9909
Deduct		
Tax at 36%	1.720	3567
Nett income	3.059	6342
Add		
Depreciation	4.150	4150
Cash flow	7.209	10,492
Payback $\frac{41.200}{7.209}$	5.7 years	41200 / 10492 ?
Return on investment:	10% DCF	≈ 15% DCF

Returns for further price increases are graphed on the next page.

?


COPPER
300
400
500
600
25
20
15
10
5
0
BROWN'S PROSPECT
DCF RETURN ON INVESTMENT
V
METAL PRICES
Basis of present study
DCF RATE OF RETURN ON INVESTMENT PERCENT
90
100
110
120
130
140
150
160
170
LEAD
METAL PRICES
£ STG PER LONG TON, LME

GMMG 1-3-6

6. Effect of Nickel - Cobalt Recovery

6.1 Nickel

70% recovery of 0.14% Ni:	2,000 tons p.a.
2000 tons at $0.70 per lb. in concentrates, at Japanese port	$3,000,000 p.a.

6.2 Cobalt

70% recovery of 0.11% Co	1,540 tons p.a.
1540 tons at $1.10 per lb. (assumed) in concentrates at Japanese port	$3,800,000 p.a.

If it be assumed that all costs of mining, milling and transport are met by lead and copper then nickel and cobalt would provide an annual gross surplus of approximately $6 million, and annual cash flow of $5 million.

This is insufficient to return the capital over the life of the mine. The D.C.F. rate of return is therefore less than zero.

7. Effect of Contract Excavation

Assumption: $0.75 per ton contract price (based on Moffitt's figure of 12/- per c.yd.).

Annual Operating Cost:

Contract	
14,800,000 tons at $0.75	$11,100,000
Supervision	
20 mining staff at $12,000	
17 milling staff at $12,000	$ 440,000
Milling	
2,000,000 tons at $0.75	$ 1,500,000
Administration & general	$ 520,000
	$13,560,000
Realisation Costs	$ 3,986,000
Total Operating & Realisation	$17,546,000
Annual Revenue	$13,885,000
Annual Loss	$ 3,661,000

G. A. McGregor.

APPENDIX I

COPY ONLY

14th January, 1969.

Memorandum to : G. W. McGREGOR, ESQ.

Copies : N. R. McDowell, Esq.

Dr. J. C. Nixon

D. S. Carruthers, Esq.

From : N. A. Gilberthorpe

Brown's Prospect

Should we continue research and exploration expenditure on Brown's Prospect? If so, at what expenditure level and with what objective? If not, what is the future of the prospect and how do we retain the title?

Investigation work on this prospect has reached a stage where answers must be provided to those questions. Would you undertake this assignment please and aim to complete it not later than February 28, 1969. To arrive at these answers the suggested approach is:

Review briefly the scope and cost of work done to date including Romig's report dated June, 1957.

Gather in results of latest metallurgical testing from Amdel now being processed and translated into economic terms by M.G. Baillie.

Through Noel McDowell, liaise with Haigh of TEP who has been working up preliminary estimates of engineering and community costs attached to Brown's development.

Combine all information and derive a complete study, classification grade 4 or grade 3. Adopt two cases, one at 3000 tons per day and the other at 6000 tons per day using CRA metal prices and return on investment of 10% and 15% DCF. Should the viability be doubtful with these parameters, extend the study to point up metal prices required to make an operation viable.

Seek opinion from Dr. Nixon on the desirability of persevering with further test work, pressure leaching for example.

From this work the answers posed in the first paragraph will emerge after due consideration is given to the practical aspects of maintaining our title and access to the prospect.

(sgd) N. A. Gilberthorpe

APPENDIX II

COPY ONLY

14th January, 1969.

Memorandum to : N. A. GILBERTHORPE, ESQ.

Copy to : Dr. J. C. Nixon

From : M. G. Baillie

Brown's Deposit - Processing Costs and Recovery

Experimental testing of Brown's ore has been proceeding at Amdel for some time. Broadly the aim of this work has been to investigate the potential of flotation to upgrade Brown's ore into -

(a) a series of separate sulphide concentrates for sale

(b) a bulk sulphide concentrate for sale or further treatment

(c) a combination of separate concentrates and bulk concentrates.

Sufficient work has now been done for the following summary of results to be prepared:-

1. Copper can be recovered into a concentrate assaying 20% Cu with a recovery of 85%.

2. Approximately 80 percent of the lead can be recovered in a concentrate assaying 50 percent lead. Under the conditions required for this result, cobalt and nickel report mainly with the tailings and are not recoverable in an acceptable concentrate by flotation.

3. Alternatively, about 40 percent of the lead can be recovered in a concentrate assaying 52 percent lead and a further 54 percent in a lead-cobalt middling assaying 6 percent lead and 0.16 percent cobalt (80 percent cobalt recovery). This middling is very little different in composition to the feed material and represents 50 percent of the total feed to the circuit.

From the above results, the following conclusions are drawn for preliminary evaluation purposes:-

1. Cobalt and nickel cannot be recovered by flotation into a suitable concentrate for further treatment. Their value must therefore be ignored in preliminary cost evaluations.

2. Copper recovery of 85% into a concentrate assaying 20% Cu is possible.

3. Lead recovery of 80% into a concentrate assaying 50% Pb is possible.

Based on the conclusions set out, Figure 1, which is a flowsheet for an operation treating 2 million tons per annum of Brown's ore, has been prepared. It is a conventional flotation mill.

Capital Costs

Using Figure 1 and costs of equipment delivered by sea to Bougainville as a guide, the following major equipment costs have been estimated:-

Major Equipment Costs	$ 000
Feed Hopper	10
Feeder	20
Grizzly	10
Primary Crusher	50
Conveyor	30
Magnet and Surge Bins (12,000 tons)	60
Screen	20
Secondary crushing (1 x Standard 7' Symons)	100
Conveyors	50
Screens	40
Belt feeders	20
Surge Bins (5,000 tons)	30
Conveyor and tripper	40
Tertiary crusher	110
Feeder belts	30
Rodmill and motor	125

Major Equipment Costs (Cont'd)	$ 000
Cyclones, feed pumps and motors	40
Ball mill (1)	125
Ball mill (2)	200
Cyclones, feed pumps and motors (2 sets)	80
Flotation cells (16 x 300 ft^3)	80
Pumps, pulp distributors etc.	20
Concentrate thickeners (1 x 125')	75
" " (1 x 50')	45
Filtration	20
Pumps, agitation etc.	20
Reagent makeup	20
Tailings thickener and disposal	100
TOTAL	1,600

To this total must be added the factored cost of the following, which are estimated as a percentage of the delivered equipment cost.

Installation	50%
Piping	25%
Instruments	15%
Electrical	20%
Buildings, foundations etc.	25%
Services	20%
Engineering, construction, contractors	40%
Contingency	25%
	220%

Total cost of operational plant is thus (3.2 x 1.6) =

$5.1 million

Operating Costs

Operating costs are very difficult to estimate from first principles at this stage, hence they have been estimated by analogy with both the Bougainville costs and published costs for other plants.

Estimated operating cost is $0.75 per ton of ore treated

i.e., $1.5 million per annum.

Concentrate Recovered

The average grade of ore fed to the mill is:

5.5% Pb.; 0.27% Cu.

Annual recovery of concentrates is then as follows:-

Copper concentrates

Total weight	27,000 tons per annum
Weight of copper	4,600 " " "

Lead concentrates

Total weight	176,000 tons per annum
Weight of lead	88,000 " " "

Comments

The conclusions drawn from the experimental programme do not rule out the possibility of developing a scheme which might permit cobalt and nickel to be recovered from Brown's ore, although they do indicate that such a scheme would have to be based on unconventional technology. Even if such a scheme is feasible and proves to be economic, its development and the demonstration of its reliability would be a long term project; and there is of course no guarantee of success at this stage.

In my opinion, the current prospects for developing an economic scheme are very uncertain, and I consider it would not be desirable to expend significant sums of money on any phase of Brown's development if the economics of the simple flotation plant described above do not appear attractive.

On the other hand, worthwhile quantities of various types of concentrate which can be produced from Brown's ore have been provided by the current test programme, and it would be worthwhile to proceed on a low priority basis with a modest programme (say one officer) to investigate the potential of some of the less conventional schemes which might be applicable to cobalt and nickel recovery.

(sgd) M. G. Baillie

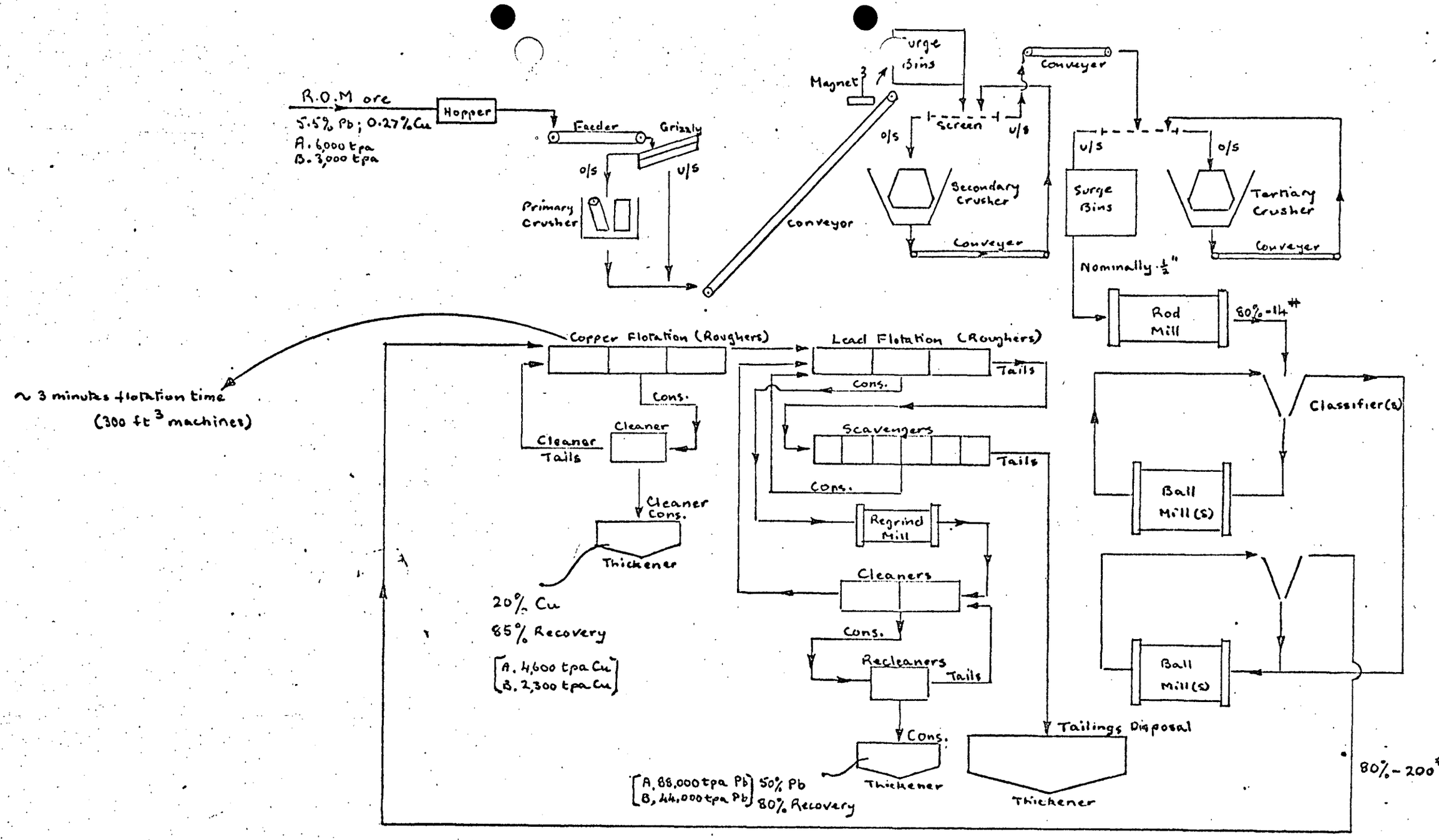


Fig. 1

Flowsheet of Flotation Plant to Treat Brown's Ore

APPENDIX III

BROWN'S SHAFT - DRIVING & DIAMOND DRILLING PROGRAMME

28-1-6

No 3 LEVEL - WEST DRIVE

DRIVE

X-CUT

No 3 LEVEL - EAST DRIVE

DRIVE

X-CUT

No 2 LEVEL WEST DRIVE

DRIVE

X-CUT

No 2 LEVEL EAST DRIVE

DRIVE

X-CUT

DIAMOND DRILLING

No 3 LEVEL

No 2 LEVEL

R. AGNEW

KVESTG

R. AGNEW

KVESTG

R. AGNEW

KVESTG

W. DRIVE 1210'

INCLINED HOLES E & W DRIVE 550'

W. DRIVE 500'

E. DRIVE 976'

INCLINED HOLES W. DRIVE 230' 590'

25/11 8/2 22/11 8/3 22/3 5/4 19/4 3/5 17/5 5/6 14/5 25/5 12/7 23/7 11/8 23/8 6/9 2/10

APPENDIX IV

List of References
Brown's Deposit
Rum Jungle

Romig, W.E. "A Preliminary Study of Brown's Prospect, N.T." Melbourne. Vic. June 1957.

Knight, C.L.
Whitcher, I.G. "Brown's Lead Orebody, Rum Jungle, N.T." C.R.A.E. Ref. No. NT67 March 1959.

Moffitt, R.B. "A Study of Brown's Lead-Copper Deposit, Northern Territory" Rum Jungle, August 1965.

Hughes, F.E. "Brown's Deposit - Rum Jungle" C.R.A.E. Ref. No. 67. July 1968.

Mathiesen, G. Updating of D.A. Berkman's report on heap leaching of copper in Brown's Deposit. February, 1969.

List of Graphs, Calculations and Summaries held at Rum Jungle relevant to the evaluation of Brown's Deposit:

1. Total Open Cut Excavation Calculation to obtain Excavation Volume for each:
   (a) Pit depths (nominal) from 100' to 600'
   (b) Batter slopes 40°, 45° and 50° each with 35° batter from RL 5200 to surface
   (c) N.B.: Volumes increased by 5% to allow for roads and berms.

2. Drawings showing cross sectional dimensions of each open cut design from 100' to 600' depth and varying batter slopes of 40°, 45° and 50°.
   Drawings Nos. B278, 279 280.

3. Summary of Volumes and Tonnages for each open cut design as detailed in (2) above. Details shown:
   (a) Oxidised ore tonnage
   (b) Primary ore tonnage
   (c) Total excavated rock
   (d) Total waste rock
   (e) Waste to ore ratio
   (f) Total ore in pit
   (g) Net remaining to 1,000' depth.

4. Volume of Pit (ore plus waste) between RL 5300 and RL 5200. To be used in calculation of earth-moving equipment requirements.

5. Graphs:

   (a) Unit cost ($ per B.C.Y.) of excavation versus Total cost of total pit excavation for each depth and batter slope combination.

   (b) Unit cost ($ per ton) to excavate ore versus Total cost of total pit excavation (for all).

   (c) Varying L.M.E. values of metals versus Total L.M.E. value of metals in entire ore body for lead, zinc and copper.

   (d) Total ore (B.C.Y.) versus Total pit excavation (for each pit depth and batter angle).

   (e) Pit depth (feet) versus Waste to ore ratio.

   (f) Pit depth (feet) versus Total pit excavation (B.C.Y.).

6. General notes on Mine Area, Township requirements, Labour requirements - incomplete as to numbers.

7. General (only) Flow Sheets of:

   (a) Mining

   (b) Mill

   (c) Transport

8. Updating of D.A. Berkman's report on heap leaching of copper in Brown's Deposit.

APPENDIX V

COPY ONLY

5th March, 1969.

Memorandum to : FILE

Copies to : N.A. Gilberthorpe, Esq.
G. W. McGregor, Esq.

From : J.B. Day

Australian Mining and Smelting Company Limited
Planned Expenditure - Brown's Prospect

I refer to an enquiry from Mr. G.W. McGregor as to whether expenditure on Brown's Prospect is within the sum approved.

Attached is a copy of a note prepared for Mr. A.J. Rew by the Budgeting and Planning Department on 23rd August, 1968, regarding planned expenditure for the year 1969, and forecast expenditure for the four subsequent years 1970/1973.

This showed planned expenditure for 1969 of $240,000, plus the sum of $133,000 for the years 1970/1973.

On 26th August, 1968, Mr. Rew advised that this matter was discussed during the then recent visit by the Chairman to the Rum Jungle area, and confirmed that the

estimated expenditure be included in the Plan on the higher basis indicated in the note from the Budgeting and Planning Department.

Similarly, an amount of $144,000 had been included in the 1968 Plan in addition to planned expenditure of $120,000 for 1967.

These plans had been submitted to and approved by the Board of C.R.A. and, therefore, including expenditure of $65,989 in 1966 which was covered by a specific application to spend $100,000 approved by the Chairman in April, 1966, the total amount approved up to the end of 1969 is $570,000, made up as follows:-

1966	$ 66,000
1967	$120,000
1968	$144,000
1969	$240,000
	$570,000

Actual expenditure to 8th February, 1969, amounts to $394,898, as set out below:-

1966	$ 65,989
1967	$132,638
1968	$181,826
1969	$ 14,445
	$394,898

In the above-mentioned note to Mr. Rew, it was reported that actual expenditure during 1967 was $133,000 and that expenditure during 1968 was then estimated at $167,000.

It is understood from the Budgeting and Planning Department that no specific applications are made by the Exploration Division for approval of exploration expenditure, other than for capital expenditure.

The procedure is that an Exploration Plan is submitted along with other operational plans and, when approved, expenditure may proceed. This is, of course, expected to conform to the Plan.

(sgd) J. B. Day

LEAD

PRICE (£U.K. per ton) | VALUE after treatment ($A per ton) | REVENUE ($A million)

£UK 170 — $300 — $20

£UK 139 — $200 — $10

£UK 85 — $100 — $0

COPPER

PRICE (£U.K.) | VALUE a/f treatment ($A) | REVENUE ($A million)

£616 — $1200 — $4

£502 — $900 — $3

£UK 308 — $500 — $2

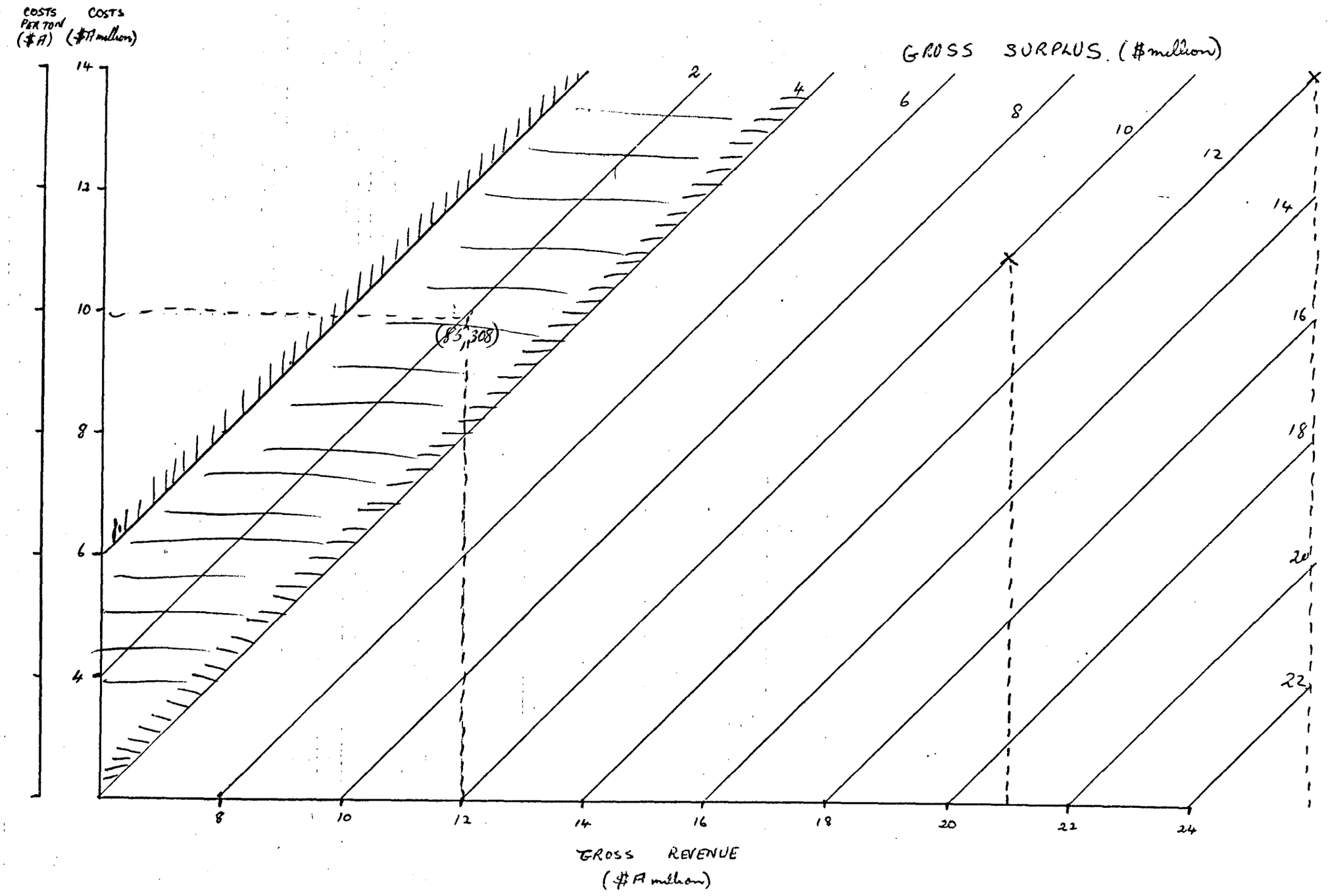
Nickel
2000 tons p.a
@ 0.70 $/lb
$3 million
(70% recovery of 0.14% Ni)

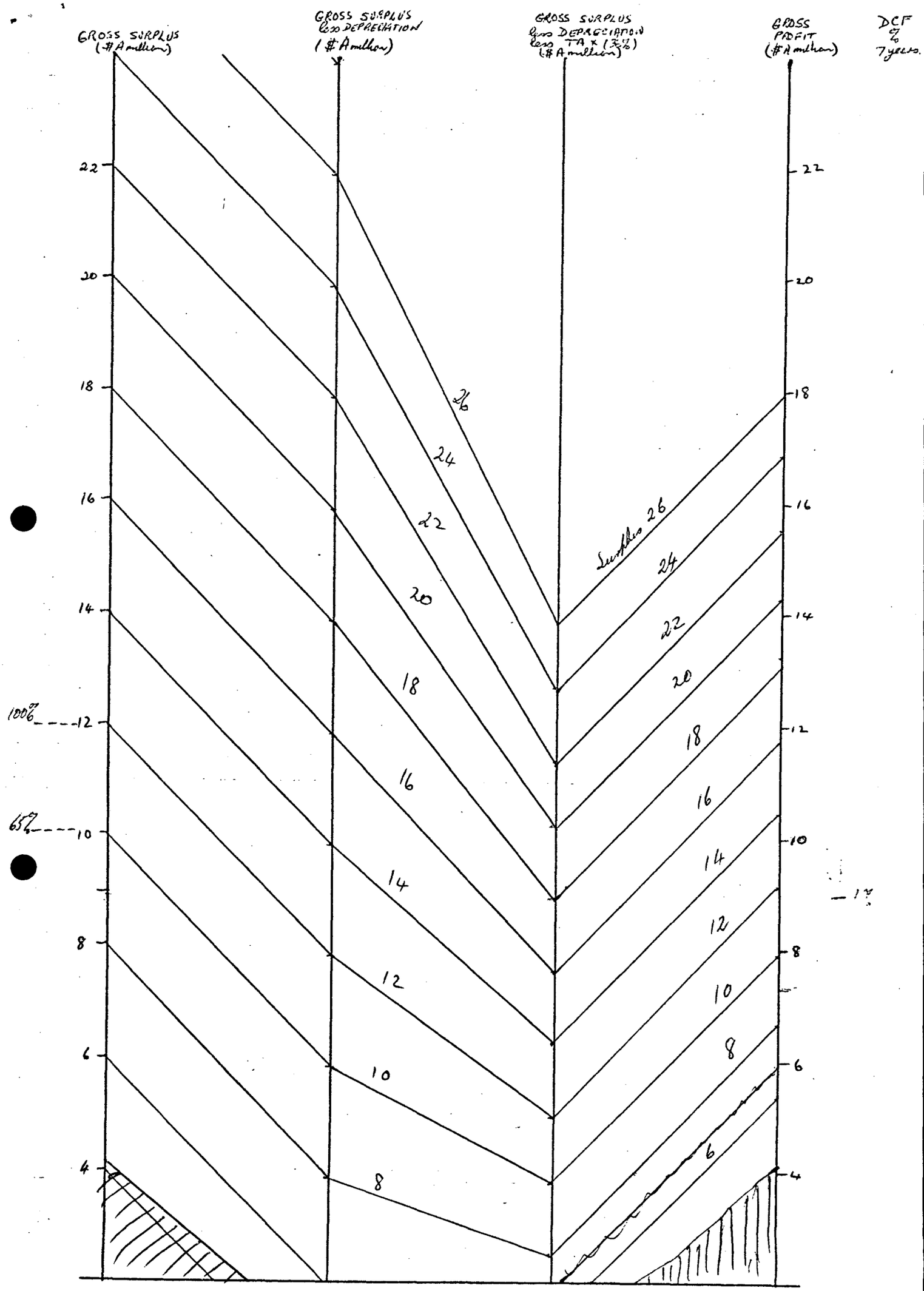
Cobalt
1540 tons p.a
@ $1.10 $/lb
$3.8 million
(70% recovery of 0.11% Co)

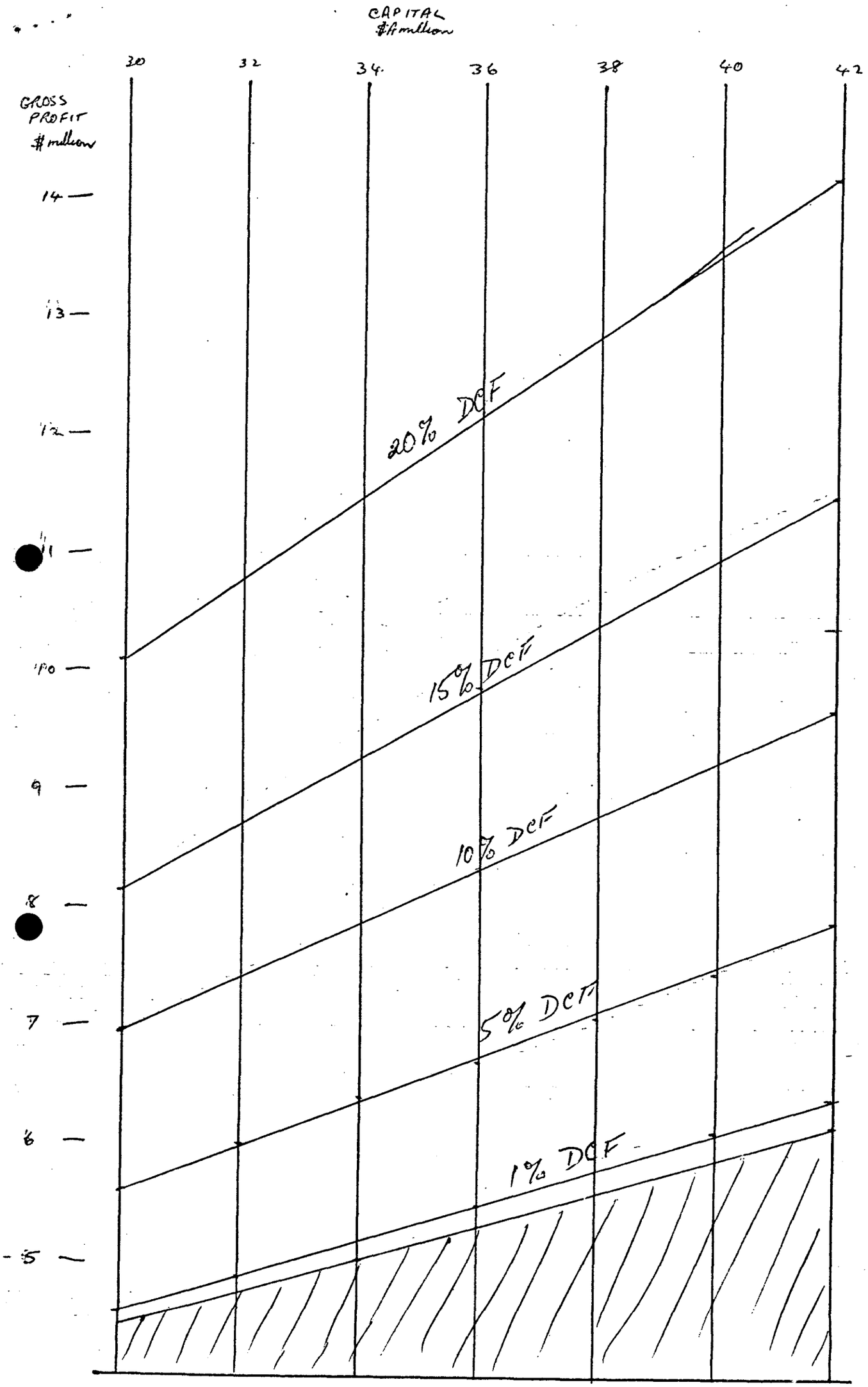
Silver
$ 800,000 p.a.

Revenue = 70,500 × Value a/f treatment
= 70,500 × (2.03 × UK price − 26)

Revenue = 3600 × Value a/f treatment
= 3600 × (2.06 × UK price − 95)


COSTS PER TON ($A)
COSTS ($A million)
GROSS SURPLUS ($ million)
14
12
10
8
6
4
2
4
6
8
10
12
14
16
18
20
22
($3,308)
8
10
12
14
16
18
20
22
24
GROSS REVENUE ($A million)


GROSS SURPLUS (£ million)
GROSS SURPLUS less DEPRECIATION (£ million)
GROSS SURPLUS less DEPRECIATION less TA x (3½) (£ million)
GROSS PROFIT (£ million)
DCF @ 7 years.
22
20
18
16
14
12
10
8
6
4
100%
65%
26
24
22
20
18
16
14
12
10
8
Surplus 26
24
22
20
18
16
14
12
10
8
6
6


CAPITAL
$ million
30
32
34
36
38
40
42
GROSS
PROFIT
$ million
14
13
12
11
10
9
8
7
6
5
20% DCF
15% DCF
10% DCF
5% DCF
1% DCF

DEPARTMENT OF THE INTERIOR.

No. NT65/4292

Minister

Brown's Lead Deposit N.T.

Australian Mining and Smelting Co. Ltd., a wholly owned subsidiary of Conzinc Riotinto of Australia Ltd., has held mineral leases over a large low grade lead deposit near Rum Jungle known as Brown's deposit for some years. The company is known to have been conducting detailed investigations into the prospect, and it is considered that the company should be approached about development of the deposit. A suggested draft letter to Sir Maurice Mawby, Chairman of C.R.A. is attached for your consideration.

Background

2. Following the declaration of the Hundred of Goyder as a prohibited area under the Defence (Special Undertakings) Act 1952, C.R.A. through its subsidiary undertook on an agency basis the development and operation of the Rum Jungle uranium project on behalf of the Commonwealth. This included prospecting for uranium.

- During exploration work, the subsidiary company became interested in lead deposits at Brown's and in July 1956, applied for and was granted nine mineral leases over the deposit.
- The company obtained three additional leases in the area in September 1957.
- The company still holds the 12 leases covering an area of about 438 acres. They are 21 year leases with rights of renewal.
- A map showing the location of Brown's deposit is attached.

3. Early exploration work on the prospect in about 1956 indicated that ore reserves were about 25 million tons assaying 5.3% lead, 0.2% copper and 2 lbs of cobalt per ton. A feasibility study by the company in about 1959 based on a concentrator at the mine and a smelter at a port site at

..2..

either East Arm or Middle Arm indicated that development of the deposit would not have been economic at that stage. Neither the Department of Territories nor the Administration received a copy of the company's feasibility study.

4. One of the conditions on which the leases were originally granted was that no mining operations were to commence other than normal exploratory work before January 1963. This condition was applied because of the Atomic Energy Commission's objection to the opening up of other mines in the Hundred of Goyder which would compete for labour and supplies.

- Since 1963 the company has been granted exemptions from the labour covenants of the leases because of either low lead prices or because exploration work was being carried out by the company.

Recent Developments

5. The company has carried out substantial exploration work on the deposit. An underground exploration programme which was commenced in 1966 is now understood to have been completed at an estimated cost of $400,000, and the company is preparing an economic evaluation of the deposit.

6. Circumstances relating to the development of the deposit have changed in several major aspects since the company's 1959 feasibility study.

- A decision has been taken to develop a port site at East Arm. In 1959, inadequate port facilities were seen as a major problem.

- Lead prices on the London Metal Exchange have been at a high level and are about $A100 a ton higher than prices ruling at the time of the company's 1959 feasibility study. Lead prices have shown a general rise in recent years. Price levels for the last 10 years are shown in attachment A.

7. A senior Atomic Energy Commission officer has expressed orally some concern about the possible development of Brown's on the grounds that the Commission's uranium operations at Rum Jungle could suffer. They may wish to

review the arrangement under which C.R.A. manages the uranium treatment works.

8. It is considered that the Commission does not have a valid grounds for objecting to moves to develop Brown's at this time. Their attitude would seem to be a defensive one against the possibility of further reductions in their interest in the Rum Jungle area following the Cabinet decision to reduce the area under exploration by or on behalf of the Commission to 100 square miles.

- Treasury is understood to be critical of the Rum Jungle operation and projected operation at Mt. Fitch on economic grounds, and is likely to press for further curtailment of the Commission's activities.

- The Commission has to approach Cabinet early next year on the possible development of Mt. Fitch uranium deposits.

9. In response to Departmental enquiries, the Administration has reported that the deposit now appears ready for development, and have suggested that a direct approach be made to C.R.A. at Ministerial level. The Administration feels that there is little to be gained from an approach at the local level.

10. Although the company has undertaken underground exploration work since 1966 at an estimated cost of $400,000, it has been granted labour exemptions over its leases almost continuously since they were granted. It is possible that development could have been achieved before now if the Administration had insisted on the company up-dating the feasibility study before granting further labour exemptions. The Australian Mining Industry Council view on the timing of development would probably be that it should be left entirely to the discretion of the company granted leases. To do this however would not seem to be in the best interests of the Territory or the national interest.

11. The Department therefore concurs with the Administration that an approach should be made to the company at Ministerial level. The form of letter which it is considered could appropriately be sent is attached for your consideration.

..4..

12. In view of your intention to have a meeting with the A.M.I.C. Executive Committee shortly it may however be undesirable for the letter to be sent at this time. Its arrival just prior to the proposed talks at which C.R.A. would be represented could be given a significance it is not intended to have. It is not seen as important that the letter be sent now rather than in, say, a month's time, as the company is not likely to come to immediate decisions arising from the recent exploration work.

13. The general question of the development of mineral deposits held under lease particularly where the deposits are large, could well be covered in the proposed talks with A.M.I.C. representatives. Notes on this aspect are being prepared along with notes on other issues likely to be covered in the talks.

Recommendation

14. That you consider the desirability of sending the attached letter to the company now as against some weeks after the discussions with A.M.I.C.

(F. L. Ahrens)
Assistant Secretary
(N.T. Industries)

24 November 1969

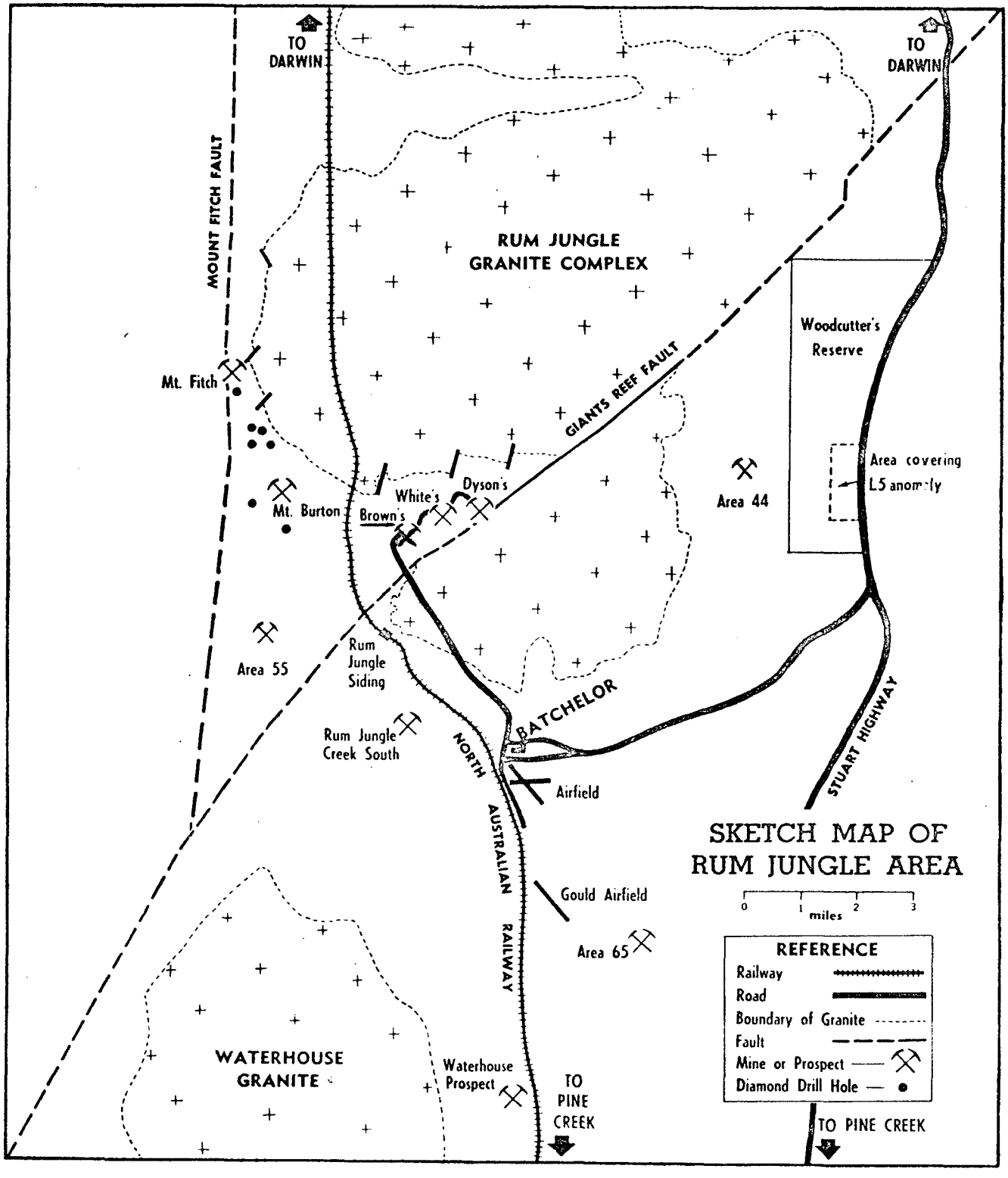
Attachment A

LEAD PRICES - 1968/69

	Australia ($ per ton)			London Metal Exchange (£stg per ton)		
	Max.	Min.	Average	Max.	Min.	Average
1959	200.00	200.00	200.00	75.34	68.37	70.78
1960	200.00	200.00	200.00	78.63	61.87	72.15
1961	200.00	190.00	198.70	68.30	57.63	64.20
1962	190.00	150.00	164.26	62.30	50.10	56.30
1963	180.00	160.00	169.18	77.50	53.82	63.47
1964	350.00	180.00	239.34	154.50	77.00	101.25
1965	340.00	250.00	281.14	155.75	95.19	115.00
1966	280.00	225.00	248.83	111.50	78.33	95.15
1967	225.00	210.00	217.50	95.38	78.06	83.83
1968	230.00	210.00	218.55	108.87	91.25	101.89
1969 (8 months)	275.00	230.00	249.40	137.37	105.80	118.1
Current price (14.11.69)		275.00			132.50	

~~APPENDIX A~~

SKETCH MAP OF THE RUM JUNGLE AREA, NORTHERN TERRITORY



BROWN's LEAD DEPOSIT

CRUDE ESTIMATE OF ANNUAL VALUE OF PRODUCTION.

Reserves: 25 million tons of ore with 6% Pb. and 0.2% Cu. Annual production rate - 500,000 tons.

Assuming: (1) 80% recovery of Pb and 100% recovery of Cu.

(2) lead price of $250 per ton and copper price of $1,000 per ton

(3) ignoring other pay-metals

Then annual value of production = $4 million (lead)
+ $1 million (copper)
= $5 million p.a. over 50 years

Doubling of ore production to 1 million t.p.a. gives annual value of production = $10 million p.a. over 25 years

N.B. (1) TIME element is of paramount importance and all future values should be discounted back to their present values to give a valid basis for comparison.

(2) VALUE to Australia differs radically from value to Company.

Australia. Value = total contribution to national product i.e. profits + taxes + wages + all other costs to the point of sale.

Company. Value = NET profits i.e. net return on Investment.
= total revenue at point of sale MINUS all costs of labour, processing, taxes, royalties, import duties, etc.

J.B. Allen.

26 November, 1969. (J. B. Allen)

A. Method of Mining

- Study considers open cut mining operations only (p.13)
- Ore resources exploitable with method design proposed, 13,643,00 tons sulphide ore (p.3)
- Estimates of reserves, March 1959.

	Tons	% Pb	% Cu	% Co
Sulphide ore	20,542,000	5.4	0.19	0.11
Oxidised ore	2,196,000	4.0	0.47	0.09

Zn (0.3%) and Nc (0.14%) were also present in the sulphide ore, and Ag averaged 1.4 dwt per ton for 1% Pb. (p.12)

Comments

National Development
- Explanation needed for choosing a method which recovers only two-thirds of the total indicated reserves.

N.T.A.
- Design and operation of method not clearly shown.
- A larger proportion of the deposit could be exploited by the use of other methods.

Interior
- Variance in reserves and non utilisation of oxidised ore noted.
- No allowance for additional data obtained from further exploration.
- Spectrographic analysis of samples may have revealed the presence of economic quantities of other valuable pay metals

Action
- Request advice regarding current estimates of reserves, in particular results of recently completed exploration program.
- Request advice regarding any analysis of other methods carried out and effects on proportion of total reserves exploitable
- Request advice regarding possible utilisation of oxidised ore.

B. Life Expectancy of Mine

- Production rate of 2 million tons of ore per year (p.3)
- Reserves life

$$\frac{\text{Reserves}}{\text{Annual production rate}} = \frac{13,643,000}{2,000,000} \text{ gives } 6.8 \text{ years (p.6)}$$

Comments

National Development

- Explanation needed for choosing mill size which would exhaust the open cuttable ore in less than 8 years.

N.T.A.

- Most major mine design studies are based on a life expectancy of at least 12 to 15 years but extraction by open cut method in less than 7 years is not unusual.
- Generally, the more quickly the ore can be extracted the better are the economics of an open cut operation.
- Impossible to show that a lower extraction rate would give a better return on investments as no comparative economics shown.

Interior

- Rate impressive for a base metal operation
- Compares with 5 million tons recently attained after extensive expansion at the record breaking Mt Isa Mines and 1.2 million tons at the highly mechanised N.B.H.C. mine (CRA) at Broken Hill.
- Little doubt that high production rate chosen to reduce pay back period.
- The high capital investment cannot be justified on deposit to be worked out in less than a decade.

Action

- Discuss mill size of 2 million tons per year and request advice on other extraction rates.

C Prices

- Metal prices

Pb ingots	£UK 85 per ton
Cu bars	£UK 308 per ton (p.4)

Comments

National Development

- Explanation needed of basis for metal prices
- Operating loss increased by $1.7 million if arithmetic corrected.

N.T.A.

- Unreal in relation to to-day's market

Interior

- Far removed from prices realised around March 1969 on the London Metal Exchange

	CRA prices	LME March 1969	LME March 1970
Lead ingots	£ 85	£110	£140
Copper bars	£308	£530	£730

Action

- Ascertain basis for CRA prices
- Discuss pricing alternatives

D. Capital Expenditure

(1) Mine capital

. Study allows for

	$ million
- Capital equipment	
Houses and community services	3.9
18 100-ton trucks	3.6
3 10 cubic yd shovels	2.3
rotary drill	0.7
bulldozers and graders	0.6
water trucks etc	0.4
miscellaneous other	0.5
	12.0
30% Contingency	4.0
	$16.0 million (p 24)

	$
- Housing and Community services include	
178 houses at $20,000	3,560,000
1 single girl's quarters	20,000
1 single men's quarters	20,000
9 8-men barrack blocks	180,000
1 guesthouse	30,000
	$3,810,000 (p 32)

- Mill plant — $5.1 million (p (iv) of Appendix II)

Comments

National Development

- Economies could arise from some form of association with the Rum Jungle operations .
- Brown's development (and possibly Woodcutters) could assist in establishing Batchelor as an important population and community centre.

Interior

- Costs quoted not unreasonable when compared with costs of houses elsewhere.
- Comparative costs for erecting a three bedroom house are

	Departmental Housing (1970/71) ($'000)	Housing Commission (1968/69) ($'000)
Alice Springs	15.0	8.3
Darwin	14.5	9.4
Katherine	18.0	11.5
Tennant Creek	17.0	11 0
Nhulunbuy	32.5	-

- Capital investment on permanent buildings of the magnitude proposed, cannot be justified when deposit will be exhausted inside a decade.
- Consideration should be made of utilisation of existing accommodation that could become available at Batchelor.

Action

- Discuss implications of recent decisions concerning the Rum Jungle area on Batchelor and mining operations in the area.

(ii) Preproduction Capital

Study allows for $8.0 million pre-production capital (p. 38)

Comments

Interior

- No details of items given

Action

- Request breakdown into items

(iii) Working Capital

Study allows for $7.0 million for working capital (p 38)

Comments

Interior

- No details of breakdown given
- Assumed to be half estimated operating costs for a year.
- Economies could result from decreases in operating costs (see F)

Action

- Request advice on basis for estimate.

E. TRANSPORTATION COSTS

Study estimates per ton of concentrate

- cartage to Darwin at $4.20
- wharfage at Darwin at $7.00
- shipping to Japan at $12.00

Comments

(i) Cartage

N.T.A.

- Verbal quote from Commonwealth Railways - $1.80 per ton

Interior

- Commonwealth Railways have suggested a maximum rate of $2.35 per ton (3.7 cents per ton mile)
- With quantities of 170,000 tons per year, it could be expected that a rate of $2.00 (3.2 cents per mile) or better, could be negotiated.

(ii) Wharfage

N.T.A.

- Port Authority quote $1.00 per ton to remove from rail truck store, place in ship's hold at East Arm.

Interior

- Port Authority would require more details regarding method of handling, tonnage per ship, etc.
- Rates have been achieved recently of 80 cents per ton for 1 million tons of iron ore, $1.20 per ton for 5,000 tons of copper concentrate.

(iii) Shipping

N.T.A.

- Mount Bundey iron ore is shipped to Japan at the rate of 200,000 tons per annum for $2.50 per ton.

- Figures possibly based on concentrates being bagged and sent in small quantities as general cargo with no account having been taken of present or projected bulk handling facilities at Darwin.

- Interesting to know reasons why bulk handling not considered.

Interior

- Size of vessels etc needed for a quote.

- Recent shipment to Japan of 2,000 tons of zircon concentrate from Sydney was at $12.35 per ton.

- Much lesser rate could be expected from Darwin for 170,000 tons per annum.

Action

- Discuss proposed handling of concentrates.

- Suggest approach to Shipping agents, Port Authority and Commonwealth Railways for quote.

F Operating Costs

(i) Excavation Expenses

- 0.75lbs gelignite per ton excavated at 40 cents/lb including fuses and detonators

  $4,440,000 (p.33)

- Cost per ton of ore excavated estimated at 52.5 cents per ton using 10 cubic yd shovels and 100 ton trucks (p.34)

Comments

N.T.A.

- Value of explosives worth two to three times the cost achieved elsewhere -
- FIMCO achieve 40 cents per ton excavated with 4 cubic yard shovels and 23 ton trucks - Expect with larger equipment and comparable haulage distances that cost per ton would be less
- Saving would be in the order of $1.8 to $2.0 million

Interior

- Cost of explosives appears excessive compared with entire Silver-Lead-Zinc industry in Australia in 1967 where more than three times as much concentrate is produced for less than ⅓ the explosives.

Action

- Discuss cost of excavation with reference to explosives and total costs on other operations.

ii) Labour

- Wages estimated at average $1.75 per hour; plus 50% for contract open pit operators and tradesmen i.e. $2.62 per hour (p.19)

- Pay hours per year per man

  8 x 6 x 50 = 2400 hours

Comments

Interior . Hourly rates quoted appear generous even when compared with the Gove award - the highest mining award at present in force

for example

Rates	Brown's Deposit	Gove Award
	$	$
for general hand	84.00 *	81.00
		less 17.00 boarding allowance
		64.00
for skilled hand	126.00 *	92.00
		less 17.00 boarding allowance
		75.00

* Hourly rate may have a loading for overtime

Action

- Discuss level of proposed wages - in relation to existing wage structure.

(iii) Administrative Expenses

Administration and General	$
Melbourne Office	100,000
Royalties	100,000
Subsidies	50,000
Contingencies	170,000
Insurances	100,000
	520,000

i.e. $0.26 per ton ore (p.35)

- Total operating cost
  $5.00 per ton ore (p.35)

Comments

N.T.A.

- Figure for Administrative expenses has a contrived air
- Royalty figure does not appear to be derived from estimated royalty less allowable realisation costs

Action

- Discuss basis for component estimates, in particular of royalties

G. General

(i) Nickel and Cobalt Recovery

- Effects of Nickel and Cobalt Recovery:

Nickel	2,000 tons p.a. at 70 cents/lb $3 million.
Cobalt	1,540 tons p.a. $3.8 million at $1.10/lb. (P. 41)

- "Cobalt and Nickel cannot be recovered by flotation into a suitable concentrate for further treatment". Appendix II - page 2.

Comments

National Development

- Explanation needed why cobalt and nickel cannot be recovered.

Interior

- Appears metallurgical problem similar to McArthur River exists.
- No consideration given to hydrometallurgy which it would be anticipated would give greatly improved recovery rates.

Action

- Discuss general metallurgical question of production of concentrates leading up to the recovery of nickel and cobalt.

(ii) Recovery of Silver

. Assays yield

Ag averaging 1.4 dwt per ton for each % pb
with sulphide ore averaging 5.4% pb
and oxidised ore averaging 4.0% pb. (p. 12)

Comments

Northern Territory Administration

. Silver content not taken into account.

. Would return $800,000 p.a. at today's prices.

Action

. Request advice regarding any problems surrounding silver recovery.

(iii) Dilution

- Recovery

  Mining (dilution 20%). (p. 3)

Comment

Northern Territory Administration

- 20% dilution factor to reduce the grade has been allowed but no adjustment has been made to increase the tonnage.

Action

- Request advice whether dilution factor has been taken into account and ~~effects~~.

(iv) Discounted Cash Flow

. Effects of Metal Prices on Economics. (p. 38, 39)

Comments

National Development

. Details of calculation of the DCF values are not explained.

Interior

. Should interest or capital be included as a capital cost (interest on loan would be tax deduction).

. Explanation of tax rate of 36% needed (does it take account of investment allowance, prior expenditure etc.).

. Insufficient details given to understand discounting.

Action

. Discuss method of discounted cash flow particularly interest payments.

. Request advice re tax rate proposed.

. Discuss economic feasibility in attempt to gain some agreement on criteria.

Brown's Lead Deposit - Feasibility Study Report
Meeting Between National Development and Interior -
Draft Agenda

---

(1) Summary of comments and possible "action" on report

- any additions or variations to list attached.

(2) Revised cash flow analysis

- validity of price and other assumptions in Interior's analysis (attached);
- prospects of viability.

(3) Method of approach and issues for discussion with C.R.A. if our assessment is that

(a) project is likely to be viable;

(b) project is clearly not viable at this stage.

(4) Any need for further work or another meeting.

(5) Arrangements for meeting with Company.

BROWN'S LEAD ORE PROSPECT, RUM JUNGLE

By

W. N. THOMAS[1] AND I. G. WHITCHER[2]

INTRODUCTION

Copper mineralization was reported from an area near Rum Jungle siding, about 60 miles south of Darwin, prior to 1907. A few shallow pits excavated at the site came to be known as the Rum Jungle Copper Mines.

In 1913, the Northern Territory Administration on behalf of a Western Australian mining company tested the occurrence by two diamond drill holes but results were discouraging and the prospect was abandoned. There is no record of any further activity in the area until 1949 when uranium was discovered at the present site of White's open cut, about one mile to the east. At this stage the area was renamed Brown's Prospect.

In the subsequent intensive search for uranium in the Rum Jungle area, considerable attention was focussed on Brown's Prospect as one of the potentially favourable areas for uranium ore occurrence. The discovery of traces of torbernite in association with secondary copper mineralization together with positive geophysical indications in the form of a radiometric anomaly and two self-potential anomalies provided encouragement for subsurface testing. Following a campaign of trenching and shaft sinking to shallow depths a programme of drilling was commenced in 1952.

This later exploratory effort failed to reveal any uranium of consequence within the limits of testing but the drilling did reveal significant amounts of lead mineralization with some copper over an appreciable strike length.

In 1956, Consolidated Zinc Pty. Ltd. recommenced testing of this mineralization as a base metal prospect and by diamond drilling has delineated a substantial, though presently uneconomic, body of low to medium grade lead mineralization extending over a length of some 3000 ft and to a depth of 1200 ft.

[1] Senior Geologist, Conzinc Riotinto of Australia Ltd.
[2] Geologist, Conzinc Riotinto of Australia Ltd.

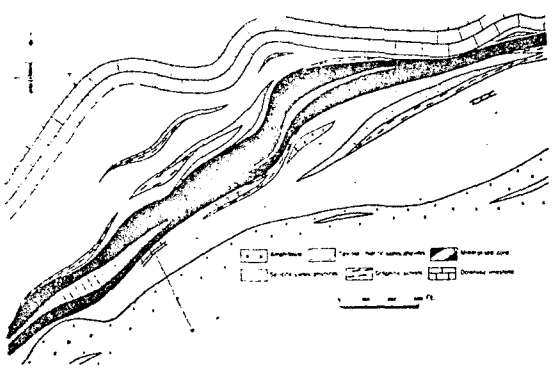


FIG. 1—Geological plan of Brown's lead prospect.

GENERAL GEOLOGY

Owing to a low topographic relief and an extensive soil cover, the surface expression of the mineralized zone and the enclosing rocks is exceedingly poor, the only exposures being the feeble showings of copper mineralization in slates and schists at the eastern extremity of the zone. Extensive trenching was necessary to determine the limits of the mineralization and to provide a concept of the geological environment. Later soil sampling in concealed areas showed that a broad indication of the nature and extent of the occurrence could have been obtained by geochemical methods.

As shown in Figs. 1 and 2, the lithological sequence at Brown's Prospect consists of dolomitic limestone, intercalated black shaly sediments of various types, and amphibolite containing narrow bands of shaly material. Elsewhere in the Rum Jungle district the dolomitic limestone is overlain by a zone of predominantly chloritic rocks but this unit has not been recognised at Brown's.

Throughout its extent, the dolomitic limestone shows considerable variation in composition and texture ranging from a grey sandy dolomite to a creamy, coarsely

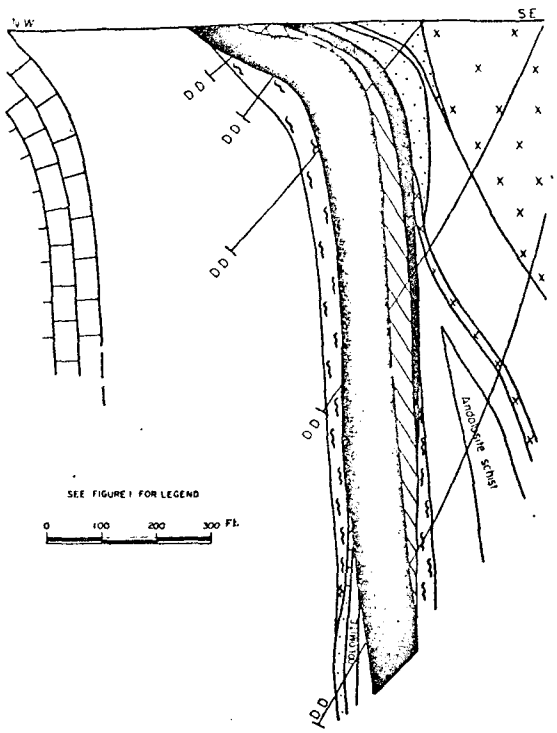


FIG. 2—Section A–A′ through Brown's lead prospect.

crystalline marble, in places containing spherules of hematite.

The overlying sequence of black shaly sediments closely resembles that exposed in White's open cut and consists mainly of grey and black sericitic slates and phyllites with lenses of graphitic schist, andalusite schist, and green and white talcose and chloritic slates and schists.

The andalusite schist is identical with that at White's, exhibiting a well-defined banding and slip-strain cleavage.

South of and overlying the shaly sequence is a very broad zone of amphibolite which is entirely concealed by soil. As seen in drill core, the amphibolite is a massive to well banded, green basic variety, highly calcareous in places and containing erratically distributed patches of iron sulphides and minor sphalerite. Intercalated with the amphibolite are narrow bands of dense, pyritic black slate and chloritic schist. A very broad and intense magnetic anomaly recorded over the amphibolite zone apparently is due mainly to the pyrrhotite content.

The main host rock for the lead mineralization is a well banded grey sericitic phyllite with a characteristic silky lustre; copper mineralization is usually most abundant in the more strongly graphitic rocks, especially in the eastern portion of the zone. The ore minerals are not confined to these rocks however, as lenses of talcose, chloritic rocks within the lead- and copper-bearing sequence may be mineralized to the same degree as the black shaly sediments though the sulphide minerals do not appear to be as uniformly distributed in these horizons.

MINERALOGY

In the oxidised zone, which extends to 50 ft, and in some places to 75 ft depth, the predominant ore minerals are cerussite and malachite while anglesite, pyromorphite, azurite and cuprite are minor components. In the sulphide zone the chief constituent is galena which is usually very fine-grained, often occurring as smears on cleavage planes. Chalcopyrite and sphalerite are minor components, the former being most abundant at the north-eastern end of the zone but subordinate to sphalerite at the south-western end. The presence of linnaeite in most polished sections accounts for the small cobalt content of the body. Covellite, bornite, digenite and pyrrhotite are present in trace amounts (Williams, 1956, 1957).

Mineragraphic studies place the paragenetic sequence as pyrite, followed by linnaeite, chalcopyrite and sphalerite, with galena, which replaces all four, being the last to form.

While much of the lead mineralization has been sheared out along cleavage planes, some galena occurs as fine-grained crystals in interlacing veinlets, often with an enclosing quartz gangue. The more brittle minerals pyrite and chalcopyrite have shattered in response to shearing stress.

Chalcopyrite occurs principally as fine stringers and veins but also has been noted in more graphitic sections as irregular coarse blebs. Some polished sections show a mixture of digenite and covellite as an alteration halo around chalcopyrite. Traces of bornite have been reported from the eastern cupriferous section of the zone.

Linnaeite is generally associated with galena, by which it has been replaced, but is also found as inclusions in chalcopyrite and pyrite.

Sphalerite is intimately associated with galena and to a lesser extent with chalcopyrite, occurring mainly as fine veins. At the western, zincy end of the mineralized zone cream coloured sphalerite occurs sporadically in coarse veins.

STRUCTURE

The mineralized zone occurs within a sequence of metamorphosed black shaly sediments, along the south-westerly extension from White's open cut of the stratigraphically favourable slate-limestone contact, which is the host environment for the bulk of the mineralization in the Rum Jungle district (Thomas, 1956, 1958). The strike of the zone is NE and the dip varies from flatly south to near vertical or vertical in the south-west portion (Fig. 2).

Drilling has disclosed that the mineralized zone is essentially a tabular, conformable body varying in width from about 40 to 160 ft, the maximum width and also the highest lead values being in the central portion.

At the surface, east of the central portion of the zone, there is evidence of pronounced warp in the strike while a short distance to the west is a sharp change in the dip from about 35° S to 90° at 150 ft depth. However, neither of these features appears to have exerted any influence on the localization of mineralization. Zones of contortion and crenelation with superimposed shearing are common throughout the shaly sequence and are not confined to the mineralized zone.

Parts of the mineralized zone are brecciated and there are also indications of minor post-ore faulting in drill core. The irregular trend of the limestone-slate contact may be evidence of a pattern of step-faulting or, perhaps, large-scale drag-folding but the pattern is not reflected in the mineralized zone.

The prominent "Main Shear" zone at White's open cut which, by projection, should pass through Brown's Prospect, possibly between the mineralized zone and the amphibolite, has not been recognised with certainty and there is little direct evidence to suggest that the mineralized zone is truncated in depth by any equivalent of this shear zone, as is the case at White's.

The outstanding features of the structural setting are the rapid convergence of the mineralized zone on the limestone along strike and dip (Figs. 1 and 2). This can be explained as being due to rapid lensing of the intervening sediments; changes of this kind are not uncommon in the Rum Jungle district.

DISTRIBUTION OF MINERALIZATION

A study of the distribution of lead values shows that it is possible to divide the mineralized zone into three lenticular bands. These comprise a footwall band, a hanging wall band of similar grade, and a third, lower

grade band which, throughout its extent, separates the other two (Figs. 1 and 2).

This interpretation of the internal distribution of mineralization satisfactorily explains the variation in thickness of the mineralized zone as being due to the thickening or thinning or lensing out of one or more of these three bands.

However, a study of the distribution of lead values in relation to lithology reveals that the internal grade contours do not always follow stratigraphic boundaries or lithologic contacts but frequently transgress them, which conflicts with both margins of the mineralized zone conforming to the bedding of the enclosing sediments.

GENESIS

In the absence of any detailed knowledge of mineral distribution in relation to lithology, due mainly to the lack of underground development, little significance can be attached to this apparent discrepancy, especially in relation to the contentious problems of origin and mode of formation of the deposit.

The only conclusion which may safely be drawn from the results of drilling at Brown's Prospect is that the mineralized zone, as a whole, is a stratigraphically disposed body which shows the effects of later shearing stresses.

In the broader view, the mineralization at Brown's, like that in the other known occurrences of the district, is intimately related to a particular sedimentary environment. The evidence supports the view that the deposits form an integral part of that environment and are of contemporaneous sedimentary origin.

ACKNOWLEDGEMENTS

This paper is published with permission of Conzinc Riotinto of Australia Ltd.

REFERENCES AND BIBLIOGRAPHY

Thomas, W. N., 1956. A report on the geological investigations of the Rum Jungle Uranium Field, Northern Territory, from 1st January, 1953 to 31st March, 1956, Territory Enterprises Pty. Ltd. Report (unpublished).

Thomas, W. N., 1958. A review of the geology and ore occurrence in the Rum Jungle Uranium Field, Territory Enterprises Pty. Ltd. Report (unpublished).

Williams, K. L., 1956. Lead ore from Brown's Prospect, Rum Jungle, Northern Territory, CSIRO Mineragraphic Invest. Rep. 659.

Williams, K. L., 1957. Further samples of lead ore from Brown's Prospect, Rum Jungle, Northern Territory, CSIRO Mineragraphic Invest. Rep. 687.

7(

CONZINC RIOTINTO OF AUSTRALIA LIMITED
95 COLLINS STREET, MELBOURNE, 3000
CHAIRMAN OF DIRECTORS: SIR MAURICE MAWBY, C.B.E.

P.O. BOX 384D
TELEPHONE 63-0491
TELEGRAMS 'CONRIO'
TELEX AA30108

9th January, 1970.

The Hon. Peter Nixon, M.P.,
Minister for the Interior,
Parliament House,
CANBERRA. A.C.T. 2602

My dear Minister,

In your letter of 15th December to me you expressed interest in knowing what the prospects are for Brown's lead deposit at Rum Jungle.

You suggested too that it would be desirable for officers of your Department and representatives of my Company to meet and discuss a paper to review the position. This we happily agree to and will await advice from you or your department as to the time and place.

In the meantime I could briefly summarise the position for you as we now see it.

NOT ACKNOWLEDGED

E/o M&P
Draft reply files (assume na. this) 14/1.
Mr. Lew.
Early draft pl. 2/2.

2

Since 1956 we have spent $1,028,000 on diamond drilling, shaft sinking, exploratory underground development, metallurgical test work and evaluation of the deposit. We concluded from the assessment of the results of that effort that metal prices, in particular lead and copper, would have to be double what they were in 1969 to make Brown's deposit viable as a mining operation.

We did not reach this conclusion before investigating, among other things, the technical and economic feasibility of employing hitherto untested hydrometallurgical techniques to revover all metals in the deposit, including nickel and cobalt. Such investigations however, failed to give us any encouragement to proceed along those lines.

Notwithstanding this of course we have not departed from our original intention of developing and exploiting Brown's as soon as it can be converted to a commercial proposition. Apart from regular reviews of the position, we will continue our programme of researching techniques that offer promise of improving metal recoveries and economics.

So summarising, until metal prices are dramatically higher, or until we can unearth a clear cut breakthrough in technology, I cannot be optimistic about the prospects of Brown's deposit. Meanwhile I truly hope we can rely on your indulgence to retain titles to the deposit.

If you need any enlargement of the above or further explanation, please do not hesitate to inform me. Alternatively should your Department wish to make direct contact with the responsible C.R.A. officer they could write to Mr. N.A. Gilberthorpe, General Manager, General Mining Division.

Yours sincerely,

Maurice Mawby

(M. Mawby)
Chairman

CONZINC RIOTINTO OF AUSTRALIA LIMITED

95 COLLINS STREET, MELBOURNE, 3000

P.O. BOX 384D

TELEPHONE 63-0491

TELEGRAMS 'CONRIO'

TELEX AA30108

17th February, 1970.

Mr F. L. Ahrens,
Assistant Secretary (Industries),
Department of Industry,
Moresby House,
CANBERRA, A.C.T.

Dear Mr Ahrens,

As agreed on the telephone this morning, I am forwarding with this letter a copy of an internal unpublished report entitled:-

"Brown's Prospect
A Financial Assessment".

We will welcome any queries or comments on this report you care to make and look forward to discussing it with you in the future.

Sincerely yours,

N. A. Gilberthorpe
General Manager
General Mining Division

Enc.

Dr. Allen
Pls examine for pops we might wish to know about - aim to discuss with me (with comments) by abt 25th Feb. DH 20/2
E/O m+P
Pls have this examined quickly & let me have a draft letter in reply if there is additional information we should have before discussion with C.R.A.
2. Draft minute to Not Dev re N.T.A. files. R 19/2/70

Parliament House,
CANBERRA. A.C.T. 2600

10 FEB 1970

Dear Sir Maurice,

Thank you for your letter of 9 January 1970 commenting on the current prospects for developing Brown's lead deposit at Rum Jungle.

Although it seems from your comments that there is little likelihood of early development of the deposit I feel it would be useful for officers of my Department to meet with representatives of your Company to discuss a paper which reviews the position.

Accordingly, I have asked Mr. F.L. Ahrens, Assistant Secretary (Industries), Northern Territory Division, to contact Mr. Gilberthorpe about the arrangements for a meeting and the scope of a paper for Departmental perusal before discussion.

I do not expect that there will be any problem in your Company retaining its titles to the deposit but I will review this matter on receipt of my Department's report of the proposed discussion.

Yours sincerely,

(Sgd.) PETER NIXON
(P.J. NIXON)

Sir Maurice Mawby, C.B.E.,
Chairman,
Conzinc Riotinto of Australia Ltd.,
95 Collins Street,
MELBOURNE. VIC. 3001

EO (ACP)

Yes rough out ideas on scope for the paper with a view to AS contacting Mr Gilberthorpe

Ahrens 11/2

Parliament House,
CANBERRA. A.C.T. 2602

15 DEC [illegible]

Dear Sir Maurice,

As you know, mineral leases over Brown's lead deposit near Rum Jungle in the Northern Territory were granted to Australian Mining and Smelting Co. Ltd. in 1956 and 1957. Since that time, exemptions from labour covenants have been granted to the Company while work of an exploratory nature has been carried out.

I understand that a feasibility study undertaken by the Company some ten years ago on the basis of a concentrator at the mine and a smelter at a port site at either East Arm or Middle Arm concluded that development of the deposit at the time was not economic. One important factor which precluded development of the deposits was, I am informed, the inadequacy of either of the proposed port sites.

You may have read recently that the Government, after considering a report by consultants, has decided to plan the development of a bulk cargo port at East Arm. A copy of the press statement on the subject is attached for your information. In the light of this decision and the improvement in lead prices since the Company's earlier feasibility study, a reappraisal of the situation at this time might yield more encouraging results.

The Government naturally desires to see the deposit developed when this is economically feasible and I would be interested to know the current prospects.

..2/

52

Might I suggest that from my point of view the best way of providing such advice would be for representatives of the Company to meet with officers of my Department (including the Northern Territory Administration) to discuss a brief paper reviewing the position.

I look forward to your advice on this matter.

Yours sincerely,

(D. J. MIXON)

Sir Maurice Mawby, C.B.E.,
Chairman,
Conzinc Riotinto of Australia Ltd.,
95 Collins Street,
MELBOURNE VIC. 3001

70/244

10 MAR 1970

The Secretary,
Department of National Development,
Canberra City, A.C.T. 2601

Attention: Mr W.J. Ricketts

Brown's Lead Deposit N.T.

Enclosed for your information are copies of recent correspondence between the Minister and the Chairman of T.R.A. regarding present prospects for developing Brown's lead deposit in the Northern Territory. The enclosed letters are dated 15 December 1969, 9 January and 10 February 1970.

2. Subsequent to this correspondence, the Company has forwarded to this Department a confidential internal report entitled "Brown's Prospect - A Financial Assessment". A copy of this report is enclosed for your consideration and I am also enclosing some preliminary comments on the report which have been prepared in this Department.

3. Your comments would be appreciated on the accuracy of the cost assumptions in this report as detailed on pages 3-6, 17-35, and 42. In addition, any comments that you would wish to make on the feasibility calculations presented on pages 36-41 of the report would be valued.

4. As it is proposed to hold an early discussion with the Company on the implications of the enclosed report for the possible development of Brown's, it would be appreciated if your comments could be received before 3 April.

F.L.A.

(F. L. Ahrens) gBA
Assistant Secretary
(Industries Branch)

Mr Cotterman, Pl. draft a reminder memo for E/C (A.121). signature gBA 6/4.

2

DEPARTMENT OF THE INTERIOR.

No.

A.S. (Industries).

(1) There appear to be no significant areas of information omitted from the study. However Dr Allen feels we should raise the question of work in hand when he visited Brown's in October 1969, & what if anything has happened since the report was completed which might alter the picture.

(2) Dr. Allen also feels the study should be examined by a Mining Engineer. I favour this. If we also need to bring Nat Dev into the picture quickly. They could not claim this to be a major development & take it over. [illegible] 2/3.

Executive Officer (M. & P.I.)

"Brown's Prospect - a Financial Assessment"

This technical report by a C.R.A. mining engineer has all the appearance of a genuine article; however, it contains several "non-sequiturs" and it would be useful to know whether the author's premises and recommendations were accepted by C.R.A. management. Thus on the opening page, Mr Gilberthorpe observes in para 4 - "there is no foreseeable break-through to a treatment method which will yield a profitable recovery of nickel and cobalt", yet he states in para 5 - "scope and justification exist to continue a modest research programme on nickel and cobalt recovery". Presumably Mr Gilberthorpe has some other justification for pursuing a foredoomed research programme such as the obtaining of further exemptions from labour covenants.

2. It would be helpful to have the report examined by a competent mining engineer, e.g. Mr R. King or Mr G. Mead at B.M.R. but the following general comments can be made. Yes.

Metallurgical Problem

3. It would appear that Brown's has a metallurgical problem similar to McArthur River viz. the prohibitive cost of obtaining marketable concentrates by normal processes of grinding and flotation. In the case of Brown's, the flotation research has been carried out at Amdel and has produced concentrates of lead assaying 50% with 80% to recovery, and copper assaying 20% with 85% recovery. It would appear that these concentrates are marketable but the process is unable to provide a concentrate containing cobalt and nickel.

4. Although hydrometallurgy would be anticipated to give greatly improved recovery rates for lead and copper as well as recovering cobalt and nickel, no consideration to this promising avenue is given in the report. Possibly the economics of hydrometallurgical treatment are also prohibitive but the company should be required to assess this and other research avenues. Comment needed, [illegible]

Reserves and grades of ore

5. Reserves and grades of ore reported on page 12 are based on a 1959 report and are as follows:

	Tons	% Pb	% Cu	% Co	% Zn	% Ni	dwt/ton Ag
Sulphide ore	20.5M	5.4	0.19	0.11	0.3	0.14	7.6
Oxidised ore	2.2M	4.0	0.47	0.09	-	-	5.6

No reference is made in the above tabulation to the additional data obtained during the further exploration of the deposit that was initiated in 1966 and completed during 1969. In the light of these new data, some revision of the above tabulation may be needed and a corresponding adjustment made to the feasibility study. There is also the possibility that spectrographic analysis of the samples may have revealed the presence in the ore of economic quantities of other valuable pay metals. These in turn could affect the feasibility study.

6. The above tabulation (page 12) is at variance with the figure of 13.6M tons for ore reserves quoted in para 3 on page 3. This figure of 13.6M tons is also quoted in connection with sulphide ore in para 3.1.2 on page 18. I am unable to establish how this calculation has been made but note that the quoted reserves of sulphide ore are reduced thereby to 7M tons for the purposes of the feasibility study. However, adoption of this reduced figure and an extraction rate of 2 million tons p.a. gives a reserve life of only 6.8 years - see para 8 on page 6.

Metal Prices

7. The metal prices quoted on page 4 are far removed from prices realised around March 1969 on the London Metal Exchange at the time the report was written.

Per ton	C.R.A. prices	L.M.E. March 1969	L.M.E. February 1970
Lead ingots	£85	£110	£136
Copper bars	£308	£531	£690

../3

While accepting the premise that metal prices on the London Metal Exchange represent marginal dealings that may have no relationship with prices quoted for metal contracts of 2-3 years duration, it might be argued with C.R.A. that for the purposes of their feasibility study the market prices are too low whereas the required rate of return on investment is too high at 15%. It is obvious that if more realistic metal prices were used in conjunction with a lower interest rate, the project becomes more attractive.

Transportation Costs

8. The Economic Services Section should have some useful comments to make on the proposed costs of cartage to Darwin and wharfage at Darwin, and may be able to assess the freight cost to Japan. In regard to freight costs, the quoted figure would appear to be meaningless unless the size of the carrier is stipulated.

Production rate, Capital Investment and Payback

9. The annual production rate of 2 million tons of ore envisaged for the theoretical development of Brown's is impressive for a base metals operation and compares with 5 million tons recently attained after an extensive expansion at the record-breaking Mount Isa mines and 1.2 million tons at the impressively mechanised M.B.H.C. mine operated by C.R.A. at Broken Hill. There can be little doubt that this high production rate has been selected in order to reduce the payback period on capital investment; however, the attainment of this rate in turn places a heavy burden on capital expenditure. Thus, on page 37, a total work-force of 202 daily paid workers and 61 staff are envisaged with housing requirements in excess of $3m. A capital investment on permanent buildings of this magnitude can hardly be justified when the deposit will be exhausted inside a decade. Apart from the possibility of utilising existing accommodation that could become available at Batchelor, the adoption of a more obtainable production rate e.g. 0.5M t.p.a., would place less strain on the company's financial and labour resources in addition to easing its requirements on local facilities, notably ore transportation facilities to Darwin.

../4

10. On the subject of payback, it is noted that a payback period of 5.7 years is reported on page 39 consequent upon a 65% increase in the author's proposed market prices for lead and copper.

JBA.

27 February 1970 (J. B. Allen)

DEPARTMENT OF THE INTERIOR

NO.

Mr. Ward

Mining and Petroleum Industries Section - Work Position

Mr. Geoff Pettit , the successor to Mr. Hyde, will be taking up duty in the Section on Thursday 3 September.

2. For the purpose of briefing Mr. Pettit on the current work situation I would like a comprehensive list of the outstanding work in the following categories:

(a) current priority items and stage reached e.g. Brown's lead - first inter-Departmental meeting held and arrangements in course for meeting with Company, variation of oil search programme - ministerial submissions and preparation, A.M.I.C. representations on mining legislation - first draft Cabinet submission prepared and under consideration by Deputy Secretary (joint submission with National Development involved);

(b) items awaiting attention in the Section e.g. review of royalties, comprehensive review of mining legislation including provisions for assistance to mining industry;

(c) items awaiting replies to correspondence from N.T.A. or elsewhere e.g. off-shore oil - proposals for release of areas, on-shore petroleum legislation - proposals for amendment to legislation (Department also has outstanding work on both these items).

3. Would you please let me have the list by close of business on 2 September.

(F.L. Ahrens)
Assistant Secretary
(N.T. Industries)

27 August 1970.

DEPARTMENT OF THE INTERIOR.

NO. 70/244

E/o Mapp & Allen. 15A

Assistant Secretary
(Industries Branch)

Brown's Lead Deposit

In your minute of 7 March 1970 you asked for comment on the financial report of the above deposit with particular reference to costs of -

- transportation
- labour
- housing.

Transportation and Wharfage

2. There is insufficient information available in the Report to offer precise comment on this item, but brief comments are -

Rail Haulage to Darwin: Shown as $4.20 per ton, with a possibility of reduction. From discussions with Commonwealth Railways it would seem that a rate of $2.35 per ton (3.7 cents per ton mile) and not $4.20 would probably be the maximum rate payable. With quantities of 170,000 tons per year, it could be expected that a rate of $2.00 (3.2 cents per ton mile) or better, could be negotiated.

Wharfage: Charge of $7.00 per ton appears high, but Port Authority unable to suggest an alternative rate without having more detail about such aspects as -

- whether a storage charge was included and the type of storage;
- method of handling from rail/storage/ships hold;
- tonnage per ship.

However, when compared with rates of 80 cents per ton for iron ore (1 million tons) and $1.20 per ton for 5,000 tons of copper concentrate (this latter charge did not include equipment amortization charges) handling at the rate of $7.00 quoted could be expected to be reduced considerably.

1

However, 170,000 tons could not be handled at the existing port and would have to be exported through the new bulk facilities proposed for East Arm, which are scheduled to come into operation during 1973.

Shipping Costs: Size of vessels etc. are needed before a more reasonable comment could be given on the rate of $12.00 per ton to Japan. From discussions with shippers we learnt that a rate of $12.35 per ton applied to a 2,000 ton shipment of zircon sands from Sydney to Japan recently. A much lesser rate could be expected for larger shipments from Darwin of a total quantity of 170,000 tons per annum.

Labour

3. The hourly rates quoted appear generous even when compared with the Gove award - which is the highest mining award at present in force. For example -

Rates	Weekly Rates: Brown's Deposit	Gove Award	
	$	$	
For General Hand	84.00ø	81	
		less 17	Boarding Allowance
		64	
For Skilled Hand	126.00ø	92	
		less 17	Boarding Allowance
		75	

ø Note however that hourly rate may have a loading for overtime.

Housing

4. The housing costs quoted are not unreasonable when compared with houses erected or to be erected elsewhere in the Territory. For example comparative costs of erecting a three bedroom house are -

	Departmental Housing (1970/71)	Housing Commission (1968/69)	Brown's Lead Deposit $
Alice Springs	15,000	8,300	
Darwin	14,500	9,400	
Katherine	18,000	11,500	20,000
Tennant Creek	17,000	11,000	
Nhulunbuy	SPECIAL 32,500	~~10,000~~	

General

5. The greatest potential "savings" in the three cost areas referred to this Branch seem to be in respect of transportation and wharfage. Of a total cost of $23.00 per ton from rail head to Japan it would seem that for sufficient quantities these special rates could be negotiated with Commonwealth Railways/Port Authority/Shippers which could attract savings of as much as half of the costs quoted. It should also be noted that it is not practicable to handle 170,000 tons per annum through the existing Fort Hill/Stokes Hill berths and that the East Arm bulk port (which could probably be adapted) will not be available until 1973.

(G. L. Mansfield)
Assistant Secretary
(Development and Services)

19 March 1970

ADMINISTRATOR OF THE NORTHERN TERRITORY

66/2598

P.O. BOX 231
DARWIN, N.T.

24 APR 1970

The Secretary,
Department of the Interior,
CANBERRA. A.C.T. 2600

BROWN'S LEAD DEPOSIT - C.R.A. REPORT

With reference to your memorandum of 11th March, 1970, the report on Brown's prospect has been examined and the following comments are provided for your information -

(1) In this report only one mining method has been suggested, that is the open cut method and the design of operation of this open cut is not clearly shown. It appears that only two thirds of the deposit will be mined. This probably accounts for the difference in total reserves of 22,700,000 tons of ore as shown on page 12 of their report and the estimated recoverable ore, 13.6 million tons as shown on page 3 of their report. Possibly using other methods of mining a larger proportion of the total deposit could be used.

(2) On page 3 they have allowed a 20% dilution factor to reduce the grade but no allowance has been made to increase the tonnage.

(3) As noted in the Department's comments it is agreed that the metal prices considered are unreal in relation to today's market. No revenue is taken into account for the silver content of concentrates which could return something in the order of $800,000 per year at today's price.

(4) It is felt that they have been conservative in their estimate of the cost per ton of excavated ore. This work is to be done using 10 cubic yard shovels and 100 ton trucks and is estimated at 52.53 cents per ton. Frances Creek Iron Mining Company believe they achieve 40 cents per ton excavated with 4 cubic yard shovels and 23 ton trucks.

Without a detailed design of the open cut and without knowing the length of the haul roads it is difficult to draw a comparison but it would be expected with larger equipment and comparable haulage distances that the cost per ton would be less. If it is assumed that they can

C/o ... For early examination & coordination of point ... with CRA.

../2

excavate for 40 cents similarly to FIMCO's operation there would be an annual saving of $1,800,000 on their estimate of 14,800,000 tons.

(5) The estimated annual cost of explosives is $4,400,000 which appears to be twice to three times the cost achieved elsewhere, so that in practice there could be a saving in the order of $2,000,000 on this factor.

(6) A comparison of costs of cartage, wharfage and shipping estimated by C.R.A. and those actually achieveable locally is as follows -

(a) Cartage - of lead and copper concentrate from Rum Jungle to Darwin -

C.R.A. estimate $4.20 per ton.

Commonwealth Railways quote (verbal) $1.80 per ton.

(b) Wharfage -

C.R.A. estimate $7.00 per ton.

Port Authority quote $1.00 per ton to remove from rail truck, store, place in ship's hold at East Arm.

(c) Shipping - C.R.A. estimate $12.00 per ton.

Morgan Mining at Mt. Bundey at present ship approximately 200,000 tons of iron ore per year to Japan at $2.50 per ton.

As can be seen, there are large differences between C.R.A.'s estimates and the figures that have been obtained locally and possibly C.R.A.'s figures are based on concentrates being bagged and sent in small quantities as general cargo with no account having been taken of present or projected bulk handling facilities in Darwin.

There may have been good reasons why bulk handling of concentrates was not considered, but in view of the saving in cost by using bulk handling methods, it would be interesting to know what these reasons are.

(7) Although most major mine design studies are based on a life expectancy of at least 12 to 15 years, C.R.A.'s proposals for complete extraction of the orebody in less than 7 years is not unusual for the open cut method. Generally in the case of open cut mining the quicker the ore can be extracted the better are the economics of operation. However the economics of extraction using other mining methods have not been examined in this report, so without a detailed analysis of capital investment and cash flow data for alternative mining methods it would be impossible to show that a lower extraction rate would give a better return on investments.

../3

(8) The figure of $520,000 for Administration & General gives a loading of $0.26 per ton of ore which rounds off the operating cost at an even $5.00 per ton. This figure has a contived air, which impression is heightened by the fact that the royalty figure of $100,000 does not appear to be derived from the estimated revenue less possible allowable realization costs.

(9) The lack of data to support many of the assumptions which are basic to the study makes it difficult for us to accept McGregor's report as a searching study of the feasibility of mining Brown's Lead Deposit at this time.

(F. C. CHANEY)
Administrator

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

TASMAN HOUSE, HOBART PLACE, CANBERRA, A.C.T.

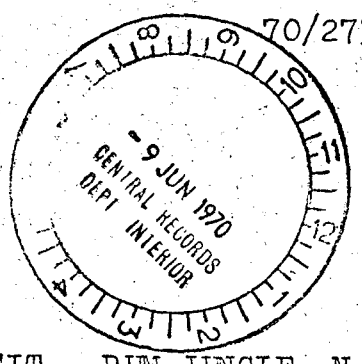
Postal Address: Box 850, P.O., Canberra City

Telephone: 496188 *Telegrams:* Natdev *Telex:* 62101

In reply please quote:

Northern Division

70/273



- 5 JUN 1970

The Secretary,
Department of the Interior,
CANBERRA. A.C.T. 2600

BROWN'S LEAD DEPOSIT - RUM JUNGLE, N.T.

I refer to your letter 70/244 seeking comments on the report "Brown's Prospect - a Financial Assessment" by G.W. McGregor of Conzinc Riotinto of Australia Ltd.

2. The report is a company internal report prepared in accordance with the instructions given as Appendix 1 to the report. The instructions and the report make a number of judgements and statements on important matters, the reasons and backgrounds for which are not set out in the documents. While this may be sufficient to meet the internal needs of C.R.A. it does not give a satisfactory appraisal of the feasibility of developing the deposit to those outside the company.

3. Important matters which are not explained in the documents are

(a) The basis of "C.R.A. metal prices". These were £UK 85 per ton for lead ingots and £UK 308 per ton for copper bars in March 1969 when the London Metal Exchange prices were £110 and £530 respectively at the same date.

(b) Why a mining method was chosen which would recover only 13,600,000 tons of ore out of a total indicated sulphide ore reserve of 20,500,000 tons.

(c) Why a mill size was chosen which would exhaust the open-cuttable ore in less than 8 years.

(d) Why nickel and cobalt "cannot be recovered by flotation into a suitable concentrate for further treatment". This is surprising; one would normally expect them to be recovered

.../2

with the copper flotation concentrate. It is also surprising that the company does not propose to pursue the matter of nickel and cobalt recovery very vigorously in spite of the fact that, even at the low prices assumed in the report, there is a possible extra net revenue of $6,000,000 per annum.

(e) The details of the calculation of the D.C.F. values.

4. Apart from these substantive matters there appear to be mistakes in the report in the method of calculating the return per ton of metal. On page 36, paragraph 4.1, we calculate the lead payment per ton Pb in 50% concentrate to be $A146.65. Again on page 37, paragraph 4.2 we calculate the copper payment to be $A539.23. Correction of these mistakes reduces the estimated revenue to $12,280,000 and increases the estimated operating loss to $1,706,000 per annum.

5. An estimate has been made of the likely lead and copper revenue at March 1970 prices. A copy is attached. Because of the lack of detail on the time stream of capital expenditures, it was not possible to use these figures to assess the viability of a possible project.

6. The feasibility study does not take into account economies which could arise from some form of association with the Rum Jungle operations, e.g. use of certain elements of the township of Batchelor to effect a saving in the cost of housing and community services which is estimated in the report to be $3.8 million.

7. The development of Brown's by itself or possibly in association with other projects e.g. Woodcutters could help in establishing Batchelor as an important population and community centre in the region and thus make a significant contribution to the development of the top end of the Territory. We see this type of development as being in line with the thinking expressed in Mr. Swartz's recent Submission to Cabinet on Natural Resources Development Policy in the 70's, where he sees the Commonwealth role as including the fostering of regional development in Northern Australia and in line with ~~the~~ views expressed in regard to the Mt. Fitch proposal.

8. In summary therefore, in our view, the C.R.A. report does not justify a number of important parameters used and is not a sufficiently comprehensive assessment of the feasibility of developing the deposit. The report therefore does not justify the Government's accepting that the deposit is incapable of development at this stage and the Company should therefore be asked to undertake a more thorough analysis of the feasibility of developing the deposit. In making such

.../3

a request we would see advantage in having a discussion with the Company to see if it can provide answers to some of the questions mentioned above and during which we could indicate to the Company matters which we would wish the feasibility study to encompass. A prior meeting between the two Departments would be useful in clarifying views.

9. The development of a deposit of this size would, on its own, be of real significance to the development of the Territory. It is of additional significance because of the possibility of its development being integrated in some degree with other projects in the Rum Jungle area and of the additional impetus which it could give to regional development. It is our view therefore that this is a major project of importance to the development of the north of Australia and as such a matter on which the primary policy responsibility falls on this Department in the same way as the McArthur River project does. Subject to any views which you may have, I suggest therefore that the approach to further negotiations with the company be carried out by the two Departments in the same way as arranged in relation to the McArthur River negotiations.

10. I have suggested above that the next step should be for our two Departments to agree on an approach by the Government to the Company in respect of their feasibility study; however, I consider that, before doing so, we should resolve the question of Departmental responsibilities.

A. D. Watt

Secretary

LEAD AND COPPER REVENUE (MARCH 70 PRICES).

(Recalculation of revenues calculated on pp 5, 6, 36, 37 of Study)

Lead concentrates produced	=	141,000 tons p.a.	
Lead content @ 50% Pb	=	70,500 " "	
Smelter pays for 94%*		66,270 " "	
Price U.K. (March 70) £140 per ton		£9,277,800	
Less treatment charge @ £6 per ton cons.		£ 846,000	
Revenue from lead		= £8,431,800	= $A 18,069,347
Copper concentrates produced	=	18,000 tons p.a.	
Copper content @ 20% Cu	=	3,600 " "	
Smelter pays 100% @ £730 per ton		£2,628,000	
Less draftage @ 1 unit per ton cons.*		131,400	
		= £2,496,600	
Deduct 1.3 U.S. cents per lb. Cu**		43,680	
Deduct $15 U.S. per metric ton cons.**		114,300	
Revenue from copper		= £2,338,620	= $A 5,011,335

Total Revenue per annum at March 70 prices = $A23,080,682.

* Deduction for metal losses in smelter

** Treatment charges

23.6.70

Secretary,
Department of National Development,
CANBERRA. A.C.T. 2600

Brown's Lead Deposit - Rum Jungle N.T.

I refer to your memorandum of 5 June commenting on an internal report and financial assessment of the above project submitted by Conzinc Riotinto of Australia Ltd., following correspondence between the Minister for the Interior and the Chairman of the Company.

2. Your comments are closely in line with points which we had previously concluded required further discussion with the Company. However, I agree that a prior meeting between the two Departments would be useful for clarifying views before entering into such discussions.

3. While I am happy that further negotiations with the Company be carried out by the two Departments I do not share your view that the primary policy responsibility falls on your Department. Under the present administrative arrangements between the two Departments the Minister for National Development has a policy responsibility for new major Government and/or private projects of importance to the development of the north of Australia.

4. Development of the Brown's lead deposit would be of some local value but I seriously doubt whether it could be described as being of importance to the development of the north of Australia in the same way as the McArthur River lead/zinc deposit. The Brown's deposit is not a major deposit - it is no more and probably far less than 10% of the ore deposit at McArthur River and on the Company's estimate would be worked out in seven years. Nor is it a new deposit - it has been held under mineral leases for over 12 years by a subsidiary of C.R.A.

5. The Company has been granted almost continuous exemption from the manning provisions of Brown's leases. I regard it as the prerogative as the Minister for the Interior, on advice from the Administrator, to require

...2/

this Department to investigate the feasibility of developing a deposit held under lease and to advise him whether justification exists for allowing further exemptions from the manning provisions of the lease. This is the basic purpose of the proposed discussions with C.R.A. following on the Minister's correspondence with the Chairman of that Company.

6. If in the light of these observations you still wish to pursue your proposal I suggest we meet to discuss the matter.

(R.S. Swift)
Deputy Secretary

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

TASMAN HOUSE, HOBART PLACE, CANBERRA, A.C.T.

Postal Address: Box 850, P.O., Canberra City

Telephone: 496188 *Telegrams:* Natdev *Telex:* 62101

In reply please quote: 70/273

The Secretary,
Department of the Interior,
CANBERRA CITY. A.C.T. 2600.

30 JUL 1970

BROWN'S LEAD DEPOSIT - RUM JUNGLE, N.T.

I refer to your memorandum of 23rd June concerning the question of our respective responsibilities in relation to the development of Brown's Lead deposit.

2. I was surprised to learn from this of your strong doubt that the development of Brown's Lead deposit would be important to the development of northern Australia particularly in the sense intended in the administrative arrangements between the two Departments.

3. With regard to your Minister's responsibilities under the Mining Ordinance, it was not, of course, the intention of my memorandum that these should be brought into question. However I would expect that if, after investigation, the development of Brown's deposit seemed feasible, the resulting policy considerations would extend beyond the provisions governing a mineral lease.

4. Other observations made in your memorandum indicate a disparity of views between our two Departments as to the significance of both the size of the deposit and the life of any mining operation.

5. In view of the foregoing and since my Department's substantive interest arises in connection with the prospective development of the deposit, I believe that, in the interest of maintaining progress, the best course of action now is to hold over the question of departmental responsibility for later consideration while we jointly set to the task of satisfying ourselves as to the development possibilities of the deposit in consultation with the Company.

6. As a first step in this direction I suggest that, as we are agreed on the desirability of a meeting between our two Departments before a further approach to the Company is made, this meeting might now be arranged.

RECEIVED 31 JUL 1970

(Signed)
Secretary

NT

2

E/o M & P.

NT70/931

20 AUG 70

The Secretary,
Department of National Development,
CANBERRA. A.C.T. 2600

Attention: Mr. W.J. Ricketts

Brown's Lead Deposit

I refer to our recent correspondence, your reference 70/273, on the report by Conzinc Riotinto of Australia Limited on Brown's lead deposit.

As discussed over the telephone today I enclose a draft agenda for a meeting between our two Departments on the Company's feasibility report. Also enclosed is a summary of comments and possible action on the report and a revised cash flow analysis.

I should be pleased if you would let me know when you will be available for a meeting.

(F.L. Ahrens)
for Secretary

LEAD PRICES

	Australia ($ per ton)			London Metal Exchange (£stg per ton)		
	Max.	Min.	Average	Max.	Min.	Average
1959	200.00	200.00	200.00	75.34	68.37	70.78
1960	200.00	200.00	200.00	78.63	61.87	72.15
1961	200.00	190.00	198.70	68.30	57.63	64.20
1962	190.00	150.00	164.26	62.30	50.10	56.30
1963	180.00	160.00	169.18	77.50	53.82	63.47
1964	350.00	180.00	239.34	154.50	77.00	101.25
1965	340.00	250.00	281.14	155.75	95.19	115.00
1966	280.00	225.00	248.83	111.50	78.33	95.15
1967	225.00	210.00	217.50	95.38	78.06	83.83
1968	230.00	210.00	218.55	108.87	91.25	101.89
1969	290.00	230.00	259.20	137.37	105.80	118.10
1970 (7 months)	290.00	290.00	290.00	127.08	141.90	135.18

Lead Prices

		Australia ($ per ton)	London Metal Exchange (£stg per ton)
1968	January	210.0	92.8
	February	210.0	96.4
	March	210.0	99.1
	April	210.0	99.4
	May	210.0	100.5
	June	210.0	100.9
	July	212.6	104.6
	August	230.0	105.8
	September	230.0	106.4
	October	230.0	104.8
	November	230.0	105.1
	December	230.0	105.9
1969	January	230.0	107.5
	February	230.0	109.4
	March	238.6	110.5
	April	250.0	113.5
	May	250.0	117.5
	June	250.0	120.8
	July	271.6	131.6
	August	275.0	133.7
	September	275.0	128.0
	October	275.0	124.3
	November	275.0	133.5
	December	290.0	141.3
1970	January	290.0	137.3
	February	290.0	141.4
	March	290.0	141.9
	April	290.0	135.8
	May	290.0	132.5
	June	290.0	130.3
	July	290.0	127.1

Australian Price of Lead

- Two producers only
  - Broken Hill Associated Smelters Proprietry Limited;
  - Electrolytic Refining and Smelting Company of Australia Limited.
- Price decided by agreement between companies
  - based on LME and US price;
  - quoted as f.o.b. ex-Port Pirie.

~~Note: LME price excludes duty and is quoted "at warehouse".~~

Domestic Consumption

- For 1968, 62,600 tons lead consumed domestically
  - approximately 17% of total Australian lead production.
- Uses for domestic lead
  - 45 per cent batteries;
  - 30 per cent cable sheathing;
  - remainder chemicals and alloys.
- 2 milligrams of tetraethyl lead per gallon of motor spirit
  - approximately 4,000 tons lead per annum;
  - all tetraethyl lead imported.