TAMARACK AREA FACILITIES

TASK 3 - PHASE 2 REPORT
Historical Archive Research and Mapping
From Hubbell Beach through Tamarack City
C&H Historic Properties of Torch Lake

Prepared for:

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

Prepared by:

MICHIGAN TECHNOLOGICAL UNIVERSITY
Carol MacLennan, Principal Investigator
With John Baeten, Emma Schwaiger, Dan Schneider, Brendan Pelto
Industrial Archaeology and Heritage Program
Department of Social Sciences

October 2014

Contract No. Y4110

TABLE OF CONTENTS

[1] The Ahmeek Mill Facilities include: the mill, pump house, and boiler house.
[2] The Tamarack Reclamation Facilities include: the regrinding plant, electric sub-station, classifying plant, flotation plant, and leaching plant.

[3] Tamarack Reclamation and Ahmeek Mill facilities highlighted in yellow. 1918-1968
[4] Tamarack Reclamation and Ahmeek facilities highlighted in yellow. 1942-1949
[5] Organized chronologically

SECTION 1: INTRODUCTION

Introduction

Phase 2 - Tamarack Area Facilities

This document encompasses the materials collected by Michigan Technological University (MTU) Social Science staff in support of Phase 2, Task 3 of the Michigan Department of Environmental Quality project to study and sample "Abandoned Mining Wastes of the Torch Lake Non-Superfund Site, Contract No. Y14110." It includes only summaries and documents from the historical archive research. Geo-referenced Google and GIS maps will be provided at a later date by MTU/MITRI.

Task 3 is devoted to the historical and archival work on C&H Torch Lake industrial facilities. Phase 2 covers the area from Phase 2 area from Hubbell Beach southward through Tamarack City, ending approximately at the junction of M-26 and Junction Road. The December 2014 Statement of Work (SOW, Appendix A) specifies the following 8 tasks that were to be accomplished by the Social Sciences Department in order to support DEQ, Weston, and MTU in identification of on-water and on-land sampling sites for Phase 2:

1. Identify major contaminants and waste streams of concern from industrial buildings and likely locations: PCBs (completed through Sea Grant Michigan); chemicals in reclamation processes; sludge from reclamation; slag from smelting; coal-related products such as fly-ash; leaching reagents from stamp mills and reclamation (ammonia, xanthates); others identified in archives.
2. Investigate MTU and KNHP C&H archives on building function, production processes, chemical processes, and waste streams by building location.
3. Produce Building Narratives for 13 buildings (in order of location from north to south).[6] Building narratives will be prioritized according to potential to produce significant contaminated wastes to optimize information necessary for soil and sediment sampling in late spring-summer season. Narratives of

[6] Building names are drawn from official names utilized by C&H and Sanborn Co. maps. Data for some buildings are largely collected through study of C&H electrical system and PCB sources.

buildings deemed insignificant for contaminated waste production will be brief, but included in order to document their elimination.

   a. Narratives will detail opening/closing dates; production activities within individual facilities; major updates in processes; repurposing of buildings for different production activities; information on incoming chemical, metal, or other waste and possible exit sites from buildings. Narratives will draw upon archival sources, maps, blueprints, and interviews.
   b. Building Narratives for 13 buildings in Hubbell Beach to Tamarack City region, listed by location north to south: Ahmeek Stamp Mill; Ahmeek Pump House; Ahmeek Boiler House; Tamarack Regrinding Plant; Tamarack Electric Sub-Station; Tamarack Classifying Plant; Tamarack Flotation Plant; Tamarack Leaching Plant; Tamarack Stamp Mill; Lake Milling, Smelting & Refining Co. Stamp Mill No. 2; Osceola Stamp Mill; Mutual Water Light & Co. Pump House.

4. Collect and scan available Sanborn maps (through 1928) and C&H blueprint maps for 13 buildings listed above.
5. Conduct interviews with knowledgeable individuals about individual plant operations.[7]
6. Provide a spreadsheet of sources consulted, relevance for which waste material or chemical – e.g. C&H box and files title/# in MTU or KNHP archives.
7. Provide a bibliography of relevant sources that detail or describe significant processing methods, chemical usages, and waste collection strategies for C&H Mining Co. during period of Torch Lake operations (1880-1970).

We have modified the format of documents presented in Phase 1 Report to include more extensive narratives on the three major facilities and their associated buildings: Ahmeek Mill and Tamarack Reclamation, and Lake Chemical Company, which operated within the Tamarack Reclamation plant. In addition, we have provided more documentation from the historical research in the form of the original notes taken by researchers from the C&H archives, *The Engineering & Mining Journal* and *C&H News and Views*.

[7] Sea Grant Michigan and KNHP have funded interviews during Fall 2013 and Spring 2014 semesters. If any additional individuals are identified during the DEQ funded research, they will be interviewed.

This remainder of this document is organized into the following sections:

Section 2 is organized into two parts. Part 1 includes the narratives and timelines of the most significant buildings and functions: Tamarack Reclamation Plant, Lake Chemical Company, and Ahmeek Mill. These narratives incorporate descriptions that also pertain to the adjacent buildings that support reclamation, chemical production, and milling. Part 2 consists of the "Building Narrative" forms that are outlined in the Statement of Work for Phase 2.

Section 3 includes multiple and extensive forms of documentation from historical archive research. Six Sanborn Maps are provided that cover Ahmeek Mill and Tamarack Reclamation buildings for different years. A list of blueprints located in the MTU Archives details relevant documents stored on a set of CDs provided with this report. Detailed notes from the *Engineering & Mining Journal, C&H News and Views* are have highlighted sections on reclamation, scrapping, and milling in the Tamarack Reclamation and Ahmeek Mill facilities. Interview summaries related to these facilities are also included. Researcher notes from the MTU and KNHP Archives are available for further reference if necessary as DEQ continues its investigation of Torch Lake pollution. They are organized by Series Number, Folder Name, and Box number to make it easy to locate files for further investigation. Finally, the multiple documents scanned from the Archives are provided in chronological. They are noted in the archive researcher notes and also have location information on their scanned copies. Because of the richness of information contained in these documents, they were scanned rather than summarized.

Research during the summer of 2014 was conducted by graduate students John Baeten (Tamarack Reclamation, Lake Chemical), Emma Schwaiger (Ahmeek Mill, Tamarack Reclamation, *C&H News and Views*), Dan Schneider (Interviews), and

Brendan Pelto (Tamarack Reclamation, *Daily Mining Gazette*, and *Native Copper Times*). Carol MacLennan, Principal Investigator and Professor, supervised and directed the research effort. All are members of the Industrial Archaeology and Heritage Program in the MTU Social Sciences Department.

SECTION 2: NARRATIVES AND TIMELINES

Emma Schwaiger

Ahmeek Stamp Mill Narrative

The Ahmeek Mining Company was one of many small copper mining companies operating in the Keweenaw Peninsula between 1870 and 1920. They built the Ahmeek Stamp Mill on the western shore of Torch Lake in 1909 and added four additional stamp mill units in 1914.[1] The mill processed the ore that came from the Ahmeek Mining Company's mines as well as a few other small mining companies that did not have their own mill. A mixed pressure turbine (2000 KW) was installed at the Ahmeek Stamp Mill in 1916 to use the low-pressure steam exhaust instead of letting it go to waste.[2]
In 1917 a fire protection system was installed in the mill to protect the building and equipment from fire.[3]

In 1923 the Ahmeek, Allouez, Calumet & Hecla, Centennial, and Osceola mines consolidated to form the Calumet & Hecla Consolidated Mining Company, which meant that C&H now owned the Ahmeek Stamp Mill.[4] On March 14, 1925, there was a letter sent from the President of C&H, MacNaughton, to E. A. Baalack, who was a C&H employee, that the booster pump currently run on steam should be switched to electricity.[5]

---

[1] *Calumet & Hecla Collection, Engineering Miscellaneous (4.4.48 (4.3.40)),* Box 139, Folder 025: "Flow Process Charts, Handwritten Notes, Critique of Ahmeek Mill-Study", Michigan Tech and Copper Country Historical Collections.
[2] "Modernization of Lake Linden Power Plant Is Approved By Directors – Two years required to complete job", in Calumet & Hecla News & Views, March 1947 (pp. 3).
[3] *Calumet & Hecla Collection, "T" Continued (4.4.40.4),* Box 038, Folder 009: "Tamarack-Osceola-Ahmeek Fire Protection", Michigan Tech and Copper Country Historical Collections.
[4] Calumet & Hecla Annual Report: 1923, Michigan Tech and Copper Country Historical Collections.
[5] *Calumet & Hecla Collection, Pumps (5.11.2.1),* Box 035, Folder 019: "Ahmeek Mill & Blueprints", Michigan Tech and Copper Country Historical Collections.

1930 was a big year for the Ahmeek Stamp Mill and the accompanying power facilities. The old power and boiler houses were torn down and replaced with new ones.[6] This work was contracted out to the Stone & Webster Engineering Company.[7] Along with these new buildings went new technology, such as an Ash Disposal System.[8] The new Ahmeek Power and Boiler houses went into commission in January 1931 and ran smoothly for the next few years.[9] The Ahmeek facilities again had an update in 1937 when the fire protection system was updated to provide ample protection for the buildings and equipment.[10] In 1938 the Ahmeek Stamp Mill housed eight stamps that could process 900 tons of material per day.[11]

This area was becoming a center for not only stamping but also for power during this time. In 1941 the Ahmeek boiler plant began providing the steam needed at the Tamarack Reclamation Plant because C&H decommissioned the Tamarack boiler plant.[12] For the next six years not much change happened at the Ahmeek Mill. Then, in 1947, two new ball mills were installed along with flotation units so the Ahmeek Mill could start participating in the secondary copper processing.[13] In January 1946 the Ahmeek Mill

---

[6] *Calumet & Hecla Collection,* McNaughton: Alphabetical, A-Z (4.4.29 (4.3.22)), Box 073, Folder 51b or 52, 1 of 2: "Stone & Webster-Ahmeek Mill Power Plant", Michigan Tech and Copper Country Historical Collections.
[7] *Calumet & Hecla Collection, Ahmeek Mill (8.1.1.6),* Box 151, Folders 5-18: "Power Plant-Memorandum of Contract", Michigan Tech and Copper Country Historical Collections.
[8] *Calumet & Hecla Collection,* McNaughton: Alphabetical, A-Z (4.4.29 (4.3.22)), Box 073, Folder 51b or 52, 1 of 2: "Stone & Webster-Ahmeek Mill Power Plant", Michigan Tech and Copper Country Historical Collections.
[9] Calumet & Hecla Annual Report: 1931, Michigan Tech and Copper Country Historical Collections.
[10] *Calumet & Hecla Collection, "T" Continued (4.4.40.4),* Box 038, Folder 009: "Tamarack-Osceola-Ahmeek Fire Protection", Michigan Tech and Copper Country Historical Collections.
[11] Benedict, C. Harry, ". Steam Stamps hold their ground at Ahmeek Mill", in *The Engineering and Mining Journal,* Vol. 139, No. 12 (pp. 53-56).
[12] Calumet & Hecla Annual Report: 1941, Michigan Tech and Copper Country Historical Collections.
[13] Calumet & Hecla Annual Report: 1947, Michigan Tech and Copper Country Historical Collections.

power plant turbines were repaired and machinery in the boiler house was modernized.[14] In 1947 it is stated that the power for C&H was centered at both the Lake Linden and the Ahmeek Mill powerhouses.[15]

On November 12, 1954, a report was released called 'Report on Lightning Protection for the Electrical Transmission System of Calumet & Hecla, Inc.' which address the fact that many electrical outages have taken place due to lightning strikes, but it also addresses any changes that should be taken place at each sub-station or power plant location. Since the Ahmeek Power Plant was still fairly new at this time, all of the lightning arresters were new and in place and the report said that no changes were needed at the Ahmeek location.[16]

Then, on November 5, 1958, another report entitled 'Report on The Leaching of Ahmeek Mill Concentrates' by L.C. Klein attempted to give answers to questions about leaching Ahmeek Mill concentrates for production of copper powder and it covers "capacities of present leaching and distillation facilities; changes in leaching and distillation equipment necessary to adapt this equipment to the leaching of concentrates and distillation of the rich solutions produced; material handling; changes in leaching techniques; leaching solution control; types of concentrates that can be leached; and the control of impurities in the oxide produced. A rough estimate is also given for capital expenditures necessary and the cost of oxide production."[17] It also mentions what Torch

---

[14] "Turbines are Repaired" in Calumet & Hecla News & Views, January 1946 (pp. 7).

[15] "Modernization of Lake Linden Power Plant Is Approved By Directors – Two years required to complete job", in Calumet & Hecla News & Views, March 1947 (pp. 3).

[16] *Calumet & Hecla Collection,* "T" Continued (4.4.40.4), Box 038, Folder 022: "Report on Lighting Protection for Electrical Transmission System", Michigan Tech and Copper Country Historical Collections.

[17] *Calumet & Hecla Collection, Ahmeek Mill (8.1.1.6),* Box 085, Folder 015: "Leaching of Concentrates", Michigan Tech and Copper Country Historical Collections.

Lake water had in it during this period because tests of the water were done to see how it would react with the chemicals in the leaching process.[18]

In 1957 we see a note that says the Ahmeek Mill Flotation process was using Dow-Froth and not pine oil like the other flotation plants.[19] This is the only mention of this so far found, and may show a difference between the processes at the Lake Linden and Tamarack facilities compared to the Ahmeek.

Between 1959 and 1968 the Ahmeek Mill was also recovering copper from slag, tailings, and brick, apart from processing ore from mines.[20] This allowed the mill to stay alive when it would otherwise have been forced to shut down for a period of time. Between 1965 and 1966 there were pushes to increase the overall efficiency at the Ahmeek Mill and they even broke up the sections of the upgrade to Phases I, II, & III, but this project never went any further.[21] C&H was slowly loosing their Calumet Division as copper prices and demand for copper fell. April 14, 1967 saw an R&D Study on Sampling & Effluent Handling at the Ahmeek Mill by L. C. Klein come out which mentions where the waste streams came from and what different types of wastes could be.[22] This was meant to be a project that would take multiple outputs and narrow them down to just one, but with the

---

[18] "Leaching of Concentrates"

[19] *Calumet & Hecla Collection, Bureau of Mines (5.7.1),* Box 166, Folder 019: "Ahmeek (Form 6-1178-A)", Michigan Tech and Copper Country Historical Collections.

[20] *Calumet & Hecla Collection, Ahmeek Mill (8.1.1.6),* Box 151, Folder 019: "Mill Return & Mill Yields", Michigan Tech and Copper Country Historical Collections.

[21] *Calumet & Hecla Collection, Ahmeek Mill (8.1.1.6),* Box 151, Folder 025: "Conversion of Mill Circuits for Increased Capacity and Proc. of Con. Ore", Michigan Tech and Copper Country Historical Collections.

[22] *Calumet & Hecla Collection, Ahmeek Mil (8.1.1.6),* Box 078, Folder 010: "Operation", Michigan Tech and Copper Country Historical Collections.

selling of the Calumet Division to Universal Oil Products in 1969, this project, along with the Ahmeek Stamp Mill and power facilities, were shut down for good.[23]

[23] Calumet & Hecla Annual Report: 1969, Michigan Tech and Copper Country Historical Collections.

Ahmeek Stamp Mill Timeline – Emma Schwaiger

From the Michigan Tech Archives & Copper Country Historical Collections

1908 or 1909: Ahmeek Concentrator was built by the Ahmeek Mining Company. 4.4.48 (4.3.40) Engineering Miscellaneous. Box 139 – Folder 25. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 9.

1912-1920: Appraisals of buildings and equipment. 5.10.2.1 Insurance Appraisals of C&H's physical holdings–Reports to general manager. Box 207 – Folder 6.

1917: Correspondence about sprinklers and the fire protection system at the Ahmeek Mill. 4.4.40.4 "T" Continued. Box 38 – Folder 9.

Oct. 26, 1921: Document copied: C&H Mining Co – Lake Superior Water Mains. 4.4.40.4 "T" Continued. Box 38 – Folder 13.

March 14, 1925: Document copied: Letter from MacNaughton to E.A. Baalack – Booster pump currently run on steam should be switched to electricity. 5.11.2.1 Pumps. Box 35 – Folder 19.

1925: Worthington Pump & Machinery Corporation – Proposal: New Centrifugal Pump for the Ahmeek Mill. 5.11.2.1 Pumps. Box 35 – Folder 19.

1925-1931: Correspondence about the pumps for the Ahmeek Mill, C&H & Worthington Pump & Machinery Corporation about increasing capacity. 5.11.2.1 Pumps. Box 35 – Folder 19.

1926: Water in Torch Lake is low and they are having a hard time reaching the water from the Ahmeek pumps. 5.11.2.1 Pumps. Box 35 – Folder 19.

1928: C&H Electric Power Line to Tailings Plant at Ahmeek Mill + Map, Mineral Range Railroad permission to cross property with drawings of the proposed trestle along with the C&H electric line crossing. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 3.

1930: Drawing showing the Tamarack Regrinding, Osceola, & Lake Mill #2, along with the pole line crossing for the C&H power line, map of the Ahmeek Stamp Mill showing the Boiler House & nearby companies. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 4.

1930: Contracts for steam generating equipment between C&H and the Stone & Webster Engineering Co. 8.1.1.6 Ahmeek Mill. Box 151 – Folders 11-14.

1930: Contracts and Specifications for the Ahmeek Mill Boiler & Power Plant – Stone & Webster. 8.1.1.6 Ahmeek Mill. Box 151 – Folders 15-18.

- *Boiler House, Turbine Room, & Electrical Bay comprise the Ahmeek Mill Power Plant.*

1930-1931: Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant. 8.1.1.6 Ahmeek Mill. Box 151 – Folders 5-10.

1937: Correspondence about changes in the fire protection system at the Ahmeek Mill. 4.4.40.4 "T" Continued. Box 38 – Folder 9.

1946-1956: Ahmeek Mill Production Statistics by year. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 10.

July 26, 1950: Ahmeek Mill – Proposed Replacement of Steam Stamps & Rolls, Report by: J.J. Vitton. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 11.

Dec. 15, 1951: Ahmeek Mill – Stage Crushing of Native Copper Ore with Nordberg Crushers, Report by: J.J. Vitton. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 11.

1952: Ahmeek Mill – Proposed Addition, Preliminary Estimate. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 11.

- *Proposed "in order to have one head as a standby unit to facilitate regular maintenance, extra ordinary repairs and take an occasional overflow of rock from the mines."*
- *Drawing 11238 – Ahmeek Mill, Flow Sheet.*
- *Ahmeek Mill – Proposed Head #9 (Steam Stamp) Addition to Building. Also shows the Old Boiler House.*

Jan. 30, 1952: Ahmeek Mill – Open & Closed Circuit Crushing of Native Copper Ore with 48" Nordberg Gyradisc Crusher, Report by: J.J. Vitton. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 11.

1953-1957: Correspondence about how or when to upgrade the Ahmeek Mill (Crushing & Concentrator Plant addition in Lake Linden). Talk amongst C&H employees & Anaconda. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 12.

1953-1968: Flow Process Charts – lists about where the rock starts and ends. 4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968. Box 138 – Folder 15.

1953-1968: Procedure for Mill Sampling and Accounting for Mine Yield. 4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968. Box 138 – Folder 15.

Dec. 8, 1956: Ahmeek Mill – Modernization or Replacement. By: C.H. Benedict. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 12.

- *Benedict says the Ahmeek Mill is fine and with some equipment changes the mill could last for many years.*

Aug. 1, 1957: Calumet & Hecla, Inc. Mill Modernization Project. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 12.

- *Report from a Task Force to study a mill modernization program.*
- *Includes some Ahmeek Mill Flowsheets.*
- *Map & Drawing of the proposed crushing & concentrator plants in Lake Linden.*
- *Page 22: "In order to furnish 60 cycle power for a new mill in the Lake Linden area it would be necessary to increase the 60 cycle generation at the Lake Linden Power Plant. Although the frequency changers presently are not fully loaded, by the time that a new*

mill could be completed, the projected load, as we see it today, would be above the capacity of the frequency changers.

To add just enough 60 cycle generating capacity at Lake Linden to take care of the new mill requirements would cost roughly $1,000,000. However, if the 60 cycle generation were to be expanded, I believe it would be wiser to put in a unit large enough to replace the present frequency changers and to supply the new mill load. The cost of power plant expansion for a unit of this size would be about $3,200,000. The cost to provide a transmission line from the Lake Linden plant to the mill site, erect a substation, and install main feeders up to each of the buildings would be an additional $250,000. These figures do not include any power or lighting installations within the mill buildings since it is understood that the Anaconda estimate has already allowed for these."

- *Drawing 11852 – New Mill & Crushing Plant, 6000 T/Day Crushing Plant, 12 Hour Operation, Flow Sheet, 1955.*

1957: Ahmeek Mill using Dow-Froth for flotation, not pine oil. 5.7.1 Bureau of Mines Box 166 – Folder 19.

1957: Insurance Appraisals for the Ahmeek Mill in Hubbell, MI. Buildings 1-5, Junction & Conveyor Houses, Fire Station, Oil House, & Pump House, Structural details and values, & Equipment details and values. 5.10.2.2 Insurance Appraisals of C&H, Incorporated's physical holdings. Box 207 – Folder 1.

Nov. 5, 1958: Document copied: Report on The Leaching of Ahmeek Mill Concentrates. By: L.C. Klein. 8.1.1.6 Ahmeek Mill. Box 85 – Folder 15.

- *Report will attempt to give answers to questions about leaching Ahmeek Mill concentrates for production of copper powder.*
- *Covers "capacities of present leaching and distillation facilities; changes in leaching and distillation equipment necessary to adapt this equipment to the leaching of concentrates and distillation of the rich solutions produced; material handling; changes in leaching techniques; leaching solution control; types of concentrates that can be leached; and the control of impurities in the oxide produced. A rough estimate is also given for capital expenditures necessary and the cost of oxide production."*
- *Mentions what Torch Lake water had in it during this period because tests of the water were done to see how it would react with the chemicals in the leaching process.*

1959-1968: Mill Returns – By month for the different mines, & amount reclaimed from slag, tailings, & brick. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 19.

1960: Drawings of the Ahmeek Mill (showing Boiler House & Turbines), drawing of the Ahmeek Mill Tailings & Ash Discharge Line. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 2.

1961: Proposal Letter by Fuel Economy Engineering Co. for a Pulverized Coal and Spreader Stoker. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 20.

1963: Document copied: Ahmeek Concentration. 4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968. Box 139 – Folder 25.

1963-1967: Document copied: Ahmeek Power Plant – Ash Handling. 4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968. Box 139 – Folder 25.

1965: Appropriation Requisition for Intake Well Repairs & Drawing 12618 – Ahmeek Mill Pump House, Intake Well Floor & Screen Guides, Details. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 22.

1965-1966: Conversion of Mill Circuits for Increased Capacity and Processing of Conglomerate Ore. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 25.

- *Mechanical & Structural Engineering Dept. – Revision to Additional and Improved Milling Facilities, Phase II.*
- *Document copied: Ahmeek Mill Project M. C. Order Numbers. Phase I, II, & III.*
- *Mechanical & Structural Engineering Dept. – Additional Facilities to Reduce Tailings Losses in Conglomerate Ore, Phase III.*
- *Mechanical & Structural Engineering Dept. – Additional and Improved Milling Facilities, Phases I & II.*
- *Mechanical & Structural Engineering Dept. – Proposed Ball Mill 6a and Accessories Circuit.*
- *Mechanical & Structural Engineering Dept. – Additional & Improved Milling Facilities, Phase I & II.*
- *Document copied: C&H Meeting Minutes – Revision of Ahmeek Mill to Provide Greater Capacity.*
- *Document copied: C&H 17248 – Ahmeek Mill – Treating Conglomerate Mine Ore, Additional Equipment Required, Flow Sheet.*
- *Correspondence about feed rate on stamps between C&H & Milltronics w/ Proposal.*

October 20, 1966: Document copied: Ahmeek Mill, Mineral Processing – Flowsheet. By: J.J. Vitton. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 9.

1966: Samples taken from the Ahmeek Mill for study – Copper Content in lbs/ton. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

1966: Document copied: Ash Pump at Ahmeek Mill. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

- *Letter between L.F. Engle & L.C. Klein talking about where the waste streams currently come from and about possibly narrowing it down so there is only one waste stream coming from the mill.*

1966: Estimates for refitting the Ahmeek Mill. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

1966: Tailings Bank Analyses. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

- *Mentions sampling being done on the sand bank on both the tailings side and the ash line side, to look at the total copper content.*

1966: A Limited Examination of the Ahmeek Mill, by: A.D. Kennedy & R.A. Campbell. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

- *Brief report on the Ahmeek Mill and opinions for better operation.*

1966: Cost Reduction Program. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

- *Sheet listing costs and a few ways of which they can reduce them.*

1966: Drawing 11898 – Gravity Flow Sheet – Ahmeek Mill 1956, rev. 1966. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 9.

1966: Mechanical & Structural Engineering Department Estimate – New Turbine for No. 7 Generating Unit, Replace Existing Terry Turbine. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 23.

1966: Metal Processing-Purchase & Appropriation Requisitions, Quotations. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 24.

- *Purchase Requisition – To Replace Badly Worn Rough Classifiers #3 & #4 Unit at Ahmeek Mill, sent to Continental Sales & Equipment Co – Hibbing, MN*
- *Quotation – Krebs Cyclone, Krebs Engineers*
- *Appropriation Requisition – Krebs Cyclone Classifier*
- *Purchase Requisition – Ahmeek Mill-Washing #5 & #6 Units*
- *Receiving Report – Slurry Pump for Hydraulic Table Rejects – Denver Pump*
- *Receiving Report – Akins Simplex Classifier*
- *Purchase Requisition – Slurry Pump for Hydraulic Table Rejects – Denver Pump*
- *Appropriation Requisition – Slurry Pump for Hydraulic Table Rejects – Denver Pump*

1966-1967: Process & Practice Analysis Spillage Flowsheet Report – Bull Jigs & Pit Launder through Concentration Tank, to Flotation Area, & Ash Pump. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

Feb. 24, 1967: Metal Processing Automating the Fuel to Steam Stamps 1, 2, 4, 5 – Proposals. Proposal for Automating the Feed to Steam Stamps 1, 2, 4, & 5. Submitted by: B.C. Peterson, Vice-President, C&H, General Manager, Calumet Division. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 26.

April 14, 1967: Document copied: R&D Study on Sampling & Effluent Handling at the Ahmeek Mill, L. C. Klein's Memo. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 27.

April 14, 1967: Document copied: R&D Study on Sampling & Effluent Handling at the Ahmeek Mill, L. C. Klein's full document. 8.1.1.6 Ahmeek Mill. Box 78 – Folder 10.

- *Mentions where the waste streams came from and what different types of wastes could be.*

October 1967: Operating Manual – Ahmeek Power Plant & Lake Linden Power Plant, Master Copy, Assigned to: T. W. Knight – Step my Step Guide to Operation. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 29.

1967: Appropriation Request – Maintenance & Alterations to Sampling & Effluent Handling System. 8.1.1.6 Ahmeek Mill. Box 151 – Folder 27.

- *"Work would provide for elimination of wastes from the mill at only two points instead of three. Materials leaving would be flotation tailings and unprocessed wastes. Unprocessed wastes would be deposited away from the general tailings pile where settled portion will* *be accessible to the dredge. This also would contribute to a more reliable sampling system and aid mill operations."*

1968: Document copied: Figure 1: Ahmeek Mill Flowsheet – Crushing & Gravity Concentration. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 9.

1968: Document copied: Figure 2: Ahmeek Mill Flowsheet – Fines Concentration – Flotation. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 9.

1968: Correspondence about sending the Ahmeek Mill Flowsheets & Flowsheet Description to the US Dept of Interior to help them further understand the processes. 8.1.1.6 Ahmeek Mill. Box 78 **–** Folder 9.

John Baeten

Tamarack Reclamation Plant Narrative

Starting in the 1870s Calumet & Hecla, along with mines such as the Ahmeek, Osceola, and Tamarack, sent the ore from its mines in Calumet to be processed at the stamp mills located at Torch Lake. The early technologies employed at these stamp mills consisted primarily of stamp batteries, which crushed the ore into particles, separating the copper metal from the mineral gangue. The copper would then be sent to a smelter for further refining, and the waste material, or tailings, were dumped into Torch Lake. Since the early milling technologies used by Calumet & Hecla failed to include such devices as regrinding machines, flotation units, and classifiers such as Wilfley and Dyster tables, a large percentage of marketable copper was laundered away from the mills in the form of tailings. Calumet & Hecla was fully aware that their milling process was inefficient and that thousands of tons of copper remained within the stamp sands at the bottom of Torch Lake. As the cost of extracting copper ore increased during World War I, Calumet & Hecla began devising plans to reclaim the stamp sands that were beginning to fill Torch Lake.

By 1914, Calumet & Hecla purchased property in Lake Linden and by 1918 they finished constructing a reclamation plant near the location of their two stamp mills there.[1] The reclamation plant at Lake Linden was designed to treat both amygdaloid and conglomerate tailings by means of ammonia leaching. The reclamation process at Lake Linden utilized a suction dredge to recover the tailings, which were then sent to a regrinding unit, consisting of ball mills. The reground

[1] Benedict, C.H. "Six-cent Copper from Calumet & Hecla Tailings", in *The Engineering and Mining Journal*, Vol. 117, No. 7, February 16, 1924 (pp. 277-284).

tailings were then leached in a bath of ammonia. By late 1918, an oil flotation unit was installed to further increase the recovery of copper from the stamp sands.

Around this same time period, Calumet & Hecla began purchasing many of the mining interests in the area, including the Tamarack and Osceola, and by 1923 merged with the Allouez, Centennial and Ahmeek mines to form Calumet & Hecla Consolidated Copper Company. In addition to now controlling most of the underground mines north of Hancock, Calumet & Hecla also owned the milling facilities and their adjacent stamp sands at Torch Lake, leading to the design of a second reclamation plant to treat the conglomerate sands from the Tamarack mill near Hubbell, Michigan. Construction of the Tamarack reclamation plant began in 1920, and the facility was completed in August of 1925.[2]

The Tamarack Reclamation Plant was designed as a smaller version of the Lake Linden plant, with a capacity of 850,000 tons of sands per year, recovered by a suction dredge of local construction.[3] Owing to its more contemporary construction, the Tamarack Reclamation Plant was fitted with an array of more modern equipment, consisting of devices such as separators, tables, conveyors, regrinding mills, settling tanks, and flotation and precipitation units.[4] By 1926, the Tamarack plant was running smoothly, with coarse sands being sent first to regrinding units and table treatment, and the finer tailings being sent directly to the

[2] "News by Mining District", in *The Engineering and Mining Journal*, 1920-1925, Vols. 110-119. From 1920 to 1925 progress on the construction work at the reclamation plant in Hubbell is frequently mentioned.
[3] The Mining News", in *The Engineering and Mining Journal*, 1922 and 1923, Vols. 114, 115.
[4] "News by Mining District: Calumet & Hecla Sees More Economical Production Ahead", in *The Engineering and Mining Journal*, 1924, Vol. 117 (pp. 68).

leaching and flotation units. In addition to reclaiming the stamp sands in Torch Lake, Calumet & Hecla also became interested in attempting to recover some of the copper contained in their smelting works' waste slag at Hubbell, which was also being dumped into Torch Lake, and by 1929 the Tamarack Reclamation Plant was regrinding and treating this slag by flotation.[5]

The Tamarack Reclamation Plant was efficiently operating three distinct treatment processes consisting of regrinding, leaching and flotation by 1931. The same year saw the facility achieve acclaim from the mining world for its centralized approach to reclamation, housing all three plants under one roof. The leaching plant within the Tamarack Reclamation Plant contained the largest structural features, consisting of six large (54 ft. in diameter) leaching tanks, while the flotation plant contained four large (40 ft. diameter) thickening tanks and associated mineral separating machines.[6] Although the Tamarack Reclamation Plant was recovering copper profitably, the Great Depression of the 1930s forced Calumet & Hecla to run only the larger Lake Linden plant for an extended period of time, idling the Tamarack plant for roughly 7 years. Calumet & Hecla continued dredging the Tamarack conglomerate sands from Torch Lake into 1944, but by the end of that year Calumet & Hecla shifted its focus to treating scrap materials as part of the effort to produce munitions for World War II.

The scrapping program and newly formed Secondary Department dominated activity at the reclamation plants into the mid-1950s, producing billets for

[5] "News by Mining District: C&H Reclamation Work May Have Eleven Years Left", in *The Engineering and Mining Journal*, 1929, Vol. 127 (pp. 930).
[6] Haskell, Robert M., "Flotation Practice: Calumet & Hecla", in *The Mining Congress Journal*, October 1931, (pp. 528-530).

Wolverine Tube and a variety of copper oxide compounds for agricultural uses. By 1956, Calumet & Hecla began dredging the plentiful Ahmeek stamp sand deposit within Torch Lake and sending the tailings to their Tamarack Reclamation Plant.[7] Calumet & Hecla worked the Ahmeek deposit into the late 1960s, with Calumet & Hecla employing upwards of 50 men within the Tamarack reclamation plant, the last functioning reclamation plant in the region[8]. In 1968, the Tamarack Reclamation Plant permanently closed, joining the idle Quincy and Lake Linden Reclamation Plants.

[7] "Annual Reports: Calumet & Hecla", in *The Engineering and Mining Journal*, 1956, Vol. 157, No. 8 (pp. 200).
[8] "Mining News", in *The Engineering and Mining Journal*, 1968, Vol. 169, No. 1 (pp. 129).

John Baeten

Tamarack Reclamation Plant Timeline:

Oct. 16, 1920: First mention of the Tamarack Reclamation Plant in E&MJ. Reports that, *"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."*

Nov. 26, 1921: Roughly a year later, Tamarack is once again promoted:
"*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."*

July 29, 1922: In 1922, C&H begins to describe the actual process that they plan to use at the Tamarack plant, including regrinding (likely by ball mills), washing (a step that I am not familiar with), leaching and flotation.

"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."

April 14, 1923: Further progress on the construction of the buildings is noted, as well as assumed monthly quantities of treatable material:
"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."

May 12, 1923: In addition to the completed structures, the machinery for the reclamation plant is now also on site. Plans to construct the dredge are under way.
"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."

January 12, 1924: Work is still ongoing at the reclamation plant in early 1924. The assumed cost of reclamation has increased from the 1922 estimate. Additionally, this posting makes note of specific pieces of equipment being installed:
"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."

May 3, 1924: A bit of a redundant post, although it does contain the first mention of the estimated longevity of the Tamarack sands, at 15 years:
"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."

June 7, 1924: Construction of the plant is still not completed, and due to low copper prices, C&H plans to hold off on operating the plant until the price increases. However, this post does make note of the construction of a trestle from the sands to the plant, as a means of transporting the deposit to the facility, a feature that does not transfer to other reclamation plants in the region.
"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."

October 4, 1924: Another slightly redundant post, but it does make mention of the construction of "a channel", which I assume to be a launder of some sort. This post also estimates an increase of 50,000 lb. of refined copper production from the May 1924 estimate:
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."

February 7, 1925: Another fairly redundant post, but note that the estimated quantities of production and cost of reclamation keep changing. This new estimated production total is 200,000 lbs. per month lower than the October 1924 post. Also the cost of reclaiming the sands has increased almost double from what the 1922 estimate.
"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."

May 2, 1925: The plant is still not yet operating, but a new estimate of the extent of the Tamarack deposit takes a nosedive from a lifespan of 14 years to 12 years.
"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."

August 29, 1925: The reclamation plant is now in operation with positive results:
"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."

April 3, 1926: This note contains a brief note on the operating practice of the plant as well as mention of the dredge employing suction recovery, rather than bucket line.
"*It is estimated that the Calumet deposit is good for tweleve to fourteen years more, and the Tamarack deposit should last equally as long. Regrinding of the coarser sand, table treatment, ammonia leaching, and oil flotation are employed in the recovery of the copper, brining the total recovery of the metal content of the conglomerate lode as mined up to over 98 per cent. The sand is removed from the lake by means of a suction dredge."*

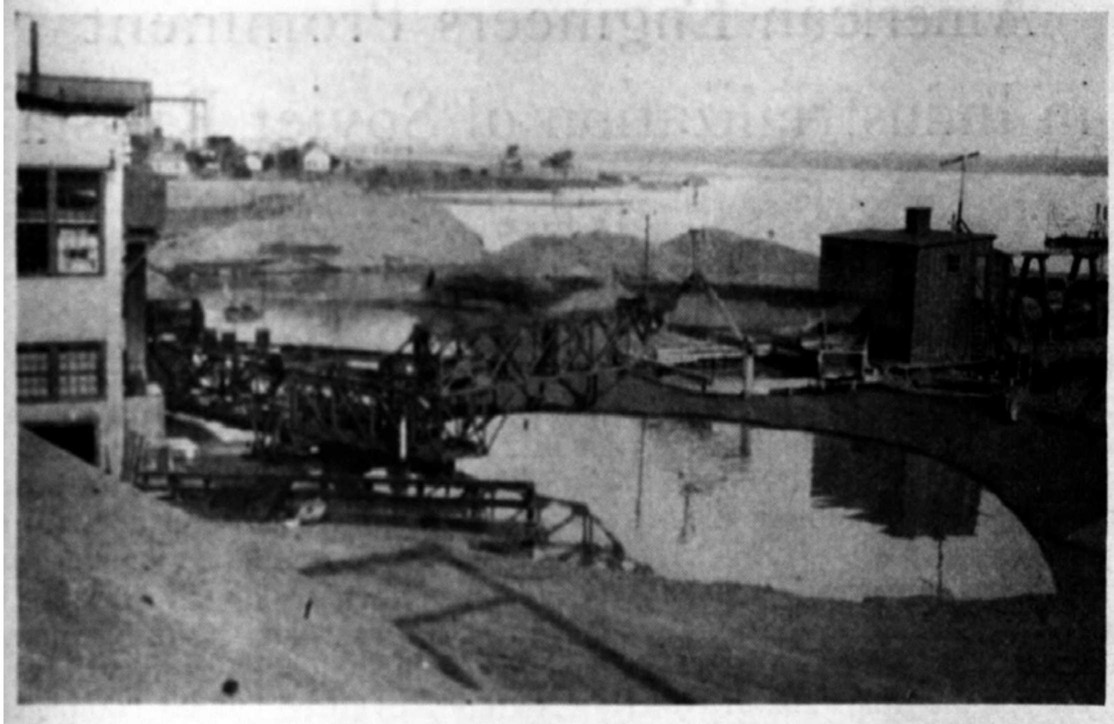
April 16, 1927: This post is a summary of production totals for the prior year and makes mention of the different consistencies of the sands recovered, either coarse or fine:

"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."

April 21, 1928: Another summary of the previous years production, showing an increase in the leaching process.
"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."

June 8, 1929: C&H estimates that the existing deposit at Torch Lake is more extensive than previously thought, and believe that the reclamation plants have enough conglomerate tailings to treat for an additional eleven years. This note also includes the only mention of direct dumping of slag into Torch Lake:
"*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."

November 30, 1929: Photo showing the plant, no date given.



The Calumet & Hecla reclamation plant at the Tamarack mill

A 1931 report from the **Mining Congress** also gives a detailed description of the interior of the reclamation plant (see pics below):

"*The Tamarack plant has its three treatment operations of regrinding, leaching and flotation practically under one roof. Instead of Hardinge mills 8 ft. in diameter by 18 in. cylindrical length, the 8 ft. mills are 72 in. in length and about three times the capacity of the smaller mill with a better efficiency* (**basically the regrinding mills are larger here than they are at Lake Linden**). *The entire plant has a capacity approximately two-thirds that of the Lake Linden plant.*

The dredge and shore plant of the Tamarack do not differ materially from that at the older plant (**in Lake Linden**) – *in fact the dredge now being used at Tamarack was the one originally purchased for Lake Linden. Correspondingly, pumps and drag classifiers are similar in operation in both plants and the coarse material is likewise conveyed by means of a belt conveyor to the top of the regrinding plant. There are 18 of these 8-ft. mills and the coarse sand after grinding is treated on Wilfley tables. The table tailings are classified into coarse sand for leaching and fine sand for flotation.*

The leaching plant consists essentially of six tanks, 54 ft. in diameter by 12 ft. high, with the necessary storage facilities for solutions and circulating pumps for the conveying of the solutions. There is a single distillation unit in the leaching bay and one crane suffices for all purposes. The flotation equipment consists of four Dorr thickeners 40 ft. in diameter, four compartments each, and the thickened product is treated on a 16-cell minerals separation machine.

The entire plant is very compact but costs are slightly higher than at Lake Linden owing to the lower capacity, and also to the fact that at Lake Linden a large part of the overhead is shared by the operation of treating mine rock. The following figures will show the costs at the Tamarack plant for the year 1930. It was operating on reduced schedule to November 15, at which time all operations were suspended pending recovery in the demand of copper."

General administration , mine and mill	9.2c
Dredge and pontoons	8.3 c
Shore plant and belt conveyor	3.9c
Grinding	11.6c
Leaching	16.5c
Flotation	2.2c
Miscellaneous	7.3c

Figure 15. Regrinding plant, Tamarack reclamation plant.

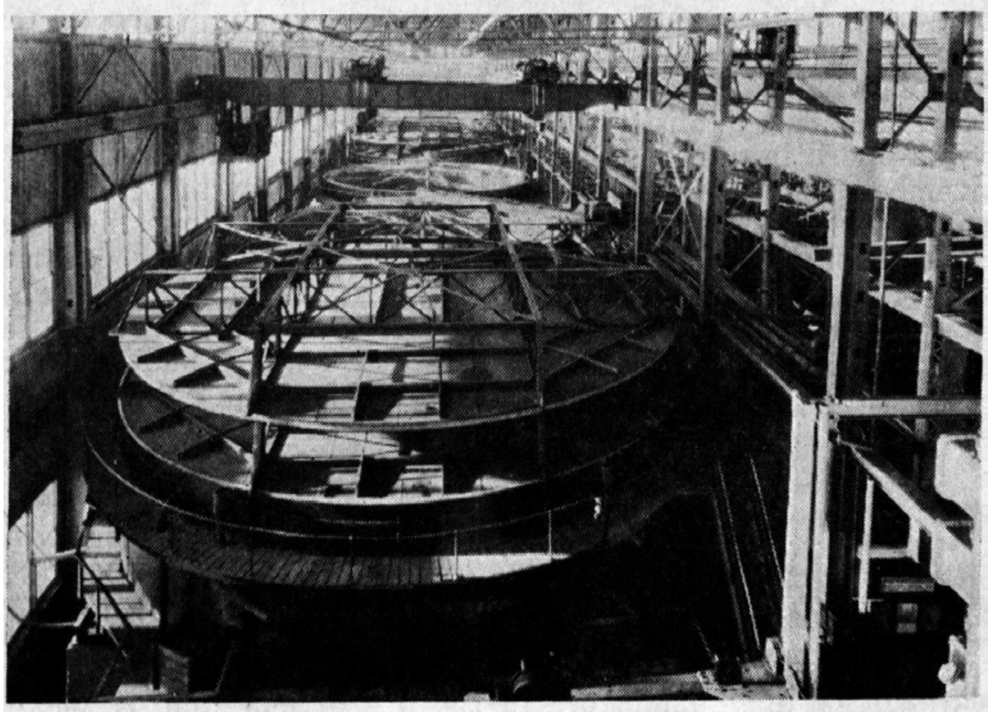


Figure 16. Ammonia leaching tanks, Tamarack reclamation plant.

September 1936: First note in a number of years regarding the Tamarack operation:
"The Tamarack reclamation plant remains idle, but at the Lake Linden plant the richest available sands are yielding a high percentage of copper."

July 1937: The Tamarack plant is back in operation and has been "reconditioned". No real note of what the reconditioning entailed.
"*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."*

April 1938: Post contains a summary of reclamation work for the prior year:
"*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."*

June 1941: Another yearly summary. This post mentions table treatment as a recovery option, which relates to the use of Wilfley tables, rather than leaching or flotation.
"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."

February 1943: The treatment of scrap copper is discussed in this month's issue of C&H News & Views:

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)

March 1943: This post contains the first mention of the exhaustion of the conglomerate deposit, and includes a new flow sheet for the treatment of the less valuable amygdaloid deposit within the Tamarack tailings – note that the leaching process will be abandoned, leading to the empty leaching tanks we will see be used for scrapping.
"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 flowsheet 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."

June 1943: This month's issue of C&H's News & Views continues the discussion regarding scrapping, this time mentioning the removal of materials from the properties of Calumet & Hecla:

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 and October 1943: The scrapping of old equipment from the mines and facilities of C&H continues to dominate the activity at the reclamation plants and the content of C&H's News & Views for the later part of 1943:

September: **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: **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

October 1944: This post details the transfer of the leaching tanks from treating sand to scrap materials.
"The fact that sand is no longer leached does not mean that the leaching plant will not be utilized. For some time excess tank capacity has been used for treating copper-clad materials and other secondary copper products. The management expects that sufficient scrap of various kinds can be obtained in the open market to permit a larger rather than smaller production of copper oxide by the leaching process. The oxide is of particular value as a wartime commodity because it is used as a base for all the non-fouling, anti-barnacle paints necessitated particularly by activity in the warm waters of the South Pacific. The entire Tamarack production of oxide is being diverted by WPB to this use."

January 1945: Scrapping of copper becomes a new focus for C&H, and the organization of a "Secondary Department" to oversee this action has formed:
"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."

February 1945: More mention of the scrapping process, which at this time is focused on producing copper oxide, is mentioned.
"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."

April 1945: A detailed account of the Secondary Department, productions shifts at Lake Linden, and mention of the first representative for the Secondary unit.

"The secondary copper business, into which Calumet & Hecla Consolidated has gone on a large scale, is handled by a new department. Material is received at either the smelter or at the leaching plants for classification and handling. The department has smelter facilities open to it and has full possession of the Tamarack leaching plant. Additional equipment will be installed as conditions warrant. At the outset of the war, large quantities of secondary material began to come on the market in the form of gilding metal clad steel. The leaching plant at Lake Linden is treating such material almost exclusively. About the same time, copper oxide from the Tamarack leaching plant became an important factor in producing ship-bottom paint. When the Tamarack deposit of sands ran out, the company purchased secondary copper for making copper oxide. K.S. Williams, of Pittsburgh, formerly with the Copperweld Steel Co., is the new department's first direct representative in the field. He will supervise purchases made in the East and endeavor to secure a steady supply of secondary copper."

June 1945: More info on scrapping, specifically "steel scrap clad with gilding 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."

August 1945: This post describes the ongoing diversification of C&H's secondary department, including the production of copper hydrate. Percy Rowe is also identified as the chemist at the plant.
"Copper hydrate, a new product, is ready to be placed in commercial production by Calumet & Hecla, according to George L. Craig, research director of the company. This compound is a component part of copper naphtenate and Quartermaster departments of the U.S. Army for mildew-proofing fabrics and canvas used by the armed forces. Calumet & Hecla built a pilot plant, which has been in operation for more than two months, turning out copper hydrate for the tests needed to meet government specifications. Percy Rowe, chemist of the Tamarack reclamation plant, developed the process. A production unit is being installed at the latter plant. A monthly output of 100 tons is expected."
"Machinery will be purchased by Calumet & Hecla for drying mixed copper oxide for the paint trade. This oxide is in demand in marine circles because of barnacle-resisting qualities."

September 1945: This post details where the scrap is coming from, and what types of things are being scrapped.
"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

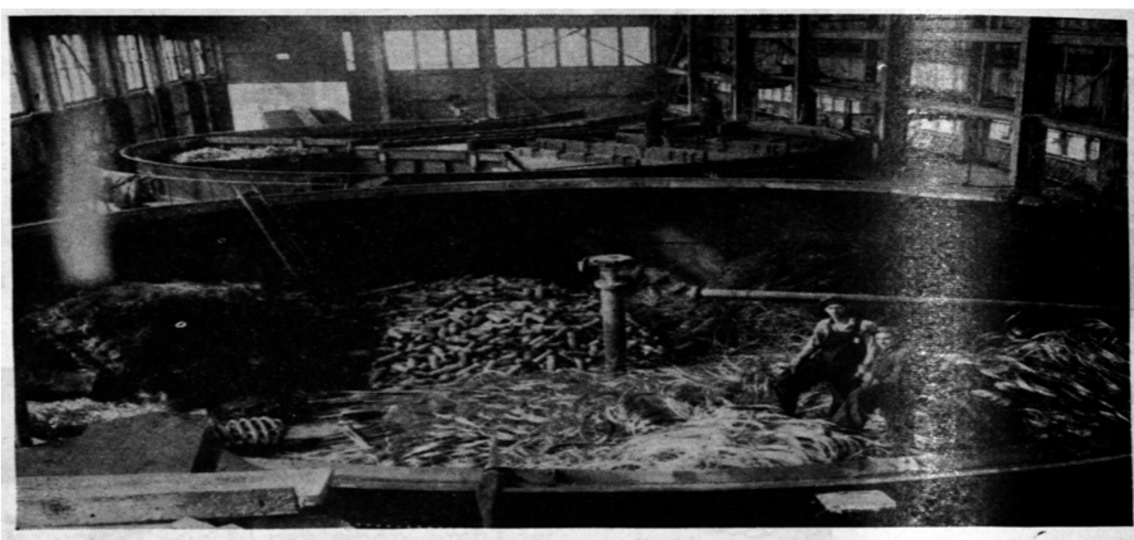
wiring battleships. Telephone wire used by the Army Signal Corps is another fruitful source of secondary copper, some of it recovered from battlefields. Secondary copper activities are not limited to war-time scrap but also include such standard items as trolley wire and bars."

"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."

October 1945: This post contains the excellent picture below, plus some information of the Wolverine Tube's role in assisting with production the atomic bomb.

"With some of the secrecy unveiled in the development of the atomic bomb, it can now be reveled that copper taken from Calumet & Hecla mines aided greatly in the completion of the most devastating weapon used during World War II. This announcement came in a War Department realese as follows:

> *"That the Calumet & Hecla Consolidated Copper Co., through the Wolverine Tube division, contributed its share in the development of the atomic bomb has not been greatly known. It can be told, however, that the raw material from the company's mines and fabricated by the Wolverine Tube division played an important part in the manufacture of the devastating bomb that brought Japan to her knees."*



LOADING SECONDARY COPPER into tank for leaching at Tamarack reclamation plant at the Calumet & Hecla Consolidated Copper Co. plant. Subdivided tank in the background is used to treat lots separately. See article on operations p. 89.

November 1945: This post details the formation of the Lake Chemical Co., it's board, and what it plans to produce:

"Calumet & Hecla Consolidated Copper Co. and Harshaw Chemical Co., of Cleveland, have formed the Lake Chemical Co., organized to manufacture and distribute copper chemicals. This new company, a Michigan corporation, with its principal office in

Calumet, Mich., has an authorized capital of $300,000, divided into 3000 shares of common stock of par value of $100 per share. Calumet and Harshaw have each subscribed to 1,500 shares. Calumet will supervise the manufacture of he new products, and the sales will be handled by Harshaw.
A large section of Calumet & Hecla's Tamarack reclamation plant will be used for the operation f the new company. Equipment is being installed to manufacture copper oxychloride sulphate (a patented copper fungicide) and copper hydroxide. Copper hydroxide is used in making mildew-proofing compounds, insecticides, fungicides, and other products."

February 1946: C&H's reclamation plant treated an immense amount of scrap during WWII, and profited heavily from its ammonia leaching process:
"…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."

September 1946: While the scrapping process seems to have been C&H's first successful diversion from metal mining, its subsidiary Lake Chemical, allowed C&H to throw its hat into another ring. During 1946 Lake Chemical began ramping up the production of chemicals. This post gives a detailed account of the chemical company's second unit and a visceral description of the copper oxychloride process:
"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."

October 1946: When C&H produced copper wire, the process created a product called copper mud. As the company continued to strive to be as economically efficient as possible it devised engineering methods to recover the copper and profit off of the waste material. I found this post to be one of the more illuminating accounts regarding the extent that C&H went to diversify its operation:
"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."

November 1946: This is the first post which provides employment numbers for the secondary department, as well as describing some of the progress at the company's foundry at Hubbell:
"…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."

January 1947: The C&H foundry seems to be expanding its operations during the early part of 1947, producing products for local mills as well as company's outside the area. This post also mentions the first shipment of fat sent to Chicago for the soap making industry:

"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."

February 1948: C&H has fully embraced its role as a producer of agricultural supplies, and has entered the realm of biocides and fertilizers:

"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."

April 1948: The reclamation plant at Tamarack has been slightly modified to include machinery tailored specifically for making copper oxide. This post also includes mention of producing "clinkered or coarse particle", which was used in the production of batteries:

"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."

June 1948: This post gives a spatial account of the dispersal of copper oxide from C&H's plant to farmers across the United States.

"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."

July 1948: A brief post mentioning the installation of a bailing machine used to compress loose scrap for easier handling during and after the leaching process:

"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."

August1948: Another brief post describing C&H's attempt to again profit from waste, this time the reclaimed conglomerate sands:

"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."

December 1948: Another post regarding the production of agricultural chemicals, this time oxychloride sulphate. This post also includes production estimates:
"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."

January 1949: This is a complex post related to the temporary shut down of the Tamarack plant, the temporary preservation of the now idle Lake Linden reclamation plant, and the promotion of the innovative uses for reclaimed 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 matrial 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."

February 1949: Another detailed post which provides specific byproducts of C&H, and the shutdown of the Lake Linden reclamation plant:

"*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."

April 1949: First mention of the newly formed Prozite Co., organized to market the reclaimed conglomerate sands, as well as the resumption of work at the Tamarack plant:

"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: cahirman 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."

February 1950: This is a slightly redundant post, but it makes note of the resumption of scrapping by C&H:

"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."

March 1950: Lake Chemical is now producing a number of products, and C&H is exploring the expansion of its Wolverine Tube unit:

"…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."

August 1956: This is the first mention of the Tamarack plant since 1950:
"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."

May 1957: The Tamarack plant seems to have shifted from scrapping to treating the Ahmeek bank sands:
"….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."
August 1960: A brief post providing production statistics from the mines and the Tamarack reclamation plant:
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."

January 1968: This is the first and last mention of the Tamarack reclamation plant, which was employing 50 people at the time:
"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."

Lake Chemical Narrative

During World War I, Calumet & Hecla began to shift some of its attention away from traditional mining and milling into research, materials science, and chemical engineering as the company strived to attain higher levels of engineering efficiency as it coped with an unfriendly copper market and competition from the burgeoning open-pit mines of the West. A longstanding inefficient practice of Calumet & Hecla was the milling of its copper ore at Torch Lake, where large amounts of native copper were discarded into Torch Lake in the form of tailings. To combat this waste, Calumet & Hecla employed new classifying equipment within its mills, and began to retreat the copper-rich tailings through a leaching process at its reclamation plant at Lake Linden. The leaching process consisted of retreating the tailings, which after being ran through a series of classifiers, were dumped into ammonia-filled leaching vats, where, after a number of hours, the copper in the tailings became dissolved into a solution. Next, the copper-ammonia solution was distilled, where the ammonia vapor was recovered and recycled, and the copper solution was precipitated into an oxide, which could later be fed to the smelter.[1]

While the leaching process introduced a more sophisticated degree of metallurgical engineering to the Calumet & Hecla toolbox, the production of copper oxides was not a new occurrence at Torch Lake, where copper oxides were produced simply from milling, where the crushed ore became exposed to oxygen and after time, began to decompose, forming a thin crust of copper-oxide around the

[1] Leisk, R.D., "Hydrometallurgical Treatment of Michigan Copper Tailings", in Metallurgical & Chemical Engineering, Vol. 13, April, 1915 (pp. 233-234).

surface of the crushed ore. The treatment of tailings by Calumet & Hecla at its reclamation plant at Lake Linden, and later at its reclamation plant at Hubbell, continued to send the reclaimed tailings first to the leaching vats, and then to the smelter up to the early 1930s, when C&H faced with another economic downturn due to the Great Depression, began to explore more extreme diversification schemes then ever before.

As a means to combat the food shortage created by the Great Depression and the Dust Bowl conditions throughout the Great Plains, the government and private enterprise began to explore soil science and invest in the use of fertilizers to help barren farms become fertile. Since copper is a common ingredient in both fertilizers and fungicides, Calumet & Hecla began shipping samples of cupric oxide to a handful of companies in the Midwest and western United States, including large shipments to The Harshaw Chemical Company of Cleveland, Ohio.[2] In addition to agricultural uses, copper oxides were used in a number of other industries during the 1930s onward, such as dyes for ceramics, paints, and synthetic materials like rayon, and Calumet & Hecla sought to have their mixed copper oxides included in all of them. From 1934 to 1944, Calumet & Hecla shipped over 50 million pounds of cupric and mixed oxides to manufacturers throughout the United States.[3] With the United States becoming involved in World War II during December of 1941, the

[2] "Cupric Oxide Shipments" from *The Calumet & Hecla Collection, President's Office Alphabetical* (4.3.30), Box 084, Folder 001: "Oxide – Copper", Michigan Tech and Copper Country Historical Collection.
[3] "Cupric Oxide Shipments"

government began demanding barnacle-inhibiting and corrosion resisting paints to be used for coating the bottoms of ships operated by the U.S. Navy.[4]

In addition to the cupric oxide business, Calumet & Hecla was also becoming heavily involved in the procurement and refinement of scrap metals, creating a "Secondary Department" in January of 1945.[5] That same year, Calumet & Hecla partnered with The Harshaw Chemical Company to create the Lake Chemical Co., organized with the "purpose of engaging in the manufacture and sale of Copper Oxychloride Sulphate and Cupric Hydroxide, and such other copper chemicals as may be determined upon at a later date."[6] Lake Chemical was established within Calumet & Hecla's Tamarack Reclamation Plant, and the responsibilities of the company were divided with C&H overseeing all aspects of production and Harshaw responsible for the sale and distribution of the various copper chemicals.

By September of 1946, Lake Chemical began to expand, installing equipment for a second unit to produce larger quantities of copper oxychloride (COCS) to be used in a variety of air borne insecticides. This second unit consisted 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*

[4] "C&H Urged to Produce More Copper Oxide in Leaching Plants", in *The Engineering and Mining Journal*, Vol. 146, No. 2 (pp. 165-166).
[5] "C&H Enters Secondary Metal Field", in The Engineering and Mining Journal, Vol. 146, No. 1 (pp. 114).
[6] Internal Correspondence, from *The Calumet & Hecla Collection, Corporate Records* (8.3.2.2), Box 022, Folder 001: "Articles of Incorporation, Minutes of Board Meetings", Michigan Tech and Copper Country Historical Collection.

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."[7]

From 1945 to 1956 Lake Chemical produced commercial quantites of COCS, Copper Hydrate and Tri-Basic Copper Sulfate (TBCS), totaling 30,666,108 pounds of COCS, 3,928,894 pounds of copper hydrate, and 1,573,498 pounds of TBCS.[8] This same time period saw Lake Chemical issuing research grants to a number of Universities and Agricultural Research Stations, such as The Florida Agricultural Experiment Station, The Ohio Agricultural Experiment Station, Purdue University's Agricultural Experiment Station, New York State College of Agriculture, Michigan State, University of Minnesota, and West Virginia University amongst others related to experiments with copper oxide as a fertilizer and the use of copper as an effective fungicide.[9] The experiments proved for the most part to be futile, as the copper chemicals shipped from Lake Chemical were generally considered to be subpar when compared against other fertilizers or fungicides.

While Lake Chemical continued to produce and ship large quantities of COCS and copper hydrate into 1956, production of TBCS appears to have been nearly

[7] "Second Unit of Lake Chemical Co. Producing COCS", in *The Engineering and Mining Journal*, Vol. 147, No. 9 (pp. 118-119).
[8] "Lake Chemical", from *The Calumet & Hecla Collection, Corporate Records* (8.3.2.2), Box 022, Folder 001: "Articles of Incorporation, Minutes of Board Meetings", Michigan Tech and Copper Country Historical Collection.
[9] Correspondence, from *The Calumet & Hecla Collection, Corporate Records* (6.3.4), Box 200, Folder 021: "Memorandums of Agreement", Michigan Tech and Copper Country Historical Collection.

discontinued by 1954. From the mid 1950s on, the research department at Lake Chemical explored a wide array of avenues into which their copper chemicals could align, ranging from livestock feed to catalytic converters. Due to a decline in sales, and the decreasing quality of their product, Lake Chemical dissolved in 1965. Calumet and Hecla absorbed all of Harshaw's interests in the company, and continued making copper chemicals up until the late 1960s. In 1968 the Tamarack Reclamation Plant officially, and presumably so too did the last vestiges of Lake Chemical.

John Baeten

Lake Chemical Timeline

This timeline covers the history of The Lake Chemical Co., a company joint-owned by Calumet & Hecla and The Harshaw Chemical Co. from 1945 to 1965. Prior to 1944, both Calumet & Hecla were producing copper chemicals, such as copper oxide and cupric sulphide, however with the merger of the two corporations, the production and distribution of copper chemicals was extended to a scale greater than if undertaken alone. Calumet & Hecla was responsible for the Lake Chemical Co.'s production facility, which was operated located at Hubbell, Michigan within the Tamarack Reclamation Plant. The Harshaw Chemical Co., based out of Cleveland, Ohio oversaw the sale and distribution of copper chemicals used primarily for agricultural operations and as an algicide for ship bottoms, but also refined the copper chemical shipments from the Lake Chemical Co. and converted them into various weapons-grade fuel for World War II. The relationship between Calumet & Hecla and The Harshaw Chemical Company appears to have been forged around 1934, when Calumet & Hecla first recorded shipping over 125,000 lbs. of Cupric Oxide to Harshaw's plant in Cleveland. In 1965 the Lake Chemical Co. dissolved, and Calumet & Hecla absorbed all of company from The Harshaw Chemical Co., and continued to produce copper chemicals for the next few years.

August, 1944: In an internal letter between Craig and Lovell of Calumet & Hecla, the production of C-O-C-S is discussed, along with the installation of a production plant within one C&H's existing facilities:

"Harshaw Chemical has made a proposal to C & H for the latter company to install production equipment for C-O-C-S (Copper Oxychloride Sulphate) at one of its existing facilities".

The letter describes the production process and lists the raw materials for a batch of CO-C-S:
1,210 lbs Copper Wire (5-24 gauge, iron and solder free)
350 lbs salt (Commercial, Chippewa, Ohio Salt Co.)
620 lbs Sulphuric Acid **(Commercial 66^{0}Be!, General Chemical Company)**
477 lbs Aqua Ammonia **(26^{0}Be!, Du Pont)**
110 lbs Caustic Soda (76% Flake, Columbia Alkali Company)

July 6, 1945: In correspondence between Harshaw and Lovell the two companies are hashing out their plans for Lake Chemical, including production totals:

Early plans called for a yearly production of "3,600,000 lbs of COCS or its equivalent Cupric Hydroxide," also the production of 300,000 lbs of black copper oxide. Harshaw also recommended "provisions should be made for the manufacture of Red Cuprous Oxide used primarily in the formulation of anti-fouling paints."

July 31, 1945: In a letter between Lovell and Harshaw, the construction of the new Lake Chemical facility is described.:

"We are proceeding as rapidly as possible to lay out both units in our Tamarack Reclamation Plant building. The scrapping and removal of idle flotation equipment will proceed promptly in order to provide the necessary space."

September 8, 1945: In a draft of the lease to Lake Copper Company, the plant is to be located in the southwest corner of C & H's Tamarack Reclamation Building.

November 1945: The Lake Chemical Co. was incorporated in September of 1945, as a subsidiary unit of Calumet & Hecla and the Harshaw Chemical Co. Lake Chemical Co. was constructed at Hubbell, within or adjacent to the existing Tamarack Reclamation Plant. In a document outlining the minutes from a meeting of Lake Chemical's directors from Nov. 12, 1945, the original purpose of the company is described as:

"Lake was organized for the purpose of engaging in the manufacture and sale of Copper Oxychloride Sulphate and Cupric Hydroxide, and such other copper chemicals as may be determined upon at a later date…"

April 1946: One of the first posts from the Engineering and Mining Journal related to the production of copper chemicals by Calumet & Hecla:
"…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."

September 1946: This post from the Engineering & Mining Journal provides a nice overview of the equipment, the basic operating procedure of Lake Chemical, and the array of products that include 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."

September 12, 1946 – In a letter between Harshaw Chemical and Lovell, early production totals appear promising:

"The production of 50 tons for the month is very pleasing. I think this is almost

a record for a new installation."

November 1946: In this post from the Engineering& Mining Journal, the secondary department of Calumet & Hecla is expanding to include foundry work, either in Ripley or Calumet:

"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."

April 1948: This post from the Engineering and Mining Journal provides a detailed account of the cupric oxide market in the late 1940s, and shows the further diversification of Calumet & Hecla into an organization dedicated to scientific research and chemical engineering:

"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."

February 1949: This post from the Engineering & Mining Journal describes the various commercial agricultural products that Lake Chemical's copper products have been added to:

"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."

March 1950: The commercial success and expansion in production of Lake Chemical is described in the post from the Engineering and Mining Journal:

"…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."

May 1957: In an internal document from 1957, the production of T.C.B.S. or Tri-Basic Copper Sulfate is described along with one of the first discussions of altering the built environment of the Chemical Co. with the installation of a ventilation hood over the COCS reaction tanks:

"Mr. Poull presented the problem of ventilation over the C.O.C.S. reaction tanks. The State Health department has made an issue of this and is currently insisting that hoods and blowers be installed. The estimated cost is about $4,200, which will be a capital expenditure. Before proceeding with this, however, Mr. Kromer will discuss the subject with Mr. Stott and we will attempt to review the recommendation with the State Health Department inspector, pointing out that the condition has existed for approximately twelve years and there has been no apparent hazard indicated in that time."

1965: In 1965, the Lake Chemical Co. dissolved, and Calumet & Hecla absorbed all of the company from Harshaw Chemical Co.

Torch Lake Building & Site Narratives

Ahmeek Stamp Mill to Mutual Water, Light, & Power Co. Pump House

(Prepared by Emma Schwaiger)

CONTENTS

Buildings & Sites from North to South

NARRATIVE TEMPLATE

Building Name: ____

Alternative (common) names for building:

Dates:

1. Built: ________
2. Modified (external structure)_______________
3. Ceased operations: ______________________
4. Structure removed: _________________________

Maps available
(Title, date, location, information present for building)

Building Narrative:
(Descriptive history of building uses, processes, major modifications described with dates where available. Includes list of major sources of information and location)

Supporting Documents:
(Copies of articles with extensive description, scientific papers on relevant processes)

Potential Waste/Pollution Concerns:

23. Ahmeek Stamp Mill

See Ahmeek Mill Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:
Tamarack Mill – used by local community to designate location of the only remaining mill ruins in the Tamarack City area. Mill also

Dates:

1. Built: 1908 or 1909
2. Modified (external structure): 1912 or 1914 & 1930
3. Ceased operation: 1969
4. Structure removed: after 1969
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928, 1935.
Archives drawer 67 - Blueprints
Board of County Road Commissioners Houghton Co. Engineer: T.A. Coon, Surveyor: W.L. Kaiser, Plotter: A. Sippola, August 1928. Map Folder 27 bb.
Calumet and Hecla Consolidated Copper Company. *Trap Rock Valley Railroad, General Map Calumet and Vicinity.* April 11, 1924. Map Folder 27 w.
General Map of Mills Along Torch Lake. 1:200. April 1, 1923. Map Folder 61 c.
Osceola, Lake N° 2, Tamarack and Ahmeek Mill Sites. 1:600. March 1, 1918. Map Folder 61 c.
Property at Mill, Ahmeek Mining Co. 1:100. April 1, 1923. Map Folder 61 c.

Building narrative:

The Ahmeek Stamp Mill was originally owned and operated by the Ahmeek Mining Co, and began producing in 1910. In 1923 it was purchased by C&H when they were expanding down the waterfront and used to process the ore from their mines. It kept producing until the company was sold and eventually closed in 1969. The mill did not operate between 1934 and 1936, and in 1947 2 new ball mills and flotation units were installed.

Supporting documents:
See the drawing in Section 3 of this report of Ahmeek Sand Bank (1914-1927).

Potential Waste and Pollution Concerns:
The Ahmeek Mill began depositing stamp sands into Torch Lake in 1910 and did so continuously until 1968. These sands came from both amygdaloid and conglomerate rock of the mines from the Ahmeek Mining Company and subsequently C&H Mining Co. They contain copper and heavy metals in the original course sands. These sands were reclaimed by Tamarack Reclamation Plant and re-deposited as fine-grained tailings in a location further south of the Ahmeek Mill, just off the waterfront from the Tamarack Reclamation facilities. The finer grained tailings are almost flour-like in their consistency.

24. Ahmeek Pump House

See Ahmeek Mill Facilities Narrative and Timeline

Significant: No
Alternative (common) names for building:

Dates:

1. Built: before 1921
2. Modified (external structure): 1930
3. Ceased operation: 1969
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928, 1935.

Building narrative:

The Ahmeek Pump House was the pumping house for the Ahmeek Stamp Mill. It was used to provide water from Torch Lake that was used in the milling process.

Supporting documents:

In 1925 there was a report stating that the Torch Lake water level was down and that the Ahmeek Pumps were having a hard time reaching the water to pump to the mill.[1] Also, on March 14, 1925, a letter was sent from MacNaughton to E.A. Baalack saying that the booster pump currently run on steam should be switched to electricity.[2]

Large-scale insurance appraisals were also done in 1957, where the mill and all area buildings were appraised and values were set for the buildings as well as the equipment.[3]

Potential Waste and Pollution Concerns:

[1] MTU Archives, C&H Collection, Box 35 – Folder 19.
[2] Box 35 – Folder 19.
[3] Box 207 – Folder 1.

Solvents used to clean machinery; potential PCBs between Pump House and Power House as the former converted from steam to electricity after 1930.

25. Ahmeek Power House

See Ahmeek Mill Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:

1. Built: Old: Before 1930 New: 1930
2. Modified (external structure): 1930
3. Ceased operation: 1969
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1935.
13200 Volt – Electric Distribution System. March 13, 1931. MS005-9654.
Osceola, Lake N° 2, Tamarack and Ahmeek Mill Sites. 1:600. March 1, 1918. Map Folder 61 c.
Single Line 13KV System Diagram. March 4, 1948. MS005-11461.
Single Line Diagram. September 8, 1960. MS005-12307.

Building narrative:

The New Ahmeek Power House provided power for the Ahmeek Stamp Mill. Originally separate, it was eventually incorporated into the C&H electrical system. It was erected by the Stone & Webster Engineering Company in 1930 and was operational by 1931.

Supporting documents:

On February 20, 1930, a letter from Stone & Webster to C&H says that the old power and boiler houses are not up to snuff and that new ones should be built. This report included cost estimates and drawings of where the old buildings were and where the new ones should go.[4] Because of this report, the entire Ahmeek Mill area was redone in 1930 by C&H, who contracted the work on the Power Plant to Stone & Webster Engineering

[4] MTU Archives, C&H Collection, Box 73 – Folder 51b or 52, 1 of 2

Company. [5] On April 1, 1930, a Revised Preliminary Estimate of Construction Costs was sent to C&H specifically for the Boiler Plant and the Turbine Plant.[6]

On July 26, 1930, another letter from Stone & Webster to C&H has the specifics for the new power house and equipment and they are telling C&H to go ahead with the installation of the equipment.[7] On August 5, 1930, Stone & Webster sent a document to C&H looking at the "possibility of operating the generators at Lake Linden in parallel with each other, and with the new Ahmeek generator." [8]

Large-scale insurance appraisals were also done in 1957, where the mill and all area buildings were appraised and values were set for the buildings as well as the equipment.[9]

On November 12, 1954, a report was released called 'Report on Lightning Protection for the Electrical Transmission System of Calumet & Hecla, Inc.' which address the fact that many electrical outages have taken place due to lightning strikes, but it also addresses any changes that should be taken place at each sub-station or power plant location. Since the Ahmeek Power Plant was still fairly new at this time, all of the lightning arresters were new and in place and the report said that no changes were needed at the Ahmeek location.[10]

Potential Waste and Pollution Concerns:

PCBs were introduced to the large transformers throughout C&H's electrical system beginning in the 1930s. Since the plant operated until 1968, the major concern is with disposal of PCB oils from the transformers when this building was dismantled in the 1970s. No information in the MTU Archives discusses the decommissioning of the Ahmeek power plant.

[5] Box 151 – Folders 5-18).
[6] Box 73 – Folder 51b or 52, 1 of 2.
[7] Box 73 – Folder 51b or 52, 1 of 2.
[8] Box 73 – Folder 52, 2 of 2.
[9] Box 207 – Folder 1.
[10] Box 38 – Folder 22.

26. Ahmeek Transformer House

See Ahmeek Mill Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:

1. Built: before 1928
2. Modified (external structure):
3. Ceased operation: before 1931
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928.
Osceola, Lake N° 2, Tamarack and Ahmeek Mill Sites. 1:600. March 1, 1918. Map Folder 61 c.

Building narrative:

The Ahmeek Transformer House held the transformers, which were used in the powering of the Ahmeek Power Plant before it was incorporated into the C&H electrical system.

Supporting documents:

On February 20, 1930, a letter from Stone & Webster to C&H says that the old power and boiler houses are not up to snuff and that new ones should be built. This report included cost estimates and drawings of where the old buildings were and where the new ones should go (Box 73 – Folder 51b or 52, 1 of 2). Because of this report, the entire Ahmeek Mill area was redone in 1930 by C&H, who contracted the work on the Power Plant to Stone & Webster Engineering Company (Box 151 – Folders 5-18).

Potential Waste and Pollution Concerns:

27. Ahmeek Boiler House

See Ahmeek Mill Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:

1. Built: Old: Before 1930 New: 1930
2. Modified (external structure): 1930
3. Ceased operation: 1969
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1935.
Archives drawer 67 - Blueprints

Building narrative:

The Ahmeek Boiler House housed the boiler for the Ahmeek Stamp Mill.

Supporting documents:

On February 20, 1930, a letter from Stone & Webster to C&H says that the old power and boiler houses are not up to snuff and that new ones should be built. This report included cost estimates and drawings of where the old buildings were and where the new ones should go.[11] Because of this report, the entire Ahmeek Mill area was redone in 1930 by C&H, who contracted the work on the Power Plant to Stone & Webster Engineering Company.[12] On April 1, 1930, a Revised Preliminary Estimate of Construction Costs was sent to C&H specifically for the Boiler Plant and the Turbine Plant.[13]

---

[11] Box 73 – Folder 51b or 52, 1 of 2
[12] Box 151 – Folders 5-18
[13] Box 73 – Folder 51b or 52, 1 of 2

Large-scale insurance appraisals were also done in 1957, where the mill and all area buildings were appraised and values were set for the buildings as well as the equipment.[14] In 1961 there was a movement to increase the efficiency of the mill by installing new steam generating units, but this never came to be.[15]

Potential Waste and Pollution Concerns:
There are similar concerns as with the Ahmeek Pump House (solvents). However, this facility was part of the conversion to electric power for the Ahmeek Mill and was the site of the new (after 1930) power system for the mill.

[14] Box 207 – Folder 1
[15] Box 151 – Folder 20

28. Tamarack Reclamation Regrinding Plant[16]

See Tamarack Reclamation Facilities Narrative and Timeline
See also Lake Chemical Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:

1. Built: 1920
2. Modified (external structure):
3. Ceased operation: 1956
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928.
Archives drawer 67 - Blueprints
13200 Volt – Electric Distribution System. March 13, 1931. MS005-9654.

Building narrative:

The Tamarack Regrinding Plant reground the tailings previously deposited by the Ahmeek, Tamarack, Lake Milling, Smelting & Refining, and the Osceola stamp mills. It was operational in 1925, remodeled in 1936, and 1943-44, and it closed in 1956. In 1945 space was leased to Lake Chemical, which produced copper oxychloride sulphate and copper hydrate.

Supporting documents:
In Section 3: See *Engineering & Mining Jounral* articles on Tamarack Reclamation; see also 1960 Flow Sheet.

Potential Waste and Pollution Concerns:
Tamarack reclamation tailings were reprocessed sands from Ahmeek, Tamarack, Osceola, and Lake #2 mills. As a finely ground, flour-like substance they were re-deposited into Torch Lake. Unlike the original course sands, they had the ability to spread through the

[16] The Tamarack Regrinding Plant was one section of several facilities housed under one roof and known as the Tamarack Reclamation Plant.

lake as suspended solids which eventually settled on lake sediments beyond the actual stamp sand deposit. They contain copper and heavy metals.

29. Tamarack Reclamation Electric Sub-Station[17]

See Tamarack Reclamation Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:
Tamarack Mill

Dates:
1. Built: 1920
2. Modified (external structure):
3. Ceased operation: 1941
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928.
Archives drawer 67 - Blueprints
13200 Volt – Electric Distribution System. March 13, 1931. MS005-9654.
Single Line 13KV System Diagram. March 4, 1948. MS005-11461.
Single Line Diagram. September 8, 1960. MS005-12307.

Building narrative:

This sub-station helped power the Tamarack Reclamation Plant until 1941 when the boiler was shut down and the Ahmeek boiler supplied the steam instead.

Supporting documents:

Potential Waste and Pollution Concerns:
Although it was closed in 1941, it is likely that this short-lived sub-station utilized PCB oils in its transformers after 1930.

[17] The Tamarack Reclamation Electric Sub-Station was one section of several facilities housed under one roof and known as the Tamarack Reclamation Plant.

30. Tamarack Reclamation Classifying Plant[18]

See Tamarack Reclamation Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:

1. Built: 1920
2. Modified (external structure):
3. Ceased operation: 1956
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928.
Archives drawer 67 - Blueprints
13200 Volt – Electric Distribution System. March 13, 1931. MS005-9654.

Building narrative:

The Classifying Plant processed the material that came from the regrinding plant to get rid of some of the non-copper material. It was operational by 1925 and was remodeled in 1936 and 1943-44. It was closed in 1956.

Supporting documents:

Potential Waste and Pollution Concerns:
The classifiers in this facility separated out much of the waste material included in the stamp sands transported from the various mill sand deposit sites along Torch Lake. Waste

---

[18] The Tamarack Reclamation Classifying Plant was one section of several facilities housed under one roof and known as the Tamarack Reclamation Plant.

material in the sands might include residue sands (with non-copper metals) and other waste material originally deposited in the stamp sands.

31. Tamarack Reclamation Flotation Plant[19]

See Tamarack Reclamation Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:

1. Built: 1920
2. Modified (external structure):
3. Ceased operation: 1956
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928.
Archives drawer 67 - Blueprints
13200 Volt – Electric Distribution System. March 13, 1931. MS005-9654.

Building narrative:

The Flotation Plant to treat smiles from the Regrinding Plant was operational in 1925. It was remodeled in 1936 and 1943-44. It was closed in 1956

Flotation is a process which uses xanthates and pine oil to get particular mineral particles, in this case copper, to adhere and float to the top of large vats in the form of foam and froth, which is then skimmed off and separated from the other materials and collected.

Supporting documents:
See multiple documents in Section 3 under Tamarack Facility, pertaining to reclamation of stamp sands and scrap material.

[19] The Tamarack Flotation Plant was one section of several facilities housed under one roof and known as the Tamarack Reclamation Plant.

Potential Waste and Pollution Concerns:
The Tamarack flotation plant was utilized only for material from stamp mills and for reclamation of stamp sand banks. It did not handle scrap material, the main chemicals of concern were pine oils and xanthates (toxic to aquatic biota) used to float copper from native rock and sands. In combination with the leaching facility, waste sludge was a likely by product. There is no information on how sludge was handled in the archive, but one interviewee suggests they were deposited directly down from the plant on the shoreline of Torch Lake.

32. Tamarack Reclamation Leaching Plant[20]

See Tamarack Reclamation Facilities Narrative and Timeline

Significant: Yes
Alternative (common) names for building:

Dates:
1. Built: 1920
2. Modified (external structure):
3. Ceased operation: 1956
4. Structure removed:
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1928.
Archives drawer 67 - Blueprints
13200 Volt – Electric Distribution System. March 13, 1931. MS005-9654.

Building narrative:

The Leaching Plant was operational in 1925. It was remodeled in 1936 and 1943-44. It was closed in 1956.

Leaching is a process where an ammonia solution is mixed with copper bearing sands and put into large holding tanks where the ammonia dissolves the copper. This ammonia and copper solution is then separated from the rest of the material and heated. The ammonia is evaporated and recycled, whereas the copper is precipitated into copper oxide, which was then sent to the smelter to be processed into pure copper.

Supporting documents:
See multiple documents in Section 3 under Tamarack Facility, pertaining to reclamation of stamp sands and scrap material.

[20] The Tamarack Reclamation Leaching Plant was one section of several facilities housed under one roof and known as the Tamarack Reclamation Plant.

Potential Waste and Pollution Concerns:

Ammonia was the primary chemical utilized in leaching copper from material produced by stamp mills and in later years, tailings and scrap metals (recovery from secondary materials). Benedict claims in *Lake Superior Milling,* that the ammonia was continuously recycled in the leaching process. A common waste material from leaching was finer stamp sand, known as tailings, which had the consistency of flour and would settle far into Torch Lake beyond the visible stamp sand bank of re-deposited sands. A third waste product in leaching (and flotation) was sludge, composed of material, heavy metals, and chemicals remaining after copper had been recovered. One interviewee believes that the sludge from Tamarack Leaching/Flotation plants was likely deposited down from the plants on the Torch Lake Shoreline.

33. Tamarack Stamp Mill

Significant: No
Alternative (common) names for building:

Dates:

1. Built: 1887
2. Modified (external structure):
3. Ceased operation: 1919
4. Structure removed: 1920
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1917.
Board of County Road Commissioners Houghton Co. Engineer: T.A. Coon, Surveyor: W.L. Kaiser, Plotter: A. Sippola, August 1928. Map Folder 27 bb.
Calumet and Hecla Consolidated Copper Company. *Trap Rock Valley Railroad, General Map Calumet and Vicinity.* April 11, 1924. Map Folder 27 w.
General Map of Mills Along Torch Lake. 1:200. April 1, 1923. Map Folder 61 c.
Osceola, Lake N° 2, Tamarack and Ahmeek Mill Sites. 1:600. March 1, 1918. Map Folder 61 c.

Building narrative:

The Tamarack Stamp Mill was originally owned by the Tamarack Mining Co. C&H purchased the majority of shares in 1910 and was remodeled between 1910 and 1914, until the Tamarack went out of business in 1917.

Supporting documents:

See Section 3 (Supporting Documents) for Tamarack Sand Bank (1954 drawing)

Salvage Old Steam Pumps for Foundry Metal – "Two steam pumps which formerly were used in supplying water for the Osceola and Tamarack Mills, now dismantled, have been converted into scrap metal to be used at our foundry. Over 600 tons of cast iron scrap were gleaned from the equipment, which was in service for many years.

The first pump was purchased from the Nordberg firm in 1898 and the second, which cost the company $40,000 was purchased in 1905. Both were in constant use until the discontinuance of operations at these two mills.

A similar pump which is located at the Ahmeek Mill has been out of service since an electrically driven pump was installed several years ago, and it too, will be scrapped in the near future."[21] (p. 8)

Potential Waste and Pollution Concerns:
The Tamarack Mill began depositing stamp sands into Torch Lake in the 1880s and did so continuously until 1917. The original course sands contained copper and heavy metals. These sands were reclaimed by Tamarack Reclamation Plant and re-deposited as fine-grained tailings in a location just north of the original sand bank and directly down from the Tamarack Reclamation Plant into Torch Lake. The finer-grained tailings were more likely to spread throughout Torch Lake due to their flour-like consistency.

[21] *C&H News & Views*, September 1944, p. 8

34. Lake Milling, Smelting & Refining Co. No. 2 Mill

Significant: No
Alternative (common) names for building:
Tamarack #2 Stamp Mill, Lake Chemical Warehouse

Dates:

1. Built: 1898 as Tamarack #2
2. Modified (external structure):
3. Ceased operation: 1930
4. Structure removed: 1947, then warehouse built
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1917, 1928.
Board of County Road Commissioners Houghton Co. Engineer: T.A. Coon, Surveyor: W.L. Kaiser, Plotter: A. Sippola, August 1928. Map Folder 27 bb.
General Map of Mills Along Torch Lake. 1:200. April 1, 1923. Map Folder 61 c.
Osceola, Lake N° 2, Tamarack and Ahmeek Mill Sites. 1:600. March 1, 1918. Map Folder 61 c.

Building narrative:

The Lake Milling, Smelting & Refining Co. Mill was the Tamarack #2 Stamp Mill before 1917. It was closed between 1927 and 1929, but in 1930 it finally closed and remained closed until it was liquidated in 1945.

Supporting documents:

See Section 3 (Supporting Documents) for Tamarack Sand Bank (1954 drawing)

New Warehouse for Lake Chemical Plant – "Owing to the variation in demand for copper oxide and the seasonal needs for C-O-C-S, a large amount of these products have to be stored at times. The available storage space in the Lake Chemical and Secondary departments is not sufficient to take care of this quantity, so additional space has to be provided.

The Lake Mill is conveniently located for this purpose as it adjoins the Tamarack Reclamation plant on the south. The upper part of the mill is not needed and will be scrapped this fall but part of the lower portion is being converted into a warehouse. All machinery and foundations in this part of the mill have been removed and openings for pumps or launders will be filled in and a cement floor laid on the fill. The roof will be replaced and made water tight. It will be necessary to put in a new wall on the west side of the warehouse before the remainder of the building is torn down.

One column was removed and a ramp provided at the north entrance so trucks can enter the building. A tow-motor will remove the pallets – on each of which 30 or 40 bags are placed – and stock them from the trucks in piles so they can be easily taken out as required.

The southern part of the building will not be needed for bag storage so will be used to house unused machinery and electrical equipment. As the building is about 80x200 feet, there will be ample space for both purposes.

As two of the four stamps in the Lake Mill are duplicates of those in the Ahmeek Mill they will be dismantled and used for spare parts for the Ahmeek heads." [22]P. 5

Depreciation, 1923-1964: Folder All: Plant Depreciation Record for LaSalle, Mutual Water Light & Power, L M S & R, Ahmeek, Osceola and L S S Co.

- Depreciation of the plants by year from the 1900s to the 1940s, but no info on Ahmeek.[23]

Potential Waste and Pollution Concerns:
The Lake Mill #2 began depositing stamp sands into Torch Lake around 1900 and did so continuously until 1930. The original course sands contained copper and heavy metal. These sands were reclaimed by Tamarack Reclamation Plant and re-deposited as fine-grained tailings in a location just north of the original sand bank and directly down from the Tamarack Reclamation Plant into Torch Lake. The finer-grained tailings were more likely to spread throughout Torch Lake due to their flour-like consistency.

[22] *C&H News & Views*, September 1947, p. 5.
[23] MTU C&H Collection, 5.10.3 (5.10.3) Depreciation, 1923-1964, Box 605

35. Osceola Stamp Mill

Significant: No
Alternative (common) names for building:

Dates:

1. Built: 1899
2. Modified (external structure):
3. Ceased operation: 1921
4. Structure removed: 1941
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1917, 1928.
Board of County Road Commissioners Houghton Co. Engineer: T.A. Coon, Surveyor: W.L. Kaiser, Plotter: A. Sippola, August 1928. Map Folder 27 bb.
General Map of Mills Along Torch Lake. 1:200. April 1, 1923. Map Folder 61 c.
Osceola, Lake N° 2, Tamarack and Ahmeek Mill Sites. 1:600. March 1, 1918. Map Folder 61 c.

Building narrative:

The Osceola Stamp Mill was owned and operated by the Osceola Mining Company before C&H bought a controlling interest in 1906 and merged it with C&H in 1911. In 1941 the mill and boiler house were scrapped.

Supporting documents:

See Section 3 (Supporting Documents) for Tamarack Sand Bank (1954 drawing)

Salvage Old Steam Pumps for Foundry Metal – "Two steam pumps which formerly were used in supplying water for the Osceola and Tamarack Mills, now dismantled, have been converted into scrap metal to be used at our foundry. Over 600 tons of cast iron scrap were gleaned from the equipment, which was in service for many years.

The first pump was purchased from the Nordberg firm in 1898 and the second, which cost the company $40,000 was purchased in 1905. Both were in constant use until the discontinuance of operations at these two mills.

A similar pump which is located at the Ahmeek Mill has been out of service since an electrically driven pump was installed several years ago, and it too, will be scrapped in the near future." [24]

Depreciation, 1923-1964: Folder All: Plant Depreciation Record for LaSalle, Mutual Water Light & Power, L M S & R, Ahmeek, Osceola and L S S Co.

- Depreciation of the plants by year from the 1900s to the 1940s, but no info on Ahmeek.[25]

Potential Waste and Pollution Concerns:

The Osceola Mill began depositing stamp sands into Torch Lake around 1900 and did so continuously until about 1920. The original course sands contained copper and heavy metal. These sands were reclaimed by Tamarack Reclamation Plant and re-deposited as fine-grained tailings in a location just north of the original sand bank and directly down from the Tamarack Reclamation Plant into Torch Lake. The finer-grained tailings were more likely to spread throughout Torch Lake due to their flour-like consistency.

[24] *C&H News & Views*, September 1944, p. 8.
[25] MTU Archives, C&H Collection, 5.10.3, Box 605.

36. Mutual Water, Light & Power Co. Pump House

Significant: Yes
Alternative (common) names for building:

Dates:
1. Built: 1907
2. Modified (external structure):
3. Ceased operation: 1937
4. Structure removed: 1944
5. Last time seen on map/aerial photo:

Maps available:

Sanborn Fire Insurance Maps, Michigan Tech Archives: 1917, 1928.

Building narrative:

The Mutual Water, Light & Power Company was incorporated in 1907 to furnish water and steam power to stamp mills. In 1944 it was owned by C&H and the Lake Milling, Smelting & Refining Co. when it was liquidated, and it was inactive between 1938 and 1944.

Supporting documents:

Depreciation, 1923-1964: Folder All: Plant Depreciation Record for LaSalle, Mutual Water Light & Power, L M S & R, Ahmeek, Osceola and L S S Co.

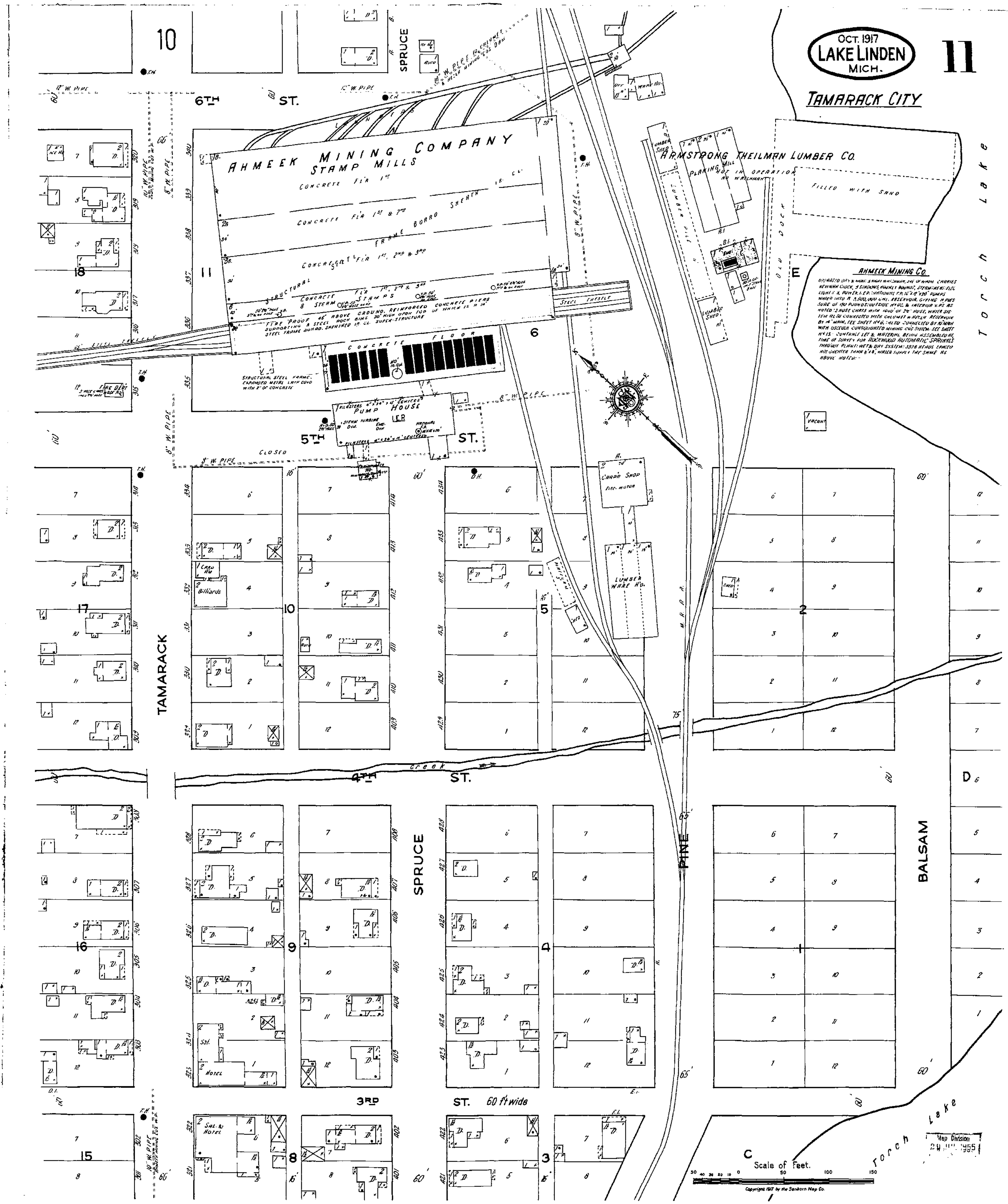
- Depreciation of the plants by year from the 1900s to the 1940s, but no info on Ahmeek.[26]

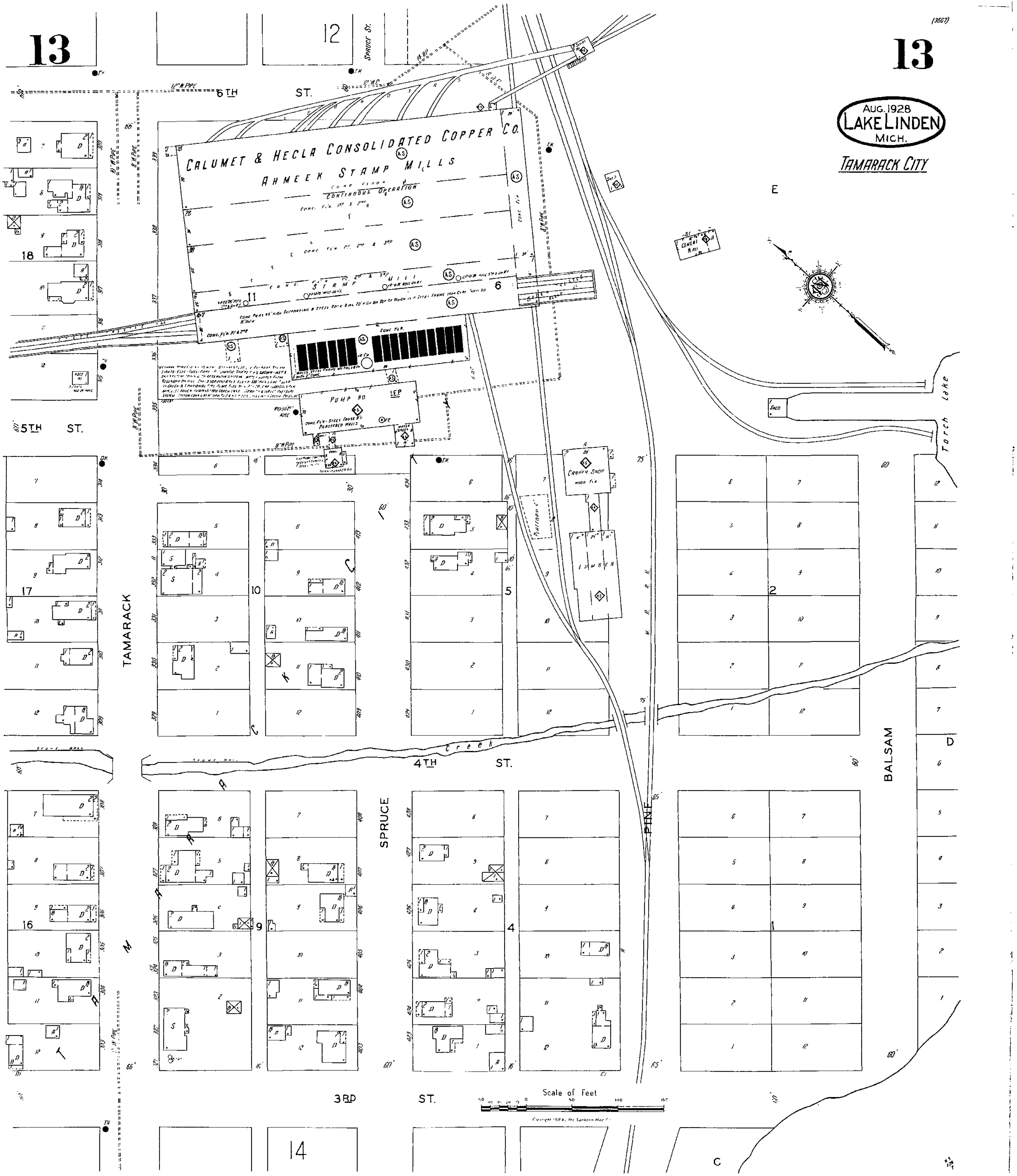
Potential Waste and Pollution Concerns:
It is likely (but not certain) that this power facility ceased operations before new transformers with PCB oils were installed. There is no information on this in archival materials.

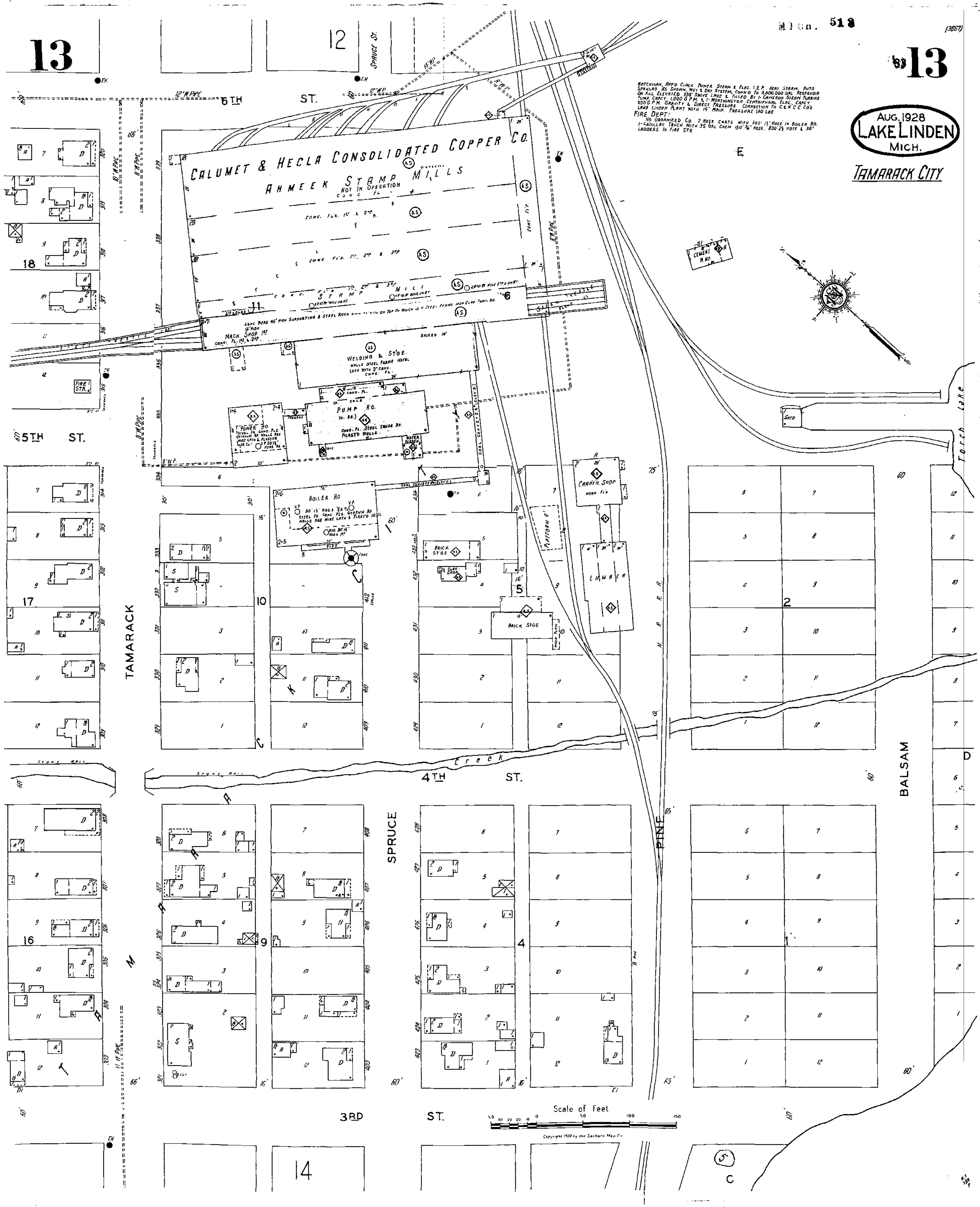
[26] MTU Archives, C&H Collection, 5.10.3, Box 605.

SECTION 3: SUPPORTING DOCUMENTATION

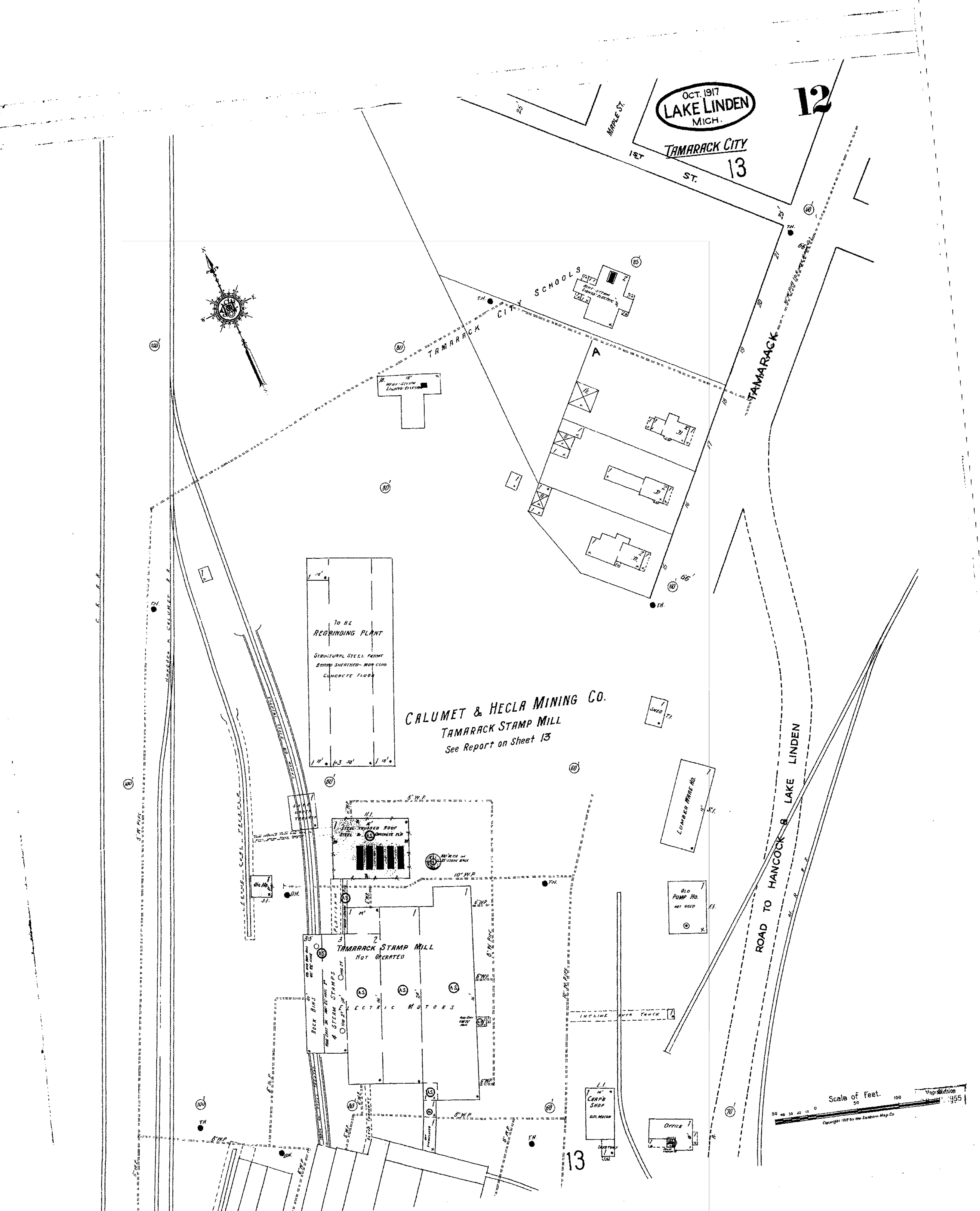
SANBORN MAPS

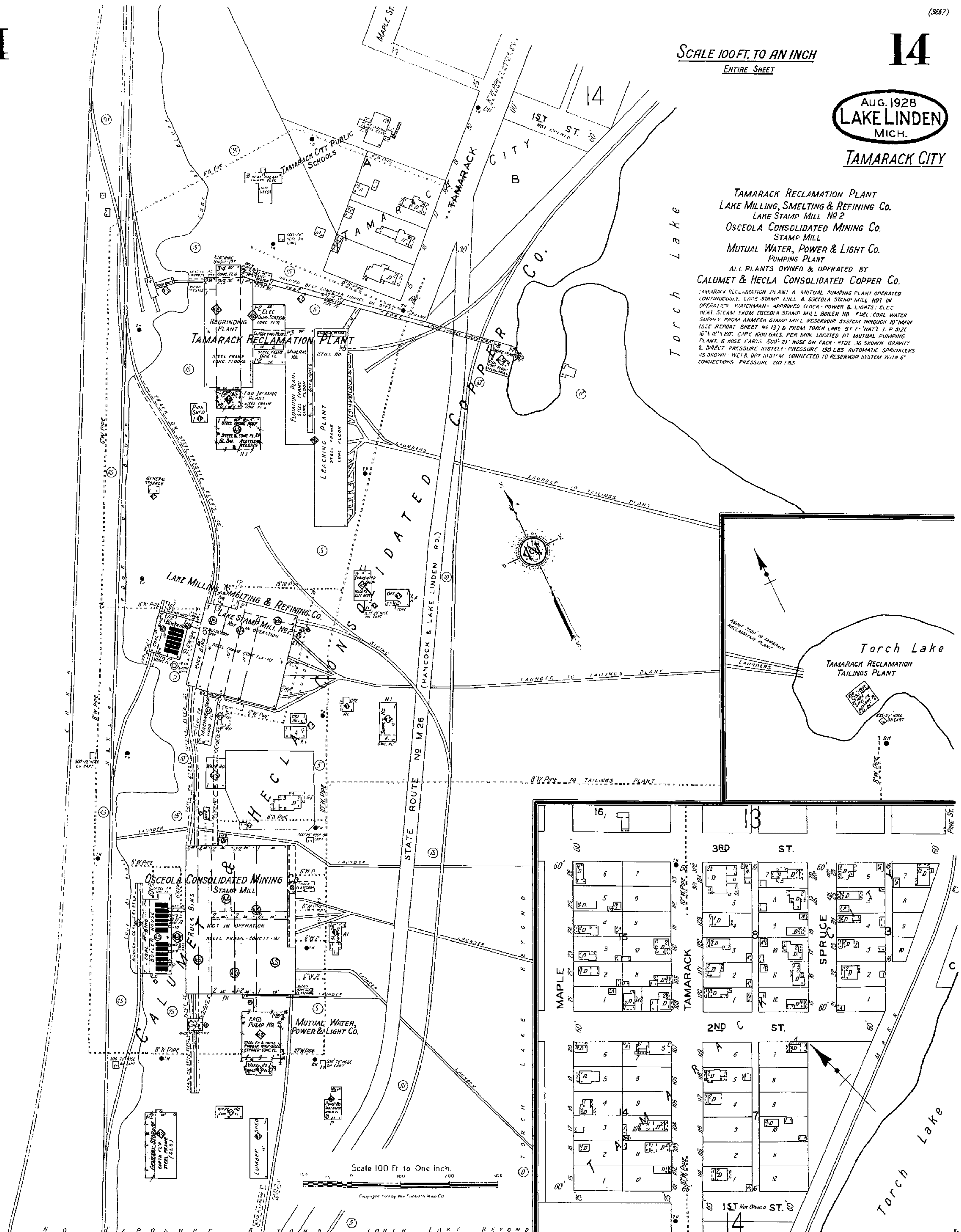

OCT. 1917
LAKE LINDEN
MICH.
11
TAMARACK CITY
AHMEEK MINING COMPANY
STAMP MILLS
ARMSTRONG THEILMAN LUMBER CO.
PLANING MILL
PUMP HOUSE
CARP. SHOP
LUMBER WARE HO.
AHMEEK MINING CO.
6TH ST.
5TH ST.
4TH ST.
3RD ST. 60 ft wide
SPRUCE
TAMARACK
PINE
BALSAM
Torch Lake
creek
STEEL TRESTLE
CONCRETE FLOOR
FILLED WITH SAND
OLD DOCK
VACANT
Billiards
Hotel
Sal. & Hotel
Scale of Feet.
Copyright 1917 by the Sanborn Map Co.


13
13
AUG. 1928
LAKE LINDEN
MICH.
TAMARACK CITY
CALUMET & HECLA CONSOLIDATED COPPER CO.
AHMEEK STAMP MILLS
CONTINUOUS OPERATION
PUMP HO.
CARPTR. SHOP
LUMBER
6TH ST.
5TH ST.
4TH ST.
3RD ST.
TAMARACK
SPRUCE
SPRUCE ST.
PINE
BALSAM
Creek
Torch Lake
12
14
18
17
16
10
9
5
4
2
1
6
11
E
D
C
Scale of Feet



13
Mich. 513
13
AUG. 1928
LAKE LINDEN
MICH.
TAMARACK CITY
WATCHMAN, APP'D CLOCK. POWER. STEAM & ELEC. I.E.P. HEAT STEAM. AUTO SPRKLRS AS SHOWN, WET & DRY SYSTEM, CONN'D TO 3,500,000 GAL RESERVOIR ON HILL ELEVATED 338' ABOVE LAKE & FILLED BY 1-CAMERON STEAM TURBINE PUMP, CAPCY. 1,000 G.P.M. & 1-WORTHINGTON CENTRIFUGAL ELEC., CAPCY. 600 G.P.M. GRAVITY & DIRECT PRESSURE. CONNECTION TO C.&H.C.C. CO'S LAKE LINDEN PLANT WITH 14" MAIN. PRESSURE 130 LBS
FIRE DEPT:
NO ORGANIZED CO. 2 HOSE CARTS WITH 300' 1½" HOSE IN BOILER HO. 1-CADILLAC TRUCK WITH 35 GAL CHEM 150' ¾" HOSE, 800' 2½ HOSE & 36' LADDERS IN FIRE STA
CALUMET & HECLA CONSOLIDATED COPPER CO.
AHMEEK STAMP MILLS
NOT IN OPERATION
STAMP MILL
MACH. SHOP
WELDING & STGE.
PUMP HO.
POWER HO.
BOILER HO.
BRICK STGE.
CARPTR. SHOP
LUMBER
PLATFORM
CEMENT
SHED
FIRE STA.
6TH ST.
5TH ST.
4TH ST.
3RD ST.
TAMARACK
SPRUCE
PINE
BALSAM
SPRUCE ST.
Creek
Torch Lake
12
14
18
17
16
11
10
9
6
5
4
2
E
D
C
Scale of Feet
Copyright 1928 by the Sanborn Map Co.


Oct. 1917
LAKE LINDEN
MICH.
12
TAMARACK CITY
13
MAPLE ST.
1ST ST.
TAMARACK
TAMARACK CITY SCHOOLS
A
To be
REGRINDING PLANT
Structural Steel Frame
Board Sheathed - Iron Clad
Concrete Floor
CALUMET & HECLA MINING CO.
TAMARACK STAMP MILL
See Report on Sheet 13
TAMARACK STAMP MILL
NOT OPERATED
ROCK BINS
4 STEAM STAMPS
ELECTRIC MOTORS
STEEL TRUSSED ROOF
STEEL & CONCRETE FLR.
OIL HO.
LUMBER WARE HO.
OLD PUMP HO.
NOT USED
SHED
INCLINE OVER TRACK
CARP'R SHOP
OFFICE
ROAD TO HANCOCK & LAKE LINDEN
HANCOCK & CALUMET R.R.
C. R. R.
Scale of Feet.
13


14
14
(3667)
SCALE 100 FT. TO AN INCH
ENTIRE SHEET
AUG. 1928
LAKE LINDEN
MICH.
TAMARACK CITY
TAMARACK RECLAMATION PLANT
LAKE MILLING, SMELTING & REFINING CO.
LAKE STAMP MILL Nº 2
OSCEOLA CONSOLIDATED MINING CO.
STAMP MILL
MUTUAL WATER, POWER & LIGHT CO.
PUMPING PLANT
ALL PLANTS OWNED & OPERATED BY
CALUMET & HECLA CONSOLIDATED COPPER CO.
TAMARACK RECLAMATION PLANT & MUTUAL PUMPING PLANT OPERATED CONTINUOUSLY. LAKE STAMP MILL & OSCEOLA STAMP MILL NOT IN OPERATION. WATCHMAN - APPROVED CLOCK - POWER & LIGHTS: ELEC HEAT: STEAM FROM OSCEOLA STAMP MILL BOILER HO. FUEL: COAL. WATER SUPPLY FROM AHMEEK STAMP MILL RESERVOIR SYSTEM THROUGH 10" MAIN (SEE REPORT SHEET Nº 13) & FROM TORCH LAKE BY 1 - NAT'L F. P. SIZE 16"x 12"x 20". CAPY. 1000 GALS. PER MIN. LOCATED AT MUTUAL PUMPING PLANT. 6 HOSE CARTS. 500' - 2½" HOSE ON EACH. HYDS AS SHOWN. GRAVITY & DIRECT PRESSURE SYSTEM. PRESSURE 130 LBS. AUTOMATIC SPRINKLERS AS SHOWN. WET & DRY SYSTEM. CONNECTED TO RESERVOIR SYSTEM WITH 6" CONNECTIONS. PRESSURE 130 LBS.
Torch Lake
TAMARACK CITY PUBLIC SCHOOLS
TAMARACK
TAMARACK RECLAMATION PLANT
REGRINDING PLANT
FLOTATION PLANT
LEACHING PLANT
LAUNDER TO TAILINGS PLANT
LAKE MILLING, SMELTING & REFINING CO.
LAKE STAMP MILL Nº 2
NOT IN OPERATION
CALUMET & HECLA CONSOLIDATED COPPER CO.
STATE ROUTE Nº M 26
(HANCOCK & LAKE LINDEN RD.)
OSCEOLA CONSOLIDATED MINING CO.
STAMP MILL
NOT IN OPERATION
MUTUAL WATER, POWER & LIGHT CO.
PUMP HO.
Torch Lake
TAMARACK RECLAMATION TAILINGS PLANT
ABOUT 1000' TO TAMARACK RECLAMATION PLANT
3RD ST.
2ND ST.
1ST NOT OPENED ST.
MAPLE
TAMARACK
SPRUCE
PINE ST.
MAPLE ST.
1ST ST.
Torch Lake
HILLSIDE BEYOND
NO EXPOSURE BEYOND TORCH LAKE BEYOND
TORCH LAKE BEYOND
Scale 100 Ft. to One Inch.
Copyright 1928 by the Sanborn Map Co.

BLUEPRINT LIST FOR AHMEEK MILL AND TAMARACK RECLAMATION FACILITIES

<u>Blueprint Index for Phase 2</u>[1]

Michigan Tech Archives & Copper Country Historical Collections
C&H Collection

Disc 1:
MS005-32B16-2of2-9720_OVSZ – Mechanical Equipment: Boiler House, Ahmeek Mill, 1930 (Boiler Room Floor Plan)

MS005-32B19-1of2-9701_OVSZ – Lot Plan: All Buildings, Ahmeek Mill, 1930 (Boiler House, Pump House, Transformer locations, etc.)

Disc 2:
MS005-32B19-1of2-9782_OVSZ – Mechanical Equipment: Pump House & Old Boiler House, Ahmeek Mill, 1930 (Boiler House, Pump House, Transformers, Generators, etc.)

Disc 3:
MS005-32C20-1of2-8329_OVSZ – Tamarack Reclamation Plant: Sub-Station, Leaching & Flotation Building Switchboard Floor & Gallery, 1923 (Gallery Floor & Switchboard Floor)

Disc 4:
MS005-32C20-1of2-11599_OVSZ – Tamarack Reclamation Plant: Fire Protection System, 1952 (Includes Lake Chemical Warehouse & Mutual Pump House)

MS005-32C21-10609_OVSZ – Tamarack Regrinding Plant: Tailings Launder General Arrangement, 1944 (Blueprint of Tamarack Reclamation Plant)

Disc 5:
MS005-33D17-2of3-11598_OVSZ – Ahmeek Mill: Fire Protection System, 1958 (Ahmeek Mill, Power House, Pump House, & Boiler House)

Disc 6:
Map 61C-22 – Property at Mill: Ahmeek Mill, 1923 (Ahmeek Mill, Boilers, Pumps, & Generator)

Map 61C-30 – C&H Stamp Mills & Houses, 1914 (Houghton County Electric Company Sub-Station #9, Regrinding Plant Sub-Station, Lake Linden Electric Power Plant, Coal Dock Sub-Station, North Flotation Plant, Leaching Plant, Regrinding Plant #2, Regrinding Plant #1, Calumet Mill, Hecla Mill, Still House, & Boiler House)

Map 61C-50 – Osceola, Lake #2, Tamarack and Ahmeek Mill Sites, 1918 (Ahmeek Mill Power Plant, Ahmeek Mill Sub-Station, Tailings Plant Sub-Station, Calumet & Hecla Coal Shed, Ahmeek Mill, Tamarack Regrinding Plant, Tamarack Mill, Lake Mill #2, Osceola Mill, Mutual Pump House)

---

[1] Six CDs provided with Phase 2 Report

NOTES FROM *ENGINEERING AND MINING JOURNAL*

John Baeten

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.”

<u>1918, Vol. 106</u>

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."

<u>1921, Vol. 112:</u>

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."

1922, Vol. 113

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."

1922, Vol. 114

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."

<u>1924, Vol. 118</u>

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."

<u>1925, Vol. 119</u>

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."

<u>1925, Vol. 120</u>

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."

<u>1927, Vol. 124</u>

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."

<u>1928, Vol.125</u>

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.

<u>1928, Vol. 126</u>

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."

<u>1929, Vol. 127</u>

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."

<u>1929, Vol. 128</u>

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."

<u>1930, Vol. 129</u>

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."

<u>1930, Vol. 130</u>

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."

<u>1931, Vol. 131</u>

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."

<u>1937, Vol. 138</u>

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."

<u>1938, Vol. 139</u>

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."

<u>1939, Vol. 140: Nothing of Note</u>

<u>1940, Vol. 141: Scanned an article on the Smelter and Reclamation plants</u>

<u>1941, Vol. 141</u>

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."

<u>1942, Vol. 142</u>

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."

<u>1946, Vol. 147</u>

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."

<u>1948, Vol. 149</u>

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."

<u>1951, Vol. 152:</u>

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."

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

<u>1953, Vol. 154: Missing from Library</u>

<u>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.</u>

<u>1955: Vol. 156</u>

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."

<u>1956, Vol. 157:</u>

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."

<u>**1957, Vol. 158:**</u>

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."

<u>**1958, Vol. 159:**</u>

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."

<u>**1959, Vol. 160:**</u>

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.

<u>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.</u>

<u>1968, Vol. 169:</u>

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."

NOTES FROM *C&H NEWS AND VIEWS*

Emma Schwaiger

C&H News & Views Newsletter (November 1942 – May 1949)
Michigan Tech Archives & Copper Country Historical Collections

Updated: Oct. 6, 2014

Key:
Ahmeek Stamp Mill & Power House
Tamarack Reclamation Plant
Lake Chemical Company

November 1942:

Reclaim Vital Metal in Leaching Process - Small calibre ammunition from the war – rejects. P. 1

December 1942:

Calumet Machine Shop Crew Rebuilding Grinding Mills – For new Quincy Reclamation Plant and for the Tamarack Reclamation Plant. P. 4

January 1943:

Progress Shown at New Quincy Plant – "…The plant at Mason will consist almost entirely of buildings provided by Calumet and Hecla. The main building was formerly the No. 1 Regrinding Plant at Lake Linden. The Shore Plant was once the old T.O.L. tailings disposal building which used to be perched out in the lake off the Tamarack shore…Electric power for the entire plant, including the dredge, will be furnished by Calumet and Hecla over a new transmission line soon to be erected from Tamarack to Mason." P. 4

Rebuilding Huge Motor for Reclamation Plant – Quincy reclamation plant is producing and they are rebuilding a "1000 HP motor that will drive the main 20" pump on the dredge at the Quincy Reclamation Plant." P. 4

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

Power Plant Crane Is Moved to Leaching Plant – 17 ton crane being moved to the leaching plant to help upload the scrap copper. P. 6

March 1942:

Amygdaloid Sands Will Be Reclaimed – Lake Linden & Tamarack Reclamation Plants will reprocess amygdaloid sands. "Part of the Leaching Plant at Lake Linden is now used to recover the copper from gilding metal scrap from munitions plants. The steel scrap remaining in the tanks is sent back to the steel mills. Some copper scrap, as old automobile radiators, etc., is also treated by itself in small tanks." P. 2

May 1943:

Accepts Position with the Electrical Staff – Martin J. Naylon takes the Assistant Electrical Superintendent position. P. 1

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

Ahmeek Mill is Very Busy Unit – Ahmeek Mill has been using 7 of its 8 heads. P. 6

Leaching Plant to be Enlarged – Lake Linden leaching plant has addition coming. P. 7

July 1943:

Remodeling the Calumet Mill to Meet New Demands – Mill has been shut down since 1939 but is being reconditioned to help process the ore coming from the mines. P. 3

Extension at Leaching Plant is Progressing – Extension at the Lake Linden Leaching Plant is Progressing. P. 4

Work at the New Quincy Reclamation Nearing Completion – "The dredge which has been receiving its finishing touches at Lake Linden is about complete, and because of the availability of power at that point, has had most of the machinery tested out. Power at Mason will not be available for another month although the poles for the transmission line are all in place and some 6,000 feet of wire has been strung.

As soon as this is completed and power is available in Mason, the dredge will dig a channel into the portion of the sand bank which it is designed to treat." P. 7

August 1943:

New Diesel Locomotive For Leaching Plant – "A new diesel electric switching locomotive has been received at Lake Linden. Its purpose is to move cars of clad metal scrap at the leaching plant. The plant is being enlarged to treat 7,500 tons per month, or about six 50-ton cars every day…

The locomotive was furnished by the General Electric Company, weighs 45 tons and can easily move two full cars. It has two distinct power units, each consisting of a 150 H.P. diesel engine direct connected to a d.c. generator which is wired to a motor geared to a driving axle."
P. 4

Extension at Leaching Plant Going Along Very Rapidly – Extension at Leaching Plant is going well. P. 6

Quincy Reclamation is Progressing – "The original promise was that power from Lake Linden would be available by August 15th and that promise will be kept to the day by the electrical crew working under Jack Goraczniak and Charlie Clouthier." P. 7

September 1943:

Quincy Reclamation Plant at Mason To Be In Production Very Soon – Quincy Reclamation Plant should be up and processing soon. P. 1

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 1943:

Government Order Stops Expansion of C&H Leaching Plant at Lake Linden–P. 1

Quincy Reclamation Plant in Operation – began November 1. P. 6

January 1944:

Motive Power Employees Clear Ice from Waterworks Intake – "C. & H. has supplied its plants and people with Lake Superior water since December 9, 1889, when the first steam pump, the Nipissing, went into service. The pumphouse was enlarged in 1895 and another pump was added, delivering 2,000,000 gallons a day into the mains. In 1908 the electric pumps were installed and a chlorinator plant was installed in September 1927 to purify the water. The present plant includes two electrical units each delivering 900 gallons a minute. The Tamarack pumping station has been operated by C. & H. since June 1, 1917 and this station uses an electric pump of 900 gallons a minute capacity.

More than forty miles of mains carry water from the pumping stations to Calumet, Laurium, Mohawk, Ahmeek and neighborhood locations as well as to the Torch Lake district. All of the company equipment throughout the entire plant relies upon these station for water supply. The homes and business houses of the territory are serviced by these C. & H. stations through many miles of service lines leading from the mains." P. 6

April 1944:

Leaching – "Another record output was hung up in March at the Lake Linden Leaching Plant and Still House where 3,264 tons of clad-steel scrap were treated to produce 1,174,831 pounds of copper in oxide. Since the Government is anxious to get the copper and steel from this scrap back into circulation for war needs, it is evident that the Torch Lake contingent has struck a sturdy blow for Victory.

Credit for this achievement should go to the Leaching Plant and Still House crews and the personnel of the Railroad and Smelter." P. 1

May 1944:

Calumet and Hecla Electrical Department Keeps Plant in Production – "The Calumet and Hecla Mining Company was one of the first users of electric power in this country. In 1878, this Company installed its first plant, which consisted of foreign manufactured generator and five arc lamps. This equipment was installed at the Stamp Mills and was followed in the year 1881 by an arc lighting machine and eight lamps at Calumet. These lamps were mounted on two 60-foot masts and were turned on the night of July 4 as part of the day's celebration.

In 1892, the first electric power was installed underground for the operation of mine pumps at the 8th and 16th levels of No. [ ] shaft, South Hecla Branch.

The first of the present 25-cycle, alternating current system of power generation was installed in 1902 in the present electric sh[ ]. This generator was driven through a ro[ ] drive by a vertical compound engine. The first 3-phase induction type motors were installed to drive the pumps in No. 7 Hecla shaft. During that same year the erection of the first unit of the present power plant was started, consisting of two engine-driven generators to furnish power for the Stamp Mill operation. In 1907 the plant was enlarged and three additional engine-driven generators were installed, generating power at 13 ,200 volts. The transmission lines were extended to Calumet and the electrification of the various drives at the Mine started. In 1913 the first turbine driven unit was installed to utilize the exhaust steam from the steam stamps at the Mills.

The growth of the electrical system has been continuous throughout the years, and new equipment has been added, in all cases it has been electrically driven. At the present time the electrical plants have a generation capacity of 40,000 Kva. There is approximately 50,000 H.P. in motors connected to the system.

Although some of the early steam-driven equipment is still in operation, electric power is of major importance throughout our entire operations. It illustrate this, it might be (Page 4) [ ]ell to follow through the operations from [ne] too smelter.

Breaking rock underground: Electric power drives the rock compressors for furnishing air [r] the operation of the rock drills and in some cases electric blasting is done.

Loading: Mucking of broken rock is done [ner] directly through motor-operated scrap-[ ] hoists or indirectly through compressed air operating scraper or loading machines.

Transportation: Storage battery locomotives haul the rock to the shaft.

Dumping: This is done indirectly through compressed air.

Signaling: Electronically operated signals are the means of communication between the underground workings and the hoisting station.

Hoisting: At the newer developments the electrically operated hoists raise the rock into the rockhouses.

General: Electricity drives the fans for ventilating and also furnishes power for the [ne] pumps.

Surface: When the rock is delivered to the rockhouses , it passes through electrically driven crushers before loading into cars for transportation to the Mills. The railroad [es] the rock at this point and electrically [s] not play a part in this stage, although it [es] handle the coal and pumps of water that keeps the steam locomotives in operation.

When the rock arrives at the Mill it passes through the steam stamps and it is here that electricity again picks up and carries it throughout the various steps in the milling.

When the concentrates, or mineral, arrive at the Smelting Works, electric power again [ps] in at the mineral house operating the [ne] for handling and mixing the mineral. [ ] follows through, operating the casting machines, conveyors, etc., and finally lands [ ] finished product in cars for shipment to our customers.

After seeing the vital part electricity plays in the various operations, one can appreciate the necessity of keeping this system in continuous operation, for a shutdown or break- (Page 5) down of an essential motor means an immediate loss of production. To maintain this system, the Company has its main electrical shop at Calumet, equipped to rewind and repair the various machines, a general stock room containing innumerable parts, as well as coils and insulating material for the various equipment. Whenever practical, all machines are brought to this shop for repairs. This shop is the headquarters for the general maintenance crews. At the various branches, such as the Ahmeek Mill, Lake Linden plants, Smelting Works, and Ahmeek mine, small crews with shop facilities are provided to maintain the equipment. The other plants, as well as all the distribution system, are served from the Calumet shop.

The Calumet crew is subject to call at any branch to help in case of an emergency or on the larger construction jobs. (Page 8)

Pages 4&5 contain many images as well. P. 4,5, & 8.

Lake Linden Leaching Plant – "The Lake Linden leaching plant and still house hung up still another production record in April when they treated 3,225 tons of clad steel scrap to produce 1,241,897 pounds of copper in oxide. We thought the March record would stand for some time, but the boys toppled it with another fin example of teamwork. Credit also should go to Bill Curnow's gang at the smelter and to the railroad crews.

Congratulations to everybody who had a hand in this fine record." P. 6

July 1944:

Meet the Folks Who Operate the C. & H. Lake Linden Reclamation Plant – Description of the LL Reclamation plant, pages 4-6. Document copied.

"The Lake Linden reclamation plant began operations in 1915 using gravity methods only for the first year. It had been conceived of as a possibility ten years earlier when motorized fine grinding equipment and Wilfley Tables became standard practice, in spite of the fact that recovery of copper from that treatment is only one-third that of the process finally adopted. Present practice includes leaching and flotation of the tailings from the regrinding plant, and fortunately both processes were available and adopted early in the life of the project.

The plant was designed entirely by Calumet & Hecla engineers and its success is due to the combined skill of those engineers and the loyal and efficient efforts of the employees. The mechanical and metallurgical engineers who deserve credit for the successful operations throughout the thirty years of its life have been connected with the project from its inception, so that they can have the possibly mournful satisfaction of closing up as well as opening up this "mine."

Description of Plant.

The reclamation plant consists essentially of five units separately housed and individually functioning:

1. Dredge and discharge pontoons.
2. Shore Plant and Belt Conveyor.
3. Regrinding Plant.
4. Leaching Plant and Still House.
5. Flotation Plant.

Dredge.

The dredge was furnished by the…

Shore Plant.

The shore plant embraces…” P. 4

“Regrinding Plant.

This building houses 64 Hardinge…

Leaching Plant and Still House

The leaching plant…The leaching solution is a complex chemical compound which first dissolves the copper from the sand and later is distilled in the still house and the copper precipitated as black copper oxide. In the distillation the volatile ammonium carbonate is condensed and goes back to the leaching plant solutions to dissolve more copper.

There are four still units in the still house, each unit consisting of one 13 section still with its preheater, reflux column, and condenser. The steam enters the bottom section and rises against and through the descending copper bearing solution. With volatile elements eliminated the barren solution, carrying the cop-” P. 5

“per oxide in suspension, flows from the bottom cutlet to settling tanks and filters. All the oxide unfortunately does not stay in suspension but bakes out in the stills and clogs them up. The units must be cleaned out every 48 hours and as the photos show a jack hammer is necessary for this job.

Flotation Plant.

In this plant the very dilute fine material coming from the Dorr classifiers is settled out in twelve 40-foot, 3-trat Dorr thickeners, and the copper is recovered from the thickened slime by oil flotation. This process is one of “blowing bubbles” by mechanical or air agitation of the slimes, previously mixed with pine oil and a certain chemical, sodium xanthate. The effect of all this is that the copper clings to the bubble surface, rises with the bubbles and is skimmed off and saved, whereas the worthless gangue settles down in the agitating tanks and is lost as a tailing.

As of January 1, 1944 the Lake Linden reclamation plant had recovered from Torch Lake 380,540,611 lbs. of copper from 32,084,000 tons of sand. The copper was produced at an average cost of 6.70¢ and has resulted in a profit to date of $28,890,000.

Now after thirty years this deposit is almost depleted and there is no hope of “just one more round” to open up new ore – “the bal” is just about played out.” P. 6

September 1944:

Amygdaloid Sands Being Reclaimed – Leaching of Scrap Continues. P. 1

Salvage Old Steam Pumps for Foundry Metal – "Two steam pumps which formerly were used in supplying water for the Osceola and Tamarack Mills, now dismantled, have been converted into scrap metal to be used at our foundry. Over 600 tons of cast iron scrap were gleaned from the equipment, which was in service for many years.

The first pump was purchased from the Nordberg firm in 1898 and the second, which cost the company $40,000 was purchased in 1905. Both were in constant use until the discontinuance of operations at these two mills.

A similar pump which is located at the Ahmeek Mill has been out of service since an electrically driven pump was installed several years ago, and it too, will be scrapped in the near future." P. 8

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

December 1944:

Steam Plant Dismantled – "The old steam plant at the Tamarack Water Works has been dismantled, giving way to modern equipment. The pumping station at the Calumet Water Works is equipped with three electrical pumps. These stations provide Calumet and vicinity with amply supply of good drinking water as well as water for fire protection." P. 3

Copper Paint in Demand – "Copper oxide, a product of the C. & H. Leaching Plant, is being used in the manufacturing of barnacle inhibiting paint and corrosion resistant paint which is used on ship bottoms by the U.S. Navy and Maritime Commission. The entire output of the Tamarack and Lake Linden leaching plants goes into the manufacture of this ship bottom paint." P. 8

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

New Pump Installed – "A new Allis-Chalmers, four inch pump was installed recently at the Lake Linden Reclamation Plant. The addition of this pump makes it possible to pump makes it possible to pump the solution from one tank to another, resulting in a richer mixture, thereby decreasing the amount of distilling formerly necessary." P. 2

June 1945:

New Product, Copper Hydrate, Ready for Production Soon – Percy Rowe Develops Important Process - "Copper hydrate a new product of Calumet and Hecla, is about ready for commercial production, according to George L. Craig, research director of the Company. Copper hydrate is a component part of copper naphtenate, which is used by the Ordinance and Quartermaster Departments of the Army, for mildew-proofing fabrics and canvases used by the armed services.

About forty million square yards of material are being treated daily for the government and a considerable amount of copper naphtenate is needed to assure continuance of the processing plants. C. & H. has built a pilot plant which has been in operation for over two months, turning out sufficient copper hydrate to put it through the tests necessary to meet government specifications. Percy Rowe, of the Tamarack Reclamation Plant is the chemist who developed the process. A production unit is being installed at the Tamarack Reclamation Plant and it is expected that a monthly output of 100 tons will be obtained from the new plant when it is placed in operation.

Drying Copper Oxide

Machinery is to be purchased for the drying classifications of mixed copper oxide which the Company is producing for the paint trade. Copper oxide is in demand in marine circles because of its barnacle resisting qualities. New trade demands require a dried copper oxide and the Company is preparing not only to provide a dried product but also plans to bag the entire product of mixed copper oxide." P. 1

Breth Appointed Assistant Electrical Superintendent – James E. Breth. 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.

October 1945:

Calumet & Hecla and Cleveland Firm Organize A New Company – Will Manufacture Chemical Products – "The Calumet and Hecla and The Harshaw Chemical Company, of Cleveland, Ohio, recently announced the organization of the Lake Chemical Company, which will manufacture and distribute copper chemicals. The new product will be manufactured by C. & H. and sold by the Harshaw firm. The principal office of the new concern will be in Calumet.

The Tamarack Reclamation plant is being remodeled to accommodate the new equipment of the new manufacturing project and it is hoped that the plant will be in production by the coming spring. Plans call for the installation of additional equipment to manufacture added products of the new plant.

The Lake Chemical Company will be the first manufacturer of Copper Hydroxide and will also make Oxychloride Sulfate. The Hydroxide is a valuable agent in mildew-proofing compounds, insecticides, fungicides and other such products, while the latter is already a proven chemical for the treatment of a number of field crops…" P. 1

November 1945:

C. & H. to Manufacture Chemicals at Lake Linden Plant – Lake Chemical Company to use Leaching Plant in Lake Linden to do more work since the Tamarack sands have been used up. Expansion is underway to house the facility. Copper oxychloride sulphate and cupric hydroxide will be produced. P. 3

Survey Electrical Plant – "Engineers of the Stone and Webster Company are making a survey of the electrical generator system of Calumet and Hecla, with a view to making equipment changes which will effect greater efficiency in the plant's power production. The work will be completed about the first of the year." P. 8

December 1945:

Big War Job Done by Leaching Plant, Last of Clad Steel Scrap for Metals Reserve Co. – "The last of the clad steel scrap on the Metals Reserve contract went into the leaching plant tanks in November and the final copper returns have been made to the Government." P. 1

January 1946:

Turbines are Repaired – "Repairs to the turbines in the Ahmeek Mill power plant was completed recently under the very able direction of J. Linker, who was assisted in the work by a crew of four men from the Allis-Chalmers Co. The work was done with very little interruption in service. This overhauling results in a very marked improvement in the efficiency of this piece of machinery.

The Westinghouse stokers at the boiler room of this plant have been completely overhauled and modernized. The changes have improved the air distribution in the boilers and higher ratings can be carried in the boilers." P. 7

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

March 1946:

C. & H. Manufacturing Oxide at Reclamation – At Tamarack Reclamation. P. 1 & 3. Document copied.

"Widespread interest is manifest in the copper oxide plant of the Company at the Tamarack Reclamation Plant. Recently the Michigan Department of Conservation send a radio recording crew to the plant to make a radio story of the unique operation so that the public might learn about its activities.

The oxide is received from the secondary department reclamation process, where it is obtained from leaching secondary metals in the large tanks. From these tanks the oxide laden solution is conveyed to a still in which the ammonia copper solution is boiled out. The resultant precipitate is then run through a pipe conveyor into a hopper. In this operation an oil fired furnace heats driven air which dries the oxide by a flash method, The moisture being driven off in the form of steam, leaving the oxide in a dry condition. The drying unit is a Raymond Flash Drying System manufactured by the Combustion Engineering Company of Chicago.

The oxide is then carried through a pipe toward the roof of the building into a cyclone separator, at the top of a cylindrical bin, where most of the air in the mixture is separated from the oxide as it drops into a large bin. The small amount of copper oxide still remaining in the air is removed by filters, in the bag house, which shake the oxide out of them into another bin. The bags are agitated automatically at regular intervals. This unit is a product of the Northern Blower Company.

The oxide, now separated from the water and air, is fed into a bagging machine, which is connected with the bottom outlet of the two supply bins. In this operation a bag of 100 pound capacity, is placed in the tray of the machine and the operator fills the bag by pressing a lever which operates the loader. The bag automatically seals itself as it is removed from the filling machine and it is then moved to the checking scale nearby to verify the weight of each bag.

The bagging machine is especially interesting as it handles the dust-fine oxide without permitting any of the oxide to escape into the air, sealing the bags tightly when they are filled…" P. 1

April 1946:

Lake Linden Plant Will Suspend Soon – Lake Linden Reclamation Plant is no longer profitable, amygdaloid sands are decreasing in profit. There are enough sands to last about three months, and then the plant will close down indefinitely. P. 1

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

To Scrap Old Plants – "A contract has been let to the Duluth Iron and Metal Company to dismantle the shafthouses at No. 12 and No. 13 on south Calumet Avenue. Work on this project will get under way in a short time.

The West End Iron and Metal Company, of Duluth, is engaged in the dismantling of the No. 5 Tamarack compressor house and the plant at No. 2 Gratiot. The material salvaged in both of these latter operations will go into foundry scrap metal. Work at the Tamarack site already has begun." P. 6

July 1946:

Lake Chemical Company Now In Production – Copper Oxychloride Placed On Market For Public Use – "Product Is Made From Scrap Metal" P. 1. Document copied.

"After many months of planning, engineering layout, and construction, the second production unit of Lake Chemical Company came of age on July 15, and without benefit of fanfare for christening began its job of producing Copper Oxychloride COCS in commercial quantities…

The unit consists of six lead-lined reaction tanks, 7 feet in diameter by 12 feet high, in which scrap copper is reacted with chlorides and sulphates to form COCS. Approximately 1[?] hours are required to make the conversion, following which the at[ ] active blue slurry is pumped into [ ] of two 18,000-gallon slurry [ ]. After the blending and condi-[ ] in the slurry tanks, the slur-[ ] is dewatered on a large continu-[ ] Oliver Filter, where the greater [ ] of the liquid is separated from [ ] blue solid. The wet cake is load-[ ] on trays and dried in large truck-[ ] driers until the material is com-[ ]cially free from water. The truck [ ] tray driers will eventually be re-[ ] with a large Proctor and Schwartz continuous Aeroform Drier, but 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 the lumps) and discharged into a storage bin, from which it is carried through a St. Regis Valve Bagging machine into multiwalled paper bags containing 50 pounds each.

The so-called "fixed coppers" sprays and dusts (high plant retention requiring fewer applications than Bordeaux or similar sprays) of which COCS is one type, are essential ingredients in many of the commonly used sprays and dusts for controlling a myriad of fungicidal growths on fruits, vegetables, and flowering plant. The "fixed coppers" may be effectively used in combination with the well-known insecticides – lead arsenate, calcium arsenate, rotenone, nicotine, sulphur, and DDT. Initially, all of Lake's production, which will be of the order of 300,000 pounds per month, will be used in compounding "Niagara COCS Spray" and "Niagara Copodust" by the Niagara Sprayer and Chemical Company, Inc., Lockport, New York. Look for them next season at your local hardware or feed store in the attractive red, blue, and brown package.

Lake Chemical Company's operations will be treated in detail in a forthcoming issue of News-Views." P. 1

Lightning Storm Damages Sub-Station at Calumet – "Caused a breakdown of one of the motor-generator sets at the Calumet substation…This left the system without any 60 cycle generating facilities, which are used for providing street and general lighting throughout the Calumet district. To provide this service, it was necessary to make a connection with the Houghton County Electric Light Company in the vicinity of the Road Commission crushing plant…During the storm, the 50 H.P. motor which drives the fan furnishing air for the cupola at the Foundry burned out, which necessitated the dumping of the cupola charge – a complete loss of production for the day…At the Lake Linden-Hubbell district, a 125 H.P. motor driving an 8-inch sand pump in the shore plant of the Tamarack Reclamation broke down. Throughout the entire district, innumerable fuses on transformers and in buildings were blown but no material damage was done at the main generating station." P. 8

New Source of 60 Cycle Power for C&H Assured – "At the time of the coal shortage, in case of complete suspension of electric service from Calumet & Hecla, provisions were made to secure enough power from the hydro plant of the Houghton County Electric Light Company to operate the Lake Superior pumping station, the fire protection system for Lake Linden and Hubbell, and general lighting throughout the Calumet district.

To provide such service, a 1000 Kw. Frequency changer, together with the necessary switching and auxiliary equipment was purchased and installed at the Lake Linden Power Plant. With this machine in operation, an exchange of power between the Houghton County Electric Light Company's system and Calumet and Hecla is possible." 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

October 1946:

Pictures of Lake Chemical Company 's COCS and Copper Hydrate Plant – p. 4-5. Document copied.

December 1946:

Stringing Wire at the Rate of One Mile Per Hour – "John Goraczniak, electrical foreman, devised a unique method for stringing wire along the pole line between Lake Linden and Calumet. Three additional wires were strung in order to provide 60 cycle power to the Calumet district from the frequency changer recently installed at the Lake Linden power plant. The pole line parallels the railroad right-of-way.

The boom on one of the locomotive cranes was fitted with 3 snatch blocks, through which the wire was run. This book was set at an elevation that cleared the top of the pole. The reels holding the wire were set up on a flatcar and together with the crane were coupled to a locomotive which slowly moved the crane and car along the track. Med on the car turned the wire reels, paying out the wire which was elevated to the crossarms. The wire was strung in this manner at the rate of one mile per hour.

The accompanying picture, which was taken under adverse conditions, gives a general view of the operation." P. 3

January 1947:

Electrical Department Turns Out A Tremendous Amount of Power – Output is four and one half times demand of whole district – "The Calumet and Hecla Company's electric power plants generate about four and one half times as much electrical power as is consumed by other users of electricity in all of Houghton, Baraga and Keweenaw counties combined. The company produces power to operate the entire plant in the Calumet, Keweenaw and Torch Lake districts.

While the Calumet and Hecla began using electricity for lighting as early as 1878, it was not until 1902 that the beginning of our present power system was started. At that time, the company had a small generating plant at Lake Linden and one at Calumet operating on 133 cycles to furnish lighting at the mine and mill plants.

The first application of electric power was at the stamp mills. Motors replaced the steam engines driving the milling machinery and sand wheels. When this original plant was being engineered, the electrical industry had not standardized on any definite frequency and as the requirement at that time was for slow speed operations, 25 cycles were decided upon.

While 25 cycle power has certain favorable characteristics, it is not satisfactory for lighting purposes as there is a decided flicker to the lights which is particularly noticeable in office and other close work.

When the system was expanded in 1907 and power extended to the mining operations, the two lighting generating plants were closed down. Frequency changers were installed at the Lake Linden power plant and the Calumet substation to provide 60 cycle current for lighting purposes. The Calumet substation at that time was the main distributing center and was designed to carry a load of 6,000 Kw. Changing operations have shifted the load center and at the present time only about 500 Kw. are distributed through this station. These changes have necessitated the concentration of 60 cycle power generation at one point.

During the coal shortage of last spring, there was a grave possibility that not enough coal would be available to maintain the pumping plant at the Lake Superior water works for the water supply, at the Pond water works for fire protection in the Calumet district and for pumping at the mills for fire protection.

Electric power from other sources in the district is 60 cycles. Consequently while the power distributed by Houghton County Electric Light Company is generated by water power, advantage could not be taken of this source. Fortunately this company was able to secure a second-hand frequency changer of 1000 Kw. capacity which was purchased and installed in the Lake Linden power plant ready to meet another such contingency. This machine can operate either from a 60 cycle source and deliver 25 cycles, or from a 25 cycle source and deliver 60 cycles, and provides a means to have an interconnection between the company's electric system and the local utility system for a limited amount of power." P.1

March 1947:

Modernization of Lake Linden Power Plant Is Approved By Directors – Two years required to complete job – "The generation of electric power for operation of the carious branches of the Calumet and Hecla Consolidated Copper Company is centered at two localities – at the Ahmeek mill and at Lake Linden. The total power consumed by the Company is 22,000 kw., and equipment is on order to bring this load up to 24,000 kw.

Lake Linden Plant

The first electric power plant at Lake Linden consisted to two engine-driven generators of 1,000 kw., 440-volt capacity each. These machines were installed in1902, and the power generated was used to operate some of the stamp mill machinery.

An addition was made to this plant in 1907 when three engine-driven generators were installed, each rated at 2,000 kw. at 13,200 volts. This permitted the extention of electric power to the Calumet district. At that time a new boiler plant was built to provide steam for the twenty-eight steam stamps at the Lake Linden mills, as well as for the increased electrical system. This boiler plant, still in operation, contains twenty-four Babcock and Wilcox boilers, each rated at 20,000 pounds of steam per hour. They are equipped with over-feed Roney stokers and generate steam at 180 pounds, and when first installed supplied steam at this pressure to both the stamps and the steam engine-driven electrical units. About 5,500 pounds of steam per hour passed through each stamp and was exhausted to a condenser.

By 1911 low-pressure turbines had been developed to a degree where it was deemed advisable to install a low-pressure unit to utilize the exhaust steam from the stamp mills and generate electric power as a by-product. A 7,500 kw. mixed pressure turbine was designed to take all of the available exhaust steam from the stamps at 1-pound gauge pressure. This machine could also operate at 170 pounds steam pressure, or a combination of both. With all twenty-eight heads operating, the turbine was capable of generating approximately 6,000 kw. from the exhaust steam alone, and this resulted in a very cheap unit cost of power.

This No. 1 unit went into service in 1913 and was so satisfactory that a second unit, No. 2 turbine, rated at 10,000 kw., was installed in 1916. This, too, was a mixed pressure turbine and was originally used as a stand-by unit.

The present equipment in the Lake Linden plant consists of Nos. 1, 2, and 3 turbines having generating capacities of 7,500 kw., 10,000 kw., and 2,000 kw., respectively, or a total of 19,500 kw. There is also a 1,250 kw. turbine in the Still House.

Ahmeek Plant

In 1916 a 2,000 kw. mixed pressure turbine, similar to the Lake Linden units, was installed at the Ahmeek mill to utilize the low-pressure exhaust steam from the Ahmeek mill stamps. The power from this unit was tied in with the general power system.

In 1931 it was necessary to replace the old Ahmeek mill boilers, and in order to provide for the increasing demand for additional electrical capacity for mine and plant operation, it was decided to install three high-pressure boiler units, each capable of generating 90,000 pounds of steam per hour at 410 pounds pressure and 680 degrees temperature. A high-pressure turbo-generator, rated at 7,500 kw., was installed in the pump house to reduce the steam pressure from 410 pounds to 170 pounds for steam stamp operations. With this new setup of boilers and turbines, the steam necessary for the operation of the mill stamps passes first through the 1,250 kw. high-pressure turbine and the exhaust steam from the stamps passes through the 2,000 kw. mixed pressure turbine.

The No. 8, 7,500 kw. unit receives steam at 410 pounds and operates condensing.

The Ahmeek plant is an efficient plant. No. 8 turbine carries a load of about 8,000 kw. continuously at a coal consumption of about 1.2 pounds per kw. No. 7 unit averages about 1,000 kw., and No. 6 unit about 2,000 kw. when the mill is in operation. Since these latter two units operate on process steam, the unit cost is very low. The present equipment in the Ahmeek power plant consists of Nos. 6, (page 1) 7, and 8 turbines, having generating capacities of 2,000 kw., 1,250 kw., and 7,500 kw., respectively, or a total generating capacity of 10,750 kw. The generating capacity of the Lake Linden and Ahmeek plants is therefore 31,500 kw.

For a period of twenty years while the stamp mills were in operation, the cost of generating power at the Lake Linden plant was most satisfactory, but as the rock tonnage from the conglomerate lode diminished and was finally cut off entirely, the cost of power from this plant, operating at 180 pounds pressure, became excessive. Present coal consumption per kwh. is in excess of 2 pounds.

The cost of coal is the largest factor in the cost of generating power, and since the price of coal has advanced from $2.70 per ton delivered to the boiler house at Lake Linden in 1913 to a cost of $7.33 per ton at the present time, it becomes imperative to supply Lake Linden with a more efficient plant. It was therefore decided to call in a firm of outside consulting engineers to make a survey and analysis of the entire power plant situation. The Chicago firm of Vern E. Alden Company, Engineers, after an investigation covering a period of three months, showed that a saving of approximately $300,000 per year on operating cost could be effected by making the following changes:

By the installation of a pulverized-coal-fired boiler to be erected in the south end of the Lake Linden power plant. This boiler is rated at 180,000 pounds of steam per hour at 850 pounds pressure and 825 degrees temperature. It will have a capacity to furnish steam for our present operations, the proposed new turbine, and have available steam for the Calumet mill should additional milling facilities, be required.

The electrical equipment will consist of a 7,500 kw. non-condensing turbine operating at 850 pounds and exhausting at 170 pounds. This turbine ,operating at 3,600 r.p.m., will drive through a reducing gear a 6,000 kw., 13,800-volt generator which will feed into the system. Mounted on the same shaft will be a 1,700 kw., 2,300-volt generator and auxiliary drives. The exhaust from this topping turbine will flow to either No. 1 or No. 2 turbine units. It is estimated that this combination will produce power at a coal consumption of slightly less than one pound per kw.

In addition to the new equipment, No. 1 and No. 2 turbines will be thoroughly overhauled and brought back to near the original operating efficiency. No. 8 turbine at Ahmeek will also be overhauled. Changes in the distribution system will be made to make the entire plant more reliable. It will take about two years to complete this work.

This scheme met with the approval of the Management and was approved by the Board of Directors at the February meeting. An agreement has been made with the Alden Company for the purchase and erection of this plant." P. 3

April 1947:

Copper Chemicals Are Being Used By the Citrus Industry – Copper used in fertilizer to help protect the trees. P.1 & 7

Twenty-Five Employees Approaching Half Century of Service with C&H – C.H. Benedict: "Chief Metallurgist. After graduating from Cornell University, he began working October 20, 1898 in the Assay Office at the Stamp Mills. Mr. Benedict is the originator of the leaching process which made possible the operations of the Reclamation Plants. During the past 30-off years, millions of pounds of copper have been reclaimed from the waste tailings of the stamp mills through the Reclamation Plants." P. 3

Chemicals Used by Calumet & Hecla – "Chemicals play a very important part in the various operations of the Calumet & Hecla and the annual purchase of several chemical items runs into rather startling figures.

A freight train of 84 cars would make quite a string stretched out along any railway. It would be much longer than any train ever pulled up over the Quincy Hill to Calumet. Yet this is actually the number od cars of chemicals received by the company during the year of 1946. The immensity of these supplies is further emphasized by the fact that they totaled over 3,550,000 pounds.

The sulphuric and other acids used during the year amounted to over 610,000 pounds. Forty seven carloads of ammonia totaled more than 1,000,000 pounds. Two carloads of bone black weighed 60,000 pounds. Soda ash is used in large amounts and 16 carloads were received totaling 1,120,000 pounds. In five months 250,000 pounds of caustic soda were received here. The carbide used in the miners' lamps required a full carload weighing over 30,000 pounds. Three cars of sodium xanthate weighing 180,000 pounds went into consumption in processing. Salt, which from time immemorable has been an important and useful item, plays a major roll in the copper industry too. Last year the company used 5 carloads, or more than 300,000 pounds." P. 8

"COCS" Will be Field Tested Extensively – "Lake Chemical's COCS will be extensively field tested throughout the country during the coming season. Large sample lots have been sent to twenty of the State Agricultural Experiment Stations for the National Cooperative Potato Spray Fungicide Experiment for 1947 under the direction of Dr. W.F. Buchholtz of Iowa State College. Additional lots are now being prepared for the National Cooperative Vegetable Spray Fungicide Experiment (carrots, onions, celery, etc.) under the direction of Dr. A.G. Newhall of Cornell University, which will be conducted at 10 State Experiment Stations. The COCS will be tested as a copper fungicide against numerous of the commercial competitive fungicides, and the results of these cooperative programs are expected to receive National publicity." P. 8

May 1947:

Grease And Oil Are Important in Mining – "Oil is important in copper mining. Some idea of the variety of products required to operate the Calumet and Hecla may be gleaned from the fact that during the past year the Company purchased 6 carloads of various oils totaling more than 53,000 gallons. The several greases used in the mine and its allied industries total more than 37,000 pounds. In addition to this, 6 carloads of Pine oil, totaling 48,000 gallons were required.

These items are entirely exclusive of fuel oil and gasoline, which in themselves constitute a large item, the fuel oil totaling 39 carloads, and the gasoline 6 carloads." P. 6

June 1947:

Field Test Being Made With Copper Treated Commercial Fertilizer – "The use of small percentages of copper in commercial fertilizers has been under investigation by state agencies in California for some time, and although no details are available, it has recently been announced that copper contributes materially towards improving the color, quality and yield of alfalfa.

Although the Copper Country is not an important alfalfa producing area, tests will be conducted by the Research Department during the summer to determine if copper feeding will produce the same results in this area. The copper oxides produced at Lake Linden and Tamarack will be added to commercial fertilizers and test plots will be treated, under the direction of the County Agent, on two farms in the Atlantic Mine location. Yield and quality of the crop will be compared with the alfalfa grown in ground where no copper was added and the results will be reported in a later issue of News-Views." P. 2

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

Plenty of Scrap Copper on Market – "The scrap copper business in peace time is quite a different thing than it was before. The change from a controlled to a free market was a good move but the last act of the government bureaus was to raise the copper price to 21 ½ cents. Thereupon two things happened: buying resistance increased, and scrap copper began to flood the market.

During the war the Office of Price Administration held the American copper price at 12 cents. That this was unrealistic was proven by the immediate jump in price when the controls were removed. The 12 cent price kept much scrap copper off the market just at a time when it was needed most, but after the removal of the ceiling the price began to rise and it became profitable to gather scrap. The increased flow of scrap will tend to prevent the price of copper from getting out of hand and may even cause the price to drop.

Under the circumstances, any company caught with a large stock of high-priced copper may be in a bad fix. It is just about impossible, however, to run a secondary copper business without a large inventory. We now have about 125 men employed in our secondary operations and they are producing, at the present writing, more copper than the underground mines. A business of this size cannot be turned on and off like a faucet. Even though market conditions make secondary copper unprofitable we will still have to continue on some reduced scale.

Some time during World War II the United States changed from an exporting to an importing nation as far as copper is concerned. It becomes more evident every day that the American market can furnish a tremendous volume of scrap copper if the price is right. The secondary, or scrap, business may in fact take the place of imports to a large degree.

The Calumet and Hecla Consolidated Copper Company was perhaps fortunate in getting a good start during the war in the secondary copper business." P. 5

Clad Scrap Contract, by: C.H. Benedict – "In these days when one is apt to pick up the daily paper and find an article telling of a war contract on which the Metals Reserve Company or some other government agency may have lost a great deal of money. It is refreshing to review the results of the Clad Scrap Contract that the Calumet and Hecla Company had with the Metals Reserve.

According to that contract the Calumet and Hecla agreed to treat copper-clad steel scrap for the government at a fixed price per ton, guaranteeing a certain copper return to the government and selling for the account of the Metals Reserve the recovered fine copper and the resulting clean steel scrap. The figures have been finally released on this contract and they show about as follows:

We delivered to the Metals Reserve 20,803,587 lbs. of copper and 40,048 tons of steel which resulted in an income of $3,066,837. Against this the raw material as purchased by the Calumet and Hecla for the account of Metals Reserve cost $1,759,128 and all charges for treating this material including the service charge of $5 per ton and the amortization charge of $4 per ton amounted to $1,213,641. The total of these two items amounting to $2,972,770 left a profit to the Metals Reserve Company of $94,068.

This profit is all the more remarkable when one remembers that the price received for the copper was the going market price of 12 cents per lb. This is as against a great many contracts made by the Metals Reserve with copper companies for the delivery of copper for which the Metals Reserve paid to those companies prices ranging from 17 cents to 26 cents per lb. of copper.

Another favorable feature of this contract, so far as the Metals Reserve is concerned, was that the government had to put up no money, except for the purchase of current material. That is to say, the only risk that the Metals Reserve took was that the price of copper or of steel might go down before the contract was completed. Of course the facts were that just the opposite was the case, and the contract was a most satisfactory one to all parties concerned." P. 8

July 1947:

Copper Hydrate – "Lake Chemical Company's Copper Hydrate is currently being advertised in the weekly trade journal "Oil, Paint and Drug Reporter", and a copy of this advertisement is reproduced above. The same advertisement will appear in other trade papers during the coming months as a means of keeping this product before industrial consumers of copper salts and by-products.

The bag pictured above is a common sight to the boys who are handling the product at the Tamarack Reclamation Plant." P. 3

August 1947:

Cupric Oxide; New Product of C. & H. – "In order to further tap the market for finished chemicals, equipment is now being installed at the Tamarack Reclamation plant to produce a chemically pure cupric oxide suitable for direct usage in industrial processes for which mixed oxide is less desirable or unsuited, viz., rayon manufacture, petroleum refining, as a coloring agent in glasses and glazes, primary batteries, etc. Mixed copper oxide will be used as a raw material in the process and it is expected that the plant will be in operation in October.

Calumet and Hecla for many years has enjoyed the position of being the largest producer of copper oxide in the world; a position which it still holds and probably will continue to hold so long as leaching process is used for the treatment of mill tailings and secondary copper-bearing materials.

Copper oxide may be a brilliant red (cuprous) of jet black (cupric), making it necessary that some caution be exercised in speaking loosely of copper oxide. Although both products are similar chemically, they are physically quite different, and as a result have widely varied applications in industry. As an example, the red cuprous oxide is a potent destroyer of the type of sea life that attach themselves to ship bottoms and is, therefore, an important constituent in the so-called anti-fouling paints; whereas in contrast, the black cupric oxide is completely ineffective.

The copper oxides produced at our Lake Linden and Tamarack Reclamation plants are mixtures of these two oxides and vary in color from black to red-brown, depending upon whether there is a predominance of the cupric or cuprous oxide. Since the oxides separately find such different usage, our mixed oxides must be processed further either to separate the two oxides or convert one to the other, viz., a high temperature roasting to convert the contained cuprous oxide to the cupric, or a reduction to convert the contained cupric to the cuprous oxide. This processing heretofore has been done by the manufacturers to whom our products were sold." P. 1

Boiler Foundation Test Holes Being Drilled at Power Plant – Holes were drilled and cleaned out & samples were taken to determine the structure of the ground. P. 3

Mentions of the promotional video put together by C&H (Wolverine Tube) showing the steps the rock goes through and how the copper is processed. P. 8
Link to video: http://youtu.be/TCtgVKwm-7U

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

Installation of a New C-O-C-S Drier at Lake Chemical Plant - "…The installation of this equipment now makes possible utilizing all other production facilities of the plant, and the Truck and Tray driers which have been used up to this time will be dismantled: the space which they occupied will provide additional storage for the raw materials used in Lake Chemical Co. processes." P. 3

Calumet Dam Sands are Being Treated at Reclamation Plant – "The remaining Calumet conglomerate sands near the Calumet Dam, at the Pond Waterworks, are being reclaimed and transported to Lake Linden for treatment at the Lake Linden Reclamation Plant.

These sands were deposited between the years 1868 and 1872 and represent the tailings from the original mill which was located near the existing Calumet Dam. Ore from the Calumet Conglomerate Lode was treated in this mill until the year 1872, at which time the stamps were moved to Lake Linden and erected at the Calumet Mill. Because of the inefficiency in milling methods at this early date and also because of the unfamiliarity with the method required to treat the conglomerate ore, the tailings loss was very high.

During the summer of 1927 work was started on reclaiming these sands and this work was continued until weather conditions forced the abandonment of the project in the fall of that year. Operations were continued during the summer months of 1928, 1929 and 1930. The amount of sand remaining to be reclaimed at this time was not considered large enough to continue the work in the spring of the following year. At the present time, however, with the sales price of copper at its present level, the work of reclaiming the remaining sands, although the quantity is small, will return a worthwhile profit." P. 4

New Warehouse for Lake Chemical Plant – "Owing to the variation in demand for copper oxide and the seasonal needs for C-O-C-S, a large amount of these products have to be stored at times. The available storage space in the Lake Chemical and Secondary departments is not sufficient to take care of this quantity, so additional space has to be provided.

The Lake Mill is conveniently located for this purpose as it adjoins the Tamarack Reclamation plant on the south. The upper part of the mill is not needed and will be scrapped this fall but part of the lower portion is being converted into a warehouse. All machinery and foundations in this part of the mill have been removed and openings for pumps or launders will be filled in and a cement floor laid on the fill. The roof will be replaced and made water tight. It will be necessary to put in a new wall on the west side of the warehouse before the remainder of the building is torn down.

One column was removed and a ramp provided at the north entrance so trucks can enter the building. A tow-motor will remove the pallets – on each of which 30 or 40 bags are placed – and stock them from the trucks in piles so they can be easily taken out as required.

The southern part of the building will not be needed for bag storage so will be used to house unused machinery and electrical equipment. As the building is about 80x200 feet, there will be ample space for both purposes.

As two of the four stamps in the Lake Mill are duplicates of those in the Ahmeek Mill they will be dismantled and used for spare parts for the Ahmeek heads." P. 5

New Foundation for Lake Power Plant – "The work of testing the ground and pilings at the Lake Linden Power Plant has been completed. The tests were made preliminary to installing a new foundation.

After drilling to a depth of 70 feel, hard rock was hit which is satisfactory for the foundation. A tunnel was diverted to inspect the piles which are approximately 19 feet below ground level. Tests indicated the wooden pilings were in good condition.

It is expected that the job of tearing out the old floors and pilings and turbine will commence in October. P. 5

Lake Plant to be Closed – "Announcement has been made by the management of the closing of the Lake Linden Reclamation plant which will take place about November 9th. The plant, engaged since 1915 in reclaiming copper from the huge sand bank of mill tailings from the old Calumet and Hecla Mills, has finally reached the limit of economical operation.

It is planned to reopen the plant next Spring for final clean-up of the sand bank, which is expected to take about four months to compete.

According to present plans some work, including repairs, dismantling of machinery, etc., will be done during the shut down period, which will provide work for part of the employees affected by the suspension of operations." P. 8

October 1947:

Work is Started on Power Plant – "All major contracts have been let for the construction of the new power plant at Lake Linden. The Vern E. Alden Company of Chicago, engineers in charge, are preparing construction drawings for the new installations.

Demolition work on the old foundations, piers and parts of the sidewalls of the present plant is expected to commence in November. Actual erection is scheduled to begin next spring.

Present work schedules call for the new boiler plant to be in operation in October, 1948. Turbine and power plant installations are scheduled for completion in January, 1949, when the present plant at Lake Linden will give way to the new one.

The vast increase in use of electrical power at the Calumet Division made increase in generating capacity a prime necessity. Total power consumed is over 22,000 kw., and will soon reach 24,000 kw., by the addition of more electrical equipment in the different operations. In addition, cost of generating power in the present plant has risen to the point where it can no longer be considered as an efficient operation.

The new high-pressure boiler, rated at 180,000 pounds of steam per hour at 850 pounds pressure and 825 degrees temperature, the new 7,500 kw. non-condensing turbine and other equipment, are expected to produce power at a coal consumption of less than one pound per kw. The present coal consumption is in excess of two pounds per kw." P. 1

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

Lake Linden Reclamation Will Suspend For Winter Months – Another mention of the Lake Linden Reclamation plant being shut down for the winter and repairs to be made for opening again in the spring. P. 5

November 1947:

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

December 1947:

C&H Experiments on Florida Farm Lands – Tests Will Determine Value on Copper Oxide as a Fertilizer – "…It has been estimated by responsible authorities that, in the state on Florida, copper treatment is being used on 625,000 acres of soils producing citrus, truck crops, and pasture lands, and that 5,000,000 acres in that state should be receiving regular treatments of copper. At a rate of 20 pounds per acre, 112,500,000 pounds of copper would be required to treat the nutritional deficiency on this acreage alone. Copper deficiencies in other sections of the United States require additional tens of millions of pounds.

Copper sulfate thus far has been used almost exclusively to control fungicidal growth, as a component of fertilizers, and in the dusting of pasture lands, but investigations are now in progress in the state of Florida to determine the effectiveness of Calumet and Hecla copper oxides in these agricultural applications. The program being sponsored by the Company involves the following specific projects: Dust mixtures containing copper oxide are being examined by the Potato Research Laboratory at Hastings, Florida; dusts, sprays and fertilizers by the Citrus Experiment Station, Lake Alfred, Florida; fertilizers and pasture treatments by the Everglades Experimental Station, Belle Glade; soil treatment at the Gainesville Station on grain crops; and fertilizers and pasture treatments by various independent growers and ranchers.

Copper is not only required for normal plant growth to provide adequate yields, but is essential to the production of grains, such as oats and barley. These grains do not normally "head out" under growing conditions in Florida, and unless copper is added, the difference is between a crop and no crop…" P. 1

January 1948:

Cows Turn Purple When Copper is Absent in Fodder – Article about a cow who is believed to have a copper deficiency and how it is purple in color. P. 8

February 1948:

C.&H. is Manufacturing Cupric Oxide at Tamarack Reclamation – "The new cupric oxide production unit, an addition to the Tamarack Reclamation plant, had been completed. In trial runs for several weeks only a few minor troubles developed, these are being corrected. The equipment makes it possible to add a new product to the line of C. & H. copper oxides. Studies of the market indicate that the investment will be justified in increased sales. Although sales of cupric will displace sales of mixed oxide to some extent, they will be made through the same customers who for many years have been buying mixed and making cupric for resale. Some new uses may develop, one important application being in the formative stage at the present time.

To produce cupric oxide, the relatively small but carefully planned installation was added to the present mixed oxide plant. Mixed oxide has heretofore been processed by drying, classification, storage in bins, and finally bagging. The cupric equipment consists of automatic feeds, conveyors, receivers, a roasting furnace, and a pulverizer. The illustration accompanying this article shows the main unit in process, the furnace from which the conveyor delivers the product to the pulverizer; thence into a receiving bin. From this it goes to the same bagging machine used for mixed oxide.

Until the new plant is turned over to the production department it will remain under jurisdiction of the Research Department. Pleased with the progress made, Director of Research, G.L. Craig, says, "Careful planning and a good groundwork of laboratory research have in this case resulted in more nearly attaining calculated capacity and quality than is usually the case. The unit will receive careful attention during the first production runs and will, during this period, require more supervision by the operator and laboratory than will be needed later on. When enough production experience has been accumulated and all control factors are known, this should closely approach the ideal 'push-button' plant unit."

The Research Department, in addition to technical developments, has investigated the market for the new product, thus combining technical and commercial research. A survey of cupric oxide uses was conducted in November and December. The results showed that the applications for cupric oxide are closely allied to those of mixed oxides.

C. & H. is unique in having a leaching process for recovering copper from tailings and scrap. This process involves the use of a number of steel leaching tanks, 54 feet in diameter and 12 feet high. Five of these tanks are located at our Tamarack reclamation, and sixteen are at the Lake Linden reclamation plant. While they were primarily designed for recovery of copper from the sands in tailings and were operated for that purpose for over 30 years, they are equally serviceable for recovering copper from scrap, including steel scrap. The tanks individually take a charge of 500 tons per loading. The leaching process uses copper ammonium carbonate, from which the copper is precipitated by steam and a portion of the solution is subsequently regenerated by oxidation for repeated use.

Buyers of copper oxide have an alternative source of supply in mill scale, an "offal" by-product of copper mills and fabricators. It is usually contaminated with grease, shop refuse, moisture, and sometimes with other metals. One characteristic of scale is its clinkered particle or grain. It is not naturally a finely divided powder.

Scale, of course, can be degreased an dried where the plant producing it has sufficiently large production to warrant doing so, but in general it is more economical to smelt it. C. & H. is a large buyer of scale for smelting. The picture generally is that fabricators of copper are learning how to eliminate losses through formation of scale. Scale used to be formed in annealing furnaces, but these now have controlled atmospheres which prevent oxidation. As industry learns to eliminate scale, the market for our precipitated oxide should expand.

While copper oxides may be produced by roasting or burning copper, this method gives clinkered particles like scale, and has no commercial importance. Coarse particles are not comparable to the finely divided powder obtained by precipitation. It is this difference which gives our oxides an edge over others, and with careful quality control we can maintain our leadership in the field.

Finely divided cupric is ideal for chemical purposes; such as, oil desulphurizing, manufacture of cupric chloride, acetate, hydrate, copper soaps, copper catalysts, etc.

Precipitated cupric oxide presents large surfaces for quick chemical reaction. Likewise for use in ceramics, where a rapid and uniform dispersion of coloring agent is desired, the finely divided oxide has big advantages.

C. & H. is conducting special research to provide clinkered or course particle similar to scale so that it will have a useful product for 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. Our product, being produced under controlled conditions with laboratory and research facilities continuously on the job, can maintain a desirable quality and consistency. Customers appreciate this service.

The Research Department believes that sales of the new product will naturally channel through those who have been buying mixed oxide and converting it to cupric. These custo-" P. 1
"mers have had relatively high costs of conversion due to the expense of maintaining their own roasting facilities and handling and rehandling the material. There are about ten different plants in which this has been done. Doing the same job for all in one place is certain to be economical.

Our sales policy is in formulation, and it appears that we shall confine sales of cupric to a few large customers who will resell to the industrial field. In this way there would be no need for enlarging our selling organization, and we keep the valuable asset of friendly relations with our large customers who have their own sales forces. If primary battery manufacturers can use our clinkered or coarse particles for making plates, this application would probably be large enough to justify sale direct to them.

During the course of the survey made by our Commercial Research Department, a possible new application was discovered which was in final stages of development, and in a matter of only a few weeks it should become apparent whether it will be successful. Regardless of success or failure in this matter, however, the rest of the market for cupric oxide should continue at its former level of consumption.

When the Research Department turns over the unit for regular production to the Secondary Department, only one major phase of the problem will remain to be accomplished; namely, product grading. As in every other field, the customers for oxides are concerned with the purity, density, particle size, etc. Oxides made from high grade scrap or from mill tailings are commercially or technically pure, but those made from low-grade scrap may contain zinc up to 3% by weight. The production of the four main grades of cupric oxide needed by our customers would be a simple matter if the leaching tanks were operated on separate circuits. As the matter stands at present, to produce different grades the entire leaching plant would have to be shifted from one grade of scrap to another. Further study may show whether division of the leaching circuits will be necessary so that flexibility of production can be obtained. It is certain that C. & H., which has produced as much as 35,000,000 pounds of copper oxide in a single year, will take in stride the problems presented by cupric oxide production." P. 8

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

April 1948:

Lake Linden Reclamation Plant to Resume Operations Soon – "The Lake Linden reclamation plant will begin operations as soon as the pontoons and dredge can be put into position, which in turn is dependent upon when Torch Lake is free of ice…What coarse sand remains is high in copper but it will prove to be contaminated by rubble and rubbish because its very proximity to the shore and town made it a convenient dumping ground in the early days when there was no thought that it might prove to be an asset in the future.

It is of no value at this late date to write of the past profitable history of this depleted and wasting asset but a few figures may be of interest. Beginning operations in 1915 with only regrinding and table concentrating available, the leaching plant for sands was put into commission in 1916, and the flotation plant on slimes added in 1919. As of the present date 36,351,000 tons of sand have been treated with a recovery of 407,038,000 lbs. of copper, and at a profit in excess of $30,000,000. In 1929 the plant made a profit of $3,332,000 and this from an operation that fifteen years earlier had been considered a risky venture.

When the sands are exhausted the dredge and pontoon line will have a fair salvage value for use either at Tamarack or Quincy, or possibly outside the district entirely. The regrinding plant and the flotation plant will be of no further value in their present location but the leaching plant and still house will be available for secondary copper operations, and for such ores as may in the future require leaching." P. 4

Calumet and Hecla Agricultural Test Program Has Been Greatly Expanded – "The agricultural research program reviewed in the January issue has been broadened and now includes 38 individual projects in the State of Florida. Calumet and Hecla 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.

It has been demonstrated that copper is essential to produce maximum yield and quality of crops, and the results obtained on Florida plantings during the past winter will be carried into other states during the summer. The need for copper exists in various types of soils, and its use is currently recommended for certain crops by the agricultural experiment stations of Florida, Georgia, North Carolina, New York, Indiana, Wisconsin, New Jersey, Oregon, and Michigan. Copper deficiencies are known to exist in other states, but additional field work is needed to confirm the results obtained in the states referred to. New Markets for copper are expected to develop in an orderly manner…" P. 7

Copper Hydrate Plant to Resume Operations – "Preparations are being made to resume production of copper hydrate in the near future. Equipment has been altered to increase the efficiency of the process, and it is now expected that the plant will be operating at near capacity in May.

Copper hydrate has been tried in a number of commercial processes, and several encouraging new applications have been developed. Renewed interest in the use of copper soaps for mildew-proofing and wood preservation has occurred in recent months, and there are indications that markets have been developed to a point where continuous operation of the plant is justified." P. 8

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

International Union of Mine, Mill and Smelter Workers – Letters and Contract Proposals. P. 5

June 1948:

Torch Lake Stamp Sands Are Being Studied – "The million tons of tailings, stamp sand which was dumped into Torch Lake, have been the subject of investigation from time to time to determine whether they have industrial value after removal of the copper.

The two 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 conglomerate sands that may make them useful.

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.

The question of whether profitable sales can be made depends on the amount of handling and screening necessary to prepare them and on the freight to the point of use. When bottoms for water shipment to points on the Great Lakes can be used, the market may broaden.

No substantial market has been found yet, but the possibilities are the subject of continuous investigation by the Research Department." P. 7

July 1948:

Fertilizer Program Tested In Florida – Treatment of crops with copper. P. 1

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

Production of C-O-C-S Is Temporarily Discontinued – "Production of C-O-C-S copper fungicide at the Lake Chemical Company plant was temporarily discontinued on July 1. The demand for this product is seasonable, and consumption has not as yet reached sufficient volume to justify operating the plant on a year-round basis. However, shipments during the past 12 months, ending June 30, increased approximately a quarter of a million pounds over the previous 12 months.

Shipments to California, Texas and Florida consumers are expected to start in October, and production will be resumed later in the summer." P. 5

Calumet and Hecla Railroad Equipment is Modernized – Replaced steam locomotives with new, diesel ones. P. 7

September 1948:

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

October 1948:

Reclamation Plant Closing After Thirty Years of Operation – "Before this article has been set in print the Lake Linden reclamation plant will probably have been permanently shut down, the available sand being about exhausted. This marks the end of the most profitable of the Company's properties and over the thirty years of its operation it has been responsible for a large percentage of the Company's earnings. It is unique in the history of metallurgical operations as being the largest tailings retreatment plant ever erected.

The idea of retreating the rich conglomerate tailings goes back almost fifty years. A small experimental unit was actually erected on the Calumet sands by outside capital as far back as 1903. At that time President Alexander Agassiz majestically waved the over-optimistic promoter off the location saying, "someone in the organization will some day show how it should be done." Metallurgical developments in the following ten years justified his judgment.

The project received serious consideration at the time of the first consolidation and in 1911 a value of $4,150,000 was established for this asset and successfully defended in court. It proved to be much too conservative but it was based on the results to be expected of a plant that was to regrind the sands and save the metal on Wilfley tables, with an anticipated recovery of only one-third of the contained copper.

Operations began in 1915 with the Regrinding plant as the only produc-" P. 1
"ing unit and while the recovery was low the cost per pound of copper was under seven cents. In 1916 the leaching process for treating sand was developed and the recovery of copper was doubled. By 1919 the flotation process for recovering copper from slimes was perfected, completing the metallurgical treatment.

The flow-sheet and general method of treatment was worked out by C.H. Benedict and the mechanical design by H.E. Williams, chief draftsman, and Robert McIntosh, mechanical engineer and later plant superintendent. The leaching plant process was developed and patented by Mr. Benedict but credit for its successful and smooth operation in practice must be attributed largely to H.C. Kenny, leaching plant superintendent before going to his present position at the smelter. Mr. R.M. Haskell has successfully piloted the flotation plant since its inception, with Adolph Stebler foreman in charge. The dredging of the sand and its delivery to the operating plants has been in charge of Oliver (Ollie) Baril. Except for Mr. Williams, who died a year ago all of the above men saw the plant being erected, operating and now shut down. It is due to their loyalty, as has been true of the whole operating personnel, that the plant has been such a success.

Before the plant was put into commission an estimate was made of the tonnage, grade and probably copper recovery, based on the Company production data of rock, mineral and tailings. These figures had to be a matter of record for both State and Federal tax accounting as to depletion value. The recovery from conglomerate was set up at approximately 400,000,000 lbs. copper from 34,470,000 tons sands, 11.6 lbs. copper per ton of sand. Through September 1948 the actual recovery has been 413,133,823 lbs. copper from 36,646,000 tons sand, a per ton equivalent of 11.3. For the three years previous to the present conglomerate clean-up, the plant has been treating mostly amygdaloid, which just about accounts for the excess tonnage and copper, and lesser pounds per ton sand. As nearly as can be figured the original estimate is within 2% of the actual performance as to tonnage and grade, and equally accurate as to estimated cost and profit.

With the closing of the plant the dredge will be transferred to Tamarack and the Tamarack dredge will be ready for sale. The pontoons and discharge pipe are all standard for Tamarack and will be gradually absorbed at that location as the discharge line becomes extended and present equipment wears out. The shore plant pump and piping on the suction bridge is also standard for the Tamarack.

The shore plant structure and belt conveyor gallery will be scrapped as soon as its equipment is removed. The conveyor belt, drive and idlers will be used at the zinc property at Shullsburg, Wisconsin, as it is the case too of some of the miscellaneous items in the flotation plant, including at least one of the 40 ft. thickeners. The flotation plant itself will be held intact for the time.

In the regrinding plant most of the pebble mills and other machinery will be scrapped. The plant will be turned over to the secondary department for storage, with possibly some of the present equipment to be used for auxiliary operations now carried on at the smelter. The secondary department will take over bodily the leaching plant and still house, which will continue in operation on copper scrap.

A matter of concern to the management equal to that of the loss of revenue has ben the fate of the employees caught by the shut down. Fortunately a retirement fund was set up years ago to meet this contingency, and all employees over 65 years of age in 1948 must, and any employee in service over five years may, retire and receive a bonus based on his years of service. Positions have been found for all the permanent employees who do not wish to accept the retirement bonus, such acceptance carrying with it as it does all future obligations of the Company." P. 8

November 1948:

Will Test Conglomerate Sands For Use As An Abrasive Agent – "…For the past few months Poor and Company at their Waukegan laboratory have been investigating the use of finely ground conglomerate sand as an abrasive in buffing bars, deburring compounds, and liquid abrasives. These items are widely used by the metal finishing industry in preparing products for plating…" P. 1

Secondary Leaching Plant Temporarily Suspended – "The Secondary Leaching department of the Tamarack Reclamation Plant has suspended operations temporarily. The Company has been unable to sell copper oxide as fast as the plant has been able to produce it and has a large inventory of bagged copper oxide on hand. The layoff is expected to continue until the inventory is reduced and sale of copper oxide catch up with production." P. 1

C. & H. Will Keep Lake Reclamation Buildings for Future Projects – "There have been rumors that the Company intends to dismantle and scrap the equipment and buildings at the Lake Linden Reclamation Plant. On the contrary, investigations are already under way looking to the utilization of these buildings and equipment for other purposes. It is hoped that it many be possible to produce other products in these plants. At any rate, the Company has no intention of scrapping the buildings." P. 8

December 1948:

Conglomerate Tailings at Lake Linden Have Been Exhausted – Now Using Copper Bearing Slimes – "An article in last month's "News-Views" indicated that the Lake Linden Reclamation plant would cease operations about December 1. While the entire plant did not shut down on that date, the exhaustion of coarse sand forced the closing of the shore plant and the regrinding plant, and they are now permanently out of the reclamation picture.

This marks the near-end of one of the most profitable of the Calumet and Hecla properties – one which has for over 30 years been responsible for a major percentage of the Company's earnings. The world's largest tailings retreatment plant has completed all but the finishing touches on the job for which it was erected.

However, the Reclamation plant is showing unexpected life. Having exhausted the supply of conglomerate sand, the resourceful plant Superintendent, Bob Haskell, turned the persistent dredge on the next best thing – the slimes which had sloughed off from the shore-plant pool during the cleanup operations. Since these are already fine enough for processing by leaching or flotation, they are being pumped directly to the leaching plant classification system. At present the system is handling 30,000 – 40,000 tons of slime per month, or about one-third of the average output of the entire plant when it was treating rough sands. The material now being handled is of sufficient high quality so that the production of the flotation plant with an occasional tank in the leaching plant will yield enough copper to operate the Reclamation for a time at a profit. Estimates of the quantity of slime available are not comprehensive, but at present they range from a 4 to 6 month's supply. The slimes being pumped into the plant are also a source of material for experimental work on abrasives.

No decision has been made as to whether the plant will operate throughout the winter. The shore plant and conveyor will be held intact for the time being, pending developments on the abrasive plant. Except for a few items including one or more 40-foot thickeners which will be used at the zinc property at Shullsburg, Wisconsin, the flotation plant will also be held intact."
P. 4

Benedict Retires After Fifty Years – C.H. Benedict retires. 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

Production of Copper Hydrate Resumed – "Production of copper hydrate was resumed in January.

Markets for this specialty product have not as yet developed to the point where the plant can be operated continuously. However, the usage is expanding, and larger backlogs are being built up for each production run." P. 5

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 original 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

February 1949:

Production of Oxide at Tamarack Resumed – "The Tamarack leaching plant has resumed production of mixed copper oxide, after having been shut down for three months because of the accumulation of too large an inventory of copper oxide. Supplementing several large industrial orders for copper oxide, orders have been received for oxide to be used for agricultural applications in Florida, and as a result the inventory of oxide at Tamarack had been reduced sufficiently to justify resuming operation of the plant. In recent weeks several cars of oxide from the Lake Linden plant have been shipped to the Tamarack plant to be dried and bagged for the use on agricultural orders." P. 1

New Company Is Organized – "The Prozite Company has been organized by Calumet and Hecla, and Poor and Company of Chicago, it manufacture buffing and polishing compounds from the conglomerate sand. The equipment requirements of the new company will be installed in the Calumet Mill and the products manufactured by Calumet and Hecla. Sales will be handled by Poor and Company. Operations thus far have been confined to pilot plant scale testing and market surveys…" P. 4

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

James MacNaughton, Former C. & H. Head, Passes – Article about his life. P. 3
<u>End of Calumet and Hecla – News & Views. November 1942 – May 1949</u>

INTERVIEW SUMMARIES FOR TAMARACK RECLAMATION AND AHMEEK MILL

<u>Interviewee #7: PS</u>
Conducted by Daniel Schneider
July 22, 2014
Topic: Working at C & H Reclamation and at Lake Chemical

PS worked at Calumet & Hecla, mostly at Lake Chemical, from 1960 through early 1964. PS worked at the Tamarack reclamation plant at the beginning of his employment with C & H. He was a third-generation worker on Torch Lake's industrial waterfront. His father and grandfather worked in C & H's smelter, the latter doing work that included adjusting the scales that were used to weigh copper ingots. PS left the Copper Country for Detroit in 1964, where he worked for General Motors until his retirement, at which time he moved back to the Keweenaw Peninsula.

PS said the reclamation plant was in continuous operation: "The only time I ever knew it to shut down is in the summer they had a two-week shutdown in July and they would repair the machines and do maintenance work." In addition to the stamp sand that was dredged from Torch Lake, C & H hauled truckloads of stamp sand in from other mining properties in the Keweenaw. PS's first job at the reclamation plant was to tend the screen that captured debris from incoming stamp sand being dumped out of trucks. These trucks would dump the sands directly into the collection pond at the head of the shore plant, the same pond which received sand pumped in from the dredge. Pumps inside the shore plant carried the commingled material from the collecting pond to the regrinding plant, where ball mills ground the sand into a fine powder for flotation.

Lake Chemical's production plant was located within the Tamarack reclamation plant. PS remembers the copper oxide products Lake Chemical produced by color, not by name. One copper-based chemical was blue in color, and others green. All of the dry Lake Chemical products were extremely dusty, especially during bagging. "And we used to breath all that stuff," PS said. "Nowadays . . . you'd have to have a mask on but . . . the only mask you ever wore (was) a little mask and that was supposed to stop the smell of ammonia a lot." He described health effects of working with the dusty copper oxide. "I'd go home, I can remember . . . blowing my nose you'd have blood clogs in it and green in it." Workers' clothing was constantly colored green from the dust, which also settled on the eating surfaces in the employees' break room.

To make the copper chemicals, scrap copper was dissolved in large vats of sulfuric acid. The sulfuric acid arrived by train in tank cars. The walls of the vats were made of lead so that they would not to dissolve in the acid. Two men worked on each chemical production system. One metered out the prescribed ratios of acid, copper, and other chemicals while the other tended the machines. PS did the latter work. Among the dangers attendant to working with these processes was that of sulfuric acid spills. Turning the wrong handle could cause acid to spill through a relief valve, rather than flowing into the tanks. This happened to PS once. He escaped uninjured, but the acid ate away the fabric of his pants.

After all the copper went into solution, water was removed by means of drying drums which rotated and were heated. The dried C.O.C.S. (this was the name of one of the products) would accrete on the inside of the barrel and get scraped off (apparently an automated process), pulverized into a fine powder, and then bagged. Another copper oxide product, Copper Hydrate, was dried on a conveyor belt rather than in a drum. Both types of drying equipment had filters which frequently needed replacement. Replacing these filters was one of PS's jobs. He said copper hydrate was made in smaller batches compared to C.O.C.S., and PS said much less hydrate was made.

PS said Lake Chemical's products were used especially by Florida citrus growers. He remembers their trucks arriving at the plant. The truck drivers would offer Lake Chemical workers crates of oranges to encourage them to load the trucks quickly. Another oral history narrator, PG, said one of the Lake Chemical products was used as a fungicide on peanut farms. Truckers from Georgia brought large bags of peanuts for the Lake Chemical workers. Product was shipped in either 50- or 100-lb bags. For international shipments, bags would be packed into fiber drums, four bags per drum. Bags to be delivered in the United States were stacked on pallets. PS suggested that the product that left Lake Chemical was not ready for application, but rather was mixed with water and sprayed.

Key Points:

- The reclamation plant received stamp sand by truck from distant points in the Keweenaw. This material was commingled with the stamp sand being dredged into the plant from Torch Lake.
- The Lake Chemical production plant was located within the Tamarack reclamation plant.
- Both the reclamation plant and Lake Chemical plant required only small work crews.
- Sulfuric acid used in the production of Lake Chemical products arrived by rail on tank cars.
- The tanks in which copper oxide chemicals were mixed had lead walls.
- Copper chemical dust covered everything in the working area of the plant.
- Health effects of working with these chemicals, particularly from the chemical dust, included green mucus and blood clots in the mucus.
- Filters that were part of the product drying mechanism had to be replaced frequently, creating a possible waste stream.

<u>Interviewee #8: JD</u>
Conducted by Daniel Schneider
August 16, 2014
Previous Interview Conducted by Jo Urion
October 13, 2005
Topic: His work at the Ahmeek Mill

JD was a third generation Calumet & Hecla employee. He worked for the company from 1948 to 1968, first in the Ahmeek mill and later as an maintenance worker, in which capacity he did work in multiple facilities along the Torch Lake Waterfront. During his time working in the Ahmeek mill, JD started out as a head feeder and worked his way down through the various steps in the milling process. Prior to working for C & H, JD worked part of a year at Horner Flooring in Dollar Bay. After C & H shut down, he worked for Michigan Technological University at its forestry center in Alberta.

JD said there were eight stamps in the Ahmeek mill. These were Nordberg duplex stamps. The mill ran 24 hours a day. The mill had its own boiler plant next door. "It furnished steam for the mill and then they used the spent steam to run a turbine," he said. "They had a power plant there, too. Electric power plant." The mill still used electrical power from C & H's centralized mill in Lake Linden. JD is not sure what the ratio was of power used from one plant versus the other. In contrast to the older mills that were located in Lake Linden, where boilers, pumps, and sand wheels were all located in separate buildings, the Ahmeek mill's accessory equipment was all consolidated in its boiler house (which was separate from the mill itself). Sand pumps were used at the Ahmeek mill, rather than the sand wheels that had been used at the earlier mills (the vertically-mounted wheels were necessary to carry stamp sand to higher elevation so it could flow out further into Torch Lake).

JD described ore from different mine shafts having different properties. Some ore was harder than others, for instance, and wore stamp shoes out more quickly.

JD described a condition called the "copper shakes" which resulted from inhalation of copper dust when changing copper oxide filter bags in the Still House in Lake Linden (he must have done this job during the time he worked on maintenance):

> When you changed those bags, you were bound to inhale a certain amount of that dust even with the respirators on. And then it didn't bother you at all during the day, but then at night, oh, you'd just get the chills you just couldn't get rid of. That would happen to everybody sooner or later if they'd work on that job. But it was a nice job because it used to take us about, oh, six hours to do it and they'd pay us three shifts for that . . . it's something you worked and you got (the copper shakes) once, and then you didn't go on that job anymore.

JD said copper in solution with ammonia moved from the leaching plant to the still house (both in Lake Linden) through pipes. Post-distillation ammonia was recycled through the system. Copper oxide produced in the still house was shipped out for fertilizer production, even before Lake Chemical started operations at Tamarack reclamation. JD said at one time there may have been a still at Tamarack reclamation (most of Lake Chemical's product was made directly from scrap copper processed in sulfuric acid).

Key Points:

- The Ahmeek mill had its own power plant. It used spent steam from the stamps to run a turbine to generate electricity.
- All of the Ahmeek mill's accessory equipment (boilers, water and sand pumps) was located in its boiler house next to the mill.
- Ammonia (pure) and ammonia with dissolved copper was carried between buildings (leaching plant and still house) in Lake Linden via pipeline.

<u>Interviewee #9: JE</u>
Conducted by Daniel Schneider
July 15, 2014
Topic: Memories related to the Ahmeek mill and Tamarack reclamation plant

JE worked for Calumet & Hecla's security force from 1948 until the company's shutdown in 1968. The security force's territory was divided into five different areas of operation, one of them being the Torch Lake waterfront. JE's work brought him into contact with the C & H facilities up and down the Keweenaw throughout the 20 years he worked there. During the last years of C & H's operations, JE's work was more focused on the Torch Lake waterfront.

JE said C & H trucked stamp sands down to its Tamarack reclamation plant from points in the Keweenaw as far away as Phoenix Location. Other oral history interviewees, including PS, have also described this practice. JE said the pipes that carried stamp sand slurry from the dredge to shore plant at Tamarack reclamation would wear from the sand passing through them, and would be turned in their mounts periodically so they would wear evenly.

JE corroborated various accounts of the coating being burned off copper wire in large, open fires outside the C & H smelter as part of C & H's scrap recycling operation. Copper-bottomed Revere Ware was one of the types of scrap processed.

JE said post-reclamation tailings, piled outside the plant, would dry in the wind and, being such a fine powder, would blow into nearby homes. He said C & H installed a sprinkler system to wet down the sands in an attempt to mitigate these effects.

Key Points:

- JE described dry, post-reclamation tailings being carried in the wind and blowing into nearby homes. C & H installed sprinklers to wet the tailings down in an effort to prevent this from happening.

- C & H trucked stamp sands from as far away as Phoenix Location to its reclamation plant.

- JE corroborated accounts of coating being burned off wire scrap in large open fires in the C & H scrap yard.

LIST OF C&H ARCHIVAL RECORDS CONSULTED

AHMEEK FILES - AUGUST 24, 2014			
Series/Description	Box	Folder	Year(s)
4.4.3 (4.3.3) Reports of Future Cost, 1918-1931			
Ahmeek	214	1	1918-1923
Ahmeek	214	2	1918-1923
4.4.22 (4.3.15) McNaughton: Alphabetical, A-Z, 1917-1921			
S.R. Smith, Superintendent of Ahmeek Mining Company	172	44	1917-1921
4.4.29 (4.3.22) McNaughton: Alphabetical, A-Z, 1929-1930			
Stone & Webster-Ahmeek Mill Power Plant	73	51b	1929-1930
Stone & Webster-Ahmeek Mill Power Plant	73	52	1929-1930
Stone & Webster	73	53	1929-1930
4.4.40 (4.3.32) Engineering Department, Alphabetical, S-W, 1911-1969			
Sheave Stands, Ahmeek #3&4-Calculations, Blueprints, Shipping, Statements, etc.	127	16	1938-1939
4.4.40.4 "T" Continued			
Tamarack-Osceola-Ahmeek Fire Protection	38	9	1916-1937
Tamarack Water Main, Ahmeek & Osceola Mills-Correspondence,Blueprints, Cost Sheets	38	13	1921-1935
4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968			
Flow Charts, Handwritten Notes, Critique of Ahmeek Mill-Study, Mill Sampling & Accounting	138	15	N/A
Calumet Foundry Automation Reports, Drawings; Ahmeek Mill Meeting Minutes	139	8	1966-1967
Ahmeek Mill-Report, Corr., Drawings	139	25	1963-1967
5.6.1 (5.6.1) Income Tax Returns			
Ahmeek Mine	231	1	1913-1924
5.7.1 Bureau of Mines			
Ahmeek (Form 6 -1190-M)	166	2	1954-1964
Ahmeek Mill (Form 6-1178-AM)	166	25	1968
Ahmeek (Form 6-1178-A)	166	19	1955-1958
5.10.2 (5.10.2) Asset Valuation and Insurance Appraisals, 1906-1965			
Information Appraisals, Allouez, Ahmeek, Centennial, Osceola, LSS Co., LaSalle, Superior, White Pine, Lake Milling	33	B	1912-1919

AHMEEK FILES - AUGUST 24, 2014 (CONTINUED)			
Series/Description	Box	Folder	Year(s)
5.10.2.1 Insurance Appraisals of C&H's physical holdings–Reports to general manager			
Ahmeek Mining Co.	207	6	1912-1920
5.10.2.2 Insurance Appraisals of C&H, Incorporated's physical holdings			
Ahmeek Mill	207	1	1956-1965
5.10.3 (5.10.3) Depreciation, 1923-1964			
Plant Depreciation Record for LaSalle, Mutual Water Light & Power, L M S & R, Ahmeek, Osceola and L S S Co.	605	All	N/A
5.11.2.1 Pumps			
Ahmeek Mill & Blueprints	35	19	1925
5.12.3 (5.12.3) Boiler Inspection Reports, 1913-1942			
Ahmeek Mill-Stirling Boilers	37	4	1930-1942
Ahmeek Mill-Old Boiler House	37	32	1927-1930
6.1.1.4 Miscellaneous Records			
Index for Letters in 573/016 Lists Subject & Page for Ahmeek Mine & Mill through White Pine Copper Co.	573	15	1909-1945
8.1.1.6 Ahmeek Mill			
Flow Sheet & Data	78	9	1968
Operation	78	10	1966-1967
Reports	78	11	1950-1952
Modernization	78	12	1953-1957
Office	78	13	1964-1969
Leaching of Concentrates	85	15	1958
Reports, Tracings, Blueprints	151	1	1927-1960
Reports, Tracings, Blueprints	151	2	1927-1960
Reports, Tracings, Blueprints	151	3	1927-1960
Reports, Tracings, Blueprints	151	4	1927-1960
Power Plant-Memorandum of Contract	151	5	1930
Power Plant-Memorandum of Contract	151	6	1930
Power Plant-Memorandum of Contract	151	7	1930

AHMEEK FILES - AUGUST 24, 2014 (CONTINUED)			
Series/Description	Box	Folder	Year(s)
Power Plant-Memorandum of Contract	151	8	1930
Power Plant-Memorandum of Contract	151	9	1930
Power Plant-Memorandum of Contract	151	10	1930
Power Plant-Contracts	151	11	1930-1936
Power Plant-Contracts	151	12	1930-1936
Power Plant-Contracts	151	13	1930-1936
Power Plant-Contracts	151	14	1930-1936
Power Plant-Specifications	151	15	1930-1936
Power Plant-Specifications	151	16	1930-1936
Power Plant-Specifications	151	17	1930-1936
Power Plant-Specifications	151	18	1930-1936
Mill Return & Mill Yields	151	19	1959-1968
Proposals Covering New Steam Generating Units, C&H, Inc	151	20	1961
Proposals Covering New Steam Generating Units C&H, Inc. Note: this Oct. 11, may complete item 1962	151	21	1961
Pump House Intake Well Repairs	151	22	1965
Power Plant. Mechanical Drive Turbine Info, Estimate	151	23	1966
Metal Processing-Purchase & Appropriation Requisitions, Quotations	151	24	1966
Conversion of Mill Circuits for Increased Capacity and Processing of Conglomerate Ore	151	25	1965-1966
Metal Processing Automating the Fuel to Steam Stamps 1,2,4,5-Proposals	151	26	1967
Metal Processing, Proposed System for Sampling & Disposal of Ahmeek Tailing. Report & Estimate	151	27	1967
Drawings: Power Generation, Power Plant, New Terry Turbine	151	28	1967
Operating manual-Power Plant, Lake Linden Power Plant	151	29	1969

TAMARACK FILES - SEPTEMBER 20, 2014		
Series/Description	Box	Folder
4.4.40.3 Tamarack Reclamation Plant		
Correspondence, Blueprints	39	19
Conveyor	39	20
Correspondence between Tamarack Reclamation Plant & American Bridge Co.	39	21
Correspondence between Tamarack Reclamation Plant & American Bridge Co.	39	22
Correspondence between Tamarack Reclamation Plant & American Bridge Co.	39	23
Conveyor	39	24
Distilling Section	39	25
Heating System	39	26
Tamarack Leaching & Flotation	39	27
Tamarack Leaching & Flotation Building - Copper Oxide Plant	39	28
Cupric Oxide Plant	39	29
Tamarack Leaching & Flotation Building-Stills	39	30
Leaching & Flotation Building	39	31
Leaching & Flotation Building	40	1
Leaching & Flotation Building	40	2
Oil House	40	3
Pumps	40	4
Tamarack Reclamation Plant - Secondary Copper	40	5
Shore Plant	40	6
Tamarack Reclamation Plant - Sketches	40	7
Steam Main	40	8
Water Supply	40	9
Flotation Section	40	10
Remodeling	40	11

TAMARACK FILES - SEPTEMBER 20, 2014 (CONTINUED)		
Series/Description	Box	Folder
4.4.40.4 "T" Continued		
Tamarack Tailings Plant	38	11
Tram Car Loaders & Scraper Hoists	38	18
Transportation	38	21
Report on Lighting Protection for Electrical Transmission System	38	22
Miscellaneous "T" Files	38	23
5.7.1 Bureau of Mines		
Tamarack Reclamation (Form 6-1184-M)	165	9
Tamarack Reclamation (Form 6-1190-M)	165	10
Tamarack and L.L.-Chemical Plant (Form 6-1115-AS)	166	28
Tamarack Reclamation (Form 6-1179-H)	166	17
Tamarack Reclamation (Form 6-1178-A)	166	18
5.10.1 (5.10.1) Inventory, 1928-1968		
Alternating Current Machines-Vol. 2 (Smelts, L.M.S.R., Lake Chemical, Tam. Rec.)	315	2
5.11.2.2 Other		
Tamarack Reclamation Plant-Sketches, etc.	36	27
5.12.3 (5.12.3) Boiler Inspection Reports, 1913-1942		
Osceola Mill, Tamarack, Reclamation Plant	37	16
6.3.4 (6.3.4) Chemical Engineering Branch Files, 1925-1969		
Tamarack Reclamation-MCMT Project	202	5
6.3.5 (6.3.5) General Department Files, 1907-1969		
WPB Research Project-Reclamation of Copper, Zinc & Steel from Gilding Metal Clad Scrap from MCMT	556	1
8.1.1.8 Ahmeek Mill–Tamarack Reclamation Office Time Books		
1940-1942	147	1
1942-1946	147	2
1940-1942	147	3
1942-1946	147	4

TAMARACK FILES - SEPTEMBER 20, 2014 (CONTINUED)		
Series/Description	Box	Folder
1944-1947	147	5
8.1.22.1 Tamarack Mining Company		
Sale of Assets to C&H Mining Co.	537	5
8.1.22.5 Tamarack Reclamation Plant		
Tamarack Reclamation-Rock & Mineral Ledger	274	4
Tamarack Reclamation-Rock & Mineral Ledger	274	5
Tamarack Reclamation Plant-Leaching & Flotation Cost Sheets, Supply Sheets, Correspondence	276	1
Tamarack Reclamation-10" Morris Sand Pump-Calculations	276	2
Report on Tamarack Reclamation Plant	276	3
Tamarack Reclamation Flow Sheet	87	3
Tamarack Sands-Corr.	270	4
Tamarack Mills-Tamarack Sands	270	5
Tamarack Reclamation-Output Lists	271	1
9.1.13 Mine Quotas		
Tamarack Reclamation Quota	583	13
9.5 (Subseries 9.5) Reclamation 1920-1972		
Secondary Copper Department-Lake Linden Leaching Plant Reports	572	1

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20		
Series/Description	Box	Folder
4.4.14 (4.3.7) MacNaughton Numeric File: #1-141, Various Companies & Topics, 1910-1914		
Dollar Bay Land & Imp. Co.-Deeds for Tamarack & Chemical Co.	55	34
4.4.38 (4.3.30) President's Office Alphabetical, A-Z, 1910-1969		
Report-Chemical Plant Proposal	84	13
Report on Copper Carbonate Chemicals	85	17
4.4.41 (4.3.33) Petermann Alphabetical, A-Z, 1941-1944		
Harshaw Chemical Co.	57	16
4.4.44 (4.3.36) Lovell Alphabetical, A-Z, 1945-1951		
Harshaw Chemical Co.	60	4
Smelting and Chemical Department	60	32
4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968		
Chemical Plants	138	3
Lake Linden Chemical Plant (Still House)-Reports, Corr. Appropriation Requistion	139	23
5.6.1 (5.6.1) Income Tax Returns		
Lake Chemical Co.	233	1
5.7.1 Bureau of Mines		
Tamarack and L.L.-Chemical Plant (Form 6-1115-AS)	166	28
5.10.1 (5.10.1) Inventory, 1928-1968		
Alternating Current Machines-Vol. 2 (Smelts, L.M.S.R., LakeChemical., Tamarack. Reclamation)	315	2
6.3.1.2 Research Department Databooks		
Chemical/Mineral Composition, Processing Techniques 1951-1968	203	All
Chemical/Mineral Composition, Processing Techniques 1951-1968	204	All
Chemical/Mineral Composition, Processing Techniques 1951-1968	205	All
Chemical/Mineral Composition, Processing Techniques 1951-1968	206	All
6.3.1.3 Project Files		
Project # 1745 Lake Chemical (Refer to #1913 Milling Process)	160	42
Project # 1810 (Refer to Project #'s (1832-1834) Chemical Research)	160	47

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Project # 1916 (Chemical Processing)	164	2
Project # 1920 (Copper Recovery from Slag and Tailings)	164	3
Project # 1921 (Refer to #1916-Chemical By-Product Removal and Recovery)	164	4
Project # 1922 (Refer to #1916-Chemical Processing Pilot Plant Studies)	164	5
6.3.4 (6.3.4) Chemical Engineering Branch Files, 1925-1969		
Abrasives	197	1
Advertising-Oxide	197	2
Agglomeration-Includes Pellitizing, Briquetting, Sintering, Pressing, etc.	197	3
Airport	197	4
Alamet	197	5
Alcohol Permit	197	6
Algicide	197	7
Am...	197	8
American Mining Congress-Research Advisory Committee	197	9
American Phylopathilogical Society	197	10
American Society of Agronomy	197	11
Analytical and Associated-Sulfite, Chemicals	197	12
Anti-Fouling Plants	197	13
Arsenic	197	14
Battelle Memorial Institute-General Information	197	15
Beebee Process	197	16
Beryllium	197	17
Binder	197	18
Blending Agriculture Oxide	197	19
Booth Impellers	197	20
Briquetting and Related Studies	197	21
Briquetting and Related Studies	197	22

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Calumet & Hecla (Canada) Limited	197	23
Case School of Applied Science	197	24
Cast Iron-General	197	25
Cast Iron-General	197	26
Catalysis	197	27
Cement Copper	197	28
Chemical Products Team Meetings	197	30
Copper Acetate	197	31
Copper Alloys	197	32
Copper and Brass Research	198	1
Copper and Copper Alloys-General 1	198	2
Copper and Copper Alloys-General 2	198	3
Copper and Copper Alloys-General 2	198	4
Copper-Arsenical-General	198	5
Copper Anodes-Electro Plating & Copper Catalysts (Smog Control)	198	6
Copper Chemicals	198	7
Copper Clad Steel	198	8
Copperoyd	198	9
Copper Salts-Petroleum Refining	198	10
Copper-Segregation Process	198	11
Copper-Silver Alloys	198	12
Copper-Root Control	198	13
Tribasic Copper Sulfate-Copper Sulfate	198	14
Tribasic Copper Sulfate-Packaging	198	15
Copper Tuyeres	198	16
Copper Wire-General	198	17
Copper "X"-Colored Ag. Copper	198	18

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	**Box**	**Folder**
Correspondence-Calumet Division-General	198	19
Corrosion	198	20
Corrosion-Mine Waters	198	21
Cost Improvement Program	198	22
Craig, George	198	23
The John Crerar Library	198	24
Crucible Steel Co. of America	198	25
Cupric Chloride	198	26
Cupric Chloride	198	27
Cupronal	198	28
Cuprous Oxide-Harshaw Chemical Co.	198	29
Cuprous Oxide	198	30
Cuprous Oxide	199	1
Cuprous Oxide-Patent Information	199	2
Cuprous Oxide-Patent Information	199	3
Cuprous Oxide Survey	199	4
Copper Sulfides-General	199	5
Cyanide	199	6
DAC Meeting Notes-L.G. Stevens	199	7
Disclosures and Waivers	199	8
Debarker (Log)-W. Warner	199	9
Die Castings	199	10
Electroplating	199	11
L.F. Engle-Correspodence	199	12
Enameling on Copper	199	13
Engine Head-Data	199	14
Engravers Copper	199	15

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Epidote Core Sand	199	16
Explosivity Testing	199	17
Fungicidal Cements	199	18
Fungicidal Cements	199	19
Fly Ash	199	20
Foundry	199	21
Flowsheet-Miscellaneous	199	22
Fungus-Mine Timber	199	23
Fuse Winder (Lyle MacDonald-Industrial Engineer)	199	24
Facilities	199	25
Fire Protection	199	26
Flexonix	199	27
Grinding Balls-Correspondence	199	32
Grinding Balls-Correspondence	200	1
Halfbreeds	200	2
Howes Ball Mill Liners	200	3
Information Sources	200	4
Int. Lead Zinc Research Organization American Zinc & Lead Industries	200	5
Invention and Idea Disclosure Record Forms	200	6
Inventory	200	7
R.W. Johnson-Evanston	200	8
Lake Copper-General	200	12
Lavas of the Michigan Keweenaw Differentiation-By T.M Broderick	200	13
Metallurgy-General	200	22
Methods of Analysis	200	23
Milling and Concentrating	200	25
Cascade Mill Test	200	27

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Tornado Crusher Test	200	28
A.C. Vibrating Ball Mill Test	200	29
Krebs Cyclone	200	31
Mining in Keweenawland & Treatment of Ores by Calumet Division	200	36
Mining and Development Programs	201	2
Process and Product Studies-Inactive (G through L)	201	4
Process and Product Studies-Inactive (M through P)	201	5
Process and Product Studies-Inactive (M through P)	201	6
Research and Development Projects	201	7
Roofing-Arsenical Copper	201	17
Silver Recovery	201	20
Slag Utilization	201	21
Slime Investigation	201	22
Smelting and Refining	201	23
Soda-Lime Refining Process	201	24
Soot Removers	201	25
Spent Wire Drawing Lubricant	201	27
Working Paper-Spent Wire, Drawing Lubricant	202	1
Surface Active Agents	202	3
Sulfuric Acid	202	4
Tamarack Reclamation-MCMT Project	202	5
Wire Rope Experiments	202	15
Wood and Wood Products	202	17
Zinc	202	18
Zinc Chromate	202	19
Basic Zinc Carbonate	202	20
Zinc Sulfate	202	21

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
6.3.5 (6.3.5) General Department Files, 1907-1969		
Report to C&H, Inc.-Acquisition Possibilities in the Chemical Industry	557	4
Miscellaneous Data on Chemicals and Metals Development	558	12
Miscellaneous Data on Chemicals and Metals Development	558	13
Miscellaneous Data on Chemicals and Metals Development	558	14
Miscellaneous Data on Chemicals and Metals Development	558	15
Miscellaneous Data on Chemicals and Metals Development	558	16
Miscellaneous Data on Chemicals and Metals Development	558	17
6.3.5.1 Foundries – Ripley and Calumet		
Roberts Chemicals Incorporated	202	28
Surface Physics and Chemical Associates	202	38
Tenneco Chemicals	202	40
6.4 (Subseries 6.4) Sales, Marketing and Advertising, 1936-1969		
Market Survey-Industrial Copper Chemicals and Copper Powder-C&H Cons. Copper Co.	557	1
8.1.20.2 Construction		
Summary Report: Supply of and Demand for Zinc Chemicals and Zinc Dust	19	6
8.3.2 (8.3.2) Lake Chemical Co. (with Harshaw), 1941-1965		
Harshaw Chemical Co. Matter, Correspondence	58	29
Harshaw Chemical Co.-Correspondence	60	4
Purchase Orders-Harshaw Chemical	26	40
Harshaw Chemical Co/Lake Chemical Co.	591	9
8.3.2.2 Corporate Records		
Articles of Incorporation, Minutes of Board Meetings	22	1
Minutes of Board Meetings	22	2
Minutes of Board Meetings	22	3
Minutes of Board Meetings	22	4
Lake Chemical Co.-Preliminary Drafts & Data, Corporate Proceedings	339	1

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Prozite Co. Records, Minutes	339	2
C&H, Inc. (Calumet Division)-Lake Chemical Co. Dissolution	512	9
8.3.2.3.3 Taxes		
Income Tax	25	26
Income Tax	26	1-7
U.S. Corporation Income Tax Return	26	8
Business Activities Tax, Gross Receipts Tax	26	13
Michigan Business Receipts Tax	26	14
Business Activities Tax	26	15-16
Business Activities Tax	26	19-20
Gross Receipts Tax	26	21-23
Michigan Intangible Tax	26	24
Income Tax Returns-Lake Chemical Co.	233	1
8.3.2.3.4 Accounts Payable		
Accounts Payable	26	11
Georgia State Department of Agriculture	26	25
Calumet and Hecla Inc.	26	26
Clairmont and Transfer Co.	26	27
Harshaw Chemical	26	28
Northern Michigan Water Co.	26	29
North Carolina Department of Agriculture	26	30
Soo Line Railroad Co.	26	31
Osceola Township Treasurer	26	32
Vouchers	26	33
8.3.2.3.5 Miscellaneous Financial Records		
General Ledger	25	22
Bank Statements	25	23

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Standard Costs	25	25
Auditor's Report	25	24
Cost Sheets, Purchase Requisitions	26	9-10
Accounts Receivable, Paid Invoices	26	12
Michigan Business Receipts	26	17-18
Standard Costs	26	35
Projected Costs	26	36-37
Plant Equipment, Depreciation Schedule	26	38
Cash Payments	26	41
Cash Payments	26	42
Lake Chemical Co. Ledger	157	1-2
Lake Chemical Co. Journal	157	3
Lake Chemical Co. Journal	157	4
Lake Chemical Co. Cost Sheets	338	1
Lake Chemical Co. Cost Sheets	338	2
Lake Chemical Co.-Financial Reports	525	1
Lake Chemical Co.-Inventory, Expenses, Misc. Data Sheets	525	2
8.3.2.4.1 Orders/Shipping		
Western Union Telegraph Co.	26	34
Purchase Orders-Calumet Division	26	39
Shipping Orders	26	43-44
Shipping Orders	27	1-9
Freight, Bills of Lading	27	10
Shipping Orders-Copper Carbonate	27	11
Advice of Shipment-Hydrate	27	12
Advice of Shipment-COCS	27	13
Advice of Shipment-TBCS	27	14

LAKE CHEMICAL FILES - UPDATED SEPTEMBER 20 (CONTINUED)		
Series/Description	Box	Folder
Advice of Shipment-Copper Carbonate	27	15
Shipping Orders-TBCS	27	16
Shipping Orders-Hydrate	27	17
Shipping Orders-COCS	27	18
Requisition-Calumet Division	27	33
Invoices to UPPCO	27	36
8.3.2.4.2 Reports and Correspondence		
Report of Pesticide Stocks On Hand	27	23
Product-Reports of Operations and Shipment	27	24
Annual Reports of Shipments and Production of Inorganic Chemicals	27	30
Annual Reports of Shipments and Production of Inorganic Chemicals	27	31

NOTES FROM THE MTU AND KNHP ARCHIVES

Emma Schwaiger

Archives: August 7, 2014 – Ahmeek Mill

4.4.40 (4.3.32) Engineering Department, Alphabetical, S-W, 1911-1969
Box 127 –
Folder 16: Sheave Stands, Ahmeek #3&4-Calc, Blueprints, Shipping, Statements, etc. 1938-1939

- Correspondence about strong winds and how it blows the sands around.
- Correspondence about machinery for the Ahmeek mill and surrounding buildings, & building of a catwalk.

4.4.40.4 "T" Continued
Box 38 –
Folder 9: Tamarack-Osceola-Ahmeek Fire Protection, 1916-1937

- Correspondence about changes in the fire protection system at the Ahmeek Mill – 1937.
- Correspondence about sprinklers and the fire protection system at the Ahmeek Mill – 1917.
- Also mentioning the system at the other nearby mills as well – 1916.

Folder 13: Tam. Water Main, Ahmeek & Osceola Mills-Corr, Blueprints, & Cost Sheets, 1921-1935

- Correspondence about the C&H water main entering the Village of Ahmeek – 1923.
- Water system from Lake Superior, both Tamarack & Calumet.
- Document copied: C&H Mining Co – Lake Superior Water Mains, Oct. 26, 1921.

4.4.48 (4.3.40) Engineering Miscellaneous, 1953-1968
Box 138 –
Folder 15: Flow Process Charts, Handwritten Notes, Critique of Ahmeek Mill-Study

- Flow Process Charts – lists about where the rock starts and ends.
- Procedure for Mill Sampling and Accounting for Mine Yield.

Box 139 –
Folder 8: Calumet Foundry Auto. Reports, Drawings; Ahmeek Mill Meeting Minutes, 1966-1967

- Foundry Automation – 1966.
- Ahmeek Mill Meeting Minutes – 1967.

Folder 25: Ahmeek Mill-Report, Corr., Drawings, 1963-1967

- Document copied: Ahmeek Concentration – 1963.
- Document copied: Ahmeek Power Plant – Ash Handling.
- Drawing 11898 – Ahmeek Mill Flow Sheet.
    - Oversized drawing, showing a flow sheet for the Ahmeek Mill, 1956, rev. 1966.

5.6.1 (5.6.1) Income Tax Returns
Box 231 –
Folder 1: Ahmeek Mine, 1913-1924
- Book on the Ahmeek Federal Income Tax Returns.

5.7.1 Bureau of Mines
Box 166 –
Folder 2: Ahmeek (Form 6 -1190-M), 1954-1964
- Production of copper per month from January 1954-December 1964.

Folder 19: Ahmeek (Form 6-1178-A), 1955-1958
- General Information – Supplement by Year, 1955-1958.
    - Name of mine & location.
    - Ahmeek Mill using Dow-Froth for flotation, not pine oil – 1957.

Folder 25: Ahmeek Mill (Form 6-1178-AM), 1968
- Lode-Mine Production of Gold, Silver, Copper, Lead, and Zinc.
    - Amount of copper produced at Ahmeek Mill
        - Rich & Poor, Flotation, Mill Mass, & Heading.

5.10.2 (5.10.2) Asset Valuation and Insurance Appraisals, 1906-1965
Box 33 –
Folder B: Information Appraisals, Allouez, Ahmeek, Centennial, Osceola, LSS Co., LaSalle, Superior, White Pine, Lake Milling, 1912-1919
- All White Pine info.

5.10.2.1 Insurance Appraisals of C&H's physical holdings–Reports to general manager
Box 207 –
Folder 6: Ahmeek Mining Co, 1912-1920
- Appraisals of buildings and equipment.

5.10.2.2 Insurance Appraisals of C&H, Incorporated's physical holdings
Box 207 –
Folder 1: Ahmeek Mill, 1956-1965
- Insurance Appraisals for the Allouez Mine No. 3 in Ahmeek, MI – 1957
- Insurance Appraisals for the Ahmeek Mine Shafts 3 & 4 – 1957
- Insurance Appraisals for the Ahmeek Mine Shafts 1 & 2 – 1957
- Insurance Appraisals for the Ahmeek Mill in Hubbell, MI – 1957
    - Buildings 1-5, Junction & Conveyor Houses, Fire Station, Oil House, & Pump House
    - Structural details and values
    - Equipment details and values

8.1.1.6 Ahmeek Mill

Box 151 –

Folder 1: Reports, Tracings, Blueprints, 1927-1960

- Ahmeek Hoist reports - 1941-1948.

Folder 2: Reports, Tracings, Blueprints, 1927-1960

- Drawings of the Ahmeek Mill (showing Boiler House & Turbines), drawing of the Ahmeek Mill Tailings & Ash Discharge Line – 1960.

Folder 3: Reports, Tracings, Blueprints, 1927-1960

- C&H Electric Power Line to Tailings Plant at Ahmeek Mill + Map, Mineral Range Railroad permission to cross property with drawings of the proposed trestle along with the C&H electric line crossing – 1928.

Folder 4: Reports, Tracings, Blueprints, 1927-1960

- Drawing showing the Tamarack Regrinding, Osceola, & Lake Mill #2, along with the pole line crossing for the C&H power line, map of the Ahmeek Stamp Mill showing the Boiler House & nearby companies – 1930.

Folder 5: Power Plant-Memorandum of Contract, 1930

- Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant – 1930.

Folder 6: Power Plant-Memorandum of Contract, 1930

- Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant – 1930.

Folder 7: Power Plant-Memorandum of Contract, 1930

- Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant – 1930.

Folder 8: Power Plant-Memorandum of Contract, 1930

- Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant – 1930.

Folder 9: Power Plant-Memorandum of Contract, 1930

- Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant – 1930.

Folder 10: Power Plant-Memorandum of Contract, 1930

- Contract between C&H and the Stone & Webster Engineering Co. to furnish the proper equipment for the Ahmeek Power Plant – 1930-1931.

Folder 11: Power Plant-Contracts, 1930-1936

- Contracts for steam generating equipment between C&H and the Stone & Webster Engineering Co. (turbine generator, circuit breakers, structural steel, & Westinghouse stokers) – 1930.

Folder 12: Power Plant-Contracts, 1930-1936

- Contracts for steam generating equipment between C&H and the Stone & Webster Engineering Co. (Coal handling equipment, motor for a 30 ton electric traveling crane, & draft fans) – 1930.

Folder 13: Power Plant-Contracts, 1930-1936

- Contracts for steam generating equipment between C&H and the Stone & Webster Engineering Co. (Turbine driven boiler feed pumps, noncondensing steam turbines for forced draft fans & boiler feed pumps, ash handling system, & transformers) – 1930.

Folder 14: Power Plant-Contracts, 1930-1936

- Contracts for steam generating equipment between C&H and the Stone & Webster Engineering Co. (Automatic combustion control equipment, 440 volt induction motors, & 2300 volt switchboard panels & equipment) – 1930.

Folder 15: Power Plant-Specifications, 1930-1936

- Contracts and Specifications – Stone & Webster
- Specification for Boiler System – Stone & Webster, 1930
  - Complete specifications for the erection of the boiler system & buildings.
- Specification for Cast Steel Pipe Fittings for the Main Steam Line – 1930
  - Furnishing, fabrication, and delivery of cast steel pipe fittings to be installed in the Ahmeek Power Plant.
- Specification for Boiler Blow-Off Piping – 1930
  - Furnishing, fabrication, and delivery of boiler blow-off piping for the Ahmeek Power Plant.
- Specification for High Pressure Steam Piping – 1930
  - Furnishing, fabrication, and delivery of high pressure steam piping for the Ahmeek Power Plant.
- Specification for Transformers – 1930
  - Equipment information for the transformers at the Ahmeek Power Station.
  - Wanted 3 total, 13,800 volts, 1,667 kva
  - "Terminals: The terminals shall be enclosed in weatherproof boxes with provision for conduit connections. Both terminals boxes shall be located on the same side of the tank."
  - Weight of oil in transformers: 11,300 lbs (1,570 gallons).
  - Oil drain valve: 2" diameter, globe type.
- Specification for Motor Driven Centrifugal Pump – 1930
  - Equipment information for the motor driven centrifugal condensate pump at the Ahmeek Power Plant.

Folder 16: Power Plant-Specifications, 1930-1936

- Contracts and Specifications – Stone & Webster
- Specification for One 7,500 KW 80% Power Factor Condensing Steam Turbine Generator – 1930
    - Construction, erection, and delivery, & performance for the Ahmeek Mill.
    - Oil coolers & oil cleaning system.
- Specification for Alternating Current Generator – 1930
    - For use at the Ahmeek Power Plant.
    - Gallons of oil per minute required for generator and turbine bearings: 100 gallons.
- Specification for High Pressure Condensing Steam Turbine and Alternator Unit – 1930
    - For Ahmeek Power House.
- Specification for Condenser Tubes – 1930
    - For Ahmeek Power Plant.
- Specification for Auxiliary Steam Piping – 1930
    - For Ahmeek Power Plant.
- Specification for Water Wall Insulation – 1930
    - For Ahmeek Power Plant.
- Specification for Hardware – 1930
    - For Ahmeek Power Plant.
- Specification for Roofing and Flashing – 1930
    - For Ahmeek Power Plant.

Folder 17: Power Plant-Specifications, 1930-1936

- Contracts and Specifications – Stone & Webster
- Specification for Fire Brick & Fire Clay - 1930
    - For Ahmeek Power House.
- Specification for Wood Doors – 1930
    - For Ahmeek Power House.
- Specification for Plastering – 1930
    - For Ahmeek Power Station.
- Specification for Metal Covered Doors - 1930
    - For Ahmeek Power House.
- Specification for High Pressure Water Piping - 1930
    - For Ahmeek Power Plant.
- Specification for Painting - 1930
    - For Ahmeek Power Plant.

Folder 18: Power Plant-Specifications, 1930-1936

- Contracts and Specifications – Stone & Webster
- Specification for High Pressure Cast Steel Gate Valves - 1930
    - For Ahmeek Boiler House.
- Specification for 400 lb. Cast Steel Globe Valves - 1930
    - For Ahmeek Power Plant.
- Specification for 400 lb. Gate Valves for Boiler Feed Discharge Lines - 1930

    - For Ahmeek Power Plant.
- Specification for 15 KV. Indoor Bus Supports, Disconnecting Switches, and Fuse and Resistor Mountings – 1930.
    - For Ahmeek Power Plant.
- Specification for Gage Boards - 1930
    - For Ahmeek Power Plant.
- Specification for Three 8" – 600 lb. Non-Return Valves - 1930
    - For Ahmeek Boiler House.
- Specification for Gypsum Roof Slabs - 1930
    - For Ahmeek Power Plant.
    - Boiler House, Turbine Room, & Electrical Bay comprise the Ahmeek Mill Power Plant.
- Specification for Metal Sash & Operators - 1930
    - For Ahmeek Power Plant.

Folder 19: Mill Return & Mill Yields, 1959-1968
- Mine Grade – Mill Recovery Reports, from the different mines sending rock to Ahmeek.
- Mill Returns – By month for the different mines, & amount reclaimed from slag, tailings, & brick.

Folder 20: Proposals Covering New Steam Generating Units, C&H, 1961
- Proposal Letter – Fuel Economy Engineering Co.
    - Pulverized Coal and Spreader Stoker.
- Traveling Grate Spreader Stoker Unit.
- Limits of Construction.
- Preliminary Price Determination.
- Performance Multi-Pass.
- Performance Single-Pass.
- Pulverized Coal Fired Unit.
- Performance Contract #2401.
- Performance Contract #2399.
- Preliminary Price Determination.
- Catalogs.
    - Riley Pulverizers
    - Riley Flare Type Burners
    - Riley Traveling Grate Spreader Stoker
    - Riley Steam Generating Units
    - Riley Continuous Tube Economizers
    - Riley Indoor & Outdoor Settings
    - Riley Steam Generating Equipment
- Drawings.
    - Folder empty

Folder 21: Proposals Covering New Steam Generating Units C&H, 1961
- Same as Folder 20.

Folder 22: Pump House Intake Well Repairs, 1965

- Appropriation Requisition – Intake Well Repairs
- Drawing 12618 – Ahmeek Mill Pump House, Intake Well Floor & Screen Guides, Details – 1965

Folder 23: Power Plant. Mechanical Drive Turbine Info, Estimate, 1966

- Mechanical & Structural Engineering Department Estimate – New Turbine for No. 7 Generating Unit, Replace Existing Terry Turbine

Folder 24: Metal Processing-Purchase & Appropriation Requisitions, Quotations, 1966

- Purchase Requisition – To Replace Badly Worn Rough Classifiers #3 & #4 Unit at Ahmeek Mill, sent to Continental Sales & Equipment Co – Hibbing, MN
- Quotation – Krebs Cyclone, Krebs Engineers
- Appropriation Requisition – Krebs Cyclone Classifier
- Purchase Requisition – Ahmeek Mill-Washing #5 & #6 Units
- Receiving Report – Slurry Pump for Hydraulic Table Rejects – Denver Pump
- Receiving Report – Akins Simplex Classifier
- Purchase Requisition – Slurry Pump for Hydraulic Table Rejects – Denver Pump
- Appropriation Requisition – Slurry Pump for Hydraulic Table Rejects – Denver Pump

Folder 25: Conversion of Mill Circuits for Increased Capacity and Proc. of Con. Ore, 1965-1966

- Mechanical & Structural Engineering Dept. – Revision to Additional and Improved Milling Facilities, Phase II
    - Replace some equipment
- Document copied: Ahmeek Mill Project M. C. Order Numbers
    - Phase I, Phase II, & Phase III
- Mechanical & Structural Engineering Dept. – Additional Facilities to Reduce Tailings Losses in Conglomerate Ore, Phase III
    - Replace & add equipment
- Mechanical & Structural Engineering Dept. – Additional and Improved Milling Facilities, Phases I & II
    - Relocate, replace, and/or add new equipment
- Mechanical & Structural Engineering Dept. – Proposed Ball Mill 6a and Accessories Circuit
    - Add & relocate equipment
- Mechanical & Structural Engineering Dept. – Additional & Improved Milling Facilities, Phase I & II
    - Add & relocate equipment
- Correspondence about pumps, cyclones, and flotation equipment between C&H & WEMCO - 1965
    - Catalogs: Warman Series ‘A’ Pumps & WEMCO – About Flotation
- Document copied: C&H Meeting Minutes – Revision of Ahmeek Mill to Provide Greater Capacity – 1965
- Document copied: C&H 17248 – Ahmeek Mill – Treating Conglomerate Mine Ore, Additional Equipment Required, Flow Sheet – 1965.

- Correspondence about feed rate on stamps between C&H & Milltronics w/ Proposal – 1965

Folder 26: Metal Processing Automating the Fuel to Steam Stamps 1, 2, 4, 5 – Proposals, 1967

- Proposal for Automating the Feed to Steam Stamps 1, 2, 4, & 5
  - Submitted by: B.C. Peterson, Vice-President, C&H, General Manager, Calumet Division – February 24, 1967
  - Mechanical & Structural Engineering Department – Install Automatic Feeders for Steam Stamps 1, 2, 4, & 5
    - Remove & purchase equipment
  - Decision should be made on April 1, 1967 – Never happened

Folder 27: Metal Proc., Prop. System for Sam. & Dis. of Ahmeek Tailing. Report & Estimate, 1967

- Appropriation Request – Sampling System for Thickener & Shovel-Wheel Tailings
  - 20" Krebs Cyclones
- Appropriation Request – Sampling System for Main Tailings
  - Pump, Launder Box, Samplers, etc.
- Appropriation Request – Maintenance & Alterations to Sampling & Effluent Handling System
  - "Work would provide for elimination of wastes from the mill at only two points instead of three. Materials leaving would be flotation tailings and unprocessed wastes. Unprocessed wastes would be deposited away from the general tailings pile where settled portion will be accessible to the dredge. This also would contribute to a more reliable sampling system and aid mill operations."
- Document copied: R&D Study on Sampling & Effluent Handling at the Ahmeek Mill, L. C. Klein's memo: April 14, 1967.
- Appropriation Requisition – Sampling System for Thickener & Shovel-Wheel Tailings
  - Ahmeek Mill – Sampler & 20" Krebs Cyclone and associated materials for combining thickener and shovel-wheel overflows

Folder 28: Drawings: Power Generation, Power Plant, New Terry Turbine, 1967

- Drawings of a Terry Turbine for the Power Plant

Folder 29: Operating manual-Power Plant, Lake Linden Power Plant, 1969

- Operating Manual – Ahmeek Power Plant & Lake Linden Power Plant, Master Copy, 10/1969, Assigned to: T. W. Knight – Step my Step Guide to Operation.
  - Ahmeek of Boilers as Winterized, 1969
  - Ahmeek – Operating Notes
  - Miscellaneous Info
  - Ahmeek Procedure for Starting #8 Turbine
  - Ahmeek Procedure for Shutting #8 Turbine
  - Ahmeek Boiler House Water Softener
  - L. L. Wickes Boilers
  - L. L. Boiler Plant Water Softener

5.10.3 (5.10.3) Depreciation, 1923-1964
Box 605 –
Folder All: Plant Depreciation Record for LaSalle, Mutual Water Light & Power, L M S & R, Ahmeek, Osceola and L S S Co.

- Depreciation of the plants by year from the 1900s to the 1940s, but no info on Ahmeek.

5.11.2.1 Pumps
Box 35 –
Folder 19: Ahmeek Mill & Blueprints, 1925

- Correspondence about the pumps for the Ahmeek Mill, C&H & Worthington Pump & Machinery Corp. – 1925-1931
    - Increase capacity
    - 1926 – Water in Torch Lake is low and they are having a hard time reaching the water from the pumps
- Drawing of a Coupling – 1925
- Worthington Pump & Machinery Corporation – Proposal, 1925
    - New Centrifugal Pump for the Ahmeek Mill
- Document copied: Letter from MacNaughton to E.A. Baalack – March 14, 1925
    - Booster pump currently run on steam should be switched to electricity.
- Report of Test of Nordberg 40,000,000 Gal Pumping Engine at Tamarack & Osceola Mills
    - By: O.P. Hood, March 17, 1907 for Osceola Mining Co.

5.12.3 (5.12.3) Boiler Inspection Reports, 1913-1942
Box 37 –
Folder 4: Ahmeek Mill-Stirling Boilers, 1930-1942

- Insurance Service Reports – Maryland Casualty Company
    - Internal and External descriptions of the boilers by a company inspector

Folder 32: Ahmeek Mill-Old Boiler House, 1927-1930

- Insurance Service Reports – Royal Indemnity Company
    - Internal and External descriptions of the boilers by a company inspector

6.1.1.4 Miscellaneous Records
Box 573 –
Folder 15: Index for Letters in 573/016 Lists Subject & Page for Ahmeek Mine & Mill through White Pine Copper Co, 1909-1945

- Inventory Item #2200, p. 253
    - MTU Box 58 (Box 34)
    - Recession Date 12/13/79
    - Ahmeek Mill – Actual Elevation of Lake Datum, 3/31/09, McCallom, Page 11

8.1.1.6 Ahmeek Mill

Box 78 –

Folder 9: Flow Sheet & Data, 1968

- Document copied: Figure 1: Ahmeek Mill Flowsheet – Crushing & Gravity Concentration
- Document copied: Figure 2: Ahmeek Mill Flowsheet – Fines Concentration – Flotation
- Correspondence about sending the Ahmeek Mill Flowsheets & Flowsheet Description to the US Dept of Interior to help them further understand the processes – 1968
- Document copied: Ahmeek Mill, Mineral Processing – Flowsheet.
    - By: J.J. Vitton, Oct. 20, 1966
- Drawing 11898 – Gravity Flow Sheet – Ahmeek Mill 1956, rev. 1966

Folder 10: Operation, 1966-1967

- Ahmeek Mill Production Statistics – By year, 1946-1956.
- Samples taken from the Ahmeek Mill for study – Copper Content in lbs/ton – 1966.
- Process & Practice Analysis Spillage Flowsheet Report – Bull Jigs & Pit Launder through Concentration Tank, to Flotation Area, & Ash Pump.
    - On back: Drawing of Sand Bank showing the Present Water Flow, Sewer, Mill Tailings Line, & Basement Launder Ash Pump Line.
- Minutes for a Meeting about the Ahmeek Mill
    - Discuss plans laid out by Mr. Leo Abell to make changes to the Ahmeek Mill – 1967
- Document copied: R&D Study on Sampling & Effluent Handling at the Ahmeek Mill, L. C. Klein's full document: April 14, 1967.
    - Mentions where the waste streams came from and what different types of wastes could be.
- Document copied: Ash Pump at Ahmeek Mill – 1966
    - Letter between L.F. Engle & L.C. Klein talking about where the waste streams currently come from and about possibly narrowing it down so there is only one waste stream coming from the mill.
- Correspondence about who will be in charge of the mill & relieving the previous superintendent of his duties – 1966.
- Estimates for refitting the Ahmeek Mill – 1966.
- Ahmeek Mill Process & Practice – Summary of Weekly Notes, 1966.
- Answers to Industrial Engineer's Report Dated 11/3/66.
    - Hourly & daily operating practices.
- Tailings Bank Analyses – 1966
    - Mentions sampling being done on the sand bank on both the tailings side and the ash line side, to look at the total copper content.
- Proposed Revisions to Floor Drain System – Sketch A
    - Talk about redoing the floor of the mill and description and sketches of what that would look like – 1966.
- A Limited Examination of the Ahmeek Mill, by: A.D. Kennedy & R.A. Campbell, 1966.
    - Brief report on the Ahmeek Mill and opinions for better operation.
- Cost Reduction Program – 1966.
    - Sheet listing costs and a few ways of which they can reduce them.

Folder 11: Reports, 1950-1952

- Ahmeek Mill – Proposed Addition, Preliminary Estimate, 1952
  - Proposed "in order to have one head as a standby unit to facilitate regular maintenance, extra ordinary repairs and take an occasional overflow of rock from the mines."
  - Drawing 11238 – Ahmeek Mill, Flow Sheet
  - Ahmeek Mill – Proposed Head #9 (Steam Stamp) Addition to Building
    - Also shows the Old Boiler House
- Ahmeek Mill – Open & Closed Circuit Crushing of Native Copper Ore with 48" Nordberg Gyradisc Crusher, Report of January 30, 1952. By: J.J. Vitton.
  - Report on Replacement of Rolls or Primary Mills.
- Ahmeek Mill – Stage Crushing of Native Copper Ore with Nordberg Crushers, Report of December 15, 1951. By: J.J. Vitton.
  - Replace steam stamps & replace 2 types of rolls.
- Ahmeek Mill – Proposed Replacement of Steam Stamps & Rolls, Report of July 26, 1950. By: J.J. Vitton.
  - To Reduce Cost of Crushing at the Ahmeek Mill.
  - Different Schemes:
    - Replacement of Rolls by Hall Mills
    - Individual Crushing Plant at Each Head
    - Centralized Crushing Plant West of Ahmeek Mill
  - Drawing 11238 – Gravity Flow Sheet Ahmeek Mill (Present).
  - Drawing 15726 – Gravity Flow Sheet Ahmeek Mill (Experimental Arrangement at Head #4) July 1950.
  - Drawing 15727 – Gravity Flow Sheet Ahmeek Mill (Proposed Arrangement) July 26, 1950.
  - Drawing 15734 – Gravity Flow Sheet Ahmeek Mill (Replacement of Steam Stamps & Rolls with Proposed Symons Cone Crushers, Scheme II) Report of July 26, 1950.
  - Basic Industries Research Laboratory – Laboratory Test Report.
    - Allis-Chalmers, Test # 2411-B. May 2, 1950.
    - Sample From: C&H, Lake Linden, MI.
    - Tested For: Crushing characteristics of copper ore in Hydrocone Crushers.
  - Drawing 15728 – Ahmeek Mill Proposed Crushing Plant, 1950.
    - Shows proposed crushing plant in relation to the Ahmeek Mill building.
- Drawing 11885 – Proposed Crushing Plant & Concentrator Layout, Lake Linden Site.
  - Located just north of the Calumet Mill in Lake Linden.

Folder 12: Modernization, 1953-1957

- Ahmeek Mill – Modernization or Replacement. By: C.H. Benedict, Dec. 8, 1956.
  - Benedict says the Ahmeek Mill is fine and with some equipment changes the mill could last for many years.
- Calumet & Hecla, Inc. Mill Modernization Project, Aug. 1, 1957.
  - Report from a Task Force to study a mill modernization program.

  - Includes some Ahmeek Mill Flowsheets.
  - Map & Drawing of the proposed crushing & concentrator plants in Lake Linden.
  - Page 22: "In order to furnish 60 cycle power for a new mill in the Lake Linden area it would be necessary to increase the 60 cycle generation at the Lake Linden Power Plant. Although the frequency changers presently are not fully loaded, by the time that a new mill could be completed, the projected load, as we see it today, would be above the capacity of the frequency changers.

    To add just enough 60 cycle generating capacity at Lake Linden to take care of the new mill requirements would cost roughly $1,000,000. However, if the 60 cycle generation were to be expanded, I believe it would be wiser to put in a unit large enough to replace the present frequency changers and to supply the new mill load. The cost of power plant expansion for a unit of this size would be about $3,200,000. The cost to provide a transmission line from the Lake Linden plant to the mill site, erect a substation, and install main feeders up to each of the buildings would be an additional $250,000. These figures do not include any power or lighting installations within the mill buildings since it is understood that the Anaconda estimate has already allowed for these."
  - Drawing 11852 – New Mill & Crushing Plant, 6000 T/Day Crushing Plant, 12 Hour Operation, Flow Sheet, 1955.
- Correspondence about how or when to upgrade the Ahmeek Mill (Crushing & Concentrator Plant addition in Lake Linden), 1953-1957. Talk amongst C&H employees & Anaconda.
- Record of Meeting – December 6, 1955.
  - Subject: New Crushing Plant and Concentrator – Ahmeek Mill Modernization.
- Record of Meeting – October 22, 1956
  - Subject: Modernized Milling Facilities.
    - Tells us what Anaconda had and how Ahmeek can get that – new plant in Lake Linden.

Folder 13: Office, 1964-1969
- Sale of Former Ahmeek Mine Office Building – 1969.
- Correspondence about the Ahmeek Mine Office being sold in 1964, then it faulted back to the company in 1969, and then sold again.

Box 85 –

Folder 15: Leaching of Concentrates, 1958
- Document copied: Report on The Leaching of Ahmeek Mill Concentrates
  - By: L.C. Klein, November 5, 1958
  - Report will attempt to give answers to questions about leaching Ahmeek Mill concentrates for production of copper powder.
  - Covers "capacities of present leaching and distillation facilities; changes in leaching and distillation equipment necessary to adapt this equipment to the leaching of concentrates and distillation of the rich solutions produced; material handling; changes in leaching techniques; leaching solution control; types of

concentrates that can be leached; and the control of impurities in the oxide produced. A rough estimate is also given for capital expenditures necessary and the cost of oxide production."

- Mentions what Torch Lake water had in it during this period because tests of the water were done to see how it would react with the chemicals in the leaching process.

Emma Schwaiger

Archives: July 25, 2014 – Tamarack Reclamation

4.4.40.3 Tamarack Reclamation Plant
Box 39 –
Folder 19: Correspondence, Blueprints – 1920-1964

- The Tamarack Mills Fire Department got permission to dismantle the garage building at the Tamarack Reclamation Plant and use the building materials for build a new fire house – 1951.
- C&H talk of installing a new boiler at Lake #2 Mill to provide the steam needed for the Tamarack Reclamation Plant and then they could demolish the Osceola Boiler House – 1940.
- Construction costs for building the Tamarack Reclamation Plant – 1924 & 1925.
- Correspondence about materials and equipment needed to build the Tamarack Reclamation Plant.

Folder 20: Conveyor – 1920-1953

- Correspondence about the conveyor belt and splicing, new belt, etc.

Folder 21: Correspondence between Tamarack Rec. Plant & American Bridge Co. – 1920-1921

- Cost estimates of erecting the Tam. Rec. Plant – 1921.
- Correspondence about building the Tam. Red. Plant.
- Tamarack Reclamation Plant – Oil House, Oct. 18, 1920.

Mr. R.T. Logeman, Engr., American Bridge Co., 208 So. La Salle St., Chicago, Ill.

"Dear Sir: - We are enclosing print of our drawing #8316 – Preliminary General Arrangement of the Oil House, which will be located at the South end of the Tamarack Regrinding Plant. This building will be fireproof and will have concrete block walls with a thin reinforced concrete roof slab, and will be separated from the Regrinding Plant by a concrete block wall 6 ft. South of Bent #2.

On working up the building, it seemed practical to use three roof trusses from the #2 Coal Shed, cut off at one end, the North end of the outside truss being riveted to existing columns I and L2 of the Regrinding Plant, the center truss to be carried by the new column extending from the lower floor to an existing horizontal 12" I beam in line of Bent #2.

As the arrangement of conical mills in the Regrinding Plant will not permit placing a stairway at the South end of the building, the concrete floor at elevation 67'-9" in the Regrinding Plant is to be extended 6 ft. South into the Oil House, stairs being provided to the floor at elevation 56' as shown.

The four Oil Tanks, 15 ft. in diameter by 12 ft. high, will be duplicates of the same size tanks furnished on your Cont. D-8065.

We think this gives you full information for going ahead with the Oil House.

Yours very truly, Chief Draftsman."

Folder 22: Correspondence between Tamarack Rec. Plant & American Bridge Co. – 1921-1923

- Correspondence about building the Tam. Red. Plant.

Folder 23: Correspondence between Tamarack Rec. Plant & American Bridge Co. – 1921

- Correspondence about building the Tam. Red. Plant.

Folder 24: Conveyor – 1920-1924

- Correspondence about building the Tam. Red. Plant.
- Tamarack Reclamation Plant – Sand Storage Bldg. & Conveyor, March 4, 1921.

Mr. R.T. Logeman, Engr., American Bridge Co., 208 So. La Salle St., Chicago, Ill.

"Dear Sir: - On looking up the matter of getting the high tension wires in the sub-station, we find we will have to run them through the bracing of the drive hours, at position shown on accompanying blue-print 8317. In order to prevent any material that is being hoisted from touching the wires, it will be necessary to move the trap to north west corner of drive house as shown on copy of your blue-print 4840-3, herewith. We think you can make this change without much trouble.

In working up the foundations we are inclined to think that anchor bolts should be provided passing through end posts of trusses at bent 8 to take up the temperature stresses due to contraction of steel in cold weather, thus keeping a tight joint in concrete of conveyor floor at this point. We have indicated these bolts on blue-print 8317, herewith. Please look into this and advise.

Yours truly, Chief Draftsman."

Folder 25: Distilling Section – 1924

- Correspondence about building the Tam. Red. Plant.
- Acknowledgements of the receipt of blueprints & other material.

Folder 26: Heating System – 1923-1924

- Correspondence about receiving the blueprints for the heating system.
- Tamarack Reclamation Plant – Heating, Oct. 11, 1923.

Morgan-Gerrish Company, 501 South Sixth Street, Minneapolis, Minn.

"Gentlemen: Referring to the heating plans which you have made for the Tamarack Reclamation Plant, we find that there will be a few slight changes required in the Sub-Station section and are enclosing a portion of your original blue print marked up to show these changes which are as follows:

1. Sub-Station to be heated by four 200 sq. ft. radiators placed upon the north wall, one 150 sq. ft. radiator on the east wall, and two 100 sq. ft. radiators on the south wall. The radiator heretofore shown on the west wall to be omitted.

2. We expect to enclose the north east corner of the gallery located above the laboratory as an office, and will therefore require a radiator in this room, which will be 16’ x 12’ x 10’ high.
3. We notice that you call for a 30 sq. ft. radiator near the south end of the wash room, but do not locate it on your floor plan. This we suppose is meant to be located in the entrance portion of the wash room.

Your proposal calls for twelve ½” and three ¾” sylphon traps for the wash room and Sub-Station sections. This does not seem to check up with the radiators shown. Will you kindly correct your drawings as above and send me four corrected blue prints?

As we will require heat in the Sub-Station this winter, we would like to order the radiators required in the entire system, but are in doubt as to the tapping required. On the elevation of the office section of the Sub-Station we note that you show the feed valve located near the top of the radiator, the Webster trap being located near the bottom of the opposite end. We are unable to find this kind of tapping in the American Radiator Company’s catalog.

We are planning to use Rococo four column radiators for this work, those in the offices, laboratories and wash room to be 32” high, while those in the Sub-Station and Oil House will be 45” high. Will you kindly send us a list of these radiators, specifically the tapping required so that we may send in our requisition for them?

A note on your drawing at the feed valve reads “Webster D.S.V.”, but we do not find any “Webster D.S.V’s.” listed on your quotation. Will you kindly advise what this note means, and also, what type of radiator valves we should purchase for these radiators?

Yours very truly, H.E. Williams, Chief Draftsman.”

Folder 27: Tamarack Leaching & Flotation – 1957-1963

- Correspondence about machinery for the Tam. Rec. Plant, specifically the chemical division – fume hoods.

Folder 28: Tamarack Leaching & Flotation Building-Copper Oxide Plant – 1914-1958

- Correspondence about machinery for the Tam. Rec. Plant, specifically the chemical division.
- Building budget, total costs.

Folder 29: Cupric Oxide Plant – 1947-1950

- Correspondence about machinery for the Tam. Rec. Plant, specifically the chemical division.
- Letter asking for information about dust collectors and capacities for the Copper Oxide Plant – 1948.

- Letter from Tam. Rec. Plant to Nichols Engineering & Research Corp. about C&H having to put a project on hold because the copper market is down, but the Cupric Oxide plant is still producing – 1949.
- Document copied: Cupric Oxide Plant – Flow Sheet, 1947.

Folder 30: Tamarack Leaching & Flotation Building-Stills – 1948-1950
- Piping for steam conservation system for ammonia stills.

Folder 31: Leaching & Flotation Building – 1920-1921
- Correspondence about building the Tam. Rec. Plant with the American Bridge Co.

Box 40 –
Folder 1: Leaching & Flotation Building – 1921-1923
- Correspondence between C&H and various companies asking for blueprints of Tamarack facilities & machines that they have purchased but Tamarack had not given them copies of – 1923.
- List of blueprints from Allis Chalmers listing the different motors and transformers ordered for the Tam. Rec. Plant – 1923.
- Correspondence about blueprints being sent back and forth between C&H and various companies about the construction of the Tam. Rec. Plant and machinery in it.

Folder 2: Leaching & Flotation Building – 1900-1960
- Roof repairs to the Tam. Rec. Plant – list of supplies, 1960.
- Document copied: Investigation Report – Copper Recovery Test – Tamarack Reclamation, Project No. 48.1.5, July 31, 1959.
- Correspondence about the machinery going into the Tam. Rec. Plant.

Folder 3: Oil House – 1920-1921
- Correspondence acknowledging the receiving of blueprints of the Oil House and sending them back and forth.

Folder 4: Pumps – 1922-1957
- Correspondence about purchasing pumps for the Tamarack Reclamation Plant Shore Plant & Dredges.

Folder 5: Tamarack Reclamation Plant – Secondary Copper – 1946-1950
- Anhydrous Ammonia Storage & correspondence on how to store it. Project was scrapped and aqueous ammonia was used instead.

Folder 6: Shore Plant – 1922-1945
- Plan view of the rubbish system & conveyor.
- Correspondence of motors for pumps.
- Correspondence about issues with blueprints for a bridge.

Folder 7: Tamarack Reclamation Plant Sketches – 1921
- Plant sketches of the plant.

Folder 8: Steam Main – 1941
- Document copied: Steam Line from Ahmeek Mill to Tamarack Reclamation.
- Order for Magnesia from the Asbestos, Asphalt, & Insulation Mfg. Co.
- Cancellation of construction jobs: Tamarack Reclamation – Steam Main & Ahmeek Mill Boiler House – Water Treating.

Folder 9: Water Supply – 1923-1948
- Correspondence about the water system for the Tam. Rec. Area including the Hungarian Dam & lake pumping station #1.

Folder 10: Flotation Section – 1946-1947
- Correspondence about Dorr Thickeners.

Folder 11: Remodeling – 1940-1944
- Estimate for the Tam. Rec. Plant R.R. Storm Shed
- Correspondence about a blueprint for an automobile door on the NW corner of the Tam. Rec. Plant.

4.4.40.4 "T" Continued

Box 38 –

Folder 11: Tamarack Tailings Plant – 1917-1920
- Correspondence about blueprints for the Tamarack Tailings Plant and the T.O.L. Mills.
- General correspondence about the TOL Mills Tailings Plant.

Folder 18: Tram Car Loaders & Scraper Hoists – 1920-1952
- Correspondence about car, trams, and hoist specifications.

Folder 21: Transportation – 1949-1961
- Correspondence about Jeep Wagon usage.
- Correspondence asking for different brochures for vehicles they saw advertised.

Folder 22: Report on Lighting Protection for Electrical Transmission System – 1949-1954
- Description of the entire electrical system, including transformers.
- Document copied: Report on Status of Recommendations – Of Vern E. Alden Co.'s Engineering Studies of Feb. 1, 1949 & Nov. 17, 1954. Submitted Jan. 6, 1955.
- Document copied: Report on Lightning Protection for the Electrical Transmission System of Calumet & Hecla, Nov. 12, 1954.
- Drawing: Single Line Diagram of 13.8 KV, 25~8.12 KV, 60~Systems, 1953.

Folder 23: Miscellaneous "T" Files – 1916-1956

- List of jobs that should be done before the Ahmeek Mill & the Tam. Rec. Plant start up again – 1949.
- List of jobs to be done before the Tam. Rec. Plant is in operating condition – 1936.
- Correspondence about roof trusses from the American Bridge Co. that C&H should use this type in the Tam. Rec. Plant – 1922.
- Correspondence about the Tamarack #3 Boiler House Coal Trestle and that it should be torn down and repaired in the #3 shaft is to remain open for more than a year or two.

5.12.3 Boiler Inspection Reports, 1913-1942
Box 37
Folder 13: Insurance Service Reports from the Royal Indemnity Company (1927-1931) & the Maryland Casualty Company (1931-1942).
1927-1942

8.1.22.5 Tamarack Reclamation Plant
Box 40
Folder 5: Correspondence between the Secondary Copper Dept. and the Smelter & Chemical Manager about the storage & use of ammonia (13,000 Gallon Ammonia Unloading & Storage System).
1949-1950

Folder 7: Sketches of the interior machinery of the Tamarack Reclamation Plant. No exterior views.
1920-1924

4.4.5 (4.3.4a) MacNaughton Numeric File: 1-625, Various Companies & Topics
Box 48
Folder 534: Correspondence about copper shipments, mining companies not paying their smelting bills, insurance on copper shipments made, and the types of ingots produced.
1914-1915

Folder 562: Correspondence on the possible use of electrolytic processes at the smelter, insurance on copper shipments made, agreements for smelting White Pine copper, silver contained in the White Pine copper,
1915

4.4.14 (4.3.7) MacNaughton Numeric File: #1-141, Various Companies & Topics, 1910-1914
Box 56
Folder 28: Notes saying they are making a map of St. Louis (1913), they want a photograph of the new Isle Royale map (1913), they want copies of the surface maps for C&H locations (1912), and that they want a blueprint of the surface locations at the various mines (1912).
1912-1913

Lake Chemical Archival Research

Michigan Technological University Archives and Copper Country Historical Collections

MS-002: Calumet and Hecla Mining Companies Collection

John Baeton

Box 22:

Folder 001: Lake Chemical Co. Minutes of Meetings – 1945-1953

This folder contains a bound volume of minutes from the meetings of Lake Chemical, including documentation related to the incorporation of the company, dividend payouts, and the production of new products, such as copper cyanide.

1. In a document from Nov. 12, 1945, the purpose of Lake Chemical is described as, "Lake was organized for the purpose of engaging in the manufacture and sale of Copper Oxychloride Sulphate and Cupric Hydroxide, and such other copper chemicals as may be determined upon at a later date…"
2. Scanned an article from this folder.

Folder 002: Lake Chemical Co. Minutes of Meetings 1954-1960

This folder contains a single bound volume containing the minutes from 1954 to 1960, the majority of the minutes are focused on finances or the ongoing elections for a variety of positions within the company. There are occasional descriptions of other activities at the meetings, such as this statement from November 7, 1956:

"General discussions followed covering inventories, the purchase of copper scrap, additional research to develop new and broader sales outlets, and periodic meetings of the Sales and Production Departments of the Company."

Folder 003: Lake Chemical Minutes of Meetings 1960-1961

This folder is empty.

Folder 004: Lake Chemical Co. Minutes of Meetings 1945-1958

This folder contains a bound volume as well as a number of individual documents. The individual documents contain more detailed information related to the production of various products, including T.C.B.S or Tri-Basic Copper Sulfate, copper carbonate, copper nitrate solution and copper chloride.

1. In a document from May 24, 1957, it is stated that, "In view of the fact that the C.O.C.S. plant has shut down, the inventory was reviewed….It is anticipated that the plant will again operate in September or October." Additionally, this document also mentions the installation of a hood over the C.O.C.S. reaction tanks:

"Mr. Poull presented the problem of ventilation over the C.O.C.S. reaction tanks. The State Health department has made an issue of this and is currently insisting that hoods and blowers be installed. The estimated cost is about $4,200, which will be a capital expenditure. Before proceeding with this, however, Mr. Kromer will discuss the subject with Mr. Stott and we will attempt to review the recommendation with the State Health Department inspector, pointing out that the condition has existed for approximately tweleve years and there has been no apparent hazard indicated in that time."

2. The bound volume contains the "Consent to Dissolution" from November 2, 1964.

<u>Box 197:</u>

Folder 001: Abrasives
1. This folder contains correspondence from the 1960s between C&H and a number of companies, such as Park Chemical, regarding the purchase of conglomerate sands from C&H to be used as an abrasive in "automotive cleaners, and buffing and polishing compounds" as a replacement for Tripoli.
2. Additionally, the folder contains a supply list for equipment to be installed at C&H's "Conglomerate Powder Plant" within the Lake Linden Leaching Plant.
3. Also included in the folder is correspondence from Sept. 15, 1960 between C&H and the Blaw-Knox Company regarding the purchase of an "autoclave reactor" used to mix copper bearing material with acetic acid.
4. A flow chart from 1960 shows the process at the Lake Linden Conglomerate Powder Plant, as basically a sophisticated regrinding unit.

Folder 002: Advertising – Oxide
This folder contains various advertisements (primarily from the 1950s) and promotional material for materials such as Calumet Brown Copper Oxide, Liddicoat Drill Bits, and an informative piece on the Calumet Foundry.
This folder also contains a number of unidentified black and white photographs, some showing close-ups of pieces of equipment likely in the chemical production facility. A number of photographs show men working in a laboratory within the C&H Research Dept. building.

Folder 003: Agglomeration-Includes Pellitizing, Briquetting, Sintering, Pressing, etc.
This folder contains correspondence from 1960 between C&H and other companies regarding the construction of various pieces of equipment to be used for "pelletizing" and "drying" of flotation concentrates, including a number of measured drawings. It appears that none of these proposals came to fruition.

1. A report titled, "The Dwight-Lloyd McWane Iron Making Process" by the McDowell Company.
2. A report from April 29, 1960 titled, "Project R 43, Progress Report No. 1 to Sulphite Pulp Manufacturers' Research League – Study of spent Sulphite Liquor

Products as Binders in the Pelletizing and Aggolmeration of Iron Ores" written by the Institute of Mineral Research from MTU.

Folder 005: Alamet

This folder contains correspondence mainly from 1966 from or regarding the Alamet Division of C&H based in Selma Alabama., mainly concerned with magnesium products.

Folder 007: Algicide

This folder contains documents from the late 1950s related to the use of copper as a product in controlling the growth of algae. The primary correspondence is between C&H and the Fish and Wildlife Service regarding the use and unsuitable nature of C&H's algicide for controlling "red tide" and the design of a tableting machine from the F.J. Stokes Corportation.

Folder 012: Analytical and Associated-Sulfite, Chemicals

This folder contains a number of subfolders.

Subfolders:

1. Analytical: Sulfite Copper & Alloys
2. Analytical: Sulfite Cast Iron
3. Analytical: Sulfite – Chemicals
4. Analytical: Sulfite – General
5. Analytical: Sulfite- Minerals

6. A report titled, "Instrument Analyses Report" from 1966.

-None of these appear to contain anything we are interested in, but instead detailed quantifiable reports describing the chemical composition of various materials.

Folder 013: Anti-fouling Paints

This folder contains articles, many of them from the late 1940s, related to anti-fouling paint used in marine equipment.

Folder 014: Arsenic

This folder contains a few reports regarding the processes used to determine the amount of arsenic in treated copper. Neither of them address our research questions.

Folder 019: Blending Agricultural Oxide

This folder contains correspondence between C&H and a handful of companies, such as Sturtevant Mill Company and Poulson Compant regarding the sale of a blender to be used in the production of copper oxides.

Folder 027: Catalysis

This folder contains a report titled, "Copper-Catalytic Reactions", a patent drawing for a converter-muffler, and a letter concerning the use of copper oxides for use in the "desulfurization of petroleum distillates".

Folder 028: Cement Copper

This folder contains 2 sheets of paper from 1956 which show stastical data related to particle size determination.

Folder 030: Chemical Products Team Meetings

This folder contains the minutes for meetings of the Chemical Products Team for 1967 and 1968. These documents contain production data, notes on research and development, product and inventory, and general maintenance. I did not see anything overly illuminating, but they might have some valuable information if we choose to go back to them.

Folder 031: Copper Acetate

This folder contains various correspondence regarding the chemical composition of C&H copper concentrate, as it relates to acetate. Not of much use.

Folder 032: Copper Alloys

This folder contains a vast assortment of patents, correspondence, guide books, published articles, and blue prints showing chemical make-ups. Nothing in this folder seems to be of importance.

<u>Box 198:</u>

Folder 001: Copper and Brass Research

This folder contains a number of bulletins produced by the "Copper and Brass Research Associates". Not of interest.

Folder 002: Copper and Copper Alloys – General

This folder contains an assortment of journal articles, US Bureau of Mine reports, nothing of which seems to be very applicable to what we are looking for.

Folder 003: Copper and Copper Alloys – General 2

This folder contains a variety of documents that tend to be more related to the smelter than to Lake Chemical.

1. A series of maps were scanned that show a proposed change to the layout of the smelter in the late 1960s.

Folder 004: Copper and Copper Alloys – General 2

This folder contains a variety of documents that tend to be more related to the smelter than to Lake Chemical.

Folder 005: Copper – Arsenical General

This folder contains a large assortment of scholarly articles related to arsenical copper, including materials from various trade journals. Additionally, a smaller amount of correspondence from the 1930s related to the use of copper pipe for water transmission and the potential risk of human poisoning from the arsenic embedded within it, but it is probably of not much value.

Folder 006: Copper Anodes – Electro Plating

This folder contains documents from the late 1950s to the early 1960s related to the chemical composition of “anode balls”

Folder 006 (02): Copper Catalysts (Smog Control)

This folder contains correspondence from the late 1950s – early 1960s related to the manufacture of catalytic converters, in which copper oxide would be used as a smog dissolvent, for smog reduction in automobiles. Probably of not much use.

Folder 007: Copper Chemicals

This folder contains an eleven page list of various copper chemicals, their composition and what they are used for.

Folder 008: Copper Clad Steel

This folder contains a report regarding the travel of G.L. Craig to Pittsburgh, PA and Warren, OH in 1933 to a number of industrial manufacturers of clad metals. Not of much use.

Folder 009: Copperroyd

This folder contains promotional materials from the Copperroyd Co., manufacturers’ of a copper based paint mixture used for boat bottoms.

Folder 010: Copper Salts – Petroleum Refining

This folder contains 2 bibliographies concerned with the use of copper in petroleum refining.

Folder 011: Copper – Segregation Process

This folder contains a report from the U.S. Bureau of Mines focused on the segregation of copper ores. It is from 1963.

Folder 012: Copper – Silver Alloys

This folder contains documents related to the silver content in copper from the 1930s. Not of much use.

Folder 013: Copper – Root Control

This folder contains correspondence regarding the use of copper oxide treated pipes for the control of root penetration.

Folder 014: Tribasic Copper Sulfate – Copper Sulfate

This folder contains correspondence and reports related to the production and use of TBCS. Nothing of note.

Folder 015: Tribasic Copper Sulfate – Packaging

This folder contains some promotional material related to devices used for packaging TBCS.

Folder 016: Copper Tuyeres

This folder contains correspondence from mainly the mid 1950s related to the production of copper tuyeres.

Folder 017: Copper Wire – General

This folder contained technical reports related to various methods of drawing copper wire.

Folder 018: Copper "X" (Colored Ag. Copper)

This folder contains a large assortment of information related to equipment used to pelletize or crush copper "X", and bits of information regarding how the product is manufactured. No mention of waste.

Folder 19: Correspondence – Calumet Divisions General

This folder contains various correspondence from 1963, 1964 and 1965. None of it seemed applicable.

Folder 022: Cost Improvement Program – 1967

This folder contains correspondence regarding measures that could increase efficiency at the facilities ran by C&H.

1. In a document written on May 19, 1967 from G.L. Craig to L.F. Engle titled "Cost Improvement, mention is made regarding slags:

"Slags – How well are we sampling slags before consigning them to the lake where their identity is lost forever? Have we exhausted all marketing possibilities – insulation, filtering media, etc.?

Folder 023: George Craig

This folder contains correspondence to or from George Craig, regarding a variety of subjects mainly related to the use of copper chemicals in the agricultural field.

Folder 026: Cupric Chloride

This folder contains correspondence regarding the sale and production of cupric chloride to a handful of businesses in the late 1950s.

Folder 027: Cupric Chloride

This folder contains a small amount of documents related to the production of cupric chloride from 1968. Nothing of interest.

Folder 028: Cupronal

This folder contains a small amount of correspondence and reports from 1944-1945 regarding the copper alloy "cupronal", not of use.

Folder 029: Cuprous Oxide – Harshaw Chemical Company

This folder contains various documents related to the production of cupric oxide from the 1940s.

1. Scanned a report which mentions the dumping of waste material into the lake.

Folder 030: Cuprous Oxide

This folder contains much of the same type of correspondence seen in folder 029, with the addition of the purchase price and inventory of suggested machines to be installed at the plant. Nothing seems to be too illuminating.

<u>Box 199:</u>

Folder 001: Cuprous Oxide

This folder contains documents and correspondence related to the production of cupric oxide from the mid-1940s. The majority of the documents are concerned with the sale of cupric oxide to various manufacturers, and the merging/partnership of the Harshaw Chemical Co and Lake Chemical. Various surveys into the economies of producing cupric oxide are also included, which contain data on other cupric oxide manufacturers

Folder 005: Copper Sulphides – General

This folder contains a single report from the US Dept of Commerce on "Thermoelectric Materials".

Folder 006: Cyanide

This folder contains correspondence and technical reports on cuprous cyanide, nothing of note.

Folder 007: DAC Meeting Notes

-Nothing of importance.

Folder 011: Electroplating

This folder contains a report from 1949, titled "Corrosion of Electroplated Steel in Automotive Applications" from the Batelle Memorial Institute

Folder 012: L.F. Engle – Correspondence

This folder contains primarily personal correspondence form L.F. Engle to friends and colleagues.

Folder 020: Fly Ash

This folder contains a small amount of correspondence related to recovering copper from fly ash. Nothing of note.

Folder 021: Foundry

This folder contains two reports, one from 1948 and one from 1963 regarding the Foundry. These reports are primarily concerned with the efficiency of the facility. The 1963 report includes a map that shows the layout of the building. Not sure if this is the foundry in Ripley or the foundry in Calumet.

Folder 022: Flowsheets – Misc.

This folder contains a number of flow sheets. I scanned four of them. Some additional flowsheets in the folder consist of flow sheets for the Champion mine and mill, a flow sheet for the Houghton Road Commission.

Folder 025: Facilities

This folder contains documents related to facilities in the Calumet region.

Folder 028: Foundry – General Reports

This folder contains some loose document and two bound reports from 1965.

1. The first report is "Appropriation Methods Report on Automation of Calumet Foundry". This report contains plan maps of the foundry, but it is unknown if this is the foundry in Calumet or in Ripley.
2. The second report is "Preliminary Appropriations Report on New Ball Production Foundry", which also contains some nice detailed drawing of a proposed facility, but it is unknown is this is in Calumet or Ripley.

Folder 029: Foundry Products Team Meeting

This folder contains the minutes from the meetings of the Foundry Products Team. Most of these are concerned with marketing of products. Not of much use.

<u>Box 200:</u>

Folder 007: Inventory

This folder contains documents listing the supplies on hand within Lake Chemical. **Included within these documents is a list of chemicals**. Not sure if this would be helpful or not.

Folder 017: Material Control Staff Meeting

This folder contains a single document from June 18, 1968, regarding Inventory clean-up at the warehouses, shipments of scrap copper, the production of grinding balls at the foundry, and problems with staffing due to National Guard obligations.

Folder 021: Memorandums of Agreement

This folder contains a large assortment of MOAs between C&H and a variety of organizations, such as: The Florida Agricultural Experiment Station, The Ohio Agricultural Experiment Station, Purdue University's Agricultural Experiment Station, New York State College of Agriculture, Michigan State, University of

Minnesota, and West Virginia University amongst others related to copper oxide as a fertilizer and the use of copper as a fungicide.

Folder 022: Metallurgy - General

This folder contains a single technical paper titled, Research Extraction Metallurgy" by A.D. Turnbull from 1962.

Folder 023: Methods of Analysis

This folder contains a handful of technical papers from abroad, and a single paper written by G.L. Craig, titled, "Distillation of Ammoniacal Copper Carbonate Solutions". Probably not of much use.

Folder 025: Milling and Concentrating

This folder contains four monthly statistical charts related to "Mine-Mill Smelter Variation and Flotation Allocation Factor-Chart, from April-July of 1962.
1. Scanned a letter from Sept. 6, 1950 from R.M. Haskell regarding sand banks and reclamation.

<u>Box 201:</u>

Folder 021: Slag Utilization

This folder contains correspondence and promotional brochures related to the use of slag in a variety of commercial products, such as mineral wool, insulation and fiberglass.

1. Scanned a piece of correspondence from February 11, 1959, that details the disposal of slag into Torch Lake.
2. Scanned a piece of correspondence from 1950, detailing the disposal of slag into Torch Lake

Folder 022: Slime Investigation

This folder contains a report from 1955 which describes the installation of a Cyclone application in order to better recover copper from slimes within the Tamarack Reclamation Plant. It is overly concerned with the economics of the process and does not articulate the input flow or the output flow from the process.

Folder 023: Smelting and Refining

This folder contains correspondence and reports regarding the efficiency of the smelting works in the late 1940s to the mid 1950s.

1. Scanned a piece of correspondence from 1957 detailing the dumping of waste into Torch Lake.

Folder 024: Soda – Lime Refining Process

This folder contains correspondence related to patent issues with a

Folder 027: Spent Wire Lubricant

This folder contains correspondence and reports regarding the separation of wire drawing lubricants and sale of the product.

1. Scanned a report from 1946 on "Spent Wire Lubricant"
2. Scanned a report detailing the "Grease Reclamation Plant: from 1947.

<u>Box 202:</u>

Folder 005: Tamarack Reclamation – MCMT Project

This folder contains correspondence about an agreement between C&H and MTU regarding the microscopic study of copper and gangue materal.

Folder 018: Zinc

This folder contains technical reports and correspondence from the 1940s and 1950s related to the leaching of zinc to produce agricultural products such as zinc carbonate. It is unknown is C&H ever produced this product.

Folder 019: Zinc Chromate

This folder contains correspondence between C&H and other companies from 1953 regarding the shipping of samples of zinc chromate, a product commonly used as a paint pigment, to C&H for testing

<u>Box 399:</u>

Folder 001: Lake Chemical – Preliminary Drafts and Data

This folder contains files related to the board of directors for the newly incorporated Lake Chemical Co., and how the shares and dividends and costs will be distributed between C&H, Harshaw Chemical and investors.

Folder 002: The Prozite Company

The folder contains a bound volume related to the finances and organization of the newly incorporated company.

<u>Box 512:</u>

Folder 9: Lake Chemical Co - Dissolution

This folder contains documents related to the dissolution of Lake Chemical into Calumet & Hecla in 1965. Most of the documents are concerned with transferring the ownership of a handful of patents to C&H from Lake Chemical.

Michigan Technological University Archives and Copper Country Historical Collections

MS-002: Calumet and Hecla Mining Companies Collection

Dan Schneider

Series 4.4.14 (4.3.7)
<u>Box 55:</u>

Folder 055/034: Dollar Bay Land and Improvement Co., Deeded to Tamarack & Hancock Chemical Company, 1910

This folder contains correspondence relating to the Tamarack Mining Company's efforts to secure deeds for a coal dock and the Hancock Chemical Company works from the Dollar Bay Land and Improvement Company.

1. July 9, 1910 — James MacNaughton to George Flagg. Letter indicates the coal dock was located on these lots: Lot 3, Section 2, Township 55, Range 33 and Lot 1, Section 32, Township 55 Range 33
2. September 20, 1910 — MacNaughton to Flagg. Letter stating "It is rather a serious situation to have our coal dock at Dollar Bay, or at least a part of it, located on land not belonging to us.

<u>Box 84:</u>

Folder 084/013: Chemical Plant Proposal, 1964-1965

This folder contains several drafts, and several copies of the final draft, of a proposal to double the production facilities of the C & H chemical plant at Lake Linden. C & H apparently produced copper oxides at its still house in Lake Linden, probably a more "raw" material than the copper-derived agricultural chemicals being produced at Lake Chemical.

1. Latest draft of the proposal is dated May 12, 1965. It includes financial projections, a history of C&H's chemical production, and a description of the process for producing copper oxides. The process is split into two "circuits," Circuit A using "uncontaminated scrap copper," which was more expensive to obtain on the scrap market, and Circuit B using material that was "often contaminated with lead and zinc and the oxide that is produced is likewise of a lesser purity. This makes excellent material for **fungicidal** and **fertilizer** uses in agriculture and is sold as such. The raw material cost is generally low enough so that the oxide can be further process into refined copper and sold at profit."
2. An earlier draft dated October 19, 1964 includes a hand-drawn flow chart of the "leaching-still house operation" for the A Circuit: Leaching → Still → Filter → Dryer → Bagging; and for the B Circuit: Leaching → Still → Filter → Smelter.
3. October 1964 – A report on the feasibility of adding a parallel production/packaging line for oxides at the Still House contains lots of financial statistics and projections, and more significantly a list of equipment used to process and package oxides. The list of manufacturers and their equipment (with [References to drawings, listed in Card File Boxes for C & H Drawings, MS-005]):

1. Combustion Engineering Inc., Raymond Division [MS-005 Card File Box 18]
    a. Raymond Furnace and Accessories
    b. 40-inch "Imp. Mill."
    c. 4-foot diameter Raymond Cyclone
    d. Two 8-inch Raymond Air Lock Valves
2. Pulverizing Machinery Division of Slick Industrial Co. [MS-005 Card File Box 25]
    a. One F1-24 Mikro-Pulsaire Collector
3. St. Regis Paper Company [MS-005 Card File Box 25]
    As. 100-pound bagging machine. *Drawings located in MS-005, Drawer 271 ("New Number" 32-D-17) indicates a bagging machine was installed at the Still House in Lake Linden.*

Folder 084/001: Report on a Proposed Cuprous Oxide Business. 1965

This folder contains a large stack of documents related to C&H's 1965 efforts to develop a process for producing copper oxide that would eliminate the use of stills and use a less costly grade of scrap. The documents include historical information from the 1950s about Cuprous Oxide production. They do not mention Lake Chemical by name, though ***cuprous oxide*** *production figures are given for cuprous oxide production facilities in both Tamarack Reclamation and at Lake Linden.*

<u>Box 85:</u>

Folder 085/017: Copper Carbamate Chemicals Project 1832 Interim Status Report, DATE???????

This folder contains a report on agricultural field trials of copper carbamate chemicals as well as a study of market feasibility for such products. No indication is given as to whether they were actually put into production.
There is a description of production process (laboratory scale); a history of copper-based fungicide use in agriculture; results of field trials for "C&H M-20" (dimethyldithiocarbamate) and "C&H E-20" (ethylenebisdithiocarbamate); and a flow chart showing an apparently hypothetical production process for these products.

Folder 085/016: Report on the Removal of Lead and Zinc from Copper Ammonium Carbonate Leaching Solutions, 1946

This report by L.C. Klein describes experiments to remove ***lead*** *and* ***zinc*** *contaminants from rich copper leaching solutions. Lead and zinc were most problematic among an unspecified number of elements that would contaminate copper-rich ammonia solutions during the leaching process. Zinc would dissolve along with the copper, and lead would form colloidal suspensions in the ammonia. In both cases, the impurities would end up in the finished oxide products, rendering them unsuitable for some applications.*

The report, dated January 15, 1946, describes processes that were tested for removing each element. There is a list of chemical reagents used during these tests. The most successful ones were:

For Zinc: **Silicates of Soda (DuPont's "F Grade")** added during leaching

For Lead: **Barium Chloride Crystals and Anhydrous Calcium Chloride**

It is not clear whether these methods were applied on a production scale.

Box 57:

Folder 057/016: Harshaw Chemical Company, 1944

This box contains correspondence relating to C&H's early business relationship with Harshaw Chemical, predating the Lake Chemical Company's organization. Correspondents include C & H President A. E. Petermann, C & H Vice President E.R. Lovell, Harshaw Chemical President W.J. Harshaw, and C & H ________ G. L. Craig. Their early partnership was spurred by the opportunity to produce cuprous oxide for the U.S. Navy as an ingredient in the paint for its ships' hulls during World War II.

1. March 24, 1944 – Petermann to Harshaw & Co.: "We understand that your process for producing cuprous oxide has proven very encouraging in laboratory and small scale operation but that no commercial practice has been developed. We also understand that you wish us to participate in the development of a commercial procedure for producing **cuprous oxide**, and possibly **cupric oxide**, and **copper powder**. We are very much interested and shall be glad to participate with you."
2. March 21, 1944 – Internal memorandum Petermann to Lovell stating Harshaw has developed a method for cuprous oxide production and is looking into getting patent protection.
3. March 22, 1944 – Internal C & H memorandum from Craig on visit to Harshaw Chemical. This describes the patent process for **"Navy grade cuprous oxide"** using C & H mixed oxide from Tamarack Reclamation as a basic raw material.
4. March 25, 1944 – Lovell to Petermann. Cuprous oxide was used in making paint for the hulls of ships. This letter describes a proposal to split the cost of setting up pilot plant for oxide production 50-50 between C & H and Harshaw Chemical.
5. April 6, 1944 – Harshaw to ??? This letter recommends installation of the pilot plant either in Elyria or Lake Linden, and to order equipment suitable for commercial-scale production right at the get-go, before testing the smaller scale plant. "Inasmuch as the situation has developed with the War Production Board which makes it practically mandatory that we move quickly, I feel that we should got to the commercial continuous rotary at once . . . I am very much afraid the War Production Board will decide to give the job to some other manufacturer and we might be out of the picture until the war is over." This letter mentions specifically **red copper oxide.**

7. August 29, 1944 – Craig to Lovell. (Copied) Harshaw Chemical has made a proposal to C & H for the latter company to install production equipment for C-O-C-S

(**Copper Oxychloride Sulphate**) at one of its existing facilities. The letter describes the production process and lists the raw materials for a batch of C-O-C-S:

1,210 lbs **Copper Wire** (5-24 gauge, **iron and solder free**)
350 lbs **salt** (Commercial, Chippewa, Ohio Salt Co.)
620 lbs **Sulphuric Acid** (Commercial 66^0Be!, General Chemical Company)
477 lbs **Aqua Ammonia** (26^0Be!, Du Pont)
110 lbs **Caustic Soda** (76% Flake, Columbia Alkali Company)

Byproduct: **Brown Oxide**
6. August 31, 1944 – Craig to Lovell. Brown copper oxide is directly saleable to Harshaw Chemical Co.

<u>Box 60</u>:

Folder 060/004: Harshaw Chemical Company, 1945-1951
This folder contains a sizeable stack of correspondence related to Lake Chemical's formal organization. These include contracts, legal incorporation details, discussions of patent protection for processes, and numerous progress reports on the construction of Lake Chemical's physical plant (some of these are included as PDF scans). In correspondence related to processes, there are frequent references to furnaces used to produce copper chemicals. The Calumet & Hecla drawings collection contains drawings of a "Furnace House," which may or may not be related to Lake Chemical. The folder contains Harshaw's Annual Report for 1944 (not especially relevant) as well as a "Babson's" report on Harshaw Chemical Co. Early setbacks to production were apparently few, but included an inability to procure ***caustic soda.*** *The folder gives some perspective on Harshaw's broader interests in minerals.*

1. July 6, 1945 – Harshaw to Lovell. Early plans called for a yearly production of "3,600,000 lbs of **COCS or its equivalent Cupric Hydroxide**," also the production of 300,000 lbs of **black copper oxide**. Harshaw also recommended "provisions should be made for the manufacture of **Red Cuprous Oxide used primarily in the formulation of anti-fouling paints**."
2. July 31, 1945- Lovell to Harshaw. "We are proceeding as rapidly as possible to lay out both units in our Tamarack Reclamation Plant building. The scrapping and removal of idle flotation equipment will proceed promptly in order to provide the necessary space."
3. September 8, 1945 – Draft of lease to Lake Copper Company. Plant to be located in the southwest corner of C & H's Tamarack Reclamation Building. (See scanned first page of lease and accompanying drawing).
4. October 1, 1945 – Petermann to D. T. Perry (C & H Secretary Treasurer). "Lake Chemical has been incorporated, but we have not held the meetings of incorporators and directors necessary to perfect its organization."
5. January 4, 1946. Harshaw to Lovell: **Black Copper Oxide** should be made an official Lake Chemical product.

6. January 7, 1946. Early report on installation of production equipment includes description of structural changes to Tamarack Reclamation Building (see included PDF scan).
7. January 15, 1946 – Lovell to Harshaw. Calumet & Hecla manufacturing Cupric Oxide, then selling it to Lake Chemical. Lake Chemical not producing it directly.
8. January 31, 1946 – Petermann to W. H. Brown (Harshaw Attorney). Petermann sent Harshaw a copy of the L.C. Klein report referenced above, relating to removal of lead and zinc from ammonia leaching solutions of copper.
9. April 22, 1946 – Harshaw to Lovell: "Steps are being taken to contact the various manufacturers of **ceramic colors**, and I am hopeful that they will see fit to place their orders with us for cupric oxide."
10. June 17, 1946 – Harshaw to Lovell. Indicates that Oliver Filters [MS-005 Card File Box 26] were part of the production process for one of more of the Lake Chemical products. C & H drawings Drawer 271 contains operator's manuals for Dorr-Oliver filters.
11. August 16, 1946 – Drake Perry (Harshaw Chem.) to Lovell. "We are also much impressed and pleased by the progress made at the new plant of Lake Chemical"
12. September 12, 1946 – Harshaw to Lovell. "The production of 50 tons for the month is very pleasing. I think this is almost a record for a new installation."
13. October 7, 1946 – Harshaw to Lovell. Refers to **"cement copper"**
14. January 9, 1951 – Harshaw to Lovell requesting 100-lb bag of **zinc concentrates** from C & H. "I believe I am correct in assuming that you are shipping your concentrates to the smelter in St. Louis."

Folder 060/032: Smelting and Chemical Department, 1945-1949
This folder contains scattershot correspondence related mostly to smelting activities, with some reference to secondary (scrap) copper and copper oxide production. There is also correspondence dealing with a proposal under which C & H would smelt Quincy Mining Company copper concentrates under contract.

1. March 16, 1945 – Smelter Superintendent H. C. Kenny to C & H General Manager A.H. Wohlrab. Letter in which Kenny describes costs and equipment necessary to ramp up secondary (scrap) copper refining.
2. October 12, 1945 – Kenny to Lovell. This letter describes accounting methods for inventories of oxides on hand at C & H: "The oxide distribution sheet for last month showed only one kind of unpackaged oxide on hand, namely, Lake Linden and Tamarack oxide combined. This was done because both materials are now kept in the same bin and there is no way of knowing which is which."
3. June 15, 1946 – Kenny to Wohlrab. Kenny proposes an estimate system for copper absorbed in smelter furnace bottoms. He estimates more than 600,000 pounds of copper were being absorbed into the bottom of their largest smelter over the course of a five-year period.

PDFs scanned from this folder:
1. January 29, 1946 – Kenny to Wohlrab. Letter describing a new plan for the storage of secondary copper scrap, one calling for new rail lines.

2. February 7, 1946 – Kenny to Wohlrab. Letter describing storage of oxide at the Tamarack plant.

<u>Box 138:</u>

Folder 138/003: Cost Improvement Program, 1967

These cost-improvement plans, dated as late June 23, 1967, list potential methods of cost savings for all of the Calumet Division's above- and below-ground operations. Given the timing relative to the strike and shutdown, it is doubtful whether any of these were implemented. Recommendations for the Chemical plants are reproduced below. There are recommendations for the smelter and Ahmeek Mill, as well.

1. Chemical Plants
    Replace "Trackmobile" with Cable Car Mover at Blending Plant
    Install Chip Handling System for Cleaning Still
    Resume use of Excess Smelter Steam at Lake Linden Still House
2. Chemical Plants (Second Set of Recommendations)
    Set up Flow Sheet and Equipment for Cal-Cop-10 Operation
    Install Unit Loading System at Tamarack
    Install Bulk Blending System (High Volume)
    Replace 40 H.P., 25 cycle motor on Raymond Mill with 50 H.P., 60 cycle – increase production – improve product quality
    Balance Leaching and Distillation Capacity by Addition of One More Still
    CO2 Method Development
    Method to Monitor Cuprous/Cupric Ratio from Oxidizing Tower
    Truck Loading Dock – Leaching Plant
    Integral Wash System on Leach Tank
    Increase Leach Tank Circulation
    P.H. Recorder at Tamarack

<u>Box 139:</u>

Folder 139/023: Parallel Circuit/Blend Bale House, 1965-1966

This folder contains reports related to upgrading the material handling equipment at the Lake Linden Still House.

1. January 6, 1966 – "Preliminary Investigation – Still House" submitted by B. N. Raudio. Subject: "Handling and disposal of oxides after they are chipped from the stills; this limited [sic] to the stillhouse." This document contains an excellent of how copper bearing **ammonia** accretions chipped from the stills were moved and utilized in the **copper oxide** production process. (Note: My oral history interviews have indicated chipping these accretions from the chambers of the stills was a regular maintenance activity). It appears most of this material was fed back into the **copper oxide** production system. (Note: This is a really excellent document for

describing the process, with two hand-drawn diagrams attached. I would have scanned it except it related more directly to the Lake Linden still house than to Lake Chemical.

2. February 23, 1966 – A. S. Edwards (Lake Linden Chemical Plant Dept. Head) to J. Alico (Division Head). Budget appropriation request for the installation of a parallel drying and packaging system to be built alongside the Still House's existing drying and bagging system for **copper oxides**. Total cost: $77,000. This included modifications to the building. There is no indication in the associated records as to whether this request was approved. This may relate to material from Box 84, described above. Here there is a more complete equipment list, including such details as air piping and ducts, electrical installation (cost only). Major equipment components are identical to those described under Box 84 above.

Box 166:

Folder 166/028: Bureau of Mines Reports, 1951-1968

This folder contains annual reports of "Consumption of Copper Materials" to the U. S. Department of the Interior's Bureau of Mines. Numbers reported are apparently for both Lake Chemical and the still house in Lake Linden. They contain data about the amount and type of copper scrap on hand at the companies and amounts of secondary copper the product contained (the total metal recovered from copper scrap for the year). The folder also contains instructions for filling out the forms, with definitions of terms.

1. Data for 1968:

Type of Scrap	Amount Received for the Year (lbs)	Amount Consumed (lbs)	Year-End Inventory (lbs)
No. 1 Wire and heavy copper scrap	1,603,000	1,648,300	218,700
"Copper Clad" scrap	7,938,300	7,351,800	1,588,500
"Cu. Bearing" scrap	5,859,100	7,424,100	3,110,000

2. Total metal recovered from copper-base scrap for the year 1968 was 5,538,875 lbs, all in chemical compounds.

Folder 166/003 National Agricultural Chemical Association, 1955-1965

This folder contains reports similar to Folder 166/028, but to the USDA's Agricultural Stabilization and Conservation Service through the National Agricultural Chemical Association. The reports are inventories of spray grade copper oxide on hand on Sept. 30 of each year. For example, in 1965 Lake Chemical had on hand 422,358 lbs of undiluted copper oxide and 329,726 lbs of copper oxide in mixtures.

Box 315:

Folders 315/001 and 315/002
Each folder is a card-file box containing equipment inventories written on 4x6 index cards. They are arranged based on the type of equipment, as opposed to location. These inventories include equipment types from beam balances to bull dozers, Dorr thickeners to steam stamps. Many have handwritten dates, many of these date 1954, but there is no indication as to the significance of the dates (date inventory was taken or what?). Nearly all of the cards list type and location of equipment. In many cases, other relevant details are listed such as drive type, size, etc. From these cards a listing of equipment in various facilities could be compiled, but it seems unlikely that this could be tied to time element.

Box 233:

Folder 233/001: Lake Chemical Tax Returns
This folder consists of Lake Chemical's Tax Return for Sept. 7, 1945 to June 30, 1946, the company's first year in business. It is bound in a ledger book with other divisions' tax returns.

- Lake Chemical was incorporated Sept. 7, 1945 in Michigan. Office address was listed as 1 Calumet Avenue, Calumet, MI. Its business serial number, "(From Instruction N)," was 66.
- Lake Chemical's gross sales for the year totaled $5360.82. The company lost $2,096.05 in its first year.
- Accompanying records indicate C & H and Harshaw each owned 50 percent of the stock in the company (each putting in a $150,000 capital investment).
- Lake Chemical bought $22,135.20 worth of material for manufacture and accrued $4,410.92 worth of "other costs." Its inventory at the end of the year was $19,924.12.

Box 26:

Folder 026/034
This folder contains invoices from the Western Union Telegraph Company. Nothing of relevance.

Folder 026/039: Purchase Orders, Calumet Division, 1963-1964
This folder contains documentation of materials C & H purchased from Lake Chemical. Most of these are blanket orders to cover future requests made by authorized personnel.

Examples:
Fine Salt → No. 1 Warehouse

Sulfuric Acid → Lake Power Plant
Copper Carbonate → external customers as indicated by marketing department
Copper Hydrate → external customers as indicated by marketing department
TBCS (Superior Label) → external customers as indicated by marketing department
TBCS (Regular) → external customers as indicated by marketing department

Folder also contains some specific orders.

1. August 19, 1963: 3,200 lbs Sulfuric Acid → C & H's Lake Boiler House
2. August 20, 1963: 50,000 lbs Superior Label TBCS → Superior Fertilizer & Chemical Co., Tampa, Fla.
3. April 17,1964: Four bags Fine Salt → Calumet & Hecla

Folder 026/040: Purchasing Orders, Harshaw Chemical Co., 1963-1964

This folder contains documentation of purchasing orders for the Harshaw Chemical Co.; the products were often shipped directly to customers. These are sufficient to offer some perspective on the volumes of different chemicals being produced for shipments during the defined time period, and the places where these materials were shipped. Copper Hydrate, in particular, is shipped in much larger amounts than was typical in the late 1940s (see below). Also a good source of information about shipping methods employed.

Examples:
June 22, 1964: 5,000 lbs Copper Hydrate → Chem-Salts Inc., Powder Springs, Ga.
April 13, 1964: 50,000 lbs C-O-C-S → Niagara Chemical, California.
April 13, 1964: 300 lbs Thallophyticidal Copper Sulfate → Chicago.
March 12, 1964: 65,000 lbs C-O-C-S → Ontario, Canada.
September 20, 1963: A note on an order for 300 lbs Copper Hydrate to be sent ground freight to Scientific Supplies Company in Seattle reads: "Must be fresh stock – Royal Blue in color and free of oxidation discoloration."
July 19, 1963: 1,000 lbs Copper Hydrate → Ontario, Canada.

Folder 026/043: Lake Chemical Shipping Orders, 1947-1948

This folder contains shipping orders for Lake Chemical product. All of these orders are for Copper Hydrate and nearly all are for small amounts. It is possible that during this early stage, these shipping orders represent samples of Copper Hydrate being sent out to prospective customers. When large amounts of Copper Hydrate were shipped, it was usually to Harshaw Chemical's plant in Elyria, Ohio.

- Product was sent in drums, tins, bottles, glass jars, bags

1. January, 1948: 11,997 lbs sent to Harshaw Chemical in bags. Notation reads: "Load opposite brake end of car."

Folder 026/044: Lake Chemical Shipping Orders, 1949

More shipping orders for Copper Hydrate. Lake is still usually shipping small amounts. One exception is:

1. February 4, 1949: 22,000-lb order (440 bags) sent to Witco Chemical Co., Chicago.

Box 27:

Folders 027/001 through 026/009: Lake Chemical Shipping Orders, 1950-1959

This folder contains more shipping orders. Below are references to specific orders, and general notes, which characterize the nature of the shipping activity during that time period. A table showing the breakdown of products shipped per year follows.

1. February 20, 1950: 40,000 lbs Copper Hydrate sent to Nuodex Products Co., Elizabethtown, New Jersey.
2. June 29, 1950: Another 40,000 lbs Copper Hydrate sent to Nuodex.
3. May 12, 1953: Internal Memorandum, F.W. Muller to various. This documents a conference between Harshaw Chemical and the Niagara Chemical Division of the Food Machines & Chemical Co. The memo indicates some kind of formal business relationship may have existed between Harshaw and Niagara. More significantly, it recommends minimizing inventories of C-O-C-S in expectation of "further decrease that is in sight for copper chemicals."

- Houghton Flour Mill (Houghton) and Best Potato Warehouse (Lake Linden) make frequent purchases of TBCS during this period.
- Shipping orders for C-O-C-S almost invariably have a handwritten analyses of the product on them.
- C-O-C-S is typically formulated at a 56 percent concentration.
- C-O-C-S is shipped in bags differentiated as "Niagara Bags," "Lake Bags," and "old style bags."
- During the early part of this period, TBCS was not shipped as frequently as were some of the other chemicals.
-

Year	Products Shipped	Comments
1948	*Copper Hydrate*	
1949	*Copper Hydrate*	
1950	*Copper Hydrate, TBCS*	*Tri-Basic Copper Sulfate (TBCS) was frequently sent as free samples to different potential customers.*
1951	*Copper Hydrate, TBCS, C-O-C-S*	*C-O-C-S is typically shipped in large amounts (e.g. 50,000 lbs to Niagara Chemical on February 19,1951)*
1952	*Copper Hydrate, TBCS, C-O-C-S*	
1953	*Copper Hydrate, TBCS, C-O-C-S*	
1954	*Copper Hydrate, TBCS, C-O-C-S*	*Shipping orders in this folder give the impression that Copper Hydrate was shipped very quickly after its production.*

1955	*Copper Hydrate, TBCS, C-O-C-S*	
1956	*Copper Hydrate, TBCS, C-O-C-S*	
1957	*Copper Hydrate, TBCS, C-O-C-S*	
1958-1959	*Copper Hydrate, TBCS, C-O-C-S*	*In contrast to earlier years, TBCS is the most popular chemical in this folder.*

Folder 027/010: Lake Chemical Bills of Lading, 1963-1964
This folder documents shipments of "copper concentrates," "fungicide," and copper hydrate via the Clairmont Transfer Co. and the Soo Line Railroad Company.

Folder 027/011: Lake Chemical Shipping Orders, 1963-1964
This folder contains shipping orders for the time period described above. Copper Carbonate emerges as a new product, not seen in previous shipping orders. In fact it is the only product covered in this folder (there are only three shipping orders in this folder).
1. August 9, 1963: 2,100 lbs "Copper Carbonate – Light" shipped to Sinclair Mineral & Chemical Co., Chicago.
2. October 12, 1964: 600 lbs Copper Carbonate delivered to Lionel Toy Corp.

Folders 027/012 through 027/15: Lake Chemical Advice of Shipping, 1963-1964
These folders contain documents which provide little information beyond that already found in the bills of lading. Lake Chemical continued to produce and ship Copper Hydrate, C-O-C-S, and TBCS during this period. Copper Carbonate, as mentioned above was also shipped.

Folder 027/016: Lake Chemical Advice of Shipping, 1963-1964
This folder is notable because the documents within it use a wide gamut of different terms to describe TBCS. It is not clear whether the terms denote different types of TBCS:

- TBCS Regular
- TBCS 53 *(Referring to a 53 percent concentration)*
- "TBCS 53 (Micronized Tribasic Copper Sulfate)"
- "TBCS 53 (Regular)"
- "TBCS 53 – Haviland Bagged Material"
- TBCS 53 Superior
- "TBCS 53 (Basic Copper Sulfate)"

Folder 027/017 and 027/18: Lake Chemical Advice of Shipping, 1963-1964
These folders contain nothing of interest.

Folder 027/033: Lake Chemical Co. Requisitions, 1963-1964

This folder contains internal C & H documents of materials requisitions for the Lake Chemical Company. The information contained is excellent with regard to the basic raw materials Lake Chemical used on an ongoing basis. The list of documents below is not a comprehensive list, but gives dates of requisition for presumably consecutive orders of each product sufficient to paint a picture of the general frequency of deliveries. Indications are this is not the complete set of requisition documents from that time period.

- **Sulfuric Acid**: One tank car requisitioned for Lake Chemical February 5, 1964; also March 9, April 30.
- **Sulfuric Acid**: 3,000 lbs transferred from Lake Chemical to C & H Lake Linden boiler house May 7, 1964. Similar amounts transferred March 3, March 12, April 6; 1,600 lbs transferred June 22.
- **Ammonia**: 10,798 lbs transferred from C & H Lake Leaching to Lake Chemical April 29,1964. Similar amounts transferred January 24, February 12, February 21, March 6
- **"Marasperse"**: 20 bags requisitioned for Lake Chemical February 19, 1964.
- **Fine Salt**: 60,000 lbs requisitioned for Lake Chemical October 16, 1963. Identical amounts December 2, 1963 and March 2, 1964
- **Caustic Soda, 50% Liquid**: 1 Tank Car requisitioned for Lake Chemical October 22, 1963. Also September 21 and November 5, 1964.
- Three glass electrodes and three asbestos fibre reference electrodes no. 39170 requisitioned for Lake Chemical September 20, 1963.

Folder 027/036: Lake Chemical Co. Invoices, 1956-1957

This box contains invoices for power and materials purchased from C & H.

1. December 29, 1956: "Electric Power – per Upper Peninsula Power Company invoices dated 12/14/56." Invoice total is $51.26. There is a handwritten notation: "COCS 40.50; Hyd 10.76."
2. December 29, 1956: Conversion Charges. 8,603 lbs Cu @ 9.96 cents → $856.86
3. December 29, 1956: Invoice for 388/M Gallons of Lake Water; 69,500 KWH electricity; 1,140 units of steam
4. December 27, 1956: Invoice

a. For No. 1 Copper Scrap diverted to C-O-C-S production:

Date	Amount (lbs)
11/8/56	40,420
11/19/56	40,745
11/23/56	40,020
12/10/56	42,255
12/14/56	44,785
12/13/56	41,555

b. For a "bailing charge" and a "direct buying charge."

c. For 8,734 lbs no. 1 copper scrap "suitable for chemical operations (hydrate)"; copper content 8,603 lbs

5. January 31, 1957: Invoice for 5,610 lbs "**Copper Bearing residue w/ 1.51% Pb**." This was apparently a credit to the Lake Chemical account, with the material being sent to the C & H smelter to be refined.

Folder 027/023: USDA Report of Pesticides on Hand, 1960-1963
This folder contains reports to the USDA Commodity Stabilization service of pesticide inventories on hand September 30 of each year. There is limited correspondence related to clerical aspects of this reporting. The folder contains the front panel of a paper C-O-C-S bag of the type used to package product sold to and branded by the Niagara Chemical Division of FMC Corporation (See attached PDFs). The middle panel of the bag includes directions for formulating C-O-C-S for crop application.

Lake Chemical reported the following chemical stocks:

Year	**Copper Sulfate (lbs)**	**Basic Copper Sulfate (lbs)**
1960	154,000	674,300
1961	274,300	360,300
1962	250,250	549,475
1963	192,900	639,198

Folder 027/024: Copper Forms & Products – Reports of Operations & Shipments, 1953-1964
This folder contains quarterly inventory reports to the U.S. Department of Commerce, Bureau of the Census, of stocks of copper and copper-based products on hand at Lake Chemical for the time period defined. Weights reported appear to be that of the copper content only for each product. Figures are reported in generic categories with Lake Chemical reporting stocks of "unalloyed copper scrap," metal in process," and "finished products." (See accompanying PDF) The numbers are so general as to not be incredibly illuminating. Inventories are broken down more specifically in handwritten note sheets accompanying each form. For example:

1. Fourth Quarter, 1954: 326,000 lbs total shipments — 52,000 lbs Copper Hydrate, 0 lbs TBCS, and 274,000 lbs C-O-C-S.

Folder 027/030: Annual Report of Shipments & Production of Inorganic Chemicals, 1951-1959
This folder contains reports to the U.S. Department of Commerce, Bureau of the Census on product produced and shipped. Total product weight is given, not just copper content.
1. Report for 1954 and 1955 gives percent copper content for formulations of Copper Hydrate (63% Cu), Tri-Basic Copper Sulfate (53% Cu), and Copper Oxychloric Sulfate (C-O-C-S; 56% Cu). Production and shipping figures for 1955-1959 are given in the same manner.

Shipping and production numbers were reported as follows:

C-O-C-S	1955	1956	1957	1958	1959
Production for all purposes (incl. further mfg.)	1,170,000	1,086,000	1,687,780	2,745,455	2,904,280
Total Shipments & Interplant Transfers	1,354,000	950,000	1,484,380	2,665,051	3,217,422
Copper Hydrate	1955	1956	1957	1958	1959
Production for all purposes (incl. further mfg.)	237,400	166,400			
Total Shipments & Interplant Transfers	222,400	156,950			
TBCS	1955	1956	1957	1958	1959
Production for all purposes (incl. further mfg.)	0	0			
Total Shipments & Interplant Transfers	3,100	8,200			

Folder 027/031: Annual Report of Shipments & Production of Inorganic Chemicals, 1960-1964
Production and shipping data reported in same manner as for 1951-1959. Figures were given as follows:

C-O-C-S	1961	1962	1963	1964
Production for all purposes (incl. further mfg.)	1,314,500	1,098,700	1,543,400	1,143,550
Total Shipments & Interplant Transfers	1,230,500	1,233,000	1,505,500	1,075,500
Copper Hydrate	1961	1962	1963	1964
Production for all purposes (incl. further mfg.)	401,600	91,400	103,400	132,350
Total Shipments & Interplant Transfers	363,850	103,200	107,100	118,750
TBCS	1961	1962	1963	1964
Production for all purposes (incl. further mfg.)	424,260	764,080	732,910	390,830
Total Shipments & Interplant Transfers	638,950	814,662	587,690	746,544
Copper Carbonate	1961	1962	1963	1964
Production for all purposes (incl. further mfg.)	6,740	12,775	-25	22,400
Total Shipments & Interplant Transfers	6,740	0	6,000	3,800

Note at bottom of report for 1959-1964: “Lake Chemical Co. was dissolved as of 11/2/64. These chemicals will be included in the report of Calumet & Hecla, Inc.” This seems to indicate C & H continued production of agricultural chemicals after Lake Chemical dissolved.

Box 26:

Folder 026/001 through 026/007: Income Tax Returns, 1957-1964
These folders contain Lake Chemical’s federal tax returns for the years’ specified. Ledger sheets other documents found alongside the tax returns are often more useful than the returns themselves.
1. “Analysis of Inventory Transactions” for Fiscal Year Ending (FYE) 6/30/58. Materials on Hand: **copper scrap, copper solutions, caustic soda, ammonia, sulfuric acid, salt, “off-color hydrate,” bags, “copper in process.”**
2. “Adjustments to Finished Goods Inventory” document associated with the above document. Inventory lists the following materials on hand**: C-O-C-S, Copper Hydrate, TBCS** (Divided into four categories: “Calumet,” E-Z Flow, Traylor Chem, Weil-Elliot, indicating Lake Chemical held finished product for multiple customers)
3. Ledger Sheet for FYE 6/30/59. Indicates **Copper Carbonate** was introduced in this year. **Sodium Chloride** listed as material.
4. Packet of ledger sheets for FYE 6/30/59. Lists raw materials associated with each product: **C-O-C-S (Ammonia, Copper Scrap, Sodium Chloride, Sulphuric Acid); Copper Hydrate (Caustic Soda, Copper In Solution); TBCS (Ammonia, Copper Scrap, Sulphuric Acid).**
5. Data Sheet for FYE 6/30/60. **Copper Carbonate** produced.
6. Ledger Sheet for FYE 6/30/61. Lists **Soda Ash** as raw material. Also lists “Fibre Drums” (Oral History narrator PS described loading bags of chemical into cardboard drums, four 50-lb bags per drum). Ledger sheet also lists “Copper Bearing Residue.”
7. 1962 Tax Return indicates an equipment investment of $3,541.81.

Folder 026/008: U.S. Corporations Income Tax, 1953-1955
This folder contains nothing of interest.

Folder 026/013: State Business Activities Tax Return FYE 6/30/58
This folder contains nothing of interest.

Folders 026/014 through Folder 026,015: State Tax Returns FYE 6/30/59 and 6/30/61
These folders contain one item of interest:
1. Ledger sheet for FYE 6/30/61. “Merchandise purchased for manufacture or resale” breaks down raw materials used to make **Copper Carbonate: Sulfuric acid, soda ash, off-color hydrate.** So at least some off-color **copper hydrate**, which was

unacceptable to customers, was repurposed for the production of **Copper Carbonate**.

Folders 026/019 through 026/024: Various tax documents, 1955 to 1964
These folders all contain state or federal tax documents, none of which contribute much information of use.

Folders 026/009 and 026/010: Lake Chemical Cost Sheets, Purchases and Requisitions, 1945-1947
These folders contain requisition orders, materials lists, and accounts of personnel expenditures (including engineering, design, and planning as well as physical construction) related to the construction of manufacturing plants for C-O-C-S and Copper Hydrate in the southern end of the Tamarack Reclamation facility. There are also cost sheets and requisition orders for physical upgrades to the building itself. The dates on these documents suggest active design, construction, and began as early as June 12, 1945 and lasted at least until June 1 of 1947. In some cases, C & H's existing equipment was retrofitted to serve a new purpose for Lake Chemical. These documents describe the materials used for these construction and installation activities in excruciatingly minute detail (down to nuts, bolts, and flanges). Scanned documents at the end of these notes provide a general overview of the various projects involved in getting the chemical manufacturing plants up and running. These documents contain job numbers which can easily be cross-referenced with the detailed documentation these folders contain, described above. There is also a flow sheet of the C-O-C-S production process. Some of the findings which stood out from this massive stack of documents follows:

- From 1945 to 1946, an oil storage tank at Tamarack Reclamation was repurposed for the storage of **caustic soda**, requiring installation of steam heating coils and piping.
- Documents relating to the C-O-C-S plant mention **"Sludge Storage Tanks,"** 14 feet inside diameter and 16 feet high made of yellow pine staves with agitators.
- Electric motors in the plant ran on three-phase, 25-cycle electricity.
- **C-O-C-S** production involved six steel reaction tanks lined with lead.

1. H.E. Williams (C & H) to R.A. Lacht (Harshaw). Letter describes placement of the plant's **sulphuric acid** unloading station, for the unloading of tank cars. The letter states the sulfuric acid storage tank was 300 feet from the proposed location for the unloading station, and at substantially lower elevation.

Folder 026/012: Accounts Receivable – Paid Invoices, 1963-1964
This folder contains Lake Chemical's sales invoices to outside customers, as well as for material transfers between it and the Calumet Division.

Folders 026/017 and 026/018: Michigan Business Receipts, 1961-1963
These folders contain financial records related to tax preparation. Nothing of interest.

Folder 026/035: Standard Costs, 1961-1962
This folder contains financial minutia which is not of interest.

Folder 026/036: Profit and Loss and Cost of Production Data, 1949-1952
This folder contains general cost of production data and a few profit and loss reports relating to Lake Chemical Company operations. It also contains a detailed cost report produced in the 1950s. This report has succinct descriptions of what Lake Chemical's products were used for:

- **Cupric Hydrate**: "This product is used primarily to make copper naphthenate and, although an excellent fungicide, is too phytotoxic for general use on plants. It is commonly used as a preservative for wood, fish nets, and various fabrics that are exposed to severe weathering." *This indicates this product was sold as a raw material for manufacture into other products.*
- **C-O-C-S:** "All COCS production goes to the Niagara Chemical Division of the Food Chemical Corporation. This organization, in turn, sees it under their own brand name as a "quality" fungicide. In reality, it is very similar — both as a product and in application — with TBCS.
- **TBCS**: "is looked upon in the market as a standard copper fungicide," but many other copper companies were able to produce and sell it more cheaply.

Folder 026/038: Lake Chemical Company Plant Equipment Depreciation Schedule
This folder contains lists of plant equipment and extensive ledger sheets documenting many of the same costs described in the documents in folders 026/009 and 026/010. It included a copy of the following letter, relating to Lake Chemical's originally expected life span as a company:
1. November 10, 1960. C & H president to W. Harshaw: "When Lake Chemical was established originally, its life was set for five years and all the equipment, etc., which the company had was to be depreciated in the five-year period." The letter goes on to state Lake Chemical's life span was later tied to that of the Calumet Division. Minutes from a November 29, 1960 Lake Chemical Co. board meeting are attached to the letter, indicating this arrangement was made official at that meeting, with Lake Chemical's life span being tied to the Calumet Division, which at that time was expected to expire as of January 1, 1967.

Folders 026/041 and 026/042: Lake Chemical Cash Payments, 1961-1964
This folder contains cash payment slips relating to everything from C-O-C-S bags to telegraph charges, freight charges to general operating expenses.
1. The final statement dated 11/25/1964 states: "To transfer cash balance to Calumet Division as of November 2, 1964 due to termination of the Lake Chemical Co." The cash balance transferred is about $1,500 less than the Calumet Division's original $150,000 ownership stake in Lake Chemical.

Emma Schwaiger

6.3.1.3 Project Files
Box 164
Folder 164/002: Project # 1916 (Chemical Processing), 1966-1968

This folder contains project information about Research and Development at C&H. The objective is to improve in chemical processing and products.

1. March 17, 1966 – C&H interoffice correspondence about additional bagged production of B-circuit oxide being in demand. Tests were done on Drying-Pulverizing by the Fine Grinding Corporation, which meant that C&H could outsource the drying, pulverizing, and blending of copper oxide.
2. July 28, 1966 – Two different tests were done concerning leaching. The results of these tests were that "the ammonia-CO_2 system is not a particularly effective extraction medium for this type of bound copper."
3. January 1, 1967 – "Calumet & Hecla, Inc. is in the chemical business especially through Calumet Division activities. There is a long and successful experience based on inorganic chemistry. New people, new techniques for research and new facilities provide capability for significant new accomplishment in copper as well as through use of related metals – zinc and manganese."
4. January 5, 1968 – To W.F. Jones from L.C. Klein. "A sample of Clevite scrap, weighing 246.5 grams was leached to completion in an ammoniacal leaching solution. Volume of solution was measured before and after leaching, and analysed for copper and nickel before and after leaching, and the amount of copper and nickel leached from the sample was calculated. Copper pick-up was 63 grams, and nickel pick-up 0.265 grams. This represents a nickel pick-up of 0.422 pounds of nickel per hundred pounds of copper leached. A sample of Detroit Aluminum and Brass material is currently being leached, and results will be available in a few days. A sample of Federal Mogul scrap has recently been obtained and will be tested following the Detroit sample."
5. January 9, 1968 – To L.G. Stevens from L.C. Klein – Production of Cal-Cop-10 at Tamarack. Document copied.
6. January 22, 1968 – Screen sizing and chemical analysis of various C&H products. Document copied.
7. March 21, 1968 – Research Project Progress Report – Changes to Tamarack Leaching Plant and the Lake Linden Still House. Document copied.

Folder 164/003: Project # 1920 (Copper Recovery from Slag and Tailings), 1968-1969

This folder contains project information about the Copper Recovery from Slag and Tailings – CD-1920 in order to develop process procedures for recovering copper from slag and tailings.

1. Project leader: L.C. Klein – "Tests were made to simulate heap leaching, with dilute ammonia solutions on oxidized tailings from the Gay, Central, and Delaware tailings deposits. Recoveries of copper were 62% from the Gay sands, 67% from Central, and 60% from Delaware sands after two weeks of intermittent leaching and aeration. Copper was

recovered from the dilute solutions on ion exchange resins, which were then eluted to give a concentrated copper ammonium carbonate solution, which under proper conditions contained in excess of 60 grams per liter of copper."

2. April 7 and 11, 1969 – From National Spectrographic Laboratories, Inc. Samples of slag were chemically analyzed and reports were sent back to C&H. Documents copied.

3. Research Project Progress Report – "Samples of the Ahmeek Bank containing 4 lbs. of copper/ton were leached using a 1% ammonium carbonate and 1% ammonia leaching solution."

4. March 12, 1969 – Summary Status Report-Ammoniacal Leaching of Mill Products, by Howard E. Day, Quality Control Manager, Calumet Division, Calumet & Hecla Group, Universal Oil Products. Technical and narrative report.

Folder 164/004: Project # 1921 (Refer to #1916-Chemical By-Product Removal and Recovery), 1969

This folder contains project information on the continuation of Project #1916 to develop process procedures for removal and/or recovery of chemical by-products.

1. Research Project Progress Report - Possible use of "a scrubbing device to be used for upgrading steel scrap generated from the leaching of copper-lead alloy clad steel. This material, after leaching has a tightly adhering scale of basic lead carbonate and in this form has to be sold at a reduced price. Plans have been drawn up for a process to upgrade the steel by wet-scrubbing, and for recovery f the lead as a by-product. Quotations have been received from the Hardinge Company for a scrubbing device.

Several tests have been made using ion exchange resins supplied by the Illinois Water Treatment Company, to determine whether a commercial process for removing nickel from ammoniacal leaching solutions can be developed. The resins in the ammonia form are first loaded with copper ammonium complex ions, then contacted with the nickel contaminated solutions, and the nickel, being more active chemically, replaces the copper. It has also been found that if the resin is loaded with cuprous copper rather than cupric, the removal of nickel is more effective. Extractions ranging from 25% to 91% of the nickel have been made under different conditions.

Samples of electronic scrap, containing several precious metals and a considerable amount of copper were received from the USBM Station at Salt Lake City for experimental recovery work. Samples were first burned to remove insulation, plastics, etc., then leached with ammoniacal solutions. Most of the copper was recovered, but it is believed that passing this material through a hammer mill after burning would partially disintegrate parts such as electronic tubes and capacitors and expose more of the copper and other metals. No additional work has been done on the previous metal recovery."

2. March 28, 1969 – Letter from Dan Lupo at the Tingstol Company to Larry Stevens talking about buying the copper salts removed during the crystallization of spent ammonium persulfate.

$CuSO_4$ (NH_4) $2SO_4$ $6H_2O$

Folder 164/005: Project # 1922 (Refer to #1916-Chemical Processing Pilot Plant Studies), 1969

This folder contains information on the continuation of Project #1916 about process improvement to reduce costs and improve product quality.

1. February 6, 1969 – Letter from G.E. Lengyel to E. Sanderson. *Break-even sales on Tamarack Leaching Products.* Document copied.
2. Research Project Progress Report – "Test work was continued on the production of a commercial grade of cuprous oxide by the distillation of highly reduced leaching solutions in the experimental distillation device. Trouble has been experienced on a laboratory scale in completely reducing the copper ammonium carbonate leaching solutions to give a water white, 100% cuprous copper solution. In practice, solutions containing 90% of the copper in the reduced form are not hard to product. We have now found an ion exchange resin that will effectively separate the last traces of cupric copper from highly reduced solutions to give a water white solution which on distillation in the absence of oxygen should give a high grade of cuprous oxide. Patent disclosure forms for producing cuprous oxide by this method have been filed."
2. Research Project Progress Report – "It was found that the carboxylate ion exchange resin does not permit selective removal of cupric ion from a cupric-cuprous ammonium carbonate solution. It was demonstrated that a colorless solution containing only cuprous ammonium carbonate can be obtained by passage of the mixed solution through the ion exchange resin taking precaution to include air. Such a process would appear to have value in the preparation of red cuprous oxide directly from such solutions. It is recommended that this process also by studied further.

Detailed reports on past work can be found in the general Research and Development files under Project #1916."

Box 160
Folder 160/042: Project # 1745 Lake Chemical (Refer to #1913 Milling Process), 1963-1964

This folder contains information about what happened with Lake Chemical products after C&H and Harshaw broke apart in 1964.

1. May 9 & 22, 1963 – Correspondence between A.C. Boorman, Jr. & L.F. Engle about the percentages of other chemicals found in the copper carbonate compared with that of the Tennessee Corporation. Document copied.
2. August 24, 1964 – Letter from A.C. Boorman, Jr. to B.C. Peterson, Stewart Bear (President), Tracy Baxter (Purchasing Agent), R.R. (Dick) Heinze (Chief Chemist), & Mr. Duckworth (Manager of Agricultural Products Division). "Mr. B.C. Peterson and I met with the above-named individuals on Tuesday, August 18, to review our respective positions and interests in Lake Chemical – Lake Chemical having recently been purchased by Calumet, and Niagara being the chief customer of Lake Chemical. Prior to our purchase of Lake Chemical, Harshaw maintained, for all practical purposes, sole contact with personnel of Niagara." Document copied.
3. September 18, 1964 – From A.C. Boorman, Jr. to Mr. Tracy Baxter at Niagara Chemical Division. Follow-up from previous document, including drawings of the machine and equipment layouts. Document copied.

Folder 160/047: Project # 1810 (Refer to Project #'s (1832-1834) Chemical Research), 1969

This folder contains information about Chemical Research CD-1810 (Formerly CD-1832 and CD-1834) about new products to serve the agricultural and industrial market and processes for their manufacture.

1. March 7, 1969 – From C.H. Suter to G.L Craig and L.G. Stevens. C&H will not proceed any further on this project.

6.3.1.2 Research Department Databooks

Box 203

Chemical/Mineral Composition, Processing Techniques 1951-1968

This box contains the databooks for Chemical and Mineral Composition and Techniques at C&H. These books contain technical measurements and numbers for different projects and processes. The list of the individual books and their contents has been copied.

1. Books 1-A – 37.

Box 204

Chemical/Mineral Composition, Processing Techniques 1951-1968

This box contains the databooks for Chemical and Mineral Composition and Techniques at C&H. The list of the individual books and their contents has been copied.

1. Books 38 – 77.

Box 205

Chemical/Mineral Composition, Processing Techniques 1951-1968

This box contains the databooks for Chemical and Mineral Composition and Techniques at C&H. The list of the individual books and their contents has been copied.

1. Books 78 – 117.

Box 206

Chemical/Mineral Composition, Processing Techniques 1951-1968

This box contains the databooks for Chemical and Mineral Composition and Techniques at C&H. The list of the individual books and their contents has been copied.

1. Books 118 – 166.

6.3.5 (6.3.5) General Department Files, 1907-1969

Box 557

Folder 557/004: Report to C&H, Inc.-Acquisition Possibilities in the Chemical Industry

This folder contains a report on the possibilities of C&H expanding into more chemical industries.

1. April 2, 1954 – Acquisition Possibilities in the Chemical Industry – Report to Calumet & Hecla, Inc. C-59077. By: Arthur D. Little, Inc. Cambridge 42, Massachusetts.

"As authorized by your acceptance of our proposal of January 6, 1954, we submit our report on the segments of the chemical industry which offer attractive possibilities for diversification by Calumet & Hecla, Inc. This completes Phase I of our study." P. IV

A list was provided telling C&H areas that they should expand in and others that they do not recommend for further study. P. 1-2.

Possible Interest:
Ceramics
Metals & Alloys
Pigments & Reinforcing Agents
Alkalis & Chlorine
Coal Tar Crudes
Petrochemicals
Plastics materials
Compressed Gases
Electrochemicals
Wood & Cellulose Chemicals
Pharmaceuticals

Not Recommended:
Acids
Adhesives
Catalysts
Chemical Equipment
Chemical Specialties
Cosmetics
Detergents
Electroplating Chemicals
Explosives
Fats & Oils
Fine Organics
Printing Inks
Protective Coatings
Solvents
Synthetic Fibers
Synthetic Rubber
Textile Chemicals
Water-Treating Chemicals

Box 558
Folder 558/012: Miscellaneous Data on Chemicals and Metals Development, 1966

This folder contains information on various chemical projects within C&H and those which incorporate C&H products.

1. February 25, 1966 – Correspondence between C&H and Terra Chemicals International. C&H to possibly provide trace element formulations for the Terra fertilizer complex, but they would have to add zinc and other chemicals to the mix to allow for the most efficient fertilizer.
2. February 7, 1966 – Information that Traylor might soon buy out Ladora Mineral & Fertilizer Inc. and that perhaps C&H should get involved and buy them before Traylor does so that they do not have such a large competitor in the industry.

3. February 18, 1966 – Executive Office document from S.N. Hartwell to Dr. C.P. Stanford, R.W. Johnson, & R.R. Allen. *Some Considerations for our Future in the Agricultural and Industrial Chemicals Business.* Document copied.
4. May 1966 – Copper Oxide vs Copper Sulfate. Document copied.

Box 558
Folder 558/013: Miscellaneous Data on Chemicals and Metals Development, 1963-1966

This folder contains information and correspondence about the use of magnesium & salt water in different chemical processes related to C&H products.

Box 558
Folder 558/014: Miscellaneous Data on Chemicals and Metals Development, 1966

This folder contains information on the different trace mineral compounds that C&H worked on or could have worked on.

Box 558
Folder 558/015: Miscellaneous Data on Chemicals and Metals Development, 1966

This folder contains information on chemical products using manganese.

1. March 18, 1966 – A Manganese Survey – By L.G. Stevens

Box 558
Folder 558/016: Miscellaneous Data on Chemicals and Metals Development, 1966

This folder contains information on chemical products using molybdenum.

Box 558
Folder 558/017: Miscellaneous Data on Chemicals and Metals Development, 1966

This folder contains correspondence between C&H and Terra Chemicals about different chemicals, information about the trace minerals that C&H has or can produced, information about possibly buying out Treylor Chemical, and articles about different chemicals used in agriculture.

1. May, 1966 – Preliminary Market Scope Study of Trace Elements in Agriculture for Calumet & Hecla, Inc. by Kirst and Sampson, Inc.

6.4 (Subseries 6.4) Sales, Marketing and Advertising, 1936-1969
Box 557
Folder 557/001: Market Survey-Industrial Copper Chemicals and Copper Powder-C&H Cons. Copper Co.

This folder contains a Market Survey about Copper Chemicals and Copper Powder.

1. September 14, 1951 – Market Survey – Industrial Copper Chemicals and Copper Powder. Calumet & Hecla Consolidated Copper Company, Calumet, Michigan. Produced by Booz, Allen, & Hamilton Management Consultants.

"This report presents our findings and recommendations relative to the market for industrial copper chemicals and copper powder. Although originally planned as a study of the primary market for mixed copper oxide and cupric oxide, this survey was broadened in scope when it was found that the Calumet division's growth opportunities in these specific fields was limited.

The importance of product and process research and development to the future of the Calumet division in industrial chemicals was also seen early in the survey. This required a much more detailed analysis of these features than a market study of this type normally requires." P. I

"Analysis of our findings has led to the summary conclusion that Calumet and Hecla has a valuable business opportunity in the field of industrial copper chemicals. In total, industrial copper chemicals represent a 27 million dollar annual business, of which 9 ½ millions is Calumet and Hecla's short range opportunity." P. II

"Regarding C&H's present mixed oxide product, it is recommended that an effort be made to develop a suitable process for conversion to cuprous oxide to gain the advantage of a higher margin and a growing market. Calumet and Hecla now has about 80% of the market for its mixed copper oxide, but this volume is in a material of limited application." P. III-IV

"Furthermore, the basic profit opportunity in a selective chemicals business makes it much more attractive to C&H than the traditional mining and smelting business." P. VI

Chapters:

"In the early 1930's the Charles Hardy Company requested permission of C&H's management to sell mixed oxide for industrial uses. Through this proposition, C&H was provided with a market for this material at a time when demand for metallic copper was at a 40-year low. Also, the oxide sold for the price of copper, f.o.b. Calumet, producing an additional profit equal to freight costs since primary copper normally was sold on a delivered basis." P. 1

"Two separate leaching facilities are available, Lake Linden and Tamarack. The main difference between the two is in the type of material processed. Lake Linden is considered the "dirty" or contaminated circuit since it is here that the lower grades of scrap are processed, resulting in an impure product. Concentrates from Lake Linden are usually smelted for their copper content or are used for agricultural applications. On occasion, the Lake Linden circuit can be "cleaned up" and the resulting oxides sent to the Tamarack plant, dried, bagged, and sold for industrial use.

Tamarack is fed selected scrap, and the resulting oxide is filtered, dried, and bagged. Oxides from the Tamarack operation are sold for industrial purposes. In addition, cupric oxide is manufactured at Tamarack." P. 4-5

Cupric Oxide = Black

Cuprous Oxide = Red/Brown

8.1.20.2 Construction
Box 19
Folder 019/006: Summary Report: Supply of and Demand for Zinc Chemicals and Zinc Dust, 1951

This folder contains the survey report on the supply and demand of zinc from the Battelle Memorial Institute for agricultural use.

1. November 30, 1951 – Survey Report on Supply of and Demand for Zinc Chemicals and Zinc Dust to Calumet and Hecla Consolidated Copper Company. By Robert E. Holmes and Richard J. Lund of the Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

"The total market for any one of the zinc chemicals – zinc dust, zinc chloride, or zinc sulfate – is insufficient to encourage investment in new capital equipment, sales organization, and research time. This is especially true of either zinc chloride or zinc sulfate, neither one of which can lead to any substantial side development in other profitable chemical production.

Zinc dust, as a single sales product, is not likely to result in an attractive net profit in view of the relatively low selling price for this product in terms of zinc value in the concentrates. It has, however, the intriguing aspects of having a present demand sufficient to provide an immediate market to support an initial investment, and of providing means leading to the development of a number of saleable zinc salts and other chemicals deriving from SO_2 and zinc. Examples of these other chemicals are zinc and sodium hydrosulfite, liquid SO_2, sulfuric acid, sodium sulfite, sodium bisulfite, sodium sulfate, sodium zincate, zinc naphthanate, oleate, and other soaps. Zinc dust, used in the manufacture of hydrosulfite or sold to dyestuff companies and other companies using it as a reducing agent, would be substantially returnable to the flow-sheet for the producing of zinc chloride, zinc sulfate, and other zinc compounds.

Any plans drawn up for building a chemical production based on zinc dust from sphalerite should include consideration of the best method of manufacturing the dust (distillation or electrolytic), availability of caustic soda and soda ash necessary for producing sodium salts, liquefying equipment for SO_2, equipment for recovering SO_2 and producing sulfuric acid, flexibility of equipment to permit switching from one product to another and the adding of new products with a minimum of shut-down time, replacements, and added investment." P. 2

8.3.2 (8.3.2) Lake Chemical Co. (with Harshaw), 1941-1965
Box 58
Folder 058/29: Harshaw Chemical Co. Matter, Correspondence, 1944

This folder contains correspondence from and to Harshaw Chemical.

1. March 21, 1944 – "The Harshaw Chemical Company has developed s method of producing cuprous oxide from Calumet and Hecla Consolidated Copper Company's zinc free mixed copper oxide. This method was disclosed to Mr. Craig and appears to be entirely different from any of the methods now used and protected by patents held by others. The Harshaw Co. is having a patent search made to confirm this opinion."

"The Harshaw Company's proposal generally was that Calumet and Hecla join with it in development of the process and in conducting a business of manufacturing cuprous oxide. Nothing very definite in the nature of the proposal fordivising costs and profits was made but Mr. Harshaw indicated that his Company would be willing to pay half the cost and I therefore assume that he intends to divide the profit equally also. The logical place to build a plant would be near the source of supply, of course, and it was thought that operations might be conducted either at our smelter or an adjoining building. Calumet and Hecla would do the operating and producing and the Harshaw Company would take care of the selling." Document copied.

2. March 22, 1944 – Report from A.E. Petermann about the Harshaw Chemical process.
3. August 29, 1944 – Memo to E.R. Lovell about the processes at Harshaw and what they want to do at C&H.
4. October 12, 1944 – Letter from R.A. Lucht to G.L. Craig about the setup at the Tamarack leaching plant. Document copied.

Box 60
Folder 060/004: Harshaw Chemical Co.-Correspondence, 1945-1951

This folder contains Correspondence and documents from the Harshaw Chemical Company, including their 1944 Annual Report (no mentions of C&H or plant at Tamarack), correspondence with Niagara stating that they want more COCS from Harshaw (1945), correspondence between Harshaw & C&H about their partnership, the new plant at Tamarack (lease & contracts), and general information.

1. July 16, 1945 – To Mr. Harshaw from C&H. "The Board of Directors of the Calumet and Hecla Consolidated Copper Company has authorized me to negotiate an agreement with your Company leading to the joint production and sales of copper chemicals substantially along the lines we have discussed, such agreement to be subsequently ratified by the Board of Directors of Calumet and Hecla before becoming effective. The details of our joint arrangement, of course, must be worked out, and we hope that this may be done promptly." Document copied.
2. August 8, 1945 – Preliminary contract between Harshaw & C&H.
3. September 8, 1945 – Updated contract between Harshaw & C&H. Document copied.
4. April 3, 1946 – C&H to Harshaw. "Calumet will sell its entire cupric oxide output to Lake Chemical Company. The Harshaw Chemical Company will sell this product under the terms of the contract of November 12, 1945, between it and Lake Chemical Company."
5. Letters addressing the shortage of caustic soda and how Harshaw, C&H, or Lake Chemical can get some, 1946.
6. August 5, 1946 – C&H to Harshaw. Letter summarizing the first few months of production. Document copied.

7. October 14, 1946 – Harshaw to C&H. Description of the proposed cuprous oxide process. Document copied.
8. November 26, 1951 – Financial Reports for Harshaw Chemical for September, 1951 & for the year ending in September, 1951.

Box 26
Folder 026/040: Purchase Orders-Harshaw Chemical, 1963-1964
This folder contains the purchase orders for Harshaw: from Lake Chemical to different chemical companies around the country.

Box 591
Folder 591/009: Harshaw Chemical Co/Lake Chemical Co, 1944-1947
This folder contains correspondence between C&H and Harshaw about putting together Lake Chemical, information about the plant & chemicals, updates to the contract, correspondence about possibly patenting some processes, and other incorporation details.

1. August 27, 1945 – Letter about the power, steam, and water at Lake Chemical. Document copied.

8.3.2.3.3 Taxes
Box 25
Folder 025/026: Income Tax, 1956-1957
This folder contains the Income Tax reports for 1956-1957, including how much they spent on certain items.

Box 233
Folder 233/001: Income Tax Returns-Lake Chemical Co, 1945
This folder contains the Corporation Income and Declared Value Excess-Profits Tax Return – 1945. Kind of Business listed as "Manufacture of Copper Chemicals." Date Incorporated: "Sept. 7, 1945."

8.3.2.3.5 Miscellaneous Financial Records
Box 25
Folder 025/022: General Ledger, 1961-1962 & 1963-1964
This folder contains the General Ledger for Lake Chemical, using a computerized record keeper to keep track of the numbers.

Box 25
Folder 025/023: Bank Statements, 1963-1964
This folder contains the bank statements for Lake Chemical with all of their check stubs.

Box 25

Folder 025/024: Auditor's Report, 1946-1956

This folder contains the Auditor's Reports for Lake Chemical stating that the company's tax reports are within reason and in good standing, and the corporation was liquidated in 1956.

Box 25

Folder 025/025: Standard Costs, 1960-1962

This folder contains the balance sheets & income/expense statements for Lake Chemical using the computerized adding and subtracting system, as well as the Determination of Standard Cost for the Years 1960-1962 done by hand.

Box 157

Folder 157/001: Lake Chemical Co. Ledger, 1955-1956

This folder contains a hand-written balance of: Cash for Lake Chemical, the balances for C&H and Harshaw individually, Hydrate Finished Goods Inventory, COCS Finished Goods Inventory, TBCS Finished Goods Inventory, Hydrate In Process Inventory, TBCS In Process Inventory, COCS In Process Inventory, COCS or TBCS In Process Tanks, Ammonia, Caustic Soda, Salt, Sulphuric Acid, Bags, Copper Scrap, Off Color Hydrate, Hydrate Plant Equipment, COCS Plant Equipment, Reserve for Depreciation Hydrate Plant, Reserve for Depreciation COCS Plant, Prepaid Insurance, Michigan Privilege Fee, Accrued Federal Income Tax, Accrued Payables, Accrued Property Taxes, Reserved for Federal Income Tax, Capital Stock Issued, Earned Surplus, Hydrate Sales, COCS Sales Returns and Allowances, COCS Sales, TBCS Sales, Cost of Sales – Hydrate, Cost of Sales – COCS, Cost of Sales – TBCS, Hydrate Sales Commissions, COCS Sales Commissions, TBCS Sales Commissions, Administrative Sales Expense – Hydrate, Administrative Sales Expense – COCS, Administrative Sales Expense – TBCS, Freight on Hydrate – LL, Freight on Hydrate – Cleveland, Trucking & Switching Hydrate, Trucking & Switching COCS, Freight on COCS, Trucking & Switching TBCS, Freight on TBCS, Administration, Accounting, Telephone & Telegraph, Travel Expense, Rentals, Property Taxes, Corporate Taxes, Heating Steam, Insurance Expense, Miscellaneous Expense, Director's Fees and Expenses, Shutdown Expense, Inventory Adjustment Account, Manufacturing – Clearing Account Hydrate, Manufacturing – Clearing Account COCS, Manufacturing – Clearing Account TBCS, Conversion Clearing Account, Plant Supervision – Hydrate, Attendants – Hydrate, Operating Miscellaneous Supplies, Plant Maintenance – Hydrate, Electric Power – Hydrate, Fuel Oil – Hydrate, Depreciation – Hydrate, Rent – Hydrate, Property Taxes – Hydrate, Heating Steam – Hydrate, Insurance – Hydrate, Plant Supervision – COCS, Attendants – COCS, Plant Maintenance – COCS, Electric Power –COCS, Water - COCS, Miscellaneous Supplies – COCS, Steam – COCS, Depreciation –COCS, Rent –COCS, Property Taxes – COCS, Heating Steam – COCS, Insurance – COCS, Property Taxes – TBCS, Plant Supervision – TBCS, Attendants – TBCS, Miscellaneous Supplies – TBCS, Electric Power – TBCS, Steam Operating – TBCS, Heating Steam – TBCS, Rent – TBCS.

Box 157

Folder 157/002: Lake Chemical Co. Ledger, 1946-1954

This folder contains the same basic categories as 157/001 for Lake Chemical, along with a list customers and bills/credits for each at the back of the ledger.

Box 157
Folder 157/003: Lake Chemical Co. Journal, 1952-1957

This folder contains hand-written amounts for: Cash Receipts, Cash Disbursements, Record of Invoices, Credit & Debit Journal, and Cost Distributions throughout the different plants and chemical processes.

Box 157
Folder 157/004: Lake Chemical Co. Journal, 1945-1951

This folder contains the same categories for the years 1945-1951.

Box 338
Folder 338/001: Lake Chemical Co. Cost Sheets, 1943-1948

This folder contains the cost and expense sheets for: Electric Power Plants (General, Detail, & Repairs), Lake Linden Boiler Plant, Metallurgical Data (Amount of Copper Treated & Produced), Tamarack Reclamation Plant, TOL Mills, Tamarack Reclamation – Sand Treatment, Tamarack Reclamation – Copper Recovery, Tamarack Reclamation-Secondary Copper – Leaching, Tamarack Reclamation – Water Pumping Plant, Tamarack Reclamation – Distribution Labor, Secondary and Purchased Copper – Combined Operations, Tamarack Reclamation – Regrinding Plants, Tamarack Reclamation – Dredge, Tamarack Reclamation – Leaching Plant, Tamarack Reclamation – North Flotation Plant, Ahmeek Mill – Milling Summary, Ahmeek Mill – Division of Expense, Ahmeek Mill – Mill Data, Ahmeek Mill – Stamp Mill General Expense, Ahmeek Mill – Stamping Expense, Ahmeek Mill – Washing Expense, Ahmeek Mill – Flotation Expense, Ahmeek Mill – Regrinding Expense, Ahmeek Mill – Tailings Disposal Expense, Ahmeek Mill – Boiler Plant Expense, Ahmeek Mill – Pumping Plant Expense, Ahmeek Mill – Distributed Labor, & Ahmeek Mill – Electric Power Plant Expense.

Great source for data about changes over time. Each month is reported for 1943-1948.

Box 338
Folder 338/002: Lake Chemical Co. Cost Sheets, 1936-1942

This folder contains the cost and expense sheets for categories similar to those in Folder 338/001, along with others: Stamp Mills – Trucking, Ahmeek Mill – Mechanics, Surface Laborers, and Teams, & Tamarack Reclamation – Mechanics, Surface Laborers, and Teams.

Great source for data about changes over time. Each month is reported for 1943-1948.

Box 525
Folder 525/001: Lake Chemical Co. Financial Reports, 1962-1963

This folder contains monthly financial statements for the Lake Chemical Company using a computerized adding and subtracting system with graphs of production for the four main products. Included in these are:

Balance Sheet:

Condensed Balance Sheet
Cash
Accounts Receivable
Inventories

Property, Plant, & Equipment
Prepaid & Deferred Charges
Accounts Payable
Corporate Equity

Income & Expense:

Condensed Income & Expense Statement
Product – Hydrate
COCS
TBCS
Copper Carbonate
Detail of Non-Products
Statistics

Graphs:

Cumulative Product Comparison – Pounds
Cumulative Sales Comparison – Pounds
Percentage of Net Profit to Total Sales
Percentage of Net Profit to Invested Capital
Percentage of Total Sales Annualized to Invested Capital Year-to-Date

Box 525

Folder 525/002: Lake Chemical Co. Inventory, Expenses, Misc. Data Sheets, 1962-1964

This folder contains Inventory, Expense, and Miscellaneous Data Sheets for each year, 1962-1964:

Raw Materials & Supply Inventories:

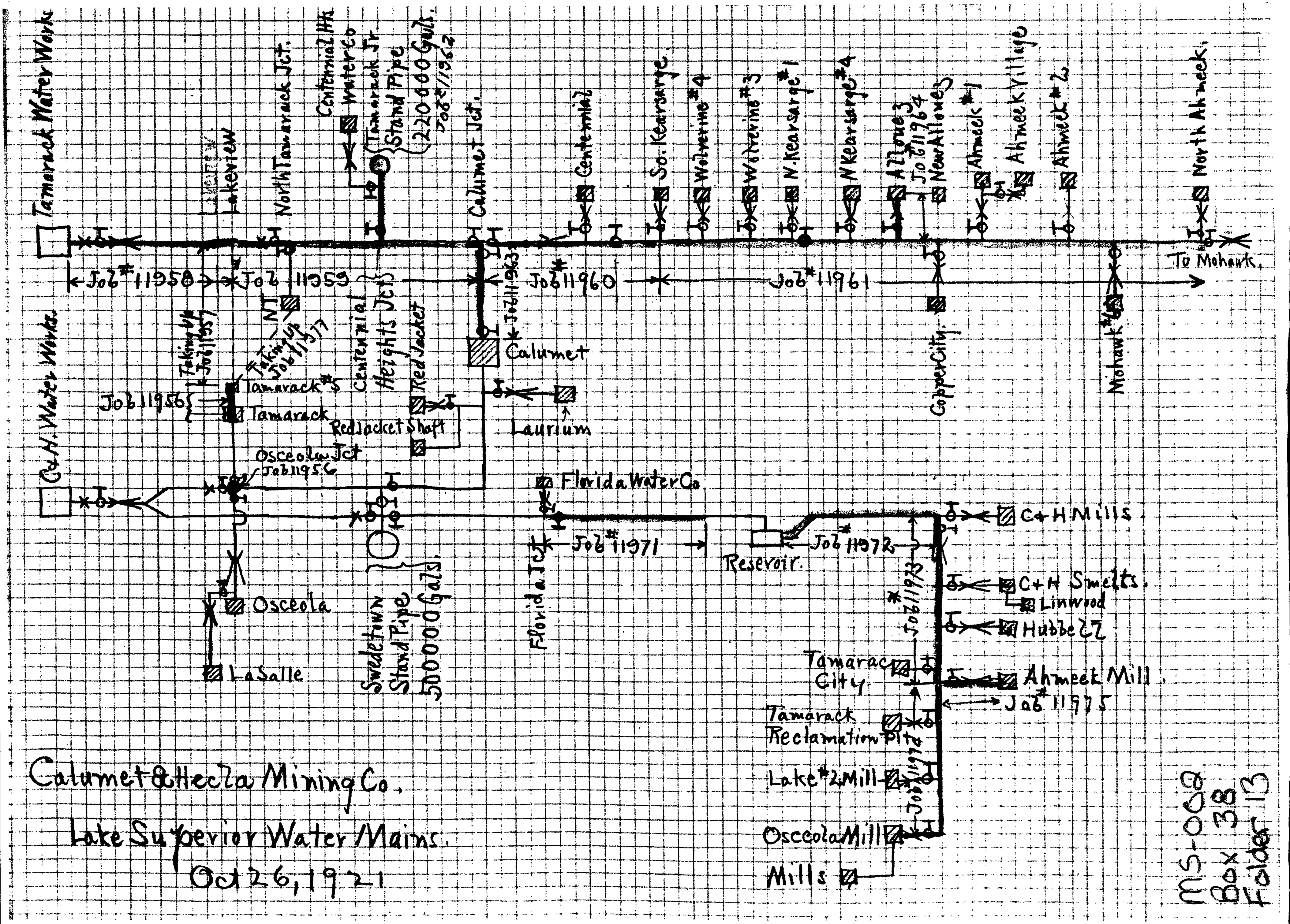
Ammonia, Caustic Soda, Copper Scrap, Salt, Sulphuric Acid, Soda Ash, & Sodium Bicarbonate.

Supplies: Bags (different sizes and for different chemicals)

Finished Goods: Hydrate, COCS, TBCS, Copper Carbonate

DOCUMENTS FROM THE ARCHIVES

AHMEEK MILL FACILITIES



Tamarack Water Works
Lakeview
North Tamarack Jct.
Centennial Ht's Water Co
Tamarack Jr. Stand Pipe 220000 Gals. Job #11962
Calumet Jct.
Centennial 2
So. Kearsarge
Wolverine #4
Wolverine #3
N. Kearsarge #1
N. Kearsarge #4
Allouez 3
Job 11964
New Allouez 3
Ahmeek #1
Ahmeek Village
Ahmeek #2
North Ahmeek
To Mohawk
Job #11958
Job 11959
Job 11960
Job #11961
Job 11963
NT
Taking up Job 11957
Taking up Job 11977
Centennial Heights Jct
Red Jacket
Calumet
Copper City
Mohawk #1
Job 11956
Tamarack #5
Tamarack
Red Jacket Shaft
Laurium
C&H. Water Works
Osceola Jct
Job 11956
Florida Water Co
C+H Mills
Job #11971
Reservoir
Job #11972
Florida Jct
Swedetown Stand Pipe 500000 Gals
Osceola
LaSalle
C+H Smelts
Linwood
Hubbell
Job #11973
Tamarac City
Ahmeek Mill
Job #11975
Tamarack Reclamation Plts
Lake #2 Mill
Job 11974
Osceola Mill
Mills
Calumet & Hecla Mining Co.
Lake Superior Water Mains.
Oct 26, 1921
MS-002
Box 308
Folder 13

MS-002
Box 35
Folder 19

CALUMET AND HECLA CONSOLIDATED COPPER COMPANY

GENERAL OFFICE

CALUMET, MICHIGAN

JAS. MAC NAUGHTON, VICE PRES'T & GEN'L MGR.
J. G. BENNETTS, ASST. TREAS. & CHIEF CLERK
F. J. NICHOLAS, PURCHASING AGENT

March 14, 1925

Mr. E. A. Baalack
Calumet, Michigan

Dear Sir:

At the Ahmeek Mill we have a steam-driven booster pump for condensing water in connection with the low pressure turbine. Mr. Burgan believes that this pump should be run by electricity inasmuch as we shall have more than enough low pressure steam to operate the turbine when all the stamps at the Ahmeek Mill are running.

Please take this matter up with him to the end that you can advise me on the subject.

Yours truly,

J MacNaughton
Vice Pres. & Gen. Mgr.

JMN/P

MS-002
Box 73
Folder 51b
(52 1 of 2)

STONE & WEBSTER ENGINEERING CORPORATION

EXECUTIVE: 49 FEDERAL STREET, BOSTON

February 20, 1930.

Mr. James MacNaughton,
President, Calumet & Hecla Consolidated Copper Co.,
Calumet, Mich.

Dear Sir:

POWER PLANT - AHMEEK MILL

We are submitting to you herein the results of our study of the steam and power supply problem at the Ahmeek Mill.

Following the procedure agreed upon in conference in your office on December 9, 1929, we have prepared estimates of construction and operating costs of a modern, low pressure, saturated steam boiler house to replace the present plant now approaching the end of its useful life. We have also prepared similar estimates of a larger, high pressure boiler house and power plant which would provide 7,500 kw. of new capacity for service in the Copper Company's system and would furnish steam extracted from the main turbine for the stamp mill and pumping engine.

CONSTRUCTION ESTIMATES

The low pressure boiler plant would supply the steam requirements of the mill at 155 lb. pressure and would include three 645 h.p. Stirling boilers equipped with forced draft underfeed stokers and would be designed for natural uptake draft operation. A coal handling system, consisting of belt conveyors between the rock bin structure and the new boiler bunkers, with crusher and auxiliary equipment would also be provided. Two boilers would have sufficient capacity to meet the steam demand for mill service but under normal conditions it is intended that three boilers would be in operation. We have assumed that, if constructed, this boiler house would be located on the southerly side of the present pump and power house and that it would be complete in all respects. We estimate that such a plant would cost $510,000, which includes an allowance for contingencies of about $48,000. A summary of this estimate may be found in Table I.

The second and larger program aside from supplying 155 lb. saturated steam for mill and pump service would generate enough additional steam to permit full capacity output of the 7,500 kw. turbine generator. For this purpose, we have selected three 865 h.p. Stirling boilers with superheater equipment to deliver steam at 410 lb. pressure, 650° total temperature. These boilers would be fired with underfeed stokers and would be equipped with feed water economizers, mechanical forced and induced draft and water-cooled furnaces, to permit operation at relatively high rates of steaming with good efficiencies. Coal handling equipment, consisting of receiving bunkers, crushers and a belt conveyor system and ash sluicing facilities would be provided. This plant would be located as contemplated for the lower pressure plant. We have planned on the construction of a separate power house located just west of the present pump and power house and in line therewith, which would contain a single 7,500 kw. extraction type turbine generator exhausting to a surface condenser through which mill water would be pumped for condensing purposes. Steam extracted from the turbine would be desuperheated to saturated temperature for mill supply service. A 13,200 volt switch house with six circuits and space for two more, has been included, as well as a 5,000 kva. bank of transformers for service between the 13,200 volt bus and the 2,300 volt mill system.

Our estimated cost of the combined high pressure boiler and turbine plants and substation is $1,500,000 including $123,000 as an allowance for contingencies. See Table II for the make-up of this estimate.

OPERATING ESTIMATES

Our estimate of operating costs for the proposed low pressure boiler plant is based on operation of the plant with a crew of eight men, which crew we believe would be sufficient for continuous boiler house service. The yearly operating and maintenance expense of this plant would total about $145,000 made up as follows: operating labor $10,700, miscellaneous supplies and expenses $2,300, maintenance labor and material $7,000, and fuel $125,000, with coal at $4.37 per net ton f.o.b. the high mill trestle. The anticipated net steam delivery is the same as that of the present boiler house, estimated to be 570 million lb. per year.

We believe that a crew of fifteen men, including a chief engineer, could operate the proposed high pressure boiler and turbine plant satisfactorily. The operators of the pumps and present low pressure turbine would remain as at present and their wages are not included in our estimate of operating costs. We anticipate that about 56,000,000 kw-hr. would be obtained from the new plant in addition to the usual steam supply to the mill, entailing an operating and maintenance cost estimated at $305,000 per year, i.e., operating labor $22,000, miscellaneous supplies and expenses $3,500, maintenance $15,500 and fuel $264,000.

COMPARISON OF PLANS

Either of the proposed programs shows a substantial reduction in operation and maintenance expense in comparison with present costs. At Ahmeek Mill the cost of boiler house operation and maintenance runs about $195,000 per year. The new low pressure boiler plant is estimated to require an annual expenditure some $50,000 less. The high pressure power plant would increase present steam generating expense at Ahmeek Mill by $110,000 but the generation of electric energy with the proposed new 7,500 kw. unit would result in a decrease of $220,000 in present operating costs at Lake Linden, assuming that the production of 56,000,000 kw-hr. per year is transferred to the new plant, so that the net saving in annual operation would be $110,000.

If capital charges be added, however, the overall result is added expense in comparison with present costs. If 6% per annum be taken for interest, 8% for appropriation to retirement reserve, sufficient, at compound interest, to retire the investment in ten years, and 1% for insurance and taxes, the annual capital charges on the replacement boiler house would be $76,500 and on the alternative power plant $225,000, so that the net total added cost over present conditions would be $26,500 annually for the one and $115,000 for the other.

The significance of these cost figures depends upon circumstances. The $26,500 added total annual cost of the new boiler house might be considered as the inevitable consequence of a necessary replacement.

The $115,000 per year, capitalized at 15%, represents an investment of $767,000, for 7,500 kw. relay capacity in the Copper Company's power system, or $102 per kw., which unit cost is low in comparison with usual costs for plants of this size.

Our analysis so far assumes that load carried on the new Ahmeek Mill power plant would be removed from the existing Lake Linden station. If, however, some or all of the energy produced at Ahmeek Mill is for the purpose of supplying new load, the situation is quite different. Plate I has been prepared to illustrate this condition.

The figures across the bottom of the chart represent kw-hr. annually supplied for new load service, and at 56,000,000 they coincide with the estimated plant output. The left-hand vertical scale represents annual costs in dollars, and the right-hand scale the incremental cost in mills per kw-hr. of the energy supplied to new load.

Line A represents the yearly fixed charges on the plant of $225,000. Line B is drawn through $530,000, to represent the addition of $305,000 operating and maintenance expense. Line C is below B at $335,000, representing a credit of $195,000, the present cost of steam production at Ahmeek Mill. Line D starts $220,000 below line C at zero new load and ends even with C at 56,000,000 kw-hr. new load. The distance at which it is below line C represents the saving in expense at Lake Linden due to load transfer, and the distance it is above the base represents the total annual increase over present costs incurred in supplying loads in excess of present loads. Line E represents the same cost expressed in mills per kw-hr. It will be noted that if the entire output of the new plant were to supply new load, the incremental cost of this energy would be six mills per kw-hr., including fixed charges, but after due credit for steam supplied to the mill.

Under such conditions there would be, of course, no relay capacity in the system.

NOTES ON SOME POINTS OF DESIGN

We attach hereto, three plates showing the location of the proposed new facilities in relation to the other structures at Ahmeek Mill, a plan and section of the proposed high pressure boiler house, and a plan and section of the proposed 7,500 kw. turbine plant. No drawing of the low pressure boiler house is included but we have had in mind that it would be essentially the same as the high pressure plant, excepting for the omission of economizers and induced draft fans and with such changes in dimensions as would naturally occur.

It will be observed that in the turbine plant, we show a turbine generator and frequency changer. We have had up with four of the principal manufacturers the matter of supplying a 25-cycle machine of this capacity and find that there is practically no modern development for such relatively small 25-cycle turbines. Four manufacturers have offered to build direct-connected, 1,500 r.p.m. extraction type units; two have offered 60-cycle extraction type machines, which are a standard development, to be used in conjunction with a frequency changer, and two have offered a geared machine, using the standard 60-cycle turbine and a 25-cycle revolving field alternator. The direct connected unit is the most efficient, most reliable and also the most expensive. The geared unit is the least expensive, about as economical but probably the least reliable, although that phase of the matter may bear further investigation. We have tentatively selected the 60-cycle machine with frequency changer because the price is lower than for the direct-connected machine and the reliability probably better than the geared machine, although the efficiency is not as good as either of the others.

We have made plans for handling coal as follows:

We propose constructing a steel coal bunker on the same bents and at the same elevation as the present rock bins. Our plan calls for cutting into two of the rock bins and taking approximately 12% of the capacity of each which it has seemed to us might not be objectionable. The capacity of the coal bunker thus provided will be about 180 tons and it will be possible to dump a trainload of coal into it in a short time so that interruptions to the rock unloading activities, if any, would be slight. The coal from the bunker would be discharged through two crushers to an inclined belt conveyor which would carry it over to the bunker in the boiler house. This plan seems to us to be simple, reliable, and not too expensive. If, however, there is grave objection to sacrificing a portion of the rock bin capacity for the storage of coal, we have worked out other alternatives utilizing the present storage facilities which can be employed satisfactorily.

The electric switching station and transformer substation has been placed on the easterly side of the Mineral Range Railroad tracks in order to keep the number of circuits crossing the tracks to a minimum. The plans call for cutting the Tamarack Reclamation and the Mutual Pumping Plant feeders, making the portion between the new switching station and Lake Linden power house serve as tie lines and the remainder as feeders. A one-line diagram of the switching arrangements is also attached hereto.

This shows a single main 13.2 kv. bus and a transfer bus with an oil circuit breaker between so that the feeder breakers may be inspected and repaired without interrupting service. We have considered that it is permissible to open all other circuits at particular times without any difficulty arising.

Yours very truly,

Joseph Pope

Joseph Pope,
Consulting Engineer.

Enclosures

J.O. No. 5556

Table I

PRELIMINARY ESTIMATE
FOR
PROPOSED 160 LB. BOILER PLANT
FOR
CALUMET & HECLA CONSOLIDATED COPPER CO.

-1-

Stone & Webster Engineering Corp.

February 20, 1930.

This estimate covers the cost of a boiler house approximately 47' x 91' and the installation of three 645 h.p. Class XXII, 21 wide, Stirling boilers for 180 lb. maximum pressure. There will be two 30,000 c.f.m. forced draft fans, concrete stack 8' x 200', two 150 g.p.m. boiler feed pumps, and a coal handling installation consisting of a belt conveyor discharging to a crusher which discharges to a bucket elevator and thence to an overhead conveyor.

Building	$91,200
Equipment Foundations (Stacks Only)	3,500
Boiler Plant	104,500
Draft System	34,500
Feed Water System	16,200
Piping and Covering	50,000
Coal and Ash Handling System	46,700
Switching and Control Equipment	3,500
Connections, Supports, Etc.	5,500
Auxiliary Equipment	8,000
Preliminary Operation	5,000
Inspection and Expediting	2,000
Insurance	4,000
Temporary Construction	7,000
Depreciation on Construction Equipment	4,000
	$385,600
Engineering Cost	22,000
Services of Constructing Engineers	46,365
Office at Works	7,500
	75,865
Contingencies	48,535
TOTAL	$510,000

J.O. No. 5556 Table II

PRELIMINARY ESTIMATE
FOR
PROPOSED BOILER PLANT, TURBINE PLANT AND SUBSTATION
FOR
CALUMET & HECLA CONSOLIDATED COPPER CO.

-1-

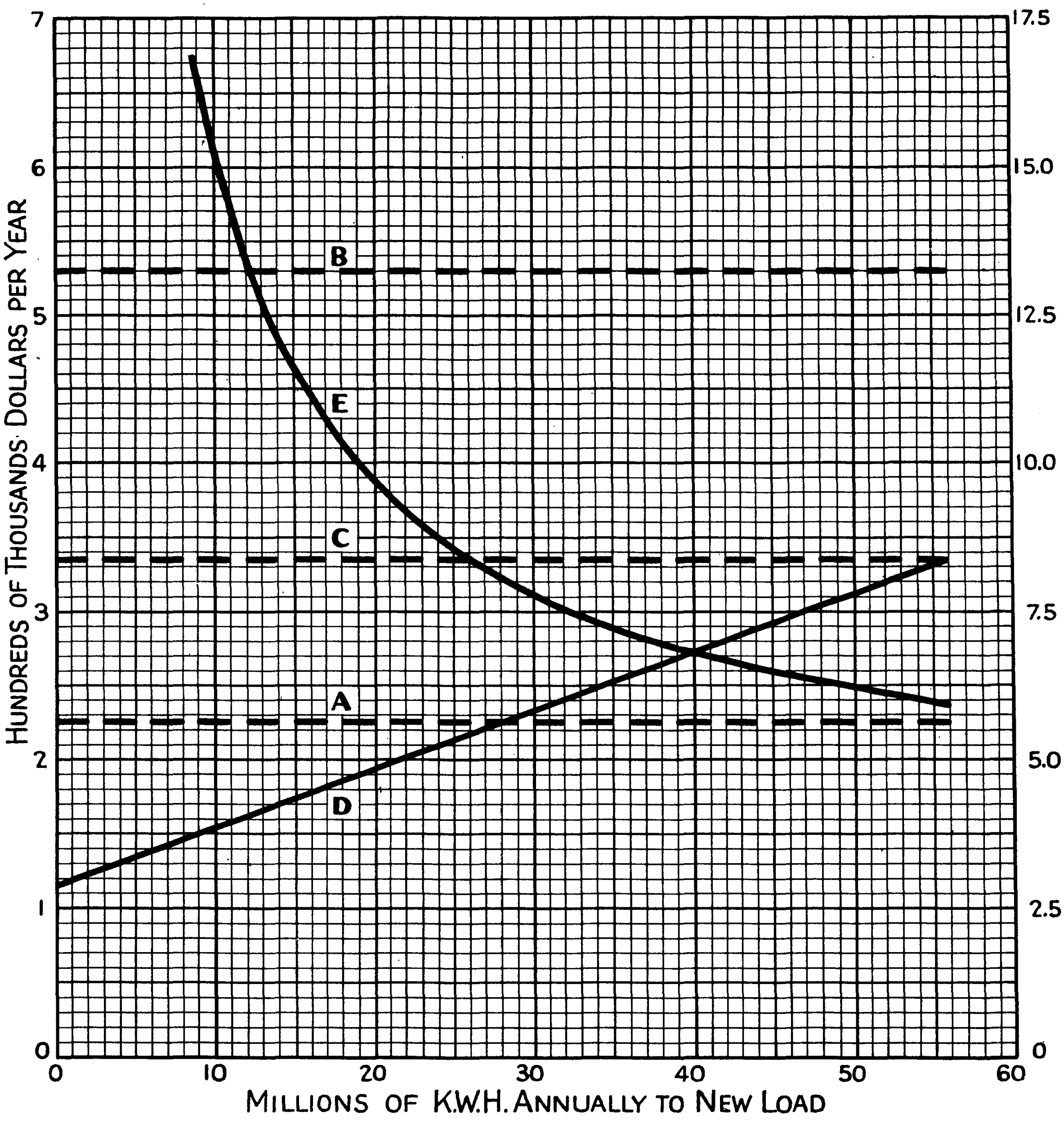
Stone & Webster Engineering Corp. February 20, 1930.

This estimate covers the cost of a boiler house approx. 56' x 104' containing three Class XXIII, 25 wide, Stirling boilers of 867 h.p. each, designed for 450 lb. pressure. Equipment includes stokers, concrete stack 10' x 175', three 30,000 c.f.m. forced draft fans, three 45,000 c.f.m. induced draft fans, 2 boiler feed pumps, three 5500 s.f. economizers and a complete coal and ash handling system.

The turbine house will be 46' x 58' and will contain one 7,500 kw. turbine-generator with air cooler and an 8,500 s.f., two pass condenser.

The substation will include three 1,667 kva. transformers and switching equipment for six 13.2 kv. circuits.

	Boiler Plant	Turbine Plant	Sub-station	Total
Building	$117,500	$34,000	$11,000	$162,500
Equipment Foundations	3,500	10,500	-	14,000
Boiler Plant	262,000	-	-	262,000
Draft System	52,000	-	-	52,000
Feed Water System	74,000	-	-	74,000
Condenser System	-	35,000	-	35,000
Piping and Covering	75,000	25,000	-	100,000
Coal and Ash Handling System	59,000	-	-	59,000
Generators and Exciters	-	217,000	-	217,000
Switching & Control Equipment	3,500	19,000	-	22,500
Connections, Supports, Etc.	5,500	7,900	-	13,400
Electrical Equipment (Substa.)	-	-	25,000	25,000
Switch Gear & Wiring (Substa.)	-	-	62,500	62,500
Auxiliary Equipment	10,000	20,000	-	30,000
Preliminary Operation	2,000	3,000	500	5,500
Inspection and Expediting				5,000
Insurance	$664,000	$371,400	$99,000	11,000
Temporary Construction				20,000
Depreciation on Construction Equipment				8,000
				$1,178,400
Engineering Cost				65,000
Services of Constructing Engineers				117,510
Office at Works				16,000
				198,510
Contingencies				123,090
		TOTAL		$1,500,000



A - Fixed Charges on New Plant
B - "A" plus Operat. & Maint. Expense
C = "B" less Credit for Mill Steam
D - "C" less Savings at L.L.P.P. and Additional Net Expense
E - Incremental Unit Cost

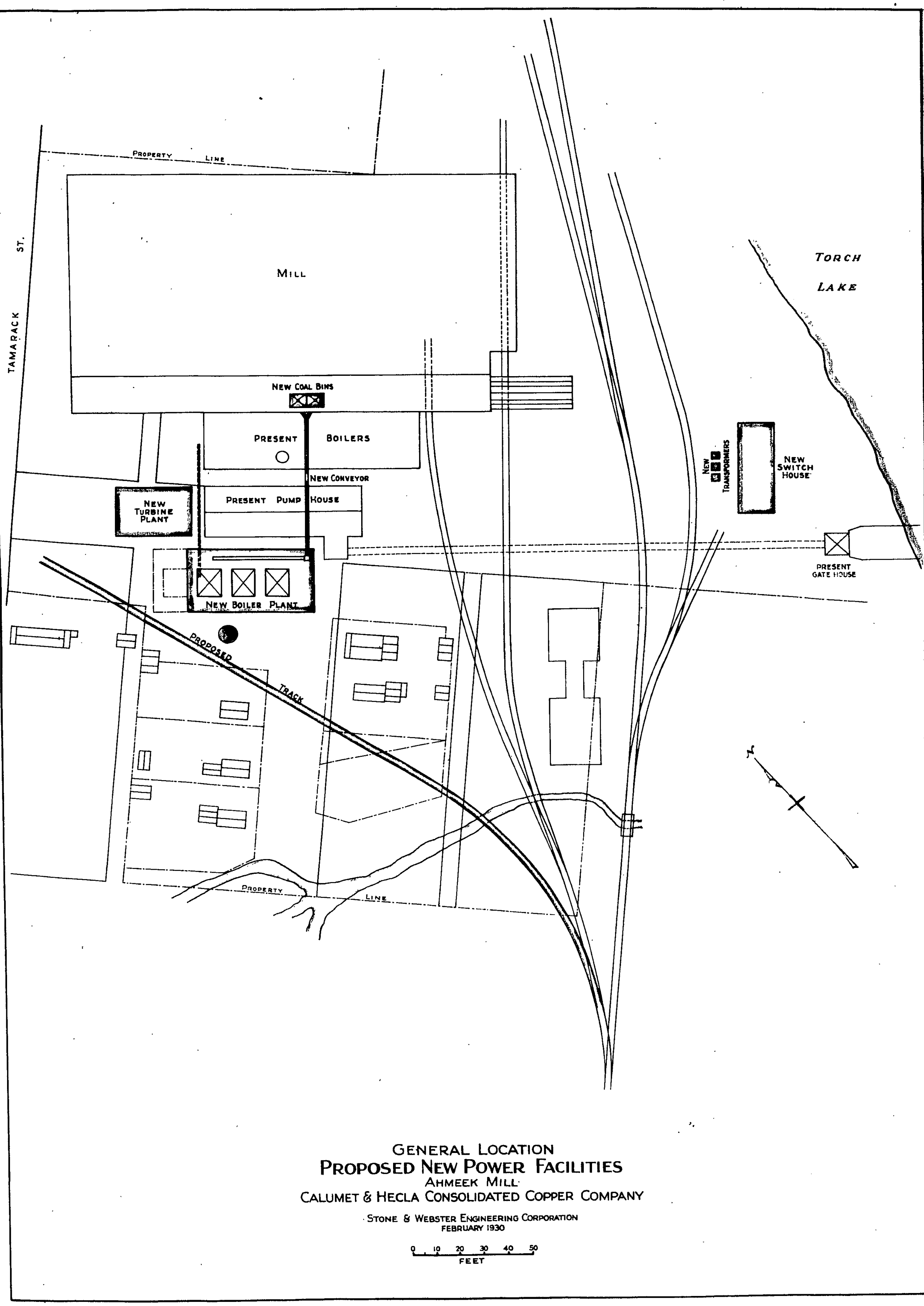
ADDITIONAL EXPENSE VS. ADDITIONAL LOAD

PROPOSED POWER PLANT

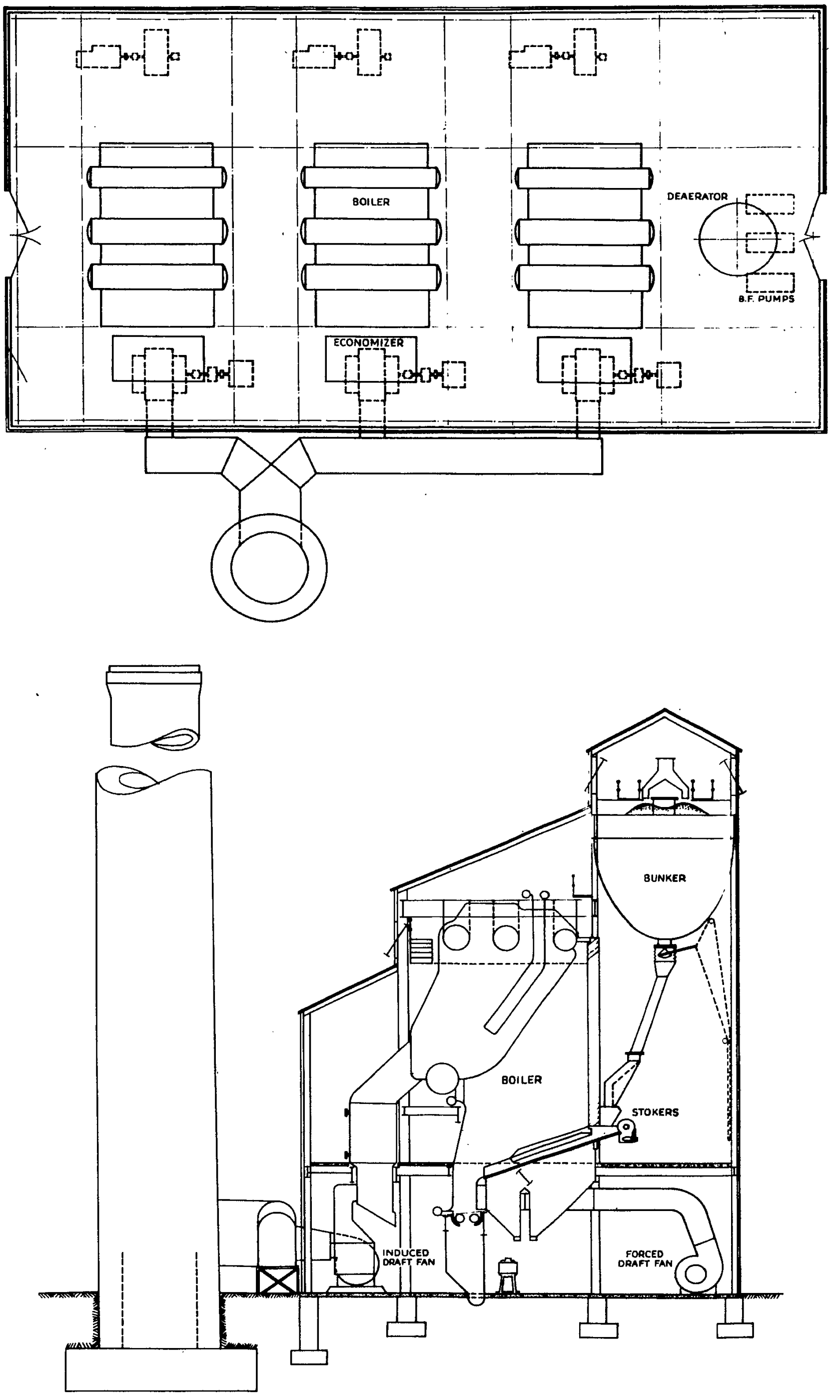
AHMEEK MILL

CALUMET & HECLA CONSOLIDATED COPPER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
FEBRUARY 1930

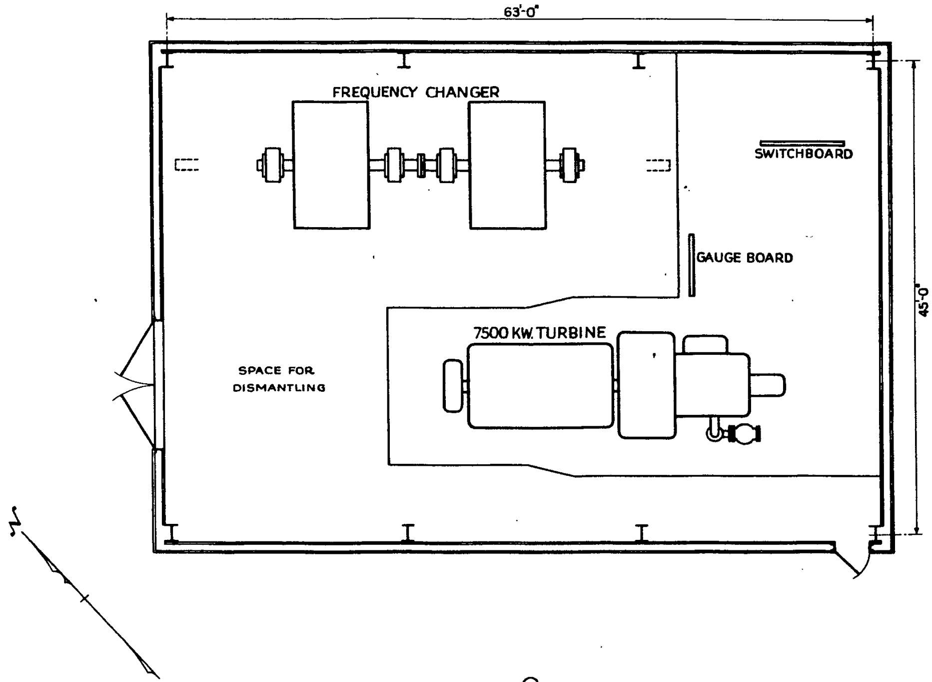


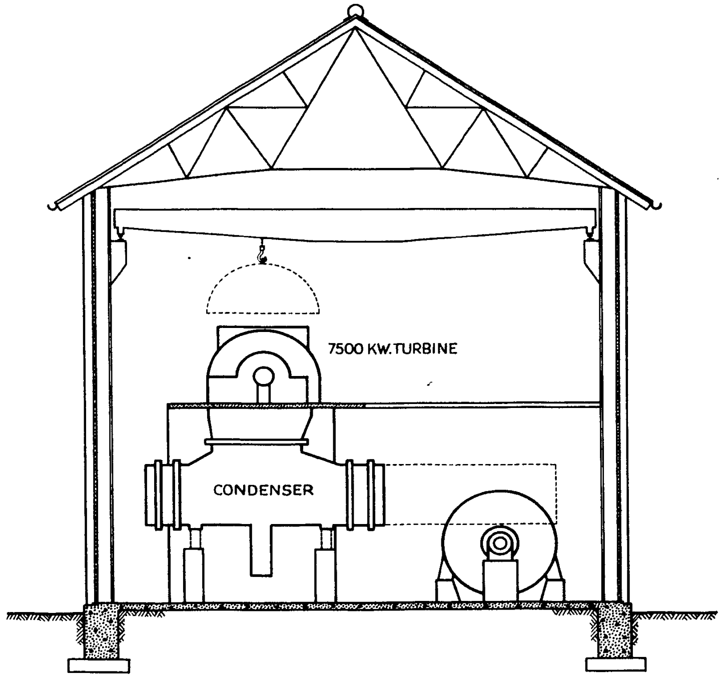
GENERAL LOCATION
PROPOSED NEW POWER FACILITIES
AHMEEK MILL
CALUMET & HECLA CONSOLIDATED COPPER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
FEBRUARY 1930



PROPOSED BOILER PLANT
AHMEEK MILL
CALUMET & HECLA CONSOLIDATED COPPER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
FEBRUARY 1930

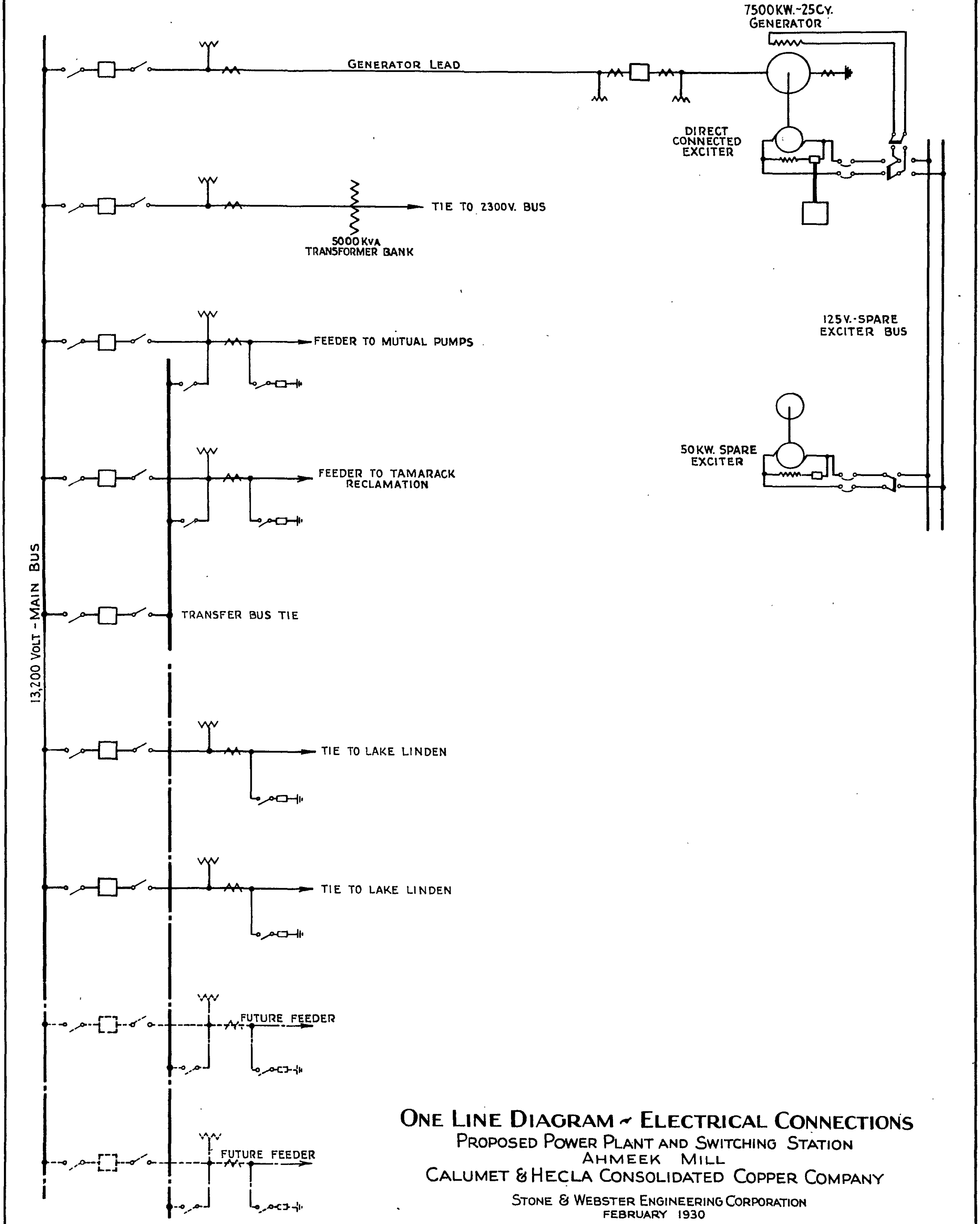
0 5 10 15 20 25
FEET





Proposed Turbine Plant
Ahmeek Mill
Calumet & Hecla Consolidated Copper Company
Stone & Webster Engineering Corporation
February 1930

0 5 10 15 20 25
FEET



ONE LINE DIAGRAM ~ ELECTRICAL CONNECTIONS
PROPOSED POWER PLANT AND SWITCHING STATION
AHMEEK MILL
CALUMET & HECLA CONSOLIDATED COPPER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
FEBRUARY 1930

MS-002
Box 73
Folder 51b
(52 1 of 2)

April 1, 1930

REVISED

PRELIMINARY ESTIMATE OF CONSTRUCTION COST

STEAM POWER PLANT - AHDEEK MILL

Estimated cost of Materials, Contracts and Direct Labor on		
Boiler Plant	$ 628,900	
Turbine Plant	367,400	
Substation	61,000	$1,057,300
Estimate of undistributed expense for		
Inspection and expediting materials	$ 5,000	
Insurance	11,000	
Temporary Construction	20,000	
Depreciation of construction equipment	8,000	
Office at works	16,000	
Engineering and drafting	65,000	125,000
Estimated charge for services of construction engineer	109,700	109,700
TOTAL		$1,292,000
Allowance for contingencies		108,000
Estimate of Grand Total Cost		$1,400,000

April 1, 1930

Boiler Plant

Fire room labor	$ 10,700	
Proportion of Chief Engr.	1,300	$ 12,000
Maintenance- 62,000 tons @ 22.6¢		14,000
Supplies		4,000
Fuel- 62,000 tons @ 4.365		271,000
		$301,000

Steam produced- 1,092,000 M #

Cost of steam per M # produced 27.6¢

Distribution

Steam and New Power Plant	645,000 M #	$178,000
Steam and Ahmeek Mill for Stamping, pumping & electric gen.	447,000 M #	123,000

April 1, 1930.

Turbine Plant

Steam and Turbine	645,000 M #/year @ 27.6¢	$178,000
Operating labor		10,000
Maintenance		1,500
Supplies		500
Total cost Operation and Maintenance		$190,000

Energy by 7500 Kw. condensing turbine- 56,000,000 Kw-H

Cost of energy by 7500 Kw. turbine per Kw-H 3.4 mills

Energy by 750 Kw. back pressure turbine- 5,000,000 Kw-H

Maintenance and supplies - 750 Kw. turbine $ 1,000

Cost of energy by 750 Kw. turbine per Kw-H 0.2 mills

Total new cost $191,000

Total new energy - 61,000,000 Kw-H

Average new maintenance cost per Kw-H 3.13 mills

April 1, 1930.

S U M M A R Y

Present cost steam production Ahmeek Mill	$200,000
Estimated new cost steam and Ahmeek Mill	123,000
Saving in costs of steam and Ahmeek Mill	$ 77,000

Energy generated L.L.P.P. at present	112,000,000 Kw-H
Energy to be generated at Ahmeek Mill	61,000,000 "
Energy remaining generation L.L.P.P.	51,000,000 "

Cost of production L.L.P.P. at present	$600,000
" " " " future	370,000
Saving at Lake Linden account load transfer	230,000

Recapitulation:	Saving steam & Ahmeek Mill	$ 77,000
	Saving in expense at Lake Linden	230,000
	Gross saving	$307,000
	Cost of generation new energy Ahmeek Mill	191,000
	Net Annual Saving	$ 116,000

April 1, 1930.

Summary of Operating Costs & Approximate Savings

Cost of steam production Ahmeek Mill 1929	$200,000
Cost of energy production Lake Linden 1929	600,000
Total for 1929	$800,000
Cost of steam and Ahmeek Mill 1931 estimate	$123,000
Cost of energy production Lake Linden 1931 "	370,000
" " " " Ahmeek Mill 1931 "	191,000
Estimated total for 1931	$684,000
Estimated net saving	$116,000

These figures are based upon the assumption that energy generated by new Ahmeek Mill power equipment is removed from Lake Linden power plant and that there is no increase in net output to load.

Received at 1930 JUL 15 PM 7 51

JS72 63 NL=BOSTON MASS 15

JAMES MACNAUGHTON.PRESIDENT=

CALUMET AND HECLA CONS COPPER CO CALUMET MICH=

WITH REFERENCE ASH DISPOSAL NEW BOILERS STOP GIRTANNER ENGINEERING CORPORATION PROPOSE CLOSED HYDRAULIC SYSTEM DEPOSITING REFUSE IN TAILINGS LAUNDER PRICE SEVEN THOUSAND DOLLARS FOB JOB STOP ALLEN SHERMAN HOFF PROPOSE OPEN SLUICING SYSTEM TO SUMP IN BOILER ROOM BASEMENT INCLUDING ASH DISPOSAL PUMP PRICE NINE THOUSAND SIX HUNDRED EIGHTY FIVE DOLLARS FREIGHT ALLOWED TO JOB STOP RECOMMEND ACCEPTANCE GIRTANNER PROPOSAL STOP PLEASE ADVISE=

STONE AND WEBSTER ENGINEERING CORPORATION.

MS-002
Box 73
Folder 51b
(52 1of2)

J.O. No. 5649

July 26, 1930

Stone & Webster Engineering Corp.
49 Federal St.
Boston, Mass.

Atten: Mr. E. LaCrosse,
Ass't. Engineering Manager

Dear Sir:

We are in receipt of your letter of July 19th with accompanying prints of your drawing VC-3367, outlining the 2300 volt switchboard.

When writing our letter of July 2nd, it was our intention that you should design, purchase, and erect the complete new 2300 volt switchboard, making all connections to generators, exciters, transformers, etc., but ending your work at the outgoing side of the feeder oil switches, we to connect the existing feeders to the oil switches, and dismantle the old board.

You are correct in assuming our letter of July 2nd is sufficient authority for you to proceed with this work. We also note that it will increase the amount of your estimate by about $22,000.

We have checked over your letter and drawing, and suggest the following:-

1. Proposed arrangement of 2300 volt switchboard:

Panel 1 - 5,000 Kva. new transformer bank.
" 2 - 50 Kw. existing exciter for 1,000 HP motor.
" 3 - 1,000 HP existing motor.
" 4 - 2,500 Kva. existing generator #6.
" 5 - 1,563 Kva. new generator #7.
" 6 - 50 Kw. new exciter for generators.
" 7 - 25 Kw. existing exciter for generators.
" 8 - 500 Kw. new transformer No. 1, for auxiliaries.
" 9 - 500 Kw. new transformer No. 2, for auxiliaries.
" 10 - 100 amp. new lighting feeder.
" 11 - 100 " " " "

July 26, 1930

Panel 12 -	? amp. feeder panel for 2 - 250 HP synchronous motors. See rating of motors under item No. 12 on page 3.	
" 13 -	For future synchronous motors, drilled for future switches, instruments, etc., for same service as Panel #12.	
" 14 -	Same as Panel #13.	
" 15 -	200 amp. existing power feeder No.	1.
" 16 -	" " " " " "	2.
" 17 -	" " " " " "	3.
" 18 -	" " " " " "	4.
" 19 -	" " " " " "	5.
" 20 -	" " " " " "	6.
" 21 -	" " new " " "	7.

Note that we have increased capacity of Panel #12 (your #18), and have added Panels 11, 13, 14. We are returning drawing VC-3367, revised accordingly.

2. We note you will provide 1-1/2" ebony asbestos panels. All our switchboards are of black marine finished slate, although we have no objections to the furnishing of the ebony asbestos if you feel this is equal or a better material to use.

3. This arrangement will be satisfactory.

4. The instruments on the motor driven exciter panel will not be available because this panel and exciter will be used for the excitation of the 1000 HP circulating pump motor, and located in close proximity to motor.

5. The present synchroscope is mounted on a swing bracket and will be available for the new board.

6. The present board had six power feeder panels and three single phase lighting panels. We have taken one single phase lighting panel and equipped it with a new circuit breaker to be used temporarily for starting the first 250 HP synchronous motor. We will, however, require seven 200 ampere feeder panels #15 to 21 incl.

July 26, 1930

7. Note the connection that you have made for starting and operating the 1000 HP motor. We have an auto transformer which we will use for starting this 1000 HP motor independent of the 2500 Kw. turbine as it is now installed. This starter will be located near the pump and panel #3 for this 1000 HP motor is to be connected directly to the buss. We have also shown this change on drawing VC-3367.

8. Watt meter arrangements on these panels are satisfactory.

9. Watt meter arrangements with a ratchet device for the 5,000 Kva. bank of transformers are satisfactory.

10. The mounting of the rheostats below the floor for the operation of the 2500 Kva. and the 1563 Kva. transformers is satisfactory, and according to our previous suggestion. The rheostat for the 1000 HP motor will be mounted independent of the new switchboard, in a location in close proximity to the motor.

11. The 250 HP synchronous motors are started directly across the line, but are provided with automatic starting. We will provide for the excitation for these machines, and exciter will be located somewhere in the Mill. The starting of these motors will have nothing to do with the new switchboard. Your switchboard equipment is satisfactory.

12. Regarding the panels for the 250 HP synchronous motor. Kindly refer to the panel arrangement, as given in item No. 1. The capacity of the switches on these panels has been left blank, but the following is the rating of the motors:-

P.F.	80%
H.P. rating	250
R.P.M.	300
Starting torque	200%
Pull-in "	120%
Pull-out "	300%
Eff. 1/2	87.9
3/4	90.5
4/4	91.6

K.V.A. inrush	675%
Kw. excitation	6.0 Kw. at 125 volts.
Motor running- 250 HP torque	254 K.V.A. input.
K.V.A. left for correction	153 K.V.A.

As stated before, there will be two of these motors connected to each panel, one motor will be installed at the present time. We have re-located these panels to avoid the necessity of carrying the heavy buss the full length of the board.

13. Note that you say there is plenty of room for the installation of this board.

14. O.K.

15. Agree with you in eliminating the oil circuit breaker slot, but you to provide drawings showing size and location of all floor openings, so we can place tubes through the floor for the outgoing power cables, and circuit breaker operating rods.

16. We feel that the slot in the rear should be left intact. This can always be closed up after the installation has been made if we feel that same will give a more finished appearance.

17. Note that you will provide conduit lay-out for the 2300 volt switchboard.

18. We feel that an additional 3 phase lighting panel, designated in item No. 1 as Panel #11, should be provided. This panel to take care of lighting in Mill, outside buildings, street lights, etc., thus providing protection from outside interference with the general lighting of the new turbine, boiler house and pump house, and to avoid the possibility of a complete lighting shut down through short circuits and the inability of the primary fusing to relieve the trouble before the operation of the oil circuit breaker.

July 26, 1930

Stone & Webster Engineering Corp. page 5.

19. The seven power conduits that now extend between the pump house and boiler house, will be connected to the new board and the extensions of same to their new location will be made inside of the old boiler house. This work to be done by C.& H.

20. This arrangement is satisfactory.

21. Your location for the 2300/460 volt transformers is satisfactory. If possible, transformers should extend not more than 12'-6" south of south face of pilasters on south wall of pump house. 2300 Volt cables can probably run underneath 2000 Kw. turbine floor and near its east edge.

Yours very truly,

President

HEW/AP
Enc.
CC to HN, FNB, ALB

MS-002
Box 73
Folder 52
(52 2 of 2)

STONE & WEBSTER ENGINEERING CORPORATION

ENGINEERING:
J.O.No. 5649

49 FEDERAL STREET, BOSTON
August 5, 1930.

Mr. James MacNaughton,
President, Calumet & Hecla Consolidated Copper Co.,
Calumet, Michigan.

Dear Sir:

OPERATION OF 13,800 VOLT SYSTEM
POWER PLANT - AHMEEK MILL

In accordance with your request to Mr. Joseph Pope on June 4, 1930, and in connection with our design for the new power plant at Ahmeek Mill, we have investigated the possibility of operating the generators at Lake Linden in parallel with each other, and with the new Ahmeek generator.

The load of the 13,800 volt system at the present time, falls into two classes, a mine load and a mill load. The mine load amounts to about 7,000 kw. and is supplied over two feeders on wood poles, aggregating about thirty miles of line traversing the higher part of the peninsula. The mill load amounts to about 10,000 kw. and is supplied over five feeders on wood poles aggregating about six miles of line traversing the lake shore. An accidental interruption to service on any of the feeders is highly undesirable. It is particularly undesirable on the mill feeders as an unexpected shut-down of a mill entails considerable work in clearing the process machinery of accumulated material before the mill can be started again.

The mine feeders, on account of their great length and higher location are subject to somewhat greater hazard than the mill feeders. In a number of cases, due to improper relay action, disturbances on the mine feeders have found their way through to the generators, shutting down the generators and mill feeders as well. For these reasons, it has appeared desirable, under existing conditions, to safeguard the mill feeders by connecting them to a separate bus and separate generators. Undoubtedly this method of operation has, in some cases, avoided mill shut-downs that might have occurred as the result of trouble on the mine feeders, if the whole system had been operating in parallel.

The 13,800 volt double bus at Lake Linden station, which was built in 1905, for a capacity of 10,000 kva., has been extended, but only slightly modified, with the addition of synchronous

Copy to Mr. Williams

capacity, the total now aggregating about 30,000 kva. The bus is not considered mechanically strong enough to withstand safely short circuits of the magnitude that might be obtained if all the present capacity were operated in parallel. This is a second justification for separating the system, under existing conditions.

From the standpoint of station economy it is probably desirable to operate all generators in parallel so that the generating capacity in operation can be made to approximate closely the load at all times and this will become more important after the new generator is added at the Ahmeek Mill. From the standpoint of continuity of service, parallel operation should not present any serious difficulty if suitable relays are used and, in case of a fault in a generator circuit, parallel operation would be a distinct advantage.

We, therefore, recommend that improvements be made in the arresters, relays and buses and all generators be operated in parallel. The recommended improvements will now be discussed in detail.

ARRESTERS

The arresters at Lake Linden are of the indoor oxide film station type manufactured by the General Electric Company, one being connected to each feeder. They are located inside the building on the mezzanine floor and the connections are reasonably short and direct. We do not recommend any material changes. We suggest, however, that the gap settings be carefully checked and that the ground connections be measured and improved, if necessary, to give the lowest practicable resistance to ground.

Some decrease in lightning disturbances at the station and of insulator flashovers out on the lines can probably be obtained by installing line type arresters at intervals along the lines. Station records indicate that although the majority of the lightning disturbances have been experienced on the two mine feeders, yet in one case, a lightning disturbance of considerable importance occurred on two of the mill feeders. We believe it would be desirable to install a few arresters on the mill feeders as well as on the mine feeders. In all cases they should be placed at locations most exposed to lightning. Both the General Electric Company and the Westinghouse Electric & Mfg. Company are now manufacturing improved types of line arresters which are comparatively inexpensive and of small size, yet have characteristics at least as good as those previously available. About thirty sets of arresters would be required. The cost of the arresters and other material would amount to about $3,000.00. We have not estimated the total cost of the installation, as we assume you will wish to attend to the purchase and installation with your own organization.

RELAYS

The relays on the generators and feeders at Lake Linden are of the overload plunger bellows type made by the General Electric Company. We understand that they are set to operate at about three to four seconds on the feeders and six to eight seconds on the generators, with the intention that in case of a feeder fault, the feeder breaker will trip instead of the generator breakers. Station records indicate, however, that in many cases, a feeder fault has opened one or more of the generator breakers, thus interrupting service on other feeders. This is probably due to the inherent limitations of the bellows type relays, particularly after long service. We believe that carefully selected induction type overcurrent relays will give the desired protection on the radial feeders. We suggest, therefore, that either Westinghouse type "CO", or General Electric type "IA-201" relays be installed on the radial feeders in place of the present bellows relays. They should be set to operate as quickly as is consistent with the speed of operation of the relays and breakers out on the feeders. It would be desirable to have them capable of clearing the usual faults within one and one-half seconds or less. We understand you are now proceeding with the installation of relays of this type.

The two tie lines to the Ahmeek Power Plant should be provided with three overcurrent relays for each line and three selective differential current relays for the two lines, the same as we are planning for the Ahmeek end of these tie lines. Three new current transformers will probably be required for each line. The relays will disconnect the faulty line in case a fault should occur on one line, and will leave the other line with overcurrent protection. Either Westinghouse type "CO" overcurrent and type "CD" current differential relays or General Electric type "IA-201" overcurrent and type "PD3" current differential relays would be satisfactory. The relays must be interlocked with auxiliary switches on the oil circuit breakers, so that when one line is disconnected, the other will have inverse overload protection. The cost of the material only, for these relays would amount to about $1,250.00.

The generators and their transformers should be protected against internal faults, but in such a manner that they can not trip on external faults. As the neutrals of the generators are not brought out, the usual differential protection can not be applied, but we believe a sufficiently satisfactory protection can be obtained, without altering the machines, by the use of Westinghouse type "CR" directional power relays, in place of the present overcurrent bellows relays. They would be connected to new current transformers to be located in the leads between the transformer banks and the buses, and to the existing potential transformers. A generator field breaker would be required, for each machine, to open the field on the occurrence of a fault in the generator or transformer bank. An auxiliary relay would be necessary to trip the two main breakers and the field breaker simultaneously. The cost of the relays, current transformers, field breaker, wire and conduit, exclusive of installation costs, would amount to about $2,600.00 for the three generators.

The 13,800 volt buses will have no relay protection with the proposed scheme of relaying, which eliminates the overcurrent relays on the generators. Differential protection is occasionally applied to station buses, but, as a rule, all bus protection is omitted as bus faults are of very rare occurrence. As these buses are well enclosed and station records indicate they have been free from faults, we believe bus protection will not be required.

BUSES

Each of the two 13,800 volt buses consists of two bars of 3 in. by 1/4 in. copper per phase tapered to one bar at the ends. The bars are supported on small corrugated porcelain insulators of a now obsolete design, spaced at a maximum of 8 ft. 10 in. centers. The bus structure is of masonry construction with precast concrete horizontal slabs and red brick vertical walls, the insulators being carried on the horizontal slabs. The two buses are backed up against a central partition wall and the leads, consisting of varnished cambric insulated cable, are carried out and upward in front of each bus.

With the present type of bus supports and the long spans between supports, we believe the mechanical stresses that might result from a severe short circuit on a feeder, in case all the present generators were operating in parallel, would about equal the mechanical strength of the bus, leaving no margin of safety, and, therefore, the system should not be operated in parallel at the present time. After the new generators are installed at Ahmeek Mill, the stresses would probably about equal the strength of the bus if the system were operated in two separate groups, but would greatly exceed it if all generators were operated in parallel. We believe it is necessary, therefore, that the bus be strengthened before the new generators are installed at Ahmeek Mill, regardless of whether the system will be operated in parallel or separated.

Inspection of the bus structure indicates that additional holes can be cut in the outer brick walls and new insulators can be added at the centers of the longer spans so as to limit all spans to not over 4 ft. 5 in. In addition to this, the present obsolete insulators can be replaced by insulators of uniform design with the new ones, and of greater strength than the present ones, so that the entire bus structure will then have a mechanical strength sufficient for safely operating the entire system in parallel, after the new generators are installed at Ahmeek Mill.

We understand you wished us to estimate the cost of this item of work on the assumption it would be done by our own organization. We estimate the total cost, including the new materials and also the installation costs based on overtime work at times when a bus can be shut down, will amount to $12,000.00.

We shall be pleased to have you advise us in case you wish us to take any further action regarding any of these recommended improvements.

Yours very truly,

H B Wood

H. B. Wood,
Chief Electrical Engineer.

MS-002
Box 38
Folder 22

COPY

VERN E. ALDEN COMPANY
ENGINEERS
33 NORTH LA SALLE STREET
CHICAGO 2

J.O. 342

November 15, 1954

Mr. P. H. Ostlender
Project Engineer
Calumet Division
Calumet & Hecla, Inc.
Calumet, Michigan

Report on Lightning Protection
For the Electrical Transmission System of
Calumet & Hecla, Inc.

Dear Mr. Ostlender:

Following your inquiry letter to us dated April 6, 1953, Purchase Order No. 14418 was issued to cover the subject report.

We are sending you herewith five copies of this report. The completion of this report was delayed until the Osceola Unwatering Project was fairly well complete as was suggested in your letter.

A minute survey of your lines and substations was made and this report embodies our findings and our recommendations for certain improvements.

We will be pleased to review this report with you after you have had an opportunity to study it.

Yours very truly,

F. D. Troxel
Project Engineer

Encl

J.O. 342 November 12, 1954

REPORT ON LIGHTNING PROTECTION FOR THE ELECTRICAL TRANSMISSION SYSTEM OF CALUMET & HECLA, INC.

1. During past years there have been a considerable number of outages of the electrical transmission system which were traceable to lightning disturbances. This study was made in accordance with the instructions in your purchase order No. 14418 and was made in an effort to find the points in your electrical transmission system which are susceptible to lightning troubles and to determine what could be done, at not too great a cost, to correct these conditions, and thus provide more reliable service from the electrical transmission system.

2. In an electrical transmission system such as exists here, the principal forms of lightning protection which might be considered are:

   A. The use of modern lightning arresters correctly applied.

   B. The use of overhead ground wires and lightning rods properly installed.

   C. The maintaining of low resistance ground connections for the arresters, the overhead ground wires and the lightning rods.

3. We have looked at each of your substations individually and find that in general there are many old lightning arresters

now in service on your system. Many of these arresters are undoubtedly useless as lightning arresters and, perhaps, even worse than no lightning arrester at all. In general this report recommends the replacement of all these old arresters with new modern arresters. The new arresters should be as follows:

15 kv station type grounded neutral service
Westinghouse Type "SV" outdoor Style No. 1533116 or equal.

2300 V Line type ungrounded neutral service
Westinghouse Type "LV" Style No. 1535071 or equal.

At certain points on your system some of the old arresters have already been replaced and these, of course, do not have to be replaced again. This report discusses in detail the conditions which exist at each substation on your system. At a few points where overhead lightning rods or ground wires are not now installed, it is suggested that they be added. In general in protecting equipment from lightning disturbances, it is well to place the lightning arrester as close to the equipment being protected as is possible. On your system, for the most part, the major equipment which is being protected is transformers and for that reason the arresters in each case should be placed as close to the transformers as is possible.

4. This report is a part of the general effort to raise the level of the reliability of your entire electrical system and other items, germane to this program, have been carried out in the past year or so. These items included the reconditioning of the 13.2 kv breakers and relays in the Lake Linden power house, revision of relay settings, automatic transfer of auxiliary supply, replacing poles on lines, etc. This work has progressed along with the work on the Osceola project. In our report to you dated February 8, 1949 we made an engineering study of each of your substations. This report covered principally the possible short circuit conditions on your system at the various points and the interrupting abilities of the breakers at the various points. In this report we made a series of recommendations. While reviewing your system in connection with this lightning study, we checked to see if the recommendations contained in the report dated February 8, 1949 had been carried out. In many cases these recommendations had not been carried out. In the earlier report certain hazards were pointed out and recommendations made to remove these hazards. As long as these conditions exist, they are a hazard to the reliable operation of this system just as are the hazards from lightning disturbances. We suggest that the report dated February 8, 1949 be reviewed and the things recommended therein, which have not been done, be carried out as soon as possible.

5. Any overhead 2300 volt or lower voltage lines which are exposed to lightning surges should be equipped with modern lightning arresters at both ends of each line. All electrical equipment and lighting circuits should be solidly and permanently connected to ground.

6. Below are listed in detail our recommendations in regard to each of the substations. You will note that in certain cases we are referring to substations which no longer carry much load. However, as long as these substations are connected to your system they constitute just as much a hazard to the reliable operation of your system as if they were carrying a heavier load. In cases where certain substations are no longer carrying any load, we would suggest that that substation and as much of the line as possible, that originally supplied such a substation, be disconnected from your system.

   A. Quincy Substation - This substation is relatively new. The equipment for the most part is relatively modern. Modern G.E. type lightning arresters are installed. The substation is located in a low spot which should be relatively free from lightning occurrence. There is no record of a lightning stroke at this location. The ground resistance is quite low. Therefore, we would suggest no changes insofar as the lightning protection for this particular yard is concerned even though there are no ground wires above the substation proper. In our report dated February 1, 1949, we stated that the breaker which is installed on the high tension side of this transformer had an interrupting capacity of 50,000 kva and that the short circuit current that might flow in case of a short at the terminals of the transformer, would be about 91,000 kva. We suggested that this breaker be removed from service since it constitutes a serious hazard to the reliable operation of the system and is a source of fire hazard as well. This breaker has not been removed and we again recommend that it be removed just as soon as practical. When the breaker is removed, it will be necessary to change the settings of the relays for the Quincy Line at the Ahmeek Power House since the clearing of a fault will depend upon the operation of these relays.

B. Tamarack Reclamation Substation - In this substation there are two banks of transformers. These transformers are each 1,000 kva in capacity, arranged in two banks of three each, one stepping down to 440 volt and the other to 2300 volt. All of this equipment is located indoors. Both transformer banks are supplied by one feeder from the Ahmeek Power Station. There are located here, three old style G.E.Co.'s oxide film type of lightning arresters. These arresters are quite old and are obsolete. Most arresters of this type have been removed from power systems many years ago since it was found that the discs in the arresters deteriorated after a period of time and that it was impossible to determine their condition in any satisfactory manner. Furthermore, the porous block type of arrester has been developed since and it is a much better arrester in every respect. We would recommend that these arresters be removed and be replaced with modern arresters. In our report dated February 1, 1949 we stated that the three oil circuit breakers located in the circuit on the high tension side of these transformers each had an interrupting rating of 25,000 kva and that the possible short circuit current that might flow with a short circuit at the high tension terminals of these transformers could be about 136,000 kva. We, therefore, recommended that these breakers be all removed from service just as soon as possible. This has not been done. We recommend again that these breakers be removed just as soon as practical as they constitute a serious fire and system reliability hazard. Furthermore this substation is located in a room which has a door which leads to the Reclamation Plant. If the oil in these transformers or the breakers should get out of the tanks and catch fire, as it does when there is a fault in the equipment, this flaming oil could flow out through this door onto a wooden platform, down a wooden stairs, thereby starting what could be a serious and costly fire. We would recommend that a curb be placed immediately at this door entrance so that this flaming oil could not flow out onto the wooden platform and stairs. Furthermore certain of this equipment is located on an elevated platform which has a stairway at one end. If a fault occurs when a man was at the opposite end of this platform he would be trapped. We would suggest that at least an escape ladder of some sort be provided at the opposite end of this elevated platform.

C. <u>No. 2 Regrinding Plant Substation</u> - This substation was originally supplied by two lines from the Lake Linden power house bus. Two transformer banks were installed, one 3750 kva in capacity and another 6000 kva. The load at this time, however, has been very much reduced and at present only one line is connected from Lake Linden to the substation. All of the transformer capacity is, however, yet in service. Apparently there is a good chance that all of this equipment will be taken out of service before long due to the regrinding plant operation being discontinued. If this is true, of course, it is not desirable to spend any money here. However, if this equipment is to continue to be energized, even though it is not carrying any load for any length of time, we would suggest that the old lightning arresters on the one line that is in service be replaced with modern type of arresters. In our report dated February 1, 1949 we stated that the breakers which are in the high tension side of the feeds to these two transformer banks each had an interrupting rating of about 25,000 kva. The short circuit current that might flow is something in the order of 232,000 kva. We, therefore, recommended that these breakers be removed from service immediately. This has not been done. If this equipment is to remain energized we would recommend again that these breakers be removed just as soon as possible. All of this equipment is quite old and it is a source of hazard to the whole system. The equipment, however, is located in a separate building and if it caught on fire it probably would not do much damage to other buildings. When the high tension breakers are removed, the relay settings at the Lake Linden bus should be changed.

D. <u>The Smelter Substation</u> - The smelter substation has three 1000 kva single phase transformers. These transformers were formerly fed through breakers on the high tension sides from a line from the Lake Linden Power House. These breakers have been removed in accordance with the recommendations of our report dated February 1, 1949. The incoming line to this substation is provided with old G.E. lightning arresters which should be replaced with the new modern type. The ground resistance at this station is low and with the new lightning arresters, a minimum amount of lightning disturbance would be anticipated. We, however, would recommend that lightning rods be placed above the switchyard structure in the usual manner that has been done on many of the substations on the C&H system.

E. Coal Dock Substation - The coal dock substation is an outdoor substation. The transformer bank formerly had an oil circuit breaker on the high tension side but this breaker has been removed in accordance with the recommendation of our report of February 1, 1949. The incoming line is provided with old style Westinghouse lightning arresters and these should be replaced with new style arresters. We would also suggest that lightning rods be added above this switchyard. This substation is fed from the same breaker and line that feeds the smelter. The relay settings for this breaker in the Lake Linden Power House are satisfactory as indicated on the last relay settings list which we gave Calumet & Hecla.

F. Ahmeek Power Plant - All the lines going out of the Ahmeek Power Plant are equipped with modern lightning arresters. These arresters are mounted on a modern steel pull-off structure. The pull-off structure does not have lightning rod protection above it but it is set adjacent to the rather tall power house smokestack which is equipped with lightning rods and this affords good protection from direct lightning strokes. We would, therefore, suggest no changes at this point. The ground resistance at this point is very low which also will lead to good operation from these lightning arresters.

G. Lake Linden Power Plant - All of the lines going out from the Lake Linden Power Plant are equipped with modern arresters. These have been replaced in recent years. The switching equipment in the Lake Linden Power Plant is all relatively modern and has recently been reconditioned and tested. The relays have been carefully cleaned and adjusted. The relay settings have been checked in accordance with the system as it is at present. Therefore, no further work would need to be done at the Lake Linden Power Plant and a minimum of trouble should be expected from lightning at this point.

H. All of the transmission lines at Substation "B", both the 60 cycle and the 25 cycle, have been provided with modern lightning arresters. Ground resistance at this point is low. Overhead lightning rods have been provided. Therefore it would appear that no work need to be done at this point in order to have a good level of lightning protection.

I. Lines to Osceola No. 13 and No. 6 Shafts and to Tamarack No. 5 - These lines and the associated substations have recently been built and they are equipped with modern lightning arresters and other lightning protection features. All of this should give good lightning protection for these lines and the substations.

J. Calumet Waterworks Substation - All of the lightning arresters at Calumet Waterworks are old arresters. These should be removed and replaced by modern arresters. There are two sets, one for each of the two transformer banks. Lightning rods should be added over the switchyard. The ground resistance at this point is rather low and with the addition of the two items mentioned above a good level of protection would be assured. The arresters on both ends of the 2300 V line to the Tamarack Water Works should also be replaced.

K. <u>Centennial Substation and Adjacent Lines</u> - The area around the Centennial Substation has the record of having more lightning difficulties than any other spot on the C&H system. This is probably due to exceedingly high ground resistance and to, perhaps, a rather exposed natural position. We would recommend that the two old lightning arresters on the line to the transformer bank be removed and that the one modern arrester be retained. We would suggest the addition of a modern arrester at the point where this connection to the transformer bank cuts into the main line. We would suggest that another arrester be placed about one thousand feet away on the line to Substation "B" and that another be placed about one thousand foot distance in the opposite direction from this tap point. Anything that can be done to lower the ground resistance of all of these arresters should be done. Modern lightning arresters should be provided on the 2300 V. distribution system. With the addition of these arresters and a low ground resistance we would think that the protection afforded was about as good as possible.

L. <u>Alloway No. 3 Substation</u> - There are modern arresters at this substation and we would suggest no change here.

M. Ahmeek No. 2 Substation - There are choke coils in the connection to the transformer bank to Ahmeek No. 2. These choke coils serve no useful purpose and in fact are a hindrance insofar as lightning protection is concerned. They should be removed. The lightning arresters at this point are very old and should be replaced with modern arresters.

N. Ahmeek No. 3 and No. 4 Substation - The lightning arresters at this point on both the incoming lines and outgoing lines are all very old and should be replaced with modern arresters. All of these new arresters should be located out of doors.

O. Seneca No. 2 Substation - The lightning arresters at this point are very old and should be replaced with modern lightning arresters. Lightning rods should be placed above the substation.

P. Iroquois Substation - The lightning arresters at this substation are very old and should be replaced with modern arresters. Lightning rods should also be placed over the substation.

Q. Trap Rock Valley Line and Substation - This line and substation have been built recently and are provided with modern arresters, etc. and should be relatively free from lightning troubles.

The estimated cost of carrying out the foregoing recommendations is as follows:

42 - 15 kv lightning arresters @ $200. ea. installed =	$8,400.
12 - 2300 V. lightning arresters @ $10.ea. installed =	120.
5 - Sets of lightning rods above substations =	500.
Total =	$9,020.

We feel that if the recommendations which are made in this report are carried out that the reliability of your electrical transmission system, insofar as lightning disturbances are concerned, will be much improved. We will be happy to discuss this report with you, after you have had an opportunity to review it, if you so desire.

Signed: F. D. Troxel

F. D. Troxel
Senior Electrical Engineer

MS-002
Box 85
Folder 15

Copies: ASK
RJM
BCP
RLP
JPP

Report on

THE LEACHING OF AHMEEK MILL CONCENTRATES

by

L. C. Klein

November 5, 1958

FC/39

INTRODUCTION

This report will attempt to give answers to several questions that have been raised concerning the possibility of leaching certain Ahmeek Mill Concentrates to produce 25,000,000 pounds of copper per year in copper oxide, for production of copper powder. In addition to this, about 3,600,000 pounds of copper oxide would have to be produced to supply the regular demand for industrial and agricultural oxide, this material to be produced from either primary or secondary copper sources.

This report will cover the capacities of present leaching and distillation facilities; changes in leaching and distillation equipment necessary to adapt this equipment to the leaching of concentrates and distillation of the rich solutions produced; material handling; changes in leaching techniques; leaching solution control; types of concentrates that can be leached; and the control of impurities in the oxide produced. A rough estimate is also given for capital expenditures necessary and the cost of oxide production.

CONCLUSIONS

Certain of the Ahmeek Mill Concentrates can be leached to produce copper oxide. "Rich" and "Poor" can be leached with minor modifications to the present 54 ft. diameter leaching tanks and piping, although smaller diameter tanks would be more efficient. "Heading" can be leached in special tanks providing faster solution turnover. The Lake Linden Leaching Plant has tank capacity to leach three or more times the required amount of copper from high grade concentrates.

With the present distillation facilities at Lake Linden, about 1,300,000 pounds of copper as copper oxide can be produced per month consistently. The Tamarack Leaching Plant can produce an average of about 750,000 pounds of copper as oxide per month.

To produce 2,000,000 pounds of copper per month for copper powder, and 300,000 pounds per month of industrial and agricultural demand, it will be necessary to do one of the following:

1. Operate both the Tamarack and the Lake Linden Leaching Plants at near capacity, or

2. Install two additional stills and accessory equipment at Lake Linden.

Plan 1 requires a capital expenditure of about \$30,000 at Tamarack, and \$25,000 at the Lake Linden plant. Oxide produced at Tamarack would cost from 4.0 to 4.5¢ per pound of copper processed, and at Lake Linden the cost per pound would be about 2.75¢.

Plan 2 requires a capital expenditure in the order of \$225,000, of which \$25,000 would be spent in the Leaching Plant, and \$200,000 in the Still House. With this plan, the cost of producing a pound of copper, as oxide, would be about 2¢.

The extent to which impurities in the concentrates, particularly arsenic and silica, will contaminate the oxide, and the possibility of the arsenic being evolved on reduction with hydrogen will have to be determined experimentally. These impurities can be precipitated from the leaching solutions if it is necessary. ?

Plan 2 = 225,000
Plan 1 = 30,000
195,000

% of difference feeds -?

AHMEEK MILL CONCENTRATES

The grades of concentrates produced at the Ahmeek Mill are as follows: Heading, Rich, Poor and Flotation.

Rich is a more or less ideal material for ammonia leaching. The assay of this grade is about 90% copper, and the individual particles are not too large to be dissolved in a reasonable leaching cycle, nor is much of the copper likely to be entrapped in the gangue. The 10% of the gangue in the material is not enough to stop permeation of the solutions through the material, and slimes are not present in sufficient quantity to create a problem.

Poor, assaying about 70% copper, is more difficult to leach. The copper particles are smaller, but the increased amount of gangue and the finer texture of the gangue inhibits the solution percolation to some extent, and creates a greater problem with slimes.

Heading, which is relatively pure copper, but large in size, can be leached in a special tank, such as rectangular tank, with rapid circulation of solutions. Leached in the conventional tanks this material would take from six to eight months to dissolve. In the rectangular tank it could probably be leached in two weeks. COST.?

Mill mass is not considered a good leaching material. It would take a period of years to leach some of the larger pieces of mass, and then any copper entrapped in the ore would not be recovered.

Flotation concentrates can be leached if special equipment were used. Something on the order of an enclosed thickener, or counter-current decantation unit could be used to leach this material, so that rakes would continuously turn over the material and expose the copper to the leaching solutions. Percolation leaching would not work on this material because of the very fine nature of both the copper and the gangue. Before leaching this material, it would be necessary to determine whether the flotation reagents and oils would contaminate the leaching solutions and show up in the copper oxide as carbon and sulfur compounds.

It is safe to assume that Rich, Poor, and Heading can be leached with no particularly difficult troubles developing. An experimental lot of mixed Rich and Poor is now being leached at the Lake Linden Leaching Plant and is progressing satisfactorily. This test is being made in a 15 ft. diameter tank with reverse flow of solutions.

LEACHING OF CONCENTRATES

The large, 54 ft. diameter leaching tanks at Lake Linden and Tamarack are not ideally suited to the leaching of mill concentrates. Small diameter tanks, about 16 ft., would be much better because less trouble would be experienced with the solutions working through the area of least resistance in the charged tank, or "channeling". By reversing the flow of solutions on the large tanks and installing porous filter bottoms, no great trouble with leaching concentrates should be experienced. It may be necessary to drain a tank once or twice during the leaching cycle and turn over the material with a clam to counteract the effect of channeling. This can be done by one man in an hour or so.

Reversing the flow of solutions in the tanks will eliminate the problem of slimes plugging up the filter bottom and cutting off the flow of solutions. Any slimes in the effluent solutions can be removed by filtering, if these solutions are sent to distillation, or by settling if they go to the leach storage tanks. Slime settling in the storage tanks could be removed by flushing the tanks periodically.

Four of the large leaching tanks will be needed to leach 2,000,000 pounds of copper per month. About 1,000,000 pounds of copper would be charged in each tank, and the leaching cycle should take from six to eight weeks.

How many small tanks? Cost

It will be simple to produce a consistently high cuprous oxide by leaching concentrates, that is a cuprous oxide content in the order of 70-75%. If a higher cuprous oxide content is desired, a small tank charged with copper shot or other pure copper material could be placed in the rich line between the stills and the preheaters in the Still House. This should boost the cuprous content of the oxide to about 90%, and would cut to less than half the theoretical amount of hydrogen necessary for reduction of the oxide to copper powder.

Careful control of the leaching solutions will be necessary if high grade concentrates are to be leached, since supersaturation of the solutions results in the precipitation of basic cuprous carbonate in the tanks with resulting high copper losses. Controlling the solutions is not difficult and the possibility of supersaturation of solutions occurring should cause no great concern if the concentrations of copper, ammonia, and carbon dioxide in the leach storage are kept in proper balance.

All equipment in the leaching plant is adequate for leaching the required tonnage of concentrates, the only expenditures necessary will be for tank bottoms and repiping. A pressure filter for rich solutions must be obtained. ?
This could be located either at the Leaching Plant or Still House.

If maximum production of cuprous oxide is to be maintained with the present facilities, it will not be possible to operate two leaching circuits at Lake Linden. If different grades of oxide are to be produced at Lake Linden, it will involve a considerable expansion of still house facilities. This will be taken up in more detail later in this report.

IMPURITIES IN COPPER OXIDE PRODUCED FROM PRIMARY

Analysis of solutions obtained from leaching Ahmeek Mill concentrates indicate that arsenic in the mineral is being dissolved by the ammoniacal solutions, presumably forming ammonium arsenate or ammonium arsenite depending on the valence of the arsenic in the ore.

The ammonium arsenates would normally break down to form the respective arsenic oxides at distillation temperatures, but other reactions can take place. If chlorides are present in the solutions being distilled, the cuprous copper reduces the arsenates forming arsenious chloride which is quite volatile. Arsenic has been detected in the distillate from the decomposition of solutions containing arsenic, so this reaction may be taking place to some extent. Since Torch Lake water is used for leaching, chlorides are present in considerable quantity. If any amount of arsenic goes into the distillate, it will be returned to the leaching plant and eventually build up quite high in the solutions.

Since arsenic has a great affinity for sodium, and is readily dissolved by alkaline sodium compounds, it is quite possible that the introduction of a small quantity of a sodium compound, preferably sodium carbonate, to the still feed will result in the arsenic forming the sodium compound. Since the sodium arsenates or arsenites do not decompose at distillation temperatures, the arsenic would be eliminated in the still waste. There is also the possibility of precipitating the arsenic from leaching solutions with small amounts of magnesium compounds or other chemicals.

There is a strong possibility that if the oxide is reduced with hydrogen at temperatures over 1300°F., the arsenic compound will be sublimed, or that it will be evolved as arsine. Arsine, if it is formed, decomposes freeing metallic arsenic at elevated temperatures, which should sublime under the right conditions.

It is likely that the silica content of the oxide made from concentrates will be a little higher than in that made from secondary, because silica is very slightly soluble in the alkaline leach liquors. ?

There is a possibility that calcium and magnesium might be a little higher in oxide made fromprimary because of the presence of the chlorides of these two metals present in the ore. The Torch Lake water also contains a high percentage of these compounds. The presence of carbon dioxide in the leaching solutions precipitates both of these metallic ions as insoluble carbonates, and calcium and magnesium getting into the oxide is carried in the solutions as fine suspensions. It is likely that filtering the solutions to remove slimes will also effect the removal of most of these compounds.

The effect of the above impurities on the quality of oxide, and copper powder produced from it, can only be determined by distilling solutions made from concentrates in a large scale test, and reducing the oxide obtained. ?

HANDLING OF CONCENTRATES

Up to 100,000 pounds of concentrates will have to be handled per day from the Ahmeek Mill to the Lake Linden Leaching Plant, and into the tanks. There are at least two ways of doing this. If no expenditure of money is to be made, the concentrates would have to be loaded into gondola cars, or into pans on gondola cars, at the mill, so that they could be transferred into the leaching tanks either with a clam, or by picking up pans of concentrates with the crane and dumping into the leaching tanks. By either method, this material could be put into the tanks in about four hours a day by the regular scrap-handling crew. The mineral would then have to be leveled off in the tanks, when a tank is completely charged.

The alternative would be to use the present mineral cars, and build a pit under the leaching plant tracks from which an elevator would take the mineral to a storage silo, from which it could be dumped into pans for transporting to the leaching tanks, or a system of movable conveyors could be used for this purpose. This method of handling the concentrates would involve a considerable outlay of capital.

HANDLING OF LEACHING RESIDUES

The handling of the residues left from the concentrates after leaching will present two problems: 1. Removal of soluble copper and ammonia, and 2. Removal of the residue from the tanks and recovery of the silver contained therein.

1. The test now being run on the leaching of Rich and Poor minerals will provide information on how well ammonia and soluble copper can be removed from the residue by washing with ammonium carbonate "distillate" and water. It is assumed that sufficiently good washing can be attained, since the volume of residue is small in comparison to the initial tank charge.

It will not be economical to steam the residue for ammonia recovery if it can be reduced to below about ten pounds to the ton.

2. Because a considerable value of silver will remain in the residue, it is assumed that some effort will be made to recover it if the cost is not too great. This will rule out the use of conventional flushing methods for eliminating the residue from the leaching tanks. If the silver particles are not too fine, it may be possible to install riffles in the tailings launder, or a settling area in which the silver can be trapped. If half of the silver could be recovered by this method it will probably be worth doing, since flushing would be by far the cheapest way of getting rid of the residue. The alternate method would be to clam and shovel the residue from the tanks, or to flush them out into a settling tank or thickener, for dewatering, and then recover the silver by flotation, cyanidation, or pyrometallurgical means, or selling the residues as such. Tests will be made with the residue from the leaching test now in progress to determine the nature of the silver particles, and to determine the best way of handling the residue.

DISTILLATION

While the Leaching Plant has capacity to leach considerably more copper from concentrates than required for this program, the capacity of the distillation facilities is definitely limited.

With the three distillation units now at Lake Linden, the maximum copper that can be produced in a seven day week, with ideal conditions, is about 1,500,000 pounds. A comfortable average production is in the order of 1,300,000 pounds per month. If a fourth still were installed at Lake Linden, maximum production would approach 2,000,000 pounds per month, with a consistent average not much above 1,600,000 pounds per month.

The production figures shown above could only be met if only one grade of oxide--high cuprous--was produced. If high cupric oxide is to be made, or agricultural grades of oxide, the production figures would be reduced considerably. This would rule out use of two circuits at Lake Linden unless additional distillation and drying facilities are installed.

The Tamarack plant has on occasion produced 1,000,000 pounds of copper in oxide per month, however, an average production of 750,000 pounds per month is all that can be produced consistently.

COPPER OXIDE DRYING, BAGGING, AND HANDLING

The drying equipment at Lake Linden will handle up to 50,000 pounds of high cuprous oxide per day. Other oxides, higher in cupric oxide content, reduce the capacity of the dryer because they contain more moisture. If production in excess of 50,000 pounds of oxide per day is expected, new drying equipment must be purchased. Drying 50,000 pounds of oxide per day will require some departures from the normal way of operation, since heavy loads of oxide, as encountered when boiling out a still before shutting it down, would overtax the drying equipment. Controlling the flow of oxide from the dewatering cones to the filter should overcome this problem.

The drying of chippings will have to be spread over a longer period of time, so as not to overload the drying equipment when it is carrying its regular load. It is possible that this operation can be mechanized to eliminate the need for a man to shovel the chippings into the drying system.

The bagging equipment at Lake Linden is adequate to handle 50,000 pounds of oxide per day, but bagging will have to be done on two shifts, rather than on one shift.

It is assumed that the oxide will be dried and bagged before reduction to copper powder. If wet oxide is to be reduced directly to powder, it will be necessary to do this with no intermediate storage, since storing the wet, high cuprous oxide for even a few hours would result in a hopelessly caked mass.

It is possible, if the oxide is not to be stored for too long a period before reduction, to eliminate the bagging operation, and transfer the oxide from the drying plant to storage bins in the reduction plant by a pneumatic or other type of conveying system. In this case, the copper powder would have to be used as a basing point for figuring costs rather than the oxide. This would eliminate the need for complete assays on oxide produced for reduction to powder. The only control needed would be the cuprous oxide content, which is a simple analysis, and could be run by plant personnel if necessary.

FACILITIES NEEDED TO MEET ALL OXIDE REQUIREMENTS

The Lake Linden Leaching Plant and Still House will not be able to produce, with present distillation facilities, the high tonnage of copper oxide required for the production of copper powder, and also make the various grades of oxide required for industrial and agricultural customers. Spray grade oxide could be made from the high cuprous oxide made for powder if it were reduced in size by some such fine grinding device as the Micronizer. To produce upwards of 2,000,000 pounds of copper per month for powder, and 300,000 pounds of copper for agricultural and industrial requirements, the following two plans are suggested:

1. <u>Reactivate the Tamarack Leaching Plant.</u>

   All of the industrial and agricultural grades of oxide would be produced at the Tamarack Plant, from either Ahmeek Mill concentrates, or a combination of concentrates and pure copper scrap. The Lake Linden Leaching Plant would operate at its average capacity producing only high cuprous oxide for copper powder. The Tamarack Plant would have enough capacity, in addition to that required for special grades of oxide, to contribute about 400,000 pounds of high cuprous oxide for the manufacture of copper powder.

   The advantages of this plan are as follows:

   A. Lowest capital outlay.

   The disadvantages of this plan are:

   A. Steam costs, for distillation, are over 150% of the Lake Linden steam costs.
   B. Cost of production would be about double Lake Linden costs.
   C. Drying and bagging equipment would have to be purchased.
   D. Oxide would have to be transported to Lake Linden for blending, or reduction to powder. Oxide handling setup at Tamarack is inefficient.
   E. The Tamarack Plant is not serviced by a C&H railroad.
   F. Duplication of labor when compared to Plan 2.

2. <u>Install Two New Stills, and Additional Drying and Bagging Equipment at Lake Linden.</u>

   Using this plan, four stills would be used to produce oxide for powder, and the fifth still would be used for production of the various industrial and agricultural grade requirements. Total production of copper would be about 2,300,000 pounds per month. Additional drying and bagging equipment, and enlargement of the Still House building would be involved.

   The advantages of Plan No. 2 are as follows:

   A. Lower cost of production.
      (1) Few extra men needed.
      (2) Lower steam cost.
      (3) Lower Material costs. Two circuits could be used.
      (4) Lower oxide handling costs.

The disadvantages of this plan are as follows:

A. Large capital outlay.
B. Building would have to be enlarged.
C. Operating three stills at a time would require up to 45,000 pounds of steamper hour and making up 45,000 pounds of water at the boiler house per hour.

CAPITAL AND PRODUCTION COSTS

This report will not go into any detail on costs, however, reasonable estimates have been prepared.

To reactivate the Tamarack Leaching Plant, capital expenditures would include the purchase of drying and bagging equipment, and repairing tank bottoms. This would cost about $30,000. If 750,000 pounds of copper in oxide is produced per month at Tamarack, the treatment cost would be from 4.0 to 4.5¢ per pound.

To equip the Lake Linden Leaching Plant and Still House to handle all of the copper oxide production requirements for both copper powder and oxide sales would require an expenditure in the order of $225,000 of which $25,000 would be needed in the Leaching Plant to adapt the present tanks for concentrate leaching. This $25,000 expenditure would be necessary at Lake Linden under either plan. About $200,000 will be needed to add two distillation units and accessory equipment in the Still House, and to make the necessary building alterations.

Treatment costs at Lake Linden will vary from 2.75¢ per pound at a 1,300,000 pounds per month production basis, to 2.0¢ per pound at a production level above 2,000,000 pounds of copper per month.

MS-002
Box 139
Folder 25

Ahmeek Concentrator

May 18, 1963

The Ahmeek Concentrator was built in 1909 consisting then of four stamp units and it was expanded to an additional four units in 1914. The Ahmeek Concentrator is situated on Torch Lake, its west boundary boarders M26 at Hubbell Michigan. A Rail Road Trestle crosses M26 at 84 feet above the main highway. Aproximately ten different Mine Ores are shipped from the various mines over the Division's Diesel Railway system. The ore shipped from the upper and lower Railway Systems converge at Lake Linden and continues to the Concentrator's 8 storage Bins each with a capacity of 900 tons. This centralized site was well chosen, providing ample gravity flow for ore treatment and suitable disposition of the Tailings in Torch Lake which is 130 feet deep.

The Concentrator employs eight similar units each treating about 35 tons of Ore per hour or a total of 6000 tons per day for the eight units. Both Amygdaloid and Conglomerate ore are successfully treated at the concentrator. Extra grinding is required to liberate the finely dessiminated copper in the Conglomerate Ore.

The ore as received from the mines, is reduced in mine Jaw Crushers set at 4" and is deposited in the concentrator ore bins which is fed by gravity to each steam Stamp by an attendant who regulates the flow of ore, sorts out the large mass copper, breaks the larger ore pieces with a sledge, and removes any debris from the Ore.

The Nordberg Steam Stamp has a high and and a low pressure piston. Steam enters the high pressure piston at 170 pound pressure, the expended steam goes to a receiver and thence to the low pressure piston at about 40 pound pressure and ... the exhaust steam from the low pressure piston is used for power generation. The stamp shaft is connected to the piston rod and carries a stamp shoe weighing about 840 lbs at the bottom of the shaft. Shaft stroke is about 24". A steel casing known as a mortar is properly lined. The mortar employes two screens (Front & Rear) with 5/8 round hole openings. These screens are removable for inspection. Splash pans also removable, cover the grates. The ore enters the mortar and is broken to minus 5/8 inch. As the ore is being broken by stamping, native copper nuggets form; are discharged through an hydraulic chamber from which it is removed during the shift, when the stamp is shut down for mortar inspection. The stamp strikes 105 blows/min. The Ni-hard stamp shoe weighs 840 lbs new and is replaced at about 500 lbs. These shoes last about 3 days on conglomerate ore and about 9 to 12 days in Amygdaloid Ore. The stamp shoes are cast at our Division's foundry.

The material discharged from the mortar goes to 4 trommels with 3/16 inch round openings and the oversize, after jigging to remove the free copper, goes to rigid Nordberg Rolls in closed circuit.

The minus 3/16 inch trommel product flows to Dorr Classifiers which forms a sand and slime product. About 1/2 of the slime is returned to the stamp mortar in order to conserve fresh water, avoiding dilution. A portion of the other half of the slimes goes to the primary ball mill and classifier circuit for density control of the classifier overflow and the balance is routed to the primary flotation machine.

The rake product (sand) from the Dorr Classifier is treated on Woodbury jigs to remove the free copper and the jig tailings after

dewatering in a shovel wheel are ground in an 8 foot by 72 inch Hardinge ball mill in closed circuit with a Dorr Classifier. Circulating load is about 200% and the grinding is minus 35 mesh.
The removal of the liberated copper from the closed circuit is effected by an hydraulic discharge to a Wilfley table and the tailings of the table are returned to the circuit. Grinding is done at 75 per cent solids and is diluted prior to becoming the flotation feed to about 30% solids by introduction of the primary slimes product and hydraulic water

The entire mill product except for the very finest overflow of the Dorr Thickeners is treated by Primary flotation on 24 inch Denver 10 cell flotation machines. The first two cells make a rougher Concentrate and the middling from the other eight cells is in closed circuit with the feed. The tailing of the flotation cells go to waste except for a small portion removed by an hydraulic classifier which is routed to a Wilfley table. This product makes a Concentrate and a tail. The concentrates are recovered if any on the basement concentrating tables while the tails go to waste. The Pilot Tables serves as a visible guide to the flotation operator enabling him to make proper reagent adjustments in the Primary Flotation Circuit.

The flotation Rougher concentrates are pumped to an esperanza type classifier, the heavier particles are conveyed from the classifier to a 4'x8' Dorrco filter from which the dried product is discharged directly into 20 ton hopper bottom mineral cars. This product runs about 11% moisture and about 40 to 45% copper and is shipped directly to the smelter by rail.

One additional flotation unit in the basement is employed for the entire mill which treats the overflows from the esperanza classifier, filter and the Primary Grinding

units overflows which have been settled by six basement thickeners forming a thickener underflow or feed to the Secondary Flotation machine fourth cell. The 6 Thickener overflow goes to waste.
The Concentrate from the Secondary Denver 10 cell Flotation machine is pumped to a 30 ft dia Dorr Thickener and the middlings of the eight cells is recirculated to the first cell of the Secondary Flotation Machine. The Tailings of the Secondary Flotation Machine are discharged as waste.

Enter here "Data on Page #5"

The Concentrate from the Secondary Flotation Machine settled in the concentrate thickener (Thickener Underflow) is pumped to the filter by a Dorrco Suction pressure diaphragm pump. The Concentrate Thickener Overflow is run to waste.

The Reagents used in the flotation machines consists of #250 Dowfroth, a Frother and xanthate, a collector. The xanthate 0.075 pound per ton floated, enters the circuit at the Dorr classifier pool and #250 Dowfroth 0.043 pounds per ton, at the classifier overflow. Supplemental #250 Dowfroth is added as required at the Flotation machine.
#2 Fuel Oil is also used, a few cc/min as required to the float feed launder.

The final Flot tail range about 1½ lbs per ton for Amygdaloid and about 2 to 2½ lbs per ton for the Conglomerate Ore. Tailing losses vary with the richness of the ore treated.
The losses are mostly in the coarser meshes (28 to 65 mesh) and are a factor of the degree of grinding.

The mill Recovery ranges about 92 to 95% with an overall mineral grade assaying about 75% Copper.

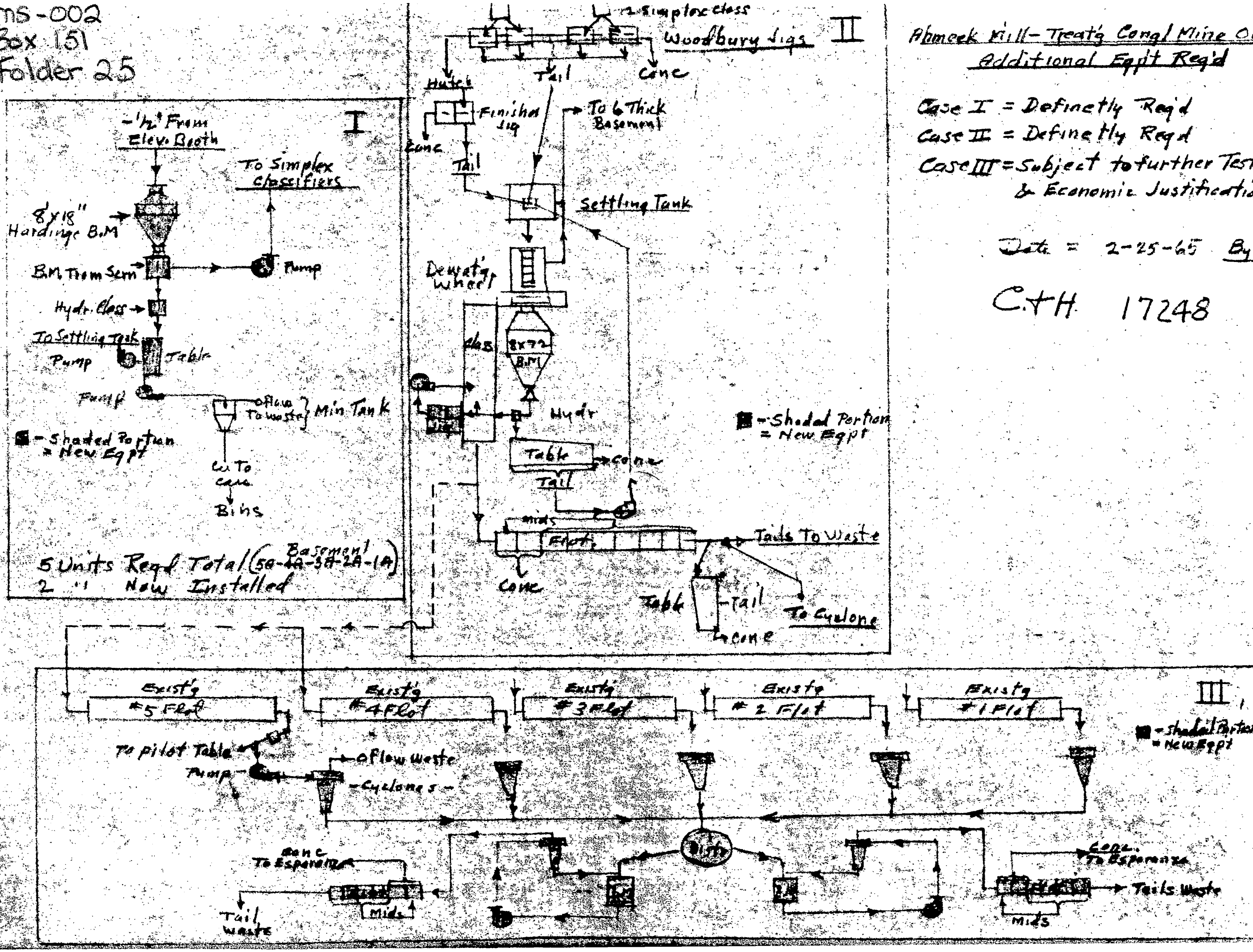
John J. Vittoro
5/18/63.

Ahmeek Mill - Treat'g Cong'l Mine Ore
Additional Eqpt Req'd

Case I = Definetly Req'd
Case II = Definetly Req'd
Case III = Subject to further Test'g & Economic Justification

Date = 2-25-65 By J.J.V.

C+H 17248



CALUMET & HECLA, INC.
CALUMET DIVISION

Minutes of Meeting: Re: Revision of Ahmeek Mill to provide greater capacity.
Date: March 9, 1965 - for milling Conglomerate Ore
Time: 1:30 P.M.
Place: John Alico's Office

Present: John Alico, Lester Engle, Arne Hill, Laurence Kline, E. Matson, George Mehrens, Laurence Michel, John Vitton

This meeting was held to review the proposed flow sheet and to plan a program to carry out Phases I and II of this flow sheet.

The following items were brought out:

1. The existing and proposed ball mills in the basement of the South side shall be renumbered as 1a, 2a, 3a, etc. beginning from the West or highway side. Existing mills No. 9 and 10 shall be 4a and 3a.

2. Additional ball mills (new or used), Nos. 1a, 2a, and 5a, and their accessories, tables, pumps, etc. will be incorporated in Phase I.

3. New Mineral Jigs with accessories are to be installed in Phase II.

4. Phase III, a regrind program for further recovery, is not to be active (construction wise) at this time. Phases I and II will be active.

5. The activity sequence for Phases I and II as tentatively agreed to is:

   a. The catch basin pump pit and contents, which will interfere with unit 5a, are to relocated near the carpenter shop.

   b. The flotation machine which will interfere with units 1a and 2a is to be relocated near the Northwest end; and the moving of it is to be scheduled so that a minimum of actual moving is required during the next vacation shutdown.

   c. Ball mill No. 5a (8'x32") is to be moved from the Leaching Plant in Lake Linden. The installation can follow after the pump pit is relocated.

   d. Layout work for ball mills, 1a and 2a, cannot be completed until it is determined what mills will be used. Mill No. 2a will be installed prior to Mill No. 1a if these mills are brought in through the West wall.

   e. The installation of the jigs shall be done where practical in the schedule.

6. Crane facilities are desired for handling the ball mill liners, balls, etc..

7. The basement location for the ball mills is desired to save on foundation costs and provide more room.

8. The proposed ball mills should have large trunions for better flow of material.

9. Direct drive rather than the clutch system should be provided for the mills.

10. Ball Mill No. 5a and accessories installation must be completed by February 1, 1966 so as to be usable for experimental purposes for about 3 months. Mill No. 2a should be installed by October 1, 1966 and Mill No. 1a by January 1, 1967.

11. The chip chute will <u>not</u> need to be relocated.

12. Work to begin as soon as possible on M & C orders. However, a cost estimate is required for the entire project.

E. Matson

cc: JA
LFE
AWH
LCK
TWK
EDM
GHM
LJM
JJV

MS-002
Box 151
Folder 25

CALUMET DIVISION
Calumet & Hecla, Inc.

Ahmeek Mill Project M. C. Order Numbers.

PHASE I.

0804 001 Purchase of Mechanical & Electrical Equipment - Phase I.

0804 002 Purchase and Installation of Power Facilities - Phase I.

0804 003 Construction of Ball Mill Foundations- Phase I.

0804 004 Mechanical & Electrical Installation of Ball Mills - Phase I.

0804 005 Construction and Installation of Launders - Phase I.

0804 006 Mechanical and Electrical Installation of Auxiliary Equip - Phaes I.

PHASE II.

0804 010 Purchase of Mechanical & Electrical Equipment - Phase II.

0804 011 Construction of Equipment Foundations - -Phase II.

0804 012 Mechanical and Electrical Installation of Denver Jigs - Phase II.

0804 013 Mechanical & Electrical Installation of Pumps & Piping - Phase II.

0804 014 Construction & Installation of Launders - Phase II.

0804 015 Purchase & Installation of Power Facilities - Phase II.

PHASE III.

0804 020 Purchase of Mechanical Equipment & Electrizal Equip. - Phase III.

0804 021 Construction of Foundation for Disbribution Tank - Phase III.

0804 022 Construction of Foundation for Ball Mills - Phase III.

0804 023 Constrution of Foundation for Cyclones & Floatation Mach.-Phase III

0804 024 Mechanical & Electrical Installation of Ball Mills - Phase III

0804 025 Mechanical & Electrical Installation of Cyclones - Phase III

0804 026 Mechanical & Electrical Installation of Floatation Mach. Phase III

0804 027 Mechanical & Electrical Installation of Pumps and Piping -Phase III

0804 028 Construction & Installation of Launders - Phase III.

0804 029 Mechanical & Electrical Installation of Auxiliary Equip. - Phase III

0804 030 Purchase & Installation of Power Facilities - Phase III.

MS-002
Box 78
Folder 9

Figure 1

AHMEEK MILL FLOWSHEET

(Crushing and Gravity Concentration)

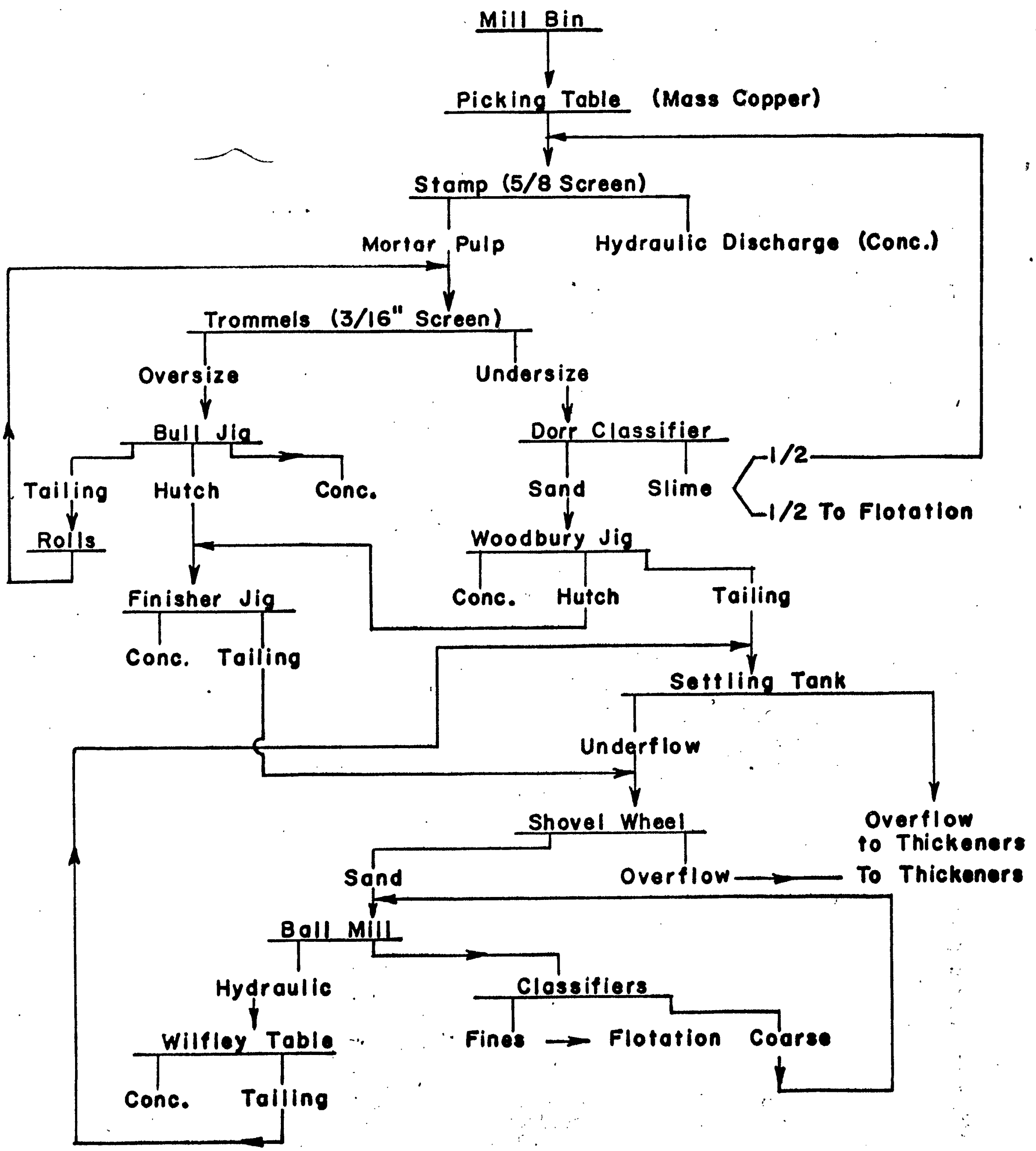
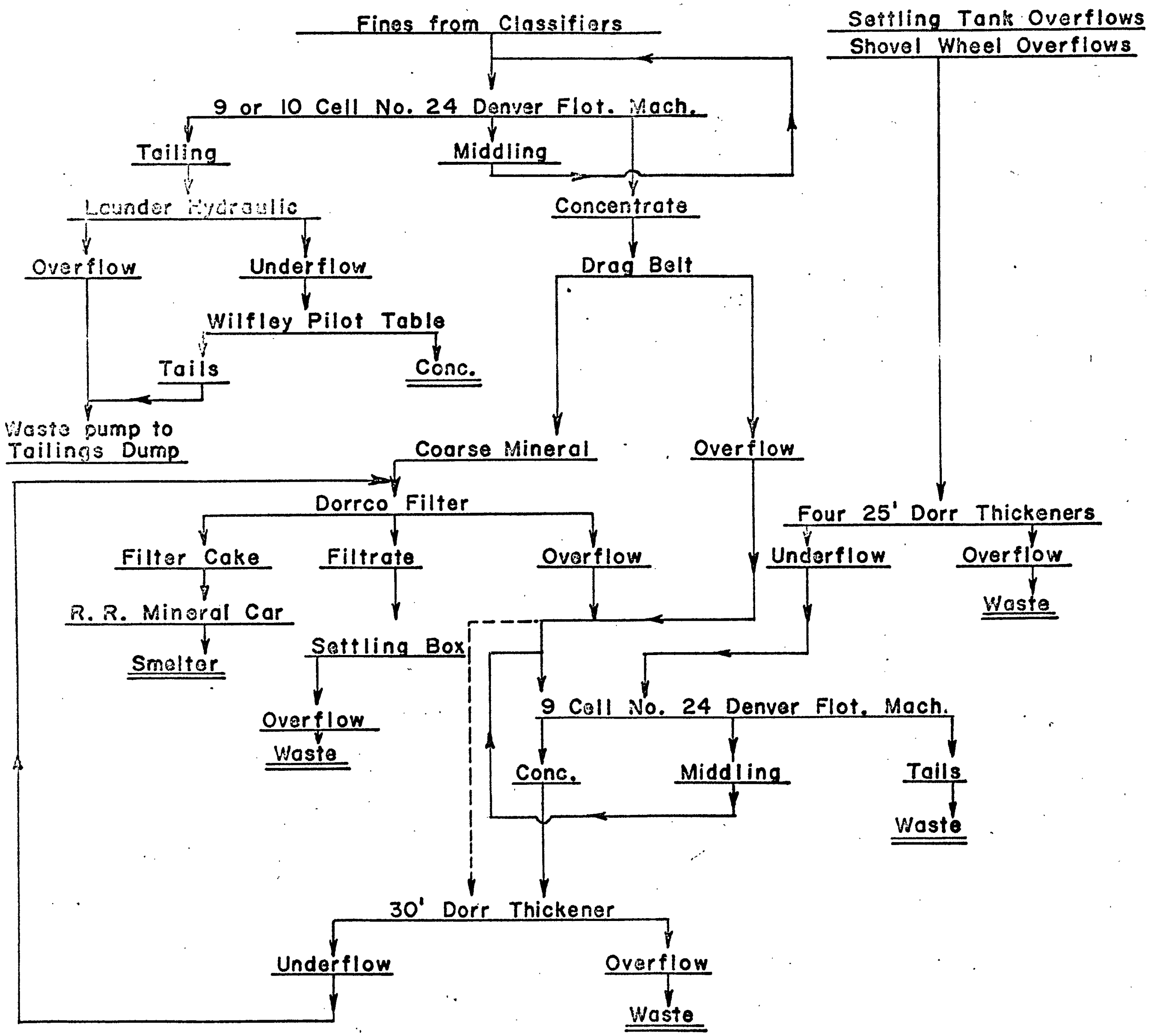


Figure 2

AHMEEK MILL FLOWSHEET

(Fines Concentration-- Flotation)



MS-002
Box 78
Folder 9

CALUMET DIVISION
Calumet & Hecla Corp.

AHMEEK MILL
Mineral Processing - Flowsheet
By J. J. Vitton
10/20/66

Introduction

The Ahmeek Mill concentrator consists of eight Units and is located at Hubbell, Michigan. Four units were constructed in 1908 and the remaining four units were installed in 1912 with Steam Stamps as crushers for each unit.

The concentrator was originally designed to treat amygdaloid native copper ore which consists of a great deal of mass and smaller coarse copper. Recent changes have been made in the Mill flowsheet in order to treat conglomerate ore as well as amygdaloidal ore. The capacity of the Mill with eight stamping units in operation is 5000 tons per 24 hours.

The Norberg Compound Steam Stamps are each rated at 300 H.P. The Steam Stamps are unique in the quantity of fines produced. About 50% of the minus 4-inch ore from the Mines is reduced to finished size (-35 mesh) and is ready for flotation. It would require two or three stages of gyratory crushing and one stage of rod milling or equivalent to equal the Steam Stamp reduction. The eight steam stamps are the only compound type in production in the world.

Flowsheet - Ahmeek Mill

The Ahmeek Mill flowsheet for processing amygdaloidal and conglomerate ores is shown on drawing No. 11898. The Mine ore is crushed in jaw crushers set at 4" at the Mine Shaft House and is delivered by the C&H Railroad to the Mill. The ore is dumped into eight (8) mill bins with a capacity of 800 tons each. The ore is fed into the Steam Stamps through chutes by gravity and by the Head Feeder Attendant who controls the flow of ore and removes any Mill mass copper before it enters the stamps. In the steam stamps, the ore is