CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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File
Homestake C-H
Mine, Michigan

HOMESTAKE MINING COMPANY
650 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94108

CABLE: HOMESTAKE
TELEPHONE (415) 981-8150

June 14, 1974

Mr. Paul I. Eimon
Manager of Exploration
Essex International, Inc.
1704 West Grant Road
Tucson, Arizona 85705

SXM
JUN 19 1974
RECEIVED

Dear Paul:

It was really nice to have you here in San Francisco and to talk about subjects of common interest. Pursuant to our conversation, I would like to present herewith some additional information on our proposed native copper concentrate production from the old Calumet and Hecla property as follows:

Commencement of Production : Second quarter of 1975.

Quantity: Approx. 3,500 tons per year of concentrate.

Cu Content: Approx. 3.7 million pounds per year.

Chemical Analysis:	Cu	50-53%
	SiO_2	28
	Fe	5
	Al_2O_3	6.5
	CaO	1.5
	MgO	0.4
	As	0.1
	S	0.2
	Ni	0.01
	Ag	7 oz/t
	Bi	nil
	Se	no record of any
Moisture:	10%	
Size Distribution:	+1"	0.2%
	-1" +28 mesh	20
	-28 +150	50
	-150	30

We would appreciate it if you would transmit this information to an appropriate department of your company and have them send us the purchase terms.

Looking forward to talking with you soon.

Sincerely,

T. Maene

TM/slm

PHONES
482-3660
482-3661

COHODAS-PAOLI COMPANY, Inc. - WHOLESALE

Receivers and Distributors of
Fruits, Vegetables and Groceries

HOUGHTON, MICHIGAN 49931

September 3 1971

Mr. John Foley, Consultant
Copper Industries Development
Dollar Bay, Michigan.

Dear Jack:

In response to your request of August 10, 1971 and in supplement to our letter of June 30, 1971, Arcadian Mines, Inc., hereby grant to you the exclusive right, for a period of one year, beginning today, to arrange for the leasing for copper mining purposes, the entire tract of land owned by Arcadian Mines, Inc., in the vicinity of Ripley, Michigan.

It is to be understood by all concerned that the lessee shall pay all property taxes, shall insure the property adequately and that the lessor shall be paid the rental fees in the form of refined copper in the amount of 2½% of the copper extracted from the Arcadian property. Also the lessee must agree to buy the "rent copper" from the lessor within thirty days after its extraction from the mines and at the current price of prime copper wire bars as quoted by the Anaconda Copper Company.

Sincerely yours,

Chester M. Guidotti

Chester M. Guidotti, President
Arcadian Copper Mines, Inc.

CMG:W

3

PHONES
482-3660
482-3661

COHODAS-PAOLI COMPANY, Inc. - WHOLESALE

Receivers and Distributors of
Fruits, Vegetables and Groceries

HOUGHTON, MICHIGAN 49931

June 30 1971

Mr. John Foley, Consultant
Copper Industries Development
Dollar Bay, Mich. 49922

Dear Jack:

As an officer and director of the Arcadian Mining Company, I am authorized to and do give Copper Industries Development our permission to bring about the re-opening of our New Baltic Shaft and our New Arcadian Shaft, or both shafts for the purpose of making a geological study of the Arcadian copper veins.

It is our understanding that this study would be made to provide geological evidence that our mineral rights holdings are of a value sufficient to warrant the investment required to extract the copper bearing rock from the mines and the copper from the rock.

It is to be understood by all persons and organizations who participate in making the study, and in preparation for it, that the Arcadian Mining Company shall be held free of all responsibilities financial and otherwise, involved in making the study and preparing to make it.

The permission herein granted is limited to preparing for and making a geological study of our mineral rights. If the study indicates feasibility of mining we will be willing then to discuss with the Copper Industries Development the matter of operating the mines.

Sincerely

Chester Guidotti

Chester Guidotti, President
Arcadian Mining Company.

Paul Environ
Mr. John Foley
Please give me your
Regards

FEB 11 1972

SXM

FEB 16 1972

RECEIVED

COPPER RANGE COMPANY
CHAMPION DIVISION
PAINESDALE, MICHIGAN 49955

WARREN L. PARKS
General Superintendent

July 19, 1967

Lawrence

Mr. John Foley
Dollar Bay, Michigan 49922

Dear Mr. Foley:

In regard to your recent inquiry, there have been several innovations in mining equipment, mining methods and mining supplies that could substanially increase mining efficiencies and decrease costs when compared to mining operations of 20 or 30 years ago. These factors would certainly affect any feasibility study that might be made concerning the reactivation of the Quincy Mining Company properties. We have proven this to our satisfaction at the Champion Mine during the last three years.

Any modern operating mine should certainly evaluate the use of tunnel and raise borers, ore pass systems and rapid dumping mine cars, larger and more efficient drills using integral drill steel having carbon tungsten insert bits (this has become almost universal usage), long-hole mining methods where applicable and ammonium nitrate as a blasting agent to replace the much more expensive dynamite. These are only a few of the innovations that are available to the mining industry at this time which have proven effective in reducing mining costs and more than offset the increase in the cost of labor and materials which has taken place over the last several years.

Concerning the possibility of the electronic sorting of copper ore, this approach is about to become an actuality in this area. While the method will be applied at first to poor rock piles for the evaluation of the efficiencies of these machines, the great benefit to the immediate area will be the eventual application of this approach to underground mining operations. Mining and concentrating costs should be greatly reduced when electronic sorting is applied to the native copper ores of the Upper Peninsula.

The modern flotation concentration of native copper ore, in conjunction with gravity separation, recovers much more copper from the mined ore than was previously recovered by the old stamp mills. Present copper recoveries well above 90% with a tailing which contains between 1 and 1½ pounds of copper is now standard at the Champion operation. This compares to old stamp mill concentrators that discarded tailings which contained between 5 and 12 pounds of copper per ton. These tailings, as you know, have been profitably reworked by both the Quincy and Copper Range Companies.

I trust that the above has answered your questions. Please do not hesitate to advise me should you need any additional information.

Very truly yours,

W L Parks

WLP/rg

Note.

I found this letter a few days ago when going through my Quincy Mining Company files. Parks is a good man.

The Champion mine made money under Parks. He left nothing behind underground but rock.

Jack Foley

COPPER INDUSTRIES DEVELOPMENT
DOLLAR BAY, MICHIGAN 49922
Tel. (906) 482-2372

BOARD OF CONSULTANTS
F. C. Schwarzenberg—Mining Engineering
William Langdon—Mine Construction
Wyllis A. Seaman—Geology
Raymond Gertz—Metalurgy
Paul D. Kimball—Financing
John Foley—Industrial Development

LANIER

January 23,1972

Mr. Paul W. O'Malley, Pres.
Essex International
Fort Wayne, Ind.

Dear Paul:

I hope the enclosures will be of interest to you.

Skillings Mining Review carried a very interesting story about 'Essex' in the January 22 '72 issue. You've gone a long way since I first knew your company back in 1937 when its one plant was in the Ford Highland Park plant.

If Ralph Mount is still alive will you send his address to me. I would like to write to him.

Tell Tom Sharples hello for me.

Sincerely yours,

Jack Foley

Jack Foley

P.S. There is a lot of words being said and written about copper in northern Wisconsin. In searching the early records and reports on this copper area I found that while the grades of ore and mineral (rock which holds metalic copper) are good the quantities in the veines run very low . This mean a lot of mining for a small amount of copper. There is considerable iron in the rock also and this means high refining costs. All that iron must be oxidized out. There is also quite a lot of nichol and this is poison to copper wire.

J.F.

Ideas and opinions expressed in this letter are those of its writer

Howard Lanier

Paul Eimon

Arcadian Mines, Inc.
Copper Industries Development
Dollar Bay, Mich.

Ft. Wayne, Indiana

Tucson, Arizona

May 8, 1972

I have recently reviewed all the material I have received from you and/or Paul O'Malley regarding the Arcadian Mines. Copper potential does exist in this area, and the entire upper peninsula of Michigan could be given major exploration study, but it is my professional opinion that this area and the new developments in Minnesota will produce much higher cost copper than that produced out of areas such as Safford and Milford.

I do not plan further investigation in the Arcadian area unless instructed to do so by you, but will maintain contact with current information on developments in Michigan and Minnesota as part of the normal exploration information review.

PE:td

COPPER INDUSTRIES DEVELOPMENT
DOLLAR BAY, MICHIGAN 49922
Tel. (906) 482-2372

BOARD OF CONSULTANTS
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William Langdon—Mine Construction
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Raymond Gertz—Metalurgy
Paul D. Kimball—Financing
John Foley—Industrial Development

Paul Einnon

SXM
MAR 16 1972
RECEIVED

During World War II the U.S.Government gave Arcadian Mines, Inc. a small sum of money to explore for copper.

Acting upon the advice of Professor Wyllis Seaman (geologist) An adit was driven into the side of the Arcddian hill. After passing through three copper bearing veins of rock of varying thickness and quality, one very rich, the vein promised by Professor Seaman was entered.

The vein was mined , north-easterly, for a short distance and in the amount of 765 tons of ore(copper bearing rock). This rock was sent to the Calumet & Hecla mill and the copper yield then sent to the Calumet & Hecla smelter for refining. This was ' run of the vein' rock.

The C&H reports from mill and smelter are attached hereto.

The above information and the reports was not included in the C.I.D. brochure on Arcadian mines because the adit is over four miles away from the New Baltic shaft , to the south-west.

Arcadian Mines, Inc, did not have the money to develope a mine then and it does not have it now.

John Foley

John Foley

Ideas and opinions expressed in this letter are those of its writer

COPY

CALUMET AND HECLA CONSOLIDATED COPPER COMPANY

GENERAL OFFICE

CALUMET, MICHIGAN

July 14, 1943

Arcadian Mines, Inc.
69 North Isle Royale St.
Houghton, Michigan

Gentlemen:

Attention: Mr. Jos. M. Donnelly,
Secy.-Treasurer

Returns on rock stamped at our Ahmeek mill in July are as follows:

Rock stamped	765 tons
Wet mineral	16.148 tons
Copper Assay of wet Mineral	70.87%
Copper content	22,888 lbs.
Smelter recovery (98%)	22,430 lbs.
Smelter recovery; Lbs. per ton	29.32

- - - - - - - - - - - - - - - - - -

Yours very truly,

E. R. LOVELL

Vice President & General Manager

AEP2/P
encs.

STAMP MILLS
Hubbell, Michigan

Assay Report for Month ending July 10, 1943

Arcadian Mineral Mill Ahmeek Date July 10, 1943

Date	No. of cars	Pounds Wet Weight	% Moisture	Pounds Water	Pounds Dry Mineral	Cu.% Dry	Lbs. Pure Copper	Cu.% Wet
Grade								
Rich		9570	2.10		9369	91.50	8573	
Poor		3390	16.32		2837	83.76	2376	
Flotation		5336	12.69		4659	54.84	2555	
Mill Mass		None						
Mine Mass		14000			14000	67.03	93844	
TOTALS		32296	4.43		30865	74.16	22888	70.8

765 tons rock stamped

Smelter Return - 98% of 22,888 lbs. = 22,430 lbs. copper.

C. H. Benedict

H. LANIER -

I guess this is what happens to Miners that live alone in log cabins too long

10-9-71.

File - Arcadia Mines

COPPER RANGE

PHONES
482-3660
482-3661

COHODAS-PAOLI COMPANY, Inc. - WHOLESALE

Receivers and Distributors of
Fruits, Vegetables and Groceries

HOUGHTON, MICHIGAN 49931

September 3 1971

Mr. John Foley, Consultant
Copper Industries Development
Dollar Bay, Michigan.

Dear Jack:

In response to your request of August 10, 1971 and in supplement to our letter of June 30, 1971, Arcadian Mines, Inc., hereby grant to you the exclusive right, for a period of one year, beginning today, to arrange for the leasing for copper mining purposes, the entire tract of land owned by Arcadian Mines, Inc., in the vicinity of Ripley, Michigan.

It is to be understood by all concerned that the lessee shall pay all property taxes, shall insure the property adequately and that the lessor shall be paid the rental fees in the form of refined copper in the amount of 2½% of the copper extracted from the Arcadian property. Also the lessee must agree to buy the "rent copper" from the lessor within thirty days after its extraction from the mines and at the current price of prime copper wire bars as quoted by the Anaconda Copper Company.

Sincerely yours,

Chester Guidotti

Chester M. Guidotti, President
Arcadian Copper Mines, Inc.

CMG:W

COPPER INDUSTRIES DEVELOPMENT
DOLLAR BAY, MICHIGAN 49922
Tel. (906) 482-2372

BOARD OF CONSULTANTS
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William Langdon—Mine Construction
Wyllis A. Seaman—Geology
Raymond Gertz—Metalurgy
Paul D. Kimball—Financing
John Foley—Industrial Development

October 5,1971

Mr. Paul O'Malley, President
Essex International
Fort Wayne, Ind.

Dear Mr. O'Malley:

It might be well for you to study this brochure

Sincerely yours,
Jack Foley
Jack Foley

Ideas and opinions expressed in this letter are those of its writer

PREFACE

It has long been the practice of the big copper producers to try to prevent the birth of small producers and to this end there are no bounds.

In trying to prevent the re-opening of long closed Michigan shaft copper mines, all stops will be pulled to discourage the needed investment and/or Federal Government financial assistance. Concentration of propaganda will zero in on the cost of production of Michigan "native" copper as compared to that of electrolytic copper made from ore taken from open pits. The fact that the cost of mining is not the only cost involved in copper production is carefully ignored in the propaganda. Although the direct labor costs in shaft mining is greater than in open pit mining, labor is not the only factor involved. Lets take a look.

To begin open pit mining it is generally necessary to remove vast amounts of overburden from the ore bed. Often, as is the case of the Twin-Buttes mine in Arizona, it amounts to many millions of tons. This is an expensive job and its cost must be charged to the cost of mining. We will call this operation #1.

Operation #2 is the actual mining of the copper ore bed. This is a simple excavating job which permits no primary separation of the ore from other geological matter. Everything is loaded by expensive, high maintenance cost power shovels into likewise expensive and high maintenance motor carriers for bringing it to the #3 operation plant where it is milled and classified. Breakdowns of shovels and carriers cause much expensive 'down-time'.

From milling and classifying the ore goes to the roasting plant where sulphur and other volatile impurities are removed in operation #4.

Moving on to operation #5 the roasted ore concentrates are put into a blast furnace for primary refining and casting into anode. The anode then goes into operation #6 which is electrolytic refining, the secondary refining treatment, and a very expensive one at that.

The product of the electrolytic tanks are called cathode and this goes on to the smelter for operation #7 which is the fire refining needed to bring the copper to commercial quality and shape.

And now we come to considering the process of making commercial copper out of "Lake" copper as God created it. Here we have only three operations and none of them have ecology problems involved. The copper bearing rock is mined---#1. The rock is milled and classified ---#2. The mineral from the mill is fire refined---#3. There are no environment poluting components to get rid of. No ecology problems and costs. No cost of restoring the beauty of the landscape by filling the ore depleted pit with the overburden which was removed to get at the ore.

In the early days of Michigan copper mining, the area which is now Arcadian Mines, Inc. property, several small companies were operating in a very limited manner. This was due to lack of funds and/or wide fluctuations in the market price of copper. Eventually all of them were forced out of business. Then, in 1898, the Arcadian Copper Company was organized embracing all the small companies of the area.

The new company put the cart before the horse and built an elaborate surface plant with steel shaft houses, large and well equipped machine and carpenter shops, and many fine dwellings before the mines were properly developed. Much publicity was given to the company plans and the price of its shares reached $90.00 on the eastern stock exchanges. Debts piled up and finally in order to save most of its copper reserves the company had to sell 800 acres of them to the Quincy Mining Company and sell its stamp mill and its surface facilities to other mining companies.

In 1909 the New Arcadian Copper Company was formed and it took over the assets of its predecessor. But once again the main objective was profit through the selling shares and so this company had a very short life. In 1919, the New Arcadian Copper Company and the New Baltic Mining Company were joined, given the name of New Arcadian Consolidated Mining Company. This time there was some developing done, through the New Baltic and New Arcadian Shafts,

which indicated a large reserve of copper in this area. Weed, in his 1922 Mines Handbook, ended his report on the New Baltic mine as follows: "The new company has good management and a property of immense mineral acreage that offers great possibilities of profitable and long continued mine operations".

The "New Arcadian Company" operated intermittently with the ups and downs of copper prices until the big bust of 1929. It was sold for taxes in the mid 1940's to its present owners, a holding company named Arcadian Mines, Inc. This company did a little exploring through an adit in the "Old Arcadian" section but lacked the financing required for conclusive explorations.

Making good and profitable mines out of long closed old mines is not a novelty in the Keweenaw Area. In recent years Calumet & Hecla (now owned by Universal Oil Products Company) revived the Seneca, the Centennial, the Kingston and the Osceola and now has plans completed for the re-opening of the Calumet Conglomerate lode under the name of "Hills Creek". Re-opening work is now quietly underway in the once productive but long closed Caladonia Mine in the north end of Ontonagon County not many miles from the Winona in the south end of Houghton County. Here a good mine is being re-developed.

Copper deposits in the Keweenaw Peninsula area are located by diamond drilling but the drilling proves only the presence, or not, of copper at the drill core. Even this proves nothing much because the drill may have passed through a vein without showing any

copper whatever, while on the other hand, a drilling but a few feet either way might pass through a solid mass of copper or rock rich in fine copper and silver. Only the sinking of shafts in, or closely parallel to, the vein permits a conclusive study of the vein. Drifting will indicate its continuity, or lack of it, and cross-cutting will reveal the pressence or non-presence of parallel veins which can be mined through the shaft in use.

Metalic copper mining and milling methods in the Keweenaw Area, even up until the 1920's, were crude and inefficient. The real fine copper was not even brought to the surface for recovery and then an average of almost 25% of the copper that came out of the mines and through the mills went out into the tailings piles. Recovery methods developed since 1920 and into the 1950's have reclaimed most of this "lost" copper but still about 10% of the mine yield "got away". Now with new leaching methods ALL of the copper in the vein can be converted into industrial copper.

Some unmined copper of old mines will never be mined because in the first minings the cream was skimmed off by "high grading". But that did not happen to the Arcadian Mines, Inc. These properties were NEVER developed. They may hold the world's largest copper reserves or they may be commercially worthless. Only a geological exploration of them will tell the true tale. And for a large consumer of copper, and in view of the imminent world shortage of copper, a "tax-write-off-study" of the New Baltic and New Arcadian Mines should be a worthwhile spending.

Exploration Program
for
New Arcadian Area
of
Arcadian Mines, Inc.

It was suggested by Wyllis A. Seaman, a most knowledgeable geologist in regard to copper mines and mining in Houghton County, Michigan, that explorations begin with the New Baltic Shaft, then enter the New Arcadian Shaft and later explore through the Ripley Adit.

The reports in the Copper Handbook-1902 (Stevens) and in the Mines Handbook-1922 (Weed) reveal that although the copper deposits in the Arcadian lodes were at par with the average of Isle Royale, Quincy and the subsequently owned Calumet & Hecla mines in the Calumet-Mohawk areas, the management and the financial factors of the two Arcadian ventures were far short of being adequate and honest.

A study of all available reports on the quality of the Arcadian copper deposits reveals that they are mostly in forms which could not be mined at a profit in those early days of meager knowledge of recovery methods and of crude recovery equipment when 3/4% to 1% fine copper content rock was considered worthless. With present day knowledge, techniques, and equipment this kind of "ore" is highly productive of profits at present day and (future day) copper prices.

In view of the pending extremely short world supply of copper and the forecast of total depletion of the world reserve of prime copper by the year 2025, it is fitting that the exploration of the Arcadian Copper Lands be carried out by some manufacturer - consumer of large amounts of copper. There is, probably, close to One Million Tons of copper in the Arcadian area copper lodes.

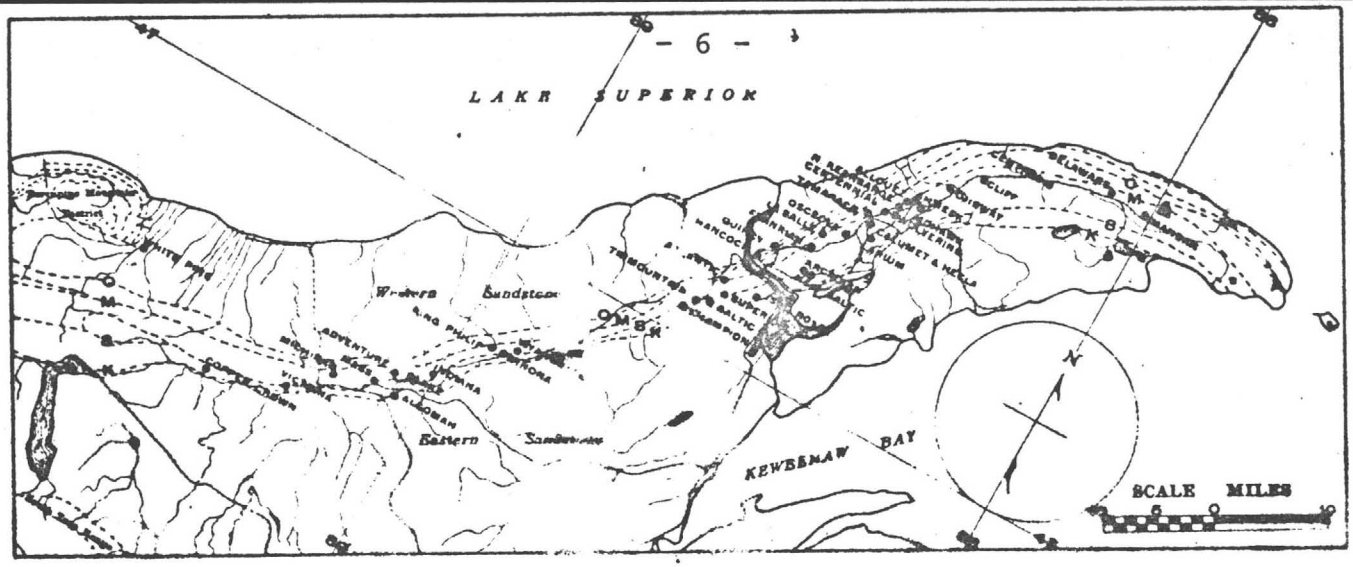
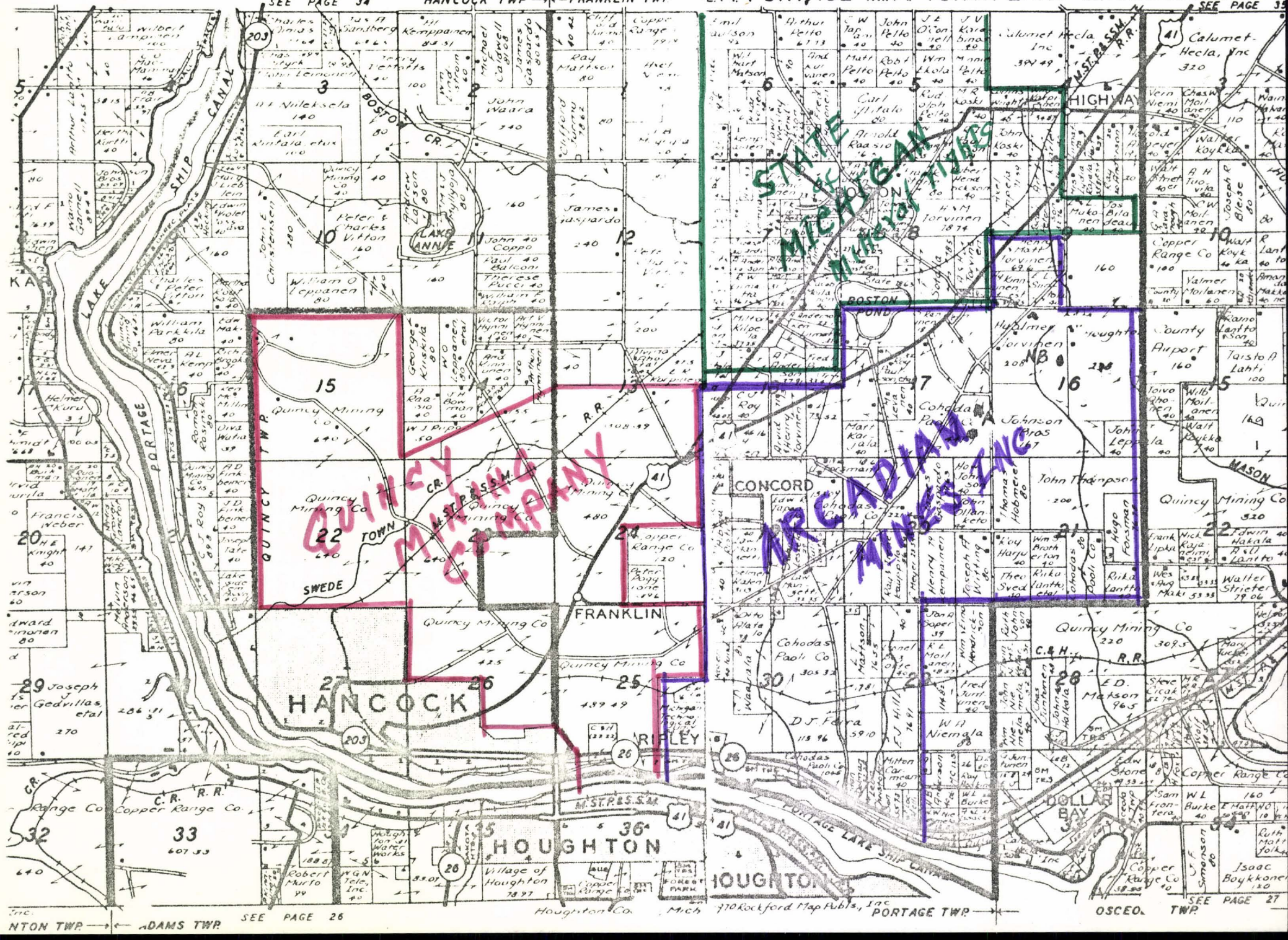


Figure 1. Outline map of Keweenaw Point showing location of mines.

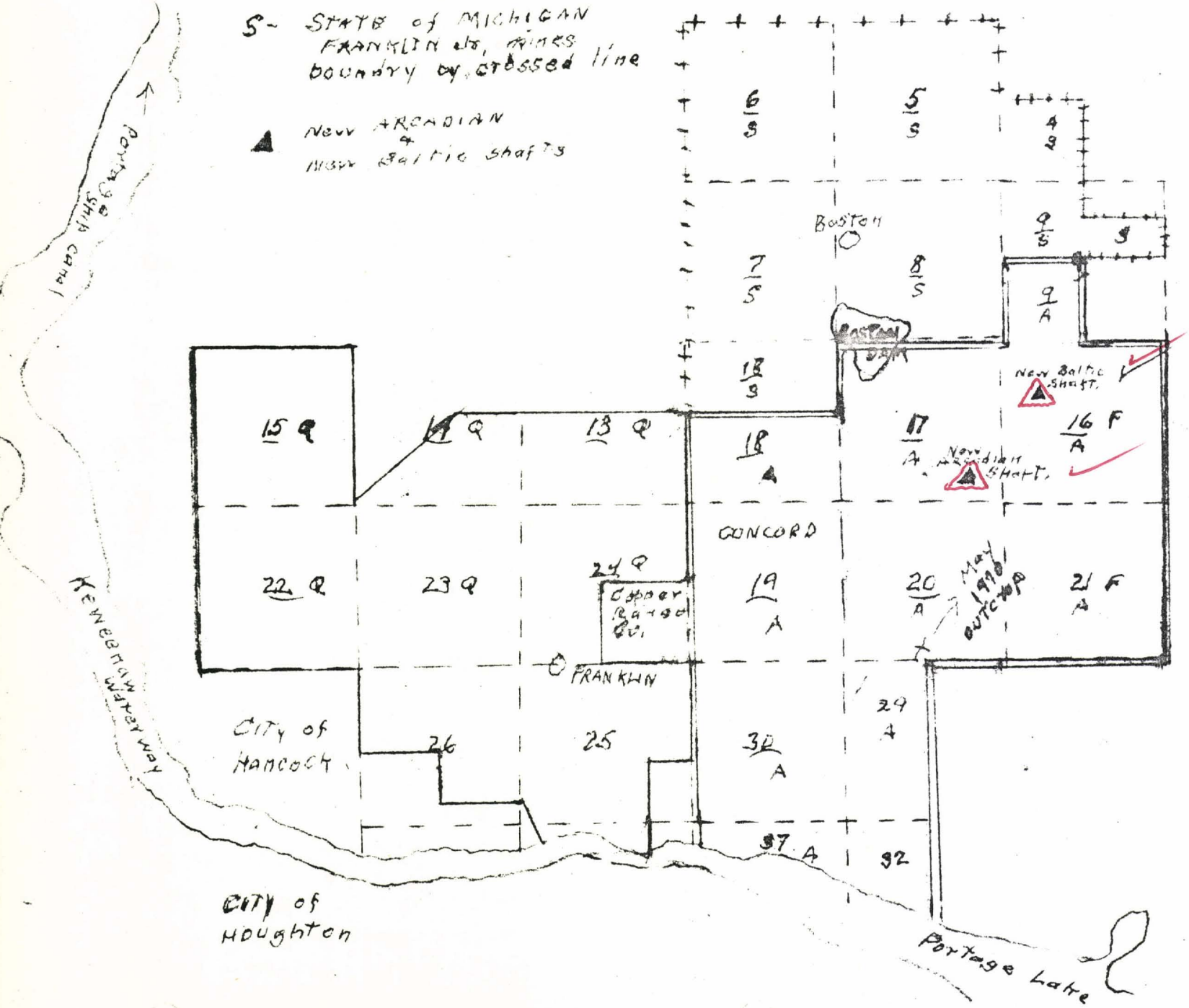
FIG. 2. CHIEF COPPER PRODUCING SECTION OF KEWEENAW POINT.

T. 55 N.–R. 34 W.

T. ADAMS NW. PT. PORTAGE — PT. FRANKLIN SW. PT. OSCEOLA — E. PT. PORTAGE NW. PT. TORCH LAKE SW. PT. SCHOOLCRAFT



Houghton County
Michigan



BULLETIN 650

Published by
The United States Bureau of Mines

Released June 1971

ECONOMIC FACTORS

Prices and Costs

The producers' price for electrolytic copper, established at 31 cents per pound on May 19, 1961, was unchanged throughout 1962 and 1963. Demand for copper began to accelerate in late 1963 and continued upward in subsequent years, except for a dip in 1967. Supply was adversely affected by a strike in 1964 and the producer price was 34 cents per pound by the end of 1964, with a further increase to 36 cents per pound by year-end 1965. In early January 1967, producers were quoting 38 to 38.25 cents per pound. Although this price was maintained for the remainder of the year, there was virtually no U.S. production of copper during the last 2 or 3 months of 1967 because of the strike.

In March 1968, primary producers were quoting 42 to 42.25 cents per pound, and by early January 1969, the quotation was raised to 44 cents. On May 9, principal producers were quoting 46 cents per pound and advanced to a range of 48 to 48.25 cents per pound in August 1969 and again in early September to a range of 52 to 52.25 cents per pound.

Small price differentials from the electrolytic wirebar quotation exist for special refinery products such as a discount for cathode copper and a premium for silver bearing copper.

Figure 3 reflects average weighted prices of copper deliveries in the United States at constant 1968 dollars. To meet increasing demand and cost projected for the future, it is estimated that copper will be 75 cents per pound in constant 1968 dollars by the year 2000. Higher cost will be associated with (1) deeper mines; (2) lower grade ores; and (3) higher cost of capital investment, labor, and supplies.

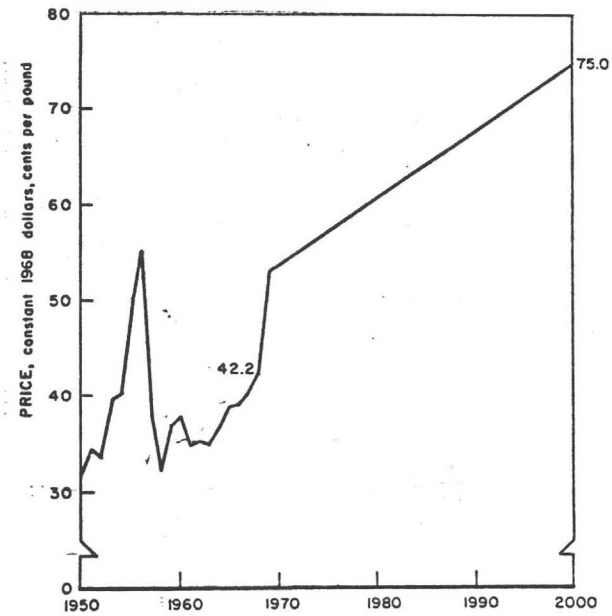


FIGURE 3.—Time-Price Relationship for Copper.

Domestic mine production (1,205,000 tons) and total primary demand (1,540,000 tons) in 1968 were valued at $1,017.0 and $1,299.8 million, respectively.

Little information is available on operational or overall costs per unit of production or of final product for mining, milling, smelting, refining, or marketing. Cost of producing copper varies widely from country to country and from mine to mine. Variable credits for associated metals or other joint products tend to complicate the significance of a calculated average cost per pound of metal.

One of the most significant factors affecting copper production cost has been the gradual and persistent decline in grade of ore. The average recoverable copper content of domestic copper ores fell to an alltime low of 0.60 percent in 1968—a drop of 18 percent in the average grade since 1964. Coming on stream within the next 3 to 5 years are two Canadian operations that will produce copper from deposits reported to average less than 0.5 percent copper.

The steadily declining grade of copper ores and the increase in demand for copper have forced the mining, handling, and treating of proportionally greater quantities of material. About 95 percent of the total material treated at the open pit mine operations is discarded as waste; also, the waste to ore ratio is generally more than 1 to 1 so that the tonnage of final waste products is substantially higher than the ore treated.

Employment and Productivity

The working force of the copper industry engaged in mining and beneficiating ores, smelting concentrates, and refining copper has remained relatively steady since World War II, averaging approximately 33,000 men and ranging from a low of 29,000 in 1949 to a high of 37,000 in 1956. The average number of men employed in 1968 was 33,000 with approximately 22,200 at mines and mills and 10,800 at smelters and refineries.

Over the last 50 years the annual rate of domestic mine production of copper has more than doubled and the ore tonnage mined per year increased almost fourfold, while man-hours assigned to copper mining have declined by two-thirds. In 1968, it required 1 man-hour to produce 4.8 tons of ore containing 70.0 pounds of copper. The rise in productivity is due to the greater proportion of copper ore mined by open pit and to highly productive, large-scale underground methods plus technological advances in mining processes and equipment.

closure of smelters began granting licenses for export of copper concentrate, precipitate or black copper that could not be processed domestically. This order was rescinded on April 15, 1968.

With the resumption of operations by the copper industry after settlement of the strike, set-asides by producers and export controls again became effective. From January to June 1969, the Office of Export Control considered applications for licenses covering exports of copper and related commodities.

No orders were issued during 1968 for the release of copper from the Government stockpile. On orders issued in previous years, 120,000 tons was authorized in 1965 followed by 400,000 tons in 1966 and by 150,000 tons in 1967. These withdrawals and another 47,000 tons earmarked for coinage purposes reduced the copper stockpile to 260,000 tons on December 31, 1968; this is below the established objective for conventional war, but above that for nuclear war.

Strategic Considerations

Prior to 1940 the United States was a net exporter of copper. Since then a substantial portion of the U.S. copper supply has been imported. During the period 1964–68, domestic mines supplied 38 percent of the total domestic supply, secondary copper 39 percent, and stockpile disposals 4 percent. Foreign ores for domestic smelting and refining contributed 11 percent and imports of refined copper 8 percent. It is expected that the United States will continue to rely on foreign sources, most of which are Western Hemisphere countries, for a part of its supply. From 1964–68, Chile supplied 34 percent of the total imports, and Canada and Peru each furnished 20 percent.

ENVIRONMENTAL CONSIDERATIONS

The domestic copper industry faces localized land-use conflicts because a large percentage of copper will continue to be produced by surface mining. In addition, large quantities of solid waste material are generated in mining, concentrating, and smelting copper ore. Careful planning by copper producers has largely solved objections to surface disturbance and waste storage problems.

Discharge of obnoxious gases and fumes from smelters is a problem that will require increasing attention. Employment of high stacks to disperse the pollutants will undoubtedly need to be supplemented by adoption of practices to remove the objectional substances. An alternative solution is the more revolutionary change to a hydrometallurgical extractive process replacing the conventional pyrometallurgical method.

With population and industry expansions, conflicts for sufficient water to process large increases of ore can be anticipated in the Western part of the United States where much of the production will be obtained.

OUTLOOK

DEMAND

A forecast of total U.S. demand for copper in the year 2000 was derived by making contingency forecasts of copper end uses, using as a starting point the estimated 1968 consumption. In order to obtain a forecast base selected economic indicators were applied to the quantity of copper consumed in each end use in 1968. Indicators used were electrical energy, gross national product (GNP), new construction, and total population. In each end use category the indicator selected was based on judgment. Once the forecast base for year 2000 was obtained, then contingency factors likely to influence future consumption were applied. The result is a range of possible demand for each end use. The aggregation of the interval ranges calculated for each end use is used to establish the total forecast range for copper.

In the following tabulation U.S. demand for primary copper and primary refined copper as well as the total adjusted demand are shown.

	Forecast range of demand for copper (million short tons)	
	1968	2000
United States:		
Total—		
High	2.81	14.35
Low		8.95
(Median)	....	(11.65)
Refined copper—		
High	1.96	10.01
Low		6.24
(Median)	....	(8.13)
Primary refined—		
High	1.54	7.86
Low		4.90
(Median)	....	(6.38)
Rest of the world:		
High	5.75	34.9
Low		16.8
(Median)	....	(25.9)

The unadjusted range of demand for the year 2000 ranges from 7.6 million to a high of 15.7 million tons. The probability of all the highs or all the lows occurring is minimal, so an adjustment was made to decrease the range to two standard deviations about the mean of 11.65 million tons. The final adjusted domestic de-

TABLE 1.—Contingency forecasts of demand for copper by end use, year 2000
(Million short tons)

End use	Demand 1968	U.S. forecast base 2000	Demand in year 2000: United States Low	United States High	Rest of the world Low	Rest of the world High
Electrical equipment and supplies	1.38	8.75	4.60	9.90	NA	NA
Construction	.45	1.80	1.00	2.00	NA	NA
Industrial machinery, except electrical	.28	1.00	.80	1.20	NA	NA
Transportation	.33	1.15	.60	1.40	NA	NA
Ordnance	.17	.28	.10	.40	NA	NA
Other uses	.20	.70	.50	.80	NA	NA
Total	2.81	...	7.60	15.70	16.8	34.9
Adjusted range	...	...	8.95 (Median	14.35 11.65)	... (Median	... 25.9)

NA Not available.

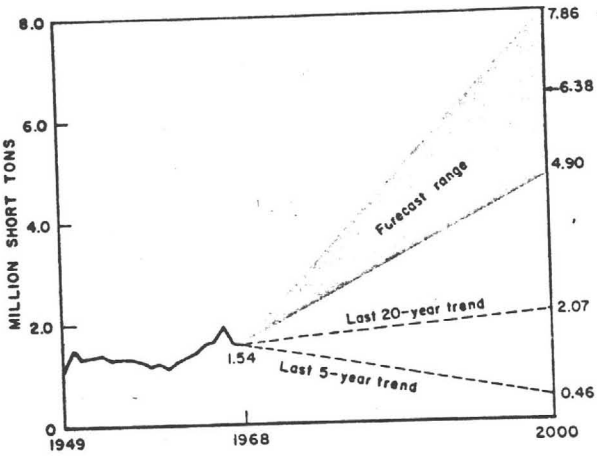


FIGURE 4.—Comparison of Trend Projections and Forecasts for Primary Refined Copper Demand.

mand range forecast for the year 2000 is 8.95 to 14.35 million tons (table 1). This corresponds to average annual growth rates for 1968–2000 ranging from 3.7 to 5.2 percent.

In 1968 primary refined copper accounted for 55 percent of the total demand. In forecasting the demand for the future it is assumed that primary refined copper, both domestic and imported, will continue to supply 55 percent of the demand. Figure 4 shows the forecast range of domestic demand for primary copper in the year 2000 to be 4.90 million to 7.86 million tons. In addition to the forecast range, straight-line projections in figure 4 of U.S. primary refined demand, based on 1964–68, show a demand of 0.46 million tons in 2000. A similar projection based on the past 20 years gives a primary refined demand of 2.07 million tons. The 1964–68 projection that shows the demand in 2000 to be only one-third of that in 1968 reflects the drastic effects of the strike in 1967 and 1968. The 20-year projection is less than 50 percent of the low of the forecast range. The high of the forecast range is nearly five times the 1968 demand while the low of the range is nearly three times the 1968 demand.

Rest-of-the-world total copper demand in year 2000 is forecast to range from a low of 16.8 million tons to a high of 34.9 million tons. This corresponds to an annual growth rate of 3.4 percent to 5.8 percent. While demand in developing countries may be expected to increase at rates similar to the growth in U.S. demand, the potential for sharp increases in copper demand is considerably greater as energy, transportation, communication, and building expansion programs develop. Since these uses are large consumers of copper, the net result is that the rest-of-the-world demand is forecast to grow at a somewhat higher rate than the U.S. demand. The growth rates determined for rest of the world are a composite based on U.S. forecast growth and a weighted estimate for growth in developing countries.

The following paragraphs present the assumptions and contingencies leading to the calculation of the forecast range of demand for copper in 2000 by major end uses:

Electrical Equipment and Supplies

This category includes electrical apparatus (motors, generators, dynamotors, and industrial controls); electrical transmission, distribution equipment, lighting and wiring equipment; communications including electronics; and household appliances (knives, hair dryers, toasters, etc.). The forecast base of 8.75 million tons in 2000 was obtained by applying certain economic indicators to an estimated breakdown of each sector in this end use. The annual growth rate forecast for electrical energy, 6 percent, was applied to the electrical apparatus and electrical transmission sectors while GNP, 4 percent, was applied to communications and household appliances. The demands of a growing and more affluent society for increased equipment providing necessities, safety, comfort, and relaxation; continued rapid growth of industrial computer usage; and an increase in appliances could lead to a high forecast demand of 9.90 million tons of copper in the year 2000. A number of contingencies could reduce demand for copper to a low of 4.60 million tons, 47 percent below the forecast base. These include substitution of aluminum for copper, use of fuel cells or nuclear power generation instead of generators; successful development of alternative methods of transmitting power such as sodium conductors; use of satellites for national and international communications and microminiaturization of communication circuitry. The possibility of multipurpose housing units becoming popular also would contribute to lower demand for copper.

Construction

Approximately 20 percent of the copper used in the United States is consumed by the construction industries. This category includes building construction, roofing, and brass and bronze for decorative and utilitarian items for public buildings and private homes. In 1968, an estimated 450,000 tons of copper was consumed in this end use. A forecast base for the year 2000 was obtained by relating the growth in copper consumption to the forecast growth in new construction, 4.5 percent annually. Thus, the high of the range, 2 million tons, could be obtained as a result of new construction requirements. Use of substitutes such as plastics, aluminum, and clad metals, glass, wood, paper, or other materials may reduce the demand for copper to the forecast low of 1 million tons, 45 percent below the forecast base.

Industrial Machinery, Except Electrical

This group includes household and commercial air conditioning, farm machinery, and as components in sea water desalination distillation plants, and in pollution control equipment. Copper and its alloys accounted for 280,000 tons of the total copper consumed in 1968. Projection at a growth rate of 4 percent per year, the growth anticipated for GNP, gives a forecast base of 1 million tons in 2000. A forecast high of 1.2 million tons would result from a rapid growth in air conditioning and increased demand for large machinery and equipment, turbines, and heat exchangers. The forecast low of 800,000 tons would occur if manufacturers design away from copper for technical or economic reasons. Fluidics, the use of devices containing no moving parts and using a fluid medium for control of other devices, may replace some electronic devices.

Transportation

The third largest use of copper is in the transportation industry where it is used in numerous applications by the automobile industry, in railroad transportation, airplane manufacture, and in marine applications. In this end use category, the forecast base is obtained by extending the 1968 demand of 330,000 tons at the same rate as that estimated for GNP, 4 percent annually. This results in a forecast base of 1.15 million tons in 2000. The high of the range, 1.40 million tons, would result through increased number of cars per family, greater leisure time, use of cars and boats for recreation, and installation of rapid transit systems for major cities.

On the other hand, the exclusion of automobiles for metropolitan commuting as an antipollution measure, and loss of markets to aluminum and plastics could reduce demand to a forecast low of 600,000 tons in 2000.

Ordnance

World political instability requiring continuing expenditures for arms coupled with arms exports to allied countries could create a demand for copper in ordnance applications of about 0.4 million tons. This quantity is 43 percent above the forecast base of 0.28 million tons, obtained by projecting the 1968 consumption to the year 2000 at the total population growth rate of 1.6 percent. Conversely, if universal disarmament were achieved, the demand for copper for this end use could reach a low of 0.1 million tons or 65 percent below the forecast base.

Other Uses, Including Chemical, Pigment, Jewelry, and Coinage

The 1968 estimated demand of 200,000 tons of copper for these and other miscellaneous end uses was related to the GNP growth rate of 4 percent annually to obtain a forecast base in year 2000 of 700,000 tons. Continued research may result in greater requirements for copper chemicals and inorganic pigments, and new copper alloys may produce jewelry of a color and quality that will create a sustained market for these uses. Copper in coinage has extended the field of copper's usefulness and the technique of laminating or cladding copper with other materials may result in its use in diverse applications. Copper as a trace element is required to sustain the life of plants, animals, and humans. A demand created by these possibilities could reach a forecast high of about 0.8 million tons or 14 percent above the forecast base. Conversely, substitutes could reduce demand for copper. The use of credit cards in place of coinage could lessen the demand in coinage. By the year 2000 demand for copper could reach a low of 0.5 million tons, nearly 30 percent below the forecast base of 0.7 million tons.

SUPPLY

U.S. resources of copper are estimated at about 140 million tons, of which about 85.5 million tons are considered as reserves economically minable at the 1968 price of 42 cents or less per pound. Potential resources contain nearly 65 million additional tons of copper.

Domestic mine production of copper based on the past 20-year trend would total 2 million tons in the year 2000 (fig. 5), compared with 1.21 million tons in 1968. If domestic primary production in 2000 accounts for the same proportion of primary refined in demand in 2000 as in 1968, then the high production would be 6.15 million tons and the low production 3.83 million tons. These projections fall short of both the high and low forecast demands of 7.86 million tons and 4.90 million tons, respectively (fig. 4).

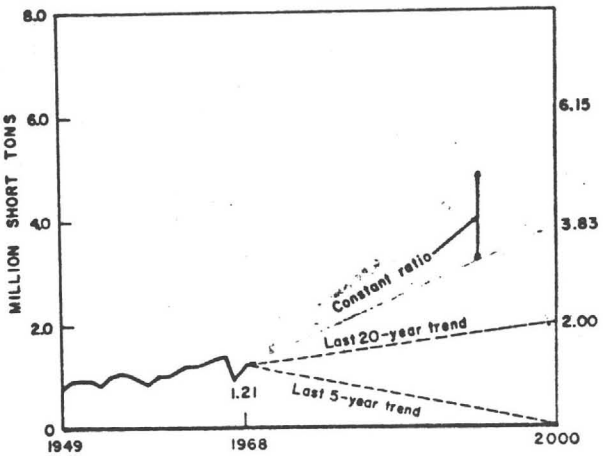


FIGURE 5.—Comparison of Trend Projections and Forecasts for Primary Refined Copper Production.

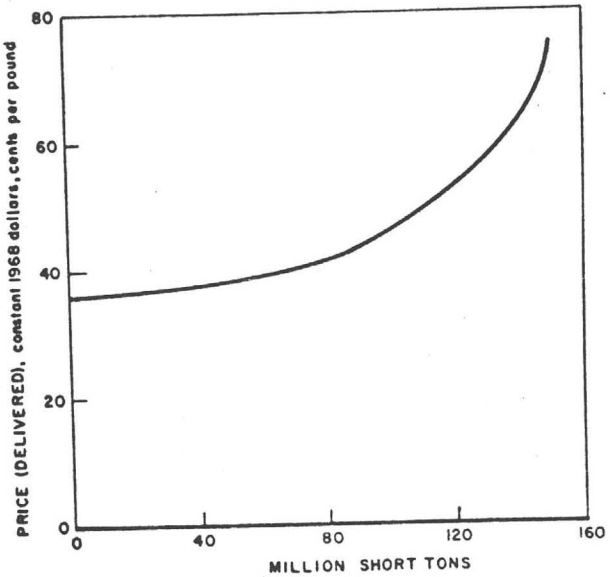


FIGURE 6.—Projected Domestic Availability of Copper.

The copper reserve in the rest of the world is estimated at 222.4 million tons of copper at the 1968 world price of 56 cents per pound.

POSSIBLE ADVANCES IN TECHNOLOGY

There is a high probability that research on production and extractive processes as well as investigations of potential resources will provide the necessary improvements in technology to maintain adequate supplies of copper at reasonable costs. Improved beneficiation methods will lead to increased copper recovery to help offset the persistent decline in grade of ore and prevent continuing and substantial losses of copper. Methods will be developed for handling the huge and growing quantities of waste materials generated in copper mining and processing that will minimize air, land, and water pollution and at the same time recover the large quantities of copper currently being discarded in the waste materials.

Problems resulting from atmospheric pollution by smelter operations will be solved by development of economical methods for recovering sulfur during smelting of copper ore and concentrate. Some of the solid waste disposal problems will be solved by development of effective and efficient methods for the salvaging of copper from automotive scrap thereby increasing copper available for recycling and also improving the quality of ferrous scrap for recycling.

Low-cost methods, possibly nuclear, for shattering large, low-grade deposits of oxidized copper minerals for recovery of copper by in-place leaching and improved methods of recovering copper from leach solutions will lower the cost of producing primary copper.

FUTURE SUPPLY-DEMAND RELATIONSHIPS

Based on the contingency forecast of U.S. demand for copper in the year 2000 (forecast tabulation), a cumulative demand was derived for primary refined copper for the period 1968–2000. Under the assumptions, cumulative demand for the United States for the high range forecast is 128.2 million tons of primary refined copper and for the low range 96.4 million tons. If U.S. mines contribute the same ratio of copper for 1968–2000 as in 1968 (constant ratio basis), then 100.3 million tons for the high of the range must come from primary domestic sources, and for the low of the range 75.4 million tons must be obtained from U.S. mines. The domestic supply of 85.5 million tons at the 1968 price of 42 cents per pound is sufficient to meet the low of the demand. However, the high range of the forecast demand could only be met from higher priced domestic output or increased imports above the constant ratio level (fig. 6).

U.S. requirements for copper are dependent on assurance of foreign supplies at reasonable prices. Therefore an assessment of the rest of the world is essential for determining possible availability to the United States. Cumulative rest-of-the-world total demand for 1968–2000 is forecast to range between 340.6 million and 538.0 million tons. It is estimated that about 75 percent of the total demand in the rest of the world is primary refined copper. Under this assumption, cumulative rest-of-the-world demand for primary refined copper for 1968–2000 totals 403.5 million tons for the high range and 255.5 million tons for the low range.

To meet the cumulative demand for primary

refined copper in the rest of the world, there is an estimated supply of 222.4 million tons available at a price of 56 cents per pound in 1968 dollars. The shortfall of 33.1 million tons of copper on the low side and 181.1 million tons on the high side indicate that available supply from the rest of the world is insufficient to provide the domestic industry with sufficient quantities of copper to meet U.S. needs even if domestic production could be expanded to meet the cumulative constant ratio of domestic production (100.3 million tons). This will bring about technical and economic reactions to maintain world supply. These would include the discovery and development of new supply at higher prices, and the development of new techniques whereby copper would be economically recovered from presently submarginal resources.

Under present technology it is estimated that a price of 75 cents per pound would be required to enable development of lower grade domestic resources to provide sufficient copper to meet the constant ratio production. At this higher price level, rest-of-the-world supply would be available to fill the gap of 28 million tons to meet the high range of forecast demand of 128 million tons.

Another reaction, partly a result of the price rise, would be displacement of copper from some of its traditional uses by aluminum and plastics. Especially vulnerable applications would include wiring and low voltage power transmission applications where copper would be displaced by aluminum and also plumbing and other uses requiring corrosion resistance which could be replaced by plastics and other metals.

Estimated value of domestic primary copper production and demand in 1968 and for the forecast range in 2000 in million constant 1968 dollars is as follows:

	1968	2000	
		High	Low
Demand	1,299.8	11,790.0	7,350.0
Production, constant ratio	1,017.0	9,225.0	5,745.0

PROBLEMS

The copper industry is confronted with technical and economic problems related to all segments of the industry. A fundamental problem of the industry is the assurance of a continuing supply which entails finding and developing new resources. Exploration is uncertain and costly and large ore bodies are required to warrant the large capital investment required. Worldwide aspects of the supply problem relate to political and social instability in some major copper producing areas which tend to discourage exploration and development. The general geographic separation of the producing and consuming areas of the world also tends to create marketing problems and trade restrictions. However, maintaining an adequate domestic supply is essential to offset drains of an expanding economy or interruption of foreign supplies by adverse events.

A pressing problem of the copper industry is related to rising costs and a declining grade of ore which has dropped from an average of 0.73 percent copper in 1964 to 0.60 percent in 1968. Reduction of the average copper tenor reflects the increased reliance on copper output from the porphyry deposits employing surface methods of the Southwest, currently accounting for more than 90 percent of the U.S. mine output. As reserves are depleted, the waste to ore ratios for surface mining can be expected to increase to an uneconomical level and the deeper deposits minable only by underground methods will have to be developed to meet supply requirements.

Underground mining has a major problem in ground control at porphyry copper mines of the Southwest employing block caving and at the room and pillar sedimentary deposits in Michigan. Uncontrolled caving results in ore dilution and loss of reserves and merits continued research in mining methods. The enormous material-handling required in copper mining requires constant improvement in methods and equipment.

Conflicts are inherent in the emerging programs designed to protect natural endowments, to improve the Nation's environment, and to insure the welfare of its growing population. Specifically, the Wilderness program designed to conserve essential land and water resources will increase confrontations with the industry and will present increasingly difficult problems of reconciliation. It is essential in the public interest that such issues be equitably resolved; the subject deserves the highest order of priority. Approximately 1 ton of makeup water is required per ton of copper ore processed in the concentrator and with population and industry expansion, conflicts for sufficient water to process increasing amounts of ore can be anticipated in the Western States where much of the production is obtained.

The supply of a host of byproducts and coproducts depends upon the rate of copper mining, processing, and refining. Any innovation or technologic improvement that affects the recovery or use of the coproducts improves the overall

economics of copper production, coincidental to the direct benefits to the coproduct, and thus merits attention.

Much of the substitution of aluminum for copper stemmed not only from competitive or technological causes, but also from the availability and aggressive marketing ability of the two industries. While substitution is expected to continue, copper may be less vulnerable today than prior to formation of national and international producer-sponsored development and research-oriented associations about a decade ago.

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Prime Copper Resources

United States: The known copper reserves, as of 1968, within the continental boundries of the United States, have been computed to be 85.5 million tons, producible at the 1968 price of 42 cents per pound with costs based on 1968 costs. The believed potential reserves producible at 75 cents per pound, based on 1968 costs, are estimated at 65.5 million tons. The total reserves at 151 million tons.

Rest of the world: The total known and potential copper reserves have been estimated at 222.4 million tons.

Prime Copper Demands

United States: (the figures used are based on the production and consumption of prime copper in the United States during the period of 1964 through 1968 and using an annual growth rate of 4%).

The average annual demand for prime copper between the years of 1968 and 2000 has been computed at 3.5 million tons. The median consumption of prime copper for this period will be 112.3 million tons.

It can be concluded that by the year 2001 the U.S. copper reserves will have been depleted down to 39.7 million tons and that by the year 2012 they will have been completely depleted.

In conclusion it can be assumed that, in normal times, the yearly demand for prime copper in the United States will exceed, by far, the yearly production of prime copper in the United States. The control, therefore, of adequate supplies of copper for United States industries will again rest with those who control the secondary copper in the United States. They will also control the price of copper.

John Foley

ESSEX WIRE

President Bowman reviewed several important additional transactions already negotiated. He said an option contract agreement with Essex International (wire) had been signed for Banner's two square miles of drilled copper claims in Greenlee county, Ariz., that are reached via the village of Morenci. Essex is a manufacturer of copper wire and plans to protect itself against lower supplies of copper in the future.

—MAY 29, 1971—SKILLINGS' MINING REVIEW

Mining Engineers' Reports
on
New Arcadian Mine and New Baltic Mine

Both owned by
Arcadian Mines, Inc.

NOTES ON THE MICHIGAN COPPER COUNTRY GEOLOGY

The structure of the Keweenawan lavas and sediments is analogous to that of the Lake Superior ice fields as blown toward and against the shore in the spring. This can be seen and has been studied and photographed in Keweenaw County.

The ice close to shore bulges up slightly and then is thrust under the block that has stopped against the shore. This is repeated many times resulting in "windrows" of ice blocks, some quite long but only a few feet wide and two or three feet thick piled against the shore, with all, or most of the blocks dipping away from the thrusting force of the wind blown ice field moving shoreward.

These long "fault blocks" of ice are intersected at intervals by cross breaks where different parts of the block encountered varying resistance. These cross breaks are analogous to the "spar crossings" and fissure veins in the Keweenawan traps.

If the thickness of ice on Lake Superior were measured in the way that the geologists have "measured" the thickness of the Keweenawan lavas and sediments, they would have arrived at a figure of 30 or 40 feet for the ice thickness, instead of the true figure of two or three feet.

Repetitious The Keweenawan lava flows are generally parallel to the numerous thrust faults for many thousand feet, though the faults eventually pass into the foot at depth and also going northward from Portage Lake.

A great many of these thrust faults were discovered when the Michigan Geological Survey did extensive detailed mapping with the added aid of dip needles in the late 1920's and early 30's. Previously few were know except where they broke through the traps at a locally more abrupt angle where they were apt to be mistaken for cross faults.

The copper and silver mineralization came UP along some of these faults and along some porous zones such as sandstone, conglomerate and amygdaloidal portions of some traps, especially where the tops of the traps were somewhat brecciated.

The "spar crossings" have been said to "rob the lode", which is true to the extent that some of the mineralization of that lode escaped to and may have enriched one or more of the lodes in the hanging.

In an amygdaloidal lode the "spar crossing", such as near # 6 Quincy shaft, is apt to have much laumontite, calcite and quartz and little else. The laumontite was called "poor spar" by the Quincy miners as it was seldom associated with copper. If followed into the hanging trap its character may be found to change abruptly within a few feet, there the "spar crossing" is a "fissure vein" often with abundant prehnite, often with datolite, analcite, natrolite and other minerals not commonly found in the lode. Also considerable copper and silver may be encountered. The motion along the "spar crossing" near # 6 Quincy has been almost directly up the dip. One side having gone up a measured 4200 feet, and probably much more, than the other side.

No lode will hold its richness for more than a few thousand feet, although it may be again enriched by other mineralizing faults farther on The Champion Copper Co.(Copper Range) wanted the Atlantic lode located at depth near Wheal Kate bluff. This was done although the Company was advised that there was little likelyhood of that lode being commercial there, because of unfavorable relations to mineralizing channels. The lode was drilled and identified at almost the precise predicted location and, as expected proved worthless.

The copper is especially rich below a constriction in an amygdaloidal lode, or below where the dip is locally flattened or beneath a dike that cuts the lode. The silver favors the hanging side of a lode and with close, parallel lodes, it favors the hanging one.

L. A. Seaman
7/24/1970

7

Received Aug 24, 1970 JF

314 Violetas,
Colonia de la Reforma,
Oaxaca de Juárez,
Oaxaca, México.
August 19, 1970.

Mr. Jack Foley,
Copper Industries Development,
Dollar Bay, Michigan 49922.

Dear Jack:

Sorry that your telephone call last week didn't get to me, but I have no phone, not hearing well enough to be able to use one. As to communication by telegraph--I'd rather NOT, as I have received too many telegrams so badly garbled that I didn't know wat they were trying to say.

If any cross-cutting was done at the Quincy "into an underlaying conglomerate vein in 1944 or 1945" it was done after my mapping there and I have no knowledge of it. However, the "underlaying conglomerate", the # 15 or the "Boston and Albion" conglomerate WAS cut previously and a small amount of stoping was done but it was discouraging lean. The same conglomerate was mined rather extensively in the Franklin Jr. mine, farther northward--near or at Boston location. It was not rich and for the most part, I believe, was not commercial. That same conglomerate was still richer and presumably profitable much farther north at the Allouez mine where it was known as the "Allouez conglomerate". There may be a profitable stretch of it between Boston and Calumet, but the richer mineralization seems to have passed into the foot, as is the usual condition going northward, with the underlying "# 13" or Calumet conglomerate and the Kearsarge lodes still farther in the foot being the richer.

The # 15(Boston and Albany or Allouez) conglomerate had a small stope on in near # 6 Quincy shaft, several thousand feet from surface. I have seen it there, and while it showed appreciable copper it wasn't commercial.

If any Company takes over the Quincy properties, they should, of course, also take in the Arcadian lands as the Arcadian seems to have the greatest area of poorly explored lands in the area north of Portage Lake. They seemed to have been looking for the "Isle Royal" or the "Baltic" lode instead of exploring to see what they actually had between those horizons and the Quincy area.

I couldn't accept any general consulting job with any mining company up north as I know from experience that you can't supervise mining nor exploration work from a distance. BUT I will be glad to offer whatever help I may at any time, so don't hesitate to call upon me.

The best means of communication between us is probably Air Mail, which takes about a week, round trip. Hope to hear from you again soon.

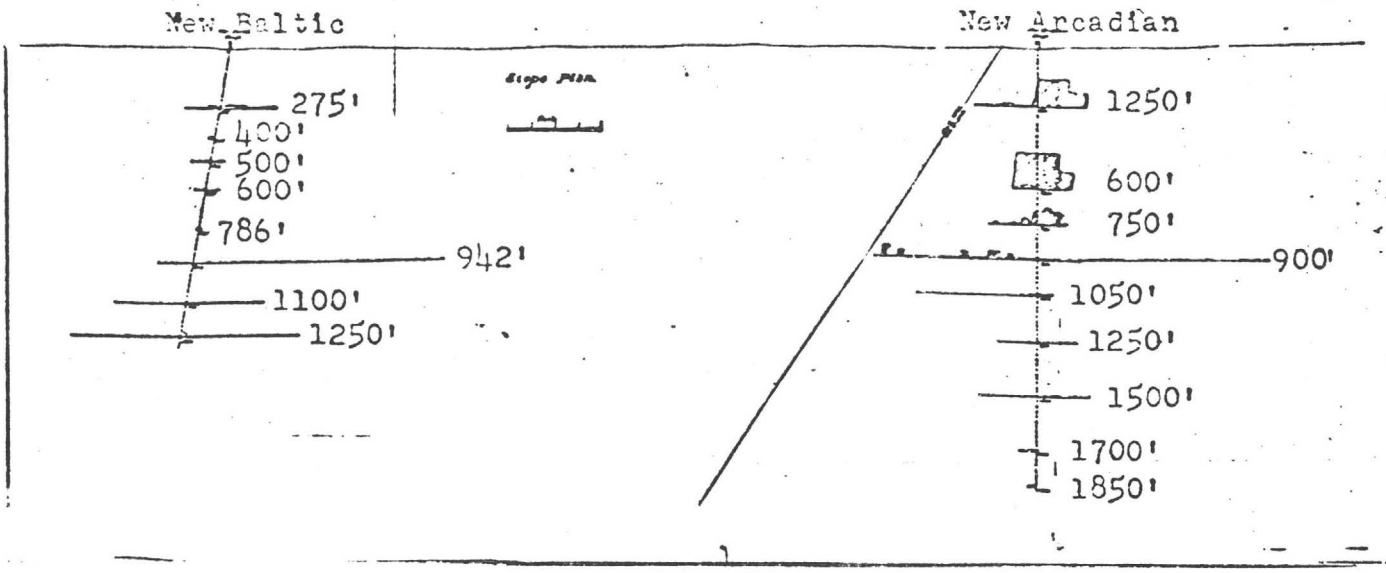
Give my regards to Ed Davis.

Sincerely,

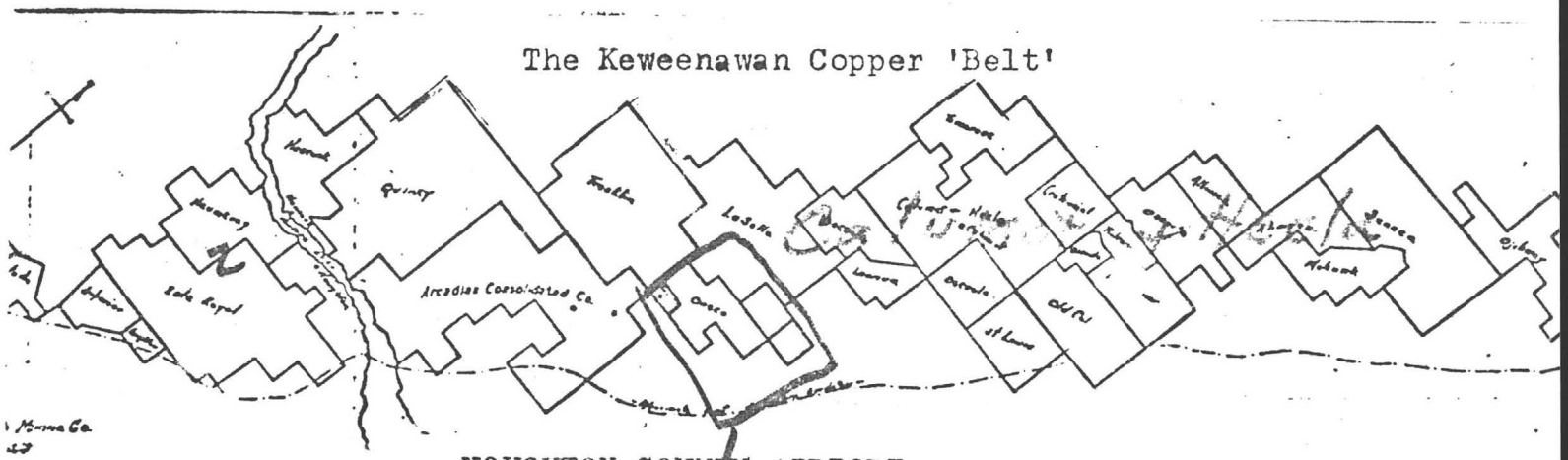
W A Seaman

W.A.Seaman.

In the"NEW ARCADIAN" mining area



The Keweenawan Copper 'Belt'



HOUGHTON COUNTY AIRPORT

This drawing shows the continuity of Michigan's KEWEENAWAN copper lodes. The Copper Range Co. mines ,if shown,would be to the left as would the mine in Ontonogan County. The general direction of the lodes is Southwest to North

Michigan Geological & Biological Survey

1914

In the Michigan Geological and Biological Survey of 1914, mining engineer, Herman Fesing reports that the New Baltic Shaft can be sunk of 3700 feet without tossing the boundry line of its neighbor, Franklin Junior. This statement, however, does not "rule out" a subshaft sunk from some point easterly of the shaft on the 37th level which would add another 5000 feet to the depth making a total of 8700 feet before reaching the Franklin Junior property line. The mineral rights of the Franklin Junior are now owned by the State of Michigan and, we believe, can be acquired by a financially sound company seeking them for mining purposes by that company in conjunction with the mining of the Arcadian lode of Arcadian Mines, Inc.

The Arcadian lode underlies the lodes formerly mined by Franklin Junior. Only God knows what copper and/or silver is down there.

New Arcadian Copper Company.

Mine location: East of Quincy mine, Houghton county.
General Manager: Robert H. Shields.

Although the operations during 1914 were greatly curtailed by the war, the development work [illegible] good results.

The work during the year was confined to the development of the New Arcadian lode and consisted of sinking the shaft to the 900 foot level, crosscutting east to expose the lode on two levels, drifting on the lode at four levels and extending a crosscut east beyond the lode at the 900 foot level.

Engineer Fesing states that the showing of the lode on the 900 foot level will compare favorably with any amygdaloid in the district. A number of good looking amygdaloids were found in the east crosscut. Stoping was done on the various levels and a stock-pile of about 2,500 tons has been accumulated. Arrangements have been made with the Franklin Mining Company for a mill test of this rock and the first shipment to the Franklin mill will be made early in May, 1915.

New Baltic Copper Company.

Location of property: East of Franklin mine, Houghton county.
General Manager: Robert H. Shields.

No active mining operations was carried on during the year 1914 because of the unfavorable industrial conditions and in order to await the results of the development work on the adjoining New Arcadian property.

The very favorable results of the development work at the new Arcadian have a most important bearing on the New Baltic. All the north openings on the New Arcadian are in good copper ground and the drift on the 250 foot level is now less than 200 feet from the boundary between the two properties. Engineer Fesing states that the New Arcadian lode traverses the New Baltic property with a workable length of about 4,000 feet and that it could be worked to a depth of about 3,700 feet at its deepest portion. This would give the New Baltic approximately 170 acres on the lode and about 5,000,000 tons of recoverable rock.

The management intends to expose the New Arcadian lode from the surface at different points by means of pits and cross-trenches as soon as weather conditions will permit in 1915.

Franklin Mining Company.

Mine location: Demmon, Houghton county.
Superintendent: Enoch Henderson

The only production during the year 1914 came from the test stamping of 7,324 tons of rock taken from the new openings on the Allouez conglomerate at the 32d level. President Edwards states that the results of this test, taken in connection with the general appearance of the openings since made, warrant the belief that the lode can be mined at a profit. Regular production will probably begin about the middle of May, 1915.

A small compressor was installed in No. 1 shaft-house and other changes made to permit the economical operation of a number of drills. One drill was put into operation the latter part of January in the foot wall cross-cut on the 32d level. Other drills were added until six were in operation. The crosscut on the 32d level was advanced 927 feet easterly to the first amygdaloid under the Houghton conglomerate. Besides the Allouez conglomerate and the Houghton conglomerate, six amygdaloid beds were cut in this crosscut. Superintendent Henderson states that three of these amygdaloids were barren, two carried copper in small quantities and one showed mineral and vein matter worthy of further development. The Calumet & Hecla conglomerate should be reached in April, 1915.

Drifting on the Allouez conglomerate at the 32d level was begun about the middle of March. A great deal of interest was shown in the openings in the Allouez conglomerate which were made for the purpose of determining the value of the lode as a whole, without selection in mining or discard from the rock broken. The drifts were cut as wide as the hanging would permit and for the first four mill-runs, all rock broken was sent to the mill. A small quantity of rock was discarded in the rock-house from the last mill-run. Superintendent Henderson reports the results of stamping as follows:

	Tons rock.	Pounds dry mineral.	Assay.	Pounds copper.	Pounds copper per ton.
April 5, 1914	906	26,220	58.35	15,300	16.89
April 25, 1914	538	14,340	55.77	7,072	13.14
May 10, 1914	1,138	22,592	54.38	12,285	10.79
June 9, 1914	2,195	48,985	46.90	22,976	10.46
August 26, 1914	2,547	63,807	55.87	35,650	14.00
	7,324	175,944	.....	93,283	12.73

Tailings averaged six pounds per ton.

Professional Paper - 144

U.S. Geological Survey

Copied From

Professional Paper 144

U.S. Geological Survey

Department of the Interior

Entitled "THE COPPER DEPOSITS OF MICHIGAN"

Arcadian Lode

The Arcadian lode (pl. 42) was first opened by the Arcadian and Concord companies, which produced a small amount of copper. The most extensive developments were made by the Arcadian Copper Company within a period of a few years, beginning about 1898. The lode was opened for about 8,000 feet along the strike by five shafts. North and south of this developed area are shallow shafts. The principal shafts from north and south are No. 4, opened to the sixth level; No. 3, to the seventh level; No. 2, to the eighth level; No. 1, to the fifth level; and shaft A, to the ninth level. The most extensive stoping was done from No. 2 shaft, near the center of the developed area, and from shaft A, at the south end of the developed area. From 1899 to 1902 the Arcadian Copper Company produced 2,950,000 pounds of copper. There is no available record of the grade of the ore, but it was not sufficiently high to justify continued mining of the lode.

The Arcadian lode is a few hundred feet above No. 8 conglomerate and is believed to be the northward extension of the Isle Royale ("Grand Portage") lode. It was said to average about 13 feet in thickness. The material on the dump indicates that the lode is well oxidized, and that, like the Isle Royale, it is strongly fragmental. The mineralization appears to be in general

similar to that of the Isle Royale, though there is considerable feldspar in the Arcadian lode and little of the sericite that is locally abundant in the Isle Royale lode.

New Arcadian Lode

The New Arcadian lode is a short distance above No. 8 conglomerate and below the Arcadian lode. It has been developed by the Arcadian Consolidated Copper Company through the New Arcadian and New Baltic Shafts. From the New Arcadian Shaft the lode has been opened along the strike for a minimum distance of about 2,500 feet on the 600-foot level, and the shaft goes down to the 1,850-foot level. From the New Baltic Shaft is has been opened for about 1,500 feet along the strike and down to the 1,250-foot level; the most work has been done on the 950-foot, 1,100-foot, and 1,250-foot levels.

The New Arcadian lode is in general of the fragmental type, but stretches of fragmental rock alternate with stretches of cellular rock. The fragmental areas show encouraging mineralization, which is mainly of the quartz-pumpellyite-epidote type with some fairly coarse copper. Areas of cellular amygdaloid in this, as in other lodes, are characterisically poor.

No heavy faulting of the lode has been recognized, but there are some faults of small throw that offset the lode and have caused some difficulty in following it. To the present time (1925) there has been only a little test stopping and no production on a commercial scale. In 1915, according to the annual report of the

company, 3,845 tons of rock yielded 79,209 pounds of copper, or an average of 20.62 pounds to the ton. In 1916, 1,391 tons or rock yielded 32,307 pounds, or 23.23 pounds to the ton. In 1917, 4,900 tons of rock yielded 53,278 pounds, or 10.87 pounds to the ton. The average for the three years was 16.3 pounds to the ton.

13-C

ARCADIAN LODE

Year	Refined Copper (pounds)
1864	4,593
1865	5,816
1879	24,760
1890	34,037
1899	500,000

Year	Refined Copper (pounds)
1900	1,350,000
1901	500,000
1902	600,000
	3,019,205

NEW ARCADIAN LODE

**Year	Rock treated (tons)	Refined Copper (pounds) Total	Per Ton
1915	3,845	79,209	20.62
1916	1,391	32,307	23.23
1917	4,900	53,278	10.87
1918-1925	-----	None	-----
	10,136	164,794	16.26

Total production, 3,184,000 pounds.

CONCORD

In Houghton County. Organized May, 1864. In 1868 Concord and Pewabic consolidated. Concord set off as separate organization in 1879. Absorbed by Arcadian in 1898.

Year	Refined Copper (pounds)
1866	9,980
1867	52,020
1868	171,185
1870	9,815
1871	123,626
1872	143,792
1873	122,169

Year	Refined Copper (pounds)
1874	22,518
1875	440
1876	900,146
1880	10,464
1881	28,849
	1,595,003

DOUGLASS

In Houghton County. Organized January, 1863, and worked until 1868. Sunk four shafts, probably on Arcadian amygdaloid. Later acquired by Arcadian.

Year	Refined Copper (pounds)	Year	Refined Copper (pounds)
1860?	27,240?	1868	50,109
1865	6,809	1877	3,258
1866	16,209		
1867	65,877		169,502

Copper Yield
Per Ton of Rock Milled

Compare the yield of copper per ton of rock shipped to mills from the Arcadian Mines as listed by the U.S. Bureau of Mines in Professional Paper 144 with those, as follows, copied from Steven's Copper Handbook-1908:

Isle Royale Mining Company
Portage Township, Houghton County

"Production of fine copper has been as follows: 2,569,748 lbs. in 1902; 3,134,601 lbs. in 1903; 2,442,905 lbs. in 1904; 2,973,761 lbs. in 1905; 2,937,098 lbs. in 1906; 2,354,198 lbs. in 1907. Yield of fine copper per ton of rockstamped has been remarkably uniform, showing less variation than almost any mine in the Lake Superior district, returner five years, 1903 to 1907 inclusive, ranging from a minimum of 15.2 pounds per ton in 1905 and 1907 to a maximum of 15.4 lbs. in 1904."

In the 1940's, after several years of abandonment, the Isle Royale was re-opened and operated for six years, producing 66 million pounds of copper at more than four cents per pound profit at a market price of 18½ cents per pound.

Quincy Mining Company
Quincy and Franklin Townships
Houghton County, Michigan

"Production of fine copper has been as follows: 18,498,288 lbs.

in 1903; 18,343,160 lbs. in 1904; 18,827,557 lbs. in 1905; 16,195,838 lbs. in 1906; 19,799,973 lbs. in 1907, and to the end of 1907 the mine had produced 390,274,045 lbs. fine copper. Production of 1908 was 20,000,000 lbs. fine copper. The mine makes about 100,000 ozs. silver yearly. The last detailed annual figures for 1905 gave a yield of 15 lbs. fine copper per ton of rock stamped, but returns probably were about 15 lbs. only in 1908."

Up until its last closing in 1945 the Quincy Mines produced 982,584,108 pounds of fine copper, including about 100 million pounds of copper recovered from the tailings from the Mason stamps mills which operated only from 1894 to 1945.

Calumet & Hecla
Osceola Amygdaloid Lode

"In 1906 the company (Calumet & Hecla) produced from Osceola Amygdaloid rock 6,892,458 lbs. fine copper and in 1907 made 11,145,220 lbs. fine copper from 603,891 tons Osceola Amygdaloid stamped rock a yield of 18.45 lbs. fine copper per ton, which was most satisfactory."

The above production figures are for run-of-mine production. They are not the high-grading figures such are used for stock selling. Selective mining can result in fabulous yields, percentage-wise, but [redacted] also in low production and operating profit.

COPPER INDUSTRIES DEVELOPMENT
DOLLAR BAY, MICHIGAN 49922
Tel. (906) 482-2372

BOARD OF CONSULTANTS
F. C. Schwarzenberg—Mining Engineering
William Langdon—Mine Construction
Wyllis A. Seaman—Geology
Raymond Gertz—Metalurgy
Paul D. Kimball—Financing
John Foley—Industrial Development

"COPPER IN 1912"

The following two pages were copied from a bulletin entitled "COPPER IN 1912" which was issued in 1913 by the geological survey division of the United States Department of Interior.

In the years of 1911 and 1912 the copper mining industry of Michigan reached its zeniths in production and profits. The shares in the Calumet & Hecla Mining Company were being sold and bought at prices which reached over ONE THOUSAND DOLLARS per share and the price of shares in other Michigan copper mining companies reached equivalent levels.

It is noteable that the report shows that only five of the twenty mines listed on pages 43 and 44 had yields of more than 1% copper per ton of ore milled and none had yields of more than 1.252%.

The production costs-selling price ratios for those mining companies whose officials were honest enough to reveal their operating costs to their share holders and the general public indicate that the profit margin has not changed much over the years from 1911 through 1970 when domestic prime copper prices reached 60 cents per pound and foreign copper was priced at 80 cents f.o.b. seaport and domestic secondary copper brought 79 cents per pound f.o.b. smelter. If the U.S. Geological Survey analysers are good at their jobs, it seems that copper will be selling at 75 cents per pound within a few years.

Now known methods for mining, milling and smelting Michigan metalic copper give promise of a 98% commercialization of the copper reserves of Arcadian Mines, Inc. and other undeveloped reserves in the same area.

NOTE: The Baltic Mine listed in the following report was not and is not in any way associated with the New Baltic Mine owned by Arcadian Mines, Inc.

When the New Baltic Mine was first opened its promoters believed, or claimed to believe, that their lode was a continuation of the rich Baltic Lode which was about 10 miles south but on the same range. This kind of stock selling is still being used by unscruplous men.

Ideas and opinions expressed in this letter are those of its writer

MICHIGAN

The rock coming from the mines is crushed by steam stamps and concentrated, producing "mineral" containing an average of about 65 per cent copper. In recent years several regrinding plants have been constructed for the finer grinding and concentration of material that had previously been discarded as tailings. The "mineral" is subjected to a combined smelting and refining process. A small amount of "mass" and "barrel work" copper are sorted out at the mine and go direct to the smelter. A portion of the output is refined electrolytically; this consists of copper sufficiently argentiferous to make the recovery of silver profitable, and of copper containing so high a percentage of impurities that further refining is necessary for certain uses. During 1911 slightly over 20 per cent of the output was refined electrolytically.

Silver in important amount is recovered only from the copper treated electrolytically. The average recovery per ton of rock from which the copper was refined electrolytically was approximately 0.211 fine ounce.

In the following table is given the production of individual companies compiled from their annual reports, together with the cost of production and the price received for the copper. The average cost of production for the district was approximately 10.28 cents per pound, and the average price received was 16.44 cents per pound, or an average profit of 6.16 cents per pound.

Production of copper by Michigan mines for 1911 and 1912, in pounds, compiled from the annual reports of the producing companies.[a]

Company.	1911	1912	Cost per pound, 1912.	Price received per pound, 1912.	Profit, 1912.
	Pounds.	*Pounds.*	*Cents.*	*Cents.*	*Cents per pound.*
Ahmeek	15,196,127	16,455,769	7.85	16.56	8.71
Allouez	4,780,494	5,525,455	13.52	16.318	2.798
Baltic	15,370,449	13,373,961	10.94	16.16	5.22
Calumet & Hecla	74,130,977	67,856,429	9.86	16.65	6.79
Centennial	1,493,834	1,742,338	13.46	16.36	2.90
Champion	15,639,426	17,225,508	8.88	16.16	7.28
Franklin	820,203	1,710,651	.....	16.794	.....
Gratiot	14,275	.....	.....	.....	.....
Isle Royale	7,490,120	8,186,957	11.89	16.58	4.69
La Salle	280,598	.....	.....	.....	.....
Mass	1,326,898	2,045,006	.....	17.0205	.....
Mohawk	12,091,056	11,995,598	10.61	16.08	5.47
Osceola	18,388,193	18,413,387	10.36	16.52	6.16
Quincy	22,252,943	20,634,800	.....	16.24	.....
Superior	3,236,233	3,921,974	12.75	16.49	3.74
Tamarack	7,494,077	7,908,745	13.15	16.44	3.29
Trimountain	6,120,417	6,980,713	11.73	16.16	4.43
Victoria	1,303,331	1,224,911	.....	.....	.....
Winona	1,275,675	2,307,237	.....	16.306	.....
Wolverine	9,408,960	8,350,312	8.66	15.89	7.23
Average[b]	.....	.....	10.28	16.443	6.163

[a] Since this table includes mines reporting their output both for the calendar and for the fiscal years, and since some of the companies report the refined copper equivalent of mineral produced and others report refined copper, the amounts do not necessarily agree with the total of either mine or smelter output.

[b] Average includes only mines whose reports are for the calendar year.

The average copper yield per ton of rock milled during 1912 was 19.1 pounds, as compared with 20 for 1911. The average copper recovery from conglomerate rock for 1912 was 27.7 pounds per ton

and for amygdaloid 17.1 pounds per ton. The copper derived from the two types, respectively, was 27.3 and 72.7 per cent.

During 1912 the rock milled amounted to 11,411,941 tons, as compared with 10,978,827 tons for 1911.

The change in grade of ore handled by the Lake companies is shown in the following table. The figures are compiled from the annual reports of the companies.

Tonnage and yield of ore milled by Michigan copper companies in 1911 and 1912, compiled from the annual reports of the producing companies.

Company.	1911		1912	
	Tonnage.	Yield per ton.	Tonnage.	Yield per ton.
		Pounds.		*Pounds.*
Ahmeek	598,549	25.4	652,260	25.2
Allouez	288,610	16.56	333,618	16.56
Baltic	696,795	22.06	652,433	20.50
Calumet & Hecla	2,909,972	25.47	2,806,610	24.18
Centennial	86,543	17.26	106,517	16.36
Champion	734,392	21.30	765,306	22.51
Franklin			176,462	9.80
Gratiot	1,347	10.60		
Isle Royale	457,440	16.4	531,105	15.4
La Salle	18,970	14.77		
Mass	73,475	17.58	132,891	15.39
Mohawk	802,548	15.07	787,941	15.22
Osceola	1,246,596	14.8	1,246,557	14.8
Quincy	1,382,521	16.10	1,309,253	15.76
Superior	162,599	19.90	172,322	22.76
Tamarack	392,338	19.1	421,385	18.8
Trimountain	347,885	17.59	366,663	19.04
Victoria	126,894	10.53	131,955	9.28
Winona	97,445	13.0912	181,148	12.7367
Wolverine	401,308	23.45	388,502	21.49

The district is well located for cheap working of the mines. The Great Lakes furnish cheap transportation for both coal and copper, the Lake transportation being brought into the heart of the district by Portage Lake and the Houghton ship canal. The district is served by the Mineral Range, Copper Range, and Keweenaw Central railroads and is connected with the main lines of traffic by the Chicago, Milwaukee & St. Paul and the South Shore & Atlantic railroads.

MONTANA.

The output of blister copper from Montana in 1912 was 308,770,826 pounds, as compared with 271,814,491 pounds in 1911. The State thus ranks second to Arizona in copper production.

The first record of production of copper from Montana is for 1868, but the State did not become an important contributor of this metal until 1880. Since that time there has been a steady and rapid increase in the copper output. To the close of 1912 the State has yielded 5,907,024,710 pounds, or 33.51 per cent of the total output of the United States since 1845. In total production the State ranks first and in the output for 1912 it ranked second. The Butte district has furnished nearly the entire output.

Three copper-smelting plants were operated in Montana in 1912: The Smelter of the East Butte Mining Co., at Butte, and the smelters of the Anaconda Copper Co., at Anaconda and at Great Falls.

Costs of Re-opening

The New Baltic Shaft

New Baltic Shaft
Re-opening Cost

The following costs are based on those of recent years similar mine re-openings and present day materials and labor costs. Prices for skip rails, accessories and pipe and mine timbers are at "frozen" levels. Hoisting engines, pumps, compressors and small tools are reconditioned used equipment of late year design.

The exploration shaft would accomodate one skip and one ladder. This is permissable for exploration work.

The hoisting engine would permit shaft sinking to 3000 feet. The shaft is now only 1250 feet deep.

The costs for exploration has not been figured, for this could have variable volume depending upon the desire of the explorer. Exploring could consist of shaft sinking, drifting, cross-cutting at several locations in the mine-simultaneously.

The re-opening and conditioning of the shaft could proceed at the rate of 10 feet per 8 hour shift under normal conditions. This means a 125 work day project at one shift per day.

underground labor -- 5 men -- $4.00 per hour -- 125 days. .	$20,000
surface labor -- 5 men -- $3.25 -- 125 days	18,500
supervision @ $50.00 per day	6,250
social security, unemployment, compensation, hospitalization	8,950
	53,700

(brought forward)	53,700
reconditioning supplies (timber, rails, pipe wire, etc.)	65,925
hoisting engine and rope for 3000 feet (reconditioned)	9,800
air compressor (reconditioned)	5,000
pumps (reconditioned)	4,800
surface buildings and facilities (temporary) (est)	25,000
miscellaneous surface equipment (est)	5,000
dewatering mine (4.35 million gallons @25¢ per 1000	1,088
contingency fund	15,000
	$185,313

Note: The electric power consumed in the mine re-opening is not estimatable but it would not exceed $3000.00 including the cost of bringing in the power line.

Note: Under a Federal Government job creation program, one half of the hourly wage cost would be picked up by the Michigan Employment Security Commission's local office.

WYLLIS A. SEAMAN:

Wyllis Seaman graduated from the Michigan College of Mines in 1907. The college was then the leading mining school of the world and was located in Houghton County-the center of Michigan's copper mine area. His father, Professor Arthur Seaman, was the head of the Geology Department of M.C.M. Wyllis also became a teacher of geology at his college and for 45 years of his tenure he spent the summers making surface and underground studies of the copper and iron mines of the Upper Peninsula for the United States Bureau of Mines, the State of Michigan Geological Survey and the copper and iron mining companies. He is probably the all-time most knowledgeable of Michigan's iron and copper reserves.

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Frank Schwarzenberg graduated from the Michigan College of Mines in 1917 and after graduation served as underground mining engineer for the Hancock Mining Company, the Quincy Mining Company (twice) and the Senica Mining Company which became part of the Calumet & Hecla group. Frank brought above many improvements in the mining practices of the mines he engineered and made the Quincy methods the most advanced of all hard rock and deep shaft mining.

WILLIAM LANGDON:

Bill Langdon spent his life working with Calumet & Hecla and for the past fifteen years was in direct charge of shaft construction. He has the re-opening of several old shafts to his credit. These include Osceola #3 and #6, the Kingston and two Central shafts.

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RAYMOND GERTZ:

Ray Gertz has spent his working life in the employment of Calumet & Hecla after earning a degree in Metallurgy at the Michigan College of Mines. He was in charge of the laboratories at the C&H smelter until his retirement in June 1971. Besides being a top flight copper metallurgist, Bill knows copper refining as well as any man in the world.

JOHN FOLEY:

"Jack" Foley is a retired copper wire manufacturer whose father, Frank Foley, came to Dollar Bay in 1885 from wire mills in Worcester, Massachusetts to operate the new rod and wire mills just erected by the Tamarack and Osceola Copper Mining Company. John Foley has more than a laymans knowledge of copper mining, milling, smelting and fabricating.

PAUL D. KIMBALL:

Paul Kimball is a sales engineer, turned educator, and organizer of State and Federal Government financed special education and training programs. Paul is the young man of our group. He knows how to get help from bureaucrats. He learns fast and will soon know everything the rest of us know.