C&H SMELTING WORKS

ADDENDUM REPORT TO PHASE 1 of TASK 3:
Historical Archive Research and Mapping

From the North End of Torch Lake to Hubbell Beach
C&H Lake Linden Operations Area

Prepared for:

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
Remediation and Redevelopment Division
55195 US Highway 41
Calumet, Michigan 49913

Prepared by:

MICHIGAN TECHNOLOGICAL UNIVERSITY
John Baeten, MS
Carol MacLennan, Ph.D. (Principal Investigator)
With help from Emma Schwaiger
Industrial Heritage and Archaeology Program
Social Sciences Department

October 2014

Contract No. Y14110

INTRODUCTION TO PHASE 1 ADDENDUM

C&H Smelting Works

The initial research on the C&H Smelter and its accompanying buildings (Smelting Works) was completed in Phase 1, Task 3 between April and June 2014 and submitted in a report to Department of Environmental Quality in July 2014.[1] In this report, the Smelter Works was only one of several sites under investigation during this period. Because of the significance of the Smelter in the production of hazardous waste material and its continuous operation between the 1880s and 1960s, as well as the volume of historical material available on the smelter site, MDEQ and MTU researchers decided to continue investigation of the C&H smelter into the summer of 2014. This report provides is an addendum to the material already available in the Phase 1 report.

C&H Smelting Works contained several buildings, two of which became the focus on continued research: Smelting and Refining Building and the Coal Pulverization Plant. A smaller amount of additional information is also provided on the Electrolytic Plant and the Coal Dock that was not previously available.

This document is organized in the following sections:

[1] Building Narratives, Maps, and Documentation: Torch Lake Waterfront.

Section 2 includes (1) an expanded narrative for the Smelter and Refining Building and general activities within the Smelting Works. It draws upon additional archival materials from the MTU and KNHP Archives, the *Engineering and Mining Journal,* and *C&H News and Views*; and (2) an expanded and detailed timeline for the C&H Smelter operation.

Section 3 includes extensive documentation not already provided in the Phase 1 Report: additional interview summaries; detailed researcher notes from the *Engineering and Mining Journal* and *C&H News and Views* with Smelting Works activities highlighted researcher notes from MTU and KNHP Archives research along with a list of all archives folders consulted, and scanned copies of correspondence and drawings from the Archives of special interest.

Research during the 2014 summer and preparation of the C&H Smelter Narrative and Timeline is the work of John Baeten, Ph.D. student in the Industrial Heritage and Archaeology Program at MTU. Additional research on coal pulverization and the electrolytic plant from the MTU archives by Emma Schwaiger, MS student in the Industrial Heritage and Archaeology Program at MTU. Carol MacLennan, Ph.D. in Social Sciences at MTU is the Principal Investigator for the project.

TABLE OF CONTENTS

[2] Smelting Works topics highlighted in yellow. 1918-1968

[3] Smelting Works topics highlighted in yellow. 1942-1949

[4] Composed of researcher notes from individual folders related to the C&H Smelter buildings located in MTU and KNHP Archives. Organized by Series and Folder names.

Section 2: C&H Smelting Works Narrative and Timeline

Calumet & Hecla Smelting Works

In 1886 Calumet & Hecla constructed a smelter adjacent to their stamp mill on Torch Lake at Hubbell, Michigan. Prior to the building of this Michigan based smelting works, Calumet & Hecla sent the ore from their mines to either a local smelter, such as The Detroit and Lake Superior Smelter for custom smelting, or to a number of established smelting works on the east coast to be refined. The smelter at Hubbell was originally designed with metallurgical technologies consistent with most mid-nineteenth century smelters, consisting of hand-fed reverberatory furnaces, hand-operated jib cranes, and hand-ladled mold casting.[1] While these methods effectively melted and refined the mass copper from the Keweenaw mines, the methods were arcane, expensive and inefficient. Similar to the way it confronted production problems in its mines, C&H relied on engineers for a technological fix for the burgeoning pinch-point in production at its Hubbell smelting works.

For the next 28 years, Calumet & Hecla continued to send their copper to the Buffalo plant, their smelter in Hubbell, or to a local custom smelter. But in 1914, the Buffalo smelter closed, and C&H shifted all of their smelting to their Hubbell smelting works.[2] To compensate for the increased work load, up to 12 larger reverberatory furnaces were installed in 1922 and a modern automatic casting machine replaced the large iron hand ladling process producing anodes for the

[1] Conant, H.D., "The Historical Development of Smelting and Refining Native Copper", in *The Mining Congress*, October 1931 (pp. 531-532).
[2] Conant, H.D.

electrolytic plant.[3] The smelting works employed a work force of roughly 350 men during this time period. This new layout had a capacity of 5 million pounds a month and produced copper sufficiently until the winter of 1922, when due to low output from the mines and problems related to the low-grade concentrates shipped from the reclamation plant, the smelting works was faced with making significant technological changes.[4]

One of the first technological changes implemented was the installation of a coal pulverizing plant in November of 1924, which replaced the traditional hand-fired method, where furnace operators would shovel-in scoops of coal and coke. The coal pulverizing plant crushed the smelter's fuel prior to feeding the furnace, which exposed a greater amount of surface area and increased the efficiency of the burning operation and lowered the fuel expense for C&H. Additionally, the coal pulverizing plant automatically fed the crushed coal to the smelter, as C&H continued to distance itself from the manual and laborious processes of the past.[5] The increased efficiency of the firing process led to other improvements and modifications at the smelting works during the mid-1920s, including the installation of larger melting furnaces, an additional larger automatic casting machine, the

[3] "News by Mining District", in *The Engineering and Mining Journal*, 1922, Vol. 114 (pp.433).
[4] "Pulverizing Plant Will Cut Fuel Bill", in *The Engineering and Mining Journal*, 1924, Vol. 117 (pp. 264).
[5] "C. & H. Coal-Pulverizing Plant in Operation, Saves Much", in *The Engineering and Mining Journa*l, 1924, Vol. 118 (pp. 705).

construction of a mineral storage building, and new methods of treating the molten waste material known as slag.[6]

During the smelting process, the waste material during firing rises to the top of the furnace and is removed by tapping-out, a process which sends the slag down a channel from the furnace to a dump. The traditional method that C&H employed at its smelter for handling slag was to channel the material off into cars, which were then pulled by horses to the slag dump, consisting of a large expanse running into Torch Lake.[7] C&H was cognizant that slag still contained trace amounts of copper, and hoped to profit from it in the future, much like the waste sands from the stamp milling process. By 1929, C&H began regrinding and retreating the slag through flotation.[8] Since slag was tapped from the smelter nearly continuously, the waste piles were slowly expanding, creating a landscape feature that could eventually envelop the smelting works. By the late 1920s C&H countered this growing problem with another technological fix, the granulating of the slag. To produce granulated slag large amounts of water were poured over the molten slag, which fragmented the material into small pellets. The granulated slag was then pumped further into Torch Lake through a series of pipes where it was allowed to sink and eventually migrate throughout the lake.

From the late 1920s to the mid-1940s the smelting works underwent a handful of small alterations, and production was generally curtailed by the

---

[6] "Calumet & Hecla Construction Program Nears Completion", in *The Engineering and Mining Journal*, 1926, Vol. 122.
[7] Coriant, H.D., "Operations – December 1920", in *Box 70, Folder 11 H.D. Coriant – Calumet & Hecla Smelting Works*, Michigan Tech and Copper Country Archives.
[8] "C. & H. Reclamation Work May Have Eleven Years Left", in *The Engineering and Mining Journal*, 1929, Vol. 127 (pp. 930).

economic downturn wrought by the Great Depression. With an increased demand for copper in 1944 in the form of munitions for World War II, C&H revamped their smelting works and began erecting new furnaces.[9] The following year C&H established its Secondary Department, which oversaw the increased processing of scrap materials that were treated at the smelting works. The Secondary Department purchased scrap in the form of insulated cables, automobile, refrigerator and vacuum cleaner motors, radiators, transformers and generators, and processed this waste material into refined copper.[10] Upon arriving at the smelting works, these materials were sorted into different lots, and either ignited to burn off waste plastics and oils, leached in vats of ammonia, or sent directly to the smelter's furnaces for treating. By 1948 the shipments of scrap material to the smelting works became so great that C&H installed a new bailing machine to assist in compressing and transporting the material.[11]

In addition to handling scrap material, the secondary department began experimenting with waste generated within its own facilities around 1946. A common practice in the Calumet & Hecla smelter involved the drawing of copper wire, which produced fine copper wire along with large quantities of copper mud, an amalgam of copper, water and a mixture of oils. In this form, copper mud was untreatable for basic smelting, due to "the high percentage of fat and water" in the

[9] "Mining News", in *The Engineering and Mining Journal*, 1944, Vol. 145, No. 7 (pp. 124).
[10] "Calumet & Hecla Recovers Scrap Copper", in *The Engineering and Mining Journal*, 1945, Vol. 146, No. 10 (pp. 89).
[11] "Calumet & Hecla Installs Press to Bale Scrap Before Leaching, in *The Engineering and Mining Journal*, Vol. 149, No. 7 (pp. 124-125).

waste product.[12] Reflecting the increasing employment of sophisticated metallurgy and chemical engineering, Calumet & Hecla devised a method to extract the copper content from the "Copper Mud" in a form suitable for smelting. The grease reclamation process also concentrated the mineral, vegetable, and animal fats found in the "Copper Mud" and stored them in large batches, up to 10,000 gallons, which were shipped to markets as far as Chicago to be used in the soap making process.[13] By March of 1947, a grease reclamation plant was installed within the old Cupola Building of the Calumet & Hecla smelter, containing a variety of equipment, including an 8 ft. tall x 4.5 ft. wide agitating tank, 10 ft. tall x 3.5 ft. wide separating tank, an 8,000-gallon grease storage tank, and a 5,000-gallon cast iron acid storage tank.[14] The late 1940s also saw Calumet & Hecla implementing new methods of treating waste slag, through a complex soda-ash process, and arsenic-leaching operation.[15]

The smelting works continued to operate for the next twenty years, but the production became sporadic, owing to an increased production of low grade copper in the West, the exhaustion of the Torch Lake stamp sands, an increased cost of scrap materials, and the steady decline of mining in the Keweenaw. By the late 1960s, C&H was purchased by Universal Oil Products, and the smelting works shutdown soon after.

---

[12] "Mining News", in *The Engineering and Mining Journal*, Vol. 147, No. 10 (pp. 108).
[13] "Mining News", in *The Engineering and Mining Journal*, Vol. 147, No. 10 (pp. 108).
[14] Klein, L.C., "Report: The Grease Reclamation Plant", internal correspondence to the Calumet & Hecla Research Committee, March 24, 1977, Michigan Tech and Copper Country Archives, Box 201, Folder 27.
[15] "News and Views", January 1949.

C&H Smelting Works Timeline

This narrative of the Calumet & Hecla Smelter at Hubbell, MI consists of posts from the Engineering & Mining Journal (1918-1969) and internal correspondence between smelter superintendents and C&H managers found within the Calumet and Hecla collection at The Michigan Tech Archives and Copper Country Historical Collections. This timeline is not meant to serve as a comprehensive historical overview of all activity at the smelter, but serves instead as an outline of the evolving built environment of the smelting works, the changing waste disposal methods employed by the smelter, and the continuing use of Torch Lake as a valuable source of water for smelting purposes and as a reservoir for slag and industrial waste.

Calumet & Hecla began smelting copper around the Torch Lake region during the later part of the nineteenth century.

During the early 20th century, the C&H smelter acted as a primary copper smelter for amygdaloid and conglomerate copper extracted from the Calumet & Hecla mines at Calumet and throughout the Keweenaw Peninsula, as well as custom smelting for a handful of mines in the area. The primary waste material produced during this time period was the molten, glass-like slag that rose to the top of the furnace in the reduction process and was channeled off into large piles within Torch Lake. As the mines began to become unprofitable, C&H sought other sources of copper, found in the large tailings piles in Torch Lake, as well as in scrap material.

May 16, 1914: Letter from Norman Warford, Engineer, stating that he can get C&H 98 to 100% efficiency using pulverized coal at their smelter, up from the 70 to 80% they were currently getting. (Series 4.4.5 (4.3.4a) MacNaughton Numeric File: 1-625, Various Companies & Topics, Box 48, Folder 541.)

June 14, 1919: During the summer of 1919, as the first World War was coming to an end, the Copper Country mines were producing and smelting large amounts of copper.

"Calumet & Hecla and subsidiary mines have the greatest amount on hand, a total of 20,000,000 lb. This is the combined total showing at the Calumet & Hecla plant at Hubbell and the Lake Superior Smelting Co.'s plant at Dollar Bay, the subsidiary plant."

June 21, 1919: The Calumet & Hecla smelter was refining the copper ore through the firing of *"…14 furnaces working at smelter".* The number of operating furnaces will soon decline significantly in response to an unstable national copper market.

Oct. 4, 1919: By the later part of 1919, C&H began exploring more efficient ways to fire the furnaces at its smelter, as the traditional hand-fired coal stoking approach was becoming laborious and expensive.

"Experimenting with electric smelting, but not successful. Survey of smeltery situation under way, but no decision as to extent of rebuilding operations at Hubbell plant."

February 11, 1921: In a letter regarding smelter slag from the blast furnace from the smelter superintendent to James MacNaughton, the superintendent proposes a new method of disposing of smelter slag into Torch Lake. This new method is described as thus:

"The slag would be loaded into the slag cars now in use, from which it would slide down into the lake at the dump. A better plan would be to load the slag into steel tip boxes, carried on flat cars, and provide an electricly operated crane mounted on three-foot gauge trucks to swing the boxes out over the lake to empty them. With this rig it would not be necessary to shift the track whenever the edge of the dump fills out too far to allow the slag to slide from the cars into the lake. Granulating the slag provides the best means of disposing of it; but granulated slag should not be deposited in navigable waters on account of its tendency to wash and fill up the water ways, so that a slag casting machine seems to be better adapted for this locality."

April 16, 1921: During 1920-1921, C&H curtailed production at its mines, and reduced the number of furnaces operating at its smelter as the national copper market was at unfavorable levels to profit.

…"Calumet & Hecla has announced a 25 per cent cut in the wages of those still on the payroll, effective April 16. This includes pump men and mill, smelter, and power plant employees."

August 13, 1921: While orders for refined copper continued to come in, C&H continued to enact cost-savings measures, such as reducing the number of operating furnaces to 2 from the 14 that were operated in 1919.

…"Calumet & Hecla is in receipt of orders for 200,000 lb. for domestic customers and 100,000 lb. for export. This metal will be shipped soon, these orders being all that are on the C&H books. Calumet & Hecla continues to operate two furnaces (out of 24) at the smelting plant."

August 20, 1921:

…"Calumet & Hecla has no orders on its books at present, but will continue to keep two furnaces in operation. There is still a considerable number of cupola blocks to smelt, and these will be made up into anodes for the electrolytic plant, being returned as cathodes and held in readiness for smelting into such shapes as may be ordered. C&H still has a large amount of mass copper and some mineral at the smelter, and this, with the cathodes, will permit filling of orders for special shapes without the necessity of recasting stock shapes. Recent orders have been comparatively small, and it is believed little difficulty will be experienced in handling all business, under present market conditions, with two furnaces."

October 1921: In a letter between H.D. Coriant, smelter superintendent, and James MacNaughton, Coriant describes the current slag storage method:

"The slag storage plan seems to be working out very well. The slag is dumped into the steel car bodies setting in a pit, from which they are lifted by electric crane into cars and transferred by locomotive to the storage yard (No. 1 Coal Dock) where they are unloaded by the steam railroad crane. The slag can be picked up again whenever required by using the clam."

December 1921: Coriant elaborates further on the slag storage practice, including the incorporation of new technologies to the disposal of the waste:

"The blast furnace started running again on December 27, with the new slag track in use, the slag cars being drawn by a locomotive instead of by horses as formerly. With some alteration of the slag cars the time hauling the waste slag to the dump will probably be cut down to not over four hours a day. One advantage of the change of gauge to three feet is that where the track is exposed it can be kept clear of snow with the tramway plow instead of having a gang of men to shovel it out, while under the cover of what is left of No. 1 Coal Dock roof there was no snow to bother after the heavy fall during the month."

February 18, 1922: The early part of 1922 saw C&H still reeling from the unfavorable copper market, but the situation was soon to turn for the mines and the smelter.

"…Since the shutdown of the mines last spring, Calumet & Hecla has continued to operate its smelter, smelting such mineral and mass copper and cupola blocks as had accumulated, and an average of more than 2,000,000 lb. a month of refined copper has been turned out. The smelter now has only enough material to keep it operating until a new supply comes from the mills upon the resumption of mining."

May 27, 1922: Production at the mines, stamp mill at Torch Lake, and smelter at Hubbell are again increasing their output.

"…At the Calumet mill of Calumet & Hecla, eight heads are being operated. Eight furnaces at the smelter are also in operation. Production is gradually increasing as shaft repairs progress and men can be employed in actual mining. Rock shipments now run about 2500 tons daily."

September 2, 1922: The smelter continues to increase its operating capacity, with the firing of four additional furnaces. This post also reflects the manpower required to efficiently fire and cast material in the non-automated smelting works.

"…At the Calumet & Hecla smelter, twelve furnaces are in operation, two of which are are smelting cupola blocks for the electrolytic plant. The smelter force now numbers 350 men, on full time."

February 17, 1923: While C&H were experiencing profitable returns from their smelting works, they were constantly seeking more efficient methods to their refining practice.

"…Calumet & Hecla has discontinued the electrolytic treatment of its copper, at least temporarily. A change in refining methods, involving cleaner skimming has

reduced the silver content in the copper to only a small amount, making electrolytic treatment unnecessary."

July 20, 1923: Correspondence about the materials needed for building the plant, equipment needed & purchased. 4.4.40.1 Smelting Works, Box 126, Folder 14.

"The process of crushing, drying and pulverizing fuel should be accomplished in a separate building used for no other purposes. This building should preferably be detached, but where this is not practicable it should be separated by a blank masonry or concrete wall containing no openings other than those necessary for the passing of pipes and shafting. The building should be constructed of incombustible materials and specially designed to secure minimum lodgement of dust and to relieve the force of an explosion through its roof and walls without danger to its frame. The frame should preferably be of steel with light non-bearing walls (except fire walls) constructed of materials such as stucco on metal lath, tile, metal or other similar incombustible material and with roof of monitor or gable type and all secured in such a manner as to give way readily under pressure of explosion. The monitors with louvered or glass sides or sky-lights should have a horizontal area not less than one-tenth of the horizontal area of the roof.

In order that the venting of explosion may be more readily facilitated, a portion of the exterior walls equal to not less than 10% of the combined area of the enclosing walls should be of glass. All glazing should be by means of thin glass not exceeding 1/8" in thickness.

Coal pulverizing mills and coal dryers should be equipped with suction fans or other approved means for removing dust. The collection of dust to take place as near the point of origin as possible and suction fans to discharge outside of building or into metal cyclone collectors. Dust collecting devices should be constructed of incombustible material and contain no cloth partitions, tubes or bags. All elevators including boots, legs and heads, or screw conveyors should be constructed of incombustible materials. Conveyors for supplying coal pulverizing mills should be provided with approved magnetic separators between source of supply and mill feed bins. Elevator heads, cyclone collectors or storage bins for handling or storing pulverized coal should be provided with approved vents exhausting outside of building. Machinery and other parts comprising the crushing, drying, pulverizing and conveying system should be effectively electrically grounded. All stationary lights should be protected with dust proof globes and wire guards. Smoking and the use of open lights or torches should be prohibited. All motors, switches and other electrical devises should conform to the standards of the National Electrical Code."

-Copied from Michigan Inspection Bureau's letter dated July 20, 1923.

February 9, 1924: An unavoidable cost involved with smelting is the purchase of fuel used to fire the furnaces. The smelting works at Hubbell up to this time were engaged in hand-firing the smelter's furnaces with chunks of copper and coke. This practice was found to be inefficient as the maximum surface area of the fuel was not

being exposed to direct heat. C&H responded to this problem with the installation of a coal pulverizing plant, which crushed the coal into finer sized pieces and automatically fed the fuel to the smelter.

"The fuel-pulverizing plant at the Calumet & Hecla Consolidated's smelter at Hubbell, Mich., will be housed in a building of steel construction, work on which will be pushed to completion. With the completion of this plant, a saving of fully 30 per cent in fuel consumption should result."

June 7, 1924: Construction continues on the coal pulverizing plant.

"Good progress is being made on the construction of the fuel-pulverizing plant, which will feed the furnaces with pulverized coal, will be completed this summer. It should effect a saving of 30 per cent or more in the fuel cost of smelting."

November 1, 1924: The coal pulverizing plant has been installed and more improvements are planned at the smelter.

"At the smelting plant of Calumet & Hecla Consolidated, in the Michigan copper district, the new fuel-pulverizing plant is working efficiently, feeding all three of the large, 150-ton reverberatory furnaces. It will save 25 to 30 per cent in coal cost in the operation of these units.

At the second step in smelter improvements, the company plans the erection of a melting furnace of large capacity. This addition to the plant's melting facilities will release the three Jumbo type furnaces, which now are used for both melting and refining, for refining only. The proposed improvement will enable the plant to keep pace with production, even though it is increased with the development of a better market for metals."

February 28, 1925: The expansion of the smelter's refining capacity is underway, with one of three new large furnaces being built.

"One of the three large furnaces which is being built at the Calumet & Hecla Smelting plant, in the Michigan copper district, will have a capacity of 220 to 225 tons of metal a day. It will be used for melting purposes only, leaving the other two furnaces for refining. These furnaces, with the smaller units in operation, will afford ample facilities for the treatment of all copper of the Calumet & Hecla companies.

May 2, 1925: Construction continues amid optimism for lowered costs and increased profits.

"Improvements in progress at the smelting plant of Calumet & Hecla Consolidated, in Michigan's copper district, including the erection of a second melting furnace and installation of equipment for handling of mineral and refined product, will result in a reduction of smelting costs. The mineral of all the producing units will be treated in three large furnaces when the improvements are completed in the fall. Practically all of the smaller furnaces will be abandoned. The three furnaces will be operated with pulverized fuel, effecting a saving of 25 to 30 per cent in coal costs. The operation of the larger furnace units will require a smaller smelter force than that at present employed."

Aug. 21, 1925: One slag car requires five to six hours to solidify before it can be dumped, which means that C&H needs more slag cars. They must dispose of at least 130 tons of waste slag per day, and each car averages 6.5 tons of slag. Series 4.4.40 (4.3.32) Engineering Department, Alphabetical, S-W, 1911-1969, Box 127, Folder 30.

April 17, 1926: The production at the smelter increased immensely with the installation of the new larger furnaces.

"…At the Calumet & Hecla smelter, where production is between nine and ten million pounds of refined copper per month, two large and nine small furances are in operation. With the completion of the third large unit, which will be used for refining, the smaller furnaces will be abandoned."

July 3, 1926: With the increased output of copper from its smelter, C&H sought to improve on its rather arcane method of hand-casting by ladle with the purchase of an automated casting machine.

"The present year will see the virtual completion of Calumet & Hecla Consoidated's big construction program. Installation of a large casting machine to serve the new refining furnace at the Hubbell, Mich. Smelter will complete the major projects. Delivery of the machine is expected in September. Ahmeek of Calumet & Hecla is shipping about 3,200 tons of copper daily, refined production per month probably running 2,700,000 lb."

September 18, 1926: Expansion at the smelter continues.

"*At the Calumet & Hecla Consolidated smelting plant at Hubbell, Mich., the furnace building has been extended to provide room for the ultimate construction of another large furnace. Three of these units have been built and will be ready within a few months to handle the entire present mineral product of the consolidated mines."*

August 13, 1927: The new technology within the smelter is beginning to pay off for C&H, and they continue to invest in new equipment.

"…Calumet & Hecla Consolidated has plans for the construction of another large furnace at its smelting plant at Hubbell, in the Michigan copper district. This will give the company four large units, three for smelting, and one for refining. The smelter also is equipped with a modern casting machine. The proposed new furnace will have a capacity of 600,000 lb. at one charge, and it is understood its construction will increase the smelter's capacity to 20,000,000 lb. of copper per month. Labor costs have been largely cut through the installation of modern furnaces and equipment at Hubbell. The casting machine is capable of handling 100,000 lb. of copper in one operation, requiring the service of only a few men."

January 11, 1928: In a letter between smelter superintendent E.R. Lovell and James MacNaughton, Lovell purposes new methods for treating soda slag from the smelter (Soda is a caustic substance added to the furnace as a flux to remove impurities near the end of the firing process). His description is, as follows:

"In the summer of 1924, experiments were conducted at the Smelting Works, to determine the feasibility of leaching soda slag (i.e. slag skimmed while blowing soda

ash to eliminate arsenic). The main idea was to throw away the arsenic as well as worthless slag. The slag was crushed or broken and loaded in small cars, which were hauled to the Liberator House south of the Electrolytic Plant. It was then placed in wire baskets, which were suspended in tanks of water which were agitated with compressed air and steam. The solution was, after decanting, filtered through a Sweetland filter. There remained a slimy residue in the tanks containing a high percentage of water, as well as copper, copper oxide, and mixtures of furnace refractories, which had been fluxed out at the time of soda blowing. The residue on the filter leaves had to be scraped off; and, together with the bulky residue, was returned to the melting furnaces to recover copper values."

Proceeding this description, Lovell provides advantages and disadvantages to this method. One of the disadvantages that Lovell expressed concern with was:

"Waste solution going to lake is deadly poision"

To which MacNaughton noted, *"Probably of not much importance"*

June 9, 1928: A slightly redundant post, but important nonetheless as it depicts the optimism and capital investment sunk into the smelting works.

"…At Calumet & Hecla Consolidated's smelter, excavating has been started for the erection of a building which will complete the modernization of the plant. Two large refining furnaces and a smelting furnace have been erected, and steel is arriving for the construction of a second smelting unit to supplement the one already in commission. It is expected this furnace will be completed this year. It will be 20 ft. wide and 70 ft. long, with a capacity of 225,000 lb. of mineral per day. It will be so built that the molten metal will flow by gravity to either of the two large refining units.

July 28, 1928: In addition to the new furnaces, a mineral storage building is scheduled to be erected at the smelting works.

"Calumet & Hecla Consolodated has awarded a contract for the erection of a mineral storage building at it smelter at Hubbell, in the Michigan copper district. When this new structure and the new smelting furnace now under construction are completed, the plant will have been fully modernized and equipped for economical operation. Two large melting furnaces and two large refining furnaces will give ample capacity for the smelting of the mineral from all the producing units of the company, including Isle Royale, which pending completion of smelter improvements, is sending its mineral to the Michigan plant at Houghton.

The new melting furnace now being built will have a capacity of 225 tons of mineral per day, and molten metal from it will flow by gravity to either of the two refining units. The melting furnace already in commission charges by gravity. One of the new refining units is especially equipped for melting and refining large masses of copper and for making billets and other irregular shapes."

December 22, 1928: Construction of the mineral building continues and another casting machine is scheduled for installation. Additionally, the smelting works are providing custom smelting for the Isle Royale Mine.

"At Calumet & Hecla Consolidated's smelter in Hubbell, Mich., favorable weather is contributing to rapid progress in construction of a large mineral storage

building, adjacent to the structure housing the furnaces. Another automatic casting machine, similar to the one now in commission, will be installed in the furnace plant. When repairs to the third large furnace are completed, the plant will operate at capacity again, enabling the smelting of Isle Royale concentrate, which for some time has been going to the Michigan smelter, at Houghton."

April 6, 1929: Second casting machine installed.

"The second and final automatic casting machine is being installed in the new furnace department of the Calumet & Hecla smelter, at Hubbell, Michigan. The metal flows from the furnaces directly into the machine, where it is cast into desired shapes without handling. The new furnaces and automatic casting equipment (the latter made in the company's shops) are effecting notable economies in the smelting department."

April 27, 1929: With construction of the mineral building complete, the smelting works at Hubbell are now operating as a modern refinery.

"At the Calumet & Hecla smelter, at Hubbell, Mich., the new mineral storage building is in commission. It will facilitate the handling of mineral, which will be automatically conveyed to the furnaces. This structure and the installation of a second casting wheel complete the modernization of the smelting plant, which is equipped to take care of all production of Calumet & Hecla and subsidiaries."

June 8, 1929: First mention of slag within the Engineering & Mining Journal. Up to this point it is assumed that slag was continually dumped into slag piles within Torch Lake. Although C&H was fully aware that this waste contained copper, they chose to exploit the tailings in Lake Linden and Tamarack rather than reprocessing the smelter waste.

"At the Calumet & Hecla smelter, slag from the "rough" furnaces now is being reground and treated by flotation for copper. A considerable saving will result, but the percentage of copper is not enough to warrant reclaiming metal from the old slag which was dumped into Torch Lake."

March 24, 1930: The smelter continues to show promising results and the outlook for C&H is looking positive in 1930.

"The Calumet & Hecla smelter has recently been in operation three times a week instead of twice, reflecting an improvement in metal demand, as the smelter is being operated only as orders are received. Concentrate is accumulating in the new storage building, which has a capacity of 15,000 tons. The efficiency of the plant has been greatly increased and smelter losses are now only 0.4 per cent. Operating costs have also been materially decreased."

September 8, 1930: The built environment of the smelting works seems to have undergone many small alterations, such as this vague description from 1930.

"At the smelter, some additions are being made to the main furnace building to provide additional storage facilities for coal."

March 17, 1931: Below is a map and photograph from a report by smelter superintendent Endicott Lovell and metallurgist Herman Kenny from 1931 showing the layout of the smelting works.

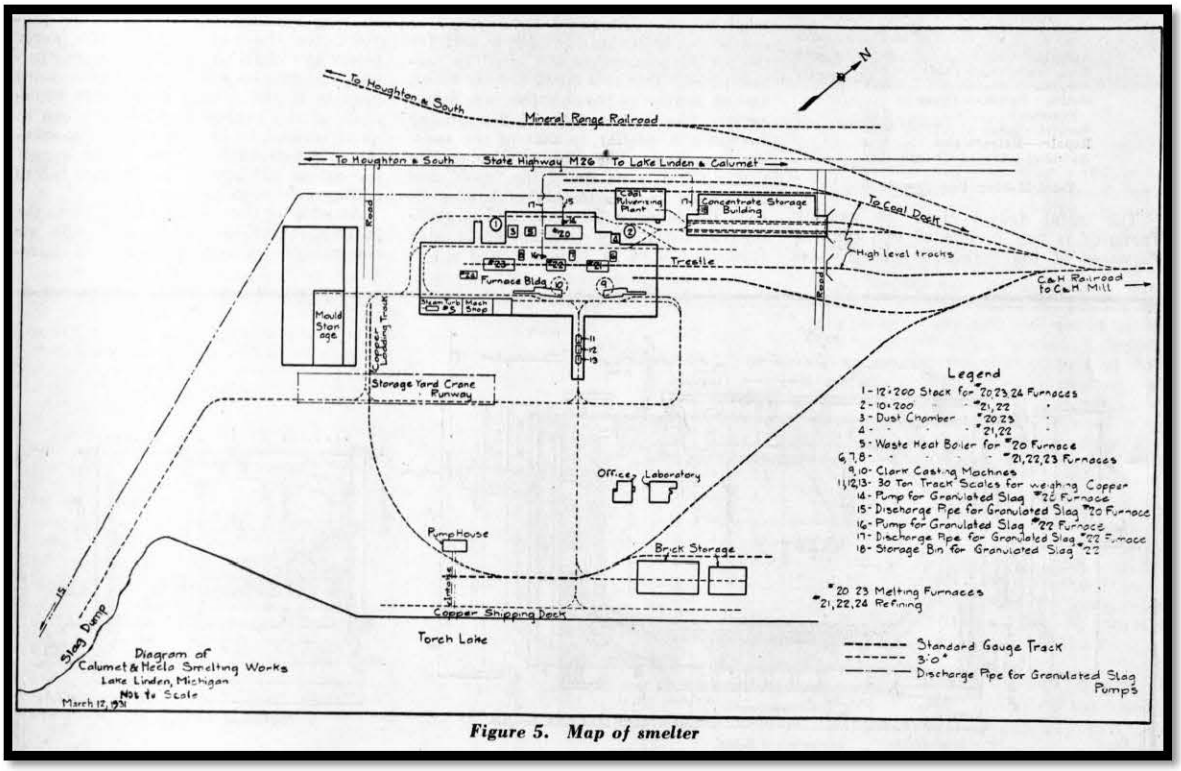


Figure 5. Map of smelter

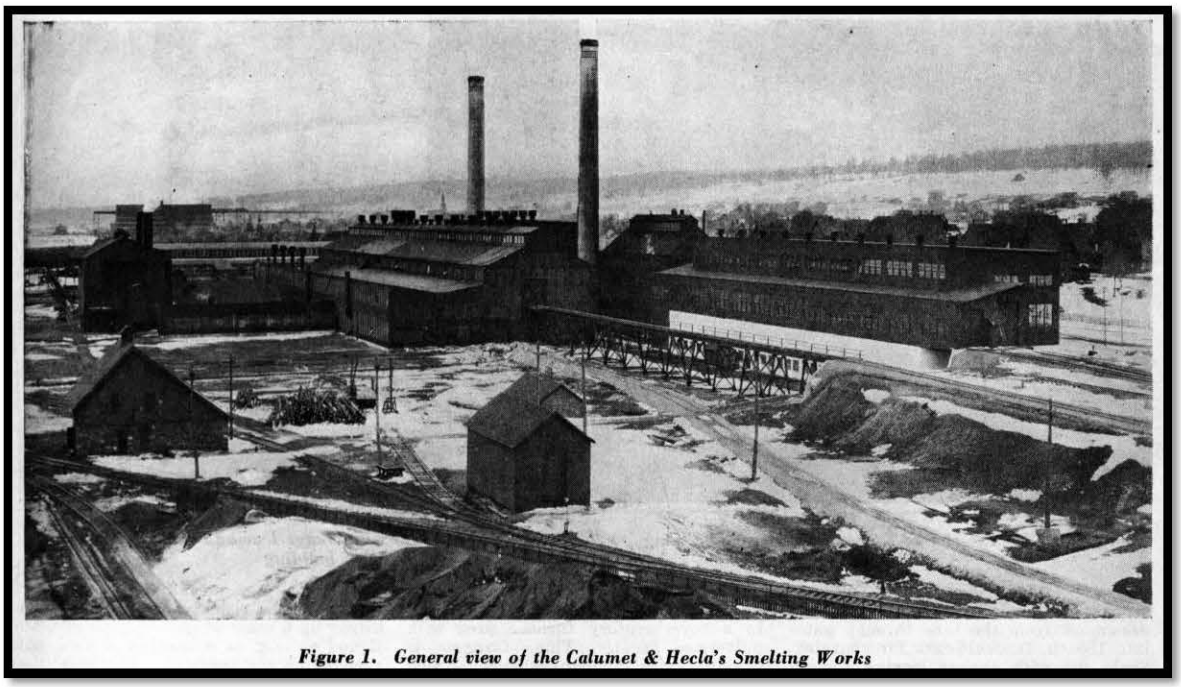


Figure 1. General view of the Calumet & Hecla's Smelting Works

March 4, 1932: In an operations report to James MacNaughton for the month of February 1932, an alteration to the slag disposal method is described:

"…On closing down the melting furnace No. 20 in January the granulated slag pump formerly used for pumping refining slag to the mineral building for resmelting was connected by a branch pipe to the waste slag line leading from furnace No. 20 to the slag dump at the lake; and is now used for pumping either the waste slag to the dump or the rich refinery slag to the mineral building, thus maintaining the system of slag disposal in vogue while No. 20 was in operation."

December 7, 1935: In the operations report for November of 1935, the pumping of slag into Torch Lake is briefly mentioned, along with plans to reduce the amount of copper lost in the current refining process.

"…In order to reduce copper losses in waste slag now being pumped to the lake, a new dewatering and classifying arrangement has been built and installed before the bull jig in the electrolytic plant. This equipment, which will be in operation soon, should result in considerable saving."

April 1936: In the midst of The Great Depression, posts related to the smelting works become sporadic and brief.

"Calumet & Hecla Consolidated Copper Company produced 36,330,800 lb. of copper from the Conglomerate mine and 9,118,000 lb. from the reclamation plant at Lake Linden during 1935, the annual report shows. The smelter produced 56,599,562 lb. of copper last year. "

April 1940: A detailed post from 1940 describes a small alteration to the casting process at the smelter:

"Under a license agreement with the American Metal Company, the smelter is being equipped to cast billets in water-cooled molds. Similar vertical castings of cakes, inaugurated in 1938, has resulted in an improved and highly desirable product. When the billet casting equipment is completed, the proportion of C&H product cast vertically in water cooled copper molds will amount to over 60 per cent of the smelter output."

June 1941: With the economy beginning to rebound after a decade of historic decline, the smelter began to be featured again in the Engineering & Mining Journal.

"During the year the smelter department received 43,396 tons of concentrates and mass, and smelted 43,890 tons. From the material smelted there was produced 55,835,544 lb. of refined copper. Copper oxide shipped to customers amounted to 2,738 tons, containing 4,169,004 lb. of copper. While the billet-casting equipment, mentioned in the last year's report, is not fully completed, of all the shapes cast during the year 51.6 percent were made in water cooled molds, 39.2 percent being VC cakes and 12.4 percent being billets."

February 1943: The onset of WWII created an increased demand for munitions and the smelting works responded with the production of brass billets.

"Brass billets are being successfully cast at the Calumet & Hecla smelter at Hubbell. Seamless tubing drawn from these billets is sawed into short lengths to be pressed into grooved recesses in high explosive shells. This causes the shell to grip the rifling of the gun barrel and to whirl rapidly. The rapid whirling holds the shell true to its course. In the old type of guns, copper was used, but with high velocity guns, such as used in this war, copper is reported to be too soft and maybe torn off the shells."

July, 1944: The smelting works is undergoing another alteration in order to keep up with the increased demand of munitions to supply the allies in WWII.

"At the Calumet & Hecla smelter, the foundation for the new No. 22 furnace has been poured, and work on the steel and brick is proceeding. Many innovations in design have been incorporated in the new furnace, which will be used as a much-needed spare for the No. 21 unit."

October 1944: In a letter from the chief draftsman of C&H to the Morris Machine Works of Chicago, the method of pumping granulated slag into Torch Lake is described.

"We are at present pumping granulated slag from No. 20 furnace at the rate of from 60 to 80 tons per day, most of which is drawn off in the course of a very few hours. We estimate that we may take off as much as 20 tons an hour at some times. This is pumped to the lake with a 6'' pump and an 8'' pump in series."

October 1945: In an editorial to the Engineering and Mining Journal the expansion of the secondary department within Calumet & Hecla is promoted and the scrap program is described as:

"On economic and patriotic grounds, the secondary-metals recovery program which Calumet & Hecla Consolidated Copper Co. expanded last year into a major project has justified itself, company officials report. The present sizeable output, affording work to more than 100 employees, was reached about six months ago.

At the peak of its secondary-metals operations Calumet & Hecla had in its yards 30 acres of scrap – half of it from the armed forces – which it was reconverting at the greatest possible speed into usable material.

…Some copper was received in a form pure enough to smelt directly. But copper containing such impurities as lead, iron, or zinc had to be leached, either instead of being smelted or after being smelted.

The leaching tanks, each of which can hold 700 tons of telephone-line wire, or 1,000 tons of gilding-metal clad steel bullet jacket stock, played no small part.

…Included in the scrap which C&H has been treating are: copper pipe from the U.S.S. Pennsylvania, sunk at Pearl Harbor; copper, brass, and bronze turnings and shavings from munitions plants; small automobile , refrigerator, and vacuum cleaner motors; generators and transformers; busbars; and above all, cable of many kinds."

January 1945: 1945 marks possibly the biggest shift in the history of the smelter, with the melting of scrap copper from the newly incorporated secondary department.

"…A new department known as the secondary department, has been formed by Calumet & Hecla to purchase and treat scrap copper-bearing material. H.C. Kenny, smelter superintendent, will be in charge. Experiments conducted in the treatment of scrap led to the decision to enter this field. Scrap will be purchased in the market for treatment at the Torch Lake plants. This is another step in the company's policy of expansion, which includes the continued exploration for new ore bodies as well as research work leading to new uses of copper."

August 1946: In addition to treating scrap material, the Secondary Department was also in charge of a number of other exploratory operations, including the recovery of copper from the effluent of the wire-drawing process.
This effluent, or copper mud, is described in detail in the August issue of "News and Views":

"Experience with diversified types of copper scrap has led to the development of numerous treatment processes whereby undesirable impurities which are present in or associated with scrap are separated from copper and leave it in the form suitable for direct smelting into the high conductivity commercial grades. The increasing use of special treatment methods has made it possible for the Secondary Department to purchase and handle larger and larger tonnages of materials which were not previously considered desirable for treatment at the smelter, and these processes are now delivering millions of pounds of copper to the furnaces, which was not possible several years ago.

The latest addition to this family of processes is one which makes possible the treatment of "Copper Mud", a waste product resulting from the drawing of copper wire. The material as received is a pasty mixture of fine copper, oil, grease, floor sweepings, etc., having an average copper content of the order of 25%, and a combination of animal, vegetable and mineral oils of approximately 40%. As received, the material is not suitable for direct furnacing due to the presence of the high percentage of fat and water; but after several months of experimentation, a procedure was worked out which not only makes possible the recovery of the copper in a highly concentrated useful form, but fat by-products as well. The equipment required to process the material involves a large lead-lined digester, filters, grease accumulation tanks, copper recovery tank, and a 10,000-gallon storage tank for grease.

Installation of the various units was started during June and production on a limited basis began the middle of August. It is expected that the unit will be operating on a continuous basis by September first.

The copper recovered as a metallic concentrate contains approximately 75% copper and in this form is suitable for direct furnacing with other concentrates. The fat is reclaimed as a semi-clear liquid and will be accumulated in 8,000 to 10,000-gallon batches (40,000 to 60,000 lbs.) for shipment in tank cars.

The fat or grease is classified as an inedible oil, and will be shipped into the Chicago district for processing into oleic and stearic acids and for the manufacture of industrial soaps.

It is anticipated that the process will add several hundred thousand pounds of copper per month to the smelter intake, with the recovery of from 20,000 to 30,000 gallons by-product fat which can be readily marketed at an attractive price."

October 1946: C&H appears to be fully invested in diversification by 1946, and to confront issues with certain types of scrap, C&H turns again to the technical knowhow of its chemists and engineers.

"Calumet & Hecla Consolidated Copper Co.'s experience with diversified types of copper scrap has led to development of numerous treatment processes whereby undesirable impurities in or associated with scrap are separated from the copper, leaving the metal in a form suitable for direct smelting into high-conductivity commercial grades. The increasing use of such methods has made it possible to for the company's secondary department to purchase and handle larger and larger tonnages of materials previously not considered desirable for treatment at the smelter. These processes are delivering million of pounds of copper to the furnaces."

1947: The grease reclamation plant is installed within the smelter, located in the old Cupola Building. Per internal correspondence, "this location was decided upon because steam and hot water were available there together with rail and handling facilities for moving materials in and out of the building."

September 1947: The smelting works are undergoing a long modernizing process, beginning with the installation of a new coal pulverizing plant. This month's "News & Views" provides a detailed account of the new plant:

"A new Raymond Coal Pulverizer has been installed at the smelting plant in Hubbell, adding another unit to the plant equipment. The new unit went into service on August 15 in the pulverizing building on the west side of the smelting plant. The pulverizer was erected by the construction department and smelter mechanics and was put into operation by factory experts who came to Hubbell to train smelter employees in the operation of the drier and the pulverizer.

The machine differs from the two older units in the pulverizing plant. The older units, one of which is being scrapped, were low side machines whereas the new one is a high side type. The old units were installed in November 1924 and had pulverized 426,000 tons of coal up to the time the new equipment went into service. The old machines were equipped with a Ruggles-Coles revolving drier but the new machine uses a flash fire drying system.

The building, housing the pulverizing equipment, is being remodeled ro accommodate the new system. One of the older units will be retained in service for emergency use. The new drier provides sufficient coal for the plant in one operating shift, where the former drier was required to be in operation two shifts in order to prepare coal enough for the smelting plant for a day. The old drier which will be retained, will be modernized and equipped like the new unit for flash drying.

This Raymond, high side, roller mill has a capacity of 11 tons of coal per hour ground to 80 to 85% through a 200 mesh screen. Its efficiency in coal dust recovery is considerably greater than its predecessors. The stoker, feeding the coal into the drier, is connected with a heating furnace which supplies warm air for drying the coal. Drying and milling of the coal are done at the same time in the new machine where it required two separate operations in the previous equipment.

A new unit has been installed for conveying the coal, by means of an air pump, from the weigh bins at the unloading place in the pulverizer building to the storage bins in the furnace building.

The dust collecting system used at this plant is of the "Norblow" design, similar to that which is at the oxide drying plant in the Tamarack Reclamation building.

Changes are being made in the electric power supply for the plant because the new drier uses motors of less horsepower than required by the old machine, but the new unit requires a change in the voltage."

January 1948: Further modifications to the smelter in order to improve the buring of scraped material, which is compacted into bales after leaching.

"A new furnace has been placed in service at Calumet & Hecla Consolidated's smelting plant. The bricks used in the furnace proper are composed largely of magnesite and chrome and contain no silica. The furnace will be used for smelting secondary copper.

The arch of the furnace is of basic material, making it possible to drive the furnace much harder than the average because the arch can withstand high temperatures, also any complications from "rabbling", or the blowing of air into the bath to remove foreign materials. The new furnace is fired by two burners, using pulverized coal. It also is equipped with a recuperator, doing away with the waste-heat boiler. The operation raises the flame temperature of the burners by several hundred degrees and decreases the coal consumption from 10 to 15%.

Capacity of the furnace is 200,000 to 250,000 lb. per charge. The monthly capacity of the furnace will be approximately 1,500,000 lb. of copper. For the most part, baled material is used in charging the furnace."

July 1948: C&H completed the installation of a bailing machine to assist with transporting the assorted scrap to the furnaces.

"Calumet & Hecla has installed a hydraulic bailing press in its smelter yard to bale copper-clad steel scrap before leaching. This will save many hours in handling the scrap in and out of the leaching tanks to the railroad cars, and will double the tonnage put into the leaching tanks. Certain kinds of copper scrap also can be compressed into convenient size bundles for charging into the smelter furnaces."

January 1949: The slag from the smelting works appears to be a new focus of the secondary department, as this waste material, similar to the tailings from the mills, contained valuable quantities of copper. In this month's "News & Views" the treatment of slag at the smelter is discussed in detail:

"An interesting illustration of the continuing progress of our smelter metallurgy has been shown during the last two months. In this period several charges of refinery slag have been melted down and so skillfully refined that the copper obtained was suitable for, and was dipped into, phosphor-copper billets. Never before has the metal from a slag charge been refined to the purity required for direct casting into commercial shapes.

The smelter has for several years been melting down and refining certain rich slags previously skimmed from the primary-copper baths. As any smelter man knows, this slag, however rich in copper it may be, bas troublesome concentrations of those impurities which are hardest to remove. Such concentrations naturally make slag refining difficult and tricky. Up until Dec. 1948, all copper so reclaimed has been unsuitable for use in commercial shapes, as it could not be economically refined to the required specifications. Therefore, it has either been "sweetened" by dilution with high-purity copper, or dipped into arsenical billets or low-grade ingots. The bulk went into ingots, which could be used only for remelting, a few at a time, in baths of copper pure enough to stand a slight contamination.

However, the slag charges of the last two months have been refined to billet specifications without dilution, and without extraordinary time or expense. The most prominent developments leading up to this achievement have been the improvement of the soda-ash process for arsenic removal, and the inception of the arsenic-leaching process, for the removal of this metal from rich soda slags.

The benefits of this achievement are two-fold. First, it means that we will be able to reclaim more copper per month from slag than we have been, and will be able to get it on the market faster, since it is going directly into a saleable product. Second, the high cost of handling, storing, remelting, and recasting the low-grade ingots will be eliminated. The accomplishment is another of many tributes to the teamwork and skill of the smelter technicians and furnace operators."

March 1949: In addition to the refined copper produced from the scraping process, C&H implemented a new method for refining slag. This is the last mention of the smelter in the Engineering & Mining Journal.

"As a result of improvement in the soda-ash process for arsenic removal, slag charges in Calumet & Hecla's smelter at Hubbell have been refined during the past two months to billet specifications without dilution, at a big saving of time and expense. Never before has copper from a slag charge been refined to the purity required for direct casting into commercial shapes. C&H now will reclaim more copper per month from slag than heretofore, and will get it to market faster as it is going directly into a saleable product. The high cost of handling, storing, remelting and recasting the low-grade ingots will be eliminated."

May 6, 1954: Similar to their treatment of slag, C&H is seeking ways to profit off of the fly ash from their smelting works by promoting it as an additive for commercial fertilizer: The fly ash is stored at the smelter, and after being put through a gravity concentrator roughly 70% of the copper content is retained. Overall, it is much more efficient to use the fly ash in the fertilizer than to purify it and extract the copper. Series 6.3.4 (6.3.4) Chemical Engineering Branch Files, 1925-1969, Box 199, Folder 20.

October 17, 1967: In the monthly minutes report from the Scrap Processing Group, mention of open burning of scrap materials, including lots of insulated wire and automotive parts are mentioned. This is prior to legislation that banned the open burning of materials.

"It was reported that our burning of insulated wire is nearly caught up and most of the material has been baled."

1968: In a letter between employees of Universal Oil Products (the company that purchased C&H) the quantity of slag within Torch Lake is discussed.

"The slag piles were measured in 1968 by survey. The volume that was calculated at that time was 7,500,000 cu. Ft. of granulated slag and 9,600,000 cu. Ft. of solid slag. A factor of 20 cu. Ft. per ton was used for the granulated slag and 12 cu. Ft. per ton for the solid slag."

"…It must be realized, however, that most of the slag lies under water and the exact measurements are impossible to determine."

Section 3: Supporting Documents

Notes from *Engineering & Mining Journal*

Notes from *C&H News and Views*

List of C&H Archival Records Consulted

Notes from the MTU and KNHP Archives

Documents from the Archives

- The Historical Development of Smelting and Refining Native Copper, 1931
- Blast Furnace Waste Slag Disposal, 1921
- Lake Superior Water Mains (Map), 1921
- Treatment of Soda Slag, 1928
- Smelting Works – Slag Pump, 1944
- Secondary Metal Department is Busy at the C&H Smelting Plant, 1945
- Smelting Works Flow Sheet, 1946
- The Grease Reclamation Plant, 1947
- By-Products Recovered by Secondary Dept., 1947
- Slag Utilization, 1950
- Report on Lightning Protection for the Electrical Transmission System of Calumet & Hecla, 1954
- Report on Status of Recommendations of Vern E. Alden Co.'s Engineering Studies of Feb. 1, 1949 and Nov. 17, 1954, 1955
- Research Activities Committee Members: Smelting and Refining, 1957
- Slag Utilization, 1959
- Proposed Alterations to Smelting Works, 1966
- National Spectrographic Laboratories – Slag Sample Feed, 1969

Engineering and Mining Journal

1918, Vol. 105

Pg. 82, Jan. 12, 1918 "New Mining and Metallurgical Construction in 1917"

"Calumet & Hecla, Calumet, Mich., completed 2000-ton ammonia-leaching plant in February at Lake Linden and started construction of addition to double capacity, having left contract to American Bridge Co.; foundation for substation for power transmission and steel addition to coal docks completed; constructing 3000 x 20-ft drainage canal in Swedetown swamp to eliminate excessive pumping in mine workings."

Pg. 221, Jan. 26, 1918 "Mining News"

"Calumet & Hecla: - Doubling 2000-ton capacity of leaching plant at Lake Linden. Expected to be ready before spring; and the substitution of Harding mills for the Chilean mills, increasing capacity from 1600 tons daily to 2400 tons. Due to delayed deliveries of machinery, change somewhat slow and units are being substituted one at a time, so not to interfere with production."

Pg. 353, Feb. 16, 1918 "Editorial Correspondence"

"The construction of the New Steel Coal Bridge, by the Calumet & Hecla at Hubbell, is nearing completion. This steel structure is built to unload a 10,000 ton cargo of coal in 24 hours. Clam diggers will be used of 10 ton weight and will handle 11 tons of coal. Everything is in readiness for the plant but the motors, which are promised for February. Because of the 6 months winter in the copper country and the necessity for securing coal by water transportation, enormous tonnages must be secured in the summer and carried through the winter. Fires in huge coal piles are numerous. This new coal bridge, with its large clean-up clams, can speedily handle a fire by the simple process of moving the coal."

Pg. 575, March 23, 1918 "Mining News"

"Calumet & Hecla: …Completion of 10,000-kw power house at Lake Linden and completion of new office house building is only construction contemplated this year."

Pg. 704, April 13, 1918 "Mining News"

"Calumet & Hecla: Subsidiaries suffering considerable loss through the continuance of the fire which has been burning steadily for two weeks in the soft coal storage at Dollar Bay. Fighting fire costly task and not yet under control, although two steam shovels and 60 men have been removing the coal steadily. Storage pile contained over 100,000 tons."

Pg. 1064, June 8, 1918 "Mining News"

"Calumet & Hecla: Not to be delayed by recent decision as to Minerals Separation patents in installing flotation plant. To put new barrel drum on

Nordberg hoisting engines at No. 5 Tamarack. Production at reclamation plant uniform and uninterrupted."

1918, Vol. 106

Pg. 305 contains a fairly comprehensive treatise on coal pulverization.

Pg. 88, July 13, 1918 "Mining News"

"Calumet & Hecla: American Bridge Co. beginning construction on 2000-ton flotation plant similar to plant in Hecla mill."

Pg. 237, August 3, 1918: "Editorial Correspondence"

"The Calumet & Hecla Co.'s Operations for the recovery of the slight copper content of the stamp sands is becoming more and more important year after year as the company adds to its equipment for working over the old sands, and a recovery of copper is now being made from this former waste material that is greater than the recovery of amygdaloid rock. For many years stamp sand has been used in the building of highways, in making concrete for construction work, in laying sidewalks, and for similar uses. It was estimated when the plans were made for building the regrinding plants, that about 37 ½% of the copper contained in the sand could be recovered. No. 1 regrinding plant, however, started recovering an average of 40% of the copper. No. 2 plant was then constructed, and a leaching plant, to still further increase the recovery was put up and handled 2000 tons of sand per day. Regrinding and leaching brought the recovery of copper up to about 75%. A second unit of the leaching plant was constructed, doubling the capacity, and then the company turned its attention to oil flotation as a means of still further increasing the recovery. Experiments proved successful, and a plant is being installed. Foundations are now going in and the 17-unit plant will take care of the slimes from approximately 5000 tons of stamp sand or tailings per day. When the entire plant is in operation, the cost of copper from the stamp sands will, it is expected, be reduced to around 4c. and perhaps even lower. This would be the lowest-cost copper produced in the district."

Pg. 240, August 3, 1918: "Mining News"

"Calumet & Hecla: Building drydock at Torch Lake for the big Bucyrus dredger, which handles tailings for regrinding mills."

Pg. 427, August 31, 1918: "Mining News"

"Calumet & Hecla: Steel for new flotation plant at Lake Linden in place. Plant under cover and ready for installation of machinery."

Pg. 808, November 2, 1918: "Mining News"

"Calumet & Hecla: Has installed electric furnace for making stamp shoes at foundry."

1919, Vol. 107:

Pg. 73, Jan. 11 1919: "New Mining and Metallurgical Construction in 1918"

"Calumet & Hecla Mining Co., Calumet, Mich., increased capacity of Lake Linden leaching plant by substituting Hardinge mills for Chilean mills; installed 240 forty-ton cars; completed 10,000-kw power house and office building at Lake Linden; installed electric furnace for making stamp shoes; began construction of 2000-ton flotation plant."

Pg. 340, Feb. 15, 1919: "Mining News"

"Calumet & Hecla (Calumet) – Installing two new heads at Point Mills. Work delayed by late delivery of steel and equipment. At Lake Linden, using new Hardinge mills recently installed and pushing construction of flotation plant."

Pg. 1062, June 14, 1919: "Editorial Correspondence"

"Copper Metal on Hand in the Lake Superior smelting plants at this writing does not aggregate 30,000,000 lb. Some of the Michigan copper mines have small amounts stored in New York warehouses, but practically none abroad. The total amount stored is just one month's output of the mines of this district, operating under normal conditions.

Calumet & Hecla and subsidiary mines have the greatest amount on hand, a total of 20,000,000 lb. This is the combined total showing at the Calumet & Hecla plant at Hubbell and the Lake Superior Smelting Co.'s plant at Dollar Bay, the subsidiary plant.

The Lake Superior plant was shut down 10 days ago and all smelting hereafter will be done at Hubbell. A substantial amount of mass copper which was on hand at Dollar Bay was reshipped to Hubbell for treatment. Whether the Dollar Bay plant will be reopened when conditions improve again or not will be determined by the future product of the Calumet & Hecla mines. Since the opening of navigation, shipments of metal have been heavy and practically all of the copper has been sent out to fill urgent orders."

Pg. 1103, June 21, 1919: "Mining News"

"Calumet & Hecla (Calumet) – Big dredge in operation, after having been overhauled in drydock at Point Mills. Revolving screen removed. Grinding and leaching plants doing full duty and oil flotation in connection therewith will be in operation in three months. Calumet & Hecla output down to 50% basis. Thirteen stamp heads out of 28 running at the mills, handling conglomerate exclusively. Small tonnage from Osceola amygdaloid comes from necessary shipments of rock taken in openings. But 14 furnaces working at smelter. Only construction in progress is erection of steel work for flotation plant at mills. When this plant is working all conglomerate slimes will be either floated or leached."

1919, Vol. 108

Pg. 292, Aug. 16, 1919: "Mining News"

"Calumet & Hecla (Calumet) – New flotation plant will be running in September, according to present plans, and will handle all conglomerate sands. Steel work completed."

Pg. 422, Sept. 6, 1919: "Mining News"

"Calumet & Hecla (Calumet) – Reclamation plant at Lake Linden recovering more copper than at any time before. Dredge working well. Additional flotation plant ready on Sept. 1. Hardinge mills being relined with Belgian flint bricks, first cargo having arrived."

Pg. 594, Oct. 4, 1919: "Mining News"

"Calumet & Hecla (Calumet) - ….Experimenting with electric smelting, but not successful. Survey of smeltery situation under way, but no decision as to extent of rebuilding operations at Hubbell plant."

1920, Vol. 110:

Pg. 790, Oct. 16, 1920: "News By Mining District"

Michigan – The Copper District – C&H Subsidiaries to Get Power From Lake Linden – Tamarack Reclamation Plant Site Cleared"

"…The steel for the addition to the Calumet & Hecla flotation plant at Lake Linden is expected to arrive soon. This building is being erected by the American Bridge Co.

The site of the Tamarack reclamation plant is practically cleared of the old Tamarack stamp mill and equipment. Excavation for the flotation and leaching buildings are well under way."

Pg. 970, Nov. 13, 1920: "News By Mining District"

Michigan – The Copper District - Flotation to be Tried on Amygdaloid Slimes

"…Some of the amygdaloid mines are planning to test the flotation process of their slimes soon. The flotation of the copper in the conglomerate slimes of the Calumet & Hecla and the shale formation of the White Pine Copper Co. has been a success. At the Calumet & Hecla the Minerals Separation process is used."

1921, Vol. 111:

Pg. 406, Feb. 26, 1921: "News by Mining District"

…"Calumet & Hecla has suspended operations at its electrolytic plant for about 2 weeks. This action was caused by the decreased supply of copper mineral with the required silver content."

Pg. 642, April 9, 1921: "News by Mining District"

…."The management of the Calumet & Hecla and subsidiaries has announced that all their properties will cease production for an indefinite period beginning April 1. This means the shutting down of the Calumet & Hecla Mining Co., the

Ahmeek Mining Co., and the Isle Royale Copper Co., these being the only mines of the group operating since last November. This action is necessitated by the condition of the copper market and is in line with the policy of other large copper producers throughout the country."

Pg. 687, April 16, 1921: "News by Mining District"

…"Calumet & Hecla has announced a 25 per cent cut in the wages of those still on the payroll, effective April 16. This includes pump men and mill, smelter, and power plant employees."

1921, Vol. 112:

Pg. 72, July 9, 1921: "News by Mining District"

SCANNED. This is a very detailed write-up which mentions a slow-down in production at the Smelter, potential value of sands for the Tamarack plant and current amount of copper at smelters.

Pg. 274, August 13, 1921: "News by Mining District"

…"Calumet & Hecla is in receipt of orders for 200,000 lb. for domestic customers and 100,000 lb. for export. This metal will be shipped soon, these orders being all that are on the C&H books. Calumet & Hecla continues to operate two furnaces (out of 24) at the smelting plant."

Pg. 314, August 20, 1921: "News by Mining District"

…"Calumet & Hecla has no orders on its books at present, but will continue to keep two furnaces in operation. There is still a considerable number of cupola blocks to smelt, and these will be made up into anodes for the electrolytic plant, being returned as cathodes and held in readiness for smelting into such shapes as may be ordered. C&H still has a large amount of mass copper and some mineral at the smelter, and this, with the cathodes, will permit filling of orders for special shapes without the necessity of recasting stock shapes. Recent orders have been comparatively small, and it is believed little difficulty will be experienced in handling all business, under present market conditions, with two furnaces."

Pg. 355, August 27, 1921: "News by Mining District"

…"Calumet & Hecla has an order for 400,000 lb., which will be shipped early in September. Half of it will be exported to France, in the form of billets, and the remainder is for domestic customers. This is the only business Calumet & Hecla now has on its books.

There will be no resumption of mining by Calumet & Hecla and its subsidiaries this fall, is further indicated by the issuance of orders to economize to the utmost extent in every department, doing away with every expense possible. Each department throughout the organization will "cut to the bone", eliminating costs not absolutely essential. The power plant will continue to operate, but just sufficiently to supply power for the maintenance of pumps. To cut costs, electric pumps have largely replaced steam and air pumps throughout the properties and in

so far as possible all necessary operations have been electrified. The central power plant at Lake Linden will serve all of the C&H mines….

Although it will take C&H and its subsidiaries several months to build up their organizations when mining is resumed, it has one big asset that can be put to work at capacity in producing copper without the loss of time when metal conditions warrant. That is the reclamation plant on the conglomerate sands at Lake Linden. This plant is in a constant state of readiness, and in twenty-four hours, could be placed on a maximum production basis of nearly 2,000,000 lb. of refined copper per month."

Pg. 872, Nov. 26, 1921: "News by Mining District"

"It is estimated that there are 12,000,000 tons of sand in the Tamarack conglomerate tailings in Torch Lake, assaying at 12 ½ lb. of copper to the ton. Calumet & Hecla plans to complete the reclamation plant there next summer, and the recovery of this metal will than begin. Though the deposit is not as extensive or as rich as that of the Calumet & Hecla proper, the copper can be recovered at a low cost and the plant investment will yield a large return.

The Calumet & Hecla deposit originally contained 40,000,000 tons, running as high as 14 ½ lb. of copper to the ton. In 1920, the Calumet & Hecla tailings assayed as 13.1 lb. to the ton, and of this amount 10 ¼ lb. was recovered. A total of 14,138,240 lb. was produced, at a cost of 6.6c per lb., exclusive of smelting and selling expense. This cost was high, on account of the abnormal price of coal and the high cot of labor and supplies. It compares to with a normal cost of 4 ½ to 5c. per lb. In the few years the Calumet & Hecla reclamation plant has operated it has recovered 48,537,488 lb. of copper. It is estimated the remaining sands carry over 450,000,000 lb. of metal."

<u>1922, Vol. 113</u>

Pg. 307, Feb 18, 1922: "News by Mining District"

"…Since the shutdown of the mines last spring, Calumet & Hecla has continued to operate its smelter, smelting such mineral and mass copper and cupola blocks as had accumulated, and an average of more than 2,000,000 lb. a month of refined copper has been turned out. The smelter now has only enough material to keep it operating until a new supply comes from the mills upon the resumption of mining."

Pg. 426, March 11, 1922: "News By Mining District"

"The tables and other equipment in the Calumet mill of the Calumet & Hecla have not been seriously affected by the long suspension, and investigation has disclosed that only minor repairs will be necessary. The work of getting the mill in readiness is proceeding satisfactorily. Probably not more than three heads will be put in operation April 1, and production will probably be comparatively small for the first few months. Vein rocks now being hoisted from some of the conglomerate

shafts during the progress of shaft repairs will be shipped to the mill as soon as the heads are ready for it."

Pg. 695, April 22, 1922: "News by Mining District"

"Only 2,000 tons of "rock" is being shipped daily from the Calumet & Hecla conglomerate department to the Calumet mill, where six heads are in operation sixteen out of the twenty four hours. If there is no decrease in the high yield obtained during the first three months of 1921, this tonnage will give 1,887,000 lb. of refined copper per month, which is only 30 per cent of normal for the entire mine in average years."

Pg. 937, May 27, 1922: "News by Mining District"

…"At the Calumet mill of Calumet & Hecla, eight heads are being operated. Eight furnaces at the smelter are also in operation. Production is gradually increasing as shaft repairs progress and men can be employed in actual mining. Rock shipments now run about 2500 tons daily."

<u>1922, Vol. 114</u>

Pg. 205, July 29, 1922: "The Mining News"

"Calumet & Hecla Resumes Construction of Torch Lake Re-treatment Plant – Work has been resumed on the construction of the reclamation plant on the Tamarack conglomerate sands, Torch Lake. Calumet & Hecla will push the project although its completion will not be possible before the spring of 1924. The plant will be designed to treat 850,000 tons per year, as compared with a maximum capacity of 1,500,000 tons for the Calumet & Hecla plant. There is approximately 12,000,000 tons in the Tamarack deposit, which averages by assay 12 ½ lb. of copper to the ton, 10lb. of which can be reclaimed. Costs under normal conditions are from 4 ½ to 5 c. per lb. The four processes used in reclamation are regrinding of the coarser sands, washing, leaching and flotation. The leaching and flotation will be practically one. The foundations are already in."

Pg. 212, July 29, 1922: "News by Mining District"

"In the Calumet and Hecla tailing deposit there is 40,000,000 tons of material containing an average of 14 ½ lb. of copper per ton. Approximately 2 ½ lb. is lost in retreatment. The sands farthest out in the lake are the dredged during the summer, those inshore being taken out in winter on account of ice in the lake. The sands farthest out are the newer tailings and are not as rich as those inshore. So while the reclamation plant may be working to capacity in summer the recovery may not be as high as it is during the winter.

Resumption of work on the Tamarack reclamation plant and haulage way in the Calumet & Hecla conglomerate department…are all cited as evidences for faith in the Lake district and forerunners of a return of normal activities and prosperity."

Pg. 433, September 2, 1922: "News by Mining District"

"…At the Calumet & Hecla smelter, twelve furnaces are in operation, two of which are smelting cupola blocks for the electrolytic plant. The smelter force now numbers 350 men, on full time."

1923, Vol.115

Pg. 37, January 6, 1923: "News by Mining District"

"…Danish pebbles continue to do duty in the Calumet & Hecla regrinding mills, no satisfactory substitute having been found in this country. A cargo if the oval-shaped flint stones was received from Denmark during the season of navigation and practically a two years' supply is kept constantly on hand. Efforts have been made from time to time to obtain flint in the domestic market but none has ever measured up to the requirements as the Danish pebbles."

Pg. 339, February 17, 1923: "News by Mining District"

"…Calumet & Hecla has discontinued the electrolytic treatment of its copper, at least temporarily. A change in refining methods, involving cleaner skimming has reduced the silver content in the copper to only a small amount, making electrolytic treatment unnecessary."

Pg. 688, April 14, 1923: "News by Mining District"

"…The reclamation plant of Calumet & Hecla should do better this year. Throughout the summer the dredge will operate on conglomerate sands deposited farther out in Torch Lake. The tailing was from rock treated in the early days of the property, when losses were comparatively heavy, and assays, better than 14 lb. to the ton. During the winter the dredge operates closer inshore, owing to ice conditions, scooping up sand deposited in the later years and containing less copper than the outlying tailing.

The Tamarack reclamation plant, which will go into operation in the spring of 1924, should add approximately 800,000 lb. of refined copper per month to Calumet & Hecla production. Tamarack tailing assays an average of 2lb. less per ton than that of C.&H., and the capacity of the Tamarack plant will be a little more than half that of the Calumet. The greater part of the machinery and tank equipment of the Tamarack plant will be installed this summer, work on the buildings being about completed."

Pg. 863, May 12, 1923: "News by Mining District"

"All equipment for the reclamation plant which Calumet & Hecla is building on the Tamarack conglomerate tailing deposit in the Michigan copper district is on the ground, and shipment of dredge parts will be made soon. The dredge will be assembled at the Calumet & Hecla drydock at Point Mills."

Pg. 908, May 19, 1923: "News by Mining District"

"Electrolytic Plant Idle for Some Time to Come – It is unlikely the Calumet & Hecla electrolytic plant will again be operated for some time to come, at least until

Osceola and the Osceola amygdaloid shafts of the parent company are reopened. The only Calumet & Hecla property now operating which has any appreciable amount of silver in its copper is Isle Royale, little being found in the conglomerate or in Ahmeek rock. Since suspension, of the electrolytic plant, orders specifying electrolytic copper are filled at Perth Amboy, N.J., where the anodes are shipped for electrolytic treatment."

1924, Vol. 117

Pg. 68, January 12, 1924: "Calumet & Hecla Sees More Economical Production Ahead"

"…Construction work in the new Tamarack reclamation plant, which will reclaim copper from the waste Tamarack conglomerate sand in Torch Lake, is proceeding. Installation of equipment involves the setting up of separators, tables, conveyors, regrinding mills, settling tanks, and flotation and precipitation units. Work on the dredge is well underway and the completion and operation of the entire plant is expected in the spring. Copper will be made for around 6c. per pound judging from the work done in the C&H plant.

Pg. 264, Feb. 9, 1924: "Pulverizing Plant Will Cut Fuel Bill"

"The fuel-pulverizing plant at the Calumet & Hecla Consolidated's smelter at Hubbell, Mich., will be housed in a building of steel construction, work on which will be pushed to completion. With the completion of this plant, a saving of fully 30 per cent in fuel consumption should result."

Pg. 738, May 3, 1924: "Tamarack Reclamation Plant Ready By Summer if Needed"

"Work is proceeding on final stages of construction at the Tamarack reclamation plant of Calumet & Hecla Consolidated, in the Michigan copper district, and it will be ready for use this summer if needed. Ten pounds or better of refined copper per ton should be reclaimed from the waste sands or tailings of the old Tamarack conglomerate mill.

It is estimated the deposit contains 12,000,000 tons of sand and operating at capacity it will take about 15 years to exhaust the supply. The capacity of the plant will be approximately 850,000 lb. of refined copper per month."

Pg. 938, June 7, 1924: "Calumet & Hecla Proceeds With Big Construction Projects"

"Construction work is proceeding at Calumet & Hecla Consolidated's reclamation plant on the Tamarack conglomerate sands, in the Michigan copper district. The trestle for the launder from the outer edge of the sand deposit to the plant is being built, and in the interior of the plant itself the installation of equipment is well toward completion.

The plant probably will not resume operation until the metal market strengthens. Good progress is being made on the construction of the fuel-pulverizing plant, which will feed the furnaces with pulverized coal, will be

completed this summer. It should effect a saving of 30 per cent or more in the fuel cost of smelting."

1924, Vol. 118

Pg. 544, October 4, 1924: "Tamarack Reclamation Plant, in Michigan, Virtually Finished"

"The new Tamarack reclamation plant of the Calumet & Hecla Consolidated is nearing completion. A channel is being built into the shore plant, and installation of equipment is in its final stages. The entire project will be completed, it is estimated, in eight weeks. It has not been decided, however, when the plant will go into operation. This is dependent on the metal market, and there is no demand in sight for additional production. The plant, working at capacity, will recover approximately 900,000 lb. of refined copper per month from the Tamarack conglomerate sands, or about half the capacity of the Calumet plant."

Pg. 705, November 1, 1924: "C. &H. Coal-Pulverizing Plant in Operation, Saves Much"

"At the smelting plant of Calumet & Hecla Consolidated, in the Michigan copper district, the new fuel-pulverizing plant is working efficiently, feeding all three of the large, 150-ton reverberatory furnaces. It will save 25 to 30 per cent in coal cost in the operation of these units.

At the second step in smelter improvements, the company plans the erection of a melting furnace of large capacity. This addition to the plant's melting facilities will release the three Jumbo type furnaces, which now are used for both melting and refining, for refining only. The proposed improvement will enable the plant to keep pace with production, even though it is increased with the development of a better market for metals."

1925, Vol. 119

Pg. 262, February 7, 1925: "Will Start Tamarack Reclamation Plant in Michigan"

"Calumet & Hecla Consolidated's new reclamation plant on the Tamarack conglomerate sands, in the Michigan copper district, will be "turned over" on March 1 for adjustments. After a thorough testing, the plant will go into operation, probably April 1 or May 1. It will produce about 700,000 lb. of refined copper per month at an estimated cost of 9c. per lb.

The capacity of the plant is approximately three-eighths that of the Calumet plant. Tamarack sands are not as rich as those of the Calumet & Hecla, and consequently recovery of refined copper will be less and cost per lb. higher. It is estimated that there are 12,000,000 tons of sand in the Tamarack deposit, from which 120,000,000 lb. of copper should be recovered. On this basis, it will require about fourteen years to treat the entire supply."

Pg. 380, February 28, 1925: "New C&H Furnace Will Handle 225 Tons Daily"

"One of the three large furnaces which is being built at the Calumet & Hecla Smelting plant, in the Michigan copper district, will have a capacity of 220 to 225 tons of metal a day. It will be used for melting purposes only, leaving the other two furnaces for refining. These furnaces, with the smaller units in operation, will afford ample facilities for the treatment of all copper of the Calumet & Hecla companies.

Aside from the 9-mile railroad from the Ahmeek mine to the Ahmeek stamp mill, no other construction work is under consideration by Calumet & Hecla. Work on railroad construction will be resumed early in the spring. The greater part of the grading and concrete construction were completed last fall, and completion of the project by July 1 is expected."

Pg. 734, May 2, 1925: "Calumet & Hecla's Monthly Output to Be 8,000,000 lb. Soon"

"Improvements in progress at the smelting plant of Calumet & Hecla Consolidated, in Michigan's copper district, including the erection of a second melting furnace and installation of equipment for handling of mineral and refined product, will result in a reduction of smelting costs. The mineral of all the producing units will be treated in three large furnaces when the improvements are completed in the fall. Practically all of the smaller furnaces will be abandoned. The three furnaces will be operated with pulverized fuel, effecting a saving of 25 to 30 per cent in coal costs. The operation of the larger furnace units will require a smaller smelter force than that at present employed.

With the operation of its two reclamation plants, Calumet & Hecla Consolidated will obtain a yield of approximately 2,500,000 lb. of refined copper per month produced at a cost, exclusive of selling, of 6 ½ c. per lb. The new plant on the Tamarack conglomerate sands will go into operation soon. Its capacity is not quite half that of the plant on the Calumet & Hecla sands. It should produce around 700,000 lb. per month and continue this rate twelve years or more."

1925, Vol. 120

Pg. 345, August 29, 1925: "Gratifying Results Obtained From C&H Reclamation Plant"

"A yield exceeding expectations is being obtained from the new reclamation plant of Calumet & Hecla Consolidated, in the Michigan copper district. Present rate of production is 900,000 lb. per month. The Calumet plant also is obtaining a higher yield than usual, production now being at the rate of 2,000,000 lb. per month, the largest in its history. This does not mean, however, that this high yield will continue. The respective dredges happen to be operating in sand bed areas rich in copper and the yield will vary as the dredges are moved."

Pg. 827, November 21, 1925: "Increase Smelting Capacity at Hubbell, Mich."

"The old Tamarack and Osceola coal dock and smelter at Dollar Bay, Mich., both of which plants are owned by Calumet & Hecla, are being dismantled. Such steel as can be used will be shipped to Hubbell, where important improvements are under way to reduce costs.

One smelting unit, which has a capacity of more than 10,000,000 lb. of mineral per month, has been completed. Another large furnace has been rebuilt for refining and a third refining unit of similar capacity is being constructed."

1926, Vol.121

Pg. 656, April 17, 1926: "Michigan Copper Mines in Fair Way to Increase Production"

"…At the Calumet & Hecla smelter, where production is between nine and ten million pounds of refined copper per month, two large and nine small furnaces are in operation. With the completion of the third large unit, which will be used for refining, the smaller furnaces will be abandoned."

Pg. 814, May 15, 1926: "Calumet & Hecla Resumes Operations on Osceola Amygdaloid"

"…A third stamp in the little Tamarack mill, on Torch Lake, will be put in readiness for use by Seneca Copper. Two heads now are in operation. Present output is around 1,200 tons daily."

1926, Vol. 122

Pg. 27, July 3, 1926: "Calumet & Hecla Construction Program Nears Completion"

"The present year will see the virtual completion of Calumet & Hecla Consolidated's big construction program. Installation of a large casting machine to serve the new refining furnace at the Hubbell, Mich. Smelter will complete the major projects. Delivery of the machine is expected in September. Ahmeek of Calumet & Hecla is shipping about 3,200 tons of copper daily, refined production per month probably running 2,700,000 lb.

The Mohawk Mining Co., Mohawk, Mich., is stamping to the capacity of its mill. This property will equal, or better, its 1925 record. Mill loses have been reduced to a minimum through the installation of regrinding units."

Pg. 467, September 18, 1926: "Plans Fourth Furnace"

"At the Calumet & Hecla Consolidated smelting plant at Hubbell, Mich., the furnace building has been extended to provide room for the ultimate construction of another large furnace. Three of these units have been built and will be ready within a few months to handle the entire present mineral product of the consolidated mines."

1927, Vol. 123

Pg. 656, April 16, 1927: "Recent Development Encouraging in Michigan Copper District"

"…There has been ample evidence of improvements in milling practice in the district by the recovery of 8,290,076 lb. of copper by table treatment of waste

conglomerate sands at the Lake Linden and Tamarack reclamation plants of Calumet & Hecla Consolidated last year. The coarse sands were subjected to table treatment, and the fines to leaching and flotation. About 18,212,000 lb. was recovered through leaching, and 4,486,000 lb. through flotation. Results at the plants vary as new areas of sands are dredged. When deposits dumped into Torch Lake during the earlier years of Calumet & Hecla are encountered the yield is higher on account of the cruder methods of extraction employed in the earlier days. Sands deposited in later years contain considerably less copper, the losses decreasing as methods improved.

At the Lake Linden plant during last year, sand above the average grade was treated, and as a result a new high record of copper production was made in spite of a lower yield at the Tamarack plant which resulted through encountering a considerable amount of amygdaloid sand. For the two plants, 11.24 lb. of copper per ton of sand treated was recovered. An average yield of 10.49 lb. has been made since treatment of the sands was started at the Lake Linden plant some years ago."

Pg. 775, May 7, 1927: "Michigan Copper Country Properties Active"

"…The conglomerate tailing from the first stamp mill of Calumet & Hecla Consolidated, which was located at Calumet, will be re-treated at the company's Lake Linden reclamation plant."

1927, Vol. 124

Pg. 265, August 13, 1927: "No. 2 Shaft of Quincy Mine Reopened After Fire"

"…Calumet & Hecla Consolidated has plans for the construction of another large furnace at its smelting plant at Hubbell, in the Michigan copper district. This will give the company four large units, three for smelting, and one for refining. The smelter also is equipped with a modern casting machine. The proposed new furnace will have a capacity of 600,000 lb. at one charge, and it is understood its construction will increase the smelter's capacity to 20,000,000 lb. of copper per month. Labor costs have been largely cut through the installation of modern furnaces and equipment at Hubbell. The casting machine is capable of handling 100,000 lb. of copper in one operation, requiring the service of only a few men."

Pg. 421, September 10, 1927: "Quincy Mine Working Full Force in No. 6 Shaft"

"…Calumet & Hecla Consolidated is shipping conglomerate sand from the site of the first Calumet stamp mill in Calumet to the reclamation plant at Lake Linden, where it will be retreated. The old tailings are rich in copper, running, it is estimated, over 30 lb. to the ton. It is said there are approximately 112,000 tons of the sand in the deposit."

Pg. "4, October 1, 1927: "Quincy Entering New Rich East Vein at Depth"

"…Calumet & Hecla Consolidated has ample stamping facilities in its mills at Lake Linden and Tamarack Mills. Only the Calumet mill at Lake Linden is now operating, the Hecla plant being idle."

Pg. 985, December 17, 1927: "Last Boat Shipments of Year Leave Michigan Smelters"

"…Steel is arriving for the erection of the fourth furnace unit at Calumet & Hecla Consolidated's smelter at Hubbell."

1928, Vol.125

Pg. 587, April 7, 1928: "Calumet & Hecla Employing More Than Five Thousand"

"…No word has yet been received at Seneca relative to the expected reopening of the property. In the event operations are resumed, the No. 2 stamp mill of Lake Milling, Smelting and Refining at Hubbell will again be available for use. It is in good condition to operate at any time."

Pg. 669, April 21, 1928: "Haulage Tunnel Makes Mining at Depth Easier at Calumet & Hecla"

"…If there is much increase in tonnage from the company's mines it may be necessary to put either the Osceola or Little Tamarack milling plants into operation. Both are said to be ready for immediate use. Calumet and Ahmeek mills are being taxed to capacity. The Hecla mill, which has been idle for some years, is not a modern plant, and there is little likelihood of it being used. About 4,000 tons of high-grade amygdaloid rock is being shipped to the Ahmeek mill daily. Most of this is from the Ahmeek mine, a small tonnage coming from the North Kearsarge openings. Rock from the four active shafts of the Osceola lode is being sent to the Calumet and Ahmeek mills….

Results of operation of the company's Lake Linden and Tamarack reclamation plants during 1927 have been made public. These plants recover copper from the waste conglomerate sand. Costs decreased from 7.10c. a pound in 1926 to 6.63c. in 1927, and, of the copper recovered, 62 per cent was obtained through leaching, compared with 58 per cent during the preceding year. Total amount of copper reclaimed by the plants since they started in 1915 amounts to 187,392,000 lb. of refined metal. It is said that the production of reclamation plant is greater than that of any amygdaloid property in the Michigan copper district with the exception of the Ahmeek mine."

Pg.946, June 9, 1928: "Carp Lake Property in Michigan Will be Explored"

"…At Calumet & Hecla Consolidated's smelter, excavating has been started for the erection of a building which will complete the modernization of the plant. Two large refining furnaces and a smelting furnace have been erected, and steel is arriving for the construction of a second smelting unit to supplement the one already in commission. It is expected this furnace will be completed this year. It will be 20 ft. wide and 70 ft. long, with a capacity of 225,000 lb. of mineral per day. It will be so built that the molten metal will flow by gravity to either of the two large refining units.

1928, Vol. 126

Pg. 146, July 28, 1928: "Contract is Awarded for New Calumet & Hecla Building"

"Calumet & Hecla Consolidated has awarded a contract for the erection of a mineral storage building at it smelter at Hubbell, in the Michigan copper district. When this new structure and the new smelting furnace now under construction are completed, the plant will have been fully modernized and equipped for economical operation. Two large melting furnaces and two large refining furnaces will give ample capacity for the smelting of the mineral from all the producing units of the company, including Isle Royale, which pending completion of smelter improvements, is sending its mineral to the Michigan plant at Houghton.

The new melting furnace now being built will have a capacity of 225 tons of mineral per day, and molten metal from it will flow by gravity to either of the two refining units. The melting furnace already in commission charges by gravity. One of the new refining units is especially equipped for melting and refining large masses of copper and for making billets and other irregular shapes."

Pg. 547, October 6, 1928: "Calumet & Hecla to Reopen No. 17 Shaft on Osceola Lode"

"…The company's conglomerate tailings, which are being re-treated in two reclamation plants, have yielded 187,392,000 lb. of refined copper up to the first of this year. The deposits originally contained 40,000,000 tons of recoverable sand – 30,000,000 in the Calumet deposit and 10,000,000 in the Tamarack. Up to 1928, a total of 18,150,000 tons has been re-treated, returning 10.32 lb. of copper per ton. In 1927, the average cost sold was 6.32c. per pound. Approximately 22,000,000 tons of sand remains to be treated, or a seven to eight years' supply at the present rate of reclamation."

Pg. 760, November 10, 1928: "Higher Prices for Copper Increases Activities in Michigan District"

"…Sampling of the larger of the two Quincy tailing dumps in Torch Lake is nearing completion, the assays showing an average of more than 8 lb. of copper to the ton. The tailing will be treated in Fahrenwald flotation machines, which will be installed in No. 2 mill. Tailing will be removed from the lake by means of a suction dredge, the method employed by Calumet & Hecla at two of its reclamation plants. It is estimated that Quincy has 29,000,000 tons of tailing which can be re-treated with a loss of about only 1 lb. per ton."

Pg. 996, December 22, 1928: "Construction Work Progresses at Calumet & Hecla"

"At Calumet & Hecla Consolidated's smelter in Hubbell, Mich., favorable weather is contributing to rapid progress in construction of a large mineral storage building, adjacent to the structure housing the furnaces. Another automatic casting machine, similar to the one now in commission, will be installed in the furnace plant. When repairs to the third large furnace are completed, the plant will operate at capacity again, enabling the smelting of Isle Royale concentrate, which for some time has been going to the Michigan smelter, at Houghton."

1929, Vol. 127

Pg. 574, April 6, 1929: "Second Automatic Casting Machine Installed at C&H"

"The second and final automatic casting machine is being installed in the new furnace department of the Calumet & Hecla smelter, at Hubbell, Michigan. The metal flows from the furnaces directly into the machine, where it is cast into desired shapes without handling. The new furnaces and automatic casting equipment (the latter made in the company's shops) are effecting notable economies in the smelting department."

Pg. 653, April 20, 1929: "Quincy Will Treat Tailing by Flotation"

"Quincy plans to treat a large daily tonnage by flotation in reclaiming copper from its waste sand deposit in Torch Lake, Mich. About 2,500 tons of tailings daily will be handled at a cost equal to that achieved at Calumet & Hecla's reclamation plant, which is less than 6c. per pound. In the Torch Lake sand banks are 29,000,000 tons of tailings which will run from 7 to 9 lb. of copper per ton. This will provide Quincy with a considerable output of low cost copper. The returns should enable the company to write off the cost of the reclamation plant in a short time."

Pg. 696, April 27, 1929: "New Storage Building Complete at C&H Smelter"

"At the Calumet & Hecla smelter, at Hubbell, Mich., the new mineral storage building is in commission. It will facilitate the handling of mineral, which will be automatically conveyed to the furnaces. This structure and the installation of a second casting wheel complete the modernization of the smelting plant, which is equipped to take care of all production of Calumet & Hecla and subsidiaries."

Pg. 930, June 8, 1929: "C&H Reclamation Work May Have Eleven Years Left"

"Copper tailing at Torch Lake, Mich., will keep Calumet & Hecla's reclamation plants in commission seven to eight years more, but it is possible it may be stretched to eleven years if the conglomerate sand is not contaminated too much by amygdaloid sand. In the rich Calumet sand bank, only an eight to ten months supply remains. Tailing in which there is more or less amygdaloid will have to be treated then. Both the Hecla and Tamarack sand deposits are contaminated by tailing of lesser copper content. The Calumet sand bank originally contained about 18,000,000 tons of high-grade tailing, which came from the mills in the early days when metallurgical practice was not so highly developed as now.

At the Calumet & Hecla smelter, slag from the "rough" furnaces now is being reground and treated by flotation for copper. A considerable saving will result, but the percentage of copper is not enough to warrant reclaiming metal from the old slag which was dumped into Torch Lake."

1929, Vol. 128

Pg. 637, October 19, 1929: "C&H Stops Work for Season at Calumet Dam"

"Dredging at the Calumet dam in the Michigan copper district by Calumet & Hecla has been discontinued for the third season. About 100,000 tons of tailing, averaging about 35 lb. of copper per ton, has been recovered from the bank deposited here by the original Calumet mill in 1867-70. The old tailing is almost twice as rich in copper as the ore now mined."

1930, Vol. 129

Pg. 320, March 24, 1930: "News of the Industry"

"C&H starts Working at Centennial; Progress Made in Adopting Flotation: …At the company's Ahmeek mill, the work of installing Fahrenwald flotation equipment made considerable progress during 1929. Recovery has shown the increase anticipated by tests made two years ago by the U.S. Bureau of Mines. Installation of a 2,000-KW low-pressure unit at the Lake Linden power plant will permit finer grinding of the tailing at this mill and should result in even better recoveries by flotation. At the No.2 mill of Lake Milling, flotation equipment has also been installed. This plant is handling ore from Seneca Copper as well as Osceola amygdaloid output from Calumet & Hecla. No. 1 mill is being dismantled.

The Calumet & Hecla smelter has recently been in operation three times a week instead of twice, reflecting an improvement in metal demand, as the smelter is being operated only as orders are received. Concentrate is accumulating in the new storage building, which has a capacity of 15,000 tons. The efficiency of the plant has been greatly increased and smelter losses are now only 0.4 per cent. Operating costs have also been materially decreased."

1930, Vol. 130

Pg. 245, Sept. 8, 1930: "News of the Industry"

"C&H Reaches 96 Level in Conglomerate Area: …"about 6,500 tons of ore is shipped daily to the Ahmeek mill, near Hubbell. At this plant, in addition to the construction of a new 7,500-kw power plant that will supplement the main power unit at Lake Linden, some changes are being made in the regrinding section. Two additional 8-ft. Hardinge ball mills are being installed, which will permit regrinding and subsequent flotation of tailing from the tables and jigs, provided the copper market justifies. At present, middling from the jigs is treated by flotation, but the tailing is sent to the banks after going over Wilfley tables. As this tailing averages only about 3 lb. of copper per ton, regrinding and flotation with copper at 10.75c a pound will probably not pay.

Other C&H metallurgical plants are running full time, although the reclamation units were temporarily closed for repairs earlier in the season. At the smelter, some additions are being made to the main furnace building to provide additional storage facilities for coal."

1931, Vol. 131

Pg. 237, March 9, 1931: "News of the Industry"

"New Ahmeek Power Plant of C&H in Operation: Calumet and Hecla Consolidated 's new auxiliary power plant at the Ahmeek's stamp mill, near Lake Linden has been completed at a cost of close to $1,500,000, and is in operation. Stone & Webster, of Boston, who built the plant, will finish their contract this month. The plant consists of power house and boiler plant, the latter having a capacity of 180,000 lb. of steam, which supplies steam both for the stamp mill and turbines. Power capacity is 11,000 KW per hour.

The new plant is supplementary to the main power station at Lake Linden, which has a capacity of 17,000 KW, and two smaller plants at the Ahmeek mill and the smelter at Hubbell. Calumet & Hecla now have sufficient power capacity for all future purposes, mining, milling, reclamation, smelting, exploration, and development work.

The new plant is one of the most modern operated by steam in the county, producing power at a very low cost. At present, owing to curtailment of operations, less than half of the power load is required. Ample power at the lowest possible cost is provided by the combined plants."

Pg. 336, April 13, 1931: "News of the Industry"

"Work at Depth in Ahmeek Shows Drop in Grade: …Average recovery per ton of tailing treated in the reclamation plant at Lake Linden, was 11.55lb. of copper. This compares with an average of 10.85lb. since operations started. Improved recovery has been achieved despite a drop in grade. The assay of all material treated in 1930 averaged 0.665 per cent copper, compared with 0.680 per cent, the average treated since starting. Actual production was considerably less than in 1929, the result of an interruption to operations in midsummer and suspension last November. Both dredges are still closed down, pending improvement in the copper market.

Cost of producing mine copper dropped from 11.43c a pound in 1930 to 10.56 in 1929. Reclamation-plant costs increased from 5.62c a pound to 6.71c.

1931, Vol. 132:

Pg. 377, October 26, 1931: "News of the Industry"

"C&H Has Fifteen Years' Ore in Upper Conglomerate Area: …The conglomerate tailing deposit in the Hecla & Tamarack sand banks will not be treated until a demand appears for larger production. The Calumet deposit is nearly exhausted, and the remaining tailing is not so rich as that already reclaimed, but it will remain a source of copper, cheaply produced, for seven to ten years, depending on rate of extraction. An average of nearly 11lb. of copper per ton has been recovered, at a cost of less than 7c. per pound, since operations were started. More than 268,500,000 lb. of copper has been obtained from these "waste" sands."

1932, Vol. 133: This Volume is formatted in a much different style than previous issues. It has been reduced to monthly issues, compared to weekly.

Pg. 406, July 1932: "Michigan Copper Country"

"Tailings Provide Copper-Ore Reserve: Calumet & Hecla's tailing deposit in the Hecla and Tamarack sand banks will remain untreated pending demand for larger production. The Calumet deposit is nearly exhausted, and the remaining tailing is not as rich as the sands already treated. Nevertheless, the remaining supply will be a source of cheap copper for seven to ten years. An average of nearly 11 lb. per ton has been recovered, at a cost of less than 7c. per lb. Companies in the Michigan copper district have large deposits of amygdaloid tailing. These sands are amenable to flotation. Deposits along water fronts have been scattered, but a large volume remains, particularly in the more compact piles near land. Sampling gives assurance that the millions of tons of tailings in the district form a potential source of copper, which can be recovered at a profit when the market warrants reclamation. The sands can be treated at a cost of about 22c. per ton, including regrinding and flotation. Average recovery will be about 6 lb. per ton. Deposits far removed from operating mills can be treated in portable plants."

1933, Vol. 134: Nothing of Note.

1934, Vol. 135: Nothing of Note.

1935, Vol. 136: This volume only mentions the involvement of Calumet & Hecla in the Ropes Gold Mine near Ishpeming.

1936, Vol. 137

Pg. 39, January 1936: "Calumet & Hecla Raises Miners' Wages"

"Following a wage increase of approximately 11 ½ per cent, affecting the 1,340 men in its employ, Calumet & Hecla Consolidated has reopened the Ahmeek mine near Hubbell, Mich., closed since April, 1932."

Pg. 157, March 1936: "Greater Exploration Planned for the Ropes Mine"

"…Calumet & Hecla also is sinking a shaft at its new exploration at Central, in Keweenaw County, where rich copper values have been opened. The company's Ahmeek mine, recently reopened, is producing, and three stamp heads in the Ahmeek mill are operating."

Pg. 207, April 1936: "Calumet & Hecla"

"Calumet & Hecla Consolidated Copper Company produced 36,330,800 lb. of copper from the Conglomerate mine and 9,118,000 lb. from the reclamation plant at Lake Linden during 1935, the annual report shows. The smelter produced 56,599,562 lb. of copper last year. "

Pg. 475, September 1936: "Ropes Gold Mine Closed Pending Decision"

"…The Tamarack reclamation plant remains idle, but at the Lake Linden plant the richest available sands are yielding a high percentage of copper."

1937, Vol. 138

Pg. 361, July 1937: "Tamarack Reclamation Plant Ready"

"Calumet & Hecla Consolidated has reconditioned its Tamarack reclamation plant, idle since the latter part of 1930. Tonnage of material available for treatment is estimated to be sufficient for five years' operation. At the Lake Linden reclamation plant, the remaining conglomerate sands will keep the plant in operation approximately seven years. The Lake Linden sands annually yield as much copper as an average-sized mine, last year's output being over 9,500 tons of refined copper. Pounds of refined copper per ton of sand treated were 12.39 in 1936, compared with an average of 11.43 since the plant started. The sands treated last year were richer than the value of the remaining reserves."

1938, Vol. 139

Pg. 78, April 1938 (Vol. 139, No.4): "Low-grade Amygdaloid Copper Sands Treated"

"…The reclamation plants at Lake Linden and Hubbell produced 20,398,000 lb. Average cost sold per pound was 7.59 c. and 6.63 c. respectively, not including depreciation and depletion….Tons of sand treated at the Lake Linden and Hubbell reclamation plants totaled 2,226,000, yielding 9.16 lb. of refined copper per ton. Dredges at both plants are working in areas necessitating inclusion of overlying low-grade amygdaloid sands in order to treat underlying and richer conglomerate."

1939, Vol. 140: Nothing of Note

1940, Vol. 141: Scanned an article on the Smelter and Reclamation plants

1941, Vol. 141

Pg. 81, June 1941 (No. 6): "Copper Mines Receive Less State Tax Valuation"

"Both the Lake Linden and the Tamarack plants operated throughout 1940 under normal conditions. Of the 1940 production 8,646,000 lb. was from table treatment, 17,251,000 lb. from leaching, and 3,785,000 lb. from flotation. At the Ahmeek mill there was stamped 731,403 tons of Kearsarge amygdaloid rock from the Ahmeek mine and 92,300 tons from the Peninsula Copper Co. territory. At Lake Linden the Hecla mill and sand wheels were scrapped. During the year the smelter department received 43,396 tons of concentrates and mass, and smelted 43,890 tons. From the material smelted there was produced 55,835,544 lb. of refined copper. Copper oxide shipped to customers amounted to 2,738 tons, containing 4,169,004 lb. of copper. While the billet-casting equipment, mentioned in the last year's report, is not fully completed, of all the shapes cast during the year 51.6 percent were made in water cooled molds, 39.2 percent being VC cakes and 12.4 percent being billets."

1942, Vol. 142

Pg. 92, April 1942 (No. 4): Extensive Exploration Programs Under Way"

"Calumet & Hecla is making available any excess foundry and machine shop capacity the company may have from time to time for armament production. The company is already engaged in turning out 7,400 lb. engine bases for Chrysler armament plants and 28,000 lb. bed plates for test stands for Packard marine engines. The company also has agreed to do the machining on several castings for tank turrets for the Rock Island arsenal. The company is more than willing to further the defense effort if by so doing its own production of refined copper is not retarded."

-Mention of C&H purchasing Wolverine Tube in Detroit.

-Scanned an article on the Quincy reclamation plant at Mason.

1943, Vol. 143

Pg. 137, Feb. 1943 (No. 2) "C&H Will Reopen Centennial Mine"

"Brass billets are being successfully cast at the Calumet & Hecla smelter at Hubbell. Seamless tubing drawn from these billets is sawed into short lengths to be pressed into grooved recesses in high explosive shells. This causes the shell to grip the rifling of the gun barrel and to whirl rapidly. The rapid whirling holds the shell true to its course. In the old type of guns, copper was used, but with high velocity guns, such as used in this war, copper is reported to be too soft and maybe torn off the shells."

Pg. 102, March, 1943 (No. 3): "C&H is Sinking New Allouez Shaft"

"Calumet & Hecla's conglomerate tailing deposit at the Tamarack mill will be exhausted during the winter of 1943-44, according to the management. Adjacent is a large block of low-grade amygdaloid tailings. Preparations already are being made for the treatment of these sands, which will require a change from the present method. The flow sheet will include closed circuit grinding using Akins classifiers and Forrester flotation machines. No leaching will be necessary. Alteration of the grinding mills, motors, and foundations, and erection of new flotation units, are being carried on without interruption to present operations. It is felt that the gamble is justified, considering the importance of prolonging the life of the company."

"Calumet & Hecla is rebuilding Hardinge mills for regrinding amygdaloid tailings, both for the new Quincy reclamation plant under construction and the Tamarack plant for use after the conglomerate sands are exhausted. The grinding must be cheap and fast. Hard iron balls will be used instead of pebbles. The greater weight of the balls calls for mills with bigger motors, gears, and bearings."

Pg. 111, May 1943 (No. 5): "Allouez No. 3 Shaft Sinking in Ore"

"The hull of the large dredge which will be used to supply copper-bearing sands for the new Quincy tailings reclamation plant, at Mason, on Torch Lake, ahs been launched and is well on the way to completion. The hull is built of Washington

fir and is 100 ft. long and 72 ft. in width. Its weight is more than 200 tons, 12 tons of which is the weight of the bolts holding the timbers together. R.C. Buck, Inc., which is building the new plant near Mason, is also constructing the dredge. There are over four miles of caulking in the bottom and deck. In addition to the hull, a large number of pontoons are being built at the shore yard. Because of the scarcity of steel, wood is being used for both base and over-water equipment. When the dredge goes into service, the pontoons will carry the conveyor pipe through which the copper-bearing tailings will be brought to the plant for treatment."

1944, Vol. 145

Pg. 121, June 1944 (No. 6): "Reduced Mine Valuation recommended – New driving record at C&H Peninsula mine"

"Clad-steel scrap is being treated at the Lake Linden leaching plant and still house of Calumet & Hecla. In one month's operations, 3,264 tons were treated to produce 1,174,831 lb. of copper. This copper and the clean steel scrap are returned to the government for use in constructing war materials."

Pg. 124, July 1944 (No. 7): "Isle Royale pays first dividend since 1937 – Iroquois showing improves below 18th level"

"At the Calumet & Hecla smelter, the foundation for the new No. 22 furnace has been poured, and work on the steel and brick is proceeding. Many innovations in design have been incorporated in the new furnace, which will be used as a much-needed spare for the No. 21 unit."

1945, Vol. 146

Pg.114, Jan. 1945 (No. 1): "C&H enters secondary metal field"

"…A new department known as the secondary department, has been formed by Calumet & Hecla to purchase and treat scrap copper-bearing material. H.C. Kenny, smelter superintendent, will be in charge. Experiments conducted in the treatment of scrap led to the decision to enter this field. Scrap will be purchased in the market for treatment at the Torch Lake plants. This is another step in the company's policy of expansion, which includes the continued exploration for new ore bodies as well as research work leading to new uses of copper."

Pg. 165-166, Feb. 1945 (No. 2): "C&H urged to produce more copper oxide in leaching plants"

"The entire copper oxide output of the Tamarack and Lake Linden leaching plants of Calumet & Hecla is going into the manufacture of barnacle-inhibiting paint and corrosion resisting paint used on ship bottoms by the U.S. Navy and Maritime Service. Recently a committee representing the U.S. Navy, the WPB and the manufacturers of ship-bottom paints visited Calumet and conferred with company officials in an effort to bring about increased production. The firms represented are the Metropolitan Refining Co., of Indiana Harbor, and the C.K. Williams Co., of

Easton, PA., both of which are large users of copper oxide in the manufacture of paint."

Pg. 139, June 1945 (No. 6): Postwar copper production will be affected by price of metal"

"Calumet & Hecla has in sight sufficient steel scrap clad with gilding metal to insure operation throughout the year. Last year nearly 12 million pounds of copper was recovered from this source by treating a total of 11,600 tons of bi-metal. The clean steel goes to steel plants"

"Calumet & Hecla has embarked on a comprehensive study of the possibility of using its idle leaching plant capacity for the treatment of various grades of copper bearing material in substantial tonnages. It is felt that if the investigation proves favorable, this field may have attractive postwar possibilities."

Pg. 139, Sept. 1945 (No. 9) "Copper subsidy extended one month"

"Most of the secondary copper handled by the Calumet & Hecla plants is of the industrial variety. Much of it comes from material scrapped in the making of munitions or damaged in service. Some of it consists of heavy cable such as is used in wiring battleships. Telephone wire used by the Army Signal Corps is another fruitful source of secondary copper, some of it recovered from battlefields. Secondary copper activities are not limited to war-time scrap but also include such standard items as trolley wire and bars."

"Because the ammonia leaching process is particularly adaptable to mixed materials such as steel and copper or tin and copper, scrap of the latter kind is being treated at the Tamarack plant. Tinned copper wire, copper clad steel wire, and motor parts are being leached in quantity."

1946, Vol. 147

Pg. 137-138, February 1946 (No. 2) "Calumet & Hecla officials report 1945 activates and appraise possibilities for 1946"

"…The last of the clad-steel scrap for the Metals Reserve Co. has been treated and final returns have been made. Calumet & Hecla's ammonia leaching process was the only method that could be used to separate the copper and the steel. Approximately 60,000 tons of scrap were treated during the war, which returned 21,000,000 lb. of copper to the Metals Reserve Co. and 45,000 tons of scrap to the steel plants. The copper salvaged was in excess of the settlement with the original suppliers of the material.

The contract was an excellent one for Calumet & Hecla because it furnished employment to a large number of men during its two year's life and called for the payment of a fixed profit per ton over cost of treatment. In treating this material, the company's railroad crew handled a total of 4,800 cars."

Pg. 134, April 1946 (No. 4): "Calumet & Hecla Opens new ground in Keweenaw – Underground employment rolls show increase"

"…The company's entry into the secondary copper field, to compensate so far as possible for the loss of production from the Calumet sands, has been successful. Another phase of operations is the production of copper chemicals in the leaching plants at Lake Linden and Tamarack mills."

Pg. 140-142, June 1946 (No. 6) "Copper Range continues testing of White Pine deposit – C. & H. sees end of Lake Linden dredging"

"…Rising prices of supplies and higher wages have made operations in the amygdaloid tailings deposit of Calumet & Hecla at Lake Linden unprofitable. This, says A.H. Wohlrab, general manager, is indicated by costs averaging 15 ½ c. per pound of copper, resulting in a loss of $20,000 for the four months' period from December 1945 to March 1946, inclusive.

With the full knowledge that the amygdaloid sands will continue to decrease in copper content as the dredge moves into more recently deposited material it is apparent that the 18 ½ c. per hour wage increase and the additional cost of coal, steel and other supplies granted, or to be granted, by OPA, will increase the cost per pound of copper at least 3 3/8 c. This will no longer permit profitable operation of the plant, even at 22 c. per pound for copper, which is the maximum obtainable under the amended Premium Price Plan.

About three months of dredging remained to be completed in comparably high grade conglomerate sand which is deposited along the shore line and under the mill buildings, after which the Lake Linden operations will be closed permanently."

Pg. 126, July 1946 (No. 7) "Calumet & Hecla coal shortage relieved – Quincy reports good results from reclamation"

"Although its mine is shut down, the Quincy Mining Co. is getting good results from its reclamation plant at Mason, on Torch Lake. It is averaging a little better than 5 ½ lb. of copper from each ton of waste sands treated. This is better than a 70 percent recovery."

Pg. 118-119, September 1946 (No.9) "Calumet & Hecla opens Gratiot shaft – Second unit of Lake Chemical Co. producing COCS"

"After many months of construction the second unit of Calumet & Hecla's Lake Chemical Co. went into production on July 15, making copper oxychloride (COCS) in commercial quantities. The unit consists of six lead-lined reaction tanks, each 7 ft. in diameter by 12 ft. high, in which scrap copper is reacted with chlorides and sulphates to form COCS. Approximately 16 hours are required to make the conversion, following which the blue slurry is pumped into one of two 18,000-gal. tanks. After blending and conditioning in the tanks, the slurry is dewatered on a large continuous Oliver filter, where the greater part of the liquid is separated from the blue solid. The wet cake is loaded on trays and dried in large truck-tray driers until the material is commercially free of water. The truck and tray driers will eventually be replaced with a large Proctor and Schwartz continuous aerofrom drier. Delivery of this unit will not be made before the end of the year. The dried product is treated in a micro-pulverizer to break up lumps and is discharged into a storage bin.

The so-called "fixed coppers" sprays and dusts, of which COCS is on type, are essential ingredients in many of the commonly used sprays and dusts for the control of a myriad of fungicidal growths on fruits, vegetables and flowering plants. The "fixed coppers" may be effectively used in combination with the well known insecticides – lead arsenate, calcium arsenate, rotenone, nicotine, sulphur, and DDT."

Pg. 108, October 1946 (No. 10) "Reopening of Champion mine is under study"

"Calumet & Hecla Consolidated Copper Co.'s experience with diversified types of copper scrap has led to development of numerous treatment processes whereby undesirable impurities in or associated with scrap are separated from the copper, leaving the metal in a form suitable for direct smelting into high-conductivity commercial grades. The increasing use of such methods has made it possible to for the company's secondary department to purchase and handle larger and larger tonnages of materials previously not considered desirable for treatment at the smelter. These processes are delivering million of pounds of copper to the furnaces.

The latest addition to this group of processes is one which makes it possible to treat "copper mud" a waste product resulting from the drawing of copper wire. The material as received is a pasty mixture of fine copper, oil, grease and floor sweepings, having an average copper content of 25 percent and a combination of animal, vegetable and mineral oils of approximately 40 percent. As received, it is not suitable for direct furnacing, due to the high percentage of fat and water, but after months of experimenting, a procedure was worked out which recovers copper in a highly concentrated, useful form and the fat byproducts as well.

The processing includes a large lead-lined digester, filters, grease-accumulation tanks, copper-recovery tank, and a 10,000 gal. storage tank for grease. Installation work was started in June and production on a limited basis began in mid-August. The unit is operating continuously. The copper thus recovered runs approximately 75 percent metal and is suitable for direct furnacing with other concentrates. The fat is reclaimed as a semi-clear liquid and is accumulated in 8,00 to 10,000-gal. batches (40,000 to 60,000 lb.) for shipment in than cars."

Pg. 111, Nov. 1946 (No. 11) "C&H president voices hope for future of copper range – Isle Royale pays dividend"

"…Calumet & Hecla has organized a secondary copper department, employing 108 men, and is treating large tonnages of scrap copper.

In conjunction with the Harshaw Chemical Co., of Cleveland, the Lake Chemical Co. was organized in 1945 and located at Hubbell for the purpose of manufacturing and selling chemicals. The company has embarked on the commercial foundry business and is using its excess foundry capacity to make castings for mid-western concerns. The company is about to set up a new department for the manufacturer of detachable drill bits for its own use and for sale in a large part of the United States. The lands owned by the company are being rapidly developed for resort purposes."

1947, Vol. 148

Pg. 126, January 1947 (No. 1) "Lake Copper leases Copper Range Smelter"

"Calumet & Hecla foundry is one of fewer than a dozen plants in the United States that have been licensed by the International Nickel Company Inc. to make the patented wear-resisting iron known as Ni-Hard. This nickel-chromium iron was developed for use where wear resistance is important. Calumet & Hecla's experience with the metal has led to its adoption exclusively for parts such as ball mill liners, pump shells, impellers, stamp shoes, and other castings that are subjected to conditions under which ordinary irons fail in a matter of weeks. Ni-Hard is only one of several types of irons produced by the foundry. A large tonnage of soft, gray iron is required in Calumet & Hecla's own operations for hundreds of replacement parts. The foundry also makes substantial quantities of "white iron" grinding balls for use in the stamp mills at Lake Linden, Ahmeek, and Tamarack; aluminum castings; brass and bronze bearings and bushings."

"Calumet & Hecla has shipped the first tank car of byproduct fat recovered in its plant for the treatment of spent wire-drawing lubricant. Both fat and copper are reclaimed from this waste material. The shipment went to the Darling & Co. in Chicago. The acute shortage of raw materials for producing soap and other fat products has provided an attractive market for the type of material being recovered by the company's secondary department."

Pg. 120, May 1947 (No. 5) "Isle Royale operations may end the year – Lake Linden power plant to be modernized"

"The Quincy Mining Co., which is operating a reclamation plant at Mason, on Torch Lake, Houghton County, treated 1,006,415 tons of waste sands during the pat year, from which were recovered 5,052,549 lb. of refined copper for an average of 5.02 lb. per ton. Approximately half of this tonnage came from the richer part of the sand pile and the remainder from sands carrying approximately 4 lb. of recoverable copper per ton. Most of the better-grade tailings have been treated, and the plant must depend largely on the lower-grade sands for future operations. The average price received for the year's production was 20.95c. per pound.

The reclamation plant was financed by the Reconstruction Finance Corporation, which advanced $1,220,342. The greater part of this loan has been repaid. The balance of $209,563 should be paid this year. Profit during the year was $416,758.34. After depreciation and depletion charges at both the mine and reclamation plant, net profit amounted to $20,532.74."

"Calumet & Hecla Consolidated's power plant at Lake Linden will be modernized to reduce costs. Present coal consumption per kwh. Is in excess of 2 lb. As the price of coal has increased from $2.70 per ton delivered at Lake Linden in 1913 to a present cost of $7.33 per ton, it has become imperative to make the plant more efficient. An investigation covering a period of more than three months by the Chicago firm of Vern E. Alden Co., consulting engineers, determined that a saving of approximately $300,000 per year could be affected by making certain changes. The proposed modernization will require about two years to complete. The principle installation will be a pulverized-coal-fired boiler, which will be erected at the south

end of the plant. This boiler is rated at 180,000 lb. of steam per hour at 850-lb. pressure and 825-deg. Temperature."

1948, Vol. 149

Pg. 102, Jan 1948 (No. 1): "Calumet & Hecla starts up new furnace for smelting secondary copper"

"A new furnace has been placed in service at Calumet & Hecla Consolidated's smelting plant. The bricks used in the furnace proper are composed largely of magnesite and chrome and contain no silica. The furnace will be used for smelting secondary copper.

The arch of the furnace is of basic material, making it possible to drive the furnace much harder than the average because the arch can withstand high temperatures, also any complications from "rabbling", or the blowing of air into the bath to remove foreign materials. The new furnace is fired by two burners, using pulverized coal. It also is equipped with a recuperator, doing away with the waste-heat boiler. The operation raises the flame temperature of the burners by several hundred degrees and decreases the coal consumption from 10 to 15%.

Capacity of the furnace is 200,000 to 250,000 lb. per charge. The monthly capacity of the furnace will be approximately 1,500,000 lb. of copper. For the most part, baled material is used in charging the furnace."

"The rebuilding of 1,150 ft. of the Lake Linden coal dock of Calumet & Hecla was completed recently by the construction department of the Calumet & Hecla company. The dock, which is 20 ft. wide, was kept in constant use during the renovating and rebuilding. During this time 15 ore carriers brought cargoes of coal to the dock. Each of these ships delivered an average of 9,000 tons of coal."

Pg. 146, Feb 1948 (No.2): "Calumet & Hecla experiments with copper oxide as aid to plant growth in Florida"

"Investigations sponsored by Calumet & Hecla Consolidated Copper Co. are in progress in Florida to determine the value of copper oxides for agricultural applications.

Dust mixtures containing copper oxide are being examined by the Potato Research Laboratory at Hastings; dusts, sprays and fertilizers by the Citrus Experiment Station, Lake Alfred; fertilizers and pasture treatment by the Everglades Experiment Station, Belle Glade; soil treatment at the Gainesville Station on grain crops, and fertilizer and pasture treatment by various independent researchers.

Copper is required for normal plant growth to provide adequate yields, and is essential to the production of grains, such as oats and barley. These grains do not ordinarily "head out" under growing conditions in Florida unless copper is added."

Pg. 128, April, 1948 (No. 4): "Tamarack plant producing cupric oxide"

"At the Tamarack reclamation plant of Calumet & Hecla Consolidated, an addition to the mixed oxide plant for the production of cupric oxide has been completed. The relatively small, but carefully planned installation makes it possible to add a new product, copper oxides, to the line of Calumet & Hecla. The equipment

consists of automatic feeds, conveyors, receivers, a roasting furnace, and a pulverizer.

Cupric oxide is a finely divided powder which is ideal for chemical purposes, and for use in ceramics, where a rapid and uniform dispersion of coloring agent is desired.

Research is being conducted to provide clinkered or coarse particle for the use in the manufacture of primary batteries. This is one of the few important uses where a large particle is desirable because battery plates of pressed cupric must be porous and porosity depends on a coarse structure.

Sales will be confined to a few large customers, who will resell it to the industrial field. If primary battery manufacturers can use clinkered or coarse particles for making plates, sales probably will be made direct to them."

Pg. 137, June 1948 (No. 6) "Calumet & Hecla reclamation plant at Lake Linden reopened – Research includes agricultural projects"

"Since the beginning of operations in 1915, the reclamation plant of Calumet & Hecla Consolidated at Lake Linden has treated 36,351,000 tons of waste sands with a recovery of 407,038,000 lbs. of copper, at a profit in excess of 30 million dollars. Closed during the pat winter, the plant has been reopened to treat the remaining tailings. Because in the early days of the mine and concentrator, the tailings were spilled out onto the ground or in shallow water at the shoreline and numerous docks and piers were erected on the site, the final scramming operations may cause irregular and intermittent operations of the plant. Remaining coarse sands are high in copper but contaminated by rubble and rubbish because of their proximity to the shore.

The company's copper hydrate plant was expected to operate at near capacity in May, and it is indicated that continuous operation may be justified. Several encouraging new commercial applications of copper hydrate have been developed, and interest renewed in copper soaps for mildew-proofing and wood preservation."

"Calumet & Hecla's agricultural research program now includes 38 individual projects in Florida. Copper oxide is being extensively tested in plant feeding, both as a constituent of fertilizers and in nutritional sprays, on pasture grasses, cover crop, oranges, grapefruit, sugar cane, snap beans, escarole, grains, potatoes, and celery. The results obtained on Florida plantings during the past winter will be carried out into other states during the summer. Use of copper in various types of soil is currently recommended for certain crops by the agricultural experiment stations in Florida, Georgia, North Carolina, New York, Indiana, Wisconsin, New Jersey, Oregon, and Michigan."

Pg. 124-125, July 1948 (No. 7) "Quincy smelter to be reopened soon – Calumet & Hecla installs press to bale scrap before leaching"

"Resumption of operations at the smelter of the Quincy Mining Co., idle since 1932, will get underway as soon as adequate repairs have been made. A crew is preparing the smelter for the treatment of copper reclaimed at the company's sand workings in Torch Lake, near Mason. Plans call for the blowing in one reverberatory

furnace in the main building, which is 144x84 ft. Actual dipping of metal is not expected until late summer or early fall."

"Another ball mill has been put in operation in the Ahmeek mill of Calumet & Hecla, making 9 such units. The new ball mill holds 50,000 lb. steel balls when fully charged. Ball mills also are used in the company's reclamation processes. A steel ball casting machine has been added to the equipment of the Calumet & Hecla foundry, which will now turn out from 28 to 30 tons of steel balls per week, with two machines in operation."

"Calumet & Hecla has installed a hydraulic bailing press in its smelter yard to bale copper-clad steel scrap before leaching. This will save many hours in handling the scrap in and out of the leaching tanks to the railroad cars, and will double the tonnage put into the leaching tanks. Certain kinds of copper scrap also can be compressed into convenient size bundles for charging into the smelter furnaces."

Pg. 131-132, August 1948 (No. 8) "Calumet & Hecla has largest employment in 10 years – Testing of Torch Lake tailings continues"

"Thousands of tons of tailings, stamp sand dumped into Torch Lake, Houghton County by Calumet & Hecla, have been the subject of investigation for some time to determine whether they have industrial value after the removal of copper. The 2 types of tailings, conglomerate and amygdaloid, are in separate banks. Amygdaloid has been used locally for concrete. It is the hardness and red color of the conglomerate sands that may make them useful. Though no substantial market has been found, tests have been made for such purposes as grinding wheels, polishing compounds, enameling frits, and roofing granules. Samples varying from small 5-pound lots up to a 50-ton carload have been shipped to users."

Pg. 134, October, 1948 (No. 10) "Inflated costs absorb copper price increase for C&H"

"From retreating stamp sands at its reclamation plant at Mason on Torch Lake, Quincy Mining Co. made a net operating profit of $175,4498.62 for the first six months. The work continues on a satisfactory basis. Recovery during the first half was 2,559,241 lb., an average of 4.81 lb. of refined copper per ton. The sands were of a better grade than in 1947, when an average of 4.33 lb. per ton was recovered."

Pg. 123, November 1948 (No. 11) "Calumet & Hecla employees sign new contract"

"A modernization program for Calumet & Hecla's foundry has been authorized by management. New equipment for sand conditioning and control, modern molding machines, roll-overs and extensive steel flask equipment will be installed in the near future. The foundry, it is stated by the management, will be one of the most modern in this part of the country and is part of Calumet & Hecla's diversification program.

During the war years numerous orders were taken from outside customers as a service to war industries and individual consumers not having adequate sources of supply for castings. This outside business will be continued, in addition to meeting the company's own requirements. Recent developments on the Minnesota Iron Range, and expansion of industrial consumers within a 250-mile

radius of Calumet, Mich., have opened up an attractive market for foundry products."

Pg. 126-127, December 1948 (No. 12) "Calumet & Hecla produce oxychloride sulphate"

"Calumet & Hecla has resumed the production of oxychloride sulphate (C-O-C-S) Oct. 11. The plant will be operated continuously until July 1, 1949. The agricultural market is seasonable, and in most areas copper fungicide are not used during the fall months. Carload shipments were started late in October. Several months will be required to provide sufficient stocks for the California and Florida markets. The plant is scheduled to produce approximately 2 million pounds of C-O-C-S during the 1948-1949 season."

1949, Vol. 150

Pg. 116, January, 1949 (No.1): "Calumet & Hecla investigates with Poor & Co. possible outlet for finely ground conglomerate sand"

"In cooperation with Poor & Co. of Chicago, Calumet & Hecla Consolidated Copper Co. is instituting an experimental program which may eventually lead to a new business in the Michigan copper district. Poor & Co. has been investigating at its Waukegan, Ill. Laboratory for the use of finely ground conglomerate sand as in abrasive in buffing bars, deburring compounds and liquid abrasives. These items are widely used by the metal-finishing industry in preparing products for planning.

Poor & Co.'s facilities, however, are not sufficient to permit large-scale commercial testing. An arrangement now has been made for Calumet & Hecla to produce about 150 tons per month of finely ground conglomerate sand for shipment to Waukegan for blending and testing, on a commercial basis. If the tests prove successful, consideration will be given to equipping a plant at Lake Linden for production of the material on a commercial basis.

To produce the necessary dried conglomerate sand, the copper-oxide drying and bagging equipment at the Tamarack reclamation plant probably will be used."

"The secondary leaching department of Calumet & Hecla's Tamarack reclamation plant has been shut down temporarily. The company has been unable to sell copper oxide as fast as the plant can produce it and has a large amount of bagged copper oxide on hand."

"Calumet & Hecla has announced that it will not dismantle or scrap equipment and buildings of the Lake Linden reclamation plant, which was recently shut down because of the exhaustion of the conglomerate tailings. It may be possible to utilize the facilities for other products."

Pg. 155, February 1949 (No. 2) "Isle Royale shuts down for good, also C&H tailings retreatment plant at Lake Linden"

"Calumet & Hecla's foundry has been modernized. It will supply the company needs and do custom work. Eventually the foundry and machine shop will be coordinated so that a large number of rough and finished products can be sold. Other byproducts of C&H are copper hydrate, copper oxychloride and copper oxide,

made in cooperation with Lake Chemical Co. Still another which is now being produced in a quantity permitting it to be distributed outside of the company's operations is the Liddicoat one-use drill bit.

The copper oxide is already being marketed in large quantities. This product has proved satisfactory in the agricultural industry, particularly in the Florida fruit and vegetable belt. It is used as a spray to control fungi, as fertilizer amendment, and in feeding cattle.

George L. Craig, of the company's staff, has been appointed director of the secondary industry, in charge of sales and research."

"Part of Calumet & Hecla's reclamation plant at Lake Linden has been shut down, including the regrinding plant, due to the exhaustion of coarse tailings. It has been one of the most profitable of the Calumet & Hecla properties for over 30 years. Part of the plant including dredge, is being used to recover copper from slimes which had been sloughed off from the shore plant pool during clean-up operations. Between 30,000 and 40,000 tons of slime per month is being treated, or about a third of the average output of the entire plant when treating rough sands. Quantity of slime available ranges from four to six months' supply."

Pg. 110, March 1949 (No. 3) "C&H making more copper from slags – Output from scrap also up – Surplus equipment to Wisconsin"

"As a result of improvement in the soda-ash process for arsenic removal, slag charges in Calumet & Hecla's smelter at Hubbell have been refined during the past two months to billet specifications without dilution, at a big saving of time and expense. Never before has copper from a slag charge been refined to the purity required for direct casting into commercial shapes. C&H now will reclaim more copper per month from slag than heretofore, and will get it to market faster as it is going directly into a saleable product. The high cost of handling, storing, remelting and recasting the low-grade ingots will be eliminated."

Decrease in copper production at Calumet & Hecla's Lake Linden leaching plant, due to curtailment of copper sand leaching, has been eased by increased production from scrap. Scrap has been treated for several years and is an important source. The work will be stepped up as rapidly as possible. During the war, the Government sponsored a program of reclaiming copper from gilding-metal scrap, a copper-covered steel from which bullet jackets were made. Many different types of scrap have been treated since. To facilitate handling, alterations are being made at the No. 2 regrinding plant."

"The Calumet & Hecla foundry recently cast an 11-ton stamp-shoe mortar housing for the Ahmeek mill. High-nickel alloy iron with a tensile strength of 55,000 lb. was used. A total of 168 man-hours to make the mold and 64 to make the cores was required."

Pg. 134-135, April 1949 (No. 4) "C&H Employment at peak – New company will make buffing and polishing compounds from sands"

"The Prozite Company has been organized by Calumet & Hecla and Poor & Co. of Chicago, to make buffing and polishing compounds from conglomerate copper sands.

The necessary equipment will be installed in the Calumet stamp mill at Lake Linden and the products will be manufactured by Calumet & Hecla. Poor & Co. will handle the sales. Officers and directors of the Prozite Company are: chairman of the board, F.A. Poor; president, E.R. Lovell; vice presidents, A.E. Chester, P.W. Moore, A.H. Wohlrab; secretary and treasurer, W.B. Devlin. Directors will comprise the officers, also A.E. Peterson and George L. Craig of Calumet."

"Production of mixed copper oxide has been resumed at C&H's Tamarack leaching plant. The plant was down for three months. Supplementing several large orders from industry, others have been received for agricultural applications in Florida. In recent weeks, several cars of oxide have been shipped from the Lake Linden plant to the Tamarack plant to be dried and bagged."

Pg. 174, July 1949 (No. 7) "Calumet & Hecla is now refining slag charges to billet specifications"

"The sudden drop in the copper market caused Calumet & Hecla to suspend copper production temporarily on May 1. During all of 1949 the company has been stressing increasing development of byproducts and scrap reclamation.

Calumet & Hecla's foundry was modernized early in the year to supply the company's needs and do custom work.

In March the Prozite Company was organized by Calumet & Hecla and Poor & Co., of Chicago, to make buffing and polishing compounds from conglomerate sands. The necessary equipment for the project was to be installed in the Calumet stamp mill at Lake Linden. Poor & Co. was to market the products.

Other byproducts of the C&H company are copper hydrate, copper oxychloride, and copper oxide, made in cooperation with Lake Chemical Co.

As a result of improvement in the soda-ash process for arsenic removal, slag charges in the smelter at Hubbell have been refined to billet specifications without dilution. Never before had copper from a slag charge been refined to the purity required for direct casting into commercial shapes. The improved process will give C&H more copper per month from slag and will get it to the market faster, at it is going directly into saleable product. The high cost of handling, storing, remelting, and recasting the low-grade ingots will be eliminated."

Pg. 116, August 1949 (No. 8)

"Calumet & Hecla is replacing old equipment at its Lake Linden power plant. High pressure boilers and steam turbines are being installed."

Pg. 128-129, Oct, 1949 (No. 10)

"During the first six months of the year, treatment of stamp sands at Quincy Mining Co.'s reclamation plant at Mason, Torch Lake, continued in a profitable basis. The plant operated without interruption and handled 523,987 tons of sand with a copper recovery of 2,654,657 lb., an average of 5.07 lb. refined copper per ton.

Tailings carried an average of 1.69 lb. per ton, which indicates satisfactory recovery."

1950, Vol. 151:

Pg. 158, February 1950 (No. 2):

"…A new product, Pryozite, is being marketed by Calumet & Hecla. It is used extensively for metal finishing in the automotive industry, but its application is not limited to that field. It is a product of the conglomerate sands at the Lake Linden reclamation plant, combined with other materials. It is produced in bars.

After a lull of several months, Calumet & Hecla's secondary department is active again. Copper bearing scrap is purchased throughout the United States and shipped to Hubbell, where the copper is reprocessed and refined. The company's chemical department also is producing different copper oxides and hydrates for nationwide consumption.

Calumet & Hecla's $2,500,000 power plant at Lake Linden has been completed and placed in commission. At the time plans were drawn over two years ago, it was estimated that the new plant would use about 2,500 tons of coal per month less than the old plant. Indications are that the anticipated saving will be realized.

The company's drill bit plant is being expanded. This plant manufactures the Liddicoat bits used in Calumet & Hecla underground drilling operations. It also makes bits for sale to other users. The company is licensed to sell these bits in 37 eastern states. Full-scale production is assured."

Pg. 121, March 1950 (No. 3)

"…Mr. (E.R.) Lovell says progress is production and sales is being made in Lake Chemical, a subsidiary; in the secondary department; in industrial and agricultural copper oxide; in the manufacture of Liddicoat underground drill bits; Prozite, a polishing compound molded into bars for use in metal work, and in production of commercial castings in the company's foundry. The creation of new products has created work for 400 men.

Both the Wolverine Tube division in Detroit, and the new tube plant in Decatur, Ala., are doing well, according to Mr. Lovell. New business is being sought by enlarging the sales force and getting additional warehouses throughout the country. Foreseeing keen competition in the sale of tubing, Calumet & Hecla is considering the manufacture of aluminum, steel and plastic tubing, in addition to copper. The Rosenquist elecro-formed tube is being produced in large quantity."

Pg. 119, May 1950 (No. 5)

"…Since the fall of 1948, Calumet & Hecla's reclamation plant at Lake Linden has been treating a large tonnage of slime which settled over a large area in Torch Lake. The slime is pumped directly into the leaching plant classifying system. Elimination of the regrinding and shore plants has reduced the treatment cost enough so that there is a fair profit on the reduced scale of operation. A small tonnage of sand is treated in the leaching plant, but the larger part, consisting of fine

slimes, is treated in the flotation plant. Severe ice conditions the past winter have greatly hampered the operation of the dredge, but after the ice goes the dredge should be able to keep the plant supplied with feed throughout the summer and possibly longer. After 33 years of operation, the conglomerate tailing in the lake had all been treated in the reclamation plant by the fall of 1948, when the slimes operations were started."

1951, Vol. 152:

Pg. 157-158, February 1951 (No.2)

"Quincy Milling Co., through its smelter division, has furnished a consignment of lump slag to Milwaukee interests for experimental material to be used in the manufacture of mineral wool. The slag is the product of an old cupola now of out commission. It is estimated that there are more than 25,000 tons available. Two carloads of lump slag have been shipped to Milwaukee as a result of experiments. If the operations prove satisfactory, it is likely that much or all of the deposit will eventually be shipped."

Pg. 135, December 1951 (No. 12)

"At Mason, on Torch Lake, Quincy Mining Co. is preparing to treat tailings of amygdaloid sands which have been built up at No. 2 mill over the last 20 years. The company will install a Bucyrus-Erie pump at the sands, will lay approximately 5000 ft. of 20-in. pipe to the shore plant, and will install a 1000-kw Fairbanks-Morse diesel generator at the sand dump to furnish power for pumping the sand."

1952, Vol. 153: Nothing of Note: Main emphasis for Michigan seems to be iron mining

1953, Vol. 154: Missing from Library

1954, Vol. 155: Nothing of Note: Main emphasis for Michigan seems to be iron mining. Mention of C&H is only found regarding their projects in other states.

1955: Vol. 156

Pg. 72, May 1955 (No.5): This is the first mention of Calumet & Hecla's work within Michigan since 1951, although it only focuses on mining, not smelting or reclamation.

"…Reserves are near exhaustion in several of the mines, but closing should coincide with the opening Osceola shafts, where 3,000 tpd will maintain present levels."

1956, Vol. 157:

Pg. 200, August 1956 (No. 8): "Annual Reports"

"Calumet & Hecla, Inc. produced some 27-million lb. of copper from Calumet Division. Major project was the unwatering of the Osceola lode. Mining started on lower levels at No. 13 shaft. No. 6 was about 70% unwatered. Production of copper from Tamarack reclamation Plant continued. Although Tamarack sands have not been exhausted, reclamation was started on Ahmeek bank sands to keep output high."

1957, Vol. 158:

Pg. 149, May 1957 (No. 5): "Annual Reports"

"….In Michigan the company has nine shafts in operation and is developing ore reserves in several other locations. Calumet produced 37,813,735 lb. of copper in 1956. Production increased at Tamarack reclamation plant. And over one-million tons of tailings were processed from the Ahmeek bank, which has about ten more years production at present rate."

Pg. 166, August 1957 (No. 8)

"Annual report of the Quincy Mining Co. for 1956 shows 9,88,041 tons of sands from the No. 2 stamp sands were treated at its reclamation plant at Mason in 1956. The plant worked on a 24 hour basis and was closed only for holidays and repairs. 4,801,000 lb. of copper was recovered, or 4.86 lb. per ton of sands. Average amount remaining in the tailings was 1.84 lb. per ton, which is considered very satisfactory."

1958, Vol. 159:

Pg. 156, December 1958 (No. 12)

"The Quincy Mining co. reclamation plant, which has been closed for nearly one year, is being overhauled to have it in condition for reopening."

1959, Vol. 160:

Pg. 196, February 1959 (No. 2)

"Quincy Mining Co.'s Torch Lake tailings reclamation plant, closed since January 1958, has been reopened. It is handling about 3,000 tpd of tailings, dug by a dredge and pumped to the plant."

Pg. 198, February 1959 (No. 2)

"Calumet & Hecla, Inc. which has been following a program of diversification, owns a 70% interest in a large magnesium producing plant to be located at Selma, Ala. A new company has been organized to operate the plant – Alabama Metallurgical Corp."

Pg. 136, May 1959 (No. 5)

"Quincy Mining Co. is reconditioning its No. 5 copper smelter at Ripley, which was closed about one year ago. By June, when the smelter is expected to be ready

for operation, enough concentrates from the concentration plant will be on hand to keep the furnace busy for a few months."

1960, V. 161:

Pg. 133, August (No. 8):

"Calumet & Hecla, Inc. produced 15,876 tons of copper in 1959 from its mines in the Calumet area in addition to over 1500 tons from its Tamarack reclamation plant on Torch Lake."

1961, V. 162:

Pg. 113, August 1961 (No. 8)

"The Calumet Division of Calumet & Hecla, Inc., from its six active shafts and reclamation from old tailings in Torch Lake, is producing and refining copper at about its 1960 rate when 53,296,407 lb. was produced from all sources."

"The Quincy mine smelter at Hancock, closed for a time to permit accumulation of concentrates from the mine's reclamation plant, resumed operating on June 5th."

Pg. 137, September 1961 (No. 9):

"The Quincy Mining Co.'s reclamation plant on Torch Lake, now in its 18th year, handled about 918,000 tons of copper tailings in 1960 and recovered almost 1720 ½ tons of copper, an average 3 ¾ lb. of copper per ton of tailings."

Pg. 137, December 1961 (No. 12)

"The Quincy Mining Co., Mason, has moved its tailings dredge from the No. 1 bank to the No. 2. About one mile of 20-in. pipe will be needed to carry the tailings from dredge to reclamation plant, and also a 1000-hp booster pump to push some 3000 tons of tailings per day through the longer line."

1962, V. 163: Nothing of Note. This volume contained two posts about C&H and nothing about Quincy.

1963, V. 164: Nothing of Note.

1964, Vol. 165: Nothing of Note. This volume contains 2 entries regarding C&H, both of which are focused on the opening of the new Kingston Mine.

1965, Vol. 166: Nothing of Note. This volume contained zero posts related to C&H or Quincy.

1966, Vol. 167: Nothing of Note. This volume contains four posts regarding C&H, all of which relate to the proposed opening of the Kingston Mine.

1967, Vol. 168: Nothing of Note. This volume contains two posts regarding C&H, both of which relate to the proposed opening of the Hill Creek Mine.

1968, Vol. 169:

Pg. 129, January 1968 (No.1)

"The Calumet Div. of Calumet & Hecla Inc., at the end of November, suspended operations of its Tamarack copper reclamation plant near Hubbell. The facility reclaimed copper from stamp sand dredged from Torch Lake.

A company spokesman said that it was no longer economical to attempt to get copper from the sand. But he added that stamp sand from other locations would be studied to determine profitability and thereby enable resumption of operations at the plant.

It is reported that 50 employees of the reclamation operation have not been laid off immediately and might be transferred to other Calumet & Hecla operations.

The Tamarack plant was the last reclamation project in the area. The Quincy Mining Col closed its smelter last spring when the operation became unprofitable because of stamp sand depletion."

Pg. 192, March 1968 (No. 3)

"Fire of undetermined origin on Jan. 26 caused damage estimated at $200,000 at Ripley foundry of Calumet & Hecla Inc. Company officials said that work usually done at the foundry was being transferred to another foundry operated by the firm at Calumet."

C&H News & Views

February 1943:

May Expand Lake War Work Plant - "Treatment of steel clad with brass is now being successfully carried on at the Lake Linden Reclamation Plant. This material is the scrap which results from operations in the manufacture of small calibre jacketed bullets. Scrap is rolling into Lake Linden from all parts of the United States, from steel mills, ammunition makers and from Government ordnance plants. After the copper and zinc are leached off, the resulting steel is sold to steel makers. The zinc is lost but the copper is refined at the Calumet and Hecla smelter and soon finds its way back to war plants.

At the request of the Government, plans are being made to expand the Lake Linden plant in order to treat a much larger tonnage. Financing will be done by Calumet and Hecla. This company has the only plant in the United States capable of decopperizing clad steel scrap." P. 1

Selecting Scrap Requires Expert Knowledge of Metal – "Perhaps you thought the billet casting crew were commandos; the scrap gang looks even worse. You have read in the newspapers all about saving scrap, but did you ever wonder what becomes of it? Well, it is picked over and sorted out by scrap gangs all over the country. Sorting scrap requires careful men with experience and most of all a good nose for distinguishing metals. It isn't easy to tell what you are going to find in a car of scrap until you pick it over piece by piece.

Scrap can save the country – so they say. It can also make money for the company or it can lose money if not properly handled. You may not have realized that fifteen pounds of lead would be enough to spoil a whole furnace charge of copper. Almost every car of scrap has a lot more lead than that and it is up to the scrap gang to go after it and get it. They may have a carload or truckload or a box full of wash boilers, automobile radiators, broken radio sets or cigarette lighters; some can be melted and some must be leached. Nice clean scrap isn't often seen.

The Calumet & Hecla scrap gang has worked together for years. They are building up a new line of business for the company and one that may keep it alive some day, if there is a depression after the war is over. It is a dirty job but there is something interesting about it; something different is always happening.

To mention a few names: George Tornuff, Clifford Sibilsky, Albert Anderson, Leo Jolly, Henry DeRoche and Tony Brinkman would make good super sleuths for finding gold in any dirty mess you may have in the cellar. Tony Brinkman is in the scrap business for Uncle Sam just at present and doing all right." P. 4

June 1943:

Scrap Drive Continues – "The wrecking of abandoned equipment around the company's property continues daily, adding to the splendid tonnage of vital scrap metal being contributed to the war effort. While the exact amount of scrap provided by the company must remain a war secret, it is certain that Calumet and Hecla had provided more of this valuable material than any other similar plant in the country.

After the old machinery has been removed from the buildings the stone walls are broken down, to make the premises safe. The breaking down of these walls is an interesting process, but also dangerous. The public is asked to remain at a safe distance while such operations are in progress." P. 4

September 1943:

Scrap Shipments Mount – "The razing of abandoned plant equipment continues here and increasing tonnage of steel, iron and non-ferrous metals is being rushed to mills for conversion into war materials. The exact number of tons shipped is a military secret, but it is permissible to state that C. & H. is making a record in this connection comparable with the best in the country.

Huge compressors, pumps and hoisting equipment, which once were the mechanical wonders of the country, have been broken into scrap, loaded into cars and transported to the mills. This project will continue until all the available scrap on C. & H. property had been salvaged." P. 7

October 1943:

Tons of Scrap Steel Have Been Salvaged – "Thousands of tons of steel and other scrap metal have been removed from the abandoned plants of the Company and shipped to War Industries.

The demolishment of these plants, and the handling of the scrap metal has been done by the Republic Steel Corp., of South Chicago. Fred Welsh, of Cleveland, has been in charge of this work for the past two years. He has employed as many as sixty men, all of which assist in razing buildings and removing scrap metal from the ruins. Considerable of this equipment is taken whole, so that is can be used again in the construction of new plants. All of the work is under the direct supervision of Superintendent Carl Fichtel." P. 4

November 1944:

New Department is Formed – "A new department, known as the "Secondary Department" has been formed to purchase and treat scrap copper-bearing material. H. C. Kenny, Smelter Superintendent, will be in charge. Bill Jones, Bill Curnow and several others will be important cogs in this new machine.

Experiments conducted in treating scrap led to the decision of the management to enter this field. At present it is proposed to purchase scrap in the market for treatment at our Torch Lake plants.

This is another step forward in the Company's policy of expansion, which includes the continued exploration for new ore bodies as well as research work leading toward the creation of new uses for copper." P. 7

February 1945:

Leaching Plant and Smelter Are Now Treating Secondary Copper – "Secondary copper consists of any copper or copper alloy scrapped in the manufacturer of commercial articles from virgin metal, - that is, newly mined metal, - or of worn out or rejected materials recovered by salvage." P. 1

July 1945:

Secondary Metal Department Is Busy At The C. & H. Smelting Plant – Lots of pictures of materials (coaxial telephone cable, stripping insulation from armored navy cable,

burning insulation and grease from motor parts, burning insulation at the Smelter, leached motor parts, salvaging armor and Vinylite insulation, and producing copper oxide, pages 4-7). Document copied.

February 1946:

Drafting Department Makes Plans for Many of the Company's New Plants – Updates to the mills, LL Reclamation Plant, LL Boiler, Power Plant, and Coal Dock, Smelting Plant, Tamarack Reclamation Plant, Quincy Reclamation Plant, and Tamarack and Calumet Water Works. P. 7

May 1946:

Coal Strike Forces Calumet & Hecla to Suspend – Company's Supply Dwindles; No Immediate Relief in Sight – Coal shortage, facilities shut down. P. 1

June 1947:

By-Products Recovered by Secondary Dept. – P. 4. Document copied. Also shows pictures of the scrap yard and materials scrapped.

"The treatment of secondary materials at the Smelter is becoming an increasingly complicated operation. In the early days materials of relatively high purity, such as clean copper scrap and copper of brass clad steel scrap, was easily processed by direct smelting or by removing the copper or brass from steel by the ammonia leaching process. During the war, however, vast quantities of scrap were generated in which the copper was associated with other metals and non-metallic materials having scrap values sufficiently high to warrant the development of separation processes. Typical of this class of materials that is now being processed in large tonnage by the Secondary Department is Navy degaussing cable which was used on merchant and naval vessels during the war to protect them from magnetic mines. The cable provided a system which neutralized the attraction of steel hulls for this type of mine.

The degaussing cable varies considerably in size and composition but is usually about two inches in diameter and consists of a fabric outer covering over an armor of heavy steel sire. The steel wire is woven over a lead sheathing under which the copper wire or conductor is located. Some forms of cable are clad with aluminum or bronze and may be insulated with neoprene rubber or vinylite, all of which have some scrap value.

The cable is received at the plant on large wooden reels measuring from 4 to 6 feet in diameter. The first step in processing is to shear the cable into suitable lengths with mechanical shears. The outer fabric is then cut and the steel armor removed by hand and segregated for sale as scrap. The lead sheaths are then passed through a stripping machine which cuts the lead armor lengthwise on opposite sides and allows the two halves to fall apart. The lead is likewise segregated and accumulated in carload lots for sale to load processors. The core of the cable, which contains the insulated copper wire, is sent to the furnaces for direct melting. Cable which is sheathed with aluminum or bronze and insulated with neoprene or vinylite is processed in identically the same manner.

Telephone communication cable is likewise a source of copper and byproduct metals. This type of cable may contain hundreds of relatively fine insulated copper wires inside of a lead sheath. The lead sheathing for this kind of conductor is usually alloyed with 1% of antimony or 1% of tin, as both elements harden lead and provide a somewhat more ridged sheath for the

copper wires. These different alloys must be separated and identified in order to receive the highest salvage value.

Occasionally miscellaneous scrap is received which contains lead of solder that cannot be separated from the copper-bearing scrap by mechanical methods. This type of material is processed through a small "sweating" furnace where just sufficient heat is applied to melt the lead of solder without melting the copper, and the white metals are accumulated in a pool at the bottom of the furnace. This metal is cast into pigs which are sold for re-processing into solder or for other uses requiring lead tin alloys." P. 4

Jim Breth Tells of Early Days of C. & H. Electrical Department – History of C&H power. P. 7-8. Document copied.

"The history of electric power in the operations of Calumet and Hecla was detailed by James E. Breth, electrical superintendent, at a recent meeting of the Midwest Section of the American Institute of Electrical Engineers, held in Milwaukee. The paper proved to be a popular and interesting one and News-Views is pleased to present it to its readers:

The history of electric power at Calumet and Hecla naturally follows the development of the company operations. The originaly installation, a Siemens generator and 24 arc lamps was made at the Calumet Mill in Lake Linden in 1878. These lamps had been at the Philadelphia Centennial in 1876 and this equipment is now in the Engineering Museum in New York City.

In 1881, a Brush arc lighting dynamo, Manufacturer's Serial Number 26, with eight 4000 candlepower lamps, was installed at the mine surface operations in Calumet.

The first use of electricity for power was at the Number 11 shaft, Calumet, when in 1892, two 80 horsepower , 1250 volt, direct current motors were installed underground for driving mine pumps at the 8th of 560-foot and the 16th of 1080-foot levels. Engine-driven shunt generators on the surface supplied power to the motors by means of cables suspended in drill holes. In 1893, this system was extended by installing another pump at the 24th level in the shaft. The feeder cable to this motor was run in iron pipe through the shaft ladder-way.

In 1895, three alternating current generators and three Brush arc dynamos were installed at Lake Linden to provide lighting in the Calumet Mill.

In 1901, an engine-driven generator, 300 kw, 3 phase, 25 cycles, 2300 volts, was installed at Calumet to furnish power for pumping at the 12th, 24th, 36th, and 48th levels. Number 7 shaft.

The next year, 1902, two 1000 kw, 3 phase, 25 cycle, 440 volt, engine-driven generators were installed at Lake Linden for furnishing power to the mill machinery.

The beginning to the power system as it is now, began in 1906 when two 13,200 volt, 3 phase, 25 cycle pole lines were constructed to connect the Calumet or mining area and the Lake Linden or milling area. At this time, three 2000 kw engine-driven generators were installed in the Lake Linden power plant.

In 1913, the first steam turbo-generator, 9375 kva, was installed at the Lake Linden power plant. The second unit, 12,500 kva capacity, was installed in the same plant in 1919.

The power system today is still using the original 25 cycle frequency and generation is at two plants, one at Lake Linden and the other at the Ahmeek Mill. Both are in the mill area on Torch Lake, near Lake Linden.

At the Lake Linden plant, there are twenty-four 512 horsepower Babcock and Wilcox water tube boilers, fed by Roney stokers with natural draft. These supply steam to the generating equipment at 175 pounds per square inch gauge pressure and also steam to the mills for process use. These old boilers are about to be replaced by a new Riley boiler, burning pulverized coal

and with a capacity of 180,000 pounds of steam per house at a gauge pressure of 850 pounds per square inch and a temperature of 825 degrees Fahrenheit. Present generating capacity at Lake Linden consists for the following steam turbo-generators:

No. 1 9375 kva Allis-Chalmers 4000 volts
No. 2 12500 kva Allis-Chalmers 4000 volts
No. 3 2500 kva General Electric 2300 volts
No. 4 1500 kva General Electric 2300 volts

This is now a total station capacity of 25,875 kva.

New generating capacity involving an 8750 kva topping turbine, which will operate with either of the old No. 1 or No. 2 units, now being rebuilt, will give a new station capacity of 34,625 kva.

Modern steel-enclosed switchgear, a new generator on No. 2 unit and other equipment now being installed with the new boiler will result in an efficient, modern plant when completed.

At the Ahmeek Mill power plant there are three Babcock and Wilcox Stirling boilers, with Westinghouse underfeed-type stockers. Each boiler has a turbine driven forced draft fan and a dual-motor driven exhaust fan. These boilers supply 180,000 pounds of steam per hour for power generation and process use at a gauge pressure of 140 pounds per square inch and a temperature of 650 degrees Fahrenheit.

Process steam is reduced through the No. 7 Terry-Allis-Chalmers, 1500 kva, 2300 volt turbo-generator to 170 pounds per square inch gauge pressure, then goes to the stamp-mill engines, returning to the No. 6 Allis-Chalmers, 2500 kva, 2300 volt low pressure turbine at pressure of 20 pounds absolute.

Steam goes directly to the No. 8 9375 kva, 13,800 volt Allis-Chalmers turbine from the boilers at generated pressure. This unit is operated on a straight condensing basis.

The Ahmeek Mill power plant, built or rather rebuilt in 1931 has an electric power total generating capacity of 13,375 kva. This is all 3 phase, 25 cycles.

In addition to the 25 cycle generating equipment, there are five 25 to 60 cycle frequency chargers, totaling 2,450 kva, with some 3,250 kva of power transformers to furnish 3 phase, 60 cycle power for special uses.

A total of 27,600 kva in power transformer capacity is used in connection with generation. These are all indoor, water-cooled type.

Main power distribution lines totaling 30 miles are operated at 13,800 volts. These lines are carried on wood poles with pin-type insulators at a 3 foot spacing in a triangular arrangement at an average pole spacing of 100 feet.

The main feeder lines, designated “A” and “B”, between the Lake Linden power plant and the Calumet or mine load center, are all 250,000 c.m. stranded copper. This same size of conductor is used on the two parallel tie lines between the two power plants. Other lines have conductors proportionately sized but none are less than No. 2 B & S gauge, stranded copper.

There are 18 main power distribution substations, 6 indoor and 12 outdoor. These step down from the distribution voltage of 13,800 volts to the local distribution systems of 2400 or 480 volts using single-phase transformers connected in delta. A single exception is one three-phase unit of 5000 kva capacity. The main distribution or power transformers total 49,500 kva.

Power is carried from surface to underground by 2400 volt circuits using three rubber-covered single-conductor cables, 5000 volt insulation, in steel or cast iron conduits carried along the shaft ladder-ways. This method of power transmission has proved very satisfactory as standard construction. The largest share of the electric power generated us used for motor” P. 7

"drives. There are some 1300 alternating motors in use representing a connected load of 46,000 horsepower. In addition, motor-generators totaling some 4000 kw furnish power to several hundred direct-current motors. Generally all alternating-current motors above 50 horsepower are 2300 volts and those below 50 horsepower are 440 volts, with some exceptions.

In 1947, net generation for the company system was over 126,000,000 kwh, which represents an average demand of some 14,000 kw with a peak demand of 22,000 kw. Incidentally, this is approximately four times the power generated by the local utility company which serves 75,000 people in the area comprising four counties. The total number of people employed by Calumet and Hecla in the Calumet Division is 2,400; 1000 of these are engaged in underground work and the balance on the surface plants.

Distribution of power used in various mining operations is divided as follows:

Mines 17%
Mills 23%
Smelter 8%
Reclamation 38%
Other 14%
Total 100%

All of the main mine hoisting is done by steam power except at the newer Iroquois and Allouez mines which have direct current hoist motors supplied from induction motor-generator sets. All mines use inclined shafts and skips, the deepest mine now in service is 6982 feet deep on the incline of 4500 feet vertically.

Air compressors and pumps comprise most of the mine electric power load. Mine transportation underground is by storage battery locomotives, of which some 100 are in use. These are Goodman 4-ton capacity powered by 48-cell Exide storage batteries.

Electricity plays a large part in surface transportation as the railroad connecting the mines, mills and smelter is now operated by Diesel-electric locomotives. Four Diesel-electrics now do the work which formerly required six to eight steal locomotives.

It is interesting to note that mining, one of the oldest industries, is using the most modern tools. Two examples are the use of high frequency induction heating in the manufacture of rock-drilling bits and the use of carrier frequency signaling in mine shafts.

We are continuing the search for new tools and processes and w[ ] that electricity will play a large part in any new development in mining.

In the assembly of data for this paper, I wish to thank my associated at Calumet and Hecla for their assistance." P. 8

Life of the Lake Linden Leaching Plant Prolonged By Treating Scrap – Lake Linden plant treating scrap. P. 8. Document copied.

"The Secondary Departments' treatment of scrap at Lake Linden Leaching Plant is a boon to the life of that plant. The decrease in copper production at this plant due to curtailment of sand leaching, is eased by increased production from treatment of scrap.

Scrap material has been treated at the plant for several years. During the war the government sponsored a program of reclaiming copper from gilding metal scrap, a copper covered steel from which bullet jackets were made. Many different types of scrap have been treated since that time, and the recovery of copper from scrap by the leaching operation is recognized as an important source of copper production.

The leaching process is particularly suited to such scrap as old motors, armatures, or even the complete generators or starters from automobiles, old telephones parts, copper clad steel wire, or other combinations of copper or steel where the copper part can be exposed to the leaching solution. The resale value of the steel scrap remaining after removal of the copper helps to pay the Leaching Plant cost and the high freight on moving such scrap to the Copper Country from all over the United States.

The Secondary Department accumulated a substantial stock of this type of material over a period of time and readied it for shipment to the Leaching Plant. The short supply of materials used in the leaching process has retarded production. The Purchasing Department, however, is doing its utmost to correct this situation.

In order to facilitate the handling of scrap, alterations are being made at the No. 2 Regrinding Plant so that the work of preparing scrap for leaching can be done there. The Railroad Department has laid a new track to make a direct connection between the Smelter yard and the Lake Leaching Plant, providing a more efficient and rapid movement of material.

Research work in developing a market for our oxide in agricultural applications has just started to bring positive results in the form of orders of oxide. With orders being received, scrap on hand ready for treatment, and the know-how developed from the experience of the past several years, the useful life of the Lake Leaching Plant will be extended well beyond the point expected at the time it was built." P. 8

August 1946:

Plant Expanded To Treat Grease From Wire Mills – "Experience with diversified types of copper scrap has led to the development of numerous treatment processes whereby undesirable impurities which are present in or associated with scrap are separated from copper and leave it in the form suitable for direct smelting into the high conductivity commercial grades. The increasing use of special treatment methods has made it possible for the Secondary Department to purchase and handle larger and larger tonnages of materials which were not previously considered desirable for treatment at the smelter, and these processes are now delivering millions of pounds of copper to the furnaces, which was not possible several years ago.

The latest addition to this family of processes is one which makes possible the treatment of "Copper Mud", a waste product resulting from the drawing of copper wire. The material as received is a pasty mixture of fine copper, oil, grease, floor sweepings, etc., having an average copper content of the order of 25%, and a combination of animal, vegetable and mineral oils of approximately 40%. As received, the material is not suitable for direct furnacing due to the presence of the high percentage of fat and water; but after several months of experimentation, a procedure was worked out which not only makes possible the recovery of the copper in a highly concentrated useful form, but fat by-products as well. The equipment required to process the material involves a large lead-lined digester, filters, grease accumulation tanks, copper recovery tank, and a 10,000-gallon storage tank for grease.

Installation of the various units was started during June and production on a limited basis began the middle of August. It is expected that the unit will be operating on a continuous basis by September first.

The copper recovered as a metallic concentrate contains approximately 75% copper and in this form is suitable for direct furnacing with other concentrates. The fat is reclaimed as a

semi-clear liquid and will be accumulated in 8,000 to 10,000-gallon batches (40,000 to 60,000 lbs.) for shipment in tank cars.

The fat or grease is classified as an inedible oil, and will be shipped into the Chicago district for processing into oleic and stearic acids and for the manufacture of industrial soaps.

It is anticipated that the process will add several hundred thousand pounds of copper per month to the smelter intake, with the recovery of from 20,000 to 30,000 gallons by-product fat which can be readily marketed at an attractive price." P. 1

September 1947:

Smelter Has Been Modernized With New Equipment – New Coal Pulverizer and a Furnace Placed in Operation – "A new Raymond Coal Pulverizer has been installed at the smelting plant in Hubbell, adding another unit to the plant equipment. The new unit went into service on August 15 in the pulverizing building on the west side of the smelting plant. The pulverizer was erected by the construction department and smelter mechanics and was put into operation by factory experts who came to Hubbell to train smelter employees in the operation of the drier and the pulverizer.

The machine differs from the two older units in the pulverizing plant. The older units, one of which is being scrapped, were low side machines whereas the new one is a high side type. The old units were installed in November 1924 and had pulverized 426,000 tons of coal up to the time the new equipment went into service. The old machines were equipped with a Ruggles-Coles revolving drier but the new machine uses a flash fire drying system.

The building, housing the pulverizing equipment, is being remodeled to accommodate the new system. One of the older units will be retained in service for emergency use. The new drier provides sufficient coal for the plant in one operating shift, where the former drier was required to be in operation two shifts in order to prepare coal enough for the smelting plant for a day. The old drier which will be retained, will be modernized and equipped like the new unit for flash drying.

This Raymond, high side, roller mill has a capacity of 11 tons of coal per hour ground to 80 to 85% through a 200 mesh screen. Its efficiency in coal dust recovery is considerably greater than its predecessors. The stoker, feeding the coal into the drier, is connected with a heating furnace which supplies warm air for drying the coal. Drying and milling of the coal are done at the same time in the new machine where it required two separate operations in the previous equipment.

A new unit has been installed for conveying the coal, by means of an air pump, from the weigh bins at the unloading place in the pulverizer building to the storage bins in the furnace building.

The dust collecting system used at this plant is of the "Norblow" design, similar to that which is at the oxide drying plant in the Tamarack Reclamation building.

Changes are being made in the electric power supply for the plant because the new drier uses motors of less horsepower than required by the old machine, but the new unit requires a change in the voltage." P. 1

Latest Type Furnace – "... The new furnace is fired by two burners, using pulverized coal like all the other furnaces in the plant, with the exception of No. 20 which has five burners. It also is equipped with a recuperator, doing away with the waste heat boiler. In order to utilize some of the heat in the flue gases, the recuperator preheats the air going to the burners. This

eliminates the necessity of heating air in the furnace, as it is already warmed before entering the furnace. The operation raises the flame temperature of the burners by several hundred degrees and decreases the coal consumption from 10 to 15 degrees…" P. 1

October 1947:

Lake Linden Coal Dock Being Rebuilt; Will Cost $48,000 – "One of the many projects which the Company has under way at the present time is the rebuilding of a section of the No. 2 coal dock at Lake Linden, a large and expensive job. Because of the heavy service required of the dock it has been kept in constant repair throughout the years. This project entails a major repair.

The dock is 36 feet wide and 1,547 feet long. A large section of the dock cast of the concrete abutment, which supports the front leg of the coal bridge, was repaired a portion at a time, during the fall and winter of 1931 and in 1937, at a cost of more than $23,000. Another section of the dock 20 feet by 72 feet was repaired in 1942, which left a section 20 feet wide and 1,475 feet long to be repaired at this time. During the course of the years when the section repairs to the dock were made the under-piling was checked from time to time, and it was found that these supporting piles had to be cut from 2 to 11 inches below the water level, in order to have a good substantial base on which to lay the new dock timbers. A Mall automatic chain saw, with an extra chain and bow to provide additional protection to the operator, was purchased for the purpose of cutting piles and timbers. This automatic saw cuts through a 14"x14" fir timber in 30 seconds, which is eight times faster than it could be cut by two men with a crosscut saw. The saw also cuts piles under water and in an actual test, the chain saw cut through 11 piles in the same time that would be required to cut through one by hand operation.

The dock reconstruction project was started on September 8th by the Construction Department under the direction of Emil Marcotte with Peter Monette in charge, as loader, with eight helpers engaged especially for this job. At the present time five sections in separate areas on the dock are under repair, making a total of 20 feet by 675 feet long. All of the old timber supporting the dock in this section has been removed and replaced with new material. Approximately 1,100 piles have been cut off before the water level.

It is estimated that 360,000 feet, board measure of timber and planking will be needed to complete the job, at an estimate cost of approximately $48,000. The job is about 35% complete at this time. Winter conditions have been most favorable, work is progressing with complete satisfaction, and will be rushed to completion." P. 4

November 1947:

Repairs Are Completed on Lake Linden Coal Dock – Dock repairs are complete. P. 5

March 1948:

Operations at the C. & H. Smelter Have Expanded – Plant Changed and Improved to Meet Demands of Industry – Rapid Progress of Last Decade Told – "…The Calumet and Hecla blast furnace was shut down in 1929 and has not operated since…The slag from the refining furnace contains more copper than should be thrown away so it is treated to remove the most objectionable impurities and it is charged back into the melting furnace with other concentrates. Copper from the refining furnace is cast into various shapes which are sold to customers…The conglomerate mine was closing; the reclamation plants were good for only a

few years; the copper market had been unfavorable for seven years. New rich mines were being found in all the countries of the world; all except the copper country.

Before 1940, the small demand for billets had not warranted the installation of equipment for mechanical casting and the few that were made were cast by hand at No. 24 furnace. In 1940 the Wolverine Tube Company, which was then an independent, began buying bullets fairly regularly. This increased demand justified mechanization and an unused casting wheel was arranged for casting billets. Copper was prepared in No. 24 furnace and transferred to small oil fired furnaces for use with the casting wheel.

In 1941 the country was making every effort to prepare for was and the whole copper picture changed. Prices were controlled; metal was allocated; the Premium Price Plan was set up. There was urgent need for every pound of copper that could be produced; cost was no object. Billets were of the utmost urgency and the smelter made these up to the limits of its capacity. When it was not casting copper it was casting brass.

By 1943 No. 24 furnace was too small to handle the amount of copper needed for billets so a new No. 22 furnace was built, so located and arranged that it could serve the billet wheel directly.

No. 24 furnace was now an orphan, and in the ordinary course it could have been torn down, as was No. 23. However, the demand for cakes and billets was so great that a new source of copper had to be found. Therefore, a few charges of secondary copper were fried in No. 24. As a secondary furnace No. 24 was a failure, but a few minor changes were made which improved it a great deal. On the strength of these experiments certain major changes were made, such as reversing the furnace end for end, and it became a successful secondary furnace. When No. 24 became overcrowded, its mate, a new No. 23, was built.

In the days of the old Calumet Conglomerate Mine, lake copper metallurgy was a comparatively simple thing. The concentrates were rich and pure and the minerals were such that they "melted like butter." Compared to them some of the low grade flotation concentrates handled by the smelter today would have been considered infusible. They are hard" P. 1
"to melt, and carry impurities such as arsenic and sometimes nickel which wear out furnaces in a hurry.

As a result of the impure copper, wartime brick, and excess heat, the bottom of No. 21 furnace failed about March 1. It will have to be completely rebuilt, bottom, sides, and top, a six week's job. Six weeks of no production from the main producer. And No. 21 was completely rebuilt just a year ago. Instead of lasting three years as bottoms formerly did, this one lasted just 12 months.

The smelter's five furnaces are shown on the accompanying sketch. No 20, the melting furnace, has a capacity of 800 tons; No. 21, the refining furnace, has a capacity of 350 tons; No. 22, the billet furnace, holds 200 tons; and No. 23 and 24, are good for 125 tons each. Already these five furnaces are taxed to capacity. Another year of high copper demand will undoubtedly call for more furnace capacity. Mine output is increasing and the secondary copper business is still growing…" P. 7

May 1948:

New Baling Machine Put In Operation at Company's Secondary Department – "The Smelter yard now looks more like a scrap yard than ever with the addition of a large baling press for scrap steel to the equipment used on Secondary copper materials. The principal by-product of the Secondary Copper Department for the past several years has been loose steel scrap obtained

after removing its copper cladding or coating by our leaching process at the Tamarack Plant. In its loose or unprepared form this scrap has had a very low value and it is only because of the terrific demand for steel scrap that we have been able to dispose of it as we went along. This new hydraulic baling press, known as the Dempster Balester No. 275, will permit us to prepare this scrap in such a form that it will continue to be saleable and at an increased price. This added value will enable us to compete for this type of scrap in the market, and aside from that the preparation of the scrap into bales before leaching will save many hours of tedious work in handling the scrap in and out of the leaching tanks to the railroad cars. Then, too, since the scrap won't be so bulky, we can double the tonnage put into the leaching tanks and obtain more copper production in the same period of time. The Secondary operation produces various types of steel scrap which are suitable for baling in this machine and also certain kinds of copper scrap can be compressed into convenient size bundles for charging into the Smelter furnace. Although this baler is usually mounted on the ground on a permanent foundation, the Surface Department at the Smelter must be credited with the original idea of mounting the baler on a railroad flat car which permits us to move the equipment to the scrap and increases the usefulness of the machine considerably." P. 1

July 1948:

Production Record Is Made By Smelter – "The Smelter cast 10,202,264 lbs. of refined copper in June. This is the highest production for any month since the record year of 1929. In those days the conglomerate Ahmeek, Osceola and the reclamation plants were in full production. Today we get copper in about equal amounts form the mines, reclamation plants, and scrap dealers. We also treat copper for other companies.

The month's production was divided as follows:

Billets for Wolverine Tube Division – 40%

Cakes fir automobile radiators – 60%" P. 4

New Crane at the Smelter – "The Secondary Copper Department is installing a new railroad crane at the Smelter. It has a capacity of 120 tons, and can handle the largest railroad cars loaded with scrap. Formerly all scrap had to be transported about a half mile to the scale at the Coal Dock. Now, incoming and outgoing scrap, and scrap in process, will be weighed at a more central location just east of the Smelter office." P. 4

September 1948:

New 12-ton Scale Is Installed at Smelter – Larger scale needed to weigh the scrap coming & going. P. 4

January 1949:

Improve Method For Refining of Slag – "An interesting illustration of the continuing progress of our smelter metallurgy has been shown during the last two months. In this period several charges of refinery slag have been melted down and so skillfully refined that the copper obtained was suitable for, and was dipped into, phosphor-copper billets. Never before has the metal from a slag charge been refined to the purity required for direct casting into commercial shapes.

The smelter has for several years been melting down and refining certain rich slags previously skimmed from the primary-copper baths. As any smelter man knows, this slag, however rich in copper it may be, bas troublesome concentrations of those impurities which are hardest to remove. Such concentrations naturally make slag refining difficult and tricky. Up until Dec. 1948, all copper so reclaimed has been unsuitable for use in commercial shapes, as it could not be economically refined to the required specifications. Therefore, it has either been "sweetened" by dilution with high-purity copper, or dipped into arsenical billets or low-grade ingots. The bulk went into ingots, which could be used only for remelting, a few at a time, in baths of copper pure enough to stand a slight contamination.

However, the slag charges of the last two months have been refined to billet specifications without dilution, and without extraordinary time or expense. The most prominent developments leading up to this achievement have been the improvement of the soda-ash process for arsenic removal, and the inception of the arsenic-leaching process, for the removal of this metal from rich soda slags.

The benefits of this achievement are two-fold. First, it means that we will be able to reclaim more copper per month from slag than we have been, and will be able to get it on the market faster, since it is going directly into a saleable product. Second, the high cost of handling, storing, remelting, and recasting the low-grade ingots will be eliminated. The accomplishment is another of many tributes to the teamwork and skill of the smelter technicians and furnace operators." P. 1

April 1949:

Operations at Calumet Division Suspend May 1 – Copper demand is so low that they cannot sell copper. Operations will close until the market looks better. P. 1

May 1949:

No Immediate Change In The Copper Situation – Price Reduction Fails To Bring Stimulation In Metal Buying – C&H is still not in operation, but they are still hopeful that operations will be resumed soon. P. 1

INTERVIEW SUMMARIES

These summaries continue from Summaries i#1-3 in Phase 1 Report.

Interviewee #4: BK
Conducted by Daniel Schneider (IA MS Program, MTU)
August 11, 2014
Topic: His account of working at the C & H Smelter

BK worked at the Calumet & Hecla Company's smelter complex from 1953 to 1957. He started out working on one of the crews which handled scrap copper before he began working around the furnaces inside the smelter building itself. BK later worked as an electrician for the Quincy Mining Company and the Copper Range Company, as well as working three years at a taconite plant in White Lake, Minnesota. He worked the last part of his career as a residential electrician.

According to BK, scrap copper came into the scrap yard, located between the C & H mineral building and coal dock, on train cars. It often came in big rolls, and this material was piled into big mounds in the scrap yard. A crew of 10 to 12 workers handled the scrap. The process started with cutting the scrap into smaller pieces using shears: "Big metal outfits, big scissors . . . and somebody had to throw the stuff into the shears and then there was somebody there with a shovel, shoveling everything into a big pile." Much of the cut-up copper scrap, including copper-coated steel, was sent to the leaching plant. A lot of the scrap copper was copper wire. Its coating was burned off of in large, open-air fires before the wire itself was sent to the smelter.

The work BK performed in the smelter building was "labor type work; throwing ingot bars around and billets and all that kind of stuff." He also worked as a ladle liner. Molten copper charges were tapped out of the smelter into a channel that fed the molten copper into a series of

molds arranged around the perimeter of a large wheel. The molds themselves were made of copper and a black coating was painted onto each mold, before tapping the furnace, to prevent the copper ingots from sticking to the molds. BK said there were at least three furnaces in the smelter, one large one and two smaller ones. Copper was smelted at temperatures in excess of 2,400 degrees. Soda ash was used extensively in the smelting operation. “I know I spent a lot of hours in the warehouse down there unloading soda ash cars,” BK said.

Periodically, the smelters’ brick linings had to be replaced. This was a hot job. Workers had to strap thick wood soles onto their boots to keep the soles of their boots from melting. Most of the liner brick was infused with copper from the smelting process, so the bricks were crushed and reprocessed.

As for the smelter slag: “They’d put it in cars. They had the regular dump cars there and they’d pull it behind the smelter there and they’d dump it on the ground.”

Key Points:

- BK corroborated accounts of the coating being burned off copper wire in large, open-air fires in the C & H scrap receiving yard.
- Scrap was cut to smaller sizes using large shears before being sent to either the leaching plant or the smelter.
- BK described a black substance that was painted onto the ingot molds to prevent the copper from sticking to them.
- Soda ash was used extensively in smelting.
- Slag was carried out of the smelter in dump cars, which were pulled behind the smelter and dumped onto the ground.

Interviewee #5: PG
Conducted by Daniel Schneider (IA MS Program, MTU)
August 8, 2014
Topic: A Summary of His Statements Related to Coal and the C & H Smelter

PG worked for Calumet & Hecla Incorporated from 1950 to 1968. His first few years, he worked underground in the mines for six years and also worked as a compressor tender at one of the mines' hoist houses. But most of the time he worked for C & H, he worked as a diesel mechanic. This work brought him to all of C & H's facilities from time to time, as many diesel engines had to be repaired in situ. So PG has a broad perspective on the C & H operations, though his in-depth knowledge relates mostly to diesel-powered rolling stock. After C & H shut down, PG worked most of the rest of his career as a diesel mechanic for a local heavy equipment dealership.

PG did discuss C & H's coal receiving practices in some detail. He once had to repair a Euclid wheel loader that broke down in the hull of a coal delivery ship. Wheel loaders were used to push the coal into piles inside the ship's hull, so the coal crane's clamshell bucket could unload it effectively. C & H also used a large Michigan wheel loader to compact the coal in the coal yard. "It would catch fire if they didn't compact it," PG said.

Different kinds of coal — anthracite or bituminous — were used for different purposes. PG did not know which kind of coal was used for smelting, but said that coal was pulverized and then blown into the smelter with forced air.

Key Points:

- C & H compacted the coal in the coal yard, using a wheel loader, to prevent it from catching fire.
- C & H used different types of coal for different purposes. This statement corroborates an account the interviewer heard during informal conversation with another C & H employee, though neither he nor PG knew which kind of coal, anthracite or bituminous, was used for smelting.

Interviewee #6: FM
Conducted by a Keweenaw National Historical Park Volunteer
February 14, 2012
Topic: The C & H Smelter

FM worked at Calumet & Hecla Smelter from 1946 to 1968, apparently with some gaps in between. His work history also includes time working on Great Lakes freighters, both before and after working at C & H. FM also worked at the Copper Range Mining Company and at Northern Hardwoods, which was a subsidiary of Mead Corporation at the time he worked there. FM was a second generation C & H smelter employee, his father having worked on the smelter's coal pulverizer.

FM described the coal pulverizer, which rendered coal into fine particles that could be blown by forced air into the smelter furnaces. FM began his employment at C & H working in the scrap receiving yard at the smelter, before moving into the smelter building itself. He described unloading box cars of "World War II stuff that the government got rid of" and the burning of piles of copper wire to remove their coatings. "We worked like horses," FM said. "Just pulling and snipping" (probably a reference to the scrap shears described by Interviewee #4, BK. FM said scrap copper was intermixed with mineral from ore in the smelters.

FM also described arsenic in connection with the copper itself, as opposed to the ore. He said certain copper had arsenic in it, which impeded its conductivity. An ingot of highly conductive copper, he said, rang like a bell when struck.

FM said there were between 30 and 40 molds on the perimeter of the molding wheel in the smelter. He said a material was sprayed into the molds to prevent molten copper from sticking to the molds. This is likely the black substance to which BK referred (Interviewee #4). Ingot handlers moved copper ingots onto narrow gauge flat cars, rotating constantly on the same

foot to move as much as 50 tons of ingots per man, per day. The worker's pushed the pace to finish a full shift's loading in six hours.

FM described cutting his fingers on a diamond-blade saw that was used to cut bricks for repairing smelter furnaces. The fingers were hanging by the skin, he said, but doctors were able to mend them and he has use of them today.

Key Points:

- Another corroboration of accounts of coating being burned off copper wire.
- FM's mention of scrapping "World War II stuff" resonates with accounts Daniel Schneider heard in informal conversations with C & H employees, who said C & H smelted ordnance and other war materials which contained lead and other impurities.
- FM described arsenic being present in some batches of refined copper.
- FM said copper scrap and mineral from mine ore were mixed together in smelter charges.

Smelter Area Folders Completed - Updated Aug. 10, 2014

3.1 (Subseries 3.1) Consolidation/Reorganization, 1864-1969	592	1	Data and maps - consolidation of C&H and subs
4.2 (Subseries 4.2) Minutes of Administrative Meetings, 1912-1968	191	7	Metal sales and procurement
	192	13	Scrap processing group
4.4.14 (4.3.7) MacNaughton Numeric File: #1-141, Various Companies & Topics, 1910-1914	56	28	Maps
4.4.25 (4.3.18) McNaughton: Alphabetical, A-Z, 1921-1922	70	11	Smelting Works
4.4.26 (4.3.19) McNaughton: Alphabetical, A-Z, 1923-1924	70	63	Smelting Works
4.4.27 (4.3.20) McNaughton: Alphabetical, A-Z, 1925-1926	71	62	Smelting Works
4.4.28 (4.3.21) McNaughton: Alphabetical, A-Z, 1927-1928	72	40	Smelting Works
4.4.30 (4.3.23) McNaughton: Alphabetical, A-Z, 1931-1932	74	6	Smelting Works
	74	7	Smelting Works – Research Dept.
4.4.31 (4.3.23) McNaughton: Alphabetical, A-Z, 1933-1934	74	40	Smelting Works – Research Dept.
	74	41	Smelting Works
4.4.32 (4.3.24) McNaughton: Alphabetical, A-Z, 1935-1936	74	77	Smelting Works
4.4.35 (4.3.27) McNaughton: Miscellaneous, 1919-1941	176	1	Copper Sales, Smelting, etc.
4.4.37 (4.3.29) President's Office Alphabetical, M-S, 1904-1964	77	1	Smelter Lab Report
	77	8	Possible new sources of copper
4.4.38 (4.3.30) President's Office Alphabetical, A-Z, 1910-1969	80	9	Copper inventory and production report
	84	7	Scrap handling
	84	8	Purchasing Dept.
	86	16	Secondary Operations - Smelter
	87	12	Water supply and power contracts
4.4.40.1 Smelting Works	124	7	Secondary Copper Department
	124	14	Secondary Copper Department - Ash Screening Plant
	123	1-8	Sketches and Data
	124	1	Research Dept.
	124	4	Sketches
	124	10	Water Supply
	126	12	Smelter Lab
4.4.43 (4.3.35) Lovell Alphabetical, A-Z, 1940-1951	59	11	Smelting Dept.
4.4.44 (4.3.36) Lovell Alphabetical, A-Z, 1945-1951	60	32	Smelting & Chemical Dept.
4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968	139	24	Smelting Works
4.4.5 (4.3.4a) MacNaughton Numeric File: 1-625, Various Companies & Topics	48	534	Smelting
	48	562	Smelting Works
5.7.1 Bureau of Mines	166	5	Census of Manufacturers - Smelter
	167	5	Munitions Board Meeting - Stockpile Copper
	168	4	Metals Reserve Contract
	168	5	Metals Reserve Contract
	168	7	Metals Reserve Contract
	168	13	Melting Cathodes
	169	12	Industrial Salvage
5.9 (Subseries 5.9) Agreements and Contracts, 1910-1978	182	3-4	Stockpile Contract
	182	11	Copperweld Scrap
	182	14	Lewis Mathis Co. – Slag Contract
	182	20	Scavenger and Garbage Contracts
5.10.2.2 Insurance Appraisals of C&H, Incorporated's physical holdings	207	3	Smelter
5.10.1 (5.10.1) Inventory, 1928-1968	610	All	Equipment, Measuring & Recording Instruments to Smelter
5.12.3 Boiler Inspection Reports, 1913-1942	37	13	Smelting Works
6.3.1.3 Project Files	164	3	Copper Recovery from Slag & Tailings
6.3.2 (6.3.2) Patent Files, 1858-1969	193	21	"Process & Apparatus for Removing Arsenic from Copper and Arsenic Containing Slag", H.C. Kenny (Serial # 706,246)

8.1.22.5 Tamarack Reclamation Plant	40	5	Secondary Copper
	40	7	Sketches
9.5 (Subseries 9.5) Reclamation 1920-1972	571	25	Copper in Slag
	572	1	Secondary Copper Department-Lake Linden Leaching Plant Reports
9.6 (Subseries 9.6) Assay, 1873- 1903, 1961-1973	570	1	Ledger-Monthly Mineral and Slag Assays
9.7.1 C&H Smelting Works-Stamp Mill Shipments to Smelter	524	35	Smelter Copper Inventory
	569	4	C&H Mining Co. – Slags
	524	29	Car Shop – Conversion of RR Car for Pole Handling at Smelter
	524	35	Smelter Copper Inventory
	578	All	Box of Notebooks belonging to Mr. Floeter – Lake Linden Smelter, Electrical Field Notes
11.4.2 (11.4.2) Water and Sewer, 1900-1970	332	2	Lake and Pond Water Lines
	332	4	Lake Superior Water System
	332	6	C&H and Tamarack Waterworks - Sketch Map
	332	7	Proposed improvement to C&H Water System
	544	2	Ledger - Sewer connections

John Baeten

MTU Copper Country Archives

Coll. # MS-002: The Calumet & Hecla Mining Companies Collection
9.5 (Subseries 9.5) Reclamation 1920-1972 (2 cu. ft.)

Box 571:
Folder 571/006: Slag Leaching Process

This folder contains a number of documents from the late 1960s to the early 1970s regarding proposed methods to extract copper from waste slag.

1. 1972 - Inter Office Correspondence regarding an inquiry from Chile about a slag leaching patent. This document contains some statistical data (concentrate feed, matte, slag) related to a number of smelters, not including C&H.
2. 1972 - Documents from SMC Industries to Mr. Julius Chazen related to copper residue available from the "Scientific Chemical Company" of New Jersey. Some of this material was sent to offices in Tennessee and Michigan. The material was a "viscous liquid" consisting of 25% copper, 12% chlorine, and the balance organic.
3. 1972 – Correspondence between L.G. Stevens of Universal Oil Products and W.A. Hockings – Assistant Director of the Institute of Mineral Research at MTU regarding a proposed project, "Autoclave Leaching of Copper Slag". This document is a solicitation for MTU to process some of the slag from the C&H smelter, and to reimburse Universal Oil a nominal sum between $3000 and $5000.
4. 1971 – Interoffice Correspondence between R.N. Speer and F.J. Gibbons "Calumet Copper Recovery"

This document provides data relating to the copper content within the slag piles located at the Hubbell smelter, in hopes of selling off the remaining amount to provide "additional value for Calumet Liquidation":

Granulated slag – 375,000 tons at 16.8 lbs./ton --- 6,300,000 lbs.
Solid slag - 900,000 tons at 15.0-20.0 lbs./ton --- 13,500,000 lbs.

"The smelter yard (top foot or so) contains an indeterminable, but probably substantial, quantity of copper derived from secondary materials and mass copper. The floor of the so-called electrolytic building also contains a lot of pieces of scrap. These are salvageable forms, but as yet sending out samples to at least two processing plants has failed to yield any kind of offer because, I suppose, the plants do not have a process which is effective or because the material will not carry the freight required."

5. 1968 - Correspondence between Ch. Suter and R.J. Weege regarding copper content and quantities of slag taken from the #20 furnace.

Folder 571/025: "Slag – Copper In"

This folder contains a number of documents relating to sampling the slag piles for copper content, using regrinding and flotation to extract copper from slag piles and generalized technical reports regarding slag treatments.

1. Aug. 02, 1968 – Correspondence between R.J. Weege and C.H. Suter relating to experimental testing of the granulated slag pile. This document does mention slag below the lake level:

"Loading and transportation costs for the initial tests were only about 10 c. per ton. An estimate from Mr. Harter indicates that it would normally cost $0.28 per ton for material above the lake level. Inasmuch as this estimate also includes the slag below water, a loading and transportation cost of $0.50 per ton is used."

2. A proposal from MTU and C&H for the "Recovery of Copper from Melting Furnace Slag"

<u>Box 572:</u>

Folder 001: "Secondary Copper Dept. – Lake Linden Leaching Plant Reports"

This folder contains an immense amount of statistical information relating to various types and amounts of materials scrapped at both the Tamarack and Lake Linden leaching plants. The documents range from 1945-1950. There isn't really any correspondence, but I think this folder, especially if we could collate/itemize the individual materials, could prove valuable.

Folder 002: "Calumet Division – "Secondary LIFO Calculations 1946-55"

This folder contains a large amount of accounting details regarding quantities of scrap, amount of copper extracted from scrap and the economics of reclamation. Also included was a list of suppliers of scrap materials coming into the Secondary Dept. from 1953.

Folder 003: "Calumet Div. Secondary LIFO Calculations 1953-1955"

This folder is a continuation of Folder 002, and contains nearly the same type of documents as the last, but from a more recent time period.

<u>Box 059:</u>

Folder 059/011: "Smelting Department 1940-1944"

This folder contains a large amount of short correspondence between H.C. Kenny among others. The majority of the documents are concerned with technical minutiae.

1. Nov. 4, 1944 - Correspondence between H.C. Kenny (Superintendent) and David Burruss of the Metals Refining Company (Hammond, IN) regarding the sale and shipment of barrels of "chippings" and cuprous oxide.

2. Oct. 26, 1944 - Correspondence between H.C. Kenny (Superintendent) and David Burruss of the Metals Refining Company (Hammond, IN) regarding the classification and grading of different types of cupric oxide produced at the Tamarack Reclamation Plant. These were divided into 4 grades:

No. 1 – Regular oxide
No. 2 – Black still chippings
No. 3 – Red still chippings

No. 4 – Sweetland filter product
3. May 12, 1944 – A document showing the "arsenic and silver content of the various grades of mineral" from the Ahmeek mill.
4. April 7, 1944 – Document describing the "phosporizing practice on the billet casting wheel".
5. April 1, 1944 – Correspondence between H.C. Kenny and E.R. Lovell praising the density and soundness of the billets produced at the C&H smelter.
6. March 30, 1944 – Report detailing the smelter costs for 1943.
7. February 16, 1944 – A document detailing "Customer Relations with Special Reference to the Wolverine Tube Division". This letter is basically a rant from H.C. Kenny describing the not so great business model of the Wolverine Tube Co.
8. February 10, 1944 – A report on the furnace bottom construction, which includes various drawings of different structural members of the furnace.

Folder 059/012: "Smelting Dept. & New York Office"

This folder contains some interesting correspondence between the Kenny and individuals at the C&H offices in Boston. Among the documents listed below, a number of letters concerned with brass billets, copper powder
1. November 20,1943 – This document contains a 5 page list of buildings and equipment (including installation dates) at the Smelter.

2. February 9, 1943 – Correspondence between H.C. Kenny and A.D. Nicholas (Secretary/Treasurer of C&H in Boston). This letter documents the creation of concentrates produced during the time period 1937-1942, when copper prices were low.

"The concentrates we mixed with slag and fluxes and were bedded together. Material to be smelted was taken from the pile without regard to its character or source. It was hoped, in fact, that the better the mixture taken the better would be the furnace results. There is no way of telling what concentrates were smelted during the period from December 1937 to June 1, 1942, nor from which plants they came."

3. November 7, 1940 – Correspondence between Lovell and Kenny regarding the handling of materials from the Stamford Rolling Mills Co., consisting of: Scale from hot rolling operations; Sludge from acid neutralizing tanks; and Brace furnace skimmings (20-30% metallic copper).

<u>Box 060:</u>

Folder 060/004: "Harshaw Chemical Co. – 1945-1951"

This folder contains an immense amount of documents, primarily correspondence between W.J. Harshaw (President of The Harshaw Chemical Co.) and E.R. Lovell of C&H. Among these are letters detailing the creation of, and construction of Lake Chemical, problems procuring caustic for producing copper hydrate,
1. July 5, 1946 – Correspondence between Lovell and Harshaw regarding the progress being made in the production of COCS and Copper Hydrate. This document

contains the possibly disconcerting information that: "There is no provision for catching the dust leaving the cyclones" in relation to copper hydrate production.

Folder 060/025: "Poor & Co. – Re Pryozite Co."

This folder contains correspondence between Poor & Co. of Chicago, and C&H regarding their subsidiary venture the Pryozite Co., which produced Pryozite, a abrasive compound.

Folder 060/032: Smelting & Chemical Dept.

This folder contains a relatively small amount of documents and correspondence regarding the C&H smelter. Among the documents are reports of shipping billets to Decataur, equipment changes within the smelter, estimated costs for processing Quincy and Isle Royale material.

1. October 19, 1949 – Correspondence between Kenny and Lovell regarding the production of copper powder.

2. March 16, 1945 – Correspondence between Kenny and A.H. Wohlrab (General Manager - C&H). This is an account of the problems that are arising with the treatment of secondary copper at the smelter. The document also describes the work situation within the smelter at this time.
"The smelter surface department which has the sorting, handling and sampling of secondary normally employs three men for handling gilding clad scrap, and three to four men for handling secondary proper. We are now using, besides the three on gilding metal, eight to nine men on secondary. The smelter laboratory averages close to 1 ½ shifts per day on secondary sampling and analysis. The time taken in the smelter office for making out settlements, bills of lading, inventories, and the like amounts to one shift per day.

The refining department can treat much more material than it does at present. There is no bottleneck there. The trouble is that before it can be treated it must be graded and prepared. The ever present danger of lead contamination is worry enough in the refinery."

<u>Box 70:</u>

Folder 11: "H.D. Coriant - Calumet & Hecla Smelting Works"

This folder contains correspondence between H.D. Corinat (Superintendent of the C&M Smelting Works) and James MacNaughton, among others. The correspondence varies between reports on billet and anode production to monthly operations reports, some of which may be valuable.

1. Most of the "Operation" reports mention something in terms of slag. A correspondence from April 3, 1922 regarding March Operations states:

"The slag on hand is estimated at 6,000 tons, containing from 3,000,000 to 3,500,000 pounds of copper; and the mineral to be smelted each month will yield some 2,000 tons of slag. The blast furnace will be started again after being idle since

June and the stock of slag gradually reduced so that the copper will be in the form of cupola blocks from which it can be more readily utilized."

2. October 3, 1921: Description of the "slag storage plan" from "Operations – September 1921":

"The slag storage plan seems to be working out very well. The slag is dumped into the steel car bodies setting in a pit, from which they are lifted by electric crane into cars and transferred by locomotive to the storage yard (No. 1 Coal Dock) where they are unloaded by the steam railroad crane. The slag can be picked up again whenever required by using the clam."

3. January 5, 1921 – "Operations – December 1920" –

"The blast furnace started running again on December 27, with the new slag track in use, the slag cars being drawn by a locomotive instead of by horses as formerly. With some alteration of the slag cars the time hauling the waste slag to the dump will probably be cut down to not over four hours a day. One advantage of the change of gauge to three feet is that where the track is exposed it can be kept clear of snow with the tramway plow instead of having a gang of men to shovel it out, while under the cover of what is left of No. 1 Coal Dock roof there was no snow to bother after the heavy fall during the month."

Box 71:

Folder 062: "H.D. Coriant – Calumet Smelting Works 1925-1926"

This folder contains much of the same type of correspondence seen in Folder #11 of Box 70. However, there does seem to be many more documents regarding issues with inferior cakes, low electrical conductivity in wires and malfunctioning billets than in prior years. Slag is barely mentioned in the Operations reports.

1. August 12, 1925: "Copper at Smelter"

This document provides quantifiable data regarding amounts of copper and slag at the smelter in Hubbell as well as in Dollar Bay. Apparently at this time the slag at Dollar Bay was transferred to Hubbell:

"All of the slag has been moved over to the Hubbell Works and is being smelted up. While the weight of this slag was estimated at 400 tons, it was found to be actually 575 tons containing probably 286,000 pounds of copper, instead of 201,500 pounds as estimated."

Box 72:

Folder 040: "H.D. Coriant (Smelting Works) – 1928"

This folder contains much of the same type of correspondence seen in Folders 011 and 062, consisting of responses to customer complaints regarding poor quality wire and billets. Additionally this folder contains much correspondence regarding the sale of "copper shot" or "copper flake".

Folder 41: "HD. Coriant – 1927"

This folder contains much of the same type of correspondence seen in Folders 011 and 062, consisting of responses to customer complaints regarding poor quality wire and billets.

Box 74:

Folder 006: "Smelting Works 1931 Correspondence– 1931-32"

This folder contains much of the same type of correspondence seen in Folders 011 and 062 and 041, consisting of responses to customer complaints regarding poor quality wire and billets.

1. March 4, 1932 – Operations report for February:

"…On closing down the melting furnace No. 20 in January the granulated slag pump formerly used for pumping refining slag to the mineral building for resmelting was connected by a branch pipe to the waste slag line leading from furnace No. 20 to the slag dump at the lake; and is now used for pumping either the waste slag to the dump or the rich refinery slag to the mineral building, thus maintaining the system of slag disposal in vogue while No. 20 was in operation."

Folder 007: "Smelting Works – (Research Department) 1931-1932

Nothing of Note

Folder 040: "C&H Smelting Works – Research Dept."

Nothing of Note

Folder 41: "Calumet & Hecla Smelting Works – 1933-1934"

This folder contains much of the same type of correspondence seen in Folders 011 and 062 and 041, consisting of responses to customer complaints regarding poor quality wire and billets., and contained practically no mention of slag.

Folder 77: "Smelting Works"

This folder contains much of the same type of correspondence seen in Folders 011 and 062 and 041, consisting of responses to customer complaints regarding poor quality wire and billets., and contained practically no mention of slag. Scrap copper does start to make more of an appearance in this folder than the prior years.

1. December 7, 1935: Operations report for November:

"…In order to reduce copper losses in waste slag now being pumped to the lake, a new dewatering and classifying arrangement has been built and installed before the bull jig in the electrolytic plant. This equipment, which will be in operation soon, should result in considerable saving."

Box 77:

Folder 001: "Smelter Laboratory Report"

This folder contains a bound report, "Smelter Laboratory Report 1929" by H.C. Kenny. The contents of the report are mainly concerned with porosity and impurities in smelted copper samples, detailed with microscope pictures of different samples.

Folder 002: "Report – Titration of NH4OH VS CuSO4 and CuCl2, March 1, 1950" by D.B. Erskine

This is a report concerned with the reactions in the COCS process at Lake Chemical Company. The work for the report was conducted at the smelter laboratory in December 1948. It doesn't appear to be very useful for our research questions.

Box 80:

Folder 003: "Re. Copper Powder"

This is a large folder concerned with the production of copper powder, produced through the leaching process. The Copper Powder plant was proposed to be built above the old Lake Linden Stamp Mill Boiler House. The correspondence within the folder is primarily from the late 1950s through the 1960s. The production of copper powder occurred through leaching various primary copper oxides. This folder does contain an engineering drawing of the proposed plant, but it doesn't show any launders or hints of waste flows. The correspondence is overly technical, but it may be of use if we want to delve further into the history of the Lake Linden leaching process.

Folder 009: "Copper Inventory & Production Report A-17 (1968-1969)

This folder contains tabular data concerned with production of copper, and secondary intake and leaching production and shipping. These reports are monthly.

Box 84:

Folder 001: "Oxides (Copper)"

This is a large folder containing correspondence and reports related to expanding the current chemical facilities used to produce copper oxides.

Folder 007: "Procedure – Scrap Handling"

This folder contains a report, "Handling & Processing Procedures Secondary Scrap Material" from 01/25/1965. The report contains information related to the receiving of scrap, grading of scrap and types of scrap received. It might be of use.

Box 86:

Folder 001: "Leaching of Sulfide Ores"

This folder contains a number of monthly reports from 1952 detailing the progress made in the leaching process.

Folder 012: "Sands (Tailings)"

This folder contains correspondence and tabular data regarding sands from the Ahmeek, Tamarack and various Keweenaw properties, including Cliff, primarily

from the 1950s, although some production reports from the late 1930s are present Additionally, this folder contains 2 maps showing:

1. *The "Reserve Area" of tailings from the Ahmeek Sand Bank" from possibly 1929. This map also shows the location of an existing and a proposed launder running from the mill.*
2. *A map showing the "Remaining Reserves" in the Tamarack Sand Bank, from 1954.*

Folder 013: "Sands (Allouez Conglomerate Tailings)"

This folder contains correspondence related to the treatment of sands from the Allouez mill in Keweenaw County, which were retrieved by dragline and trucked from Ahmeek to the Lake Linden leaching plant.

Folder 016: "Re. Secondary Operations – Smelter"

This folder contains correspondence from the 1950s regarding the economics of treating scrap material at the smelter. A detailed report (~20-25 pgs.) from July 9, 1954 includes types of copper scrap treated and where it originated. This report might be of interest.

Folder 020: "Smelter – Scrap"

This folder contains a small amount of correspondence from the early 1960s regarding the purchase of scrap to keep the smelter operating.

Folder 022: "Smelter Flow Sheet –(1946-1960)

"This folder contains a report from 1969, "Smelting & Refining Procedure Used at Calumet & Hecla Smelter as of January 1969" written by Henry King and R.A. Gertz. This report details the materials smelted, including things such as Shop Scrap and Irony Motor Parts, and the daily furnace procedures of the No. 20 and No. 21 furnaces. A flow chart from 1946 was photocopied.

Folder 023: "Smelter –Misc."

This folder contains a varied mix of assay reports, a proposal for the installation of a sand drying plant and correspondence primarily from the 1950s.

Box 087:

Folder 03: "Tamarack Reclamation Plant Flow Sheet - 1960"

Photocopied.

Box 123:

This box contains correspondence between C&H and various manufacturers regarding the design and production of equipment and structures.

Box 124:

Folder 004: "Smelting Works Sketches"

This folder contains a large number of measured drawings of various pieces of equipment and moulds.

Folder 005: "Smelting Works Slag Granulating"

This folder contains a small amount of correspondence regarding the purchase of "Texrope drive furnishings".

Folder 007: "Smelting Works Secondary Copper Department"

This folder contains correspondence regarding the purchase of bailing equipment for scrap copper.

Folder 010: "Smelting Works Water Supply"

This folder contains correspondence related to the purchase of various pumps and equipment related to feeding water into steam pumps in the smelter. Not of much use.

Folder 014: "Secondary Copper Department Ash Screening Plant"

This folder contains correspondence between C&H and various manufactures regarding the design and construction of an "Ash Screening Plant". Not of much use.

Box 125:

Folder 002: "Slag Pump"

This folder contains correspondence with the Morris Machine Works regarding the design and installation of a "sand pump" to be used for granulated slag disposal. Calumet & Hecla were looking for:

"Sand pump to pump 35,000 gals. of water, plus 20,000 lbs. granulated slag per hour through 1,000 linear feet of 4'' pipe, against 55 ft. static head, velocity 15 ft. per sec. Pump to be provided with bed plate, flexible coupling, 3 phase, 25 cycle, 440 volt, 40° C. rise, squirrel cage motor, and across the line starter."

-Photocopied a letter from Oct. 4, 1944 detailing the current practice of pumping granulated slag directly to the lake.

Box 139:

Folder 022: "Lake Leaching – Still House and Blending Plant"

This folder contains various proposals for technological changes to the Lake Leaching plant used to produce copper oxides. Nothing too illuminating.

Folder 024: "Smelting Works"

This folder contains an assortment of reports related to the "Simplification" of work at the smelter.

Folder 025: Unnamed – Ahmeek mills and tailings.

This folder contains a large amount of files related to the Ahmeek mill. Included within these files is a report concerned with the disposal of the Ahmeek Boiler

House ashes. ***This document, from February 23, 1967 includes information related to the direct disposal of coal ash to Torch Lake****. Another diagram shows the "Recovery of Spills and Overflow Water" from the Ahmeek Mill Basement Recovery System, from 1966, and shows the basement floor launder running directly to the Lake.*

Box 164:

Folder 002: "Chemical Processing"

This folder contains correspondence regarding the alteration of some methods used to produce various materials in the late 1960s at the Chemical plant. Nothing seemed to be illuminating.

Folder 003: "Copper Recovery From Slag and Tailings"

This folder contains some technical reports regarding ammonia leaching of slag and mill products as well as a handful of spectrographic reports detailing the composition of slag residue.

Box 166:

Folder 005: "Census of Manufacturers – Smelters"

This folder contains some statistical data related to the smelter for the year 1962, including:

No. of employees – 145
Value of shipments - $15,722,000
Cost of fuels consumed - $147,000
Cost of purchased electricity - $78,000

Box 167:

Folders 004-005:

These folders contain correspondence and reports from the Munitions board regarding the creation of a copper stockpile. Nothing of interest.

Box 168:

Folder 013: "Data re. Melting Cathodes -1946"

This folder contains dictated telephone conversations and an application to the Office of Price Administration regarding the melting of stored cathodes (large electrolytic blocks) by C&H for consumers with limited fabricating facilities.

Box 169:

Folder 012: "Government War Board – Industrial Salvage"

This folder contains a large amount of correspondence regarding the procurement of scrap iron and steel for the War Production Board. The only

information of note is a report which lists various C&H properties that were scrapped prior to the late 1940s.

Box 176:

Folder 001: "Copper Sales, Smelting, Etc. – 1927"

This folder contains correspondence regarding sales of copper bars, ingots and cakes from the smelter and mainly complaints from various customers about the quality of the materials that they received.

-This box contained an additional 4 folders dealing with the same stuff but from different years. I did not search through these in order to preserve time.

Box 182:

Folder 009: "Treatment of Gilding-Metal Clad Scrap"

This folder contains correspondence and a small tabular report regarding the purchase of scrap and the sale of refined secondary copper.

Folder 014: "Slag Contract – Lewin-Mathes Company"

This folder contains a small amount of correspondence between C&H and the Lewin-Mathes Company of St. Louis, MO. From 1955 regarding the sale of C&H slag.

Folder 020: "Contracts – Scavenger and Garbage"

This folder contains contracts between C&H and various garbage collectors in the area. The contracts are for emptying privies and removing garbage from dwellings in the Keweenaw.

Box 191:

Folder 007: "Committee on Metal Sales & Procurement"

This folder contains two letters of internal correspondence concerned with the direction the company was heading in terms of its production of supplies to Wolverine Tube Co.

Folder 012: "New Products Advisory Committee (Corp) & R&D (10/14/57-2/3/66)

This folder contains meeting minutes from the New Products Advisory Committee regarding proposals for the production and development of new products.

Box 192:

Folder 012: "Minutes of Meetings – Re. Purchase and Sale of Copper"

This folder contains two documents which describe the minutes of meetings held to discuss the sale and purchase of copper. Both of these discuss the possibility of reentering the secondary copper market. Probably not of much use.

Folder 013: "Minutes of Scrap Processing Group Meetings (1/21/64 – 6/28/68)"

This folder contain a large amount of minutes from meetings of the Scrap Processing Group. These minutes mention types of scrap materials being treated by leaching and smelting, including notes such as this from October 17, 1967:

"It was reported that our burning of insulated wire is nearly caught up and most of the material has been baled." Mention of burning automotive motors is also frequently mentioned.

Additionally, the upcoming government ban on open burning is addressed.

A letter from June 14, 1966 states:

"Drums of high iron lead residues on the Lake Shore seem to have no value, and we concluded that they should be discarded" – Possibly the drums we've seen with sonar?

<u>Box 193:</u>

Folder 021: "Process and Apparatus for Removing Arsenic from Copper and Arsenic Containing Slag"

This folder contains correspondence regarding the submitting of a patent by H. Kenny. Not of use.

<u>Box 207:</u>

Folder 003: "Insurance Appraisals –C&H Smelter…"

This folder contains a number of insurance reports, including one for the smelter from 1956. This report contains a list of equipment within buildings and the estimated values of the contents. Probably not of much use.

<u>Box 332:</u>

Folder 002: "Reports from Other Dept's. on Lake and Pond Water Lines"

This folder contains a number of one page descriptions of service conducted on water lines. Most of these are for broken domestic water lines. Not of use.

Folder 004: "Lake Superior Water System"

This folder contains correspondence related to the private and public consumption of water from either the Tamarack or Calumet Waterworks. Likely not of much use.

Folder 006: "C&H and Tamarack Waterworks"

This folder contains a single sketch of the location of a domestic property.

Folder 007: "Water System (Calumet)"

This folder contains two large reports: "Lake Superior & Pond Water Systems – A Study (1959)"; and "Proposed Improvements to Water Sysem – Calumet & Hecla Inc. (1959). Neither contain data relevant to discharge or sewage, questions relevant to the research study.

Box 524:

Folder 020: "Smelter – (Bailer) –etc."

This folder contains invoices and correspondence regarding the bailer at the smelter. Not of much use.

Folder 035: "Smelter Copper Inventory July 31, 1967"

This folder contains tabular data related to the copper sales and production of 1967.

Box 544:

Folder 005: "Report of Research on Torch Lake and Hammell Creek Water Quality"

This folder contains a report and a research proposal on the quality of water in Torch Lake. These documents are written by J.D. Spain of MTU Biological Sciences. ***They both appear to be valuable for our research objectives.***

Box 570:

Folder 001: "Monthly Mineral and Slag Assays"

This is a large bound volume which gives assay statistics for slag and minerals from mines. Likely not of much use.

Box 578:

This box contains notebooks concerning different properties of C&H. Each notebook contains an inventory of equipment and supplies within the buildings, including serial numbers.

Box 592:

Folder 001: "Data & Maps – Consolidation of C&H and Subsidiaries"

This folder contains a report and a number of maps concerned most with the current value of mines held by C&H. Not of use.

Box 610:

This box is a collection of index cards that list specific types of equipment. I searched the miscellaneous and the Oil & Waste Saving Machines. Not of much use.

Michigan Technological University Archives and Copper Country Historical Collections MS---002: Calumet and Hecla Mining Companies Collection: Smelter Complex

4.3.4a MacNaughton Numeric File: 1-625, Various Companies & Topics
Box 44:
Folder 227/044 –
Hawley Down Draft Furnace Co. small change in blueprints, 1907.

4.3.40 Engineering Miscellaneous, 1953-1968
Box 138:
Folder 013/138 –
Pamphlets for Pressure Controllers & Pneumatic Trip Valves from the Fisher Co, Calculations on sizing Ahmeek Boiler House and the Smelter-Lake Linden Steam Line, 1965, calculations on steam loss, total steam produced and used, 1944, General Map of Mills Along Torch Lake (Smelter Complex to Hecla Stamp Mill).

017/138 –
Drawings for Smelter furnace & ventilation, Centennial Mine, Kingston Mine, C&H Smelter Complex blueprint (able to see the turbo generators inside the smelter building.

Series 4.4.38 (4.3.30) President's Office Alphabetical, A-Z, 1910-1969
Box 82:
Folder 013/082: Hydrology of Waste Disposal
Info on hydrochemical mining – 1967

Box 86:
Folder 020/086: Smelter Scrap
Smelter has decreased activities, so C&H has told them to buy more scrap metal to process – 1961

Folder 021/086: Smelter – Spectographic & X-Ray Equipment
New equipment purchased for the smelter – 1960

Folder 022/086: Smelter Flow Sheets
Procedure at the smelter – 1969
Sources stating that the slag went away to the "waste slag dump"
Large smelter flow sheet – 1946

Folder 023/086: Smelter – Misc.
Schedule for rebuilding the smelter – 1965
Cost reports
Proposed sand drying plant, no year listed

Series 4.4.5 (4.3.4a) MacNaughton Numeric File: 1-625, Various Companies & Topics
Box 45:
Folder 377/045: Smelting
Correspondence about the smelter (tests, shipments, prices).
1910-1911

Box 46:
Folder 454/046: Smelting
Correspondence about the smelter (tests, shipments, prices).
1912-1913

Series 4.4.14 (4.3.7) MacNaughton Numeric File: 1-141, Various Companies & Topics, 1910-1914
Box 55:
Folder 012/055: Slag Smelting
No to use iron flux – 1910

Folder 027/055: Smelting
Sale and quality of ingots – 1911

Series 4.4.33 (4.3.25) McNaughton Alphabetical, A-Z, 1937-1938
Box 75:
Folder 039/075: Smelting Works
Production records for smelter, shipments of copper.
1937-1939

Series 4.4.34 (4.3.26) McNaughton Alphabetical, A-Z, 1939-1941
Box 75:
Folder 074/075: Revere Copper & Brass
Correspondence between C&H and Revere about getting and supplying copper.

Letter from Revere Copper and Brass Inc. dated April 1, 1937, saying that they would like more Lake Copper, and then a response from C&H saying that they did not have any to spare as their lode was nearing its end.
1937-1938

Folder 076/075: Smelting Dept.
Correspondence about rebuilding furnaces and updates to the smelter, production records and amounts of copper being shipped, a few mentions of secondary copper.
1939-1941

Series 4.4.38 (4.3.30) President's Office Alphabetical, A-Z, 1910-1969
Box 86:
Folder 020/086: Smelter Scrap
Smelter has decreased activities, so C&H has told them to buy more scrap metal to process – 1961

Folder 021/086: Smelter – Spectographic & X-Ray Equipment
New equipment purchased for the smelter – 1960

Folder 022/086: Smelter Flow Sheets
Procedure at the smelter – 1969
Sources stating that the slag went away to the "waste slag dump"
Large smelter flow sheet – 1946

Folder 023/086: Smelter – Misc.
Schedule for rebuilding the smelter – 1965
Cost reports
Proposed sand drying plant, no year listed

Series 4.4.40 (4.3.32) Engineering Department, Alphabetical, S-W, 1911-1969
Box 127
Folder 030/127: Slag Disposal
Correspondence about conveyors to carry the slag away from the smelter plus a drawing, copper slag use in chimneys at other industrial plants in Chicago, but C&H does not have enough slag to spare – 1929, need of slag cars, more cars have been ordered,

Aug. 21, 1925, one slag car requires five to six hours to solidify before it can be dumped, which means that C&H needs more slag cars. They must dispose of at least 130 tons of waste slag per day, and each car averages 6.5 tons of slag.
1921-1949

4.4.40.1 Smelting Works
Box 124:
Folder 005/124: Slag Granulating
Correspondence for the requisition of pipe for granulated slag and correspondence for Texrope drives from Allis-Chalmers.
1932-1937

Folder 026/124: Brick Dust Mill Air Separating Sys – Blueprints
Brick Dust Mill Air Separating System – Blueprints (6' Mechanical separator – single whiz. Chromium Min. & Smelt. Corp. Ltd., Raymond Pulverizer Division) – 1941, brick dust mill air separating system correspondence between C&H and Raymond Pulverizer Division where equipment is coming from – 1948.

Series 4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968
Box 138:
Folder 003/138: Smelter Projects/Smelter Secondary Projects
Smelter Projects: Smelter & Scrap handling info, including small changes they could make to make more money.
1965

5.10.2 Asset Valuation and Insurance Appraisals, 1906-1965
Box 207:
Folder 002/207 –
Insurance Appraisal of C&H Coal Dock – Hubbell, MI by the Arkwright Mutual Fire Insurance Company, 2/7/1957. Substation & Office total 3,992 sq. ft. Also includes the machinery which was in the area at the time.

Series 5.9 Agreements & Contracts, 1910-1978
Box 181:
Folders 5-9: Copper Slag Agreements & Contracts
Folder 005/181:
C&H shipping 'peanut slag' (20-25% copper) to American Metal Climax – 1960, C&H shipping 'insulation ashes' to American Metal Company – 1953 & 1954. "About 250 tons of Copper contained in High Silica Copper Slag crushed to minus ¾ inch, assaying about 45% Cu, 15% Si, 3.40% Al2O3, 3.78% Mgo, 11.67% CaO, 2.50% Fe."
1953-1960

Folder 006/181:
"Product: The output of various copper-bearing material (Arsenical Copper Slag, #5 Granulated Slag and flue dust), and Copper Ashes produced during the period of this contract from operations owned or controlled by the SUPPLIER at Lake Linden, Michigan, which SUPPLIER agrees to ship regularly and currently as produced." – Contract with American Smelting & Refining Co. – 1960, contracts with American Smelting & Refining Co. for the slag and ashes – 1953, 1954, 1955, 1956, & 1960.
1953-1960

Folder 007/181:
Correspondence with American Smelting & Refining Co. for the purchase of "lead/copper residues produced in the leaching of light copper" & "lead carbonate residue and remelted impure lead" which C&H sent to Colorado.
1954-1955

Folder 008/181:
"Our special crushed or broken slag, maximum size 10 inches, and containing 42.81% copper, based on current records. The stock on hand plus estimated production to December 15, 1955 is 898,059 pounds of material, containing approximately 384,465 pounds of copper." – letter from C&H to Lewin-Mathes Co. at Lewin Metals Div. – 1955.

Folder 009/181:
Cancellation of contract with the Sullivan Machinery Company for drills.
1939

Series 6.3.4 (6.3.4) Chemical Engineering Branch Files, 1925-1969
Box 199:
Folder 020/199: Fly Ash
Correspondence between C&H workers about fly ash and the total amount of copper content left in it.

May 6, 1954, memorandum saying that fly ash was blended into the fertilizer. Fly ash is held in inventory at the Smelter and that it is put through a gravity concentrator to concentrate the copper out of it to about 70%. Overall, it is much more efficient to use the fly ash in the fertilizer than to purify it and extract the copper.
1951-1954

Box 201:
Folder 021/201: Slag Utilization
Slags are not uniform in construction or chemical contents, granulated slag has not had a lot of interest from other companies and this product should be dropped as a product, C&H was trying to sell off their slag as a building material, use of slag in the mineral wool industries of the US and Canada, use slag and asbestos for insulating homes, pipes, and industrial machinery and buildings,
1949-1961

Folder 025/201: Soot Removers
Chemical removal of soot and slag from boiler furnaces (table with the description & amount of the waste material) – 1957, formulas for different chemical combinations to remove soot from the furnaces, correspondence with other industrial companies about how to remove soot, the effectiveness of different removers, document discussing flue dust – COPY, recovery of copper from flue dust.
1951-1964

Series 9.7.1 C&H Smelting Works – Stamp Mill Shipments to Smelter
Box 524:
Folder 021/524: Report on Copper Bearing Brick and Ash Residues at Smelter
Document: Cost Study; Processing of Copper Bearing Brick and Ash Residues at the Smelter – 1957.

"All waste materials produced in grinding, jigging, and tabling flow into Torch Lake. Consequently, no additional handling costs are incurred for disposal."

Copper Available for Smelting & Refining: Ashes – 680,000 material pounds, 20% copper, 136,000 total copper, 102,000 estimated copper recovery.

Series 9.5 Reclamation 1920-1972
Box 571:
Folder 006/571: Slag Leaching Process
Note saying that "a sample was taken from the waste pile near the smelter" to be tested for copper content – 1968, correspondence about the slag having copper left in it and UOP is trying to determine if they can reprocess it economically or sell it off to someone else – 1971, Hazen Research is interested in possibly reprocessing the old slag – 1972, MTU is also interested in being involved with the research as to whether low acid leaching will yield usable copper – 1972
1968-1972

Michigan Technological University Archives and Copper Country Historical Collections MS---002: Calumet and Hecla Mining Companies Collection: Electrolytic Plant

4.3.31 Engineering Department, Alphabetical, A-Z, 1912-1916
Box 41:
Folder 013/041 –
Building the Electrolytic Plant and surrounding buildings, 1912-1915.

4.3.4a MacNaughton Numeric File: 1-625, Various Companies & Topics
Box 46:
Folder 432/046 –
Not worth continuing electrolytic because silver contents of Allouez product has fallen. "Referring to the matter of the possible dumping into Torch Lake of 5000 lbs. of 6% Sulphuric acid daily, as noted in your letter of Nov. 16th, I think it need occasion no alarm. The waters of Torch Lake are alkaline and the floating slimes likewise, there is some circulation through the Canal, and at most the acid will amount annually to less than .0001% by weight. As an added precaution, although I think an unnecessary one, we could neutralize the acid with calcitic rock, which would require possibly 500 lbs. daily. There is just a possibility that extreme contamination of iron salts (ferric), might if sufficiently long continued occasion trouble, in which case the plan suggested by you of pumping into a pit would be advisable, for the ferric salts could not find their way into the Lake in a soluble form." –C.H. Benedict. 1911.

Folder 461/046 –
Correspondence about the specs of the new electrolytic plant, construction, machinery, build the plant on Torch Lake and then close the one in Buffalo, 1912-1913.

Box 47:
Folder 525/047 –
Correspondence showing that C&H received blueprints and sketches for the Electrolytic Plant, electrical power for the Electrolytic Plant, 1914-1915.

Box 48:
Folder 556/048 –
Contracts for Electrolytic Plant went to the Allis-Chalmers Company, 1914-1915.

Box 49:
Folder 607A/049 –
One document suggesting what the Electrolytic Plant might produce, 1917.

Folder 607/049 –
Correspondence about the silver retrieved from the Electrolytic process, credit given to those in Buffalo for their work on the electrolytic process, 1916-1917.

4.3.7 MacNaughton Numeric File: #1-141, Various Companies and Topics, 1910-1914
Box 55:
Folder 072/055 –
Allouez copper no longer contains enough silver to make electrolytic processing worth it (July 1911), Osceola and Ahmeek are being treated with the electrolytic process and are being processed in Buffalo (October 1911), mentions of arsenic in the anodes from different mining companies.

Michigan Technological University Archives and Copper Country Historical Collections MS---002: Calumet and Hecla Mining Companies Collection: Coal Pulverization Plant

4.4.40.1 Smelting Works
Box 125:
Folder 015/125: Furnace #20 – Pulverized Coal

Drawing of the coal feeder – 1931, correspondence about coal feeders, General Arrangement of Proposed Feeders & Burners for #20 Furnace – 1929, C&H Smelting Works No. 20 Furnace Building, No. 20, 21 Coal Storage & Burning System Blueprint – 1927; Drawing # 9030. 1927-1930

Box 126:
Folders 13-20: Coal Pulverized Pit – Blueprints, Drawings, Telegrams, Etc.
Folder 013/126:
Correspondence about a dryer for the coal pulverizing plant, drawings of the dryer, boilers for the plant, drawing of the proposed coal crushing plant from Stevens-Adamson Mfg. Co. for C&H Smelting Works. 1922, 1923

Folder 014/126:
Correspondence about the materials needed for building the plant, equipment needed & purchased.

"The process of crushing, drying and pulverizing fuel should be accomplished in a separate building used for no other purposes. This building should preferably be detached, but where this is not practicable it should be separated by a blank masonry or concrete wall containing no openings other than those necessary for the passing of pipes and shafting. The building should be constructed of incombustible materials and specially designed to secure minimum lodgement of dust and to relieve the force of an explosion through its roof and walls without danger to its frame. The frame should preferably be of steel with light non-bearing walls (except fire walls) constructed of materials such as stucco on metal lath, tile, metal or other similar incombustible material and with roof of monitor or gable type and all secured in such a manner as to give way readily under pressure of explosion. The monitors with louvered or glass sides or sky-lights should have a horizontal area not less than one-tenth of the horizontal area of the roof.

In order that the venting of explosion may be more readily facilitated, a portion of the exterior walls equal to not less than 10% of the combined area of the enclosing walls should be of glass. All glazing should be by means of thin glass not exceeding 1/8" in thickness.

Coal pulverizing mills and coal dryers should be equipped with suction fans or other approved means for removing dust. The collection of dust to take place as near the point of origin as possible and suction fans to discharge outside of building or into metal cyclone collectors. Dust collecting devices should be constructed of incombustible material and contain no cloth partitions, tubes or bags. All elevators including boots, legs and heads, or screw conveyors should be constructed of incombustible materials. Conveyors for supplying coal pulverizing mills should be provided with approved magnetic separators between source of supply and mill feed bins. Elevator heads, cyclone collectors or storage bins for handling or storing pulverized coal should be provided with approved vents exhausting outside of building. Machinery and other parts comprising the crushing, drying, pulverizing and conveying system should be effectively

electrically grounded. All stationary lights should be protected with dust proof globes and wire guards. Smoking and the use of open lights or torches should be prohibited. All motors, switches and other electrical devises should conform to the standards of the National Electrical Code."

-Copied from Michigan Inspection Bureau's letter dated July 20, 1923.

Fuller Engineering Co. letter to C&H, February 3, 1923 telling C&H about many other companies and facilities switching over to pulverized coal and that C&H should think about doing this as well. "All of the above goes to show that pulverized coal if delivering the goods and that higher efficiencies can be obtained with it than by any other method, and that pulverized coal enables them to operate their plants more economically."

Screening test of pulverized coal, June 23, 1923. Hubbell Smelter vs Anaconda Smelter.

Over 100 Mesh: 9.0 % vs 7.0 %
Over 200 Mesh: 14.6 % vs 20.3 %
Through 200 Mesh: 76.4 % vs 72.7 %

1923

Folder 015/126:
Correspondence about equipment and drawings for the plant. 1923, 1924

Folder 016/126:
Correspondence about equipment and drawings for the plant, more in depth as the building has been underway and fittings are being installed. Blueprint of Raymond Bros. Impact Pulverizing Co, Chicago, IL. 1924

Folder 017/126:
Drawings of the plant – 1924, may have used asbestos painted tar paper to help with the dust-locks, correspondence about equipment and drawings for the plant. 1924

Folder 018/126:
Correspondence about equipment and drawings for the plant, drawings of some interior equipment parts. 1924

Folder 019/126:
Correspondence about equipment and drawings for the plant, drawings of equipment, list of equipment ordered & costs. 1924, 1925

Folder 020/126:
Correspondence about equipment and drawings for the plant, drawings of equipment, drawings & blueprints of other plants from various locations, & quotations for equipment from various suppliers and companies.

Nov. 3, 1943. The Northern Blower Company telegram. "Metals Reserve Co. has instructed us to suspend all work on our Leaching Plant Extension, subject to probable future cancellation. Therefore please stop all work as of today and all shipments on our order No. A-5136 covering dust collecting equipment. Acknowledge these instructions."

There were narrow gauge railroad tracks running between the Coal Pulverizing Plant and the No. 22 Stack.

Correspondence with The Northern Blower Co. about Dust Collecting Equipment, specifically a bag house and cyclones – April 29, 1943.
1926-1944

Box 127:
Folder 001/127: Coal Pulverized Pit – Blueprints, Drawings, Telegrams, Etc.
Roller mills at the Pulverizing Plant – 1960, blueprints of machines & equipment, Moisture Content of Coal – 1954, info about Sly Dust Filter Equipment to filter the dust out of the building,

September 18, 1953, flow-sheet showing the present flow in our Coal Pulverizer Plant. Document copied. 1946-1960

Folder 002/127: Coal Pulverized Pit – Sketches & Data
Coal Pulverizing Plant sketches – 1924, Raymond Pulverizer Division proposal – 1946.

Series 4.4.5 (4.3.4a) MacNaughton Numeric File: 1-625, Various Companies & Topics
Box 48:
Folder 541/48: Pulverized Fuel for Smelting
Correspondence about using Pulverized Coal for reverberatory smelting at C&H and that Anaconda has also just begun to use pulverized coal at their smelter.

May 16, 1914, letter from Norman Warford, Engineer, stating that he can get C&H 98 to 100% efficiency using pulverized coal at their smelter, up from the 70 to 80% they were currently getting.

May 19, 1914, letter from the Superintendent to MacNaughton saying that they should wait until Warford has installed the plant for Anaconda and for them to get data back before they agree to go ahead with their own plant, and also that they were doing experiments of their own with coal pulverizing at Dollar Bay. 1914

Series 4.4.40.1 Smelting Works
Box 124:
Folder 26/124: Brick Dust Mill Air Separating Sys – Blueprints
Brick Dust Mill Air Separating System – Blueprints (6' Mechanical separator – single whiz. Chromium Min. & Smelt. Corp. Ltd., Raymond Pulverizer Division) – 1941, brick dust mill air separating system correspondence between C&H and Raymond Pulverizer Division where equipment is coming from – 1948.

4.3.7 MacNaughton Numeric File: #1-141, Various Companies and Topics, 1910-1914
Box 55:
Folder 011/055 –
Correspondence allowing the Lake Superior Smelting Co. to use the Tamarack-Osceola Copper Co. dock.

4.3.31 Engineering Department, Alphabetical, A-Z, 1912-1916
Box 41:
Folder 007/041 –
Information about Coal Dock #2 (smelter dock), the addition of a coal bridge and man trolley, clean-up bucket, 1918.

Folder 008/041 –
Confirmation is shipments for the #2 Coal Dock, responses from different firms about building the dock including different materials, orders for motors for the dock from GE, mention of blueprints including the sub-station, 1918.

4.3.32 Engineering Department, Alphabetical, S-W, 1911-1969
Box 127:
Folder 006/127 –
Blueprint for Buffalo Smelting Works Concrete dock, info about dock in Buffalo, 1919.

4.3.40 Engineering Miscellaneous, 1953-1968
Box 138:
Folder 013/138 –
Pamphlets for Pressure Controllers & Pneumatic Trip Valves from the Fisher Co, Calculations on sizing Ahmeek Boiler House and the Smelter-Lake Linden Steam Line, 1965, calculations on steam loss, total steam produced and used, 1944, General Map of Mills Along Torch Lake (Smelter Complex to Hecla Stamp Mill).

5.10.2 Asset Valuation and Insurance Appraisals, 1906-1965
Box 207:
Folder 002/207 –
Insurance Appraisal of C&H Coal Dock – Hubbell, MI by the Arkwright Mutual Fire Insurance Company, 2/7/1957. Substation & Office total 3,992 sq. ft. Also includes the machinery which was in the area at the time.

Drawings & Blueprints (Drawer #):
180 – Blueprints of the #2 Coal Dock & Coal Dock Sub-Station (1917) with additions, blueprints of the transformers which were housed in the Coal Dock Sub-Station.

John Baeten

Keweenaw National Historic Park Archives – 16 July 2014

Calumet & Hecla Smelter Records:
Box 204

Folder 028.00019/006.02-001: Smelter Miscellaneous – Correspondence, 1955

-This folder contains two documents:

1. The first, dated 01-05-1955, is correspondence between T.J. Phelen and Paul Maurer regarding the interest of Mr. Farley and the C&H "Production Planning" and the ability to "relieve the Director of Smelter Operations of keeping Secondary Procurement advised of his needs, based on inventory information". Mention of the Leaching facilities and the production of copper oxide occurs, but it is difficult to understand if this is at the Smelter or not.
2. The second document is an account of the installation of a sprinkler system at the Smelter.

Folder 029.00019/006.002-002: Proposal for Installing Spectographic and X-Ray Polychromatic Equipment at the Smelter Laboratory, 1960

-This folder contains a single document regarding the title. The document is concerned with quality of incoming scrap materials to the smelter, and the instances of high levels of lead, nickel, tellurium and bismuth. The installation of this equipment would alert the smelter of the presence of these metals. The article also mentions "the complex nature of scrap shipments (cars will contain several items either separated or quite thoroughly mixed) and because of the further complexity that some of the analytic chemical procedures are very much involved (wet chemical determination for tellurium requires two days), it becomes quite apparent that a completely adequate job of scrap classification and segregation by wet chemical methods would tax the facilities of laboratories very much larger than ours."

Folder 030.00019/006.02-003: Smelting Slag Piles Volumes, 1968-1976

-This folder contains a handful of documents.

1. The first document is a correspondence between "UOP Realty" employees J.I. Haataja and R.P. Grasseschi regarding slag piles at Hubbell. This document mentions "a map of the Torch Lake area showing the location of the slag piles near Hubbell." However, the map is not located in the file. The document goes on to mention:

"The slag piles were measured in 1968 by survey. The volume that was calculated at that time was 7,500,000 cu. Ft. of granulated slag and 9,600,000 cu. Ft. of solid slag. A factor of 20 cu. Ft. per ton was used for the granulated slag and 12 cu. Ft. per ton for the solid slag."

"…It must be realized, however, that most of the slag lies under water and the exact measurements are impossible to determine."

2. The remaining documents give data regarding amounts of slag at specific stations. I am guessing that these documents articulate with the missing map. Bummer.

Tamarack Reclamation Records:
Box 204

Folder 005.001.07.02: Tamarack Reclamation Plant Folder – New Production Facilities Proposed, June 1956

-This folder contains "a proposal to increase the return of recovery of sands from Torch Lake through the Tamarack Reclamation Plant". It's stated purpose is to, "Acquaint management with the opportunities that exist for increasing the production of copper from the Tamarack Reclamation Plant and decreasing operating costs by providing new processing facilities." The proposal suggests "The existing building will accommodate a new processing unit which is capable of increasing the capacity of the plant by 40% or 1,000 additional tons per day. The installation of an additional single grinding system will increase the processing ratio 1,260,000 tons per year with a reduction in operating costs and will shorten the useful life of the Tamarack Reclamation Plant from 13 ½ years to 9 ½ years."

Folder 006.00019/005.01.07.02-002: Correspondence and Notes regarding the Purchase of a Sulfuric Acid Tank, June-August 1973

-This folder contains correspondence between C&H and American Cyanamid Company regarding the latters purchase of "Baume Sulfuric Acid" from C&H. This sale was completed on Aug. 30, 1973 and totaled a net of 63.63 tons of sulfuric acid shipped by Schneider Tank lines.

The Historical Development of

SMELTING *and* REFINING Native Copper

By H. D. Conant*

WITH the beginning of copper mining in the Lake Superior region of Michigan about the year 1847, a new feature was introduced into the metallurgy of copper. Before that time copper had been obtained from sulphide or oxide ores by a smelting process that involved several operations for separating the metal from the sulphur, iron and other impurities with which it was combined in the natural state. The product of the Lake Superior mines is native copper, and no complicated processes are required to prepare the metal for use in industry; it is necessary only to melt the concentrates and massive copper, remove the slag formed by the rock in which the copper is found, and then, by a simple refining operation, to prepare the metal for pouring into the various shapes required by manufacturers. Both melting and refining were formerly performed in the same furnace, but as practice has improved, the two functions have been separated and are now generally performed in different furnaces.

When the Lake Superior copper mines began operation, the concentrates were shipped either to the Revere Copper Works near Boston, or to the copper smelter at Baltimore where the sulphide ores of the Atlantic states had been smelted for many years; but in the year 1850, owing to dissatisfaction with the quality of copper produced at those works, and in order to reduce expense, four of the largest copper rolling and brass manufacturing companies in Connecticut joined in constructing a copper smelting works at Detroit, Mich., of which the present Calumet and Hecla smelter is a direct outgrowth.

At the Detroit works there were at first one small reverberatory furnace for smelting the concentrates from the mines and refining the copper and one small cupola for recovering the copper contained in the slag taken from the reverberatory furnace. The maximum furnace charge of refined copper was limited to about 16,000 lbs., while today charges of 600,000 lbs. are common. In 1861 a copper smelting works was built and put in operation on the shore of Portage Lake, opposite Houghton, in the mining district of Michigan. The equipment was of the same type as at the Detroit works and one description will apply to both.

The reverberatory furnaces were used for melting the mineral, as the concentrates from the stamp mills at the mines are called, and the massive copper which ranged in size from pieces weighing a pound or less to some that weighed ten or fifteen thousand pounds. The concentrates and smaller masses were shipped to the smelter in barrels—thus giving rise to the term "barrel work" for the smaller pieces. At the smelter the barrels were emptied on the floor alongside the reverberatory furnace and the concentrates shoveled into the furnace by hand, while the heavy masses were lifted by hand-operated jib cranes and lowered into place through a large opening in the top of the furnace. Charging the furnace was usually done during the afternoon and the melting was accomplished during the night; the slag formed by the portion of crushed rock that remained in the concentrates and mass was skimmed from the furnace as the charge melted, and by morning the furnace held only clear molten copper ready for refining. Following the old Welsh methods, the first step in refining was to remove impurities by oxidation, called rabbling. This was accomplished by forcibly splashing the copper up into the air with a rabble—a hoe-like implement with a 4 by 6-in. blade and a long iron handle. While the impurities were being oxidized in this manner, they formed a slag that floated on the surface of the charge and could be easily skimmed off. As some copper oxide was formed in this operation, the next step was accomplished by burying the ends of hardwood poles in the copper, permitting the carbon in the wood to unite with the oxygen in the copper which left the latter in a pure metallic state. On the completion of refining, the copper was poured into molds of various shapes, some for small ingots used in brass making, some for flat

* Superintendent of Smelter.

square cakes for rolling into sheet copper, and some for bars suitable for drawing into wire. The ingot molds made of copper and the wire bar moulds made of cast-iron were set on the edge of a tank of water into which the cast copper, after solidifying, was tipped and cooled. The cast-iron cake molds rested on the floor and were deep enough to permit five or six cakes to be poured, one on top of the other, each cake being allowed to solidify and chill slightly before the next was poured. After the cakes had cooled they were pried apart with chisels. The copper was dipped out of the furnace by men with small long-handled iron ladles holding from 15 to 20 lbs. each; these were carried across the floor and their contents poured into the molds. In pouring a flat cake, which might weigh between 150 and 300 lbs., from four to eight men, according to the size of the cake, stood around the mold with filled ladles poised ready to pour the copper simultaneously at a given signal so as to completely cover the bottom of the mold at one pouring; other ladlers followed in quick succession until the full thickness of the cake was attained. This method, inefficient as it was spectacular, has passed into history.

In 1886 the Calumet and Hecla Mining Company, whose product had for 20 years been smelted at the Portage Lake smelter, built a plant of its own near its stamp mills on Torch Lake. This was followed in 1888 by the erection of a somewhat similar plant at Dollar Bay on Portage Lake by the Tamarack and Osceola Mining Companies, which companies were later consolidated with the Calumet and Hecla. At neither of these plants was there any departure from the old established practice and equipment; reverberatory furnaces of the conventional size and type were housed in each of the four corners of dimly lighted stone buildings.

The first radical change from the simple furnace refining of lake copper was made in 1894 by the Calumet and Hecla Mining Company at its branch smelter erected at Buffalo, N. Y., in 1891. At that place an electrolytic plant was constructed for the purpose of purifying the copper obtained from reverberatory slag and for recovering silver from that portion of the concentrates that carried it in paying quantities. The cathode product and the richer grades of mill concentrates were melted together, resulting in a copper product of higher electrical conductivity than could otherwise have been obtained without excessive furnace treatment. The size of reverberatory furnaces was gradually increased from time to time until they had a capacity of about 30,000 lbs. of copper; but aside from the introduction of the electrolytic treatment, no change in method was made until 1898 when, at the Dollar Bay smelter ,a reverberatory furnace measuring 40 ft. in length was built for melting concentrates, with provision for drawing off the slag and accumulating within the furnace molten copper that was permitted to flow by gravity at intervals of from 8 to 12 hours into one of the existing smaller furnaces for refining. At this same time casting machines were built and installed. In these machines the copper molds were supported by cast-iron plates provided with rollers and connected by link belt chains that passed over sprocket wheels at each end of the steel frame forming the body of the machine. At first the copper was dipped from the furnace and poured into the molds by means of ladles holding from 100 to 150 lbs., which were suspended from overhead trolleys thereby permitting them to be moved in and out of the furnace and swung over the molds by hand. Later these ladles were superseded by larger ones operated by hydraulic power and into which the copper flowed direct from the furnace by gravity.

This practice of melting in one furnace and refining in another proved so successful that three additional melting furnaces of about the same size and type were built, the only difference being that in the latter the charge holes in the top were located along the sides, permitting the concentrates to protect the side walls from attack by slag and heat and thereby greatly reducing furnace repairs. This is the first instance on record of side wall charging, a process patented by others many years later and which has resulted in much litigation.

At the Buffalo plant in 1900 a reverberatory melting furnace in connection with a refining furnace, having a capacity of 100,000 lbs., was built and equipped with a Walker circular casting wheel permitting a charge of copper to be poured in less than a quarter of the time consumed previously and at much less cost. In the same year a second and larger electrolytic plant was built with a daily capacity of 40 tons, both this plant and the earlier one being arranged on the multiple system of deposition. With an ample supply of cathodes available, it was the practice to melt them in the refining furnace, the mineral being charged into the adjacent melting furnace from which molten copper was drawn, flowing through a spout from one furnace to the other to supplement the cathode copper already melted in the refining furnace. Several of the furnaces were at the same time provided with waste heat boilers, and an appreciable amount of steam was obtained at low cost to aid in the generation of electric current for the electrolytic plant.

In 1905 the practice of using sodium carbonate and lime to lower the arsenical content and raise the electrical conductivity of copper was introduced at the Dollar Bay works. A mixture of soda ash and lime in equal proportions was thrown over the surface of the furnace charge during the oxidizing stage of refining, forming a slag in which the oxidizing arsenic was absorbed and with which it was skimmed out of the furnace. This proved to be effective and less expensive than the former practice of using cathodes in the charge in order to dilute the arsenic, especially if the copper from which the cathodes were made did not contain enough silver to pay for the electrolytic treatment. The use of soda ash for this purpose has continued to the present time; but instead of shoveling it over the surface of the copper as at first, it is now blown through iron pipes into the copper below the surface, thus assuring more intimate contact with the arsenious oxide.

Early in 1914 the feasibility of burning pulverized coal in the reverberatory furnaces was considered as a factor of economy and efficiency, the use of that type of fuel having been general for many years in the cement industry and since 1912 for copper smelting in Canada. The advantages of burning coal in this form appeared so pronounced that it was decided to apply the system at the Dollar Bay works; but since powdered coal had not as yet been tried anywhere in the refining of copper, an expensive pulverizing plant was not considered advisable and a unit pulverizing mill of the type used in cement burning was chosen for the experiment. The trial was successful from the beginning, for not only was the melting accomplished readily, but the refining resulted in a more even grade of copper than had ever before been attained. Later on when the designs for the improved and enlarged reverberatory furnaces at the Hubbell works were made, there was also provided a capacious and efficient central pulverizing plant completely equipped for drying, fine grinding and distribution of powdered coal by means of compressed air to storage bins at each furnace.

In 1914 the Buffalo works were closed and all operations were transferred to the Hubbell works on Torch Lake where a new electrolytic plant of five million pounds a month capacity had been built, which would operate under the favorable condition of a low electric current cost owing to the utilization of exhaust steam at the stamp mills for generating power. Two 100-ton reverberatory furnaces, each of 200,000 lbs. holding capacity, had also been built and equipped with Walker casting machines and were used principally in the preparation of anodes for the electrolytic plant. The latter was closed in 1922 because of the lowering of silver values in the copper and the fall in the price of silver. These furnaces and their equipment were inadequate for making cakes and wire bars, while the constantly increasing proportion of low grade concentrates presented a problem in melting for which the existing furnaces were unsuitable. Plans were made accordingly for the construction of a large reverberatory melting furnace to melt all of the concentrates and deliver molten copper to the refining furnaces, and for enlarging and deepening the latter so as to hold as much as 600,000 lbs. of copper at a time. In connection with these improvements it was planned to replace the small casting machines with large Clark type wheels capable of handling copper at the rate of over 100,000 lbs. an hour. The completion of this construction marked the end of the transition from the laborious, expensive and inefficient methods of early times to the economical and efficient procedure of the present day.

This transition period has seen the passing of the blast furnace used formerly to smelt the slag that was skimmed from the reverberatory furnaces, during both the melting and refining stages, and to recover the copper carried by the slag in the form of silicate. Numerous attempts had been made to prevent copper from entering the slag while melting the mineral, but success was reached only after the application of pulverized coal. Now a slightly reducing atmosphere is maintained in the melting furnaces while oxidation of metallic copper is prevented by mixing coal or coke screening with the charge. This permits the immediate discard of the slag from the reverberatory melting furnace without further treatment; and as the refining slag can be effectively cleaned of copper in the melting furnace, the blast furnace has become unnecessary.

Box 79 - folder 11

CALUMET & HECLA SMELTING WORKS

SUBJECT: BLAST FURNACE WASTE SLAG DISPOSAL:

HUBBELL, MICH., February 11, 1921.

JAS. MACNAUGHTON, Vice-Pres. & Gen. Mgr.
H. D. CONANT, Superintendent
L. E. WILLIAMS, Clerk

IN REPLYING PLEASE CONFINE YOUR LETTER TO ONE SUBJECT AND REFER TO FILE NO.

James MacNaughton, Esq.,
,Vice President & General Manager,
CALUMET, Michigan.

Dear Sir:

The expense of disposing of the blast furnace waste slag - which averages 175 tons a day - has been reduced by the change made last month in hauling it to the dump from $80 a day to $54 (or from $24,000 a year to $16,000) and the number of men from 23 to 16. A further reduction of $43 a day or $13,000 a year, with 13 less men, could be effected by putting in a slag casting machine similar to the Uehling machine used at iron blast furnaces and providing a steel-concrete bin with sufficient capacity to hold the slag during the night. The slag would be loaded into the slag cars now in use, from which it would slide down into the lake at the dump. A better plan would be to load the slag into steel tip boxes, carried on flat cars, and provide an electrically operated crane mounted on three-foot gauge trucks to swing the boxes out over the lake to empty them. With this rig it would not be necessary to shift the track whenever the edge of the dump fills out too far to allow the slag to slide from the cars into the lake. Granulating the slag provides the best means of disposing of it; but granulated slag should not be deposited

J. M. - February 11, 1921

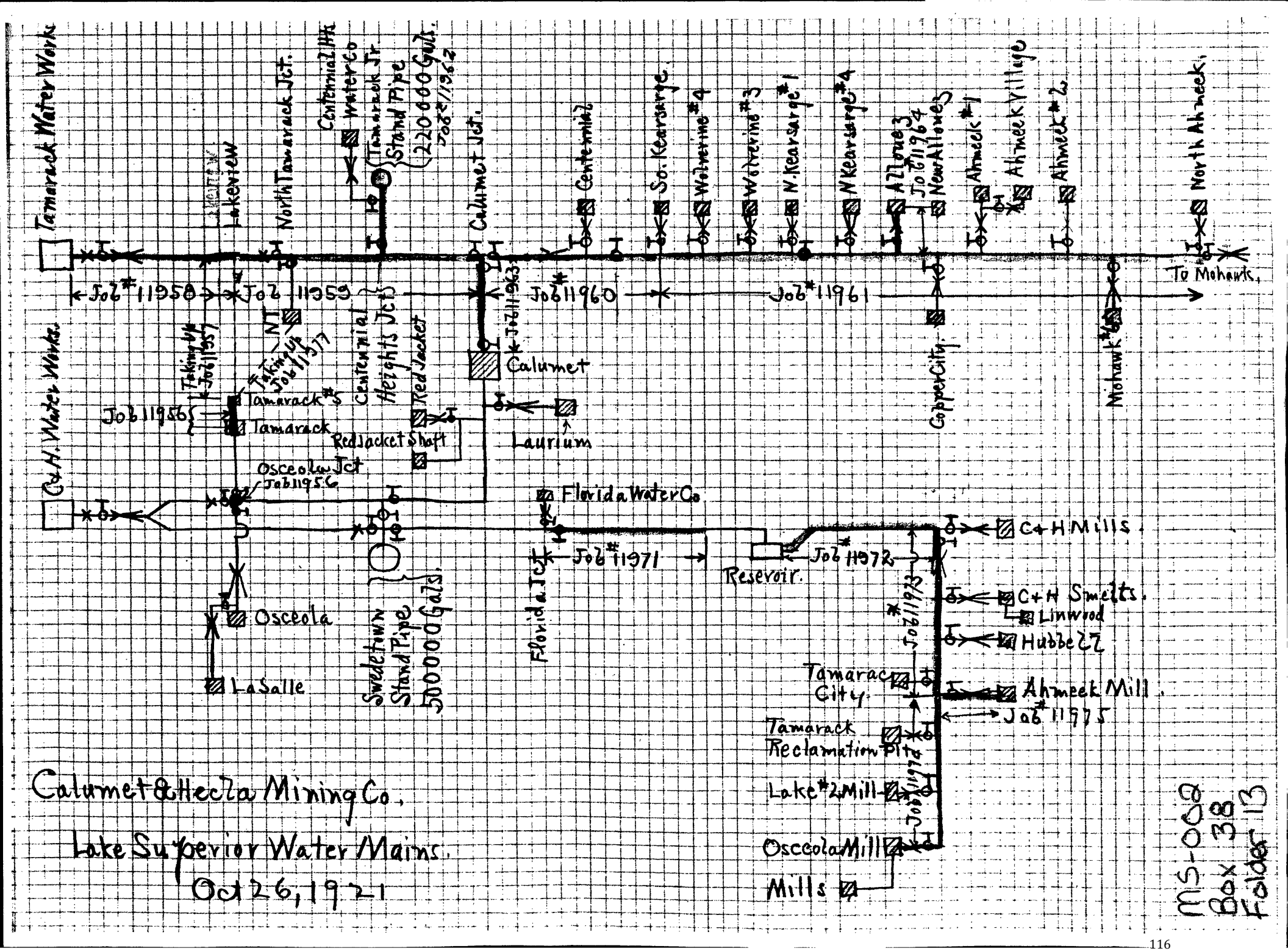
in navigable waters on account of its tendency to wash and fill up the water ways, so that a slag casting machine seems to be better adapted for this locality.

A slag casting machine, which could be built in the shop at Calumet, would cost possibly $10,000, and the bins perhaps $5,000, and the total expenditure should not exceed $20,000 to accomplish a definite saving of $13,000 a year.

Respectfully,

W. B. Williams

Superintendent.



Calumet & Hecla Mining Co.

Lake Superior Water Mains.

Oct 26, 1921

MS-008
Box 38
Folder 13

1 Box 72 - Folder 40

CALUMET & HECLA SMELTING WORKS

HUBBELL, MICHIGAN

JAS. MACNAUGHTON, PRESIDENT
H. D. CONANT, SUPERINTENDENT
E. R. LOVELL, ASST. SUPERINTENDENT
E. C. MESSNER, CLERK

January 11, 1928

James MacNaughton, Esq.,
President,
CALUMET, Michigan.

Dear Mr. MacNaughton:-

I am enclosing an amended description of the treatment of soda slag.

Under the "Advantages" I have added No. 6, which relates to the elimination of at least 30 percent of the arsenic contained in this slag when it is treated in a melting furnace.

Respectfully,

E. R. Lovell

Assistant Superintendent.

In the summer of 1924, experiments were conducted at the Smelting Works, to determine the feasibility of leaching Soda Slag (i.e slag skimmed while blowing soda ash to eliminate arsenic). The main idea was to throw away the arsenic as well as worthless slag. The slag was crushed or broken and loaded in small cars, which were hauled to the Liberator House south of the Electrolytic Plant. It was then placed in wire baskets, which were suspended in tanks of water which were agitated with compressed air and steam. The solution was, after decanting, filtered through a Sweetland filter. There remained a slimy residue in the tanks containing a high percentage of water, as well as copper, copper oxide, and mixtures of furnace refractories, which had been fluxed out at the time of soda blowing. The residue on the filter leaves had to be scraped off;and, together with the bulky residue, was returned to the melting furnaces to recover copper values.

ADVANTAGES OF THIS OPERATION

1 . - Removal of small amount of arsenic

2 . - Removal of small amount of slag.

DISADVANTAGES OF THIS OPERATION

1. Some of the soda slag contains so much copper, copper oxide and refractory material that it would be practically all insoluble and,therefore, it would be useless to attempt to leach.
2. During the last half of the soda blowing period, owing to the chemical law of "Mass Action", a very small amount of arsenic is eliminated. Consequently, the resulting slag contains so little arsenic it would be futile to leach.
3. The residue,returning to the melting furnace after leaching, contains from 50 to 70% water; and this results in a high fuel

Copy to R. L. A. - 3/3/28

loss, due to evaporation.

4. Extra labor and handling is required.
5. Steam and compressed air must be used.
6. Waste solution going to lake is deadly poison. (Probably of not much importance)
7. Extra equipment is necessary.

PRESENT METHOD OF TREATING SODA SLAG

This slag is crushed with all other copper bearing slag, and is charged back to a melting furnace. The resulting copper is refined and cast as arsenical copper in any desired form.

DISADVANTAGES OF THIS OPERATION

1. None that I know of, unless selling arsenical copper at lower price than Prime is one.

ADVANTAGES OF THIS OPERATION

1. All soda and other slag is treated in the same manner making for simplified operation.
2. Extra labor not required.
3. Extra equipment not required.
4. The crushed slag, being "Basic", helps to flux the other slag with which it is melted. If we lacked soda slag it would be necessary to purchase crushed limestone, and charge with refinery slag in order to render it fluid.
5. We sell worthless arsenic to our customers for the price of copper.

6. Present information shows us that at least 30% of the arsenic returned to the melting furnaces is eliminated either by volatization or going into the waste slag.

Box 125 - Folder 002

Smelting Works-No.22 Slag Pump

Oct. 4, 1944

Morris Machine Works,
211 West Wacker Drive,
Chicago 6, Ill.

Attention: Mr. F.S. Salchenberger

Dear Sirs:

We submitted your letter of Sept. 29 to Mr. H.C. Kenny our Smelter Supt., who advises as follows:

"We are at present pumping granulated slag from No.20 furnace at the rate of from 60 to 80 tons per day, most of which is drawn off in the course of a very few hours. We estimate that we may take off as much as 30 tons an hour at some times. This is pumped to the lake with a 6" pump and an 8" pump in series. The two pumps are lined, the 6" running at 720 r.p.m. with an 18" diameter impeller and the 8" pump running at 720 r.p.m. with a 21" diameter impeller. Although the two pumps are in series the connection between them is broken by a sump box. Because we are pumping through a very long slag line we find that the installation above is necessary. We would much prefer to shorten the line and to use a single pump. Furthermore, if we can smooth out the variations in the flow of slag we can use a much smaller pump than the ones we have. That is the reason that we were first interested in the 5" slag pump from the Morris Machine Works.

"At present we have considerable difficulty furnishing enough water to the pumps to keep the slag in suspension and we are running a good many hours a day at an extremely light feed. Not only the power consumption but the wear and tear would be considerably reduced with a smaller pump and a uniform flow.

"In order to find out what the 5" pump would do we decided to order one for our new No.22 furnace. For this furnace we can use a very small pump because not much slag is skimmed off and we can skim it at a rate just sufficient to keep the pump busy. It is the latter pump that we have had so much correspondence about just recently. The 6" pump at Tamarack is of the same type and if you would prefer to have all our pumps the same size we can use the 6" pump as well as the 5". The only disadvantage is that we will pump more water, although if the pump is belt driven we can reduce the speed to the point where the delivery will be the same as for the 5".

"I note the power for both pumps is about the same for the same delivery and the 6" pump seems to be more efficient at the lower rates of speed. The only disadvantage I can see for the unlined pump is that the wear is going to be rather serious. The granulated slag is highly abrasive, much more so than sand and it requires a higher velocity to keep it in suspension. I like the design of the new pump, however, and especially the bearing layout. With V-belt pulley we can adjust the speed to whatever we find necessary."

From the above we think the pump should be lined. We have patterns for repair parts for the 6" pump shown on your drg. 13165-M2. However, you may find it desireable to use a 5" pump. Pump to be V-belt driven.

We regret that we havn't more specific data to present to you.

Yours truly,

H. E. Williamson

Chief Draftsman.

HEW:HB
cc/HCK
Morris Machine Works

Secondary Metal Department Is B At The C. & H. Smelting Plant

Ray Dusseault and Frank Brula, loading secondary copper into tank for leaching at Tamarack Reclamation. Subdivided tank for treating lots separately, shown in background.

Arthur Congdon, inspecting coaxial telephone cable used i Radar.

THE greate part of th met and l cla plans comes fro material damaged in se ce.

One of t photograp cable such as ed by the N ship in aervic equipped a battleship is ken into d defective is di rded and by steel armo nd either armor and the lastic are sulated and th insulation

Telephon ire used ful source of ondary co fields and fre maneuver material at th factory.

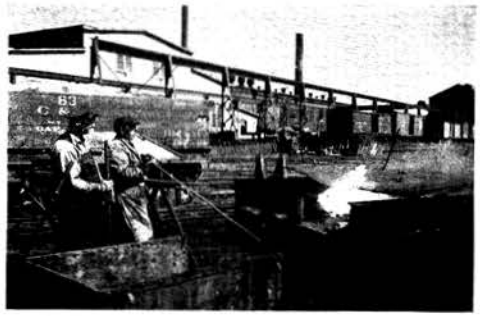
During t war, gover as far as copp is concern room as possib to a second be reclaimed.

Seconda department scrap but also include such and the like which are mo

Because the ammonia to mixed mat ials such a of the latter variety is bein copper wire, copper-clad st ed in quantity.

The Navy has put cons to produce a maximum amo has taken some hustling t the oxide.

Carl A. Deiro, Edmund Emond and Leo Jolly, stripping insulation armored navy cable.



Roy Matson and James Zubiena, burning insulation and grease from motor parts.

H. C. Kenny, Superintendent, examining signal corps field telephone wire.

Removing insulation from scrap wire by burning.

r handled by the Calu- ial variety. Much of it making of munitions or

f a stock pile of heavy ttleships. Every battle- y miles of it and when s, the cable found to be f this kind is protected e jacket. Both the steel per itself is heavily in- ed by burning it off.

Corps is another fruit- recovered from battle- the inspection of the

have been very strict de must be turned in as y and the copper must

limited to war time trolley wire, bus bars. e times.

particularly adaptable e tin and copper, scrap marack plant. Tinned parts are being leach-

on the Tamarack plant ship bottom paint. It dary copper to make

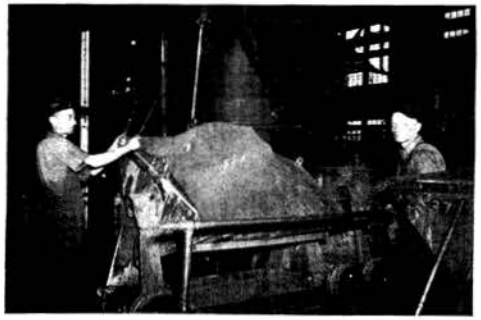
W. J. Curnow, burning insulation at smelter.

Oli Horsma, Sven Sjogren, Marvin Desellier and John Damjanovich, unloading Copper "Mud" from box car.

William Helbacka, Frank Brula, Earl Johnson, Ray Dusseaul and Ed. Wilmers, unloading and weighing secondary copper from box car at the Tamarack Reclamation.

Ernest Rheault, Wilfred Godin, John LaBelle, Gerald Anderson and John Stukel, stripping navy cable, salvaging armor and Vinylite insulation.

ed Faller and Richard Bree, separating leached motor parts for p.



Adolph Dupuis and John Peterson, unloading copper oxide made at the Tamarack Leaching Plant. This is the base material for ship bottom paint used by the Navy and Merchant Marine.

NEWS ABOUT OUR BOYS IN THE SERVICE

Corporal Robert C. Hill of the Army Air Corps has returned to Pyote, Texas Air Field, after spending a furlough with his parents, Mr. and Mrs. Albert Hill of Laurium. His father is shift boss at the Ahmeek Mine.

Pfc. John Filipovich, son of Mr. and Mrs. Thomas Filipovich of Calumet recently was awarded the good conduct ribbon at his division headquarters in Germany. He has spent three years overseas and has been in five major engagements. His father is a miner at Ahmeek.

S/Sgt. Wilfred Levasseur has arrived home after spending four years overseas. His wife and son arrived here several months ago to make their home with his father John B. Levasseur of the Lake Linden Reclamation Plant.

Sgt. Carl J. Maurin, son of Peter Maurin of the Kearsarge Mine staff, has been returned from the 12th Air Force in Italy to the U. S. after twenty-eight months overseas. He expects to be redeployed to the Pacific area.

Sgt. Arthur Sincock, son of Albert Sincock of the Motive Power Department, visited his parents at Tamarack recently. He served through the African and Italian campaigns and is now at Santa Ana, California.

Lt. Reuben Peterson whose father Oscar is employed at the Ahmeek Mine and brother John is at the Blacksmith Shop, returned recently from England where he was co-pilot of a B-24 bomber. He is stationed temporarily at Bradley Field, Connecticut.

Pfc. Earl Bryant, whose father Irving is employed at the Ahmeek Machine Shop, recently returned from overseas duty with the 86th division and spent a furlough with his relatives here.

Emil Plante, Jr., whose father is employed at the Tamarack Reclamation Plant, spent a thirty day leave with his parents after spending the past two years in the eastern war theater. He is a Seaman 2/c.

Allen R. Josey, Chief Electrician's Mate, has returned from the Pacific theatre and visited his parents Mr. and Mrs. John A. Josey of Ahmeek. His father is an engineer at the Ahmeek compressor plant. Allen served on the Hornet and the Lexington and for the past year aboard a minesweeper. He saw action in several of the Pacific Island campaigns.

Melvin D. Blom, S1/c, son of Andrew Blom of the Calumet Supply Department, is at the Atlantic fleet's amphibious training base, Little Creek, Virginia. He expects to go overseas within a few weeks.

Sgt. Harrison R. Nicholas, whose father Robert is employed at the Ahmeek Mine, is now located at Casablanca in French Morocco. His unit is engaged in flying American troops from Naples to Casablanca on the first lap of their journey home. He saw considerable service in the bombing of Italian and Austrian cities.

John Tucker, MM2/c recently spent a leave with his parents Mr. and Mrs. Frank Tucker of Calumet. His father is employed on the police force.

Ernest Pasanen, GM3/c recently spent his thirty day leave with his parents Mr. and Mrs. Victor Pasanen of Ahmeek and has returned to Detroit for reassignment. He was a member of the crew of the destroyer Morrison which was sunk at Okinawa. His father is employed at the Ahmeek Mine.

Pfc. Howard Holm, whose father Edward is employed at the Ahmeek Mill spent a furlough with his parents recently. He was liberated by the Russians from a German prison camp last April and has left for Florida for reassignment.

Pfc. Harold Guy, who was employed in the company's electrical department until January, 1944, when he entered the Army, spent a leave with his wife and family here recently. He was wounded during the battle of Germany and is undergoing treatment at the Nicholas General Hospital at Louisville, Kentucky.

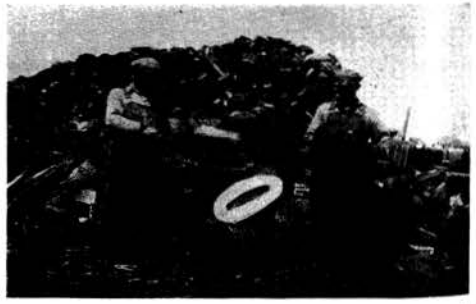
Lloyd P. Jones, Joseph Parisot, and crawler crane handling scrap.

John Verbanac, with scrap motor parts to be burned and leached

R. Gipp and O. Symonds hauling insulated wire scrap to the shelter.

Stock of scrap navy cable at coal dock.

Guy Desselliер, with aluminum and steel armor recovered from navy cable.



Joseph Parisot and Lloyd Jones, sorting clad-scrap for Lake Linden Leaching Plant.

Believe It or Not

On June 17th, John Silva of Allouez No. 3, killed one of his rabbits. When it was dressed and cleaned it weighed 16 pounds.

The largest bear ever seen in Keweenaw County was the one that Albert Stimac of Iroquois Shaft saw in June. The bear was 4½ feet from the ground to its back.

When "Billy" Medlyn of Tamarack Reclamation was a young man, he was champion long distance and under water swimmer and floater of Cornwall.

Joe Mishica has started training the boys of the Calumet Construction Department and expects to have a champion football team. Games may be had by calling the manager of the team, "Billy" Cox.

On July 4th, 30 years ago, it was so cold that "Pat" Sheehan of Iroquois shaft, had to wear his winter overcoat and mitts.

Summer comes early at Ahmeek Mine location. On June 17th, Ocha Potter picked the first strawberry in his strawberry patch.

When "Vic" Giacoletto was a young man he was a bath-tub maker.

The best insurance you can get doesn't cost you a cent. It's the habit of working safely.

George Mehrens of the Calumet Machine Shop is coaching his 7 year old grand-nephew to be a baseball player.

On July 10th, "Dick" Kauppila and Joe Cosso of the Smelter Surface were seen with the ear-laps of their caps pulled down over their ears. They are still waiting for that extra month of summer in the Torch Lake district.

Eugene Lepine of the Ahmeek Mill Boiler Plant claims he has discovered the fountain of youth.

Julius "Atlas" Berg of Ahmeek Mine was seen buying fish at a local market after returning from a week-end fishing trip.

"Jake" Grahek of Ahmeek Mine is an expert weather forecaster.

"Les" Chapman, C. & H. watchman, has gone to Grayling with the State Troops. He says it will be educating.

When Felix Hjort of Ahmeek Mine visits in Keweenaw County he wears his white trousers.

On June 27th, Andrew Benrick, Ahmeek Mine Captain, claims he caught 13 brook trout. This was the first time in 15 years that he had gone fishing.

John "Tamarack" Verbanac of Ahmeek Mine has started farming and will have vegetables for sale.

Albert "Chucka" Hiltunen of Ahmeek Mine has perfected a new method of trapping bears.

"Jack" Yates, Centennial watchman, has never been to a safety party.

The Centennial Engine House boys have quite a collection of pin-up girls which they are real proud of.

You won't get hurt if you're alert.

In 1894, "Billy" Johns of Ahmeek Mine started as office boy at Hecla Mine at $35.00 a month.

Chris. Mihelich of Ahmeek Mine, who was born in Keweenaw County and claims to know the woods, was recently lost on one of the familiar well-known trout streams.

On July 12th, Wendell Phillips of the Calumet Office was seen wearing his winter overcoat.

John L. Sullivan of the Calumet Motive Power claims that he has never been to a safety party and dinner. He has been employed by this company for 47 years and during that time he's had but one small compensable accident and that one occurred in 1925.

Rachel Allen, Stenographer, Secondary Department.

PAUL KING DECORATED, PROMOTED TO CAPTAIN

Paul S. King, son of J. Arthur King of the Central Office, recently was promoted to Captain in the 13th Air Force. He has experienced lengthy combat service with the Air Corps in the Pacific theater of war. He wears the Distinguished Flying Cross with two oak leaf clusters and the Air Medal with four oak leaf clusters for meritorious achievement while participating in sustained operational flights.

Another brother, First Sergeant Robert A. King, serves with the combat engineers in Europe.

Albert T. Hainault, Howard Steele, James Oxnam, Weldon Gagnon, Joseph Hainault, smelter laboratory crew.

AWARDED BRONZE STAR

Joseph Notario of the Calumet foundry force has been advised that his son, Corporal Ernest Notario of the 42nd Infantry received the Bronze Star medal for having remained behind his company and retrieved company records and equipment while under severe artillery and mortar fire from the enemy.

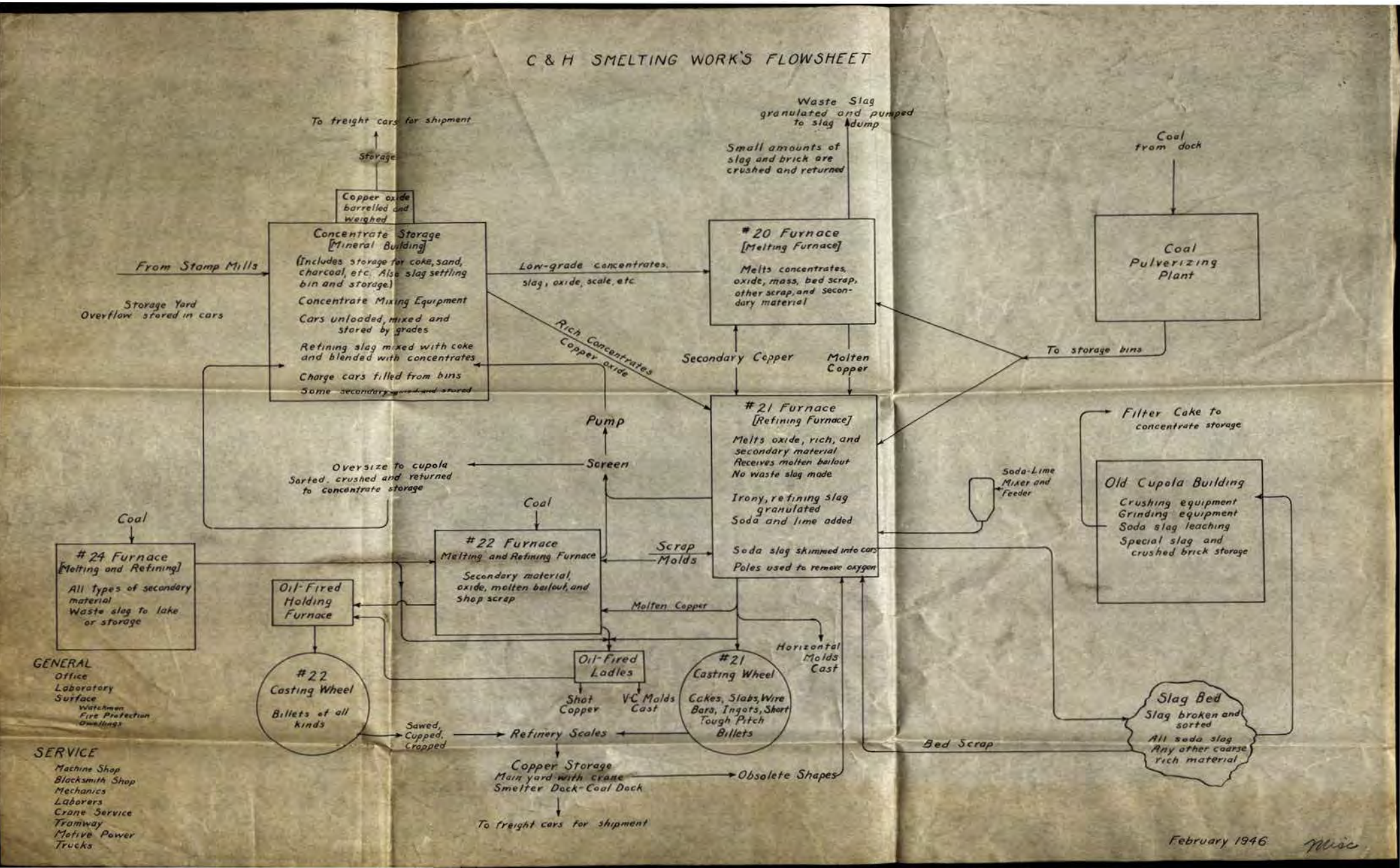
Raymond A. Gertz, Chemist in Laboratory.

Kenneth F. Farley, Accountant, Secondary Department.

W. F. Jones, in charge of purchases and accounting, Secondary Department.

Shearing gilding-metal-clad scrap.

Wm. DeRoche, Vinylite recovered from navy cable; will be made into soles for shoes.


C & H SMELTING WORK'S FLOWSHEET
To freight cars for shipment
Storage
Copper oxide barrelled and weighed
Concentrate Storage [Mineral Building]
(Includes storage for coke, sand, charcoal, etc. Also slag settling bin and storage.)
Concentrate Mixing Equipment
Cars unloaded, mixed and stored by grades
Refining slag mixed with coke and blended with concentrates
Charge cars filled from bins
Some secondary [illegible] and stored
From Stamp Mills
Storage Yard
Overflow stored in cars
Waste Slag granulated and pumped to slag dump
Small amounts of slag and brick are crushed and returned
Low-grade concentrates, slag, oxide, scale, etc.
#20 Furnace [Melting Furnace]
Melts concentrates, oxide, mass, bed scrap, other scrap, and secondary material
Coal from dock
Coal Pulverizing Plant
To storage bins
Rich Concentrates Copper oxide
Secondary Copper
Molten Copper
#21 Furnace [Refining Furnace]
Melts oxide, rich, and secondary material
Receives molten bailout
No waste slag made
Irony, refining slag granulated
Soda and lime added
Soda slag skimmed into cars
Poles used to remove oxygen
Pump
Screen
Oversize to cupola
Sorted, crushed and returned to concentrate storage
Soda-Lime Mixer and Feeder
Filter Cake to concentrate storage
Old Cupola Building
Crushing equipment
Grinding equipment
Soda slag leaching
Special slag and crushed brick storage
Coal
#24 Furnace [Melting and Refining]
All types of secondary material
Waste slag to lake or storage
Coal
#22 Furnace
Melting and Refining Furnace
Secondary material, oxide, molten bailout, and shop scrap
Scrap Molds
Oil-Fired Holding Furnace
Molten Copper
Horizontal Molds Cast
Oil-Fired Ladles
Shot Copper
VC Molds Cast
#22 Casting Wheel
Billets of all kinds
#21 Casting Wheel
Cakes, Slabs, Wire Bars, Ingots, Short Tough Pitch Billets
Sawed, Cupped, Cropped
Refinery Scales
Slag Bed
Slag broken and sorted
All soda slag
Any other coarse rich material
Bed Scrap
Copper Storage
Main yard with crane
Smelter Dock-Coal Dock
Obsolete Shapes
To freight cars for shipment
GENERAL
Office
Laboratory
Surface
Watchmen
Fire Protection
Dwellings
SERVICE
Machine Shop
Blacksmith Shop
Mechanics
Laborers
Crane Service
Tramway
Motive Power
Trucks
February 1946
Misc