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FILE MEMO September 28, 1971

HOMESTAKE PROPOSAL ON C & H

On Sept. 24 Henry Colen, Vice President Homestake, called from Mexico City to inquire as to our interest in a joint venture proposal for exploration of the C & H property. He was to have Paul Henshaw, President of Homestake, call me as to details.

Paul Henshaw called Sept. 25. He pointed out that in previous discussions with Mr. Logan of Universal Oil Products, that they had been very close to an agreement regarding Homestake acquiring the C & H holdings. Hanna Mining was also negotiating with Universal Oil and submitted a more attractive proposal to Universal. Later Hanna withdrew (it was at that time that we investigated the C & H property).

Universal Oil Products has now approached Homestake again and is offering to renew negotiations indicating a willingness to soften their previous stance.

Homestake is interested in exploration on the C & H property and have a specific target for this work. They plan either to sink a shaft or to drift from the Centennial Mine shaft. The target of interest lies at the west end of the Centennial shaft area. Homestake has no interest in resuming operations in the old C & H facilities.

Homestake estimates the exploration would cost approximately $5 million over the next 2½ to 3 years. Henshaw's proposal would be for Essex to cover all exploration expense but Homestake would finance their share of facilities. Homestake, because of their underground experience, would be the managing partner.

Currently Homestake is re-examining the complete labor relation situation before making any other commitments to U.O.P. They have retained a consultant to make this investigation which will be completed by mid-October. If the labor problems which previously inhibited any interest in the C & H area have been resolved, Homestake will be looking for a partner to proceed.

I have advised Mr. Henshaw as follows:

> "The proposal is interesting but it is totally unacceptable for Essex to cover all expense for high risk exploration and relinquish management."

H. Lanier
9/28/71

cc: P.W. O'Malley
J.R. O'Hare

F C&H

BAGDAD COPPER CORPORATION
55 EAST THOMAS ROAD, PHOENIX, ARIZONA 85012
263-9407

Discussed w/ Dave 3/11/71 — Advised were looked at & no action planned — X

March 1, 1971

Mr. Howard Lanier
Essex International, Inc.
1704 West Grant Road
Tucson, Arizona 85705

Dear Howard:

A man named John Ryan visited me this morning. He is a Bagdad stockholder that we have known for many years. His home is in Calumet, Michigan. He is a local booster for his area and would like to see the Calumet Mine and smelting operation resumed if this could be done to someone's benefit. Evidently the mine is inactive and gradually filling with water although it is still at a point where it could be very satisfactorily pumped. The mill is old and would need replacing. The smelter is evidently operable, but it is tailored specifically to the native copper ore body and scrap. There is no converter section.

I very well may be telling you things you already know. Since this is an underground operation, I don't think Bagdad could make much of a contribution, but it occurred to me it is something you might want to investigate.

The labor problem has been horrible. However, Ryan indicated he believes the workers themselves are sufficiently fed up that they would be very happy to resume work at Calumet without a union. Many of them commute ninety miles one way daily to White Pine. On a winter day I think they would get sick of this about noon of the first day.

I doubt if John Ryan would want to be quoted on any of the above statements, but I am sure he would be more than happy to talk with you if you care to follow up.

I hope things are going well with you.

Sincerely,

Dave

David C. Lincoln

cc: E. C. Kenney

memo

FROM

1969	APRIL					1969
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

1969	MAY					1969
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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

CLEMENT K. CHASE

Howard -

I have absolutely no point of reference for evaluating the rather "ball-park" rehabilitation estimate figures.

Clem.

CYANAMID

February 16, 1971

Mr. John Foley
Industrial Development
Dollar Bay, Michigan 49922

Dear Mr. Foley:

In compliance with our telephone conversation this morning I am returning to you the information that you forwarded with your covering letter dated December 10, 1970.

Very truly yours,

ESSEX INTERNATIONAL, INC.

Howard Lanier, General Manager
Copper Operations

HL:td
enclosures

314 3ª Calle de Violetas,
Colonia de la Reforma,
Oaxaca de Juárez,
Oaxaca, México.
November 1, 1967.

Mr. John Foley,
Industrial Development,
Dollar Bay, Michigan 49922.

Dear Jack:

Just received you letter of October 28th, which I have been awaiting, as in your previous letter of October 7th you asked if I would "help by answering questions Frank and Warren raise and which no one here can answer"; I have been waiting for those questions.

Am glad that you gave up the idea of re-opening the old Quincy and Torch Lake Railroad, as I deem it entirely unnecessary. Their old mill was too far away, but in the old days they used and thought that they needed a tremenduous amount of water and a large area in which to dispose of their tailings. Not so now. Water nowadays can be recirculated and the tailings stacked or otherwise disposed of.

You mentioned that you have looked over some of the Quincy owned lands in search of a suitable mill site. PERHAPS YOU OVERLOOKED THE BEST SITE OF ALL! Why not put the mill UNDERGROUND, and the tailings could be used to fill some of the old, worked out stopes. Water for the mill would be less of a problem than if the mill were on surface.

As to using the mine water for mill purposes:- The composition of the Minewater should be given careful consideration. It used to be that the surface water was practically all drained off through an adit and most of the mine water that was pumped out was from lower depths. That mine water seemed to be about saturated with calcium chloride and sodium chloride. Both of these reagents, and especially the former are quite destructive to metal, especially iron.

It might be possible to salvage the calcium chloride from the mine water at approfit.

With the mill underground, transportion of the ore to the mill would be much simpler. Haulage of the concentrates to the smelter should be by truck.

Yes, I agree with Frank Schwartzenberg about operating the #2 shaft down to 6,000 feet or thereabouts. I am dubious about using # 8 shaft at greater depths because of the hoisting costs. BUT--the Quincy has never got down to where the copper was diminishing in quantity nor richness--it is the cost of hoisting that limits the depths to which the lodes can be worked. And with improved mining methods and better sorting underground(so that less waste rock is hoisted) the mine can be operated at a profit to greater depth.

As to "where would you start drilling..." I DO NOT recommend diamond drilling. You can push a diamond drill through the richest lodes and come up with a core showing little or no copper. Also, a drill core can show a solid bar of copper by going ALONG a thin seam in a lode that is entirely too lean to work. (Wasn't it at the Cherokee that they got a beautiful copper core, but when they went in after it they found almost nothing?). I think that I mentioned in a previous letter that I had had an opportunity in the Quincy to

find a cross-cut that paralleled a previous diamond drill hole out into the far,far west lodes. The drill cores showed what appeared to be excellent copper values in the last(farthest) lode drilled, and none in the lodes below it. On the contrary, the cross-cut went through very good copper ground in one of the underlying lodes and very little in that last or farthest lode. For the number of drill holes necesary to give reliable results--a cross-cut could be driven at no greater cost. (And you CANNOT tram much copper out of a drill hole!)

As to where to explore "for high silver content":-- It's not necessary. When you have the copper you have some silver. If you have two or more commercial lodes quite close(such as the Quincy and the 1st West lode), the silver is usually richer in the hanging lode. And in any one copperbearing lode, the silver seems to favor the hanging side of the lode. If a "spar crossing" is encountered, the foot lode(or lodes) are apt to be lean in both copper and silver, but the hanging lode(or lodes) are usually richer in both copper and silver. Also the silver, as well as the copper, is not uniformly distributed along the lodes. Very rich silver pockets may be unexpectedly found--in which case much of the silver will come up in the miner's dinner buckets, the mill getting the leaner material.

With the mill UNDERGROUND you wouldn't have to hoist the ore so far, and should be able to operate at greater depths at a profit.

I read your letter to E.J.Hauswirth(a copy of which you enclosed) with a great deal of interest. You brought up some very good points. Also, the Michigan Geological Survey has a great deal of information regarding the Quincy and the State Tax commission should have some interesting figures. Also Franklin G. Pardee(Box 210, Crystal Falls,Michigan 49920) should be consulted regarding unmined reserves,etc. He is a mining Engineer who was with the Michigan Geological Survey, and later with the Tax Commission, for a number of years.

That's all for now, but I'll be waiting for any further questions and hope that I'll be able to answer them.

Sincerely,

W.A.Seaman

W. A. Seaman.

From the desk of
GUERDON E. JACKSON

2-9-71

HOWARD

WHAT IS PRESENT STATUS OF QUINCY & ARCADIAN PROPERTIES?

THEY SEEM TO HAVE A LOT OF POTENTIAL MERIT WITH OR W/O C&H PROPERTIES.

Guerdon

Memorandum from . . .

HOWARD LANIER

PLEASE REVIEW & BE

PREPARED TO DISCUSS IN

A MEETING. DEC 22, 1970

PAUL — WHAT ARE RESERVE

POSSIBILITIES.

CLEM - CLYDE - ARE PRODUCTION

ESTIMATES & COSTS

REALISTIC.

Memorandum from . . .

HOWARD LANIER

Paul —

Is this worth any effort in light of our total program?

H

Yes — But, I think we have a number of better prospects under consideration

Paul

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

Mrs. Baker -
I'll write on
this
S/O'Malley
11-19-70

October 22, 1970

Mr. Walter Probst, Chairman
Essex International
Fort Wayne, Indiana.

Dear Walter:

It is better than probable that some company ,such as Essex, or even a smaller company, will be able to control the production and sale of 75 million pounds of refined copper per year at the cost of a loan of $3 million for ten years, or less. In addition the loaning company could participate in the profits from the sale of copper oxide and from the manufacturing of ni-hard iron liners and balls for material crushing plants.

If you care to discuss this with please telephone me any afternoon at about four oclock your time.

What do you think is going to happen, within the next 60 days, to the price of domestic prime copper? Will it hold or break under the pressure from dealer and foreign copper prices?

I have just completed a study into the cost of rehabilitating two Quincy Mining Company shafts which can produce, for 50 years or more, about 25 to 30 million pounds of copper per year. In addition I have tied up, (loosely), the mining rights in the Arcadian Mining Company lands. Professor Seaman , the best geologist ever to live in and studied the copper geology of Houghton County, Michigan says that these 4300 acres contain mor e copper than was ever mined in the county. It is very fine copper which is now the most easy to recover but in the early days was passed up for lack of knowledge and good recovery equipment. It will average about 1% copper content.

Ask yourself these questions. ---- How long will Essex Inrenational last? How much copper will it need per year in about 50 years? Will it still be entirely at the mercy of the " bandits" , the big copper producers?

Regards,
Jack Foley
Jack Foley

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

C&H

January 31,1971

XM

FEB 3 1971

RECEIVED

Mr. Howard Lenier
Essex International
Tuscon, Arizona.

Dear Mr. Lenier:

It may be helpful to you to know that the water level in the Kinston and Centenial #6 shafts (C&H - U.O.P.) has risen about 300 feet since the pumps were shut down a few weeks ago. This rise doesnt mean much because at the bottom the drifts and stopes dont amount to much. --- These shafts 'make water'at this time of the year at a rate of about 300 gallons per minute. The rate will skyrocket in April.

C&H costs have always been'way high due to a top heavy administrative staff and other white collar workers. Also there was always two or more supervisors for every department when one could handle two or more departments. Everyone, almost, had a secretary. There were a dozen or more men in the drafting department drawing up like drawings for the machine shop when the machinists did not need them nor used them when given to them. C&H didnt know the meaning of'time and motion' and,like the government, bureaucracy and staff meetings held sway.

HOW COULD MANAGEMENT EXPECT EFFICIENCY FROM HOURLY WORKERS WHEN SETTING SUCH EXAMPLES?

I believe that THE WAY to get C&H operations on an efficient basis is to start with a profit sharing plan with the hourly workers having benefits coming out of a share of the operating profits. There should be incentives for everyone and not only for the miners. What good is knocked down rock if it it not moved out and up and on through the works, at a profitable rate?

I think the former C&H workers are ready to go back to work. And I mean WORK. I am sure of it IF the attitude of a new company does not carry on in the beligerent attitude of the old one. If the new company is managed by men who understand human and public relations , instead of by one hatchet man after hatchet man with attitudes towardsworkmen which are of the 1913 strike vintage. Such attitudes will not prevail in the 1970s and onward.

Dont forget that I have a 100 ton per day secondary copper refinery available to Essex International. Come and see it . Come and talk to me about it.

Sincerely yours,

Jack Foley

Jack Foley

(over)

Frank Gibbons

Universal Oil Products

(312) 792-3344

Patalin Frank 312-359 6300

GIBBONS —

1/26/71

No hope of reactivation.

Hanna dropped out — Letter of intent with C&H

Labor problem.

Internation took Trusteeship of local

paying Sick benefits to 200 men.

Before Close

1000 day pay

~~245~~ Salary Supervisor, Cl

350 have gone to White Pine.

27 Caretaker — Engr., Finance, 2 acct.

Mining Engrs.

11 Geological — separate

Jake Hancock

NC

SXM

FEB 1 1971

RECEIVED

uop

Universal Oil Products Company
30 Algonquin Road • Des Plaines, Illinois 60016
Telephone 312 • 763-6000

January 29, 1971

Mr. Howard Lanier
Essex International, Inc.
1704 West Grant Road
Tucson, Arizona 85705

Dear Mr. Lanier,

Under separate cover, I am sending you a copy of "Red Metal" which was published in 1951 as a history of Calumet & Hecla. You may find some of the old history interesting.

I look forward to hearing from you in a week or two regarding any interest you may have in our Calumet Division.

Very truly yours,

F. J. Gibbons

Francis J. Gibbons

bjm

314 3ª Calle de Violetas,
Colonia de la Reforma
Oaxaca de Juárez, Oaxaca, México.
May 28, 1967.

Mr. John Foley, Consultant,
Industrial Development Section,
Community Action Agency, Inc.
Dollar Bay, Michigan 49922.

Dear Jack Foley:

It was quite a surprise to learn from your letter of the 21st, that Chet had bulldozed the rock piles down the Arcadian shafts, for I hadn't recommended any such action. When Joe Donnelly was down here in March, he told me that the Mine Inspector had requested them to do something about the dangerous condition of someof the old workings and I suggested putting old scrap rails across the shafts. They would have to beplaced, of course, below any cave-in had widened the shafts. After such rails or other old iron had been put in to span the openings, then what could be done would depend upon material available, cost and convenience. Perhaps placing large slabs of rock across the rails to span the interstices, then some smaller rocks and finally concrete. Or reinforced concrete slabs.

However, the filling of the shafts should have but little effect upon future exploratory work as the shafts would have been available only for exploration in the immediate vicinity of that one mineralized zone.

Our intention, in driving the adit, was to drive it towards the nearest of the old shafts and when close to it, to unwater it above the adit level through advanced drill holes, then when the adit was connected with the shaft, to unwater that shaft by electric pump for the next 100 feet or so in depth, and then th come back through the ore underneath the adit level. The adit level, remember, was driven just above the zone of most of the ore. Shortly before the hanging cross-cut(where the dam was built) that was driven from the main hanging lode, we did some stoping. The Government stopped this as they contended that we shouldn't go downward from an adit exploration. One drill is, I believe, still stuck in mass copper down in that underhand stope. Near the mouth of that same hanging cross-cut, Captain Hans and I tried to dig a sump to collect water below the adit level and we didn't succeed as we struck heavy mass copper in both places where we tried. In several places along the course of the adit we encountered mass copper at track level but with none showing in the back.

The Kennecott people are probably quite wise in wanting BOTH the Arcadian and the Quincy, and not the Quincy alone, for while the Quincy is a remarkably valuable property, it is the Arcadian that has such a large acreage of unexplored potentially rich mineral ground.

Any prospecting that may be done should bear in mind that if copper is found at surface in any lode, that it will go down for a considerable distance--BUT that a very rich copper lode in depth may not show copper at surface. Of the dozen or so of the Quincy lodes that have been profitable, I know of only three that showed good to faircopper at surface, and none of them for their entire length. WATCH the mineralizing fault zones and never mind whether a"new"lode lines up with any of the previously known ones or not!

Hope you can keep the Quincy smelter running. Good luck to you.

Sincerely,

W.A.Seaman.

314 3ª Calle de Violetas
Colonia de la Reforma,
Oaxaca de Juárez, Oaxaca, México.
July 24, 1970.

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

Dear Jack.

The report by the Bechtel Corporation, which was received three days ago is being returned with some marginal notes. These notes are amplified and supplemented in part in the page of notes on the Geology of the Copper Country.

I am a day or two slow in writing the geological notes as it took considerable time and thought to get them technically correct, and also to put them into language that could be understood by a non-technical leader or evan by a geologist.

When Gen. Mgr. Lawton called me up one day and said he wanted to talk to me, the first question he asked was "Are you a geologist"? and when I told him that I wasn't a geologist--just simply been teaching geology to mining students for twenty some years-- he said"Fine". "The eastern office thinks I should hire a Geologist but I don't want one" so he told them that he had hired a "Professor of Geology" and that they were appeased.

After working three or four years mapping in the Quincy, I asked if he had any objections to my writing up the Geology for publication. "None at all" he said"but don't say ANYTHING about the faulting." I told him that without the faulting, there was nothing to write about, for without the faulting there wouldnT be any copper there. "We know that", he said, but the stockholders, the eastern office and the Damned geologists DON'T know it--so keep it quiet. I was also Geological Consultant for the Mohawk Mining Co, the Champion Copper Company and others

It occurs to me that you might need additional copies of the geological notes. If so, I presume thay can be readily duplicated by photostat, or other means.

Hope you have good luck with your idea of consolidating the properties north of Portage Lake, and remember!! The Copper has barely been SCRATCHED in the search for copper. Much utterly useless work has been done looking in the wrong places for copper that couldn't be there, and looking for continuations of famous lodes that couldn't be well mineralized where they were searched for. And all that useless diamond drilling-- you could punch many holes through any of the famous rich lodes and miss all of the copper.

Sincerely,

W.A.Seaman

314 3ª Calle de Violetas,
Colonia de la Reforma,
Oaxaca de Juárez,
Oaxaca, México.
Jan. 25, 1967.

Mr. John Foley,
Dollar Bay, Michigan 49922.

Dear Mr. Foley:

In reply to your letter of January 21st, I will try to answer your questions to the best of my ability. However, I have no notes nor maps with me here in México and will have to rely solely upon my memory, and as it has been about 25 years since I did most of my work at the Quincy, I will not be able to answer all of your questions as fully as I would wish.

In regard to your first question--"was there ever any diamond drilling done into these lodes?"

Yes. Considerable drilling was done, both from surface and from underground. This drilling, however, did not always(nor seemingly usually) produce reliable results. For instance, I was able to locate some of the underground drill holes, examine the cores and then also find out what the later cross-cutting disclosed. For example,- in one case a drill hole was bored from one of the foot lodes clear out to the "Far-Far"West lodes. The cores showed good copper in one of the Far-far west lodes, but none(or practically none)in the Far West lodes. But the cross-cut that was driven later showed practically NO copper in the Far-Farwest lodes but very good copper ground in one of the Far West lodes which was later stoped.

It is possible to put a drill hole through one of the richer lodes without hitting any copper. Also a drill hole into a very poor lode has sometimes shown very good copper. I learned not to look for copper but rather to examine the cores for certain associated minerals which might indicate its presence.

Second question,-- "Could the mine be worked profitably just in the Pewabic lode from the 50th level up?". Probably, but there may be more copper in one or more of the hanging lodes above the 50th level. Also, I am not sure which lode IS the "Pewabic" lode in different parts of the mine, as the correlation was not certain, and there seemed to be a tendency to call the best looking lode near that horizon the "Pewabic lode".

Third question,-- "How many years of profitable mining is left under these conditions?" Entirely problematical!

Fourth Question,--Do you think it would pay to mine # 2 from the 50th level back up.....and ...other lodes?" Certainly!

There are about a dozen(or more) copper bearing lodes in the Quincy. To the best of my memory they are, from the foot wall up,--

The Felsite conglomerate, called variously # 15 conglomerate, the "Allouez conglomerate" or the "Boston and Albany" conglomerate. A small amount of stoping was done on this but it was not rich. It was richer to the northward and was mined extensively at the Franklin Jr. Mine, near the Boston location. It may have also been of commercial grade in the vicinity of # 9 Quincy shaft, though I do not think it was explored there.

Close above the felsite conglomerate is a great thrust fault which is nearly parallel to the beds, though it appears to dip in general a little steeper and probably cuts toward the foot to the northward. I have seen this fault in several places and it has been cut by some drill holes, in fact I practically followed it down for several THOUSAND feet.

From this great thrust fault, many adjustment faults pass into the hanging lodes. These cross faults are from right angles(90 degrees) to about 70 degrees to the main thrust fault. These adjustment faults are commonly known as "spar crossings", and the movement along them has been almost directly up along the dip. In the case of the "Spar crossing" near # 6 shaft, I finally had a chance to get some idea of the displacement. The slickensides(or fault grooves) were almost exactly up the dip, and while both sides of the cross fault had been shoved up an enormous distance, I found that the north side had gone up AT LEAST 4200 fwet farther than had the south side.

Where these "spar crossings" intersent the foot lodes, the lodes are very poor, or even bare in copper, for from a few feet to 50 or more feet. The material in the spar crossings is here mainly calcite and laumontite. The miners called the laumontite "poor spar" and claimed that the spar crossings "robbed the lode". In a sense that is true, as the copper escaped along these "spar crossings" and greatly enriched one or more of the hanging lodes. The laumontite(a soft, crumbly, yellowish to pinkish prismatic material) and the calcite gave way, within a few feet when the "spar crossing" was followed into the hanging trap to prehnite, epidote, copper, etc.

To resume,- The Quincy lodes, as I recall them, are about as follows counting up from the felsite conglomerate. The distances between them are about as I visualize them as I mentally retrace my steps along the cross-cuts, hence these distances are apt to be in error by 50% or so.

The Felsite conglomerate.
a few feet
Thrust fault, with some places up to two or three feet of "gouge".
50 ft between,
The "Epidote" lode.
200 ft of "trap" between.
"Pewabic" East lode
50 ft
"Pewabic" main lode
50 ft
"Bastard East lode
0 to 20 ft
"Quincy Main" lode(also called? in places, the Pewabic lode)
40 ft
First West lode
75 ft(plus or minus)
Far West lodes
200 ft
Far-Far West lodes.

Thus the Quincy was mining a zone of lodes extending over a horizontal width of 800 feet or more.

No one of these lodes was consistently commercial for its entire length, and usually for only a few hundred feet, though it might be good in another place farther along the strike where it has been mineralized by another mineralizing fault.

The copper mineralization came UP from below, contrary to the theory held by some geologists and advocated by Dr. A.C. Lane, until, in later life, he found out differently. (I was with him when he changed his opinion).

In the U.S. Geological Survey report I have only the following comments to make,--

Near the bottom of p -27-, "The Pewabic amygdaloids are all characteristically coalescing." They are OFTEN but not ALL. That much publicized effect seems due to microscopic fault cracks along the bedding which permitted the mineralizing solutions to permeate the zone more thoroughly. Many times I have followed along such a zone and have found that in one direction the "Coalescent" effect has vanished while in the other direction it passes into a breccia.

Near the bottom of page -28-. The "Spar Crossing"--is described more fully near the top of page 2 of this letter.

Page -29-. Mineralogy.

"There is enough native silver with much of the copper to warrant its separation." The silver favors the hanging of any lode and especially is apt to be more abundant in the hanging lodes. In one case a"pillar" that was not mined, being obviously too poor in copper, ~~was found upon~~ sampling and assaying to carry several ounces of silver to the ton. (It was later mined).

"The secondary minerals..." are quartz, calcite, epidote(often nearly black), chlorastrolite(mis-called pumpellyite), PREHNITE and chlorite. The prehnite is a very good indicator of the presence of copper and also probably of silver in the lode.

Page -30-. Correct, but ADD the hanging lodes!

COPPER RESERVES of the QUINCY MINING COMPANY.

I am in full accord with practically all of the information given in these two pages.

In regard to Mr. Todd's letter of Sept 16, 1966. I agree cmpletely with Him. In 1943 the # 2 shaft was in excellent condition, being the reserve shaft and being kept in shape for operation in case any thing had happened to # 6 or # 8. While the timber seemed to be in excellent shape a t that time it is likely that dryrot or other deterioration in the nearly 25 years since would necessitate the replacement of much of it.

I mapped in the Quincy for about six years--from 1938 to 1943 inclusive. I got into much of the older workings including "air-blasted" ground, sometimes having to crawl for long distances on my belly through areas where the footwall had been shoved up almost to the hanging. The crushing of the timbers, the shoving of thetrack up against the hanging, etc, were apparently the result of an unsatisfied post-thrust faulting pressure from the south-southeast. The hanging might seem to be perfectly straight but the footwall was bulged up against it. Mr. Lawtoh and I were quite sure that much of the "Air-blasted" ground could be safely reopened now that the ground had had so many years in which to re-adjust itself.

Duringthe six years that I worked in the Quincy, Spiroff was never underground and I doubt if he went down in the short time after I left until the mine was closed. Hence his knowledge is probably "hearsay".

As to the Arcadian. The possibilities there are enormous and I described some of them in a letter to Mr. Donnelly last December.

I am not returning the documents you sent me,at present, as I wish to mull them over quite a bit more, but will return them if you need them.

No, I am not at present contemplating a trip to the Copper Country in the near future--though--who knows?

Sincerely

W.A. Seaman

W.A.Seaman

314 3ª Calle de Violetas,
Colonia de la Reforma,
Oaxaca de Juárez, Oaxaca, México.
April 10, 1967.

Mr. John Foley, Consultant,
Office of Economic Opportunity,
Industrial Development Section,
Dollar Bay, Michigan.

Dear Jack Foley:

Your letter of the 5th just arrived today and I'll try to answer your questions as fully as possible. I'm sorry that there is little chance of my coming to the Copper Country, either now or in the near future. It's too long a trip for an old guy in his eighties, and if I were up there I wouldn't be able to do much. Furthermore I am pretty well tied up here at present, having opened up a very rich lode that some friends down here are hoping to develop--and they sure need my help.

Question, "What shafts would you repair and equip and where would you start mining"?

2 shaft, as it is probably in better condition than # 6. It was in good condition when I left there, and I believe that there is a good deal of unmined ground, especially in the hanging lodes, near and to the south of # 2.

6 shaft was not in good shape and seemed to be getting pretty "tight" in places and had the troublesome "hump" near the 540 level--ask Frank Pardee about that. # 8 shaft may have been deepened since I was there, but I wouldn't be concerned about what copper may be left in depth--copper in the upper workings should be our first interest. It used to be that two shafts were in use(such as # 6 and # 8) with a third shaft ready for use if either working shaft "closed up". Thus, if # 2 shaft is put into commission, then # 6 should be renovated enough to be used for ventilation and as an escape shaft.

Question, "What do you know about the water levels in Quincy?"

After being closed for, I think, about 6 years, it was flooded 1938? up to, and slightly above the 850 level. As most of the surface water is trapped way up above and led out through the adit, the mine does not make water very fast. But the mine water is quite warm, I think about 95 degrees, and is saturated with Calcium chloride and supersaturated with sudium chloride(halite or common salt). A crust of halite crystals up to an inch or two in thickness was formed at the flood level. Some halite crystals were more than an inch across the cube faces.

The mine was dewatered by means of pumps and "bailers" which were long box-car like skips.

At the present time, the mine may be flooded up higher than then, but I doubt if the water would be up into the 600 level.

In the early days of the Quincy the levels were generally about 10 fathoms(or 60 feet) apart. Later they became 100 feet apart on the incline, and still later, 100 feet apart vertically. (The Cousin Jack miners used to say "they be bloody long fathoms" but still designated the levels as the 420 fathom level, etc.) Thus what is now called the 540 level is the 540 fathom("long fathom") level.

Question,"Where, by section" is the location of the copper Strike you and Andy Sweet made...?"
The map you enclosed has me somewhat baffled and I have not as yet been able to locate for certain even some of the more important mines and prospects as it fails to show even the Quincy, old Arcadian, New Arcadian, New Baltic, Franklin Junior, etc.

Also some of the secondary roads are new to me and some of the familiar old ones are no longer shown. I also miss the old street car line right-of-way to Calumet. I notice, too, that the Copper Range Railroad no longer seems to run through Ripley and that west of Mason it climbs up onto Quincy Hill and seems to go along where the old Quincy and Torch Lake narrow guage mining road used to run. I also find that the old Mineral Range RR has now become the Trap Rock Valley RR, and that the D.S.S. & A. east of Houghton has now become the Copper Range.

What is the meaning of these signs all over the map? ?. They are not the strike of the formation, nor that of the faults. Neither are they the direction of the glacial grooves that can be seen on so many of the outcrops.

Now, most of the copper bearing area from the Copper Range mines northeastward into Keweenaw county has been mapped by the Michigan Geological Survey to a scale of 20 inches to the mile. These maps were on file in the Survey office in Lansing and should be available. They show the locations of most shafts, roads,(old railroad grades included), and the thicker or more prominent trap flows and a great deal of the predominantly slide or thrust faulting--the mineralizing type.

Dr. Carl A. Lamey(later head of the Geology Department at Ohio State University) and I started this work about 1927 and the work was continued for several years. We followed the hanging traps of the lodes, (which are magnetic of varying intensity) by means of dip needles and dial compasses. Readings were taken at close intervals and most of the available outcrops were also accurately mapped. This work involved up to more than 25 miles of traverses in each of many sections.

Mr. Franklin G. Pardee can probably tell you of the availability of these maps.

As to the trenching done during the"Depression", records of this should be available yet in the Geology Department of Michigan Tech and also with the Michigan Geological Survey. Records were also sent to Washington I believe. Andy Sweet can probably give you the required information about this. His address is(or lately was),

Andrew T. Sweet, 1127 Washington St.,Denver, Colo. Better check this with the Alumni records at Michigan Tech.

Although I am as yet unable to pin point the location of any of the trenches mentioned, I do remember that the one which showed a very promising lode, from which tons of mass copper were carted away in private cars, was striking so as to lie something like a couple of thousand feet in the hanging of the Arcadian lode. Of course, coming southwestward the mineralization would almost surely shift gradually or in some cases suddenly to lodes in the nearby hanging. Going northeastward the mineralization would occur in lodes progressively more in the foot.

An example of this is the # 15(Boston & albany or Allouez) conglomerate. In the Quincy it was too lean to mine although a little stoping was done on it. Farther NE it contributed considerable copper to the Franklin Junior(which was also mining hanging amygdaloidal lodes, though they were not as rich as in the Quincy). Still farther north it was the principal copper producing horizon at the Allouez mine, although most

of the richer copper ground in the Calumet area was, of course, farther in the foot and in lodes(conglomerate and amygdaloidal) that were not productive in the Quincy. Also the amygdaloidal lodes that are so rich at the Quincy are nearly barren in the Calumet area.

It is important to understand that the mineralization in the Copper Country is controlled by the mineralizing thrust faulting which is about parallel to the hanging beds but generally a little steeper and slightly diagonal to those formations in the foot.

The cross faulting is better known to most geologists, many of whom have seemingly completely ignored the more important slide or dip faults. It was Dr. A.C. Lane who said "a thrust fault by its very nature is the most retiring sort of thing". The cross faults are at some places very important as they may be very rich for short distances in copper, copper sulfides or arsenides and even native silver. Much of the mining in early days was done along them. These cross faults are adjustment faults where the hanging formations when thrust up and over the underlying formations have broken to allow part of the hanging traps to go up farther on one side of the cross fault than on the other side.

Now I hope I have answered your latest questions satisfactorily, but if not--call on me again. Also, you should probably have a lot more questions in the near future. I'll do what I can at all times.

I am keeping the map you sent for the time being as I want to pore over it some more and see if I can get something more out of it.

In you letter you seem a little worried about my working for nothing--don't worry about that, as I am working for the Arcadian, the Quincy, the Copper Country, etc. And don't call that "nothing". As to"money"--I have worked many times for many years for less than"Nothing".

You may be asking me about those State owned lands north of the Arcadian. I presume that they have gone back to the state for taxes. I suspect that the State lands east of the old black top highway, especially in sections 8 and 4 might be of considerable value as the Quincy mineralization zone may have worked down into foot lodes in that area.

That's all for now. Call on me again.
Good luck to you.

Sincerely,

W A Seaman

W. A. Seaman.

314 3ª Calle de Violetas,
Colonia de la Reforma,
Oaxaca de Juárez, Oaxaca, Méx.
April 20, 1967.

Mr. John Foley,
Dollar Bay, Michigan 49922.

Dear Jack:

The map you sent on the 15th, is good topographically and I can locate myself on it quite easily--provided I ignore the "geology" which is extremely ancient and faulty. It appears as though the mines, new roads and drill locations have been superimposed upon an old map, perpetuating the old geological errors. More about that later.

From the later map in conjunction with the one previously sent, I think that the trenching that uncovered that promising lode was probably on section 3(33-55/ and just off of the map limits. The lode was discovered by the trenching, which went pretty deep in places(as it was possible to freeze the sides to prevent caving). Trenching was carried on along the lode, in a southwesterly direction, to verify the strike and to demonstrate the character of the lode.

At that time I had no interest in either the Arcadian nor the Quincy, not having worked for either, but I noted that this lode was striking toward the Arcadian lands, which I thought were either quite close unless the trenching was on them. It appeared that, if persistant for an appreciable distance, that it should lie about 2,000 feet in the hanging of(above) the Arcadian lodes. It was not considered to be the Kearsarge lode, which was presumed to be non-productive in that area. Some of the WPA workers had cars and they carted off, probably during the night, a great deal of mass copper uncovered in the trenching. I presume that this was illegal, but I don't know whatwas done to try to prevent it.

I still think that you should probably write to Andy Sweet.

Now to try to answer the questions in your letter,-

I do not know anything about the diamond drilling done just before Jim McKie died, but in view of the poor quality of information obtained from several Hundred thousand feet of other drilling in the Copper Country, I would deduce that little reliable information was obtained.

Question,- Can the shaft pillars be robbed?
In territory to be abandoned--Yes.

Question,- "Do you believe there is commercial mineable copper in the upper levels of all 9 Quincy shafts?
Yes. I think that the levels above the 540 were generally considered "upper levels".
"Would the mineable copper be mostly in (1) rock that was considered too poor to mine?" Not much.
(2)"Left behind .... in drifts and stopes?". A little.
(3) "In unmined or partially mined lodes?" YES.
Especially so in those stopes that were left unfinished because of "air blasts". Much of these areas should now be mineable with safety. Mr. Lawton was quite emphatic about that!
Also in parallel lodes that in the earlier days were not explored sufficiently by cross-cuts. A lode exposed in a cross-cut on one level

may have been deemed toolean to mine, whereas on the next level, not opened by cross-cut, the lode might have been quite rich.

Question re "term paper" by William H. Pyne .....Published in June 1957. I don't know anything about him. Have no record of anyone by that name at Tech. A William J. Payne went to Michigan Tech, Class(I think)-of 1958, but don't think he finished. In any case, his paper is undoubtedly a rehash of other publications. Just ask Franklin G. Pardee--he knows about the Quincy reserves. His address is,-

Franklin G. Pardee,
Consulting Mining Geologist,
Box # 210, Crystal Falls, Michigan 49920.

Frank was Mine appraiser for the Michigan Geological Survey, for several years.

Question,- Might there be quite a lot of flakey silver mixed in the rock with the flakey copper in the upper levels of Quincy? If so, which shafts are most likely to be the best silver producers?"

There was always more or less silver with the copper in the Quincy. I do not think that much of either was flakey, both came in nuggets, crystals and massea. A great deal of the silver came up the shafts in the miners dinner buckets--and of course never got to the stamp mill. The mill recovered much of, but no where near all, of the finer silver.

I do not suspect any Quincy shaft being more productive of silver than any other. The silver favors the hanging of a load, and often is more abundant in one of the hanging lodes, than in a foot lode.

ALSO-- some ground, obviously too lean in copper may be left, not knowing that it may be, and sometimes was, rich in silver. (Seven ounces of silver per ton is better than 25 pounds of copper!)

Now a few comments on the "geology" as shown(supposedly) on the map you sent.

The felsite(rhyolite, quartz porphyry,etc) intrusion into the Keweenawan is a myth. It is intrusive into the older lava flows and sediments such as the so called "South trap range" or"Bessemer traps" extending from down in Wisconsin to just north of Ironwood and Bessemer, Trout Creek,etc, and on to Silver Mountain. This series consists of a thin and not prominent conglomerate(except locally), succeeded by a sandstone or quartzite(as north of Bessemer,etc) and then a number of Uralitic diabase trap flows--lacking or low in magnetite and olivine. These are not only considerably older but also much more altered than the Keweenawan traps, and it is hard to see how Van Hise and others confused them with the Keweenawan lavas. These older lavas ARE intruded by dikes and sills, etc of the "rhyolite"(more often referred to as the Felsite). But this series of OLDER flows as well as the "Felsite" are cut by(intruded by) dikes of the Keweenawan olivine diabases. I use to show these relations to my students on field trips. Especially north of Bessemer and just west of Bergland) (Also similar olivine diabase intrusives into this series in Nipigon Bay) (On the North shore of Lake Superior the Bessemer sandstone is called the "Sibley" from the excellent exposures on Sibley Peninsula east of Port Arthur.).

The Keweenawan lava flows were preceded in most areas by the "Felsite" conglomerate whose pebbles were derived mainly from the felsite flows and intrusions. Intrusions such as the numerous exposures from Bergland to Mount Houghton.

The Keweenawan lavas poured out, mostly on this felsite conglomerate from the hundreds of fissures or dikes that ringed much of the pre-Keweenawa

basin approximating that of the present Lake Superior.

The lavas poured out of these fissures and advanced down the gentle slope, circling some of the felsite "knobs". While the lavas were piling up to thicknesses of several hundred feet, felsite conglomerate and sandstone was forming, especially from the felsite that was being rapidly eroded.

Subsequent thrust faulting has caused a great deal of repetition, not only of the trap flows but also of the conglomerate and portions of the late Keweenawan sills such as part of the "Greenstone" series. The "geological" map shows a thrust fault at the New Arcadian and the New Baltic Mines. True. But it does not connect with the Hancock Fault. There are a great many other thrust faults between, and they are more nearly parallel to(and govern) the strike of the formation. The faulting at the New Baltic was examined by me when Chet Gibbs, then the Superintendent, called me up and wanted to know why they found what seemed to be the "#8" conglomerate in the hanging of the shaft as well as in the foot. It was exposed in cross-cuts buth to the foot andto the hanging. He asked me what I knew about the conglomerate and I told him, over the phone, that he probably would encounter it in the hanging as well as the foot, because in surface mapping and following the magnetic traps in the hanging I had mapped a fault headed for the vicinity of the New Baltic shaft. Later, the next day I think, I went underground with him and verified it.

The Hancock fault apparently has numerous branches, one of them being the great slide fault just above the Felsite conglomerate in # 6 shaft. Now, this branch fault in the Quincy is NOT SHOWN on the maps although the motion was several THOUSANDS OF FEET up thedip. The "Spar Crossings" in the Quincy are only minor adjustments in the hanging of this thrust fault . "Minor", considering the multitude and the magnitude of the faults in the Keweenawan. a "minor" adjustment in which one side of the cross adjustment fault went up AT LEAST 4200 feet farther than on the other side!

There is no "Keweenaw Fault", as the entire peninsula is practically a fault ZONE, and what is mapped as the "Keweenaw Fault" is any one of the numerous branches where the faulting has brought traps up against sandstone. Where it is trap to trap on each side of the fault zone, the fault is usually missed or ignored.

I am trying to prepare a cross-section or two of the Keweenawan to show the conditions and relations BEFORE and AFTER the great faulting, but I haven't had time to get it ready for this letter.

For 45 years I spent most of the summers mapping and closely examining the formations and their relationships in the Lake Superior region--and much of the winter months mapping underground,so I am not inclined to swallow some of the theories promoted by those who have done but little field work.

As to what areas in the Quincy can be expected to produce good copper, the mine maps should show what areas have not been thoroughly explored and Frank Schwarzenberg should be of great help to you.

And Frank Pardee probably knows more about the geology of the Copper Country and also the possibilities of the Quincy than any one else available.

And I guess that's all until the next epistle.

Sincerely,

W. A. Seaman

(Sorry to hear about Bill Clish)

N and MAP
OF THE
olidated Mining
pany

New Baltic

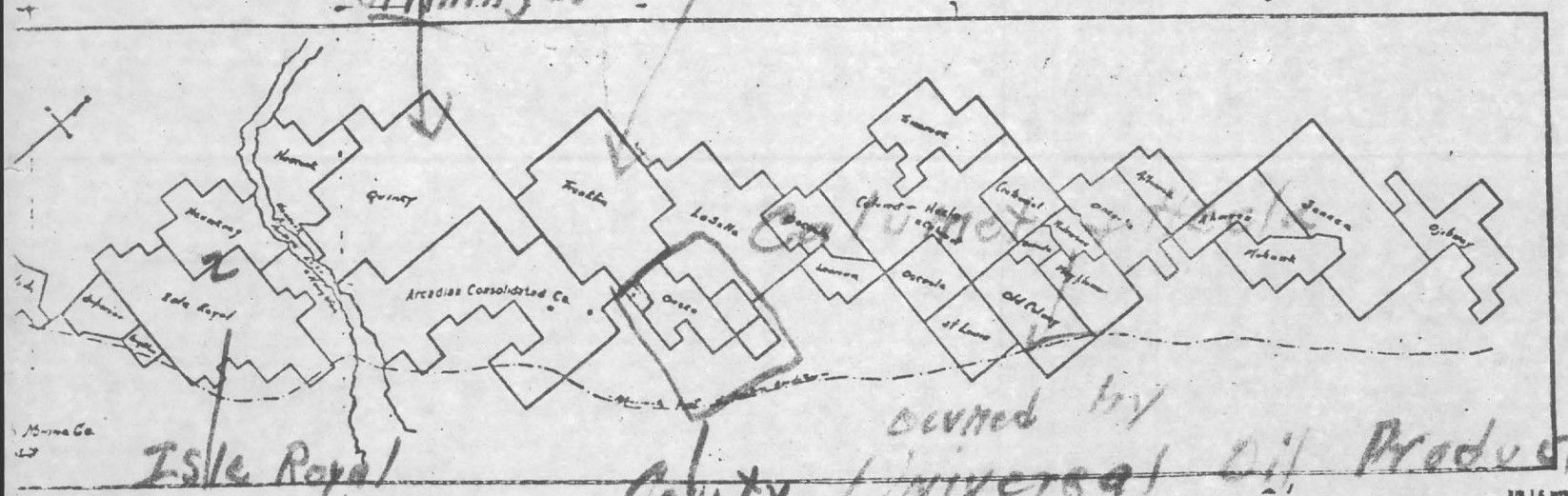
275'
400'
500'
600'
786'
942'
1100'
1250'

New Arcadian

1250'
600'
750'
900'
1050'
1250'
1500'
1700'
1850'

State of Michigan

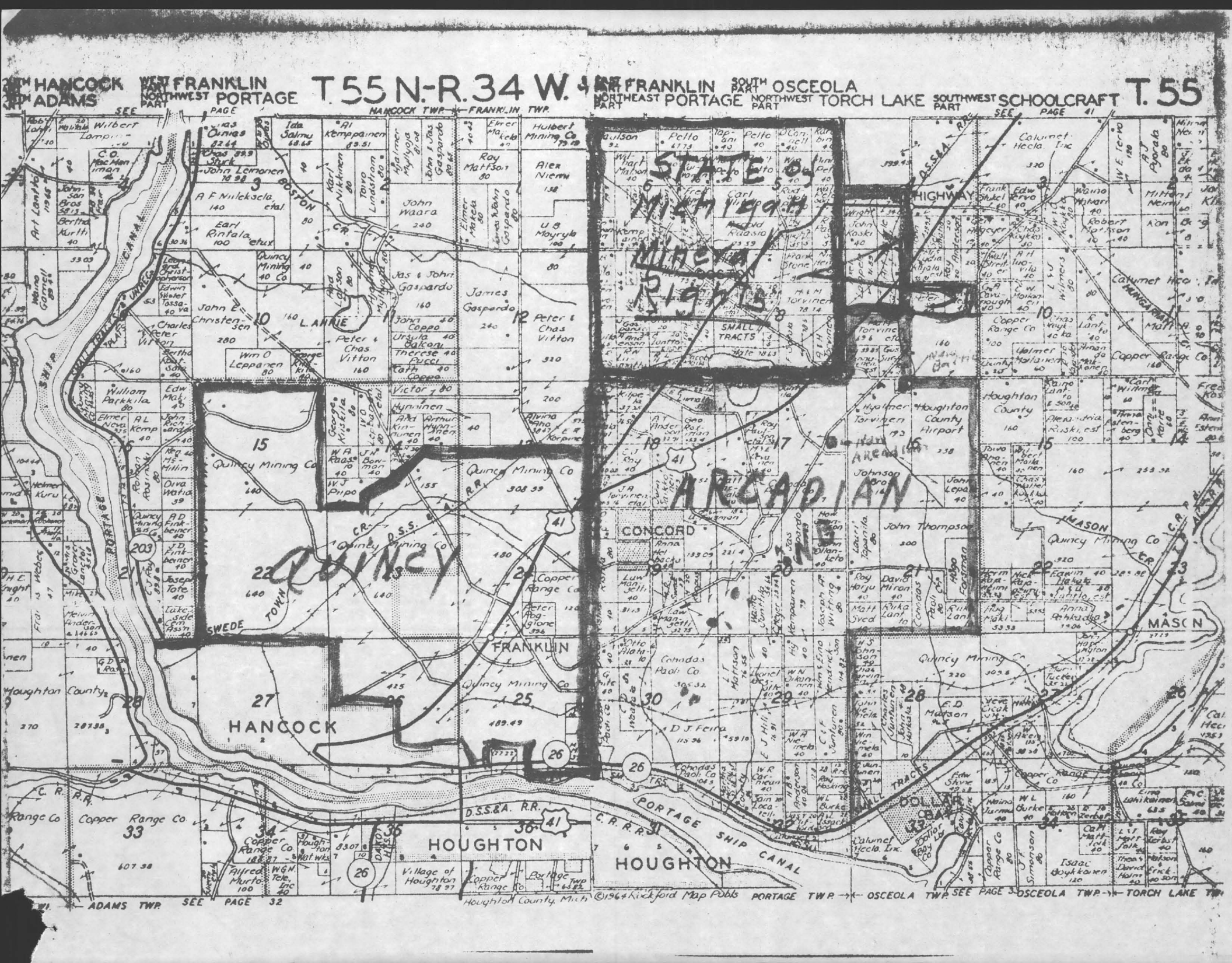
Quincy Mining Co



owned by Universal Oil Products Co.

Isle Royal
owned by
Copper Range Co

County
AIR
PWT


T. 55 N.-R. 34 W.
T. 55
HANCOCK
ADAMS
WEST FRANKLIN
NORTHWEST PORTAGE
FRANKLIN
NORTHEAST PORTAGE
SOUTH OSCEOLA
NORTHWEST TORCH LAKE
SOUTHWEST SCHOOLCRAFT
HANCOCK TWP. ← FRANKLIN TWP.
STATE HIGHWAY
MINERAL RIGHTS
SMALL TRACTS
QUINCY
ARCADIAN
CONCORD
SWEDE
FRANKLIN
HANCOCK
HOUGHTON
HOUGHTON
MASON
DOLLAR BAY
PORTAGE SHIP CANAL
CANAL
L. ANNIE
BOSTON
Quincy Mining Co
Copper Range Co
Houghton County
Houghton County Airport
Calumet Hecla Inc
Village of Houghton
Houghton County, Mich.
©1964 Kickford Map Pubs
ADAMS TWP. SEE PAGE 32
PORTAGE TWP. → ← OSCEOLA TWP. SEE PAGE 3
OSCEOLA TWP. → ← TORCH LAKE TWP.
SEE PAGE 41

Excerpt from report made by U.S.Geological Survey based on geological maps made in years 1942 - 1946.

The following information regarding the Quincy mine is taken from a report on Michigan Copper mines prepared by the U.S.Geological Survey. The authors are:

H.R.Cornwall
J.J.Runner
A.A.Stromquist
R.W.Swanson
W.S.White

Quincy mine production	1864 to 1945	880,975,324 pounds
Reclamation plant production	1943to 1967	101,608, 784 pounds
		1,092,584,108 pounds

See page 30

Quincy mine (pls. 13 and 14)

Introduction.--The Quincy mine of the Quincy Mining Co. is in secs. 23, 24, 25, and 26, T. 55 N., R. 34 W., 1 mile northeast of Hancock, Mich. A large number of closely spaced amygdaloidal flow tops, the Pewabic lodes, have been mined. Their average strike and dip are N. 33°E., 55°NW. in the upper levels, and N. 38°E., 35°NW. in the lower levels. The mine workings extend for 12,500 feet along the strike of the lodes and 8,800 feet down the dip. The mine was shut down in 1945. The total production up to that time was almost exactly one billion pounds of copper. (880,975,324 pounds)

The accessible workings of the Quincy mine were not mapped in detail by the writers. Underground inspection of the mine was limited to a few days, which were spent mostly in the lower levels. The following description of the mine was prepared from a detailed study of the company records, including geologic maps and sections of parts of the mine by W. A. Seaman; from published descriptions of the mine, principally U. S. Geological Survey Professional Paper 144; and from the brief observations that were made underground.

The lodes.--The Pewabic amygdaloid lodes at the Quincy mine occur in a group of relatively thin, glomeroporphyritic flows which overlap one another. Where a flow terminates, its amygdaloidal top is in contact with the amygdaloid of the underlying flow, but no sharp boundary can be drawn between these two amygdaloids. The Pewabic amygdaloids are all characteristically coalescing. A typical lode averages 3 to 5 feet in thickness and contains 2 to 10 coalesing amygdular layers which are now mostly filled with secondary minerals and copper.

Locally, however, there are large areas of amygdaloid that is fragmental and somewhat thicker, especially on the stratigraphically lowermost lode that has been mined, the Pewabic. The average thickness of the trap layers between amygdaloids is of the order of 20 feet, but locally a single flow may attain a thickness of 100 feet or more.

The correlation of individual tops through the mine is uncertain in many places. Records of crosscuts or drill holes on some levels reveal more flow tops in a given stratigraphic interval than are shown on the level above or below (pl. 14). The tops are not plane surfaces, and correlation at such points must be rather arbitrary. Considerable uncertainty is a result of the incompleteness of the geologic record in many parts of the mine. Correlation is most certain on those lodes that have been fairly continuously stoped, such as the East, Main, and First West lodes.

Structure.--The variation in strike of the lodes in the mine is small, but the dip varies from 55° at the surface to 35° in the lower levels. The dip flattens more abruptly at the south than at the north end of the mine, forming a gentle flexure which pitches at a low angle to the north.

One particularly prominent and persistent fissure, the "Spar Crossing," extends through the mine; it strikes nearly at right angles to the lodes and dips steeply northward. Less persistent fissures with a similar trend are shown on the company maps (see pl. 13). The only fault of note that affects the Pewabic lodes is the Hancock fault, which

cuts the lodes in the upper levels at the south end of the Quincy mine, as shown on plates 13 and 14. The fault strikes northeast and dips rather steeply to the northwest; it causes a repetition of the beds and has a horizontal stratigraphic displacement of about 500 feet.

Mineralogy.--Native copper is the chief ore mineral, and occurs in minute grains and in masses up to 100 tons or more. There is enough native silver with much of the copper to warrant its separation.

The secondary minerals that occur in the lodes with the copper are quartz, calcite, epidote, prehnite, and chlorite. These minerals have filled cavities and have replaced the original rock-forming minerals. The Spar Crossing, described above, contains these minerals and, in addition, laumontite.

Distribution of copper.--In the coalesing amygdaloids the copper occurs in and near the coalescing layers; it has filled the coalescing vesicles and replaced some of the adjacent trap. The copper is fairly uniformly distributed from top to bottom of the fragmental amygdaloids in areas where they are mineralized.

The distribution of stopes (pl. 13) suggests that most of the copper in the upper levels was mined from lodes that are stratigraphically higher than the lodes principally mined in the lower levels. Too great reliance cannot be placed on stopes as indicators of the distribution of copper at this mine, because many of the lodes have been explored only by an occasional crosscut or drill hole. This is particularly true of the Pewabic, the Far West, and the Far Far West lodes. In some places the lodes are too closely spaced to permit safe mining of two adjacent

lodes, yet not closely enough spaced to permit taking both together; in other places stopes started on one lode have cut across the intervening trap and continued on another. There is no reason to believe that all, or even most, of the copper has been recovered from the Pewabic lode within the mine area, particularly in the upper levels.

The stoping pattern in the bottom of the mine reflects the fact that about 50 percent of the ground has been left in pillars because of the depth of these workings. The grade of the ore on the bottom levels is as good as that on the upper levels.

See attached report on Quincy mine production

John Hoyt
Cad,

COPPER RESERVES
of the
QUINCY MINING COMPANY

The copper bearing lands of the Quincy Mining Company are included in an unbroken tract of approximately 3000 acres of surface and/or mineral rights in Hancock, Quincy and Franklin toenships of Houghton County, Michigan. These rights are well located in the'Keweenaw Copper Belt' which runs from Ontonogan County through Houghton and Keweenaw Counties. Southerly from Quincy in this copper belt are the White Pine and Copper Range mines and to the northeast for 40 miles are the copper lands of Calumet & Hecla, Inc.

According to the most knowledgeable of the geologists of U.S.Bureau of Mines, in regard to Michigan's copper mines, and according to the geologists of the Sate of Michigan and of the mining department of Michigan Technological University, there are seven known copper bearing lodes running the full north-south length of Quincy's mining lands.

All of the now living geologists and mining engineers who have studied the Quincy mines or have worked in them have this to say: " It is probable that there is as much copper left in the Quincy mine as has ever been taken out" or other statements meaning the same.--Up until its closing in 1945 Quincy produced close to one billion pounds of copper.

Harry J.Hardenberg, Deputy State Geologist, State of Michigan in a letter dated November 29,1966 wrote as follows:

"From a study of the maps of the mine and from a review of various reports, I believe that the Quincy Mine property has possibilities of containing commercially mineable ground. In my opinion a feasibility study of this potential is warranted."

From the U.S.Geological Survey of Michigan's copper mines made during the 1940s:

" The (Quincy) mine was shut down in 1945. The total production up to that time was almost exactly one billion pounds of copper.

" There is no reason to believe that all , or even most, of the copper has been recovered from the Pewabic Lode within the mine area, particularly in the upper levels.--- About 50% of the ground has been left in pillars.--- The grade of the ore on the bottom levels is as good as that on the upper levels." *Note. The Pewabic Lode is the only lode Quincy has worked since the lode was discovered in the early days of Quincy. There are seven other known lode

(continued onpage -2)

W.A.Seaman , geologist and former professor of geology at the Michigan College of Mining and Technology, wrote on December 8,1966:

"Mr. (Chas) Lawton,General Manager of the Quincy, before he died, agreed with me that we would get more copper out of Quincy " on our way back up" than was mined on the way down.--- Much of the upper workings were negelected. "

Franklin G.Pardee, Mining Geologist and for 25 years the Appraiser of Mines for the State of Michigan wrote in September 1965:

" Since there are seven lodes at the Quincy known to carry copper but which have not been tested in the upper part of the Mine, the exploration of this area at the Quincy is a worthwhile project -- especially as a developement of a favorable lode will undoubtedly continue at depth."

" It stands to reason that some of the above mentioned lodes(7 of them) must extend through to surface and that a careful and thorough geological exploration would show copper- probably in commercial amounts - in one or more of the lodes."

" the Quincy Mine offers possibilities for future exploitation on a commercial basis".

Frank C.Schwarzenberg,P.E.Chiefmining engineer for Quincy Mining Company: for many years wrote as follows in a letter of January 16,1967.

" in my opinion there still remains in the Quincy mine as much commercially mineable copper rock in pillars and undeveloped lodes as has been mined in the 99 years the mine was worked."

Mr. Lenier:

Please return this letter to meas soon as possibel. Make a copy, if you wish to.

J.R.

September 11, 1970

[redacted]

[redacted]X

My home work is finished up to the point of a very close estimate of the cost of rehabilitating number 6 and number 8 shafts of the Quincy mines and the construction and equipping both with what is needed for 2,000 tons per day rock hoisting from each shaft.

My figures are based on the assumption that the mine operators might want the mines to be equipped for full production right from the start and that all equipment be purchased new. It is also based on contractors prices for all work done in preparing the mines for operation. (Two used 120 ton diesel switching locomotives are included.)

A large amount of money can be saved by having much of the rehabilitating of the shafts done by mine employees who are experienced in timbering and electrical and mechanical work such as for power, lighting, and air and water plumbing. Very good used equipment would also save some money.

My figures include the construction of 4 miles of railroad needed to ship rock to the C&H Ahmeek stamp mill via the Soo Line Railroad (about 8 miles) and the C&H railroad (about 7 miles).

A contingency fund of $500,000.00 is also included for unforeseen costs, small equipment and inflation between now and then.

All my "numbers" are substantiated by quotations from contractors or suppliers.

Included is a dewatering U.P. Power Co. electric power charge of $500,000.00 for pumping out the 2 billion gallons which are probably now in the mines, including the 150 million gallons of water which will come in during the two years of pumping. (Gas fueled diesel-electric power at $250,000.00.) We figure that only the 46 lower levels of the mines are flooded.

I believe that the Quincy mines should have their own management in order to assure that high quality labor is employed there, instead of having to take the "second team". The success of Quincy depends

on work efficiency underground as well as upon good equipment. There are some very good men available to whoever operates Quincy including a top flight geologist--mining engineer and a man for surface management who is operation wise and cost conscious.

My numbers total $13,017,520.00 (thirteen million, seventeen thousand five hundred and twenty dollars)

Regards,

Jack Foley

September 12,1970

	Hoisting equipment, crushers, skips etc. ---	$7,045,570
	Mine collar and shaft rehabilitation ------	2.650,000
	Compressors, drills , drill shop ----------	737,000
	Shaft timber(western fir) ----------	670,000
	Shaft ladders (~19,000 feet) ----------	19,000
	Skip rails (85 pound) ----------	170,000
	Pipe (water , air) ----------	190,000
	Pipe fittings ----------	7,700
	Pumps (day to day dewatering USED) -------	20,000
	Machine shop (building repairs, used equip)	100,000
*	Railroad: track by Soo Line ----------	170,000
	Diesel swith engines (two,used)-	70,000
	Dewatering: Pump and platform ----------	20,000
	Labor , two years ----------	120,000
	Electric power (U.P.P. Co.) --	500,000
	Extra hoisting rope (10,000 ft) ----------	28,250
	Contingency fund ----------	500,000
		$13,017,520

* rock cars would be leased from Soo Line

Trucks , bulldozer, snow removal equipment available from Quincy Mining Company -- free of charge

There is also some useable mine equipment such as $20,000.00 sheaves.

Please return

Dewatering

QUINCY MINING COMPANY August 10,1970

Mine water -- Bailed and pumped during 1919

total gal. 69,617,500
bailed 20,610,000
pumped(est)49,007,500

No.2 shaft ---	bailed	3,737,000 gal.	
No.6 "	"	5,231,000 "	
No.8 "	"	11,642,000 "	20,610,000 gallons
No.6 "	pumped	14,880,000 gal.	
No.8 "	"	13.140.000 "	
No.8 drinkwater	"	2,737,000 "	
Mo.9 drinkwater	"	18,250,000 "	49,007,000 gallons
			69,617,000 gallons per yr

The mines have been closed for 25 years, therefore, if water is not leaving the mine at some point down deep there is, as of now about 1,740,000,000 gallons of water in the mine. If it would take two years of pumping we must add another 150 million gallons to the as of now total to have the mine dry at the bottom of #6 and #8 shafts.---- At comparatively little cost, mining could be started in the upper ground through #2 shaft long before deep mining is
** underway through #6 and # 8.

The above tabulations were taken from 1919 records kept by the Quincy mining engineers.(Ray Armstrong, I think)

** Note. Mineralization of the Quincy veins increased with depth in the northerly direction. Richer in the upper levels in the southerly end of the veins. The upper levels of #2,#5,#7 should be reworked and parallel veins mined from #2 shaft.

J.F.

V. Clare Kelburn

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

December 10,1970

Mr. Howard Lenier
Essex International
1704 West Grant Road
Tuson, Arizona 85700

Dear Mr. Lenier:

Enclosed herewith is some information which could be helful to you. Bring it with you when you come, if you come,to Houghton County. If yu dont come please mail it back to me.

Please write or telephone telling me when you will arrive. I will met you at the airport.

F.
Maynard Ayler
1315 Normandy Road
Golden
Colorado

Telephone 238-2063
2063

Am looking forward to meeting you.

Sincerely yours,

John Foley

John Foley

November 16, 1971

CALUMET & HECLA

Contacted William (Bill) Jones, presently with Harvey Ferer in Omaha, at the following number: (402) 342-2436. Jones was formerly in charge of sales with C&H.

I inquired regarding the facilities and condition of the equipment at the C&H smelter and mine operation. He advised that they had three reverb furnaces and no converters. They were principally fire refining and casting 8" billets. Their nominal production rate was 1.4 million pounds per week. Personnel who may still be at the plant are Tom Knight, Chief Engineer, and Ken Farley, Materials Control Supervisor. They had two operational mines at the time the plant closed because of labor dispute on Aug. 21, 1968.

C&H has been acquired by Universal Oil Products. I plan to contact Mr. Richard N. Spear. Mr. Spear is the Group Vice President in charge of the C&H Operations, 800 Northwest Hy., Palatine, Illinois. The Evanston, Illinois number is (312) 869-5900. (In calling this number we were referred to (312) 792-3344 in Chicago). In addition to the mine and fire refining plant they had an ammonia leach system that was used to upgrade scrap.

December 3, 1970

Was able to get in touch with Richard N. Spear regarding the status of the C&H property. He advised that they are currently in negotiation and, as a consequence, he is in no position to discuss the status. He indicated that a decision should be reached within a month. At that time if the negotiations are not successful they will be glad to initiate discussions with Essex. I am to write a letter to him confirming our telephone call stating our interest.

January 7, 1971

Called Richard Spear to determine the status of the C&H property, inasmuch as I had heard that the Hanna deal had fallen through. Spear confirmed that Hanna had made an offer to the union and that as a consequence of the union position, Hanna had withdrawn. I inquired if he was willing to have Essex enter the picture at

this time. He responded that it would be highly inappropriate for anyone else to enter negotiations with them or the union regarding the property. He indicated that they would be reviewing their position and would advise me of what action could be taken at an appropriate time.

January 19, 1971

Received a call from Jack Foley advising me that Mr. Gibbons was in the area with the intent of initiating liquidation procedure for the C&H properties. He wanted me to authorize him to contact Mr. Gibbons to convey Essex's interest. I advised him that I would not do this but would contact Mr. Spear to see if Universal Oil's position had altered regarding the C&H property. Foley's interest in the deal is his desire to tie the Quincy operation to anyone taking the C&H property.

January 20, 1971

Called Richard Spear to check on Foley's comments about liquidation of C&H. Spear referred me to a Robert W. Johnson, Assistant to the President (John Logan) of Universal Oil. Johnson and I had a very frank discussion regarding the problems with the union and their concern about bringing anyone in to attempt to operate any or all of the operations at C&H.

Universal Oil's decision is to liquidate. They will not permit anyone to come into the area to operate any or all of the facilities. They feel the union and community problems are too deep-seated. He claims that liquidation will not hurt them financially and that it is the only answer to the union's problems.

The man handling the liquidation is Frank Gibbons, who was formerly Financial Vice President for C&H. Johnson will have Gibbons contact me regarding liquidation in the event that we have interest in any part of the plant facilities. Johnson advised that the ammonia leach plant for scrap processing is more of a process than a group of facilities that can be reclaimed. Apparently tanks are constructed in the ground and cannot be removed. I shall do nothing further until I hear from Mr. Gibbons.

H. Lanier

Jan. 26, 1971

CALUMET & HECLA

Frank Gibbons, former Vice President Finance with C&H, and presently on special assignment to liquidate the C&H assets, called regarding Essex's interests in the property and facilities.

Gibbons states emphatically that there is no hope of UOP re-activating the operation. A letter of intent was developed with Hanna Mining Company to provide a basis for Hanna re-negotiating a position with the union. Hanna has now dropped out. The United Steel Workers International has taken trusteeship of the local and it indicated interest in reactivation of the operation. The International is now paying strike benefits to 200 employees.

Before the closing in Aug. 1968, C&H had 1,000 hourly employees and 242 salaried employees (supervisory, clerical and technical). 350 of the hourly employees have gone to work for White Pine. Currently UOP has 27 caretaker employees at the facilities, including engineering, accounting, and mine engineering personnel. UOP has a separate geological staff of 11 men who are working on other properties. These men would not be involved in any agreement with an outside party. However, Gibbons did indicate that they have other properties that may be of interest if a lease arrangement were made.

I advised him that we are interested in inspecting the property as well as the records. I indicated that I would contact him next week to confirm arrangements for a visit the second or third week in February.

H. Lanier

1704 W. Grant Rd.
Tucson, Arizona

December 3, 1970

Mr. Richard N. Spear
Universal Oil Products
C&H Operations
800 Northwest Highway
Palatine, Illinois 60067

Dear Mr. Spear:

This confirms our telephone conversation of Dec. 3, 1970, in which I inquired regarding the status of the C&H Operations in Michigan.

It is my understanding that you are currently in negotiations with another party which prevents further discussion regarding these properties. If the current negotiations are not fruitful, Essex would appreciate an opportunity to enter into discussions with you regarding the mining and processing facilities in upper Michigan.

It would be appreciated if you would advise me of any change in the status which may warrant further discussions.

Very truly yours,

ESSEX INTERNATIONAL, INC.

Howard Lanier, General Manager
Copper Operations

HL:td

cc: P. W. O'Malley
Essex International, Inc.
1601 Wall Street
Ft. Wayne, Ind. 46804

November 16, 1970

CALUMET & HECLA

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cc: P.W. O'Malley

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800 Northwest Hy. Palatine Ill.

November 16, 1970

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Check Number.

HA7-9690
RO3-6000

359-6300

December 3, 1970

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H. Lanier

cc: P.W. O'Malley

H. Lawrence –

This guy is a reformed drunk. AFTER READING THE letters it looks like the reformation is over

1-26-72.

Memorandum from . . .

HOWARD LANIER

1/27/72

Paul Simon ——

More on C&H.

SXM

FEB 3 1972

RECEIVED

file under C & H.

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

1/21/72

Dear Paul:

It just occured to me that you might wonder why Calumet & Hecla, now Universal Oil Products Co., or the Quincy Mining Company did not acquire the Arcadian and Franklin Junior mines.

The only reply I can honestly make is to make reference to the histories of those two companies. Neither are in good character.

C&H once owned the White Pine copper reserves. They were let go at a tax sale for a few hundred dollars to Copper Range. White Pine is now the fifth largest (maybe 4th now) copper producer in the U.S.

C&H also owned the rod mill and wire mill (Foley Copper Products) in Dollar Bay. They acquired it with the Tamarack & Osceola mines. They shut them down and sold them just one year before Anaconda built a rod mill near Butte and bought a couple of wire mills. Foresight?????

With this kind of record it is now wonder that they ignored what is under their nose.

Quincy changed from an expanding copper producer, up to 1914, into a ' dairy' operation which believed in milking the cows but not feeding them. Quincy has some very good unmined mineral just west of the Arcadian and Franklin Junior properties. It also has some scavaging copper in the upper levels of all its shafts.

Jack

Jack Foley

P.S.

Russell Hoyer and Bill Veeser the President and Vice President of the Upper Peninsula Power Company have taken on the responsibility of raising the local share (10%) of the $185,000.00 it will take to pump out and recondition the New Baltic shaft. We are already working on Uncle Sam for 80% and on E.I.Inc. for 10%.

Visual inspection of existing shaft and/drift will indicate how much exploring can be done without further drifting cross cutting and sinking.

J.F.

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

1/21/72

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

Dear Paul:

I spent over a year researching old records and reports to put this brochure together, with the aid of Frank Schwarzenberg and Bill Langdon, the U.S. Bureau of Mines and the Michigan Department of Natural Resources. The old books from the old Calumet & Hecla librrary were very helpful and accessable, now that they are in the library of the Michigan Technological University at Houghton.

There is no one left at C&H who knows anything about anything and they would not tell me any of it if they did. Neither C&H nor Copper Range wants competition for mine labor coming into "their" labor market. White Pine (Copper Range) has about 300 former C&H men who are riding a bus, round trip, more than 3½ hours per day. They will quit at the first job opening back in Houghton County.

There is no mine knowledgeable men left at Mich. Tech. There has not been one for twenty five years or more. The head of the so called mining department has had two years experience as a safety engineer and two years as a pump man. He knows nothing unless he has a book open in front of him.

I have told you the above so that if you want opinions other than ours, you had best send a mining man up here to study the geological data available.

I call your attention to Wyllis Seaman's letter, brochure page 19. Also study carefully the data on pages 18 through 33.

It is our belief that the Arcadian mineral lands can produce 75 million pounds of copper per year forover 75 years. AT A PROFIT .

Sincerely yours,

Jack Foley

Jack Foley

P.S. Calumet & Hecla will be operating agin within three years. They first got rid of their union and their old men and now they are scraping all their antiqauted equipmeny . There will be a new milling and refining complex right at their mines .

J.F.

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.

The Milwaukee Sentinal
January 1,1972.

Copper Exploration Sliced

Tucson, Ariz. –AP– Four copper companies with exploration offices here are reducing or completely shutting down their exploration staff work because "times are tough in the copper business."

Kennecott Copper Corp., Anaconda Co., Copper Range Co. and Cerro Corp. revealed the economic moves Friday.

Herman L. Bauer Jr., president of Kennecott's exploration subsidiary known as Bear Creek Mining Co., said about 65% of exploration employes will be laid off.

"General adverse circumstances confronting the copper industry is the reason for this cost reduction effort," Bauer said.

Anaconda's exploration staff will be cut in half, said Robert Weed, head of the primary metals division headquartered here.

James Richardson, president of Copper Range which has its principal mining interests in Michigan, said the firm is consolidating its exploration efforts in one small office in Denver. He said the firm has had exploration offices in several cities, including Tucson.

Cerro Corp. district chief Thomas W. Mitcham said the entire exploration department of the firm is being phased out. He said the exploration department employed 50 persons, including 28 geologists.

Mitcham said the curtailment even meant termination of his own job.

"The popularity of mining is going down because of the unrealistic environmental regulations that are being proposed by extreme groups," Mitcham said. "This influences politicians."

The information in the above news release strengthens the economic position of shaft mining of Michigan's metalic copper in the Keweenaw area . Here the only polutants are very minute quantities of calcium amd sodium chlorides in the mine waters.

Every winter , in Houghton County, Michigan alone, more than one thousand tons of salt is spread upon the streets and roads for ice removal. All of this gets into the ditches and gutters and, eventually,Lake Superior . All the copper mines of the Keweenaw Peninsula,ever to have been operated, if all were operated at the same time,would not result in this much contamination over a period of twenty five years.

There is no air polution resulting from the mining, milling and refining of Michigan's metalic copper.

BACK TO THE SHAFT MINES.

The following copper mining news indicates that Anaconda Co. also is going back to old shaft mines to re-work them with modern tools and techniques.

The LEONARD mine was first opened sometime in the 1890s. It became the property of BOSTON & MONTANA then of the AMALGAMATED COPPER COMPANY and is now owned by ANACONDA.

ANACONDA RECALLS MEN AT MONTANA FACILITIES

The Anaconda Co. has announced that all its Montana copper workers were recalled to their jobs by Oct. 18. Martin K. Hannifan said Oct. 18 had been designated as "production day" for the Butte mines. The Berkeley pit, underground mines, Weed concentrator and mechanical-construction department were back in full operation on that day. The Leonard mine, closed since 1967, also is to reopen. The company said the Leonard initially will employ about 20 men with the work force projected to increase to about 150 in the next 18 months.

Company operations in Butte, Anaconda, Great Falls and East Helena were closed by strike on July 1. After the strike settlement was ratified by the unions on Sept. 22, the Anaconda, Great Falls and East Helena plants resumed work, but the start-up in Butte was delayed until the smelter could absorb the production. At the end of the strike the company estimated it would take about six weeks before the Butte operations could resume.

Machines of this type have been in use in iron mining and other industries for several years. It has now been adapted to processing metalic copper bearing rock such as is mined in Houghton, Keweenaw and (south) Ontonogan counties, Michigan. The crusher will take rock of 10" size and discharge it at floatation tank size, bearing the very finest of fine copper, after automatically separating and discharging the heavier chunks of copper.

Told to John Foley by John W. Keck

Daily Mining Gazette
Houghton, Michigan January 14,1972

Copper research showing results

HOUGHTON — Initial results are encouraging in study of the feasibility of grinding native copper ore autogenously, conducted by the Michigan Tech Institute of Mineral Research.

These ores traditionally have been crushed in steam stamps and ground in mills containing steel balls. Operation of the steam stamps was expensive due to high labor and maintenance costs. Also, grinding steel consumption in the ball mills was high.

In autogenous grinding, an ore grinds itself by the action of rock striking other rock in a tumbling mill. Successful application of this process to the treatment of native copper ore would enable a single piece of grinding equipment to replace the steam stamps and several stages of conventional grinding, reducing the cost of ore processing.

As the ore is ground autogenously, large pieces of liberated native copper would be removed continuously from the circuit by gravity concentration, and fine copper would be recovered by flotation.

In order to study the feasibility of using autogenous grinding with native copper conglomerate and amygdaloid ores, a three-month pilot plant test was run at the Institute of Mineral Research. The test was under the direction of John W. Keck, IMR research engineer.

Keck said the objectives of the test were to observe the behavior of the ores in the autogenous grinding mill, to determine the power required to do the grinding, and to test various methods of removing pieces of native copper liberated during the grinding process. The tests were conducted on 40 tons of conglomerate ore and 30 tons of amygdaloid ore.

Keck reported that the test rusults were encouraging. Power consumption for autogenous grinding was about as expected, and the recovery of copper from the ground ore was at least equal to that obtained by traditional treatment of the ores.

Dr. W. L. Freyberger, director of the MTU Institute of Mineral Research, said the next phase of the study will be to make a more detailed analysis of improved economics and processing efficiencies re ulting from the use of autogenous grinding.

SUPERVISING the autogenous grinding operation in the pilot plant of the Institute of Mineral Research at Michigan Tech is lab technician Frank Herveat.

Milwaukee Journal - October 17,1971

Reactivation of Mines Explored

Special Correspondence

Houghton, Mich. – Despite the fact that not a pound of refined copper is being produced now in Upper Michigan's Houghton or Keweenaw Counties, formerly the prime copper counties in the Midwest, the possibility of reactivating some mines is being explored.

At Winona in Houghton County, the Lake Superior Copper Co. is exploring the old King Philip Mine with an idea toward putting it into production ultimately. The exploration is down beyond the eighth level.

At Greenland in Ontonagon County, the US Bureau of Mines this fall will reopen the former Caledonia property, mainly for research purposes. This mine formerly was part of the once great Calumet and Hecla holdings.

A group named Copper Industries Development is attempting to resurrect the former Arcadian Copper Company's new Baltic shaft.

The Arcadian is between two famed copper deposits, that of the renowned Calumet and Hecla and the still widely known Quincy. The Quincy is the deepest mine from which copper has been extracted in North America. Neither of these deposits is being worked now.

All costs of reopening the new Baltic as far down as the 1,250 foot level have been worked out by experienced mining men.

Copper Industries Development has been given the exclusive right to mine the new Baltic and the new Arcadian shafts, both of which formerly were producers. The development firm, which has headquarters at Dollar Bay, has the rights to 4,300 acres of mining property along the Keweenaw Peninsula range.

In the early days of 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 <u>One Million Tons</u> of copper in the Arcadian area copper lodes.

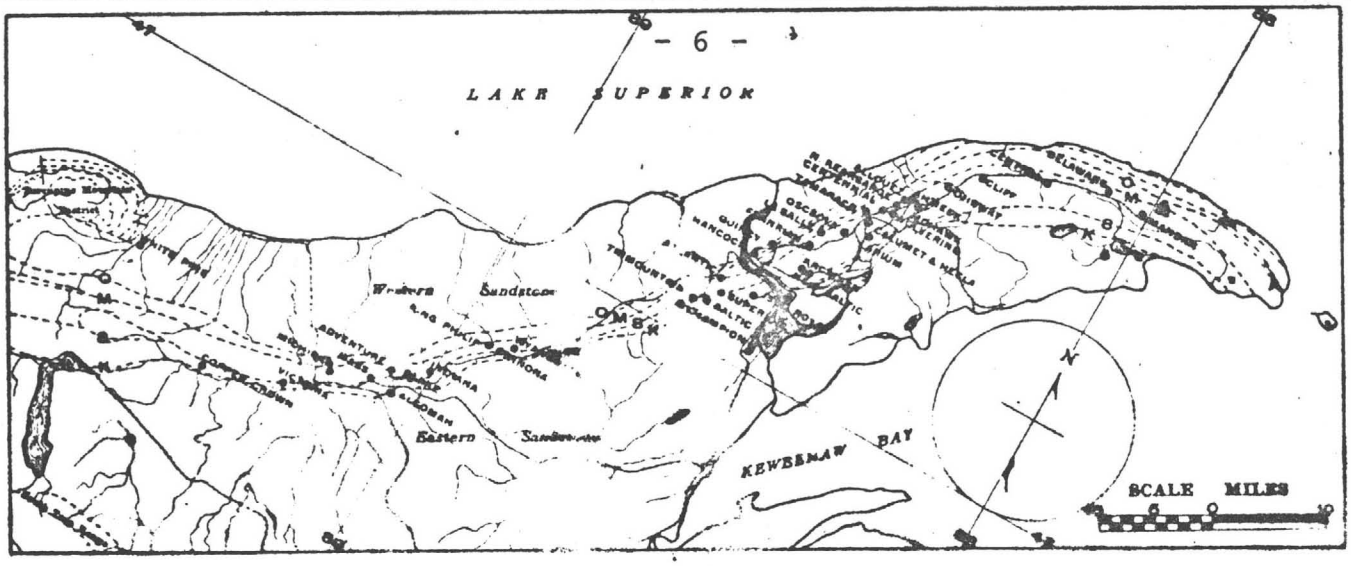


Figure 1. Outline map of Keweenaw Point showing location of mines.

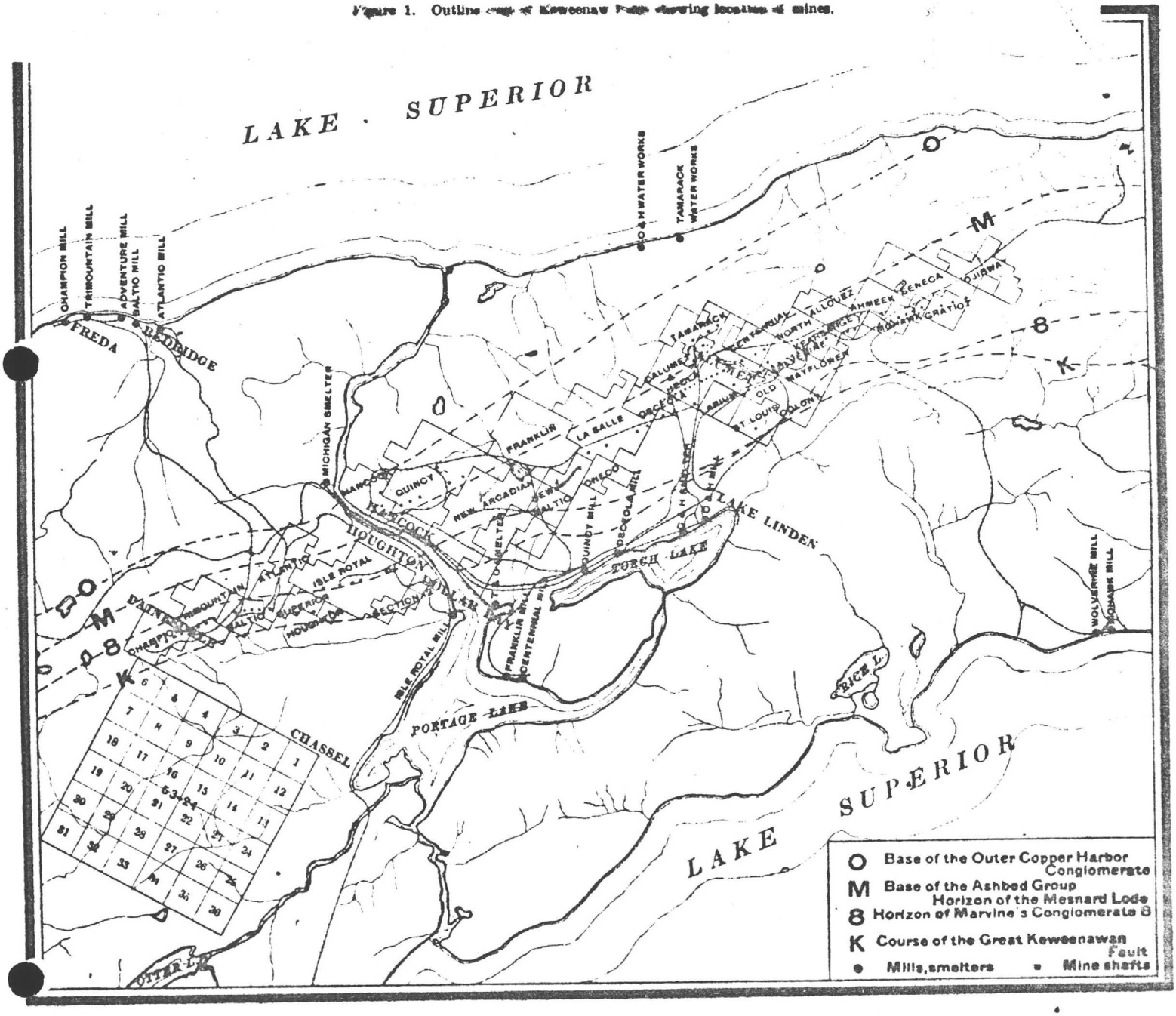
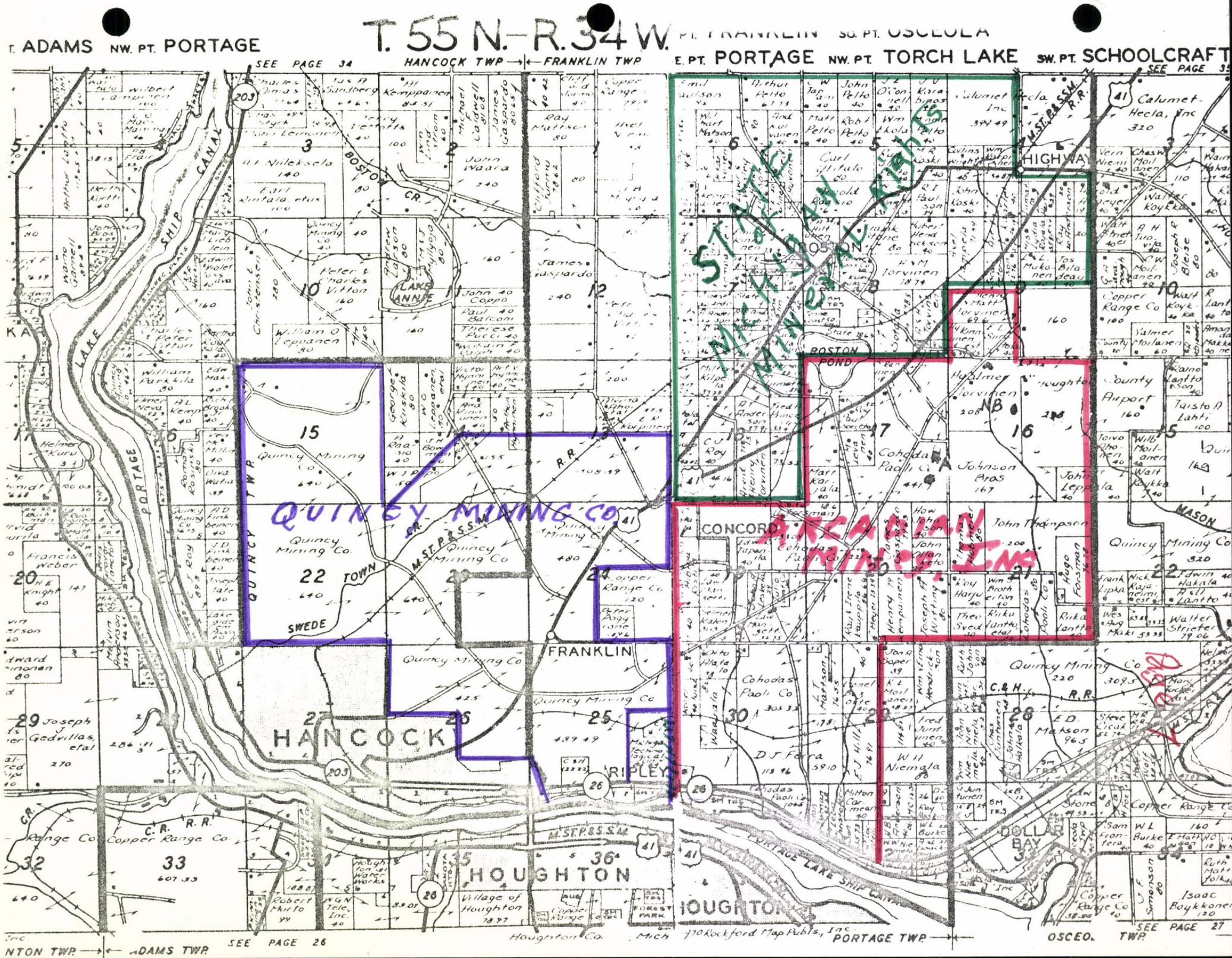


FIG. 2. CHIEF COPPER PRODUCING SECTION OF KEWEENAW POINT.

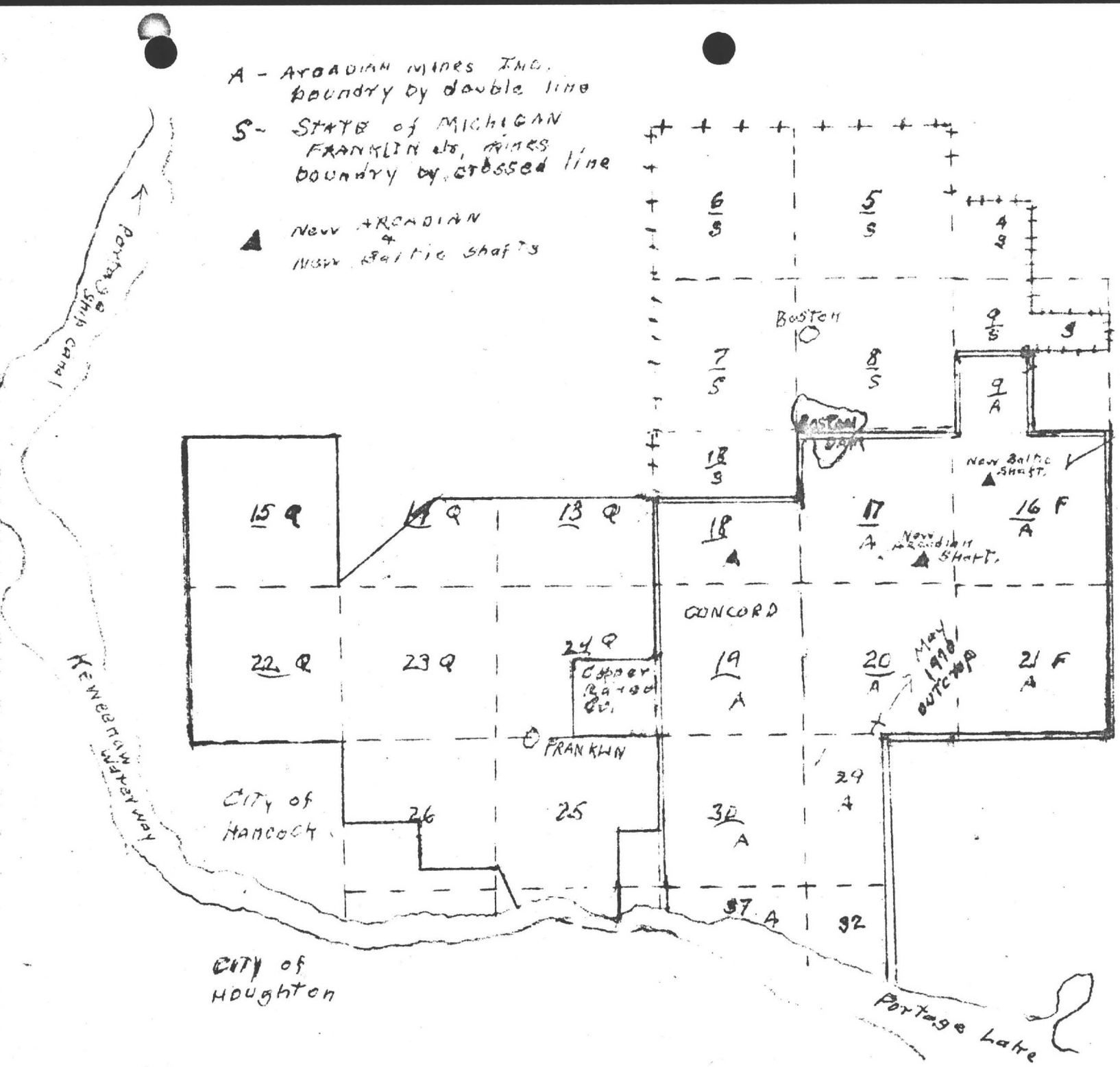

T. 55 N.–R. 34 W.
T. ADAMS
NW. PT. PORTAGE
SEE PAGE 34
HANCOCK TWP
FRANKLIN TWP
E. PT. PORTAGE
NW. PT. TORCH LAKE
SW. PT. SCHOOLCRAFT
SEE PAGE 35
STATE OF MICHIGAN MINERAL RIGHTS
QUINCY MINING CO
CANADIAN NICKEL INC
LAKE PORTAGE
SHIP CANAL
QUINCY TWP.
PORTAGE TOWN
BOSTON
LAKE ANNIE
BOSTON POND
CONCORD
FRANKLIN
HANCOCK
RIPLEY
HOUGHTON
DOLLAR BAY
M.ST.P.&S.S.M. R.R.
C.&H. R.R.
C.R.
HIGHWAY
MASON
SWEDE
PORTAGE LAKE SHIP CANAL
Houghton Co. Mich.
©1970 Rockford Map Publishers, Inc.
NTON TWP.
ADAMS TWP.
SEE PAGE 26
PORTAGE TWP.
OSCEOLA TWP.
SEE PAGE 27

A - ARCADIAN Mines Inc.
boundry by double line

S - STATE of MICHIGAN
FRANKLIN etc, Mines
boundry by crossed line

▲ New ARCADIAN & New Baltic shafts

Houghton County
Michigan



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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		Rest of the world	
			Low	High	Low	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.

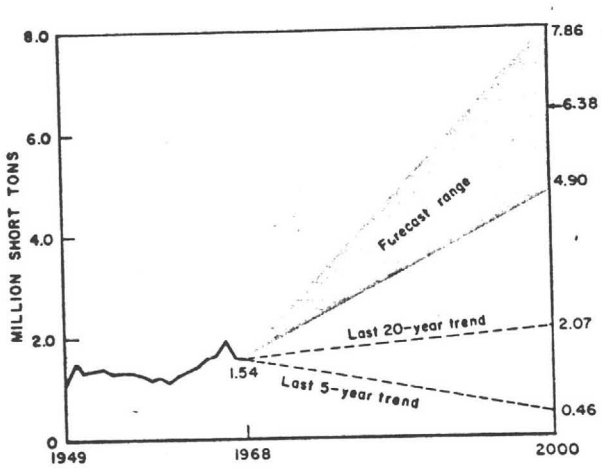

FIGURE 4.—Comparison of Trend Projections and Forecasts for Primary Refined Copper Demand.

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).

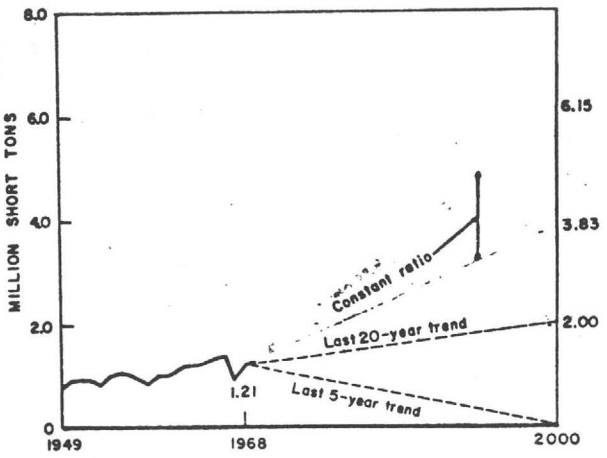

FIGURE 5.—Comparison of Trend Projections and Forecasts for Primary Refined Copper Production.

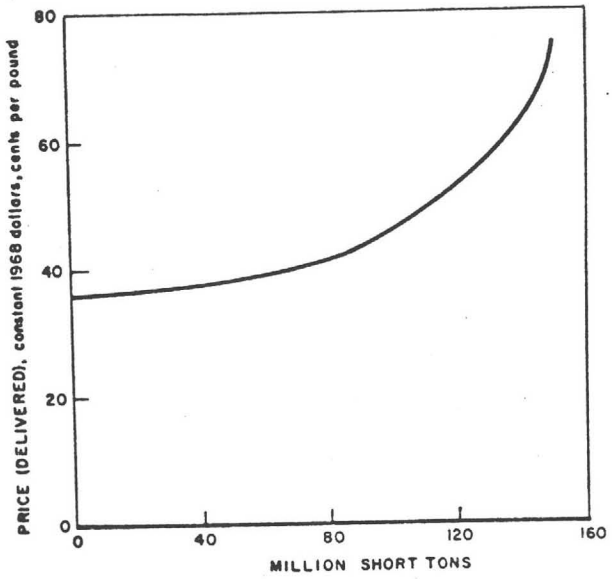

FIGURE 6.—Projected Domestic Availability of Copper.

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 ccoss 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.

W A Seaman
7/24/1970

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Received Aug 24, 1970

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 what 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.

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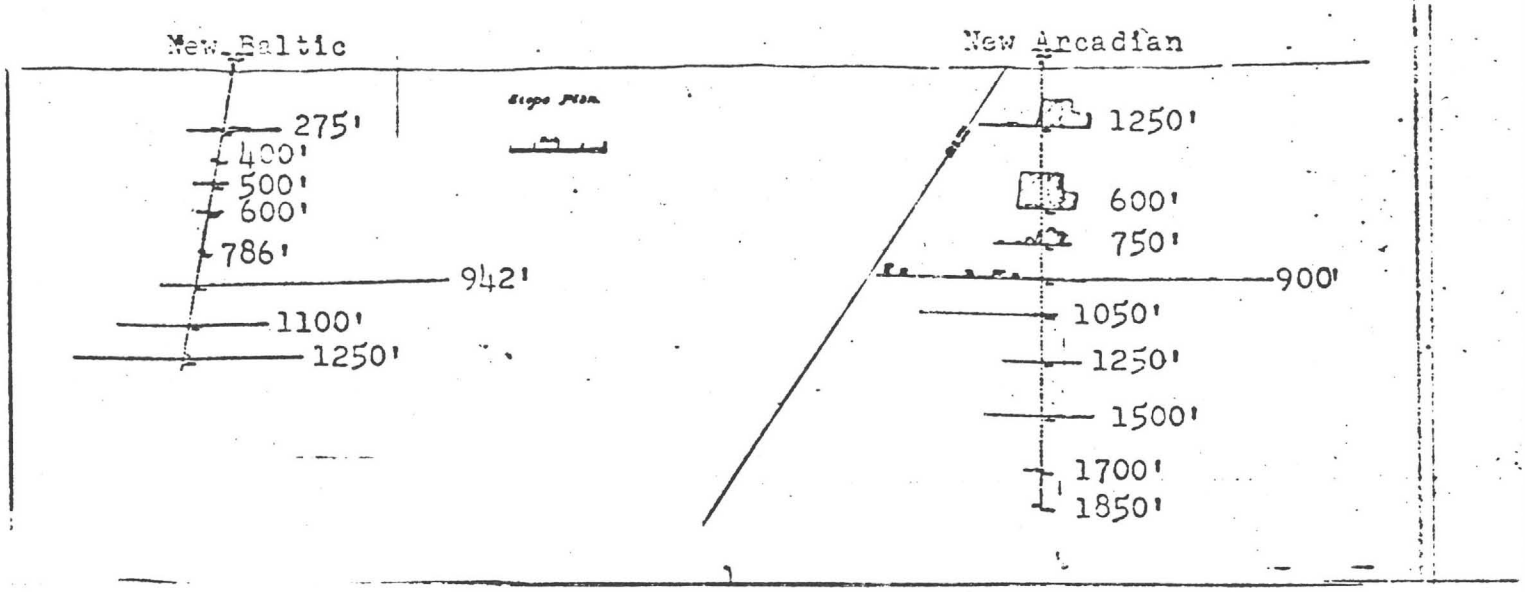
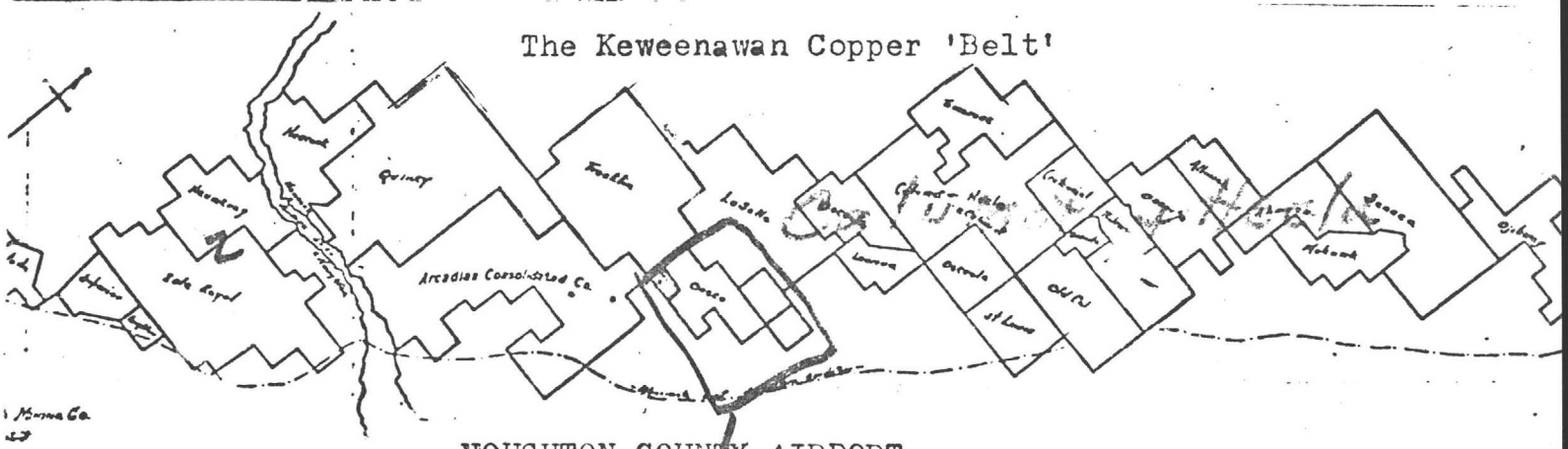
In the"NEW ARCADIAN" mining area



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 mines in Ontonogan County. The general direction of the lodes is Southwest to North

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.

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)	Year	Refined Copper (pounds)
1864	4,593	1900	1,350,000
1865	5,816	1901	500,000
1879	24,760	1902	600,000
1890	34,037		
1899	500,000		3,019,203

NEW ARCADIAN LODE

**Year	Rock treated (tons)	Refined Copper (pounds) Total	
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	Refindd Copper (pounds)	Year	Refined Copper (pounds)
1866	9,989	1874	22,518
1867	52,020	1875	440
1868	171,185	1876	900,146
1870	9,815	1880	10,464
1871	123,626	1881	28,849
1872	143,782		
1873	122,168		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	50,100
1865	6,809	1877	3,253
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 both also in low production and operating profit.

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

"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.

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

MICHIGAN

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.

FRANK C. SCHWARZENBERG:

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 Centennial shafts.

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.