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James Doyle Sell Mining Collection

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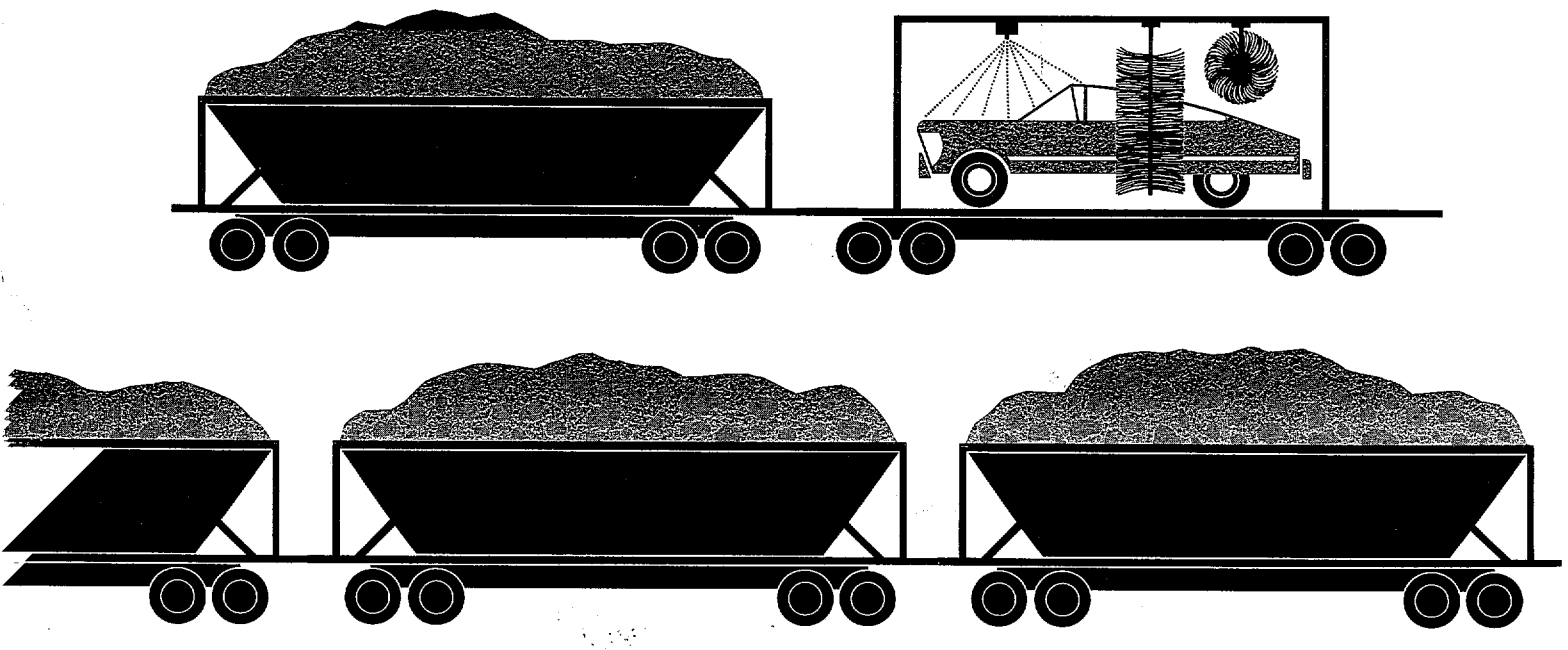
No acknowledgement necessary

BAGDAD COPPER CORP.
BAGDAD, ARIZONA 86321

GEORGE W. COLVILLE
EXECUTIVE VICE PRESIDENT
AND TREASURER
GENERAL MANAGER

PHONE 633-2241

ANNUAL REPORT
1968
BAGDAD COPPER CORPORATION



Financial Summary

	1968	1967
Sales	$21,210,839	$17,816,563
Net Income	$ 3,398,039	$ 2,532,107
Depreciation	$ 820,825	$ 724,506
Capital Expenditures	$ 1,384,000	$ 1,162,000
Year End Current Ratio	4.2:1	4.1:1
Year End Net Worth	$20,713,851	$17,526,272
Shares Outstanding, Year End	1,351,365	1,329,692*
Net Income per Share	$ 2.51	$ 1.90*
Copper Production - Pounds	36,476,000	36,749,000
Year End Inventory of Copper - Pounds	2,404,000	5,224,000
Average Copper Price per Pound	41.9c	41.6c

*Adjusted for 5% stock dividend paid December 10, 1968

COLOR POSTCARDS

1. Mine and Mill
2. Acid Plant, Refinery, and Leach Plant
3. Mine and Mill
4. Townsite

Highlights

Sales and net income both set records in 1968. Copper production for 1968 was about the same as last year, but sale of the excess inventory accumulated during the strike boosted 1968 earnings.

The copper industry strike was settled in the spring of 1968 and the industry began returning to normal. Copper became available to most users, but premium prices in the dealer market have persisted to the present time, albeit at much lower levels than during the strike. We do not participate in these premiums on our post strike production.

The copper powder refinery continued operating at a loss in 1968. Production did not reach the breakeven point, but significant progress was made in defining solutions to our problems. Our joint venture partner, Chemetals, is leaving the venture and the refinery program will be unclear until we know what disposition will be made of their part of the venture.

Garland experienced record sales in 1968, but increases were in basic fabricated products which command the lowest profit margin, so that net income set no records.

Bagdad Plastics Company operated at a profit during the fourth quarter, and we expect it to continue profitable in the future. This is still a very small part of our total company, but it serves an industry that is capable of substantial growth.

Bagdad Mine

PERSPECTIVE

The Bagdad Mine continues to be by far the largest segment of our business. It contributes about three-quarters of our sales, more than 95% of our net income, and employs about three-quarters of our people.

COPPER INDUSTRY AND MARKETS

Turmoil in the copper industry subsided rapidly following the end of the strike in March of 1968. Continued heavy demand for copper, both domestically and abroad, has kept dealer price above primary producer price, although premiums are not nearly as large as during the strike. We do not participate in these premiums because we sell to one of the primary producers.

Prior to the strike, primary producer price was about 38 cents per pound. This was raised to 42 cents per pound following the strike, and in January of 1969 it was raised again to 44 cents. Considerable additional world productive capacity is programmed to come on stream during the next few years, and it is entirely possible that world supply will exceed demand. In this event I would expect dealer premiums to disappear and pressure could develop on the primary producer price.

The strike resulted in substantial wage increases throughout the copper industry. Although we were not on strike, we experienced the same cost increases.

PRODUCTION

Sulphide concentrate production in 1968 was 22,218,000 pounds copper content, which is 13% lower than 1967. Ore grade during 1968 was 0.65% compared to 0.77% in 1967. Reduction in grade is the chief cause for lower production this year. Production in future years can be expected to vary somewhat, depending upon ore grade, but neither 1968 nor 1967 production should be considered untypical.

Leach production in 1968 was 14,258,000 pounds copper content, which is 29% higher than 1967. This increase was possible because the new ore pile was in production for the full year 1968, which enabled us to greatly reduce the degrading effect that iron accumulation exerts on leach production. Production during 1969 is expected to be about the same as 1968, and by the end of 1970 we hope to have eliminated the iron problem entirely by introduction of the solvent extraction method of recovery. This is discussed in a later paragraph.

Molybdenum shipments in 1968 were 599,207 pounds of contained metal, compared to 519,639 pounds in 1967. Price in 1968 was about 4% lower than 1967, which reduced the benefit from increased production. Molybdenum is a by-product, so that production may experience relatively wide variations from year to year, but I expect it to continue to stay in the same neighborhood that it has been during the last few years. Molybdenum is in ample world supply, and I do not expect any price increase in the near future, and it is possible it may decrease.

Silver is very small by-product of our operation. We produced 63,242 ounces in 1968.

Rate of stripping changed little in 1968 compared to 1967. This rate is about twice that required to stay even with ore mining, and we expect stripping to continue at about this rate for the next several years.

Production costs during 1968 increased about 10% compared to 1967. This arises from a combination of higher labor cost in the industry, increases in cost of material and services, and somewhat more difficult mining locations this year compared to last. In addition, escalation of smelter costs have added about a penny per pound of copper. The total increase has been

New flotation cells recently installed to replace old less efficient units.

in the neighborhood of three cents per pound of copper, which substantially reduces the benefit from recent price increases.

We have under way several major improvement projects. The flotation cells have been replaced with new and larger ones. The new cells give improved efficiency and lower maintenance. Our pit continues to get deeper, and we are lowering the crushing point 190 feet. This will shorten the ore haul and avoid major overhaul of the present system. We are laying about 12 miles of pipeline to a new source of water. This should give an adequate supply for many years. The cost of these three projects will be about $1,200,000. To this must be added the usual yearly capital expenditures at the Mine.

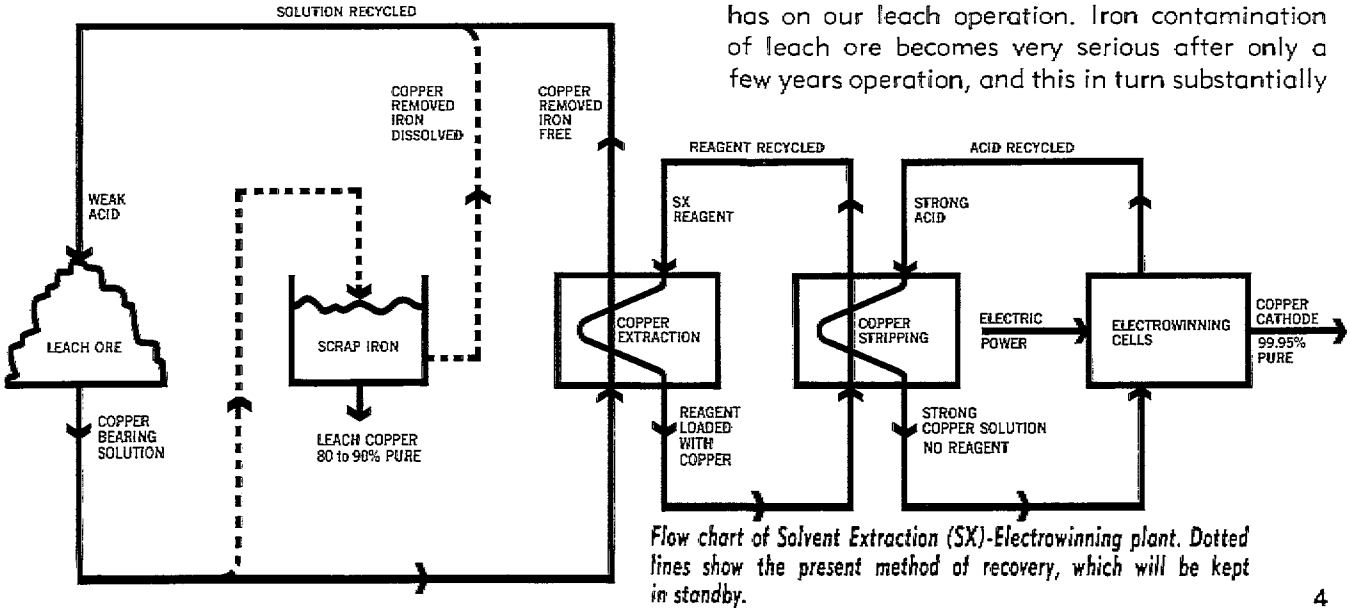
OUTLOOK

Our copper production is relatively stable and no large variations are expected during 1969 compared to 1968. I do not expect price during 1969 to go higher than the present 44 cents per pound, and it is entirely possible that some pressure on price might develop by year end, depending upon world demand. It is almost certain that costs will be higher next year, both at the Mine and the smelter to which we ship. Cost increases cannot be pinpointed, but they might be in the range of one or two cents per pound. Because of the uncertainties of costs and price, there is no way to accurately forecast results from the Mine during 1969.

SOLVENT EXTRACTION

We have decided to proceed with installation of the solvent extraction (SX) plant. This will treat our leached copper and produce commercial copper cathodes rather than leach (cement) copper. The value of cathodes is six or seven cents per pound more than the value of leach copper. SX will eliminate the cost of iron and replace this with the costs for SX reagents, power for electrowinning, and getting the cathode to market. Operating costs for producing cathodes with SX are only a trifle higher than producing leach copper with iron, so that most of the increase in value of the product can be credited against depreciation and return on investment. Investment will be on the order of $5,000,000 so that the direct return will not be impressive.

The chief benefit of SX is that it eliminates iron and, therefore, the degrading effect this has on our leach operation. Iron contamination of leach ore becomes very serious after only a few years operation, and this in turn substantially



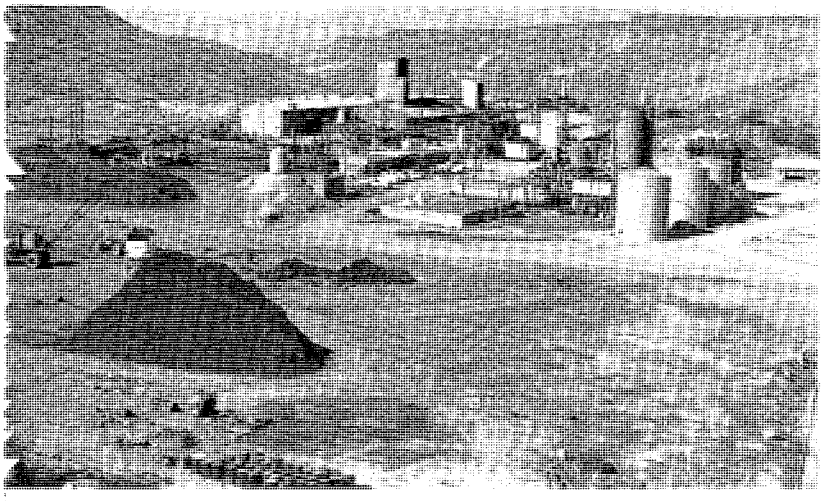
Flow chart of Solvent Extraction (SX)-Electrowinning plant. Dotted lines show the present method of recovery, which will be kept in standby.

reduces production. This can be seen by comparing the 11,066,000 pounds of leach production in 1967, when we were working on partly contaminated ore, to the 14,258,000 pounds this year after we brought a new ore pile into production. We fully expect SX to materially extend the life of our leaching ore body, but it is not possible to put a dollar figure on this benefit. Over the life of the ore body our additional recovery should pay for the SX plant several times.

The accompanying sketch shows generally how SX works and compares this to the present method.

Chemical reagents for SX are produced by General Mills. We have tested this process quite thoroughly in our pilot plant at Bagdad during the last two years. A production plant similar to the one we will install has been operating satisfactorily at another mine in Arizona.

Holmes & Narver of Los Angeles have been selected as engineering contractor. Engineering

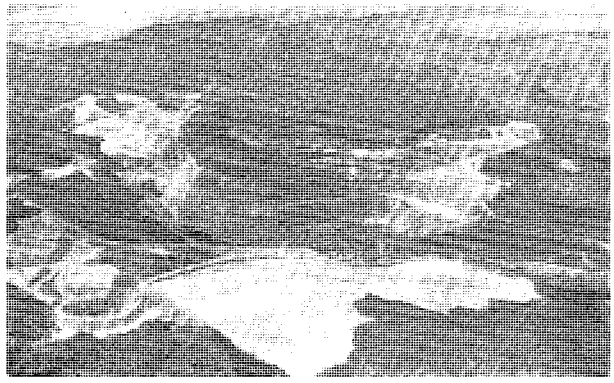


The SX Plant will be located in the leveled area in foreground. The acid plant and iron launders are just beyond the SX site and the powder refinery is behind these.

is proceeding, but there are still one or two parameters to be determined from our pilot plant before we can complete engineering data. The SX plant should be in operation sometime during the latter part of 1970, but an exact construction schedule will not be determined until engineering is complete.

NEW ORE PROSPECTS

Continued drilling adjacent to our present ore body has enabled us to define an additional 141 million tons of material with a grade of 0.52% copper. Stripping ratio over this would be about



The possible new ore lays against the present ore but extending deeper and further into the mountain. Principal areas are in the main pit in the center of the picture and in the unmined area at left center.

2:1. If this is combined with our present ore, the total is about 185 million tons of 0.56% grade. The combined grade is too low for economic treatment with our present mining and milling facilities. We are studying the possibility of constructing an entirely new 20,000 ton per day mill and increasing mining facilities to feed this mill. At present we can only guess at the capital cost of this project, but it could be on the order of $35,000,000. This would be a very major project for Bagdad, and I am sure it will not materialize for some time, if ever. We will continue drilling to perfect definition of the ore prospect. We will also get a better idea of capital costs involved and operating economics.

Refinery

JOINT VENTURE

During 1968 our partner elected to resign from the joint venture. This resulted from a policy decision of Gulf States Land & Industries, the parent of Chemetals, to cease participation in the metal business and concentrate on fields more nearly in line with their basic activity. We have had lengthy discussions with Gulf States Land personnel concerning disposition of their half of the joint venture, but to date no conclusion has been reached. It is likely that they will either sell their half to a new venturer who will assume their position, or arrange for Bagdad to take over the entire project.

1968 OPERATIONS

The refinery produced 4,120,000 pounds of copper during 1968 which was an increase of 165,000 pounds over 1967. Inventory increased 870,000 pounds during the year, so that 1968 sales were about 3,250,000 pounds. After de-

ducting costs of copper feed, sales of the refinery were $725,000 in 1968 which compares to $673,000 in 1967. Loss at the refinery in 1968 was $604,000 compared to $1,012,000 in 1967. The operating loss (before depreciation and equipment writeoff) in 1968 was $268,000 compared to $469,000 last year. Reduction in loss this year was possible because of somewhat more favorable pricing and improved cost control. During 1968 Bagdad took half of the total loss up to September 21, and the full operating loss plus half of the depreciation thereafter. September 21 is one possible cut off date for joint venture accounting, but this could be adjusted when final disposition of the venture is established.

During 1968 the refinery continued to be plagued by process and plant problems. We have solved a number of these and have done enough investigation so that we now believe we know how to handle most of the rest. We probably will not remedy all of these problems until we know disposition of our partner's half of the joint venture. One of the most severe problems was corrosion in the reduction autoclaves. Titanium vessels were installed about a year ago and results to date indicate that corrosion has been eliminated as a major problem.

In spite of the problems, operation of the refinery during 1968 was much more routine and reliable than in the past and by year end production was somewhat ahead of sales. This enables us to intelligently plan our marketing program which will be emphasized during 1969. The powder continues to be well received by customers.

FUTURE

Powder markets continue to attract us because of the 12 to 18 cent per pound premium that powder commands over metal and because powder is a small specialized market that we are capable of serving as well as or better than the major copper producers. Because of this, it is our intention to solve problems at the refinery and stay in the powder business. Break-even operation at the refinery will require sales of about twice the 1968 level, but we believe this and more can be attained. Whether or not this will be reached in 1969 is questionable.

It is possible that there will be a relation between SX and the refinery in that certain types of powder might be produced more economically by electro-refining. These electrolytic powders could then be finished in the present refinery. This would broaden our ability to serve the powder markets.

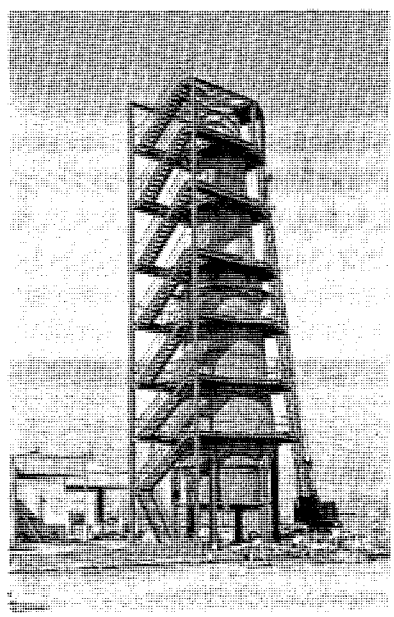
Garland Steel Company

1968 OPERATIONS

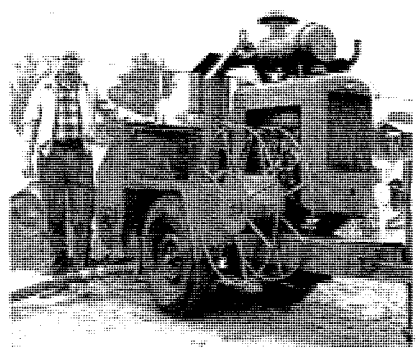
Sales during 1968 (including sales to the mine) set a record high of $5,055,000. This compares to $4,455,000 in 1967. The increase in sales occurred in product lines that command the lowest profit margins, so that profit during 1968 set no records. It was $114,000 compared to $82,000 in 1967.

PRODUCTS

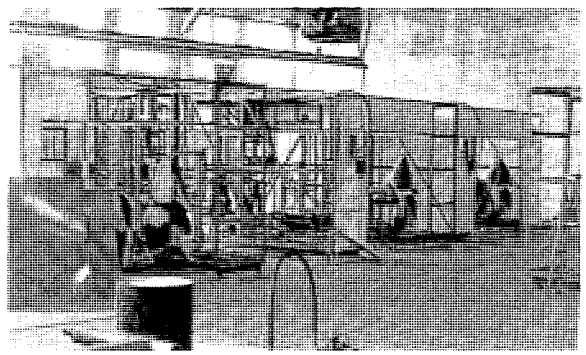
The shop was extremely busy during the year. Sales of steel fabricated items increased substantially. Sales of highway culvert decreased from 1967 due to a freeze on the Federal highway program during the last four months of 1968. The freeze has now been lifted.



Vertical lime kiln built and erected by Garland Steel Company.



Gunite machine added to the Garland product line this year.



Three car wash machines in various stages of assembly in the factory space recently taken for this purpose.

We built and sold 50 Rood Cotton Harvesters in 1968, which indicates that demand for this machine is returning. In 1968 we built about $400,000 worth of Hurricane Car Wash equipment, and we are expecting two or three times this amount in 1969. Additional factory space has been rented to accommodate assembly of this equipment.

The lettuce machines are well along in prototype development, and we hope will be ready for production this year. A gunite machine was added to our line in 1968.

FUTURE

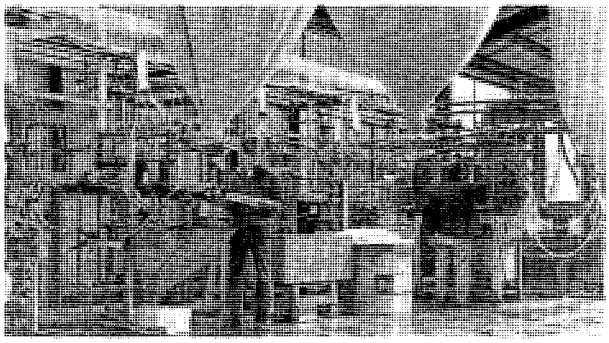
Garland entered 1969 with about three months backlog in the fabricating shop, which is a record high. Indications are that 1969 sales will set another record, with strong showings in steel fabrication, highway culvert, and car wash equipment. Profit during 1969 should continue to improve. Emphasis on development of new products will continue.

Garland is an alert, well-managed operation with a superior work force. Potential for growth in both the near and long-term future is good.

Bagdad Plastics Company

1968 OPERATIONS

This operation is very small as expected. Sales during 1968 were $100,000. There was an operating loss of $32,000 for 1968, which was the first full year of operation for this company. It operated at a profit during the last quarter of 1968, and we expect this to continue.



Line of molding machines at Bagdad Plastics Company.

During 1968 we manufactured products only in the expanded polystyrene foam line. Our patented machine for producing polyurethane products was not completed by the inventor, who has since moved to another part of the country.

ACQUISITION

During the latter part of 1968 we acquired Miller Plastics Company, which was about the same size as Bagdad Plastics Company and had a product line similar to ours. The Miller production equipment will be moved into our plant and the two operations completely integrated. I believe the combined company will be large enough to serve as a base for carrying out our plans for the future.

FUTURE

During 1969 Bagdad Plastics Company sales should increase substantially compared to 1968 and the operation should be profitable. However, it will still be a very small part of the total operation.

We are developing an understanding of the plastics industry, and particularly the expanded polystyrene foam part of this industry. During 1969 it is our intent to analyze markets for expanded polystyrene products in locations other than Arizona. We also intend to analyze markets in Arizona and elsewhere for plastic products other than expanded polystyrene foam that might be attractive to us. This analysis will include planning of facilities and management required to serve the new markets. By the end of 1969 we intend to have sufficient information to make a long-range decision on how far we want to go in the plastics business. If our decision is to move ahead, we should have specific plans for proceeding. We will call on outside consultants for assistance with this analysis and planning.

Corporate Matters

PROGRAM FOR GROWTH

There are some changes in emphasis in our program for growth. We will continue to actively seek new ore bodies with a variety of minerals, including copper, sulphur, and other metals and non-metals. In the past we have pursued this by exploration of unproven prospects, but in the future we will add the possibility of acquiring existing and operating mines. We are not limiting ourselves to domestic ore bodies. Copper is one of the most important minerals to us, but it increasingly appears that our best prospects for this will be exploration immediately adjacent to our present ore body at Bagdad. Consequently, emphasis on copper is shifting back home.

We continued work on the Tucson copper property during the year. Indications there are not becoming more positive, but we still have not made a final decision.

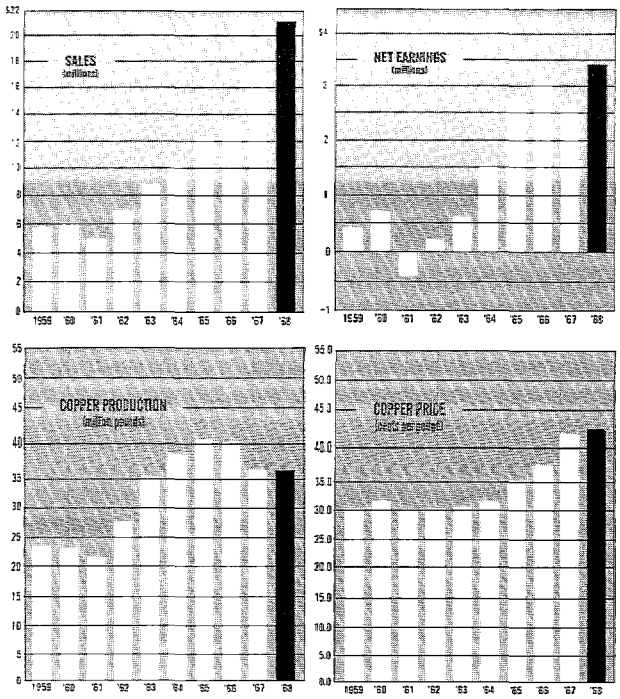
Regarding manufacturing activity, it increasingly appears to us that there are tremendous opportunities for expansion of Garland Steel Company by increasing sales of present products, developing markets for special products, and adding new special products. In addition, we believe that Bagdad Plastics Company may be capable of substantial expansion, as discussed above. Because of these factors, we have decreased emphasis on acquiring additional companies and increased emphasis on internal growth of our present operations. This by no means eliminates the possibility of outside acquisitions if the appropriate ones appear.

FUTURE EXPECTATIONS

During 1968 we reduced the inventory of copper accumulated during the strike. This added about $700,000 to before tax earnings and, of course, will not recur in 1969. On the other hand, if present price holds at least part of this amount can be recaptured.

The present mining operation is relatively stable and earnings growth in the future will come from improvements at Garland, the Refinery, and Plastics Company, all of which are expected. In addition, SX will contribute to earnings. We also expect that new ore bodies will be found and will contribute to future earnings.

In 1968 the surtax reduced after tax income by $132,000. I expect the surtax to remain in 1969, but there is a chance it may not. All in all, it is not possible to estimate whether or not earnings during 1969 will achieve another record. The Ten Years Charts show four factors with important bearing on earnings.

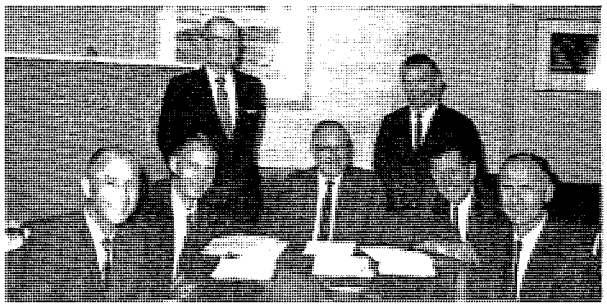


DIVIDENDS

The regular quarterly dividend of 7½ cents was continued during 1968. In addition, a 5% stock dividend was paid in December of 1968. The 7½ cents per share cash dividend is being continued into 1969.

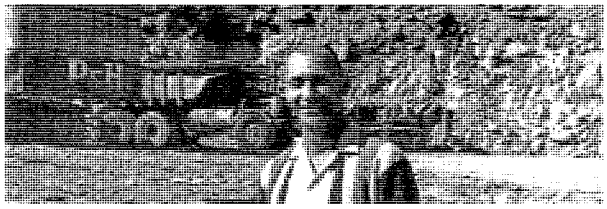
MANAGEMENT

Management is an exceedingly important factor to us, as with any company. We have excellent management at all levels in each of our operations, but we do not have great depth of management. In order to improve management skills, we have initiated periodic meetings of supervisors for the purpose of improving communications throughout the organization, and also imparting new knowledge to our people. In addition, from time to time we conduct specific programs for specific groups.



Group attending a one day management seminar. Left to right: R. C. Bogart - Vice President; D. C. Lincoln - President; G. W. Colville - Executive Vice President; Dr. Charles Phillips - professor at Northern Arizona University and seminar leader; R. G. Pollack - President of Bagdad Plastics Company; W. T. Garland - President of Garland Steel Company; and W. N. Brown - Vice President of Garland Steel Company.

Robert C. Bogart is Vice President of the Company and Assistant General Manager of the Mine. We are proposing he be elected a Director at the annual meeting.



Robert C. Bogart at one of the Mine benches.

STOCKHOLDER MATTERS

An application for listing on the American Stock Exchange is well along in preparation and should be filed so that, if approved, listing could be effective in two or three months. It is hoped this will give a broader and more ready market for our stock.

I would like to express thanks to our stockholders for the confidence they have shown in our Company and its management.

EMPLOYEES

We have about 675 employees in all of our operations. Each year I find myself searching for new words to express my feelings about our employees and each year I find I repeat myself. Repetition is probably in order and is certainly sincere. Our employees are the most important asset of our Company. They constantly seek and find ways to do a better job. Their loyalty is above question. They display great ingenuity and flexibility in solving problems and coping with new and difficult situations. We are indeed fortunate in having the work force we have, not only at the Mine, but at Garland and Bagdad Plastics as well.

This year operations at the Mine resulted in a bonus there of $422,000 which is a record high. I extend my hearty thanks to each and every employee in all of our operations for a splendid job well done.

BAGDAD COPPER CORPORATION

David C. Lincoln

David C. Lincoln, President

Consolidated Statement Of Income And Retained Earnings

FOR THE YEARS ENDED DECEMBER 31, 1968 AND 1967

	December 31	
	1968	1967
INCOME:		
Sales of basic metals (Note 7)	$16,111,935	$13,379,506
Sales of manufactured products (Note 7)	5,098,904	4,437,057
Interest and other income	229,523	185,609
	21,440,362	18,002,172
COSTS AND EXPENSES:		
Cost of basic metals sold	7,453,988	6,412,048
Cost of manufactured products sold	4,061,856	3,570,940
Selling, general and administrative expenses	3,218,530	2,771,986
Depreciation, depletion and amortization, including $324,704 amortization of prior years' mine development costs (Notes 3 and 5)	1,285,677	1,189,332
Joint venture loss (Note 4)	272,272	505,759
Estimated income taxes (Note 9)	1,750,000	1,020,000
	18,042,323	15,470,065
NET INCOME. ($2.51 and $1.90 per share of stock outstanding adjusted for stock dividend) (Notes 3 and 6)	3,398,039	2,532,107
RETAINED EARNINGS beginning of year	12,505,550	10,384,548
Less: Cash dividends ($.22½ declared in 1968—$.30 paid in 1968 and $.25 in 1967—Note 6)	(288,373)	(411,105)
5% Stock dividend	(1,500,522)	
Cash for fractional shares	(12,306)	
RETAINED EARNINGS end of year	$14,102,388	$12,505,550

Consolidated Balance Sheet

DECEMBER 31, 1968 AND 1967

ASSETS

	December 31	
	1968	1967
CURRENT ASSETS:		
Cash	$ 6,957,196	$ 650,727
Accounts receivable, less allowance for doubtful accounts of $46,693 ($33,055 in 1967)	3,019,487	5,447,200
Inventories (Note 2)	2,210,131	2,242,931
Supplies, at cost	1,357,760	1,234,575
Prepaid expenses	92,479	90,629
Total current assets	13,637,053	9,666,062
DEFERRED CHARGES AND OTHER ASSETS (Note 3):		
Mine development, less amortization	974,112	1,298,817
Excess cost of stock of subsidiary over book value of assets acquired	772,072	736,504
Patents and trademarks, less amortization	290,485	424,555
Cash surrender value of life insurance	277,079	233,177
Other	338,087	202,933
	2,651,835	2,895,986
INVESTMENTS (Note 4)	1,558,975	1,610,549
PROPERTY, PLANT AND EQUIPMENT, net (Note 5):		
Buildings, machinery and equipment, less accumulated depreciation	5,549,428	5,247,967
Mining properties and land, less accumulated depletion	529,803	459,605
	6,079,231	5,707,572
	$23,927,094	$19,880,169

LIABILITIES AND STOCKHOLDERS' EQUITY

	December 31	
	1968	1967
CURRENT LIABILITIES:		
Accounts payable and accrued expenses	$ 1,051,138	$ 1,139,647
Notes payable	674,563	325,837
Dividend payable		94,978
Taxes on income (Note 9)	1,078,561	326,310
Other taxes	408,981	443,864
Total current liabilities	3,213,243	2,330,636
LONG-TERM DEBT:		
6% mortgage note payable, less current portion		23,261
STOCKHOLDERS' EQUITY (Note 6):		
Capital stock — authorized 4,800,000 shares of $2.50 par value — 1,351,365 shares outstanding (1,266,373 in 1967)	3,378,412	3,165,932
Other paid-in capital	3,233,051	1,854,790
Retained earnings per accompanying statement	14,102,388	12,505,550
	20,713,851	17,526,272
	$23,927,094	$19,880,169

Consolidated Statement Of Source And Application Of Funds

FOR THE YEARS ENDED DECEMBER 31, 1968 AND 1967

	December 31	
	1968	1967
FUNDS PROVIDED:		
Net income	$3,398,039	$2,532,107
Depreciation, depletion and amortization	1,285,677	1,189,332
	4,683,716	3,721,439
FUNDS APPLIED:		
Additions to property, plant and equipment (Net)	1,198,561	1,736,333
Patents and trademarks acquired		558,625
Cash dividends and payments for fractional shares	300,679	411,105
Investments in other companies, less losses of joint venture	(16,006)	624,940
Other, net	112,098	45,241
	1,595,332	3,376,244
Increase in working capital	$3,088,384	$ 345,195
WORKING CAPITAL:		
End of year	$10,423,810	$7,335,426
Beginning of year	7,335,426	6,990,231
Increase	$ 3,088,384	$ 345,195

Notes To Consolidated Financial Statements

DECEMBER 31, 1968

NOTE 1 — Principles of consolidation:

The consolidated financial statements include the accounts of the company's wholly-owned subsidiaries, Garland Steel Company and Bagdad Plastics Company after elimination of intercompany transactions and balances.

NOTE 2 — Inventories:

Inventories are comprised of the following:

	December 31	
	1968	1967
Copper products:		
Copper concentrates		$ 534,598
Copper precipitates	$ 170,041	96,749
Coper powder — in process	41,412	49,578
Copper powder — finished	419,765	126,294
Molybdenum concentrates	49,771	36,732
Steel products:		
Raw materials	507,910	494,184
Work in process	494,790	360,764
Finished goods	518,050	535,637
Plastic products:		
Raw materials	2,746	207
Work in process	5,646	8,188
	$2,210,131	$2,242,931

Copper inventories are generally stated at average cost. Steel and plastic materials are stated at first-in first-out costs. None are in excess of current market values. Inventory of the by-product molybdenum concentrates is priced at estimated realizable value.

NOTE 3 — Deferred charges and other assets:

Mine development costs are charged to expense as incurred, except for amounts deferred in prior years, which are amortized at $324,704 per year.

Excess cost of stock of subsidiaries over book values of assets acquired has an indefinite life in the company's opinion, and consequently no amortization is required.

Patents and trademarks are amortized over lives to 1971; $134,070 was charged to expense in 1968.

NOTE 4 — Investments:

The company owned a 50% interest in Arizona Chemcopper Company, a joint venture organized to own a chemical process copper refinery; the venture was terminated during 1968 by withdrawal of the other party. Under the venture agreement Bagdad operated the refinery, and the venturers shared all profits or losses equally. The company's share of the losses in 1968 to the date of termination was $226,096. Bagdad has continued to operate the refinery since termination and has absorbed losses of approximately $60,000 in its operating accounts and depreciation of $46,176 (one-half of the venture's total depreciation after termination) through December 31, 1968.

The company's investment in the venture has been reduced by its share of losses of the venture since inception.

NOTE 5 — Property, plant and equipment

	Balances at December 31	
Description	1968	1967
Buildings, machinery and equipment:		
Copper Mine	$12,656,302	$11,754,818
Garland Steel	1,016,977	934,554
Bagdad Plastics	110,429	38,156
	13,783,708	12,727,528
Less accumulated depreciation	8,234,280	7,479,561
	5,549,428	5,247,967
Mining properties and land:		
Copper Mine	1,584,515	1,539,746
Garland Steel	259,166	227,660
	1,843,681	1,767,406
Less accumulated depreciation	1,313,878	1,307,801
	529,803	459,605
	$ 6,079,231	$ 5,707,572

Property, plant and equipment are included in the consolidated balance sheet on the basis of cost to the consolidated group either in cash or in capital stock of the parent company at par value.

Depreciation has been provided over the estimated useful lives of the respective assets on the straight-line method or on accelerated methods provided by the Internal Revenue Code. Income taxes have been computed on the same basis.

Depreciation included in costs and expenses in the consolidated statement of income has been provided for the principal types of buildings, machinery and equipment as follows:

	Year	
	1968	1967
Machinery and equipment	$687,350	$604,178
Buildings	100,460	92,984
Land improvements	33,015	27,344
	$820,825	$724,506

Depletion of $6,077 has been provided on the cost of mining properties at .2895 cents per ton in 1968. Depletion for tax purposes has been computed on a statutory basis and differs from the amount recorded in the accounts.

NOTE 6 — Stock options and changes in paid-in capital:

The company has two stock option plans under which shares of capital stock are made available to officers and employees of the company and its subsidiaries. Options have been granted for

all shares reserved for option under the 1963 plan. The status of the plans is as follows:

Shares under option	1963 plan	1967 plan	Total
Granted but unexercised, January 1, 1968	30,044	2,596	32,640
Increase for 5% stock dividend	445	128	573
Exercised	(21,140)		(21,140)
Granted but unexercised, December 31, 1968	9,349	2,724	12,073
Available for future options		23,526	23,526

All options exercised during the year were exercised at a price of $4.27 and were issued from authorized but unissued capital stock. The 12,073 options outstanding, are all exercisable at a price of $14.41 per share.

Changes in other paid-in capital are summarized as follows:

	Year	
	1968	1967
Balance beginning of year	$1,854,790	$1,854,861
Excess of amount received over par value of optioned shares sold	37,369	11,839
Premium paid on purchase of treasury stock		(11,910)
Excess of market value over par of shares issued as stock dividend	1,340,892	
Balance end of year	$3,233,051	$1,854,790

NOTE 7 — Sales:

Sales are comprised of the following:

	Year	
	1968	1967
Basic metals:		
Copper products -		
Concentrates	$ 8,843,670	$ 6,482,683
Precipitates	3,480,528	2,827,066
Electrolytic copper (toll)	854,514	1,228,753
Copper powder	1,889,777	1,951,781
Molybdenum concentrates	933,313	838,346
Silver bullion	110,133	50,877
	$16,111,935	$13,379,506
Manufactured products:		
Steel	$ 4,999,006	$ 4,433,751
Plastic	99,898	3,306
	$ 5,098,904	$ 4,437,057

NOTE 8 — Retirement and profit sharing plans:

Retirement benefits for all eligible mine employees are provided under an employer funded plan established on April 1, 1965. The company's policy has been to fund pension costs accrued, including provision for amortization of past service costs over a period of ten years. The company paid and charged to expense $135,000 for pension costs in 1968.

The actuarially computed value of employees' vested benefits under the plan exceeded the pension fund by approximately $58,000 at December 31, 1968.

Garland Steel Company contributes to a trusteed employer-employee funded savings and profit sharing plan up to 12½% of its net income. The company's contribution of $52,584 has been accrued at December 31, 1968.

NOTE 9 — Income taxes:

The provision for estimated income taxes is comprised of the following:

	Year	
	1968	1967
United States income taxes	$1,517,500	863,000
Less investment tax credit for the year	68,000	40,000
	1,449,500	823,000
Arizona income taxes	300,500	197,000
	$1,750,000	$1,020,000

Federal returns of Bagdad have been accepted through 1965 for Bagdad, and 1964 for Garland Steel.

NOTE 10 — Commitments:

As of September 30, 1968 the company entered into an agreement for the construction of a solvent extraction electrowinning plant at the present mine site. At present it is estimated that this plant will involve a capital expenditure of approximately $5,000,000. The company has the right to cancel the agreement at any time and reimburse the contractor for costs incurred to the date of cancellation.

PRICE WATERHOUSE & CO.
222 North Central
Phoenix, Arizona 85004

February 22, 1969

To the Board of Directors and Stockholders of
Bagdad Copper Corporation

In our opinion, the accompanying consolidated balance sheet and the related consolidated statements of income and retained earnings and of source and application of funds present fairly the consolidated financial position of Bagdad Copper Corporation and its subsidiaries at December 31, 1968 and the results of their operations and the supplementary information on funds for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year. Our examination of these statements was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

Price Waterhouse & Co.

PRICE WATERHOUSE & CO.

Directors

WALTER R. BIMSON	Chairman of the Board The Valley National Bank of Arizona Phoenix, Arizona
GEORGE W. COLVILLE	Executive Vice President and General Manager, Bagdad Copper Corporation Bagdad, Arizona
WILLIAM T. GARLAND	President and General Manager Garland Steel Company Phoenix, Arizona
DAVID C. LINCOLN	President of Bagdad Copper Corporation Phoenix, Arizona
JOSEPH T. MELCZER, JR.	Member of the law firm of Snell & Wilmer Phoenix, Arizona
FRANK L. SNELL	Member of the law firm of Snell & Wilmer Phoenix, Arizona
R. L. WEBB	Securities Broker Prescott, Arizona

Board of Directors in front of office at Mine. Left to right — R. L. Snell, J. T. Melczer, Jr., W. R. Bimson, W. T. Garland, G. W. Colville, D. C. Lincoln, and R. L. Webb.

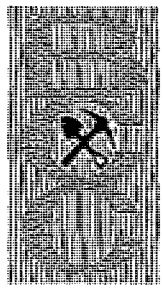
Officers

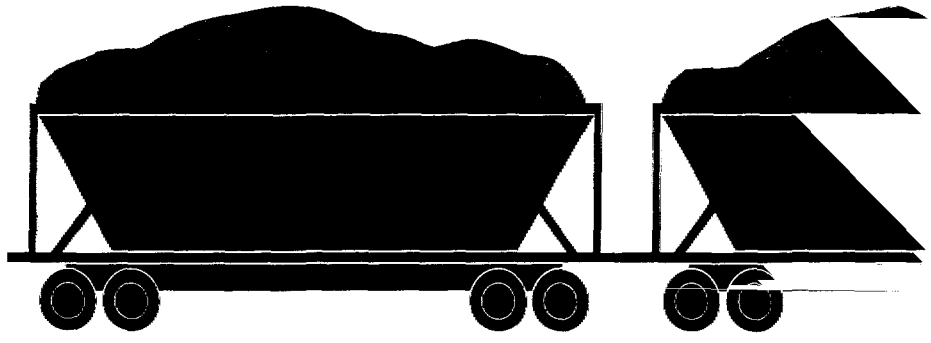
DAVID C. LINCOLN	President
GEORGE W. COLVILLE	Executive Vice President and Treasurer
ROBERT C. BOGART	Vice President
WILLIAM T. GARLAND	Vice President
FRANK L. SNELL	Vice President
BROOKS WILDER	Secretary
JERRY C. RYAN	Assistant Secretary

TRANSFER AGENTS

The Valley National Bank of Arizona Corporate Trust Division
P. O. Box 71 — Phoenix, Arizona 85001

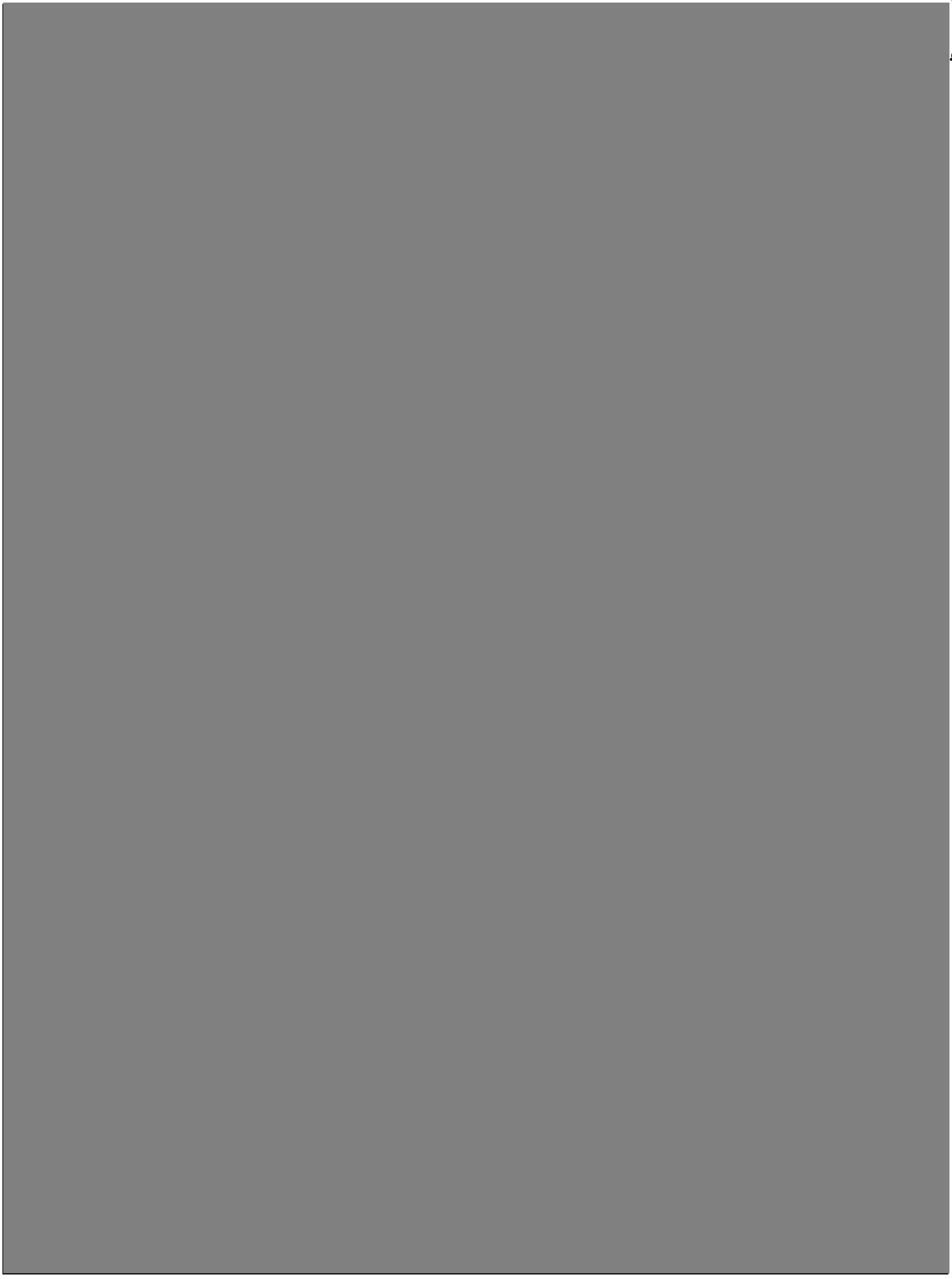
United States Corporation Company
15 Exchange Place — Jersey City, New Jersey 07302

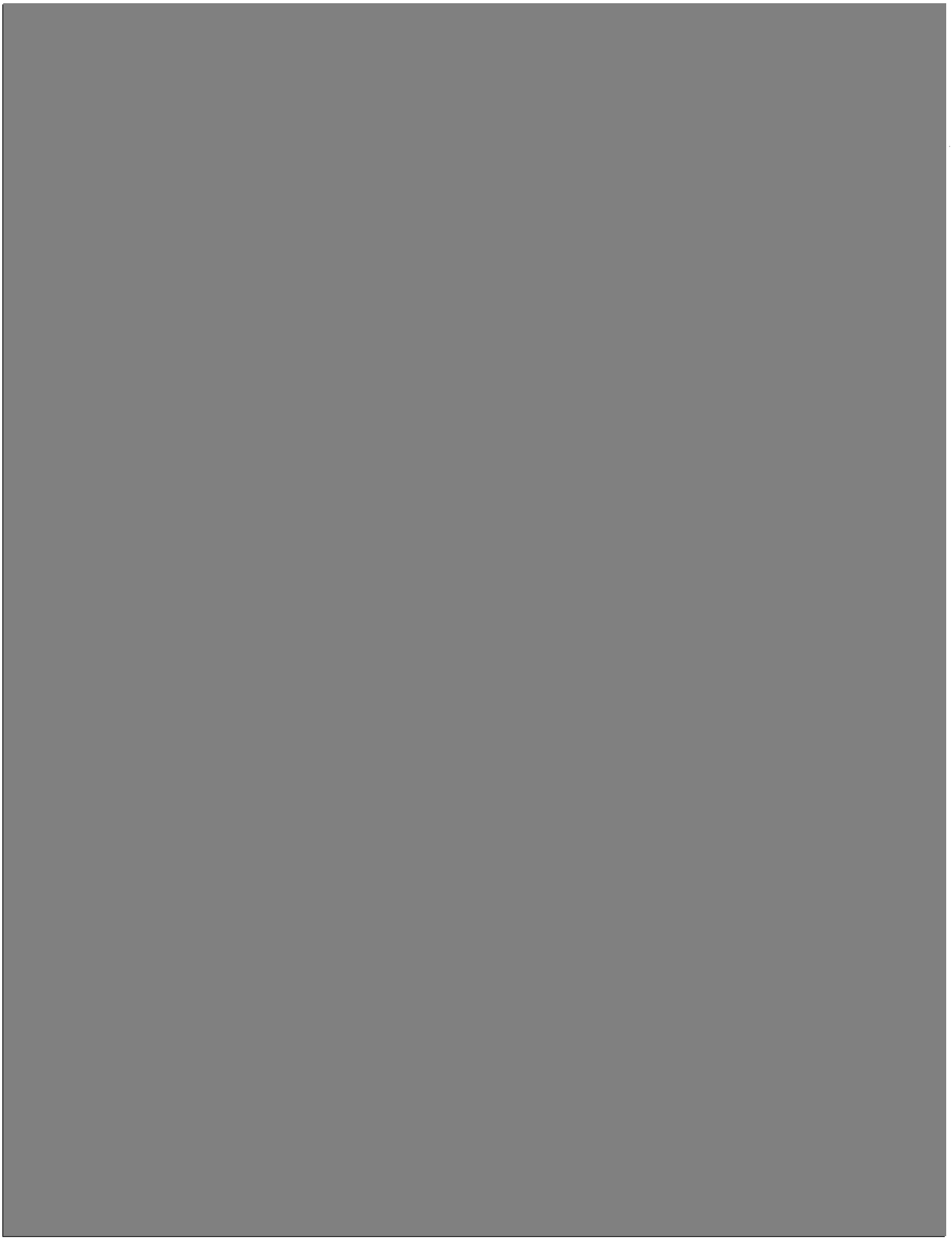


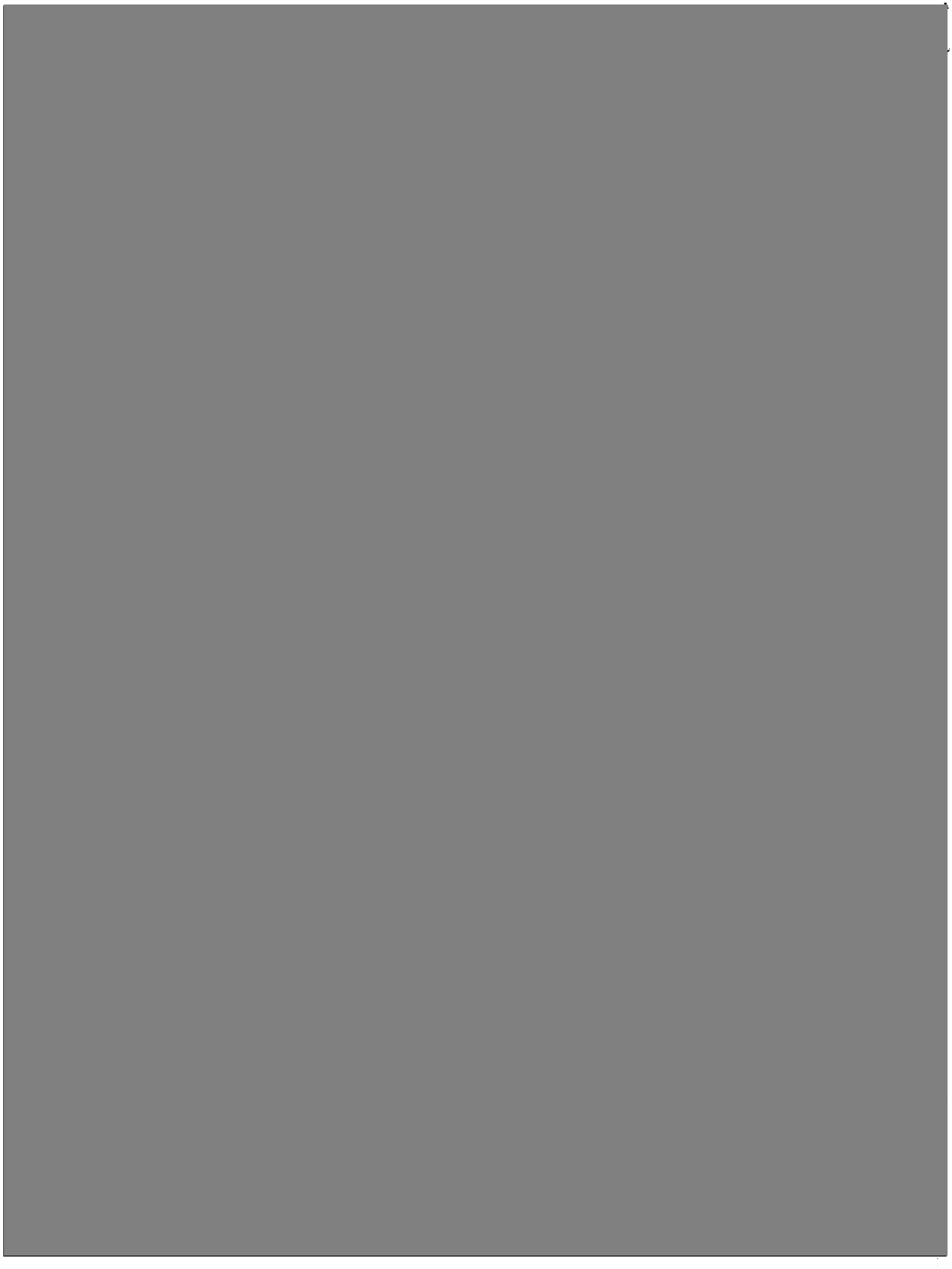


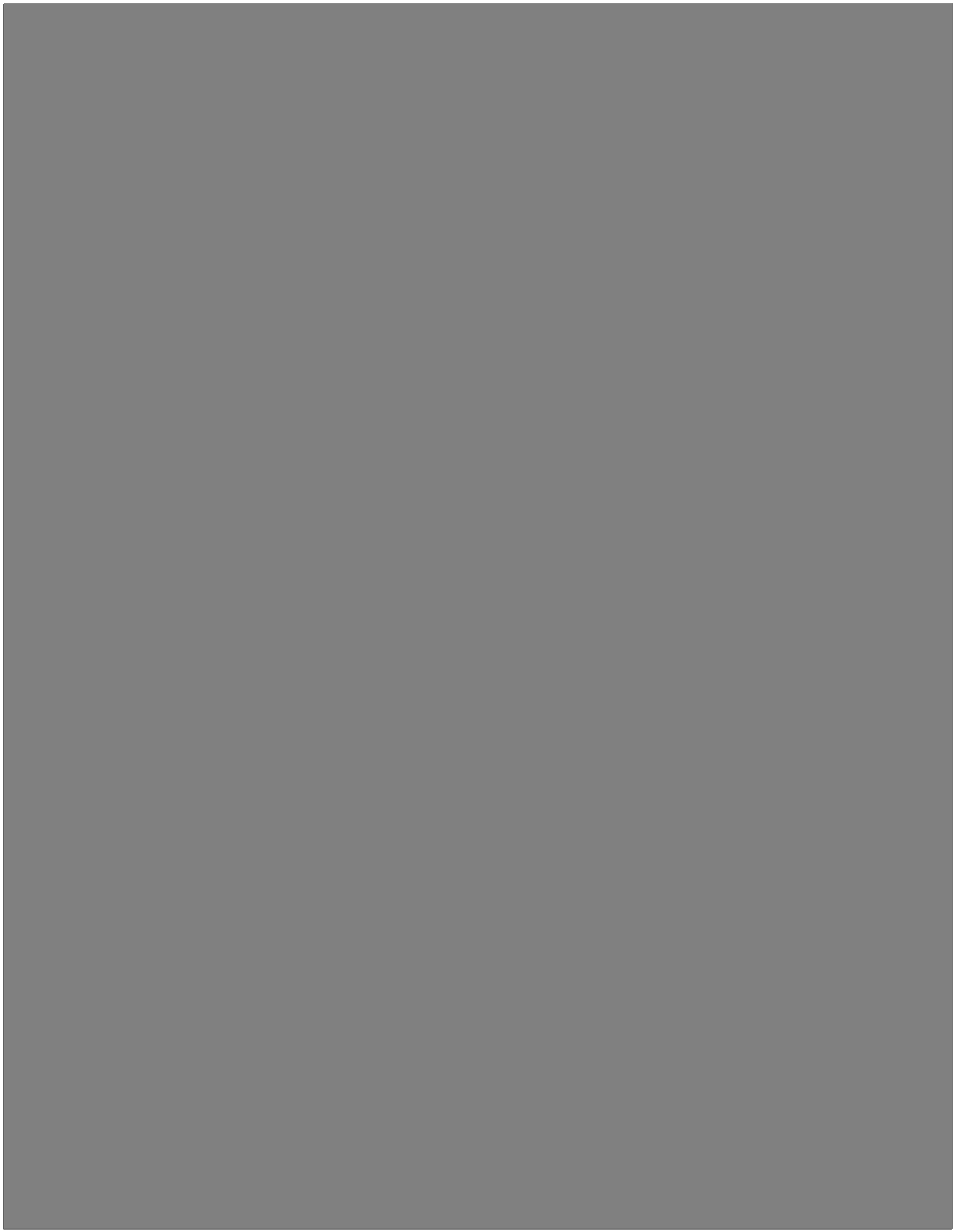
Cyprus Bagdad's Solvent Exchange Process

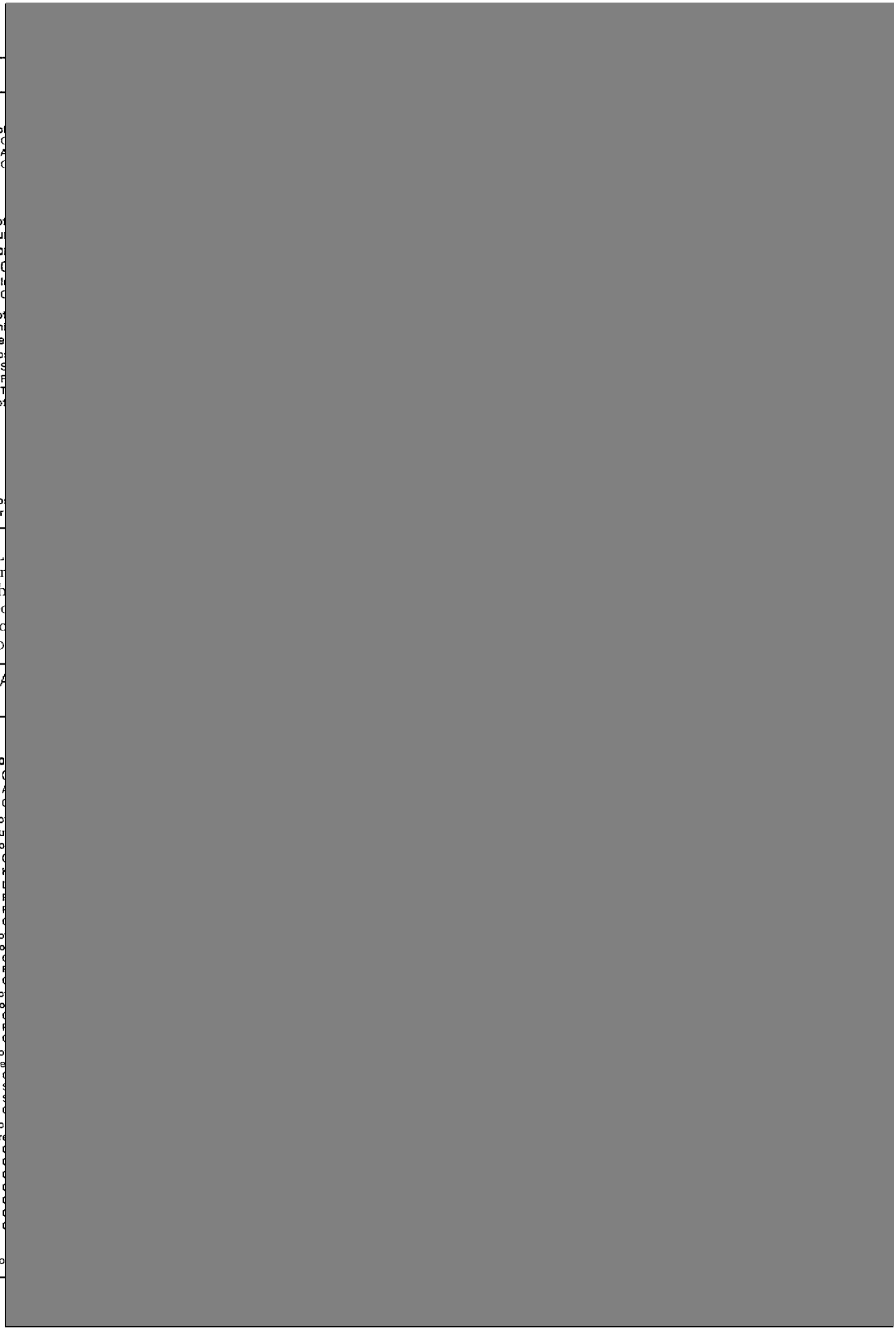
Raymond L. Jones, Cyprus Bagdad Copper Co.











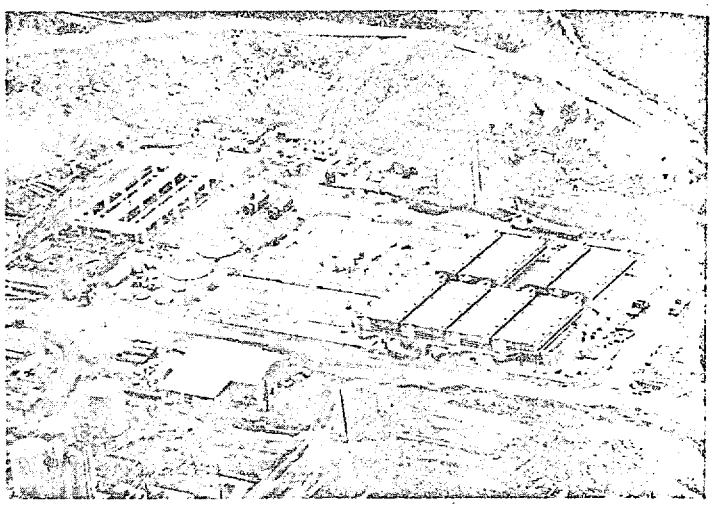
able economically, and it is planned to operate in the future at the 8,000,000 pound per year rate. The plant should show a comfortable profit at this production level.

Markets for copper powder continue strong. We have learned how to control characteristics of our powder to meet customer specification on repeat orders. This has been a significant help in capturing our share of the market. Total market for our type of powder is about 40 million pounds per year, which means that we will be serving about a fifth of it.

Solvent Extraction Refinery

Construction of the Solvent Extraction-Electrowinning (SX) refinery should be complete by midsummer, and it should be producing cathodes by the end of summer. Capacity of this plant will be about 14,000,000 pounds per year of copper, which is all of the leach copper we produce. At this production rate no feed would be left for the powder refinery. In order to meet this situation, we are stockpiling leach production until the SX plant comes onstream. The powder refinery can operate on this stockpile for the balance of 1970, after which we plan to purchase leach copper to feed the powder refinery. A permanent solution for this problem is development of another small leaching ore body away from Bagdad, the output of which would be used to feed the powder refinery. We are actively seeking this type of ore body.

The SX refinery will benefit Bagdad in two ways. It will upgrade present leach production to cathodes, which are about seven cents per pound more valuable than the present production. Even more important will be elimination of iron from the leach operation. Iron contaminates the leaching ore, and in the past has caused significant decreases in production. Cost of the SX plant will be slightly more than $5,000,000.



SX refinery under construction. Solvent extraction tanks are on the right. The less complete framework on the left will be electrowinning cells. The present acid plant and powder refinery are off the bottom of the picture.

Prospective New Ore

Drilling has continued on the area surrounding our present ore body for the purpose of better defining characteristics of this material as a possible future large low grade copper ore body. Results are incomplete, but to date it appears we could have, in addition to our present ore, 200 million tons of material with a grade of 0.50% total copper. We have not yet evaluated molybdenum content. Stripping ratio over this material would be about 1.5:1. Part of the stripping would consist of 110 million tons of leachable ore with a grade of 0.4% copper.

To put the above in perspective, ore reserves as defined today are 46 million tons with a grade of 0.69% copper and a stripping ratio not much more than 1:1. We currently have about 65 million tons of oxide ore on our leach dumps with a grade between 0.4% and 0.5% copper. Completion of stripping for the present ore body will add about 20 million tons to the leach piles.

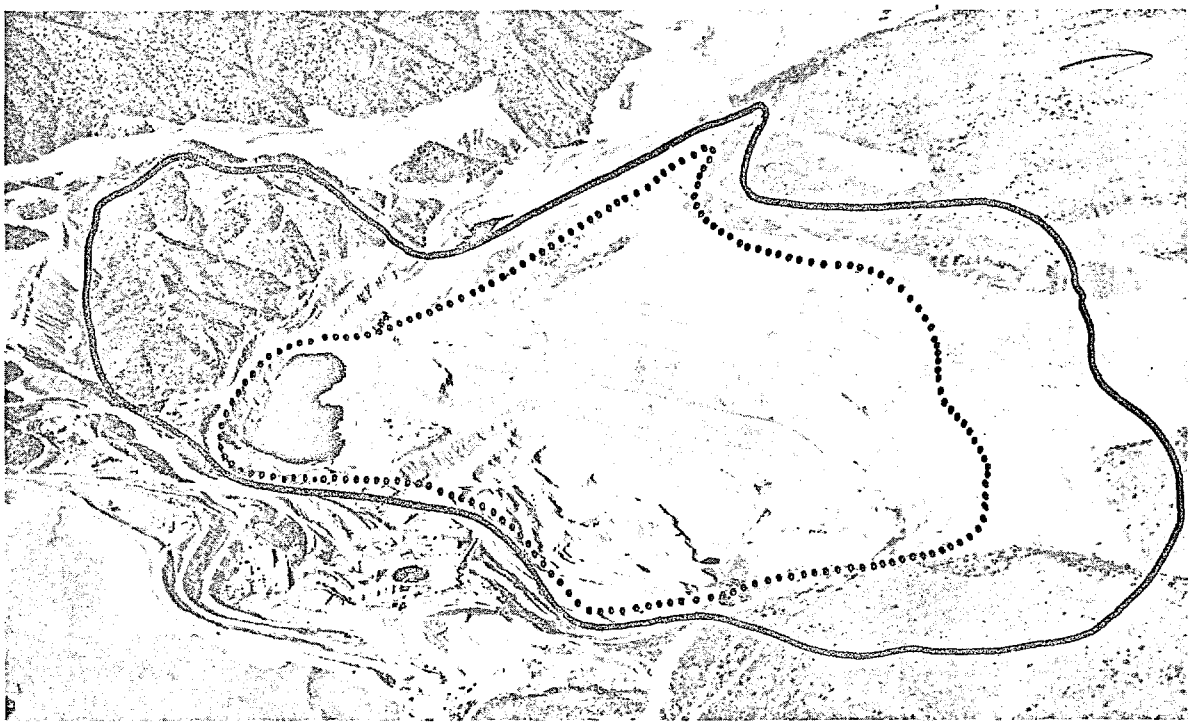
Capital expenditure could be in the $50,000,000 region, which is much greater than any required on our past projects. To put further perspective on this prospect, if the mill was sized at 25,000 tons of ore

per day, recovery of sulphide copper would be on the order of 35,000 tons per year, which is slightly more than three times current sulphide production. At 25,000 tons per day, the 200 million tons would last 22 years. Leach production could probably also be increased, but not to three times its present rate.

Costs of the project are not known. Until economics are determined, it is impossible to estimate the effect, if any, this prospect might have on earnings.

Two tasks are before us. One is definition of equipment and facilities to exploit this quantity and grade of material and determination if the economics are satisfactory. The second is to engage an independent consultant to verify our data on possible ore reserves.

The ore prospect previously reported in Tucson does not now appear promising.



Prospective additional ore lies within the solid line. The dotted line defines limits of the present ore body.

Steel Fabrication

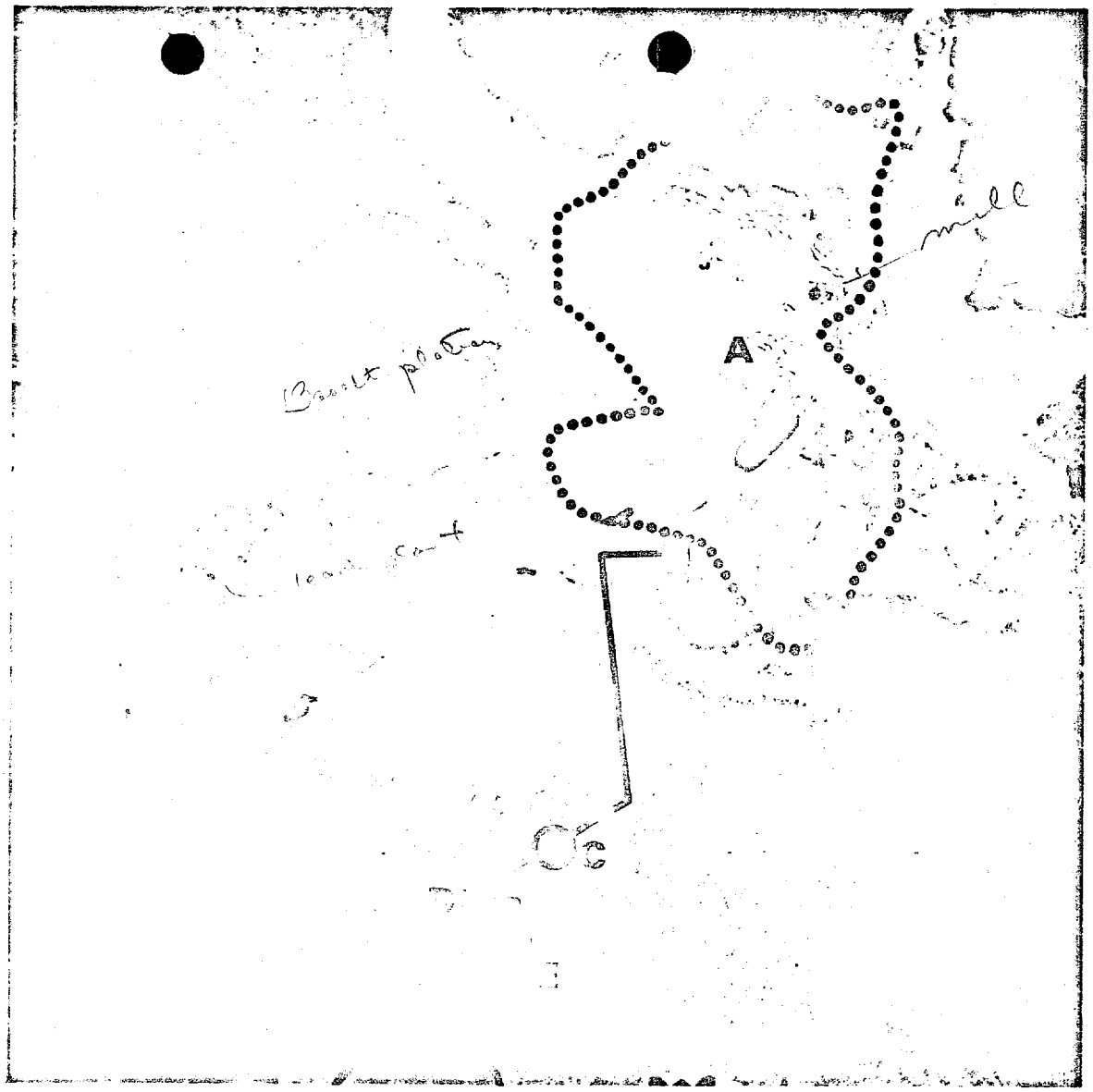
During 1969, sales of Garland Steel Company (including inter-company sales) were $5,703,000 compared to $5,055,000 last year. Profit after tax in 1969 was $162,000, which is a substantial improvement over the $122,000 of 1968.

During 1969 no significant new products were added at Garland, but there was development of present products. Sales of car wash equipment more than doubled and reached a level where the Hurricane people have decided to do their own assembly, which leaves us with only the steel fabrication. This will reduce our share of car wash sales in 1970. An order was received for a second and larger amusement park ride. The lettuce planter and thinner has been improved as the result of field tests, and we hope this will lead to sales of this product. There is revived interest in the cotton cleaning machine developed a couple of years ago.

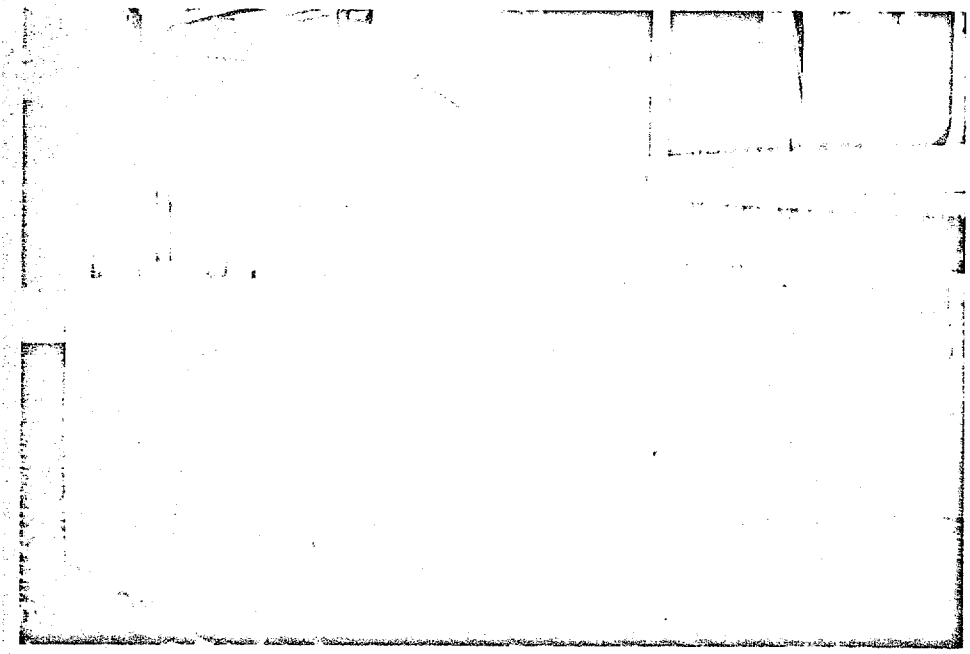
In 1970 Garland should show modest growth, but with the economy softening I expect this to have no major proportions.

Cyclones made by Garland for a mine in Arizona. This equipment removes dust from air.

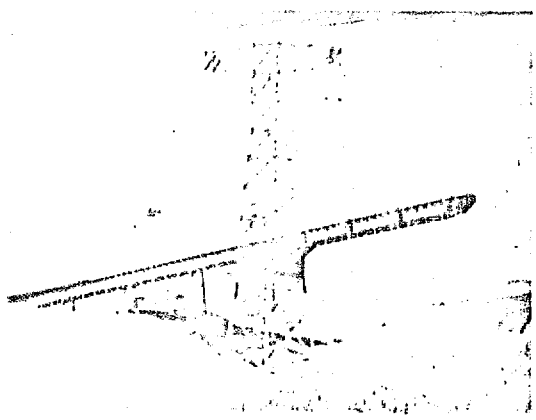
A. Expanded pit outline
B. Primary crusher
C. Course ore storage
D. Secondary crusher
E. Mill
F. Tailings pond



Aerial view of the Mine showing location of proposed expanded pit limits, ore handling facilities, and tailings pond. The pit is at upper right. Present mill is on right hand edge of the pit. Present tailings pond is right of the mill. Cathode and Powder Refineries are at left center. It is one and a half miles between the present mill and the Refinery area. Bagdad Townsite is about one half mile off top right of the picture.



Electrowon Cathodes. These are finished and will be washed and bundled for shipment.



Conveyor from relocated Crusher. The conveyor leads out of the new crusher location, which is below ground at the left. Ore is piled at the right hand end of the conveyor, and then fed down to the main conveyor to the concentrator mill.

GENERAL COMMENT

Improved results in 1970 were the result of increased price for copper. Sales increased 8% from last year and set a new record. Earnings during 1970 were 53% greater than 1969 and 42% above 1968, which was the previous record.

Inventories of copper products increased during the year and resulted in 3,308,000 pounds of inventory at the end of 1970, compared to 1,960,000 pounds at the end of 1969. Inventory rose because cathode is a new product and required a working inventory, and sales of both powder and cathode were sluggish during the second half of the year. Further increases of inventory during 1971 are not expected, but market conditions could change this.

Our program for growth during 1970 focused on possible expansion of the Mine. Until financial requirements of this expansion have been determined, we are not actively seeking other situations, either in mining or our two fields of diversification; steel fabrication and plastics. However, we did acquire Hurricane Car Wash Systems as a companion to Garland Steel under somewhat emergency conditions. In addition, the acquisition of Molded Container Corporation in Portland, Oregon, is still pending.

MINING AND REFINING

Mining and refining is by far the largest segment of our business. It provides about three quarters of our sales, more than 95% of our net profit, and employs about two-thirds of our people.

Copper Markets

Markets for copper were very strong during the first part of 1970, but have softened greatly during the second half. Primary producer price began the year at 56 cents per pound; it climbed to 60 cents per pound; and then fell to about 50 cents per pound at year end. Price in dealer markets has been lower than primary producer price, indicating additional declines in price are possible. The present price of 50 cents per pound, I believe, is not uncomfortable for either producers or consumers.

There has been talk of foreign producers agreeing to stabilize the world price. It seems to me this is a sufficiently difficult political task that it will not be done.

Mine Production

In 1970, 22,112,000 pounds of copper in concentrate form were produced, which is 8% above 1969. The increase resulted from higher ore grade, which was 0.75% in 1970, compared to 0.65% in 1969. Ratios of mill recovery in 1970 were less than 1969, which prevented the entire increased ore grade from appearing as increased production. We forecast that concentrate copper production in 1971 will exceed 1970.

Production of leach copper in 1970 was 12,440,000 pounds, which is 16% less than in 1969. This reduction was caused by iron contamination in the leach circuit, a shortage of good precipitation iron, and about a month of lost production while changing leach recovery from the old iron precipitation to the Cathode Refinery. Leach production has been back to normal since October, and it is expected 1971 production will be about 14,000,000 pounds of cathode.

Molybdenum production in 1970 was 402,000 pounds, compared to 450,000 pounds in 1969. The reduction was caused by less molybdenum in the ore. Molybdenum is a by-product of concentrate copper production, and we take what we get. Price for molybdenum in 1970 was almost identical to 1969.

Recovery of silver from our concentrate by the smelter in 1970 was 64,000 ounces, which is almost the same amount as recovered in 1969. This is a small part of total sales.

Stripping during 1970 continued at about a 4:1 rate. This is about three times the rate needed to keep up with ore production. The higher stripping rate gives an efficient operation and puts us in a good future position on both the present ore body and the expanded ore body when we get there.

Mine Operation

The Mine continued to operate well during the year. Facilities are not all new, but they are in good condition and are giving good service. Operating costs during 1970 were about the same as 1969. However, total costs in 1970 exceeded 1969 by about 7%. We expect to hold the increase in 1971 below that experienced in 1970.

Smelting costs during 1970 were less than 1969 because during 1970 we were able to ship a higher grade of concentrate. This will not continue into 1971, and we expect smelter costs to increase next year. Concentrate is shipped to the smelter of American Smelting & Refining Company at Hayden, Arizona. They are faced with air pollution requirements along with other smelters. Their program for compliance made it necessary to reduce feed to their smelter beginning last summer. This reduction is still in effect. It has not curtailed any of our shipments to date, but it could in the future.

The primary crusher is working at its lower location in the pit. The pipeline from the new source of water is now expected to be complete before the peak summer demand for water. No major new capital programs are contemplated for the Mine in 1971.

Cathode Refinery

The Cathode Refinery was delivered to us by Holmes & Narver, the contractor, during the first part of August. After only five weeks, production of cathode was at rated capacity of 40,000 pounds per day. Mr. Robert C. Bogart and his people were responsible for this, and considering that the plant contains relatively new and sophisticated technology, it was a remarkable achievement. Capital cost of the plant was very close to the $5,000,000 estimates prepared at the beginning of the project.

Operating costs have not been fully evaluated, but to date they are as forecast and are lower than costs using the former method of iron precipitation.

Most cathode produced to date has been sold directly to a single large user of copper. Price has been split equally between primary producer and quotes on the London Metal Exchange. We are seeking to make a long term contract for sale of our cathode at a price based on primary producer price.

Powder Refinery

Purchase of the Chemetals' half of the Powder Refinery was concluded during 1970 at a cost of $534,000. Since that time powder operations have been fully integrated with other departments at the Mine. Value added (after deducting cost of unrefined feed copper) by the Refinery in 1970 was $1,513,000 compared to $1,460,000 in 1969. During 1970 the Powder Refinery had an operating profit of $516,000 compared to $366,000 in 1969. After depreciation and general overhead, the 1970 profit was about $185,000.

During 1970 the Refinery produced 7,133,000 pounds of powder compared to 6,268,000 pounds in 1969. The rate of production reached during 1970 can be sustained, or slightly increased if future market conditions warrant. Operation of the Refinery continues to be a combination of art and science. We have found solutions to many of the problems that originally plagued us, but diligent effort along this line must continue.

In 1970 we sold 6,491,000 pounds of powder compared to 6,328,000 pounds in 1969. Markets for powder softened progressively during the year and are currently quite depressed. There are few signs of immediate market strengthening, so that production and sales during 1971 are expected to be noticeably below 1970.

We currently purchase feed material for the Powder Refinery from a mine outside of Arizona. This is satisfactory, but we are still seeking a separate leaching ore body so that we could produce our own feed.

Expansion Plans

During 1970 considerable progress was made toward defining the body of low grade copper contiguous to our present pit and developing plans to exploit this as ore. In addition to the present ore, we have blocked out at least 228 million tons of material with a grade of 0.47% total copper. Stripping ratio over this would be about 1.2:1 and stripping would include 41 million tons of leach ore with a grade of about 0.42% total copper. These figures have been verified by an independent consulting geologist, using our drill and core data. For perspective, the present ore body has 43 million tons with a grade of 0.69% total copper and a stripping ratio of about 1:1. We currently have about 73 million tons of oxide ore on our leach dumps with a grade between 0.4% and 0.5% copper. Completion of stripping for the present ore body will add about 11 million tons to the leach piles.

Holmes & Narver, the contractor that built the Cathode Refinery, has prepared preliminary plans and estimates for the mill and ore handling facilities. The plant would process 24,000 tons per day of ore, which is four times our present rate. Recovery would be about 40,000 tons per year of copper in concentrate form, which is more than three times our present rate. Assumed recovery of leached copper would not change from the present 7,000 tons per year, although with the additional stripping, leach production might increase some. Holmes & Narver estimates, together with our estimates of the additional mining equipment and support facilities, give a total cost less than $50 million.

The above figure is for carrying the project to a point that will produce copper concentrates. It does not include smelting, which has become a major consideration. In light of the pollution problem, no smelter in the southwest desires to contract for additional feed, much less commit to any expansion necessary to treat additional material. We are evaluating many possibilities, but at the moment two appear most promising. One is to build a smelter at Bagdad for our material only, using a relatively new technique. The second is to participate jointly with others and build a smelter in the southwest to handle material from all participants in the smelting project. Smelting techniques in either alternative would reduce pollution to acceptable levels. It will probably be six months before sufficient data are available for us to determine if either method is satisfactory and which might be preferable.

Another important consideration is the long range outlook for copper price. Analysis of this is in progress to give us confidence that the project is economically sound. It is hoped analysis of the project can be completed during 1971 and that by the end of the year we will be able to make a decision to proceed or defer. In any case, I believe it is a program that we will do at some time.

STEEL PRODUCTS

Hurricane Car Wash Systems, Inc.

In October, Bagdad acquired control of Hurricane Car Wash Systems. We purchased or obtained options on 52% of the stock of that company. When the options are fully exercised, cost to Bagdad will be $100,000. In the past, Garland Steel Company manufactured much of the equipment sold by Hurricane, which resulted in a substantial receivable due Garland from Hurricane. Hurricane overextended themselves financially and were about to become bankrupt. We liked their product and the market and decided to provide sufficient financial backing to restore the Company to health. In addition to the $100,000 for purchase of stock, up to December 31, 1970, Bagdad had loaned Hurricane $521,000 and, further, there is the manufacturing receivable due Garland in the amount of $661,000.

Hurricane produces a full line of automatic car wash equipment, from simple manually operated units to complete high capacity commercial systems capable of the most rigorous service. Sales are through a distributor network and during the past twelve months have been about $1.6 million. The forecast for next year is for sales to increase more than 50%. The car wash industry is in its infancy, and I believe Hurricane gives us a good position for the future.

Garland will manufacture all Hurricane equipment, which is a natural tie between the two companies and will be an excellent product for Garland.

Annual Rept. – "new ore"			w/o
1970	228 mil.	.47% Cu	1.2:1
1969	200 mil	.50% Cu	1.5:1
1968	141 mil	.52% Cu	2:1

3-31-71

Bagdad Lincoln Bogart + Coffinville

(assume 6000+tpd)

yr 1968 — head grade : .65 % Cu } mill rec. 81 %
(recovered : .53 % Cu
22,200,000 lb rec. moly .3 lb/ton recovered

year 1969 — head .65 } mill rec 75 %
recov .49

year 1970 — heads .75 % Cu } +70 % rec
(recov .53
22,112,000 lb moly recov .2 lb/Cu

leach 14,000,000

228 mil .47 % Cu 1.2:1 strip.

43 " .69

73 m oxide .4-.5 — on dumps

new project 24 000 tpd — 50 million capital
Oxides + mixed — 40,000+ p y Cu
leach continue at 7000 tpd

27

$$
\begin{array}{r}
26 \\
24\overline{)651} \\
48 \\
\hline
171 \\
144 \\
\hline
\end{array}
$$

$$
\begin{array}{r}
6510 \\
35\overline{)228000} \\
210 \\
\hline
180 \\
175 \\
\hline
50
\end{array}
$$

$3 \times 9 \quad 27$

$2 \times 9 \quad 18$

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 31, 1969

Reed F. Welch
BUILDING

BAGDAD
Yavapai County, Arizona

This memo briefly summarizes Bagdad's copper potential on the results of our 1956 detailed study plus information published recently.

In March of this year, David C. Lincoln, President, announced the following reserve:

	Tons	Grade (% Cu)	w / o
"new ore"	141,000,000	.52	2:1
Total, including existing reserve	185,000,000	.56	?

They are currently mining at a 4:1 stripping ratio and milling 6000 tpd with a head grade of around .60% Cu. This amounts to roughly 1000 tons of copper per month, with an additional 800 tpm from dump leaching operations. Molybdenum production in 1968 totalled 600,000 lbs, silver 63,000 ounces.

In December 1956 we (KR, JHC) reported open pit reserves as follows:

	Cutoff (% Cu)	Tons	Total % Cu	N.S. % Cu	w/o
Sulphide ore	.40	101,400,000	.68	.10	1.63% /
Leach		76,100,000	.46	?	- -

Due to the rather wide spacing and erratic distribution of many of the drill holes, only a part (around 35%) of the total can be considered as "measured" ore. The balance is classed as "indicated", or "inferred".

Considering the possibility of eventual commercial interest in deposits averaging around .50% Cu, it should be emphasized, we believe, that Bagdad has a huge tonnage potential of that grade. (end of quote)

Exploratory drilling during the subsequent 13 years has increased the reserve but lowered the grade of the sulphide reserve. The volume of leach material has no doubt been increased, also.

In the past, production has been from enriched ores, partly oxidized. These reserves are nearing exhaustion and possibilities of finding more chalcocite ore zones of important size are slim; however, exploration possibilities for primary chalcopyrite ore are considered attractive. Mr. Saegart, who initiated revival of interest in Bagdad, reported in May of this year: "From my conversation with the Resident Geologist, I conclude that the limits of ± .50% copper have yet to be determined -- to the northeast, to the west and at depth. The eventual development of several hundred million tons of Cu-Mo ore is reasonable expectation."

With greater depth, of course, higher stripping ratios will be involved, but this factor is offset to some extent by the higher mill recovery in chalcopyrite mineralization essentially free of oxidation products.

It is estimated that an up-to-date appraisal of ore reserves and exploration possibilities would require at least three months' time. As a basis for option negotiation, 300,000,000 tons at .50% copper is regarded a realistic projection.

J. H. Courtright

J. H. Courtright

JHC:lab
cc: JJCollins
TASnedden
WESaegart
RFWelch - 6 extra

New file

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DEPARTMENT
P.O. BOX 5795, TUCSON, ARIZONA 85703

J. H. COURTRIGHT
CHIEF GEOLOGIST
L. P. ENTWISTLE
ASSISTANT CHIEF GEOLOGIST
W. E. SAEGART
ASSISTANT CHIEF GEOLOGIST

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

May 21, 1969

Bagdad Copper
Yavapai Co
Ariz - WES

Mr. Jerry C. Ryan, Controller
Bagdad Copper Corporation
Bagdad, Arizona 86321

Dear Mr. Ryan:

On behalf of the ASARCO Engineers who attended the sub-section open pit meeting at Bagdad last Friday, I would like to thank you and your staff for a most informative and enjoyable visit. Those of us in the Exploration Department were especially pleased with the separate tour of the pit and surrounding areas, which was very well conducted by Mr. Rana Medhi.

As I indicated during our dinner conversation, I am interested in recent exploration developments of the Bagdad Copper deposit. We hope to schedule an appointment with Mr. Lincoln to discuss the possibility of updating the 1956 Bagdad evaluation prepared by Kenyon Richard, J.H. Courtright and other engineers from our staff. Data used in preparing that study was made available largely due to the excellent relationship which has always existed between our companies. It is our sincere wish to continue to maintain close laison with your organization. I will look forward to an opportunity to continue our conversation and to meet other members of your staff.

Very truly yours,

W. E. Saegart

W.E. Saegart

WES:lzb

cc: JJCollins
TASnedden
RFWelch
JHCourtright

Blind note on ASARCO copies:

The following statement is extracted from KER-JHC report of Dec. 29, 1956. "However, it certainly is worth noting that Bagdad has one of the larger potentials of low grade copper "ore" in the United States."

From my conversation with the Bagdad Resident Geologist, I conclude that the limits of ±0.5% Cu have yet to be determined--to the northeast, to the west and at depth. The eventual development of several hundred million tons of low grade Cu-Mo ore is a reasonable expectation. By updating the 1956 report, I would hope to develop factual documentation of the above inferences.

W.E.S.

Baqdad - 5/16/69

200 - 300' leach zone
100 - 150' cc
dips NE

10'-20' cpy coated w/ covelite
slightly higher grade than primary

1:1 pit slopes
1' change in pit slope amounts to 20 MT of rock to mine or retain

failure in SE cor of pit

Total sulfide content in primary zone is uniform at 3 % ± 1 cpy / ton
highly variable

screw feed diamond drills - taking sludge samples every 5'

use low-loss 36-38 viscosity

22-year reserves at present rates

new reserves of 141 MT would require enlarging pit perimeter and mining 150' below present pit plans.

diamond drilling to develop reserves at 100 ft grid spacing

6 3/4" shot holes
18' x 18' hole spacing on upper benches
12' x 12' " " " lower benches

NH_3NO_3
~~$(NH_4)_2NO_3$~~ + fuel oil blasting

very little secondary blasting

waste in this range includes leach rock.

size core = AX
95% core recovery
hydrolyic core splitter
can split 375' of core
in 8 hr shift

10 shift mining / wk
8,000,000 Tpy stripping
will reduced to
4,000,000 Tpy by 1972

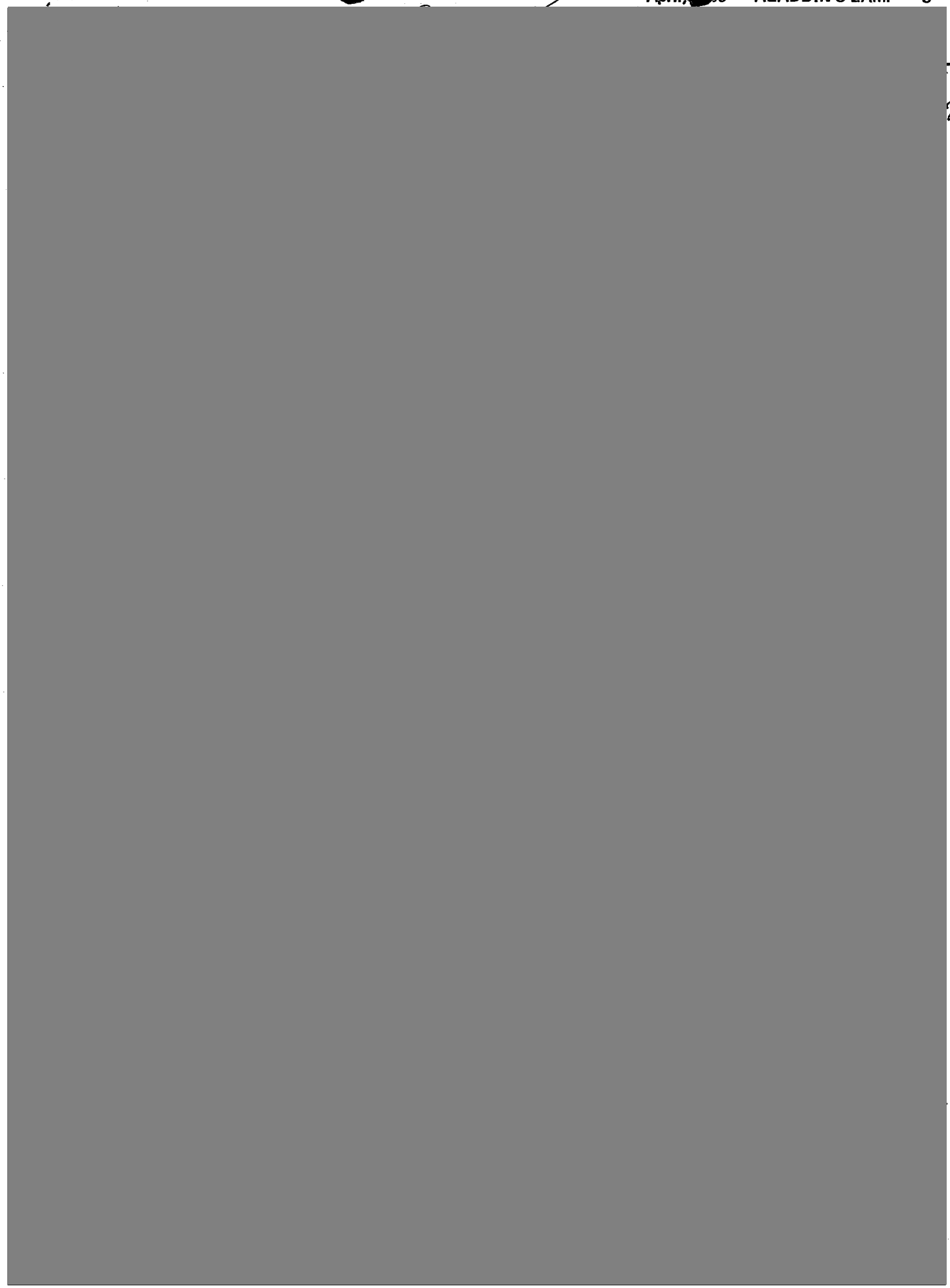
11 shift milling
6000 Tpd milling
of sulfide
→ w/o = 4:1 currently
will drop by 1972

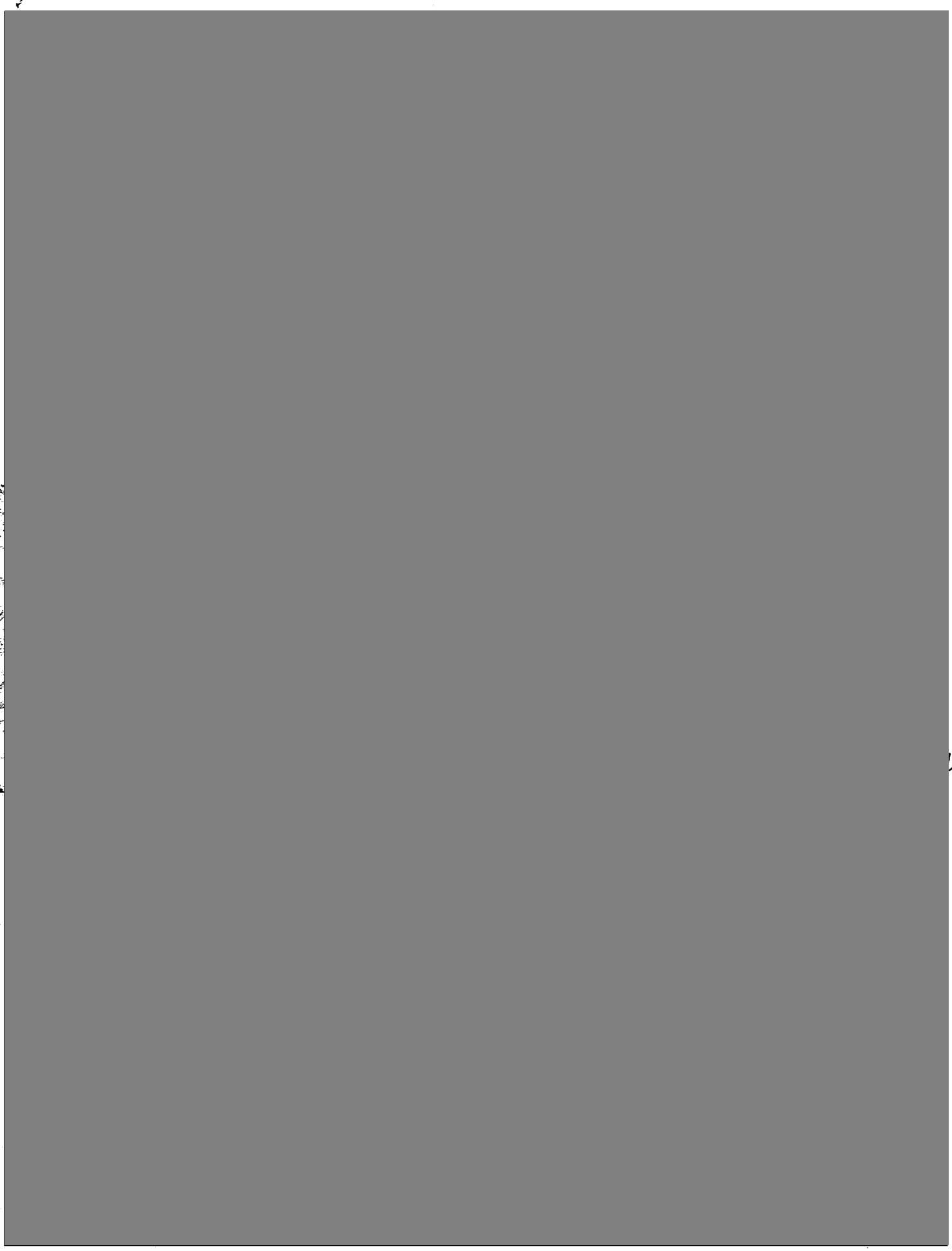
2,000,000 Tpy sulfide ore

20 mil pounds copper
per year from sulfide

15 mil. pounds copper
per year from leaching

JHC File
7





J. H. C

NOV 24 1967

BAGDAD COPPER CORPORATION
NINE MONTHS REPORT 1967

November 10,1967

The third quarter was an unusual one for your Company. In the past we have been operating under a contract with the smelter whereby we sell our output to them just as soon as we produce and ship. Under this arrangement we reported production as sales and any copper in inventory was carried at a price that we were realizing from the smelter. The industry strike has closed the smelter, making it necessary for us to put our production into inventory. We are putting production into inventory at cost and we will book our profit when the copper is actually sold. For this reason results for the third quarter are highly distorted from what would be considered normal.

Net profit per share booked for the first nine months of 1967 was only 71 cents, which actually represents a loss for the third quarter of 11 cents per share. This is in spite of the fact that production during the third quarter was above normal and costs were well in line or below past periods. The loss arose simply because at September 30 we had in inventory 8.7 million pounds of copper and booked this inventory at production cost (18.4 cents per pound), which does not even cover our G&A expenses.

Since September 30 we have arranged to export about 6.6 million pounds of our inventory, and we expect to realize about 34 cents per pound on these shipments. The shipments consist of about two months' concentrate production to Japan and about three months' of available precipitate production to Europe. Base price in export markets is significantly higher than domestic prices, but freight is also higher so that we probably will not capture much benefit from the higher foreign price.

Prior to the strike we had been realizing about 33 cents per pound on our copper. If the inventory had been sold at this price, the 71 cents per share would have been $1.37 for nine months. In addition, company sales would show a significant increase over last year due principally to the addition of Garland Steel Company. However, the $1.37 still represents a lower profit than last year and is due to decreased copper production. Our mining program scheduled low grade ore during the first six months of 1967; whereas, the first six months of 1966 had significantly higher grade ore. During the third quarter of this year we have been in better ore and sulphide copper production has started to catch up with last year. However, it probably will not catch up all the way by yearend.

The new pile of leaching ore is being brought into use and has increased leaching production. Production is not at desired levels, but is higher than it has been for a number of months.

Copper production for the full year 1967 is not expected to reach the level of 1966. The effect of this lower production on earnings will be partly offset by higher price and also by the addition of Garland steel earnings this year. At present I expect full year earnings for 1967 to be somewhat below 1966 because of the lower production and the likelihood that we will not have realized profit on all of our inventory by yearend.

The copper industry strike has lasted longer than I thought it would. Widespread copper shortages are just beginning to appear so that until now pressure from copper users to settle has been minimal. We have continued normal operations during the strike, except that we have put into inventory considerable amounts of our output. This has required us to arrange for bank borrowing to continue operations..

Ultimate effect of the strike on our earnings is hard to determine. There will be interest cost on value of the inventory, which will be about a penny or two a share. Bagdad maintains wage levels comparable to the rest of the industry, so that the strike settlement will result in increased employment costs. How much this will be is unknown, but I would expect it to be around a penny a pound of copper produced. The major effect on current year earnings will be associated with the profit we finally realize on our inventory and how soon we can book the profit. This cannot be determined until the strike is over.

In any event, anyone associated with Bagdad; stockholders, employees, town folk, and suppliers are much better off because Bagdad has continued to operate during the strike.

The first series of modifications at the refinery are installed and appear to be working as expected. The major modification of installing titanium reduction vessels and associated piping is scheduled for January. The refinery is currently operating at about 40 per cent of capacity, which is better than past levels but still not up to the break even point.

Work on liquid ion exchange as an independent sub-system is about complete. We have reached the tentative conclusion that it will perform satisfactorily and that operating costs are attractive. We need closer study of capital costs. We also need to establish compatibility between ion exchange and our present refinery. Tests to this end are under way.

Operations at Garland Steel are going well and several new products show good promise. A machine for field cleaning of cotton as it is received from a "strip" picker has been tested and results appear excellent. Construction of a relatively large amusement park ride is well along and chances for repeat orders appear good. A higher quality car wash has been added to the one we have been manufacturing.

Sales at Bagdad Plastics Company are increasing but are still relatively small. This operation has not as yet shown a profit, but opportunity in the plastics field continue to make us optimistic about this venture.

We have been active in evaluating potential new ore bodies and acquisitions but nothing concrete can be reported at this time.

At a Directors' Meeting on November 3 cash dividends of ten cents per share were declared. This consisted of the regular quarterly dividend of five cents per share, plus a yearend extra dividend of five cents per share. These dividends are payable December 10, 1967, to shareholders of record November 10, 1967. In addition, beginning with the dividend payable for the first quarter of 1968, the amount of the regular quarterly cash dividend was increased from five cents per share to seven and one-half cents per share. The seven and one-half cents per share first quarter cash dividend is payable March 11, 1968, to stockholders of record February 9, 1968. The Board of Directors intends to continue the regular quarterly dividend rate at seven and one-half cents per share provided that the earnings of the corporation continue to justify payment of such a dividend.

Sincerely,

BAGDAD COPPER CORPORATION

David C. Lincoln, *President*

June 29, 1959.

Dear Kenyon:

Thanx for your comments on tonnage — guess I can't keep my columns straight.

Revised figures on page 2 are:

P 2 - line 2, 68.6 @ 0.89% Cu or 90.8 @ .43% Cu

P 2 - line 4, 697,320,000 lbs for 68.6 million, about 908,000,000 for 90.8 million and 0.43% Cu (including Mineral ave)

P 3 - line 2 becomes 397,332,000 (for 68.6 million tons) instead of 520,000,000

P 3 - line 3 - becomes 27.6 years instead of 40.

P 4 - line 4, 60,000,000 becomes 46,000,000 ± for 68.6 million tons

I telephoned Dennie the correct figures, which he marked in on his letter — you can do same for your copy.

Regards

Dick

WESTERN MINING DEPARTMENT
Salt Lake City, Utah

June 22, 1959

Mr. Kenyon Richard, Chief Geologist
Southwestern Department
American Smelting and Refining Company
813 Valley National Building
Tucson, Arizona

Dear Ken:

Here is a copy of a letter I have written to Darwin. Please keep it confidential, but I thought you would like to know that the opportunity came along to say another word or two.

Darwin, during a telephone conversation, asked me what my current thinking on Bagdad was. In a fairly politic manner, I have told him.

Regards,

Dick

J. D. Vincent

JDV:lh

Encl.

WESTERN MINING DEPARTMENT
Salt Lake City, Utah

June 22, 1959

CONFIDENTIAL

Mr. D. J. Pope, Assistant to Vice President
Mining Department
American Smelting and Refining Company
120 Broadway
New York 5, New York

BAGDAD COPPER

Dear Sir:

I have briefly reviewed the Bagdad correspondence and reports, including that of Mr. R. G. Crane of Central Research.

In view of Company policy on smelting and refining of concentrates and precipitates, I think that Case III, wherein the flotation concentrate was roasted, leached, and the copper precipitated by iron scrap and sent to the smelter along with the copper produced from leaching waste dumps, should be eliminated. Likewise, Case IV, the Dorr fluosolids-electrolytic process as used in the Bagdad pilot plant, can be eliminated for the same reasons, although technically and economically I think it has potential advantages for Bagdad over normal procedures.

I have limited consideration to Case I and Case II, as they are called in Mr. Crane's report: Case I, without any credit for copper production from leaching waste rock and mixed ore, and Case II, wherein that is taken into consideration.

Bagdad is now leaching waste rock to an extent limited by their low production of acid and their water supply. Although my information is not up to date, I have no reason to believe that they have not found it practical and economic. Therefore, I do not believe Case I is a fair statement of the property's potential. In considering Case II, two other factors also should be given consideration:

(1) Basing freight and treatment charges on shipping to El Paso, although Bagdad is shipping to Hayden at the present time, is a small plus factor.

(2) Capital cost for an acid plant was estimated at $1,000,000, based on a contact plant. The Keyes auto-oxidation type of plant would radically reduce this cost and has other important advantages.

(a) Cost of acid would be lower by an appreciable degree.

(b) The barren solution after precipitation of copper contains $FeSO_4$ which is necessary as a catalyst, according to Sid Neslen, and which is oxidized to ferric sulphate by the SO_2. This is highly desirable for leaching chalcopyrite and native copper. Ordinarily, due to the low amount of pyrite in Bagdad ore, not too much ferric sulphate is formed by leaching. Inspiration, who have similar ore, do everything in their power to build up the ferric sulphate content.

With the large pit and a cutoff of 0.4% copper there is an estimated 101.4 million tons of leach rock with an assay of 0.39% copper and 7.5 million tons of mixed ore with an assay of 1.04% copper. This is a tremendous reserve of copper, approximately 947,520,000 lbs.

Using a figure of 50% recovery for the leach rock and 80% for the mixed ore, an overall recovery of over 520,000,000 lbs. of copper results--or nearly 40 years at a leach rate of 40,000 lbs. per day.

If we assume 6.0 lbs. of acid at 0.9¢ per lb., 1.5 lbs. of scrap iron at 3¢ a lb., miscellaneous costs of 2.0¢ per lb. and treatment, freight, refining costs of 6.0¢ per lb. for a total of, say 18.0¢ a lb., a net of 12¢ @ 30¢ copper amounts to $60,000,000 or $1,680,000 in a year, before taxes and amortization.

It is true that there may be better ways to treat the mixed ore such as the Anaconda dual process, LPF or Cyprus methods. However, for simplicity I have limited the calculations to leaching.

I have used an estimated recovery of 50% for leaching waste dumps although Bagdad test results indicate that a higher extraction is probable. The Bagdad ore contains copper oxides, copper silicate, chalcocite, native copper, and chalcopyrite. Solution of copper oxides, silicates and chalcocite should be nearly complete, native copper is soluble with acid, oxygen, and ferric sulphate, according to Inspiration, and chalcopyrite is thought to be soluble to an extent of 40% or thereabouts, perhaps more with long time oxidation in waste dump heap leaching. No one knows definitely.

This hypothetical production of copper from leach rock and mixed ore also depends on having an adequate supply of water to circulate about 3000 gpm, which assumes a loss of about 20% due to evaporation and seepage. This does not allow for discard of part of the leach solution since Bagdad is low in pyrite content.

According to this calculation a minimum of 500-600 gpm of water would be required for leaching. This is perhaps conservative since the Bagdad waste dumps are considerably higher in copper content than many of those being leached in Arizona and a flow of 3000 gpm may not be needed to obtain a production of 40,000 lbs. per day.

To date there has always been an adequate supply of iron scrap, mostly supplied from the coast or Texas. Since many of the smaller cities have not been tapped as a source, I would imagine that supply will keep up with demand.

Although these items are large plus factors, they still do not solve the problem of purchasing the stock at a reasonable price, nor do they get around the necessity for spending a large amount of capital on a property that is marginal during periods of low metal prices.

I still hope something comes of it and that I get a chance to work on it before I retire.

Very truly yours,

J. D. Vincent

JDV:lh

Misc. 3A

J. H. C.
APR 1 9 1957

WESTERN MINING DEPARTMENT
Salt Lake City, Utah

April 16, 1957

K. R.
APR 18 1957

Mr. D. J. Pope
Assistant to Vice President
American Smelting and Refining Company
120 Broadway
New York 5, New York

MR JHC
READ ... TURN
PREPARE ANSWERS ... HANDLE
FILE ... INITIALS

Dear Sir:

In reply to your letter of April 4 with the attached copy of Dr. Phillips' letter of March 22, I agree that the argument is somewhat academic until we know whether Bagdad can be acquired on a reasonable basis. It is obvious that the large reserve of leachable mixed ore and waste rock of the estimated copper assay is an important asset of the project.

The question is not so much whether the copper from the waste and mixed ore dumps can be recovered by leaching, which has been confirmed in tests and practice, but how can we obtain cheap acid. Sulphuric acid brought in from the west coast costs about $40.00 per ton 100% basis delivered at Bagdad, which is 12 cents per lb. of copper, based on a hypothetical consumption of 6 lbs. of acid per pound of copper recovered. FluoSolids roasting of the concentrate and TVA conversion of SO_2 was one way of doing this; there are other schemes and modifications, all of which have as their primary aim the production of cheap acid. If Bagdad could buy acid at $6.00 per ton plus freight from Hayden or even El Paso there would probably be no point in considering any of them. As matters stand now, it is not available.

I do not agree that my correction in my letter of February 12 eliminates the economical recovery of copper by leaching at Bagdad from consideration. On the contrary, there are other possibilities that would give us cheap acid. They are:

1. Burn sulphur and produce H_2SO_4 with a Keyes-TVA plant or by a "contact" plant as is done at Inspiration. The cost of acid will be much lower than we can buy it for at the present time.

2. Burn pyrite, if enough can be recovered from the flotation tailings, and produce the acid from the gases by a contact plant or the TVA process. The ore is not high in free pyrite, but probably some could be recovered. This is conjectural.

3. Roast the copper concentrate at Bagdad to produce gas for acid manufacture by either a contact plant or the Keyes-TVA process.

4. Employ the Bagdad fluosolids-electrolytic process.

Mr. Phillips questions whether the magnitude of the operation justifies a leaching plant. The estimate of 71,800,000 tons of leach rock at an assay of 0.42% copper for the small pit, using a cutoff of 0.30% copper, plus 6,900,000 tons of mixed ore at an assay 1.04%, appears to me to be well worth consideration. The estimate based on the large pit is even more favorable. At a recovery of 50%, and this I consider conservative, approximately 374,700,000 lbs. of copper, worth over $100 million, could be recovered--if cheap acid is available.

The comparison of buying acid as compared to burning sulphur or roasting pyrite and/or flotation concentrate is estimated as follows for the production of 374,700,000 lbs. of copper.

Cost of Acid

(a) Shipped in @ $40.00/ton 100% - 2¢ per lb.

(b) Roasting concentrate and pyrite produced using Keyes-TVA process at property - 0.6¢ per lb.

(c) Burning sulphur, using contact acid plant = 1.2¢ per lb.

(d) Burning sulphur, using Keyes-TVA = 0.9¢ per lb.

Acid Cost per lb. of Copper

A	B	C	D
12.0	3.6¢	7.2¢	5.4¢

If acid becomes available from El Paso at $6.00 per ton plus $6.00 freight, the margin will be the same as (b) or even better if it becomes available from Hayden.

In regard to Mr. Phillips' comments on certain other phases, I believe that he may not fully understand what is proposed. The waste rock would be leached in dumps after it has been stripped from the pit; it would not be leached in vats or ponds, and would not be rehandled. The proposed leaching operation is essentially the same as that employed at Utah Copper, Chino, Cananea, Bisbee, Castle Dome, and as that proposed for Silver Bell. The ponds or reservoirs are employed as settling basins, also to oxidize part of the ferrous sulphate in the barren solution from the iron precipitation launders to ferric sulphate, and, further, to allow much of the ferric hydroxide or basic ferric sulphate to precipitate out before recycling the solution to the leach dumps. Otherwise the dumps may become blinded.

Usually no special precautions are taken to seal the ground beneath the dumps or the bottom of the settling ponds. Most waste dumps

of porphyry ores have enough clay and slime to seal the ground effectively, and the precipitation of the ferric hydroxide and basic ferric sulphate in the leach solutions provides the cementing medium. In nearly all cases the tendency for the precipitation of these salts must be prevented rather than encouraged. The Bagdad conditions are similar to those at most of the successful heap leaching operations.

Scrap from from Houston, Los Angeles, and San Francisco is used at all of the plants in the Southwest. Mr. Mountjoy of Miami Copper Company told me that it costs them about $43.00 a ton, delivered, on the average. Other properties quoted prices ranging from $40.00 to $55.00 per ton with the exception of Cananea in Mexico who pay up to $70.00 a ton because of transfers and border crossing. For the purpose of these calculations I have used $60.00 per ton. The average consumption of scrap iron in precipitation plants leaching rock similar to Bagdad's is about 1.3 lbs. per pound of copper. I have conservatively used 1.5 lbs. in the estimate. Therefore, I believe Mr. Phillips' fears regarding the cost of scrap are groundless.

I have discussed the Keyes-TVA acid process with Mr. Sid Heslen and am attaching a memorandum concerning his comments and also a copy of his report on the Cyprus operation. To summarize his views, the Cyprus installation has worked out very satisfactorily and he believes that there should be no difficulty in designing or operating such a plant using sulphur, flotation concentrates or pyrite as a source of SO_2. Our Mr. Ed King, assistant mill superintendent at Silver Bell, is also well acquainted with the Cyprus installation and its operation. Mr. King also worked under Mr. Keyes in his Phoenix, Arizona, experimental plant some years ago.

The capital investment required for any of these procedures requires careful consideration because of the following factors:

1. The actual acid requirements are unknown and may be considerably less than six pounds per pound of copper due to generation of acid in the leaching process.

2. The possibility of roasting, leaching and copper precipitation by scrap iron or electro-winning still remain, even if it seems remote because of power requirements and the existence of company smelting capacity in the Southwest.

3. The possible manufacture of sulphuric acid at Hayden or El Paso must be kept in mind.

I would think that first consideration should be given to burning sulphur in conjunction with a Keyes-TVA acid plant. This would minimize capital expenditure without prejudicing later developments in procedure or economics.

Yours very truly,

ORIGINAL SIGNED BY
J. D. VINCENT

J. D. Vincent

JDV:lh

cc: DJPope(2)
TJSheddan
FVRichard

WESTERN MINING DEPARTMENT
Salt Lake City, Utah

April 14, 1957

FILE MEMORANDUM:

KEYES H_2SO_4 PROCESS AT CYPRUS MINES

The Keyes or TVA-Bureau of Mines sulphuric acid process has been proposed by many authorities as a means of producing weak acid for hydrometallurgical leaching. Cyprus Mines Corporation on the Island of Cyprus put in a plant in 1951 and which has continued to function satisfactorily to date with very low acid costs. Attached to this memorandum is a copy of Mr. Sid Neslen's report on the Cyprus plant. Mr. Neslen was loaned to Cyprus to expert and start their operations up.

I have discussed the process with Mr. Neslen and he believes than an improved plant could be designed that would obviate some of the mechanical difficulties that were first encountered at Cyprus. These points of design are:

1. The concrete reactor cells should be lead lined. (Leo Able stated that they were eventually able to use bituminous paint satisfactorily).

2. The gas cooler from the sulphur burner or sulfide roaster should be an air cooled heat exchanger.

3. The blowers should work on the dry gases rather than on the wet gases as was done at Cyprus. In other words the blowers would be between the cooler and the scrubber, rather than following the scrubber.

4. The blowers should be plated with lead and Mr. Neslen recommends the Kestrer blowers made in England as being very satisfactory. The Sutorbilt blowers plated by Mr. Neslen in 1952 are still in service, and have not been repaired since that date according to Mr. King of Silver Bell.

5. The fused silica SO_2 dispersion tubes gave considerable trouble due to blinding. Mr. Neslen drilled 1/16" holes in them which seemed to cure the trouble with no apparent loss in efficiency. Mr. Ed King, Assistant Mill Supt. at Silver Bell, states that these tubes were later replaced with orlon bags or sacks that have proven very satisfactory.

6. Mr. King also reports that once the plant was in steady operation they were able to operate with only one man per shift who took care of the roaster and the acid plant. Direct cost of acid was $4.00 per ton excluding the cost of pyrite.

7. Early laboratory investigations of the process had indicated that copper ion would inhibit the reaction. Mr. Neslen stated that this was not found to be true at Cyprus and no ill effects were found even though some pregnant leach solution was circulated through the cells.

8. Mr. Neslen states that 1.0-2.0 grams of ferrous sulphate per liter is sufficient to trigger the reaction. More $FeSO_4$ has no ill effect aside from consuming SO_2 to form ferric sulphate instead of H_2SO_4. This could be easily controlled, depending on how much ferric sulphate is desired for leaching if barren solution from the precipitation launders is used.

9. Acid mist and SO_3 losses were not serious after a packed tower was put in on the exhaust system. Work done by the Bureau of Mines at Henderson, Nevada, indicates that turbo agitators will put most of the SO_3 and H_2SO_4 in solution. Mr. Neslen thought that this might be a worthwhile improvement.

10. Both Mr. King and Mr. Neslen approve of the process for manufacturing low grade H_2SO_4 for leaching. Mr. Neslen stated that there was no difficulty in making 10% - 12% H_2SO_4 if desired.

J. D. Vincent

JDV:lh

N-3 Hydro

Xero,

17th September 1952.

Mr. R. J. Hendricks,
Resident Director & Manager,
Cyprus Mines Corporation,
Skouriotissa.

Dear Sir,

As requested by your Mr. George Dubb of the Los Angeles Office, I am attaching a report of my work in connection with the acid plant. I am at your service for any discussion concerning the plant operation or any future improvements that you might have planned.

Yours truly,

A. S. Nielsen

The following report is a brief description of the operations of the Cyprus Mines Corporation in conjunction with the acid plant.

The ore from the mine containing 3.5% copper is handled in the usual manner for a conventional flotation process for copper sulphide flotation. The major content of the ore is iron pyrite which is separated into two grades and pumped to stock piles. The first grade is a very clean pyrite of 50% sulphur content and the second grade is a slimes pyrite of 42% sulphur. The mill handles 2200 long tons of ore per day and produces 300 tons of 18% copper concentrates, 1800 tons of first grade pyrite and 100 tons second grade pyrite. The two grades of pyrites are sold for the manufacture of sulphuric acid.

The finely ground ore from the crushing plant is leached with weak sulphuric acid in special revolving drums. The acid consumption is 15 pounds acid (100% basis) per ton ore The acid strength is regulated to leach only the oxidized copper and to maintain a minimum amount of excess acid for deposition of copper over scrap iron in the cementation plant. After leaching the mixture is pumped to four 120 ft. Dorr thickeners. The ore goes to an alkaline circuit flotation plant and the solution to the cementation plant which produces approximately six tons of 85% cement copper per day. A small stream of the thickener solution overflow is pumped to the acid plant supply tank. Also a small stream of water from the cementation plant reject is pumped to another acid plant supply tank. Streams from these two supply tanks are properly mixed and furnish the feed solution for the acid plant process.

The sulphur dioxide for the acid plant is produced by roasting the slimes pyrite in a twelve deck Herreshoff roaster. Tonnages of eight to thirty long tons of pyrite per day were roasted successfully. The roaster gas is cooled and scrubbed in a spray tower using the water mixture as mentioned above. The feed water regulation is governed by the ferrous iron content and is mixed to give a final solution of 1.5 to 2.5 grams per liter of soluble ferrous iron. The wet sulphur dioxide gas is pumped with a small Roots Connorsville type positive displacement blower of Carpenter #20 stainless steel. The gas is pumped through four oxidation cells at 2.2 lbs. per sq. inch pressure. The solution from the scrubbing tower is pumped to the oxidation cells and flows by gravity to the final pump for storage. The cells consist of four rectangular tanks 21 feet long, 15 feet wide and 10 feet deep and hold approximately 16,000 imperial gallons per cell. Each cell has four submerged headers for the diffusion of the gas and air. Water scrubbed air is pumped by a Nash compressor through a series of tubes in the header. The tubes are made of a very finely divided and bonded quarts particle. These tubes give a very fine air bubble which is required for maximum oxidation. The air header is submerged eight feet in the solution and the sulphur dioxide header five feet. The sulphur dioxide header consists of a series of lead tubes drilled with holes of 3/32" diameter to give a bubble to react with the air bubble for proper oxidation of the SO2 gas. The best oxidation results were obtained with equal volumes of gas and air. The chemical reaction is due to the catalytic action of the ferrous iron in solution. The completeness of the chemical reaction is determined by analysis of the solution. When all of the ferrous iron is oxidized to the ferric state the acid concentration goes on to completion. A maximum strength of 12% H_2SO_4 was made in this plant but the writer firmly believes that stronger acid can be made with improved and enlarged design. The process at present is making 6% acid which is best suited for the present leaching problem.

The exit gases from the oxidation cells (0.2 to 0.3% SO2) are drawn from the top of the cells by means of an exit header and an all lead fan. The fan pulls the gases through two absorption towers in parallel. The solution from the number one cell is pumped over the towers for the absorption medium. The sulphur dioxide gases are absorbed completely but the exit gases still contain appreciable amounts of SO3 and H2SO4 acid mist. The fog and mist come from the catalytic action on the gases in the roaster. These gases are not absorbed in the plant solutions at all but pass on out to the atmosphere. Present plans at Cyprus are to build a coke tower and lead lined stack to filter the excess moisture from the gases. These mists will not be caught by the coke. The use of a mist cottrell system will aid very much in the removal of these gases but the overall economics of this should be investigated.

The experience of the writer has been that complete removal of the mists involved in any of the plants can be obtained by mist cottrell treatment.

A. S. NESLEN

The following report gives in detail the various changes, improvements and operations of the acid plant at Cyprus.

Elevator

The elevator gave considerable trouble both mechanical and electrical for a period of approximately one month before it was operating properly. Electrical cables and junction boxes were relocated several times. The shaft was completely housed in with asbestos sheeting because of weather conditions causing trouble.

Roaster

The general construction and mechanical condition of this equipment was very good. A considerable cutting of steel flooring etc. was required to prevent transmission of vibration and allow room for heat expansion. Suitable working tools and platforms were made to aid operations. An oil tank, oil lines, air lines and oil burners were made and installed before roasting operations could start. A slow burning wood fire was used in several locations to properly dry the brick work before operations. A large vent pipe was installed to handle the hot exit air from the roaster arms. It was made so that the hot air could be directed against the ore hopper to help dry the pyrite. A butterfly damper was installed at the inlet of the cooling fan to regulate the cooling air to the roaster arms. Calcine and cyclone hoppers and gates were improved to keep dust losses to a minimum. A six inch bed of refractory sand was rabbled on the top six floors of the roaster. This protected the brick work and helped the roasting. It also aids in the removal of any hard incrustations formed which is very common in roasting. After approximately four months of operations the speed of the roaster was changed from 55 sec. per rev. to 84 sec. per rev. This improved feeding and roasting. The high grade pyrite was roasted for several months and gave good results. Since then the slimes pyrites have been used with good results. Incrustations from either type has been very little but requires daily attention. The slimes had to be screened due to the hard lumps and general condition of the ore as these large lumps would cause arm and rabble breakage, also would not burn good. All alloy rabble blades of the lower seven floors are being currently replaced by cast iron made in the local foundry. The alloy rabbles will be used for spares on the upper floors as required. In cases of emergency the arms can be handled the same way. The calcines have varied in sulphur percentage from 0.5 to 1.9 due to operations. With more experience the operators should be able to get 1.5% or less. The roaster has six floors in excess of the requirements of maximum roasting. The lower six floors just rabble the calcines to the hoppers. Tonnages from 8 to 30 tons per day have been roasted with good results. The upper decks and sections of the roaster building have been suitably housed with asbestos sheeting for bad weather. The roaster cooling fan is not needed for present production requirements.

Cyclone & Cooling Tubes

The cyclone settlers are giving excellent results with the fine dust and mechanical carry over. A small amount of the finest of particles go on through to the spray tower. The two types of pyrite create little dusting due to roasting, the slimes being much greater due to the large amount of material less than 200 mesh. Gas velocities are very low due to small tonnages required. The cooling tubes were cut out of the circuit with blind flanges installed at the

bases. The automatic temperature controlled dampers that were installed to use the cooling tubes are not needed. These dampers might be required in the case of maximum production at a future time or whenever gas temperatures go too high for the spray tower to handle.

Scrubbing Towers

These towers are producing good results in cooling and scrubbing. A very small amount of dust is caught here and goes with the acid solutions to the final storage tanks. Temperatures as high as 800° F have been handled very well. The forty low pressure sprays show a small amount of corrosion. At the last inspection after six months use showed indications of lasting six to nine months longer. The original berl saddle packing of assorted sizes has been removed and replaced by 1½" saddles only. This prevents plugging to a great extent. There is no entrainment of liquids as velocities are low enough. A very small amount of fine dust plus selenium passes through the packing and is deposited along the equipment and also precipitated in the acid solutions but finally settles in the storage tanks. The original mechanical safety seals became useless due to corrosion by the roaster gases. These were replaced by an all lead liquid seal and have functioned properly since. The purpose of these seals is to prevent collapse of the lead linings due to a sudden increase of vacuum. All sump covers had to be covered with lead and sealed in the openings to keep the gases from hindering operations and getting out to the atmosphere.

Sutorbuilt Blowers

These blowers have given considerable trouble since operations were started. The driving shafts of the two blowers were broken shortly after the start of operations due to poor base alignment, excessive knocking and vibration. The corrosion of the gases and liquids was excessive. The centrifugal force of the rotors on the gases deposits a weak acid drip in the blower which analysed as high as 500 g.p.l. of sulphuric acid. These gases consist mainly of sulphur dioxide, sulphur trioxide, sulphuric acid mist, water vapor, oxygen and nitrogen. The roasting of pyrite ore causes the formation of sulphur trioxide due to catalytic action on the sulphur dioxide and in turn combines with the water vapor to give stages of sulphurous to sulphuric acid mist. These mists are very fine and are not completely scrubbed out in the spray tower or cells or absorption towers but continue out to the atmosphere. The corrosive action and mechanical troubles have created a considerable amount of work in the mechanical dept to keep one or two blowers in operation. A complete separate report of this has been made by the acid plant and mechanical dept. The four semicircular side sections of the blowers were very porous and gave evidence of poor technique in casting. The variable speed pulleys and belts for these blowers proved unsatisfactory and were replaced by solid pulleys and belts to suit and are giving good service. The stainless steel pulsation silencers were corroded beyond use in the first few weeks. They were replaced by lead castings of eight per cent antimony and have given good service since. The lead line for transport of sulphur dioxide from the blowers to the cells was suitably covered and protected by wood.

Oxidation Cells and Headers

The mechanical design of the air and sulphur dioxide headers was very poor and the entire thirty two had broken down within several weeks of operation.

Excessive vibration and swaying of the equipment was the main cause. Suitable wooden supports and bracing and improved lead hangars were installed and have given a good performance up to the present time. All stainless steel thermo-couple wells were corroded and were replaced by lead ones. All lead plugs for the drainage of the cells and sumps were removed because they were located in inaccessable places. A portable pump was built to remove the acid from the cells when repairs were necessary. By pass lines for the air and sulphur dioxide have been built so that either blower can supply gas or air to either section of cells. The total oxidation process by air from the aloxite tubes has been very good. The air bubbles are very small and give a maximum of chemical action required for oxidation. The turbulence of the liquids is very good. The ratio volume of air to sulphur dioxide was originally 1.2 to 1.0 but since has been cut to equal volumes or less of air and giving good results. The aloxite tubes are gradually showing signs of plugging. The blower pressure required has increased from 4 to 7.5 lbs. per sq. in. The life of the tubes has been prolonged somewhat by soaking the tubes in the cell acid for short periods during operations. At present the useful life of the tubes would be difficult to predict. The increase in resistance effects the volume delivered directly. Some research work was performed on the tubes but no definite improvement was obtained. Due to the high initial cost and labor installation, substitutes should be tried in the near future. About 100 of these tubes have been used in replacements mostly due to mechanical breakage in handling and trouble in the cells. The 64 flow meters for the regulation of air and sulphur dioxide volumes have been removed as they are not required for good operation of the cells. All rubber hose connections to the cells have been covered with steel clamps due to the increase in pressure required and protection from the sun. The bituplastic coating of the cells and storage tanks has failed to a considerable extent. Concrete piers were installed beneath the partitions of the cells to support the headers because the reinforcing steel was dissolved by the acid solution and partitions were developing cracks. The cell partitions have been covered with several layers of fibre glass and bituplastic to prevent excessive corrosion at these points. The coating of the cells on the north section was repaired two to three months ago and is showing definite signs of corrosion and must be repaired again. The acid storage tank at the flotation mill has been repaired the second time. The coating in the tower sumps is in good condition due to little or no oxidation reaction and the acid strength is very low at these points.

Nash Blowers

The Nash blowers have given a good performance of supplying air to the oxidation cells. After several months of operation they were completely coated with lime deposition and would not operate. This was removed and supply and return lines were constructed to handle the treated water from the power house. The blowers have operated very well on this water. The air filters are operating satisfactorily and have been housed in to keep the dust particles out during windy weather. Suitable connections for inter-locking the blowers and bleeder valves for regulation of flow were installed.

Absorption Towers & Stacks

The distribution weirs at the top of the towers gave very poor distribution of liquids but were changed and improved and the absorption of the exit gases has been excellent. Proper distribution of absorbents in towers is very important in any process. The original solution level floats were discarded for various reasons. Others have been made and installed in more suitable locations and giving good results. The present stacks are too small and gas velocities too great.

Suitable coke towers are being built to scrub out some of the moisture of the exit gases.

Pumps and Storage Tanks

The pumping system is giving a good performance with a minimum amount of repairs. All pump priming devices were removed as they are not necessary. Some changes were made to balance the plant flow. The ammeters for the pumps and blowers were transferred from the power house to the control room to improve operations in general. By pass connections for the storage pumps were made so that either pump could pump to either storage tank. Pads of fibre glass have been placed in the bottoms of the storage tanks for protection where the acid falls into the empty tanks. Full storage tank capacity will supply the leaching plant for approximately twenty days at the present rate of consumption which is also about the minimum rate of roasting slimes.

Kestrer Fans

One fan was considerably out of balance but was repaired before operations. The variable speed drive pulleys have given considerable trouble and have been replaced by solid pulleys. The general performance of these fans has been excellent.

Homogenized Lead —

Diesel Engine

This power unit is an excellent one and will handle the load of the Kestner fans when necessary. The water supply for flooding the towers in case of a power failure has never been used. Operations have been adjusted to handle the roaster gases in case of repairs on the roaster or acid plant so thatthe exit gases have been held very low in sulphur dioxide content.

Comments in General

The chemical process is sound and very easily controlled. The minimum production rate operates very nicely with little or no trouble. Several months past the maximum production rate was tried and the liquid flow, gas outlets and gas velocities were too high for good operation. Suitable connections between the cells for increased flow can be easily made. The gas outlets of the cells are too close to the surface of the acid for increased production but can be changed by raising the exit header. This will eliminate mechanical entrainment of the acid.

In the original design of the plant a saving of six pumps could have been made by having gravity flow from the tower sumps to the cells.

Some relief has been gained for the life of the air header tubes by drilling 904 1/16" holes in the tubes. This reduced the pressure and increased the air flow by approx. 400 c.f.m. A limit on this procedure will be determined by the proper oxidation of the solution.

The wooden supports and bracing for the headers will eventually get soft and weak and start vibrating and swaying. This should be watched and repaired at the proper time.

Safety guards on all moving equipment were made and installed.

A data sheet is attached giving good operating conditions at various dates for the past six months.

Flow meter volumes of sulphur dioxide and air are comparative. The location of the orifice plates are very poor and will give inaccuracies in volumes.

Respectfully yours

A. S. Nelson

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 5, 1956

J. D. Vincent, Assistant Milling Engineer
Salt Lake Office

BAGDAD LEACH MATERIAL

Dear Sir:

In accordance with our telephone conversation this morning, Mr. Courtright and I have made a rough estimate of the non sulphide copper content of various classes of material which might be available for heap leaching:

OXIDE COPPER, PROPOSED LATEST PIT

		Tons (Mlns.)	Total % Cu	Non-S % Cu
"Leach" Material (now on dump)	(A)	12.0	0.35	0.25
"Mixed" Ore (in reserves)	(B)	7.5	1.04	0.49
"Leach" Material (in reserves)	(.4 Cutoff (C)	68.6	.39	0.20
	(.5 Cutoff (D)	90.8	.43	0.15
Totals: A + B + C		88.1	.44	.23
A + C		80.6	.38	.21
A + B + D		110.3	.46	.18
A + D		102.8	.42	.16

As you can see, there is considerably less non sulphide copper in the material which remains to be mined than in the leach material now on the dumps. Mr. Howell undoubtedly collected samples of this latter material for his leaching tests. You probably can consider his samples as being representative of that twelve million tons. The material that remains to be mined at a .5% copper cutoff contains a good deal more sulphide copper, principally as chalcopyrite, than the material Howell tested. The leach material which would be mined at a .4% copper cutoff would contain more chalcocite since it would come largely from the upper portions of the ore body.

The thought occurs to me that most of this remaining chalcopyrite occurs in finely disseminated grains in hard rock. Much of this could not

be reached by the acid in a heap leaching process, except possibly over a very long period of time, in which the exposure to acid might accomplish the complete breakdown of the rock.

Yours very truly,

KENYON RICHARD

KR/ds

cc: JHCourtright

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 30, 1956

Mr. J. D. Vincent
Assistant Milling Engineer
Salt Lake Office

BAGDAD METALLURGY

Dear Sir:

In our telephone conversation of November 28 you asked about the amount of oxide copper in the Bagdad ore reserve. Since then, in going into the matter, we have found that it may be necessary to make separate outcome calculations on the chalcocite and chalcopyrite ore types as distributed within the "small" and the "large" pits at different grade cutoffs. Therefore, we have estimated the non sulphide copper contents and tonnages of these various classes of material. These figures have been weighted to give the non sulphide copper content of combined chalcocite and chalcopyrite, or "average".

These figures are tabulated below. We would like to have you complete the columns on metallurgy, giving per cent recovery and grade of concentrate for each class of ore. We are planning to include this table in our report.

Pit	Cutoff	Tons (Mil.)	Grade		Metallurgy	
			% Total Cu	% N.Sulph.Cu	% Recov.	% Conc.Cu
Chalcocite Ore:						
Small	.5	20.0	0.95	0.19		
"	.4	20.0	0.95	0.19		
Remainder	.5	10.0	0.85	0.12		
"	.4	10.0	0.85	0.12		
Large	.5	30.0	0.92	0.17		
"	.4	30.0	0.92	0.17		
Chalcopyrite Ore:						
Small	.5	17.8	0.72	0.10		
"	.4	39.1	0.60	0.09		
Remainder	.5	21.0	0.60	0.06		
"	.4	32.3	0.56	0.05		
Large	.5	58.8	0.65	0.08		
"	.4	71.4	0.58	0.07		

(Continued next page)

Pit	Cutoff	Tons (Mil.)	Grade % Total Cu	Grade % N.Sulph.Cu	Metallurgy % Recov.	Metallurgy % Conc.Cu
Combined Chalcocite and Chalcopyrite, or "Average" Ore:						
Small	.5	37.8	0.84		0.15	
"	.4	59.1	0.72		0.12	
Remainder	.5	31.0	0.68		0.06	
"	.4	42.3	0.63		0.07	
Large	.5	68.8	0.77		0.12	
"	.4	101.4	0.68		0.10	

The most important set of figures on the above table is at the bottom --- the "average" ore in the large pit at a .4 Cutoff --- 101.4 million tons at 0.68% total copper with 0.10% non sulphide copper. We had first thought that all we would need from you would be the recovery and concentrate grade for this figure. However, we decided this might be misleading since there really is no such thing as "average" ore; so we broke the figure down into the various classes of ore which are important, either metallurgically or from the mining standpoint.

Yours very truly,

KENYON RICHARD

KR/ds
cc: LHHayes
JHCourtright

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 26, 1956

CONFIDENTIAL

MEMORANDUM FOR MR. SNEDDEN:

BAGDAD
Ore Reserve Estimate

Attached is a tabulation of Bagdad ore reserves, with explanatory notes.

It would be complicated to describe our analysis of the accuracy of the basic assay data, the assumptions made, and the calculation methods used. This will not be attempted here. However, detailed descriptions of these problems and procedures will be included, together with this tabulation, in our final report. This tabulation is being distributed in advance of the final report because it will probably be of general interest by itself.

Without commenting in detail, I might point out that the overall tonnage is very substantially higher than in former estimates. And the grade and waste/ore ratio are such that the property now has a somewhat more interesting commercial aspect. This change is due, for the most part, to the derivation of data which permitted us (1) to accept Bagdad's special curve for combining and adjusting diamond drill core and sludge assays and (2) to accept churn drill assays practically at face value, rather than to make large arbitrary cuts in all assays. I believe the results tend to justify the unusually large amount of time we have put in on this work.

It should be noted that there are good possibilities for finding appreciable tonnages of ore in the .5 to .6 grade range. This would be in addition to the tabulated ore tonnages.

With these ore reserve data as a basis, working maps have been prepared for Mr. Meen and Mr. Barlow, and they are laying out haulage systems and dump sites as a basis for estimating mining costs. It is planned that these costs will be worked up on a 10,000 tpd production rate as well as on Bagdad's current rate. We would appreciate comments if other production rates would seem more appropriate.

By his copy of this letter Mr. Vincent is asked to comment on the feasibility of installing a special plant for handling the Mixed ore. This material can be mined separately and will have to be mined anyway. According to our understanding, it cannot be put through the regular sulphide circuit. Therefore, the question in our minds is: Is this material of sufficient tonnage and grade to amortize a separate plant and produce an operating milling profit? Four possible processes are noted in Mr. Weiss' confidential report of February 9 to Mr. F. V. Richard.

At one time Mr. Vincent mentioned to me that he would be able to learn (through Dorr metallurgists, I presume) whether or not the operation of Bagdad's experimental Fluo-solids plant in recent months indicates commercial application. If so, the availability of acid for leaching would make the Leach material a very large resource. We would appreciate it if Mr. Vincent could get the results of this plant's operation and advise us.

Kenyon Richard
KENYON RICHARD

Att: 1 tabulation
cc: DJPope w/att.-conf. LEHart w/att.-conf.
WRLandwehr " " FVRichard " "
JDVincent " " RIMeen " "

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

SUMMARY OF ESTIMATE

Schedule	Description	Direct& Indirect Costs	
A	Primary Crushing Plant	$ 311615	
B	Secondary Crushing Plant	331000	
C	Mill Expansion	1169123	
D	Substation & Miscellaneous	855615	
	Total - Western-Knapp Estimate		$ 2667353
E	Roasting Section	615000	
F	Leaching Section	375000	
G	Electro-Winning Section	2930000	
H	Casting Section	330000	
	Total - The Dorr Company Estimate		$ 4250000
	TOTAL COST BEFORE FEE		$ 6917353
	Fee		$ 290694
	TOTAL COST		$ 7208047

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

BREAKDOWN OF ESTIMATE

SUMMARY OF DIRECT AND INDIRECT COSTS

SCHEDULE A - PRIMARY CRUSHING PLANT

Item No.	Description	Equipment	Material	Labor	Total
1.	1 - 54" x 31' Apron Feeder	$ 25941	$ 2680	$ 5438	$ 34059
2.	6' x 16' Vibrating Grizzly	12850	1200	2400	16450
3.	2 - Apron Feeders 48" x 6'0"	13253	800	1720	15773
4.	2 - Conveyors 48" & 42"x150'	20194	14855	9181	44230
5.	1 - 500 Ton Surge Bin		5390	3720	9110
6.	6' x 16' Ripl-Flo Screen	8870	1075	1930	11875
7.	1 - No. 24-60 Superior McCully Crusher	61260	2580	5870	69710
8.	1 - Conveyor 30" x 75'	4899	1800	1718	8417
9.	1 - Primary Crusher Building, 32' x 66' x 53'	9540	18332	8343	36215
10.	Electric Wiring		2623	830	3453
	TOTAL DIRECT COSTS	$156807	$51335	$41150	$249292
	Contingencies @ 10%	$ 15681	$ 5133	$ 4115	$ 24929
	Indirect Costs @ 15%	$ 23521	$ 7700	$ 6173	$ 37394
	TOTAL DIRECT & INDIRECT COSTS	$196009	$64168	$51438	$311615

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

BREAKDOWN OF ESTIMATE

SUMMARY OF DIRECT AND INDIRECT COSTS

SCHEDULE B - SECONDARY CRUSHING PLANT

Item No.	Description	Equipment	Material	Labor	Total
1.	Alterations to Primary Conveyor	$ 7828	$ 400	$ 750	$ 8978
2.	Distributing Bin		861	530	1391
3.	3 - Belt Feeders	8910	620	780	10310
4.	2 - Conveyors Nos. 26 & 2C, 30" x 83'	8961	1928	2536	13425
5.	2 - Screens	8585	2502	2086	13173
6.	Conveyor 4a, 30" x 32'	2479	383	450	3312
7.	2 - 51/2" Symons S.H. Crushers	85004	6334	12534	103872
8.	Conveyor 3a, 30" x 27'	2479	383	450	3312
9.	Alterations & extension to Conveyor No. 4, including Gallery	26909	16650	10954	54513
10.	Electrical, 440 Volt		8461	3075	11536
11.	Crusher Building Addition	9540	11177	8455	29172
12.	Alterations to Conveyor No. 3	560	656	270	1486
13.	Removal of existing equipment			3920	3920
14.	Alterations to 16" McCully Crusher		570	830	1400
15.	Moving Dust Collector		1200	3800	5000
	TOTAL DIRECT COSTS	$161255	$52125	$51420	$264800
	Contingencies @ 10%	$ 16126	$ 5212	$ 5142	$ 26480
	Indirect Costs @ 15%	$ 24188	$ 7819	$ 7713	$ 39720
	TOTAL DIRECT & INDIRECT COSTS	$201569	$65156	$64275	$331000

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

BREAKDOWN OF ESTIMATE

SUMMARY OF DIRECT AND INDIRECT COSTS

SCHEDULE C - MILL EXPANSION

Item No.	Description	Equipment	Material	Labor	Total
1.	Mill Bins, 3 - 40' x 40'		$ 39871	$ 21613	$ 61484
2.	6 - Hardinge Feedometers	$ 9444	180	660	10284
3.	3 - Weightometers	7474	150	430	8054
4.	3 - Belt Feeders, 18"	6891	919	1955	9765
5.	3 - 10 1/2' x 11' Ball Mills	295709	9410	23130	328249
6.	3 - Classifiers	108266	2349	12407	123022
7.	Copper Flotation Section, 60 - 66" Cells, 2 - 56" Cells & Pump	97144	4307	9593	111044
8.	Copper Concentrate Thickeners 2 - 50' x 10'	9649	10289	4125	24063
9.	Molybdenum Flotation Section, complete	66000	2800	6200	75000
10.	Mill Building		67328	57858	125186
11.	Power Wiring, 440 & 2300 Volt		45047	14100	59147
	TOTAL DIRECT COSTS	$600577	$182650	$152071	$935298
	Contingencies @ 10%	$ 60058	$ 18265	$ 15207	$ 93530
	Indirect Costs @ 15%	$ 90087	$ 27397	$ 22811	$ 140295
TOTAL DIRECT & INDIRECT COSTS		$750722	$228312	$190089	$1169123

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

BREAKDOWN OF ESTIMATE

SUMMARY OF DIRECT COSTS

SCHEDULE D - MISCELLANEOUS CHANGES

Item No.	Description	Equipment	Material	Labor	Total
1.	New Substation	$606243	$20425	$78325	$704993
2.	Moving Assay Office & Laboratory		5000	20000	$ 25000
3.	Moving Existing Water Line		4680	1740	6420
4.	Moving Acid Storage Tank		200	600	800
5.	Reagent Storage Building		3400	3400	6800
	TOTAL DIRECT COSTS, SCHEDULE	$606243	$33705	$104065	$744013
	Contingencies 10%	Included in above			
	Indirect Costs 15%	$ 90936	$ 5056	$ 15610	$111602
TOTAL DIRECT & INDIRECT COSTS		$697179	$38761	$119675	$855615

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

SUMMARY OF THE DORR COMPANY ESTIMATE

ROASTING, LEACHING & ELECTROLYTIC SECTIONS
(Estimate by Dorr Company)

Schedule	Description	Equipment	Material	Labor	Total
E	Roasting Section				$ 615000
F	Leaching Section				375000
G	Electro-Winning Section				2930000
H	Casting Section				330000
	TOTAL DIRECT COST				$4250000

BAGDAD COPPER CORPORATION

Bagdad, Arizona

CRUSHING PLANT AND MILL EXPANSION

BASIS OF ESTIMATE

Scope of Estimate - includes installed cost of the following:

a. All equipment, motors, wiring, motor control, substatinns, chutes, launders, process and water piping, lighting, foundations, buildings, operating platforms and walkways, overhead cranes and alterations to existing facilities, in the Primary Crushing Plant, Secondary Crushing Plant, Fine Grinding Section, Flotation Section and Thickening Section.

b. The Dorr Company estimate for installed cost of Concentrate Roasting Plant, Leaching Plant, Electro-Winning Plant and Casting Plant.

Estimate does not include cost of -

a. Tailings disposal system; water supply system; source of power in excess of present capacity; office buildings; camp facilities for operating crew; housing; boarding and transportation of construction crew.

Flowsheet - Primary Crushing Plant, WKE-212-SK5; Secondary Crushing Plant, WKE-212-SK4, Mill, Conventional Flowsheet.

Types of Construction -

1. Primary Crushing Plant Building, additions to Secondary Crushing Plant Building and additions to Grinding and Flotation Building: Steel frame, steel girts and purlins, corrugated galvanized iron cover, steel sash windows. Concrete foundations and floors, steel frame and wood deck operating platforms.

2. Heavy equipment foundations: Concrete.

3. Light equipment supports: Steel Frame.

4. Conveyors: Steel frames and supports; wood walkways.

5. Outside conveyor galleries: Steel frame, corrugated galvanized iron covers.

6. Ore Bins: Steel shell on concrete foundations.

Types of Construction - Continued

7. Lighting in building to be incandescent.

8. Electrical Substation: Estimate based on incoming current at 120 KV on existing lines. Estimate does not include reinsulating existing lines for this voltage.

9. Painting: All steel to have one (1) shop coat zinc Chromate primer and one (1) field coat approved paint.

10. Piping: Mill piping to be standard black pipe.

11. Electrical: All wiring to be in rigid conduit. All motor controls to be in factory-built control centers.

Labor Costs -

Estimated on 40 hour per week. If construction work is carried on more than 40 hours per week, an additional 2% will be added to labor estimate for each hour worked over 40 hours per week.

BAGDAD COPPER CORPORATION - EXPANSION PROGRAM

SUMMARY OF POWER REQUIREMENTS

SCHEDULE A - PRIMARY CRUSHING PLANT

Motors

Quantity	HP	Total HP	
2	7 1/2	15	440V
2	15	30	"
1	25	25	"
2	50	100	"
1	200	200	"

Total, Schedule A 370 HP

SCHEDULE B - SECONDARY CRUSHING PLANT

5	5	25	440V	
2	7 1/2	15	"	
3	15	45	"	
1	250 W.R.	250	"	Replaces 1-125 HP Motor present plant
2	200	400		

Total, Schedule B 735 HP

SCHEDULE C - MILL EXTENSION

6	3/4	4	440V
6	1 1/2	9	"
2	3	6	"
5	15	75	"
90	20	1800	"
1	25	25	"
3	30	90	"
1	60	60	"
3	800	2400	2300V

Total, Schedule C 4469 HP

Total, Schedules A, B, & C 5574 HP - 4200 KW
Total, Schedules E, F, G, H (The Dorr Co.) 10628 KW

Total Added Power Required 14828 KW

BAGDAD COPPER CORPORATION CE-304
FLUOSOLIDS

		Q.	Unit Weight	Unit Cost	F.O.B. Site	Erection	Total
101	Reactors	2	600,000		98,800	50,000	148,800
102	Feeding System	2	15,600		14,500	1,000	15,500
103	Blowers	2	13,200		21,000	1,000	22,000
103A	Duct Work	2	1,000		3,000	3,000	6,000
104	Cyclone Systems	2	80,000		54,600	5,000	59,600
104A	Duct Work		3,000		4,000	4,000	12,000
105	Instrument Panel	2	5,000		12,000	2,000	14,000
106	Power Wiring				10,000		10,000
107	Compressors	2	5,600		5,100	300	5,400
108	Finish Prod. Conv.	2	15,000		24,000	6,000	29,000
109	Cyclone Stack Lining	1	18,000		5,000	6,000	11,000
120	Structural Build. & Equip. Supports						22,000
130	Excavation						15,000
140	Foundations						28,000
150	Piping						12,000
	Misc. Freight						20,000
190	Designing & Engineering						36,000
191	Field Supervision						13,500
					TOTAL		479,800

[A]DAD COPPER CORPORATION CE-304

LEACHING

		Q.	Unit	Unit Cost	F.O.B. Site	Erection	Total
201	18x18 Agitator Tank, Wood	3	17,500	1,900	7,275	2,100	9,400
	Foundation	1				5,200	5,200
	Stain. Steel Mech.	3	1,900	$2.50 Lb.	15,960		
	Structural Steel	3	2,050	.30 lb.	2,025	1,000	23,500
	Structural Mech.	3	2,100	.70 lb.	4,470		
201A	360 CFM Compressor	1	5,700	5,600	5,800	400	6,200
	Air Reducer	1	2,000	1,700	1,900	200	2,100
202	50'x8' Type S Thickner	4	34,000	4,500	19,360	6,000	25,400
203	Stain. Steel Mech.	4	5,400	2.50 lb.	54,430		
204	Structural Steel	4	2,200	.30 lb.	2,870	9,000	81,000
205	Structural Mech.	4	5,000	.70 lb.	14,400		
202A	Operators Shed	1		7,000		1,500	8,500
202B	Foundations	1			28,000		28,000
206 to 9	#3VMR Dorrco Pumps	4	900	1,344	5,500	100	5,600
210 to 215	300 GPM 6" A.P.Pumps	2	1,000	1,300	2,700	200	2,900
211-12&13	50 GPM 3" A.P.Pumps	3	450	800	2,400	100	2,500
214-302	30x20 Storage Tank	2			21,000		21,000
216	Moore Filter	1			40,000		40,000
303	250 GPM A.P.Pump	1	1,000	1,300	1,350	150	1,500
304	50 GPM 4" A.P.Pump	1	750	750	770	30	800
220	Piping & Launders				6,000	10,000	16,000
230	Electrical				10,000		10,000
240	Tank Linings	27,00 sq.ft.					10,800
290	Designing						44,600
291	Field Supervision						13,500
450	Excavations						15,000
					TOTAL		$73,500

BAGDAD COPPER CORPORATION CE-304

ELECTROWINNING

		Units	Unit Cost	F.O.B. Site	Erection	Total
305	Electrolytic Tanks (conc.)	104 yds.	.14 yd.	12,194	17,420	29,700
	Lead Accessories	208,347 lbs.	.27 lb.	56,253	20,850	77,100
306	Anodes	2,323,360 lbs.	.20 lb.	490,000	1,000	491,000
307	Lead Starting Blanks	398,300 lbs.	.27 lb.	110,600	400	111,000
308	Copper	600,000 lbs.	.35 lb.	215,900	11,800	227,700
309	Copper Starting Sheets					
310	1300 gpm 8x6 A.P.Pump	8	3,000	24,900	1,000	25,900
311	3100-81V Motor Generator	3		500,000	50,000	550,000
312	Lift Truck Motor Generator	1				2,500
313	5 ton 115' Span O.H.Crane	2				76,000
314	Washing tank Anode	1	350	375	125	500
315	Cathode Wash Tank	2	350	750	200	950
316	Stripping Rack	2	300	600		600
317	Pallets	10	30	300		300
318	Lift Trucks	4	4,200	16,800		16,800
319	Shears	1	4,000	4,100	200	4,300
320	Punch	1	1,200	1,300	100	1,400
321	Baler	1	7,500	7,600	200	7,800
322	Anode Rock	4	180	720	80	800
323	Basket Rack	1	180	180	70	250
324	Baskets	5	60	300	50	350
325	Platform Scale	1	6,250	6,700	250	6,950
326	Launders	1,800 L.F.	$ 5 L.F.	8,000	10,000	18,000
340	Structural Steel	900 tons	300 T.	306,000	45,000	351,000
	Reinforcing	120 tons	100 T.	17,000	18,000	35,000
	Misc.	15 tons	400 T.	6,600	750	7,350
341	Roofing & Siding R.57,000 S.	18,000	1.50 sq.'	112,500	37,500	150,000
342	Windows & Doors	270 units		24,400	10,000	34,400
343	Concrete-floors etc.	2,200 yds.	$ 14 yd.	30,800	44,000	74,800
330					15,000	15,000
344	Floor Covering	30,000 sq.'	.30 sq.'		9,000	9,000
345	Tank Linings	54,000 sq.'	.40 sq.'	13,300	8,100	21,600
346	Glass Insulating Blks.	832 sq.'	.15 sq.'	12,480	70	12,550
347	Form Lumber	100,000 BM	122/MBM	11,200	22,400	33,600
348	Painting	1,200 gals.	$ 5 gal.	6,000	18,000	24,000
350	Piping & Process Lines	5,300 '	$ 5 L.F.	26,500	15,900	42,400
360	Lighting					15,800
390						55,800
391	Field Supervision					13,500
				TOTAL		2,545,700

BAGDAD COPPER CORPORATION CE-304
FURNACE REFINING

401	Melting Furnace	64,000
	Hearth Lining	
	Stack	
402	Oil Burner, etc.	1,500
403	Charger	35,000
405	Casting Wheel	40,000
406	Cooling Basis	8,000
407	Pan Conveyor	10,000
409	Overhead Crane	60,000
410	Structural Shed	22,000
	Foundations	8,000
	Pourways	1,500
420	Power	10,000
430	Excavations	13,000
440	Misc. Items of Equipment	6,000
490	Designing	33,480
491	Field Supervision	13,500
	TOTAL	327,980

BAGDAD COPPER CORPORATION CE-304
TOTALS

Section 100	FluoSolids	$ 479,800.00
Section 200	Leaching	373,500.00
Section 300	Winning	2,545,700.00
Section 400	Refining	327,980.00
TOTAL COSTS		$ 3,726,980.00
	10% Contingencies	372,698.00
TOTAL (Turn Key) COST		$ 4,099,678.00

Plus FluoSolids Start-Up Services of 90 days at $75 plus travel 7,750.00

Plus Commuted Royalty at 25 ¢/ton on 200 tons concentrate per day 124,930.00

TOTAL ESTIMATED ERECTED COST $ 4,232,358.00

Dickey quoted estimate of $4,250,000.00

June 1, 1951

BAGDAD COPPER REDUCTION PLANT

POWER REQUIREMENT ESTIMATE

		KW	HP	$ Per Ton Concentrate*	¢ Per lb. Cu Produced**
	Section 100 - Roasting				
	Feeding System		70		
	Blowers - 2 at 250 HP		500		
	Auxiliaries		10		
	Total	432.5	580	0.1167	0.0179
	Section 200 - Leaching & CCD				
201	Three 18' x 18' agitators, with compressor at 12 HP each.		36		
202-205	Four 50' Type S thickeners at 2 HP each.		8		
206-209	Four #3 VMR diaphragm pumps at 1 HP each.		4		
210,215	Two 3" centrifugal pumps at 15 HP each.		30		
211-213	Three 2" centrifugal pumps at 15 HP each.		45		
216	Moore filter with vacuum pump		50		
	Total Section 200	129	173	0.0348	0.0054
	Section 300				
301	Tankhouse, input	9,000			
	Pumps	75	100		
	Auxiliaries	925			
	Total	10,000	13,415	2.7000	0.4122

* At 2.25 mills per KWH and 200 tons concentrate per day.

** At 2.25 mill per KWH and 131,000 lbs Cu per day.

Power Estimate, Bagdad, continued

		KW	HP	$ Per Ton Concentrate	¢ Per lb. Produced
303	3" centrifugal pump		15		
304	2" centrifugal pump		15		
305	Melting furnace heat		20		
306	Casting wheel		15		
	Cranes & auxiliaries		10		
	Pan Conveyor		10		
	Total	67	85	0.0181	0.0028
	Total, Section 300	10,067	13,500	2.7181	0.4150
	Totals - Section 100	432	580	0.1167	0.0179
	Section 200	129	173	0.0348	0.0054
	Section 300	10,067	13,500	2.7181	0.4150
	Total	10,682	14,253	2.8696	0.4383

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THE DORR COMPANY

Barry Place
Stamford, Conn.

July 3, 1951

Mr. E. R. Dickey, Manager
Bagdad Copper Corporation
Bagdad, Arizona

Dear Mr. Dickey:

This will confirm our telephone conversation of the other day during which I advised you to raise the estimated cost of the plant given in Mr. Russell's memorandum to you from $4,250,000 to 5,000,000.

Mr. Russell's estimate had information concerning the electrolytic installation which was subsequently changed as a result of further discussions with the Engineering Department of General Electric Company. We enjoyed very much having Mr. Lincoln call on us and hope that he obtained the information that he wanted.

Sincerely yours,

THE DORR COMPANY

signed/ J. D. Grothe, Manager
Consulting Engineerint Dept.

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BAGDAD COPPER CORPORATION

REDUCTION PLANT

The following process has been designed by the Dorr Company to treat 100,000 lbs. of copper per day in the form of copper concentrates containing 25% of copper and 30,000 lbs. of copper per day as cement copper from the treatment of oxide ore on the dump. Both classes of material are products of the Bagdad Copper Corporation.

These products as received at the Reduction Plant will be mixed and fed as a slurry to a Dorr FluoSolids Reactor. In the Reactor air under pressure is blown through the bed of concentrates and the sulphur in the ore provides the heat for roasting. When air is blown through the roasted and roasting concentrates, the individual particles of the mass are suspended in the upward flow of gases, and the contents of the Reactor behave like a liquid and are said to be fluidized. Each particle is surrounded by gas, and the whole content of the Reactor is in the state of ebullition; and consequently, like any other boiling fluid, the temperature throughout the whole mass is the same. Furthermore the temperature of the reaction can be very closely controlled as has been demonstrated at one pilot plant that has been roasting copper concentrates for the past year. The temperature has been maintained for many consecutive hours with a variation of less than $\pm$ 10° F.

This close control of the temperature and of the operation of the Reactor makes it possible to roast Bagdad concentrates so that the copper sulphides can be converted into water soluble copper sulphate and weak acid soluble copper oxide, while the iron sulphides are roasted to ferric oxides insoluble in water and weak sulphuric acid.

The calcines from the Reactor are then leached in agitators by weak sulphuric acid solution heated by the waste gases from the Reactor, resulting in a 98.5% extraction of the copper. The insoluble residue is washed in a counter current decantation system, giving a clarified solution containing 40 grams per liter copper, 3 grams per liter iron, and not less than 10 grams per liter sulphuric acid.

The pregnant solution is sent to the tankhouse where the copper is electrolytically plated out as cathode copper using insoluble lead anodes. A part of the spent electrolyte, which will contain from 70-80 grams per liter of free sulphuric acid, will be returned to the head of the leaching system, and the remainder used for leaching oxide ore on the mine dump. The amount of acid produced as a by-product can be as high as 90 tons H_2SO_4 per day.

In stripping down the solution, granular copper will be produced in the end of the tankhouse, which will be melted and cast into anodes for making starting sheets. The rest of the cathode copper will be washed, melted and cast into wire bar copper.

B. H. McLeod
Consulting Engineering Department
THE DORR COMPANY
Stamford, Connecticut

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BAGDAD COPPER CORPORATION REDUCTION PLANT

PROCESS, FLOWSHEET, AND METALLURGY

Reference Drawing S-304-1

The proposed Bagdad Reduction Plant will take 200 tons per day of flotation concentrate from the flotation plant. Concentrate grade is assumed at 25% Cu, and will be received at the plant as either filtercake or as thickener underflow. In addition to the concentrate the plant will receive approximately 40,000 lbs. of copper as the content of cement copper from heap leaching operation, which will include 33,000 lbs. new copper plus 80% of the copper in the spent electrolyte used as "on" solution to heap leaching.

The mixed plant feed will be fed as a slurry to a Dorr FluoSolids Reactor, and 98.5% of the copper content will be converted to water or acid soluble form. The heat required by the reactor will be furnished by the sulfur content of the concentrate feed.

Products of the FluoSolids Reactor will be collected continuously and leached in a solution composed of strong acid return spent electrolyte plus fresh water dilution. Leach time will be from 5-8 hours. Extraction of all the water and acid soluble copper from the calcine will be made. Leach residue will be separated from pregnant solution in a standare CCD system. Washing effeciency is calculated at plus 99.94%.

The analysis of pregnant solution to copper electorysis is estimated to be:

Copper	40 g/l
Fe	3 g/l
Fe ++	1.7 g/l
Fe +++	1.3 g/l
Sol. Al_2O_3	0.1 g/l
As	-
$CaSO_4$	0.5 g/l
Sb	-
H_2SO_4	3 g/l

Pregnant solution will be passed through clarifactions before electrolysis.

Electrolysis of pregnant solution will be according to standard practice. Soluble anodes will be used in preparation of starting sheets. Stripping will be carried at least 3 g/l Cu in the tankhouse "off" solution. Plus 90% of tankhouse production will be furnished cathodes and less than 10% will be off-grade requiring purification.

Tankhouse cathodes will be melted, poled and cast to wirebar according to standard practice, with soluble anodes for the tankhouse also cast in the wirebar section.

Bagdad Copper Corporation

A portion of the spent electrolyte from the tankhouse will be returned to the leach section to furnish acid. The balance of the spent electrolyte, containing approximately 180,000 lbs. H_2SO_4 per day, will be available for Bagdad's heap leaching operation on oxide ore. The copper content of the spent solution to heap leaching is regarded as being 80% recoverable into cement copper.

Total fresh water requirements for the plant are approximately 260 gallons per minute.

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BAGDAD COPPER CORPORATION
Bagdad, Arizona

ORE RESERVES ESTIMATE

1 June 1951

This estimate of the ore reserves here at Bagdad is a recapitulation of earlier reports and estimates, together with the results secured by recent exploration. Quantities and grades are based on early churn drilling and diamond drilling which have been performed during the past five years. The composite assays from these holes, reduced to proposed mining benches, are shown in the tables at the back of this report.

Reserves listed are comprehensive and deal with overall grades and tonnages, the rational approach in considering any large-scale open-pit operation, rather than with individual blocks and areas. A key map showing the location of these reserves and drill holes with respect to the local coordinate system is attached to, and made a part of, this report.

Area "D"

This area comprises the remaining ore in the present pit, plus the unmined ore from the stopes in our former underground operation and the ore adjacent to and surrounding our current pit operation. This consists of an area of approximately 53.6 acres and a depth which was found to average 101 feet.

Reserves for this area are estimated as follows:

19,000,000 Tons @ a grade of 0.90% Cu

The cut-off grade for this ore was taken at 0.60% total copper, containing not more than 0.10% occurring as oxide. Three typical sections through this ore body are attached showing the final pit slopes for mining out these reserves. The sections are bent sections for the purpose of bringing them around to a position which is normal to the average ground contours.

The ratio of overburden to ore in this area is estimated at 2-1/2 to 1. This overburden consists of gravels, basalt and copper-bearing oxide capping. The oxide capping is amenable to leaching. Since there are 26,000,000 tons of this material at a grade of 0.40% copper in the overburden of the area, it becomes of real economic importance in the overall production. The assays for various holes in the oxidized zone are in the attached tables.

Area "H"

This area shows probable ore as determined by a limited amount of exploration. The grade is lower, but the thickness should average about 150 feet with a very favorable stripping ratio approximating 1/4 to 1, or less. Further exploration is being performed in this area. No sections are included because of the limited number of drill holes.

Probable ore in this area is:

17,000,000 Tons @ 0.55% Cu

Area "G"

The ore in this area has been a little more firmly established by more extensive drilling than in Area "H". There are about 2,000,000 tons which may be regarded as definite, but for the purposes of this report it is included in the overall tonnage of probable ore in the area. As this ore contains a considerable portion of rather high oxide, it may be feasible to treat a major portion of it by heap leaching. A typical section through the middle of the area is attached.

Probable ore in this area:

10,000,000 Tons @ 0.70% Cu

In addition to the foregoing estimate, drilling is being done in the area connecting "J", "H", and "G", with fair prospects for increasing our reserves.

BAGDAD COPPER CORPORATION

By George W. Colville
Chief Engineer

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15 October,
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Mr. Ernest R. Dickie, Gen. Mgr.
Bagdad Copper Corporation
Bagdad, Arizona

Dear Mr. Dickie:

In order to carry out our proposed expansion program, it is necessary that our supply of fresh water be increased. It is estimated that 2500 GPM will be required to fill our needs for processing and domestic use.

At the present time our source of water is from the surfaceflow of Burro Creek. The water is picked up and pumped through a 10" line for a little over seven miles with the aid of a booster station. The static head is about 1000 feet. These facilities furnish us between 1000 and 1100 GPM.

The natural flow from this creek is insufficient to supply the necessary 2500 GPM at a continuous rate, but the yearly average flow is considerably greater than this. As a solution to the problem the following suggestion is offered:

Build an impounding dam to store floodwater from seasonal runoffs, pipe this water to the site of our present pumping station which must be doubled in capacity, double the capacity of our booster station, and lay a parallel 10" line with our present line.

A tentative site for the impounding dam has been selected on Burro Creek in Sec. 22, T. 15 N., R. 10 W., Gila and Salt River Base and Meridian. This location is about 1-1/4 miles upstream from our present pump station. The height should be 220 feet above the stream bed, and will require about 1,260,000 cu. yds. of material. An earth-fill dam is proposed, and it is felt that it may be constructed for around $730,000. An 18" pipeline from the dam should be installed over the necessary 1-1/4 miles of rough terrain for about $50,000. Doubling our pumping stations will cost $28,000 at current prices. Cost of the 7 miles of 10" line is estimated at $235,000. Because of mild ambient temperatures it is unnecessary to bury these pipelines.

Summing up, this brings the items above for water development to a total estimated cost of $1,043,000.00. The cost of increasing our sub-stations to furnish the additional power required is not included here, since it has been taken into account in another estimate.

Respectfully submitted,

Engineering Department

Geo. W. Colville,
Chf. Engr.

GWC/hb

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No. 4

In order to carry out the expansion program it was necessary to look into the possibilities of securing additional water for the expanded operations.

Application was made to the State Land and Water Department for a permit to take additional water from Burro Creek, our nearest source of supply, which is a distance of approximately 7½ miles from Bagdad.

The permit has been granted.

The natural flow the year around will not furnish the required amount of water needed. It has been established that by building a dam to impound water during the wet seasons enough water could be made available for the Bagdad operation.

It is hereby proposed to build a dam on Burro Creek to impound water during the wet seasons thereby assuring ourselves of a steady supply of water during all seasons of the year.

It will be necessary to double our present pumping capacity and install another ten inch pipe line from Burro Creek to Bagdad, a distance of approximately 7½ miles.

The estimated cost for furnishing water is as follows:

Building Dam	$730,000.00
Pipe line from Dam to Pump	50,000.00
Increasing pump capacity	28,000.00
7½ miles of 10" pipe	235,000.00
Total for Water Supply	$1,043,000.00

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No. 6 Increasing Mill Capacity

At present we are milling ore at the rate of 100,000 tons per month. We propose to increase this capacity to an average of 234,400 tons per month. The ore furnished by the open pit will average 0.90% total copper, including oxide at 0.10% which is unrecoverable by the sulphide flotation process.

We propose to install the necessary additions and equipment to our present mill to handle an average of 234,400 tons of ore per month assaying 0.80% sulphide copper. With present and past experience we can expect to recover 80% of the sulphide copper in the average ore furnished to the mill. The results would be as follows:

234,400 tons milled per month at eight tenths percent sulphide copper would represent 3,950,400 pounds total copper in ore per month. Eighty per cent recovery of the above would represent 3,160,320 pounds recovered per month by flotation. For the purpose of this proposal we have used the figure of 3,000,000 pounds per month recovered by flotation.

To accomplish the above, we have asked the Western-Knapp Engineering Company to give us an estimate on the cost of increasing the mill and crushing plant capacity to handle the total tonnage required. This is included in their report which is enclosed herewith.

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No. 7 Camp Facilities

In engineering the proposed expansion of mining operations and mill capacity, it is necessary that we move the rest of the dwellings and other camp facilities to the Bagdad Townsite, a distance of approximately two miles.

Up to date we have moved about fifty percent of the camp to the new location, making room for the open pit operations.

It will be necessary to move or rebuild our general office, assay office, laboratory, general merchandise store, post office, service station, hospital and nurses home, boardinghouse, bunk houses, staff houses and other facilities to make room for the proposed plant expansion and mining operations. In addition, we will need at least one hundred new houses for additional employees with families.

In this program we will have to provide for additional utilities such as water, lights, sewage disposal and for additional school facilities. This will necessitate the providing for clearing, grading, sewer lines, water lines, lights, etc.

The estimated cost of the above is as follows:

New General Office and vaults	$15,000.00
Hospital, nurses home & add'l. equipment	20,000.00
Guest House	12,000.00
Boardinghouse & refrigeration plant	12,500.00
Dormitories for 100 men	30,000.00
Twelve Staff Houses	89,500.00
Store, Postoffice, Service Station, etc.	153,500.00
100 new 4 & 5 room family dwellings	500,000.00
Addition for school facilities	199,897.00
Sewage Disposal	50,000.00
Water and Power lines	49,893.00
Clearing land, etc., estimated	10,000.00
Overhead and miscellaneous items	27,000.00
Total for Camp Facilities	$1,169,290.00

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No. 8 Power

We have explored every possible source of power available for our proposed expansion program. Through our negotiations with the U. S. Bureau of Reclamation and other sources of electric power we have succeeded in entering into an agreement with the Central Arizona Light and Power Company whereby they propose to furnish the necessary electric energy for our proposed expansion program as follows:

We are to advance the cost of construction of the high voltage line from Prescott, Arizona to Bagdad, a distance of approximately 48 miles, at a cost not to exceed $450,000.00, which we will recover at the rate of 10% of our monthly power bill.

For power we will be billed at the rate of $3.00 per KW demand plus 2½ mils per KWH energy charge. And at the lead factor which we expect to maintain of ninety-four percent the power will cost us six and nine-tenths mils per KWH consumed.

We are enclosing a copy of the contract submitted by the Central Arizona Light and Power Company.

Capital needed for electric power:

Advance to Central Arizona Light & Power Co. $450,000.00

3600
4200
10520

C
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No. 9 Necessary Stripping ahead of Mining

To be able to increase the rate of mill production to approximately thirty-six million pounds copper per year it will be necessary to start stripping overburden as soon as possible.

It will be necessary to strip at least four million cubic yards of overburden before we can be in a position to mine ore at the rate of ten thousand tons per day.

Using our present cost per cubic yard for stripping of $0.1886, it will necessitate the expenditure of $754,400.00 for operating expense, only.

To accelerate the stripping program, we will need additional equipment as follows:

One 6-yard Electric Shovel	$190,000.00
Two Model 27-T Churn Drills	25,600.00
One Portable Air Compressor	7,800.00
Six 50-ton Dump Trucks	498,000.00
Two T. D. 24 Tractor and Dozers	48,600.00
Addition to Pit Shop and Garage	25,000.00
Machine Shop and Garage Equipment	15,000.00
Miscellaneous items	30,000.00
	$840,000.00

Additional for stripping ahead of mining	754,400.00
Total for Pit Operation -	$ 1,594,400.00

C
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P
Y

No. 10 Estimated Cost for Refining and Casting

As per the report by the Dorr Company, the refining costs are estimated as follows:

	Per pound copper
Labor	$C.006688
Electric power at 6.9 mils per KWH	0.017500
Repairs and Maintenance	.007000
Taxes, Insurance and General Overhead	.008000
Total Operating Cost	$0.039188

The above does not include amortization or depreciation.

COPY

No. 11 Proposed leaching of the oxide copper bearing material stripped from over the sulphide ore zone

At present we have stockpiled for the purpose of leaching, about 2,000,000 cubic yards of oxide copper bearing ore. The proposed stripping program will add 7,000,000 cu. yds. of the same material, making a total of 9,000,000 cubic yards of material to be leached during the period.

This leaching program can only be carried out if we install the Dorr Company process which will give us the necessary sulphuric acid as a by-product from the refining plant to leach the oxide bearing materials.

Material to be leached by using the sulphuric acid produced as a by-product from the proposed refining plant is as follows:

On present dump	2,000,000 cu. yds.
From future stripping the next 7 yrs.	7,000,000 cu. yds.

Equals 9,000,000 cubic yds. or 13,500,000 tons. The above material will average 0.35% copper or 7 pounds copper per ton or a total of 94,500,000 lbs. copper. Estimated recovery by leaching is 90% of total copper within 7 years after production starts.

Total copper recovered during seven year period 85,050,000 pounds, making possible production of 12,000,000 pounds copper per year, which will be added to the mill production of sulphide copper and the total treated in the refining plant.

The cost of producing copper by the heap-leaching process is as follows:

	per pound copper
Transporting acid solution to dumps, acid spraying system, labor, power, maintenance, collecting copper-bearing solution and precipitating same with de-tinned scrap iron, settling, thickening and preparing for roasting and refining	
Total above	$0.10980
Refining and casting	0.03919
Total cost of producing copper by the leaching process	$0.14899

We will have a capital outlay of approximately $73,900.00 for the necessary equipment to place the leaching program into production, as follows:

Acid-proof pumps and fittings	$8,500.00
Complete spray system (acid proof)	25,500.00
Acid-proof pipe lines - 15,000 feet at $2.66 per foot	39,900.00
Total capital needed for Leaching Program,	$73,900.00

We have on hand, and installed, a large precipitator of ample capacity to handle the total leaching program.

COPY

No. 12 Cost of Production of Copper from Sulphide Ore by Milling and Flotation

For estimating the cost of future production we are using the average cost for the first six months of 1951 as audited by the Harmon Audit Company of Phoenix, Arizona. We are enclosing a copy of this report for your perusal.

It is estimated that the cost of production per pound of refined copper is as follows:

	Cost per pound of copper
Cost of Production	$ 0.11475
Other charges to operations	.02673
Other expenses	.00346
Depletion, Depreciation, Amortization, etc.	.02624
Total Cost	$ 0.17118
Deduct other income	.00216
Cost per pound of copper in concentrates	$ 0.16902
Estimated cost per pound copper for refining and casting	.03919
Total cost per pound of refined copper, not including depreciation of new capital investment.	$ 0.20821

The above cost does not include the additional cost for power which will be about doubled what we are paying at this time. We estimate that the labor cost in the mill should be enough less to count for the difference.

AMERICAN SMELTING AND REFINING COMPANY

BAGDAD COPPER CORPORATION

ORE RESERVE ESTIMATE AS OF JANUARY 1, 1956

	(11)	Unit Tonnages (1)								Ore Combinations, Grades and Waste/Ore Ratios											
		SULPHIDE ORE (2)				MIXED (3) ORE	LEACH (4)	BEDROCK (5) WASTE	GRAVEL (6)	SULPHIDE ORE			MIXED ORE		LEACH		SULPHIDE ORE PLUS MIXED ORE			LEACH PLUS MIXED ORE	
		Measured	Indicated	Inferred	Total					Tons	Grade (2)	W/O (7)	Tons	Grade (3)	Tons	Grade (4)	Tons	Grade	W/O (8)	Tons	Grade
SMALL PIT	.5 Cutoff	18.8	17.7	1.3	37.8	6.9	71.8	1.7	15.3	37.8	0.84	2.53/1	6.9	1.06 T / .50 N	71.8	0.42	44.7	0.87	1.99/1	78.7	0.48
	.4 Cutoff	28.9	27.8	2.4	59.1	6.9	56.4	1.7	15.3	59.1	0.72	1.36/1	6.9	1.06 T / .50 N	56.4	0.40	66.0	0.75	1.11/1	63.3	0.47
(9) REMAINDER	.5 Cutoff	1.7	7.5	21.8	31.0	0.6	19.0	17.7	55.1	31.0	0.68	2.98/1	0.6	0.83 T / .35 N	19.0	0.44	31.6	0.69	2.91/1	19.6	0.45
	.4 Cutoff	1.9	12.9	27.5	42.3	0.6	12.2	17.7	55.1	42.3	0.63	2.02/1	0.6	0.83 T / .35 N	12.2	0.38	42.9	0.64	1.98/1	12.8	0.40
(10) LARGE PIT	.5 Cutoff	20.5	25.2	23.1	68.8	7.5	90.8	19.4	70.4	68.8	0.77	2.73/1	7.5	1.04 T / .49 N	90.8	0.43	76.3	0.79	2.37/1	98.3	0.47
	.4 Cutoff	30.8	40.7	29.9	101.4	7.5	68.6	19.4	70.4	101.4	0.68	1.63/1	7.5	1.04 T / .49 N	68.6	0.39	108.9	0.71	1.45/1	76.1	0.46

(1) In millions. Gravity factor of 12.5 cu.ft./ton used for all rock except gravel, caved areas and dumps.

(2) Per cent Total Cu. Less than 30.0% of the Total Cu in this Sulphide Ore exists as Non-sulphide Cu. (Practically all of this ore contains less than .10% Cu as Non-sulphide Cu.)

(3) More than .80% Total Cu and more than 30.0% of the Total Cu is Non-sulphide Cu. (This material would require an especial treatment process.)

(4) More than .15% Total Cu but unqualified as Sulphide Ore or Mixed Ore. (This accounts for the relatively high grade of the Leach --- see Note (11).)

(5) Less than .15% Total Cu.

(6) Gravity factor of 16 cu.ft./ton. Includes dump and cave material.

(7) Gravel + Bedrock Waste + Leach + Mixed Ore.

(8) Gravel + Bedrock Waste + Leach.

(9) This material remains within the Large Pit when the Small Pit is completed.

(10) This represents total material, including Small Pit.

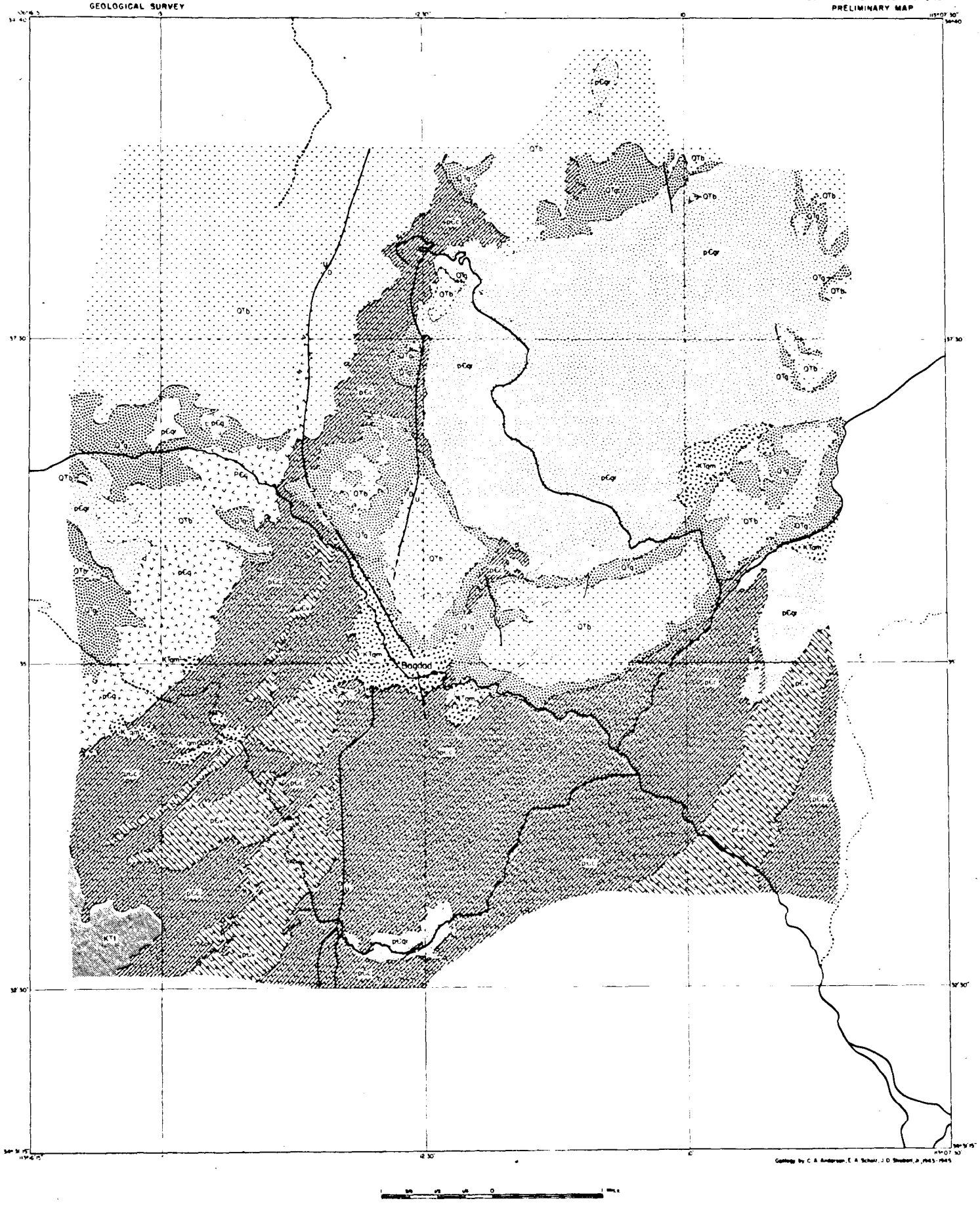
(11) These Bottom Cutoffs apply on Sulphide Cu content only.

Compiled by: J. H. Courtright
B. S. Hardie
A. H. Haworth
K. E. Richard

July, 1956

Geol. Soc. Am., Memoir
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Vacquier et al., Pl. 8
GEOPHYSICAL INVESTIGATIONS
PRELIMINARY MAP



EXPLANATION

LATE TERTIARY (?) TO PLEISTOCENE

QTb — Basalt flows

QTg — Gila (?) conglomerate (Includes some tuffaceous beds)

TERTIARY (?) TO QUATERNARY (?)

LATE CRETACEOUS (?) TO EARLY TERTIARY (?)

KTgm — Quartz monzonite

KTr — Rhyolite tuff

Rhyolite (intrusive)

CRETACEOUS (?) TO TERTIARY (?)

pCgr — Granite (Includes some aplite-pegmatite)

pCg — Gabbro

pCv — Metavolcanics (Largely andesite and basalt flows metamorphosed to chlorite schist or amphibolite)

PRE-CAMBRIAN

pCc — Pre-Cambrian complex (Largely granite, gabbro, diabase porphyry, rhyolite and mica schist)

U / D — Fault (U, upthrown side, D, downthrown side)

Probable Fault

Geology by C. A. Anderson, E. A. Scholz, J. D. Strobell, Jr. 1943-1945

GENERALIZED GEOLOGIC MAP OF THE BAGDAD AREA, YAVAPAI COUNTY, ARIZONA


BLACK MESA AREA
GIROUX AREA
Waste Dump
LEGEND
Basalt underlain by rhyolite tuff
Gila conglomerate & recent alluvium
Diorite porphyry
Lamprophyre(?) dike
Quartz monzonite
Silicified & pyritized rock
Metamorphic rocks
Granite
Diamond drill hole
Churn drill hole
Faults & shears
Leached cavities
Oxide mineralization
Sulphide mineralization
Magnetometer contours
Pyrite, chalcopyrite, chalcocite
NOTE: Contour interval - 50 feet
Topographic control taken from existing mine and claim maps.
BEAR CREEK MINING
OUTCROP 'MAP
BAGDAD COPPER M
Bagdad, Arizona
Geology by R Robinson A S
D Maltzahn W M
Scale 1"=200'

J. H. Courtright Compliments of the writer

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
Technical Publication No. 2352
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Structural Control of Copper Mineralization, Bagdad, Arizona

J. H. Courtright
Tucson, Ariz.

Compliments of the writer

ALTERATION AND METALLIZATION IN THE BAGDAD PORPHYRY COPPER DEPOSIT, ARIZONA.

CHARLES A. ANDERSON.

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